DRIN CORDA

Enabling
& Transboundary Cooperation
Integrated Water Resources Management
in the extended DRIN RIVER BASIN

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DRIN BASIN

TRANSBOUNDARY DIAGNOSTIC ANALYSIS

In the framework of:
Memorandum of Understanding for the Management of the Extended Transboundary Drin Basin

www.drincorda.org

The Coordinated Action for the implementation of the Memorandum of Understanding for the Management of the Extended Transboundary Drin Basin (Drin CORDA) is supported by the Global Environment Facility (GEF) Drin Project. The latter is implemented by the United Nations Development Programme (UNDP) and executed by the Global Water Partnership (GWP) through GWP-Mediterranean (GWP-Med). United Nations Economic Commission (UNECE) is a partner in this process. GWP-Med serves as the Secretariat of the Drin Core Group, the multilateral body responsible for the implementation of the Drin Memorandum of Understanding.

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Acknowledgment:
A warm thank you to Ms. Thomais Vlachogianni (MIO-ECSDE) for the kind provision of photographs.

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ABBREVIATIONS

a.s.l.	above sea level
ALB	Albania
APSFR	areas of potential significant flood risk
AQC	analytical quality control
BOD	biological oxygen demand (five days)
BQE	biological quality elements
CCA	causal chain analysis
COD	chemical oxygen demand
DCG	Drin Core Group
EEA	European Environment Agency
EQS	environmental quality standards
EU	European Union
EWG	Expert Working Group
GDP	gross domestic product
GEF	Global Environment Fund
GIZ	Gesellschaft für Internationale Zusammenarbeit
GWP-Med	Global Water Partnership – Mediterranean
ha	hectares
HPP	hydropower plant
IUCN	International Union for Conservation of Nature
KOS	Kosovo
LME	large marine ecosystem
MNE	Montenegro
MoU	Memorandum of Understanding
MW	mega watts
N	Nitrogen
NAP	National Action Plan
NEAP	National Environmental Action Plans
NMK	North Macedonia
P	phosphorus
p.e.	population equivalent
PBT	persistent bioaccumulative toxic compounds
RBMP	River Basin Management Plan
SAP	Strategic Action Programme
SDGs	Sustainable Development Goals
TDA	Transboundary Diagnostic Analysis
TN (N')	total nitrogen
TP	total phosphorus
UNDP	United Nations Development Fund
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
UNWTO	United Nations World Tourism Organization
WISE	Water Information System for Europe

EXECUTIVE SUMMARY

Action at the Drin Basin level was uncoordinated until the development of the Shared Vision for the Sustainable Management of the Drin Basin and the signing of a related Memorandum of Understanding (Drin MoU – 25 November 2011, Tirana) by water and environment ministers and high-level officials of the Drin Riparians (Albania, Greece, Kosovo,[1] Montenegro and North Macedonia). The objective of the MoU is to deliver the agreed shared vision, to "promote joint action for the coordinated integrated management of the shared water resources in the Drin Basin, as a means to safeguard and restore to the extent possible the ecosystems and the services they provide, and to promote sustainable development across the Drin Basin".

Under the Drin CORDA (Drin Coordinated Action for the implementation of the Drin MoU) process, Global Water Partnership – Mediterranean (GWP-Med), the United Nations Economic Commission for Europe (UNECE), and the United Nations Development Programme (UNDP) initiated the Global Environment Facility (GEF) financed project "Enabling transboundary cooperation and integrated water resources management in the Extended Drin River Basin" (GEF Drin Project) to facilitate the implementation of the MoU. This has been undertaken through the GEF-inspired TDA/SAP process, which involves developing a Transboundary Diagnostic Analysis (TDA), which provides information on transboundary problems affecting the basin's water and environment, and a Strategic Action Programme (SAP), which presents the agreed strategy and actions to address the transboundary problems.

The main technical role of the TDA is to identify, quantify and set priorities for environmental problems that are transboundary in nature. Consequently, the TDA provides the factual basis for the formulation of an SAP. In the case of the Drin, further to the above, the TDA assists in enhancing the knowledge basis of the Riparians regarding the state of the natural and anthropogenic environment in the basin, developing the building blocks of a Drin Basin management plan in accordance with the European Union (EU) Water Framework Directive, should the Riparians decide to develop such a plan in the future.

The GEF Drin Project developed the TDA through wide stakeholder engagement. To analyse the system, the Source-to-Sea approach was adopted, to the extent allowed by the information available on transitional waters and the marine area.

The "Situation Analysis: Management of the Extended Drin Basin" (Drin Situation Analysis) served as a starting point for the Drin TDA. The TDA is the core document that synthesizes the findings of basin-wide thematic reports, undertaken at three levels: sub-basin; Drin Riparian within each sub-basin; and the Drin Basin:

1 This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

- Thematic Report on Socio-economics

- Thematic Report on Institutional and Legal Setting

- Thematic Report on Biodiversity and Ecosystems

- Thematic Report on the Hydrology and Hydrogeology

- Thematic Report on Pollution and Water Quality

- Thematic Report on the Nexus (water-food-energy-ecosystems).

This TDA focuses mainly on the issues that are affecting the basin at the transboundary level, with the information presented in the thematic reports providing additional details at the sub-basin level.

Based on the extensive assessment developed through the thematic reports and previous studies (including TDA/SAP activities undertaken through the GEF-supported projects on the Prespa and Skadar/Shkodër lakes), the following four key priority and crosscutting transboundary issues have been identified and confirmed by the Drin Core Group (DCG):[2]

- Deterioration of water quality, which affects – at different levels – all parts of the Drin Basin (surface water, groundwater and coastal water). Of particular concern is the presence of excess nutrients (from domestic wastewater and agriculture) pollution, leading to excess demand on the water's oxygen content (with consequences for ecologically important species), as well as industrial and municipal solid waste from mining and settlements.

- Natural and regulated variability of the hydrological regime as a result of climate variability, and, in some sub-basins, seasonal over-abstraction of water resources and hydropower generation, impacting the quantity of water available for the ecosystem and socio-economic development. Furthermore, it exacerbates naturally occurring extreme phenomena, such as floods and droughts. Agriculture is a key user of water for irrigation – under certain conditions, this may be affected by water shortages during the summer period from June to August.

- Biodiversity degradation. The importance of the biodiversity of the Drin Basin at the European level is significant, though it is under pressure due to multiple threats to the basin's ecosystems from pollution, changes in water quantity, alien species, loss of wetland, illegal activities and climate variability and change, among others.

- Variability of the sediment transport regime, which is affected by natural events (for example, rainfall), climate variability and change (such as the increase of extreme weather, rainfall and drought) and anthropogenic impacts from gravel extraction, deforestation, poor land-use management and hydropower generation, among others. These changes are having impacts on both freshwater and coastal ecosystems.

Climate variability and change was also recognized as a significant factor that is likely to be influencing the four key transboundary problems impacting the Drin Basin's ecosystems and socio-economic status.

Through analysing the observations from the thematic reports, results from stakeholder meetings and the initial assessments made by the Drin Project, a causal chain analysis (CCA) was undertaken to identify the immediate, underlying and root causes of the transboundary problems.

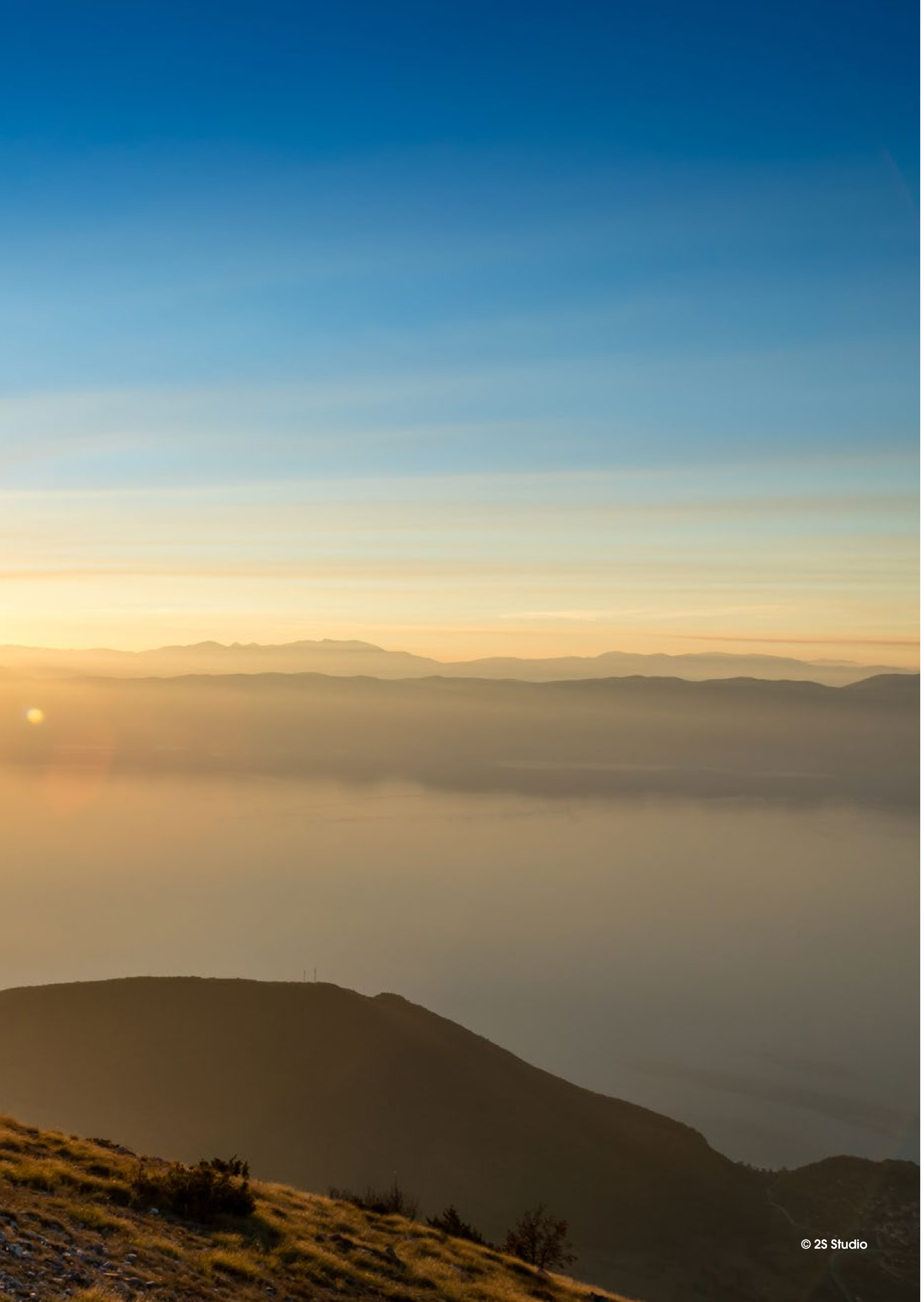
The TDA and the CCA included therein provide the necessary information that enabled Drin Riparians to agree on the priority actions to be included in the SAP. The SAP will provide the framework for a new era under the Drin MoU, regarding the Riparian cooperation in managing the Drin Basin.

The TDA document and the associated thematic reports are 'living' documents that will be periodically revised and are intended to serve as a baseline against which future progress is measured.

2 The joint body established under the Drin Memorandum of Understanding (MoU) in November 2011, which is mandated to coordinate action for the implementation of the MoU.

PART A

BASIN OVERVIEW AND TRANSBOUNDARY PROBLEMS



1. INTRODUCTION TO THE TRANSBOUNDARY DIAGNOSTIC ANALYSIS

This Transboundary Diagnostic Analysis (TDA) has been prepared through the Global Environment Facility (GEF)-supported project "Enabling transboundary cooperation and integrated water resources management in the extended Drin Basin" (GEF Drin Project). The project aims to support the Drin Riparians (Albania, Greece, Kosovo, Montenegro and North Macedonia) to enhance cooperative management of the shared water bodies within the Drin Basin using a wide range of means, including institutional capacity-building, testing novel basin management approaches, developing the means to enhance trust-building through information exchanges, etc. The core action of the project is to develop a TDA and a Strategic Action Programme (SAP). Problems in the natural and anthropogenic environment are assessed through the TDA, providing the factual basis for an agreed set of interventions included in the SAP to address the problems. The GEF approach of using a TDA and an SAP to deliver transformational change has been applied in over 35 international rivers, groundwaters, lakes and large marine ecosystems (LMEs).

To analyse the system, the Source-to-Sea approach[3] was used to the extent allowed by the information available on transitional waters and the marine area.

The boundaries of the Drin Basin area are defined considering the natural characteristics of the area and its local conditions, with the area comprising natural elements, including catchments, aquifers, transitional waters, coastal waters and the coastal zone.

The land boundary of the Drin Basin area was defined using the physical boundary of the Drin watershed. In the case of Montenegro, this boundary conforms to the administrative boundary of the river basin district, while for Albania, Kosovo and North Macedonia, the (watershed) boundary does not always conform to such districts' administrative boundaries.

Underlying aquifers extend beyond the watershed's boundaries and were therefore not included, as any measures later defined as part of the SAP would fall outside the sub-basins of each Drin Riparian.

3 A Source-to-Sea approach consolidates analysis, planning, policymaking and decision-making across sectors and scales. It considers the entire social, ecological and economic system from the land area that is drained by a river system to the coastal area and even the open ocean it flows into (http://stapgef.org/sites/default/files/publications/S2SBrief.pdf). A source-to-sea system includes the land area that is drained by a river system or systems, its lakes and tributaries (the river basin), connected aquifers and downstream recipients, including deltas and estuaries, coastlines and nearshore waters, the adjoining sea and continental shelf, as well as the open ocean. Water, sediment, pollutants, biota, materials and ecosystem services key flows connect the subsystems in the source-to-sea continuum and their geographies.

The marine boundary and the coastal zone were estimated taking into consideration the primary influence of the surface-water flows on marine waters, as indicated by the levels of salinity, as a proxy measure of the main influences of land-based activities.

The Drin Riparians are either Member States of the European Union (EU) or in the process of seeking EU membership. A significant and relevant part of the EU acquis relates to the environment, especially water. Compliance with two water-related directives – the EU Water Framework Directive and Flood Risk Directive – requires a detailed analysis of river basins. The approach adopted by the GEF Drin Project has led to the development of detailed thematic reports that analyse a range of the basin's characteristics, addressing the needs of the TDA and assisting the Riparians in the implementation of the Water Framework Directive[4] and the Flood Risk Directive. The Drin TDA was developed in such a way to enable the Riparians to enhance environmental management.[5]

The Drin Project also builds on a significant history of collaborative action in the region through the development of specific TDA/SAP activities for key sub-basin lakes (Lake Prespa and Lake Skadar/Shkodër). While the Drin Project is assisting GEF-eligible Riparians, Greece, as a member of the EU, complies with the requirements of the Water Framework Directive and has previously participated in the Lake Prespa TDA/SAP, which is the only part of the Drin Basin involving Greece.

1.1 Drin Basin

The Drin Basin (Figure 1) sits in the south-east of the Balkan Peninsula with water bodies and watersheds spread across Albania, Greece, Kosovo, Montenegro and North Macedonia. It comprises the sub-basins of the Black Drin,[6] White Drin,[7] Drin and Buna/Bojana[8] rivers, of the Prespa, Ohrid and Skadar/Shkodër[9] lakes, the underlying aquifers, and the adjacent coastal and marine area.

Lake Prespa is the starting point of the water flow towards the Adriatic Sea, comprising two lakes (Micro and Macro Prespa) linked by a small channel, with regulated water flow, which traverses the alluvial isthmus that separates them. Micro Prespa is shared by Albania and Greece, while Macro Prespa is shared by Albania, Greece and North Macedonia.

4 The thematic reports were prepared in a manner that enabled also the development of necessary elements to be used as building blocks for a river basin management plan (RBMP) at the Drin Basin level, should the Riparians decide to develop one (including an initial proposal for delineating water bodies in accordance with the Water Framework Directive, calculation of a water budget under different scenarios, analysis of pollution pressures, assessment of generated pollution loads, assessment of chemical pollution, identification of protected areas, analysis of the governance of water and environment in the basin and an initial assessment of the condition of and the pressures on biodiversity, among others).

5 The two (first ever) monitoring campaigns across the Drin Basin in 2016 and 2017 were implemented to fill in knowledge gaps. The monitoring network used was defined in cooperation with national institutions to: (i) cover the entire Drin Basin; and (ii) include routine sampling stations used by the Drin Riparians for their annual surface and underground water quality monitoring, as well as additional monitoring stations for which routine sampling is not performed. All information gathered or generated through the TDA development is stored in an online geographic database that enables institutions to use related information in their everyday conduct of business.

6 The river is called Drin i Zi in Albania and Crn Drim in North Macedonia.

7 The river is called Drini i Bardhë in Albania and Kosovo.

8 The river is called Buna in Albania and Bojana in Montenegro.

9 The lake is called Skadar in Montenegro and Shkodër in Albania.

Water also flows through underground karst cavities from Lake Prespa to Lake Ohrid. Shared by Albania and North Macedonia, Lake Ohrid is the largest lake in terms of water volume in South-East Europe. As the only surface outflow of Lake Ohrid, the Black Drin River flows north through North Macedonia. It forms the border with Albania for some kilometres, before entering the country between the cities of Debar and Peshkopi. The White Drin River rises in Kosovo and flows into Albania, where it meets the Black Drin River, near the city of Kukës, to form the Drin River.

Flowing westward through Albania, one branch of the Drin River joins the Buna/Bojana River approximately 1 km from where it flows from Lake Skadar/Shkodër near the city of Shkodra in Albania. Shared by Albania and Montenegro, Lake Skadar/Shkodër is the largest lake in terms of surface area in South-East Europe. The largest river flowing into the lake is the Morača River, which passes through Podgorica, the capital of Montenegro.

The Buna/Bojana River drains Lake Skadar/Shkodër and flows into the Adriatic Sea. Its lower part (23 km) forms part of the Albania–Montenegro border. The other branch of the Drin River, which is the older branch, discharges its limited flow directly into the Adriatic Sea, south of the city of Shkodra, near the city of Lezhë.

A number of aquifers exist, often with complex groundwater–surface water interaction and interdependency. There are five large reservoirs used for hydropower production and more than 110 irrigation reservoirs.

With its extensive water resources (the third greatest river discharge into the European Mediterranean, after the Po and Rhone rivers), this complex system provides a wealth of services to the Drin Riparians that share the basin: energy supply, recreation and tourism, fisheries, water supply for irrigation and domestic uses, sustenance of unique endemic biodiversity, and livelihoods. The basin is home to over 1.61 million people, living in over 1,450 settlements.

Figure 1. Map of the Drin Basin

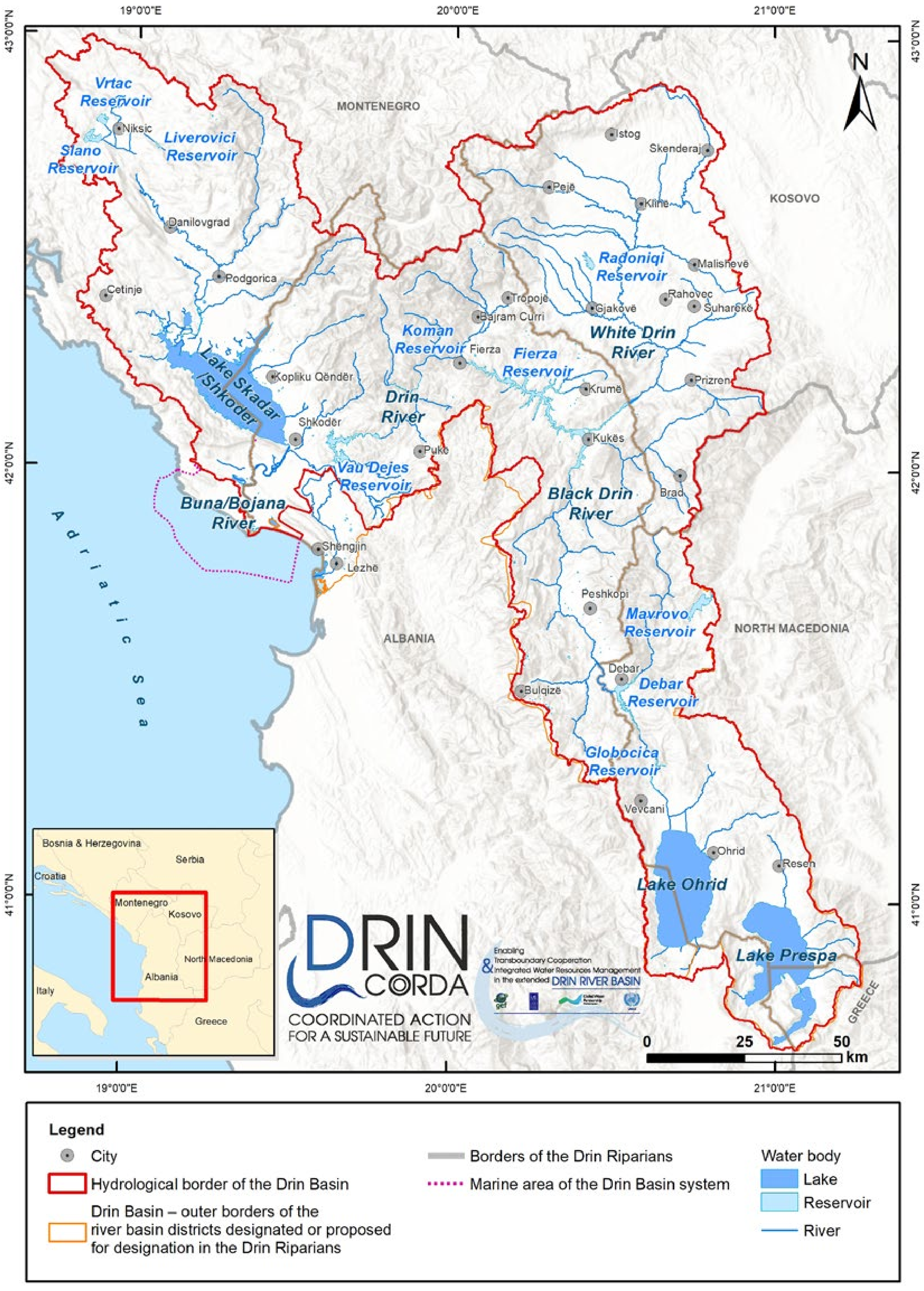
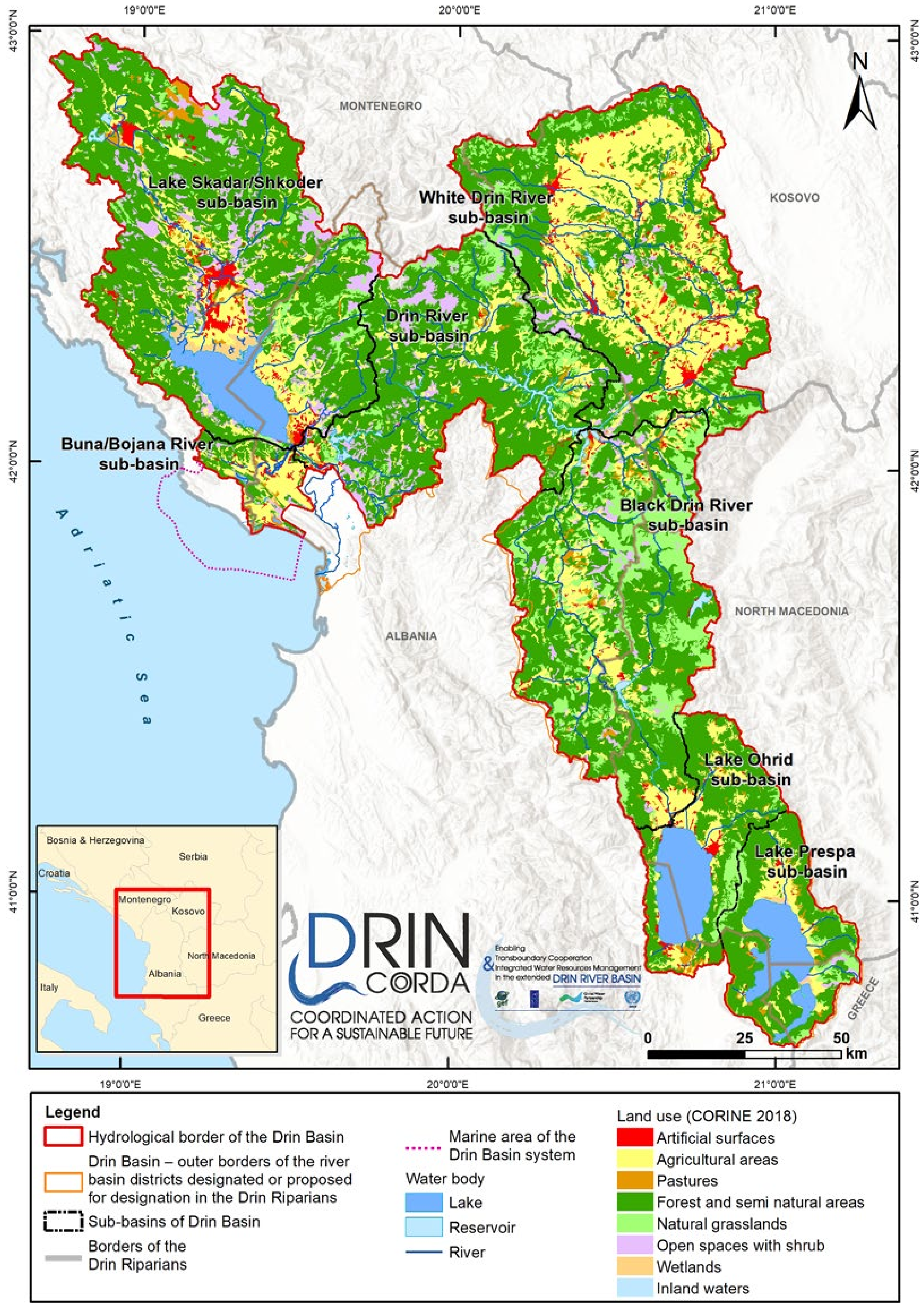


Figure 2. Land uses in the Drin Basin



1.2 Drin Coordinated Action

Action at the Drin Basin level was uncoordinated until the development of the Strategic Shared Vision for the sustainable development of the Drin Basin and the signing of a related MoU (25 November 2011, Tirana) by ministers and high-level representatives of the water and environment ministries of the Drin Riparians (Albania, Greece, Kosovo, North Macedonia and Montenegro). This was an outcome of the Drin Dialogue, coordinated by the Drin Riparians with the support of GWP-Med and the United Nations Economic Commission for Europe (UNECE).

The ultimate goal of the work in the Drin Basin is to reach a point in the future where the scale of management lifts from single water bodies to the basin's interconnected hydrological system, eventually leading from the sharing of waters among Riparians and conflicting uses, to the sharing of benefits among stakeholders.

A process referred to as the Drin Coordinated Action for the implementation of the Drin MoU (Drin CORDA) was established. Following the provisions of the Drin MoU an institutional structure was established, which includes:

- the Meeting of the Parties
- the Drin Core Group (DCG), comprising officially appointed representatives of the Drin Riparians' line ministries and mandated to coordinate actions for the implementation of the MoU
- four Expert Working Groups (EWGs) to assist the DCG in its work:
    - Water Framework Directive Implementation EWG
    - Monitoring and Information Exchange EWG
    - Biodiversity and Ecosystems EWG
    - Floods EWG.

The DCG Secretariat provides technical and administrative support to the DCG. By appointment of the Parties through the MoU, GWP-Med serves as the Secretariat.

1.3 GEF Drin Project

The aims, objectives and content of the GEF Drin Project are aligned with the Drin MoU.

The objective of the project is to "promote joint management of the shared water resources of the transboundary Drin Basin, including coordination mechanisms among the various sub-basin joint commissions and committees". Albania, Kosovo, Montenegro and North Macedonia are the project beneficiaries. Greece, as an EU Member State does not receive support from the GEF.

The GEF Drin Project has five components:

Component 1: Consolidating a common knowledge base

Component 2: Building the foundation for multi-riparian cooperation

Component 3: Institutional strengthening for integrated river basin management

Component 4: Demonstration of technologies and practices for IWRM and ecosystem management

Component 5: Stakeholder involvement, gender mainstreaming and communication strategies.

The project is implemented by UNDP and executed by GWP, through GWP-Med. UNECE is a partner to this process. The DCG acts as the project's Steering Committee.

1.4 Methodology for the development of the TDA

The Drin Project has followed the GEF TDA/SAP guidance.[10] The TDA builds upon (i) the formative work undertaken in 2014 by GWP-Med that led to the "Drin Situation Analysis" and (ii) six basin-wide thematic reports, which provide a detailed assessment and characterization of the Drin Basin:

- Thematic Report on Socio-economics
- Thematic Report on Institutional and Legal Setting
- Thematic Report on Biodiversity and Ecosystems
- Thematic Report on the Hydrology and Hydrogeology
- Thematic Report on Pollution and Water Quality
- Thematic Report on the Nexus.[11]

The thematic reports were developed with guidance from the GEF TDA/SAP as well as the EU Water Framework Directive. The thematic reports were elaborated at three levels:

- the sub-basin level i.e. Lake Prespa, Lake Ohrid, the Black Drin River, the White Drin River, the Drin River, Lake Skadar/Shkodër and the Buna/Bojana River
- the Riparian level within each sub-basin
- the overall Drin Basin level.

A summary of these thematic reports presented in this TDA focuses on the main transboundary problems with specific references to the details in the reports, particularly those regarding sub-basins and national specific issues. The thematic reports will also provide a substantive input to the development of Riparian river basin management plans (RBMPs) to meet the needs of the EU Water Framework Directive and the Flood Risk Directive, acting as a baseline for monitoring the future implementation of the SAP.

1.4.1 Stakeholder involvement in the development of the TDA

The GEF Drin Project has had significant stakeholder involvement in identifying priority transboundary problems and developing an agreed causal chain analysis (CCA) to understand the root, underlying and immediate causes of the problems. A summary of the processes that lead to the development of the Drin TDA is summarized in Table 1.

10 https://www.iwlearn.net/manuals/tda-sap-methodology.

11 The nexus report supplements information collected in the other thematic reports by assessing the linkages between water, food and energy security with the integrity of the ecosystem.

A total of fifteen national experts, four international experts, three companies and the Project Management Unit (PMU) worked to collect data and develop the TDA thematic reports and synthesis report.

Table 1. Stakeholder meetings towards the development of the Transboundary Diagnostic Analysis

Time	Location	Meeting	Topic
Project life	All Drin Riparians	DCG and EWG meetings/twice per year	The TDA table of contents was adopted. At each consecutive meeting, TDA development progress was discussed, specific thematic reports were presented to the DCG/EWG members, and the reports were reviewed/approved. The TDA was presented and approved.
Project life	All Drin Riparians	Individual meetings with representatives of the relevant Institutions: ministers, directors of departments, heads of agencies, etc.	Introduction of the project (the TDA was part of the introduction), investigation of opportunities for cooperation, presentation of developments, receiving of guidance on issues related to the development of the TDA ensuring compatibility with national priorities, especially the implementation of the EU Water Framework Directive.
Oct-Nov 2016	Six cities covering all Drin sub-basins	Focus Group meetings in Tirana, Shkodra, Pogradec, Ohrid, Podgorica and Pristina	Among others: identified the perceived key management issues and problems at the sub-basin and basin levels, as well as their causes and impacts from the stakeholders' perspective.
Mar 2017	Tirana	Meeting with riparian experts from all Drin Riparians	Coordination for the preparation of the thematic reports.
Nov 2017	Podgorica	Stakeholders conference	The stakeholders were presented with key findings from the process of developing the TDA thematic reports and provided input. Focus was placed on socio-economic, biodiversity and institutional and legal setting thematic reports, as well as on the main findings of the TDA and the causal chain analysis (CCA).
Nov 2018	Ohrid	Stakeholders conference	The stakeholders were presented with key findings from the process of developing the TDA and provided input. Focus was placed on the pollution and water quality, and hydrology and hydrogeology thematic reports, as well as the main findings of the TDA and the CCA.
Dec 2018	Athens	CCA-SAP workshop	Local and international experts participated in the preparation of the thematic reports reviewed the CCA analysis and prepared a first set of interventions to address the transboundary issues identified.
Jan 2020	Tirana	Stakeholders conference	The TDA was presented to the stakeholders.

A detailed stakeholder analysis was undertaken to understand: (i) the stakeholders' perception regarding the transboundary issues and problems; and (ii) the multilevel non-linear linkages among the groups of stakeholders that are by default engaged in the management of the Basin and that the project activities concern.

The stakeholder analysis and the six Sub-basin Focus Group meetings in Tirana, Shkodra, Pogradec, Ohrid, Podgorica and Pristina cited the following issues of transboundary importance:

- the unsustainable management of wastewater and solid waste
- industrial, mining and quarrying activities in the basin, which are linked to an increase in pollution loads, especially of toxic substances
- hydropower production and infrastructure, which reduce downstream water flows to less than the ecological minimum
- climate variability and change and related phenomena in the basin
- floods
- a lack of coordination between Riparians on how to manage hydropower infrastructure in order to regulate flows, which has reportedly intensified flooding problems in the past
- agrochemicals and excessive use of water in intensive agriculture
- preserving ecosystems and protecting biodiversity.

The stakeholder analysis and involvement has guided the final selection of developing CCA priority transboundary problems.

1.4.2 Situation analysis

A situation analysis, which was carried out by GWP-Med in 2014, has guided the development of the current GEF Drin Project, providing an important assessment of the basin. The TDA has also been guided by this situation analysis, which identifies the major issues and problems as relating to:

- water balance
- sediment balance
- water quality
- unsustainable forestry management and deforestation
- unsustainable fishing practices and the introduction of alien species
- urbanization and unsustainable tourism
- hunting
- sand and gravel extraction
- climate variability.

The situation analysis identified the key causes as:

- insufficient management of the sub-basins at the national level (including legal frameworks, institutional capacity, monitoring and research)
- insufficient management of the sub-basins at the transboundary level.

1.5 Structure of the TDA report

The TDA has two main parts:

PART A: Basin overview and transboundary problems

- Section 1: Presents the Drin Basin, covering the work of the MoU the GEF Drin Project and the development of the TDA.
- Section 2: Provides baseline information on the geographical scope of the Drin Basin.
- Section 3: Summarizes the priority transboundary problems, their CCA and preliminary summary recommendations for the SAP. The transboundary problems and CCA represent the main conclusions of the TDA that will guide the SAP formulation. These conclusions are supported by over 1,500 pages of evidence and analysis present in the thematic reports.

Part B: Summary of the Drin Basin characterization

- Sections 4–9: These sections present summary findings and conclusions from the extensive research contained within the thematic reports.

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2. BASELINE INFORMATION ON THE DRIN BASIN

2.1 Geographical scope

The total geographical area of the Drin Basin is 20,361 km². The basin is characterized mainly by mountainous relief, the highest peaks of which are the Dinaric Alps[12] at over 2,500 m above sea level, as well as flat land around the basin's coastal area in Albania. The Drin Basin comprises parts of five Riparians, with their respective share of the basin shown in Table 2.

Table 2. Main water bodies of the Drin Basin and their catchments

Sub-basin	Drin core sub-catchments[13]	Area (km²)	Area - cumulative (km²)	Shared by/areal extent of each Riparian (km²)					River length (km)
				Albania	Greece	Kosovo	Montenegro	North Macedonia	
Lake Prespa	Micro Prespa	249.50		40.44	209.06				
	Macro Prespa	790.30		246.44	47.68			496.18	
	Golema River	178.40						178.40	22.60
	Brajčinska	77.80						77.80	16.20
	Kranska	30.00						30.00	11.40
	Agios Germanos	65.60			65.60				14.50
			1,391.60						
Lake Ohrid	Lake Ohrid	685.60		208.46				477.14	
	Cherava	71.00		71.00					10.10
	Koselska	190.40						190.40	21.20
	Sateska	453.70						453.70	23.00
			1,400.70						
Black Drin River	Black Drin 1	159.10						159.10	11.60
	Globočica reservoir	146.90						146.90	10.60
	Black Drin 2	124.80						124.80	8.70
	Spillje Reservoir/Lake Debar	189.70		34.00				155.70	20.60
	Radika	635.90				113.00		523.00	41.50
	Rosocka	101.60						101.60	9.20
	Tresonecka	97.20							12.00
	Black Drin 3	134.20		127.61				6.59	79.20
	Zalli i Bulqizes	455.60		455.60					17.50
	Black Drin 4	542.50		542.50					
	Seta r.	91.50		91.50					7.40
	Black Drin 5	83.20		83.20					
	Veleshnica	107.20		90.74		16.40			10.50
	Black Drin 6	62.40		24.97		35.68		1.74	
	Molla e Lures r.	149.50							21.50
	Bushtrice r.	176.90		6.74		170.16			12.50
	Black Drin 7	51.50				51.50			
	Black Drin 8	102.60				102.60			
			3,412.30						
White Drin River	White Drin	1,121.40				1,121.40			
	Istogut	448.60				448.60			20.00
	Kline	425.40				425.40			71.90
	Lumbardie e Pejës r.	487.50				487.50			37.50
	Mirusha	335.90				335.90			38.10
	Lumbardhie I Deqanit r.	253.90				253.90			46.90
	Ereniku	519.60				519.60			52.30
	Toplluhes	312.20							14.50
	Lumbardhiee Prizrenit	283.30		283.30					34.50
	Lumi i Thate	86.20		86.20					7.50
	Semetishta	110.10		110.10					
			4,384.10						
Drin River	Lake Fierza	988.50		988.50					
	Luma r.	557.50		557.50					19.80
	Kruma r.	51.10		51.10					7.40
	Vlahina r.	77.40		77.40					15.50
	Lake Komani	399.00		399.00					
	Valbona	661.20		661.20					46.50
	Curraj r.	154.20		154.20					7.20
	Shala	273.60		273.60					20.40
	Vau i Dejës reservoir	159.70		159.70					

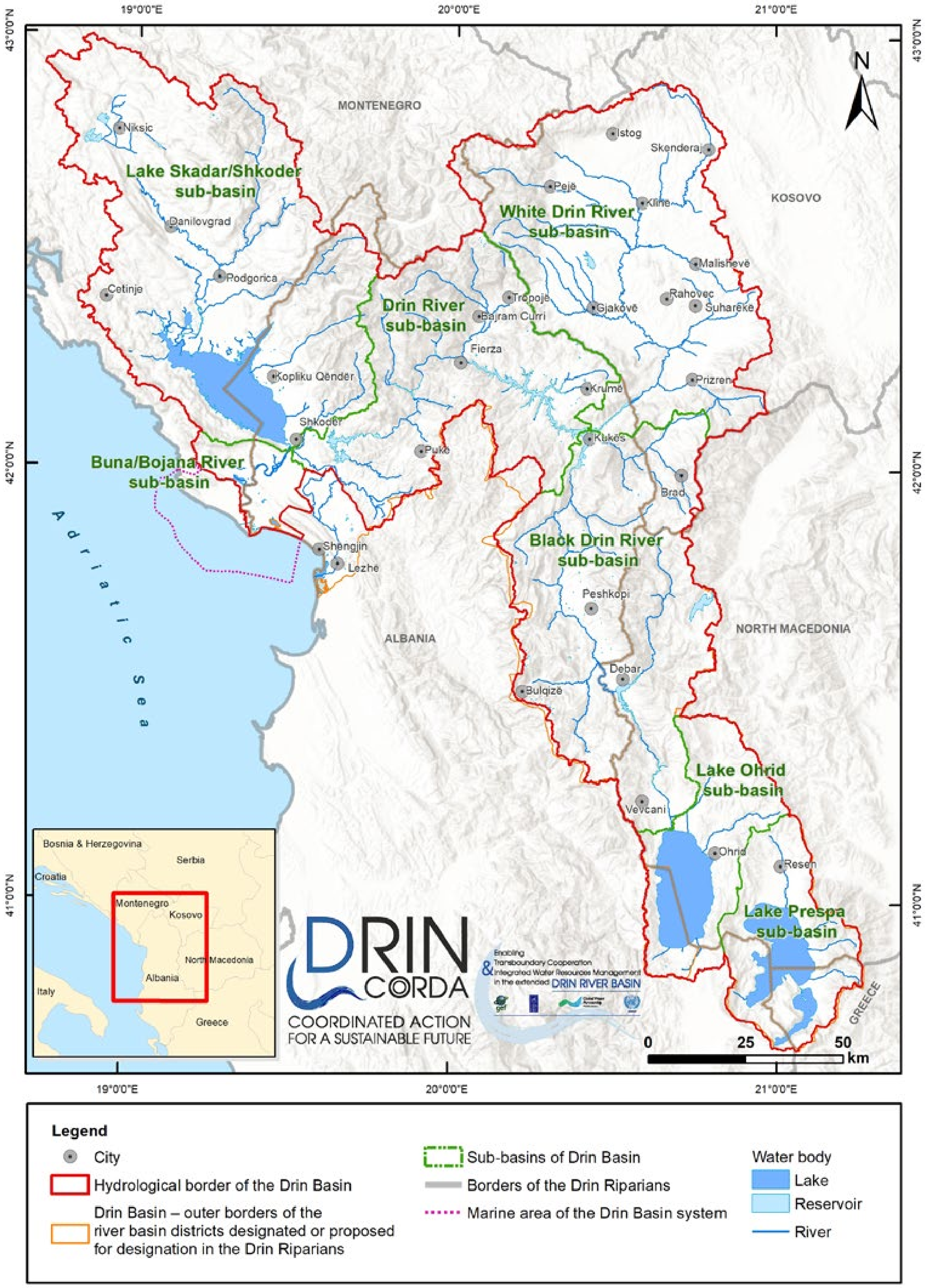
12 Prokletije/Bjeshkët e Nemuna Mountain.

13 The listed sub-catchments are identified as part of the work for the preliminary delineation of the surface-water bodies at the Drin Basin level, done to calculate the water balance in the Basin. The Drin Core sub-catchments are depicted in Figure 21 – Preliminary identification of surface-water bodies in the Drin Basin.

Sub-basin	Drin core sub-catchments[13]	Area (km²)	Area – cumulative (km²)	Shared by/areal extent of each Riparian (km²)				River length (km)	
				Albania	Greece	Kosovo	Montenegro	North Macedonia	
	Perroii Gomsiqes	146.70							19.60
	Drin 1	49.50							
	Gjadri r.	208.70		208.70					33.30
	Kiri	271.40							
	Drin 2	68.70					68.70		
			4,067.20						
Lake Skadar/ Shkodër	Morača	814.50					814.50		
	Mala Rijeka	142.70		80.87			61.79		18.50
	Zeta	1,655.90					1,655.90		50.90
	Cijevna	440.80					440.80		31.20
	Sitnica	252.10					252.10		11.40
	Lake Skadar/ Shkodër	2,036.50		1,692.17			344.33		
			5,342.50						
Buna/ Bojana River	Buna/Bojana	362.10	362.10						

2.2 Sub-basins in the Drin Basin – hydrology and interaction with marine waters

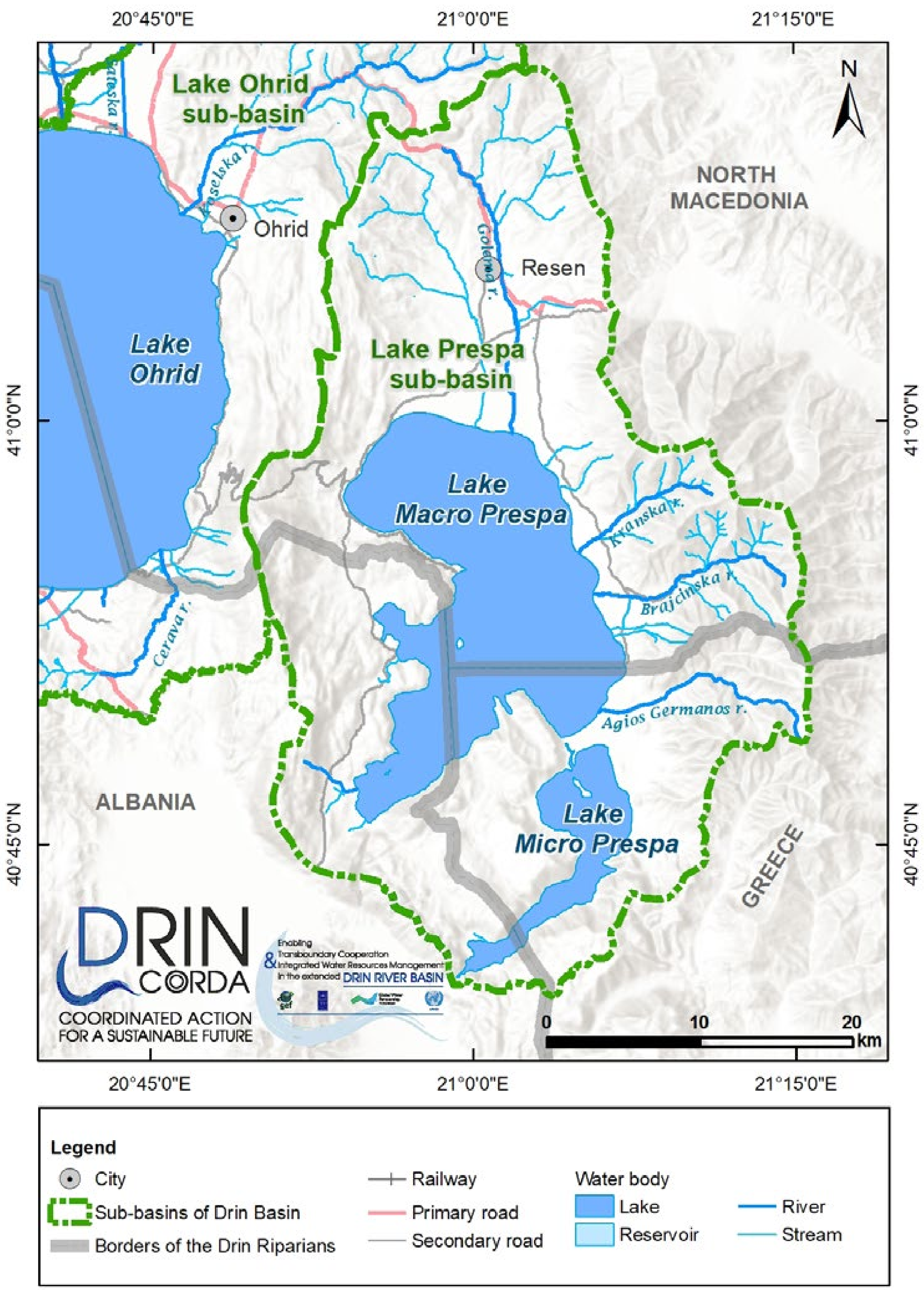
Figure 3. Sub-basins in the Drin Basin



The Drin Basin comprises the following interconnecting sub-basins with their main characteristics as summarized above in Table 2.

LAKE PRESPA

Figure 4. Map of the Lake Prespa sub-basin



In the Lake Prespa sub-basin there are two lakes – Micro Prespa and Macro Prespa – which are connected through an artificial canal. Lake Prespa is a tectonic lake with an average depth of 16–18 m and an average water residence time of 11–20 years (depending on the source of information). The karst geology of the area between the Prespa and Ohrid lakes makes it difficult to define the hydrogeological boundary, resulting in variations among studies of the Lake Prespa catchment's dimensions.

The total distribution of water inflows in the Macro Prespa Lake is estimated as follows: 56 percent from surface run-off, 35 percent from direct precipitation and 9 percent from Micro Prespa Lake. From 1976 to 2004, irrigation accounted for approximately 20 percent of the outflow, with 17 percent of total water losses for the same period comprising undefined outflows.

Water shortages in the watershed usually occur from May to September due to increased water demands and decreased precipitation, while at other times of the year there is no water deficit.

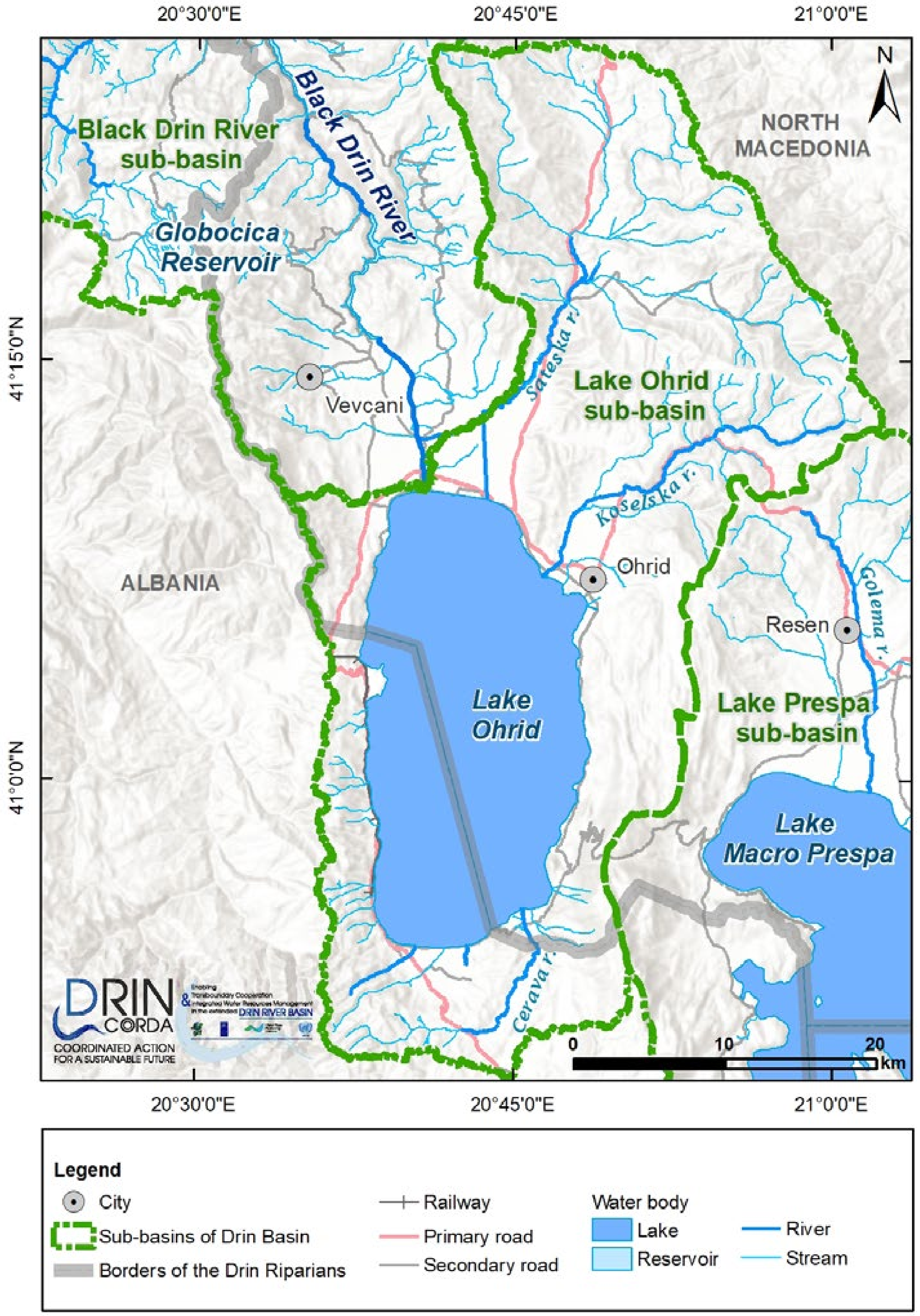
Under normal hydrological conditions, there are no surface outflows.

Water level oscillation causes the Macro Prespa surface area to vary from 259.4 to 280.0 km^2. The level of the water has fallen by more than 9 m in the last 60 years. The water level peaked during the 1963 flood at 853 m above sea level, falling in the years after, with the sharpest decline occurring between 1986 and 1991.

Even though the reasons for the decline in water level are not fully understood, they are believed to be predominantly related to natural variations in rainfall combined with human extraction and variations in the 'karstic outflow' regime.

LAKE OHRID

Figure 5. Map of the Lake Ohrid sub-basin



Note: The Lake Ohrid sub-basin is Ohridsko Ezero in North Macedonia and Liqeni i Ohrit in Albania.

Lake Ohrid is a tectonic lake with an average depth of 155 m and a maximum depth of 289 m. The average water residence time is 70–85 years.

Lake Ohrid is hydrogeologically connected to Lake Prespa, which sits around 150 m higher than Lake Ohrid (depending on water level variations). The hydraulic connection between Lake Prespa and Lake Ohrid, through the karstic massif, makes Lake Prespa its most important source of water, contributing over 40 percent of its water. It only takes six hours for the water to travel through the karstic system from Zavir/Zaveri to Tushemisht, which means that any change in the quality of Lake Prespa's waters would also affect – almost immediately – Lake Ohrid.

The Sateska River in North Macedonia is the lake's main surface tributary. In 1962, the river was diverted from its natural confluence with the Black Drin River into Lake Ohrid. The diversion almost doubled the size of the lake watershed and greatly increased its siltation (the mean annual sediment yield is over 100,000 m^3). As a result, the pollution levels of the lake, especially with respect to phosphorus, have significantly increased. There is ongoing work to redivert the Sateska River to its natural riverbed.

About two thirds of Lake Ohrid's water outflows pass into the Black Drin River (the only outflow of Lake Ohrid), while the remaining third either evaporates or is consumed. Since 1962, the outflow to the Black Drin River has been controlled with a weir that regulates the lake's water level. This limits water level fluctuation to within the range of about 1 m.

BLACK DRIN RIVER

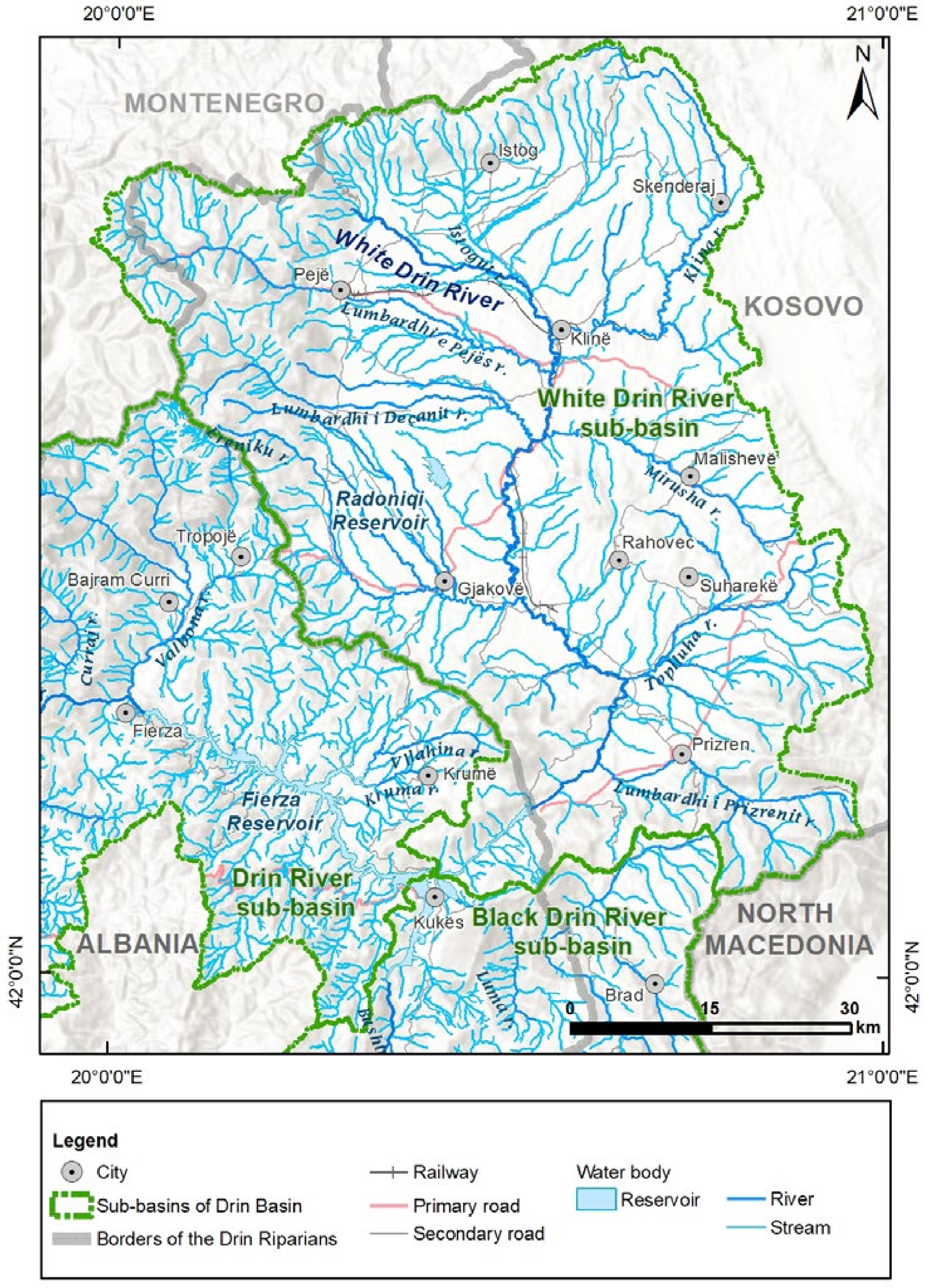
Figure 6. Map of the Black Drin River sub-basin

Apart from Lake Ohrid, the main tributary of the Black Drin River is the transboundary Radika River, which is shared by Kosovo and North Macedonia. The upper part of this river enters the artificial Mavrovo reservoir, which diverts its flow through a hydroelectric power plant into the Vardar River watershed (out of the Drin Basin), as an 'inter-basin transfer' of water. Due to this, the upper part of Radika River watershed is classified as an artificial and highly modified water body and is therefore not included in the hydrological and water balance analysis carried out for the needs of the present TDA.

There are two large dams constructed on the Black Drin River in North Macedonia: Globočica (92 m high) and Špilje (112 m high) close to the point before the river enters Albania. There are plans for the construction of two large-scale hydropower plants – Boskov Most and Lukovo Pole – and over 60 small plants in the Black Drin River watershed in North Macedonia.

WHITE DRIN RIVER

Figure 7. Map of the White Drin River sub-basin



Note: The White Drin River is Drini i Bardhë in Albania.

The White Drin River rises in Kosovo in the foothills of the large mountainous area north of the town of Peja. Its basin is the largest of the country's four sub-basins, and drains almost half of Kosovo. Only a small part of the sub-basin extends into Albania. The only existing dam in the White Drin River is in Radoniqi, which is 58 m high.

Altogether, the river discharge represents less than half of the inflow from natural springs and precipitation. Springs make up about 5 percent of the total inflow, but contribute around 9.5 percent to river discharge.

DRIN RIVER

After the floods of 1848–1858 and 1896, the Drin River[14] in Albania was split into two branches: one flowing via its original channel (old Drin) and a new one flowing towards the Buna/Bojana River, which it joins roughly 1.5 km from the outlet of Lake Skadar/Shkodër. At present, the 'old' Drin communicates with the Drin River through groundwater discharges in the Gjader fields and also the Gjader River itself.

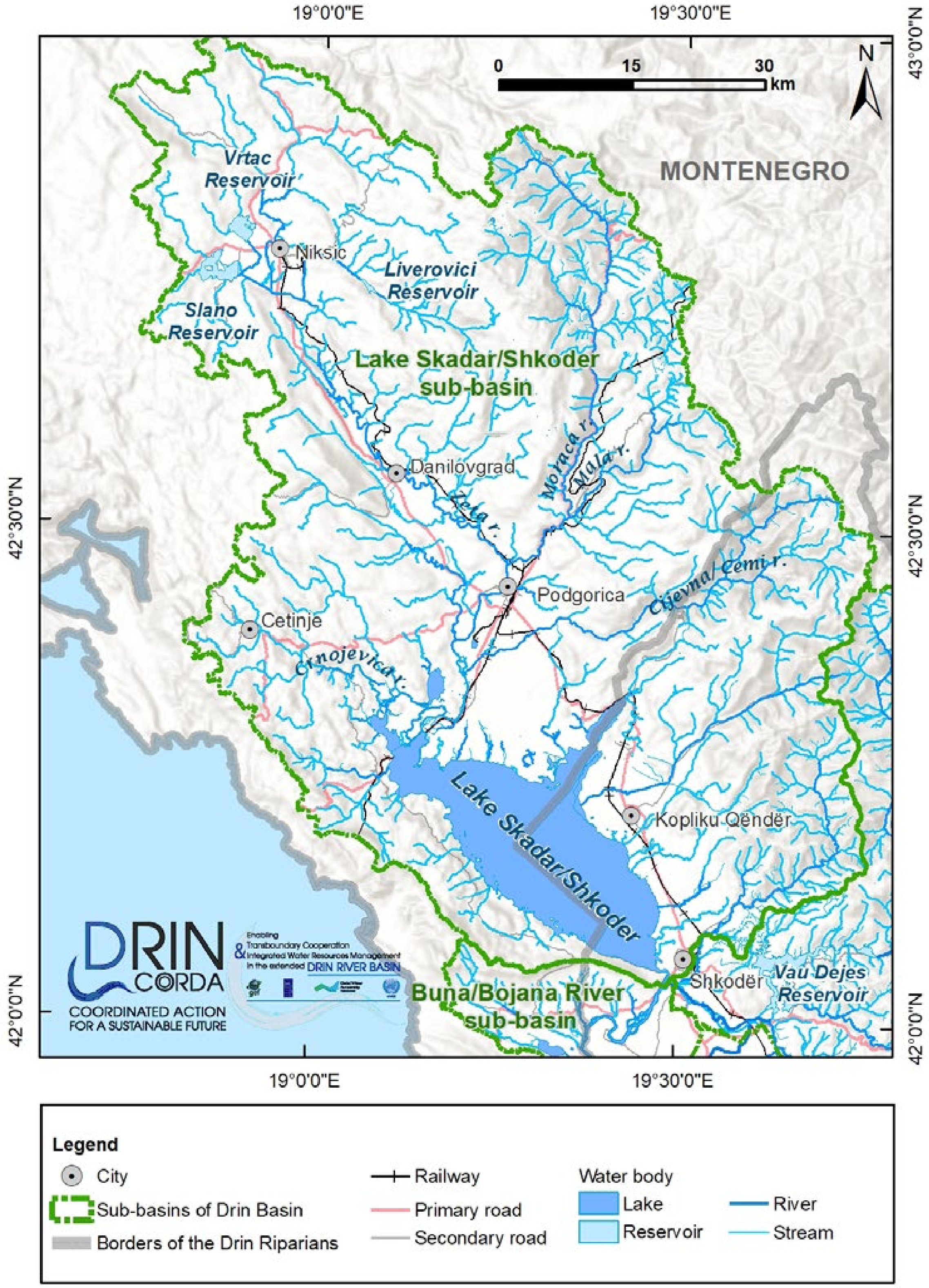
There are three major dams and associated reservoirs built on the Drin River. Of these, the Fierza reservoir has by far the largest storage. From October to March, the winter level is not exceeded, though during April, it increases to the maximum operating level. This provides maximum flood protection in winter when most floods occur, with the accumulated run-off from the last month of snow melt in spring maximizing available storage for summer. The total volume of all three reservoirs on the Drin River equals 3.76 x 10^9 m^3, which is greater than the average volume of Lake Skadar.

An analysis carried out for the needs of the TDA indicated that the operation of the dams in the Drin cascade is an important factor influencing the flow regime downstream of the Drin River and the Buna/Bojana River, and therefore influences the hydrological conditions in Lake Skadar/Shkodër. The functioning of the three dams alters the natural intra-annual flow distribution downstream of the dams, reducing some of the peak discharges during the wet season and increasing average discharges during the dry season. Because of the volume of its reservoir, the operation of the Fierza dam can – under specific conditions – affect the multiannual discharge distribution and eventual flooding events (see extreme observed values of the water level in Lake Skadar/Shkodër on page 45). Data from the Albanian Power Corporation (KESH) would allow more precise results and conclusions.

14 Drini i Bardhë (in Albania).

LAKE SKADAR/SHKODËR

Figure 8. Map of the Lake Skadar/Shkodër sub-basin



Note: Lake Skadar/Shkodër is Skadarsko jezero in Montenegro and Liqeni i Shkodrës in Albania.

Lake Skadar/Shkodër is a relatively shallow tectonic lake, which has a maximum depth of 9 m. The lake's water level varies widely, with extreme observed values recorded as 4.97 m and 10.31 m (2010 flood). Respective water volumes are 1.8×10^9 m^3 and 4.25×10^9 m^3. The lake's surface area at the mean water level of 6.52 m is 475 km^2.

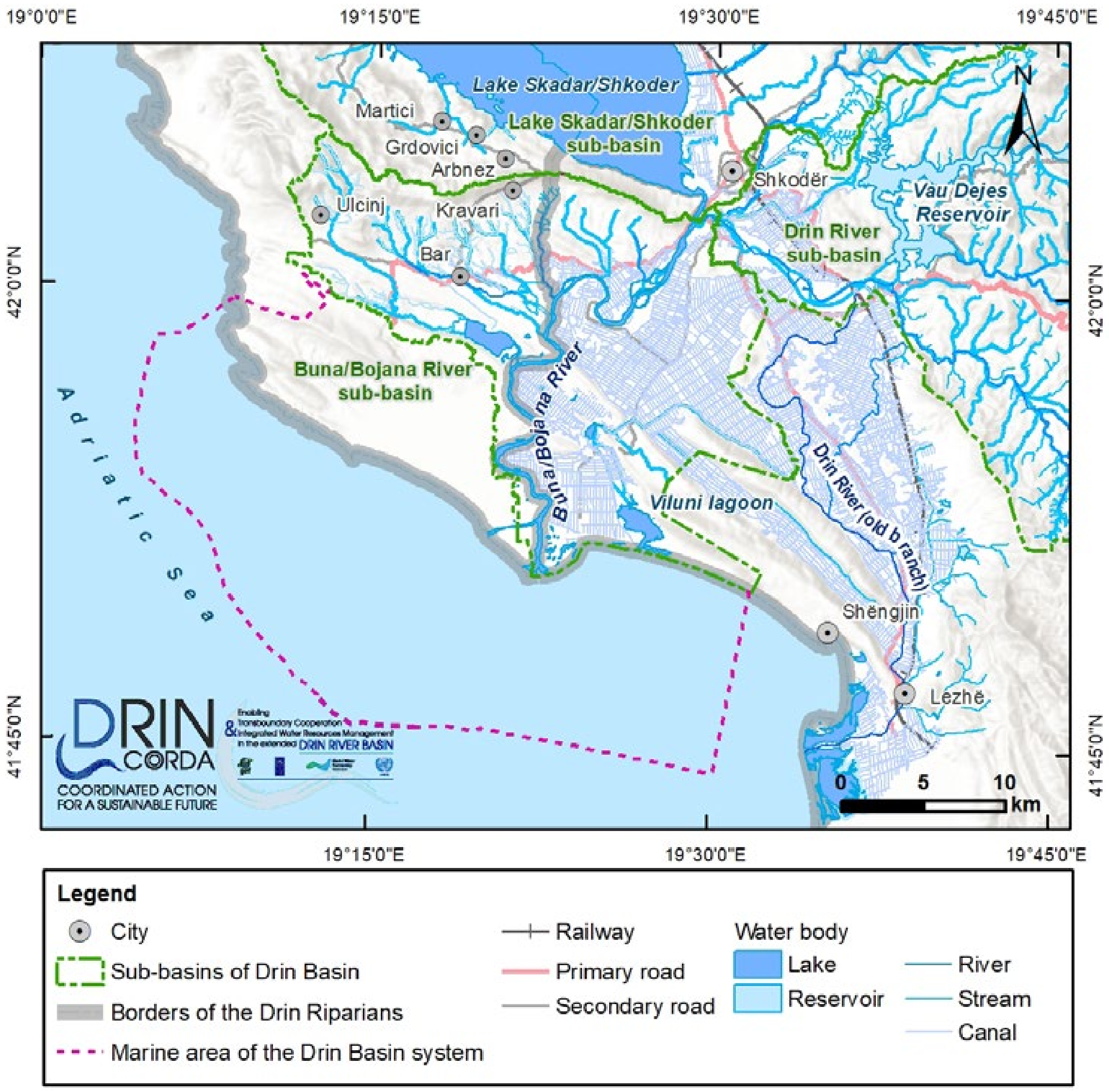
The main tributary of Lake Skadar/Shkodër is the Morača River, which drains about 32 percent of the territory of Montenegro and contributes around 60 percent of the lake's water. The lake also receives water from springs and groundwater bodies. The Syri i Sheganit[15] and Syri i Zi (in Albania) and Bolje sestre[16] and Karuč (in Montenegro) are the most important perennial springs in this region. They appear as small round lakes with a diameter of 15–20 m and have an estimated discharge of 0.15–10 m^3 s^{-1}. Several temporary springs also appear on the shore of the lake after intense rainfall or during the snow melt period.

15 The annual average discharge is 1,400 lt^{-1}. While discharge varies, the flow is equivalent to that of a river in winter.

16 The minimal capacity of the source (in September–October) is higher than 2 m^3/s, of which a maximum 1,200 l/s is used for the regional water supply of the Montenegrin coast.

BUNA/BOJANA RIVER

Figure 9. Map of the Buna/Bojana River sub-basin and adjacent marine area



The Buna/Bojana River – which is 44 km long with a depth that varies from 2 m to 4 m – is the only outflow from Lake Skadar/Shkodër. Discharges from Lake Skadar/Shkodër combine with flows from the Drin River about 1.5 km from the lake to produce a mean annual discharge of over 20 $km^3 yr^{-1}$.

Sometimes the outflow from the lake into the Buna/Bojana River is impeded due to an increase in the flow of the Drin River. This occurs mostly from December to February, but may also occur throughout the rest of the year, depending on the water released from the three hydropower dams upstream of the Drin River. The management of the dams depends on rainfall and electricity demand. The restriction to out-flowing water in the Buna/Bojana River significantly increases the lake's water level. With high Drin River water levels and low Buna/Bojana River water levels, Drin River water can enter the lake. The Drin River also deposits sediment, thereby further obstructing the flow in the Buna River and the outflow from the lake.

Land-use changes adjacent to the river channel have reduced the area of the floodplain, altering ecosystem structures and the hydrological functioning of the river. Before the intensive drainage and melioration of the area, almost 50 percent of the whole Buna/Bojana River and Delta region was regularly flooded.

COASTAL ZONE AND THE ADJACENT ADRIATIC SEA (AREA INFLUENCED BY THE DRIN FRESHWATER SYSTEM)

The Buna/Bojana Delta area comprises a recently developed small delta, several different lagoon complexes and freshwater lakes, as well as typical riverine and coastal landscapes. The growth of the delta by 1.0–1.5 km in the last 100 years is relatively slow compared with other Mediterranean deltas, such as the Rhone and Po (about 4 km in 100 years).

Lake Šaško and Viluni Lagoon are important wetlands in terms of biodiversity. Lake Šaško is situated within the Montenegrin part of the Buna/Bojana Basin (Ulcinj Field) and is fed by the Buna/Bojana River under favourable hydrological conditions. The lake is approximately 3 km long and 1.5 km wide. Viluni Lagoon, which is 3 km long and 0.9 km wide, lies in the Albanian part of the delta and is one of the most important lagoons in terms of biodiversity.

In the marine area, the predominant currents are northward during autumn and winter and reverse during summer. Four main external forces drive marine currents in the area: inflow of Ionian waters from the south; local winds; air–sea heat and water fluxes (collectively termed buoyancy forcing); and freshwater run-off from the Buna/Bojana River. Different factors dominate depending on the season. Freshwater river run-off and the influx of Ionian waters seem to be the main forcing factors for circulation in early spring.

Tides occur in this water system. As the bottom slope of the Buna/Bojana River is quite flat, tides can travel upstream of the river for several kilometres, with sea water potentially reach Reč or locations even further upstream. This phenomenon can be observed during dry periods, when the flow of fresh water is reduced. River fluxes influence a number of parameters, including sea surface salinity. Salinity levels are lowest between the Buna/Bojana River and the Ulcinj Salina wetland.

The coastal aquifers interact with the sea, including as submarine groundwater discharges, which contribute to the creation of brackish water habitats in the coastal zone. The submarine groundwater discharges to the Adriatic Sea in the Albanian portion of the study area are estimated to be 0.29 $mm^2 yr^{-1}$; no estimates exist for Montenegro.

3. PRIORITY TRANSBOUNDARY PROBLEMS

The TDA identified four key transboundary problems that affect the Drin Basin:

- deterioration of water quality
- natural and regulated variability of the hydrological regime
- biodiversity degradation
- variability of the sediment transport regime.

Climate variability and change has also been recognized as a significant regional (and global) problem that influences the four priority transboundary problems. Details of the potential impacts from climate change scenarios are outlined in the Thematic Reports on Biodiversity and Ecosystems, Hydrology and Hydrogeology, and Socio-economics and summarized in the following related sections of this TDA. In addressing the causes of the priority transboundary problems, climate change was recognized as a root cause of each problem, with the impacts of climate variability and change for each problem considered in the CCA.

The CCA presents these problems following the approach outlined in the GEF guidance.

The following section presents a summary of the analysis of the four problems in a simple and common format:

- description of problem: presenting a short summary of the transboundary problem, reference to the relevant thematic reports, etc.
- CCA: presenting a summary of the goods and services at risk, ecosystem and socio-economic impacts, the relevant sectors involved and the immediate, underlying and root causes of the problem
- linkages with other transboundary problems
- significant knowledge gaps
- preliminary recommendations to guide the SAP in addressing problems.

3.1 Priority problem 1: deterioration of water quality

3.1.1 Description of the transboundary problem

The deterioration of water quality (in all or part of the following in the case of each of the Riparians: rivers, lakes, groundwaters and coastal and transitional waters) is a problem that affects all Riparians in the Drin Basin. All kind of diffuse (agriculture and agglomerations) and point sources of pollution (towns and villages, industrial activities, etc.) exist in the Drin Basin. Different sources and pollution pressures of varying intensity are found in different sub-basins.

All Riparians are either meeting the requirements of the EU Water Framework Directive (as in the case of Greece) or are in the process of meeting these requirements through the development of RBMPs that will address the issues resulting in the failure to reach good ecological status (or potential).

The analysis (see Thematic Report on Pollution and Water Quality) highlighted the following water quality issues that are of transboundary concern:

- Excess nutrients (nitrogen and phosphorus) are considered a problem across most of the Drin Basin. About 50 percent of the total nutrient load derives from agricultural diffuse sources, with 30 percent deriving from inadequate or insufficient wastewater treatment from domestic sources. Although nitrogen pollution is considered low compared with Europe, within the basin there is evidence of high levels in Lake Ohrid, the White Drin River, tributaries of Lake Skadar/Shkodër and especially the Morača River. Phosphorus (a significant part of which derives from wastewater effluents) was considered a major issue across the basin. Coastal waters are considered to be at risk from receiving excess nutrients.
- Excess biochemical oxygen demand (BOD) is an issue across the Drin Basin, particularly in the White Drin River and Lake Skadar/Shkodër sub-basins.
- Industrial, mining and solid waste sources are having detectable impacts in the form of chemical oxygen demand (COD), heavy metals (although there is a need to better understand anthropogenic and natural sources) and in some locations, priority substances. Heavy metals and priority substances are also an issue in groundwaters (for example, the White Drin River) and in sediments (for example, Lake Skadar/Shkodër).

3.1.2 Causal chain analysis for deterioration of water quality

Figure 10 indicates the main links between the causes of pollution for nutrients, BOD/COD and heavy metals/priority substances in the Drin Basin. This is further elaborated in the summary presented in Table 3, which shows the main goods and services at risk, the main ecosystem and socio-economic impacts, sectors causing and impacted by the problem of pollution and the immediate, underlying and root causes of the deterioration of the water quality.

Figure 10. Causes and impacts of deterioration of water quality

ROOT CAUSES

- Pressure from increasing urban populations and intensification of agriculture
- Low level of financial resources for environmental protection
- Climate variability and change
- Increasing demand for food production
- Low political will

UNDERLYING CAUSES

- Insufficient/inadequate policies for agriculture
- Insufficient/inadequate policies for solid waste
- Insufficient monitoring
- Low level of enforcement
- Low capacity
- Low awareness of polluting activities

IMMEDIATE CAUSES

- Excess nutrients from diffuse sources
- Excess nutrients (and BOD) from wastewater
- Phosphates-containing detergents
- Inappropriate use of agrochemicals (herbicides, pesticides and fertilizers)
- Industrial wastewater discharges (priority substances and heavy metals)
- Heavy metals from mining activities
- Insufficient/inadequate wastewater treatment
- Inadequate management including collection/disposal of solid waste

IMPACTS

- Deterioration of biodiversity
- Drinking water quality
- Eutrophication
- Reduced food production
- Reduced amenity value

Table 3. Causal chain analysis for the deterioration of the water quality in the Drin Basin

Deterioration of water quality	
Goods and services at risk	• Drinking water supply • Ecological requirements/services • Tourism • Freshwater and marine fisheries • Agricultural/industrial water supply
Impacts (resulting from deterioration of water quality) on: ecosystems and socio-economics	• Deterioration of biodiversity • Drinking water quality • Eutrophication • Reduced food production (agriculture, fish) • Reduced amenity value
Sectors	• Agriculture • Urban › urban development › water supply › solid waste management • Industry (including solid waste management) • Mining
Immediate causes	• Excess nutrients from diffuse sources • Excess nutrients (and BOD) from wastewater • Phosphates-containing detergents • Inappropriate use of agrochemicals (herbicides, pesticides and fertilizers) • Industrial wastewater discharges (priority substances and heavy metals) • Heavy metals from mining activities • Insufficient/inadequate wastewater treatment • Inadequate management including collection/disposal of solid waste
Underlying causes	• Insufficient/inadequate policies for agriculture • Insufficient/inadequate policies for solid waste • Insufficient monitoring • Low level of enforcement • Low capacity • Low awareness of polluting activities
Root causes	• Pressure from increasing urban populations and intensification of agriculture • Low level of financial resources for environmental protection • Climate variability and change • Increasing demand for food production • Low political will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3.1.3 Linkages with other key transboundary problems

Water quality is impacted by the variability of the hydrological and sediment transport regime (for example, increased rainfall can cause additional surface erosion of soils and the release of pollutants), including from the impacts of climate variability and change, which affect the water quantity or concentration of dissolved oxygen in water. Pollution also has significant effects on the key problem of biodiversity degradation.

3.1.4 Preliminary recommendations to guide the SAP in addressing the transboundary problem of pollution and water quality

The Thematic Report on Pollution and Water Quality identified several issues that could be considered by the SAP as priorities. These included:

- The gathering or generation of water quality data has highlighted that methods used in the basin need to be strengthened to enhance the quality and comparability of results. This strengthening should address all stages from sampling, analyses and quality control to reporting. For a number of priority substances, the current analytical methods are not sufficiently sensitive to reach the very low environmental quality standards set by the EU directives.
- Data and information management and exchange systems should be implemented at the Drin regional level to facilitate the implementation of coordinated actions to reduce pollution.
- Policies (for example, introducing bans on phosphates-containing detergents) as well as their enforcement for all pollution-related issues should be strengthened.
- The lack of adequate wastewater collection systems should be assessed and considered for development, along with the upgrade or construction of new wastewater treatment works for agglomerations with a population equivalent above 2,000. Priority should be given to agglomerations that are responsible for the largest shares of pollution in the basin.
- Sensitive and protected areas for all water uses and services need to be defined with appropriate targets set noting any specific transboundary issues.
- Management of the solid waste (municipal and industrial, including hazardous) needs to be significantly improved. Adverse effects of the unproper management (particularly on the quality of the groundwater) needs to be better understood with mitigation measures developed and implemented.
- Appropriate agricultural measures to reduce nutrients and pesticides/herbicides should be identified, especially in the White Drin River and Lake Skadar/Shkodër sub-basins as diffuse agricultural sources are a significant cause of nutrient pollution.

3.2 Priority problem 2: variability of the hydrological regime

3.2.1 Description of the transboundary problem

The TDA has identified several issues that either result in or are influenced by the variability of the hydrological regime as a key transboundary problem, including:

- Increasing frequency of droughts, as a result of climate variability/change or extreme weather events, can have an adverse effect during the summer period in agriculture and industry. Drought impacts can be worsened by additional impacts from hydromorphological modifications (as a result of hydropower dams and flood defences) that can, for example, reduce groundwater recharge.
- The variability of the hydrological regime is affected by the management of the dams to maximize energy production as well as the uncoordinated management of the cascade of dams between countries; this can further exacerbate extreme events (floods).
- Water level fluctuations in the Lake Prespa sub-basin are of concern regarding the ecosystems.
- Linkages between surface water and groundwater are significant, especially between the Prespa and Ohrid lakes via karst structures – the karstic connections within the basin need further investigation.
- The White Drin River and Drin River sub-basins are characterized as having relatively high water stress (consumption is more than 70 percent of the available water) during the summer months of dry years.
- Preliminary modelling indicated that the water resources in the main sub-basins and entire Drin Basin are adequate to cover the current water demands for anthropogenic purposes, though further modelling is required to improve understanding of the water demand under various development and climate change scenarios and to assess possible water stress.
- Mitigation measures are necessary to minimize water losses and apply water-saving measures (especially in agriculture).
- A lack of adequate hydrological monitoring and data management at the Riparian and regional levels prevent the Riparians from identifying and applying management solutions.

3.2.2 Causal chain analysis for the variability of the hydrological regime

Figure 11 presents the main links between the causes of the variability of the hydrological regime. This is further elaborated in the summary presented in Table 4, which shows the main goods and services at risk, the main ecosystem and socio-economic impacts, sectors causing and impacted by the problem and the immediate, underlying and root causes of the variability of the hydrological regime.

Figure 11. Causes and impacts of the variability of the hydrological regime

ROOT CAUSES

- Climate variability and change
- Increasing water demand from increasing urban populations and intensification of agriculture
- Lack of financial resources
- Low political will

UNDERLYING CAUSES

- Lack of integration between sectors/ministries
- Lack of cooperation between hydropower plant operators
- Low enforcement of existing policies
- Low integration between Riparians on water management
- Low awareness/capacity
- Low application of climate change adaptation measures
- Lack of water protection measures
- Low/lack of emergency planning

IMMEDIATE CAUSES

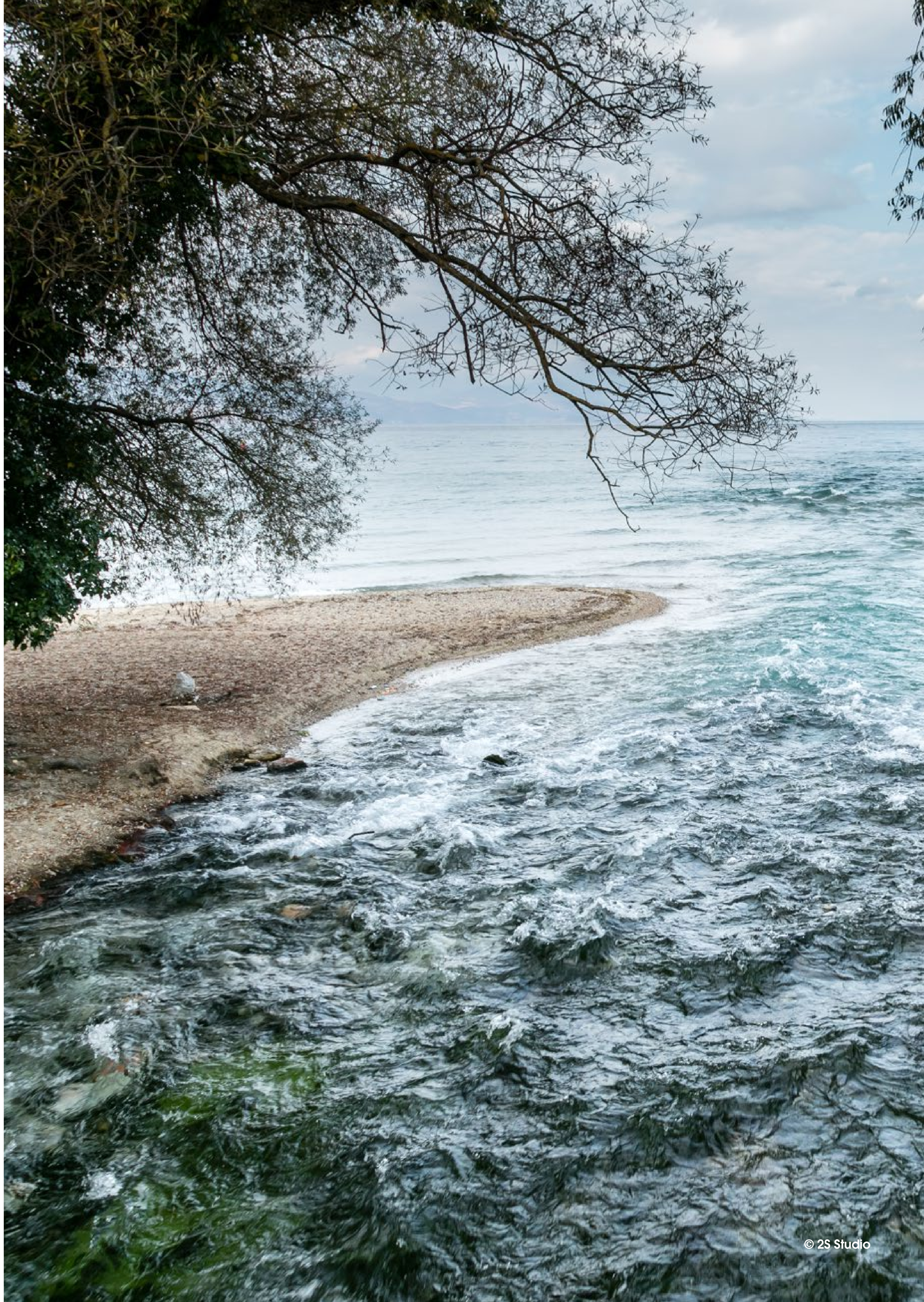
- Exacerbation from extreme weather events (floods and droughts)
- Increased pressure on resources (water demand) locally or in sub-basins
- Hydromorphological alterations
- Hydropower plant operations of dams in the Drin River cascade (aiming to maximize energy production)

IMPACTS

- Economic loss (farming, fisheries, industry)
- Loss of food production
- Hydropower generation losses
- Flood damage (urban and rural)
- Fluctuations in lake water levels
- Wetland losses (and of services provided)
- Biodiversity loss/changes in geographic distribution of biological communities
- Increased erosion from deforested and agricultural land
- Increased sedimentation
- Coastal erosion
- Impacts on water quality

Table 4. Causal chain analysis for the variability of the hydrological regime

Natural and regulated variability of the hydrological regime	
Goods and services at risk	• Aquatic and land-based ecosystems and associated services • Groundwater recharge • Water supply (drinking, irrigation, industrial, hydropower) • Tourism • Freshwater fisheries • Marine fisheries
Impacts (resulting from variability of the hydrological regime) on: ecosystems and socio-economics	• Economic loss (farming, fisheries, industry) • Loss of food production • Hydropower generation losses • Flood damage (urban and rural) • Fluctuations in lake water levels • Wetlands losses (and of services provided) • Biodiversity loss/changes in geographic distribution of biological communities • Increased erosion from deforested and agricultural land • Increased sedimentation • Coastal erosion • Impacts on water quality
Sectors	• Agriculture • Industry/power • Urban planning • Tourism
Immediate causes	• Exacerbation from extreme weather events (floods and droughts) • Increased pressure on resources (water demand) locally or in sub-basins • Hydromorphological alterations • Hydropower plant operations of dams in the Drin River cascade (aiming to maximize energy production)
Underlying causes	• Lack of integration between sectors/ministries • Lack of cooperation between hydropower plant operators • Low enforcement of existing policies • Low integration between Riparians on water management • Low awareness/capacity • Low application of climate change adaptation measures • Lack of water protection measures • Low/lack of emergency planning
Root causes	• Climate variability and change • Increasing water demand from increasing urban populations and intensification of agriculture • Lack of financial resources • Low political will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3.2.3 Linkages with other key transboundary problems

Variability of the hydrological regime is most closely aligned with climate variability and change, especially with the likely increase in extreme events, and also to socio-economic activity demand, such as for irrigation. While hydropower generation is a non-consumptive use of water, it influences water flows (leading to hydropeaking, among others) and sediment transport, which have consequential impacts on the state of ecosystems and the services they provide. The retaining dams for hydropower generation can also lead to sedimentation in the dams themselves, which in the absence of adequate maintenance will eventually lead to reduced generation capacity and changes in sediment transport. Changes in the hydrological regime can influence pollutant concentrations throughout the Drin Basin, particularly in karstic regions (for example, the Prespa and Ohrid lakes).

3.2.4 Preliminary recommendations to guide the SAP in addressing the transboundary problem of the variability of the hydrological regime

- Detailed studies (including modelling) are required on:
  - potential climate change effects on the water availability
  - water stress under different climate and water demand scenarios
  - environmental water requirements (minimum flow)
  - impacts of the current Prespa and Ohrid lakes water demand activities on the hydrological regime
  - effects of hydropower generation on the hydrological regime (including effects from hydromorphological alterations, hydropeaking, etc.)
  - sediment transport (including erosion and deposition)
  - calculation of pollutant loads (based on concentrations and discharges).
- The benefits of a coordinated monitoring network to cover the entire Drin Basin needs to be assessed during the implementation of the SAP, considering all aspects of monitoring sites, monitoring techniques, analytical methods, quality control, reporting, etc.
- Drought forecasting should be carried out.
- Flood risk/hazard modelling and flood preparedness/risk management (including warning systems) should be developed.
- Following the recommendations of the nexus study, an investigation into multisector requirements for water resources should be conducted.
- Discussions and feasibility studies on the coordinated management of the large dam cascades in Albania and North Macedonia should be enabled.

3.3 Priority problem 3: biodiversity degradation

3.3.1 Description of the transboundary problem

Biodiversity in the Drin Basin is of significant importance at the European level. The Thematic Report on Biodiversity and Ecosystems identified multiple threats to the ecosystems as well as issues that impede their sustainable management. These include:

- use of agrochemicals
- pollution, gravel activities, intensification of agriculture and urbanization leading to habitat degradation in rivers
- fluctuations of lake water levels impacting or resulting in the shifting of habitats in littoral zones
- hydromorphological alterations from flood and hydropower constructions resulting in lateral and longitudinal disruptions as well as the loss of wetlands
- deforestation and inappropriate use of and/or poorly managed forest resources
- inappropriate cultivation practices leading to destruction of soil structures or exposing soil to excessive erosion
- overfishing and inappropriate fishing practices
- illegal hunting
- invasive and alien species[17] putting pressure on local species
- a lack of recent information on fish stocks and other aquatic taxa
- unmapped or unidentified marine habitats.

3.3.2 Causal chain analysis for biodiversity degradation

Figure 12 indicates the main links between the causes of biodiversity degradation. This is further elaborated in the summary presented in Table 5, which shows the main goods and services at risk, the main ecosystem and socio-economic impacts, sectors causing and impacted by the problem and the immediate, underlying and root causes of biodiversity degradation.

17 Including 12 fish species in Lake Prespa, 7 fish species in Lake Ohrid, 13 fish species in Lake Skadar/Shkodër.

Figure 12. Causes and impacts of biodiversity degradation

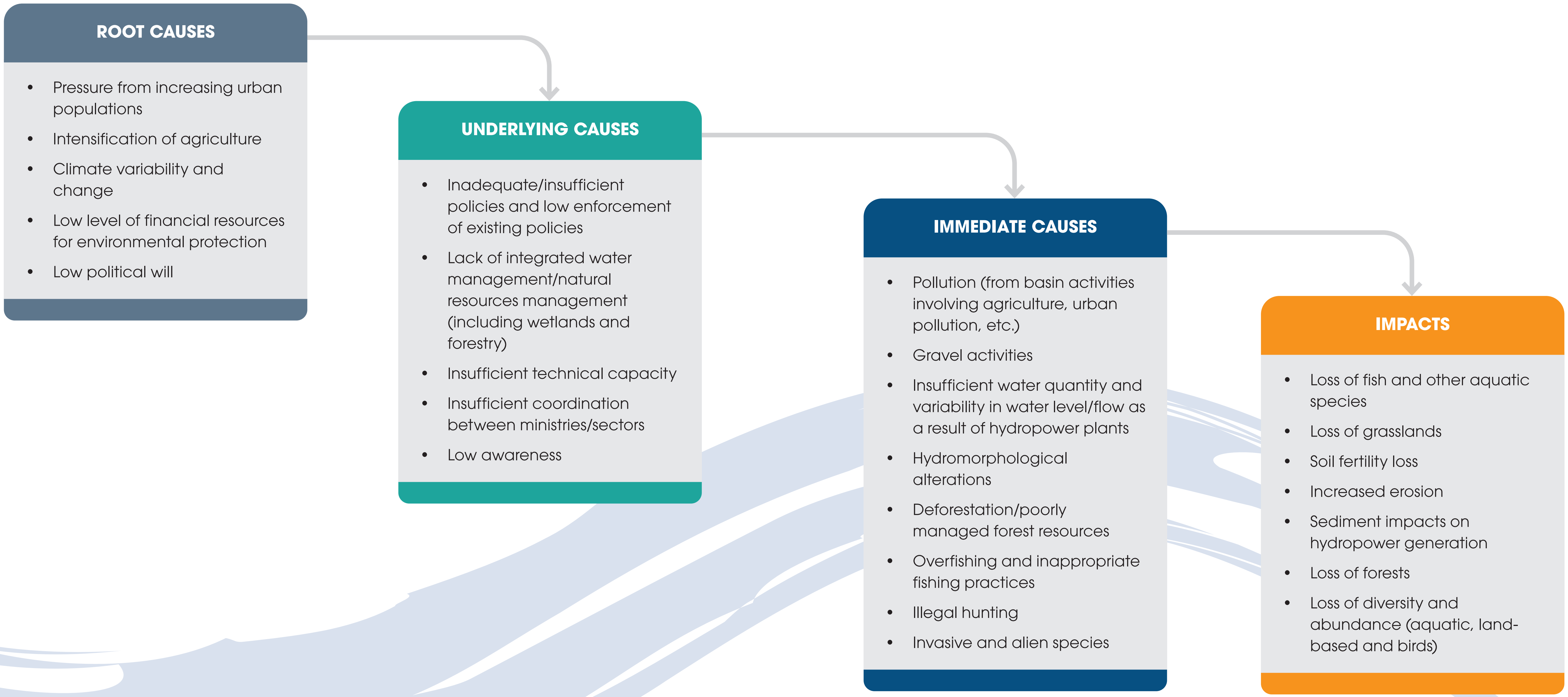

Table 5. Causal chain analysis for biodiversity degradation

Biodiversity degradation	
Goods and services at risk	• Food from fishing and agriculture • Wild foods/herbs • Tourism (including hunting and fishing)
Impacts (resulting from biodiversity degradation) on: ecosystems and socio-economics	• Loss of fish and other aquatic species • Loss of grasslands • Soil fertility loss • Increased erosion • Sediment impacts on hydropower generation • Loss of forests • Loss of diversity and abundance (aquatic, land-based and birds)
Sectors	• Agriculture • Fisheries • Forestry • Tourism • Industry (power generation) • Cultural activities (hunting, wild foods, etc.)
Immediate causes	• Pollution (from basin activities involving agriculture, urban pollution, etc.) • Gravel activities • Insufficient water quantity and variability in water level/flow as a result of hydropower plants • Hydromorphological alterations • Deforestation/poorly managed forest resources • Overfishing and inappropriate fishing practices • Illegal hunting • Invasive and alien species
Underlying causes	• Inadequate/insufficient policies and low enforcement of existing policies • Lack of integrated water management/natural resources management (including wetlands and forestry) • Insufficient technical capacity • Insufficient coordination between ministries/sectors • Low awareness
Root causes	• Pressure from increasing urban populations • Intensification of agriculture • Climate variability and change • Low level of financial resources for environmental protection • Low political will

Podarcis tauricus

3.3.3 Linkages with other key transboundary problems

Biodiversity is subject to impacts from the other three key transboundary problems and the crosscutting problem of climate variability and change.

3.3.4 Preliminary recommendations to guide the SAP in addressing the transboundary problem of biological degradation

The Thematic Report on Biodiversity and Ecosystems concluded that the SAP should consider the following issues:

- The establishment of systematic research and monitoring of biodiversity and its management in the Drin Basin, focusing on information gaps and conservation priorities.
- The development of a common vision regarding conservation.
- The establishment of flagship biodiversity projects.
- The exploration of opportunities for large-scale climate change mitigation and adaptation-related funding.
- Clarification of responsibilities and improved coordination between all institutions involved in conserving and managing natural resources.
- The strengthening of natural resource management institutions through the provision of adequate long-term budgets, staffing and training.
- An increase in the area of protected areas of rivers, streams and wetlands, as part of future Natura 2000 network.
- The introduction of community-based management of natural resources.
- Improved managerial framework related to fishing and hunting, including the enforcement of legislation.

3.4 Priority problem 4: variability of the sediment transport regime

3.4.1 Description of the transboundary problem

Sediment transport is affected by both natural events, climate variability and change (such as extreme weather events) and anthropogenic impacts (such as gravel extraction, deforestation, poor land use, dams and other hydromorphological alterations), resulting in sediment transport variability – both excess and reduced sediment transport – with consequential impacts on ecosystems and coastal environments. The Thematic Report on Hydrology and Hydrogeology identified the impacts and causes of excessive and insufficient sediment transport as:

- hydromorphological alterations
- reduced hydrostatic head for hydropower production due to the sedimentation in the dams
- decreased sediment loads and increased erosion from the operation of hydropower plants downstream of discharge locations
- Buna/Bojana River deposition and erosion
- coastal changes from changing sediment processes and interaction with the sea
- loss of habitats from changes of sediment deposition.

3.4.2 Causal chain analysis for the variability of sediment transport regime

Figure 13 indicates the main linkages between the causes and impacts of the variability of sediment transport. This is further elaborated in the summary presented in Table 6, which shows the main goods and services at risk, the main ecosystem and socio-economic impacts, sectors causing and impacted by the problem and the immediate, underlying and root causes of changes to sediment transport.

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Figure 13. Causes and impacts of the variability of sediment transport regime

ROOT CAUSES

- Climate variability and change
- Low level of financial resources for environmental protection
- Low political will

UNDERLYING CAUSES

- Lack of enforcement
- Lack of capacity (identify and assess problems) and mitigation measures (nature-based solutions)
- Lack of monitoring
- Insufficient national and international coordination
- Lack of awareness

IMMEDIATE CAUSES

- Unsustainable agricultural practices
- Deforestation
- Extreme weather events (floods and droughts)
- Hydromorphological alterations
- Hydropower plant operations
- Gravel extraction

IMPACTS

- Hydropower plant operations
- Gravel extraction
- Changes in sedimentation in rivers and coasts
- Coastal erosion
- Tourism
- Fisheries (freshwater and coastal/marine)
- Biodiversity

Table 6. Causal chain analysis for the variability of sediment transport regime

Variability of sediment transport	
Goods and services at risk	• Hydropower plant generation • Flood protection • Navigation/tourism (Buna/Bojana River) • Tourism • Fisheries (freshwater and coastal/marine) • Biodiversity in lakes, rivers, coastal waters
Impacts (resulting from variability of the sediment transport regime) on: ecosystems and socio-economics	• Hydropower plant operations • Gravel extraction • Changes in sedimentation in rivers and coasts • Coastal erosion • Tourism • Fisheries (freshwater and coastal/marine) • Biodiversity
Sectors	• Forestry • Agriculture • Tourism • Industry (power production, gravel extraction)
Immediate causes	• Unsustainable agricultural practices • Deforestation • Extreme weather events (floods and droughts) • Hydromorphological alterations • Hydropower plant operations • Gravel extraction
Underlying causes	• Lack of enforcement • Lack of capacity (identify and assess problems) and mitigation measures (nature-based solutions) • Lack of monitoring • Insufficient national and international coordination • Lack of awareness
Root causes	• Climate variability and change • Low level of financial resources for environmental protection • Low political will

3.4.3 Linkages with other key transboundary problems

Changes in sediment transport are linked to the variability of the hydrological regime as well as climate variability and change. Changes in the water flow as a result of socio-economic activities (such as hydropower production) also impact this problem. Sediment transport variability has an effect on habitats and therefore ecosystems.

3.4.4 Preliminary recommendations to guide the SAP in addressing the transboundary problem of the variability of sediment transport

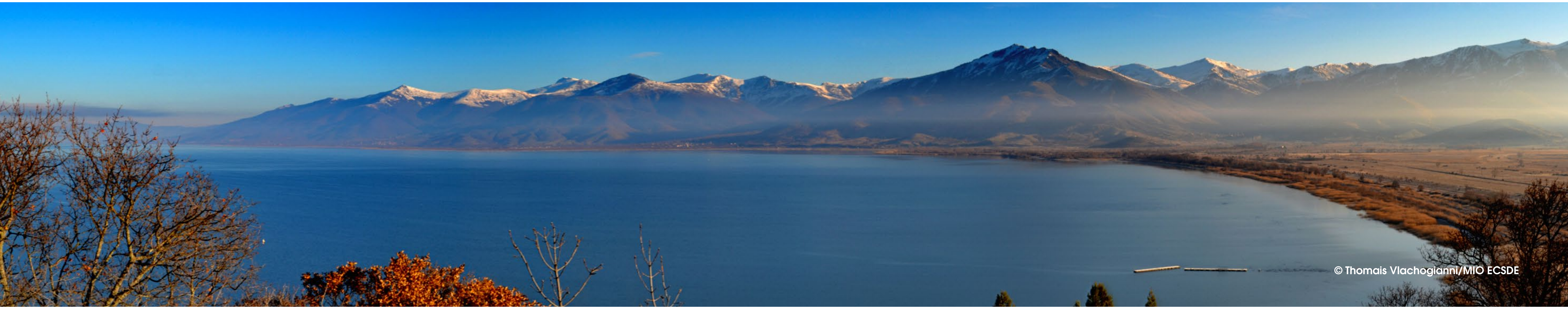
Studies and actions/measures are required to assess and address the impacts of sediment transport variability, including:

- developing and implementing harmonized approaches to sediment monitoring
- assessing impacts on sediment transport changes from deforestation, land use and other related activities
- assessing impacts from changes to the sediment transport regime on biodiversity and tourism (for example, the loss of beaches)
- assessing impacts from in-river gravel extraction on the sediment transport regime
- assessing impacts from hydropower operation on sediment transport to identify means to reduce negative impacts from dams.

3.5 Preliminary overall recommendations to guide SAP development

The key issues raised in the thematic reports are summarized throughout this TDA and together with the CCA will guide the development of SAP actions. Furthermore, the CCA is supplemented by the results of an expert workshop (December 2018, Athens), which examined in more detail the specific problems, causes, impacts and potential actions to address the problems. The TDA identifies key/overall coordinated management actions that will assist in addressing groups of or all of the key issues, some of which include:

- improving intersectoral and regional coordination (including consideration to establishing a regional body/commission for the Drin Basin) for water and ecosystem management
- regional harmonization of approaches to water management, monitoring and data/information approaches, reporting, etc.
- regional policy strengthening, for example, on best available practices in agriculture or on the use of phosphates-containing detergents, through testing approaches in targeted pilot projects
- capacity development (technical, policy, enforcement, etc.)
- practical demonstrations to highlight common solutions to the transboundary problems that could be upscaled across the basin
- awareness-raising at all levels of society, from community to the Government
- procedural enhancements (for example, how hydropower plant cascades operate)
- infrastructure upgrades (wastewater treatment works, municipal solid waste, etc.) in accordance with EU Association Agreement commitments of the Riparians
- updating and implementing national action plans (NAPs) and/or strategies to reflect the ambition and objectives of the SAP at the Riparian/sub-basin level.



PART B

SUMMARY OF THE DRIN BASIN CHARACTERIZATION

4. SOCIO-ECONOMIC ASPECTS

This section summarizes the socio-economic background, focusing on elements related to ecosystem and water management, such as population trends, economic conditions (gross domestic product – GDP) of the Riparians, and the main economic activities (agriculture, forestry, fisheries, hydropower, industry, mining and tourism). The impacts of these activities on the water resources and ecosystems are summarized in sections 5–9 of this TDA.

4.1 Population[18]

The total population of the Drin Basin is 1,615,939, split almost equally between the female (50.1 percent) and male populations (49.9 percent). Of the total, 37.4 percent live in Albania, 34.6 percent in Kosovo, 0.1 percent in Greece, 11 percent in North Macedonia and 16.9 percent in Montenegro (Table 7).

Table 7. Drin Basin population distribution by Drin Riparians

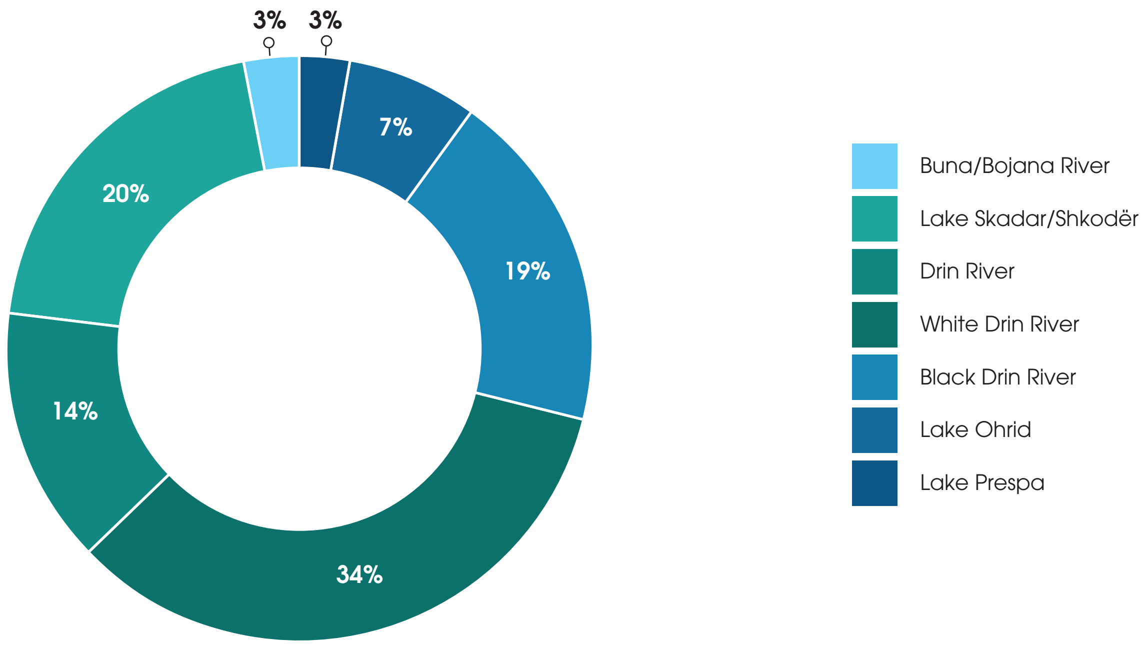
	Population					
Country	**Total country population (2011)***	**Female population in the basin**	**Male population in the basin**	**Total population in the basin**	**% of population in the basin**	**Population density (cap/km²)**
Albania	2,821,977	300,530	304,102	604,632	37.4%	81
Kosovo	1,739,825	280,262	279,397	559,659	34.6%	123
North Macedonia	2,069,162	88,866	89,000	177,866	11.0%	63
Montenegro	625,883	139,702	134,080	273,782	16.9%	67
Drin Basin		**809,360**	**806,579**	**1,615,939**	**100%**	**85**
		50.1%	*49.9%*			

Notes: Area of inland waters is not included in the population density calculation. Information about Greece is not included in the table.
Source: Riparians' statistical agencies.

18 The main source of data and other information are based on the latest population censuses carried out in the Drin Riparians. Apart from North Macedonia, all Riparians conducted population and household censuses in 2011.

Figure 14 provides summary information regarding the distribution of the current population of the Drin Basin by sub-basin.

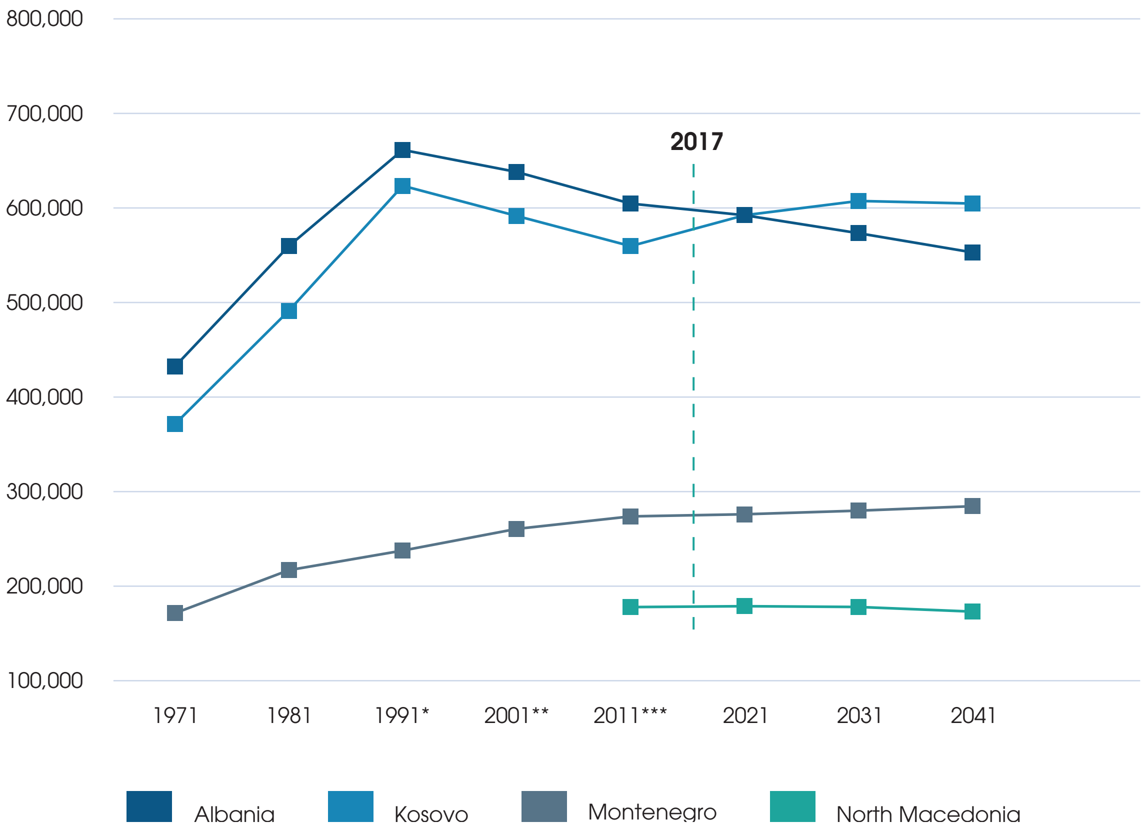
Figure 14. Distribution of current Drin Basin population by sub-basin



Population trends, 1971–2041

The Drin Basin population has varied significantly over the past 40 years. As shown in Figure 15, the population of all four Riparians analysed under this TDA had an increasing trend between 1971 and 1991, with its recorded total peak of 1,698,150 in 1991, which is almost 50 percent higher than the population in 1971 (1,129,732). In the period between 1991 and 2011, the populations of Albania and Kosovo had an almost constant descending trend, while the population of North Macedonia and Montenegro continued to grow, though at minimal annual rates.

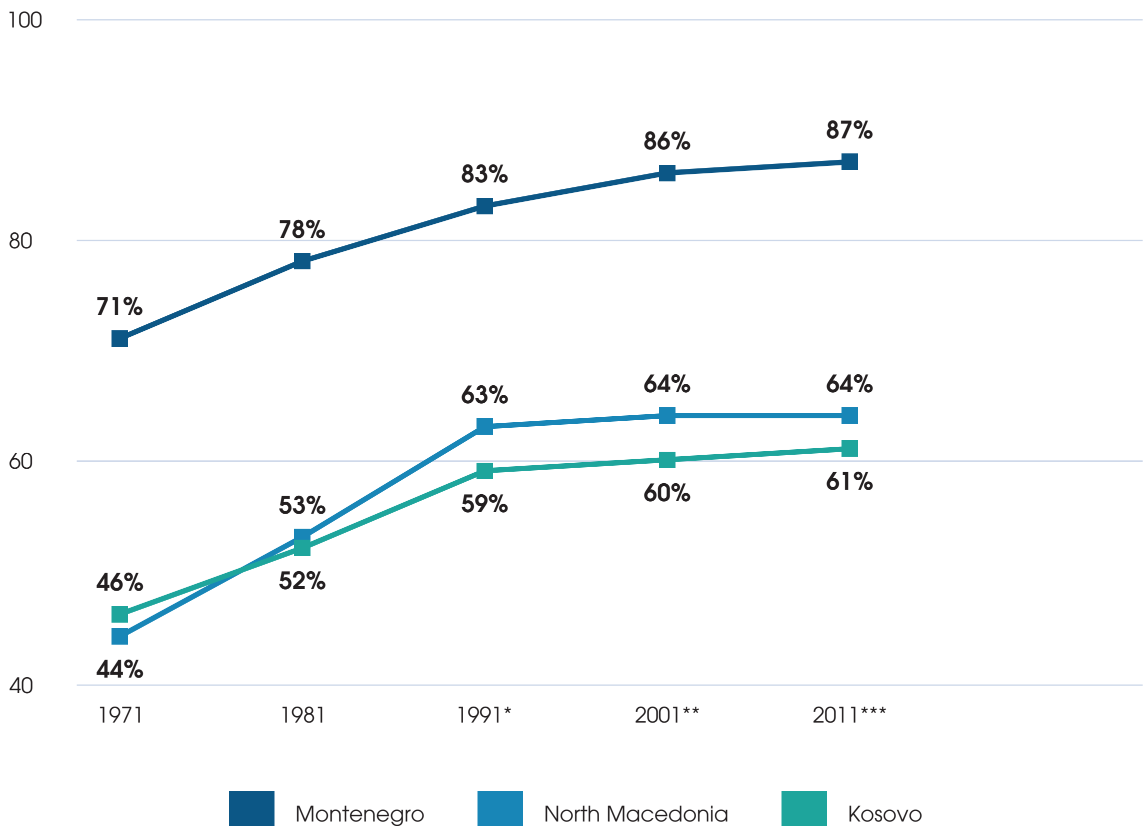
Figure 15. Drin Basin population changes and trends, 1971–2041



Notes:
* North Macedonia 1994.
** Number for Kosovo estimated.
*** Albania 2016; North Macedonia 2015 estimates.
**** Albania population estimates based on INSTAT (2014). Albania Population Projections 2011–2031.

The overall percentage of the urban population to the total population in the Drin Basin was 57.9 percent in 2011. The increase in urban populations (Figure 16) is an issue that has an effect on environmental management due to, for example, increases in point source pollution pressures from existing urban wastewater treatment works. Based on available data for Kosovo, Montenegro and North Macedonia, the average urban population in 1971 was 53.5 percent, with 70.6 percent in Montenegro and 46.4 percent in Kosovo. In 2011, the average was 70.6 percent, with 86.5 percent in Montenegro, 64.4 percent in North Macedonia and 61 percent in Kosovo.

Figure 16. Urban population increase trend, 1971–2015



Notes:
* North Macedonia 1994.
** North Macedonia 2002.
*** North Macedonia 2015 estimates.

4.2 Gross domestic product

GDP is a monetary measure of the market value of the total volume of all final goods and services produced during a given period of time within the geographical boundaries of a given geographical area.

Table 8 and Figure 17 provide an overview of the GDP of the four Drin Riparians that are analysed under the TDA at current prices, along with GDP annual growth rates and the GDP per capita ratio.

Table 8. Drin Basin GDP and GDP per capita in each Riparian at current prices, 2011–2015

Drin Basin: GDP on a state level at current prices – mill EUR (2011-2015)					
Country	**2011**	**2012**	**2013**	**2014**	**2015**
Albania	9,268	9,539	9,629	9,952	10,150
Kosovo	4,815	5,059	5,327	5,567	5,807
North Macedonia	7,544	7,585	8,150	8,562	9,061
Montenegro	3,264	3,181	3,362	3,457	3,624
Drin Basin: GDP real growth rate (2011-2015)					
Country	**2011**	**2012**	**2013**	**2014**	**2015**
Albania	2.5%	1.4%	1.0%	1.8%	2.2%
Kosovo	4.4%	2.8%	3.4%	1.2%	4.1%
North Macedonia	2.3%	-0.5%	2.9%	3.6%	3.8%
Montenegro	3.2%	-2.7%	3.5%	1.8%	3.4%
Drin Basin: GDP per capita on a state level at current prices - EUR (2011-2015)					
Country	**2011**	**2012**	**2013**	**2014**	**2015**
Albania	3,191	3,289	3,324	3,439	3,508
Kosovo	2,672	2,799	2,935	3,084	3,277
North Macedonia	3,665	3,680	3,948	4,141	4,377
Montenegro	5,266	5,128	5,415	5,562	5,825

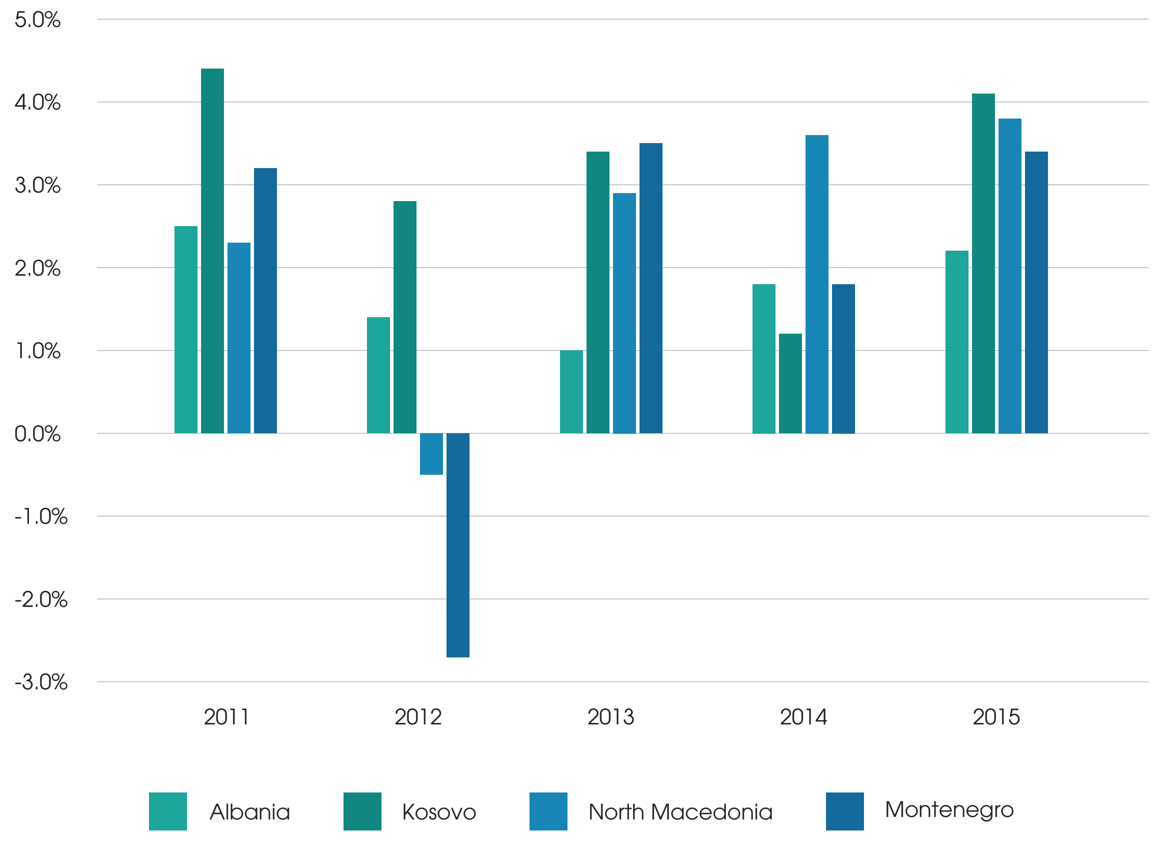
Source: Riparians' statistical agencies.

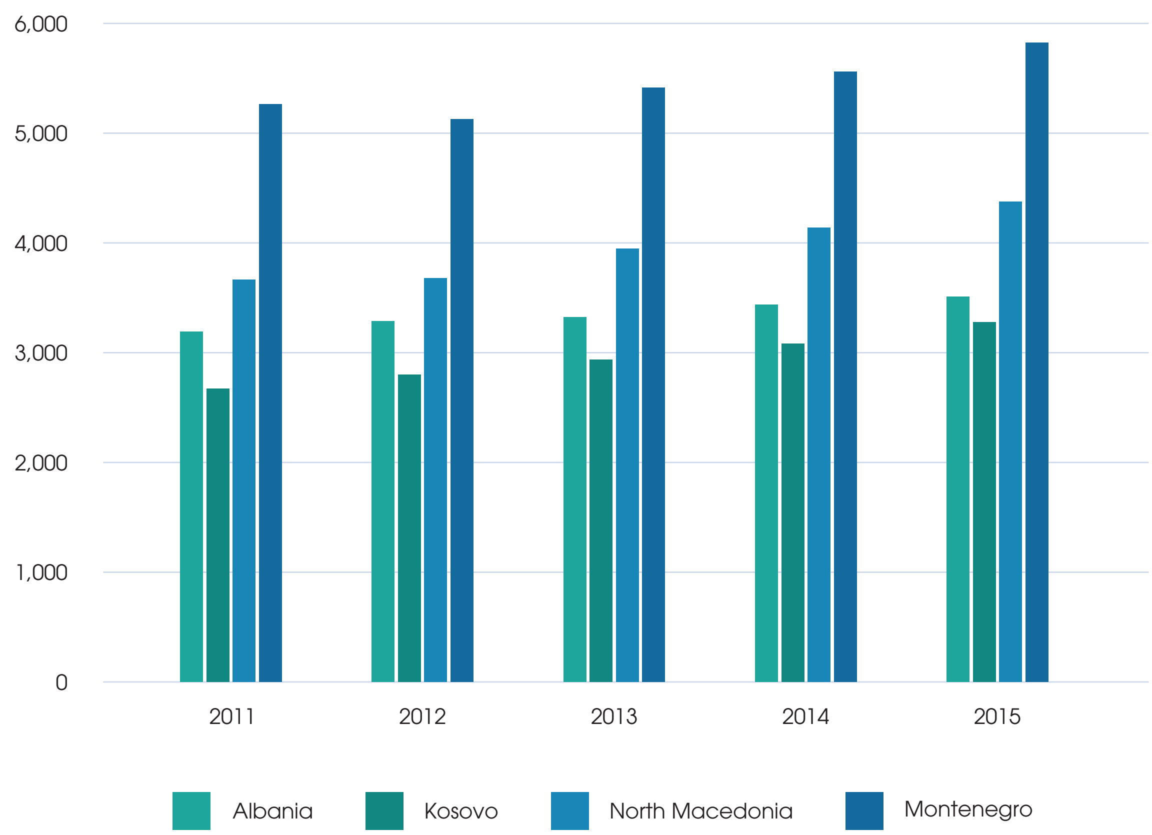
The Riparians' economies had a relatively stable growth over the analysed period, albeit at moderate rates of 2 percent annually for Albania, 4.1 percent for Kosovo, 2.2 percent for Montenegro and 4 percent for North Macedonia.[19] The real growth over the analysed period as a whole (2015 compared with 2011) was 10 percent for Albania, 21 percent for Kosovo, 11 percent for Montenegro and 20 percent for North Macedonia. In 2012, Montenegro and North Macedonia experienced negative growth rates.

As regards the values of GDP per capita, Montenegro has the highest ratio (€5,825/capita, 2015), followed by North Macedonia (€4,377/capita), Albania (€3,508/capita) and Kosovo (€3,277/capita). It should be noted, however, that comparing GDP per capita values at current prices does not reflect differences in the cost (standard) of living or the inflation rates of the Riparians.

19 Average value for the analysed period.

Figure 17. Drin Basin GDP growth rates (%) and GDP per capita at current prices (€), 2011–2015





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4.3 Socio-economic activities

Table 9 shows the overall land use (urban, arable, forestry, etc.) within the Drin Basin and its sub-basins. Agriculture (including the use of agrochemicals), forestry and fisheries are summarized in more detail in the following sections.

Table 9. Land use in the Drin Basin

Drin Basin: CORINE land classes, 2012 (%)						
Country	**Urban fabric**	**Arable land***	**Forests**	**Pastures**	**Inland waters*****	**Scrub and open spaces****
Albania	1.43%	17.19%	28.78%	1.50%	5.37%	45.59%
Kosovo	2.41%	41.71%	32.71%	1.54%	0.41%	21.39%
North Macedonia	1.09%	15.43%	38.07%	1.22%	14.93%	29.19%
Montenegro	2.68%	12.37%	36.72%	2.98%	7.86%	37.32%
Total	*1.87%*	*21.45%*	*32.96%*	*1.79%*	*6.36%*	*35.53%*

Notes:
* Includes arable land, cultivated land and permanent crops.
** Includes open/uncultivated land.
*** Includes the Prespa, Ohrid and Skadar/Shkodër lakes.

4.3.1 Agriculture

The main uses of cultivated land are presented in Table 10, indicating that the significant majority of the activities are focused on arable and pasture grazing.

Table 10. Drin Basin cultivated land (ha) categories of use

Country	**Cultivated land**	**Arable land and gardens**	**Orchards**	**Vineyards**	**Pastures**
Albania	94,993	77,459	3,271	2,662	11,601
Kosovo	121,427	80,169	2,233	3,148	35,878
North Macedonia	28,072	16,981	4,092	742	6,257
Montenegro	22,005	2,273	61	381	19,291
Total	*266,498*	*176,882*	*9,656*	*6,933*	*73,026*
% of total cultivated		*66.4%*	*3.6%*	*2.6%*	*27.4%*

Source: Thematic Report on Socio-economics.

Table 11 provides summary information regarding fertilizer and pesticide use in the Drin Basin. Overall, the basin has 226,498 ha of cultivated area, including meadows, almost 160,000 ha of which are fertilized with mineral fertilizers and 92,700 ha with organic fertilizers. Pesticides are applied to 67,783 ha of land.

Table 11. Fertilizer and pesticide use in the Drin Basin

Country	**Fertilized area (ha)**		**Fertilized area as % of total (ex. meadows)**		**Total quantity of fertilizers used (t)**		**Fertilizers in t/ha**		**Area treated with pesticides (t)**
	Mineral	**Organic**	**Mineral**	**Organic**	**Mineral**	**Organic**	**Mineral**	**Organic**	
Albania	57,698	70,583	0.7	0.8	45,535	148,643	0.8	2.1	34,480
Kosovo									
North Macedonia	15,010	8,516	0.7	0.4	10,965	66,927	0.7	7.9	2,798
Montenegro	1,989	1,141	0.7	0.4	2,109	5,928	1.1	5.2	2,744
TOTAL	*74,697*	*80,240*			*58,608*	*221,498*			*40,023*
AVERAGE							*1.1*	*5.2*	

Source: Expert elaborated State statistical data of the Riparians.

Data on irrigated area and implemented irrigation techniques in the Drin Basin are presented in Table 12. The highest percentage of irrigated agricultural area is in Montenegro (90.4 percent), while the lowest percentage is in Kosovo (19.4 percent). In Albania and North Macedonia, the percentage of irrigated areas is similar: in Albania, the irrigated area is 62.7 percent (52.255 ha), while in North Macedonia, the irrigated land is 56 percent (10.347 ha). The main irrigation techniques applied include drip, furrow, sprinkler and pumps (in Albania most likely from wells as a furrow irrigation) (Table 12). The highest percentage of area covered with drip irrigation is in Montenegro (44.0 percent), while the lowest is in Albania (13.1 percent). The percentage of drip irrigation out of the total irrigated land in North Macedonia is almost 30 percent, which yields a total irrigated area of 3,104 ha (area under apple trees in Prespa and Ohrid). Furrow irrigation is most frequently used in Albania (72.9 percent) and North Macedonia (67.4 percent). Crops irrigated with furrow irrigation include spring cultivars, such as maize, beans, melons and tobacco. Relatively small areas are irrigated with sprinkler irrigation, which is a result of the specific cropping pattern in the basin and the specific equipment needed for sprinkler irrigation.

Table 12. Irrigated areas and applied irrigation techniques in the Drin Basin

Country	Irrigated area, ha	Irrigated land as % of cultivated	Irrigation techniques			
			Drip	Furrow	Sprinkler	Pump
Albania	52,255.0	62.7	13.1%	72.9%	3.4%	10.6%
Kosovo	16,564.4	19.4				
North Macedonia	10,346.6	56.0	29.6%	67.4%	3.0%	
Montenegro	2,455.0	90.4	44.0%	43.3%	12.8%	

The total number of livestock units in the Drin Basin area according to data presented in Table 13 is over 1.4 million animals and 3.2 million units of poultry.

Table 13. Head of livestock and poultry units in the Drin Basin

Country	Cattle	Sheep	Pigs	Goats	Horses	Poultry
Albania	171,707	363,275	99,549	201,311	25,744	1,407,510
Kosovo	153,268	97,291	11,969	13,178	1,588	1,215,012
North Macedonia	9,990	95,856	1,650	8,532	586	310,284
Montenegro	25,545	75,306	24,181	23,010	1,278	251,350
Total	*360,510*	*631,728*	*137,349*	*246,031*	*29,196*	*3,184,156*
% of total for Drin Basin						
Albania	47.6	57.5	72.5	81.8	88.2	44.2
Kosovo	42.5	15.4	8.7	5.4	5.4	38.2
North Macedonia	2.8	15.2	1.2	3.5	2.0	9.7
Montenegro	7.1	11.9	17.6	9.4	4.4	7.9
Total	*100*	*100*	*100*	*100*	*100*	*100*

Sources: Albania and Montenegro, State statistical data; Kosovo, Statistics Agency (2015). Agriculture Census 2014; North Macedonia, Agency for Food and Veterinary of North Macedonia, http://www.fva.gov.mk/index.php?lang=mk.

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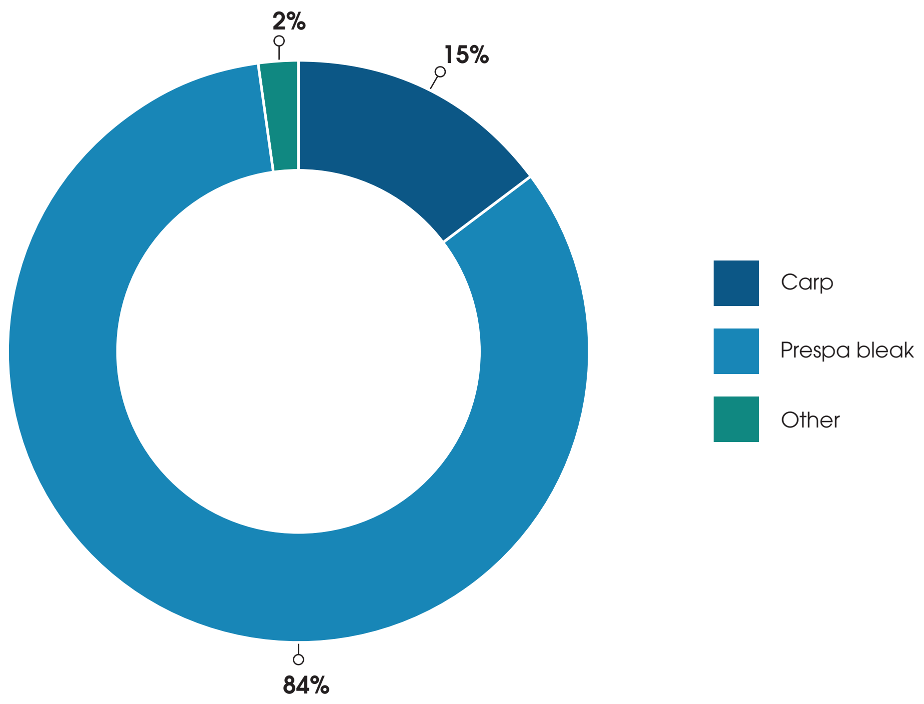
4.3.2 Fisheries/aquaculture

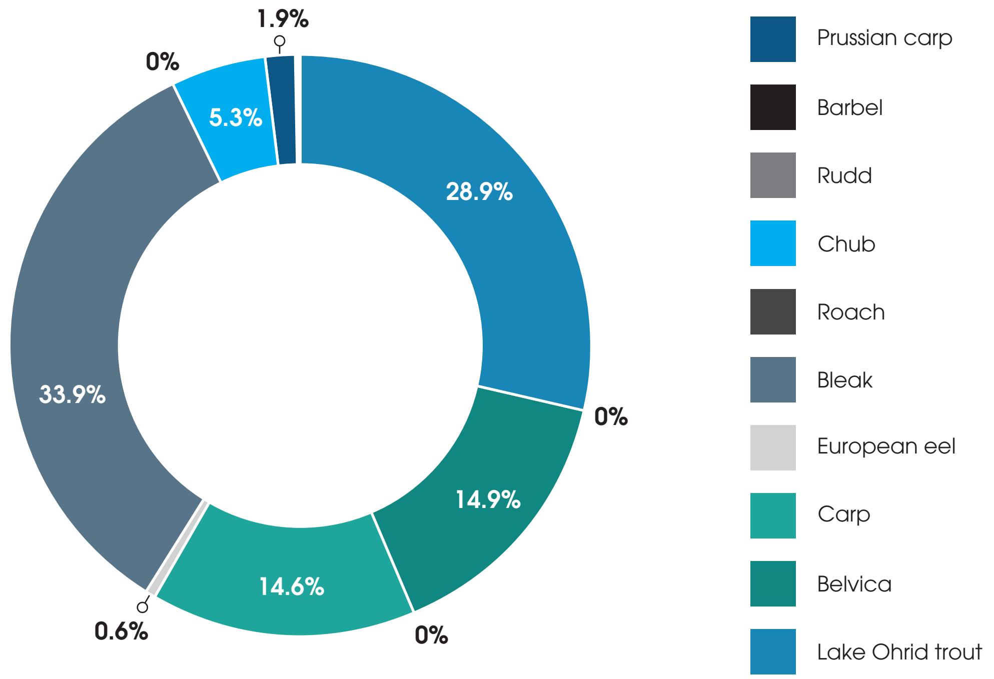
Fisheries are an important sector in the Drin Basin and contribute substantially to economic growth in the region. In Albania, fisheries are based on coastal lagoons and over 240 lakes. There are around 800 fishers in total, who use various fishing techniques and land approximately 1,770 tonnes of catch (2014). Catches from the large lakes (Prespa, Ohrid and Skadar/Shkodër) are indicated in Figure 18. In all three water bodies, fisheries are organized as artisan fisheries. At present, there are no fishing fleets. Commercial fishing on these lakes is geared towards gill netting, while in the past, beach trawls and beach seine nets were used. From April 2004 to September 2012, a moratorium on fishing was implemented in the North Macedonian part of Lake Ohrid, with a similar moratorium implemented in Lake Prespa for the 2006–2013 period, both for commercial and recreational fishing.

Figure 18. Fish catches from the Prespa, Ohrid and Skadar/Shkodër lakes (%), 2014

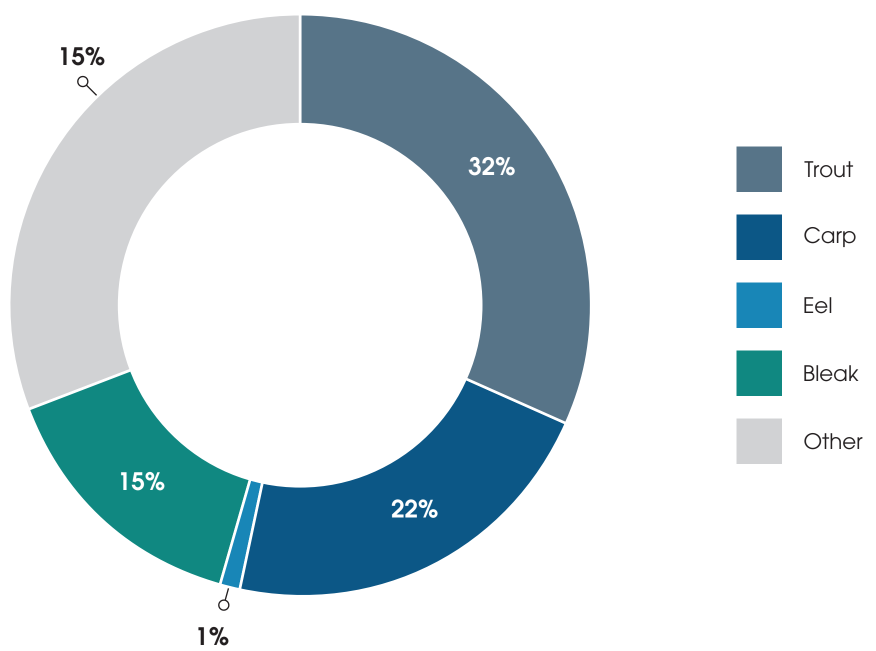
Lake Prespa: Fish catch, 2014



Lake Ohrid: Fish catch, 2014



Lake Skadar/Shkodër: Fish catch, 2014



In recent years, the national average household consumption of fish and seafood has fluctuated, reaching 3.56 kg per capita in 2014. Based on calculations of the supply balance and the total apparent consumption of fisheries and aquaculture products, the average annual apparent per capita consumption decreased 8 percent in 2010–2014.[20]

Based on available data regarding fish catches in 2014 and average fish market prices for 2015 (Table 14), the total value of the annual catch in Lake Ohrid is estimated at roughly €820,000 and nearly €6 million in Lake Skadar/Shkodër.

Table 14. Fish market prices, 2015 (€/kg)

	Jan-15	Apr-15	May-15	Aug-15	Dec-15	
Lake Ohrid trout	7.10	7.60	8.20	7.90	8.30	7.82
Belvica						5.50
Rainbow trout	3.70	3.90	4.00	4.10	4.30	4.00
Carp	2.08	2.12	2.21	2.68	2.66	2.35
Crucian carp	1.53	1.65	1.24	1.26	1.24	1.38
Bighead carp	1.53	1.39	1.22	1.35	1.33	1.36
Perch	5.71	5.23	2.57	3.57	2.63	3.94
Other freshwater fish	3.34	3.02	3.01	3.10	2.50	2.99

In Albania, intensive aquaculture systems have been applied for polyculture of carp species and in some cases for trout, using coastal lagoons (11,000 ha), agriculture reservoirs (27,000 ha surface), artificial lakes (7,000 ha) and natural lakes (25,000 ha). Aquaculture activities in Kosovo have expanded in the past five-year period, mainly through cooperation and the provision of technical assistance by international donor organizations. It is estimated that about 650 tonnes of trout are produced within a year that are traded mainly for domestic consumption. In North Macedonia there are 20 breeding facilities, of which 17 are fish farms and three are used for restocking purposes. In Montenegro, freshwater aquaculture has a long history and is mainly based on the rearing of rainbow trout (*Oncorhynchus mykiss*). In the Riparians, between 450 and 550 tonnes of trout aquaculture are farmed, with the entire production distributed locally.

4.3.3 Forestry

Stocks and growth in most of the forests are below this habitat's potential, which in particular refers to newly healed forests (spruce forests and shrubs). The share of private ownership has been increasing in the last 10 years due to denationalization and the cultivation of private agricultural land by forest. In terms of size, almost 57 percent of private estates are in the up to 5 ha category, 27 percent are in the 6–20 ha category and 13 percent are in the 21–50 ha. Only two thirds of forest owners use their forest (for cutting), with slightly more than half of the wood (53 percent) used for their own needs (mainly firewood).

Despite important differences in the total area within each Riparian (Table 15), the area under forest and forest land (CORINE LUC 2012) in the basin is evenly distributed. The percentage of forest in each of the Drin Riparians is as follows: Albania – 28.8 percent; Kosovo – 32.7 percent; Montenegro – 36.7 percent; and North Macedonia – 38.1 percent. In the two latter countries there are uninterrupted forested areas.

Table 15. Forest area within the Drin Basin

Country	Area within Drin Basin (km²)	Forest within basin area (km²)	Forest as % of the Drin Basin area
Albania	7,724	2,223	28.8
Kosovo	4,567	1,494	32.7
North Macedonia	3,295	1,254	38.1
Montenegro	4,377	1,607	36.7

Source: CORINE LUC (2012).

4.3.4 Power generation

Table 16 presents summary information regarding electricity generation in the Drin Riparians. The average annual electricity generated for the 2010–2015 period is 19,975 GWh, of which 32 percent is generated in North Macedonia, 27 percent in Kosovo, 26 percent in Albania and 15 percent in Montenegro.

Table 16. Electricity generation in each Drin Riparian by type

Country	2010	2011	2012	2013	2014	2015	Average (2010-2015)
Hydro -1 MW	12	26	32	132	100	127	43
Hydro 1-10 MW	203	150	147	862	636	819	301
Hydro 10+ MW	12,690	6,697	7,159	10,196	7,098	8,444	8,146
Combustible fuels	11,113	12,532	12,432	12,324	10,788	11,128	11,480
Solar photovoltaic		1	3	9	14	23	10
Total	*24,018*	*19,406*	*19,773*	*23,523*	*18,636*	*20,541*	*19,980*

Sources: Eurostat (2016); State-level data.

20 https://www.eurofish.dk/index.php/albania.

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Overall, 57 percent of the total power generated comes from combustible fuels (mainly coal), 41 percent from hydropower plants with above 10 MW of installed capacity, and 2 percent from hydropower plants with capacity of 1–10 MW.

The hydropower generation potential of the Drin Basin has been used for decades. In total there are nine hydropower plants in the basin above 10 MW installed capacity, producing 6,000 GWh of electricity annually (Table 17). Of the total annual electricity produced, 75 percent is from hydropower plants in Albania, with the remaining 25 percent roughly shared equally between hydropower plants in the Montenegrin and North Macedonian parts of the Drin Basin.

Table 17. Electricity generation by hydropower plant in the Drin Basin (Pins > 10 MW), 2011–2015

Albania	2011	2012	2013	2014	2015
Fierze – capacity 500 MW	1,238,000	1,228,000	2,053,762	1,055,071	1,636,522
Koman – capacity 600 MW	1,602,000	1,828,000	2,444,000	1,548,096	1,882,721
V. Dejës – capacity 250 MW	815,000	973,000	1,314,000	805,382	932,732
Ashta – capacity 48.2 MW	0	8,819	211,190	200,992	235,604
Total, Albania	*3,655,000*	*4,037,819*	*6,022,952*	*3,609,541*	*4,687,579*
North Macedonia	**2011**	**2012**	**2013**	**2014**	**2015**
Globocica – capacity 42 MW	168,545	170,794	248,767	137,074	226,644
Spilje – capacity 84 MW	258,937	241,271	395,170	191,565	314,456
Vrben – capacity 12.8 MW	31,207	33,458	26,545	34,656	35,551
Vrutok and Raven (60% of total)	319,004	138,989	157,332	219,171	243,113
Total, North Macedonia	*777,693*	*584,512*	*827,814*	*582,466*	*819,764*
Montenegro	**2011**	**2012**	**2013**	**2014**	**2015**
Perucica – capacity 307 MW	-	808,500	1,334,000	1,007,000	783,360
Total, Montenegro	*0*	*808,500*	*1,334,000*	*1,007,000*	*783,360*
Total, Drin Basin (MWh)	**4,432,693**	**5,430,831**	**8,184,766**	**5,199,007**	**6,290,703**

Sources: Eurostat (2016); North Macedonia, ELEM (2017); Albania, KESH.

The number of planned/future hydropower plants is significant, particularly for the classes of 0.1–1 MW and 1–10 MW plants, which equates to over 600 plants in the four Riparians. The number of planned hydropower plants is particularly high in Albania (313) and North Macedonia (199). Although the exact number of hydropower plants planned to be installed in the Drin Basin remains decisively unknown, given the basin's immense hydropower potential, it is estimated that a minimum of 25–30 percent of the total number of plants will fall within its boundaries.

The number of planned new hydropower plants in each Riparian, including small hydropower plants, is given in Table 18. Planned hydropower plants are divided into four classes: 0.1–1 MW, 1–10 MW, 10–50 MW and above 50 MW. It should be noted that in most of the studies, the 0.1–1 MW class refers to small hydropower plants, though in many cases, these can reach up to 10 MW of installed capacity.

Table 18. Planned hydropower plants in the Drin Riparians

Country	0.1-1 MW	1-10 MW	10-50 MW	> 50 MW	Total
Albania	128	154	22	9	*313*
Kosovo	12	68	5	2	*87*
North Macedonia	126	55	13	5	*199*
Montenegro	9	53	12	10	*84*
Total	*275*	*330*	*52*	*26*	*683*

Source: Schwarz, U. (2015). Hydropower Projects on the Balkan Rivers – Update. RiverWatch and EuroNatur; State-level data.

4.3.5 Industry and mining

The potential pressure and impact of industry on water resources in the Drin Basin from industrial environmental hotspots, mining sites, large metallurgy plants and industrial landfill sites are detailed in section 6 (Pollution and water quality). Albania, Kosovo and Montenegro are all home to industrial hotspots, with almost all originating from the former central planning economic system, though several have ceased operation. There is limited information available on mines, the key aspects of which (minerals extracted and locations) are included in the pressure assessment (section 6.1).

Table 19 provides an overview of industry production volume indexes of the Drin Riparians, based on data from their statistical agencies. Data are available for selected industry sub-sectors (such as mining and quarrying, manufacturing, electricity, gas and steam supply) and there are different years used as a baseline for the indexes.

In general, for the sub-sectors with data available, it is evident that Albania and North Macedonia experienced growth in their industrial production over the 2011–2015 period. Growth in manufacturing is evident in Kosovo, though at the same time, there was a decline in the volume of production in mining and quarrying and electricity, gas and steam supply. Likewise, there has been an increase in electricity and gas generation in Montenegro, but also a significant decrease in mining and quarrying and manufacturing over the 2011–2015 period.

Table 19. Industry production volume indexes of the Drin Riparians, 2011–2015

Mining and quarrying	2011	2012	2013	2014	2015	
Albania	361.4	475.4	614.1			Index, 2005=100
Kosovo			119.3	109.3	94.2	Index, 2012=100
North Macedonia	102.6	104.4	108.0	105.9	104.4	Index, 2010=100
Montenegro	106.5	84.1	82.9	94.8	87.2	Index, 2010=100
Manufacturing	**2011**	**2012**	**2013**	**2014**	**2015**	
Albania	192.1	188.5	181.2			Index, 2005=100
Kosovo			98.1	105.2	109.1	Index, 2012=100
North Macedonia	109.6	107.2	110.2	120.1	127.3	Index, 2010=100
Montenegro	106.9	96.1	91.3	85.2	102.2	Index, 2010=100
Electricity, gas, steam and air-conditioning supply	**2011**	**2012**	**2013**	**2014**	**2015**	
Albania	49.6	66.4	103.8			Index, 2005=100
Kosovo			118.5	90.1	102.4	Index, 2012=100
North Macedonia	97.0	87.7	92.4	79.3	81.8	Index, 2010=100
Montenegro	67.3	68.2	94.6	76.1	71.7	Index, 2010=100

4.3.6 Tourism

Tourism is also a highly important activity for the Drin Riparians. In 2016, travel and tourism directly contributed 11 percent to the GDP in Montenegro and 8.4 percent in Albania. The total (direct and indirect) contribution in the same year was 26 percent of the GDP in Albania and 22.1 percent in Montenegro.[21] Nevertheless, it should also be outlined that these figures are for the most part a consequence of mass tourism along the Adriatic and Ionian coastline.

The Drin Basin's climate, geography and varied territory, which includes mountain ranges, lakes and rivers, is accompanied by a rich biodiversity of flora and fauna as well as culture monuments and historical sites. A number of national parks and nature reserves are located within the basin, offering the potential for various types of water or lake-based tourism and travel experiences to be developed, which mainly includes leisure activities related to 'beach and sun' tourism, alternative or adventure tourism in the form of various rural, environmentally friendly or natured-based and cultural or history-based activities, and business and transit tourism largely linked to business trips and associated activities.

Table 20 and Table 21 provide an overview of registered visitors within the Drin Basin area in Kosovo, Montenegro and North Macedonia over the 2011–2016 period.

Table 20. Foreign and domestic tourists/visitors by Drin Riparian, 2011–2016

Country	2011	2012	2013	2014	2015	2016	Average 2012-2016
Albania							
Kosovo		15,402	16,256	22,211	40,292	44,962	23,540
North Macedonia	276,602	274,410	287,485	289,325	320,881	345,050	293,025
Montenegro	86,703	95,594	105,202	109,961	136,711		111,867
Total		*385,406*	*408,943*	*421,497*	*497,884*		

Note: Data for Bar and Ulcinj municipalities are not included. Data for Albania's part of the Drin Basin were not identified.
Source: Countries' statistical agencies.

Table 21. Foreign and domestic overnight stays by Drin Riparian, 2011–2016

Country	2011	2012	2013	2014	2015	2016	Average 2012-2016
Albania							
Kosovo		21,580	22,029	33,631	60,477	61,895	34,429
North Macedonia	1,291,936	1,258,145	1,204,610	1,139,148	1,261,695	1,276,610	1,215,900
Montenegro	185,463	202,852	205,123	219,481	276,407		225,966
Total		*1,482,577*	*1,431,762*	*1,392,260*	*1,598,579*		

The number of visitors to the Drin Basin area of Kosovo, Montenegro and North Macedonia increased from 385,000 in 2012 to nearly 500,000 in 2016, which is roughly a 30 percent increase, while the number of registered overnight

21 World Travel & Tourism Council (2017) Travel and Tourism Economic Impact 2017 – Albania.

stays increased from 1.48 million to almost 1.6 million over the same period (8 percent increase).

Overall, as an average for the 2012–2015 period, the number of foreign visitors compared with domestic visitors has been approximately equal in Kosovo and North Macedonia, while in Montenegro the number of foreign visitors has been significantly higher than domestic visitors, accounting for 82 percent of the total number of visitors in the country.

As regards tourist overnight stays, although the total number for the three Riparians also increased over the period analysed, the trends varied. Kosovo has the highest and most constant increase, reaching almost 80 percent in 2014–2015. Montenegro experienced an increase of both foreign and domestic overnight stays for the 2012–2015 period, with an average rate of 9–10 percent annually. In North Macedonia, the number of total (foreign and domestic) overnight stays decreased from 2011, with a minimum number recorded in 2014.

4.3.7 Key observations from the TDA on the socio-economic aspects of the Drin Basin

The information summarized in the previous sections highlights the following key issues of relevance in the Drin Basin:

- Although the overall basin population has not changed significantly, the urban population has increased to more than 57 percent of the total population.
- Over 23 percent of the total basin land is used for arable/pasture activities. Around 160,000 ha are subject to mineral fertilizers, with 90,000 ha receiving organic fertilizers and over 65,000 ha receiving pesticide treatments. Irrigation is a significant water user in the basin, though this varies considerably among Riparians, ranging from less than 20 percent of arable land being irrigated in Kosovo to more than 90 percent being irrigated in Montenegro. Most of the irrigation methods are not optimized to reduce water consumption.
- The basin retains between 28 and 36 percent of land as forests, offering an important means for overall water management through natural retention if managed appropriately.
- Tourism to the basin saw a 30 percent increase between 2011 and 2016.
- In Lake Ohrid, around an estimated €800,000 of fish are landed with over €8 million landed in Lake Skadar/Shkodër.
- In terms of hydropower generation from the basin, Albania accounts for 75 percent, with North Macedonia and Montenegro providing the remaining 25 percent. There is a significant number of planned hydropower plant systems in the basin.

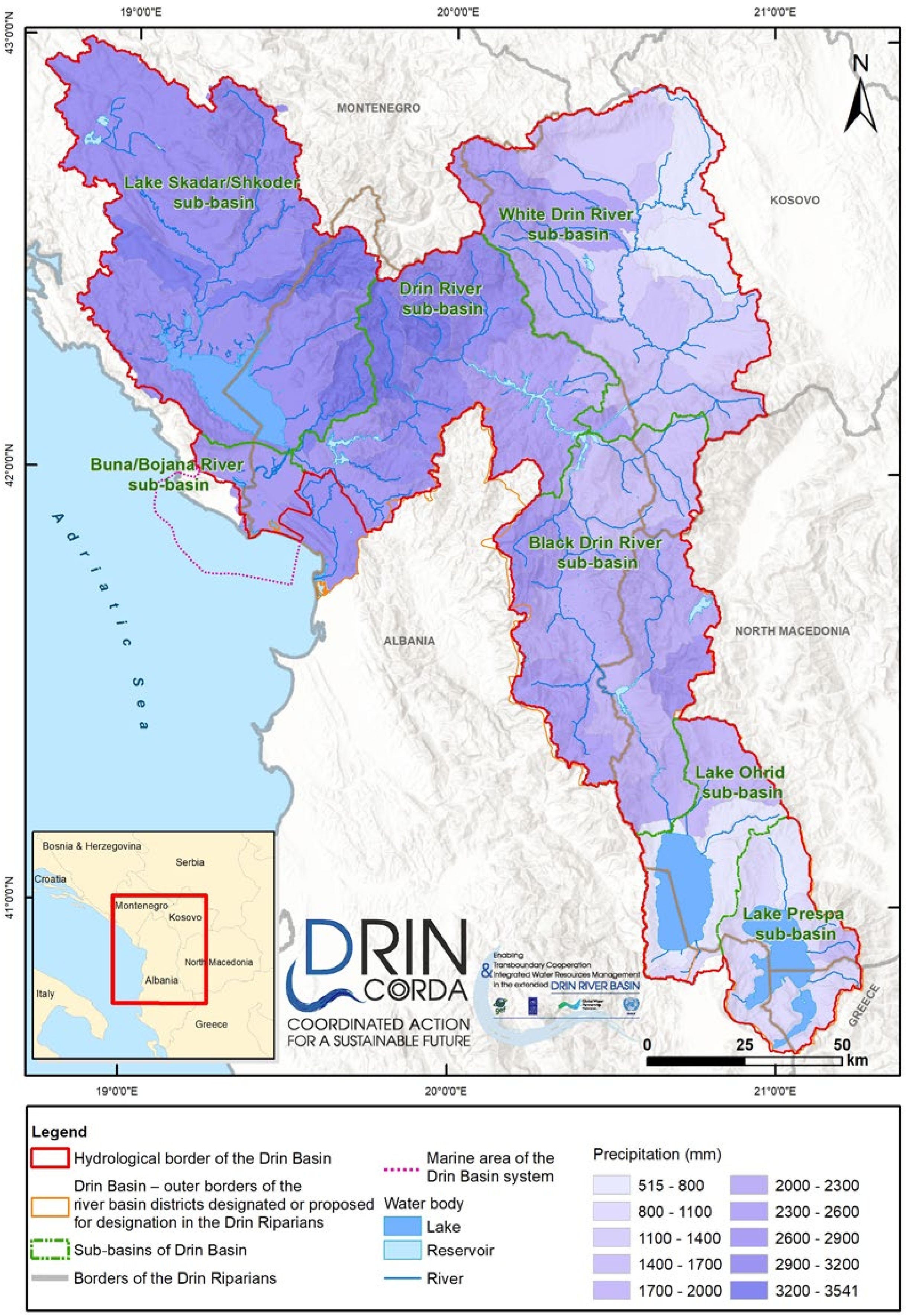
5. WATER RESOURCES AND SEDIMENT TRANSPORT

5.1 Hydrology

The Drin Basin has the third largest discharge in the European side of the Mediterranean basin after the Po and the Rhone, with an annual discharge of about 22,134 M m^3.

An overview description of the surface hydrological system is provided in section 2.2 (Sub-basins in the Drin Basin).

Figure 19. Precipitation in the Drin Basin



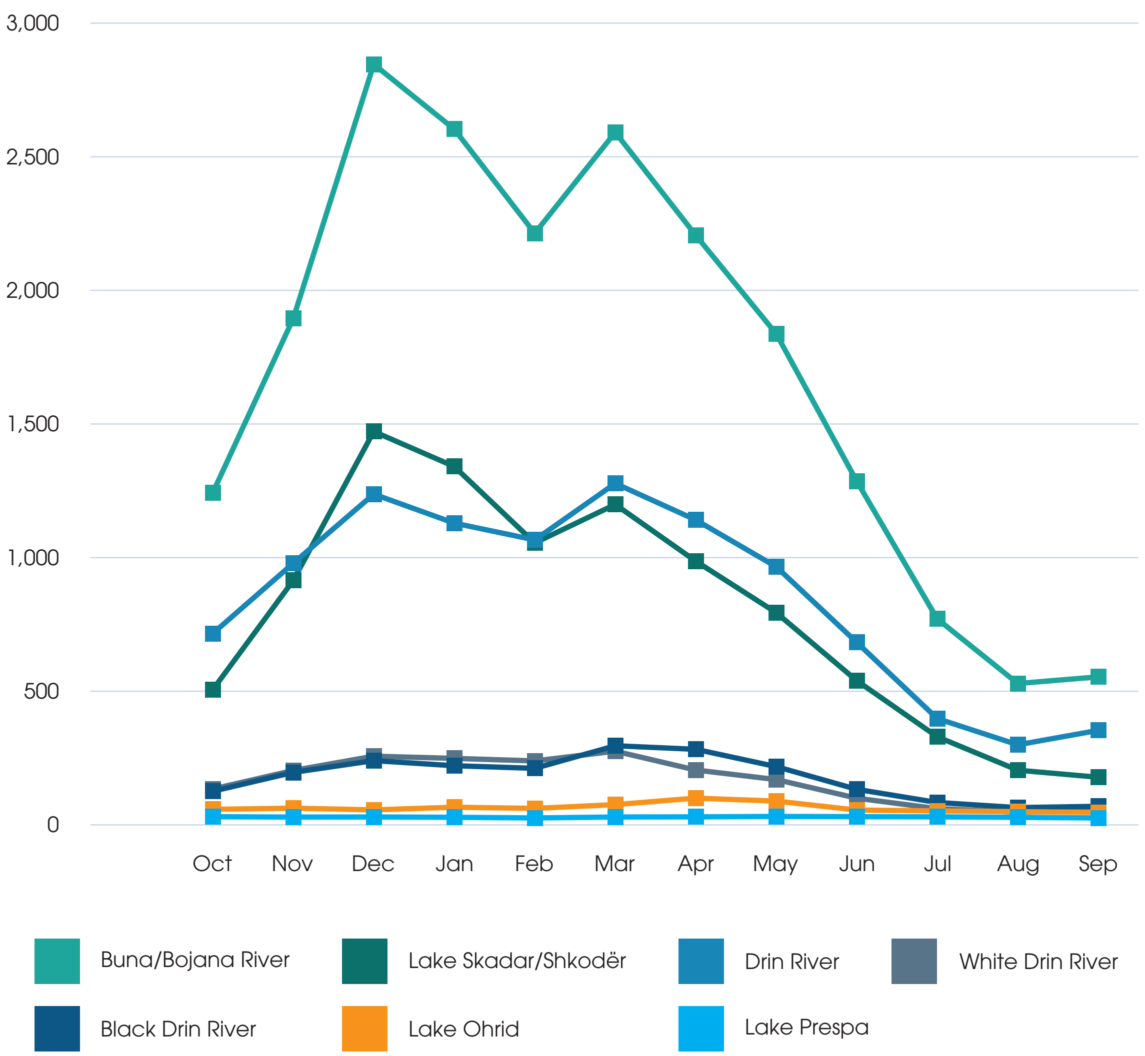
The total annual precipitation in the sub-basins varies from 515 mm (Mirusha) to well above 3,000 mm (Cijevna and Shala Rivers). Most of the waters from the Mavrovska River watershed in North Macedonia (part of the Black Drin River sub-basin) are transferred through the hydropower plants into the Vardar River watershed that sits outside the Drin Basin. The characteristics of the Drin sub-catchments and sub-basins are previously summarized in Table 2 and illustrated in Figure 1. The annual water balance developed for this TDA (for details, see Thematic Report on Hydrology and Hydrogeology; section 9) is presented for the main sub-basin outflows in Table 22. The multiannual monthly average discharge of the major rivers and lakes in the Drin Basin has been also calculated and is illustrated in Figure 20.[22]

Table 22. Annual water balance in the Drin Basin

Sub-catchment outflow	Area (km²)	Annual average discharge (m³ s⁻¹)	Total annual run-off (M m³)
Lake Prespa	1,391.6	14.51	457.7
Lake Ohrid	2,792.4	32.80	1,034.3
Black Drin River	6,204.8	102.86	3,243.8
White Drin River	4,383.3	63.50	2,002.4
Drin River	14,656.8	338.28	10,667.9
Lake Skadar/Shkodër	5,342.5	350.90	11,065.9
Buna/Bojana River mouth	20,361.3	701.87	**22,134.1**

22 The hydrological model used to develop the water balance (developed through projects implemented by GIZ) takes into account the consumption in the basin, yielding 'net' results, i.e. the river discharges with the consumption already deducted. The water outflows from the model represent both surface-water and groundwater discharges.

Figure 20. Multiannual monthly average discharge for the major rivers and lakes in the Drin Basin



The discharge in the watercourses varies significantly over the seasons in a year, depending on meteorological variability (precipitation and temperature). The wet period is from November to May with peak discharges in December through March. The dry period is from June to October, with minimum discharges in the summer period.

The average maximum outflow from the Buna/Bojana River mouth in dry years is less than 860 $m^{3}s^{1}$, while the respective value in a 'normal' year is more than 1,040 $m^{3}s^{-1}$ and in a wet year more than 1,800 $m^{3}s^{-1}$.

5.1.1 Surface-water bodies

In the Drin Basin, apart from Greece where the EU Water Framework Directive is fully implemented, only some action was taken until the date that the TDA was prepared, to delineate and characterize the water bodies (as per the EU Water Framework Directive definition).

- Water bodies in the Drin Basin in Albania have not been delineated.
- In Kosovo, there has been some delineation in the White Drin River sub-basin by the EU Instrument of Pre-accession Assistance (IPA) projects. Further delineation and characterization are expected to follow by the Swedish International Development Cooperation Agency (Sida)-supported Kosovo Environmental Programme.
- In North Macedonia, river basin districts have been officially established. Detailed delineation of water bodies for the Macro Prespa was carried out in the framework of the development of the Macro Prespa Lake Water Management Plan of 2011 (updated in 2016).
- The water bodies of Lake Ohrid have been delineated and characterized as part of the Lake Ohrid Watershed Management Plan prepared in the framework of the GEF Drin Project.
- In Montenegro, delineation made within the framework of projects has not yet become official, however, it is expected that the EU IPA-funded project to support the implementation of the Water Framework Directive (ongoing) will address this issue.

The preliminary delineation of 68 surface-water bodies[23] at the Drin Basin level (see Figure 21) was completed as part of the work to calculate the water balance in the Drin Basin. The main characteristics[24] and the typology of each water body are listed with related maps in the respective thematic report (see Thematic Report on Hydrology and Hydrogeology).

This work will form the basis for delineating the water bodies (in accordance with the EU Water Framework Directive) at the Drin Basin level in the future, within the framework of preparing the Drin River Management Plan should the Riparians decide to prepare this.

23 Preliminary identification of potential water bodies in line with the EU Water Framework Directive System A typology (based on ecoregions, size of catchment, altitude, basic geology, etc.).

24 Name, area, elevation (highest, average), water body length (start–end).

Figure 21. Preliminary identification of surface-water bodies in the Drin Basin

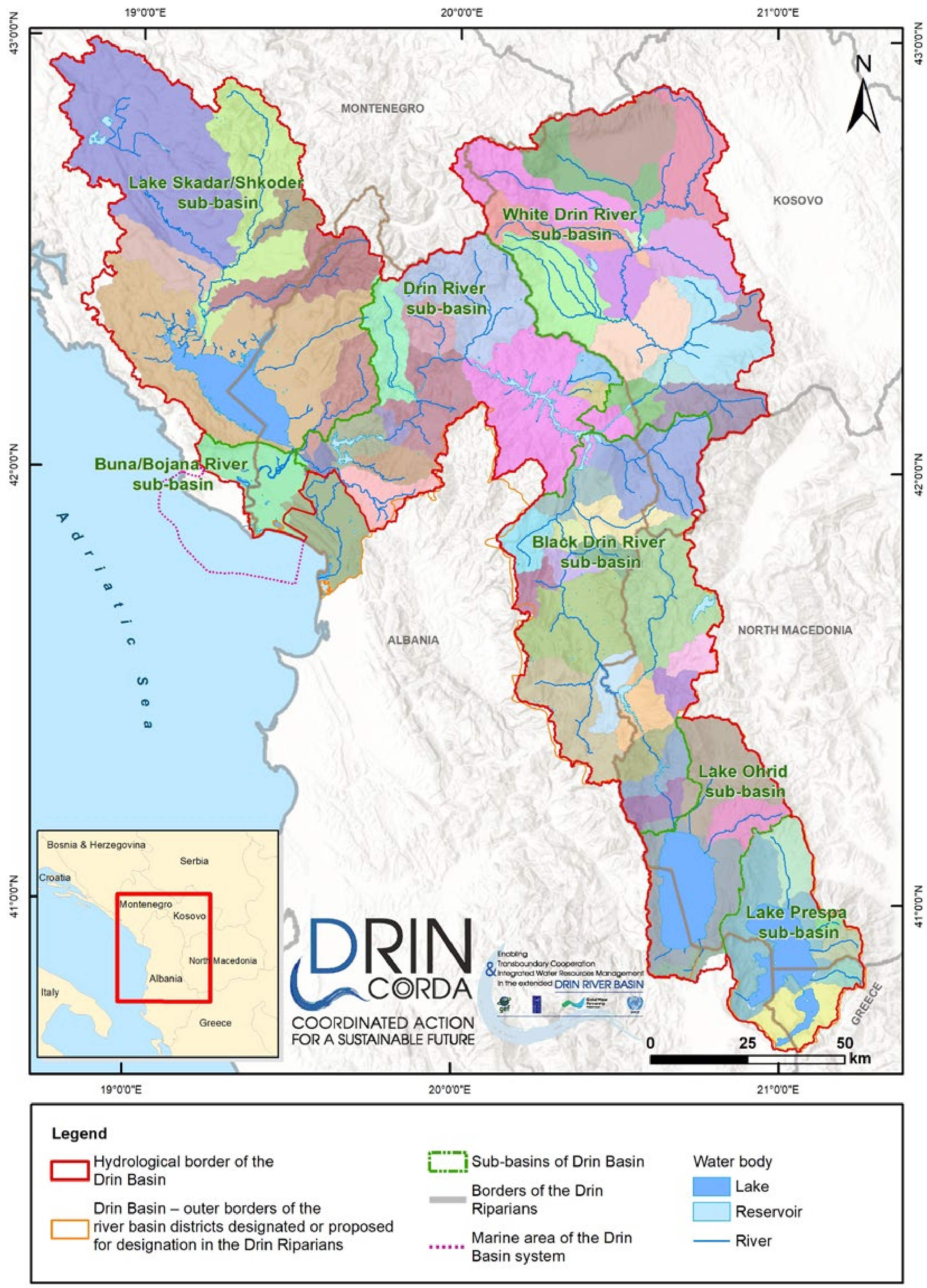
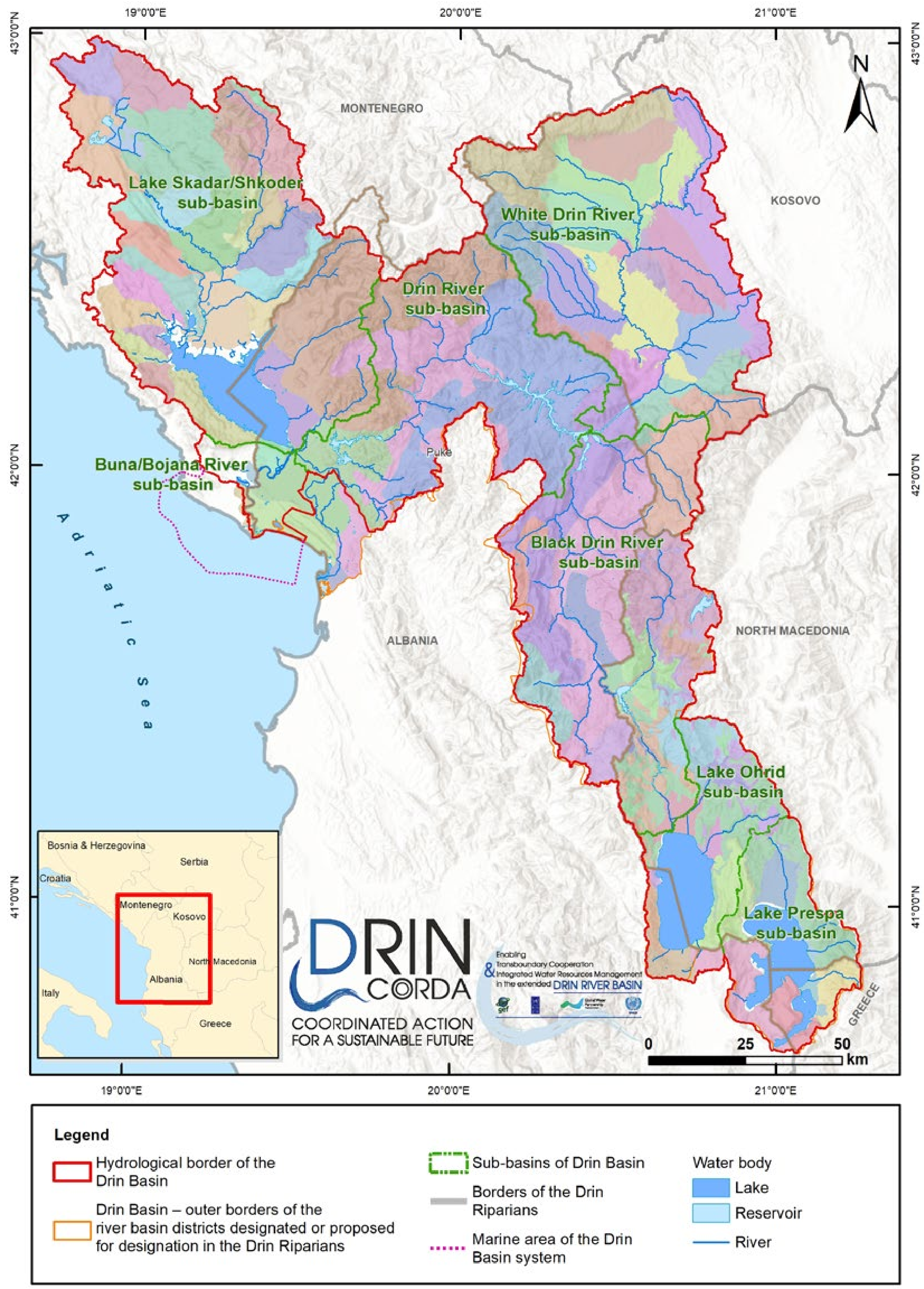


Figure 22. Delineated aquifers in the Drin Basin as designated by the Drin Riparians



5.2 Hydrogeology

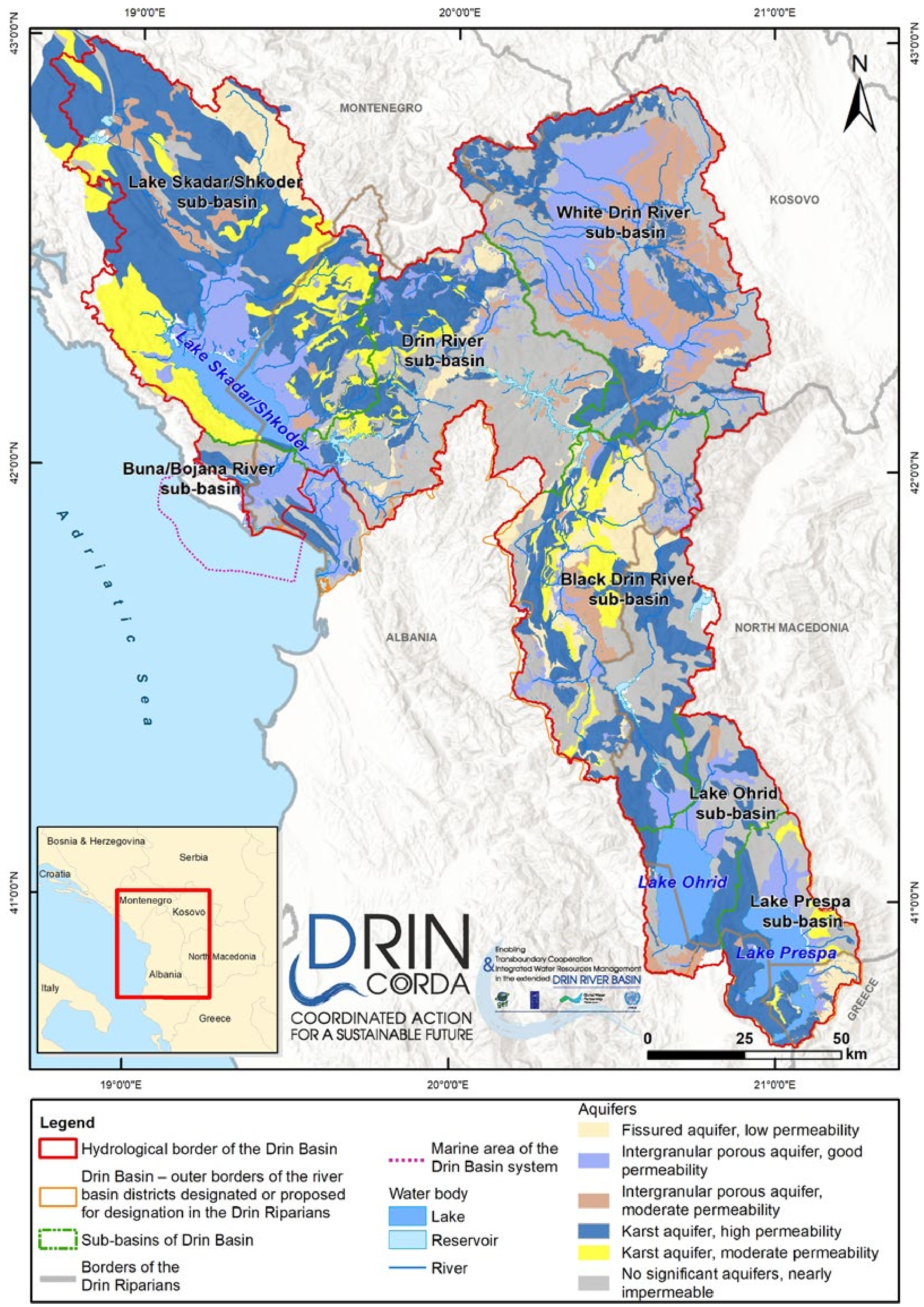
The region has significant and important groundwater resources. Preliminary identification or delineation of aquifers and/or groundwater bodies have been performed by the Riparians' responsible institutes. This has led to the identification of 84 aquifers and/or groundwater bodies as indicated in Figure 21.

Using this information, an aggregation exercise was attempted through the TDA to homogenize the aquifers identified in each of the Riparians by following purely geological and hydrogeological criteria as a first attempt in preparing a map of the Drin Basin's aquifers (see Figure 23). Karst aquifers with high permeability cover the largest part of the Drin Basin (around 34 percent, especially in the north-western part; see Table 23), while the area with no significant aquifers (nearly impermeable) is almost 28 percent of the total (central and eastern parts of the basin). There are also karst aquifers with moderate permeability (9 percent of the basin) and porous aquifers of moderate to good permeability (23 percent in total). Overall, almost two thirds of the Drin Basin has hydrogeological characteristics that allow potential groundwater exploitation, while more than 50 percent is of high permeability and therefore has increased vulnerability.

Table 23. Aquifer types in the Drin Basin and their area

Description	Area (m^2)	% of total
No significant aquifers, nearly impermeable	5,548,986,524	27.89
Fissured aquifer, low permeability	1,328,316,263	6.68
Intergranular porous aquifer, good permeability	2,816,882,506	14.16
Intergranular porous aquifer, moderate permeability	1,739,484,494	8.74
Karst aquifer, moderate permeability	1,752,224,459	8.81
Karst aquifer, high permeability	6,708,365,668	33.72

Figure 23. Types of aquifers in the Drin Basin



Due to the complex hydrogeological structures, the surface hydrological boundaries often do not coincide with the hydrogeological boundaries of the catchments of surface-water bodies. For example, Lake Prespa has an underground hydraulic connection with Lake Ohrid. The catchment area of the Radika River is affected by the areas of Resen, Ohrid and Struga, Piskupstina and Debar, as well as the mountain areas of Galičica, Stogovo, Ilinska Planina and Karaorman, among others.

Nine potential transboundary aquifers were identified[25] (see Table 24) and depicted in Figure 24.

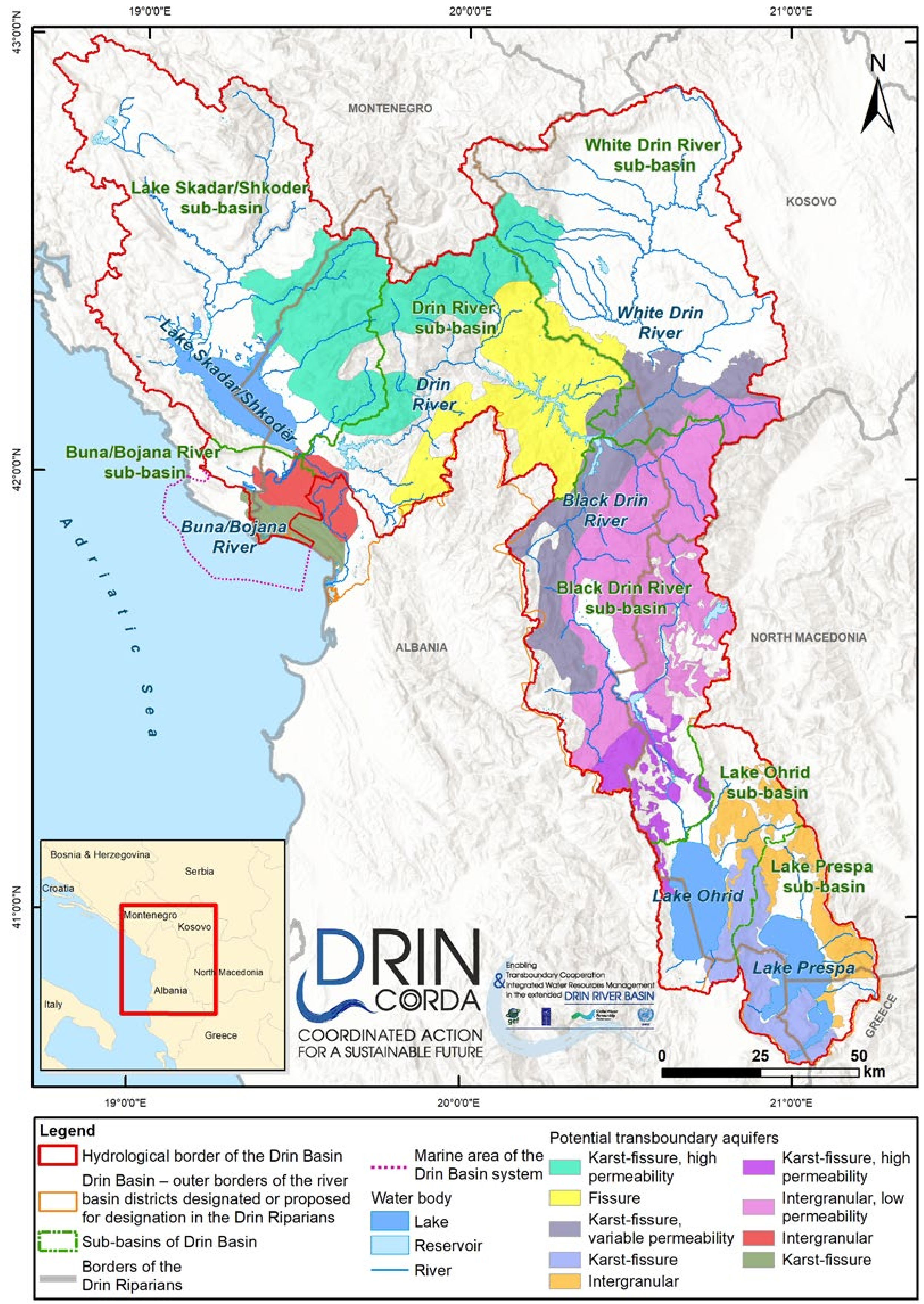
Table 24. Potential transboundary aquifers in the Drin Basin

Aquifer no.	Description	Area (m²)	% of total
1	Karst-fissure, high permeability	2,062,404,100	22.81
2	Fissure	1,414,883,610	15.65
3	Karst-fissure, variable permeability	1,214,111,975	13.43
4	Karst-fissure	612,633,819	6.78
5	Intergranular	623,087,480	6.89
6	Karst-fissure, high permeability	388,992,452	4.30
7	Intergranular, low permeability	2,180,953,418	24.13
8	Intergranular	324,837,138	3.59
9	Karst-fissure	217,884,172	2.41

The largest identified transboundary aquifer is shared by Albania, Kosovo and North Macedonia, comprising intergranular formations of low permeability. The next largest transboundary aquifer, and also the most important, is shared by Albania, Kosovo and Montenegro, and comprises karst formations of high permeability, with an extent of approximately 2,000 km².

25 Similar hydrogeological formations were aggregated according to the following criteria:
- formations that may interact in hydrogeological terms, due to their common physical characteristics and their location
- proximity of formations to the Riparians' boundaries.

Figure 24. Potential transboundary aquifers in the Drin Basin



The main uses of groundwater in the Drin Basin are potable water supply and irrigation, often through non-registered abstractions. Many agglomerations are not connected to the regional water supply systems and have their own local water supply systems using groundwater sources.

5.3 Water use

Domestic and industrial use

The total produced potable water amounts to 197.3M m³. Compared to the overall annual discharge it is about 1 percent of the overall water resources in the Drin Basin. Other than North Macedonia, no reliable data were available on the use of non-drinking water and privately-owned water systems in the Riparians. It was therefore assumed for these Riparians that industry is also supplied with water through local/regional water utilities. The estimated water consumption, theoretical domestic water demand per Riparian and per sub-basin as well as the monthly mean demand per sub-basin are presented in Table 25, Table 26, Table 27 and Figure 25 respectively.

Table 25. Water consumption per Riparian in the Drin Basin

Riparian	Residential water consumption (l/c/d)	Reference year
Albania	95	2013
Greece	353	2013
North Macedonia	158	2013
Kosovo	93	2013
Montenegro	237	2012

References:
Albania: World Bank (2015a)
Greece: Eurostat (2018)
North Macedonia: World Bank (2015b)
Kosovo: World Bank (2015c)
Montenegro: World Bank (2015b)

Table 26. Annual theoretical domestic water demand per Riparian

Riparian	Area (km²)*	Area (%)	Theoretical water demand by permanent population (hm³ y⁻¹)	Theoretical water demand by tourists (hm³ y⁻¹)	Total theoretical water demand (hm³ y⁻¹)	Total theoretical water demand (%)
Albania	7,530.3	38.9	21.0	1.2	22.12	29.3
Greece	260.0	1.3	0.2	0.0	0.18	0.2
Kosovo	4,611.8	23.8	19.0	0.0	19.00	25.2
North Macedonia	2,860.1	14.8	10.3	0.1	10.40	13.8
Montenegro	4,111.3	21.2	23.7	0.1	23.78	31.5
Total	*19,373.5*	*100.0*	*74.2*	*1.4*	*75.48*	*100.0*

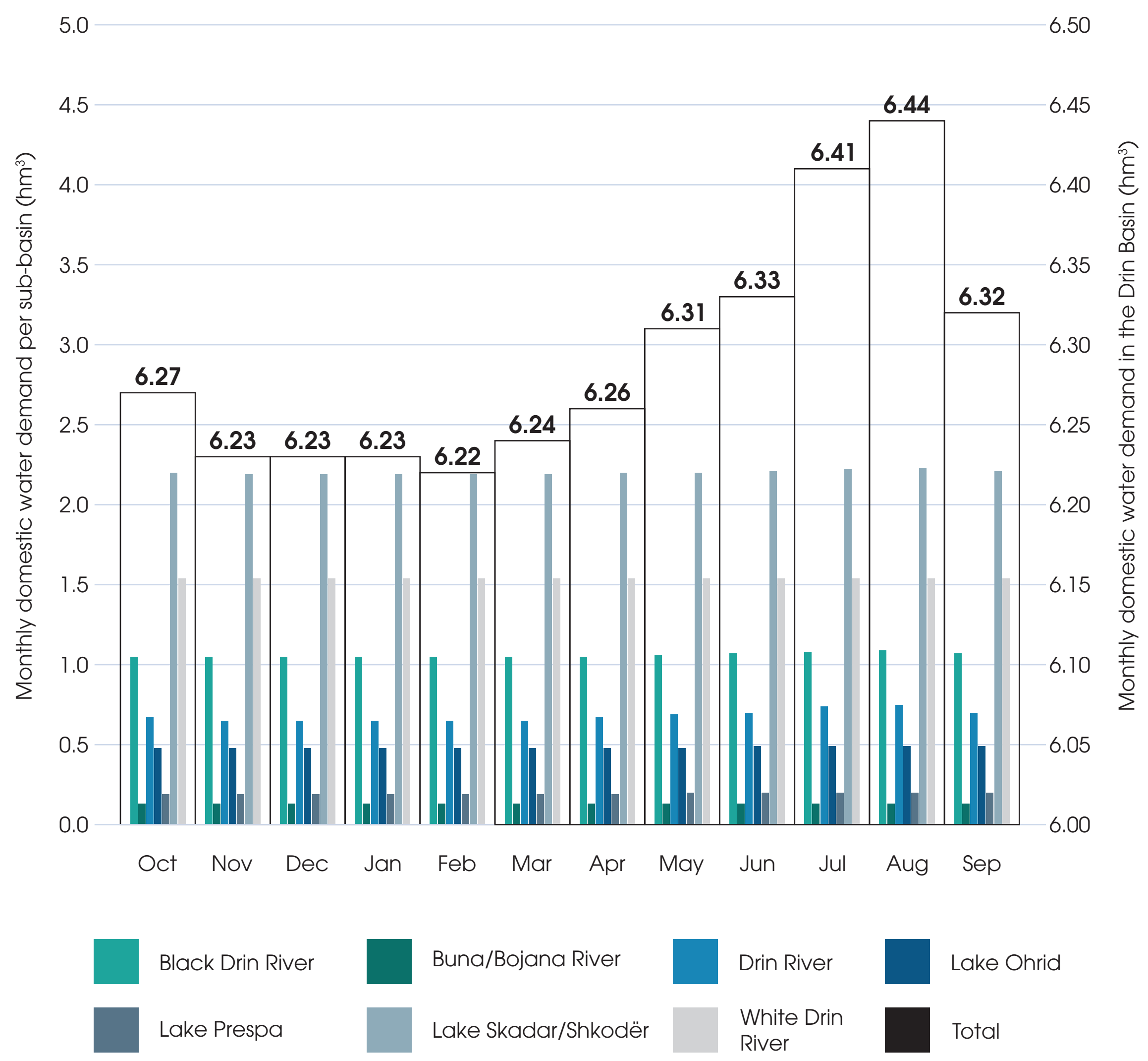
Note: *Lake area not included.

Table 27. Annual theoretical domestic water demand per sub-basin

Sub-basin	Area (km²)*	Area (%)	Population	Population (%)	Water demand (hm³/y)	Tourists	Tourists (%)	Water demand (hm³/y)	Total theoretical water demand (hm³/y)	Total water demand (%)
Lake Prespa	1,058.2	5.5	50,454	3.1	2.3	37,922	1.1	0.0	2.3	3.1
Lake Ohrid	1,053.7	5.4	123,409	7.6	5.7	211,244	6.3	0.1	5.8	7.7
Black Drin River	3,960.1	20.4	294,958	18.2	12.4	678,003	20.3	0.3	12.7	16.8
White Drin River	4,347.9	22.4	541,925	33.5	18.4	132,683	4.0	0.0	18.4	24.4
Drin River	3,426.5	17.7	215,421	13.3	7.5	1,785,294	53.5	0.7	8.2	10.8
Lake Skadar/ Shkodër	5,105.0	26.4	350,917	21.7	26.2	429,168	12.9	0.2	26.4	35.0
Buna/ Bojana River	422.2	2.2	39,731	2.5	1.6	65,422	2.0	0.0	1.6	2.1
Total	*19,373.6*	*100.0*	*1,616,815*	*100.0*	*74.1*	*3,339,736*	*100.0*	*1.3*	*75.4*	*100.0*

Note: *Lake area not included.

Figure 25. Monthly domestic water demand per sub-basin



The highest theoretical domestic water demand was found to be in the Lake Skadar/Shkodër sub-basin (26.4 hm^3/y, 35.0 percent), followed by the White Drin River (18.4 hm^3/y, 24.4 percent) and Black Drin River (12.7 hm^3/y, 16.8 percent). The ratio of consumed water compared with produced water from the supply systems was roughly 40 percent for Kosovo and Montenegro, 36 percent for Albania and 25 percent for North Macedonia.

Agricultural use of water

The extent of agricultural land and the estimated water demand by agriculture are shown in Table 28 and Table 29, as well as Figure 26 and Figure 27.

Figure 26. Agricultural area in the Drin Basin

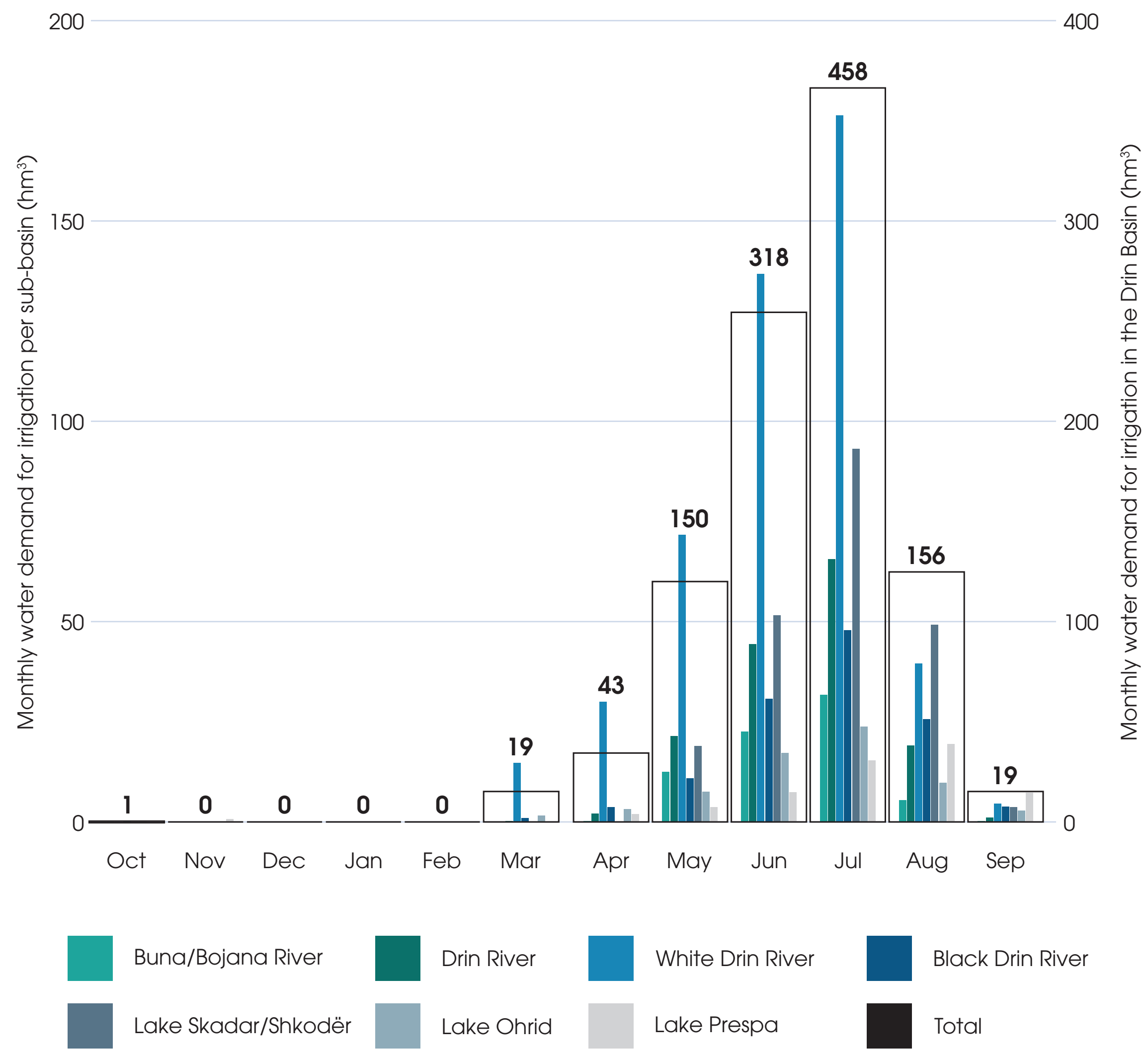
Table 28. Monthly theoretical water demand for irrigation (hm³) per Riparian

Riparian	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Total (%)
Albania	0.0	0.0	0.0	0.0	0.0	1.1	5.3	48.5	104.7	157.9	53.4	6.0	376.9	32
Greece	0.7	0.0	0.0	0.0	0.0	0.4	0.6	1.0	3.0	4.1	4.0	1.9	15.7	1
Kosovo	0.0	0.0	0.0	0.0	0.0	14.6	29.9	71.5	137.4	178.0	41.3	4.7	477.4	41
North Macedonia	0.3	0.0	0.0	0.0	0.0	3.3	7.0	15.7	35.2	47.1	17.1	3.3	129	11
Montenegro	0.0	0.0	0.0	0.0	0.0	0.0	0.1	13.6	38.0	70.5	39.9	3.1	165.2	14
Total	*1.1*	*0.0*	*0.0*	*0.0*	*0.0*	*19.3*	*42.9*	*150.3*	*318.3*	*457.7*	*155.8*	*18.9*	*1,164.3*	*100*

Table 29. Monthly theoretical water demand for irrigation (hm³) per sub-basin

Sub-basin	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total	Total (%)
Lake Prespa	0.7	0.0	0.0	0.0	0.0	1.9	3.6	7.4	15.3	19.4	7.3	3.1	58.8	5
Lake Ohrid	0.1	0.0	0.0	0.0	0.0	1.6	3.2	7.5	17.2	23.8	9.7	2.8	66.0	6
Black Drin River	0.2	0.0	0.0	0.0	0.0	0.9	3.7	10.9	30.7	47.8	25.6	3.8	123.5	11
White Drin River	0.0	0.0	0.0	0.0	0.0	14.7	30.0	71.6	136.8	176.3	39.5	4.5	473.4	41
Drin River	0.0	0.0	0.0	0.0	0.0	0.2	2.1	21.4	44.3	65.6	19.1	1.0	153.7	13
Lake Skadar/ Shkodër	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.9	51.5	93.1	49.2	3.6	216.3	19
Buna/Bojana River	0.0	0.0	0.0	0.0	0.0	0.0	0.2	12.5	22.5	31.7	5.4	0.2	72.5	6
Total	*1*	*0.0*	*0.0*	*0.0*	*0.0*	*19.3*	*42.8*	*150.2*	*318.3*	*457.7*	*155.8*	*19*	*1,164.2*	*100*

Figure 27. Monthly theoretical water demand for irrigation (hm³) per sub-basin



The total theoretical annual water demand for irrigation in the Drin Basin is estimated to be 1,164 hm³. The highest needs are found to be in Kosovo and Albania (41 percent and 32 percent of the total, respectively) and in the White Drin River and Lake Skadar/Shkodër sub-basins (41 percent and 19 percent of the total, respectively). Regarding monthly water demand for irrigation, the highest theoretical needs are in June and July.

Based on Riparian data, the following estimates have been prepared for the Drin Basin on consumptive animal use of water resources (Table 30).

Table 30. Annual animal husbandry water needs per sub-basin

Sub-basin	Cattle	Sheep	Pigs	Poultry	Equine	Water needs	
	Number					hm³	%
Lake Prespa	4,320	37,693	1,321	128,582	1,133	0.73	4.2
Lake Ohrid	6,018	49,883	1,376	207,864	1,443	0.96	5.5
Black Drin River	51,907	231,689	4,390	423,287	6,768	4.76	27.3
White Drin River	136,087	90,982	11,799	1,067,033	1,484	3.98	22.8
Drin River	57,502	147,353	34,378	417,129	5,613	3.96	22.7
Lake Skadar/ Shkodër	35,963	101,486	24,318	392,651	2,857	2.69	15.4
Buna/ Bojana River	5,116	13,023	3,983	56,843	383	0.37	2.1
Total	*296,913*	*672,109*	*81,565*	*2,693,389*	*19,681*	*17.45*	*100.0*

The total annual theoretical water needs for animal husbandry is 17.44 M m³ or 1.45 M m³/month (based on the assumption that the animals' water needs are equally distributed throughout the year). The highest water needs are found in Albania (56.8 percent of the total). The Black Drin River, White Drin River and Drin River sub-basins have almost the same share of water needs (27.3 percent, 22.8 percent and 22.7 percent of total, respectively).

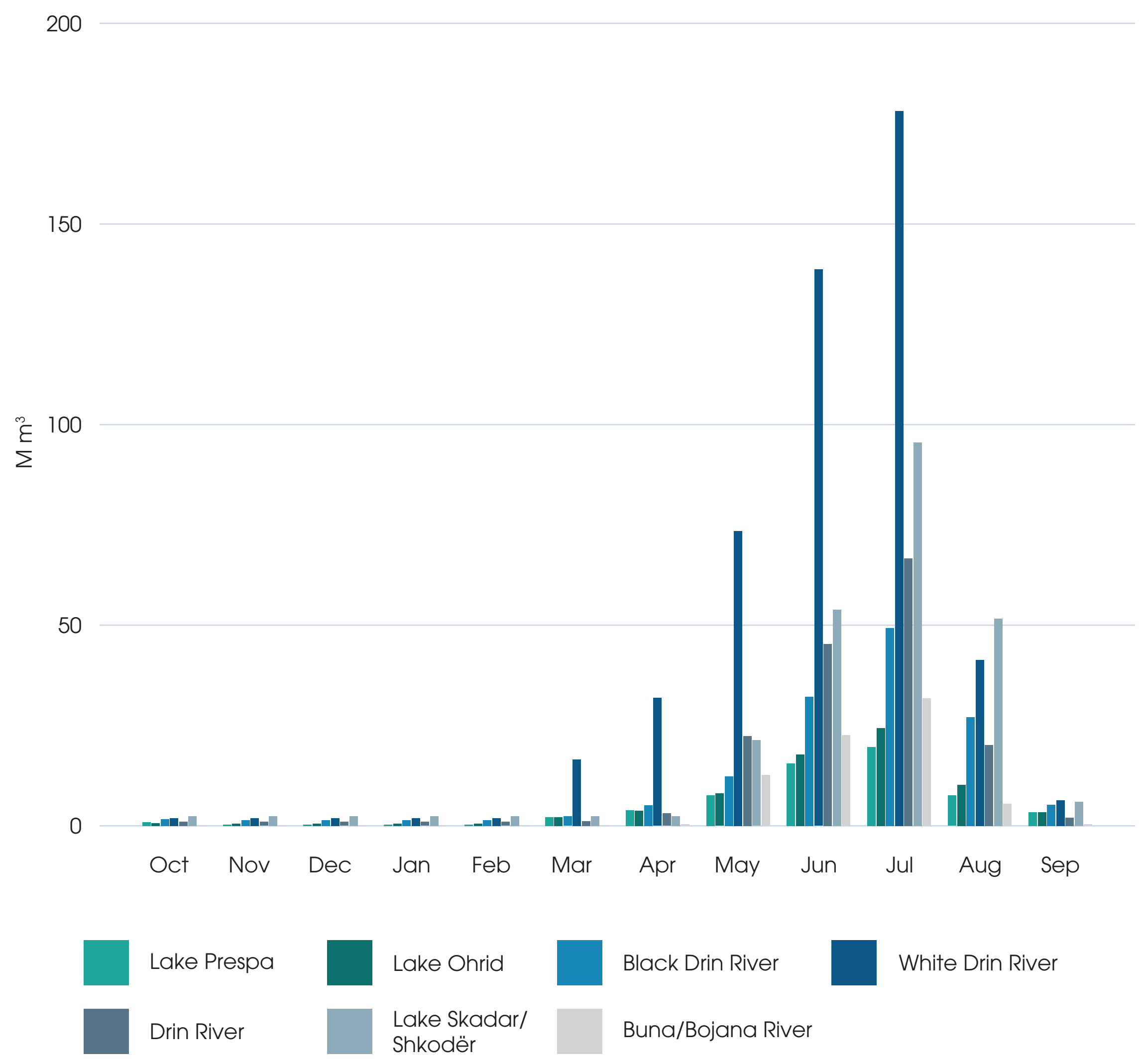
Overall water demand

The research for the preparation of the TDA estimated that there is a theoretical demand of approximately 1.3 billion m³ of water across the entire Drin Basin. Related information per sub-basin is summarized in Table 31 and Figure 28. Theoretical water needs for irrigation are the largest accounting for 95 percent of total needs in the Lake Prespa sub-basin, 91 percent in the Lake Ohrid sub-basin, 88 percent in the Black Drin River sub-basin, 95 percent in the White Drin River sub-basin, 93 percent in the Drin River sub-basin, 88 percent in the Lake Skadar/Shkodër sub-basin, and 97 percent in the Buna/Bojana River sub-basin.

Table 31. Theoretical consumptive water use per month and major sub-basin (in M m³)

Sub-basin	Water demand	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total (M m³)
Lake Prespa	Animal husbandry	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.72
	Domestic	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.2	0.2	0.2	0.2	0.2	2.33
	Irrigation	0.7	0	0	0	0	1.9	3.6	7.4	15.3	19.4	7.3	3.1	58.7
	Total	0.95	0.25	0.25	0.25	0.25	2.15	3.85	7.66	15.56	19.66	7.56	3.36	61.75
Lake Ohrid	Animal husbandry	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.96
	Domestic	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.49	0.49	0.49	0.49	5.8
	Irrigation	0.1	0	0	0	0	1.6	3.2	7.5	17.2	23.8	9.7	2.8	65.9
	Total	0.66	0.56	0.56	0.56	0.56	2.16	3.76	8.06	17.77	24.37	10.27	3.37	72.66
Black Drin River	Animal husbandry	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	4.8
	Domestic	1.05	1.05	1.05	1.05	1.05	1.05	1.05	1.06	1.07	1.08	1.09	1.07	12.72
	Irrigation	0.2	0	0	0	0	0.9	3.7	10.9	30.7	47.8	25.6	3.8	123.6
	Total	1.65	1.45	1.45	1.45	1.45	2.35	5.15	12.36	32.17	49.28	27.09	5.27	141.12
White Drin River	Animal husbandry	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	3.96
	Domestic	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	1.54	18.48
	Irrigation	0	0	0	0	0	14.7	30	71.6	136.8	176.3	39.5	4.5	473.4
	Total	1.87	1.87	1.87	1.87	1.87	16.57	31.87	73.47	138.67	178.17	41.37	6.37	495.84
Drin River	Animal husbandry	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	3.96
	Domestic	0.67	0.65	0.65	0.65	0.65	0.65	0.67	0.69	0.7	0.74	0.75	0.7	8.17
	Irrigation	0	0	0	0	0	0.2	2.1	21.4	44.3	65.6	19.1	1	153.7
	Total	1.00	0.98	0.98	0.98	0.98	1.18	3.10	22.42	45.33	66.67	20.18	2.03	165.83
Lake Skadar/ Shkodër	Animal husbandry	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	2.64
	Domestic	2.2	2.19	2.19	2.19	2.19	2.19	2.2	2.2	2.21	2.22	2.23	2.21	26.42
	Irrigation	0	0	0	0	0	0	0	18.9	51.5	93.1	49.2	3.6	216.3
	Total	2.42	2.41	2.41	2.41	2.41	2.41	2.42	21.32	53.93	95.54	51.65	6.03	245.36
Buna/ Bojana River	Animal husbandry	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.36
	Domestic	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	1.56
	Irrigation	0	0	0	0	0	0	0.2	12.5	22.5	31.7	5.4	0.2	72.5
	Total	0.16	0.16	0.16	0.16	0.16	0.16	0.36	12.66	22.66	31.86	5.56	0.36	74.42
Total		*8.71*	*7.68*	*7.68*	*7.68*	*7.68*	*26.98*	*50.87*	*157.95*	*326.09*	*465.55*	*163.68*	*26.79*	*1,257.34*

Figure 28. Monthly theoretical consumptive water use per major sub-basin



5.4 Future water use scenarios

Water use scenarios were calculated using the Panta Rhei hydrological model developed for the Drin Riparians with the support of GIZ to determine overall water balance run-off in the Drin basin.

5.4.1 Water balance scenarios

Three water budget scenarios were used to assess water availability and stress in each one of the sub-basins, as well as related transboundary issues.

1. Business as usual: present climate, present water demands.

This scenario assumes that the hydrological conditions affecting surface water and groundwater availability are similar to conditions observed in the recent historical record (1979–1989 and 2001–2010).

To assess the so-called 'water stress', the theoretical consumed water has been compared with the theoretical water resources available (i.e. without any consumption).

According to results, during the irrigation season, the theoretical water consumption increases up to approximately 75 percent of the available resources in the White Drin River, while in the Black Drin River, the corresponding consumption reaches around 40 percent of the available resources, with demand highest in the June–August period. In the rest of the year, water consumption and demands are limited in relation to the available resources. Water used each month as a percentage of the available resources under the business-as-usual scenario is shown in Figure 29.

Figure 29. Water used each month as a percentage of the available resources under the business-as-usual scenario – hydrologically average year

Sub-basins	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Lake Prespa	3.51%	1.03%	0.99%	1.03%	1.08%	7.77%	12.96%	20.11%	34.43%	40.64%	22.22%	12.40%	16.51%
Lake Ohrid	1.12%	0.89%	0.99%	0.84%	0.90%	2.78%	3.63%	8.32%	24.32%	31.89%	17.23%	6.75%	8.62%
Black Drin River	1.29%	0.73%	0.60%	0.65%	0.68%	0.79%	1.79%	5.37%	19.49%	37.07%	29.58%	7.06%	6.18%
White Drin River	1.38%	0.91%	0.72%	0.75%	0.78%	5.67%	13.45%	30.25%	58.17%	74.65%	46.60%	10.22%	19.90%
Drin River	0.14%	0.10%	0.08%	0.09%	0.09%	0.09%	0.27%	2.27%	6.23%	14.36%	6.31%	0.57%	1.59%
Lake Skadar/ Shkodër	0.48%	0.26%	0.16%	0.18%	0.23%	0.20%	0.25%	2.62%	9.09%	22.47%	20.17%	3.28%	2.51%
Buna/Bojana River	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.68%	1.73%	3.97%	1.04%	0.07%	0.36%

It can be concluded that in a hydrologically average year there are no significant problems in covering all water needs in the Drin Basin. The issues of inadequate and/or inefficient water supply networks, which insufficiently supply users, are related to the design, investment and operation of water provision infrastructure.

During a dry year, water stress increases when irrigation needs are increased (for example, in the summer June–August period). Theoretical consumption in terms of the percentage of available water resources reaches around 85 percent in the White Drin River, 41 percent in Lake Prespa, around 35 percent in the Black Drin River, around 34 percent in Lake Skadar/ Shkodër and around 33 percent in Lake Ohrid (Figure 30).

Figure 30. Water used each month as a percentage of the available resources – dry year

Sub-basins	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Lake Prespa	3.51%	1.03%	0.99%	1.03%	1.08%	7.77%	12.96%	20.11%	34.43%	40.64%	22.22%	12.40%	16.51%
Lake Ohrid	1.10%	0.91%	0.92%	0.89%	0.85%	3.21%	5.77%	12.15%	25.48%	32.79%	17.55%	6.84%	9.55%
Black Drin River	1.43%	1.23%	1.27%	0.96%	0.97%	1.31%	3.27%	7.96%	21.99%	34.81%	25.90%	6.16%	8.72%
White Drin River	3.63%	2.75%	2.02%	1.30%	1.10%	7.37%	23.02%	51.82%	70.94%	85.22%	60.69%	13.15%	31.92%
Drin River	0.30%	0.25%	0.23%	0.18%	0.11%	0.12%	0.47%	5.25%	10.29%	22.33%	8.92%	0.69%	2.78%
Lake Skadar/ Shkodër	0.84%	0.78%	0.38%	0.30%	0.25%	0.19%	0.26%	4.73%	16.17%	34.00%	31.39%	5.61%	3.76%
Buna/Bojana River	0.02%	0.02%	0.01%	0.01%	0.01%	0.01%	0.02%	1.44%	3.14%	6.81%	1.67%	0.09%	0.59%

2. Climate change scenario: future climate, present water demands.

This scenario assumes that hydrological conditions affecting water availability reflect changes in the climate that may be expected by the year 2050. Climate changes are estimated using global and regional climate models, as reported in the national communications to United Nations Framework Convention on Climate Change (UNFCCC). It is assumed that there will be no change in the water demand and that it will remain the same as the current demand, except in the irrigation sector, where consumptive water use requirements are assumed to change due to rainfall and evaporation changes as a result of climate change.

Water stress is estimated by calculating the rate of theoretical water use as part of the available water under the climate change scenario. Water stress in the White Drin River significantly increases under this scenario, with theoretical consumption reaching 81 percent of available water resources during July when irrigation needs are at the highest level. The Black Drin River sub-basin ranks second, with theoretical consumption reaching around 43 percent of available water resources also during July, again when irrigation needs are at the highest level. For the rest of the basins, no significant stress is projected. The estimated water consumption, under the climate change scenario, is indicated in Figure 30.

This implies that water resources will undergo significant stress in parts of the basin in the next 30 years, especially during June to August. Moreover, in the case of dry years, it is likely that available water resources in large parts of the basin will not be adequate to satisfy the demand.

Mitigation measures should be designed to overcome this eventual problem by implementing water-saving measures and managing the demand through economic and other tools.

Figure 31. Water stress in 2050 with climate change impacts on water availability

Sub-basins	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Lake Prespa	3.21%	0.91%	0.83%	0.86%	0.94%	6.98%	11.66%	20.00%	38.05%	44.81%	24.00%	12.23%	15.89%
Lake Ohrid	1.20%	0.95%	0.96%	0.81%	0.87%	2.84%	3.70%	8.49%	24.82%	35.31%	19.08%	7.48%	8.89%
Black Drin River	1.37%	0.78%	0.59%	0.64%	0.67%	0.80%	1.83%	5.48%	22.60%	42.98%	34.30%	7.49%	6.42%
White Drin River	1.46%	0.97%	0.69%	0.71%	0.74%	5.79%	13.72%	30.87%	62.55%	80.27%	50.11%	10.87%	20.24%
Drin River	0.15%	0.11%	0.08%	0.09%	0.09%	0.09%	0.28%	2.32%	7.83%	18.06%	7.94%	0.60%	1.69%
Lake Skadar/ Shkodër	0.50%	0.28%	0.17%	0.18%	0.23%	0.21%	0.25%	2.67%	9.29%	22.98%	31.77%	3.46%	2.61%
Buna/Bojana River	0.01%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	0.70%	2.04%	4.66%	1.17%	0.07%	0.37%

3. Full development scenario: future climate, future water demands.

This scenario assumes that climate change will affect hydrological conditions and that consumptive water demands (water supply, industry, agriculture) will also change in the future.

This scenario assesses the level of water stress in each basin throughout a year as a result of the development of economic activities and expansion of water supply networks. Temporal changes in water availability in different parts of the basin as a result of non-consumptive uses (of which the most important sector is energy) and possible subsequent transboundary issues are not assessed in this TDA, as data that would enable the use and coupling of water and energy models were not available.

An increase in domestic consumption is expected in the coming years, though there are no reliable data to make projections. According to some planning documents, consumption will likely increase by approximately 64 percent. A more conservative figure of 50 percent of current consumption was used in this scenario.

Major increases in water use are expected in the agriculture/irrigation sector due to the development of irrigation schemes. For the purposes of this report and using the best available information from sectoral planning documents, the figures used for the projected increase in irrigation by 2050 were 30 percent of current consumption for Albania, Montenegro and North Macedonia, and 50 percent for Kosovo. This amounts to an increase of around 610 M m^3 per year on average.

Based on water resources availability in 2050 under the climate change scenario and the increased consumption, water stress in the study area will further increase. It is likely that water demands will be marginally satisfied or not be satisfied from June to August in dry years in the Lake Prespa and Black Drin River sub-basins. Under this scenario, needs in the White Drin River during July will be double the available resources.

The estimated water consumption under the full development scenario is indicated in Figure 32.

Figure 32. Water stress in 2050 with climate change and water demand impacts on water availability

Sub-basins	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Lake Prespa	4.90%	1.37%	1.24%	1.30%	1.42%	10.86%	18.57%	33.34%	70.48%	86.63%	40.91%	19.53%	25.89%
Lake Ohrid	1.80%	1.43%	1.44%	1.23%	1.31%	4.31%	5.66%	13.30%	42.51%	64.32%	31.64%	11.66%	13.96%
Black Drin River	2.07%	1.17%	0.89%	0.97%	1.01%	1.21%	2.76%	8.46%	38.21%	82.13%	62.10%	11.68%	9.94%
White Drin River	2.21%	1.46%	1.04%	1.07%	1.11%	8.94%	22.10%	54.75%	136.53%	201.13%	100.30%	17.24%	33.77%
Drin River	0.22%	0.16%	0.12%	0.13%	0.14%	0.14%	0.42%	3.52%	12.22%	29.78%	12.40%	0.91%	2.56%
Lake Skadar/ Shkodër	0.76%	0.42%	0.25%	0.28%	0.35%	0.31%	0.38%	4.07%	14.62%	38.94%	56.66%	5.29%	3.97%
Buna/Bojana River	0.02%	0.01%	0.01%	0.01%	0.01%	0.01%	0.02%	1.05%	3.10%	7.15%	1.76%	0.10%	0.56%

5.5 Floods

Floods are the most challenging and recurring natural hazard in the wider Western Balkan region and therefore also in the Drin Basin. River floods occur mainly from March to June (spring) and from September to November (autumn) in plains and lowlands. As snow melting causes spring floods, these often last longer than autumn floods, which are caused by heavy rainfall, making them more sudden with very high flows. Flash floods are common in mountain areas where average annual precipitation can be as much as 1,750 mm per year, sometimes triggering mudflows. Outburst floods pose a threat to many cities, owing, among other things, to the structural vulnerability of dams. Climate change is forecasted to increase both the frequency and intensity of flooding and droughts in the region.

Floods in the Drin Riparians occurred prior to the construction of dams. Since 2010, floods have been a significant disaster factor and have been increasing in frequency over time.

In Albania, following the devastating floods of 1962–1963, flood defences were built to the 1 percent return period in some rivers, but such standards of protection are decreasing due to climate change. Historic data on flooding in Montenegro show that from 1979 to 1997 there were five major flooding events, but in the six years from 2004 to 2010, floods occurred six times.

In January and December 2010, floods caused major damage and disruption over a wide area in the lower Drin River, Lake Skadar/Shkodër and Buna/Bojana River areas.

In January 2010, as a result of increasing rainfall, the Drin River flow rapidly increased. The floods were exacerbated by the operation of three hydropower reservoirs in Albania, which were forced to release water, increasing the discharge to 2,450 m^3/s into the Buna/Bojana River, which has a maximum capacity of only 1,600 m3/s. The January 2010 flood in the district of Shkodra in Albania inundated 10,400 ha of land, affecting 2,500 houses and leading to the evacuation of 4,800 people.

Intensive precipitation and snow melt in the northern part of the Morača Basin, combined with high tides in the Buna/Bojana River due to the strong south wind and high discharge of the Drin River increased the water level in Lake Skadar/Shkodër (10.44 m above sea level) in December 2010. It is believed that the floods were exacerbated by reservoirs in Albania (Vaus Deis, Kumana, Fierza) that released 3,000 m3/s of water into the Buna/Bojana River. The December 2010 flood resulted in unprecedented water levels, flooded areas and damage. In Montenegro, the total countrywide damage and losses exceeded €40 million (1.3 percent of GDP), impacting largely rural areas. The floods led to the evacuation of 1.5 percent of the population.

Due to the retained volume of the dams, the overall hydrological regime has changed to low flow and small flood events (1–10 years). There is no evidence that the dams change extreme flood events, however, the magnitude of impact can be more dangerous further downstream after releasing large flood waves. Due to the retention volume, it is estimated that floods of about 5,000 $m^{3/s}$ can be reduced to about 2,000 $m^{3/s}$ downstream of the last dam if the dams are not filled with water.

The hydropower dams in the Drin Basin and their reservoirs could be used to regulate river flows both seasonally and in the long term. The operation of hydropower dams and reservoirs within the basin should be included in the flood risk assessment, modelling and mapping. Based on climate risk information, the current and long-term ability to operate dams in a flood alleviation role should be investigated. Ideally, stakeholders would agree to optimize dam operations for multiple uses, including power generation, flood alleviation and dam safety. At the very least, dams should be operated in a manner that avoids exacerbating flood risks and that takes into account the increasing risks posed by climate change.

In addition to dams, changes in land use adjacent to the river channel area have reduced the area of the floodplain, altering the ecosystem structure and hydrological functioning of the river. Before the intensive drainage and melioration of the area, almost 50 percent of the whole Buna/Bojana River and Delta region was regularly flooded.

A preliminary flood risk assessment was carried out by the Riparians that worked together in a transnational Technical Working Group, which was guided by international and national experts.[26]

The assessment identified 46 areas of potential significant flood risk (APSFR) throughout the Drin Basin.[27] Of these, 21 are located in North Macedonia, 12 in Kosovo, 7 in Albania and 6 in Montenegro. The numbers neither reflect the extent of potential risk nor the size of the risk areas. The bigger flood risk areas are situated in Albania in the delta of the Drin Basin and around Lake Skadar/Shkodër, whereas the number of smaller risk locations are found in the upstream Riparians. Areas in Kosovo and North Macedonia are facing flash flood risk and pluvial flood risk (in smaller catchments and along the headwaters of smaller streams that cross the villages).

The rating of the significance of potential flood risk areas followed the approach of the EU Floods Directive, using significance criteria for the assets at risk (human life, economic and ecological assets, as well as cultural heritage).

The APSFR were categorized with two levels of potential significant risks (high and low): 'high significance' characterizes areas in which more than two of the significance criteria were met, whereas 'low significance' characterizes areas in which one or two criteria were met. Following this exercise, about 76 percent of all potential flood risk areas can be considered highly significant (in Kosovo, 100 percent, because the available level of compared data is low). One quarter of the APSFR are of low significance, meeting just one or two significance criteria.

Table 32 provides summary information on the potentially flooded areas in the Drin Basin sub-basins from flood events with 50- and 100-year return periods (in terms of probability). The main areas flooded are highlighted in Figure 33.

26 The process was supported by the project "Climate Change Adaptation through Transboundary Flood Risk Management in the Western Balkans", funded by the German Federal Ministry for Economic Cooperation and Development and implemented by GIZ. The methodology and the working steps in identifying the areas of potential significant flood risk (APSFR) followed the EU Floods Directive, chapter III, article 4. The assessment considers different types of floods according to the European flood risk management guidelines of the EU Working Group on Floods.

27 Presented in overview map in the report prepared by GIZ.

Table 32. Flooded areas in the Drin Basin sub-basins

Sub-basin	Flooded area (km²)	
	50-year RP flood	100-year RP flood
Buna/Bojana River	135.9	141.8
Lake Skadar/Moracha	146.4	158.5
White Drin River	62.8	65.7
Black Drin River	47.0	49.3
Drin River	96.2	98.7
Lake Ohrid	0.0	0.0
Total	*488.4*	*513.9*

Note: Presented in the Thematic Report on Socio-economics.
Source: Dottori F., Alfieri L., Salamon P., Bianchi A., Feyen L., Lorini V. et. al (2016). Flood hazard map for Europe – 100-year return period. European Commission, Joint Research Centre (JRC). https://data.jrc.ec.europa.eu/dataset/jrc-floods-floodmapeu_rp100y-tif.

Apart from climate change effects, geomorphological characteristics, hydrological features of watercourses and geotechnical formation of the terrain, flood events in the Drin Basin region are also augmented by environmental degradation factors such as continued pollution and poor waste management, as well as by factors such as improper urbanization and/or inappropriate land use.

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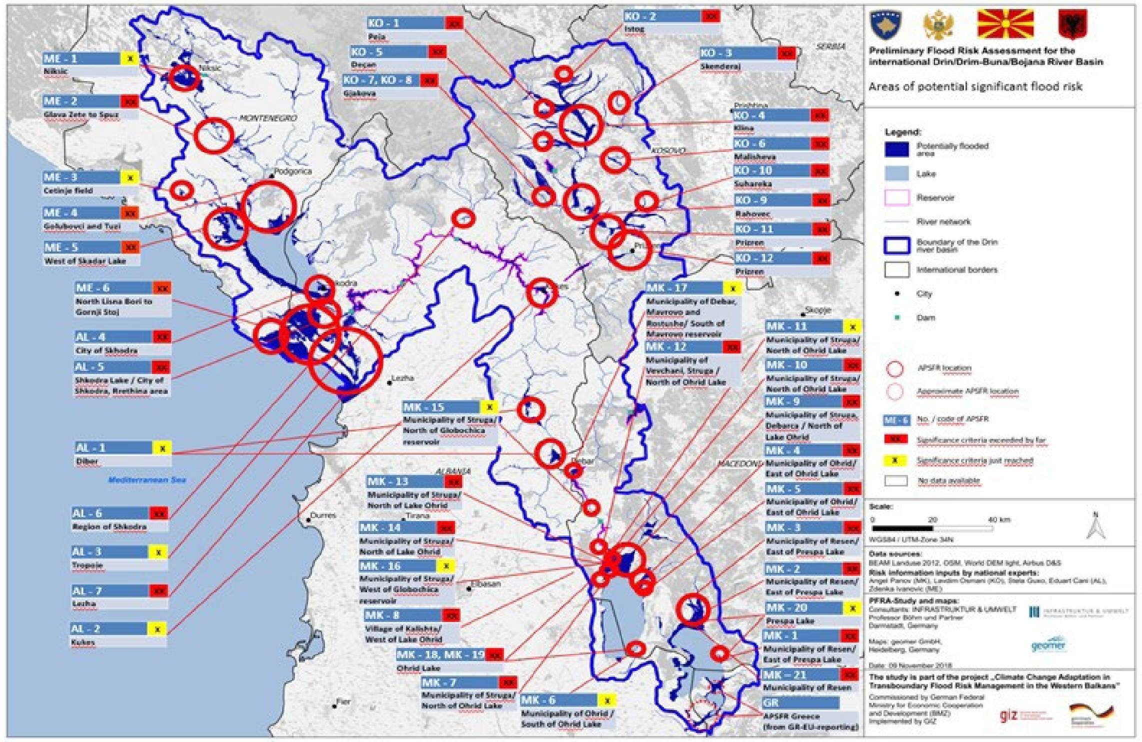
Figure 33. Areas of significant flood risk in the Drin Basin



Source: German Federal Ministry for Economic Cooperation and Development and GIZ (2019). Climate Change Adaptation in Transboundary Flood Risk Management in the Western Balkans. https://www.giz.de/en/worldwide/29000.html.

5.6 Hydromorphological alterations and impacts

5.6.1 Hydropower in the Drin Basin

There are more than 110 irrigation reservoirs in the Drin Basin. The hydropower plants on the Drin River are listed in Table 17 under section 1.3.4 (Power generation).

There are plans for the construction of small hydropower plants in the four Riparians; their number is estimated between 150 and 200. According to available information, most of the new small hydropower schemes will not use vertical obstacles (dams) for energy production, but instead will deviate part of the flow, which then returns to the river further downstream. This has less impact on the sediment volume in the total transport in relation to dams, but the temporal distribution of the sediment flow remains high (since the discharge is regulated).

In addition to the hydropower dams, there are those that serve other purposes, such as the Radoniqi dam in Kosovo, the reservoir of which is used for water supply and irrigation.

Overall, the dams have changed the hydrological, hydraulic and sediment regime of the river considerably. The existing important dams and associated reservoirs in the Drin Basin are shown in Figure 34.

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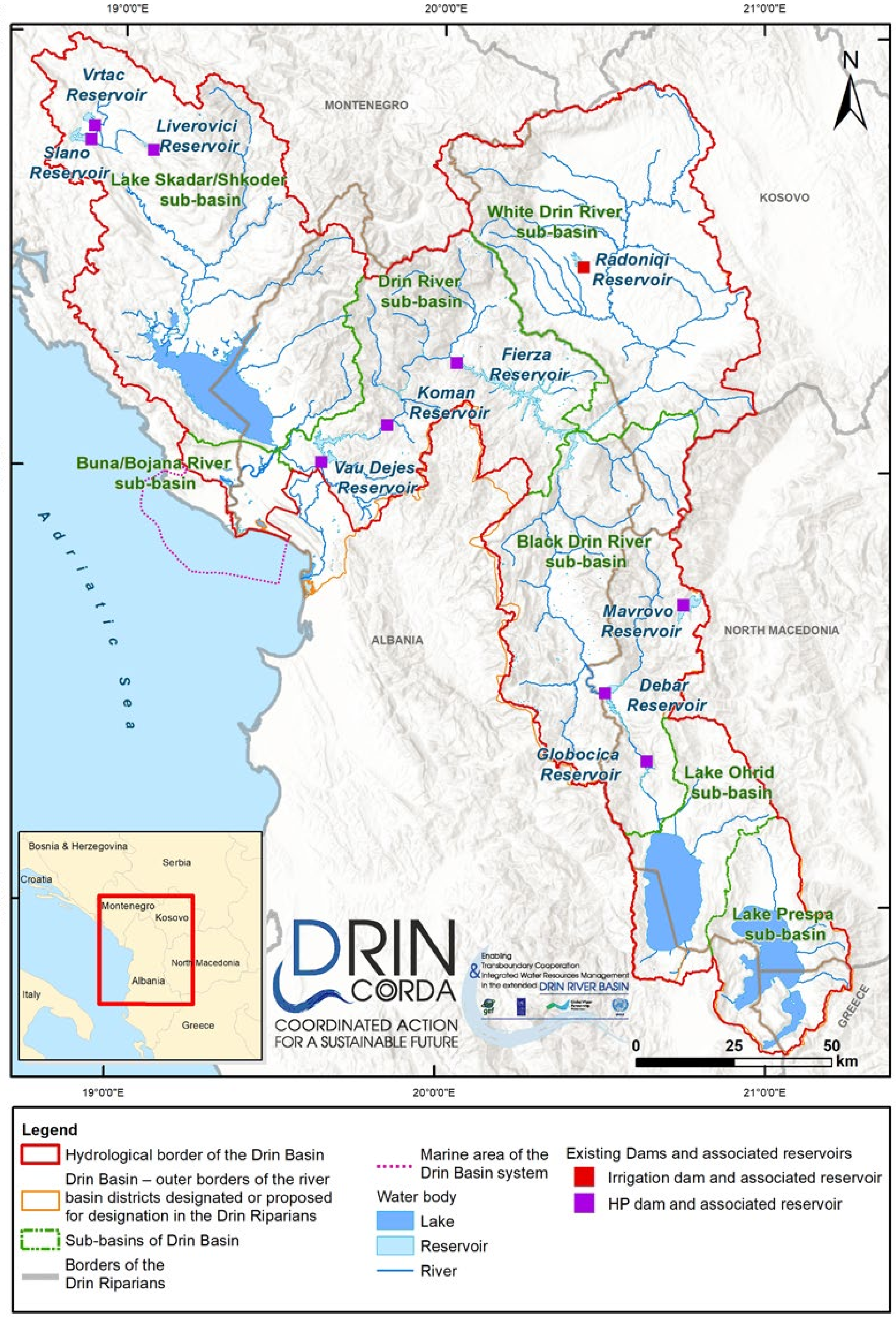
Figure 34. Existing important dams and associated reservoirs in the Drin Basin



5.6.2 Sediment transport

The natural river sediment transport has been significantly altered in the past years. This alteration influences the rivers' morphology and geomorphology, delta evolution and ecosystem health and stability, as well as the coast (causing erosion – see below).

The construction of the reservoirs and hydropower plants is one of the causes. Their construction resulted in the transported sediment load being drastically reduced (by nearly 95 percent) in the downstream part of the basin. Furthermore, high discharge releases downstream of dams with no or little sediment loads cause channel vertical erosion, disconnection from the floodplain and bank erosion.

A realistic estimation of average annual sediment transport from the Drin River is 6.9 million t. Of this, 0.5 million t yr^{-1} passes through the dams' turbine and floodgate, while the rest accumulates in the dams' reservoirs. Dams are traditionally designed to provide enough reservoir storage to sustain at least 100 years of sedimentation; the current rate of sedimentation may affect the lifespan of the dams.

After the Drin–Buna/Bojana confluence, sediments enter the latter to join the very small quantity of Lake Skadar/Shkodër sediments (mainly clay and sand). The limited movement of water from the lake allows only small amounts of the suspended sediments to flow out, especially during the wet season or during high discharge events (for example, when the water speed is increased above 1 m s^{-1}). Furthermore, the Drin River flow joining the Buna/Bojana River a kilometre after the outlet of the latter from the lake creates a blockage of the discharge outflow from the lake, influencing the sediment transport.

In addition to dam construction, the sediment distribution regime in the Drin and Buna/Bojana rivers has been altered to some extent by deforestation, as well as soil and water abstraction.

Gravel extraction is an issue. In the case of the White Drin River, extraction for more than 20 years has significantly changed the morphology of the river. The gravel excavation process involves the separation of mainly medium coarse material from inert material. In the process, finer particles are washed out, leaving behind a disturbed river landscape of mud heaps. Particularly during floods, the main branch of the river is charged with considerable loads of suspended material, which is then deposited further downstream. The total area affected by erosion in the White Drin River sub-basin is estimated to be 1,156 ha.

A rough estimate of erosion was performed.[28] The average rate of soil loss in the catchment is estimated to be 10–20 t ha-1 yr^{-1}. The rate of soil loss is higher in the Albanian part than in other parts of the catchment. There are also some highly eroded areas in Montenegro, but these are small, isolated areas. Moderate soil erosion losses are estimated for Kosovo, while the lowest soil loss rates are in North Macedonia. In the Lake Prespa, Lake Ohrid and Black Drin River sub-basins, two areas on the borders between Albania and North Macedonia stand out; in the North Macedonian part,

28 An estimate of erosion for the Drin Basin was performed using the revised universal soil loss equation (RUSLE). CORINE land cover data from 2006 were used. The uncertainty of the modelled erosion risk is high, especially at local level.

there is an estimated average soil loss rate of 7 t ha^{-1} yr^{-1} while in the Albanian part, the average rate is 12 t ha^{1} yr^{1}. In the case of the White Drin River in Kosovo, the average soil loss rate is estimated to be 9 t ha^{1} yr^{1}. The highest rate in terms of soil erosion – 20 t ha^{-1} yr^{-1} – is in the central part of the Drin Basin. At Lake Skadar/Shkodër, the estimated rate of soil erosion is about 6 t ha^{-1} yr^{-1}.

The theoretical sediment budget and distribution regime in the different sub-basins was estimated.[29] The annual average sediment transport of the Drin River in the area of the Fierza Hydroelectric Power Station is 4.72 million t km^{-2} yr^{-1}, while the annual average soil loss reaches 557 t km^{-2} yr^{-1}. The annual average sediment transport in the area of the Vau i Dejës hydropower plant reaches 15.4 million t km^{-2} yr^{-1} and the annual average soil loss is 489 t km^{-2} yr^{-1}.

According to Albanian data, sediment transport between Fierza and Vau i Dejës is estimated to be very high. This analysis uses sporadic data and in associated studies and the calculation error ranges from 7 to 20 percent. In the case of Vau i Dejës, even with a high margin of error (20 percent), the soil loss values are very high. This is confirmed by the dam operators in the Drin cascade.

5.6.3 Coastal erosion

The morphology, hydrography and the related values of the Buna/Bojana deltaic complex are defined by the balance among the following:

- accumulation of sediments in the Drin and Buna/Bojana rivers
- sediment load reaching the mouth of the Buna/Bojana River in the Adriatic Sea
- water flow regime in the Skadar/Shkodër–Drin–Buna/Bojana system
- influences from the sea, including variability of the wave activity and sea level in combination with short-term events (storm waves and tides) and long-term processes (sea transgressions).

The Buna/Bojana Delta was growing in area before the dams' construction, with the most intense deposition occurring in the 1940s, at an average rate of about 45 m yr^{-1}. Decrease of sediment reaching the coast (see factors listed above) caused a decrease and eventual reversal in this trend. Accumulation during the period 1950–1984 is estimated to be from 5 to 10 m yr^{-1}. Erosion during 1984–2016 was extensive in some parts, occurring at a rate of 3 m yr^{-1} in Ada and 4 m yr^{-1} in Albania. Ada Island disappeared entirely in 2016. In the same period, some sediment accumulated at the coast of the Ulcinj Municipality (0.5–0.8 m yr^{-1}) in Montenegro and on Velipojë beach in Albania (deposition reaches 7–10 m yr^{-1}).

The coastal zone in front of the right branch of the delta is a sediment accumulation area. The coastal zone in front of the left branch, in contrast, is being eroded.

Figure 35 illustrates the areas of erosion and deposition of sediments at the mouth of the Buna/Bojana River.

29 The main parameters used to evaluate the sediment budget are: ρ_0: multiannual average suspended sediment; R_0: multiannual average solid sediments passing from the bottom of the riverbed; W_S: yearly volume calculated from the suspended sediments; W_B: yearly volume calculated from the solid sediments; W_T: total of the sediment transport from the river; $r_{0,s}$: multiannual average soil loss distributed in the river.

Figure 35. Image indicating regions of erosion and deposition in coastal zones adjacent to the delta in the 1984–2016 period

Note: Accumulation is depicted in green and erosion in red.

5.7 Key observations from the TDA on water resources and sediment transport in the Drin Basin

The information collected through this TDA highlights the following observations on the water resources and sediment transport in the Drin Basin:

- Monitoring, data management and modelling within Riparians and at the basin level needs to be strengthened.
- Improved understanding of climate change impacts in different scenarios, of the availability of water resources and the impacts of extreme events (floods and droughts) need to be established and addressed.
- Under the current conditions, there is enough water available for all different socio-economic uses. There is high probability that climate change will in the future lead to severe water shortages in certain sub-basins with high irrigation needs during the June–August period.
- Better understanding on minimum ecological flows is necessary.
- Assessments of the multi-purpose use and operation of hydropower cascades should be carried out.
- There is high erosion in some parts of the basin possibly affecting the lifespan of reservoirs used for hydropower generation. Understanding of and action to manage erosion and sediment issues, including deposition in hydropower plant reservoirs, need to be improved.
- Understanding of the coastal erosion patterns and causes, as well as taking action, is important.

6. POLLUTION ASSESSMENT, WATER, SEDIMENT AND BIOLOGICAL QUALITY

The analysis for the TDA has utilized information from pollution pressures, based on source apportionment approaches, and data from the Riparian and the (Drin Project-organized) chemical assessment of groundwater, surface and coastal waters, and sediments. The pressures (and water quality) as well as the impacts are the consequences of the socio-economic activities summarized in section 4 detailed in the Thematic Report on Socio-economics and linked to the legal and institutional strengthening summarized in section 9 (detailed in the Thematic Report on Institutional and Legal Setting). Full details of the pollution assessment and water quality analysis are presented in the Thematic Report on Pollution and Water Quality.

6.1 Pollution pressure analysis

The analysis of pollution pressure focused on point sources of pollution (for example, wastewater treatment outlets, industrial sources and waste disposal sites) and diffuse sources (for example, agriculture, including animal waste and pollution caused by fertilizers and pesticides, domestic property with no sewerage network, among others).

For diffuse sources of pollution, respective emission loads were calculated based on the land-use type (agriculture, arable, urban, pasture and forests). In addition, the potential of two significant sources of diffuse pollution (manure and septic tanks) are presented as a first insight of their potential to contribute to the identified emission loads.

For quantifying purposes, the analysis focused on the organic load (as reported in the form of BOD) and nutrients load (as reported in the form of total nutrients (TN) and total phosphorus (TP), due to the well-known effects of the above to the eutrophication and deterioration of water quality.

The main share of the nutrients in the Drin Basin comes from agriculture land (almost 50 percent) followed by the nutrient emission through untreated wastewater (almost 30 percent). All other identified nutrient sources contribute less than 20 percent.

The TN emissions in the Drin Basin were estimated to be 6,708 tonnes/year for 2011–2012. Arable land was the major source (48.4 percent), followed by sewerage (29.9 percent), forests (13.0 percent), urban areas (3.7 percent), municipal solid waste landfills (3.5 percent) and pastures (1.1 percent).

The TP emissions were approximately 761.6 tonnes/year in the 2011–2012 period. As in the case of TN, arable land (53.3 percent) was the main source, followed by sewerage (34.8 percent), forests (6.5 percent) and urban areas (4.8 percent). Together, municipal solid waste landfills and pastures contribute only about 0.6 percent of the TP emissions.

In terms of location, a considerable amount – 40 percent – of total nutrient (TN and TP) emissions in the Drin Basin originates from the White Drin River sub-basin. The Lake Skadar/Shkodër sub-basin ranks second at 26 percent. All other sub-basins contribute to one third of the entire nutrient emissions.

A summary of the TN and TP loads from source apportionment in the Drin Basin sub-basins is presented in Figure 36 and Figure 37.

Figure 36. Total nitrogen load from source apportionment estimations in the Drin Basin

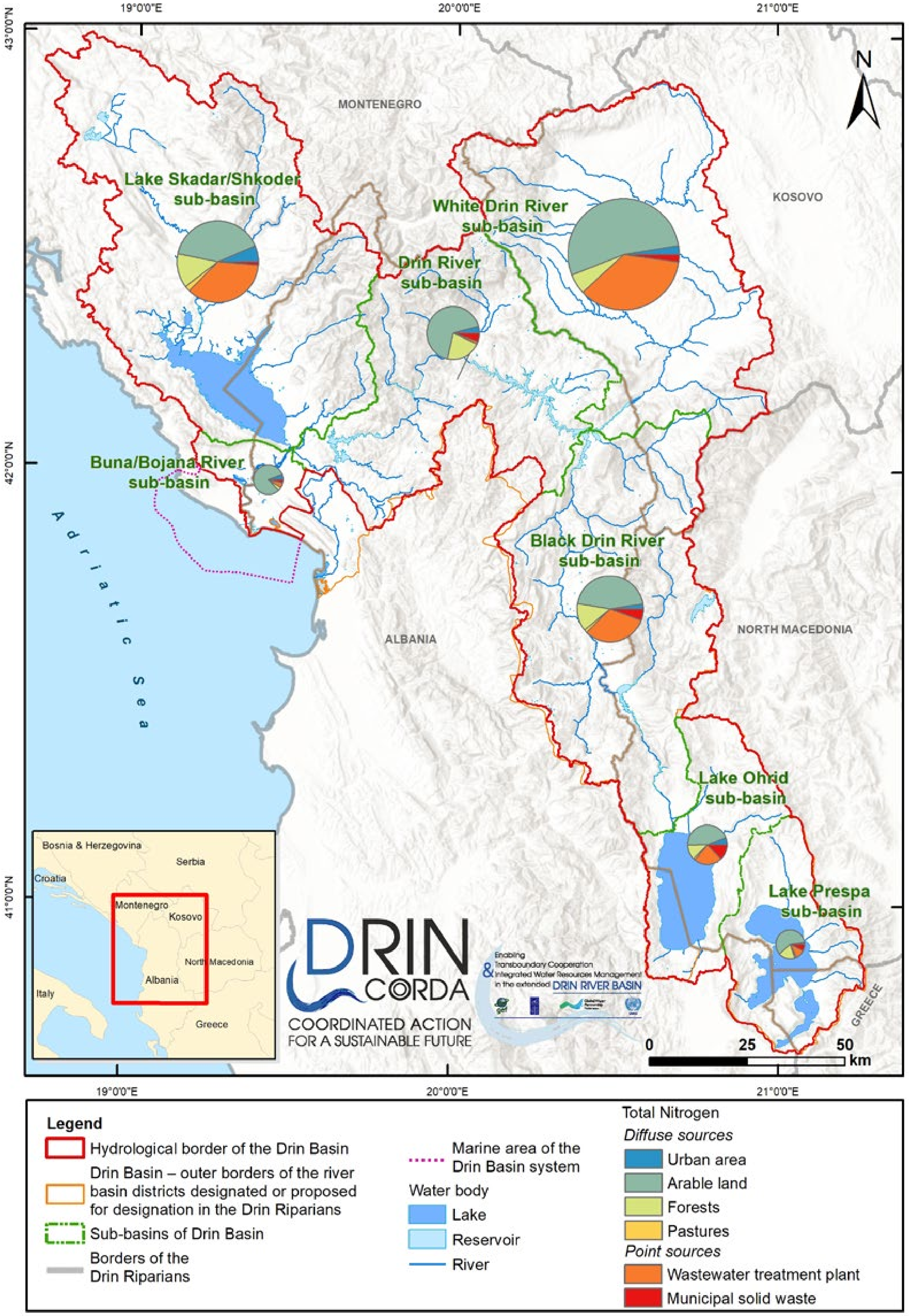


Figure 37. Total phosphorus load from source apportionment estimations in the Drin Basin

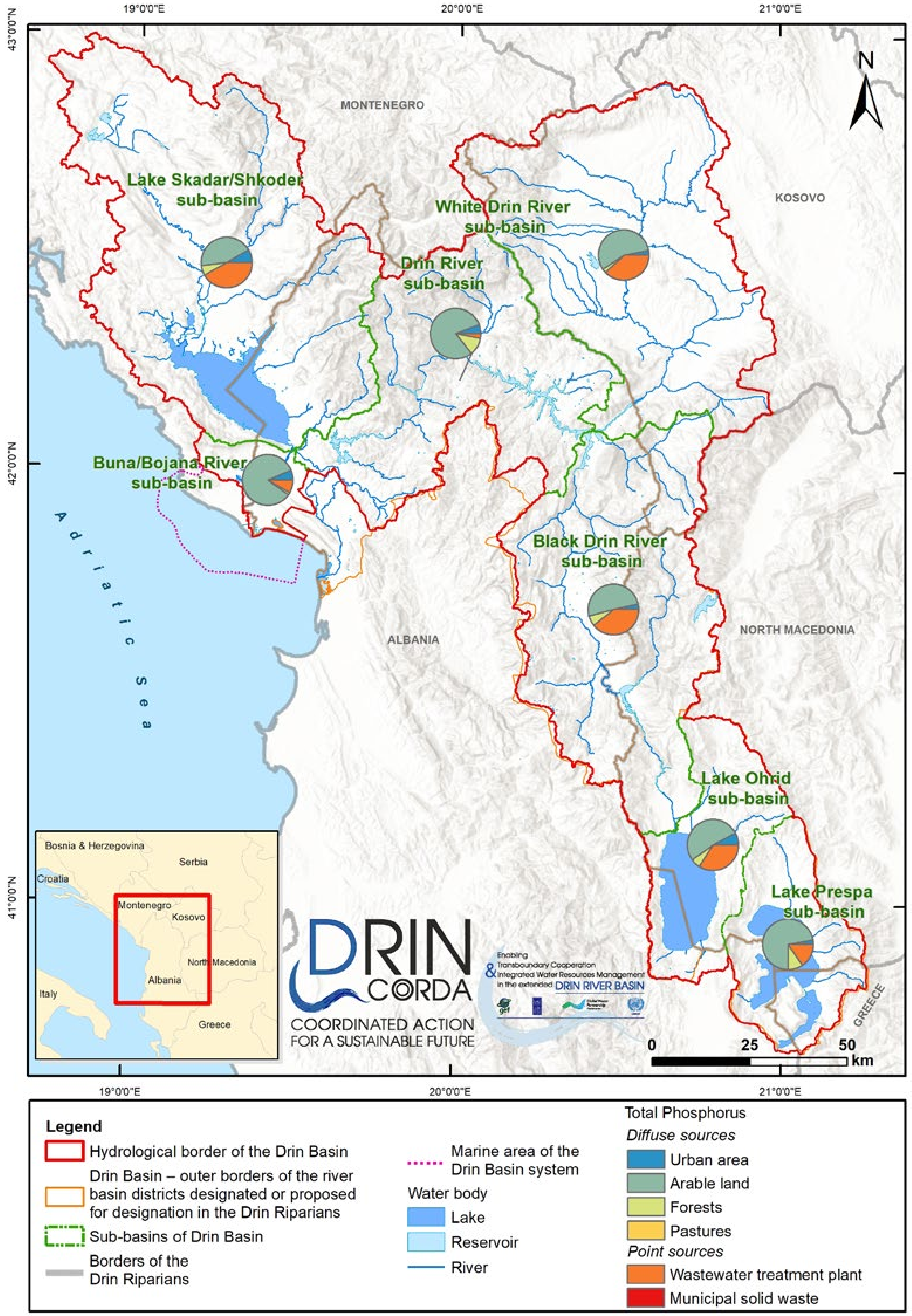


Table 33. Source apportionment of nitrogen and phosphorus in the sub-basins of the Drin Basin

Emissions	Total nitrogen (tonnes/year)								
	Diffuse				Point source		Total TN	Diffuse	Point
Sub-basin	Urban area	Arable land	Forests	Pastures	Wastewater treatment plant	Municipal solid waste			
Lake Skadar/ Shkodër	95.9	600.2	201.5	33.7	537.0	19.6	1,488.0	931.4	556.6
Drin River	24.5	417.3	133.0	5.4	10.0	32.9	623.0	580.1	42.9
Black Drin River	24.7	442.0	134.0	15.1	317.0	53.6	986.3	615.7	370.6
White Drin River	69.0	1,490.0	160.7	13.9	1,001.0	61.5	2,796.0	1,733.5	1,062.5
Lake Ohrid	19.6	158.8	43.0	5.8	82.0	45.6	354.9	227.3	127.6
Lake Prespa	3.7	112.6	34.0	3.7	20.0	14.4	188.4	154.0	34.4
Buna/ Bojana River	10.4	159.1	7.2	1.4	10.0	7.9	196.0	178.1	17.9

Emissions	Total phosphorus (tonnes/year)								
	Diffuse				Point source		Total TP	Diffuse	Point
Sub-basin	Urban area	Arable land	Forests	Pastures	Wastewater treatment plant	Municipal solid waste			
Lake Skadar/ Shkodër	14.5	75.0	11.0	1.5	72.0	0.1	174.2	102.1	72.1
Drin River	3.7	52.2	7.3	0.2	2.0	0.2	65.5	63.4	2.2
Black Drin River	3.7	55.2	7.3	0.7	43.0	0.2	110.2	67.0	43.2
White Drin River	10.5	186.2	8.8	0.6	126.0	0.3	332.4	206.1	126.3
Lake Ohrid	3.0	19.8	2.3	0.3	13.0	0.2	38.7	25.4	13.2
Lake Prespa	0.6	14.1	1.9	0.2	3.0	0.1	19.7	16.7	3.1
Buna/ Bojana River	1.6	19.9	0.4	0.1	2.0	0.0	24.0	21.9	2.0

6.1.1 Point sources of pollution

Domestic wastewater

Wastewater management is unsatisfactory in all sub-basins of the Drin Basin (except for the Lake Ohrid sub-basin) by Urban Wastewater Treatment (UWWT) Directive standards.

Wastewater collection (sewerage) systems are mainly located in urban areas. In most cases, the collection system is combined (sewage and storm water). The systems do not function efficiently due to the lack of investment, inappropriate management and limited coverage. Further issues are caused by clogging, undersized pipes and leaks. Rural areas are served mainly by individual household wastewater collection systems, principally simple pit latrines with no drainage pipes.

Less than half (46 percent) of the estimated generated wastewater load is collected through centralized sewerage networks. In > 2,000 population equivalent settlements, 73 percent of the estimated wastewater load is collected. Estimates provided in the Thematic Report on Pollution and Water Quality suggest that 108 > 2,000 population equivalent settlements generate 63 percent of the estimated load and 1,320 < 2,000 population equivalent settlements (rural areas) generate the remaining 37 percent. To comply with the UWWT Directive's requirements for collecting systems, all the agglomerations (i.e. of 2,000 population equivalent or more) must have complete collecting systems. None of these 108 settlements (agglomerations) above 2,000 population equivalent in the Drin Basin comply with this requirement.

As for the collected wastewater, the percentage of the population in urban agglomerations (settlements > 2,000 population equivalent) served by treatment plants is 25.6 percent.

The UWWT Directive requires provision of secondary treatment for all agglomerations larger than 2,000 population equivalent that are discharging wastewaters directly into fresh water. In the Drin Basin, the majority of such agglomerations have no wastewater treatment: 17 out of 108 agglomerations are served by 11 wastewater treatment plants (nine of which have secondary treatment capabilities and two of which have primary treatment only).

In total, 33 main sewerage system outlets were identified, of which wastewater from only 12 sewage networks have some treatment. The remaining 21 networks discharge untreated wastewater mainly into the rivers.

The locations of the basin wastewater treatment work (and outlets) along with the BOD discharged and an overview of wastewater management are shown in Figure 38 and Figure 39.

Figure 38. Wastewater treatment plants, outlets (recorded) and BOD discharge in the Drin Basin

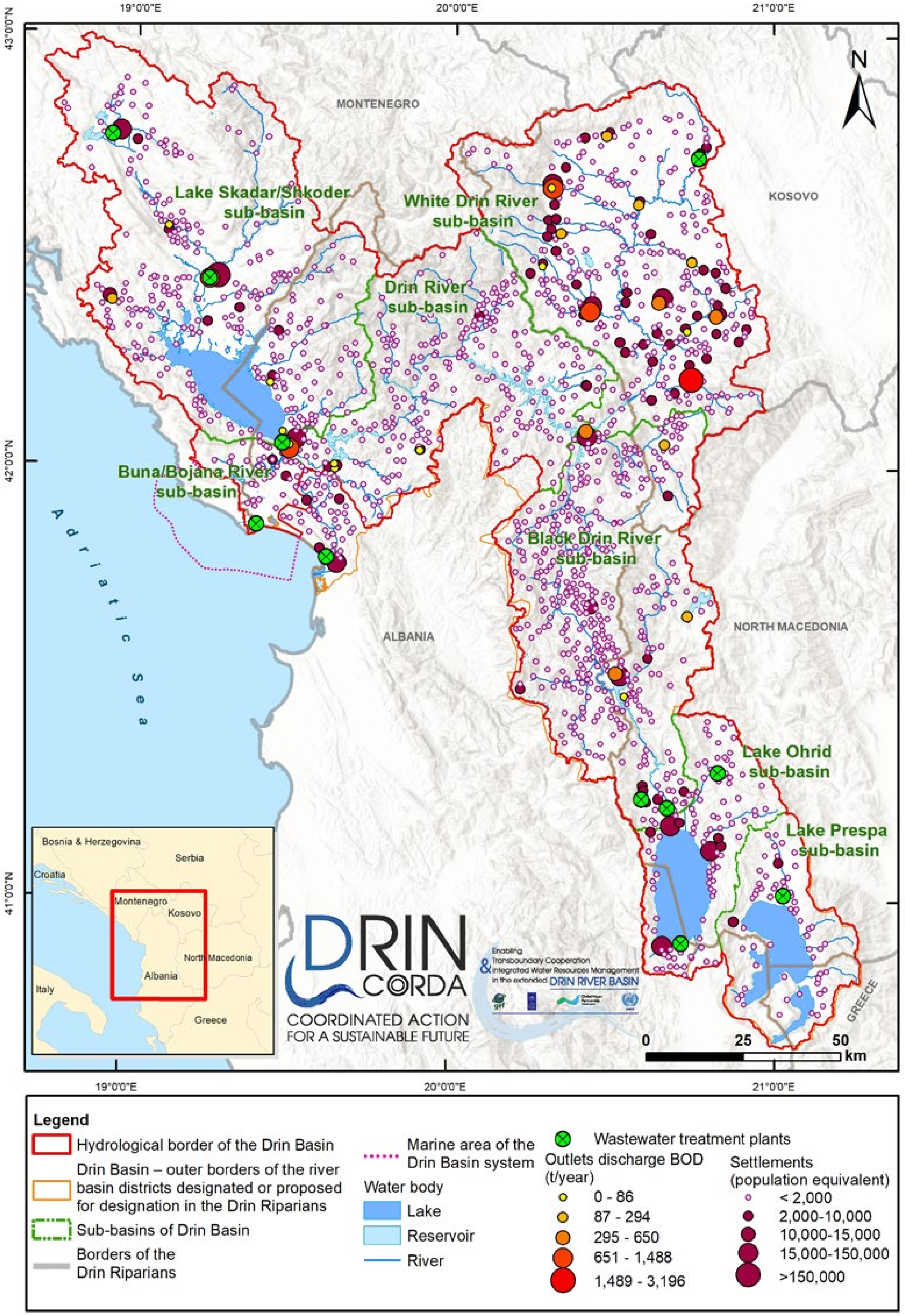
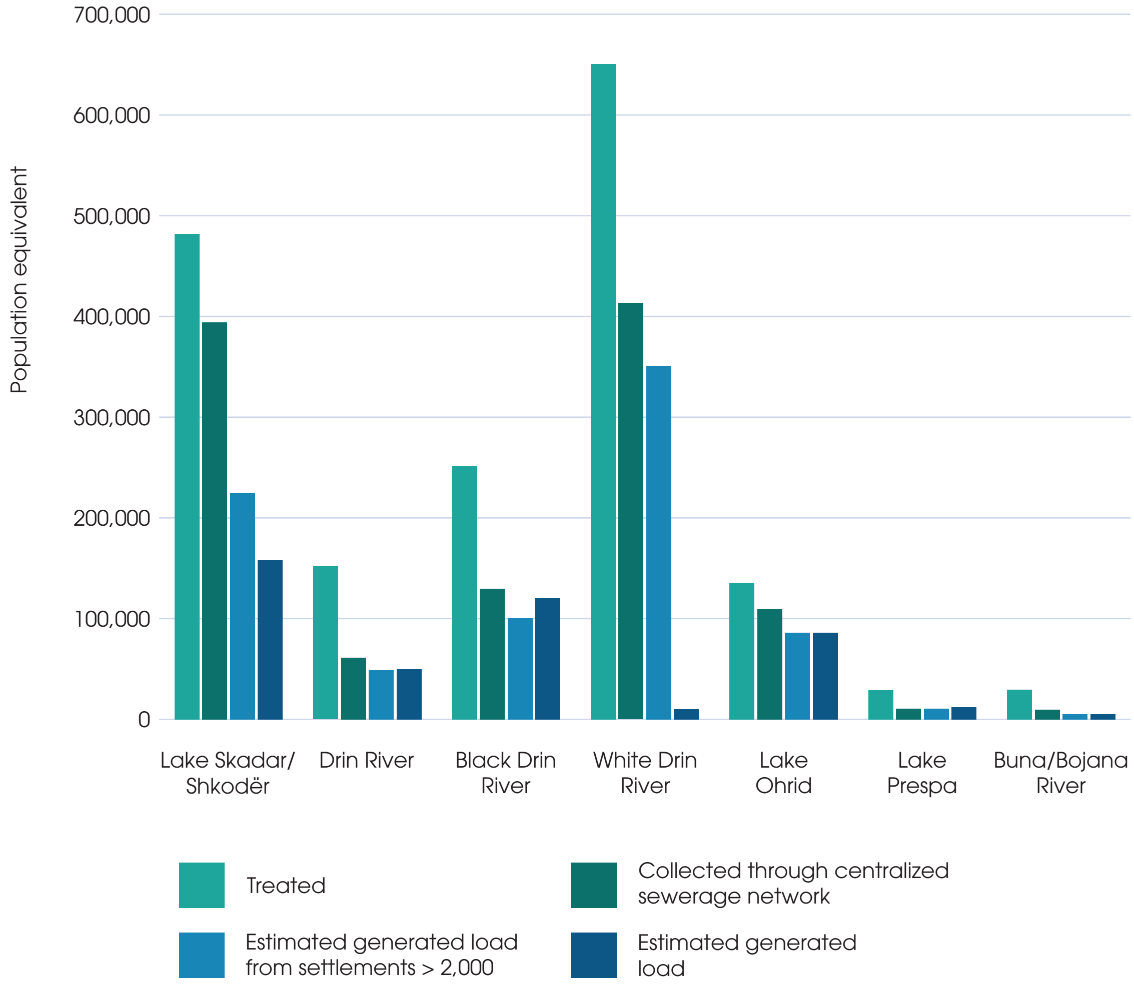


Figure 39. Overall management of wastewater in the Drin Basin (per sub-basin)



The discharged load from the collected wastewater in the Drin Basin has been estimated to be BOD_5: 13,109 tonnes/year; COD: 21,384 tonnes/year; TN: 2,006 tonnes/year, and TP: 265 tonnes/year.

The biggest pollution load from the collected wastewater (in terms of BOD_5) is discharged in the White Drin River sub-basin, with Lake Skadar/Shkodër sub-basin ranking second, and the Black Drin River sub-basin ranking third. The BOD_5 discharged loads in the rest of the sub-basins are relatively minor. The discharged loads per sub-basin are indicated in the Table 34.

Table 34. Wastewater – discharged loads per sub-basin (tonnes/year)

Sub-basin	BOD_5	TN	TP
Lake Skadar/ Shkodër	3,321	537	72
Drin River	37	10	2
Black Drin River	2,026	317	43
White Drin River	7,326	1,001	126
Lake Ohrid	294	82	13
Lake Prespa	70	20	3
Buna/Bojana River	35	10	2

To address wastewater management in the Drin Basin, a priority is to extend collection and treatment systems in agglomerations that discharge most of the pollution loads (in terms of BOD/COD or nutrients) into water bodies. These agglomerations include Prizren, Shkodër, Podgorica and Gjakova.

Waste disposal sites and dump sites

The total amount of municipal solid waste generated in the Drin Basin is estimated to be 492,183 tonnes/year or 364 kg of waste generated per capita (reference year 2016). This rate is lower than the EU average (483 kg municipal solid waste per capita in 2016) and comparable to the lower end of the reported municipal solid waste generation rates in EU countries for 2016 (Czech Republic, Estonia, Poland, Romania and Slovakia).[30] These differences can be explained by consumption patterns and economic wealth. In addition, there are differences in the modalities of municipal waste management in the beneficiary Riparian countries of the Drin Basin.

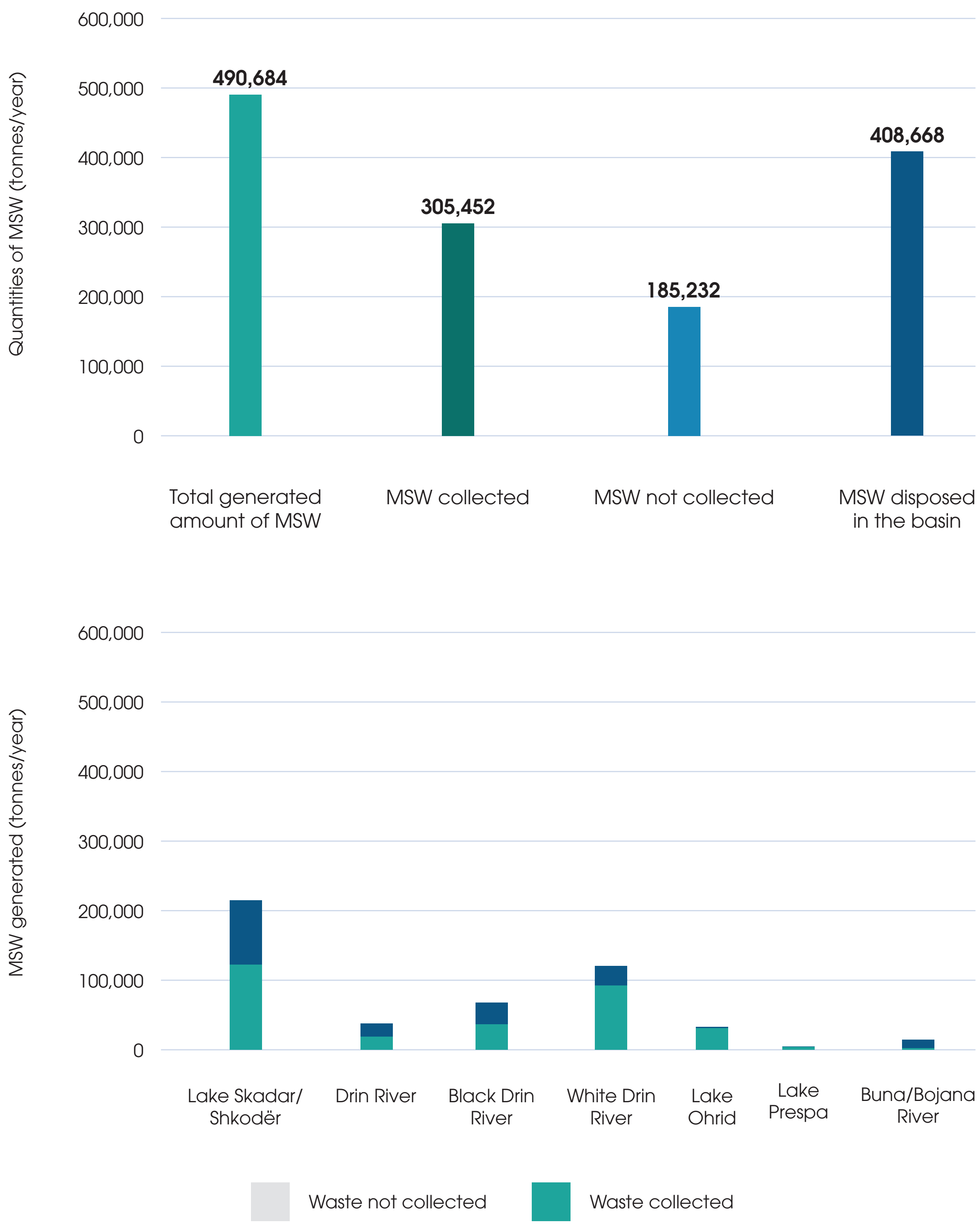
Waste management is poor. Most (62.3 percent or 305,452 tonnes/year) of the total municipal solid waste generated is collected. This collection rate is consistent with the rates reported for lower middle-income countries.

Most of the municipal solid waste is generated in the Lake Skadar/Shkodër sub-basin; the White Drin River sub-basin ranks second. The Lake Skadar/Shkodër sub-basin has the lowest collection rate among the sub-basins (57 percent). Municipal solid waste collection rates are good in the Lake Prespa sub-basin (78.6 percent) and very good in the Lake Ohrid (95.2 percent) sub-basin.

Figure 40 provides a comparison in terms of waste generation and collection rates among the sub-basins.

30 Eurostat (2018) Municipal waste statistics.

Figure 40. Municipal solid waste generation and collection in the Drin Basin (2016)



Only a third of the collected waste (32.2 percent) is disposed of in landfills that fulfil EU requirements for disposal (408,668 tonnes/year of the collected waste). These are the regional landfills of Livade (Montenegro) and Bushati (Albania). The rest of the waste is disposed of at 25 non-compliant municipality/regional landfills (Figure 41).

Disposal is the predominant (almost only) form of municipal solid waste

management. The landfill rate (landfilled waste as share of generated waste) is 83.3 percent. In contrast, the landfill rate in the EU-28 dropped from 64 percent in 1995 to 24 percent in 2016. Recycling accounts for only 2.01 percent of the municipal solid waste collected, while biodegradable waste accounts for 35–45 percent of the municipal solid waste generated.

Total nutrient emissions from municipal solid waste disposed of in non-compliant landfills and subsequently leaching into groundwater were estimated to be: 235 tonnes/year TN and 1.2 tonnes/year TP. This represents 3.5 percent of all estimated TN emissions in the Drin Basin.

Based on this information, the nutrient load (in the form of TN and TP) from non-compliant landfills in the Drin Basin per sub-basin is indicated in Table 35.

Table 35. Unregulated waste disposal sites: nutrient loads per sub-basin (tonnes/year)

Sub-basin	TN	TP
Lake Skadar/ Shkodër	19.6	0.1
Drin River	32.9	0.2
Black Drin River	53.6	0.2
White Drin River	16.5	0.3
Lake Ohrid	45.6	0.2
Lake Prespa	14.4	0.1
Buna/Bojana River	7.9	0

Appropriate waste management of other special waste streams is completely absent. A total of 16 waste disposal sites have been characterized as pollution hotspots, based on the literature, and a further 157 locations have been identified as potential industrial waste disposal sites (mines and quarries), illustrated in Figure 42.

A number of fly-tip areas exist in the basin, including ones on the riverbanks.

Figure 41. Municipal solid waste disposal sites in the Drin Basin

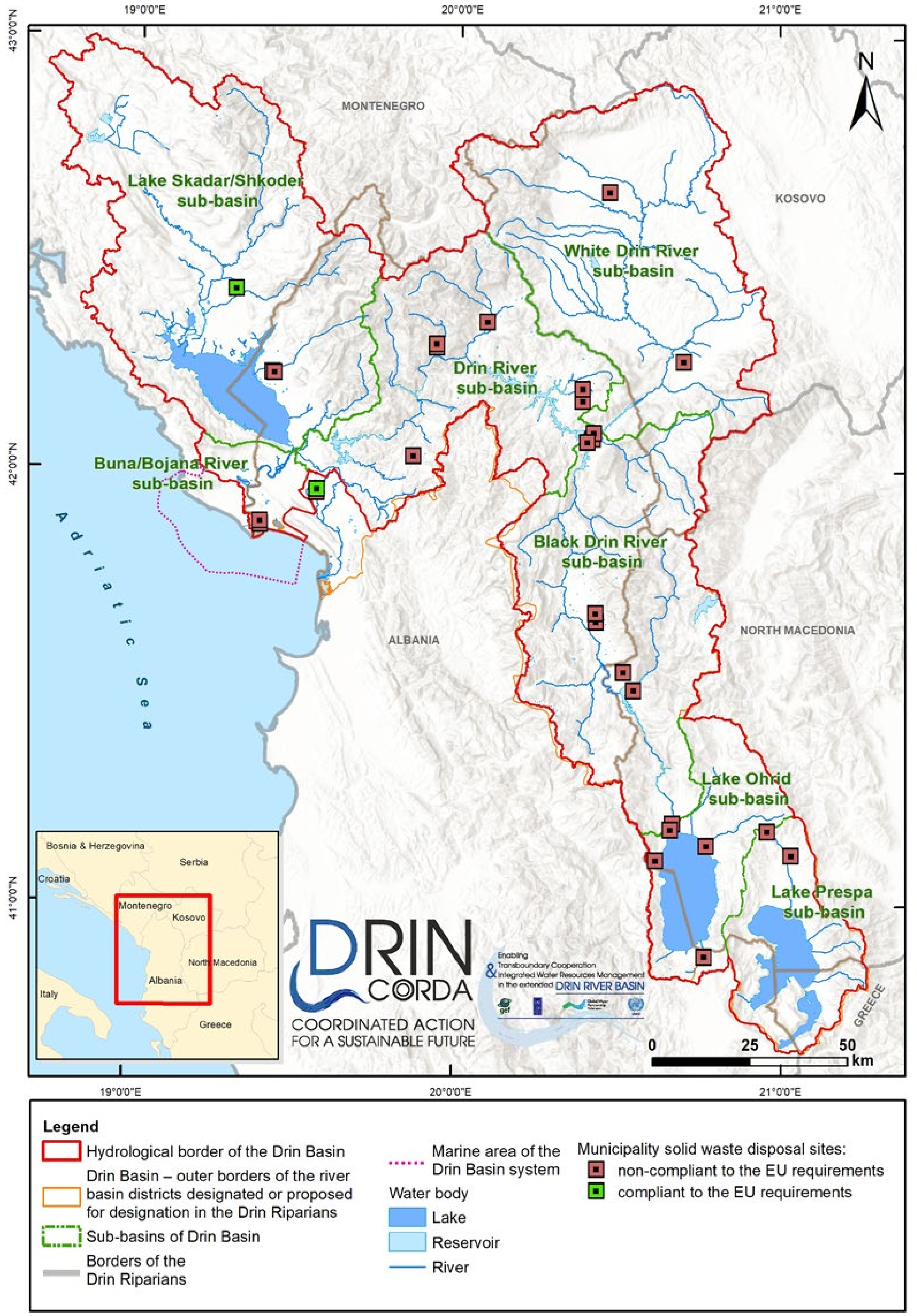
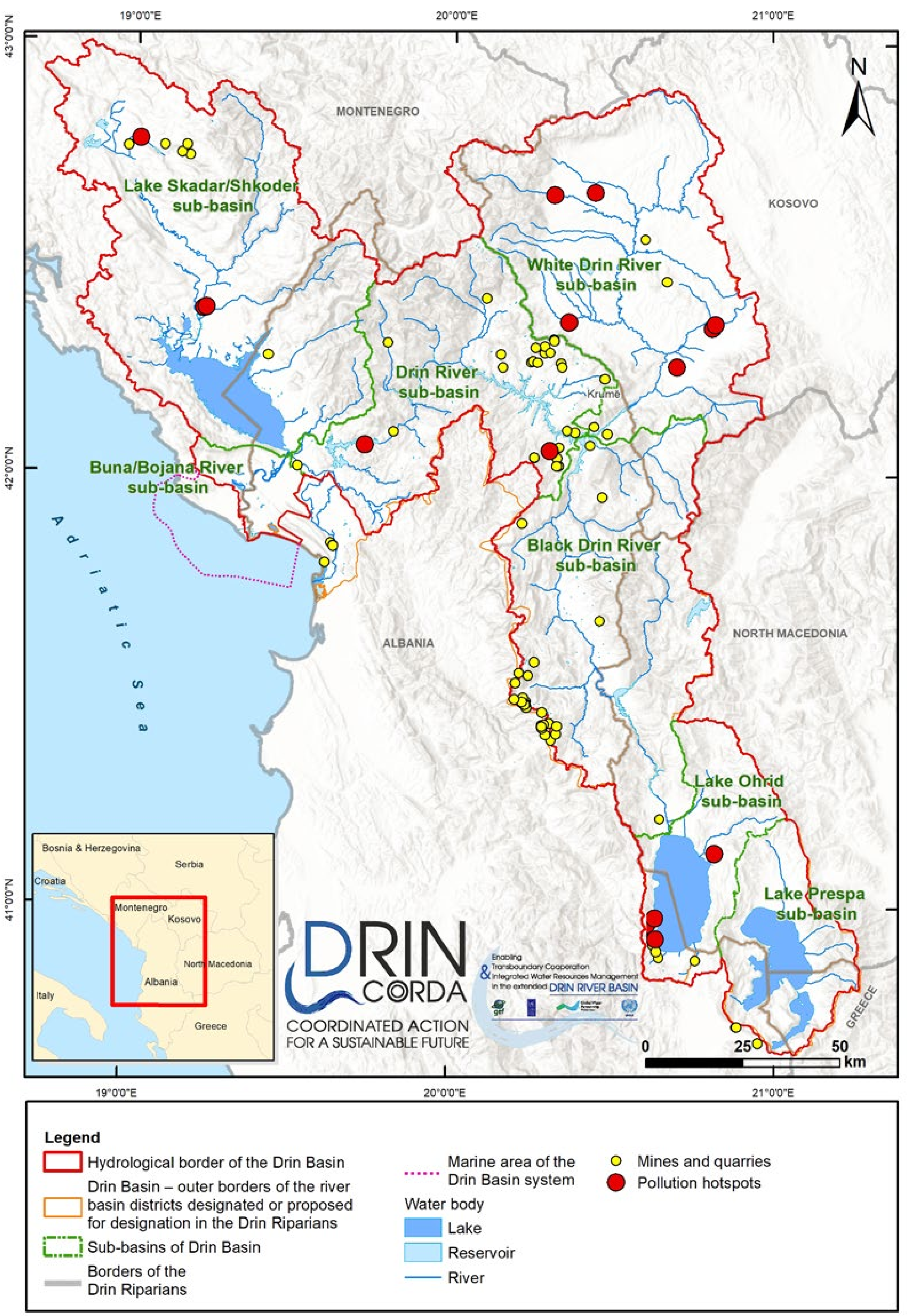


Figure 42. Identified pollution hotspots, mines and quarries in the Drin Basin



Industries and mines

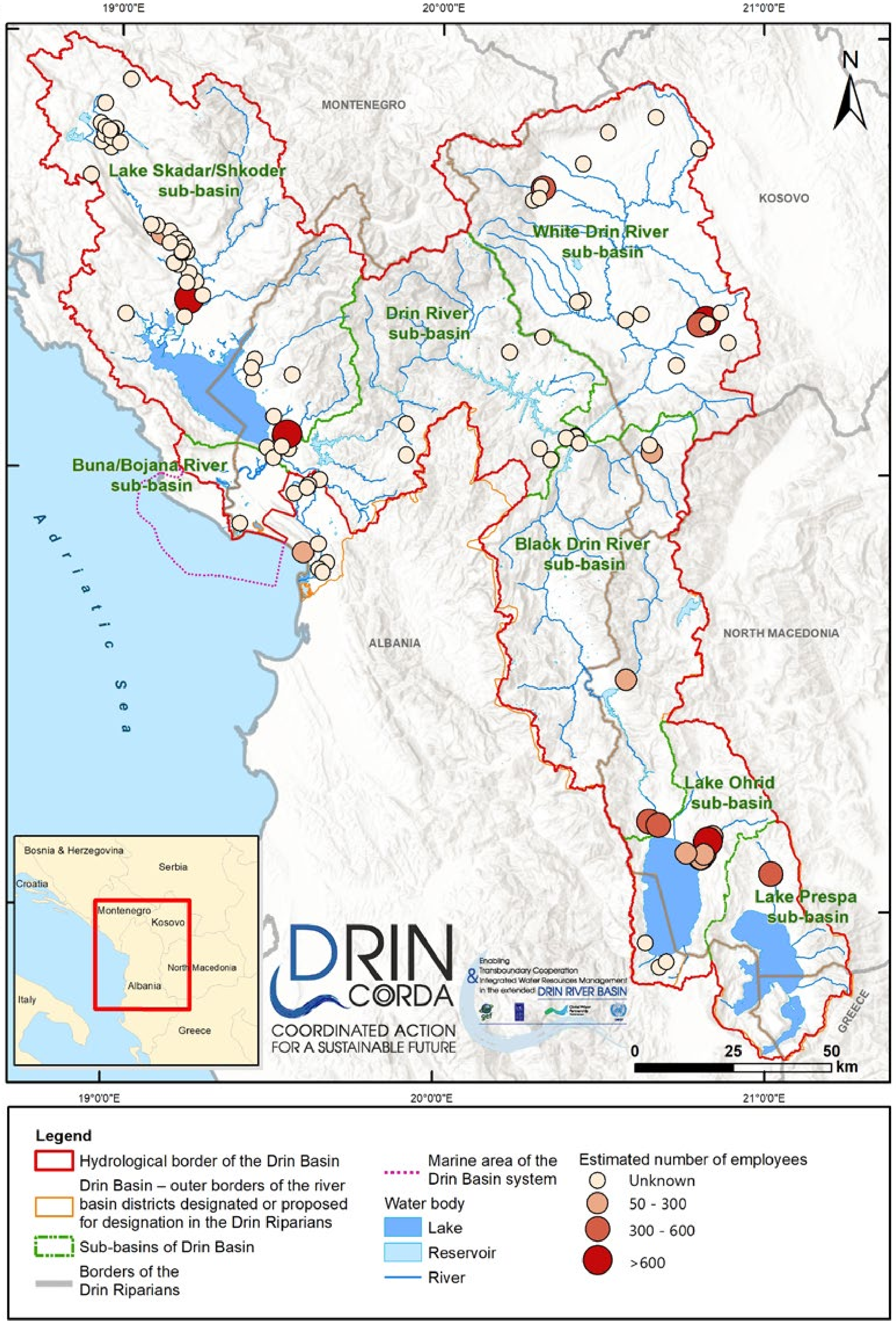
In terms of overall nutrient emissions, pollution from large industries is of low significance, partly due to the decline of large industries in all Drin Riparians in the 1990s. Nevertheless, industries may cause significant specific pollution depending on the characteristics of their emissions and the receiving medium. Major industries were mapped (Figure 43) and toxic metals were estimated for the Drin Basin. Emissions from industries of North Macedonia and Montenegro were estimated at 590 tonnes/year to land and 4.15 tonnes/year to water.

The mining sector is particularly extensive (in terms of number of mines) in Albania; many of the mining facilities are small and scattered over the – mainly remote – mountain areas. The Lake Shkodër and Drin River sub-basins have copper deposits, with chrome mining concentrated along both sides of the Black Drin and Drin rivers, and iron-nickel deposits situated mainly within the Lake Prespa sub-basin.

There are few mines in the Drin Basin in Montenegro (bauxite mining takes place in the upper part of the Zeta watershed in the Lake Skadar/Shkodër sub-basin) and Kosovo (chrome and bauxite are extracted in the White Drin River sub-basin). There are no significant mining activities in the North Macedonian part of the Drin Basin. Construction aggregates are also extensive, particularly in Albania and Kosovo.

There was no information available for small and medium-sized enterprises (including mines and quarries) on production, discharge levels, or on the number of commercial and industrial sites that discharge effluent to the sewerage system (for example, those with discharge licences). Hence, it was not possible to directly quantify pollution from these sources. However, the pollution report provides an initial inventory of small and medium-sized enterprises, mines and quarries that can be potential hotspots of water pollution sources in the Drin Basin (see Figure 42 and Figure 43).

Figure 43. Enterprises in the Drin Basin



6.1.2 Diffuse sources of pollution

Additional information (maps and data) on diffuse sources of pollution is presented in the introduction to the presentation of the pressure analysis (section 6.1).

Diffuse pollution emission load in the Drin Basin from arable land, forested and urban areas is estimated to be 4,231.6 tonnes TN/year and 482 tonnes TP/year (Table 36).

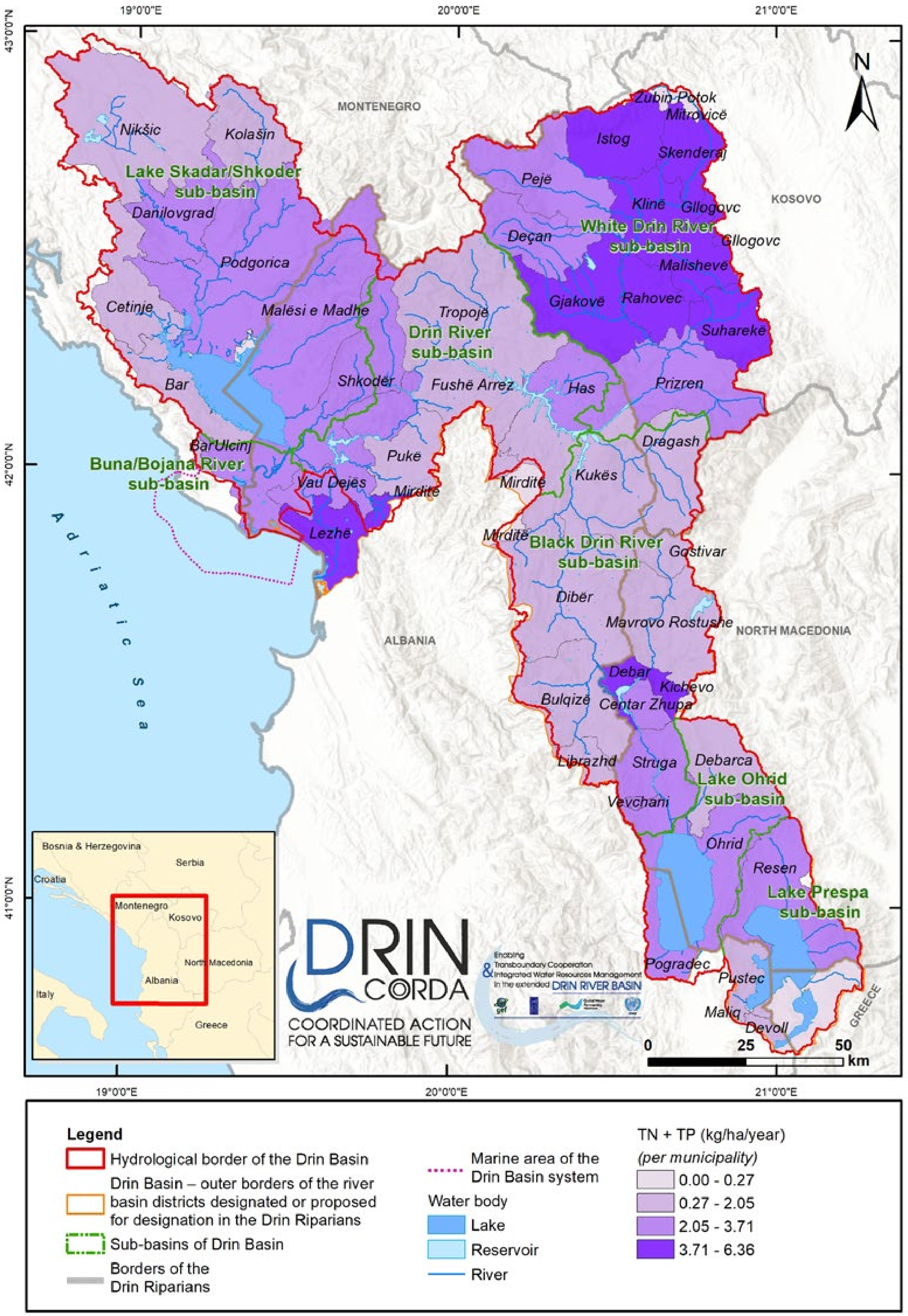
Table 36. Diffuse emission loads of Nt and Pt from arable land, forested areas and urban areas within the Drin Basin

Sub-basin	Total area analysed (ha)	TP (tonnes/year)	TN (tonnes/year)
Lake Skadar/ Shkodër	504,616.90	102.1	931.4
Drin River	321,454.30	63.4	580.1
Black Drin River	341,443.80	59.4	544.0
White Drin River	428,503.70	206.1	1,733.5
Lake Ohrid	54,674.13	17.2	150.6
Lake Prespa	74,861.72	16.7	154.0
Buna/Bojana River	28,162.75	17.0	138.1
Total per category	*1,753,717*	*481.8*	*4,231.6*

The largest share of the total emission load in the Drin Basin is from the White Drin River sub-basin (40 percent), followed by the Lake Skadar/Shkodër sub-basin (22 percent), the Drin River sub-basin (13 percent), the Black Drin River sub-basin (13 percent), the Lake Prespa sub-basin (4 percent), the Lake Ohrid sub-basin (4 percent), and the Buna/Bojana River sub-basin (3 percent).

Arable land ranks first among the four main land uses in terms of calculated pollution loads for nitrogen and phosphorus (63 percent and 82 percent, respectively) followed by forests (28 percent and 10 percent), urban areas (7 percent and 7 percent) and pastures (2 percent and 1 percent); also see Figure 44.

Figure 44. Estimation of the diffuse emission loads (TN+TP) from the arable land, forested areas and urban areas in the municipalities of the Drin Basin



The generated nutrient pollution load from livestock manure and septic tanks adds to agriculture-related emissions in the basin. The pollution load generated by livestock manure in the Drin Basin is estimated to be 44,903 tonnes N/year and 3,371 tonnes P/year. The pollution load generated by septic tanks is estimated to be 1,867 tonnes N/year and 259 tonnes P/year. Generated nutrient pollution loads from livestock manure vary for different sub-basin municipalities within the range 3–50 kg TN/ha/year and 2–8 kg TP/ha/year. Generated nutrient loads from septic tanks vary for different sub-basin municipalities within the range 0.1–4.0 kg TN/ha/year and 0.01–1.36 kg TP/ha/year. See also Figure 45, Figure 46, Figure 47 and Figure 48.

Figure 45. Estimation of generated nitrogen load from septic tanks in the municipalities of the Drin Basin

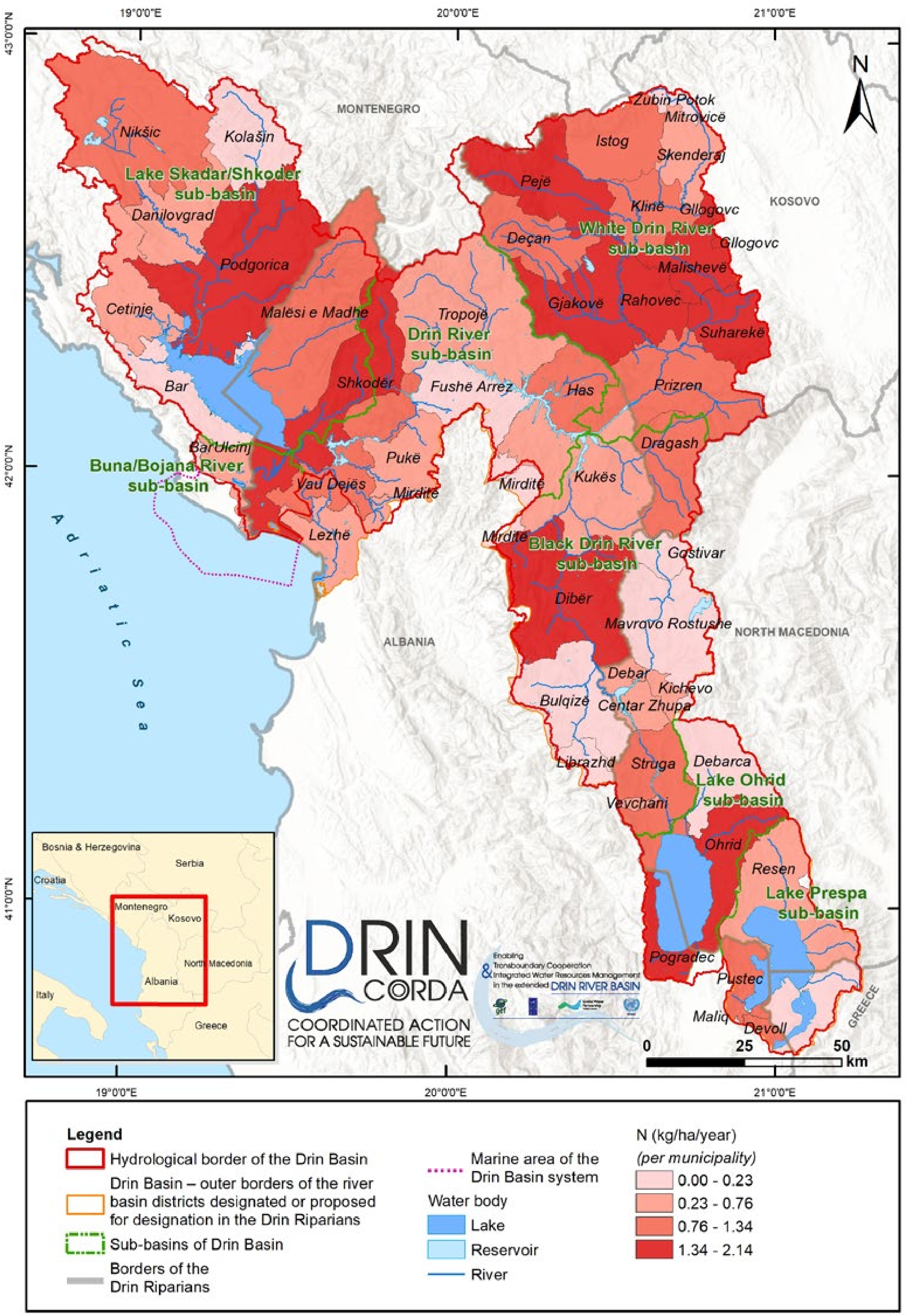


Figure 46. Estimation of generated phosphorus load from septic tanks in the municipalities of the Drin Basin

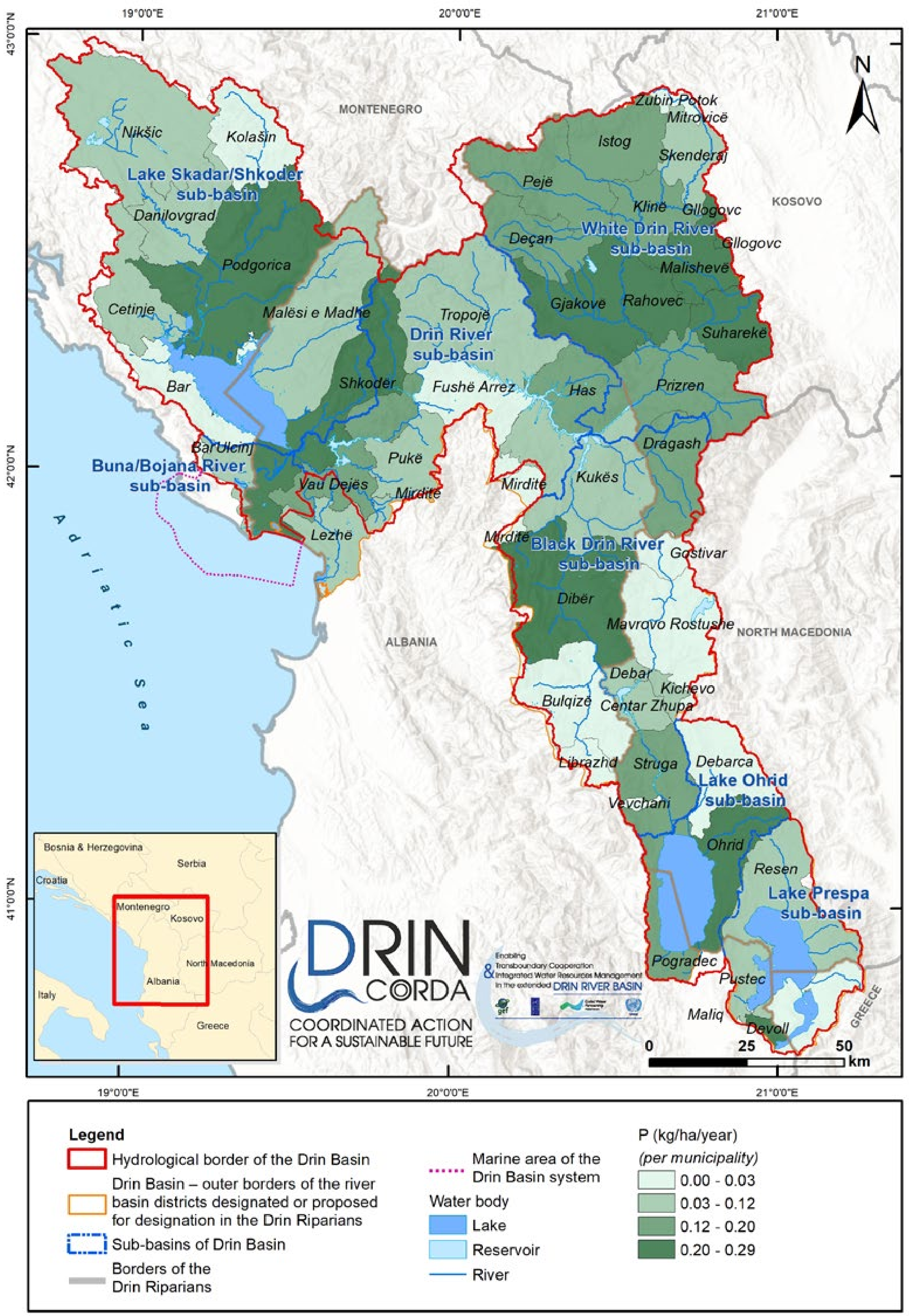


Figure 47. Estimation of generated nitrogen load from livestock manure in the municipalities of the Drin Basin

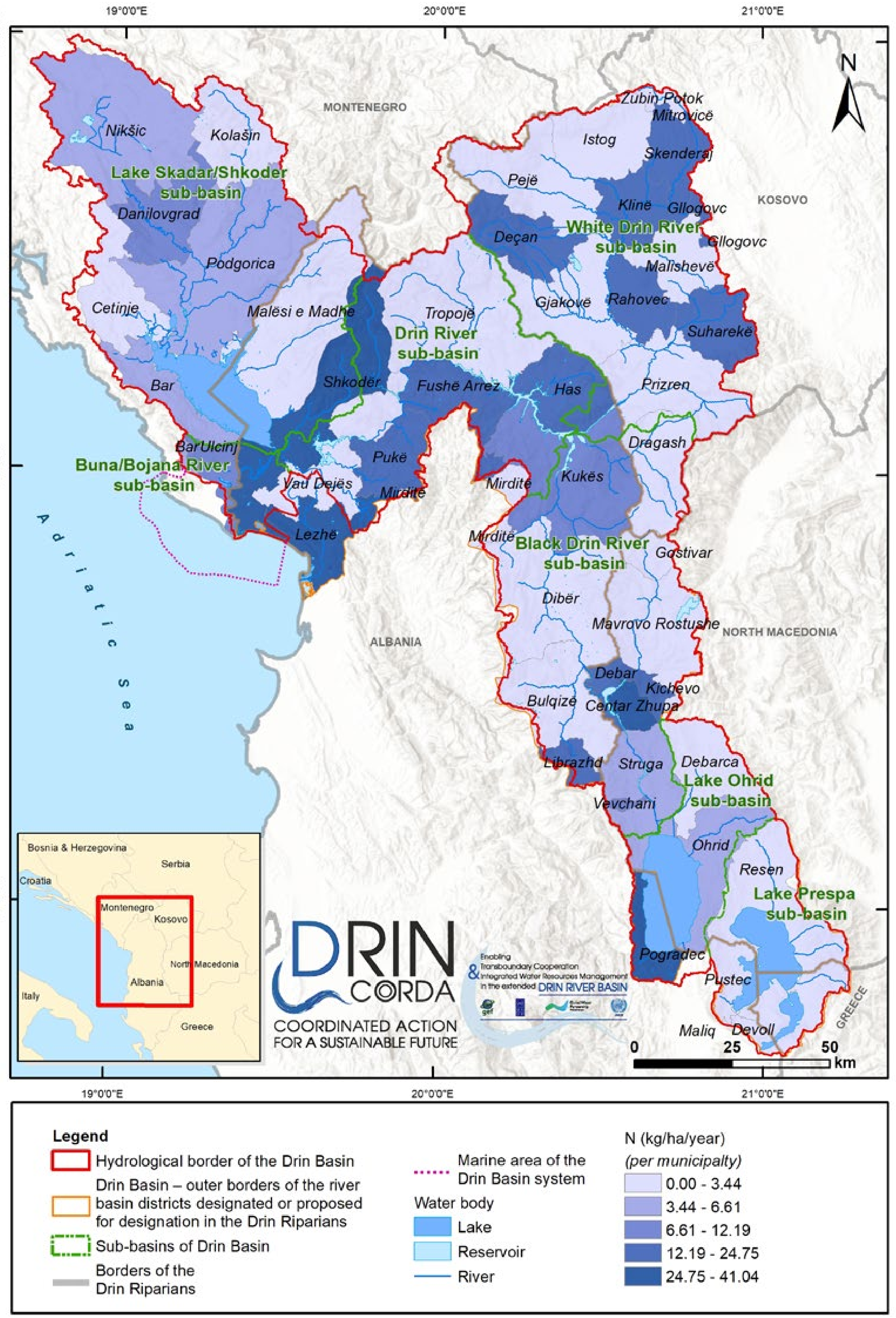


Figure 48. Estimation of generated total phosphorus load from livestock manure in the municipalities of the Drin Basin

6.1.3 Key observations from the TDA on the pressure analysis in the Drin Basin

- The diffuse load (TP and TN) from agriculture is the most important nutrient pollution source in the Drin Basin.

- Wastewater sources contribute about one third of all nutrient emissions in the Drin Basin and are its second most significant nutrient pollution source. A priority is to extend collection and treatment systems in agglomerations that discharge the larger part of pollution loads (in terms of BOD, COD or nutrients) into water bodies. These agglomerations include Prizren, Shkodër, Podgorica and Gjakova.

- Currently, waste management is very problematic and, in some cases, poses a critical risk to the environment.

- Pollution of water from industries may cause significant specific pollution depending on the characteristics of their emissions and the receiving medium.

6.2 Chemical assessments of water and sediment quality

The chemical water quality assessment in the Drin Basin was developed using two data sets:

- The 2006–2016 long-term data series, covering a period of 11 years of the national monitoring networks including surface waters and groundwater monitoring stations.

- The results delivered from the monitoring campaigns conducted under the Drin Project (from this point forward 'Drin Project surveys') that took place in December 2016 and July 2017. These two campaigns aimed at improving the understanding of the present baseline water quality conditions of the Drin Basin in relation to the expanded set of monitoring parameters listed in the Water Framework Directive. The sampling network included 40 sampling sites for groundwater, 60 sites for inland surface water, seven sites for transitional and coastal waters and 11 sites for sediments (Figure 49).

The chemical water quality was assessed with respect to: a) the chemical and physicochemical parameters that support the biological elements; b) priority hazardous substances; and c) specific pollutants.

The classification of riverine water quality, with respect to the chemical and physicochemical parameters, adopts the approach of the European Environment Agency (WISE)[31] as a comparison of their mean annual values in rivers across Europe and transitional and coastal waters of the Mediterranean Sea.

With respect to priority and priority hazardous substances, surface waters are classified as either of 'good' chemical status or 'failing to achieve good' chemical status, depending on whether they comply with the environmental quality standards (EQS) set at the EU level (Environmental Quality Standards Directive 2013/39/EU).

31 https://www.eea.europa.eu/themes/water/interactive/water-live-maps/all-water-live-maps.

Specific pollutants were also identified and prioritized in each sub-basin for future, site-specific EQS development.

The chemical status of groundwater was assigned by applying the quality standards set by the EU Groundwater Directive (2006/118/EC), as well as the threshold values and background levels derived for the Drin Basin to ensure that groundwater is suitable for drinking.

Sediment quality was assessed through the comparison of elemental contents of sediment quality guidelines and world average background levels.

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Figure 49. Location of sampling sites of the national monitoring networks for surface (49.a) and groundwater (49.b) and the Drin Project campaigns (December 2016 and July 2017) for surface, ground, transitional and coastal waters, and sediments (49.c)

Figure 49.a

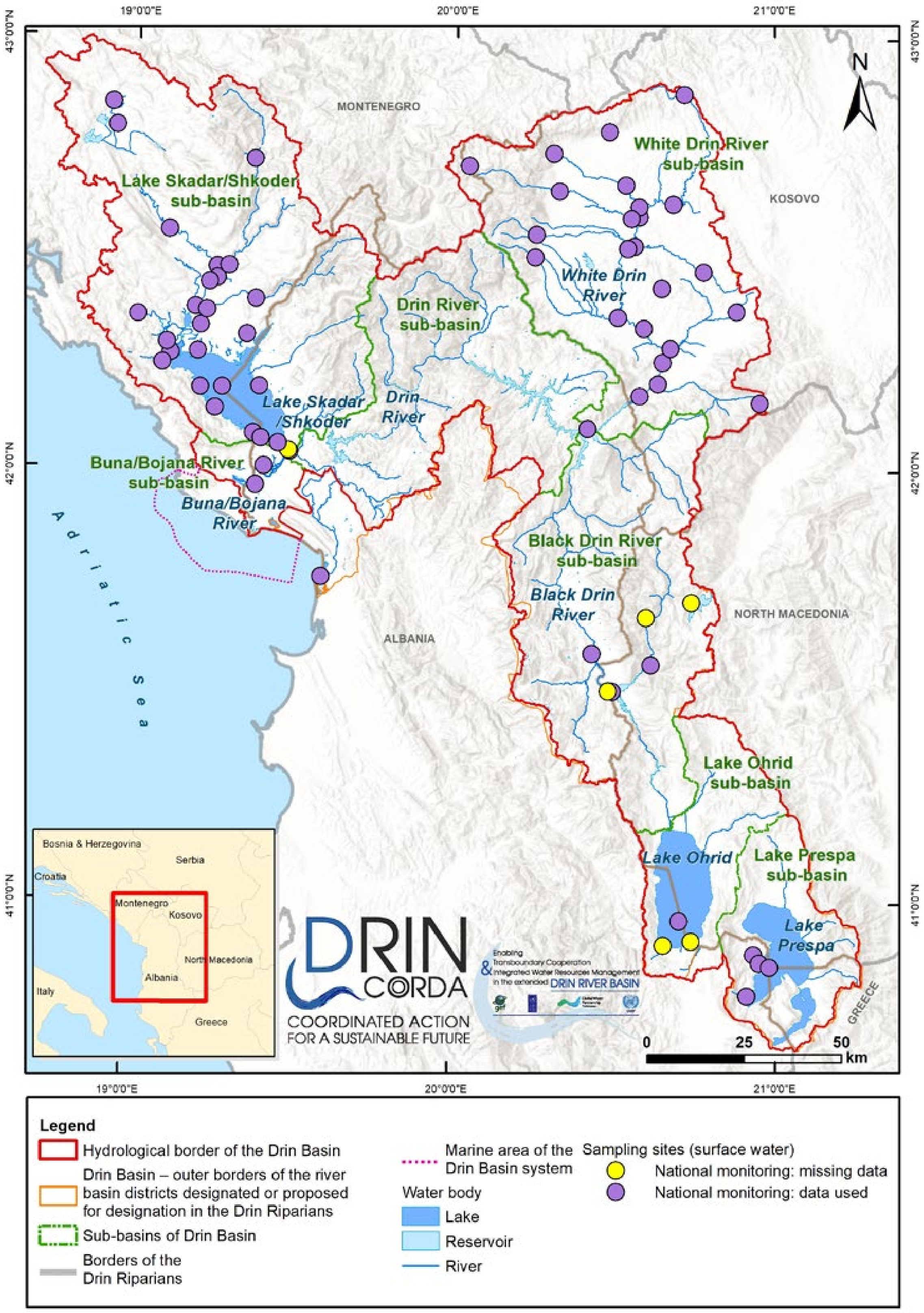


Figure 49.b

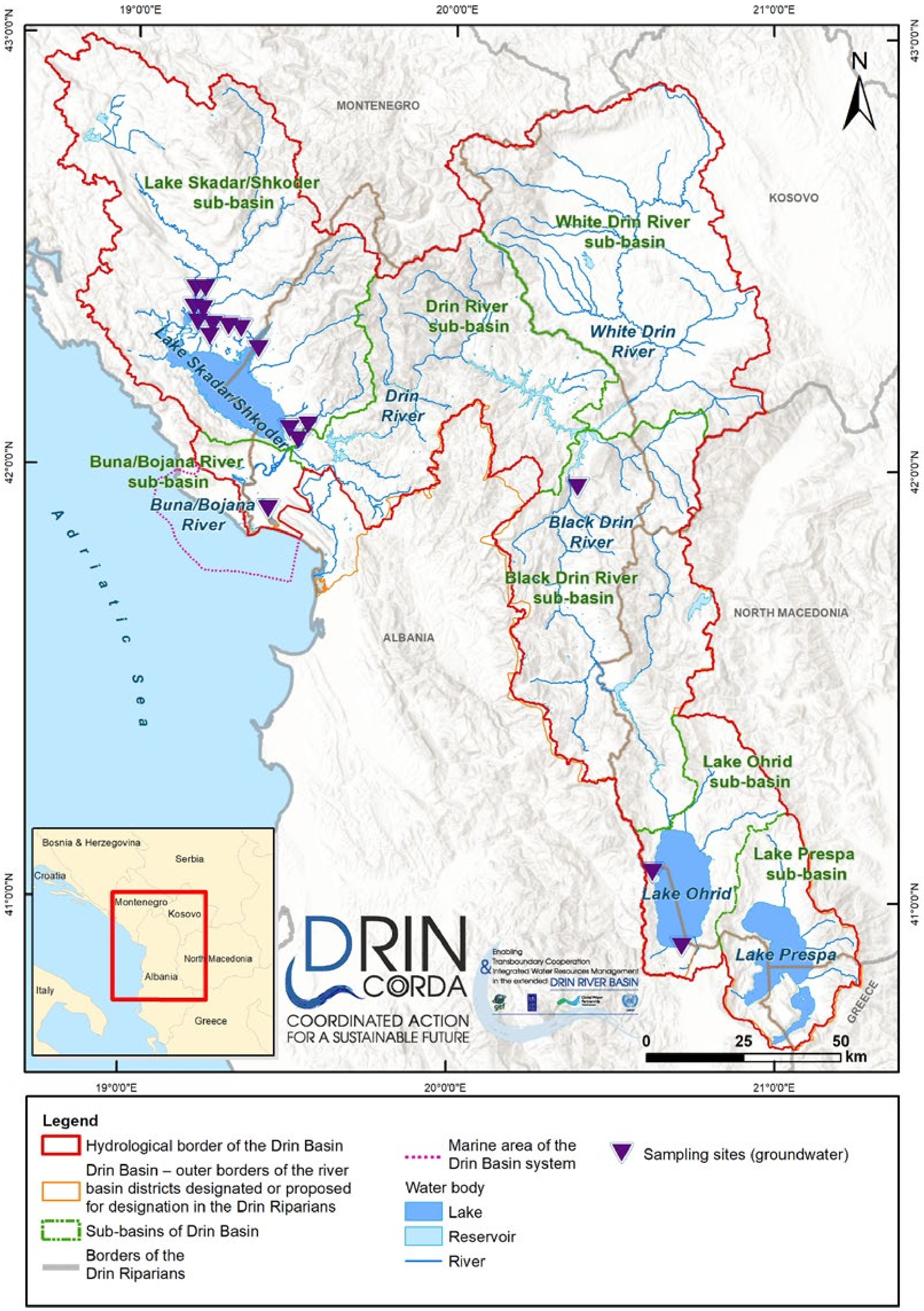
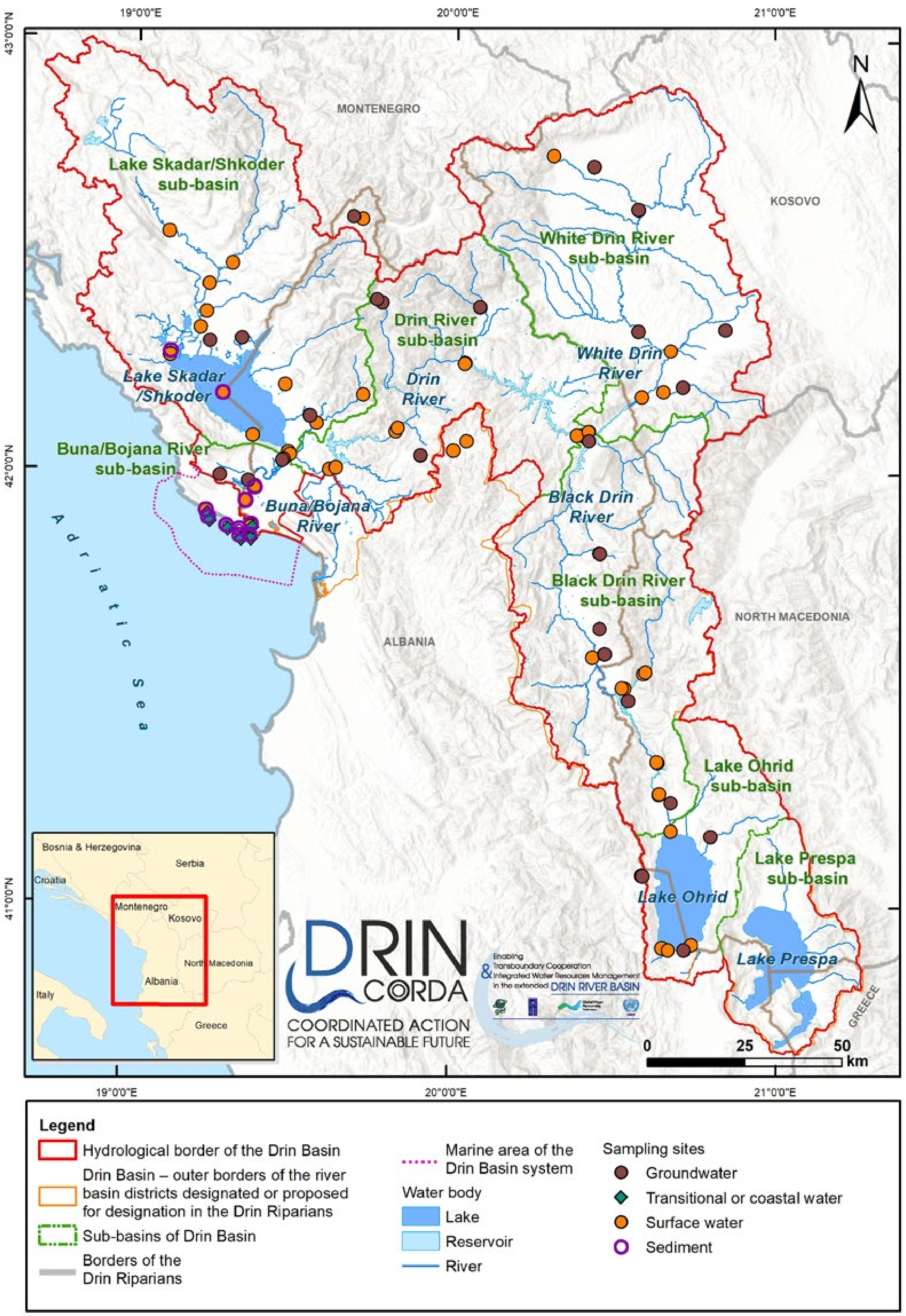


Figure 49.c



6.2.1 Chemical water quality of inland surface waters

The inland surface-water chemical quality status with respect to the chemical and physicochemical parameters was assessed by combining the results of the two Drin Project surveys with the latest two-year period of the national monitoring programmes in a total of 76 sampling sites. For the priority and priority hazardous substances, the assessment is based on the results generated from the Drin Project surveys at 35 monitoring sites. Data for the specific pollutants were derived mainly from the Drin Project surveys, and when available, the national monitoring programmes. The criteria applied for the characterization of the chemical status are outlined in detail in the Thematic Report on Pollution and Water Quality.

Chemical and physicochemical parameters that support the biological elements

Organic load (in terms of BOD) in the Drin Basin riverine system is a serious environmental problem. The highest number of most polluted sites (Class 5) are located within the sub-basin of White Drin River (72 percent of sampling sites, or 21 out of 29 sites) as well as the tributaries of the Lake Skadar/Shkodër (30 percent or 6 out of 20 sites) (Figure 50). These two sub-basins have been identified as having the highest generated BOD load from wastewater outfalls among all sub-basins in the Drin Basin, as indicated by the pressure analysis (above). Thus, it is concluded that the discharges of insufficiently treated urban wastewater have caused a significant deterioration of water quality.

Nitrate concentrations in the Drin Basin are among the lowest in Europe. Seventy-six percent of sampling sites were in Class 1. The most polluted sites (of Class 2 or lower) were found in the White Drin River sub-basin. One hundred percent of sites in the Lake Ohrid, Drin River and Buna/Bojana River sub-basins were in Class 1 (Figure 51).

With regard to ammonium concentrations, 34 percent of sampling sites are in Class 1 and another 28 percent in Class 2. Sites enriched with ammonium were found in all sub-basins. The highest concentrations of Class 5 were found in the sub-basins of the White Drin and Drin rivers, the tributaries of Lake Skadar/Shkodër and Lake Ohrid (Figure 52). These elevated concentrations are related primarily to the discharges of untreated, or insufficiently treated, wastewater (see section 6.1 – Pollution pressure analysis).

Elevated nitrite concentrations (not classified by the EEA) were found during the Drin Project monitoring campaigns in the surface water of the White Drin River, the Drin River, and to a lesser extent, in the Buna/Bojana River. Nitrite ions (NO_2-) are the intermediate products of both nitrification and denitrification processes, hence, their elevated levels will eventually affect either ammonium or nitrate concentrations. Furthermore, NO_2- constitutes the most toxic form of nitrogen species. It is necessary to establish site-specific EQS for this nitrogen compound.

Phosphate concentrations were Class 1 in 43 percent of sampling sites, whereas 15 percent of sampling sites were in Class 5 and 6. The highest concentrations were found in the sub-basin of Lake Skadar/Shkodër. Elevated concentrations were reported in one sampling event in the sub-basin of the Drin River (Figure 53). Additional monitoring is necessary to verify these results. Investigating monitoring could also help identifying which sources cause such an enrichment.

Considering the lakes, nutrient enrichment is of environmental concern in both Lake Ohrid and Lake Skadar/Shkodër. For the former, this is of great importance, considering the low renewal rate of water. Monitoring of additional parameters such as chlorophyll a, transparency and TP by all Riparians is a prerequisite for obtaining a clear picture of the trophic state of lakes.

Priority and priority hazardous substances

Based on the preliminary results of the two Drin Project monitoring campaigns, failures to meet the Water Framework Directive objective of good status occurred at a few sampling sites in the sub-basins of the White Drin River and the Lake Skadar/Shkodër (and tributaries). This is due to the high concentrations of di(2-ethylhexyl)-phthalate (DEHP), a widely used plasticizer (at two sites in the Lake Skadar/Shkodër sub-basin), benzo(b)fluoranthene, a polyaromatic hydrocarbon (at one site in Morača River), and the metals cadmium, lead (in the sub-basins of the White and Black Drin rivers) and nickel (in the Drin River sub-basin). Nevertheless, the assessment of water quality at the majority of sampling sites was challenged by the very low EQS set for a number of substances in comparison to the analytical capabilities of the laboratories. For a set of parameters, the reported limits of detection were not sensitive enough to determine whether the EQS values had been exceeded or not. These sites were assigned unknown status. Figure 54 provides classification of water quality on priority and priority hazardous substances from the GEF Drin Project's surveys.

Specific pollutants

The substances detected as potential specific pollutants of environmental concern include: arsenic and mineral oils in the sub-basin of the Black Drin River; chromium and copper in the sub-basin of the White Drin River; arsenic in the sub-basin of the Drin River; phenols, cyanides and chromium in the sub-basin of Lake Skadar/Shkodër and phenols in the sub-basin of the Buna/Bojana River. These pollutants should be monitored regularly by national authorities. In the case of chromium and arsenic, speciation analysis is also necessary. Monitoring will allow the generation of more results, the establishment of site-specific background levels and, subsequently, EQS.

Figure 50. Classification of BOD concentrations in surface-water sampling sites of the Drin Project and national monitoring programmes, according to the EEA scheme of European rivers

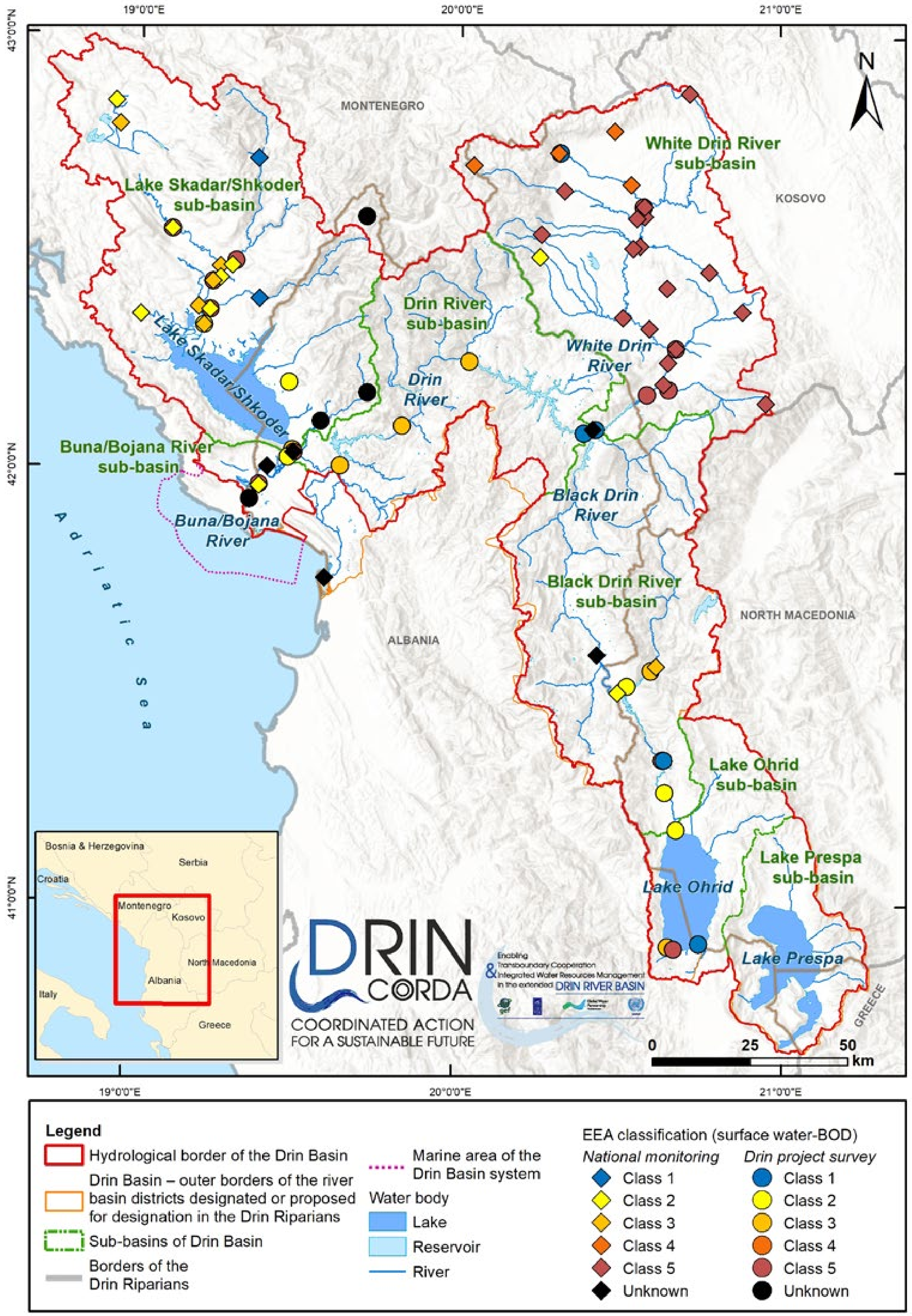


Figure 51. Classification of nitrate concentrations in surface-water sampling sites of the Drin Project and national monitoring programmes, according to the EEA scheme of European rivers

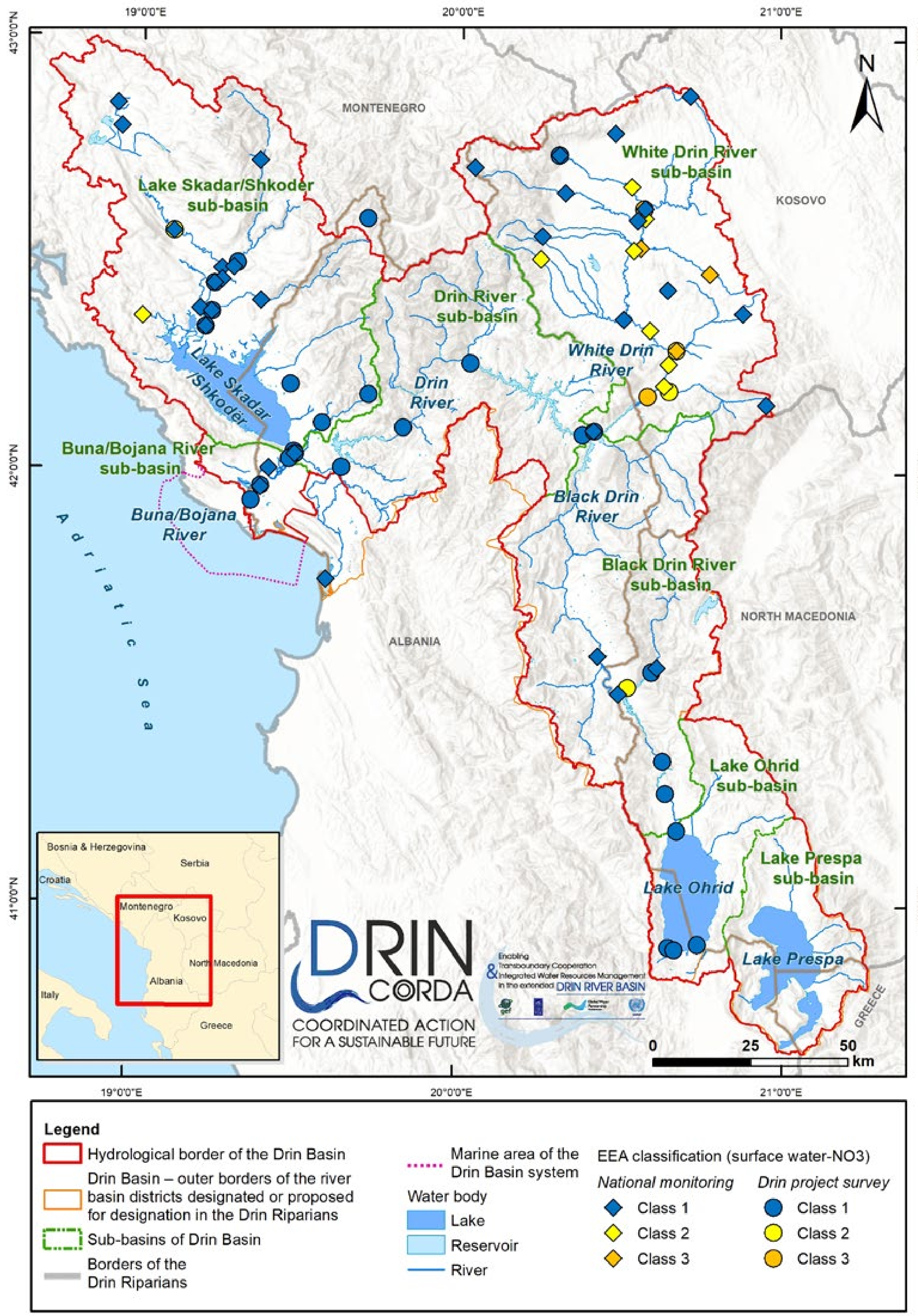


Figure 52. Classification of ammonium concentrations in surface-water sampling sites of the Drin Project and national monitoring programmes, according to the EEA scheme of European rivers

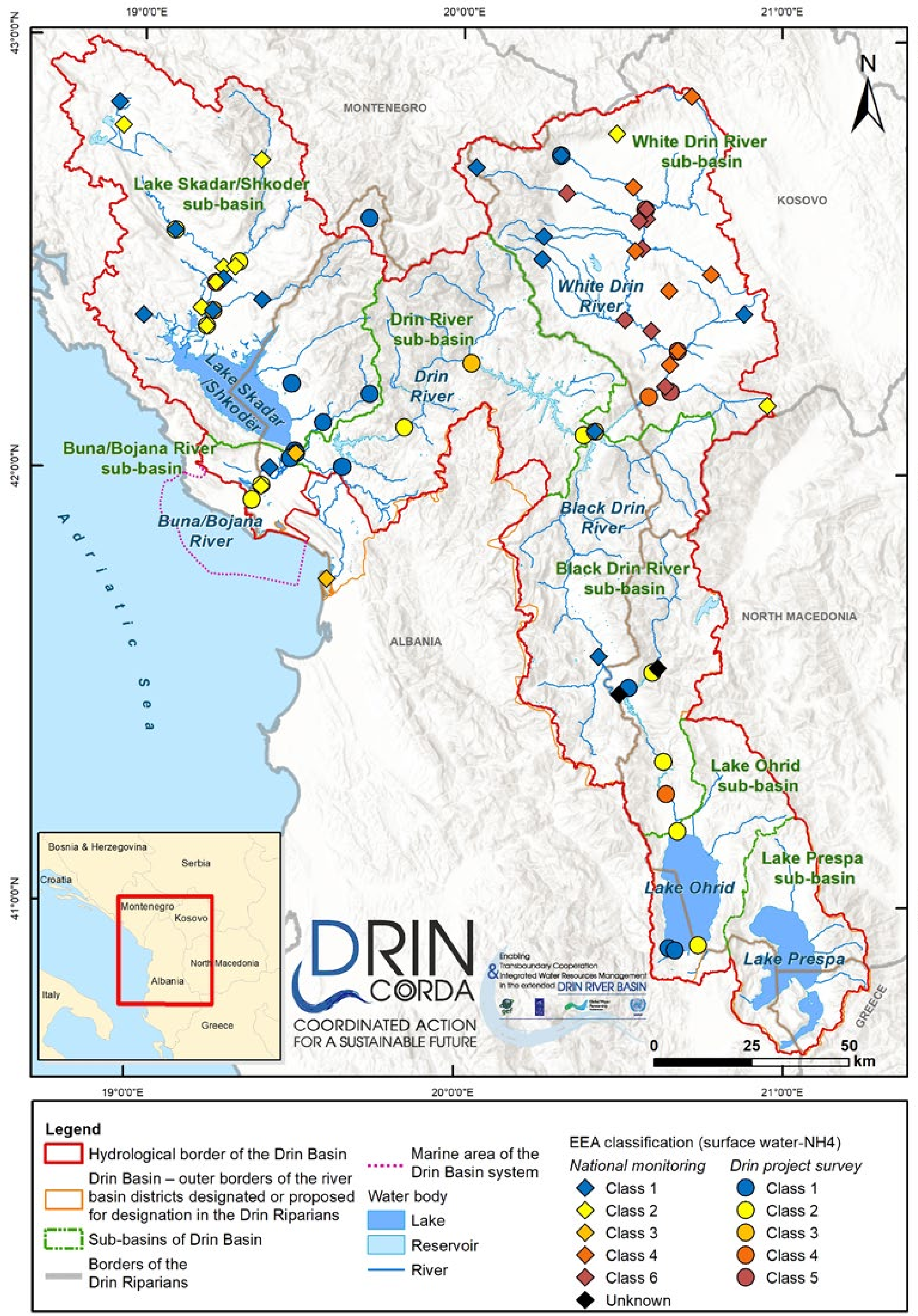


Figure 53. Classification of phosphate concentrations in surface-water sampling sites of the Drin Project and national monitoring programmes, according to the EEA scheme of European rivers

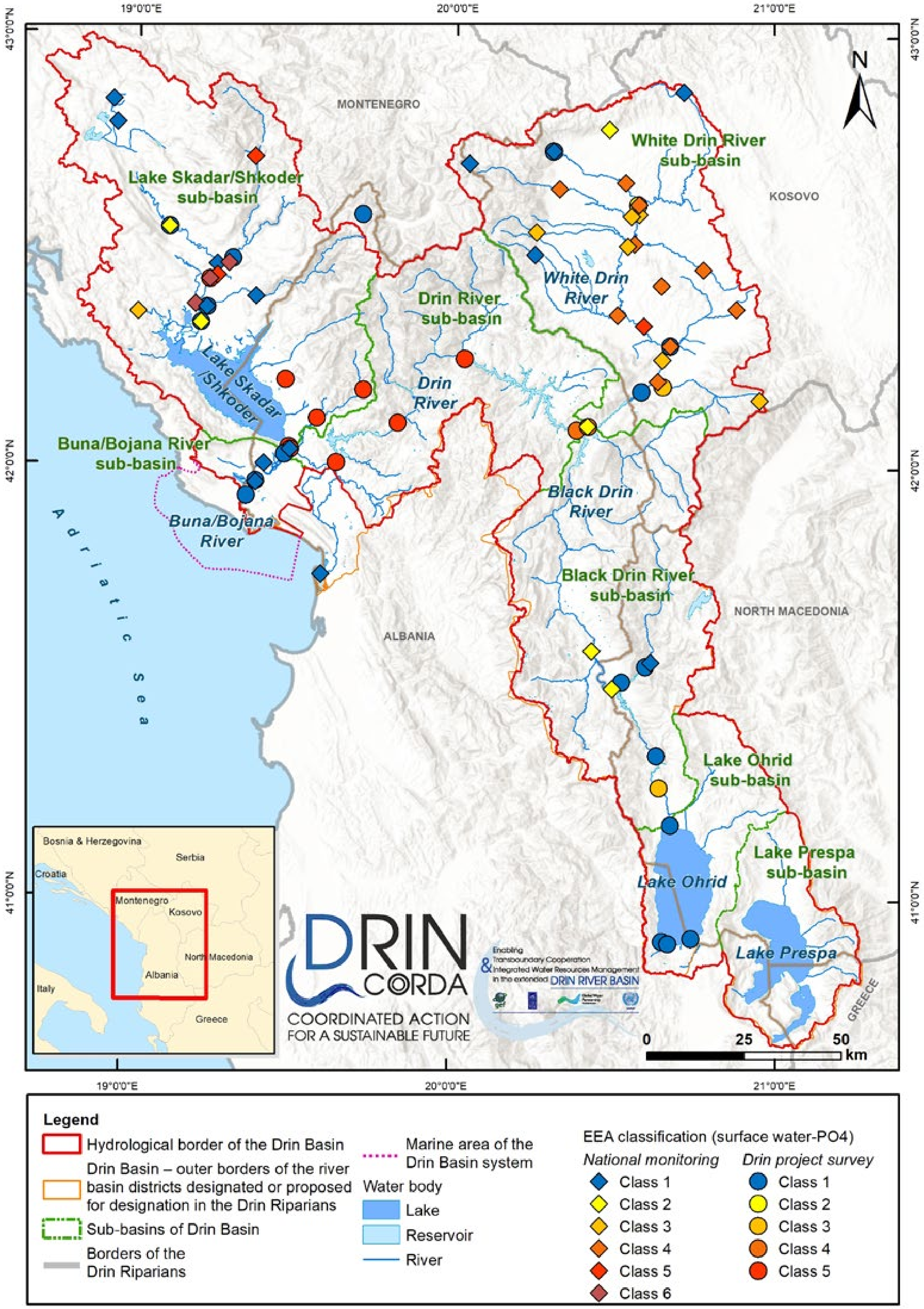
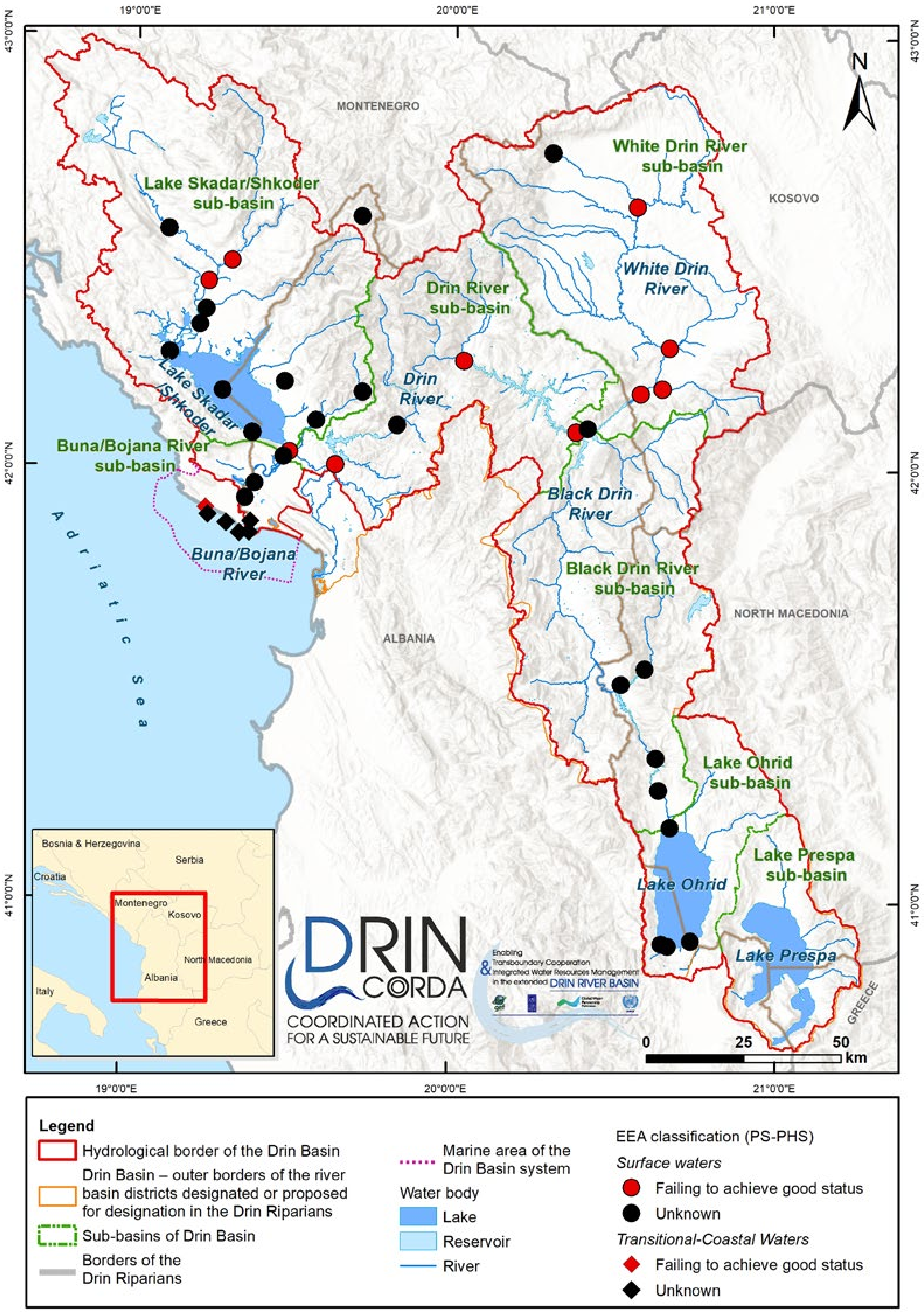


Figure 54. Classification of surface-water quality in the Drin Basin – priority and priority hazardous substances



6.2.2 Chemical status of groundwaters

The Water Framework Directive (2000/60/EC) establishes the objective of reaching good groundwater chemical and quantitative status across Europe. In order to reach this aim, the Groundwater Directive (2006/118/EC) sets detailed quality criteria for the assessment of groundwater chemical status in Europe.

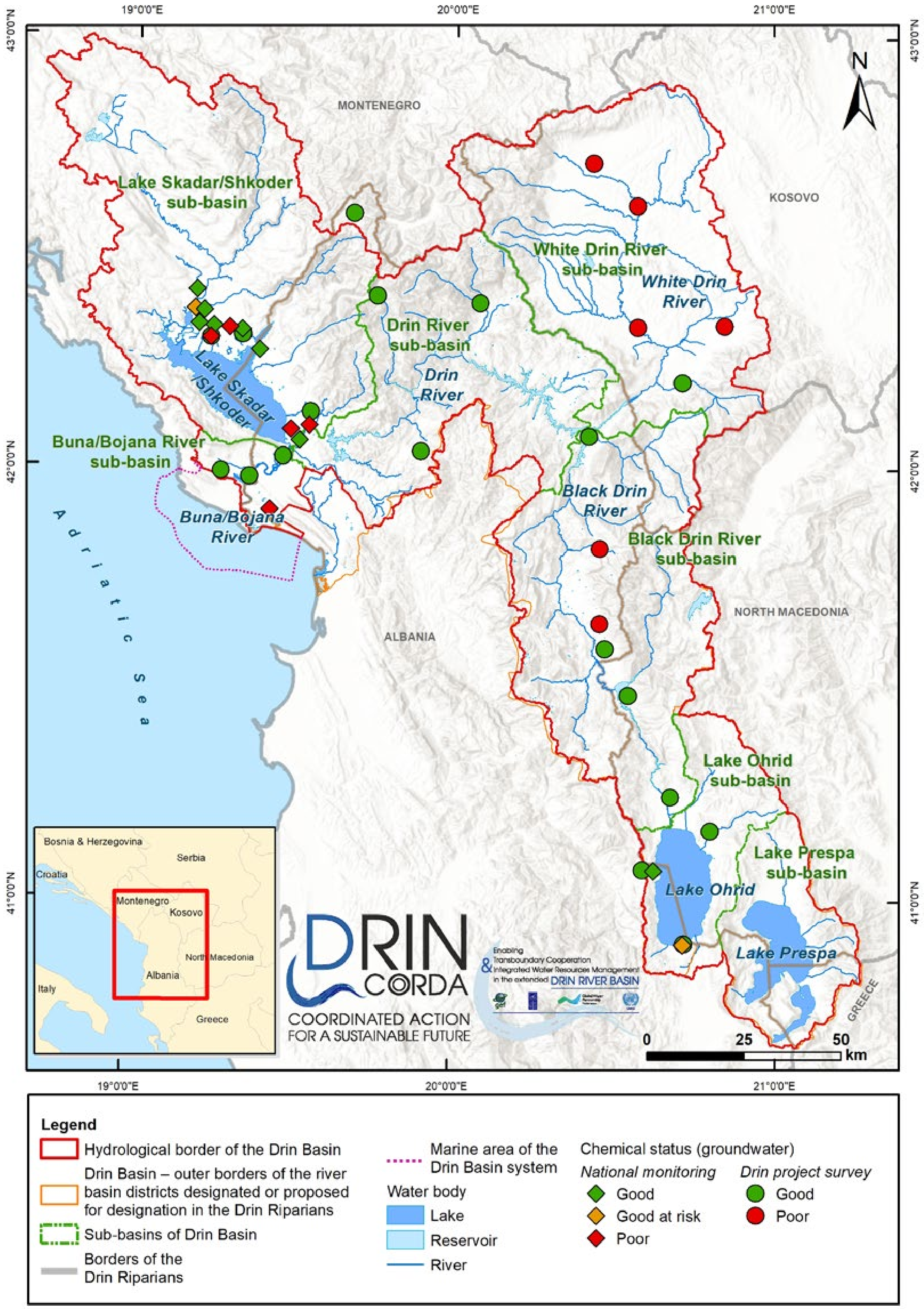
The assessment for the Drin Basin is based on the analysis of 39 sampling sites: 24 from the GEF Drin Project monitoring campaigns and 14 delivered from national programmes, in this case, Albania and Montenegro (see maps presented in Figure 49). The estimated groundwater chemical status is shown in Figure 55.

Higher levels of ammonium were found in the Lake Ohrid sub-basin and in the groundwaters of the White Drin River, where 80 percent of samples (four out of five) are considered to be of poor status due to ammonium, chromium and nickel.

The following concerns will need to be addressed to reduce the pressures impacting groundwaters:

- The White Drin River sub-basin has the greatest proportion of monitoring sites failing to meet the Water Framework Directive's objective of good status.
- Based on the results of Montenegro's monitoring programme, microbiological pollution is extensive in the groundwater of the Lake Skadar/Shkodër sub-basin and should be treated adequately prior to human consumption.
- In Tushemisht (the Lake Ohrid sub-basin) there is an increasing trend of ammonium (NH_4+) concentration.
- In Grbavci (Lake Skadar/Shkodër sub-basin) there is increasing trend of iron (Fe^2+) concentration.

Figure 55. Groundwater chemical status in the sampling stations of the Drin Basin



6.2.3 Transitional and coastal surface waters

Transitional and coastal water samples were obtained from six sites in July 2017 under the Drin Project survey and analysed for basic chemical elements, synthetic organic substances and non-synthetic pollutants. Of the nutrient compounds, only nitrate ions were detected. On the spatial scale, $N\text{-}NO_3^-$ concentrations decreased from the fresh to transitional waters and coastal waters, due to dilution processes. Taking into consideration the natural seasonal variability of dissolved inorganic nitrogen (DIN), the results of the summer campaign imply that nitrogen discharges into the Adriatic Sea could be significant (Figure 56).

Of the priority and priority hazardous substances, only the concentration of fluoranthene exceeded the EQS in the Port Milena sampling station. For all other substances, the reported concentrations were below the limit of detection, which in turn equalled or exceeded the EQS. For this reason, the water quality status at the rest of sampling sites is presented as 'unknown' (shown in Figure 57).

Figure 56. Dissolved inorganic nitrogen at transitional and coastal waters according to EEA classes for the Mediterranean Sea

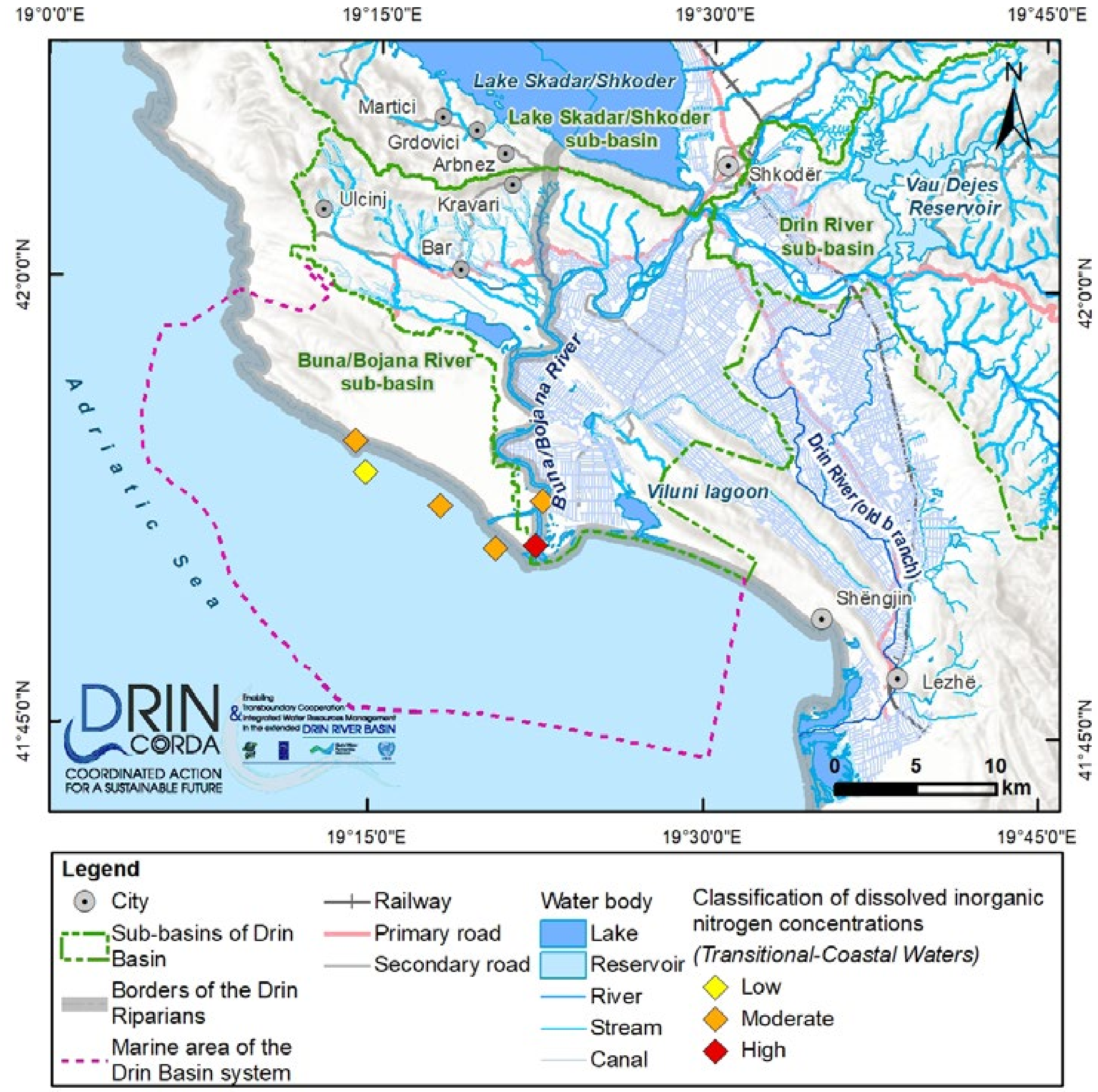
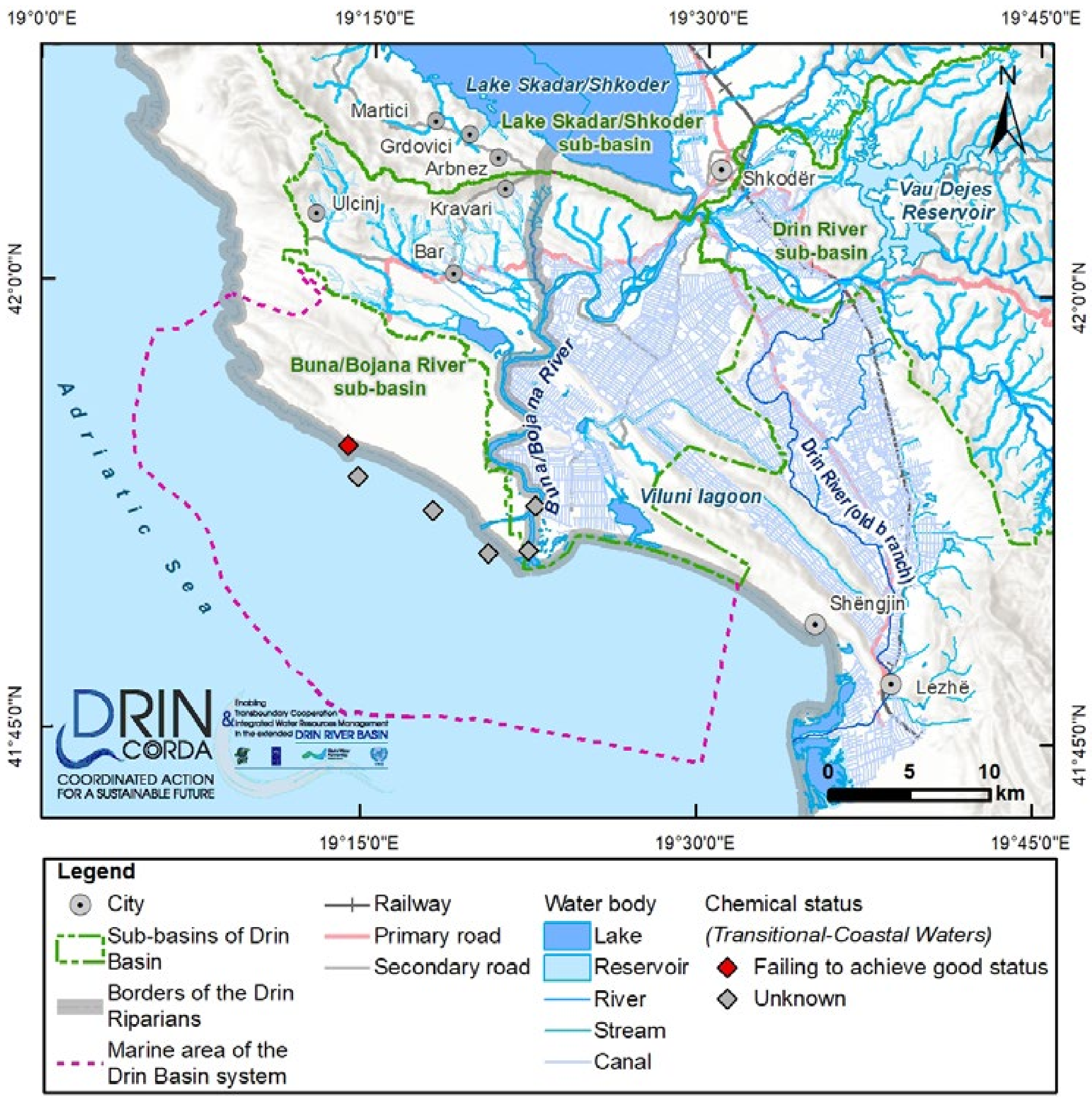


Figure 57. Chemical status of transitional and coastal waters of the Drin Basin system for priority substances, persistent bioaccumulative substances and heavy metals



6.2.4 Sediments quality

The Drin Project survey collected 11 sediment samples from the Lake Skadar/Shkodër, Buna/Bojana River, the delta and the coastal marine area of the Montenegrin section (Figure 58). The samples were analysed for basic geochemical parameters (organic carbon and carbonate contents), priority and priority hazardous substances, heavy metals and metalloids, and other specific pollutants.

- The levels of the majority of priority and priority hazardous substances were very low. The persistent, bioaccumulative and toxic polycyclic aromatic hydrocarbons (PAHs) were the class of compounds with the most detections in the studied sediments, particularly in the Skadar/ Shkodër Lake. Future studies should incorporate monitoring of PAHs in biological samples.

- Tributyl-tin, although at low concentrations, is another polybutylene terephthalate (PBT) compound that deserves scientific attention, particularly at the estuary of the Buna/Bojana River.
- The metals chromium and nickel found at elevated concentrations are of natural, geogenic origin. The analyses of cored sediment samples for establishing local background levels will facilitate the identification of metal pollution. This is particularly important for Cd, which was found to be enriched in the studied sediments.

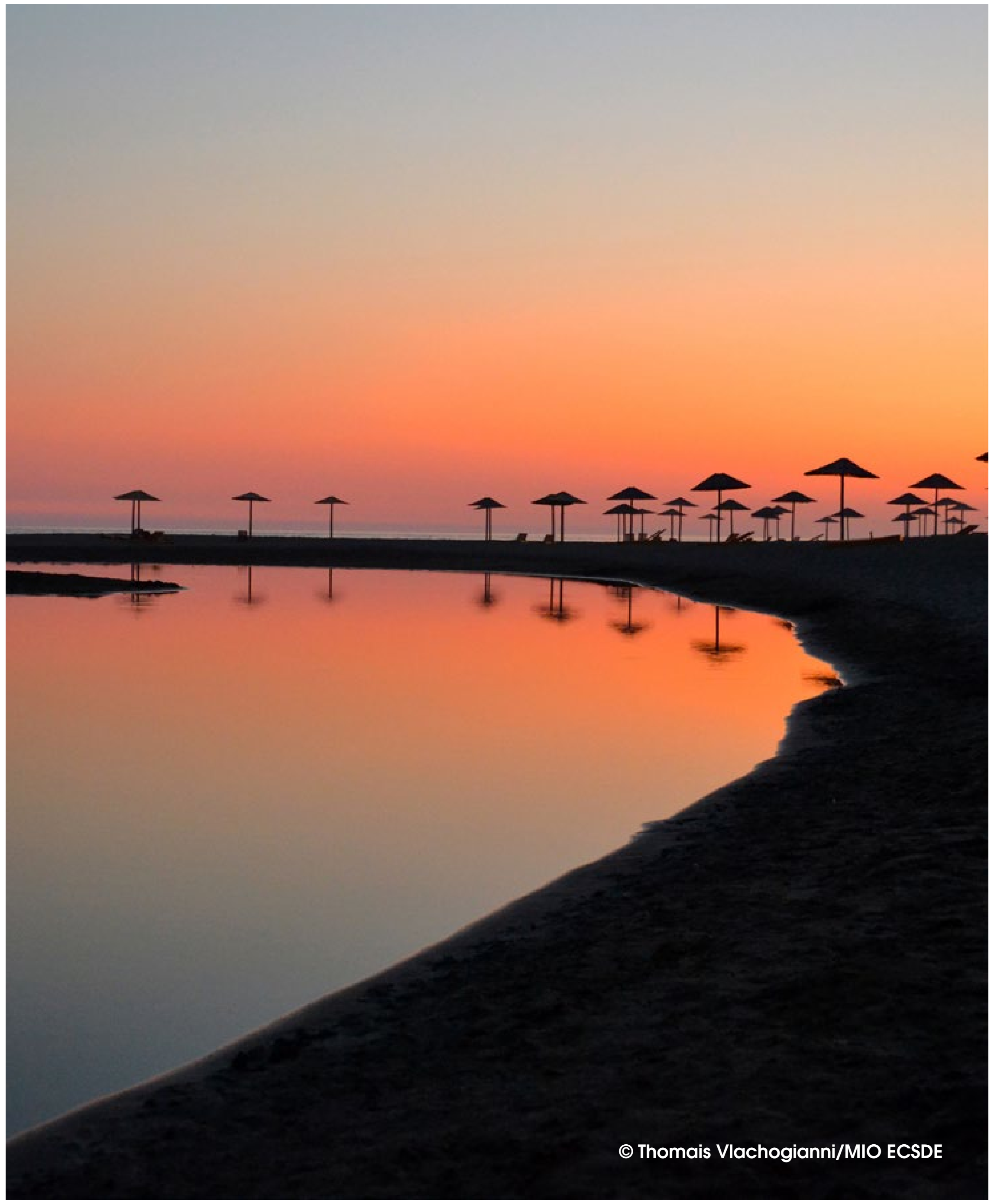


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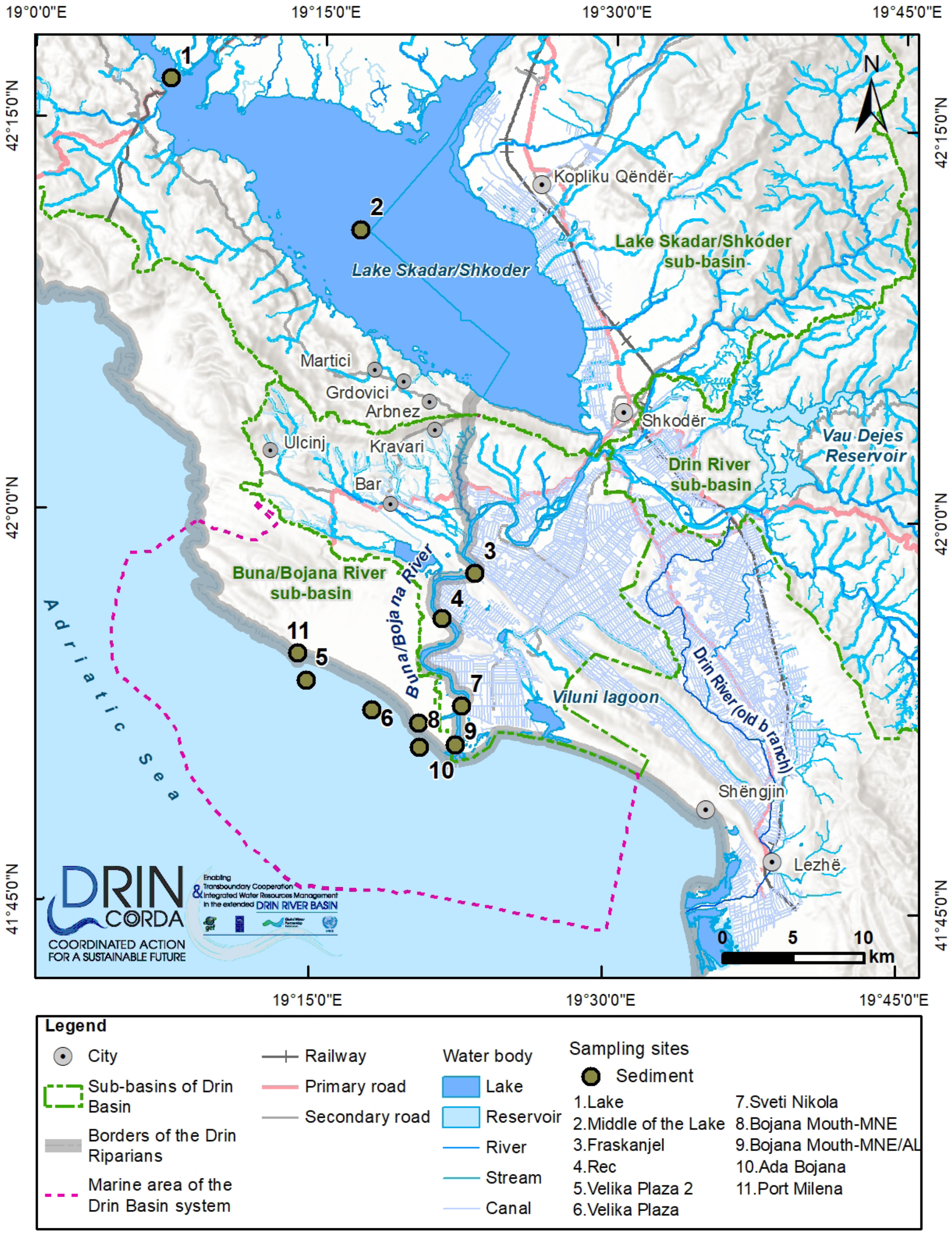
Figure 58. Location of sampling sites for sediments



6.2.5 Key observations from the TDA on the chemical analysis in the Drin Basin

The Drin Project has undertaken chemical analysis on the water quality of surface waters, groundwaters, transitional coastal waters and sediments. The main observations are summarized below:

- General observations on chemical analysis
  - Improvements on sampling, analytical methods and quality control are required to meet the demands of the Water Framework Directive.
  - Inter- and intra-laboratory and intercalibration exercises could ensure the comparability of sampling and analytical techniques.
  - Improvements in analytical techniques and sampling will produce higher quality results and assessments with a high level of confidence.
- Observations on the surface-water analysis
  - The Drin Project data set provided baseline information on the parameters that define the chemical status of aquatic systems in accordance with the Water Framework Directive.
  - Analysis revealed:
    - BOD: high levels detected in the White Drin River with over 72 percent of samples in the lowest classification and 30 percent of samples considered Class 5 in the tributaries of Lake Skadar/Shkodër.
    - Ammonium: highest levels were found in the White Drin River, the Drin River and tributaries of Lake Ohrid and Lake Skadar/Shkodër.
    - Phosphates: 15 percent of samples were at high levels, notably within Lake Skadar/Shkodër.
    - Overall nutrients were of environmental concern in Lake Ohrid and Lake Skadar/Shkodër.
    - Priority substances were an issue at a few sites in the White Drin River and Lake Skadar/Shkodër tributaries.
    - Metals of concern (including arsenic, copper, and chromium) were found in samples from the White Drin River tributaries and Black Drin River.
  - For a number of parameters, the very low EQS are a challenge for analytical laboratories.
- Observations on the groundwater analysis
  - National monitoring networks must be expanded to groundwater to ensure that groundwater sources for drinking water are protected

and managed in a way that health risks arising from the consumption of contaminated water are diminished.

- › The sub-basins of Lake Ohrid and the Drin River have the greatest proportion of monitoring sites at good status.
- › Higher levels of ammonium were found in groundwaters of the White Drin River, where 80 percent of samples were of poor status due to contamination from ammonium, chromium and nickel.
- › Sixty-six percent of groundwater sampling sites (26 sites out of 39) are at good status.

- Observations on the transitional and coastal water analysis
    - › The Drin Project data set provided baseline information on the parameters that define the chemical status of aquatic systems in accordance with the Water Framework Directive.
    - › Fluoranthene was detected at levels of above the environmental quality standard in Port Milena samples and the only nutrient detected was nitrate.
    - › Nitrogen discharges into the Adriatic Sea could be significant.
    - › Regular monitoring over an extended sampling network is necessary in order not only to meet the objectives of the Water Framework Directive but also the EU Marine Strategy Framework Directive.
- Observations on the sediment analysis
    - › The concentrations of the majority of priority and priority hazardous substances were very low.
    - › Persistent, bioaccumulative and toxic PAHs were the class of compounds with the most detections in the studied sediments, particularly in Lake Skadar/Shkodër. Future studies should incorporate monitoring of PAHs in biological samples.
    - › Tributyl-tin, although at low concentrations, is a compound that deserves scientific attention, particularly at the estuary of the Buna/Bojana River.
    - › The metals chromium and nickel that were found at elevated concentrations are most probably of natural, geogenic origin.

6.3 Biological quality assessment

According to the Water Framework Directive, monitoring of key 'biological quality elements' is required to assess the ecological status of water bodies. To do so, reference conditions must be established and periodic and long-term monitoring campaigns (of at least five consecutive years) must be carried out.

The Drin Project undertook a single monitoring campaign during July 2017 and assessed three key indicators: macroinvertebrates, macrophytes and diatoms at 31 sampling sites (11 in Albania, 5 in North Macedonia, 5 in Kosovo and 10 in Montenegro; see Figure 59).

Given the fact that the biological analysis was based on a single set of results and no reference conditions have been defined in all Riparians, this assessment is considered the first indicative assessment of the status of the system along the Drin Basin in response to pollution-related pressures. The results of applying the integrated water quality assessment (according to the calculation of different macrozoobenthos[32] and phytobenthos[33] indices) are given below:

- In Albania the results are as follows:
    - › Water quality in the two main tributaries of the Drin River, the Kiri and Luma rivers, appears to be slightly impacted.
    - › Water quality in the monitoring stations of Lin, Lake Ohrid, Kukës and Fierza appears to be moderately impacted.
    - › Water quality seems to be significantly impacted where the Black Drin River joins the White Drin River, the Vau i Dejës and the lower stream of the Buna River (outflow), based on the macroinvertebrate, macrophyte and diatom indices values.
    - › The composition of the diatom population, the numeric values of diatoms indices and values of the ecological quality ratio (EQR) indicate a slight impact on water by inorganic and organic matter in most of the stations of the Drin Basin. A tendency for eutrophication has been observed in some monitoring stations (the Fierza, the White Drin River and Buna River). However, this needs to be verified through future extensive monitoring.
    - › The values of the Macrophyte Index (MI) indicate an impact on water quality at the Buna River monitoring station.
- In Montenegro, according to the results:
    - › On the basis of macroinvertebrate indices, the water quality was found to be good at monitoring stations in the Zeta River, Morača River, Cijevna River and Bojana River, while in the Port Milena channel and Lake Skadar, water quality was found to be poor.
    - › The Trophic Index indicated a significant eutrophic level and high nutrient concentration

32 Plafkin et al. (1989) *The Ephemeroptera, Plecoptera, and Trichoptera* (EPT) Index; Bode et al. (1991, 1996) Family Biotic Index (FBI); Friedrich et al. (1996) Biological Monitoring Working Party (BMWP); Schmiedt et al. (1998), McGonigle (2000), SWRC (2007) Water Research Commission Biotic Index; Armitage et al. (1983), Friedrich et al. (1996) Average Score per Taxon (ASPT).

33 Lenoir and Coste (1996) Biological Diatom Index (IBD); Coste in French Research Institute for Agricultural and Environmental Engineering (CEMAGREF) (1982) Specific Pollution-Sensitivity Index (IPS); Rumeau and Coste (1988) Generic Diatom Index (IDG); Descy (1979) Specific Pollution Sensitivity Index (SPI); Sladecek (1986) Sladecek's Index (SLA); Dell'Uomo (1996) Eutrophication/Pollution Diatom Index (EPI-D); Rott et al. (1999) Rott Trophic Index (Rott TI); Rott et al. (1997) Rott Saprobic Index (Rott SI) and Macrophytes Index (MI).

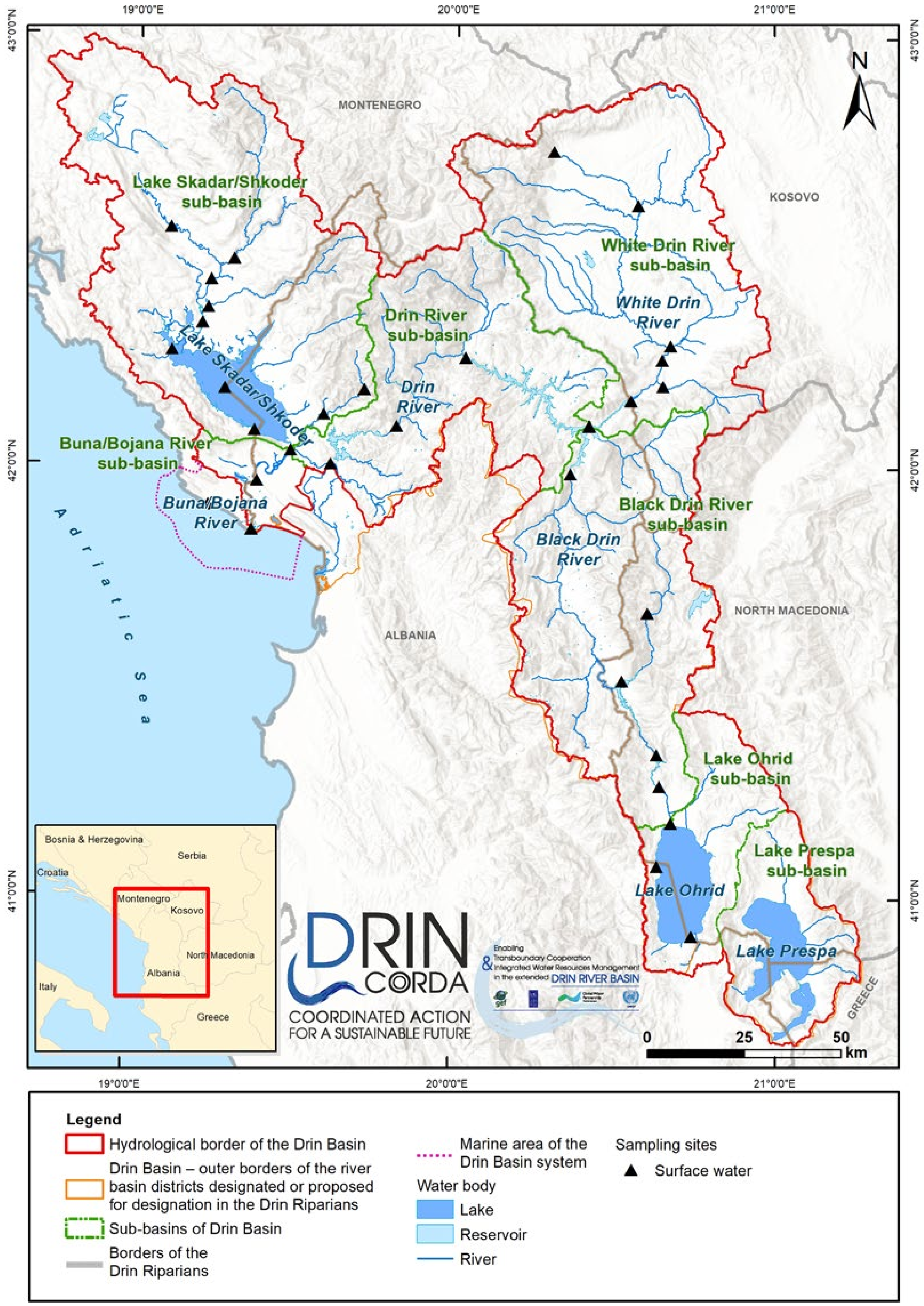
in Morača River, Bojana River, Port Milena and Lake Skadar.

- According to diatom indices, the water quality in the monitoring stations has not been significantly impacted. The best water quality, according to diatoms indices, appears to be in Cijevna River, though impacts were discernible in the Bojana River–Port Milena monitoring station.
- The MI indicated good water quality at all monitoring stations.

- In Kosovo, the results indicate that:
  - Drini i Bardhe, Radavc monitoring stations: water quality at this station appears to be good.
  - Klina–Kline monitoring station: water quality appears to have been slightly impacted.
  - Toplluha–Pirane monitoring station: water quality appears to have been considerably impacted.
  - Lumbardhi i Prizrenit–Vlashnje monitoring station: water quality appears to have been slightly impacted.
  - Drini i Bardhe, Vermicë: water quality appears to have been considerably impacted.

- In North Macedonia, according to macrozoobenthos and phytobenthos bioindicators the impacts on water at the monitoring stations listed seem to come from different sources. Water quality in the rest of the country's monitoring stations, according to macroinvertebrate, diatom and macrophyte indices values, have been assessed as not impacted.
  - Water quality in the Black Drin River appears to be moderately impacted. This may derive from anthropogenic activities – various waste inputs, mainly from wastewater discharge and agricultural leaching.
  - Water quality in the Radika River monitoring station has been slightly influenced by organic pressure (according to the diatom community structure). However, according to macroinvertebrate indices, water quality is good (only slightly impacted) and according to the macrophyte community structure, the Radika sampling site appears to be in moderate ecological status.

Figure 59. The Drin Project survey biological sampling locations



6.4 Key observations from the TDA on the biological quality assessment in the Drin Basin

- Overall, no reference conditions have been defined in the countries.
- There is a lack of periodical long-term data series on the biological quality data and data on biodiversity suffers from large deficiencies and gaps.
- There is limited capacity on the taxonomy of the taxa indicator at the species level.
- There is a lack of specific indicator indices per Riparian – the current indices calculations have been carried out based on the indices set for EU member countries with conditions similar to the Drin Riparians.
- The range of biodiversity that has been tackled is narrow.
- Geographical coverage of information varies.

Female *Calopteryx splendens*

7. BIODIVERSITY

7.1 Overview

The Drin Basin area has a very high level of biodiversity compared to the rest of Europe. This is the result of its geographical position straddling three European biogeographical zones, its diverse topography – including three major tectonic lakes – and the human effect that has so far been lower than in more industrialized countries and which has created a mosaic of natural and anthropogenic habitats.

Much of the surface waters of the Drin Basin are still in a natural or an only moderately modified condition, such as the unbroken connectivity between the Adriatic Sea, Lake Skadar/Shkodër and the Morača and Zeta rivers. Due to the high level of biodiversity, a significant portion of the basin has already been declared to be protected areas – several parts of the basin are considered Important Plant and Important Bird Areas.

The status of the biodiversity is summarized in this section and presented in more detail in the Thematic Report on Biodiversity and Ecosystems. The anthropogenic pressures (summarized in the socio-economic analysis presented in section 4, water resources and sediment transport in section 5 and pollution assessments in section 6) have resulted in some habitats being lost and species affected. For example, the connectivity between the Adriatic and Lake Ohrid was interrupted by the system of high dams on the Drin River and two species of sturgeon that were present in the Buna/Bojana River and Lake Skadar/Shkodër appear to be extinct. Several other species of fish, fauna and plants are subject to destructive practices and are considered endangered. Several fish and animal populations are so reduced that they are no longer available for fishing and hunting.

A further example is the drastic decline in the Lake Ohrid trout population since the beginning of the 1990s. Lake Ohrid trout, as well as Lake Ohrid belvica, are drastically endangered, due to overfishing and the introduction of rainbow trout. Despite the efforts of both littoral Riparians to improve the abundance of the species with joint restocking programmes, the results are insufficient, as mature specimens are still being fished, mainly by poachers. At the same time, endemic but commercially non-valuable species are in a relatively good condition.

Habitats under the most pressure are the sea and lake shores, the wetlands – due to urbanization and agriculture intensification – and the mountain rivers, due to hydropower development. Forests and grasslands are not existentially threatened but are under the pressure of unsustainable use, an increased frequency and intensity of wildfires. Climate change is also a significant potential threat to the biological resources of the region.

The current assessment for the TDA is based on the relatively limited monitoring that has been undertaken by the institutions of the Riparians (see Box 1).

Box 1. Biodiversity monitoring in the Drin Basin

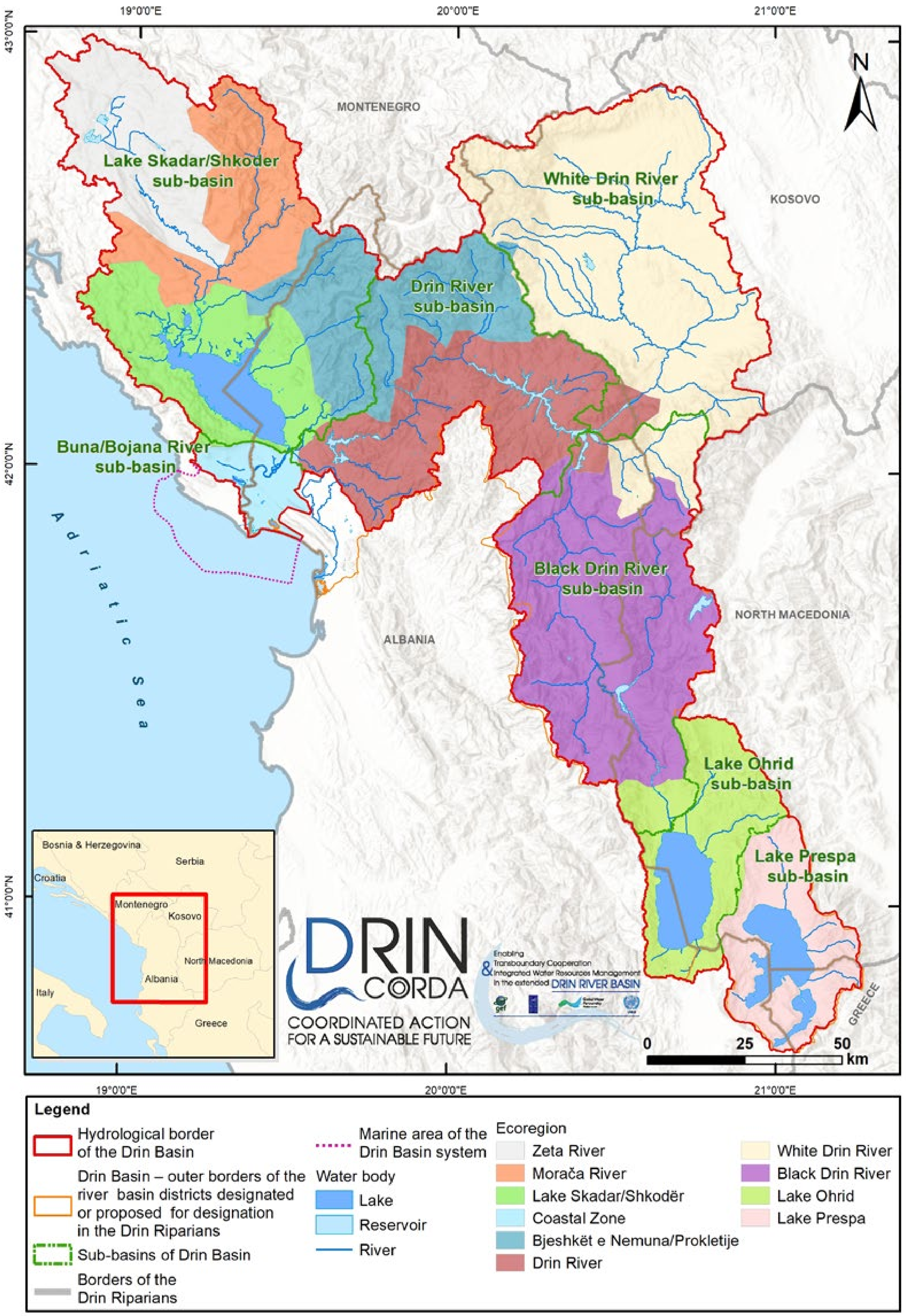
- The range of monitored biodiversity aspects is rather narrow. The majority of the studies are in the field of taxonomy and systematics of particular groups, with little comprehensive data on the ecology of species (population dynamics, status, trends and pressures), community interactions, ecosystem dynamics and functions, among other factors.
- There is a bias towards certain taxonomic groups. Birds, fish and plants appear to be the best researched, while other taxonomic groups, especially invertebrates, are far less covered. Data on species composition, status, trends and other factors for some taxonomic groups are largely lacking.
- Geographical coverage is patchy. Some parts of the region are better researched than others. This primarily includes protected areas, where data on biodiversity are available as a result of protected area designation and management process. There are locations outside protected areas where information on biodiversity is extremely scarce (for example, the Zeta River ecoregion in Montenegro).
- Some of the available data that are currently used for various purposes (conservation programmes, environmental impact assessments, protected area designations, among others) are the result of research that was carried out several decades ago, and as such have become outdated, giving a misleading picture of the species and community status and trends.
- There is a general lack of information on the extent and coverage of alien species. The transboundary diagnostics analysis identified nine plant species; 14 fish species, one insect species and one crustacean as alien species that are threatening habitats or competing with endemic species.

The above suggests the need for a coherent, basin-wide monitoring programme to address the main species of interest and concern and provide information on abundance and trends to inform regional and Riparian management actions to protect the biodiversity.

7.2 Habitats, flora and fauna

The Drin Basin includes three main biogeographical regions according to relevant EU approaches: 'Mediterranean', in the south-west part of the Drin Basin, 'Alpine', in the central regions of the basin and 'Continental' in the northern parts of the basin (mainly in Kosovo). Figure 60 indicates the ecoregions in the basin, the designation of which is based on the specific ecological units, taking into consideration the ecological features of each area/ecoregion within the Drin Basin. The demarcation of regions is mostly based on the hydrological sub-basins of the larger rivers or lakes, while areas with similar features were grouped together in cases where demarcation was unclear, as in the case of the upper part of Cijevna: a part is in the Bjeshkët e Nemuna/Prokletije ecoregion, as it has more in common with Valbona than with Morača, while the lower part is in the lowlands surrounding Lake Skadar/Shkodër.

Figure 60. Ecoregions of the Drin Basin



The basin hosts a diverse range of habitats, from terrestrial to freshwater. Heaths and Maquis are present in all ecoregions, with six Habitat Directive types across the whole river basin. Grassland habitats are among the more represented habitats in the Drin Basin. So far, 10 Habitat Directive grassland habitats have been identified in the area. Due to the largely limestone composition of the region, geological history and high-altitude mountains, there are several types of patchily distributed rocky habitats across the region. In terms of forests, there are 21 Habitat Directive types identified so far, though more are likely to be found with increased research efforts in the field.

Eleven different freshwater habitats have been identified in the Drin Basin. The vulnerability level of these freshwater habitats could be generally assessed as medium, with habitat alteration, invasive and alien species, and erosion (sedimentation) being the main pressures.

Figure 61 and Figure 62 show the terrestrial and aquatic biodiversity including the habitat types identified per ecoregion within the Drin Basin.

Inachis Io
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Figure 61. Terrestrial biodiversity in the Drin Basin

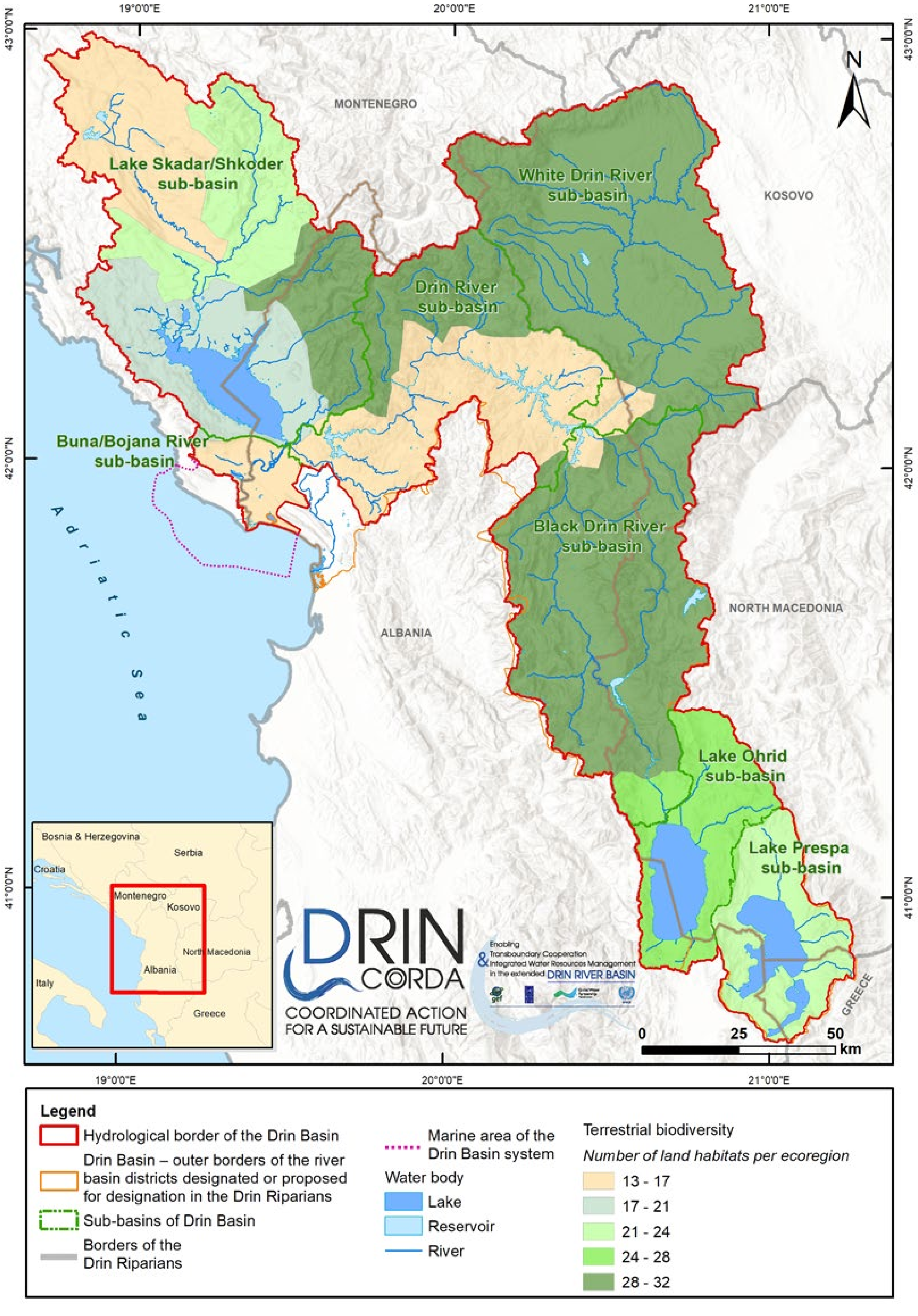
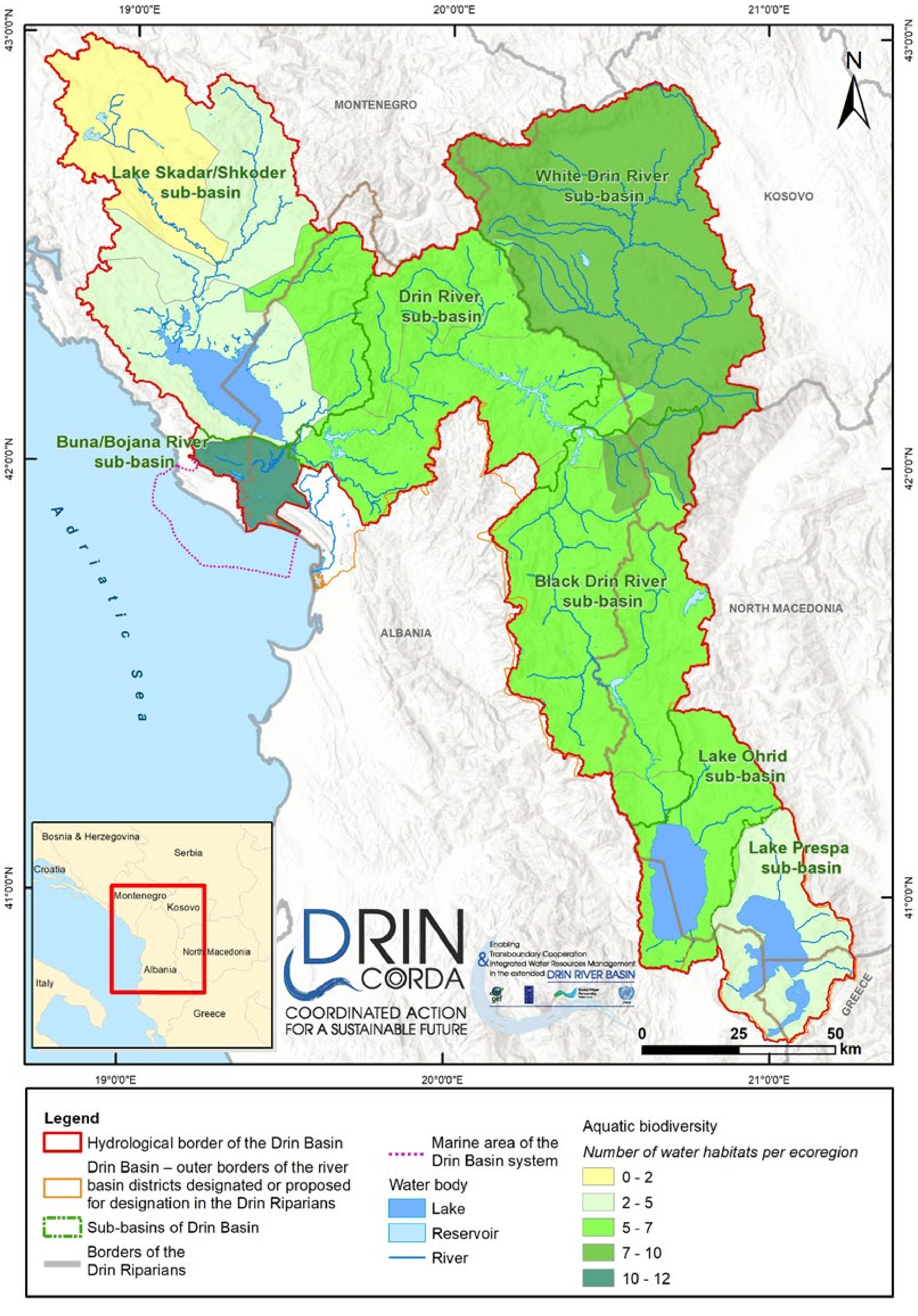


Figure 62. Aquatic biodiversity in the Drin Basin



Flora

A comprehensive database of information on flora in the Drin Basin does not exist, but the analysis undertaken for the TDA indicates a significant number of flora species in the different ecoregions within the Drin Basin (see Table 37).

Table 37. Flora in Drin Basin ecoregions

Ecoregion	Number of species
Lake Prespa	> 1,100 plant, 120 fungi and 120 lichen
Lake Ohrid	> 1,000 plant, > 200 endemic
Black Drin River	> 1,400 plant,
White Drin River	> 1,000 plants, > 30 endemic
Drin River	> 1,000 plant, > 15 endemic
Bjeshkët e Nemuna/Prokletije	> 1,500 plant
Morača River	> 120 lichen
Zeta River	No information
Lake Skadar/Shkodër	> 1,396 plant
Coastal zone	> 450 plant, > 15 endemic

7.2.1 Fauna

As in the case of flora, there is no comprehensive information on fauna. The analysis undertaken for the TDA indicates a significant number of flora species that exist in each of the ecoregions (see Table 38).

Table 38. Fauna in Drin Basin ecoregions

Ecoregion	Number of species
Lake Prespa	> 23 fish (6 endemic), 270 bird (130 breeding), 7 amphibian, 7 reptile, 60 mammal species
Lake Ohrid	> 20 fish (7 endemic), 135 bird, 13 reptile, 10 amphibian, 39 mammal species
Black Drin River	> 135 bird, 11 amphibian, 24 reptile, 49 mammal species
White Drin River	> 200 bird, 220 butterfly, 250 vertebrate species
Drin River	> 13 fish species
Bjeshkët e Nemuna/Prokletije	> 8 fish, 13 amphibian, 10 reptile, 148 bird, 36 mammal, 129 butterfly species
Morača River	> 28 fish, 130 bird, > 45 aquatic invertebrate species
Zeta River	24 bird, > 40 aquatic invertebrate species
Lake Skadar/Shkodër	50 fish, 30 reptile, 15 amphibian, 280 bird, 57 mammal species and 555 species from 22 zoobenthic groups
Coastal zone	50 fish, 11 amphibian, > 10 aquatic invertebrate species

7.3 Protected areas

About 3,264 km² fall within various protected area categories in the Drin Basin. Table 39 and Table 40 show the total protected surface area within each ecoregion and sub-basin within the Drin Basin area.

Table 39. Protected surface area per ecoregion

Ecoregion	Protected area (km²)
Albanian Alps total	377.69
Black Drin River total	622.25
Coastal zone total	197.72
Drin River total	61.86
Lake Ohrid total	268.11
Lake Prespa total	268.70
Lake Skadar/Shkodër total	263.83
White Drin River total	*1,203.86*

Table 40. Protected surface area per sub-basin

Sub-basin	Protected area (km²)
Black Drin River	974.25
Buna/Bojana River	193.87
Drin River	370.92
Lake Ohrid	268.85
Lake Prespa	267.69
Lake Skadar/Shkodër	265.69
White Drin River	922.75
Total	*3,264.02*

The current protected areas with International Union for Conservation of Nature (IUCN) categorization are shown below in Table 41, Table 42, Table 43 and Table 44. Figure 63 shows their location.

Table 41. Existing Albanian protected areas located in the Drin Basin

Protected area	IUCN category	Area (ha)	Biogeographical region
Gashi River	I	3,000	Alpine
Valbona Valley	II	8,000	Alpine
Theth National Park	II	2,630	Alpine
Shebenik – Jabllanicë National Park	II	33,928	Alpine
Prespa National Park	II	27,750	Continental
Lura National Park	II	1,280	Alpine
Korab-Koritnik Natural Park	IV	55,550	Alpine
Lake Shkodër Managed Nature Reserve	IV	26,535	Mediterranean
Tej Drini i Bardhe Managed Nature Reserve	IV	30	Alpine
Buna River-Velipojë Protected Landscape	V	23,027	Mediterranean
Pogradec Terrestrial/Aquatic Protected Landscape	V	27,323	Continental

Table 42. Existing Kosovo protected areas located in the Drin Basin

Protected area	IUCN category	Area (ha)	Biogeographical region
Shutman Strict Nature Reserve (SNR)	I	5,057	Alpine
Bredhik SNR	I	126.16	Alpine
Pashallarë SNR	I	400	Alpine
Koritnik SNR	I	818	Alpine
Bjeshka e Kozhnjerit SNR	I	1,110. 57	Alpine
Malet e Prilepit SNR	I	106.04	Alpine
Oshlak SNR	I	550.47	Alpine
Maja e Arnenit SNR	I	145.48	Alpine
Sharri National Park	II	53,469	Alpine
Bjeshkët e Nemuna National Park	II	62,488	Alpine
Pashtriku dhe liqeni i Vermicës Natural Park	V	5,934	Alpine
Shkukza Gjakovë Protected Landscape	V	70	Alpine

Table 43. Existing Montenegrin protected areas located in the Drin Basin

Protected area	IUCN category	Area (ha)	Biogeographical region
Lake Shkodër National Park	II	40,000	Mediterranean
Komovi Regional Park	VI	19,504	Alpine

Table 44. Existing North Macedonian protected areas located in the Drin Basin

Protected area	IUCN category	Area (ha)	Biogeographical region
Shebenik-Jabllanicë	N/A*	17,980	Alpine
Ezerani	I	2,137	Alpine
Galiica National Park	II	22,750	Alpine
Lake Ohrid	III	24,370	Alpine
Lake Prespa	III	19,000	Alpine
Beliško Blato	N/A*	1,544	Alpine
Mavrovo National Park	II	73,088	Alpine
Ohrid-Prespa Transboundary Biosphere	N/A*	892,489.05	Alpine

Ciconiidae
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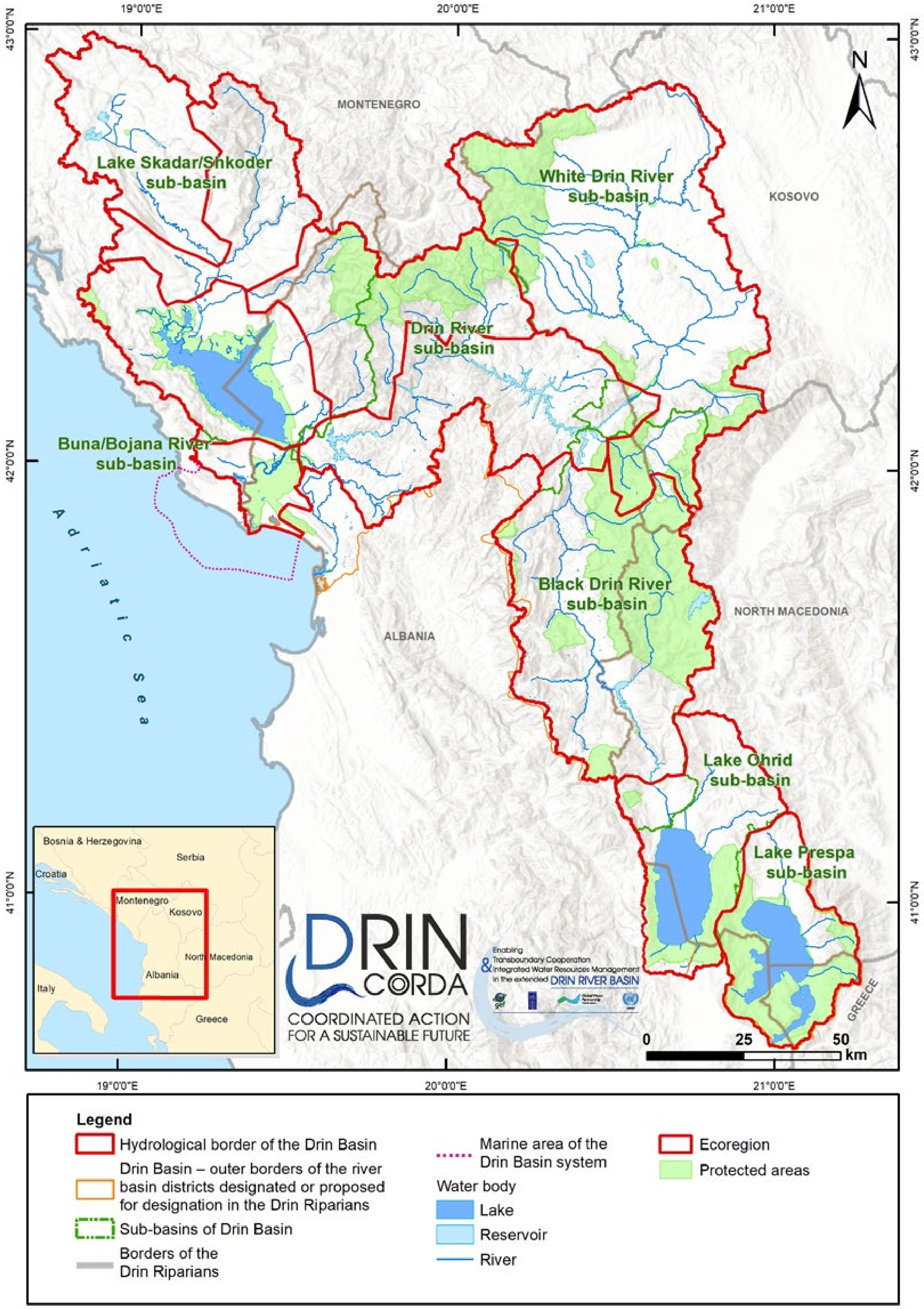
Figure 63. Protected areas in the Drin Basin



7.4 Ecosystem services

'Ecosystem services' is the collective term describing the various benefits provided by the natural landscape when it is functioning properly. The ecosystem services in the Drin Basin are presented in Table 45.

Table 45. Ecosystem services identified in the Drin Basin provided by terrestrial and aquatic ecosystems

Ecosystem service	Provided by terrestrial habitats	Provided by aquatic habitats
Farming	+	
Fishing and aquaculture		+
Animal husbandry	+	
Wild food and herb collection	+	
Wood	+	
Gravel		+
Drinking water		+
Irrigation		+
Hydropower		+
Waste disposal	+	+
Climate change mitigation	+	+
Moderation of extreme weather effects		+
Erosion prevention and maintenance of soil fertility	+	+
Biological control	+	
Wastewater treatment	+	+
Local climate and air quality	+	+
Habitats for species	+	+
Maintenance of genetic diversity	+	+
Recreation and health	+	+
Tourism	+	+
Aesthetic appreciation and inspiration	+	+
Spiritual experience	+	+

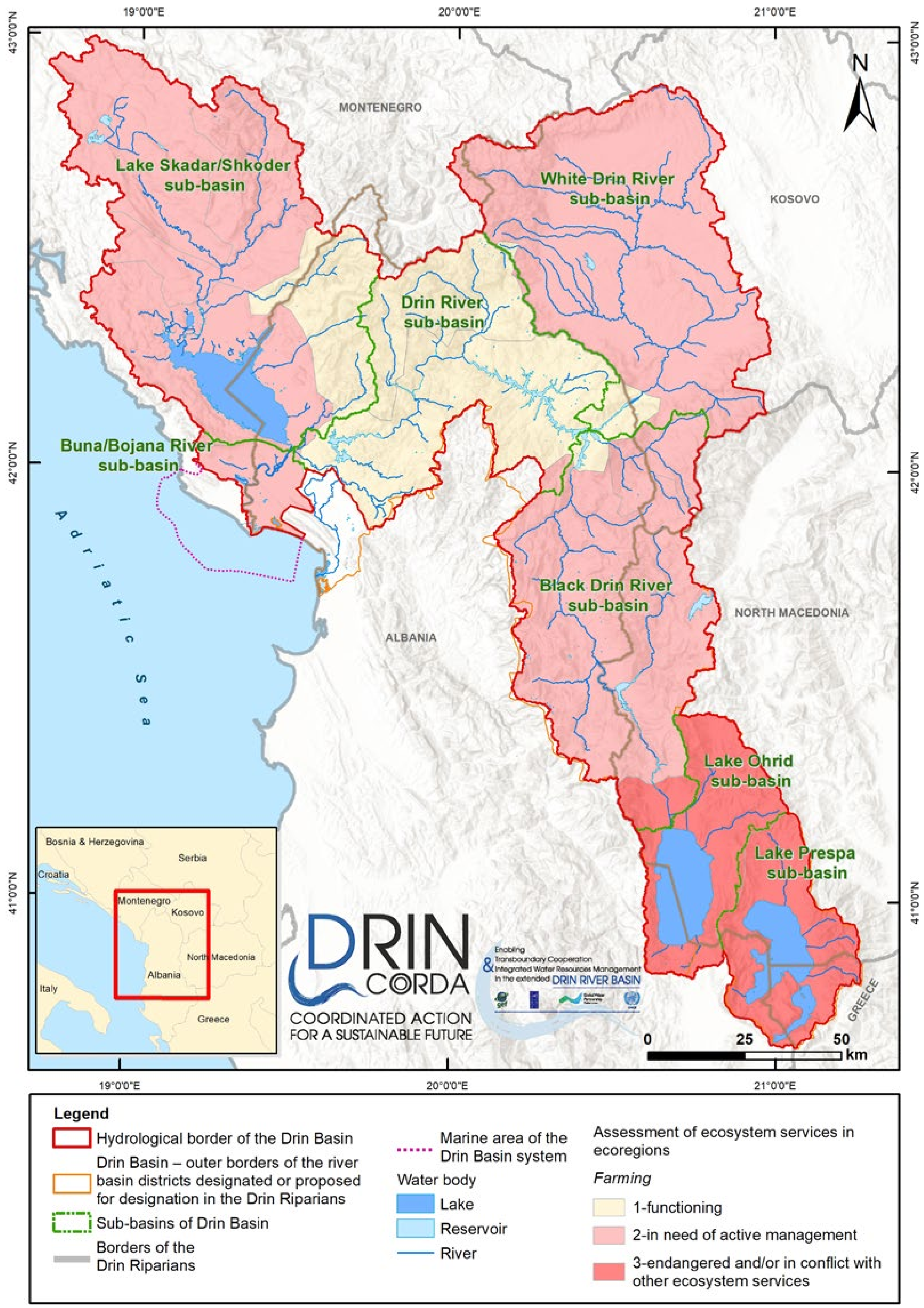
Ecosystem services that were identified in specific ecosystems as most at risk and/or impacting other ecosystem services include:

- farming, especially in Lake Prespa and Lake Ohrid ecoregions
- fishing and aquaculture, especially in the coastal zone, Drin River and Black Drin River ecoregions
- gravel, especially in Lake Skadar/Shkodër and Morača River ecoregions
- hydropower, especially in the coastal zone, Drin River, Black Drin River, White Drin River and Bjeshkët e Nemuna/Prokletije ecoregions
- wood, especially in the coastal zone, Drin River, Black Drin River, White Drin River and Bjeshkët e Nemuna/Prokletije ecoregions
- drinking water, especially in the coastal zone, Black Drin River, White Drin River and Bjeshkët e Nemuna/ Prokletije ecoregions
- tourism, especially in the coastal zone ecoregion.

The following maps (Figure 64, Figure 65, Figure 66 and Figure 67) illustrate the basin-wide assessment of selected ecosystem services.

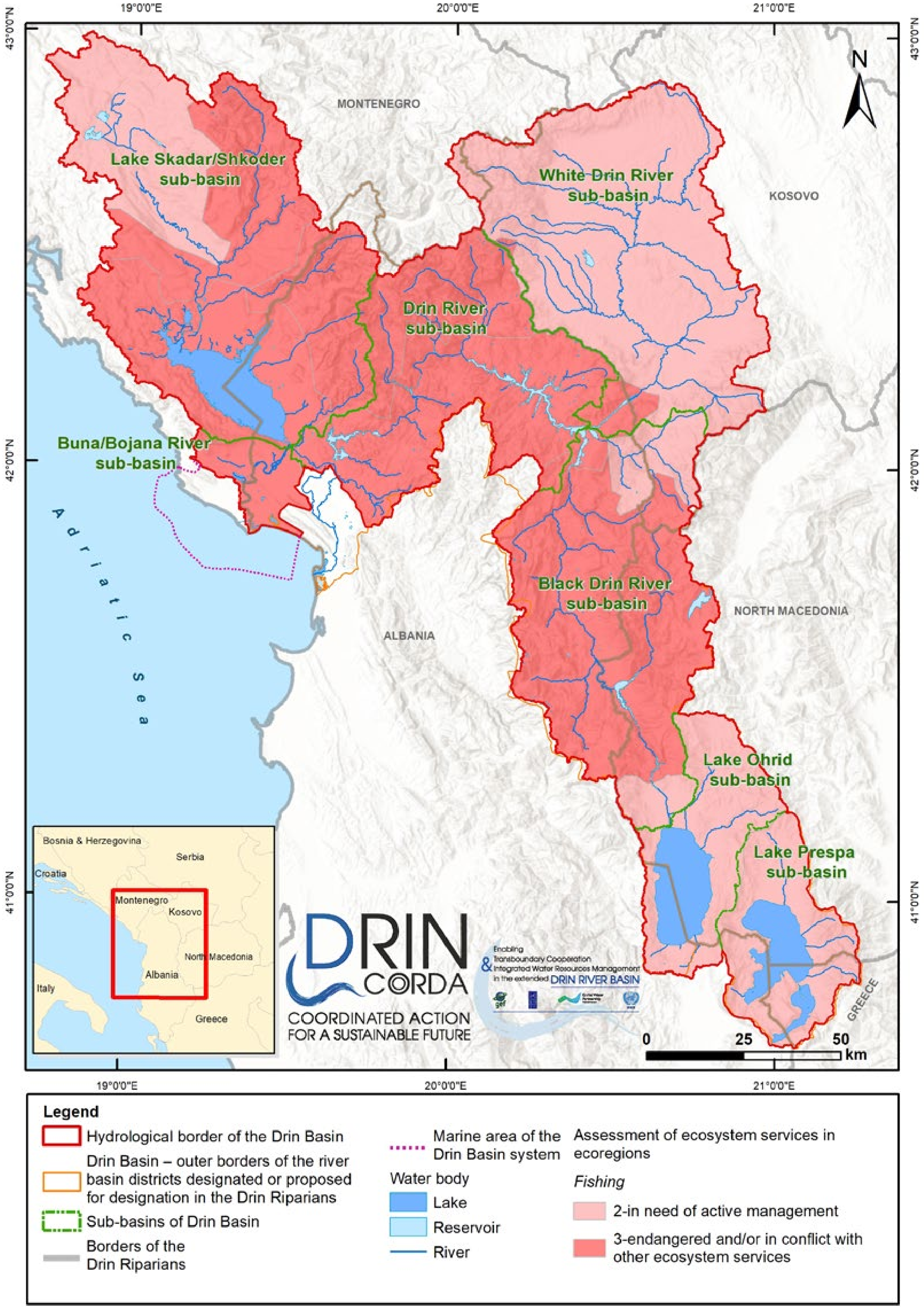
1. Farming: The use of fertilizers and pesticides (see section 6 on the pressure and chemical analysis of pollution arising from agricultural activities) has already a negative effect on fauna, flora and habitats, particularly in and around Lake Prespa, Lake Ohrid and Lake Debar.

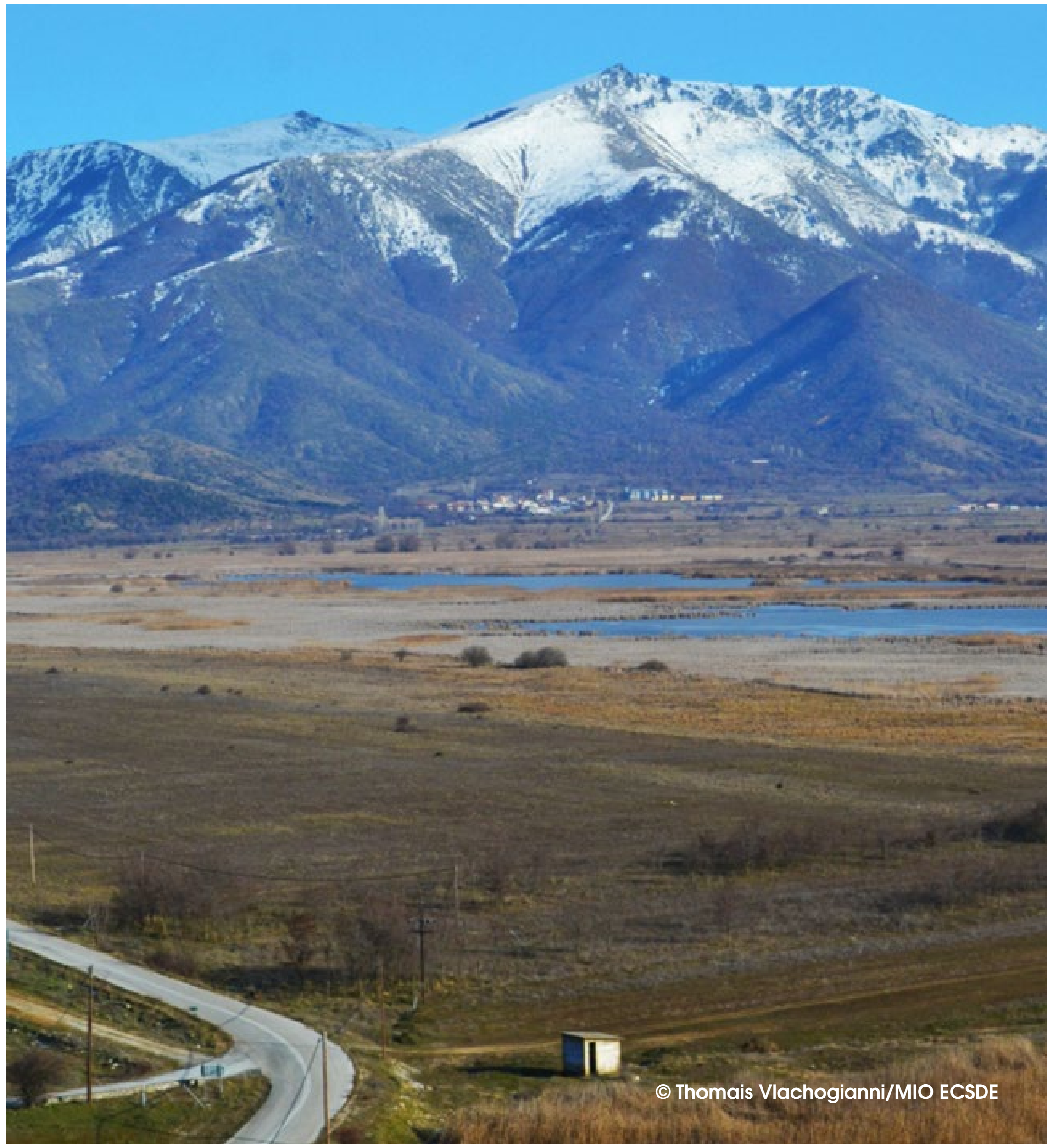
Figure 64. Assessment of status of ecosystems services – farming



2. Fishing: Fishing has deteriorated significantly in Montenegro and Albania due to overfishing and illegal fishing practices, such as the use of explosives and electricity. In Albania, the large dams on the Drin disrupt habitat connectivity and in Montenegro, the river habitats are disturbed by excessive gravel extraction. In Kosovo, fish are largely depleted, while the river habitats are relatively well preserved. In North Macedonia, fishing is better regulated, but Lake Ohrid's fish stocks are under pressure due to the lack of fish stock management and overfishing.

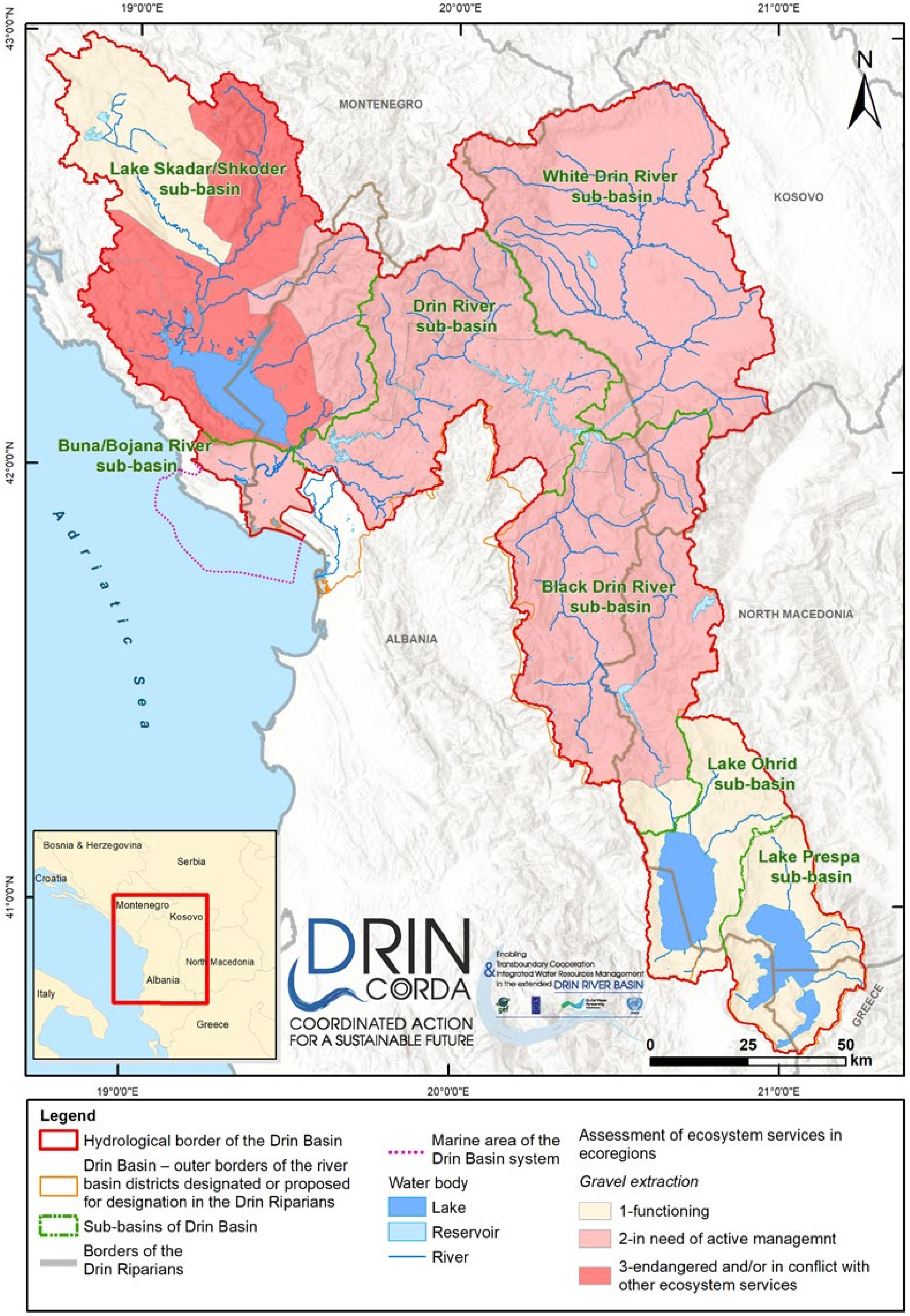
Figure 65. Assessment of status of ecosystems services – fishing





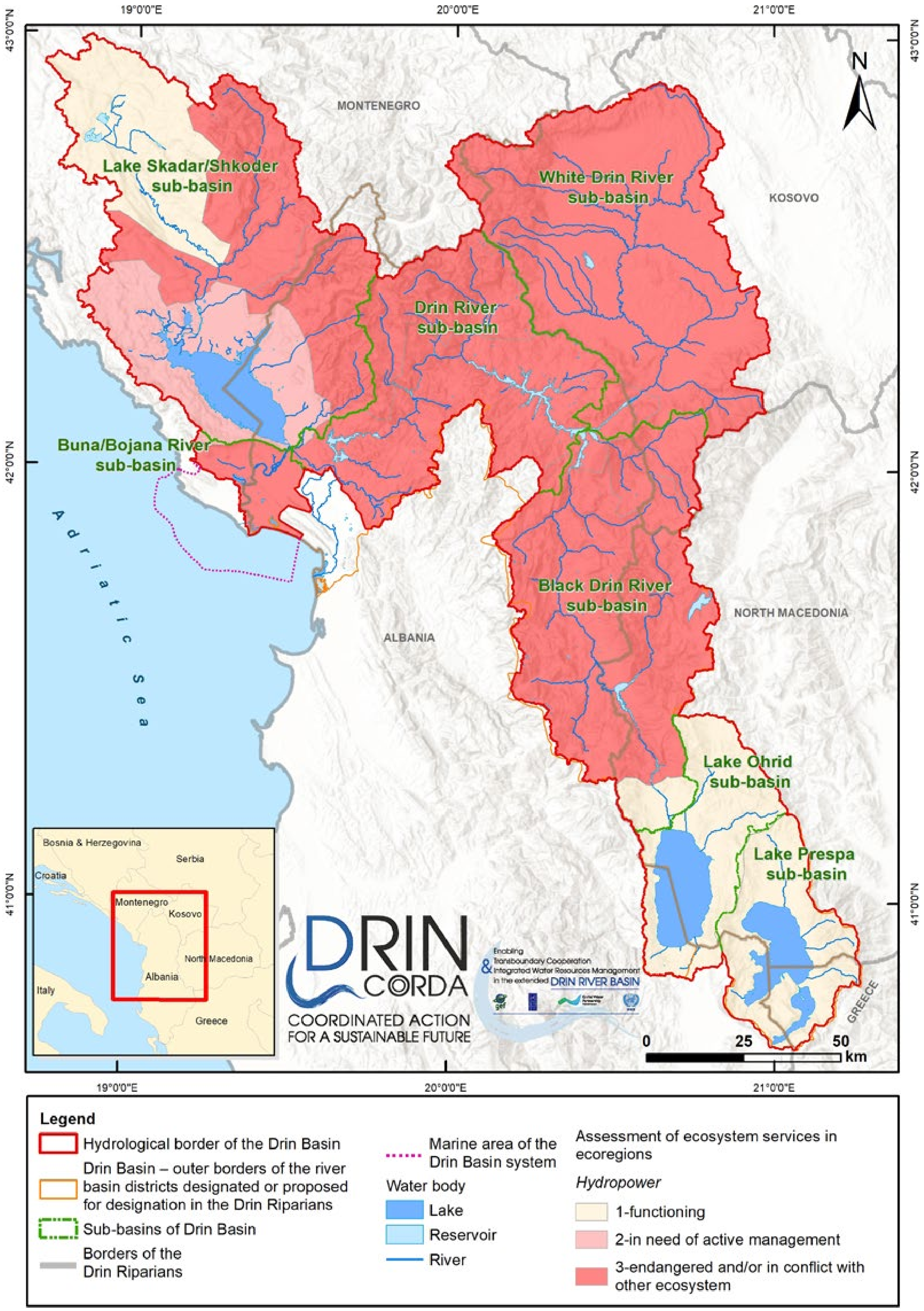
3. Gravel extraction: With high demand for construction materials, extracting gravel from riverbeds is an important activity linked to watercourses. Excessive gravel removal has detrimental effects on river habitats (especially destruction of gravel beds where fish spawn and oxbows where young fish develop) and causes additional river erosion downstream, as well as erosion of coastal beaches as they are not replenished naturally.

Figure 66. Assessment of status of ecosystems services – gravel extraction



4. Hydropower production: The level of electricity production from hydropower differs significantly among the Riparians. While providing a beneficial ecosystem service, hydropower production also places significant pressure on other ecosystem services. Hydropower production is discussed in more detail in section 5.

Figure 67. Assessment of status of ecosystems services – hydropower



7.5 Pressures on biodiversity

The Drin Basin is subject to a wide range of anthropogenic pressures, including:

- eutrophication and agrochemical pollution resulting from diffuse and point sources of pollution (see section 6 on pollution and water quality)
- freshwater habitat alteration due to hydromorphological changes including construction of dams for hydropower plants (see Figure 34), flood protection, erosion, deforestation, intensive agriculture and irrigation (see section 5.6 and section 6.1)
- complete or partial loss of wetlands through conversion into agricultural areas and over-pumping of surface and underground waters for irrigation
- unsustainable forest management, fires and the expansion of pastures contributing to continued deforestation
- non-sustainable and illegal fishing using destructive methods of fishing
- illegal hunting.

Information available indicates that anthropogenic pressures (described in other sections of the TDA) and the current approach to ecosystem management may lead to a severe reduction in biodiversity and the deterioration of ecosystem services. If current conditions are sustained and the pressures on ecosystems are not mitigated, the recovery and/or sustainability of biodiversity will be threatened. This scenario could include the further collapse of indigenous fish stocks if all the planned hydropower plants are constructed, and deterioration of the mountain forests and grasslands due to a combination of land abandonment, increased impact of wildfires and overexploitation. The newly urbanized areas in the lowlands will be affected by pollution, a lack of drinking water, floods and heatwaves as the regulatory functions of the surrounding ecosystems deteriorate.

The TDA identified issues that impact the effective management of biodiversity in the Drin Basin, including:

- Kosovo and Montenegro: Although the transposition of the Habitats Directive has been completed, the practical implementation is yet to begin due to the weak enforcement capacity of the key institutions.
- North Macedonia: Both the Ministry of Environment and the Ministry of Agriculture, Forestry and Water Management are involved in lake management, although neither has clear responsibility for their management. Local government authorities also play a role in management. The decision-making authority for biodiversity conservation for these areas is unclear and therefore confusing.
- Basin practices, including the overuse of agrochemicals (fertilizers, pesticides and herbicides). For example, in Resen, near Lake Prespa, apple orchards are treated more than 15 times a year.

The TDA assessed the cumulative pressures on biodiversity in terrestrial and aquatic habitats of the basin, which are depicted in Figure 68 and Figure 69. As the biodiversity data analysis has been carried out based on official existing data in all Riparians, the results obtained refer to the existing biodiversity situation within the basin area. The analysis of biodiversity data collected through the TDA shows a rather significant diversity of terrestrial and aquatic habitat types and therefore species in the Drin Basin area. Based on existing habitat records and data in the basin, terrestrial habitats show greater diversity than aquatic ones. Aquatic habitat types are more endangered by different activities in the Drin Basin area than terrestrial ones.

The coastal zone ecoregion is under the highest cumulative pressure both on terrestrial and aquatic habitats. Lake Prespa, Lake Ohrid and Zeta ecoregions are facing the least significant pressure both on terrestrial and aquatic habitat types. In these ecoregions, the highest number of ecosystem services are being provided to a satisfactory degree, either naturally or by management that takes into account the pressures and conflicts (drinking water, tourism, hydropower, etc.).

Male *Calopteryx splendens*
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Figure 68. Pressures of activities and services on terrestrial biodiversity

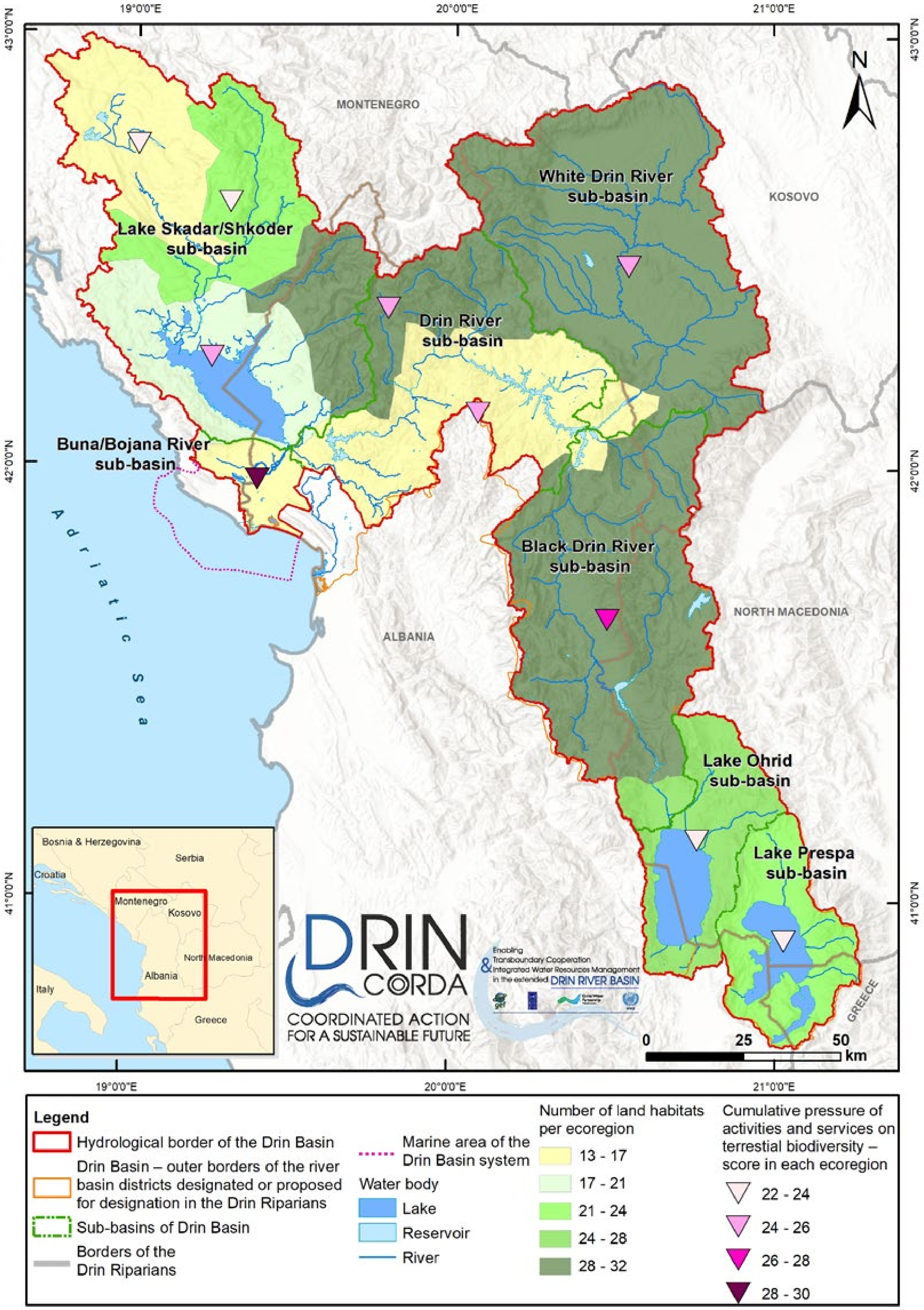
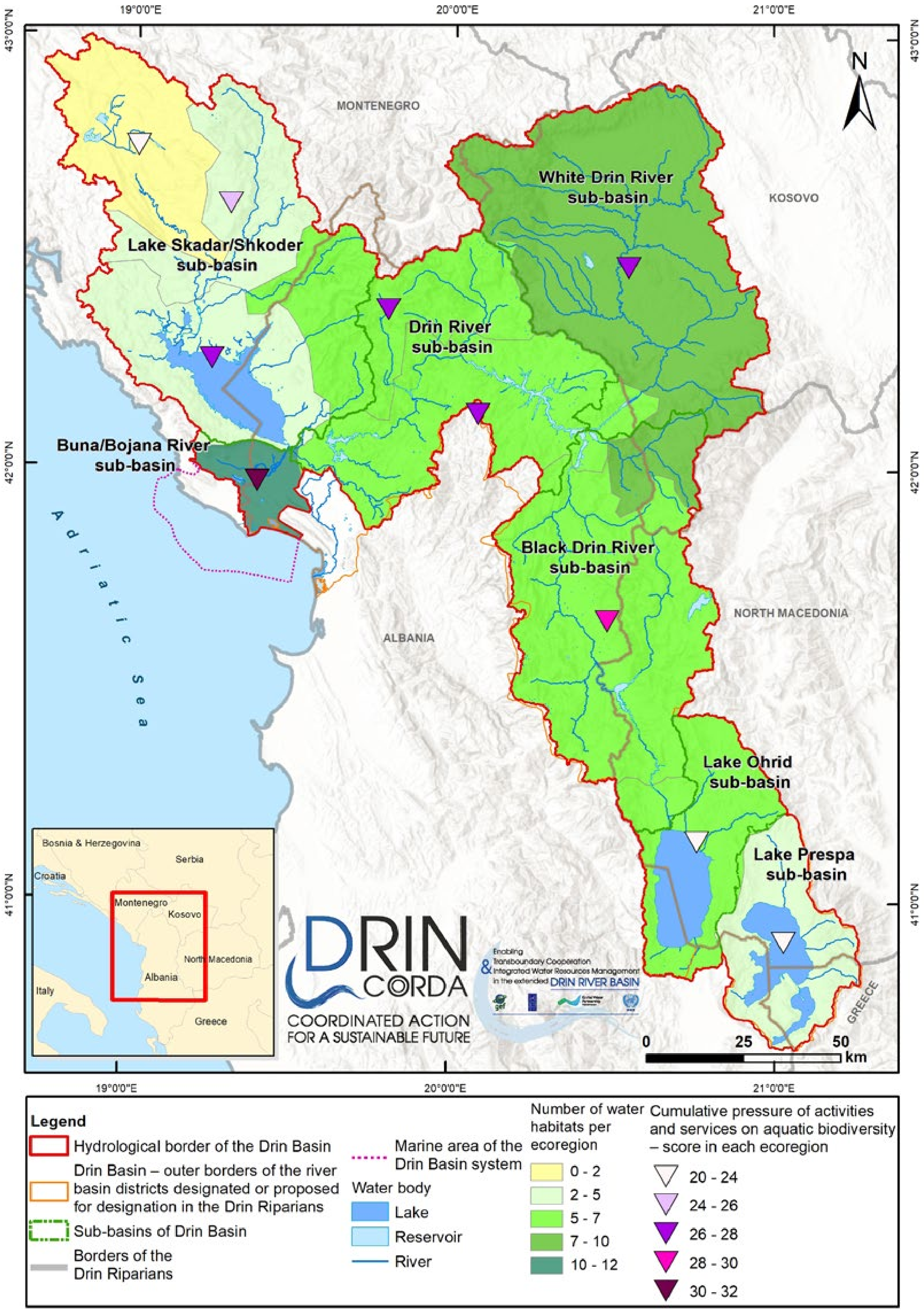


Figure 69. Pressures of activities and services on aquatic biodiversity



7.6 Key observations from the TDA on the biodiversity assessment in the Drin Basin

The key observations from the analysis of biodiversity in the region and issues to be addressed include:

- the lack of monitoring systems providing adequate data and information
- unclear governance responsibilities in some Riparians
- current management practices that may threaten the recovery and maintenance of biodiversity and moreover lead to a severe reduction in biodiversity and the deterioration of ecosystem services
- a number of threats to biodiversity, summarized as follows:
  - intensive farming practices
  - unsustainable forest management (including illegal logging)
  - excessive collection of wild plants
  - fires
  - alien species
  - illegal hunting
  - illegal/unregulated fishing
  - gravel extraction
  - hydromorphological alterations (dams, flood defences, wetland loss)
  - habitat alterations
  - urbanization.


Vipera ammodytes
© Thomais Vlachogianni/MIO-ECSDE

8. THE WATER–FOOD–ENERGY–ECOSYSTEM NEXUS

Among the water and environment issues reported in the previous sections there are some that originate from shortcomings in cross-sectoral governance and others that are compounded by such shortcomings. Examining the policy framework of different sectors can help identify such shortcomings and ways for these to be addressed. The Thematic Report on the Nexus provides insight on issues in the energy, forestry, and agriculture sectors in the context of river basin management, and shows that there are at least three areas where improving cross-sectoral governance could have a significant positive effect on the basin and beyond. These are:

1. energy and water, due to the key role of hydropower operators in flow regulation and floods management, along with the need to increase resilience to water stress across the economy
2. energy, forestry and water/basin management, due to the importance of forest management in relation to water resources, basin management and erosion and sedimentation, as well as the economic and environmental benefits of upgrading the value chain of wood biomass
3. agriculture and water, since agriculture ranks first in terms of water consumption in many of the sub-basins and because of the need to boost a sector that is crucial for the rural economy.

8.1 Energy and water

The maximization of electricity production is typically at odds with flood mitigation requirements. As indicated in the previous sections, due to high Drin River levels and low Buna/Bojana River levels, Drin River water sometimes enters Lake Skadar/Shkodër, which increases its water level significantly. Although this is mainly due to natural causes, it may also be caused by quantities of water released from hydropower dams upstream in Albania, which in turn depends on rainfall, electricity demand and the dams' operation rules.[34]

There is some cooperation at the transboundary level for cascade dam operations, which is restricted to emergency situations in Albania and North Macedonia, and flood forecasting among hydrometeorological institutes. Cooperation on emergency situations is relatively effective, though it could have adverse effects. According to experts, the floods in Lake Ohrid at the beginning of 2010 were the result of water being withheld in the dams on the Black Drin River in North Macedonia to assist the management of flooding in the Lake Skadar/Shkodër area in Albania and Montenegro. Overall, the basin-wide impact of dam operations needs to be better understood.

34 GWP-Med (2014) Situation Analysis of the Drin River Basin (1.6.1).

At the national level, in Albania and North Macedonia, hydrometeorological monitoring systems are not integrated with those of the KESH and ELEM. This is also the case at the transboundary level. A flood forecasting system for the basin is in use by the National Hydrometeorological Services (NHMS) of the four Riparians,[35] though with varying levels of efficiency, as if not used or fed with information from hydropower operators, results in sub-optimal flood forecasting and possibly sub-optimal dam operations.

An integrated approach that accommodates both electricity production and flood mitigation is possible. Achieving this requires action with regard to policies and legislation along with cooperation along dam cascades, between countries and among water and energy institutions, dam operators and authorities responsible for flood forecasting and flood emergency operations. The dams' operation regimes will also need to be revisited. Although it may not directly impact the extent of flooding, cooperation under normal flow conditions (both within Albania and North Macedonia, and at the transboundary level) could also be improved in a logic of 'basin optimization'.

Elements to support the optimization of both flood management and energy production include: an adequate knowledge base for science-based decision-making; capacity-building of the monitoring network; common standards for information-sharing; transparency of data, including public accessibility; structured databases; protocols for sharing of information; public participation and stakeholder engagement.

It is crucial that the energy sector is involved in basin management discussions to ensure that future energy policy decisions are informed by and inform water resources management. Several energy sector-related factors must be taken into account, which should ideally inform hydrological models used to define the basin's water balance.

The sustainability of hydropower production is not only related to water availability, but also to competitiveness. Currently, hydropower production is considered a cheap and stable means of electricity production and has a central role in the Riparians' energy systems, particularly in Albania. This may change depending on the costs of other renewable technologies as they gradually decline or with greater availability of natural gas in the region. Furthermore, with modest growth rates in electricity demand and population, investment in efficiency across the whole energy sector (for example, power infrastructure refurbishment, power plant rehabilitation, efficiency measures on the demand side) has the potential to contribute to a reduction in electricity demand, which could potentially lead to lower demand for hydropower.

Taking into account the Riparians' stated goal to establish a fully functional integrated power system at the regional level (within the framework of the Energy Community), the hydropower operations in the Drin Basin could be optimized not only along the Drin and Black Drin river cascades, but also across the whole regional electricity system by taking into account power production outside the basin and from other energy sources.

35 Albania, Montenegro, North Macedonia and Kosovo.

8.2 Energy, forestry and water/ basin management

A large part of the basin's land area is forest, which provides significant forest-related services and livelihoods for many who live in the surrounding rural areas. The forests are primarily used for their wood, which is needed for energy, industrial and construction/ manufacturing purposes. The forests also provide various non-timber products, such as forest fruits, mushrooms and aromatic plants that can be foraged, while supporting a great variety ecosystem services, including recreational and income-generating activities (hunting, beekeeping, tourism, etc.), as well as intangible yet vital services (provision of clean water, soil stabilization, carbon storage, flood mitigation, etc.).

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The role of forests on the region's economies is large and evolving. The contribution of forest assets to GDP goes beyond wood production and includes many other services, such as tourism and recreation, though national statistics do not necessarily capture this.

Wood energy is a renewable source that is widely available and accessible in the region. Its use is therefore being increasingly encouraged by policymakers, with wood becoming increasingly valuable for exports, particularly to the EU. As a result, this primary use of the basin's forest area remains at the centre of the land's future development. However, the value chain of biomass – from production to consumption – is largely unsustainable. Firewood is consumed to a far greater extent than processed products with higher calorific values and a lower environmental impact. This creates a serious problem of indoor and outdoor pollution, which is often aggravated by the poor quality or condition of the wood that is burnt (for example, wet), the inefficiency of the stoves used or the fact that other materials (such as plastic) are burnt together with it, releasing toxic fumes. At present, the switch to efficient or cleaner biomass products is promoted but not incentivized, with biomass and forestry-related issues failing to be prioritized in the Riparians' development plans (except Montenegro). In general, the production of pellets in the Riparians remains very low and limited to private businesses, wood is mostly exported as raw material and no efficient stoves are being domestically manufactured.

The Riparians face a major problem with managing logging, which is often unrecorded, illegal, not planned coherently with other forest uses and not in line with the forests' natural characteristics. In 2016, Albania imposed a total ban on logging in attempts to address the issue. Premature cutting of trees is a common practice in the most exploited forest areas, though forestry authorities are yet to effectively tackle this problem at the level of governance and there is weak enforcement. Overlapping and conflicting responsibilities between the central and local governments contribute to ineffective governance in the sector. Finally, regional forest data need to be improved, from the accounting of forest stocks to the collection of data on fuelwood consumption, production of fuelwood and pellets, and trade of wood.[36]

The consequences of unsustainable management affect forest ecosystems and all the services that they provide. In particular, forest degradation contributes to soil erosion, adding to the pressure from various sectors, such as gravel extraction and agriculture. This is problematic in Albania and a serious issue in the three other countries. Loss of forest cover also affects air quality and compromises the ability to moderate temperatures (a problem already occurring in Albania).[37]

Upgrading the value chain of wood biomass is a sensible starting point to reverse this trend and enhance the sustainability of forest management. Such an investment will lead to direct and immediate benefits, including: formalization of a largely informal sector; employment opportunities in a sector where skills are already well developed; palpable impacts on local populations in terms of air quality; preservation or restoration of ecosystems; increased erosion control and reduced flood risks;[38] conservation of major carbon sinks that are valuable for Europe and the world. Wood biomass is a well-established resource that does not require new distribution chains and does not create competition with food production, though it should be noted that there is very little utilization of agricultural residues and no cultivation of energy crops, which could also be explored.

A more holistic approach to forest management could better integrate forest-related activities and reconcile their different objectives that all too often remain in competition, building on complementarities in order to plan sustainable biomass production, and renewable energy in general, that is more streamlined in terms of procedures, more environmentally friendly and more beneficial for the local economy. More coordination would also boost entrepreneurship. As noted in a recent study on non-timber forest products in South-East Europe, there are no specific policies in place for the development of non-timber products. Closing this gap seems feasible, as several elements of such

36 The lack of precise data on exported forest products is reported in Montenegro (Nexus country report, 2017).

37 GWP-Med (2017) Thematic Report on Biodiversity and Ecosystems.

38 The report "Managing Flood Risk in the Shkodër Region through Ecosystem-based Adaptations" (Field et al. 2018) provides interesting insight on the potential of reforestation and other ecosystem-based approaches to adaptation.

a policy are already in place (support to small and medium-sized enterprises (SMEs), nature protection and forestry), with the interest and vitality of private businesses already observable.[39]

8.3 Agriculture and water

Agriculture is the main livelihood of most of the basin's rural population. However, despite the presence of strategic rural development and sustainability objectives, the sector significantly lags behind its real potential. The agricultural sector is shrinking in the basin due to several factors, including outmigration and urbanization, which is resulting in fewer people working in the sector.

Land fragmentation is a common characteristic of the region and reflects the recent history of land reforms. However, the problem is not the presence of small farms (a common feature of many EU countries), but the lack of coordination among producers, which results in: 1) a dependency of small farmers on volatile production, leading to financial instability and the inability to develop strong agri-food value chains; 2) limited capacity to ensure food safety standards and quality control, which is a barrier to the marketing and exporting of agricultural products. This situation compromises the profitability of the agricultural sector as well as its attractiveness for young people, entrepreneurs and innovators, at a time when re-framing agricultural development in the broader context of rural development stands out as a common goal of all Riparians' strategies for the sector.

While climate change adaptation is an explicit objective of the Riparians' agricultural policies (along with sustainable resource management), mentions of water availability in national policy documents reflects the common perception that water is, and will remain, widely available. This is in contrast with the fact that the agricultural sector is already water stressed in some sub-basins during the summer months and will become even more vulnerable to droughts in the future (see section 5).

If new developments, such as the intensification of production or expansion of irrigated land, are not properly planned as part of sustainable agricultural policies, the sector may become more vulnerable or unsustainable. Greater clarity on future demands of water from agriculture would greatly help countries in implementing their climate adaptation plans and strategies, as well as their river basin management plans, eventually also at the transboundary level.

The crops and animals in which farmers decide to invest are determined by agricultural markets (their demands and prices), support schemes, investment opportunities and the ability (or failure) to trade agricultural products with neighbouring countries or nearby markets. These choices may have a non-negligible impact on water resources in the basin.

At present, the level of agricultural trade within the region is low, with production mostly serving national or local markets, though the export of agricultural goods is gaining momentum and presenting opportunities, particularly in terms of trade with the EU and Russia. Most countries see the proximity to the EU

39 Živojinovi et al. (2017) Non-timber forest products in transition economies: innovation cases in selected SEE countries. *Forest Policy and Economics*, 81(18–29).

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and its markets as an opportunity for expanding their export of higher-value agricultural and food products. There is also a political will to create a common market for South-East Europe, which could present new opportunities for trade, thus incentivizing the production of exportable, added-value products. However, if investments in the necessary food safety and quality control laboratories and facilities remain insufficient in these countries, exports and inter-country trade will continue to be limited.

If coupled with a strong drive towards sustainability, trade opportunities could greatly revitalize the sector. For example, organic farming is currently very limited in the basin due to the high end-consumer prices on local markets, but could be boosted through producing for buyers ready to pay this price on foreign markets. The production of beans around Lake Prespa (Greek side) is one example of successful organic farming in the basin.[40]

8.4 Key observations from the TDA on the nexus in the Drin Basin

- Strengthened transboundary coordination between hydropower operators, and between hydropower operators and competent institutions could be crucial in improving flood management.
- Further analysis is needed to clarify the impact and benefits of increased transboundary cooperation on dam operations (in terms of energy production) also to better understand the cost competitiveness of new hydropower in the basin (considering climate change and other energy sources available).
- Forest degradation in the basin area (which has hydrological and hydromorphological implications due to increased erosion and sediment) could be reduced by tackling widespread and inefficient use of wood energy for household heating.
- An upgrade and modernization of the wood biomass value chain would help to address forest degradation and invest in a mature economic sector, resulting in multiple benefits ranging from income diversification, improved health, climate mitigation, biodiversity protection, improved erosion and sediment control.
- The agricultural sector is stagnating which makes it difficult to address unsustainable farming practices through new investments. The potential for adding value through organic farming and local produces linked to tourism is significant.
- A higher commitment to regional cooperation in agriculture, notably towards developing trade in high-quality agricultural products for export, could revitalize the sector and potentially motivate organic farming. This would be in line with a climate-smart and tourism-oriented view of agricultural development.

40 Sixth Drin Stakeholders Conference. Ohrid, 2018.

9. INSTITUTIONAL ARRANGEMENTS

9.1 Introduction

The TDA has assessed the institutional and legal setting and the efforts of the Riparians to meet the basin management-related EU acquis. The full analysis is presented in the Thematic Report on Institutional and Legal Setting.

There are regional initiatives in the Drin Basin and legal frameworks that are shared and are important for management at the transboundary level: the Drin MoU and the EU directives.

- Drin MoU: As summarized in the introduction (section 1.2), the establishment and agreement of the Drin MoU provides a sound basis for the current and future management of the transboundary river basin. The MoU's vision and objectives are consistent with the expectations of the EU Water Framework Directive and supported by the GEF Drin Project. The DCG was established to coordinate the MoU implementation.
- EU directives: All Riparians of the Drin Basin are either members of the EU (Greece) or are in the process of acceding to the EU. The EU directives are transposed (at different levels) to the legislation of the Riparians, creating a basic harmonized system for managing the basin and the resources therein.

Information on the institutional, legal and regulatory framework for water resources; wastewater and solid waste; urban and territorial planning and land use; agriculture, fisheries, hunting and forestry; nature protection and protected areas; environmental information and transparency were gathered for the TDA. The general status of implementation of policies and legislation for each of the above fields was assessed and gaps and challenges related to the implementation at the national and local levels were identified. In addition, progress towards approximating legislation related to basin and water resources management with the EU Water Framework Directive and other related Directives on natural resources management and environmental protection is summarized.

The key Riparian policies and strategic documents of relevance to the management of the Drin Basin are listed in Table 46. List of policies and strategic documentswhile the ministries responsible for the preparation and enforcement of policies are listed in Table 47.

Table 46. List of policies and strategic documents

Theme	Name of policy/strategic document	Year of preparation (where available)
Environment and sustainable development	**Albania**	
	National Intersectoral Environmental Strategy 2013–2020	2013
	National Strategy for Development and Integration 2015–2020 (NSDI II)	2016
	Draft Intersectoral Environmental Strategy 2015–2020	2015
	National Program for Environmental Monitoring	2015
	National Tourism Development Strategy 2018–2022	drafted
	Kosovo	
	Kosovo Development Strategy 2016–202141	
	Kosovo Strategy for Environmental Protection 2013–2022	
	North Macedonia	
	National Strategy for Sustainable Development 2009–2030	2010
	Second National Environmental Action Plan (NEAP 2)	
	Third National Communication on Climate Change	2013
	Plan for Institutional Development of National and Local Environmental Management Capacity 2009–2014	2009
	National Strategy for Harmonization in the Field of Environment	2008
	MEPP Strategic Plan 2016–2018	
	National Programme for Adoption of the Acquis (NPAA) revised for 2017–2019	
	The Accession Partnership Council Decision of 18 February 2008 (2008/212/EC) on the principles, priorities and conditions contained in the Accession Partnership with North Macedonia and repealing Decision 2006/57/EC	
	The Accession Partnership Council Decision of 18 February 2008 (2008/212/EC) on the principles, priorities and conditions contained in the Accession Partnership with North Macedonia and repealing Decision 2006/57/EC.	
	Montenegro	
	National Strategy for Sustainable Development until 2030	2017
	National Strategy with Action Plan for transposition, implementation and enforcement of the EU acquis on Environment and Climate Change 2016–2020	2016
Water resources	**Albania**	
	National Strategy for Water Supply and Sewerage 2011–2017	Outdated (the new one is being prepared)
	Master Plan for Water Supply and Sewerage 2011–2025	Under review process
	National Strategy for Integrated Water Resource Management	2018
	Kosovo	
	Kosovo Water Strategy 2017 (approved)42	2017
	North Macedonia	
	National Water Strategy 2011–2041	2010
	Initial Characterization of Lakes Prespa, Ohrid and Shkodra/Skadar	
	Lake Prespa Management Plan	
	National Strategy for Protection and Rescue (Official Gazette no.23/09)	2009
	National Platform of the Republic of North Macedonia for Disaster Risk Reduction	2010
	Montenegro	
	Water Basis of Montenegro	2001
	Water Management Strategy	2017

41 http://www.kryeministri-ks.net/repository/docs/National_Development_Strategy_2016-2021_ENG.pdf.

42 Approved by Decision No.16/20 on 20 December 2017 (http://kryeministri-ks.net/wp-content/uploads/docs/Vendimet_e_mbledhjes_se_20.pdf).

Theme	Name of policy/strategic document	Year of preparation (where available)
	Master Plan for Water Supply on the Coast of Montenegro and in Cetinje Municipality	2005
Wastewater and solid waste	**Albania**	
	National Strategy for Water Supply and Sewerage 2011–2017	Outdated (the new one is being prepared)
	Strategy and Action Plan for Sewerage Treatment in Urban Areas	2003
	National Cross-Sector Strategy on Waste Management 2010–2025	2011
	National Waste Management Plan 2010–2025	2011
	Strategy and Action Plan for Water Supply, Sewerage and Waste Management in Rural Areas	2003
	Kosovo	
	Strategy of Kosovo on Waste Management 2013–2022	2013
	Kosovo Waste Management Plan 2013–2017	2013
	North Macedonia	
	National Waste Management Strategy 2008–2020	2008
	North Macedonia National Waste Management Plan 2009–2015	2008
	Plan for Closure of Non-compliant Landfills in North Macedonia	2012
	Regional waste management plans for Skopje region, East Region, South-East Region and Patagonia Region	2011
	Montenegro	
	National Waste Management Plan with Action Plan 2015–2020	2015
	Strategic Master Plan for Sewerage and Waste Water in Central and Northern Region of Montenegro	2005
	Master Plan for Waste Water Management on the Coast of Montenegro and in Cetinje Municipality	2005
	National Medical Waste Management Plan until 2020	2016

Theme	Name of policy/strategic document	Year of preparation (where available)
Urban and territorial planning and land use	**Albania**	
	Strategy and Action Plan for the Development of the Tourism Sector based on Cultural and Environmental Tourism	2006
	National Sectoral Plan for Tourism in the Alps Region	2017
	General Development Plan for Albania 2030	2015
	Kosovo	
	Kosovo Spatial Plan 2010–2020+	2010
	Sharri Park Spatial Plan 2013–2022	2013
	Spatial Plan on Nature Monument of Special Importance – Mirusha Waterfalls	2014
	North Macedonia	
	North Macedonia Spatial Plan (1998, revised in 2004)	1998
	Spatial Plan of the Ohrid-Prespa region 2005–2020 (Official Gazette no. 22/10)	2005
	Montenegro	
	Law on Spatial Planning and Construction 2017	2017
	National Strategy for Integrated Coastal Zone Management	2015
	Spatial Plan of Montenegro until 2020	2008
Agriculture	**Albania**	
	Strategy and Action Plan for Protection of Land from Erosion	2005 (only draft)
	Crosscutting Strategy for Rural and Agricultural Development	2014
	Strategy for Irrigation, Drainage and Flood Protection in Albania	Drafted 2018 (in approval process)
	Kosovo	
	Land Consolidation Strategy 2010–2020	2010
	North Macedonia	
	National Agriculture and Rural Development Strategy 2007–2013	2006

Theme	Name of policy/strategic document	Year of preparation (where available)
	National Strategy for Climate Change Adaptation in Agriculture	In preparation
	National Plan for Organic Agriculture of North Macedonia 2013–2020	2013
	National Programme for Development of Agriculture and Rural Development 2013–2017	2013
	Financial Support Programme for Agriculture 2017	2017
	Financial Support Programme for Rural Development 2017	2017
	Rural Development Programme 2014–2020	2014
	Third National Communication to the United Nations Framework Convention on Climate Change	2013
	Montenegro	
	Strategy for Agricultural Development and Rural Areas 2015–2020	2015
Fisheries	**Albania**	
	National Fishing and Aquaculture Strategy	2007 (only draft)
	Kosovo	
	-	
	North Macedonia	
	Financial Aid Programme for Fisheries and Aquaculture 2017	2016
	Fishing grounds in Black Drin Basin 2011–2016	2011
	Fishing grounds in Ohrid Lake Basin 2011–2016	2011
	Fishing grounds in Prespa Lake Basin 2011–2016	2011
	Montenegro	
	Fishery Strategy with Action Plan 2015–2020	2015
Hunting	**Albania**	
	-	

Theme	Name of policy/strategic document	Year of preparation (where available)
	Kosovo	
	-	
	North Macedonia	
	-	
	Montenegro	
	Hunting Development Programme 2014–2024	2014
Forestry and pastures	**Albania**	
	Strategy for the Development of the Forestry and Pastures Sector in Albania	2004
	Kosovo	
	Policy and Strategy Paper for Forestry Sector Development 2010–2020	2010
	North Macedonia	
	National Strategy for Sustainable Forestry Sector Development	2006
	Rural Development Programme 2014–2020	2014
	Montenegro	
	Forestry Strategy 2014–2023	2014
Nature protection – protected areas	**Albania**	
	Protected Areas, Short and Midterm Strategic Programme 2015–2020	2015
	National Environmental Action Plan	1993, updated in 2002
	National Environmental Monitoring Programme	2015
	National Annual Environmental Monitoring Programme	2015
	Strategic policies document regarding the protection of biodiversity	2015 (December)
	Strategic Environmental Evaluation of the General National Plan	2016
	Strategic Action Plan for Sustainable Development of Prespa Park	2002, updated in 2010

Theme	Name of policy/strategic document	Year of preparation (where available)
	Kosovo	
	Biodiversity Strategy and Action Plan 2011–2022	2011
	Sharri National Park Management Plan 2015–2024[43]	2015
	North Macedonia	
	North Macedonia Strategy and Action Plan for Protection of Biological Diversity	
	Local biodiversity action plan for municipality of Debar	2013
	Montenegro	
	National Biodiversity Strategy with Action Plan (NSBAP) 2016–2020	2015
	Management Plan for Lake Shkodër National Park 2016–2020	2015
	Management Plan for Lovcen National Park 2011–2015	2010
Environmental information and transparency	**Albania**	
	Aarhus Convention Implementation Strategy	2005
	Kosovo	
	Management Programme for the Environmental Information System 2018–202244	
	North Macedonia	
	Strategy for Environmental Communication	2003
	Strategy for Raising Public Awareness about the Environment	2003
	Environmental Data Management Strategy	2003
	Montenegro	
	-	

43 https://mmph.rks-gov.net/assets/cms/uploads/files/Publikimet/Plani_i_menaxhimit_i_PK_Sharri__verzioni_anglisht_26083.pdf.
44 http://ammk-rks.net/repository/docs/Programi_p%C3%ABr_menaxhimin_e_SIM_final_shq.pdf.

Table 47 summarizes the main ministries involved in water and environmental management in the Drin Riparians.

Table 47. Ministries in charge of legal drafting on different sectors of environmental/ natural resource management

Theme	Riparian	Riparian Ministry
Horizontal legislation	Albania	Ministry of Tourism and Environment
	Kosovo	Ministry of Environment and Spatial Planning
	North Macedonia	Ministry of Environment and Physical Planning
	Montenegro	Ministry of Sustainable Development and Tourism
Water management and protection	Albania	Water Resources Management Agency Council of Ministers Ministry of Tourism and Environment Ministry of Agriculture and Rural Development Ministry of Health Ministry of Infrastructure and Energy
	Kosovo	Ministry of Environment and Spatial Planning
	North Macedonia	Ministry of Environment and Physical Planning Ministry of Agriculture, Forestry and Water Economy Ministry of Health Ministry of Economy Ministry of Transport and Communications Ministry of Foreign Affairs
	Montenegro	Ministry of Agriculture and Rural Development Ministry of Sustainable Development and Tourism Ministry of Health Ministry of Interior
Nature protection	Albania	Ministry of Environment
	Kosovo	Ministry of Environment and Spatial Planning Kosovo Environmental Protection Agency Kosovo Institute for Nature Protection
	North Macedonia	Ministry of Environment and Physical Planning

Theme	Riparian	Riparian Ministry
	Montenegro	Ministry of Sustainable Development and Tourism Ministry of Agriculture and Rural Development
Waste management	Albania	Ministry of Sustainable Development and Tourism Ministry of Infrastructure and Energy
	Kosovo	Ministry of Environment and Spatial Planning Kosovo Landfills Management Company
	North Macedonia	Ministry of Environment and Physical Planning
	Montenegro	Ministry of Sustainable Development and Tourism Ministry of Health Ministry of Agriculture and Rural Development
Urban and territorial planning	Albania	Ministry of Infrastructure and Energy
	Kosovo	Ministry of Environment and Spatial Planning Department for Spatial Planning, Construction and Housing
	North Macedonia	Ministry of Environment and Physical Planning Ministry of Transport and Communications
	Montenegro	Ministry of Sustainable Development and Tourism
Industrial activities and risks	Albania	Ministry of Tourism and Environment Ministry of Health and Social Protection
	Kosovo	Ministry of Trade and Industry Ministry of Economic Development Kosovo Emergency Management Agency
	North Macedonia	Ministry of Environment and Physical Planning
	Montenegro	Ministry of Sustainable Development and Tourism Ministry of Interior
Hydropower	Albania	Ministry of Infrastructure and Energy
	Kosovo	Ministry of Economic Development
	North Macedonia	Ministry of Economy Ministry of Environment and Physical Planning

Theme	Riparian	Riparian Ministry
	Montenegro	Ministry of Economy
Public participation	Albania	Ministry of Tourism and Environment
	Kosovo	Office of Prime Minister Ministry of Environment and Spatial Planning Ministry of Agriculture, Forestry and Rural Development Ministry of Economic Development
	North Macedonia	Ministry of Environment and Physical Planning
	Montenegro	Ministry of Sustainable Development and Tourism
Gender	Albania	Council of Ministers
	Kosovo	Office of Prime Minister
	North Macedonia	Ministry of Labour and Social Policy
	Montenegro	Ministry of Human and Minority Rights
Agriculture, fisheries, hunting and forestry	Montenegro	Ministry of Agriculture and Rural Development
	Kosovo	Ministry of Agriculture, Forestry and Rural Development

9.2 Legal, policy and management frameworks

9.2.1 Horizontal issues

In Albania, more effort is necessary to align the horizontal legislation with the EU acquis. Additional legislative work is necessary to fully implement the Environmental Impact Assessment (EIA) and Strategic Environmental Assessment (SEA) Directives. The legislative framework and instruments to guarantee the public's right to information are in place.

The National Strategy for Development and Integration 2015–2020 (NSDI II) serves as the guiding document for sustainable development and is closely aligned with the Sustainable Development Goals (SDGs). The Albanian Government has affirmed its full commitment to the 2030 Agenda.

In Kosovo, legislation for EIA and SEA is in place, but implementation needs to be strengthened for plans, programmes and projects in industrial sectors that have environmental impacts. The same is true with regard to the permitting of activities. Public participation and consultation in the decision-making process, particularly at the local level, needs to be strengthened.

There are no strategic documents in place to set sustainability goals and provide a framework for sustainable development. The Kosovo Strategy for Environmental Protection 2013–2022, an updated review of the Environmental

Strategy (2005–2015), will provide a framework for enhancing sustainable management of natural resources once it has been approved by the Government.

In Montenegro, horizontal legislation is to a large extent aligned with the EU acquis in terms of environmental issues; there is legislation in place for EIA, SEA, free access to information, liability for environmental damage, etc. Action plans for administrative procedures to implement legislation are also in place.

The framework documents governing sustainable development and setting related framework objectives are the National Strategy for Sustainable Development until 2030 (prepared in 2016) and the National Strategy with Action Plan for transposition, implementation and enforcement of the EU acquis on Environment and Climate Change until 2020 (prepared in 2016).

North Macedonia is at an advanced stage in terms of transposing horizontal environmental directives. Further work is needed on transposing and implementing the remaining horizontal environmental directives, such as the Environmental Liability Directive and the Environmental Crime Directive that regulate horizontal issues affecting the implementation of water management legislation. The EIA legislation needs to be amended in order to transpose the requirements related to climate change projects and to address issues in relation to public participation in the EIA process. There is room for improvement in terms of implementing and enforcing the SEA legislation. The EU Integrated Pollution Prevention and Control (IPPC) Directive has been fully transposed into national legislation. Regarding access to environmental information, there is a need for some improvement related to rules on exceptions and reasonable fees for access to environmental information.

Since 2008, a number of strategic documents have been adopted that govern sustainable development and set sustainability objectives. The National Strategy for Sustainable Development 2009–2030 (adopted in 2010) and the Second National Environmental Action Plan (NEAP 2) are among them.

Interministerial bodies to address the SDGs (in Albania) and specific issues, for example the Water Council (Kosovo) and the Solid Waste Management Committee (Albania), have been established.

9.2.2 Water management

In Albania, additional work is necessary in relation to legislative alignment with the acquis on water quality and administrative capacity for water management. The Water Framework and Bathing Water Directives have been largely transposed, and responsibilities partly clarified. However, more effort to align with the directives on groundwater is required, and regulations to strengthen implementation are not yet in place. Most of the EU legislation is currently being adapted to Albanian conditions.

Four water management pillars have been defined:

- water for the people, i.e. drinking water and sanitation
- water for food, i.e. agriculture
- water for industry, i.e. hydropower, hydrothermal sources, heavy industrial activities, solid waste management, fishing/aquaculture, shipping/recreation
- water for the environment, i.e. protected areas, wetlands and forests.

Policy, strategic and action documents as well as a consolidated national investment plan relevant to integrated water management are generally lacking.

The country is divided into six river basins. The first river basin management plan for the Drin Basin has been developed.

Investment decisions related to water are often made on the basis of single-sector considerations.

The institutional setting for water resources management is centralized and undergoes regular reform. The Water Resources Management Agency was recently established (2018) as a response to fragmented and overlapping responsibilities between central and local-level institutions. Exercising its new competencies under the Prime Minister's Office, it will operate at the central and river-basin level. The National Environmental Protection Agency is responsible for environmental monitoring.

The institutional capacity of and cooperation between monitoring institutions need to be strengthened.

In Kosovo, the Water Strategy 2017–2034 has a broad, multi-sectoral approach, in line with the principle of IWRM. It is presently under the approval process. The existing law on water does not fully transpose the EU Water Framework Directive. Significant efforts are needed to implement and enforce water legislation. Water management is addressed at the river-basin level. The establishment of river basin management authorities is necessary as a prerequisite for preparing/implementing RBMPs and completing the water monitoring network.

The Ministry of Environment and Spatial Planning (MESP) is the line ministry for water resources management, while the Kosovo Environmental Protection Agency (subordinate to the MESP) is responsible for environmental monitoring. The Ministry of Agriculture, Forestry and Rural Development is responsible for irrigation and drainage. There are additional institutions and ministries dealing with water issues. The Inter-Ministerial Water Council is a body of coordination among the competent ministries. There are challenges related to the permitting process that need to be addressed.

In Montenegro, the cost for full alignment with the EU water acquis, assuming compliance in terms of system quality and extension, is estimated at more than €1 billion over a 20-year period to 2035, representing more than 50 percent of the total cost of full compliance with the entire environmental acquis. A river basin management plan for the Adriatic River District, covering the Skadar and Bojana sub-basins, has been prepared.

The Ministry of Agriculture and Rural Development and its Directorate for Water Management is the line institution for water management. Certain responsibilities on water are shared with the Ministry of Sustainable Development

and Tourism, which is responsible for the sustainable use of natural resources, strategic integration and processes for the environment, integrated protection against marine pollution, coordination of regional water supply systems, environmental monitoring and so forth. The National Council for Sustainable Development, Climate Change and Integrated Coastal Zone Management was established to provide advice to the Government of Montenegro on policy issues. The Agency for Nature Protection and Environment deals with the issuance of all environmental permits, except for water, which are under the competence of the Water Administration. Similarly, the agency covers all environmental monitoring, apart from water monitoring.

In North Macedonia, the water-related directives are transposed but the body of secondary legislation needs to be enriched. Some work is required to develop definitions and provisions that would enable implementation in relation to, for example, identification of surface and underground water bodies and setting of emission limit values; analysis of river basin district characteristics, of significant pressures and impacts of human activity, and of economic aspects of water use; determination of pollutants or indicators of pollution in groundwater in accordance with the acquis requirements. An adequate and clear permitting, pricing and inspections system is missing. Consequently, environmental objectives for surface and groundwaters cannot be achieved. Some work on the subsidiary legislation concerning the hydrological monitoring of water bodies is also necessary. There are management plans for Lake Prespa and for Lake Ohrid.

The Ministry of Environment and Physical Planning (MEPP) and the Ministry of Agriculture, Forestry and Water share responsibilities. Decentralizing some responsibilities of the MEPP and its Department of Waters would enable it to better perform its basic role of planning and implementing policies on water resources management. The establishment and management of the international river basin districts is a competence shared between the MEPP and the Ministry of Foreign Affairs.

9.2.3 Wastewater and solid waste management

The main challenges regarding waste management are related to poorly defined roles and responsibilities at various levels of government, weak enforcement of laws, a low level of administrative and institutional capacity to implement existing legislation and a lack of policies and measures for recycling or processing waste.

The legal frameworks of the Drin Riparians are partially aligned with the EU acquis in this field. Considerable efforts are needed to develop and implement national strategies and laws on waste management that concentrate on clarifying the roles and responsibilities of various institutions, implementing local waste management plans, strengthening financial and administrative capacities at the municipal/local level, improving systems to separate waste collection, increasing the effectiveness of waste management planning, and addressing the management of hazardous waste. The situation in relation to waste management in each of the countries is summarized as follows:

In Albania, the strategic framework is partly in place, including the National Strategy of Water Supply and Sewerage 2011–2017 (which is currently being updated) and a master plan on water supply and wastewater treatment plants. The Government approved the National Inter-Sectoral Waste Management Strategy 2010–2025 and the National Waste Management Plan 2010–2025. However, there is insufficient alignment with the directive on urban wastewater treatment and a lack of regulations to strengthen implementation. The number of operational wastewater treatment plants and waste management systems is low. The hazardous waste management system is very weak and most waste collection is carried out by the private sector, which also owns the recycling facilities. Public awareness on waste management is low.

In Kosovo, the legal framework is partially aligned with the EU acquis. Basic waste management definitions and concepts, such as recycling and recovery of different waste streams, are not sufficiently supported by current legislation. Nevertheless, the draft master plan that has been finalized defines the concept of waste prevention, reuse and recycling. Despite initiatives and individual projects in Kosovo, there is no general system for recycling, reusing or treating waste. Defining appropriate policies and increasing law enforcement are areas that require work, particularly given the high number of illegal landfills that need to be addressed. An increasing number of municipalities are developing their local waste management plans in accordance with objectives and targets set at the national level. Institutional capacity to implement the existing legislation is low as the competences of many institutions have not yet been clearly defined; the strategy currently in place aims to address such issues and determine the main objectives and activities for the next ten-year period related to the integrated management of waste.

In Montenegro, wastewater treatment is regulated by law, in accordance with the Urban Waste Water Treatment Directive (UWWTD). The following strategic documents for implementation of measures defined by the UWWTD were adopted in 2005: (i) the Strategic Master Plan for Sewerage and Waste Water in the Central and Northern Region of Montenegro and (ii) the Master Plan for Waste Water Management on the Coast of Montenegro and in Cetinje Municipality. Both were revised in 2017 in compliance with the UWWTD. Wastewater treatment plants in settlements with 2,000 population equivalent are scheduled to be constructed by 2029, by which time over 90 percent of the population will be connected to the sewage network.

While the strategic and legal framework for the solid waste management sector is fairly developed, a number of EU acquis provisions are yet to be transposed into national legislation. Considerable efforts are needed to ensure implementation of the national strategy for waste management to 2030 and the 2015–2020 national waste management plans. According to the Law on Waste Management and municipal regulations, local governments are responsible for collecting municipal solid waste. Municipal public utility companies registered for waste management activities are operated as separate legal entities.

In North Macedonia, the waste-management-related legal framework is partially aligned with the EU acquis. Further alignment of legislation related to special waste streams has commenced and the National Waste Prevention Plan is being prepared. The Mining Waste Directive is in the process of being transposed, while transposition of the Sewage Sludge Directive and the Waste Electrical and Electronic Equipment Directive has advanced. The Law on Waste Management was amended in 2012 as a precondition for introducing a regional system for integrated management of municipal waste. The implementation of the waste directives is still at an early stage. Regional waste management plans and technical documentation for establishing waste management centres have been developed.

Almost all municipalities have sufficient administrative and financial capacities to establish networks of facilities for waste treatment, recycling and disposal. The process of establishing an integrated municipal waste management system has started. Regional waste management bodies have been set up in some regions of the country and the procedure for issuing concessions for regional municipal waste landfills has been launched in others; however, they suffer from a lack of administrative and financial resources and are not fully operational. Efforts to close non-compliant landfill sites and establish regional waste management centres continue.

9.2.4 Agriculture

In Albania, the Government considers the agricultural sector to be of crucial importance for the country's economic development and hopes to boost agricultural production by providing financial support to farmers and facilitating private investment in the agro-processing sector. Over the last five years, the Government has allocated on average US$10 million annually to develop fruit and olive orchards, vineyards, greenhouses and storage capacities in direct support for rural development. Albania does not have a separate strategy for land protection, although land protection and sustainable use are mentioned in several other sectoral strategies, including those for agriculture and rural development. The draft Strategy for Irrigation, Drainage and Flood Protection in Albania has been finalized and is awaiting approval from the Council of Ministers.

In Kosovo, the Environmental Protection Strategy 2013–2022 includes a chapter on agriculture in the context of development goals, which emphasizes the protection and rational use of agricultural land, support for organic production, control of the use of fertilizers and pesticides and the protection of native species of plants and animals that are at risk. The Strategy on Climate Change includes measures for adaptation to climate change in the agricultural sector, while greenhouse gases from this sector are inventoried. Illegal changes in agricultural land use remain an obstacle for the development of this sector and undermine the effective implementation of the Law on Spatial Planning, yet there is no strategy or action plan to address illegal changes in land use. Kosovo has no irrigation plan and lacks minimum standards and cross-compliance measures in the areas of food safety, animal health and welfare and the environment.

In Montenegro, agriculture is regulated on the basis of the principles in the EU Good Agricultural Policy; more work is necessary to reach the EU acquis standards. The Strategy for Agriculture and Rural Development 2015–2020 does not include specific provisions to address issues related to water use in agriculture, food production and fisheries. Protection of groundwater sources located in river valleys whose catchment areas include settlements, industry and intensively used agricultural areas is a serious challenge. One example is the protection of groundwater in the Zeta plain and wider Lake Skadar area. Implementation of the Nitrates Directive in Montenegro is regulated by the Water Law and the Law on Plant Protection, both implemented by the Ministry of Agriculture and Rural Development.

The main legal framework for the agricultural policy in North Macedonia is defined by the Law on Agriculture and Rural Development and the Law on Agricultural Activity that regulate the conditions and conduct of agricultural activities and set out users of water for irrigation purposes. The enforcement measures do not include fines. There is no system established to evaluate the effectiveness of measures taken in the agricultural sector to reduce pressures to the level needed to achieve the status required by the Water Framework Directive.

The National Agriculture and Rural Development Strategy (2014–2020) is the basic strategic planning document. An agricultural holding may cover one or several production units. The agricultural holdings may establish agricultural cooperatives as users of waters for irrigation. Protecting waters from nitrates is a major issue. The Code of Good Agricultural Practices has been adopted but is not consistent with the Water Law.

The Ministry of Agriculture, Forestry and Water Economy (MAFWE) is the competent authority for planning, monitoring and evaluation of the agricultural policy measures and instruments, while the Agency for Financial Support in Agriculture and Rural Development is responsible for the implementation and control of the agricultural policy measures.

9.2.5 Nature protection

Nature protection priorities include the establishment of the Natura 2000 network, strengthening the capacities of protected area authorities, and implementation of regulations concerning the obligations of hydropower investments to protect nature. Administrative capacities will have to be significantly strengthened, in particular in relation to the application of the Habitats Directive and Birds Directive.

In Albania, there is partial alignment with the acquis on nature protection. Transposition of the main directives, namely the Habitats Directive and the Birds Directive, has been largely achieved, reaching a transposition rate of over 80 percent. A number of laws in the field of nature protection and biodiversity have been drafted and approved since 2006. The 2016–2020 strategic policy documents on protecting biodiversity were adopted. The ecological impacts of hydropower plants and projects are not properly assessed to ensure compliance with relevant EU nature legislation.

Responsibilities regarding nature protection lie with the Ministry of Tourism and Environment and its Directorate for Biodiversity and Protected Areas, under the Directorate of Forestry and Biodiversity. The National Agency of Protected Area (NAPA) uses management plans for the network of protected areas and other natural networks such as Natura 2000.

In Kosovo, alignment with the acquis on nature protection, in particular the Habitats Directive and Birds Directive, has only begun. Designated protected areas are not effectively protected. There are neither management bodies nor management plans for protected areas; monitoring and enforcement is missing. The laws do not define the actions allowed or prohibited in the national parks.

MESP coordinates activities in the field of environmental protection. The Environmental Inspectorate is responsible for inspection and control of activities that are potentially harmful to nature.

In Montenegro, the Law on Nature Protection governs most issues in the field. Other specific aspects on nature protection are governed by other laws including the Law on National Parks, the Law on Forests and the Law on Hunting. The National Biodiversity Strategy and Action Plan (NBSAP) 2016–2020 is a framework document; individual nature and biodiversity protected areas are covered by sectoral strategies.

The Ministry of Sustainable Development and Tourism (MSDT) has overall competences with regard to environmental protection. The Agency for Nature Protection and Environment (the executive body within MSDT) is the key institution for the implementation of nature protection regulations. The agency is responsible for issues concerning the monitoring of natural habitats and species. Competences are shared with a number of other ministries, most importantly the Ministry of Agriculture and Rural Development in the areas of forestry, fishery and game protection. The Public Enterprise for National Parks is responsible for the management of national parks. Each of the national parks is managed by semi-autonomous bodies that report to the Public Enterprise. These bodies monitor compliance with the laws related to construction, fishing, hunting and so on. The Public Enterprise is partly self-financed (income earned from different uses of the national park assets, including entrance fees).

In North Macedonia, alignment with the acquis in the field of nature protection, in particular the Habitats Directive and Birds Directive, has advanced. The Law on Environment and the Law on Nature Protection Regulation for protected areas management regulate allowed activities, licensing procedures, data management and so forth. A national strategy and action plan for nature protection will be prepared. Initial steps have been taken to establish and manage the Natura 2000 network. This encompasses additional harmonization of national legislation with EU directives related to nature protection. A strategic approach for the protection of nature in line with the EU acquis is necessary in relation to hydropower development.

Protection and monitoring of nature, and biodiversity conservation fall within the responsibilities of the MEPP and the MAFWE. The State Inspectorate for the Environment within the MEPP has a major role in enforcing legislation. The MAFWE has management authority over forests and regulation in the field of hunting, fishing and plants protection.

The protected areas management system is decentralized. The MEPP holds regulatory responsibilities, while a range of other entities manage the protected areas. Overlapping of competences need to be addressed. The rights and responsibilities of landowners, concessionaires, local authorities and other statutory bodies in protected areas (including national parks) are not clearly defined, leading to inappropriate or illegal use of resources. Protected areas within the Drin Basin have a management plan.

9.2.6 Forest management

An overly restrictive legal framework limiting the rights of forest owners and users has hampered the application of sustainable forest management practices. There is a need to strengthen capacities in the field of municipal forest management by involving local communities, owner associations and other stakeholders in the preparation of forest management plans.

In Albania, work to approximate the legislation to the EU directives is complete. Structures and capacities for the implementation and/or enforcement of all legal provisions are weak.

Forest and pastureland are under the jurisdiction of the Ministry of Tourism and Environment and its Forestry and Biodiversity Directorate. Local authorities have the right to use and manage some of the forests (40 percent of total forests owned by the State) and accordingly they are responsible for drafting forest management plans and establishing the administrative bodies for developing the forest inventory. Public forest management in Albania is not centralized; responsibilities for forests and pastures have been transferred to 315 local government units that are supported through management plans. The monitoring of forests and collection of data are spread between different institutions. Illegal and/or unregulated logging is continuing despite government efforts to control it. In February 2016, the Law on the Moratorium in Forests introduced a 10-year ban on logging for industrial purposes and export but guarantees the supply of firewood to the population.

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In Kosovo, the Forest Law and other laws with a bearing on forestry generally lack enforcement due to inadequate secondary legislation and a lack of institutional capacities including unclear division of roles and responsibilities between central government and local authorities.

Forestry is under the jurisdiction of the Ministry of Agriculture, Forestry and Rural Development and managed through the Kosovo Forestry Agency and the Agency for Agricultural Development. The main responsibilities of the Kosovo Forestry Agency include: implementation of the forestry legislation and forest policies; administration and management of the public forest and public forest lands; and issuing permits for wood and non-wood products. There is extensive illegal logging.

In Montenegro, the strategic and legal framework for forest management is relatively new and to a large extent harmonized with good practices from EU countries, particularly the Strategy and Plan for Forests and Forestry Development (2014). The main issues in forestry management derive from the complex administrative structure and system of responsibilities.

The Ministry of Agriculture and Rural Development and its Forestry Department are responsible for the development and implementation of forestry and rural development policies, legal and strategic documents and plans. The Forest Administration is the State body responsible for the management and protection of State-owned forests as well as for professional activities related to private forests. Responsibilities with regard to the protection of forests are shared with MSDT, which is a competent authority with regard to the Natura 2000 network and related EU acquis. Inspection of forests falls to the Administration for Inspection Affairs.

In North Macedonia, logging is regulated; the land must be left in good condition for regeneration. Reforestation is widely exercised. General/national as well as special forest management plans are prepared by the MAFWE, which also performs on-site inspections and issues licenses.

The public forest enterprise Makedonski Sumi reports to the MAFWE and is responsible for the management of public-owned forests that are not within protected areas. The State Forestry Inspectorate is responsible for supervising the enforcement of the provisions of various laws and regulations. Forest management plans are prepared by the MAFWE, which also performs on-site inspections and issues licenses.

9.2.7 Fisheries

In Albania, the fisheries sector is poorly regulated. Institutional coordination and capacities are missing, as are effective monitoring of fish populations or the fishing fleet. Law enforcement is minimal due to insufficient human resources and the lack of financial resources and equipment.

Responsibilities for fisheries management (since September 2013) is with the Ministry of Agriculture and Rural Development. The Fishing Inspectorate is responsible for the enforcement of the related legislation. The Advisory Commission on Fishing and Aquaculture is a consultative body to the Ministry of Agriculture and Rural Development, defining rules and regulations and even drafting management and development plans. Fishery Management Organizations (FMOs) organize the fisheries sector in inland and marine waters, manage

the fishing ports and, in partnership with the Albanian Government, co-manage fisheries in marine and inland water habitats. Each FMO is responsible for drafting a management plan for fishing that defines the number of fishing licenses and controls/regulates the prohibition of fishing in spawning periods and areas. FMOs have been established in the Prespa, Ohrid and Shkodër lakes. Illegal fishing is practised.

In Kosovo, both the legislative framework and the institutional capacities are inadequate. Law enforcement is an issue. The issue of ownership of previously State-owned aquacultures is not addressed.

The Ministry of Agriculture, Forestry and Rural Development is responsible for fisheries, including the control and regulation of fishing. The Kosovo Federation for Recreational and Sport Fishing and 15 local fisher associations also have some responsibilities.

The Fisheries Strategy of Montenegro 2015–2020 and Action Plan for transposition, implementation and enforcement of the EU acquis was adopted to structure the process of aligning national legislation with the EU Common Fisheries Policy and other rules and regulations. The strategy does not include specific measures focused on freshwater fisheries. However, a draft Law on Freshwater Fisheries has been prepared.

The Ministry of Agriculture and Rural Development (MARD) is the line ministry. The Administration for Inspection Affairs is responsible for inspecting fisheries.

In North Macedonia, according to the Law on Fisheries and Aquaculture, the authorized institution must prepare a six-year management plan for each fishing category (commercial fishing, sport fishing and fish production) and submit it to the MAFWE (which has overall responsibilities for fisheries) for adoption. In the cases of the Ohrid and Prespa lakes, the authorized institution is the Hydro-Biological Institute. There are management plans for the Fishery Basin of Black Drin (2011–2016), the Fishery Basin of Lake Ohrid (2011–2016) and the Fishery Basin of Lake Prespa (2011–2016) and there are concessions granted. Concessions for breeding of fish and water birds and commercial fishing may also be granted. The Government has adopted a decision for granting a concession for commercial fishing to a private company.

9.2.8 Hunting

In Albania, the Directorate of Biodiversity and Protected Areas of the Ministry of Tourism and Environment is responsible for the licensing of hunters as well as for monitoring related activities. The Forestry Service Directorates established in each district are responsible for day-to-day administration of protected areas, including wildlife and game hunting. Enforcement of legislation needs considerable improvement. Due to widespread illegal hunting, the Government declared a ban on hunting in 2014, which it extended in 2016 for the next five years.

In Kosovo, hunting is regulated by the Law on Hunting and a 10-year management plan. Designated hunting areas can be private (none at present), common (20 are established) or of special importance. Hunting is not allowed in nature protected areas such as national parks. Low institutional capacity affects the level of monitoring, making illegal hunting an issue.

The Ministry of Agriculture, Forestry and Rural Development has the competency for regulating hunting.

In Montenegro, the legislative framework for hunting is adequate in many areas and is based on good practices: planning is hierarchical and multi-phased, parameters of hunting grounds take into account the large-area needs of game species and the legislation requires data collection on population and status of managed species and culled animals, while it contains multiple safeguards to ensure hunted species do not become endangered (such as hunting seasons, refuges where hunting is banned, protection of reproductive categories for species where the aim is to increase population size).

MARD – and its Directorate of Agriculture and Directorate of Forestry and Hunting – is the responsible institution. The ministry cooperates with the Hunting Association of Montenegro to develop related legal and strategic documents, including the National Hunting Plan. Hunting units associated with the Hunting Association administer the hunting grounds and develop their Management Programme in compliance with the National Hunting Plan. Inspection of hunting activities falls to the Administration for Inspection Affairs.

In North Macedonia, hunting areas are found in protected areas, with activities regulated by the Law on Nature Protection. An amendment to the Law on Hunting introduces a new category of hunting grounds – special purpose hunting grounds within the territory of national parks – and rules for granting concessions. Hunting areas are established by the Government in accordance with the National Spatial Plan.

MAFWE is the line institution. The State Forestry and Hunting Inspectorate is responsible for supervising the enforcement of the provisions of various laws and regulations on hunting.

9.3 Key observations from the TDA on the institutional and legal settings in the Drin Basin

The analysis highlighted the need for further work in all areas related to basin management:

- approximating legislation to the EU acquis
- strengthening institutional capacities in policy development and implementation
- strengthening enforcement of policies and legislation
- strengthening overall water management including practices and enforcement of water abstraction licences
- improving waste management
- introducing and implementing management tools other than command and control, such as incentives and disincentives
- improving the management framework of protected areas
- promoting sustainable land-use planning and sustainable use of natural resources
- increasing public participation in environmental decision-making and availability of environmental information.

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