



Lake Shkoder Transboundary Diagnostics Analysis

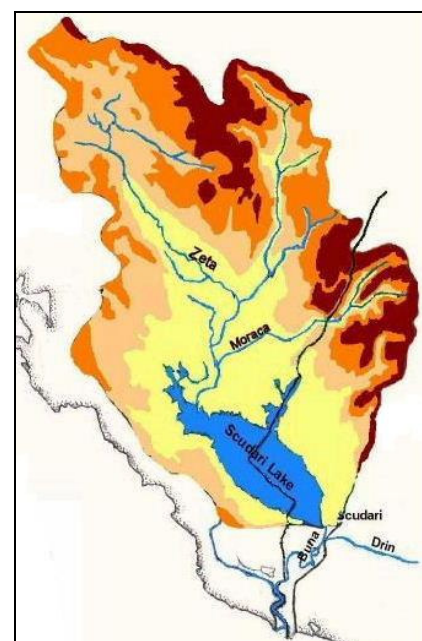
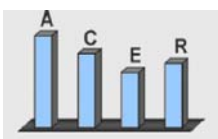
Albania & Montenegro

World Bank (IBRD)

20 April 2006

Final Report: Main Document

9P6515




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Document title	Lake Shkoder Transboundary Diagnostics Analysis Albania & Montenegro
Document short title	Lake Shkoder TDA
Status	Final Report: Main Document
Date	20 April 2006
Project name	Lake Shkoder Transboundary Diagnostics Analysis
Project number	9P6515
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Client	World Bank (IBRD)
Reference	9P6515/R/FKE/Nijm

**ABBREVIATIONS AND ACRONYMS**

ACER	=	Albanian Center for Economic Research
Alb.	=	Albania
a.s.l.	=	above sea level (Adriatic Sea)
BOD	=	Biological Oxygen Demand
CARDS	=	Community Assistance for Reconstruction, Development and Stabilisation
CETI	=	Ju Centar za Ekotoksikoloska Ispitivanja Crne Gore (Center for Ecotoxicological Research of Montenegro)
COD	=	Chemical Oxygen Demand
COOPI	=	Cooperazione Internazionale (Italia)
EAR	=	European Agency for Reconstruction
EC	=	European Commission
EEA	=	European Environment Agency
EIA	=	Environmental Impact Assessment
EU	=	European Union
FMO	=	Fishery Management Organisation
Geozavod	=	Institute for Hydrogeology and Engineering Geology, Serbia and Montenegro
GIS	=	Geographic Information System
HMI	=	Hydrometeorological Institute (Albania, Montenegro)
IBRD	=	International Bank for Reconstruction and Development (World Bank)
IEE	=	Initial Environmental Examination
IPPC	=	Integrated Pollution Prevention and Control
IUCN	=	International Union for the Conservation of Nature
KAP	=	Kombinat Aluminijuma Podgorica (aluminium factory)
KNMI	=	Koninklijk Nederlands Meteorologisch Instituut
MAFWR	=	Ministry of Agriculture, Forestry and Water Resources
MEPPP	=	Ministry of Environmental Protection and Physical Planning (M.N.)
M.N.	=	Montenegro
MoE	=	Ministry of Environment (MoE)
MoU	=	Memorandum of Understanding
MPAS	=	Methylene Blue Active Surfactants (detergents)
NGO	=	Non-Governmental Organisation
NPMN	=	National Parks of Montenegro
PIU	=	Project Implementation Unit
POP	=	Persistent Organic Pollutants (e.g. DDT, PCB)
PPU	=	Project Preparation Unit
RBMP	=	River Basin Management Plan
REA	=	Regional Environmental Agency (Albania)
REC	=	Regional Environmental Center
REReP	=	Regional Environmental Reconstruction Programme
RH	=	Royal Haskoning, Dutch consultancy firm
RS	=	Remote Sensing
SAP	=	Strategic Action Plan (Lake Shkoder/ Skadar)
SNP	=	Skadar Lake National Park
TDA	=	Transboundary Diagnostics Analysis
ToR	=	Terms of Reference
UMN	=	University of Montenegro
UNEP	=	United Nations Environment Programme
UNDP	=	United Nations Development Programme
USAID	=	United States Agency for International Development
WB	=	World Bank
WFD	=	Water Framework Directive (European Union)
WHO	=	World Health Organisation
WWF	=	World Wide Fund for Nature

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1 PROJECT BACKGROUND AND OBJECTIVES

1.1 Introduction

This Final Report for the Lake Shkoder Transboundary Diagnostics Analysis (TDA; Albania and Montenegro) concludes ten months of data search, meetings, interviews, field visits, analyses and reporting regarding Lake Shkoder and its environs. Sections 1.2 and 1.3 describe the project context and objectives. The people and institutes executing the TDA are mentioned in Section 1.4, while the stakeholders met and the areas visited are listed in Section 1.5.

Lake Shkoder is known under various names, depending on the language. Skadar Lake (Serbian: Skadarsko jezero), Lake Shkodër or Lake Shkodra (Liqeni i Shkodrës in Albanian), also sometimes called Lake Scutari (Lago di Scutari in Italian). It is named after the city Shkodra or Shkoder (Skadar, Scutari) in northern Albania. In this report the name 'Lake Shkoder' will be used, unless it concerns the title of a book, article, institute, citation etc. The city is spelled in this report 'Shkodra', to avoid confusion with the lake.

1.2 Project context

The TDA is a preparatory study for a larger project, the Lake Shkoder Integrated Ecosystem Management Project. The TDA started 1 May 2005 and was completed 1 March 2005.

The overall objective of the Lake Shkoder Integrated Ecosystem Management Project is to assist the Governments of Albania and Montenegro in achieving more sustainable use of the natural resources of Lake Shkoder and its watershed. The global environmental objective of the project is to reduce pollution and conserve the lake and its biodiversity as an internationally important natural habitat, especially for waterfowl. Because of the complex nature of the lake's problems, the project would pursue an integrated approach to land and water issues, by promoting cross-sectoral cooperation throughout the watershed. The project will achieve its objectives by implementing priority measures as identified in the Lake Shkoder Strategic Action Plan, that will be prepared jointly by both countries.

1.3 Project objectives and expected results

A Transboundary Diagnostic Analysis (TDA) is defined by GEF as "a scientific-technical assessment by which environmental issues affecting international waters in a region are identified and quantified, their causes analyzed and their impacts assessed, and the main actions needed to improve the problem are identified.". The TDA should lay the foundation for the preparation of the Strategic Action Plan.

According to the ToR, the baseline analysis for the TDA should assess the state of the environment and the trends in natural resource use and condition in Lake Shkoder and its watershed. Using these data, the TDA should then identify and quantify the environmental threats to the lake outlined in each category above. Finally, the TDA should identify options to address the identified problems and develop strategic recommendations for the lake's conservation that fit the scope of the funding available for this project through the GEF.

The ToR specifies the essential objectives of the TDA as follows:

1. Working with appropriate technical counterparts in Albania and Montenegro, gather relevant physical, chemical, biological, and legal data about the lake.
2. Evaluate the important sources of toxic pollution in the watershed and to the extent possible, quantify their impacts by conducting a preliminary ecological risk assessment.
3. Predict the most important potential environmental impacts of the proposed project for altering lake water levels by lowering the Buna-Bojana channel bed by evaluating the area and types of land exposed, the impacts on groundwater flows to the lake, the potential impacts to critical fish spawning and bird habitats, and the effects on water quality.
4. Evaluate the relative importance of overfishing, destructive fishing practices, habitat change (including barriers in the Buna-Bojana River), and pollution as sources of the declines in commercial fish populations in the lake.
5. Inventory farming practices in the watershed and assess the impacts on water quality.
6. Project the most significant threats to critical habitats and biodiversity in the watershed.
7. Identify key natural resource and environmental data gaps and recommend the most practical and cost effective ways to fill these data gaps.
8. Inventory and evaluate the existing institutional and regulatory systems for lake management at the national and transboundary level. Evaluate enforcement of environmental laws in both countries.
9. Analyze the sustainability of the existing modalities of natural resource use (especially of fishing), as well as practical alternative opportunities for livelihood (for example, eco-tourism and handicraft production).
10. Propose a pathway towards a suitable, bilateral management structure for Lake Shkoder that might practically be implemented over the project period, including the sequencing of steps in the pathway.
11. Recommend small (up to \$30,000) and medium (\$50-100,000) investments that might be incorporated into the Strategic Action Plan.

The following objective is added by the Consultant to the above 11 points:

12. Identify plans that are likely to affect the water quality and/or ecology of Lake Shkoder (e.g. new industries, marinas, roads).

The expected result (project output) of the TDA is a report that summarizes all the data collected and analyses conducted. It should contain the following sections:

1. Executive Summary: Concisely presents and discusses the most significant findings and recommended actions.
2. Baseline analyses: Describes the data bases available in each country, clearly indicating the accuracy, completeness, and availability of each major data source. Include maps, figures, and tables as appropriate. Summarizes basic findings about the current state of the environment.
3. Environmental threats and most significant management challenges: Discusses the major threats and challenges, making clear the level of uncertainty associated with predictions about trends and future conditions. Identifies critical data gaps and missing information.

4. Analysis of potential ecosystem management actions: Recommends potential strategies for addressing the most significant environmental threats. Although comments about large scale environmental mitigation measures might be provided for context, the focus should be on small and medium scale investments that might be accomplished within the scope of this project. The recommendation might include environmental mitigation measures, limited and focused environmental monitoring, capacity development and training, and other areas of intervention.
5. Appendices: These should include any data used in the TDA but not included in the body of the report, records of coordination meetings in each country, lists of additional project contributors, and other materials as needed to completely document the work presented and support the development of the Strategic Action Plan.

1.4 Consultant team

The TDA is executed by specialists from Royal Haskoning (Netherlands), Geozavod (Serbia-Montenegro) and ACER (Albania).

Royal Haskoning

Haskoning Nederland B.V., a company of Royal Haskoning, with its head office in Nijmegen, the Netherlands, is an independent, world-wide operating multi-disciplinary consultancy firm with a staff of about 3,000. The Advisory Group 'International Water Resources and Ecology' is responsible for the TDA. Haskoning has the lead of the TDA and is responsible for overall co-ordination, data processing and reporting to the World Bank.

Geozavod - Institute for Hydrogeology and Engineering Geology

Geozavod is a leading Serbian institution in geological and hydrological research based in Belgrade and with a staff of almost 100 people. It realises scientific research and exploration works in the field, in desk reviews and in laboratories. Geozavod is sub-contracted by Haskoning and is responsible for co-ordination of the specialists in Montenegro.

ACER - Albanian Center for Economic Research

ACER is an NGO based in Tirana and provides consulting services and technical assistance and training in, among others, the field of environment. ACER's core team comprises 10 permanent staff members and has collaborating experts in many districts of Albania, but is in particular familiar with Shkodra. ACER is sub-contracted by Haskoning and is responsible for co-ordination of the specialists in Albania.

Further details of the involved companies can be found on Internet (www.royalhaskoning.com, www.geozavod.net, www.balkanetwork.org/albania.htm) and in the Technical Proposal for this TDA.

Experts involved

Royal Haskoning, Geozavod and ACER provided the experts for the TDA. They are, in alphabetical order:

<i>Name</i>	<i>Position</i>
Gjeta, Zef (ACER)	Agronomist
Goffau, Ad de (Haskoning)	Geohydrologist
Gulan, Alexandra (Geozavod)	Co-ordinator Geozavod Specialists
Haxhimihali, Enio (ACER)	Environmental Law and Policy Analyst
Hetoja, Agron (ACER)	Co-ordinator ACER Specialists
Ivanovic, Stanisa (Geozavod)	Environmental Hydrogeologist
Kapidani, Eqerem (ACER)	Fisheries Biologist
Kashta, Lefter (ACER)	Interdisciplinary Aquatic Ecologist
Keukelaar, Frank (Haskoning)	Team Leader and General Co-ordinator
Maren, Marion van (Haskoning)	Biologist
Misurovic, Ana (Geovazod)	Water Quality and Ecotoxicology Expert
Pradhan, Trilokya (Haskoning)	Agronomist and Water Resources Engineer
Prifti, Argile (ACER)	Hydrologist
Sutmuller, Guus (Haskoning)	Institutional Specialist
Uskokovic, Borislav (Geozavod)	Rural Economist / Environmental Sociologist

Several other specialists are involved when required to cover issues that fall outside the expertise of the above-mentioned people. The specialists are all working in the field of environment and familiar with Lake Shkoder and its basin. They have access to the majority of the existing data.

1.5 People met, areas visited, and activities undertaken

People met

The team leader visited the project area in the periods 9 to 20 May, 4 to 10 September and 11 to 17 December 2005. He visited the following institutes and people (alphabetically):

Albania

- Euronatur: Martin Schneider-Jacoby (Project Manager)
- GEF Shkodra: Agim Shimaj (Coordinator)
Belrima Balliaj (Environmental Specialist)
- GTZ Shkodra: Edlira Kruja (Coordinator)
- GTZ Tirana: Ismail Beka (Coordinator)
- Hydrometeorological Institute: Emirjeta Adhami (Head Environmental Dept.)
Manjola Banja (Deputy Director)
- Maize & Rice Institute, Shkodra: Ilia Leka (Head Laboratory)
Zhaneta Miloti (Biochemist)
- Ministry of Agriculture and Food: Roland Cristo (Director Fishery Directorate)
- Ministry of Environment: Mirela Kamberi (Director of Pollution Prevention)
Narin Panariti (Dir. of Policy, Integr. and Legisl.)
Pellumb Abeshi (Secretary General)
Zamir Dedei (Director of Nature Protection)
- REC Shkodra: Djana Bejko (Project Manager)
- REC Tirana: Mihallaq Qirjo (Country Director)
- Regional Environm. Agency, Shkodra: Ilir Zajs & colleagues
- Shkodra Municipality: Deputy Mayor

- University of Shkodra: Adem Bekteti (Environmental Chemist)
Marash Rakaj (Phytoplankton Specialist)
Nevila Bushati (Microbiologist)

Montenegro

- Ecotoxicological Research Center: Danijela Sukovic (Assistant Director Technical Issues and Laboratory)
- Hydrometeorological Institute: Luka Mitrovic (Director)
Ljubica Vulovic (Senior Consultant)
- Ministry of Agriculture, Forestry and Water Management: Nikola Spahic (Head Inspector Waterpower)
- Ministry of Environmental Protection and Physical Planning: Victor Subotic (Project Manager)
- Municipality of Podgorica: Dordije Vukcevic (Deputy Mayor of Podgorica)
Veselinka Vukcevic (Envir. Department)
- National Institute for the Protection of Nature: Darko Saveljic (Ornithologist)
Vasilije Buskovic (Environmental Consultant)
Zlato Bulic (Director)
- National Parks of Montenegro: Rade K. Gregovic (Director)
- National Park of the Skadar Lake: Zoran Mrdak (Director)
- REC Podgorica: Snezana Dragojevic (Project Officer)
Srna Sudar Vilotic (Field office head)
- University of Montenegro: Branko M. Radujkovic (Professor, Biology Dept.)
Svetlana Perovic (Microbiologist)
- World Bank, Belgrade: Nikolai Ilie (Senior Rural Development Specialist)

The specialists each involved their own local network and sources for information and data procurement.

On 13 December a feedback meeting was organised in Shkodra with 12 staff members from Shkodra University, and on 15 December in Podgorica with representatives of Skadar Lake National Park, the Institute for the Protection of Nature, and the REC.

Areas visited

The specialists from Montenegro and Albania are all familiar with Lake Shkoder and its environs, on both sides of the boundary. Some of them guided the team leader during his visits around the lake and in the basin.

In Montenegro the following areas inside the Lake Shkoder basin were visited:

- Podgorica and the Zeta Plain;
- The Moraca Delta wetlands, Vranjina and the northern causeway (north-western corner of the lake);
- The road Podgorica – Cetinje, with views over the lake and part of the basin, and Cetinje;
- The road from Podgorica to the north-eastern side of the lake, leading to Shkodra (Albania), with good views on wetland areas;
- The Buna-Bojana Delta near Ulcinj.

In Albania the following areas were visited:

- The road between Hani i Toti (village at the border with Montenegro) and Shkodra on the eastern side of the lake, adjacent to wetland areas;
- Shkodra town and its environs, the junction of the Drin and Buna-Bojana Rivers;
- The road from Shkodra to Ulcinj, on the right bank of the Buna-Bojana River (looking from MN on the Buna-Bojana delta near Reci and towards Velipoja);
- The villages Shiroka and Zogaj on the southern lake coast.

Activities undertaken

Annex I details the institutions visited, people met and subjects discussed during the missions of the team Leader. The specialists from Geozavod and ACER live in or near the project area. The activities of the project team consisted of the following:

- Contact the key stakeholders and interview them about their role and fields of involvement with Lake Shkoder;
- Make an overview of the environmental information available for Lake Shkoder and its basin;
- Collect, organise and analyse the key data (environment, legislation, plans, institutions) for Lake Shkoder and its basin;
- Describe the current environmental status and trends for Lake Shkoder and its basin;
- Identify information gaps;
- Identify the critical environmental issues for Lake Shkoder and its basin;
- Identify possibilities and investment options to reduce the pressure on the lake;
- Contact the stakeholders for feedback on the findings, conclusions and recommendations by the project team;
- Produce the reports and maintain contact with the Client.

2 ENVIRONMENTAL DESCRIPTION OF LAKE SHKODER AND ITS BASIN

2.1 Introduction

This chapter describes in brief the environment of Lake Shkoder and its basin, and gives an overview of the data that are available. The focus is on the lake itself and its direct surroundings, but subjects at basin or national level that have an impact on the environmental situation of the lake and its near environs are described as well.

For a sound analysis of the environmental situation of Lake Shkoder various types of data are needed. It has become clear that environmental data exist only limitedly in Montenegro and especially in Albania, for the following reasons:

- In the period up to 1989, during the socialist/ communist era, interest in environment was limited, in particular in Albania;
- During and after the changes in the early '90s the economies of both countries were in disarray and poor and did not allow expenses for environmental purposes;
- The social and political unrest in former Yugoslavia in the 1990s disrupted environmental data collection in many areas;
- The political changes in both countries resulted in many institutional and staff changes, and some studies and data sets could not be traced.

In particular systematically collected data is hardly available. Only in recent years data collection and monitoring is expanding, but financial resources still lack for extensive programmes. Some institutes are reluctant to give away their data, as data have an economic value and represent some sort of power.

2.2 Data sources

Various types of data sources can be distinguished:

- Paper and digital reports and other documents;
- Digital databases;
- Maps, aerial photographs and satellite images;
- Experts' knowledge;
- Photographs taken in the field.

These may be available at institutes, archives, libraries, museums, bookshops, with specialists or on Internet. For this TDA all above-mentioned types of data sources have been searched (except for aerial photographs), including a literature search in renowned international databases (Swets, Aqua Science and Fisheries, Google Scholar). All digital data without copyrights will be included on the DVD(s) with the Final Report.

2.3 Overview of data availability in both countries

	Subject	Country	Parameters included	Coverage in space	Coverage in time	Data quality / reliability	Key data collected ?
1	<i>Geology and geomorphology</i>						
	<ul style="list-style-type: none"> Geological processes, formations and structures Geomorph. processes, formations and structures 	Alb. & MN	General processes, structures and materials.	Whole basin of Lake Shkoder.	Latest periods better understood.	Underground karst structures limitedly known.	Only as far as relevant for current ecology in the basin.
2	<i>Climate and hydrology</i>						
	<ul style="list-style-type: none"> Climate Hydrology Water balance and lake water level 	Alb. & MN	Basic parameters. Parameters differ between stations.	Coverage sufficient for ecological purposes. Groundwater data lacking.	Non-continuous.	Quality varies strongly between stations, institutes and periods.	Data only from HMI's at high cost; partly collected through others.
3	<i>Quality of groundwater, surface water, rain and air</i>						
	<ul style="list-style-type: none"> Chemical parameters Physical parameters Micro-biological parameters Pollution sources Geographical areas affected by pollution Impacts of pollution on flora, fauna and humans Impacts of pollution on area use and functions 	Alb.	Project based. Lab equipment primitive.	Project based; no fixed stations.	Very irregular.	Quality varies strongly between stations/ institutes and periods.	Part of the project data collected. Overview lacking.
		MN	Project based, but more data than in Albania. Lab equipment CETI good.	Project based; no fixed stations.	Non-continuous.	Quality of recent CETI analyses good; others unknown.	Most of the existing data collected through CETI.
4	<i>Flora and fauna</i>						
	<ul style="list-style-type: none"> Waterfowl Fish Other fauna (aquatic, terrestrial) Wetland flora Other flora (aquatic, terrestrial) Habitats Status and protection Biodiversity indicators 	Alb. & MN	Only for waterbirds (semi-)regular winter monitoring. Some fish info through licenses/ inspectors. All other flora/ fauna data project based.	Waterbirds well covered lake-wide, others project based.	Semi-continuous for waterbirds, irregular for other flora/ fauna.	Quality varies strongly between projects.	Mainly on waterbirds and fish. Other data only indicative.

	Subject	Country	Parameters included	Coverage in space	Coverage in time	Data quality / reliability	Key data collected ?
5	<i>Institutional context and stakeholders</i>						
	<ul style="list-style-type: none"> Stakeholders (governmental institutions, NGO's, population/ villages, trades etc.) and their interest Institutional context: functions, roles, relations at national and international level 	Alb. & MN	Stakeholders (government, NGO's) are known. Governmental development and reorganisations cause changes in structures and roles.			Collected data quality good, but 'ageing' quickly.	More in-depth data needed for detailed analysis.
6	<i>Socio-economy and population</i>						
	<ul style="list-style-type: none"> Industry Roads and traffic Agriculture (incl. use of fertilisers, pesticides) Fishing (incl. species, methods used, status) Sewage and waste Tourism Land use in the zone bordering the lake Demographic trends Economic trends 	Alb. & MN	For most subjects essential info does not exist or is not accessible (centralised data collection is missing or inadequate).			Quality varies between institutes. Sensitive info is unreliable.	Only indicative data collected for TDA component. More data in social project component.
7	<i>Projects and programmes</i>						
	<ul style="list-style-type: none"> Past interventions Current projects and programmes Plans and expected projects and programmes 	Alb. & MN	Projects and programmes are known. Implementation and actual content depend mainly on availability of funds and institutional collaboration.			Quality varies between institutes. Implementation of many projects uncertain.	Data collected for important projects/ programmes for the Shkodra basin.
8	<i>Environmental policies and legislation</i>						
	<ul style="list-style-type: none"> Environmental policies National environmental legislation International envir. legislation Areas with a special status in the Lake Shkoder basin (zones, parks, reserves) Law enforcement 	Alb. & MN	Details on environmental legislation and policies available. Data on protected areas and law enforcement limited, as these subjects are not well elaborated yet.				Available data collected.

Alb. = Albania

MN = Montenegro

2.4 Geology and geomorphology

2.4.1 Data availability

The geology and geomorphology of the lake basin is complex, but the 'big picture' is clear. The processes and the eras when these took place are known. Details of some faults and formations are missing, as well as the exact karstic underground structures (caverns, pipes) and groundwater flow. Maps and cross-sections of the area exist. Enough information on geology and geomorphology (and soils) is available for the purpose of the Lake Shkoder Integrated Ecosystem Management Project. There is only an important knowledge gap in groundwater flow, in particularly related to the karst features.

The main data sources are the Academies of Science (Podgorica, Tirana), the Universities of Montenegro, Shkodra and Tirana, the Institutes of Geological Research (Podgorica, Tirana), and Geozavod (Belgrade).

2.4.2 Description

The Balkan peninsula experienced a strong orogenic period (period of mountain formation) during the late Tertiary and early Quaternary periods, resulting in the Dinaric Alps. The basin of Lake Shkoder is a depression located south of the Dinaric Alps and orientated northwest-southeast, parallel to the current shore of the Adriatic coast.

Glaciation has eroded and reshaped the landscape in the Pleistocene. The Zeta Plain and the Lake Shkoder area is filled with some Tertiary, but mainly Quaternary deposits of fluvial and glacial origin (gravel and sand), sometimes cemented into conglomerates and sandstones. The youngest deposits in the Zeta Plain is loess, now only preserved in the foothills.

The Zeta Plain and the Lake Shkoder area are still sinking. That is best seen on the Crnojevic River, currently almost dry and with the lower section a bay of the lake. Something similar happened to the Malo Blato, a river transformed into a lake next to Lake Shkoder. Also as a result of the sinking, lake water moves 'upstream' into the valleys, giving a wavy coastline on the west side.

The Zeta Plain and Lake Shkoder basin are being shaped by several rivers: Moraca, Zeta, Sitnica, Cijevna, Crnojevic, Orahovac and Crmnica River are the most important ones. They have cut their channels into the Quaternary sediments (gravel, sand and conglomerate); some channels are shaped like canyons (Cijevna and Moraca). Along the Moraca and Cijevna Rivers terraces are formed (four levels, Quaternary period). All terraces are relatively low but morphologically distinct.

Lake Shkoder is separated in the southwest by steep hills from the Adriatic Sea: the Tarabosa and Rumia mountains. This zone is only 10 to 15 km wide but with peaks up to 1600 m. Along the lake's coastline there are elongated islands following stratum orientation. They are all of Mesozoic limestone representing peaks of the Rumia mountain range above water level. The water in the hills infiltrates partly in the underground; superficial flow is limited. Many springs ('okos') can be found in the south-western part of the lake.

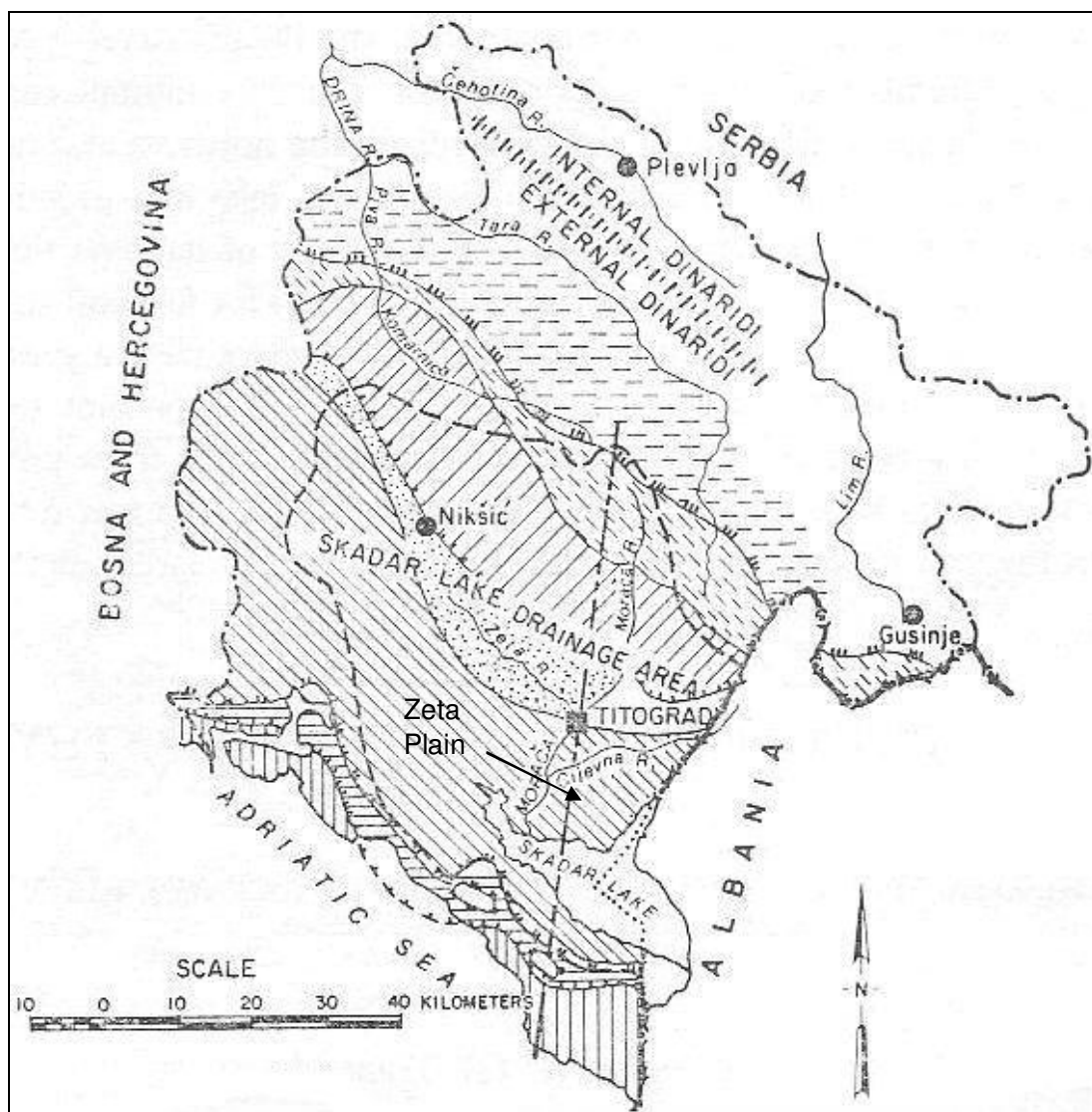
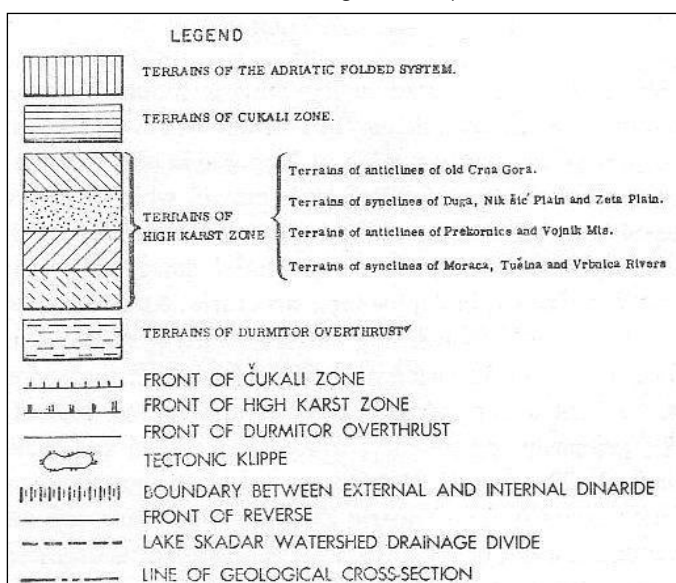


Figure 2.1 The geology of the Lake Shkoder drainage basin and surrounding areas; the line through Titograd, i.e. Podgorica, indicates the location of the cross-section in Figure 2.2 (Karaman and Beeton, 1981)



Legend for Figure 2.1

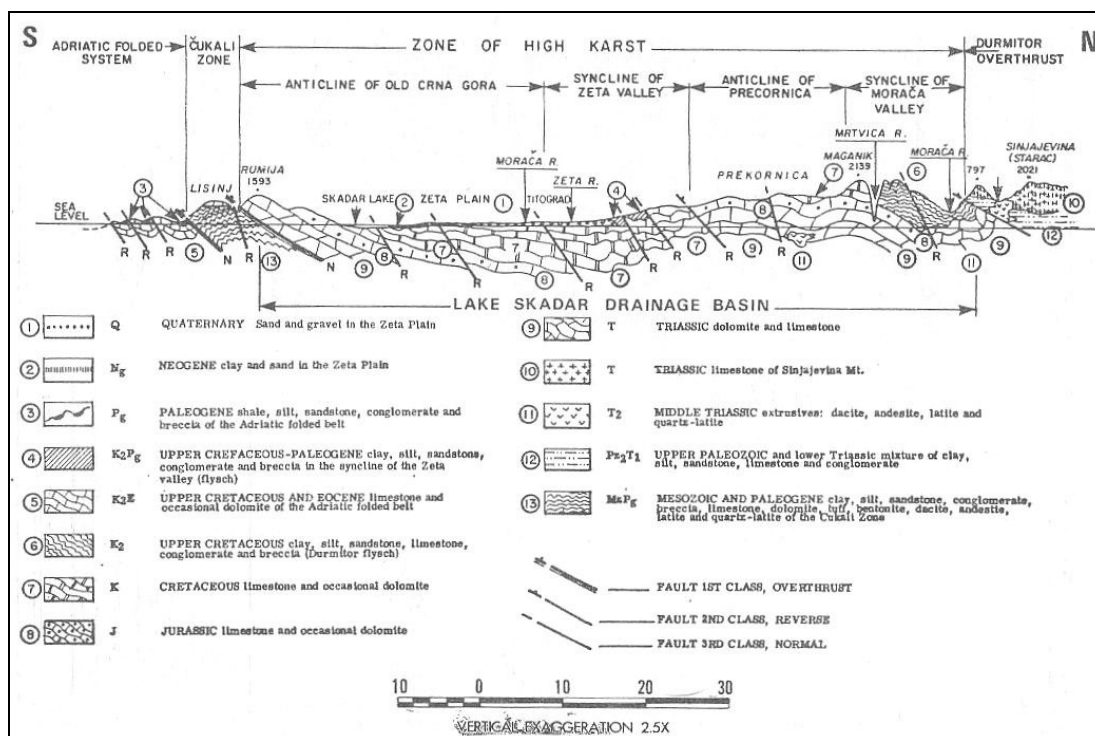


Figure 2.2 Geological north-south cross-section through Podgorica (Karaman and Beeton, 1981)

On the northern and north-eastern side of the lake the flat Zeta Plain with the main inflowing rivers are located. Their deposits (deltas) and the lower edge of the Plain have created a wide marsh belt that is regularly flooded. The lake area is tilted to the south-east and drains through the Buna-Bojana River to the Adriatic Sea.

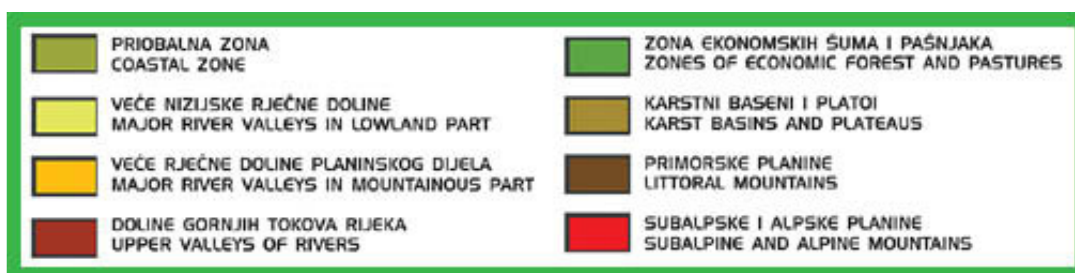
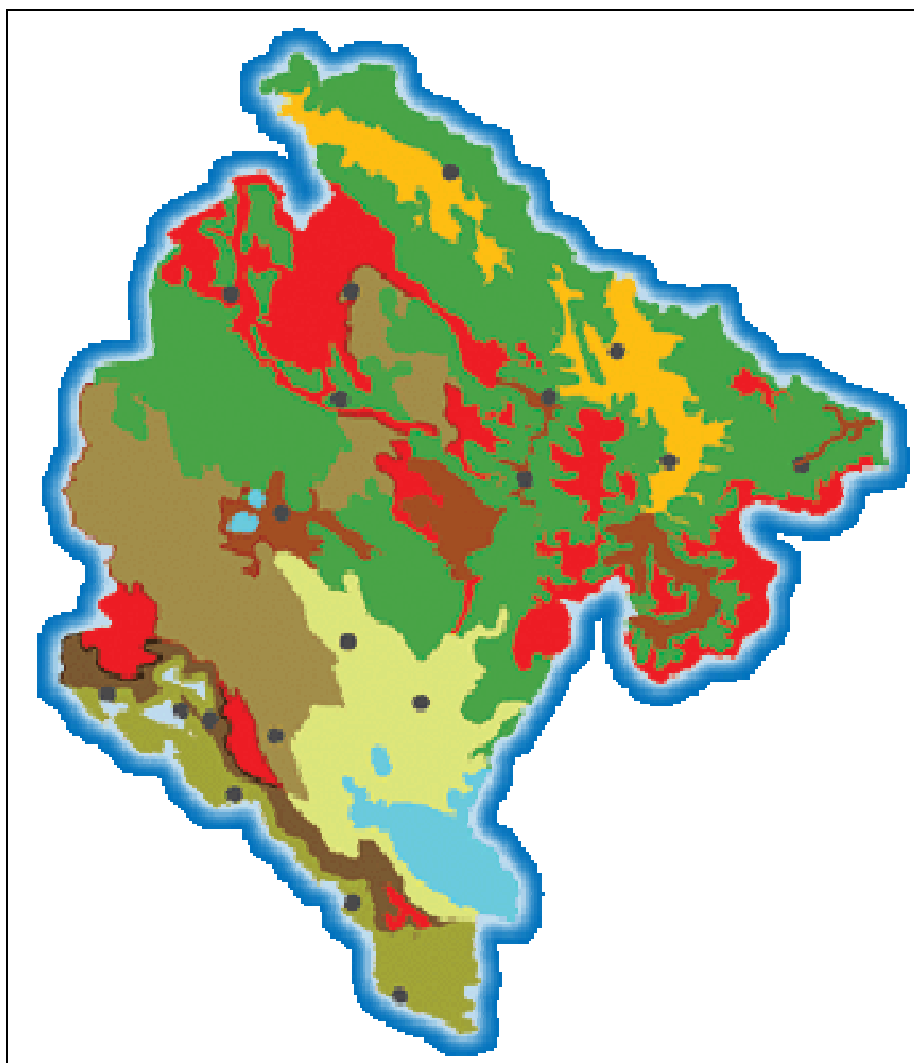


Figure 2.3 Geomorphological zones in Montenegro (Ministry of Environmental Protection and Physical Planning, www.plan.cg.yu, 2005)

2.5 Climate

2.5.1 Data availability

The hydrometeorological measurements in Albania were published in the state bulletins up to 1985-1990. Data after that period can only be obtained through the Hydrometeorological Institute (HMI), which asks a high price for them.

Climatological and hydrological studies done between 1975 and 1990 in Albania can be found in the archive of the HMI. Some were published during that same period.

Also there is the Climate Atlas of the Republic of Albania, which contains data from 1975 up to 1985 and was published in 1988. The atlas presents climatic data in maps and tables: the key maps will be included on the DVD of this TDA (see also Section 2.5.1).

Also in Montenegro exist a Hydrometeorological Institute, monitoring hydrology, climate, water and air quality. In the National Atlas of Montenegro (2005) climate data of the period 1931-1960 are presented. More recent data are also in Montenegro not available for free.

Enough information on climate is available for the purpose of the Lake Shkoder Integrated Ecosystem Management Project: older data for both countries; recent data through the HMI in Podgorica and Tirana (against a fee).

More climatological data were obtained through the Dutch Meteorological Institute (KNMI) and through internet (WeatherBase: www.weatherbase.com).

2.5.2 Description

Climate in the Shkoder basin is Mediterranean, but with higher rainfall amounts than in general in Mediterranean areas due to the mountains. Rainfall on the lake is between 2,000 and 2,800 mm per year, but within the basin some areas receive over 3,000 mm annually. Humidity levels are low, sunshine hours and temperature in summer are high, giving a high evaporation. Temperature in winter is low, due to the high elevations and predominant easterly and northerly winds. Figure 2.5 shows the key data for the cities Podgorica and Shkodra. Differences between the two cities, about 50 km from each other, are small.

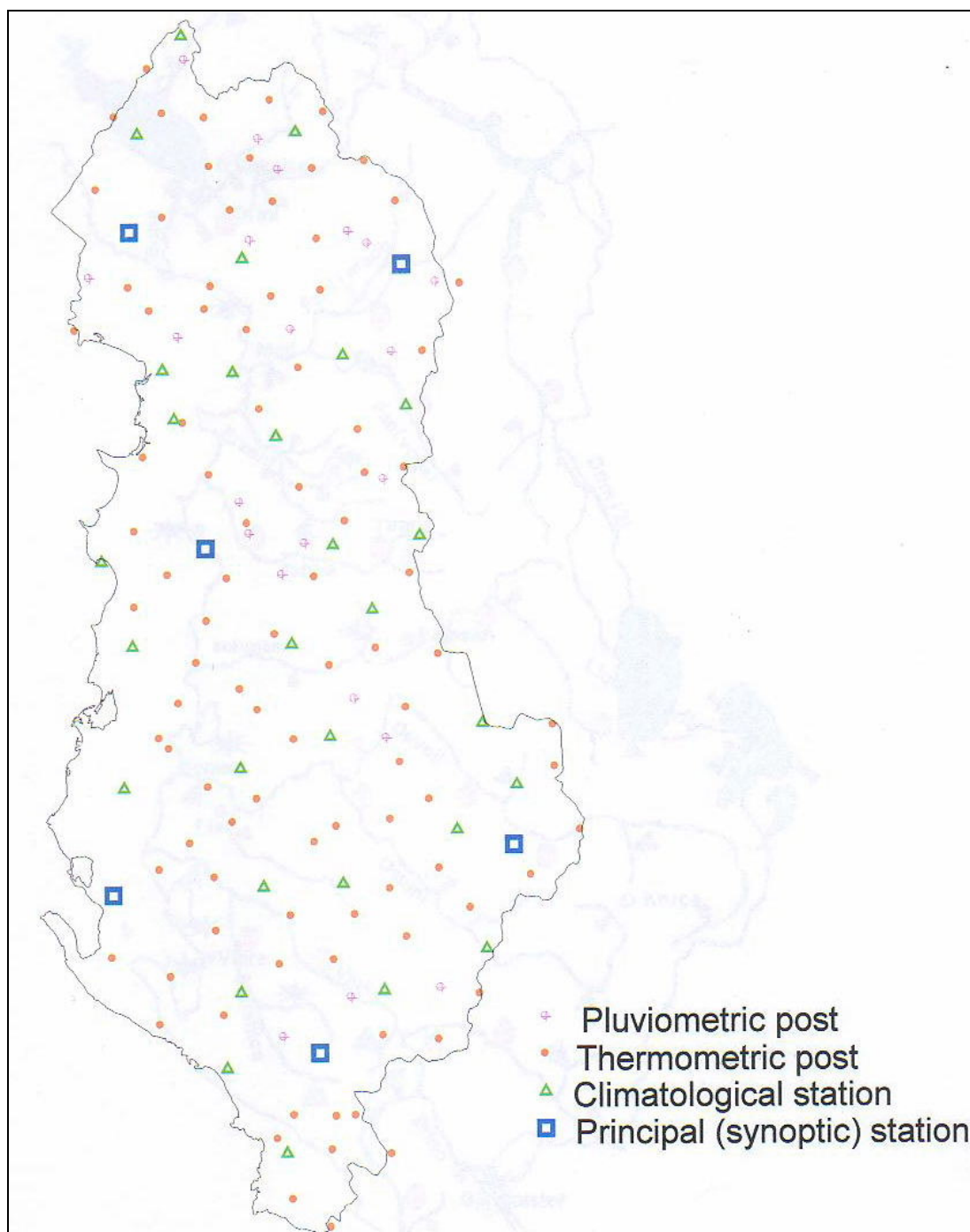


Figure 2.4 Meteorological measuring network in Albania, 2005 (HMI Tirana)

Table 2.1 Climate data available from the Hydrometeorological Institute of Albania

Station	Coordinates		Type of station	Parameters, years					
	x	y		Precipitation	Temperature	Air humidity	Snow	Wind	Remarks
				from-to	from-to	from-to	from-to	from-to	
Koplik	42°13	19°26	Climat 07	1951-2003	1951-2003		1983-2003		
Shkoder	42°06	19°32	SYNOP	1951-1999	1951-1999	1951-1999	1951-1999	1951-1999	
Razme	42°21	19°34	07,14,21	1961-1992	1961-1992	1961-1992	1961-1992	1961-1992	
Rrapsh	42°23	19°30	07	1971-1996, 1998-2003			1971-1996, 1998-2003		
Hot	42°20	19°26'	07	1973-2003			1973-2003		
Dajç Bune	41°59	19°25'							
Bahçallik	42°02	19°29	07	1961-1990			1961-1990		
Velipoje	41°52	19°22'	07,14,21	1951-2003	1951-2003	1951-1990	1951-2003	1951-1990	After 1990 only 07
Boks	42°08	19°34	07	1955-1993			1955-1993		
Bushat	41°58	19°32	07	1951-2003					

Table 2.2 Climate data available from the Hydrometeorological Institute of Montenegro

Station	Coordinates		Parameters, years					
	x	y	Precipitation	Temperature	Air humidity	Snow	Wind	Remarks
Podgorica (HMZ)	42° 26'	19° 17'	1949 – to date	1949 - to date	1949 - to date	1949 - to date	1949 - to date	Some climatic data exist since 1931; mostly hourly measurements
Niksic	42° 46'	18° 57'	1949 – to date	1949 - to date	1949 - to date	1949 - to date	1949 - to date	Mostly hourly measurement
Cetinje	42° 24'	18° 56'	1949 - to date	1949 - to date	1949 - to date	1949 - to date	1949 - to date	Mostly hourly measurement
Virppazar	?	?	1981 - to date	1981 - to date	1981 - to date	1981 - to date	No measure- ment	Measured 3 times a day
Danilovgrad	?	?	1981 – to date	1981 - to date	1981 - to date	1981 - to date	No measurements	Measured 3 times a day
Golubovici	42° 22'	19° 15'	?	?	?	?	?	

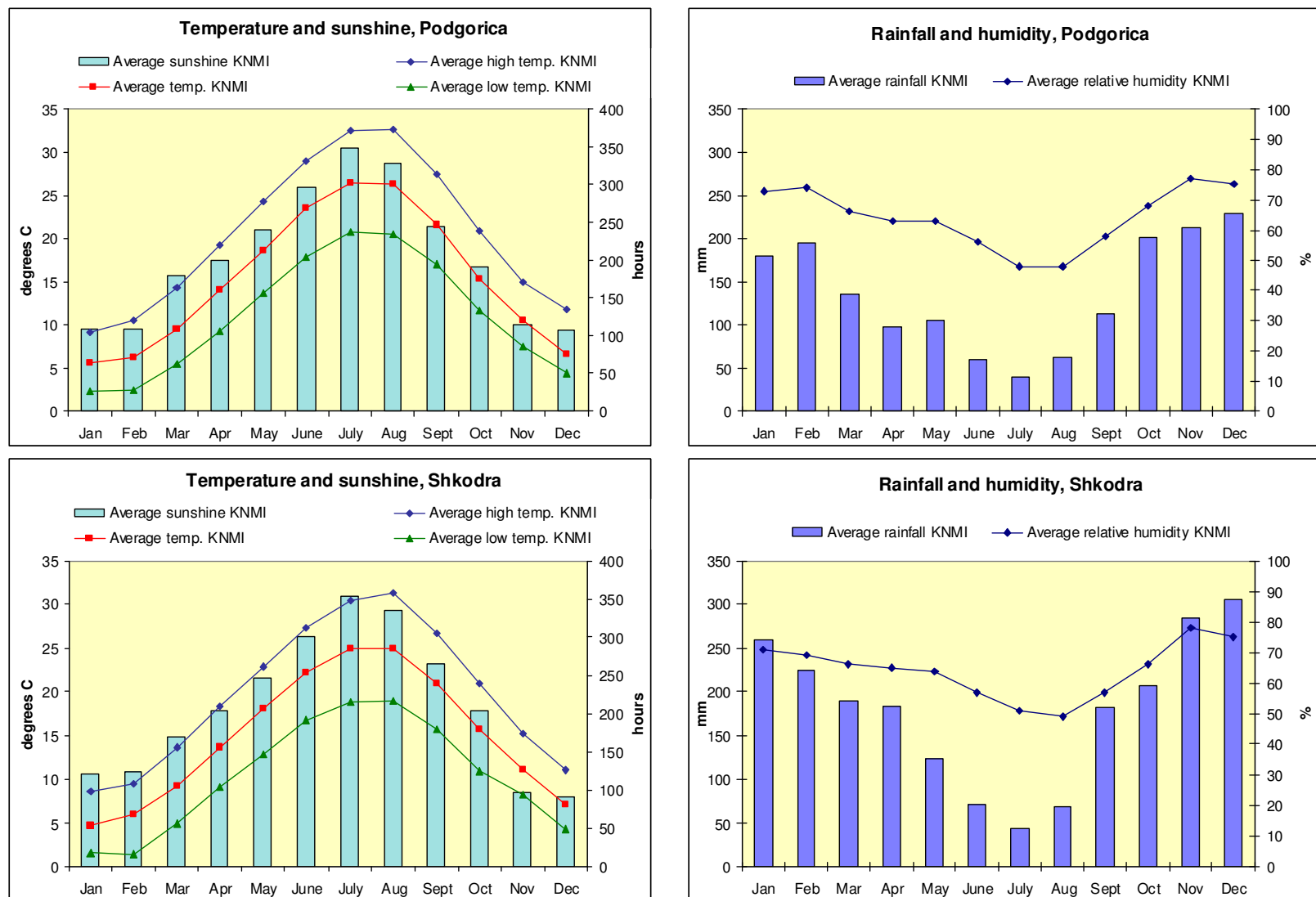


Figure 2.5 Key meteorological data for Podgorica and Shkodra (source: KNMI, 10 to 20 years of data, between 1970 and 1990)

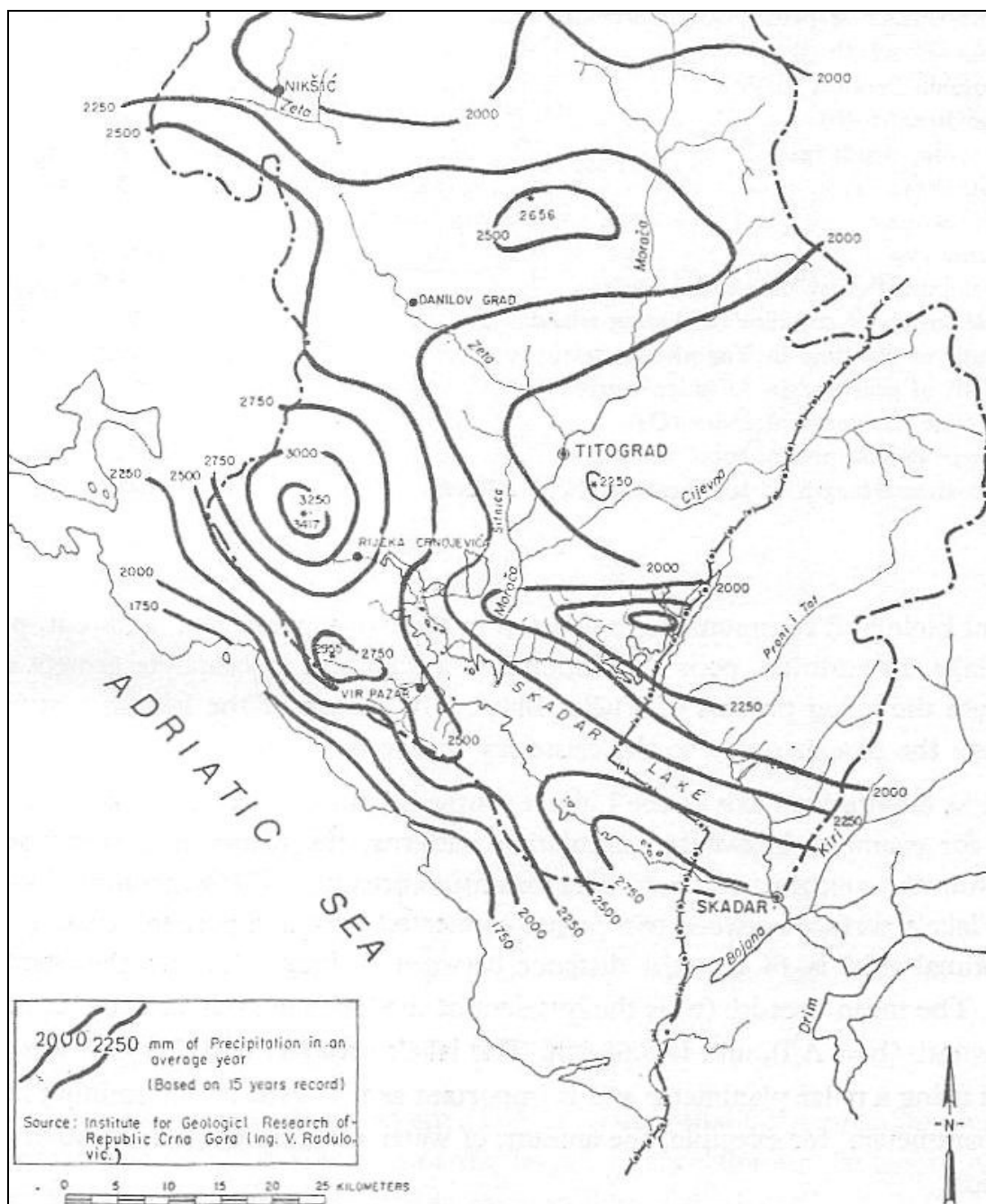


Figure 2.6 Precipitation distribution (annual average in mm) around Lake Shkoder, period about 1962 – 1976 (source: The biota ... Skadar, 1981)

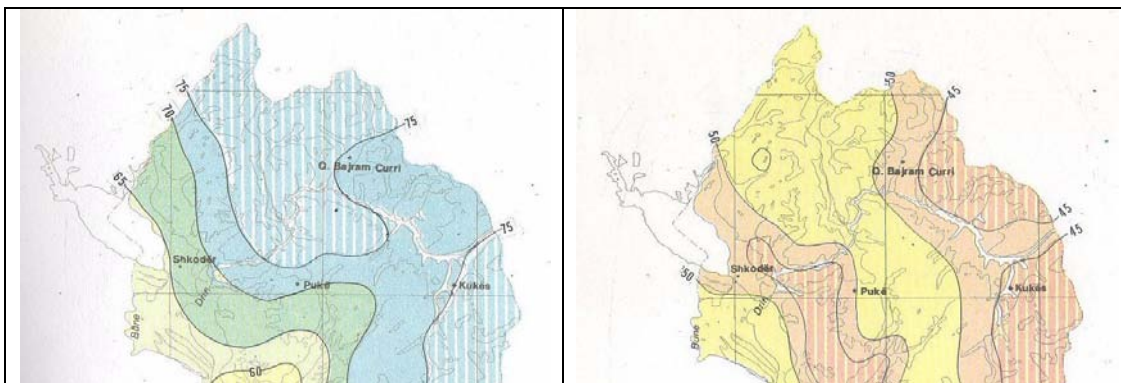


Figure 2.7 Relative humidity (%) in Januari and July (14:00 h) in northern Albania (source: Climate Atlas of Albania, 1988; based on period 1975-1985)

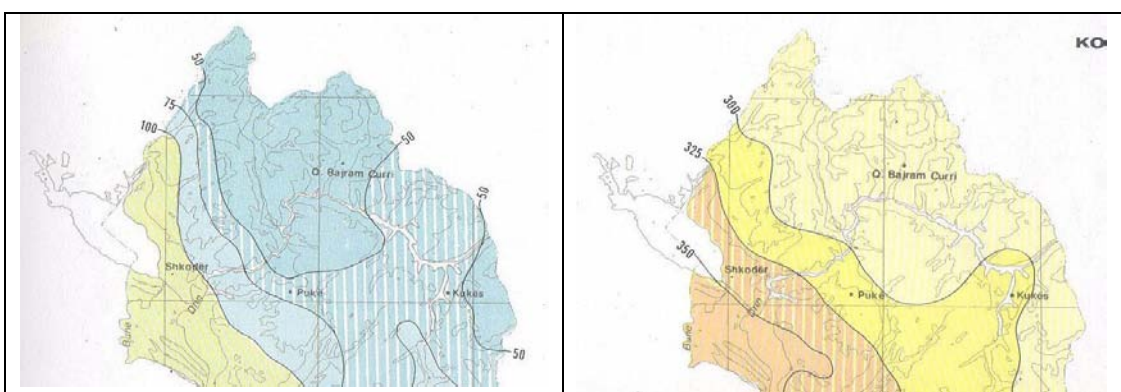


Figure 2.8 Hours of sunshine in Januari and July in northern Albania (source: Climate Atlas of Albania, 1988; based on period 1975-1985)

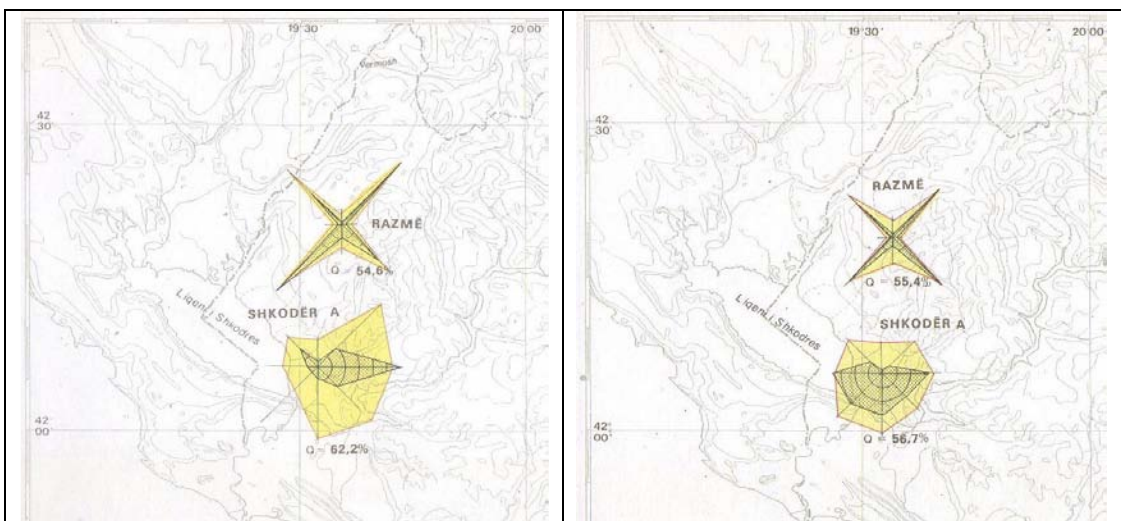


Figure 2.9 Wind speed (m/s) and direction (frequency, in %) in Januari and July in northern Albania (source: Climate Atlas of Albania, 1988; based on period 1975-1985)

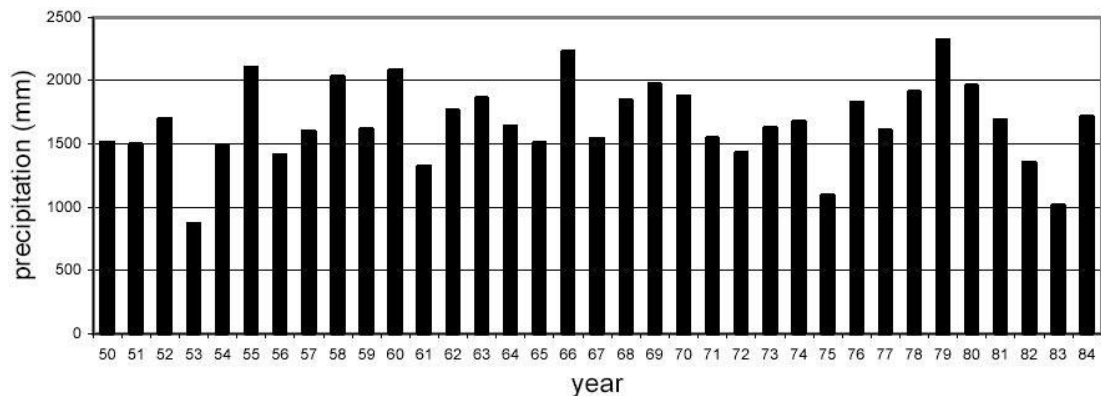


Figure 2.10 Annual precipitation in Podgorica from 1950 to 1984 (source: HMI, Knezevic, 2004)

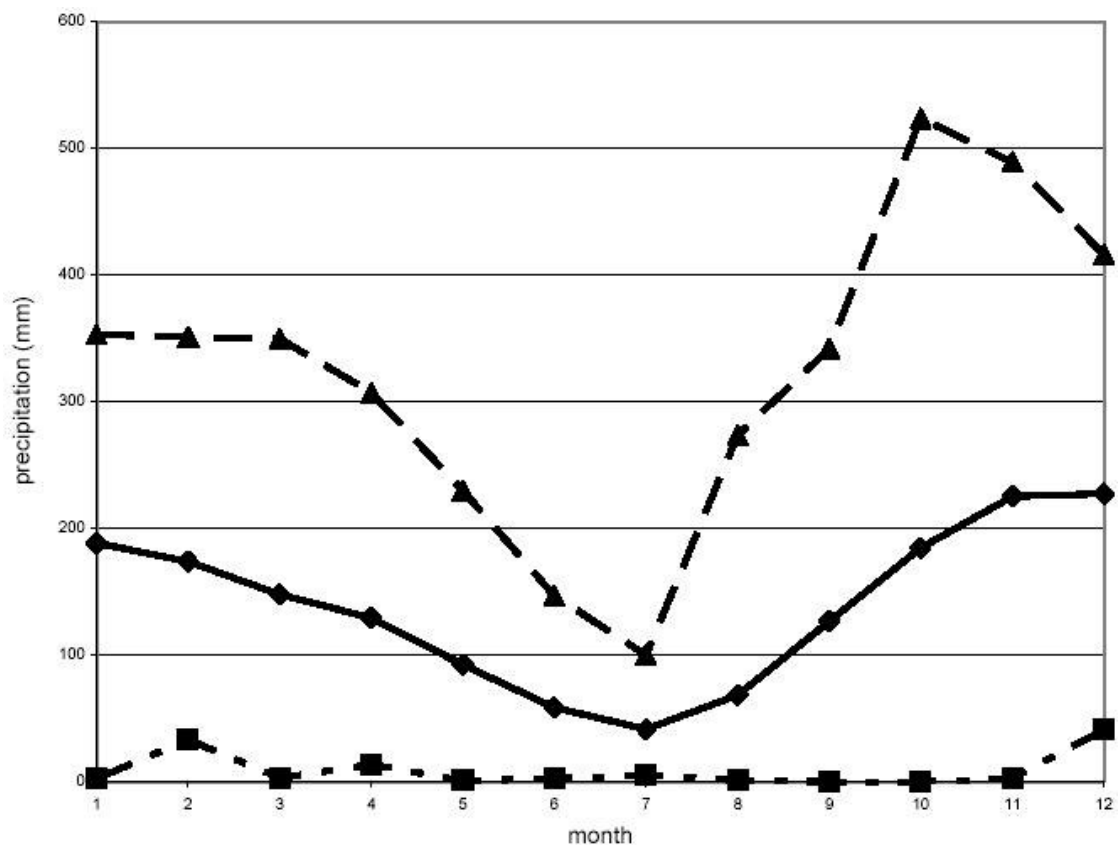


Figure 2.11 Monthly minimum, average and maximum precipitation in Podgorica, period 1950 – 1984 (source: HMI, Knezevic, 2004)

2.6 Hydrology

2.6.1 Data availability

Maps with the limits of the Lake Shkoder basin and the surface waters exist: see Figure 2.14 and Figure 2.16. Water level measurements of Lake Shkoder and the main rivers exist, both from Albanian and Montenegrin side: see Table 2.3 and Table 2.4. However, measurements are only at a few locations continuous.

Groundwater data is available for some spots in and near the Zeta Plain. Flow quantities in the karstic underground appear to be high, but figures do not exist (not in Albania nor in Montenegro). In the water level and water quality of Lake Shkoder groundwater seems to play an important role. Through a water balance only rough estimates can be made of the total volume of groundwater entering the lake.

In Albania there are studies from 1949 up to 1975 of surface water inflow/ outflow, precipitation/ evaporation, and lake area-volume-water level relationships for the hydrological stations of Shkoder, Koplik, Boks and Razem. After 1975 there are gaps in the data series. Also on Montenegrin side hydrological studies have been done; the ones done before 1981 are summarised in Karaman and Beeton (1981). Recent studies on the hydrology on Montenegrin side have been presented at the BALWOIS Conference 2004 (Ohrid, 25-29 May) by Prohaska et al. (Fac. of Mining and Geology), Boskovic et al. (HMI), and Knezevic (Biotechn. Inst.).

Bathymetric measurements of Lake Shkoder were done in 1972-1973. No recent measurements have been done.

Table 2.3 Monitoring stations for water levels in Lake Shkoder and the rivers Buna and Drin (source: HMI Albania)

River, lake	Station	Coordinates		Water level		Discharges
		x	y	from-to	frequency	
Lake Shkoder	Shiroke	42° 03'	19° 27'	1951 - present	Daily	Discharges are calculated from the curves which are measured 6 to 7 times per year
Buna	Buna Dajc	41° 51'	19° 25'	1958 - present	Daily	
Buna	Buna Shkoder	42° 03'	19° 30'	1964 - present	Recorder	
Buna	Buna cement factory	42° 02'	19° 29'	?	Recorder	
Drin	Drin Bahcallek	42° 02'	19° 30'	1947 - present	Recorder	
Drin	Pulaj	?	?	1960 - 1989	Daily	

Table 2.4 Monitoring stations for water levels in Lake Shkoder and the tributaries on Montenegrin side (source: HMI Podgorica)

Station	Coordinates		Years	Frequency
	x	y		
Virpazar	42° 15'	19° 07'	1974 - present	up to 8 times per year
Kamenik	42° 18'	19° 06'	1990 - present	
Vranjina	42° 16'	19° 08'	1966 - present	
Donja Plavnica	42° 16'	19° 12'	1974 - present	
Podhum	42° 18'	19° 21'	1990 - present	
Starëeva Gorica	42° 11'	19° 13'	1990 - present	
Moraënik	42° 08'	19° 16'	1990 - present	
Ckla	42° 05'	19° 18'	?	

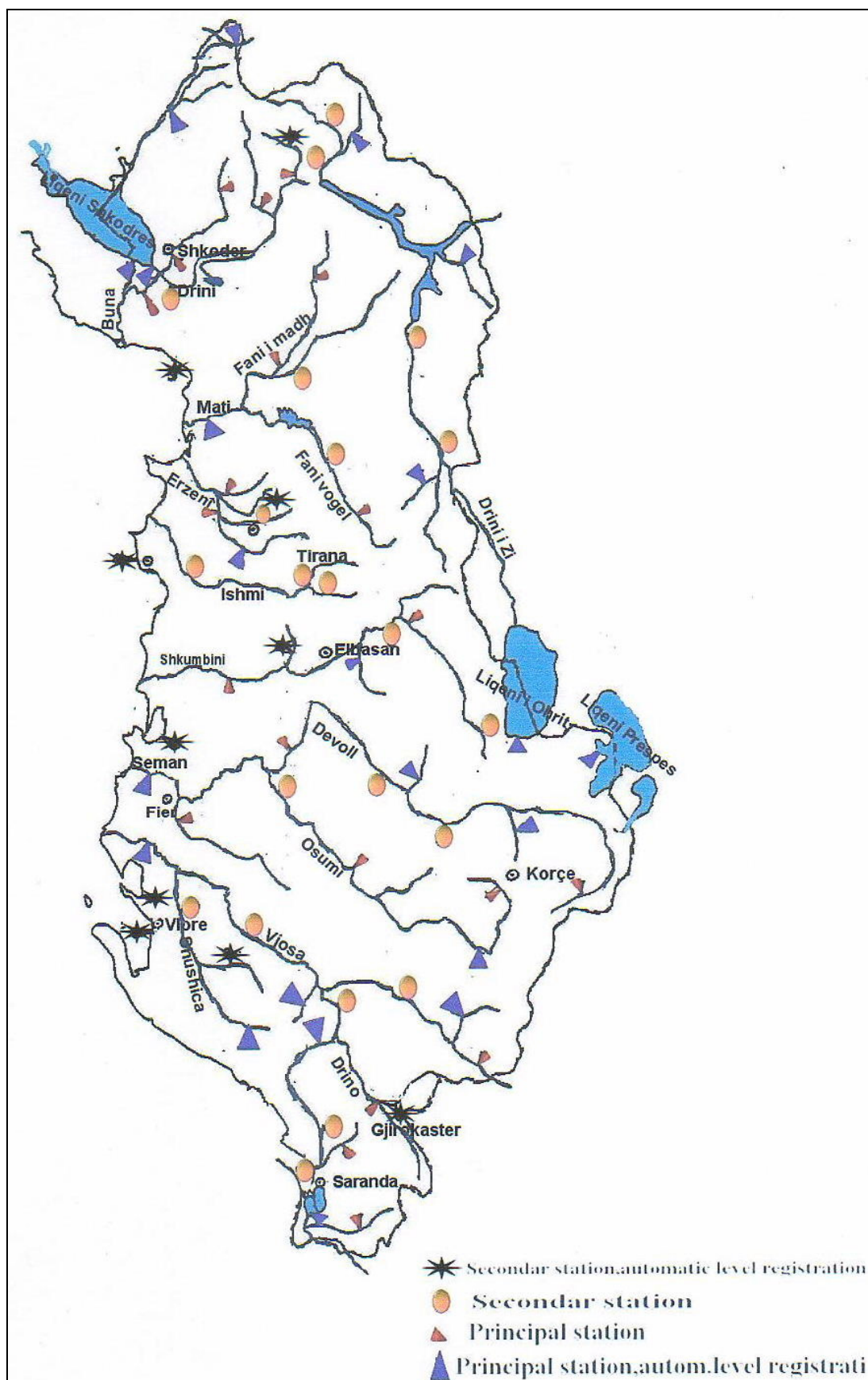


Figure 2.12 Hydrological measuring network in Albania, 2005 (source: HMI Tirana)



LEGEND:

▲▲ Gauging stations in the basin

Figure 2.13 Gauging stations within the basin of Lake Shkoder (not all stations are included; source: Prohasca, BALWOIS Conference 2004)

2.6.2 Description

- General

Lake Shkoder is the largest lake on the Balkan Peninsula in terms of water surface. The drainage area of the lake is about 5,500 km² (4,470 km² in Montenegro and 1,030 km² in Albania). The lake area varies between 353 km² in dry periods and 500 km² in wet periods (at maximum level, 335 km² is in Montenegro and 165 km² in Albania). The lake volume varies between 1.7 km³ in dry periods to 4.0 km³ during wet periods. The distance between the mouth of the Crnojevica River (northwestern lake edge) and the lake's outlet (Buna-Bojana River) is 44 km (maximum length); its greatest width is 13 km.

Table 2.5 Surface area and water volume for different water levels in Lake Shkoder, Virpazar (Montenegro; data period: 1950-1984)

Water level above m.s.l. (m)	Surface area					Volume of water				
	Total (km ²)	Montenegro		Albania		Total (km ³)	Montenegro		Albania	
		(km ²)	(%)	(km ²)	(%)		(km ³)	(%)	(km ³)	(%)
4.60 (min.)	353.3	205.4	58.1	147.9	41.9	1.71	1.01	59.1	0.70	40.9
5.25 (avg. low)	381.3	231.1	60.6	150.2	39.4	1.96	1.16	59.2	0.80	40.8
6.37 (avg.)	418.0	263.9	63.1	154.1	36.9	2.39	1.43	59.8	0.96	40.2
8.55 (avg. high)	463.0	301.9	65.2	161.2	34.8	3.35	2.06	61.5	1.29	38.5
9.82 (max.)	500.0	335.0	67.0	165.0	33.0	3.97	2.48	62.5	1.49	37.5

Source: Knezevic, M. and M. Todorovic (2004); "Sustainability Aspects of the Skadar Lake Water Level Regulation", BALWOIS Conference, Ohrid, May 25-29, 2004.

The most important tributaries of Lake Shkoder enter the lake from the north: Moraca, Crnojevica, Orahovstica, Karatuna, Baragurska River in Montenegro, and Rjolska and Vranka River in Albania. On the west side many streams flow into Lake Shkoder, among others Crmnicka, Bistrica, Orahovacka, Poseljanska, Crnojevic and Karatunu. On the DVD accompanying this report, detailed river discharge and level data can be found.

Floods between 1848 and 1858 and in 1896 (Boskovic, 2004) diverted the Drin River (Albania), whose watershed is around 14,000 km², towards the west into the Buna-Bojana River, a few hundred meters from the lake outlet (see Figure 2.18). The large amounts of sediments raised the river bed and resulted in an increase in the lake level with several meters, until today.

Monthly minimum, average and maximum lake level data from Virpazar (Montenegro) for the period 1950 – 1984 have been obtained: see Figure 2.17.

Sometimes the outflow from the lake in Buna-Bojana is impeded due to the increase in the flow in the Drin river. This occurs mostly in the period from December to February, but may also occur during the other months, depending on the water released from the (three) hydro-power dams that were constructed end 1960s, early 1970s upstream in the Drin river (Vau I Dejes, see Figure 2.48). The management of the dams depends upon the rainfall and electricity demand. The impediment of outflowing water in the Buna river increases the water level in the lake significantly. With high Drin levels and low Buna levels, Drin water even enters Lake Shkoder. An increased flow in the Drin river also causes sediment deposition in the river channels at the meeting point of the two rivers, thereby further obstructing the flow in the Buna-Bojana river and the outflow from the lake.

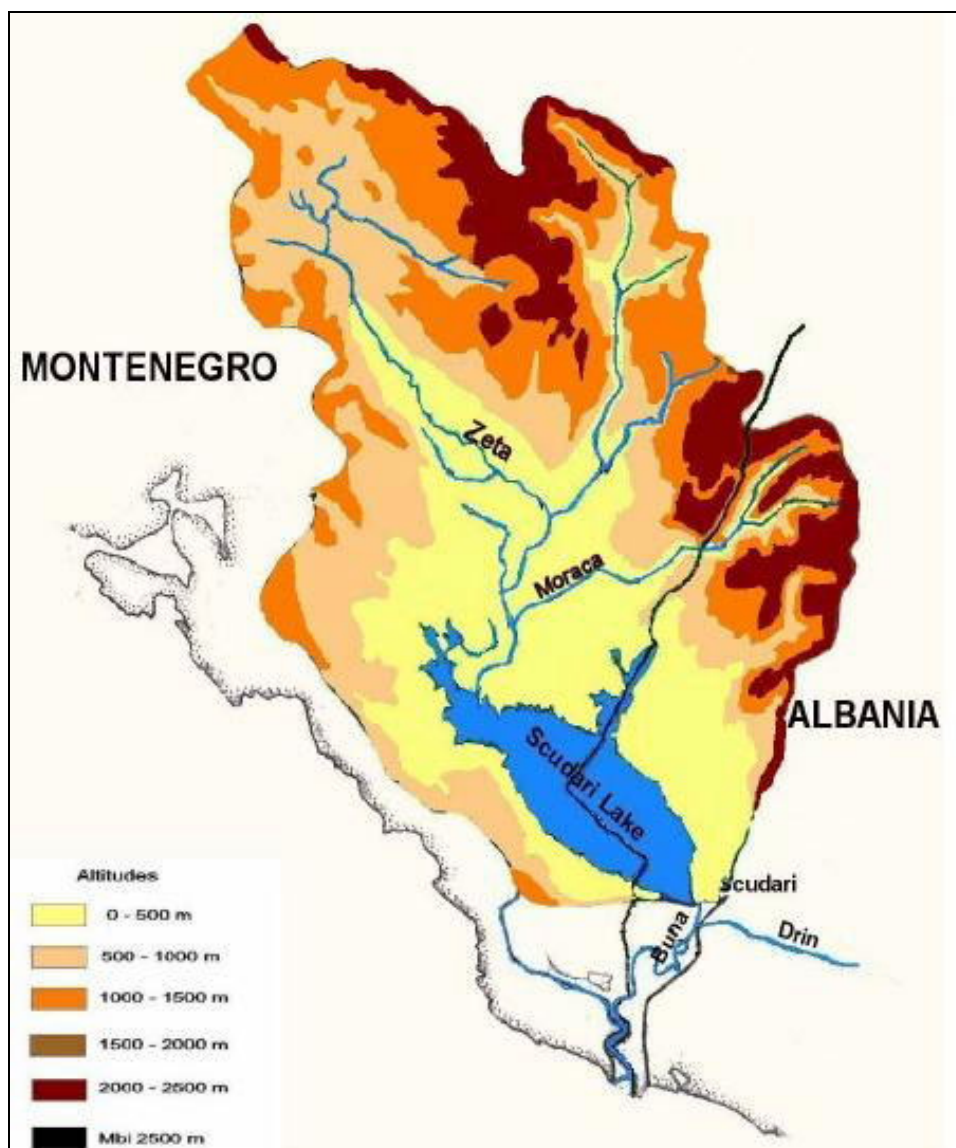


Figure 2.14 The basin of Lake Shkoder (source: HMI Tirana)

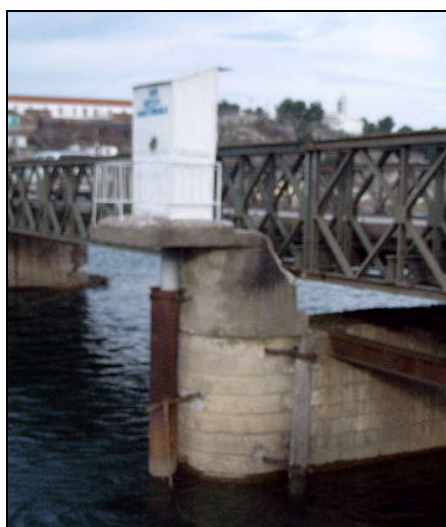


Figure 2.15 Water level station of the HMI (Albania) at Buna bridge, Shkodra

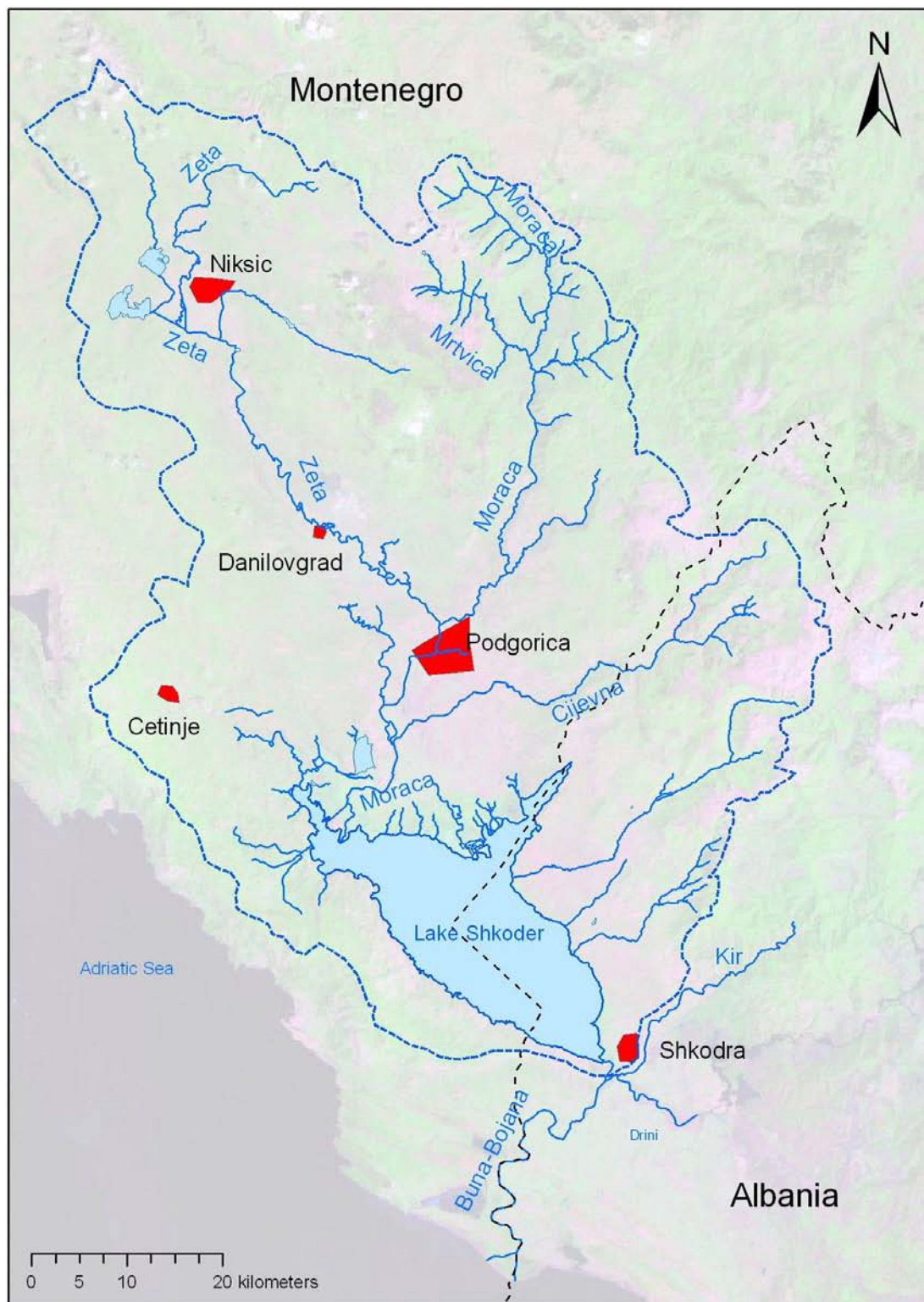


Figure 2.16 The Lake Shkoder drainage basin with the main rivers and streams [Royal Haskoning]

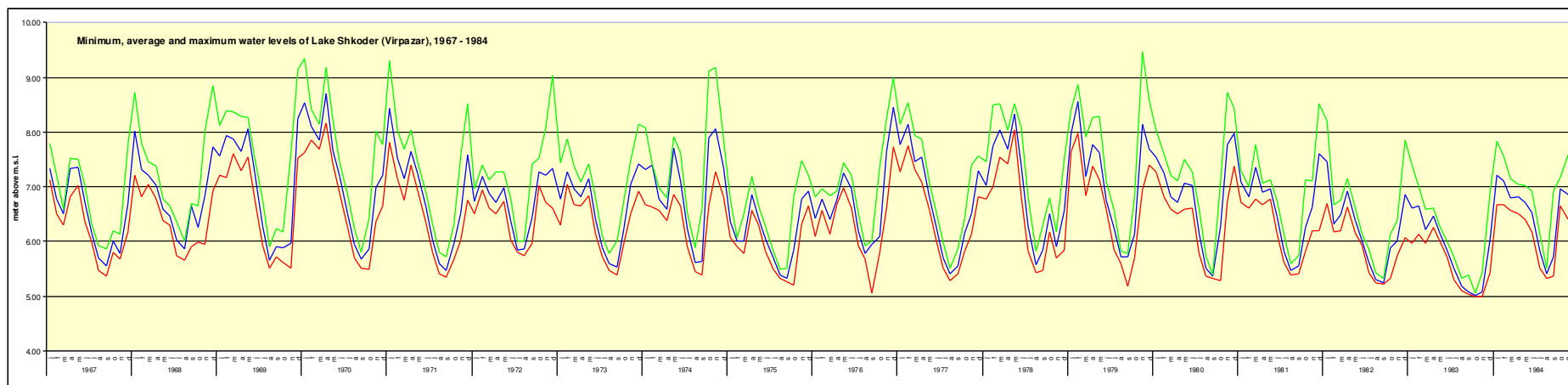
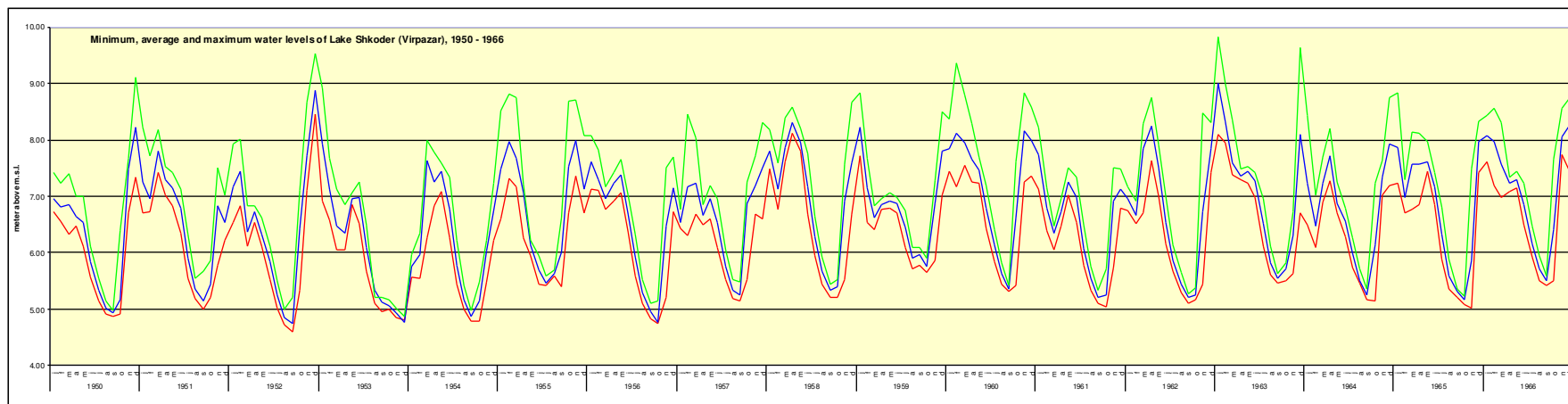


Figure 2.17 The minimum, average and maximum water levels of Lake Shkoder at Virpazar between 1950 and 1984 (source: HMI Podgorica)

The water levels for two time series, 1965 – 1967 and 2002 – 2004, are available at five hydrometric stations: at Shiroke (Lake Shkoder), at Bahcallek (Drin River: the most upstream station), at the Buna bridge near (in) Shkoder, at Dajc (Buna-Bojana River: the most downstream station) and a partial data series (1965 -1967) of the Buna-Bojana River near the Cement Factory. In general, the water levels in the period 2002 – 2004 are considerably lower than those in the sixties. This is caused by the construction of the hydro-power dams.

The data for the period 1965-1967 show that the water level of Lake Shkoder is very similar to, but slightly higher than, the water level observed at the station (bridge) Buna-Skhoder. The 2002 – 2004 data show occasions where the water levels at Buna Skhoder are briefly higher than the lake level at Shiroke. This can be explained by the presence of the reservoirs upstream in the Drin, which came into operation early 1970s. Storage of water in the reservoirs leads to lower water levels at Buna Skhoder, while releases from the reservoirs cause short increases in water level.

The water levels at Drin-Bahcallek, further upstream on the Drin River, show a considerable variability, both in the period 1965 – 1967 and 2002 – 2004. In the period 1965-1967 minimum water levels are above 6 m (+ reference level). In the recent data series the minimum water levels are only 4.5 m. The 1965 – 1967 water levels at Buna Skhoder remain consistently below the levels observed at Drin Bahcallek, while the 2002-2004 data show the water level at Buna Skhoder often above the level of Drin Bahcallek, in these years during the winter periods. This last phenomenon is probably caused by water being stored in the Drin reservoirs, while the water level at Buna Skhoder is 'buffered' by the level in Lake Shkoder. Water may temporarily flow in an 'upstream' direction of the Drin.

The data observed at Buna Dajc, further downstream of the Buna-Bojana River, indicate water levels in the recent years lower than those for the period 1965-1967.



Figure 2.18 The Drin River (left) connecting to the Buna-Bojana River that flows from Lake Shkoder (outlet: right) towards the Adriatic Sea (horizon)

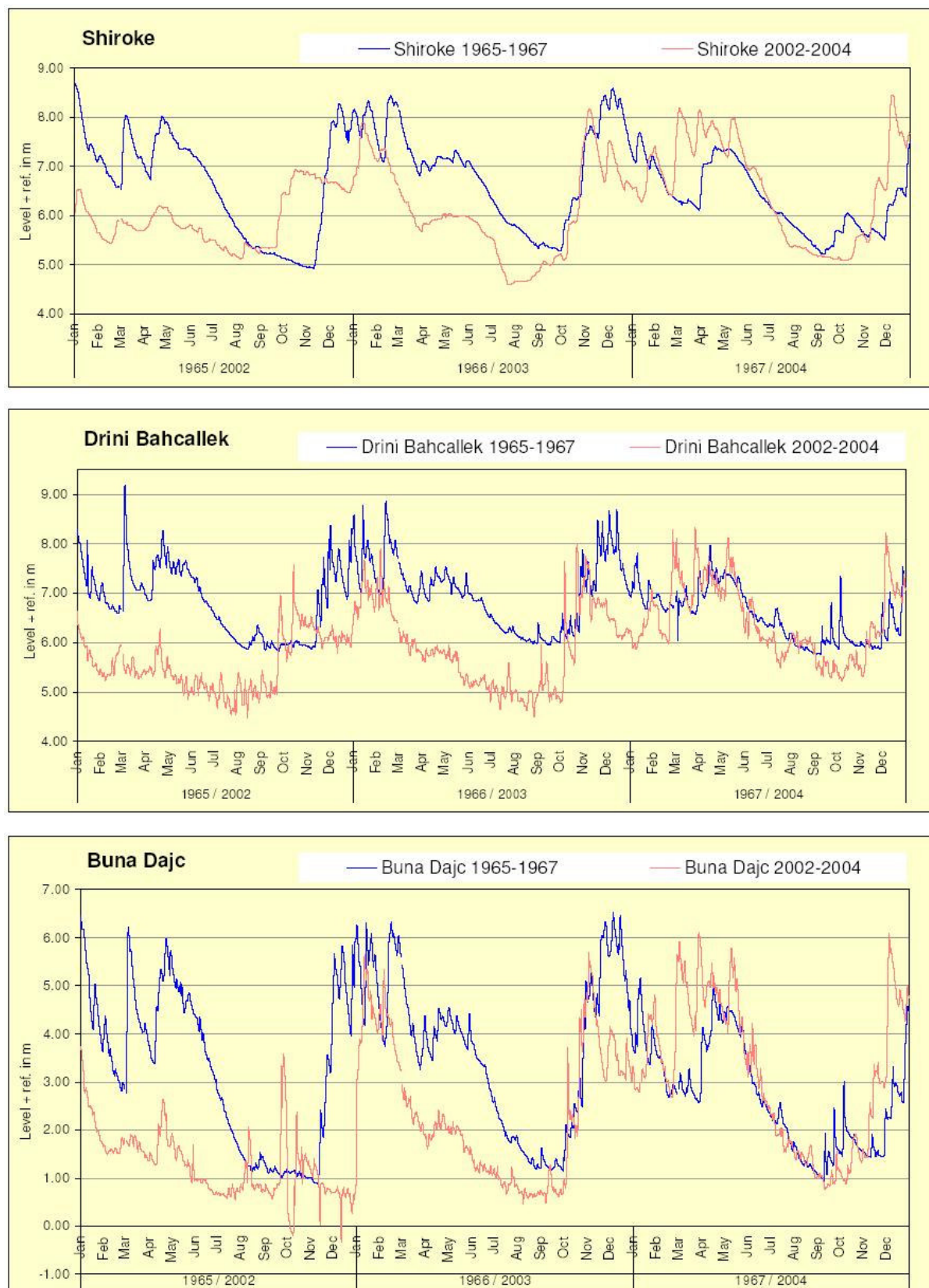


Figure 2.19 Water levels from 1965 to 1967 (before reservoir construction in the Drin in 1973) and from 2002 to 2004, at Shiroke (Lake Shkoder), at Drini Bahcallek (just before the junction with the Buna) and at Buna Dajc (8 km downstream of the junction Drini-Buna); see also Figure 2.20

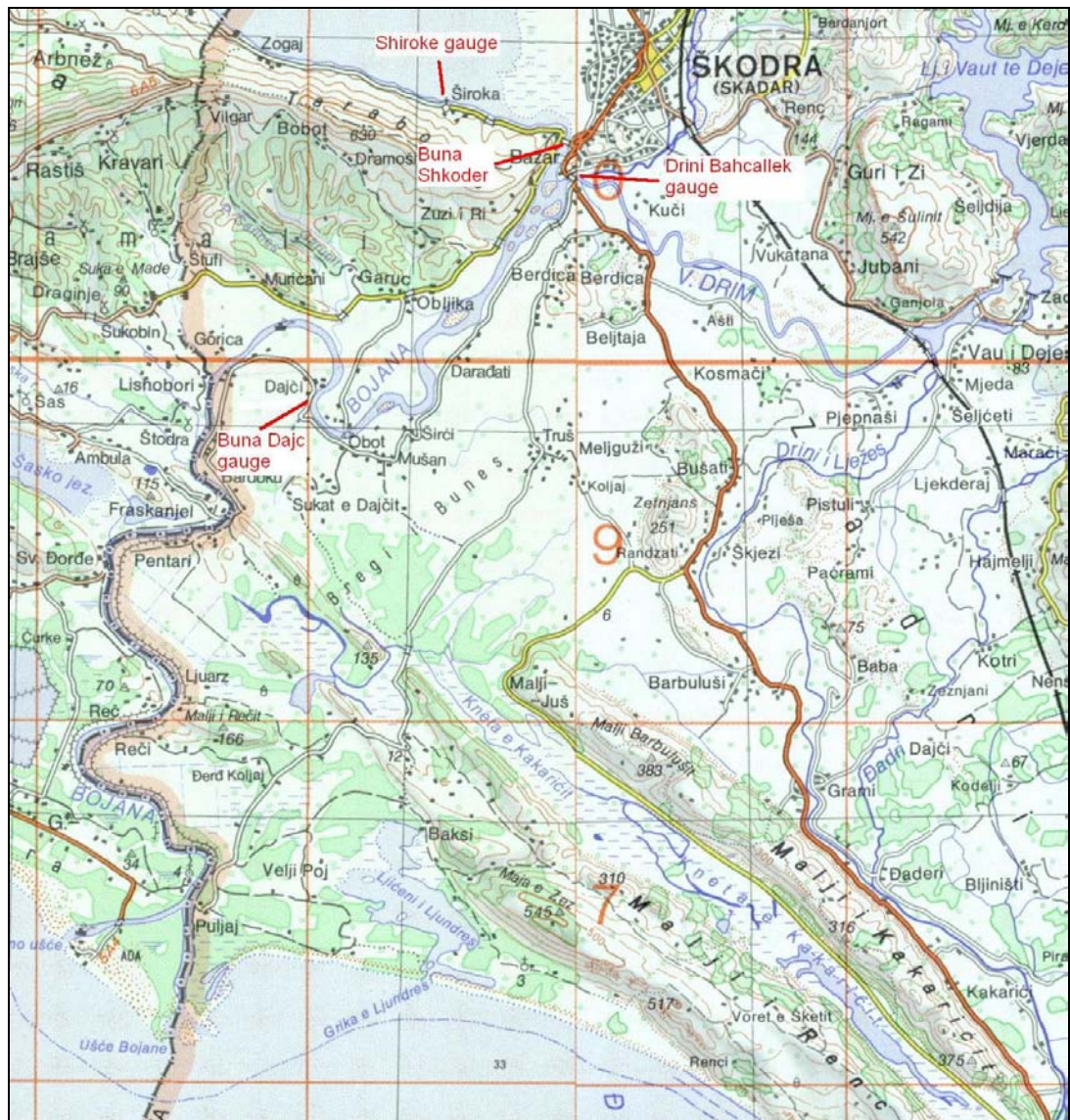


Figure 2.20 Location of three key gauge stations (see their graphs in Figure 2.19)

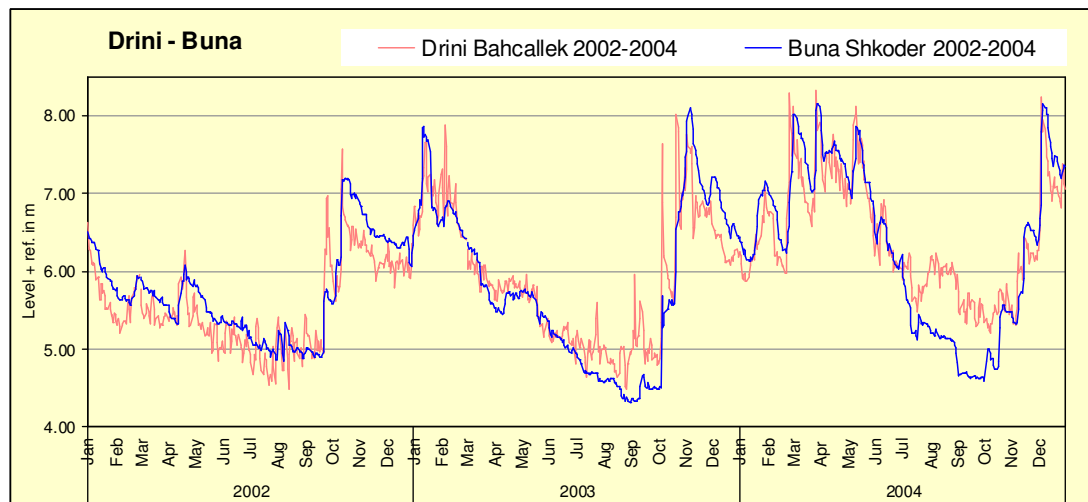


Figure 2.21 Difference in water level between the Drini and the Buna, just before there junction point

Precipitation on the lake, groundwater from the Zeta Plain aquifer and karstic springs contribute also to the inflow in Lake Shkoder (see 2.5.2). The lake outflow by River Buna-Bojana is on average about 300 m³/s.

The lake surface is only 5 to 10 m above sea level. At 5 m a.s.l. the lake depths go down to 8 m (except in some funnel-shaped depressions or 'oko' where groundwater wells up); this means that part of the lake is below sea level (about 165 km²).

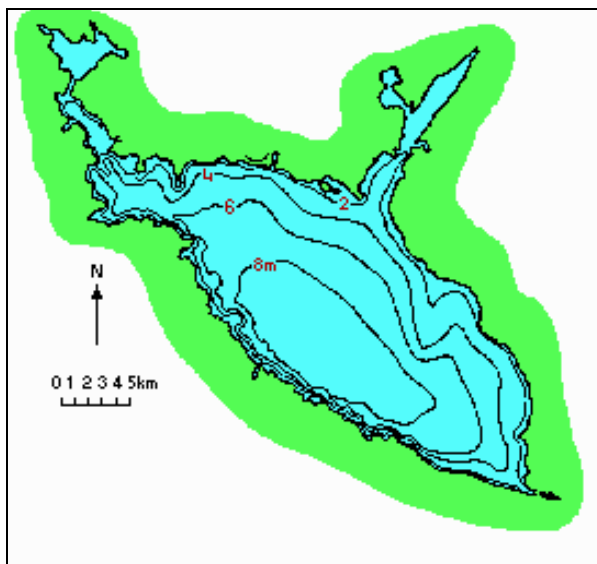


Figure 2.22 Bathymetry (depth in m) of Lake Shkoder (source: Lasca, N.P. et al, 1981, pp. 17-38); see also figure Figure 2.49

Water quality and water biology of the lake are described in Sections 2.7 and 2.8.

- Groundwater

Two main groundwater sources can be distinguished: 1) aquifers in the Zeta Plain and 2) karstic springs, mainly on the southwestern side of the lake.

Big reservoirs (aquifers) in fluvio-glacial deposits are located on the Cemovsko Field and the Zeta Plain, north of Lake Shkoder. Here peak elevations of the aquifer are up to 30 m in dry periods and up to 36 m in wet periods. Near Lake Shkoder levels of groundwater are 6 to 8 m and 8 to 10 m respectively. The flow gradient during high groundwater levels is between 0.00154 and 0.00141; in the northern parts it is higher than in the southern parts. The capacity of the majority of the wells is from 30 l/s/m and goes past 100 l/s/m.

Recharge of the Quaternary aquifer of the Zeta Plain is from direct infiltration of precipitation, infiltration of river water and inflow from surrounding karst aquifers. The aquifer of the Zeta Plain, the karst springs at the plain rim, the surface currents and the lake water are all hydraulically connected.

The Rivers Moraca, Cijevna and Ribnica contribute considerably to the Quaternary aquifer feeding. According to the OCDE report (1972; monitoring period 1951-1965), in dry periods 10 m³/s infiltrated over a length of 1 km. In dry periods River Cijevna falls dry in

the lower section. The average recharge amount of the Quaternary aquifer during this period is 1 m³/s, but normally around 5 m³/s.

Karst springs on the plain rim add significantly the aquifer recharge. For example spring Mareza (used for Podgorica water supply) yields 2 to 10 m³/s and Ribnica up to 30 m³/s.

Most of the groundwater discharges directly into the lake, but on higher piezometer levels into the rivers and streams: Zetica, Gostiljska, Plavnica and Tara River (estimated flow of the Plavnica and Gostiljska River is 1 m³/s for the average piezometric level). During dry periods the water inflow from these small streams can be clearly seen in the lake springing out from the sand and gravel.

Karstic springs drain a wide area of Montenegro. One of those 'vrelo' springs, in Rados, represents a karst 'vrtaca' (depression or 'okos') with a depth of 60 m. There are many springs along the southwestern lake coast, especially in periods with heavy rain. The majority of these springs appear at lake level or below it.

Groundwater is extracted for drinking water, irrigation and industry. Karstic spring water is used for drinking, as this is of good quality.

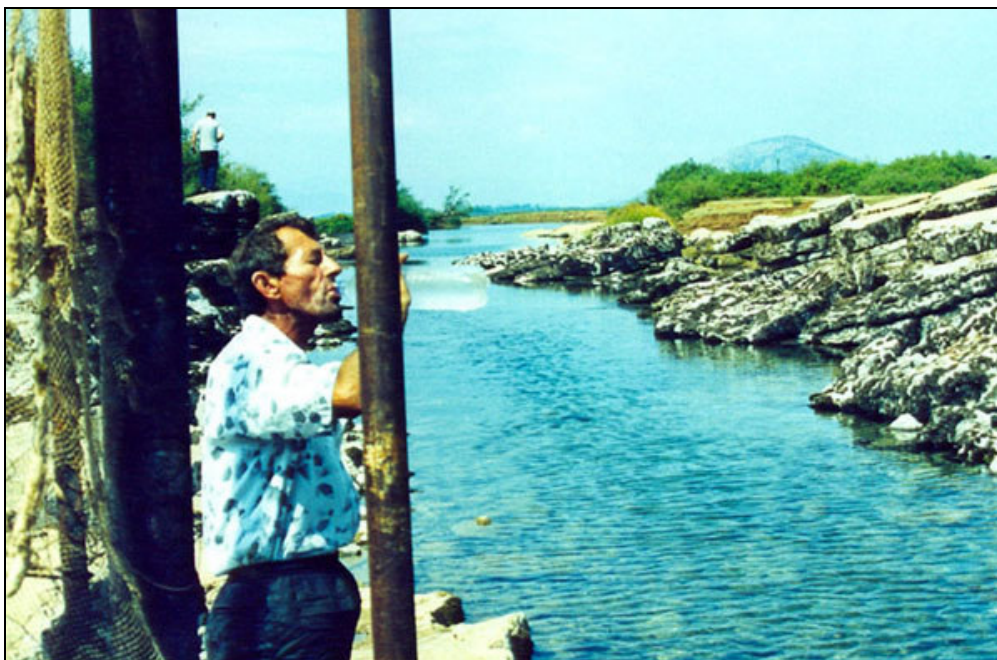


Figure 2.23 Water of the karstic spring at Shegan, Albania, is of good quality (source: L. Kashta)

- Water balance

Quantification of the parameters that determine the water balance of Lake Shkoder gives insight in the importance of each parameter. Table 2.7 lists the main in- and out-flows for Lake Shkoder and quantifies them. It is clear from the table that the water level of the lake is strongly related to the inflow by the Moraca River: see also Figure 2.24.

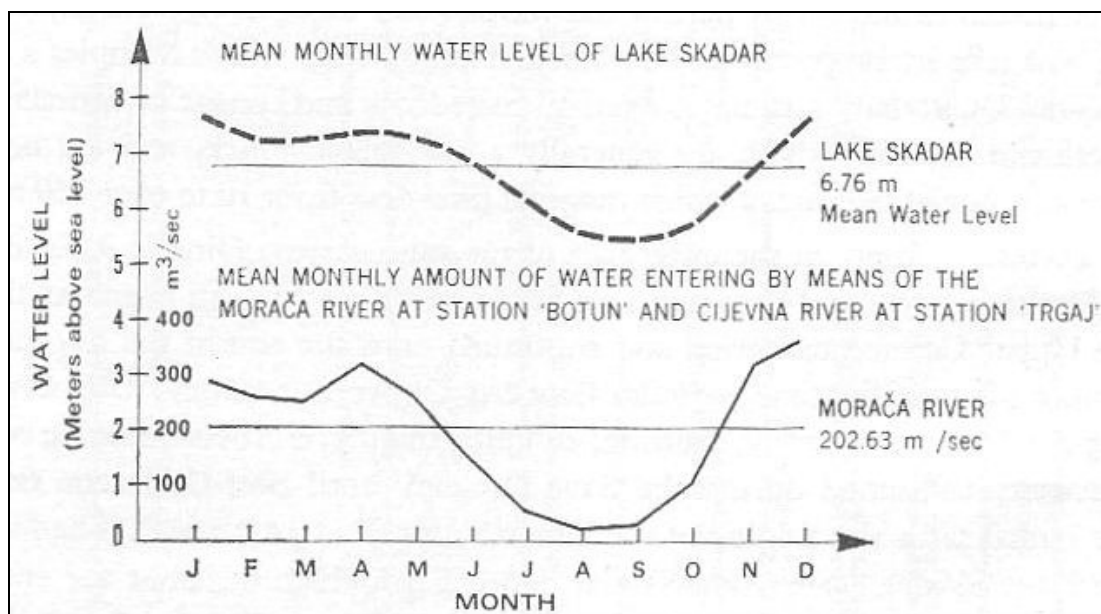


Figure 2.24 Relation between the Lake Shkoder mean monthly level and the mean monthly inflow from the Moraca River (1956 – 1975; source: Karaman & Beeton, 1981)

Table 2.6 Minimum, maximum and average monthly water levels in Lake Shkoder (Moraca delta) in the period 1950 – 1984 (source: HMI, Knezevic, 2004)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Hmax	9.82	9.37	8.78	9.18	8.52	8.08	6.96	6.24	7.42	9.12	9.46	9.64
Havg	7.42	7.24	7.13	7.19	7.13	6.65	5.98	5.52	5.48	6.02	6.84	7.40
Hmin	5.56	5.54	5.78	6.04	5.94	5.44	5.02	4.72	4.60	4.74	4.84	4.80

All water inflow is precipitation-dependent, meaning that the highest water contribution by rivers and springs is in winter and in spring. The highest quantity of water is taken out from the lake by River Buna-Bojana, but evaporation is significant too. The highest Buna-Bojana water levels are in February and the lowest in August; average outflow is over 300 m³/s. Evaporation is the lowest in February and the highest in August.

The following figures have been assumed for calculating the tentative water balance:

- Basin area	=	5,500 km ²	
- Lake area	=	400 km ²	
- Avg. rainfall in basin	=	2,500 mm/yr	= 13.75 x 10 ⁹ m ³ (incl. lake area)
- Avg. rainfall on lake	=	2,300 mm/yr	= 0.92 x 10 ⁹ m ³
- Avg. actual evap. basin*	=	800 mm/yr	= 4.40 x 10 ⁹ m ³
- Avg. actual evap. lake*	=	1,200 mm/yr	= 0.48 x 10 ⁹ m ³
- Avg. inflow Moraca	=	200 m ³ /s	= 6.30 x 10 ⁹ m ³
- Avg. inflow other rivers	=	30 m ³ /s	= 0.95 x 10 ⁹ m ³
- Avg. inflow groundwater	=	? m ³ /s	= ? x 10 ⁹ m ³
- Avg. outflow Buna-B.	=	300 m ³ /s	= 9.46 x 10 ⁹ m ³
- Avg. outflow groundwater	=	¿ m ³ /s	= ¿ x 10 ⁹ m ³
- Others (agriculture, drinking water, industry)	=		negligible

(* source evaporation: Dam, 1971)

➤ Basin approach to calculate the balance:

$$\begin{aligned}
 \text{In:} & \quad \text{rainfall in basin} & = & \quad 13.75 \times 10^9 \text{ m}^3 \\
 \text{Out:} & \quad \text{actual evap. basin + outflow Buna-B.} & = & \quad - (4.40 + 9.46) \times 10^9 \text{ m}^3 \\
 \text{Balance:} & & = & \quad - 0.11 \times 10^9 \text{ m}^3
 \end{aligned}$$

➤ Lake approach to calculate the balance:

$$\begin{aligned}
 \text{In:} & \quad \text{rainfall on lake + inflow Moraca + inflow other rivers + inflow groundwater} = \\
 & \quad (0.92 + 6.30 + 0.95 + ?) \times 10^9 \text{ m}^3 = (8.17 + ?) \times 10^9 \text{ m}^3 \\
 \text{Out:} & \quad \text{actual evap. lake + outflow Buna-B. + outflow groundwater} = \\
 & \quad (0.48 + 9.46 + ?) \times 10^9 \text{ m}^3 = - (9.94 + ?) \times 10^9 \text{ m}^3
 \end{aligned}$$

With the basin approach the error ($- 0.11 \times 10^9 \text{ m}^3$) is relatively small. As both groundwater inflow and outflow are unknown, a balance cannot be calculated with the lake approach. However, groundwater outflow will be much less than groundwater inflow, considering the geology of the basin. River discharge figures may be inaccurate. Probably the inflow of Drin water into the lake is not taken into account in the average Buna-Bojana outflow. The above figures for inflow/ outflow, both in the basin and the lake approach, are comparable to the figures presented by Boskovic et al (2004, Table 1) at the BALWOIS Conference in Ohrid in May 25-29, 2004.

Table 2.7 shows a tentative water balance of Lake Shkoder. The contribution of groundwater – through the Zeta Plain and karstic springs – in this table (marked ?) corresponds with the annual amount of 1.9 million m^3 derived by Radulovic (1997) and quoted by Boskovic et al (2004).

Table 2.7 Tentative water balance of Lake Shkoder

Parameter	Lake inflow 10^9 m^3 per year	Lake outflow 10^9 m^3 per year
Rainfall on lake	0.9	-
Evaporation from lake	-	0.5
Moraca River	6.3	-
Other rivers	1.0	-
Buna-Bojana River	-	9.5
Groundwater: Zeta Plain	2 (?)	-
Groundwater: karst springs		
Groundwater: other		
Groundwater: out	-	0.2 (?)
Total	10.2	10.2

The River Buna-Bojana, the lake outlet, has a weak transport and erosive capacity to remove sediments from the river bed, due to the low gradient of its channel bed. Sediments accumulate, contributing to the rise in water level in the river and flooding of the lands around Lake Shkoder. Further, as mentioned earlier, the outflow from the lake is impeded – back/ reverse flows occur - with a high discharge in the Drin River and a low water level in the lake. Also, landfills to build new constructions have been narrowing the outlet. Controversial plans exist to dredge the Buna-Bojana River and to build a hydro-power plant (near Bushati, Albania) that will influence the lake level: see Section 2.11.

- Stratification, circulation and water temperature

Stratification and water circulation are important for the chemistry and biology of a lake. Quantities of in-/outflow, water temperature, wind and lake morphology/ bathymetry are determining factors. Water circulation and mixing in Lake Shkoder is high, as in-/ outflow is high. Water residence time is about 120 days: the lake is shallow, and groundwater wells up from the deeper parts and mixes with the water originating from surface inflow. Stratification does not occur. This means that the habitats of many water species present in the lake cover wide areas.

Due to its low elevation, southern position and shallow water, Lake Shkoder has high water temperatures. This gives high rates of decomposition of organic materials, but favours also swimming and water sports. As the lake never freezes, it is a popular location for birds in winter.

Table 2.8 Lake Shkoder water temperatures in °C (monitoring period: 1952 – 1970; source: HMI Podgorica ?)

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Low	1.0	0.0	4.0	8.4	11.2	16.0	19.9	17.2	12.8	9.8	4.0	1.4
Medium	6.4	7.2	10.4	13.8	17.8	22.2	24.4	23.6	18.6	14.1	11.6	8.5
High	12.6	12.8	15.0	18.0	24.6	27.5	28.0	28.8	24.6	19.2	17.4	13.6

2.7 Quality of groundwater, surface water, soil, rain and air

2.7.1 Introduction

Factors that affect water quality of a lake and its basin can be classified as natural and human made. Human intervention is the most important factor influencing water quality, and it must be controlled.

Various studies and reports on Shkoder basin suggest that during the past decades the basin has experienced significant pollution of its water bodies and the surrounding area, causing losses in aquatic biodiversity; a threat to fisheries, public health and tourism. Most important are industrial pollution and untreated wastewater discharges from the cities and towns. The Moraca River, the main tributary of the lake, brings most pollutants into the lake. See also Section 2.7.5.

2.7.2 Data availability in Montenegro

There is quite some literature, mostly research papers and reports, on the quality of water and sediments in Lake Shkoder and in its tributary rivers. However, the literature suggests that analyses of water quality of the lake before 1990 are fragmentary.

The most comprehensive analysis of the lake water and its tributaries is presented by Petrovic and Filipovic in the compendium "The Biota and Limnology of Lake Skadar" (ed. Karaman, G.S. and Alfred M. Beeton, 1981, Chapter II and III, p.68-107). Their analyses are based on the data collected in the period 1974-1978. It can be considered as a basis for evaluation and comparison, as the lake until then had hardly been affected by pollutants such as agricultural fertilizers, chemical detergents; municipal and industrial wastes (Petrovic, 1981; p.68 and p.97).

Since 1990 onwards, efforts started to regularly monitor water quality of the lake and its environs. The environmental monitoring of the lake is carried out mostly by the Hydro-

meteorological Institute (HMI), the Center for Eco-toxicological Research (CETI) and the Institute for Nature Protection, in the framework of environmental assessment projects and in cooperation with external research institutes. The monitoring programmes include periodic analysis of the lake water, groundwater, water in the tributary rivers, soils, fishes, air and rain. As a start of the monitoring, during the period 1990-1991, many samples of soil and groundwater at various locations in the Aluminium Plant (KAP) area of Podgorica, water at the mouth of the Moraca River, lake sediments, fishes and vegetation in the lake were analysed. Phase I (1992-1993) and Phase II (1993-1996) of the environmental study in the Zeta Plain examined groundwater, river waters, soil, lake sediments and air quality, especially in the areas affected by the KAP. Annexes IV and V to XI give an indication of the data collected and frequency of observations by the HMI of Montenegro and the CETI on water, sediments and air quality in and around the lake. Figure 2.26 and Figure 2.25 show the locations where the HMI monitors the quality.

The Faculty of Natural Sciences and Mathematics, Biotechnical Institute, Department of Biology and Institute of Technical Investigations of the University of Montenegro also conduct analysis of the lake water, on its own or in cooperation with other research institutes. These institutes follow the sampling, analyses and data processing standard procedures recommended by international agencies like WMO, WHO, APHA, US EPA, AWWA and others.

Since 2000, the Institute of Hygiene of the Heidelberg University in Germany and the Institute of Analytical Chemistry of the University Graz in Austria, together with the Universities of Shkodra, Tirana and Montenegro, have been carrying out environmental studies within the framework of the project 'Integrated Monitoring of Shkodra Lake'. Study results on water quality, microbiology and the surrounding environment of the lake are presented in the Heidelberg Conference Reports of 2001 and 2002. The results also show, among others, the content of some heavy metals (Zn, Mn, Cu, Al, Pb, Cr, Cd and Fe^{3+}) in lake sediments and the mercury content in carp tissues. Bekteshi et al. (2003) give some data on concentration of metals (Cu, Zn, Cd, Pb, Cr, Mn, Co, Fe) in water and sediments of Lake Shkoder.

In general, the HMI collects and analyses, in collaboration with the CETI, surface and groundwater samples eight times a year on monthly basis, particularly during the warm periods. The physical and chemical parameters for water quality analysed (by the HMI) are: temperature, pH, electric conductivity, suspended solids, dissolved oxygen, saturation percentage by O_2 , BOD_5 , COD, iron, ammonium, chloride, sulphate, phosphate, nitrate, nitrite, phenol, MPAS, total coliforms, faecal bacteria, dry residue (experiment), dry residue (calculation), HCO_3 , hardness, Ca, Mg, Na and K. The CETI analyses the heavy metals and organic pollutants. It has the capability to analyse 56 parameters, radiology and microbiology). The ISO and US EPA standards are used in the laboratory analysis. Most data at the CETI are stored electronically since 1998. The digital recording of data by HMI seems to have begun in 1981, but it is irregular.

The methodology for the data analysis is that the adequate parameter values are established from the two most unfavourable years. On the basis of these values, the quality class for each group of parameters is established for each water category. Annex XII presents the standards of Montenegro for the classification and categorisation of surface and groundwaters.

Table 2.9 Monitoring stations for surface water quality in Montenegro (source: HMI Podgorica)

Station		Coordinates		Years	Frequency
		x	y		
Moraca River	Pernica	42° 38'	19° 22'	1985 – present	up to 8 times per year
	Zlatica	42° 29'	19° 19'	1985 – present	
	Gradska plaža	42° 27'	19° 16'	1966 – present	
	Gradski kolektor	42° 26'	19° 14'	1985 – present	
	Grbavci	42° 22'	19° 12'	1969 – present	
	Vukovci	42° 20'	19° 13'	1991 – present	
Zeta River	Vidrovan	43° 09'	18° 57'	1985 – present	
	Duklov most	42° 54'	19° 00'	1966 – present	
	Danilovgrad	42° 45'	19° 07'	1974 – present	
	Vranjske Njive	42° 28'	19° 16'	1985 – present	
Cijevna River	Trgaj	42° 23'	19° 24'	1990 – present	
	Na ušæu	42° 21'	19° 13'	1991 – present	
Bojana River	Fraškanjel	41° 58'	19° 24'	1968 - present	

Note: There exist some more stations, but their monitoring is irregular/ on request (CETI).

Table 2.10 Monitoring stations for groundwater quality in the Zeta Plain (source: HMI Podgorica)

Station	Coordinates		Years	Frequency
	x	y		
Farmaci	42° 24'	19° 11'	1996 - present	up to 4 times per year
Dajbabe	42° 25'	19° 14'	1996 - present	
Grbavci	42° 23'	19° 11'	1996 - present	
Golubovci	42° 20'	19° 14'	1996 – present	
Drešaj	42° 19'	19° 21'	1996 – present	
Vukovci	42° 17'	19° 12'	1996 – present	
Vranj	42° 19'	19° 18'	1996 – present	
Mitroviæi (Cijevna)	42° 22'	19° 13'	1996 - present	
Gostilj	42° 18'	19° 15'	1996 - present	

Bekteshi et al. (2003) give some data on concentration of metals (Cu, Zn, Cd, Pb, Cr, Mn, Co, Fe) in water and sediments of Lake Shkoder.

Table 2.11 Monitoring stations for air and rain quality (source: HMI Podgorica and Biological Institute)

Station	Coordinates		Type of station	Parameters				Frequency
	x	y		Ash & SO ₂	Precipitation	Sediment	NO	
Nikšić	42° 46'	18° 57'	in meteo station	+			+	once per 24 h
Cetinje	42° 24'	18° 56'	in meteo station	+	+			once per 24 h
Podgorica (HMI)	42° 26'	19° 17'	in meteo station	+	+	+	+	once per 24 h
Podgorica (Biol. Institute)	42° 26'	19° 17'	in meteo station	+				once per 24 h
Golubovci	42° 22'	19° 15'	in meteo station	+	+	+	+	once per 24 h
Danilovgrad	?	?	in meteo station	+	+			once per 24 h

Note: Golubovci data for the period 1998-2002 (from CETI)

In the station network the following is measured: ash, sulphur dioxide and nitrogen oxide in 24^h air sample; from 7am of the previous day to 7am of the following day according to SEV. In addition, climatologic elements and quantity of precipitation are monitored too. Monitoring started 20 years ago.

The data on solid waste and wastewaters in Montenegro are available from the Ministry of Environmental Protection and Physical Planning, the Municipality of Podgorica, CETI and Master Plans for wastewater management.

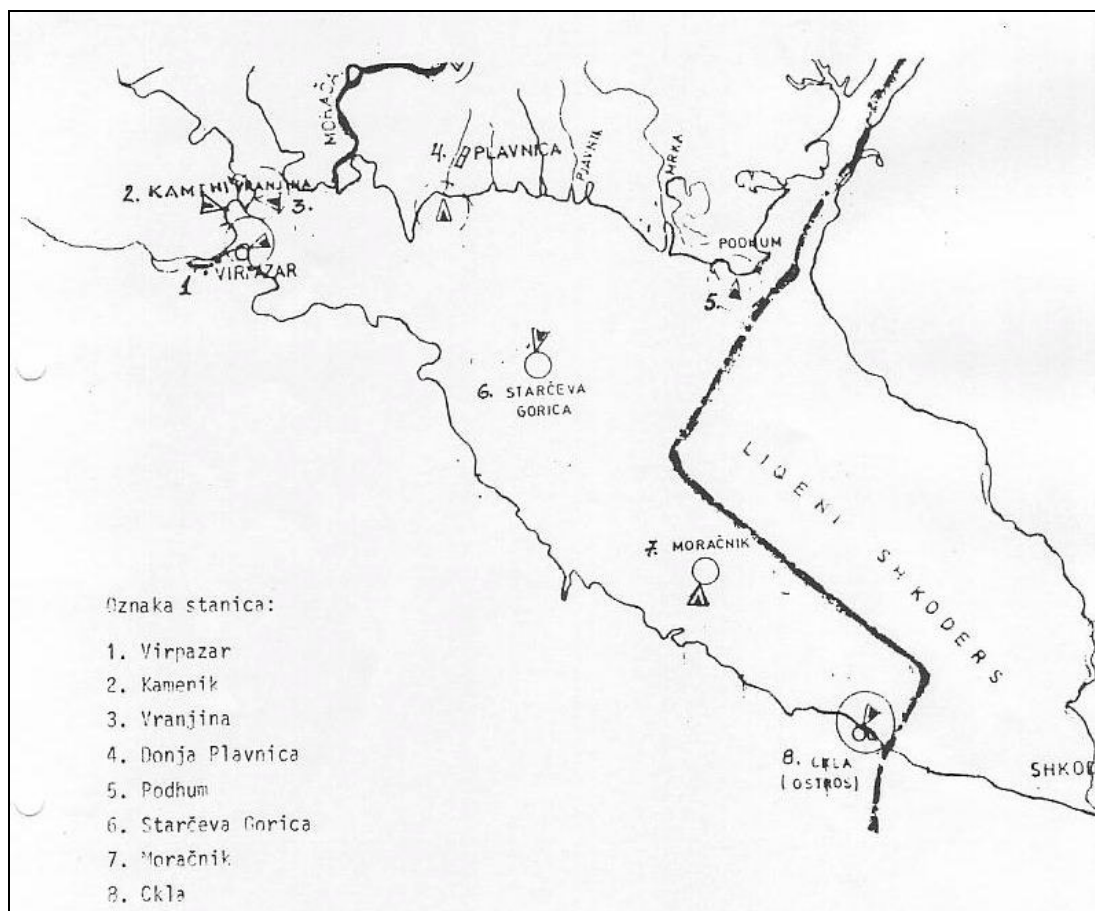


Figure 2.25 Water quality measuring points on the Montenegrin side of Lake Shkoder (source: HMI Podgorica)

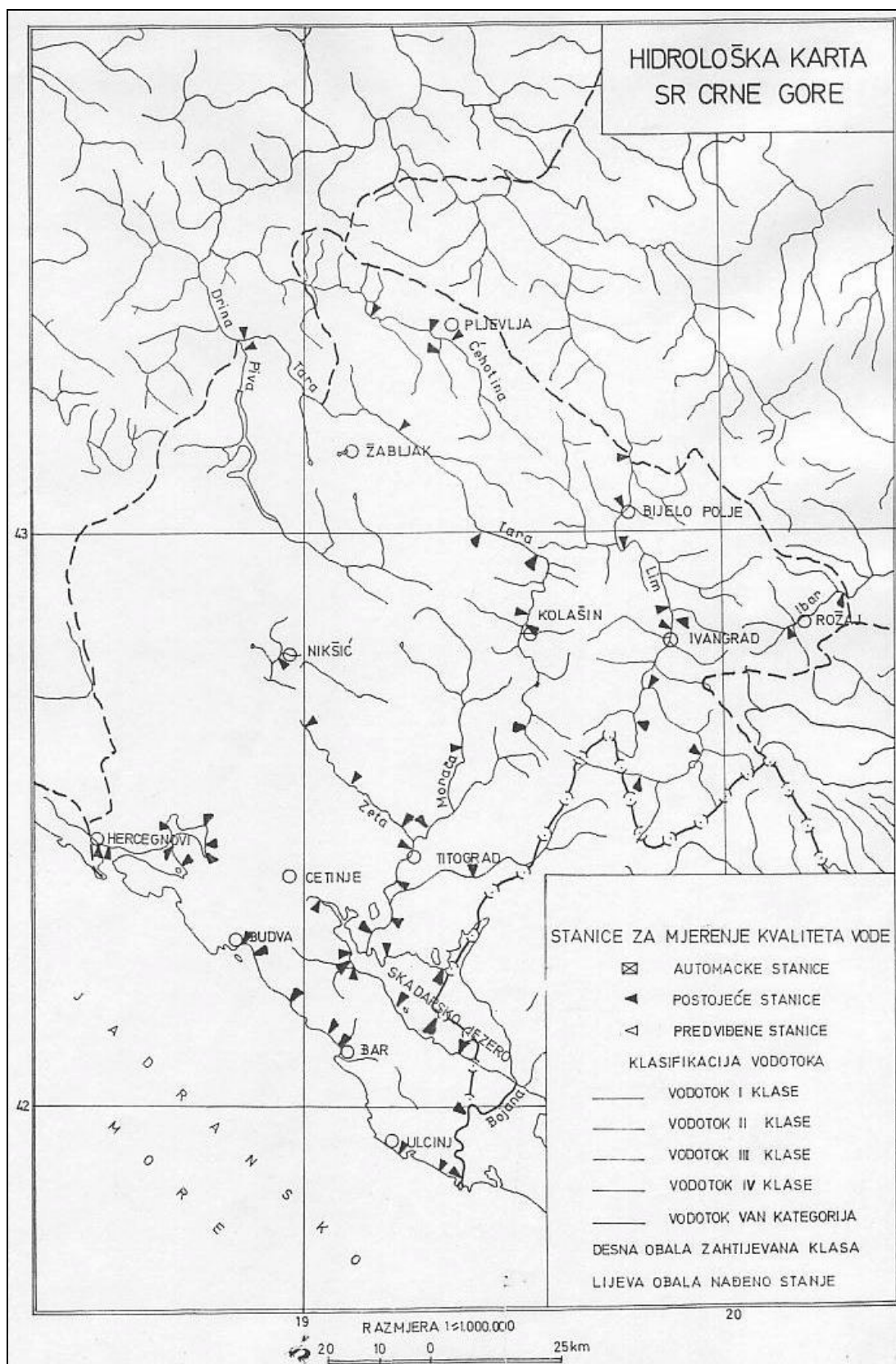


Figure 2.26 Water quality measuring points in whole Montenegro (source: HMI Podgorica)

2.7.3 Data availability in Albania

Like in Montenegro, data on water, sediment and air quality on the Albanian side of the lake watershed before 1990 is limited. Most of the available data, indicating the main physical-chemical characteristics of the water, were carried out by the Hydrometeorology Institute (HMI). Dulli & Bushati (1974) describe the hydrological and chemical characteristics of the groundwater (of wells) in Shkodra including their linkage with the lake. The publication by Maska (1990) on groundwater in the lake watershed describes the physical-chemical characteristics of the water of some springs near the lake.

The physical and chemical parameters of water quality analyzed by the HMI Albania are: temperature, salinity, transparency, pH, acidity, alkalinity, COD, BOD, conductivity, dissolved oxygen, nutrients (nitrogen as ammonia, nitrite, nitrate, and phosphorous as PO₄, total P), chloride, sulphate, Mg, Ca, Na, K, carbonate and bicarbonate.

Table 2.12 shows the general data of the meteorological station where air and rain quality are measured, while Table 2.13 gives information on the surface water quality stations. Figure 2.27 gives the location of the current HMI monitoring stations.

Table 2.12 Air and rain quality monitoring stations and data types in the Albanian part of the lake basin (source: HMI Albania)

Station	Coordinates		Type of station	Parameters, years			Frequency
	x	y		Dry deposited matter	pH of precipitation	Cations	
				from-to	from-to	from-to	
Shkoder (Fshati I pages)	42° 03'	19° 27'	Included in meteorological station	2002 - present	2002 - present	2004	monthly
Shkoder Qytet	42° 04'	19° 31'	Included in meteorological station	2004	2004		monthly

Table 2.13 Water quality monitoring stations in the Albanian part of the lake basin (source: HMI Albania)

Station	Coordinates		Years	Frequency
	x	y	from-to	
Lake Shkoder No.1	42° 08' 19"	19° 24' 32"	2000 - present	2 times/ year
Lake Shkoder No.2	?	?	2000 - present	2 times/ year
Lake Shkoder No.3	?	?	2000 - present	2 times/ year
Drin Bahcallek	42° 02' 56"	19° 29' 52"	2000 - present	6 times/ year

Other Albanian institutes that are involved in testing and monitoring the lake water quality are: Ministry of Environment, University of Shkodra and Tirana University.

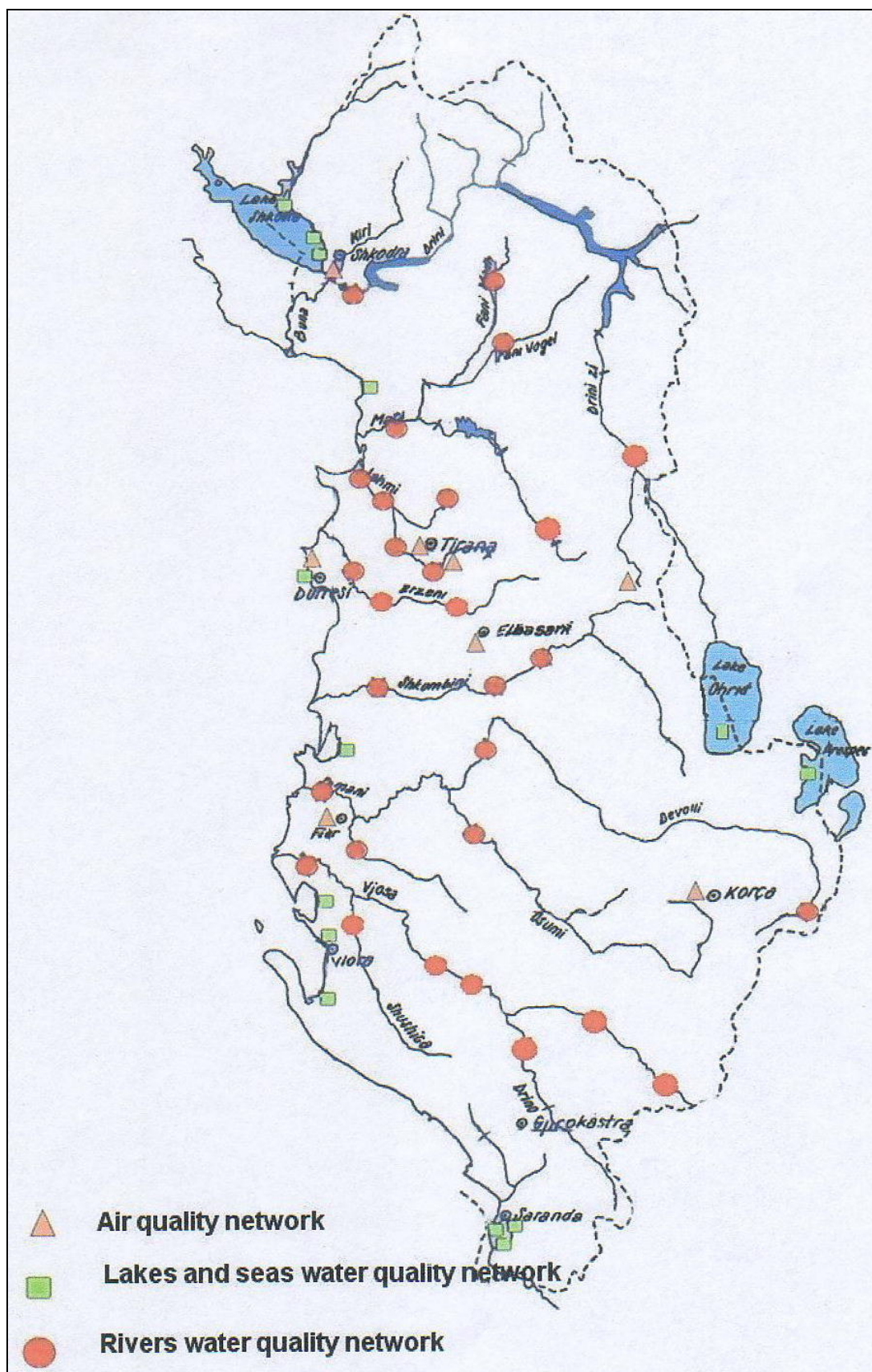


Figure 2.27 Measuring network in Albania for air and water quality, 2005 (source: HMI Tirana)

From 1995 onwards, data on physical and chemical characteristics of Lake Shkoder can be found in various reports and studies carried out at the University of Shkodra and by the HMI. Due to the limitations of their laboratory facilities, only basic physical and chemical parameters such as temperature, pH, conductivity, dissolved oxygen, ammonia, nitrites, nitrates, phosphates, total phosphorous and transparency were examined during the early period. Data on the lake water quality at different locations and depth for the period 2002-2004 are given in the monitoring reports of the HMI. The Heidelberg Conference reports of 2001 and 2002 related to the project 'Integrated Monitoring of Shkodra Lake' (mentioned in Section 2.7.2 above) also gives some data on the water quality of the Albanian part of the lake.

Since recently, researchers at the University of Shkodra (also the University of Montenegro for this matter) have been using innovative technologies to examine the presence of toxic hydrophobic organic pollutants (HOPs). One of the most recent publications is the "Identification of Readily Bio-available Pollutants in Lake Shkodra/ Skadar using Semi-permeable Membrane Devices (SPMDs), Bioassays and Chemical Analysis" by Rastall et al. (2004, p.240-253). SPMDs are used to test the presence of polynuclear aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs) in water and to simulate bio-accumulation. Traces of organic pollutants such as naphthalene, fluorine, phenanthrene, fluoranthene and chrysene were identified on the Albanian side of the lake in 2002. However, the concentrations of these were low.

Seasonal data on water quality of Buna, Drin and Kiri rivers are also available since 2000. Samples are generally taken in March, April, June, August, October and November.

Data on wastewater, solid waste and landfill sites are limited. The Waterworks of the Municipality of Shkodra have data on wastewater discharges from Shkodra. The Ministry of Environment has information on solid waste production in Shkodra.

2.7.4 Main pollution sources

There exist several sources of pollution in the Lake Shkoder Basin. Most pollutants for surface water, groundwater, soil and air in the basin originate from Podgorica, situated on the Moraca River terraces in the Zeta Plain. On the Albanian side the main polluter is the City of Shkodra with its solid waste and wastewater. The main sources of pollution are:

- 1) The Aluminium Plant Podgorica (KAP = Kombinat Aluminijuma Podgorica);
- 2) Steelworks in Niksic;
- 3) Wastewater from the cities and towns in the basin;
- 4) Municipal wastes from the cities and towns in the basin;
- 5) Mineral waste oils in the Zeta Plain;
- 6) Agriculture in the Zeta Plain;
- 7) Others.

- 1) The Aluminium Plant Podgorica (KAP = Kombinat Aluminijuma Podgorica)

The KAP, situated in the Zeta Plain south of Podgorica (see Figure 2.29), is a major source of pollutant inputs into the lake. This aluminium processing plant is about 32 years old (production at its full capacity begun in 1973) and has several production facilities: production of aluminium and anode, extraction of aluminium, electrolysis, foundry, cold rolling, foil rolling, cylumin production, forging, and quality control (see Annex IV for

its general information). The plant is operating at its full capacity and produces about an annual average of 400,000 tons of cathode production residue ('red mud') (Rastall et al, 2004).

The present disposal sites - two basins - for the 'red mud' are a threat for groundwater contamination and leachate reaching the waters of Lake Shkoder: see Annex X. The first basin has a liner – an insulation layer – to protect against the seepage of heavy metals into groundwater. The second basin, which does not have any protection layer, possesses a serious threat of groundwater contamination, including drinking water, because the plant is located near (about 10 km) the city. At present about 4 million tons of red mud have already been dumped over 220,000 m² in the second basin (Peck. UNEP, Draft Report, 2004, p.113).

The electrolytic process and anode production of the plant causes air pollution from fluoride, phenols, SO₂, NO_x fumes and smut. Other pollution threats associated with this plant include tons of polychlorinated biphenyls (PCB-s) that are stored in poor and unprotected conditions and the continued production of phenolic compounds, polycyclic aromatic hydrocarbons (PAH-s) and mercury-containing wastes. Annex IV gives some key data on solid waste and wastewaters of the KAP and Annex X shows KAP area pollution sites and nature of pollution analysis.

Water quality investigations conducted in 1991-1996 already showed significant contamination of groundwater in the Zeta Plain. High proportions of PCB-s and PAH-s have been found in the groundwater and in the Rivers Plavnica, Gostiljska Rijeka, Velika i Mala Mrka and Podgdhumin Hum bay: see Annexes VI to IX.



Figure 2.28 The KAP factory with the 'red mud' basins (photos: V. Buskovic)

The KAP is currently in the process of privatisation, in accordance with the privatization plan and policy of the Montenegrin Government. One of the important issues in the privatization of the plant is to solve problems caused by its waste products that are potential harmful to the environment. A bidder offered to invest in environmental measures: about €20 million in sanitation and about €35 million in new equipment and technologies.

2) Steelworks Niksic

The Steelworks Niksic (established in the 1950s), situated adjacent to the Zeta River, is another heavy industry with a considerable environmental impact. It produces engineering steels and a small quantity of special high-alloy steel. It has a steel melting

shop with two 60 tons of ultra high-power (UHP: a scale for power requirement level; UHV furnaces require over 700 kVA per ton of steel produced) furnaces, three electric arc furnaces, four hot rolling mills, a combined bar, rod and section mill, medium and light section mill, a forging plant and drawing (drawn steel) mill. The steelworks have the capacity to produce 190,000 tons of steel annually.

As the factory is far from Lake Shkoder, its pollution effect on the lake water and its environment is not directly felt. However, its waste products increase the pollutant contents of the Moroca through the Zeta river. The factory operates practically without any filters or scrubbers and, consequently, discharges a range of pollutants such as waste oils, phenols, heavy metals and toxic substances which contaminate soil and water including groundwater (EPR, 2003, chapter 10, p.145). These wastes are discharged into Bistrica river and ultimately to Zeta river, without proper treatment. Further, acid gas emissions from the steelworks add to the air pollution. The monitoring of the wastes from the steelworks is not carried out, except when requested for inspection.

Like the KAP, the Steelworks in Niksic is also in the process of privatisation. The privatization plan also focuses on the investment in environmental measures.

Besides the steelworks, the wastewaters from a.o. milk and meat factories and two hospitals are discharged into the precipice in Niksic via the municipal wastewater system. The pollutants in these wastes infiltrate most likely to the groundwater that ultimately flows into the lake.

3) Wastewaters from the cities and towns

Wastewaters from the cities are major sources for surface and groundwater pollution in the Shkoder basin. Millions of cubic metres of untreated or poorly treated municipal wastewater from the cities and towns on the banks of Moraca and Zeta rivers are discharged each year into these main tributaries of the lake. These are predominantly of household origin, combined with the rain water. They contribute mainly to the microbiological contamination of water with suspended matters, BOD, COD, NH_4 , nitrates, nitrites, mineral oils, sulphides, phenols and phosphates. Annex V presents sources and quantities of industrial and municipal wastewater.

Podgorica has a wastewater treatment plant, but it has a capacity to treat only about 50% of the city wastes. Wastewaters from Cetinje and Niksic are discharged into open drains without any purification. By comparison, the contamination by Cetinje wastewater is less than that from Podgorica or Niksic. The wastewaters from Cetinje (including the Obod factory) drains into the Obod Cave and also through sub-lacustrine springs on the west side of the lake. The Crnojevic River receives via groundwater part of the municipal and industrial waters of the town, because of the karst topography. Most wastewaters in Danilovgrad are discharged into the Zeta River without purification. See Annex V for more information.

Wastewater treatment in the Albanian part of the lake basin is practically absent. Figure 2.30 shows pollution with solid wastes and wastewater from Shkodra city.

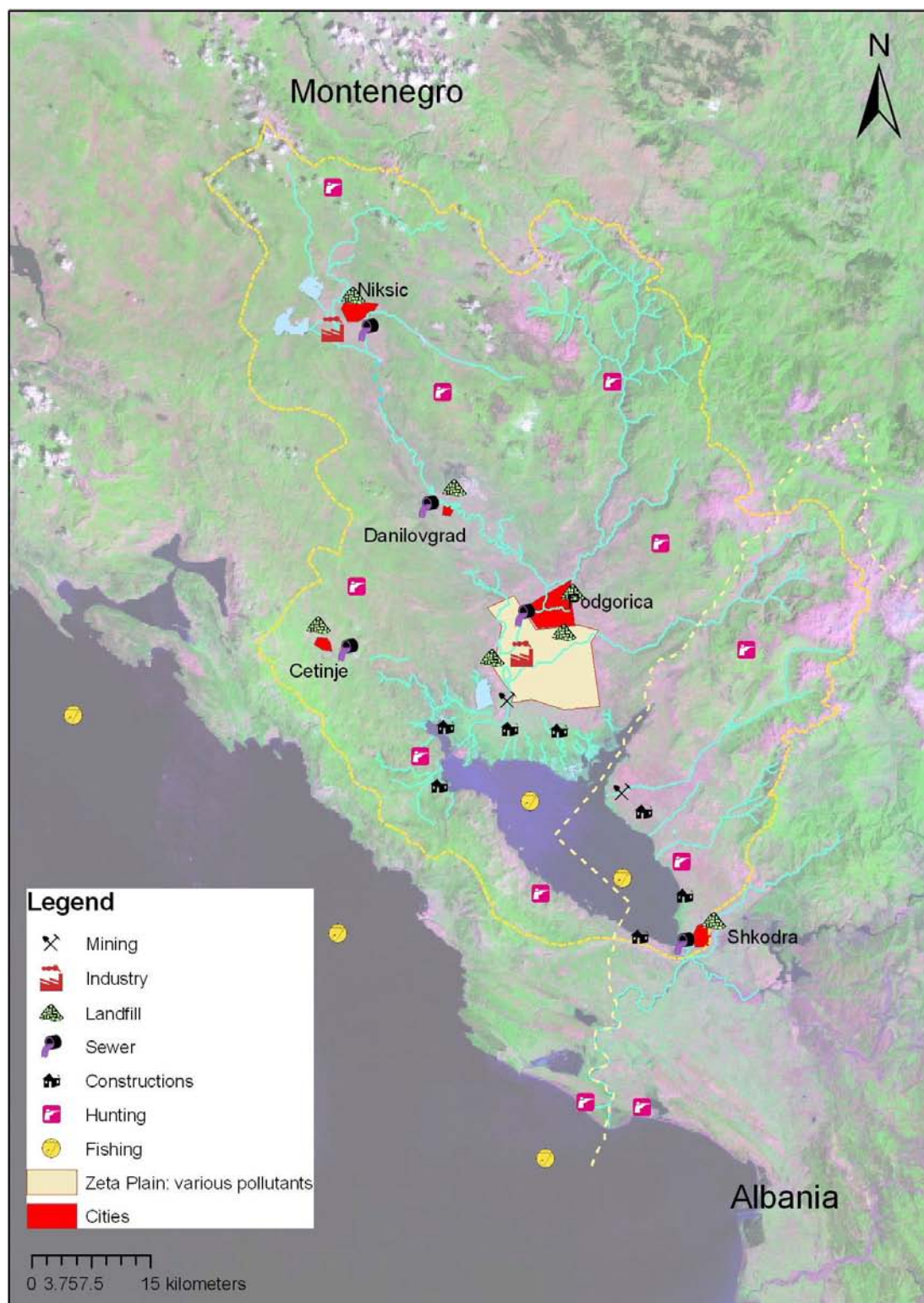


Figure 2.29 Indicative location of the main pollution sources and pressures in the Shkoder basin



Figure 2.30 Solid waste and polluted water close to the wastewater drain from Shkodra city (May 2005)

4) Municipal wastes from the cities and towns

Solid waste disposal from cities and towns within the lake basin is a severe cause for environmental problems. Municipal wastes include, among others, household waste, waste from commercial enterprises and small industries, bio-medical/ hospital waste, waste from demolition of houses and from streets sweeping. Pollution of groundwater (leakage, percolation), air pollution (gas emissions) and risk of diseases (for both man and animals) are the main issues. The waste problem is caused by: ineffective legal framework for waste management, inadequate waste collection system (especially in rural areas), lack of awareness among most people about proper waste management, improper separation of wastes and uncontrolled disposal sites, insufficient funds and technical means to deal with the waste disposal.

The data on municipal wastes is fragmentary. The waste generated per person per day is estimated to be close to 1 kg in Montenegro, while in the Albanian cities this is about 0.7-0.8 kg/ person/ day.

In Albania, only 50-70% of the urban waste is deposited in official waste disposal sites, and proper sewage treatment is virtually absent. Untreated sewage effluents, especially from households along the lake in the Shkodra city are directly released to the lake or to the small tributaries feeding the lake. Improper disposal of sewage and extensive use of septic tanks can possibly contaminate the lake water and drinking water system.

Table 2.14 Annual solid waste production (registered and estimated, in tons) in whole Montenegro

1998	1999	2001	2003	2005	2007	2009	2011	2013	2015	2017
235,829	247,863	262,092	276,320	290,549	304,777	319,000	329,100	334,900	340,800	346,700

Source: MEPPP, 2001

Table 2.15 Annual solid waste production in Shkoder District in 2004

No	Municipality	Population	Waste per inhabitant (ton)	Total waste (ton)
1	Shkoder	90,500	0.255	23,077
2	Vau i Dejes	9,700	0.182	1,765
3	Puke	4,700	0.182	855
4	Fushe Arrez	4,200	0.182	764
5	Koplik	3,250	0.219	712
6	District Shkoder	265,000	0.157	41,500

Source: Ministry of Territory Regulation and Tourism (2004), Annual report of urban and inert solid waste

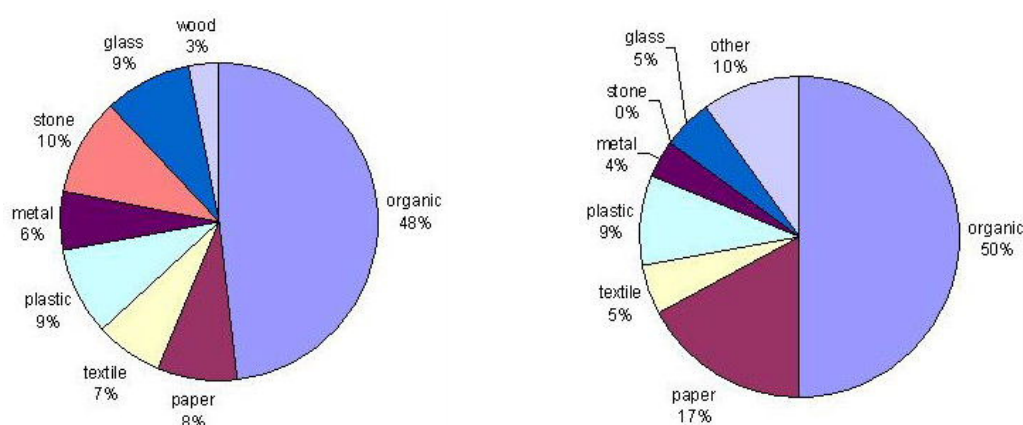


Figure 2.31 Composition of solid waste in Shkodra and Montenegro, 2001 (source: Burimi ISHP for Shkodra and the MEPPP for Montenegro)

The municipal waste, both in Albania and Montenegro, is generally disposed of at open landfill sites, which are close to the cities, without insulation layer as protection of groundwater, soil contamination and without an environment protection system. While recyclable materials such as paper, glass, plastic and metals are to a certain extent recovered from the disposal sites, solid hazardous materials like used batteries, neon and mercury lamps, transformers, condensers, refrigerators are left on the dumping sites. There are no facilities for the treatment and disposal of hazardous materials, nor are there any proper storage facilities for these wastes in Albania or Montenegro (lake basin). This has resulted in a built-up of hazardous wastes, especially at industrial sites.



Figure 2.32 Uncontrolled waste disposal near Shkodra city

For over 30 years municipal wastes from Podgorica have been dumped at the Cemovsko Polje landfill site situated about 8 km east of the city. At this site annually about 400,000 cubic metres of unsorted waste is dumped on about 54 hectares (Rastall et al, 2004). Information on the quantity of waste dumped is inconsistent. The prolonged storage of untreated waste at this location has contaminated the underlying soil and groundwater.

Industrial wastewater from the candy factory, stone quarries, pig farm and dairy farm in Spuz (Danilovgrad) are disposed into the municipal waste collector drains, which ultimately discharges into the Zeta River.

5) Mineral waste oils in the Zeta Plain

Waste oils are spilled all around in the Zeta Plain without any control. Automobile garages and carwash services in Podgorica, Tuzi, Golubovic and other villages in the Zeta Plain are the main source of these pollutants. Analysis of soil and sediment samples confirmed the contamination: see Annex VIII. As an example of localized pollution, the soil in the KAP area near the 'Mazut' (crude oil) station is polluted with spilled oil, and one of the piezometer boreholes in the area contained crude oil.

Other notable sources of pollution are waste oils and tar spills from the boilers of the tobacco factory in Podgorica, the winery "Plantaze" and the metal industry "Radoje Dakic".

6) Agriculture in the Zeta Plain

Most agricultural activities take place in the lower part of the Zeta Plain and on the east side of Lake Shkoder. Where agriculture farming is practised, the (limited) use of pesticides and chemical fertilisers by inadequately trained farm workers using poorly maintained or outdated equipments presents a threat to the lake ecosystem due to the contamination through surface run-off and infiltration into groundwater (high percolation rates). Analyses of the soils in this area and the lake water show significant presence of pollutants and nutrients that are possibly caused by pesticides and fertilizers: see Annexes VI to IX.

There is a large vineyard – "the Plantaze" - of about 4,000 hectares, situated close to Podgorica (see Figure 2.29). Irrigation using trickles and sprinklers is practised. The "AD Plantaze" of Agrocombinat "13 jul" utilizes annually 130 kg of cristaline fertilizer and 350 kg of Nitrogen, Phosphorous and Potash (NPK) fertilizers on 1,050 ha. The 'plantaze' uses 16 tons "Tiolit" sulphur preparation, 16 tons of copper lime, 10 tons of insecticides and 5 tons of fungicides (new generation of III and IV groups of poison products) annually. The use of pesticides is low, less than 0.5 kg/ha, but it can cause contamination of groundwater, and ultimately the lake water, because of highly porous (intergranular) soil (personal communication with Mr. Mirko Knezevic, Dec. 2005). The plantaze is also planned to be privatized.

7) Others

In addition to the above-mentioned sources of pollution, there are several locations that may be contaminated by different pollutants. For example, around 1992 some containers with organo-chlorine pesticides were received from Germany in Bajza (Albania). The pesticides remained in place for some time without being used. Part of it leaked into the ground until they were returned to Germany. Although no specific examination of its con-

tamination was done, it is apparent that the ground (water and soil) have been polluted from the pesticides. (personal communications A. Misurovic, CETI, 2005).

Some agricultural wastes are discharged directly into the environment or stored in ponds near farms. In relatively large animal farms (e.g. pig farms) manure is often stored in the field before spreading, which leads to run-off of nutrients and other substances. Such manure handling system might cause serious point-source pollution.

The Drin River contributes, to some extent, to the contamination of the lake with trace elements originating from the disposal of by-products from iron and copper mines upstream: see Figure 2.33. Further, the large number of private generators used by the shopkeepers – due to the electrical power shortage - in Shkodra city is a source of air pollution.



Figure 2.33 Mines within the Drin basin, causing pollution in Lake Shkoder in the periods that Drin water enters the lake

2.7.5 Quality of water, soil, sediment, rain and air

- *Water quality (entire basin)*

Water quality is represented by many parameters. Annex VI show an extensive list of parameters used by the HMI Montenegro and Albania and the CETI (Montenegro) for the assessment of water quality.

The basic parameters generally used to indicate lake water quality are:

1. Transparency and turbidity
2. pH and alkalinity
3. TDS and general chemistry
4. Dissolved oxygen and oxygen-depleting substances
5. Phosphorous and nitrogen as nutrients and sources of eutrophication
6. Trace elements and metals

These indicators are briefly discussed below, with values indicating the quality of the water in Lake Shkoder.

Recent publications by Puric et al. (Konferenca Report 2004, p.35) show that Shkoder Lake is still relatively clean. Soluble pollutants will spread quickly in the lake, in particular when entering through the Moraca River in the northwestern lake corner, but will also disappear fast (to sea) because of the short retention time of the water. The analyses of the lake water by Petrovic and Beeton (1981, p.84) show that the chemistry of the lake water is similar to the chemistry of the Moraca River from October to June, the warm period of the year. Further, high contamination by afore-mentioned parameters is found in the lake near the mouth of the Moraca and Crnojevic Rivers. This supports the impression that most pollutants in the lake come from these two main tributaries. Annex VI gives the results of various water analysis campaigns.

1. Transparency and turbidity

Good quality water should be transparent. Turbidity is a measure of the water's clarity. Turbid water is caused by suspended matter or impurities. These impurities may be clay, silt, finely divided inorganic and organic matter, soluble coloured organic compounds, plankton and other microscopic organisms. Typical sources of turbidity in lake water include: waste discharges, run-off from watersheds, algae or aquatic weeds and products of their breakdown, humic acids and other organic matters resulting from decay of plants, leaves etc. Turbidity obstructs light, thus reducing the growth of marine plants, eggs and larvae, which are usually found in the lower levels of an aquatic system. With higher levels of turbidity, water loses its ability to support a diversity of aquatic organisms. Suspended solids can clog fish gills, reduce growth rates and decrease resistance to disease. The turbidity of the lake water varied from 0.6 -10.4 NTU (Nephelometric Turbidity Unit).or 5-45 mg SiO₂/l. On average it is around 1.7 NTU.

Colour gives an indication of the relative amount of dissolved organic matter in the water. The colour of the Shkoder lake water varies from 5-10 Pt-Co (platinum-cobalt standard or Pt-Co units). At some locations, like Virpazar and Vanjina (Montenegro), the colour value is 20 Pt-Co. In general, values between 0-20 Pt-Co are considered clear.

2. pH and alkalinity

In simple terms, pH is a measure of the acid-alkaline relationship in a water body. Its values range on a scale of 0 to 14 with 7 being neutral. Water with a pH value less than 7 is acidic, while water greater than 7 is alkaline. A pH of 6 to 9 is favourable for aquatic life. While moderately low pH does not usually harm fish, the metals that become soluble with low pH can be important. In low pH water, aluminium, zinc and mercury concentrations increase, if they are present in lake sediment or watershed soils.

Alkalinity represents a measure of the capacity of water to buffer or neutralize acids. It is not really a measure of a pollutant and is different from pH. It is important for fish and aquatic life because it protects or buffers against pH. Alkalinity in water is due to the presence of bicarbonate, carbonate and hydroxide. It is generally measured in milligrams per litre (mg/l) as calcium carbonate (CaCO_3). A higher alkalinity represents a greater ability to neutralize acids. Lakes located in areas of calcareous glacial till will have higher alkalinity than lakes formed on non-calcareous bedrock.

Available data on chemical analyses show that the pH-value of the lake water hardly reaches below 6.8, and the alkalinity is less than 0.20 meq/l. In 1975, total alkalinity of the lake water varied from 1.5 to 4.2 meq/l, while bicarbonate alkalinity varied from 87 to 254 mg/l. This implies that the lake had and probably still has a good buffer capacity, according to the classification of Sweden and US EPA. The bicarbonate alkalinity of the lake water reduced to 195 in 1990-1995.

3. Total Dissolved Salts (TDS) and general chemistry

Total dissolved salts (TDS) refer to the amount of dissolved salts per unit volume of water and is used to express the salinity of water. Salinity also refers to the presence of salts in soils. The direct source of salts is surface and groundwater. Other sources of salts, which are the result of human activity, include: irrigation and drainage water, chemical fertilizers, animal wastes, sewage sludge and effluents. The suitability of water for drinking, industrial use, wild and aquatic life depends on the type and concentration of dissolved salts in water. The salinity of water is expressed in mg/l and is determined by evaporating a small amount of water in the lab, and weighing the remaining solids (dry residue).

At present, electrical conductivity (EC) is mostly used as indicator to express salinity (in microSiemens per centimetre or $\mu\text{S}/\text{cm}$) by measuring the conductivity of a water sample and converting its resistance (in micro-mhos) to TDS. Pure water is a poor electric conductor. Conductivity of water is affected by the presence of dissolved salts such as chloride, nitrate, sulphates (negatively charged ions) or sodium, magnesium, calcium, iron, and aluminium (positively charged ions). It is also influenced by temperature. High EC values may indicate high levels of pollutants. EC values in the period 1995-2005 were between 154 to 237 $\mu\text{S}/\text{cm}$.

Water hardness is a measure of the concentration of metal ions such as calcium, magnesium, iron, zinc etc. In most water it consists mainly of calcium and magnesium salts, with trace amounts of other metals. It is, from a fish viewpoint, one of the most important aspects of water quality, as it affects so many areas of fish health. Hardness has a major effect on pH and pH stability of water. It affects the toxicity of many common substances, including some fish disease treatments. The most commonly used method measures general (total) hardness of calcium carbonate (CaCO_3) in mg/l. Another

common measurement is German hardness, measured as °dH. Total hardness of the lake water varies from 7.6 to 10.5 °dH (to convert °dH to mg/l of CaCO₃ hardness: multiply by 17.9), implying that the lake water is moderately hard, like all water (including drinking water) in the region, due to the karstic geology.

Organic matter plays a major role in aquatic systems. It affects biogeochemical processes, nutrient cycling, biological availability, chemical transport and interactions. It also has direct implications in the planning of wastewater and drinking water treatment. Organic matter content is typically measured as total organic carbon (TOC). TOC values of the lake water varied from 0.05 to 1.85 mg/l (maximum value of 2.32 mg/l is found in the right branch of the Moraca River, in 1990-1995, likely indicating the influence of Podgorica's wastewater plant).

Trihalomethanes (THMs) are a by-product of the water treatment process and are used as indicators of total disinfection by-product formation. They are formed when natural organic material, such as the decaying vegetation commonly found in lakes and reservoirs, reacts with chlorine used to treat the water. THMs in the lake water are found to be low; in the range of 0.01-12.7 µg/l, which is below the limit prescribed for safe drinking water (0.1 mg/l). Other water quality parameters such as Cl, F, K, Na, Ca, Mg, SO₄, CN, and H₂S are always within the prescribed limits for safe drinking water.

4. Dissolved oxygen and oxygen-depleting substances

Dissolved oxygen (DO) in a water body is a measure of oxygen held in the water. Aquatic life uses oxygen that is dissolved in the water. Much of the dissolved oxygen comes from the atmosphere and is dissolved in the water through diffusion and wave action. The remainder comes from plants through photosynthesis. DO in water also depends on temperature, weather, salinity and metabolic activity in sediments. Cold fresh water holds more oxygen than warm or salty water. Running water, because of its churning, dissolves more oxygen than still water, such as that in a reservoir behind a dam. Respiration by aquatic animals, decomposition, water vegetation at night and various chemical reactions consume oxygen. Pollutants such as sewage or agricultural runoff result in the build up of organic matter and the consumption of dissolved oxygen by microbial decomposers as they break down the organic matter. Low levels of DO can be the result of elevated temperature and thus the inability of the water to hold the available oxygen; it can also indicate an excessive demand on oxygen in the system.

The dissolved oxygen content in the Lake Shkoder water has remained mostly above 7 mg/l (see Table 2.16 and Annex VI, average lake water quality for the period 1995 – 2005). This implies that the water is abundant with oxygen, which is important for the biota in the lake.

Chemical oxygen demand (COD) is used as a measure of oxygen requirement of water that is susceptible to oxidation by strong chemical oxidants. The COD was less than 5.25 mg O₂/l (K₂Cr₂O₇) and 10.75 mg O₂/l (KMnO₄). These values are below the limits for safe drinking water.

5. Phosphorous and nitrogen as nutrients and sources of eutrophication

Phosphorus occurs naturally in surface waters, and originates from the weathering of igneous rocks, soil leaching and organic matter. It is usually present in natural water as phosphate. Phosphorus is introduced into the environment from sources such as: human and animal wastes, fertilizers, detergents (polymeric), and industrial wastes. Total phosphorus (TP) is a measure of the total amount, both soluble and particulate forms, of phosphorus, potentially available to biological systems and is measured in mg/l.

Phosphorus is the key nutrient influencing plant growth in lakes, but it can also be a pollutant. An increase in phosphorus results in an increase in biological productivity, and can lead to an increase in algae and aquatic weeds (eutrophication), which eventually can damage an ecosystem by draining oxygen levels when the plants decompose and during the night. Excessive growth of macrophytes and algae is usually a problem in stagnant or semi-stagnant water that are shallow and stratified.

Trophic status is a useful way of classifying a lake and describing the lake processes in terms of the productivity of the system. Basins with infertile soils release little nitrogen and phosphorus leading to less productive lakes, classified as oligotrophic or mesotrophic. Watersheds with rich organic soils or agricultural regions enriched with fertilizers yield much higher nutrient loads, resulting in a lake with higher biomass production (eutrophic or even hyper-eutrophic). The mean value of ortho-phosphate concentrations in Lake Shkoder ranged from 0.005 to 0.085 mg/l over the last 30 years. The concentrations vary with season and location. These values suggest that the water is mainly oligotrophic-mesotrophic. However, at some places the water shows eutrophic characteristics. The values are high on the northern and eastern lakeshore, near to the Moraca mouth and the Zeta Plain. Also on the Albanian side the higher concentrations of nutrients are in the east, where most agricultural activities take place (Project "Integrated Monitoring of Shkodra Lake", 2002).

In fresh water, it is usually the supply of phosphorus that regulates the production of algae and other plants; but in some cases, nitrogen supply is the key factor. Nitrogen is found in different forms in terrestrial and ecosystems. These forms of nitrogen include ammonia (NH_4), nitrates (NO_3), and nitrites (NO_2). The decay and decomposition of plants produce ammonia which, through bacteriological process, turns the ammonia into nitrate. Fertilizers, sewage and municipal wastes, effluents from septic tanks, run-off of manure, automobile exhausts and discharges from industrial wastes are main sources of nitrates. Nitrate is also a nutrient that helps the plants growth. Together with phosphorous, nitrates in excess amounts can cause eutrophication.

Nitrate reactions in fresh water can cause oxygen depletion. Nitrites (NO_2) can produce a serious condition in fish called 'brown blood disease'. Nitrite/ nitrogen levels below 90 mg/l and nitrate levels below 0.5 mg/l seem to have no effect on fish. The nitrate and nitrite/ nitrogen levels of the lake are below these levels (see Table 3.16 and Annex VI).

Phosphorus is used as a general indicator of eutrophication, while the quotient between nitrogen and phosphorus (N/P) is used as an indicator of which nutrient is the limiting factor. The nitrogen-phosphorous quotient in the lake varies from 11 to 15 and is in some places 23. Using the Swedish EPA classification, this means that the lake is moderately N deficient.

6. Trace elements and metals

Low concentrations of trace elements and metals occur naturally in fresh waters. The level strongly depends on the chemical composition of the sediments and the geological origin of the water. Human activities can accelerate the accumulation of trace elements through point and non-point sources. Major point sources of trace elements are industrial and domestic waste-water discharges. Anthropogenic pollution of water with heavy metals is common through atmospheric deposition or through unpurified wastewater discharge.

The most toxic heavy metals are As, Cd, Cr, Ni, Pb, Zn and Hg. The average values of these heavy metals, measured at 14 different places in the lake, fall in Class 2 (low concentration) and at some places in Class 3 (moderate to high concentration). Clearly Class 2 concentration of heavy metals have little (risk of) biological effects. Class 3 concentration has more effects in acidic water (promotes metal mobility) and in soft water with low concentration of humus and nutrients (little binding capacity). The mercury (Hg) concentration is low and is within the prescribed limits for safe use for human consumption.

Table 2.16 gives a comparison of the above-discussed parameters of the Lake Shkoder water and its basin from 1974-2005.

Table 2.16 Values for basic water quality parameters in the Shkoder basin, 1974 - 2005

Parameter	Units	1974-1975 ¹	1990-1995 ²	July 2005 ³
Transparency	-			
Real colour	(Pt-Co)	Colourless	5	5
Turbidity NTU	NTU	-	1.6	3
pH	-	7.2 – 8.5	8.22	8.25
Alkalinity				
Total alkalinity	mval/l	1.5 -4.2	-	-
HCO ₃	mg/l	86.6-254	195.2	-
Dissolved oxygen				
Surface water	mg/l	7-12	12.2	9.4
Lake bottom	mg/l	5-12	-	-
Dissolved salts				
Dry residue	mg/l	98-164	140-160	135-170 (2004)
Conductivity	µS/cm	-	205	237
Phosphorus				
Phosphates (PO ₄)	mg/l	0.002-0.004	0.005	<0.01
Total phosphorus (TP)	ug/l	8-40	-	-
Nitrates (NO ₃)	mg/l	0.012-1.200	0.45	2.9
Nitrites (NO ₂)	mg/l	0.012-0.030	0.004	0.006
Trace elements				
(Cd, Co, Cr, Fe, Hg, Mn, Ni, Pb, Zn etc.)	ppm	7-731	-	-
	mg/l	0.02-4.6	<0.01	0.01-0.05

Sources:

- 1) "The Biota and Limnology of Lake Skadar", 1981
- 2) HMI Montenegro and CETI (A. Misurovic). Mean values of water samples from Kamenik Radus Vucki
- 3) CETI and HMI Montenegro (A. Misurovic). Mean values of water samples taken at Kamenik Radus Vucki

In addition to above-mentioned basic parameters, polychlorinated biphenols (PCBs) and polyaromatic hydrocarbons (PAHs) are used as indicators of organic chemical pollutants in soil, sediment and water. Unlike PCBs, which are exclusively manmade compounds that have wide industrial uses, PAHs are of both natural and anthropogenic origin. Some PAHs can dissolve in water. As an example, in the KAP area, some 70 tons of PCBs are stored under poor conditions (Rastall et al. (2004, p.242). Further the KAP plant produces PAHs.

The PCBs and PAHs in the lake water (also in the Moraca River, at the entry point to the lake), in 2005, were less than 0.1 µg/l and 0.01 µg/l respectively. These were null in 1995-2000 (see Annex VI, p.VI-2, p.VI-6). Maximum permissible limit according to the EU standards for water is 0.2 µg/l.

- *Groundwater quality (entire basin)*

Data on groundwater in the Lake Shkoder basin is very limited and fragmentary, both in terms of number of parameters and measuring frequency. These data show that the pollution of groundwater is insignificant. However, it is difficult to come to some conclusion on the basis of these data alone.

Annex IX gives the PCBs in the groundwater in the Zeta Plain, for the period from 1990-2004. Water quality investigations conducted in 1990-1996 already showed significant contamination of groundwater in the Zeta Plain (Annex IX, p.IX-1). High proportions of PCBs and PAHs have been found in the groundwater and in the rivers Plavnica, Gostiljska Rijeka, Velika i Mala Mrka and Podgdhum Hum bay. However, the measurements in 1998-2004 showed practically no traces of PCBs (at the same locations). This is probably due to the following. Firstly, as mentioned earlier the Zeta Plain is intergranular and comprise of sand and gravel; the amount of rainfall in Podgorica is around 1,500-2,000 mm per year, the heavy rainfall has practically washed out PCBs from the soil into the groundwater to the lake sediments. Secondly, the old barrels of Pyralen and part of the polluted soil in the KAP area were transferred to a special bunker, thus removing a major groundwater pollution source.

- *Water quality (Albanian part of the basin)*

As a result of the high replenishment/ refreshment rate of the lake water, about two times per year, the quality of water remains within acceptable limits (in the same class as specified for the classification and categorization of watercourses in Montenegro, Ls.List RCG no.14/96), despite uncontrolled developments on both Albanian and Montenegrin sides.

The water quality on the Albanian side of the lake does not differ much from that on the Montenegrin side. The Drin River water enters into the lake in some winter periods and is a source of pollutants. The river water carries waste products from the mines located at various places upstream in its watershed (see Figure 2.33) and municipal wastewater of Shkodra city.

The physical and chemical parameters of waters of the Buna-Bojana River, the outlet of Lake Shkoder, measured during June 2000 - December 2001, did not differ much from those of Lake Shkoder. Differences were observed in the concentration of the nutrients (phosphates, nitrates and ammonium) which have higher values in the Buna-Bojana

River. These nutrients probably came from the discharges of wastewater of Shkodra town (during the study period).

Beka, I. and A. Bekteshi (Heidelberg Conference Report 2001, p.47-54) give an indication of the changes and trends in the quality of the lake water at the Albanian side, for the period 1995-2000. This study shows that the water of the lake is slightly alkaline; the pH values varying from 7.3 to 8.5, with a mean value 7.9. The alkalinity of the water is mostly due to bicarbonate, and is well buffered. Values of conductivity vary from 190 - 305 $\mu\text{S}/\text{cm}$. The amount TDS (as dry residue) in the Lake Shkoder water varies seasonally and with weather conditions: 165 to 220 mg/l in 1995-2000, with a mean value of 193 mg/l, indicating that the mineralization of the water was low. The concentration of dissolved oxygen was relatively high, an indication that the water is good for supporting aquatic life. The trace elements and metals in the Albanian side of the lake show that their concentrations are lower than the EC standard (Heidelberg Conference Report 2001, Table 2, p.52). The concentration of nutrients – nitrates, nitrites and phosphates - was higher in the eastern part of the lake than west (Heidelberg Conference Report 2001, p.52). In general, their concentrations are within the requirements of EC Directive for Cyprinid waters. The higher concentration of the nutrients on the eastern side is possibly due to the run-off and infiltration of agricultural fertilizers used, through surface and underground water.

Later, as a follow up, analysis of the some water quality parameters measured between September and December 2001 has been done within the project framework of “Integrated Monitoring of Shkodra Lake” (Beka et al., Heidelberg Conference Report 2002, p.45-49). Compared to the results for the period 1995-2000 (Beka and Bekteshi, Heidelberg Conference Report 2001, p. 47-54), the results of the analyses show no significant changes in basic physical and chemical parameters of water. Apparently, trace elements were not measured during this period.

Some of data on the trace elements/ metals, nutrients (nitrates, nitrites, ammonia, phosphates) and conductivity of the lake water are shown in Annex VI, p.VI-11 and VI-12, for the period 2002-2003. Compared to the Montenegrin part of the lake, the data show relatively higher concentrations of trace elements: 0.1 to 4.6 $\mu\text{g}/\text{l}$ (maximum value 8 for Cu, p.VI-11).

Data on the groundwater in the Albanian side of the lake basin is very limited. Some available data on groundwater quality are given in Annex IX (p.IX-2), for the period 2004-2005. It is difficult to draw conclusions on the basis of these data.

- *Sediment quality (entire basin)*

Sediment contamination is a pervasive environmental problem that threatens the aquatic ecosystem, in particular the benthic flora and fauna. Once released into surface or groundwater, many toxic and persistent pollutants become absorbed to sediment or soils and can become incorporated into aquatic food webs. Polluted sediments in water bodies pose potential risks to fish, as well as humans and wildlife who consume contaminated fish. Both toxic and chemical analyses of sediment are necessary to evaluate the effect of pollution on the ecosystem.

Data on sediment and soil quality in Lake Shkoder basin is limited. Annex VII (p.VII-1) and VIII (p.VIII-1, 2) give some fragmentary data on the sediments and soil quality in the Shkoder basin and the location of measurements for 1990-2005. These data present

mainly the trace elements, metals, PCBs, PAHs and organo-chlorine pesticides. The data on sediment quality in the Moraca River upstream of the lake was not available at the time of this assessment. The limited data (and also sample sizes) is a constraint to draw conclusions.

The content of heavy metals such as Pb, Hg and Cr in lake sediments varies with the location, but the available data show that, in general, the concentrations are in Class 1 or 2, low to very low. Pb concentration in 2005 at different locations in the lake was less than 5.0 mg/kg and maximum concentrations of Hg was 1.77 mg/kg (Annex VIII). Annex VIII (p.VIII-1) shows the data on some parameters in the sediment of various locations on the Albanian side of the lake basin for 2003. These data show that, compared to the Montenegrin side, the Pb concentrations were relatively higher (maximum value 27.3 mg/kg), while the Hg concentrations were lower than 0.5 mg/kg. The concentration of Hg in the Montenegrin sediment exceeds the EU standards on four of eight locations and of Ni on two out of eight locations in 2005. On the Albanian side of Lake Shkoder in 2003, at 7 out of 10 locations the concentration of Ni exceeded the EU standards.

The PCBs and PAHs in the sediments were found to be higher at the entry points of the Moraca river branches than at the lake locations: 0.3 – 0.5 µg/kg of PAHs and 0.8 – 100.7 µg/kg of PCBs for 1993-1996 (Annex VIII, p.VIII-2), indicating that the pollutants come from the Moraca River. However, these pollutants were reduced in 2005: 0.09 µg/kg PAHs and less than 0.01 µg/kg PCBs (Annex VIII, p.VIII-1). The higher concentrations of PAHs and PCBs earlier and their reduction later are possibly due to the same reasons as mentioned above in the groundwater pollution in the Zeta Plain.

- *Soil pollution (Montenegro)*

As mentioned earlier, municipal wastes, both in Albania and Montenegro, are generally disposed of at open landfill sites without any implementation of an environment protection system. This causes pollution of soils, especially at and around the landfill sites.

The CETI, since 1998, regularly tests soils at different locations in Montenegro for chemicals and toxic substances such as heavy metals, PCBs, PAHs, pesticides etc. Quality standards prescribed for toxic materials in soil – SL. List SCRG Br. 16/97 – are used as guidelines for monitoring.

Tests of soil samples by CETI in 1998-2004 at 12 different locations in the Zeta Plain showed varied concentrations of heavy metals like Pb, Hg and Cr, and PAHs and PCBs. The PAHs in the soils at 8 locations in Podgorica ranged from 0.0 to 6 µg/kg and the Pb concentrations were 20 to 475 µg/kg. Annex VIII-2 shows PCBs in the soils near the KAP area for 1990-1996; the values range from 17.3 to 381.1 mg/kg. The high values of PAH and PCB are a threat for the biota.

Data on soil pollution in the Albanian side of the lake basin were not available.

- *Air quality (entire basin)*

Air pollution is a major environmental problem affecting the health of humans and animals in developing and developed countries alike. Air pollutants that are inhaled have serious impact on human health. Air pollutants comprise gaseous substances, odours and suspended particulate matter (SPM) such as dusts, fumes, mist and smoke. Common sources of air pollution are agriculture, mining and quarrying industries, power gen-

eration and traffic. Depending on their source and interaction with other components of the air, the pollutants can have different chemical compositions and health impacts.

As mentioned earlier, the main stationary sources of air pollution in the Montenegrin part of the Lake Basins are the KAP and Steelworks Niksic. The other sources are the increasing use of automobiles in the city and the landfill sites.

Although monitoring of air pollution in Montenegro dates back to 1982, it is only since 1998 that the CETI and the HMI began monitoring air quality regularly and in an organised manner. Air quality is examined at the following locations:

- CETI office
- Konik, near the landfill
- Village Srpska
- Donja Gorica

At these stations, daily samples are collected and analyzed for SO₂, NO_x, fume and soot, O₃, H₂S, NH₄, F, formaldehyde, phenols, heavy metals and Persistent Organic Pollutants (POPs) in dust and quality of rainfall. Standards prescribed in the Air Quality Standard Regulations - SL.List SRCG Br. 4/82 - of Montenegro are used as guidelines for monitoring.

The HMI Podgorica also monitors air quality. There are differences in the values measured at different sites by these institutions in the same cities for the same parameters (Environmental Performance Review, 2003, Ch.6, p.87).

Table 2.17 gives the mean and maximum values of some air pollutant parameters for 2004 in Montenegro. Some air quality indicators such as metals and PAHs in suspended matter are presented in Annex VII-1 for January-September 2005. Table 2.18 shows SO₂ and SPM concentrations in Podgorica from 1998 onwards. It shows a significant increase in suspended particulate matter within the last 6 years, indicating increased air pollution in Podgorica. Though this still meets EU/EC directives for the allowable limits of 125 µg/m³ for SO₂ (24 hr), the increasing trend needs serious consideration. The degradation of air quality is probably caused by emissions from the KAP and the increase in vehicular traffic in the city (see Section 2.10.2).

Long duration data on air quality in the Albanian side of the lake basin was not available at the time of this assessment. Air quality measured in 2003 showed a high SPM (total PM) value of 224 µg/m³ (permissible value according to the Albanian National Standard = 140 µg/m³), while the values for SO₂ (24 hr) and NO₂ were 9 µg/m³ and 14 µg/m³ respectively (lower than the Albanian permissible values of 60 µg/m³).

- *Rainwater quality (entire basin)*

Rainwater can be polluted by various gaseous and non-gaseous substances that enter into the atmosphere from industrial emissions, landfill sites, from vehicles' exhaust and from the decay/ decomposition of plants. In general, urban and industrial emissions account for most suspended particulate matter. Industries such as coal-fired power plants are the main sources of SO₂ emissions; automobiles and electric utilities are the main source of NO_x emissions.

Acid deposition occurs when sulfur dioxide (SO₂) and nitrogen oxide (NO_x) gases chemically change to sulfuric and nitric acid in the atmosphere and fall to the earth with rain and snow (wet deposition), or with dust and microscopic particles (dry deposition). Acid deposition harms aquatic and terrestrial life through direct contact and by changing the chemistry of surface water and soils. It also enhances the decay of buildings and other man-made structures. Increase in air pollution affects directly the rain quality.

Data on rainwater quality in the Lake Shkoder basin was not available at the time of this assessment, though both CETI and HMI in Montenegro apparently are to monitor the rain quality too.

Table 2.17 Mean and maximum values of air pollutants ($\mu\text{g}/\text{m}^3$) in 2004 in Montenegro (source: CETI)

Parameter > Location:		SO ₂	NO _x	O ₃	Suspended matter (PM)	Fume and soot	F	Phenols	NH ₄	H ₂ S	Formaldehyde
CETI	mean	2.03	3.33	30.16	156.24	26.09	1.42	0.84	3.67	0.29	1.63
	max	12.25	29.53	166.7	375.52	112.45	5.20	6.25	54.30	2.91	8.50
KONIK	mean	7.66	7.56	82.33	200.29	38.12	1.55	1.62	2.17	0.39	1.07
	max	49.16	14.34	153.9	715.00	71.49	19.67	9.07	7.88	2.16	7.55
DONJA GORICA	mean	3.14	7.26	33.33	108.12	15.41	2.77	0.97	1.96	1.83	0.87
	max	36.23	16.21	112.5	170.55	71.45	14.14	6.00	7.77	4.81	6.75
SRPSKA	mean	4.04	1.46	26.61	190.14	14.43	1.54	0.12	2.08	0.32	2.59
	max	82.90	6.49	114.2	332.2	99.37	5.20	1.80	10.45	2.40	11.96
MPL GVZd		110	150	125	110	60	1	10	200	8	12
GVZk		300	300		300	160	3	10		8	12

Note: The measuring locations at Srpska and Donja Gorica represent the influence of KAP in the air pollution

MPL = maximum permitted limit

GVZd = maximum value: allowed (C95%; granična vrijednost zagađenja – dozvoljena)

GVZk = maximum value: critical (30 minutes value; granična vrijednost zagađenja – kritična)

PM data for 2004 are probably PM2.5 plus PM10

Table 2.18 Mean and maximum values of SO₂ ($\mu\text{g}/\text{m}^3$) and particulate matter (PM, in $\mu\text{g}/\text{m}^3$) in Podgorica from 1998 onwards

Parameters	1998	2002	2004
SO ₂ - maximum (24h)	22	15	82.9
- mean	4	4	7.7
- minimum	3	2.5	not available
PM - maximum	41	59	375.5
- mean	17	16	200.3
- minimum	1	5	not available

Sources: 1998 and 2002 figures are from HMI; 2004 figures from CETI (see Table 2.17)

Note: SPM data for 1998 and 2002 are probably only PM10, while that for 2004 are PM2.5 plus PM10

2.8 Flora and fauna

2.8.1 Data availability

The flora and fauna of Lake Shkoder was subject to several studies before the turmoil in Albania and former Yugoslavia in the early 1990s. Since then almost no coordinated and long-term biological research programmes have been implemented; only occasional studies when funds were available. The consequence is that there are little details on the current biological status of the lake and its basin. Only for waterfowl counts have been done since 1990 (IWC, Wetlands International: for details see their website).

The REC, with support from the Swiss Agency for Development and Cooperation, published in August 2001 the 'Bibliography on Shkodra/ Skadar lake'. Both Albanian and Montenegrin experts contributed to this bibliography. In the field of biology it covers the following groups: algae, mushrooms, vascular plants, invertebrates, fish, amphibians, reptiles, birds, mammals and microbiology.

The REC (Swiss Agency for Development and Cooperation) published in December 2001 the 'Biodiversity database of the Shkodra/ Skadar Lake (checklist of species)'. This document lists all the known species in the lake and its direct environs.

For the Montenegrin side of the lake, on the Ramsar list of wetlands, exists the Ramsar data sheet, summarizing the biodiversity of the lake with special attention to waterfowl (extended version by EuroNatur).

Trifon Ziu and Stanka Filipovic describe the biology and ecology of Lake Shkoder briefly in 'A Survey of Shkodra Lake's Natural Values and Threats' (July 2001). Sections 2.8.2 to 2.8.9 are based on this text with additional data of the involved biologists.

Information on Albanian fish was obtained in collaboration with the Fisheries Department and Fishery Management Organisation. The status of the population sizes of migratory, autochthonous and exotic fish is based these official statistics. The statistics can be divided in two periods: 1961-1990 and 1991-2003. The statistics regarding the period before 1990 are very reliable due to the fact that in the communist regime catch, production and distribution of the fish was organised centrally and well controlled. The statistics after 1990 are not very reliable (especially for the period 1990-2003) due to lack of data collection. There is improvement since 3 years, but further improvements are needed.

In Montenegro fish data are reliable up to 1987; figures after that year are estimates. Most information on fish and fisheries originates from Skadar Lake National Park organisation.

The project "Biomonitoring of Lake Skadar" or "The Way to Innovative Cross-border Monitoring" was initiated at the workshop organized by the REC Offices in Podgorica (Snezana Dragojevic) and Shkodra (Djana Bejko), on 4 - 5 March 2005 in Shkodra, Albania. The programme and the work plan of Montenegrin team were presented; a follow-up from Albanian side is expected. The main goal of the Lake Shkoder biomonitoring is to examine the current status of its flora and fauna. A document about the national Albanian indicators for environmental monitoring was prepared in 2004 - 2005.

The impacts of pollution on biota have been studied by the Center for Ecotoxicological Research of Montenegro (CETI) and the universities of Montenegro, Shkodra and Tirana: see Section 3.3.3.

2.8.2 Biological importance of Lake Shkoder

Lake Shkoder's biodiversity has developed in a unique physical environment where geology, geomorphology, hydrology and climate provide a wide variety of habitats. Total biodiversity is high (species-area relationship = 0.875) and the region is considered to be a biogenetic reserve of European importance.

From a zoogeographic perspective, the Shkoder Lake region is located in a zone where two major zoogeographic areas meet: the Palaearctic region (Europe, Asia, the Mediterranean and North Africa) and the Palaetropic region (Africa). Their linkage and influences can be seen among bird fauna, with incidences of African species (e.g. African cuckoo, African black heron, flamingo) and winter migratory species of West Siberia (ducks, geese). Annex XVI shows main bird migration corridors involving Lake Shkoder. During the last glacial period Lake Shkoder represented a refuge for several species occurring at that time. As a result, today some relict and endemic animal and plant species are met in the area. After the ice age, species such as the turtledove, the Dauric swallow, Syrian woodpecker and Spanish sparrow have come to the region as they expanded their distribution area.

2.8.3 Invertebrates

The majority of Shkoder Lake invertebrate groups have not been well researched. As invertebrates play an important ecological role, among others as principal food source for many higher level species, the lack of knowledge of these groups prevents a thorough understanding of the lake's ecological functioning.

Table 2.19 Number of known invertebrate species by Order

Taxonomic group (Order)	No. of species	Taxonomic group (Order)	No. of species
Spongia	1	Cladocera	41
Cnidaria	2	Copepoda	16
Trematodes	25	Ostracoda	13
Cestodes	7	Isopoda	1
Nematoda	11	Amphipoda	5
Rotatoria monogonata	51	Decapoda	3
Gastrotricha	1	Mysidacea	1
Acantocephala	7	Chironomidae	7
Molusca	34	Chaoboridae	1
Oligocheta	4	Epheremeroptera	1
Hirudinea	5	Bryozoa	2
Hydrachnidia	18	Total	257

2.8.4 Amphibians and Reptiles

Due to a favourable geographic location in the Mediterranean region and suitable hydrologic and climatic conditions, Shkoder Lake is very rich in amphibians and reptiles. These include endemic and endangered species. Taxons belong to various biogeographical entities. For some species, Shkoder Lake is the border area of their distribution area, or a zone where different subspecies overlap.

Table 2.20 Number of amphibian and reptile species by Order

Taxonomic group (Order)	No. of species
Caudata	6
Anura	12
Chelonia	2
Sauria	15
Ophidia	16
Total	51

The lake, with its wide zone of water vegetation, floodplains, humid forests as well as many streams, is an ideal habitat for the majority of the amphibians: the Ranidae (frogs), in particular the Shkoder green frog (*Rana shqipERICA*). The population of green frogs is an important link in the lake's food chain; on the one hand insects are their main food, on the other hand they are the main food for some reptiles (e.g. water snakes) and birds (heron and some ducks). Some amphibians and reptiles are also of direct benefit for humans. The frog *Rana ridibunda* is used for consumption and is an export product. The poison of the vipers (Viperidae) is extracted for serums. The herpetofauna keeps numbers down of insects and rodents.

The amphibian and reptile fauna of Shkoder Lake comprises a large number of protected species, including many endemics:

- Palaearctic, widely spread species such as the common viper (*Vipera berus*);
- Central European varieties, including: slow-worm (*Anguis fragilis*), ordinary Aesculapius snake (*Soluber longissimus*), *Coronella austriaca*, grass snake (*Natrix natrix*), dice water snake (*Natrix tessellata*), grey lizard (*Lacerta agilis*), wall lizard (*Podarcis muralis*), and green lizard (*Lacerta viridis*);
- Mediterranean endemic species: marsh turtle (*Emys orbicularis*), land turtle (*Testudo hermani*), *Hemidactylus turcicus*, karst lizard (*Lacerta melisellensis*), coastal lizard (*Lacerta sicula*), dark lizard (*Algyroides nigropunctatus*), lizard fish (*Ophisaurus apodus*), *Zamenis dahlia*, coastal Aesculapius' snake (*Zamenis gemmonensis*), coloured Aesculapius' snake (*Elaphe situla*), striped Aesculapius' snake (*Coluber quatuorlineatus*), dark Aesculapius' snake (*Coelopeltis monspessulanus*), *Tarbophis fallax*, viper (*Vipera ammodytes*);
- Yugoslav endemic species: sharp-headed lizard (*Lacerta oxycephala*).

2.8.5 Birds

Shkoder Lake attracts birds, flying long migratory routes, but also provides good nesting and colonisation conditions. The avifauna shows a large number of species: some 271 belonging to 18 taxonomic orders. 90% of the bird species are regionally and intercontinentally mobile, linking the region to neighbouring countries, Asia and Africa. 73 species of migratory nesting birds inhabit the lake in spring and summer, leaving in autumn. About 18 species fly over the area of the lake during autumn and spring, and 45 species are regular winter guests. 12 species spend summers on the lake, while their populations nest in the north. In addition, there are some 90 species that visit the lake irregularly, including those that fly over or visit the lake during the winter or summer season. Among the nesting birds of Shkoder Lake, there are species that have been forced out of almost all their original nesting sites in Europe, but are not endangered or rare in the lake area. An example is a small cormorant called 'fendak' in Montenegro (*Phalacrocorax pygmaeus*), which is regularly observed on the lake.

Table 2.21 Number of bird species by Order

Taxonomic group (Order)	No. of species	Taxonomic group (Order)	No. of species
Anseriformes	23	Galiformes	3
Apodiformes	2	Gaviiformes	3
Caprimulgiformes	1	Gruiformes	10
Charadriiformes	45	Passeriformes	114
Ciconiiformes	15	Pelecaniformes	5
Columbiformes	5	Phoenic opteriformes	1
Coraciiformes	4	Piciformes	6
Cuculiformes	2	Podicipediformes	5
Falconiformes	32	Strigiformes	6
		Total	271

The number of waterfowl on the Montenegrin side is determined by winter (January) counts since 1990 (International Waterfowl Census or IWC). Between 1990 and 1999 numbers varied between 150,000 and 250,000, but since 1999 numbers have dropped strongly to 35,000 this year (January 2005). There were no counts in 2001, 2002 and 2003 (source: Darko Saveljic). In 1999 more than 150,000 *Fulica atra* (see Figure 2.34), 15,000 *Anas platyrhynchos* and 40,000 *Aythya ferina* were counted during the course of one year. About 250,000 birds stayed that winter at the lake. The Albanian part of the lake is also highly valued for the large numbers of birds, but exact counts are missing. Due to large numbers of birds and based on the Group Three criteria, Shkoder Lake is listed as an internationally important wetland and waterfowl habitat (Ramsar site).



Figure 2.34 The Dalmatian pelican (*Pelecanus crispus*) and the Common coot (*Fulica atra*)

Endangered bird species that can be found in Lake Shkoder:

- *Pelecanus*
- *Aythya nyoca*
- *Crex crex*
- *Botaurus stellaris*
- *Ardeola ralloides*
- *Ardea purpurea*
- *Chlidonios hybridus*

2.8.6 Mammals

The mammals related to Lake Shkoder are not well researched. The total number of species found is 50 (belonging to 6 orders). Only a few mammals are strongly linked to the water habitat, like the otter (*Lutra lutra*). Bats are especially abundant around the lake if compared to the other mammals. The other mammals live mainly in the forested areas, predominantly located on the southwestern shore of the lake.

Table 2.22 Number of mammal species by order

Taxonomic group (Order)	No. of species
Insectivora	10
Chiroptera	16
Lagomorpha	1
Rodentia	11
Carnivora	10
Artiodactyla	2
Total	50

2.8.7 Algae

In shallow lakes growing conditions for littoral flora, composed of aquatic macrophytes and periphyton algae, are better than for phytoplankton. Measurements of primary production in Shkoder Lake indicate that photosynthetic intensity is not determined by the quantity of phytoplankton: marked changes in the quantity and composition of the plankton community did not have significant effects on the intensity of photosynthesis.

In Shkoder Lake about 64 genera with 310 species and infraspecific taxa of phytoplankton are met. The phytoplankton population is mainly composed of Diatomeae. The majority of the species found are cosmopolitan and alkalophilic. Among the diatoms of the lake, the most common species are *Cyclotella ocellata* and *Aulacoseira ambigua* (Rakaj, 2005).

The observed phytoplankton composition is a good indicator of the lake's oligotrophic conditions and is one of the parameters that must be examined through a monitoring programme. Oligotrophic conditions prevail in the lake due to the low level of nutrients caused by the limestone geological base. However, the low level of nutrients of the lake is to a large extent compensated by a morphometric factor: because of its shallow depth, the trophogenic layer reaches all the way to the bottom. Thus, the entire supply of nutrients is accessible and used. In addition, favourable temperature and light conditions during the year increase the level of production in the lake to a higher level than normally observed in other oligotrophic lakes in a moderate climate zone.

Due to the abundance of macrophyte vegetation in the lake, especially in its northern and northwestern parts, a disproportion between the primary production by this vegetation and the primary production by planktonic algae occurs. This is due to the fact that shoreline plants use disproportionately high quantities of nutrient salts from the water, thus creating an oligotrophic environment for the plankton. This factor, among others, influences the community of planktonic algae and encourages the dominance of Diatomeae characteristic of oligotrophic waters. Silicate algae, as a dominant algae group in Shkoder Lake, are also important as bio-indicators. They are very sensitive to environmental changes and are capable of rapidly responding to these changes. Beta-mesosaprobic organisms and high level saprobic forms (beta-alfa, alfa-beta, alfa) prevail over the low level saprobic forms.

2.8.8 Higher plants (macrophyta)

Lake Shkoder is a typical shallow temperate lake with water originating from rivers and karstic springs. These favour the development of a rich aquatic flora with great variety in communities. The total number of aquatic macrophytes for the whole area of Lake

Shkoder is 164 species belonging to 66 genera and 43 families (Stesevic et al., 2004). The composition of the aquatic vegetation indicates that Lake Shkoder could have developed from a bay of the Adriatic Sea into the freshwater lake ecosystem of today. A large share of flora exhibits phylogenetic and ecological links with seaside flora elements. At the same time endemic forms are rarely observed.

The number of vascular plant families known in the region of Shkoder Lake is 726. Macrophytic vegetation is well developed, covering some 34 km² (Ristic J., and Vizi, O., 1981), mainly on the northern shore of the lake. These plant communities are expanding, in particular in and near both deltas of the Moraca River and the area of Podhumski Bay (Vizi, O., 1997). At the lake's northern shore, in the area from Thin Cape to Podhumski Bay, dominant plant communities include the *Scirpus* – *Phragmites* community (*Phragmites communis*, *Scirpus lacuster*, *Typha angustipholica*) and the *Myriophyllum verticillati* – *Nuphar* community (W. Koch), where especially *Nuphar*, *Ceratophyllum*, *Trapa* and *Potamogeton* species are represented. The *Scirpus* - *Phragmites* community stands out for its high biomass production.

Table 2.23 Plant communities (Lakusic, R. and D. Pavlovic, 1976, 1981)

Plant community	Source
Najadetum marinae	Fuk. 1961
Potameto-Najadetum	Horvatic et Mic. 1960
Potametum perfoliati	Lakusic and Pavlovic 1976
Potametum lucentis	Hueck 1931
Potamion eurosibiricum	(W. Koch 26) Oberd. 1956
Nymphaeion	Oberd. 1957
Myriophyllo-Nupharetum lutei	W. Koch 1926
Nymphoidetum peltatae	(All 22) Oberd. et Th. Mull. 1960
Potametum natantis	Lakusic and Pavlovic 1976
Phragmitetalia	W. Koch 1926
Phragmition	W. Koch 1926
Sparangio-Glycerion	Br.-Bl. et Siss. 1942
Ranunculetum fluitantis	All. 1922
Scirpo-Phragmitetum	W. Koch 1926
Utricularietum vulgaris, Eupotamion	W. Koch 1926, Oberd. 1957
Polygonetum amphibii-natantis	
Menthetum aquaticae	Lakusic 1976
Ludwigietum palustris	Lakusic 1976

The high biomass production of the macrophytes on the northern shore of the lake has various functions. The seasonally flooded fields, which dry out during the summer, are used for cattle grazing. In particular the reeds can be used in construction, interior decoration and handicrafts. The marsh vegetation provides a shelter for many animal species, the most important ones being nesting birds (reed, water lilies). The bird colony in Crni Zar is an example, where a large surface area of water is covered with reeds and floating vegetation. The floodplains are used by various fish species as spawning and nursery grounds.

The western lake shore consists of rocks and hills with only poor submersed vegetation. Along the eastern and southern lake shore extended reed beds (*Phragmites*) have developed. Macrophytes play an important role in the chemistry of the lake (Beeton & Sikes, 1978). From october to june the chemistry of the lake resembles that of the

Moraca River. After the aquatic macrophytes have become well established in late spring, the chemical characteristics of the lake waters differ from those of the river water. Usually, values for conductance and alkalinity are lower in the lake than in the river.

Reed beds and other macrophytes have purification capacities through nutrient retention, nutrient transformation (nitrogen, phosphor) and binding of pollutants. The water quality of the Moraca River improves by passing through the vegetation of the wetland before it enters the lake. The lake's large flood zones ('helophyte filters') and the many springs emerging from the lake bed prevent eutrophication.

Thirteen aquatic plant communities of submerged and floating species and helophyte species are known on the Montenegrin side of the lake: More than 1,500 plant species are known for the whole watershed. Some of them are of economical interest.



Figure 2.35 White willows (*Salix alba*) and Paleyellow irises (*Iris pseudacorus*) in the wetlands of the Moraca Delta (May 2005)

2.8.9 Forests

Stands of willow (*Salicetum albae*) are the most abundant forests around the lake, growing either as rows of trees around the flooding fields tended by the local population, as small forests or as randomly scattered trees, mainly on the northern shore and in the flooding area. Shkoder's oak (*Quercus robur* ssp. *Scutariensis*) forests, which were widespread in the past, have become substantially degraded. Today, these forests can only be found as small stands around the village of Gostilj in Zeta, in the fields of Crmnica and in communities with *Fraxinus oxycarpa* and *Periploca greca*. Among the forest communities that currently exist or were registered earlier, the most significant ones are stands of domestic chestnut and oak (*Querceto castanetum montenegrinum*), oak and European Turkey oak (*Querceto confertae ceris*), as well as hornbeam (*Carpinetum orientalis*) with several sub-communities. Only degraded stands remained from the once well developed forests of the region ('pseudo-macquis').

The flooding willow forests that dominate the area today, most often as scattered formations, are used by the local population for the production of fuel wood, for construction and for woven handicraft products. For the local population in Krajina, chestnut forests around Ostros and the fruits collected from them are economically important, as there is a demand for chestnuts on the local markets such as in Bar and Podgorica. From an ecological perspective, the significance of these forests as habitats for other plant and animal species — most frequently birds — is unquestionable. For example, grey heron most often nest in the area of "Manastirska tapija," or monastery willow forests.

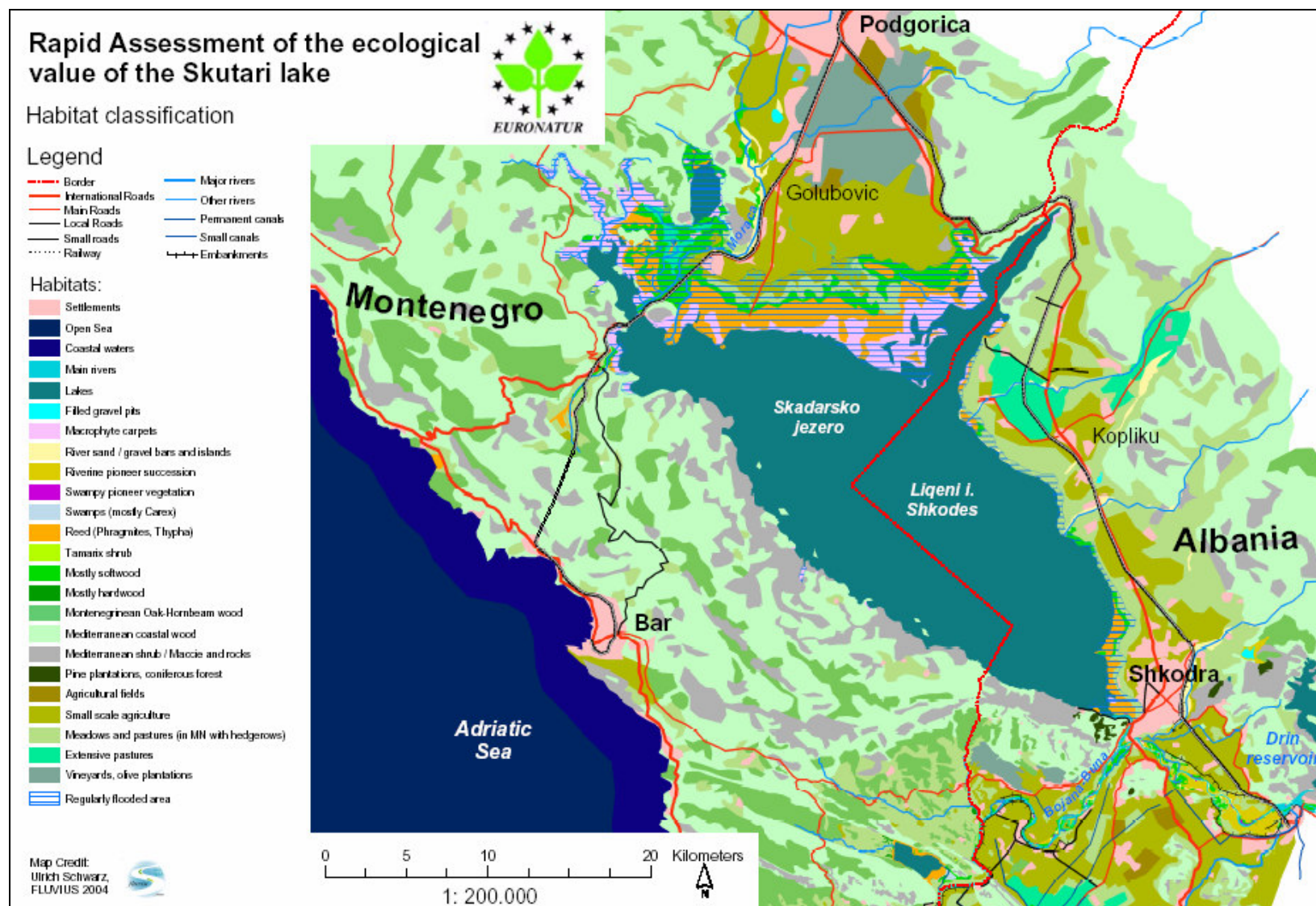


Figure 2.36 Habitat map of the Lake Shkoder surroundings

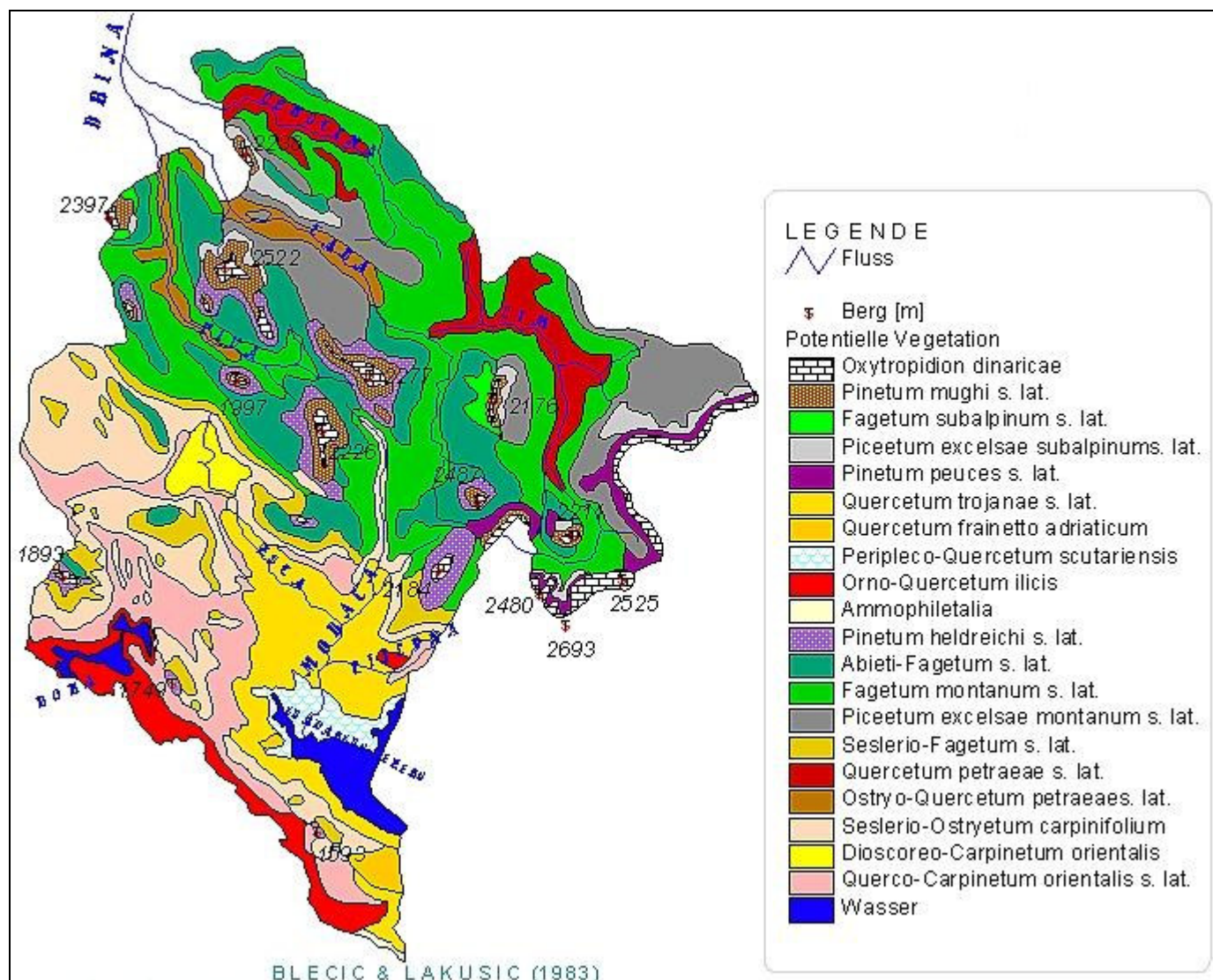


Figure 2.37 Plant communities near Lake Shkoder, Montenegrin side, if human influence would be eliminated

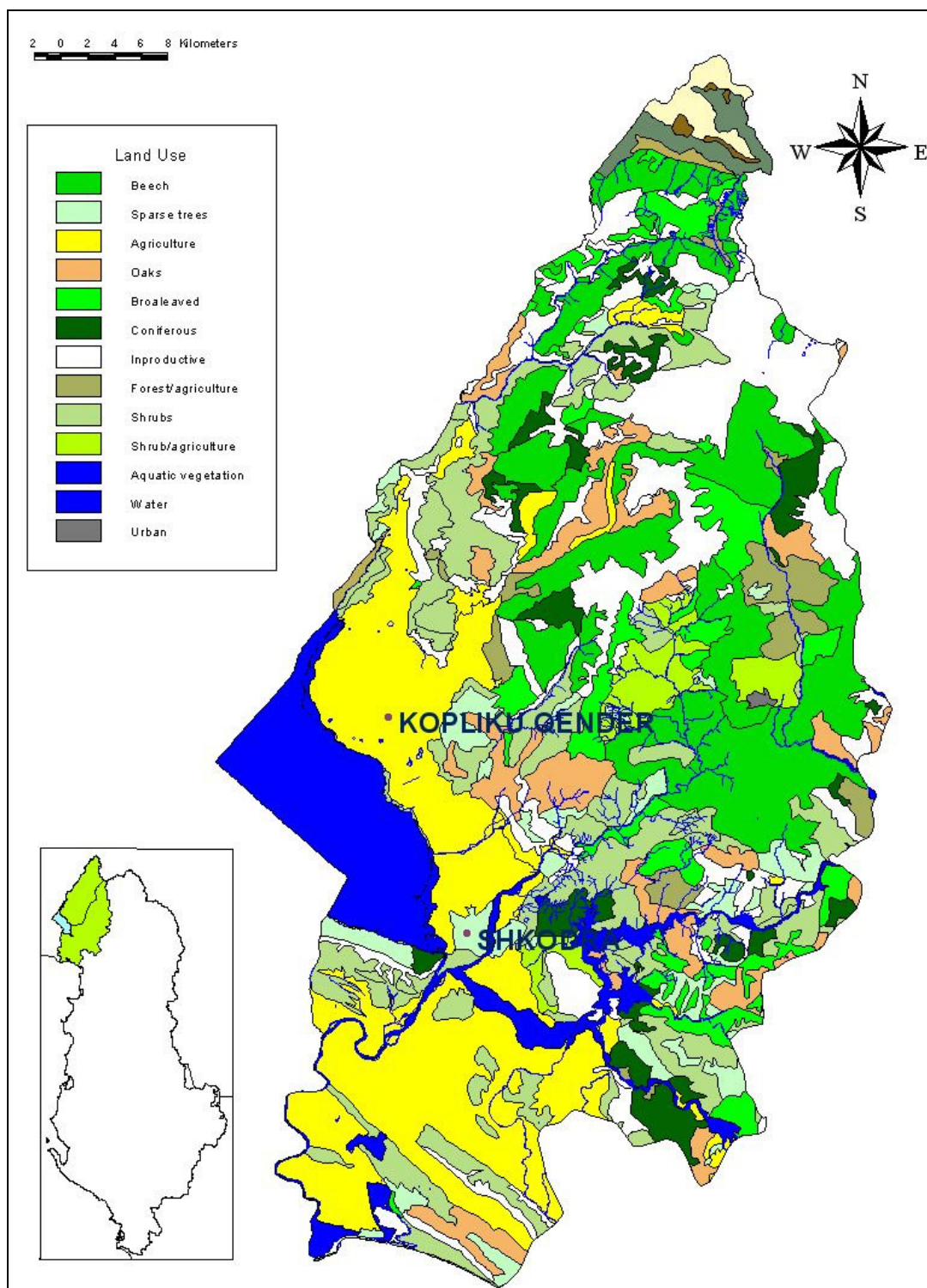


Figure 2.38 Land use in the Shkoder and Malësi e Madhe districts (source: ACER)

Land use	Area (ha)	Land use	Area (ha)	Land use	Area (ha)
Beech	80,346	Coniferous	11,389	Water	73,210
Sparse trees	14,962	Inproductive	51,680	Urban	189
Agriculture	59,844	Shrubs	41,405	Mixed	13,070
Oaks	19,371	Aquatic veg.	2,338		
Broadleaved	15,825			Total	383,629

2.8.10 Fish and fisheries

- General description (Albania and Montenegro)

Lake Shkoder is generally characterised by a high biodiversity and especially a high variety of fish fauna, making this an important lake for the Balkan. The high biodiversity that characterises the lake is the result of the existence of a good communication with the sea, and of an extensive network of rivers and streams, communicating with the lake. Its ichthyofauna includes highland coldwater fish species, warm freshwater fish species and several marine species. From ichthyologic studies carried out by both states it appears that the lake has 60 fish species belonging to 17 families (see Annex XIII). The relatively high number of endemic species (15 species according to Maric, 1995) makes the lake significant on regional level (i.e. North Mediterranean). For a relatively warm lake, the number of fish species is considered great. About 10 species are commercially exploited (e.g. carp, bleak and eel). Two fish families are especially important: cyprinids (most abundant in species) and salmonid fish (which are much rarer in the lake due to their specific requirements).

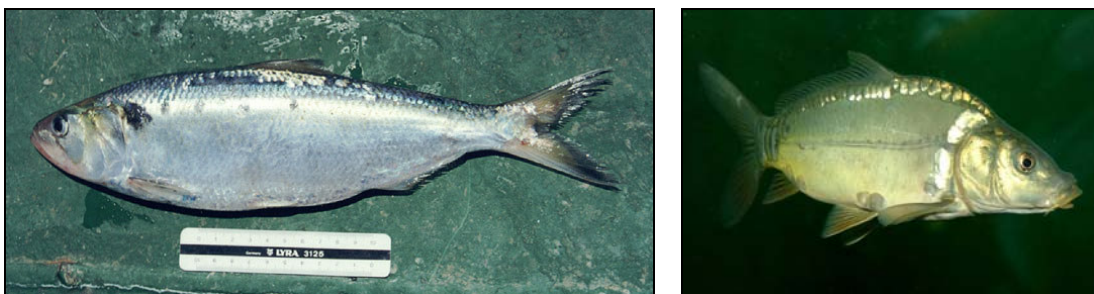


Figure 2.39 Twait shad (*Alosa fallax fallax*) and Common carp (*Cyprinus carpio*)

The ichthyofauna of Lake Shkoder is divided into 3 main groups:

- | | |
|-----------------------|--|
| 1. Autochthonous fish | 31 species of which 5 are economically important |
| 2. Migratory fish | 15 species of which 4 are economically important |
| 3. Exotic fish | 14 species of which 9 are economically important |

51 species were found on the Albanian side of the lake, 9 species have not yet been encountered (according to Annex XIII the species 13; 14; 24; 28; 35; 36; 44; 54; 60).

- Fishery (Albania and Montenegro)

Fishery constitutes one of the most vital activities in the whole coastal area of Lake Shkoder and fish productivity has been always high. From the collected data we can see a steady production, but if we analyse the fishing data in more detail we observe some concerning phenomena (see Figure 2.40 and Annex XIII):

1. Significant decline of migratory fish in the overall production;
2. Decline of autochthonous fish in the 1980s, but a recovery since then;
3. Increase in exotic species, especially after 1980.

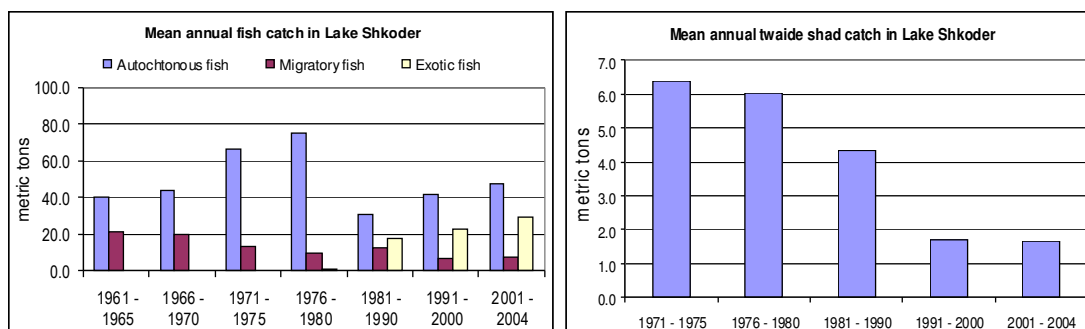


Figure 2.40 Mean annual fish catch in the Albanian section of Lake Shkoder (source: E. Kapidani: FMO, Shkodra Univ., fishery inspectors, various fish specialists)

Regarding the catches of migratory fish, the catches of Twaide shad (*Alosa alosa*) show a sharp decline from 1980 onwards. Among the migratory species also the Mugilidae are of economic importance. They also suffered a decrease in the catches although not as drastic as twaide shad. The Mugilidae catches fluctuate mainly as a result of hydrological changes, especially during the period September-November. Their catch figures for Albania are:

- Catches in 1973: 85 MT
- Catches in 1988: 25 MT
- Catches in 2004: 40 MT

Eel catches seem to be related to hydro-meteorological conditions, but in general the production is stable. Among the autochthonous fish, catches of carp intensified, but bleak catches were less; low value species like *Rutilus*, *Pachychilon* etc. are not exploited, which has caused a sensible modification of the catch structure after 1990. Among the exotic fish, the catches of *Carassius* show a significant increase (100 MT in Albania) and lately also the catches of *Perca* and *Stisostedion* increased. During the last years, also large fishes, belonging to the herbivore and planktivorous exotic fish group, like grass carp and big head carp showed an increase.

Above description is primarily based on information from Albanian fishermen. The following should be kept in mind:

- Fishermen in general do not make a distinction between migratory and autochthonous species, so when they state that the production of autochthonous species is in decline, they probably include also fish like mullets and twaite shad (which have really declined).
- Fishermen only take into account the fish of high economic value (from 31 autochthonous species only 5 have economical importance for the fishermen). Species of low value like *Rutilus* and *Pachychilon*, which in the 1980s represented 34-50% of total catch, now only represent 8%. So as long as these species are analysed *en group*, even when species like salmonids are declining, the group as a whole is not.
- Some of the 2004 statistics may be overestimative.
- Bleak and carp (native carp production was not separated from cultivated carp in the report statistics) has production fluctuations due both to overexploitation (they are the two main target species for fishermen) and to hydrological conditions.
- The recovery of *Chondrostoma* is interesting as this species is an important indicator for water quality.

- The number of fishermen has increased a lot in the past years, thus for the same product (species) less fish are caught per fisherman, giving the impression of a lower production.

Reliable catch figures for the Montenegrin side of the lake are not available for the period after 1987. However, one can assume that the catch/ population trends found in Albania are representative for the whole lake.

- Causes for changes in catches

In general, both primary and secondary productivity in Lake Shkoder is good as it is a shallow lake with sufficient food supply. The decline in the catches of the migratory species (especially twaide shad catch) is probably caused by abusive and uncontrolled fishing which occurred mainly during the 1992-2002 period. Uncontrolled fishing took place during the reproductive period of the species; nets were built over the entire length of Buna-Bojana River and, also until 1990, stationary nets were placed when the twaide shad was going to enter the lake in order to catch the big specimens. Considerable damage was done also by light fishing for young twaide shad together with bleak. This fishing technique has brought considerable damage to the stock which needs time to recover. With respect to the sturgeon not only uncontrolled fishing, but also damage to their spawning grounds has caused its decline. The only migratory species that did not suffer from this situation was eel because:

- During the period of entrance to the lake the eel is in the glass eel stage and cannot be caught by uncontrolled fishing practices.
- The high discharge of Buna-Bojana and Drin waters and their good quality during winter and spring attracts eel to enter in the Drin and Buna-Bojana area.



Figure 2.41 Fishing boats and the premises of the fishermen association near Shiroke (May 2005)

It is important to obtain funding for carrying out a glass eel stock assessment, so that the possibility of stocking eel also in the reservoirs of Hydro Electrical Plants, in the Drin River and in Ohrid Lake can be calculated. Lake Shkoder has a stable and consistent stock of eel and is the most abundant area of the Adriatic and Ionian Sea.

Among the autochthonous species there is a trend to catch high value species like carp and bleak, whereas the populations of *Rutilus* and *Pachychilon*, before 1990 representing a consistent production, remain unexploited. Prior to 1990 this part of the fish pro-

duction was destined for feeding livestock (cattle etc). Nowadays this no longer does take place. This selective fishing caused a change in the composition of the catches. Another important decline is observed in the catches of predator fish like the Salmonidae or bleak (see Figure 2.40 and Annex XIII).

Another factor for the increasing presence of 'low value' species may be the decrease in numbers of some ichthyofagous birds like *Ardea*, *Egretta*, *Pediceps*, *Phalacrocorax* and *Pelecanus* (see Annex XV).

The decline of other autochthonous fish like trout for example is the result of uncontrolled fishing in their spawning grounds and in streams and rivers that communicate with the sea. Moreover, small hatcheries for stock rehabilitation, such as used in other locations (e.g. Ohrid Lake), are lacking.

A positive fact is the rehabilitation of the *Chondrostoma* stock. This species, belonging to the family of Cyprinidae, is worldwide known as an indicator for water quality. The increase in the *Chondrostoma* populations is the result of improved water quality of the rivers which discharge into the lake, such as the Drin and Kiri Rivers. Their water quality has improved after the wood processing and leather processing industries stopped and also as a result of a reduction in the use of pesticides and fertilizer in the fields located in the eastern lake area.

As for the introduced (exotic) species, their increase is the result of:

- a) Capability of adaptation to different conditions, e.g. *Carassius*, *Perca*
- b) Having a wide feeding spectrum and a high growth rate, e.g. big head carp, grass carp etc.
- c) Absence of other predators like trout or twaide shad which favoured the increase of predator fish with a low market value.

- Fish reproduction

In order to protect the fishery resources in an effective way and to promote sustainable development of fisheries in Lake Shkoder, management measures are necessary to support migration of fish in Lake Shkoder and its surrounding water network; for feeding, spawning and wintering purposes.

The reproductive period for the main species is represented in Annex XIII. It is obvious that the most important period for the protection of spawning grounds and of migration for reproduction purposes is the period from 1 April to 30 June.

For the most important species maps of their spawning grounds are given in Annex XIII: Carp (*Carassius*), map 1; bleak, map 2; *Chondrostoma*, map 3; twaide shad, map 4; sturgeon, map 5. Regarding migration, for bleak is referred to map 6 and for twaide shad to map 7. The most threatened area with respect to illegal fishing is the south-east area, where the spawning area of carps is located and where illegal fishing methods are applied, such as explosives, electric fishing, poison etc. Apart from their economic value, carps comprise in the entire area near the lake, including also the Shkodra city, a lot of species, which are valuable for both states.

The sturgeons *Acipenser sturio* and *A. naccarii* are anadromous species that enter in Lake Shkoder and Drin River for reproduction. The "Washington Convention" (CITES = Convention on the International Trade of Endangered Species) has established that

these species are in risk of extinction worldwide and therefore in recent years several international initiatives were presented for protection and reproduction of these species and for the protection of their natural habitats in this area. During 1996-1997 several species were caught and funds were raised for the construction of a hatchery, but for several reasons this project did not proceed. The protection is even more important for the future when their natural spawning grounds definitively may have disappeared. This has already happened in the upstream stretch of Drin River, where their main spawning ground has been destroyed by the construction of the Vau Dejës hydro-electrical plant, and because in the midstream of the Buna-Bojana the deep gravel holes were gradually filled up.

In the dynamics of the fish and birds populations, the lake flora plays an important role: the aquatic vegetation provides food, shelter and spawning grounds. Presently, there is no deterioration of the vegetation situation in the lake or in the Buna-Bojana River. The aquatic plants of primary importance for the ichthyofauna are listed in Annex XIV. In general, the aquatic vegetation of Lake Shkoder promotes a high productivity, especially of zoobenthos and mussels, which play an important role in the diet of fish and some species of waterfowl (see Annex XVII).



Figure 2.42 Fuke nets at the exit of Lake Shkoder (Buna-Bojana River) and a small fishing boat

- Fishery organisation

The fishing activities in Albania and their impacts can be divided into 3 stages:

1) Fishing up to 1990

The fishing activity was organised by the state enterprise: 110 fishermen were distributed over 9 fishing groups according to the fishing grounds and the fishing gear used: manual trawls for bleak and carps; gillnet, fish barriers and fyke nets for the twaide shad; two small vessels for the bottom trawl and bleak light fishing. All kind of fish species were exploited, even the low value species which were used cattle food.

After a sharp decline in the catches of twaide shad, the fyke nets used for capturing this species at the lake entrance were banned in 1989, together with the light seiner that damages also the small specimens of twaide shad. In this period also the bottom trawl has been forbidden, because it can damage the lake bottom and has an adverse impact on the carp stocks. With respect to illegal fishing activities, control was strong during these years.

2) Fishing between 1991 and 2001

Once the control by the state had decreased, the consequences of uncontrolled and irresponsible fishing became apparent. High value species like carp, twaide shad, eel etc were overexploited and that not only changed the catch composition but also damaged their stocks. During 1994-2000 the number of legal and illegal fishermen reached a number of 1000 persons. Abusive fishing occurred also in the Buna-Bojana River during fish migration and in the south-eastern part of the lake during carp reproduction.

3) Fishing since 2001

In Albania:

In order to have a more sustainable and responsible fishing activity, in 2001 the Albanian Government started to intervene. The government, in cooperation with the World Bank, FAO and Cooperazione Internazionale (COOPI, Italy), is implementing the Fishery Development Project. One of its main objectives is the organisation and strengthening of the Fishery Management Organisation (FMO) leading to protection and management of fishery resources and appropriate fishing methods.

Presently, two FMOs in Albania, involving 540 fishermen, 260 fishing boats operating in 24 areas of the lake, are present in Lake Shkoder. The Ministry of Agriculture and Food (Directory of Fisheries) has two fishing inspectors, which in collaboration with central and local authorities monitor the implementation of fishery laws and regulations.

This organisation has positive effects, although some other problems persist and need commitment for the future, especially abusive fishing in the rivers and streams linked with the lake, and, near the mouth of the Buna-Bojana River, gear blocking the migration of catadromous and anadromous fish.

The number of fishermen that operate in Lake Shkoder should be gradually reduced to avoid overexploiting of the valuable fish populations. The economical strengthening of the FMO and broadening of their activities will allow the FMO to be more effective in this gradual reduction.

Another problem is the uncontrolled urbanisation on the lakeside, which will affect in the future the quality of the lake's nearshore waters and eventually of the fish.

A Strategic Action Plan started in 2005 in Albania to control the fishing pressure and to deal with illegal fishing. A Task Force is set-up to implement the Action Plan in the coming years.

In Montenegro:

On the Montenegrin side one organisation represents all fishermen, although the organisation has not a strong structure; the fishermen work independently.

Today everybody can buy a fish license, but in 2006 a new law on freshwater fishing will distinguish between professional and leisure fishing. Also zoning will be introduced in this law. Current licenses, issued by the management board of Skadar Lake National Park, indicate the fishing locations, equipment allowed and fish species that can be

caught. Commercial and sports licenses are subject to different regulations. Sport licenses can be issued with a validity of one day up to one year. For 2005 about 170-200 commercial licenses for carp fishing were issued, about 25 for eel, 10 for bleak and 300 licenses for sports fishing. A fish factory has a ten-year license for fishing in one of the underwater springs ('oka').

There is a general fishing ban from 15 March to 1 June for all species, while for bleak this period extends to 1 November.

2.8.11 Biodiversity monitoring

The diversity of species and their habitats on and around the lake are continuously endangered by human activities: poaching and uncontrolled hunting and fishing, pollution from agricultural drainage water and from other wastewaters, cutting of trees and construction of new buildings.

On the Albanian side of Lake Shkoder no regular monitoring of biodiversity takes place. However, in 2004-2005 a document has been prepared which lists the national indicators for environmental monitoring. According to the most recent information, the different indicators of biodiversity show the following characteristics:

- *Indicator 1. The number of species (main groups)*

<u>Main groups</u>	<u>Number of species</u>
Micro algae	around 1100 as a whole lake
Higher Plants	726 species - for all the area of Lake Shkoder 1,900 species on the whole lake catchments area
Aquatic macrophytes	164 species - for all the area of Lake Shkoder
Invertebrates	257 species, from which:
Molluscs	54 species (Lake and waters of his depressions)
Cladocera	47 species
Copepoda	18 species
Fishes	57 (on the whole lake catchments area)
Amphibians	15 (on the whole lake catchments area)
Reptiles	30 (on the whole lake catchments area)
Birds	271 (on the whole lake catchments area)
Mammals	7 ? (on the whole lake catchments area)

- *Indicator 3. The number of endemic species*

Because Lake Shkoder is a relatively young lake, it is poor in endemic species.

<u>Main groups</u>	<u>Number of species</u>
Microalgae	2 (<i>Cyclotella scadariensis</i> , <i>Cymbella scutariana</i>)
Oligochaeta	1 (<i>Peloscolex scodranensis</i>)
Molluscs	9 (2 on the lake)
Aquatic plants	1 (<i>Trapa longicarpa</i> subsp. <i>scutariensis</i>)
Fishes	2 (<i>Pachychilon pictum</i> , <i>Salmothymus obtusirostris zetensis</i>)
Amphibians	1 (<i>Rana shqipERICA</i>)
Terrestrial plants	many locally and for the Balkan endemic species

- *Indicator 6. The number of threatened species (IUCN categories)*

Main groups	Threatened in Albania				
	<i>Ex</i>	<i>E</i>	<i>V</i>	<i>R</i>	<i>K</i>
Water plants (hydro- and hygrophytes)	1	2	7	5	-
Molluscs	3	-	-	3	3
Fishes	4	6	5	14	3
Amphibians	-	-	2	4	5
Reptiles	-	-	-	2	2
Birds	5	17	7	24	12
Mammals	-	1	-	-	-
Total	13	26	23	52	23

- *Indicator 11. The number of specie protected by EC Conventions (Albanian part)*

Groups	Bern Convention		Bonn Convention <i>Annex II</i>
	<i>Annex II</i>	<i>Annex III</i>	
Water plants (hydro- and hygrophytes)	3	-	-
Molluscs	-	-	-
Fishes	6	13	-
Amphibians	6	-	-
Reptiles	-	-	-
Birds	50	-	15
Mammals	1	-	-
Total	66	13	15

Source: Kashta L., Dhora Dh. & Sokoli F. The Shkodra/ Skadar Lake Project, Heidelberg Conference Report 2001, pp.41-46; Sokoli F. & Dhora Dh. 2000. Liqeni i Shkodrës. Biodiversiteti (Lake Shkoder Biodiversity).

- *Indicator 23. The number of habitat categories of National Red List*

The following plant associations are included in the Red List of Albania:

Trapetum natantis, *Nymphoidetum peltatae*, *Leucojo-Fraxinetum angustifoliae*, *Potamo-Vallisnerietum*, *Potameto-Najdetum* and *Myriophyllo-Nupharetum*

- *CORINE habitats*

Threatened: beds with water chestnut, *Trapa natans* (*Trapetum natantis*);

Vulnerable: beds with *Nuphar lutea* (*Nymphaeetum albo-lutea*).

Although many studies have been conducted on the flora and fauna of Lake Shkoder, up to now no program has been implemented that comprised monitoring of different groups of organisms in the same localities over a longer period of time. Therefore the

Regional Environmental Center (REC) proposes to conduct a monitoring program to examine the current status of the flora and fauna of the lake. Indicator species and their habitats would be monitored in order to detect changes in the lake ecosystem resulting from natural processes and from anthropogenic impacts. A data base would be established through continuous and systematic monitoring.

2.9 Institutional context and stakeholders

2.9.1 Introduction

Lake Shkoder is located in two countries: Albania and Montenegro. The Montenegrin part of the lake boundaries three municipalities, Podgorica, Bar and Cetinje, while the Albanian part falls in two districts: Malesia e Madhe and Shkodra. Further, a number of institutions, both in Albania and Montenegro, with overlapping attributes and powers (authorities) are involved in the management of the lake. Given its rich biodiversity, its tourism potential, its economic benefits (e.g. through fishing), national stakeholders and international agencies are interested in preserving the natural ecosystem of the lake from degradation. Any institutional arrangement should therefore be (re)viewed with due consideration to the interest of all stakeholders.

Because of its very nature of being under the shared ownership of two bordering countries, the protection and sustainable preservation of the lake and its natural environment calls for continual support from, cooperation of, and coordinated action by all stakeholders, especially of the two neighbouring countries.

The following groups of institutions play a role in the preservation (and exploitation of the potential) of Lake Shkoder:

- Government institutions and public enterprises
- Community (local) level institutions
- Non-government organizations (NGOs)
- Educational and scientific institutions
- International organizations
- Private entrepreneurs
- State level councils

Each institution has its own established arrangements as regards to the roles, power and responsibilities to suit its specific interests and objectives. The roles and responsibilities of the key environmental institutions overlap to some extent, mainly due to vague and conflicting legal arrangements. The overlapping competencies aggravate law enforcement and hinder effective management of protected areas.

The key institutions and stakeholders that are involved in the protection of the lake are described in the following sections.

2.9.2 Data availability

General data on institutions, organisations and stakeholders involved are available mainly through their websites and various publications. The publications by the REC offices in Podgorica and Shkodra on roles and responsibilities of Lake Shkoder stakeholders give useful information about various stakeholders (REC publication, May 2004). The knowledge of the local specialists engaged in this assessment and the visits to various institutes of the two countries by the team members have provided additional information.

2.9.3 Description Montenegro

The key institutions involved at the government level in Montenegro are:

- The Ministry of Environmental Protection and Physical Planning (MEPPP)
- The Ministry of Agriculture, Forestry and Water Resources Management (MAFWR)
- The Ministry of Internal Affairs
- The Ministry of Tourism
- The Ministry of Economy
- The Ministry of Health
- The Ministry of Maritime Trade and Transport

The MEPPP, established in 1992, is the most important government institution and is responsible for the formulation and execution of the general environmental policy. Its responsibilities include nature protection, biodiversity and protected area management. As a part of environmental protection, the ministry deals with two sectors: Sector for Environmental Policy & Information Systems and Sector for Environmental Quality. In addition to these, it has a regulatory and coordinating role in communal and housing issues, including waste and wastewater management; highly relevant for the protection of the lake. Further, the ministry coordinates activities of nature protection institutions such as Public Enterprise National Parks of Montenegro (PENP) and Republic Nature Protection Institute (RNPI). It also drafts laws and acts related to biodiversity protection, and cooperates with international institutions.

The MAFWR is responsible for, among others, the management of water resources (including their protection against pollution), agricultural land, forests, hunting and fishing. Some of its responsibilities overlap with those of the MEPPP, particularly in the control of collection and trading of wildlife species, fishing and hunting in protected areas. The MAFWR is also responsible for the development of projects that regulate water levels of the lake. Further, it plays an important role in the preparation of legislation, policies and plans for fishing.

The Ministry of Internal Affairs has the authority to control fishing activities through their National Park wardens. The Tourism Ministry is inter alia responsible for the promotion of National Parks, environmental values and their use for tourism purposes. The Ministry of Economy is particularly interested in long-standing considerations of peat reserves from the National Parks areas. The Ministry of Health has responsibility in protecting the public against environmental impacts. The Ministry of Maritime Trade and Transport and its directorates, supporting institutes, and public companies design, execute, supervise and monitor transport sector projects; and as such they are responsible for environmental management.

- Local governments

Local governments play an important role because of their direct involvement in physical planning and implementation of urban development, and in acts that regulate the use of areas adjacent to the National Parks. They can have considerable impact in the Park management by controlling (and monitoring) illegal construction of buildings. Further, their responsibilities and authorities extend to the management and operation of public utility services such as municipal (solid) waste, water supply and sanitation. The inspectorates for these public utilities are organised within local administration.

Municipal pollution sources contribute significantly to the environment of Lake Shkoder. Three municipalities – Podgorica, Bar and Cetinje – bounding the lake, can play a very effective role in the protection and management of the lake resources by controlling the waste dumps, litters and such pollution sources. Also see below for their further role in the management of Skadar Lake National Park.

- Public enterprises

The key public enterprises responsible for the management, protection and monitoring of the lake are:

- National Parks of Montenegro (NP)
- Nature Protection Institute (NPI)
- Natural History Museum
- Hydro-Meteorological Institute (HMI)
- Center for Ecotoxicological Research (CETI)
- Institute of Geological Research

These public institutions are directly under the supervision of the MEPPP which coordinate their activities.

The Public Enterprise National Parks (PENP), established in 1993 in accordance with the laws regulating National Parks and Nature Protection, is responsible for protecting, promoting and managing the four Montenegrin national parks: Biogradska Gora, Lovcen, Durmitor and Lake Shkoder. This enterprise is a member of the Euro-Park Federation (Federation of European National Parks). It is partly self-financed and partly supported by the national budget. Its revenue is generated from the collection of fees and charges levied on hunting, fishing, wood cutting and other economic activities. The main responsibilities of PENP include maintaining cadastre of animal and plant ecosystems and their habitats, controlling the use of natural resources in the national parks, determining the internal rules of conduct in the national parks, and performing other activities of public interest as stipulated by the laws and relevant acts. The PENP constitutes warden service and park wardens have rights to check fish catches and equipment and, in case of illegal fishing (or hunting), apply penalties and collect fines as provided by the laws.

The Skadar Lake National Park (SNP) management authority is directly involved in the preservation, protection and management of the lake. The SNP authority has been trying to suppress illegal hunting and fishing in the lake area. Hunting inside Lake Shkoder National Park was banned in 2003, in line with the new Law on National Parks and the Local Physical Plan adopted by the Parliament. The SNP pursues an approach with incentives for ecologically and economically sustainable fisheries in the lake. The SNP has a 5 year programme (2005-2010) and annual plans for the conservation and development of the park (see Section 2.11).

The municipalities Podgorica, Bar and Cetinje have a twofold role in the management of the SNP. They act as protection institutions as well as resource users. These local governing bodies are directly related to the park management and preservation because of their responsibility for managing communal (municipal) waste and wastewater (through public enterprises). They are also the sources of funding for the public enterprises. However, they have limited budget and, as a consequence, shifts their interests towards the use of the lake's resources through different economic activities. The Skadar Lake

Physical Plan (Official Gazette of RM, 46/01) gives priority to waste management and wastewater treatment projects in Podgorica, Bar and Cetinje in the lake basin.

Both the Institute for Nature Protection and the Natural History Museum have the responsibilities to record, protect and conserve protected objects, animals and plant species such as historical monuments, nature reserves, endangered species of plants and animals. It is also responsible for the implementation of nature protection policies and advising on future plans and programmes related to the preservation of protected objects and species.

The Center for Ecotoxicological Research (CETI) and the Hydrometeorological Institute (HMI) monitor the quality of the water, air, rain and soil, as part of their regular activities or upon the request of the MEPPP. Both the HMI and CETI have their electronic databases consisting of time series with water quality data. The CETI database, available from 1997 onwards, contains (among others) a large number of water quality measurements.

- Non-governmental institutions

There are many environmental non-governmental organizations (NGOs) active in promoting the potential of Lake Shkoder and in protecting the lake environment. Some have become important contributors in the preservation and management of the lake. They have achieved results in terms of increased awareness about the need to protect lake resources, especially the need to protect certain rare species and habitats. These NGOs obtain most of the funds for their promotional activities from international donor agencies, though in 'peace-meal' amounts.

A major NGO, registered in several central and eastern European countries including Albania and Montenegro, is the Regional Environmental Center (REC) for Central and Eastern Europe. The REC field office has contributed to promote and preserve the potential of Lake Shkoder and its surroundings. The Lake Forum that they established, has been able to obtain transboundary cooperation from the two countries. The office also provides services to local NGOs.

Local NGOs can help produce immediate and direct benefits to the community and its surroundings through community development projects. The following local NGOs are involved in the promotion, preservation and development of Lake Shkoder and its ecosystem (REC, NGO Directory):

- Ecoteam;
- Bio-top;
- Biologists' association "Sempervivum";
- Animalworld Preservation Society "Lynx";
- Environmental Consulting of Montenegro – ECOM;
- Center for Protection and Research of Birds.

- Educational and scientific institutions

Most important educational and scientific institutions which have their activities related to the preservation and management of Lake Shkoder are:

- Faculty of Natural Sciences and Mathematics (in particular the Department of Biology), University of Montenegro
- Faculty of Metallurgy and Technology, University of Montenegro
- Biotechnical Institute, University of Montenegro
- Forest Institute, University of Montenegro
- Public Health Institute
- Department of Natural Sciences, Montenegrin Academy of Arts and Sciences

These educational and scientific institutions contribute to the environmental protection of the lake basin through their research projects, conferences, publications, and support to the concerned government agencies, despite their financial constraints. Given the opportunity for cooperation, these institutes can help the SNP to develop and implement an effective monitoring programme for important ecological parameters of the lake.

- International organizations and foreign agencies

Over the past decades, several international organizations have been involved in the preservation of Lake Shkoder and its ecosystem, especially after the SNP became a Ramsar Site in 1996. Their activities ranged from supporting local NGOs to providing technical assistance to nature protection institutions and funding the government in capacity building. International cooperation is particularly important for the global recognition of the significance of the Lake Shkoder ecosystem. The main international organizations that have been supporting the lake preservation and management are:

- The World Bank
- European Agency for Reconstruction (EAR)
- United States Agency for International Development (USAID)
- United Nation Development Programme (UNDP)
- United Nation Educational, Scientific and Cultural Organization (UNESCO)
- Food and Agriculture Organization (FAO)
- World Wildlife Fund (WWF)
- Kreditanstalt für Wiederaufbau (KfW), German Development Bank
- Swiss Development Cooperation Agency (SDC)
- Various embassies

Other international organizations include Europark Federation, IUCN, OSCE, Friends of Nature, EuroNatur, ... The main environmental projects and programmes of the above-mentioned international organizations are given in Section 2.11.

- Private enterprises

Private enterprises and local businesses such as hotels, handicrafts shops, tourist agencies, fish markets, hunting clubs, restaurants, catering services etc. are another group of stakeholders who could help improve the conservation and management of the lake and its environment. Many illegal buildings - restaurants and hotels - have been built along the lake shore. Such developments add to adverse environmental effects on the lake.

Further, there are the individuals who exploit the lake resources through fishing and hunting. A licence for both fishing and hunting is required, issued by the SNP. Nevertheless, illegal hunting is a problem faced by the Park authorities. Local fishermen's interests are represented by the local communities.

- State level councils

In addition to the institutions and enterprises mentioned above, there exists a Council of Ministers of the State Union of Serbia and Montenegro. This Council oversees the implementation of international agreements and conventions that have been ratified by the former Federal Republic of Yugoslavia (FYR) and for ratifying further ones.

In the case of Lake Shkoder, issues subject to international agreements and ratification by the council are, among others, protection of migratory species, protection of birds, protection of natural habitats, of animal and plant species in Europe etc. Most relevant and ratified conventions are given in Section 2.12.5.

The National Council for Sustainable Development (Montenegro) was formed in the early 1990s. Its main task is to promote and supervise the implementation of national strategic documents related to sustainable development, conflict resolution and assist the government in global agreements.

However, little progress has been made in implementing international agreements due to the political transformation of former Federal Republic of Yugoslavia, poor cooperation between republican and federal authorities of the past, and the (transition) period of developing new institutions of the State Union.

2.9.4 Description Albania

- Introduction

In Albania, the system of environmental administration is vertically organized as a 'cascade' model, with many delegated competencies and with vested administrative and managerial rights (REC, Roles and Responsibilities of Skadar Lake Stakeholders, May 2004). The governing of relations between the several institutional and non-institutional actors is based on dedicated laws, short, medium and long-term agreements covering problems, issues and division of management capacities with regard to the lake administration and development.

In the context of Lake Shkoder, government ministries responsible for planning, formulating and implementing environmental policies and strategies are:

- Ministry of Environment
- Ministry for Territorial Regulation and Tourism
- Ministry of Health
- Ministry of Agriculture and Food
- Ministry of Industry and Energy
- Ministry of Local Government and Decentralization
- Ministry of Transports and Telecommunications
- Ministry of Economy

The Ministry of Environment (MoE) is the most important stakeholder and responsible for environmental protection in the country. After a recent restructuring of the government, the MoE also encompasses forestry and water management sector. The ministry has the authority to represent Albania in international relations, both bilateral and multilateral. Its activity is guided by the Law 'Concerning the protection of the Environment'. It is responsible for the categorization of environmental areas in

accordance with the criteria developed by the International Union for the Conservation of Nature (IUCN). The Ministry cooperates with central and local level institutions, and/or with third parties, in formulating environmental related plans and programmes. It has the authority to represent the government's point of view regarding the environment, to assess the impact of human activity on the environment, and to monitor the status of the environment. Under the guidance of the ministry, other ministries are responsible for ensuring the implementation of the national program on environmental protection.

The ministry of Territorial Regulation and Tourism is an important stakeholder as it is responsible for the policy and planning of activities related to the development of tourism areas along the lake, water related activities in the lake basin and territorial regulation. The Ministry of Agriculture and Food has, among others, the authority to ensure sustainable use of Lake Shkoder's resource potentials such as fishing and preservation of aquaculture. The Ministry of Local Government and Decentralization is responsible for efficient functioning of local governments and advising the Council of Ministers on local development policies that can help control the ecological degradation of Lake Shkoder.

- Council of Ministers

The Council of Ministers is the highest body entrusted with approval of urban planning studies, master plans and regional plans needed to account for environmental planning, procedures for the proclamation of protected and buffer zones, and the creation of nature reserves.

Other government institutions and inter-ministry committees involved in the lake development and management are:

- National Council of Waters (NCW)
- Council of Aquiferous (River) Basins
- The Council of Territorial Regulation
- Albanian Geological Service
- The Academy Sciences, Institute of Hydro-Meteorology
- The Institute of City Planning Study and Design

The National Water Council is the central decision making body for the development and management of water resources in the country. The NCW is headed by the Prime Minister and its members include Ministries of Environment, Tourism, Foreign Affairs, Energy, Agriculture, Health, and Academy of Sciences and the Technical Secretariat for Water. It formulates water strategies, decides national water policies and has the power to endorse international agreements on cross border water bodies. For each river basin or a group of river basins a Council of Aquiferous (River) Basin is formed. The organizational structure and responsibilities of a river basin council is determined by the NCW.

The Council of Territorial Regulation of the Republic of Albania is responsible for the approval of urban studies concerning development of National Parks, development of tourism, ports and physical infrastructures, mostly at the national level. Under special provisions, it also has the authority to approve studies on city planning, studies on development of natural resources and preservation of biodiversity and impact evaluations on environment.

The Institute of Hydro-Meteorological monitors the quality and quantity of all water bodies, including the water of Lake Shoder.

In January 1993, the Albanian parliament endorsed the basic law for environmental protection and some other laws related in particular to environmental items. As a result of this, the National Environmental Agency, an independent body, was established in 1998. Until then, the Committee for Environmental Protection (CEP) as part of the Ministry of Health and Environment was responsible for the administration of the country's environmental issues.

See Section 2.12.5 for the relevant international agreements, including transboundary cooperation and ratified conventions.

- Local level Institutions

Local level institutions are the most concerned and biggest stakeholders of all. The government institutions and authorities that are responsible for the implementation of plans and programmes related to the conservation and management of environment at the local level are:

- The Prefectures of the Shkodra Region
- The Directorate of the Drin-Bunë Basin
- The Directorate of Agriculture and Food, Shkodra/ Malësia e Madhe
- Albanian Geological Service, Shkodra
- Directorate of Forest Service, Shkodër/ Malësia e Madhe
- Public Health Directorate, Shkodër/ Malësia e Madhe
- Regional Environmental Agency (REA)
- Directorate of Construction Policy

Of these, the Regional Environmental Agency (REA) has an important role by virtue of its responsibility for the protection and monitoring of Lake Shkoder. It is authorised to make environmental planning and to make recommendations regarding the environmental management issues. It also carries out awareness programmes and educational campaigns related to environment protection. The Environmental Inspectorates verify overall environment protection of waters and air.

There are local government bodies, the municipalities and communes representing administrative and territorial units covering the urban and rural areas. Most relevant of these are:

- Council of the Region of Shkoder
- Municipality of Shkoder
- Council of Territorial Regulation of Shkoder
- Commission of Restitution and Compensation of Property (to the former owners).

These local level institutions are responsible for the design of local environmental action plans in accordance with national environmental strategies and technical assistance provided by the Ministries.

With respect to Lake Shkoder, the Council of Territorial Regulation of the Shkodra region has an important role since it functions on the basis of bilateral agreement on the delegation of the power of urban planning. The communes around the lake have dele-

gated such competences to the Region's Council. The Council of Territorial assists the Municipality of Shkodra in the sustainable development of environmental plans. The Municipality is also a member of the European Campaign for Cities and Sustainable Development.

The role of the Commission of Restitution and Compensation of Property is important considering its responsibility to conduct a legal review of ownership rights of former owners. Forest land, pastures and/or land bordering the lake coast were designated for restitution and compensation only after its monetary value had been established.

- Educational and Scientific Institutions

The following educational and scientific bodies are involved in the protection and preservation of the lakes environment:

- University of Shkodra
- Museum of Natural Sciences, Faculty of Natural Sciences, University of Tirana
- Fishing Inspectorate, Shkodër/ Malësia e Madhe
- The High Forestry School, Shkodra
- General Middle School "28 Nëntori", Shkoder

The Faculty of Natural Sciences, the track of Biology-Chemistry and that of Geography of the Shkodra University are main contributors through their studies and research in and around the lake. The biology and chemistry departments of the university has a special laboratory dedicated primarily to the monitoring of environmental quality in the region.

The Fishing Inspectorate of Shkodër/ Malësia e Madhe (under the Directorate of Agriculture and Food) monitors regularly the growth and proliferation (or reduction) of certain fish species in Lake Shkoder. The inspectorate conducts this activity in co-operation and coordination with the scientific and research institutions. It also controls the operation of fishing establishments and maintains the records of fishing boats.

- International organizations and foreign agencies

International organizations and donor agencies are taking increasing interest to assist the Government of Albania in environmental sector. The main international organizations and foreign agencies that have been supporting the lake's preservation and management are:

- The World Bank
- German Technical Cooperation (GTZ)
- Global Environment Facility (GEF)
- Various embassies

While GTZ primarily focuses on the sector of services, small business and tourism development in the surrounding area of the lake, GEF has been supporting the research activities of local entities, such as the University of Shkodra and other non-profit /non-government organizations, for promoting the potential and environmental values associated with the flora, fauna and biodiversity of the lake.

- Community Organisations, Non-profit Organizations, and NGOs

Community organizations, non-profit organization and NGOs play a role by supporting local communities and functioning as grass root mediators. They are key actors in long-term environmental conservation and management. The following stakeholders also contribute to the conservation and management of Lake Shkoder through their specific interests and objectives:

- Fishing Associations
- Cooperazione Internazionale (COOPI, International Cooperation), Italy
- Cooperazione per lo Sviluppo dei Paesi Emergenti (COSPE, Cooperation for development in the countries experiencing emergencies)
- Commune Vico-Equense-Italy
- Movimiento por la Paz, el Desarme y la Libertad (MPDL, Movement for Peace, Disarmament and Freedom, Spanish NGO)
- Regional Environmental Center (REC)
- Various small local non-profit organizations

Fishing associations, as primary beneficiaries of the lake resources, are directly involved with the lake's biodiversity. In recent years there has been a reorganization of the fishing sector to limit it to specific fishes and areas.

The REC field office in Shkodra has been engaged since 2000 in various activities related to the lake protection, preservation, conservation and development. It established a forum for transboundary meetings with discussions on environmental and social issues.

Local non-profit organizations represent the local people's interest best since they are aware of the current state of the (community level) affairs. These organizations receive donations from national and international organizations for their promotional activities related to the lake environment.

2.10 Socio-economy and population

2.10.1 Data availability

Socio-economic and demographic data of both Albania and Montenegro are available from various sources. The figures however vary between sources. In this section, the relevant data published by the two governments (e.g. Albania: INSTAT 2003) and those presented by organizations like WB, EU, WHO, UNDP, WIIW and REC have been used.

2.10.2 Description

Economic activities influence the surrounding environment. Increased economic activity increases pressure on the environment through increasing migration of people, increasing pollution and increasing consumption of natural resources. However, the resulting economic growth potentially ensures the opportunities to finance environmental protection and introduction of less polluting and more efficient technologies.

- *Cultural history*

Through its history and culture of the lake's region one can understand its present political and economical importance and heritage.

During the Ottoman period, in the 14th-17th century, the present cross-border region between Albania and Montenegro was an economically integrated area with intensive economic activities. The regional identity in the Shkodra-Montenegro cross-border region is attributed to the economic role that the city of Shkodra played in that time. Shkodra was the most important economic centre in whole Albania. The city was a transit place for the goods moving from the Adriatic Sea to the Balkan hinterland and vice versa. In the mid-18th century it had about 40,000 inhabitants and was a big commercial place with around 1000 shops. The Buna-Bojana River allowed the navigation of ships up to 60 tons. The river played an important role in strengthening economic relations between commercial centres in the Adriatic and Mediterranean Seas and Balkan regions such as the ports of Ulcinj and Bar. During this century the cities of Ulcinj (with around 10,000 inhabitants), Prizren, Peja and Gjakova were important economic centres of this region. From the 18th to the 19th century the economic importance of Shkodra increased further and as a result, in mid-19th century the population of Shkodra had increased to about 55,000 and had about 3,000 shops.

At the end of the 19th century the economic importance of Shkodra started to decline due to various political and economical developments that took place in the Balkan region. First, the construction of the railway line connecting Thessalonica, Skopje and further north diverted and reduced the trade in Shkodra. Second, the emerging Balkan nation states, which started to develop their own national economies, reduced the input from the hinterland. Further, with the creation of a truncated Albanian state in 1912, Shkodra and Albania lost their traditional market place in Kosovo. During the inter-war period agreements between the Yugoslav and Albanian states were reached in order to mitigate the negative effects of borders on the life of the people living in frontier areas. The Albanian Yugoslav border was finally decided in November 1921.

From 1945 to 1948 the border between Albania and Yugoslavia was relatively open, indicating an improved relationship between the two countries. Politically there appeared the possibility of Albania becoming the seventh Yugoslav Republic. However, due to the strained relations that began in the following years between the two countries, all border crossings were closed except for the Bozhaj - Han i Hotit point. The movement of the people across the border was very difficult. During the communist period, from 1948 to 1989, 85% of the foreign trade of Albania took place through this border point. During this period Albania traded with Yugoslavia and, through it, with other communist countries.

At the end of 1980s the movement of the people across the border resumed gradually, as a result of the agreements between Albanian and Yugoslav tourism agencies. The two countries even agreed to have special provisions for the cross-border trade that would be exempted from paying custom duties (Bumci, A. 2001). Since then the effort to improve trade and transit relations from both sides has increased.

- *Demographics*

The Lake Shkoder watershed with its transboundary area of about 5,500 km² (550,000 ha) consists of about 500,000 people most of which live in the Montenegrin cities Podgorica, Niksic, Cetinje and Danilovgrad, and Shkodra in Albania.

Table 2.24 Population sizes of the districts and cities of Montenegro and districts in Albania in the Lake Shkoder basin (WB Feb. 2003; REC May 2004; Atlas of MN Dec. 2005)

Opštine				
Opština	Površina u km ²	Broj naselja	Stanovništvo (popis 2003. g.)	Opštinski centar i stanovništvo 2003. g.
Andrijevića	283	24	8785	Andrijevića, 1073
Bar	598	83	40 037	Bar, 13 719
Berane	717	66	35 068	Berane, 11 778
Bijelo Polje	924	98	50 284	Bijelo Polje, 15 883
Budva	122	33	15 909	Budva, 10 918
Cetinje	910	94	18 482	Cetinje, 15 137
Danilovgrad	501	80	16 523	Danilovgrad, 5208
Herceg Novi	235	27	33 034	Herceg Novi, 12 739
Kolašin	897	70	9949	Kolašin, 2989
Kotor	335	56	22 947	Kotor, 1331
Mojkovac	367	15	10 066	Mojkovac, 4120
Nikšić *	2065	110	75 282	Nikšić, 58 212
Plav	486	23	13 805	Plav, 3615
Plužine	854	43	4272	Plužine, 1494
Pljevlja	1346	159	35 806	Pljevlja, 21 377
Podgorica	1441	143	169 132	Podgorica, 136 473
Rožaje	432	26	22 693	Rožaje, 9121
Šavnik	553	27	2947	Šavnik, 570
Tivat	46	12	13 630	Tivat, 9467
Ulcinj	255	39	20 290	Ulcinj, 10 828
Žabljak	445	28	4204	Žabljak, 1937
Crna Gora	13 812	1256	620 145	Podgorica, 136 473

* Nikšić, teritorijalno najveća opština u Crnoj Gori i bivšoj Jugoslaviji

Albania: District	Population in 2003
Shkoder	196,431 total; 125,240 within basin
Malësi e Madhe	45,718 total; 28,729 within basin

The current population growth in Serbia and Montenegro is 0.03% (World Fact Book, www.cia.gov, August 2005), and the life expectancy is 73 years (UNICEF, 2003). In Albania it is 0.6% (WB, World Development Indicators, 2004). The life expectancy at birth in Albania has increased from an average of 53 years (52.6 for male and 54.4 for female) in 1950-1951 to 74 years (71.7 for male and 76.4 for female) in 1999 (INSTAT, Albania, 2003). The population living below the poverty line in both countries is 30%.

The settlements/ villages in the lake area are not demographically stable. Because of the good road connections with nearby cities like Podgorica, only a small proportion of the population prefers to remain in the settlements. However, in some settlements, such as Krajina and Donji Murici (in Montenegro), the population has increased.

There are 17 settlements/ villages within the National Park area (Montenegro), with their population varying from 6 to 550 people (REReP Bulletin 2003). The population showed a decline in size in the park area in 1990s. However, this trend has reversed in the past years. This is partly due to the expansion of development activities as a result of the increasing political stability in the region.

On the Montenegro side of the lake, the emerging socio-economic and ethnic groups are: Krajina and Crmnica (in Bar municipality), Rijecka Nahija (in Cetinje municipality), and Ljestanska Nahija, Zetska Ravnica and Milesija (in Podgorica municipality). Likewise, there is an increase in the population on the Albanian side of the lake. People also move to the lake shore for its pleasant environment.

The migration of people to the lake side has increased the pressure on the coastal environment of the lake. The urbanisation on the lake side affects the coastal habitats and the quality of the lake water (disposal of untreated wastewater).

More information on demographics can be found in the Social Assessment, part of the Lake Shkoder TDA.

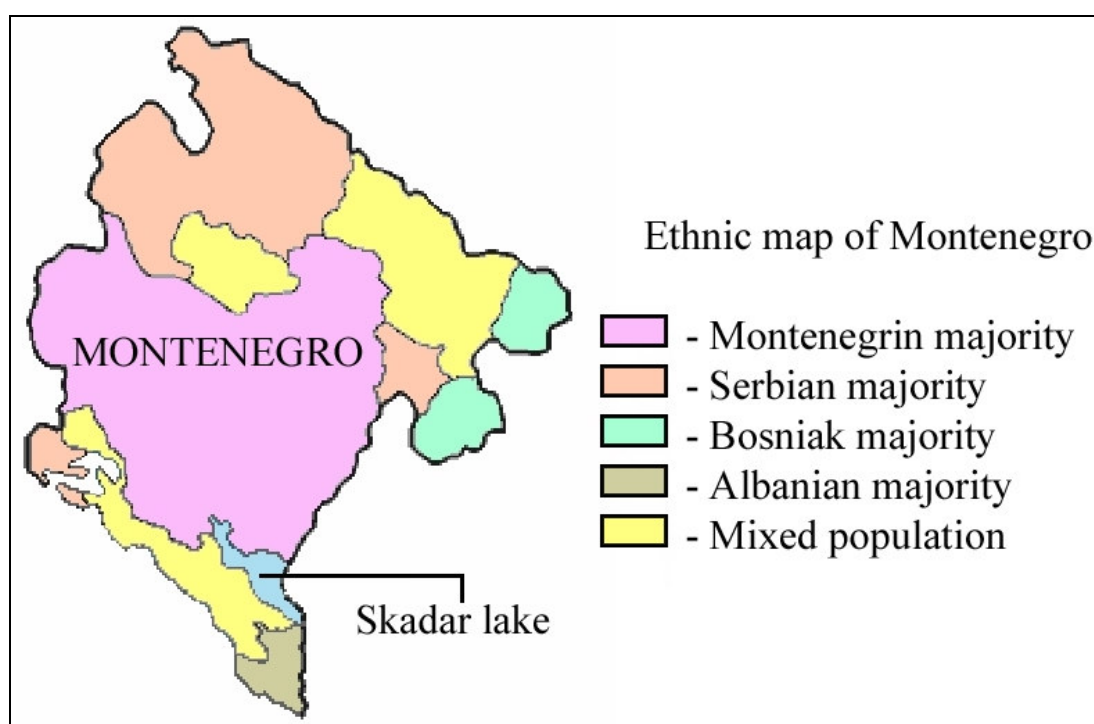


Figure 2.43 Ethnic map of Montenegro (source: en.wikipedia.org)

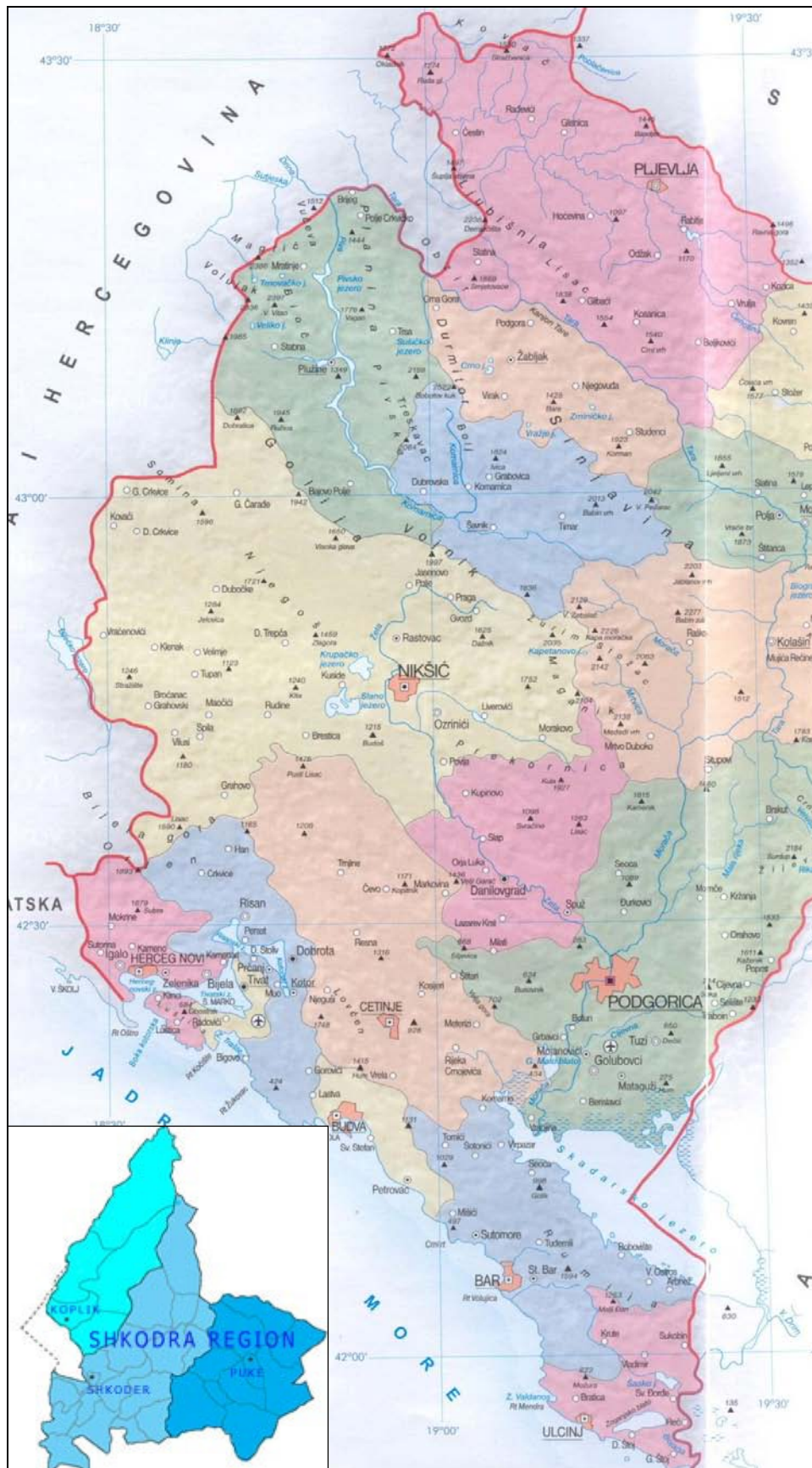


Figure 2.44 Districts (municipalities) in Montenegro (source: Atlas of Montenegro, Dec. 2005) and in the Shkodra region in Albania (inset)

- *Economics*

Albania has made significant economic progress since its transition from a communist regime towards a market-based economy. The country's economy has been increasing since 1993 at an annual rate of about 8%, except in 1997 when the GDP contracted due to the financial crisis caused by the collapse of pyramid schemes. The real growth in economy in 1999 and 2000 was at an annual rate of 8.9 and 7.7% respectively (IN-STAT, Albania, 2003). There was a setback in 2002 resulting from a crisis in the electricity sector. The growth rate for 2004 was estimated at 5.6% (the World Fact Book at www.cia.gov). Although agriculture has traditionally played an important role in the economy and still contributes considerably to the GDP of the country, recent growth has been driven by the services and construction sectors. Besides, Albania is rich in mineral resources, notably oil, lignite, copper, chromium, limestone, salt, bauxite and natural gas.

While per capita income has increased steadily and inflation is under control, Albania remains one of the poorest countries in Europe. The country has adopted far-reaching structural and economic reforms and has pursued the establishment of democratic institutions. Nonetheless, the country faces considerable challenges. The main issue of the Albanian economy is that the imports exceed significantly the exports.

Unlike Albania, Montenegro has experienced a severe decline in the standard of living in the last decade. The GDP has dropped by 50% since 1989. The contribution of Montenegro to the Union State's - Serbia & Montenegro - GDP is less than 10%. The (real) GDP growth rate, for 2004, is estimated at 6.5%. The inflation rate established for the year 2004 is 8.8%. However, according to a recent report of the EBRD, Serbia and Montenegro combined show signs of improvement in the performance of agriculture and industry, as the pace of growth has increased during the 2004 (EBRD, website 2005; Wiener Institute für Internationale Wirtschaftvergleiche: www.wiwi.ac.at/balkan/files/data/Montenegro.pdf).

The current steady progress in the economy and resulting stability in both Montenegro and Albania is partly due to the development assistances received from international financial agencies like World Bank, IMF and EU. For example, the inflation rate in Serbia and Montenegro reduced from 113% in 2000 to 13.4% in 2004 (World Bank, 2004), since the country (re)collaborated with the World Bank in 2001.

Key economic indicators for both countries are given in Annex XX.

- *Land use*

On the Montenegro side of the lake basin, the proportions of land use is: 40% arable, 10% pasture and the rest 50% (including inaccessible mountains and marsh lands). Figure 2.36 shows the land use in the vicinity of the lake.

The Skadar Lake National Park (Montenegro) is about 40,000 ha, of which the area of open water and floating vegetation occupies 25,400 ha (at average water level). The border land and marsh occupy about 14,600 ha.

Figure 2.38 and associated table give the land use on the Albanian side of the basin, which lies within the Shkodër prefecture. The main land uses include park land and protected areas, forest, pastures, irrigated land, scattered small industries, fish farming

and coastal tourism. Figures on the proportion of the land use are not available. Shkodra city comprises the most built-up area, with its industrial zone in the north of the city.

The areas designated to the conservation of rare/ endangered species, biodiversity and historically important monuments include (see Figure 2.50 for Montenegro and Figure 2.51 for Albania):

- a. Panceva Oka, 120 ha; Manastirska Tapija, 300 ha, as special natural conservation;
- b. the northern wetland part of the lake area;
- c. the natural reserves of Crni Zar, Grmozur, Omerova Gorica, Djurovacki Skolj and Karauc;
- d. the natural monuments in Obodsko Vrelo.

- *Agriculture and fishery*

Agriculture remains an important economic activity in Montenegro, though it presently employs less than 5% of the labour force and contributes to 15% of the country's GDP. Areas suitable for farming in Montenegro are the river valleys, mainly along the Zeta River, on the plain areas around Lake Shkoder in the southwest, and near the town of Cetinje. The agriculture products include cereals, tobacco, vegetables, grapes, figs and olives. Wheat, barley and maize cover most of the arable land.

Around 35,000 ha of land in the valleys are intensively cultivated. The intensive cultivation has increased the use of pesticides and chemical fertilizers, although the level of use is still low due to the low incomes. The types of pesticides and chemical fertilizers used are discussed and presented in Section 2.7.4.

The scale of farming is small and farmers use old and poorly maintained farming equipments. Irrigated agriculture is limited. According to a World Bank report (Country Environmental Analysis, Serbia and Montenegro, Annexes, 2003), the profitability of agriculture remains low because of poor quality products, lack of capital to modernize agriculture and difficulties in marketing. The low profitability of farming is the main cause of migration to the cities, especially by young people. More information on agriculture and land use can be found in the Social Assessment, part of the Lake Shkoder TDA.

There are plans to lower the water level in Lake Shkoder, one of the objectives being to increase the area of agricultural land by about 14,000 ha. This plan is linked to plans in Albania to construct a hydropower station (Bushati Hydro Power Plant) on the River Drim-Drini (see Section 2.11.4). It is likely to have severe effects on the biodiversity in the lake.

Unlike in Montenegro, agriculture in Albania counts for about 25% of its GDP (WB World Development Indicators, 2004). About 20% of the land is cultivated and approximately 50% of the labour force is engaged in agriculture; the majority of the balance is involved in industries. Cereals (especially wheat and corn), cotton, tobacco, potatoes, and sugar beets are grown and livestock is raised. Agriculture was formerly in the form of collective and state farms, but by 1992 most agricultural land had been privatized.

Fishing is another main activity in the coastal area of Lake Shkoder. Shkodra city (Albania) is an important fishing center. For many people living on the lake side, both in Montenegro and Albania, this is the only source of livelihood.

Until 1990-91, fishing on the Albanian side of the lake was under control of a state enterprise. Fishermen nominated by the State were grouped based on the fishing ground and the type of fishing gears used, and they were allowed to catch all sorts of fishes. After the political changes of 1991 in the region, the state control in Albania and Montenegro over the fishing in the lake weakened and uncontrolled fishing increased. By the end of 2000, there were thousands of fishermen, legally and illegally, fishing in the lake. Following the sharp reduction of the twaite shad, the two governments limited the allowed gear types, methods of fishing (e.g. using explosives or electricity) and periods of catching certain species. Projects were initiated with the World Bank, the FAO and COOPI. Further details on fishing can be found in Section 2.8.10.

- *Industries*

While an increasing level of industrial production represents economic growth, industry is the primary source of non-organic pollution. Most of the existing heavy industries in the region started after the 1960s.

Though there are no polluting industries within the Skadar Lake National Park, there are some heavy industries in the Montenegrin part of the Shkoder basin. Most of these are located near the Moraca and Zeta Rivers. The KAP (aluminium factory) in Podgorica and Steelworks in Niksic are the main industrial sources of pollutants for the lake. The extent of pollution of the lake and its basin area due to these industries is discussed in Section 3.7.

Before World War II, Albania had very limited industries: a cement plant at Shkodër and small-scale flour-milling, food-processing, cigarette-making, and fellmongery. The industry's contribution to the country GNP was then less than 10%. There was virtually no export of industrial products. After the war, the government's emphasis on industrial development, primarily through development projects, increased the number of industries (Encyclopedia of the nations, Albania 2003). Major industries include food processing, textiles and clothing, lumber, oil refineries, cement, chemicals, and basic metals. There are, however, no industries that pollute directly into Lake Shkoder.

Industrial development indicators for both countries can be found in Annex XX.

- *Sand and gravel mining*

Sand and gravel mining is limited in the Lake Shkoder basin. When major infrastructural projects are executed, pits are opened. Currently only near Golubovci (between Podgorica and Lake Shkoder) and in two of the streams between Shkodra and Hani i Hoti (Albania) sand and gravel is mined.

- *Roads, railways and water (river) ways*

Montenegro has a well developed road network, in terms of density and pavement quality. The country has about 850 km of main roads, 950 km of regional roads and 5,300 km of local roads (UN Environmental Performance Review, 2003). Because of its geography, the roads in Montenegro are costly, both in terms of construction and maintenance. Due to the limited budget for maintenance, many roads are deteriorating. The total number of vehicles registered to date is not clear. However, there were about 131,000 vehicles listed in 2000 according to the Ministry of Maritime Trade and Transport. There are 250 km of railway lines, one of which connects the coastal city of

Bar with the city of Podgorica. It is part of the European railway network. The secondary roads around the lake and the railway network are in poor conditions. The Montenegrin rivers do not allow transport of any significance.

Due to the increased number of motor vehicles, 80% of the air pollution in downtown Podgorica is caused by their emissions. Air pollution from the automobile emissions in Montenegro are monitored in major urban areas (See section 3.7).

Compared to Montenegro, the road and railway infrastructure in Albania is poor. The country has a total of about 18,000 km of roads and 447 km of railways. The Albanian government lacks funds to improve and develop its road transport network. Traffic volume on the secondary roads around the lake are low, but this is likely to increase with the present economic developments. In Shkodra city, poorly maintained roads, use of diesel as fuel and the use of old cars contribute considerably to the air pollution.

During the past decade, the number of automobiles has tremendously increased in Albania. Until 1989, Albania had only about 2,000 cars, but by 1998 the number had increased to more than 90,000 (REC, Country report Albania, 2000, p.13). The current Albanian taxation system apparently does not take into account any environmental protection considerations regarding the import of used cars. According to the taxation system, the customs taxes are lower for used cars than for new, or for those equipped with catalytic converters. There is no systematic inventory available for automobile emissions.

- *Tourism*

The presence of cultural and historical monuments, remnants of ancient monasteries (e.g. in Cetinje) and fortresses (such as Zabljak, capital of Zeta in the Crnojevic times, and the fortress next to Shkodra) and remnants of old fishermen's settlements located on the lake coast (e.g. Radus, Krnjice, Poseljani, Karauc) make the lake area a suitable place for cultural tourism. The rate of development of this tourism potential has been slow due to the lack of proper planning and financial constraints. The fact that Rijeka Crnojevic still does not have a good hotel illustrates the financial limitations in this sector. As a result, local and regional tourism prevails at present and international tourists are still rare.

The beautiful west side of the lake in Albania, with steep slopes and rocky shores, was completely closed for people until 1991. Following the political changes, Albania has gradually introduced market economy. As a result, people began to build clubs and restaurants in this area. More than 100,000 people live presently around the Albanian side of the lake, most of them in Shkodra. The lake is a place of diverse economic activities related to recreation, fishing and watersports. The lakeshore activities and constructions pollute the lake with untreated wastewaters and solid waste.



Figure 2.45 Tourists can enjoy both cultural objects (reconstruction in Poseljani, by V. Buskovic) and the natural values (lake shore near Drume) in the basin

- *Energy*

The generation of energy in Montenegro is almost entirely dependent upon hydro and coal power resources. Hydropower plants account for about 75% of total installed capacity in Serbia and Montenegro. Montenegro has been importing, almost continuously, electricity since the early 1970s. The largest consumer of hydro-electric power is the Aluminium Production Plant (KAP) in Podgorica. Both Albania and Montenegro have a large hydro-power potential.

The energy sector in Montenegro has remained in a poor state since the turmoil in 1999. The hydro and thermal power plants need reconstruction and rehabilitation. Because of its decreasing supply capacity, Montenegro presently imports about 30% of its energy from neighbouring countries. Most of the imported electricity comes from Serbia. Alternative sources of energy such as sun, wind, biogas etc. are presently not economically viable. The country has plans to improve the existing facilities and exploit further the hydro- and thermal power resources. Changes as liberalisation in the energy market are on hand, in line with the EU policies.

Compared to Serbia & Montenegro, Albania has a large hydro-power potential of which only about 35% has been presently utilised. Hydropower is and remains the main source of energy in Albania. It contributes to more than 85% of the energy supply. About 90% of this power supply is generated in three hydropower stations in the Drin basin.

Albania was once an exporter of electricity, but, due to the political upheaval in the 1990s, it now imports energy. The country has plans to improve the existing and build new hydropower plants in the coming years with the assistance of international development agencies. The proposed dam construction on the Drin River near Skavica villages to generate 250 MW of electricity is a case in point.

Despite the large hydropower potential of Albania and Montenegro, there are regular power interruptions in the lake area. This has adverse effects on population, tourism and businesses. The shopkeepers and businessmen in Shkodra use small generators during the power-off periods, creating noise and air pollution.

- *Water supply & sanitation, solid waste management*

The quality of drinking water in the lake basin area is discussed in Section 2.7.5.

Both Montenegro and Albania face problems in wastewater treatment and solid waste management facilities. Following the adoption of a market economy and the expected economic growth, the production of solid and liquid wastes in both countries will grow significantly.

In Montenegro:

Waste management is a serious problem in Montenegro, causing long-term implications for soil and water quality. According to the UN report on Environmental Performance Review (2003), Montenegrins generate about 1 kg of municipal waste per person per day. Municipal wastes collected in all municipalities are dumped at uncontrolled open air sites without any separation or treatment. The quantities of industrial wastes produced and their current disposal locations are discussed in Section 2.7.4. The largest landfill sites are in Podgorica and Niksic. There are plans to improve municipal waste treatments with the help of external financing agencies (see Section 2.11).

The water supply and sanitation systems in Montenegro are relatively well developed. More than 90% of the people in urban areas are supplied with some form of piped drinking water and proper sanitation facilities. Most drinking water supplies in Montenegro are from groundwater sources, primarily from springs (70%). However, the quality of the drinking water hardly meets the required standards of the WHO or EU. The poor quality of drinking water is partly attributed to the old pipeline infrastructures and lack of finance for treatment and maintenance of the system. Further, there are frequent interruptions in water supply and there are shortages in the coastal cities.

Large quantities of poorly treated municipal wastewater (about 18 million m³) and industrial wastewater is discharged each year into rivers and gorges, often nearby urban areas and sometime close to drinking water sources. This results in pollution of surface and groundwater.

The waste products – red mud (cathode production residue) – generated by the KAP (aluminium plant) in Podgorica are disposed at two disposal sites. The first disposal site has an insulation layer to protect against seepage into the groundwater. The second basin does not have any protection layer. More than 4 million tons of red mud have already been deposited at this site of 220,000 m². As such, the second basin poses a serious threat to groundwater contamination, threatening drinking water supply and Lake Shkoder (UN, Environmental Performance Review 2003, p100); see also section 2.7.4.

In Albania:

In 1998, Albania produced already about 520,000 tons of solid wastes (UNEP Report, 2000). The same year, municipality waste collection services were available to only 55% of the population. The country lacks proper management of municipal, industrial hazardous and health wastes. The solid waste is dumped unrestricted and unplanned, often on sites along rivers and other water bodies, and threatening groundwater as well. There are plans to set up six landfill sites, but their creation is likely to be a slow process due to financial constraints.

Albania has abundant water resources. Most of the drinking water - about 80% - is originating from groundwater and the remainder comes from surface waters. Around 80% of the urban population have access to piped water (EC, Stabilization and Association Report, Albania, 2004, p.28). Drinking water standards exist since 1997; they are similar to the WHO standards. However, water supply systems in Albania are plagued by diverse problems: rampant construction, illegal connections, leakage and contamination due to infiltration from parallel sewer lines. Leakage is primarily due to the old pipeline infrastructures built before 1990. Further, poor collection of revenues, only about 30 to 40%, adversely affects the maintenance of the infrastructure.

About 80% of drinking water is originating from groundwater and the remainder comes from surface waters. Groundwater is vulnerable for pollution by uncontrolled waste disposal sites. Drinking water standards exist since 1997; they are similar to the WHO standards.

Regarding the sewage, only about 40% of the urban population has a sewage connection and sewage treatment continues to be virtually non-existent or very limited; see also section 2.7.4.

In 2003 the Council of Ministers adopted both the National Strategy of Water Supply and Sanitation, as well as the Rural Strategy of Water Supply and Sewerage. Decentralisation and privatisation in the sector are in progress, but they are yet to produce the expected results in terms of quality of service, maintenance and development of infrastructure.

2.11 Projects and programmes

2.11.1 Introduction

Lake Shkoder is a common property between Albania and Montenegro. As a shared boundary, the lake requires the cooperation between the two countries for the protection and management of its environment. Because of its unique flora, fauna, biodiversity and ecosystem, it has also drawn the attention of international organizations. Consequently, many short- and long-term projects and programmes are currently being implemented and planned to preserve and manage the environmental properties and potentials of the lake and its basin.

2.11.2 Data availability

Information about projects and programmes that have been implemented in the past, are being implemented at present and planned for the future are available from the following sources: government institutes and organizations of Montenegro and Albania, project reports and country strategy papers of international agencies and NGO's like the EU, WB, REC and organizations for nature conservation.

2.11.3 Past projects and programmes

Little was done about protection of the ecology of Lake Shkoder during the former regime of Yugoslavia. Review of the available documents shows that there were virtually no plans for the sustainable protection and management of the lake and its basin. The heavy industries such as KAP and Steelworks in Niksic were established without considering their impacts on the environment. A noteworthy action of Montenegro towards the conservation of nature and environment was the proclamation of a part of Lake Shkoder basin as a National Park (40,000 ha) in 1983. After the disintegration of

the Federal Republic of Yugoslavia (FRY), during the transition period, environmental problems became visible.

As early as 1955, an agreement between the then Yugoslavia and the People's Republic of Albania was signed for all water related issues as well as fishing in transboundary waterbodies, especially in Lake Shkoder, Lake Ohrid, the Crni Drin, the Beli Drin and the Buna-Bojana. However, this agreement has remained ineffective for various political reasons since 1968, when Albania withdrew from the Warsaw Pact.

Since early 1990s, attempts to conserve the lake resources were initiated by both countries, supported by international donor agencies. The declaration of the Montenegrin Lake Shkoder National Park as a Ramsar site in 1995-96 illustrates the increasing importance given by Montenegro to the environment.

In Albania, a number of programmes were initiated and plans developed during the transition period in 1990s. Some important programmes are: the Environmental Assistance Programme(s) of PHARE since 1993, the National Water Strategy, the National Waste Management Plan, the Lake Ohrid Conservation Project, the Forestry Project, and the creation of the Environmental Center for Administration and Technology (since 1995).

In 1992-93, the first environmental strategy study was prepared in Albania with the co-operation of the World Bank. This study formed the basis for the National Environmental Action Plan (NEAP) published in 1993 and approved by the Government in January 1994. It set Albania's environmental goals and recommended an action plan. The NEAP document focuses on integrated environmental planning and capacity building among decision makers and environmental users. It includes action programmes for short-, medium- and long-term as well as a series of priority projects related to sewage treatment, urban wastes, deforestation and measures against erosion. The NEAP also identified several short-term priorities that include:

- Monitoring of industrial and urban pollution, including air and water pollution;
- Establishing admissible pollution standards;
- Halting illegal logging and investing in soil erosion prevention measures;
- Assessing environmental needs of the Albanian coastline;
- Regenerating severely polluted zones;
- Implementing European level environmental conservation standards.

Despite their planned efforts, inadequate institutional, organisational and financial capacity of both countries has limited the effectiveness in dealing with environmental issues.

2.11.4 Current and planned projects and programmes

The concern shown by the national governments and international organizations towards the conservation of the nature and environment of the Shkoder Lake basin has resulted in many plans, programmes and projects. Most of these projects and programmes are planned to be implemented with the assistance of external financing/ donor agencies like World Bank, EU (EAR), UNDP, OSCE, UNECE, KfW (German Development Bank), USAID, embassies, NGO's (e.g. REC, EuroNatur) etc. Priority is given to the water and wastewater sector, with emphasis on projects related to the treatment of municipal and industrial wastes and wastewater in the lake basin. Table 2.25 presents some of the environmental projects recently completed, ongoing or planned.

Table 2.25 Recently completed, ongoing and planned environmental projects and programmes

<i>Country</i>	<i>Sector</i>	<i>Location/organisation</i>	<i>Project name and principal activities</i>	<i>Funding agency</i>	<i>Status</i>
Montenegro	Water and wastewater	Coastal region	Feasibility study for wastewater treatment in the coastal region	EU/EC through EAR	Completed in 2003
Montenegro	Solid waste management	Country	Preparation of a solid waste development master plan	EC	Completed
Serbia and Montenegro	Solid waste and wastewater		Technical assistance for strengthening legal and institutional framework; support in maintenance and development of civil society network; strengthening the municipal institutions responsible for solid waste and wastewater management	EU	Ongoing (2002-2006)
Serbia and Montenegro	Environment legislation		Improvement of environmental legislation with EU directives; improvement in public participation; EIA's; integrated pollution prevention and control (IPPC)	EU	Completed (2002-2006)
Albania & Montenegro	Wastewater	Lake Shkoder basin	Sewerage and wastewater management; Construction of sewage and wastewater treatment facilities	EC	To be completed in 2006
Montenegro	Capacity building & strengthening	MEPPP	Strengthening the capability of the MEPPP	UNDP	To be completed at end of 2005
Albania & Montenegro	Research and monitoring	Universities of Shkodra and Montenegro	Laboratory equipment facilities for chemical and biological analysis	German Rectors Conference	Completed in 2003
Albania	Institutional support	Ministry of Environment	Upgrading of the 'Institute of Environment to enable the institution to carry out effective environmental monitoring, including rehabilitation of laboratory facilities and equipment	EU/Netherlands	2003-2006
Albania	Institutional support and local governance promotion	Shkodra Region Municipalities and Communes	Shkodra Region Area Based Development Programme; Formation of community based organizations, formulation of commune development plans through participatory approach, support the achievement of the Millennium Development Goals (MDGs) and goals set forth in the National Strategy for Socio-Economic Development (NSSD)	UNDP	Ongoing (2005-2007)

<i>Country</i>	<i>Sector</i>	<i>Location/organisation</i>	<i>Project name and principal activities</i>	<i>Funding agency</i>	<i>Status</i>
Albania and Montenegro	Environment and ecosystems		Lake Shkoder Integrated Ecosystem Management: assist the Governments of Albania and Montenegro in ensuring and developing the sustainable use of the natural resources; support effective joint management of the watershed	WB/GEF	Started (2005-2010)
Montenegro	Culture, nature	Ministry of Culture, Lake Shkoder National Park	Support the sustainable development of local communities, focusing on cultural and natural heritage, including Lake Shkoder	Council of Europe	Started in 2005
Albania	Natural resources		Natural Resources Management: conservation of the lake and its biodiversity; reduction of pollution; transboundary lake management; promotion of integrated natural resources management; public awareness and replication strategy	WB	Planned
Montenegro	Environment		Plans to invest in environmental sector: specific areas to be determined	KfW Germany	Planned

Source(s): World bank, European Commission's Delegation, UNDP, KfW

In addition to externally financed projects, small-scale projects and programmes to preserve the lake and its surroundings are implemented by government agencies, local NGO's and private entrepreneurs.

Three major water projects, which were taken up by Montenegro and Albania, have been stopped or deferred, due to the conflicts of interest, financing issues and potential adverse social or environmental impacts. These projects are: 1) Moraca Hydropower System in the Moraca River basin, 2) Water Supply Project that includes transfer of water from Lake Shkoder to the coastal area (of Montenegro), and 3) Bushati Hydropower Plant on the Drin River in Albania. The hydro-power projects are essentially of bilateral interests because of the increasing energy demand of the two countries. Although on halt, the projects are still under discussion.

- Moraca Hydropower Project, Montenegro

Moraca River in Montenegro has an enormous potential for hydro-power production. Montenegro has plans for hydro-power project(s) on this river. The government estimates that the total usable power potential in the country would increase from 4,600 to 5,300 GWh per year, if water would be transferred from the Tara River into the Moraca (Montenegro Investment Challenge, 2004, p.20; Water Resources Master Plan of Montenegro). This transfer plan is still in a planning stage. The government issued a tender document for the construction of a Moraca Hydro-Power System, but this project has been stopped, among others, due to little interest shown by international donors as a

consequence of conflicts of interest regarding water use and environmental preservation between the two countries. Clearly, the usage of hydro-electrical potential of the Moraca River combined with the possible transfer of Tara water will influence the water regime of both rivers and the lake and it will change the flora and fauna in its influence area drastically.

- Water Supply Project – use of Lake Shkoder for drinking water supply to the coastal area of Montenegro

Lake Shkoder, as natural sweet water reservoir, is also a potential source of drinking water. The Karuc Springs on the northwestern side of the lake have good quality water and high yields (1,500 l/s). The Montenegro government plans to supplement the drinking water system of the coastal area by using these springs. The environmental impacts seem to be limited, according to an EIA from early 1990s (a new EIA is to be finalised), but biologists are worried that springs with unique flora and fauna will be affected if the intake site is not carefully selected (source: personal communications with M. Jacoby-Schneider). However, alternative sources are available along the coast but considered unacceptable for political reasons (dependency on other territories).

- Bushati Hydropower Plant, Albania

The preparations for the Bushati hydropower project involving the Drin River in Albania started in 2002. This project has become a subject of great debate among the local people, scientists and politicians. While both countries would benefit from the hydropower generation (84 MW), the Bushati project will have significant environmental consequences in the lake area and in the direct surroundings of the dam. Some in Montenegro would like to combine the Bushati project with dredging of the Buna/ Bojana, which would lower the lake level and make land available, in particular on the Montenegrin side of the lake.

The hydropower station is proposed to be constructed in the Zadrima Plain, near Bushati town. The water of the Drin would be almost completely diverted south-west, to the powerplant, and then redirected to the Buna/ Bojana or directly to the Adriatic Sea: see Figure 2.46 and Figure 2.48 (option II is considered favorite). The section of the Drin between the intake and the junction with the Buna/ Bojana will be left with only a small quantity of water (see Figure 2.47).

The almost empty river bed of the Drin will result in a lower level of the Buna after the junction with the almost 'empty' Drin, and will subsequently result in a lower lake level. Flow of Buna/ Lake Shkoder water towards the east in the Drin will be limited, as the slope of the Drin is considerable before the Drin-Buna junction. Some people in Montenegro propose to dredge the Buna, in conjunction with the water diversion for the Bushati powerplant. This will lower the lake level further: studies indicate a level reduction of 1.5 m.

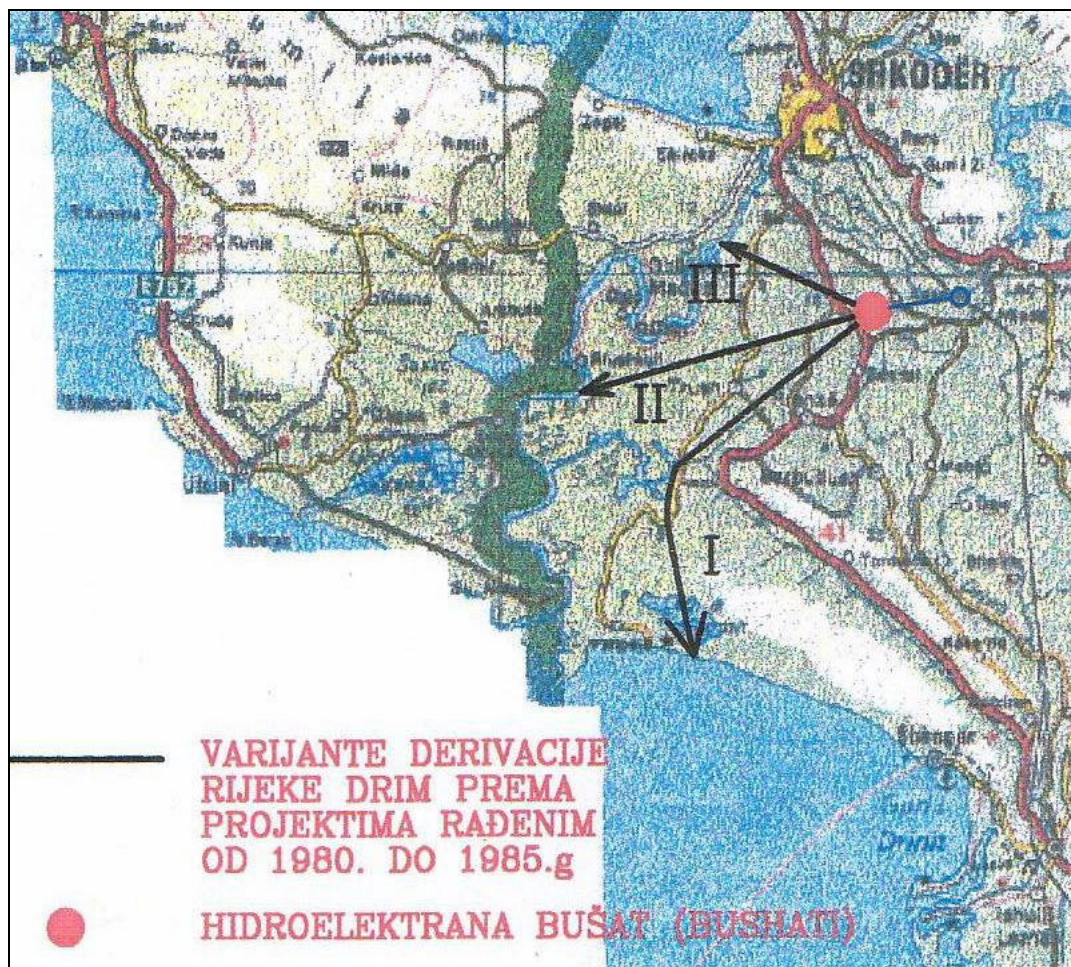


Figure 2.46 Location of the planned hydropower plant at Bushati, the intake (in blue) and route options for the exit flow (Spahic, 2001)

The consequences of the combined Bushati powerplant and dredging of the Buna/ Bojana are complex and an EIA is needed to sort out the impacts. The following can (at least) be expected:

- Depending on the actual reduction in lake level, a large area will fall dry. In the most likely option (low water at 1.5 m above sea level, high water level at 5.35 m a.s.l.) 7,600 ha will become available in Montenegro and 1,200 ha in Albania. Figure 2.49 shows the areas that are currently regularly falling dry: Zone A (between 5.5 and 6.5 m a.s.l. = 6,006 ha), Zone B (between 6.5 and 8.0 m a.s.l. = 4,262 ha) and Zone C (between 8.0 and 9.9 m a.s.l. = 1,475 ha). The two articles by Knezevic and Boskovic (BALWOIS Conference 2004), included on the DVD, give details. The land could be used for agriculture or peat excavation ('treset', useful as soil fertiliser). However, the currently available agricultural land can not be fully exploited by lack of financial resources.
- The inflow of pollutants in the lake may increase, depending on the use of dry land and the reduction in filtration/ cleaning capacity of the shallow lake area (wetlands) that has fallen dry. The risk of eutrophication in some stagnant sections of the lake will increase.
- The groundwater regime around the lake will change (level drop), in particular in the Zeta Plain. This will have consequences for agriculture, drinking water and the flora.

- Many of the sublacustrine springs will surface up. These springs are the sheltering places for many fish species, especially for *Alburnus alburnella* ('ukljeva') during the winter.
 - Protected natural reserves in the National Park like "Panceva Oka", "Manastirska Tapija", "Crni Zar", "Grmozur", "Omerova Glavica", "Djuravacki Skolj" and "Karuc", which are nurseries for fishes and nesting places for protected birds, will lose their function.
 - A sudden drop in lake level would destroy the current wetlands, as they will not be given time to 'move' to the new level.
 - If the lake level fluctuations are reduced as well, the ecology that is characterised by strong water dynamics, will change into another type.
 - A reduction in lake volume will cause an increase in water temperature, which will change the unique flora and fauna of the lake.
 - Local climate will change. The coastal zone will experience higher temperatures in summer and lower temperatures in winter.
- Waterway potential of the Buna-Bojana River

Related to the Bushati Hydropower Project, the option to use the Buna-Bojana River as a waterway is being investigated. Its potential is currently constrained by its limited depth. The government of Montenegro has shown interest to dredge the sediment deposits and deepen the channel of the river. Opening Buna for navigation would make it possible for bigger boats from the harbours on the Adriatic coast like Bar, Ulcinj, Kotor to reach Lake Shkoder. This would stimulate the development of tourism and the construction of hotels, restaurants and other services along this route. Plans exist to develop marinas at Donji Murici, Virpazar, Plavnica, Karuc and Rijeka Crnojevic.

While this waterway and flow regulation plan will potentially enhance the economic development of the area, it presents a threat to the sustainability of the natural environment and ecosystem of the lake.



Figure 2.47 The water intake for the Bushati powerplant has been built already several years ago (by Chinese); the Drin downstream of this intake would be left with only a small quantity of water

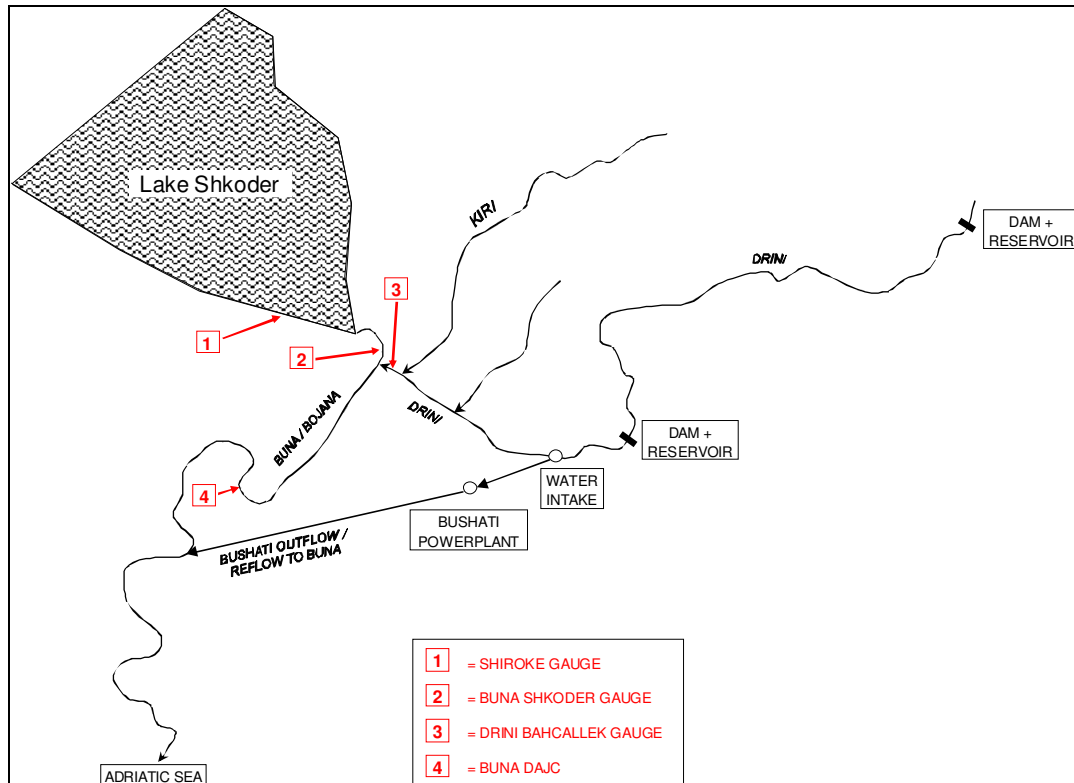


Figure 2.48 Schematic map of the hydrological network related to the Bushati powerplant project; information of the gauge stations can be found in Section 2.6.2 and on the included DVD

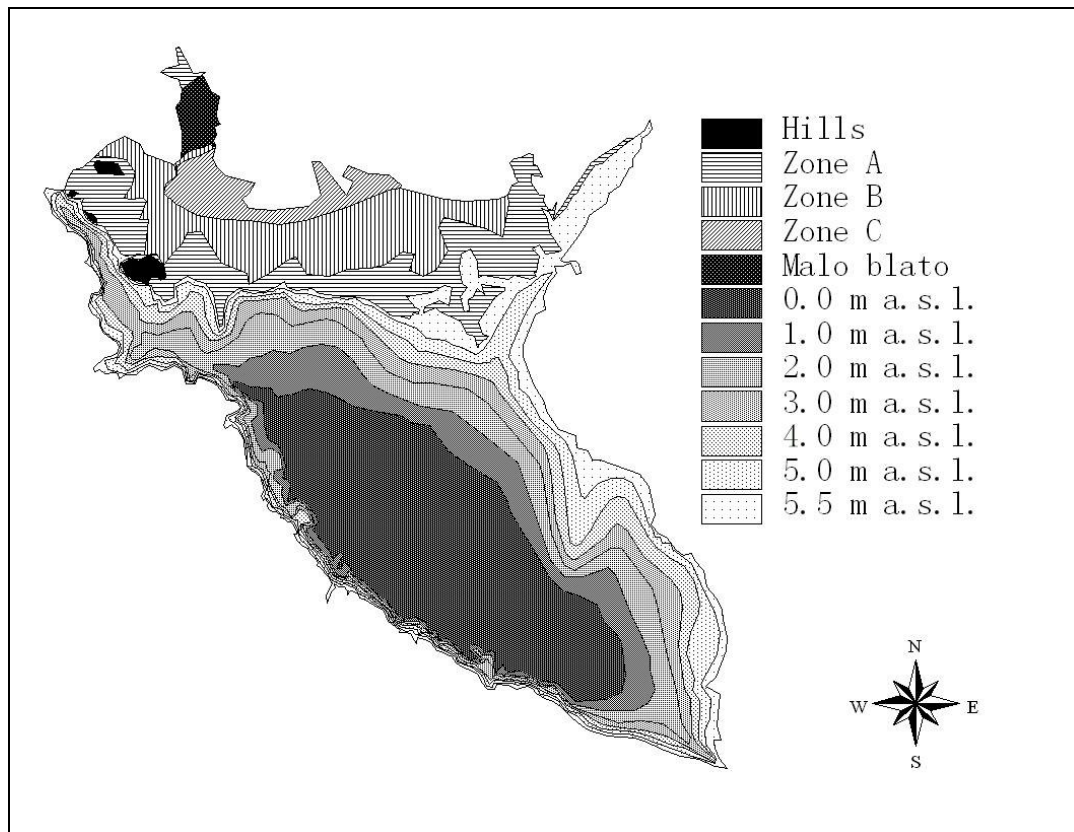


Figure 2.49 Lake bathymetry and zones (A, B, C) that are regularly flooded

In addition to the above-mentioned externally funded projects and programmes, both Montenegro and Albania have various plans to harness the potential of the lake and its environs. The governments of the two countries are likely to enter into a bilateral agreement in the near future for the sustainable preservation and management of Lake Shkoder and its basin.

- Skadar Lake National Park (Montenegro)

As mentioned earlier, a 40,000 ha of the Lake Shkoder basin on Montenegrin side was proclaimed as a National Park in 1983 by the Law on Shkoder Lake: Nat. Her. SRCG 33/83. However, the management of the Park began only in 1985. After the political transformation, a law on National Parks was passed by the Parliament of Montenegro. Based on this law, the Public Enterprise of the Montenegro National Parks was established in 1993. Since then the government makes efforts to preserve and manage the Skadar Lake National Park. The recognition of the lake area as a Ramsar site in 1995-96 has drawn international attention towards the management of the lake and its surroundings.

A 5-year program (2005-2010) for the conservation and development of Shkoder Lake National Park was prepared by the National Park Management, detailed by annual plans. The program has three sections:

Section A: Context of the programme and introduction;

Section B: Strategy on 1) natural resources, 2) cultural-historical patrimony, 3) tourism and recreation, 4) scientific work, 5) cultural-educational work, 6) commercial activities, 7) reconstruction and maintenance of space, and 8) protection against natural hazards;

Section C: Implementation, including finance.

The following lists some of the envisaged activities:

- Establishing areas that need special protection such as tree planting (autochthony species), fishing and old fishing settlements e.g. Radus eco-ethno village, and locations suitable for an organic food production;
- Monitoring and investigation of chemical deposits, hunting zones, and important habitats of specific flora and fauna groups (setting up international ornithological observatory);
- Fishing and aquaculture development: traditional fishing and introduction of artificial spawning;
- Promote ecotourism such as bird-watching and eco-based rural tourism in Karuc, Dodosi, Krnjica, Godinje, Zabljak, Vranjina;
- Remediation/ improvement of the damage caused by construction without permits;
- Provide systematic archaeological work on the localities and categorization of their foundlings;
- Conservation of the Bogorodica church and monastery on Kom, Blagovjestenjskoj church in Jeksi;
- Protecting the most endangered parts of the ramparts;
- Improvement of the Sv Petar winter shelter in Karuc;
- Publications on 'Flora of the National Park', 'Red List of Flora', map endemic and rare flora types;

- Establish, in co-operation with tourist organization of Montenegro, tourist information centres with promotion material, souvenirs, etc. (in Vranjina, Virpazar, Bozaj, Rijeka Crnojevica);
- Locate resting places with wooden benches and tables (e.g. in Karuc, Dodosi, Godinje, Sinjac, D. Murici, Plavnica, Podhum);
- Improvement of facilities (e.g. sanitary, waste containers, fire fighting equipment) at eco-camping sites;
- Organize specific programmes, e.g. seminar workshops on nature conservation and on educating people about the use of organic fertilizers (e.g. treset coal);
- Completion of the business object National Park in Vranjina (organizing terrain);
- Organize small scale farms (cows, chickens, ...);
- Production of organic food (fruits and vegetables), spirits (wine, brandy), honey; picking chestnut, collecting and processing medical herbs (Ostros location etc.);
- Extraction/exploitation of pebbles, sand, and treset in harmony with ecology;
- Bamboo exploitation and use of good quality clay for making souvenirs and/or in small business;
- Improvement of the existing hotels and extend facilities in Donji Murici, Rijeka Crnojevica, Karauc, Dodos, Vranjini, Plavnici and Virpazar (including golf terrain project in south Virpazar zone);
- Provide/ acquire quality tourist boats (electrical power);
- Build and equip beaches;
- Apartments/flats adaptation;
- Organizing camp terrains (camps: Sinjac, PonoriBistrica, Lipovnik, Podseljani, Donji Murici, etc.), and horse riding sport;
- Promotion of water sports like sailing, surfing, rowing and water polo programs;
- Provision and improvement of (fish) restaurants, boat-restaurants;
- Cultural-entertainment in Zabljak fortress and Lesendro;
- Schools in nature, nature collection, zoo park (on Plavnica);
- Rehabilitation and modernisation of Rijeke Crnojevic by: a) reconstruction and completion of the ruined hotel "Obod"; b) revitalization of the "Ljeskovac" complex as an exclusive place; c) establishment of spa medical center on the therapeutic properties of treset coal; (this will require moving and/or modernizing the fish processing factory in Rijeka Crnojevica, preferably to Velji Lug location); the current factory location needs to be freed up and used for a modern spa medication; d) revitalization of Obod's mills and camps and sporting grounds next to, and e) construction of 'the floating village' (apartments).

- Skadar Lake National Park (Albania)

In November 2005 the Albanian government proclaimed its part of Lake Shkoder a 'Managed Natural Reserve' through the Council of Ministers' decision No. 684 dated 02.11.2005. See Section 2.12 for recent decisions related to protected natural areas.

- Tourism (Albania and Montenegro)

The lake area has a great potential for tourism. Lake Shkoder has been identified as one of the five main tourist regions in the Tourist Master Plan (May 2001) of Montenegro. At present, tourism to the area is mostly limited to seasonal visits by tourists from neighbouring countries and local tourism. To exploit its potential, the physical planning departments of both countries focus on developing areas within their respective parts of the lake basin such as Godinje, Zabljak and Rijeka Crnojevic with activities involving artistic colonies (cultural tourism), fishing and watersports. Settlements between Donji

Murici and Ckla are planned to be developed as a base for mountaineering and for rural tourism.

The realization of the tourism development plans require, among others, protection of the waterbodies against pollution, restoration of historical monuments and traditional architecture, improvement of natural and anthropogenic conditions in e.g. Zabljak (Crnojevica) and other settlements, increase in the accommodation facilities, adequate road and transport facilities, reliable power supply etc. Table 2.26 shows accommodation facilities required/ planned in the main touristic areas, as projected in the Physical (Spatial) Plan of Montenegro.

Table 2.26 Projected accommodation facilities up to 2015 (in number of beds)

<i>Location</i>	<i>Hotels and similar facilities</i>	<i>Camps, floating houses, pile dwellings</i>	<i>Bed & breakfast-like accommodations</i>	<i>Total</i>
Donji Murici	150	100	80	330
Virpazar	110	-	50	160
Rijeka Crnojevic	170	50	50	270
Vranjina-Lesendro	60	-	80	140
Plavnica	60	-	-	60

Source: B. Uskokovic, 2005

As the tourist inflow will increase, vehicular traffic on the motorways along the lake and seaside (Podgorica-Skadar and Adriatic-Ionic Sea motorway and on the Beograd-Bar railway) will increase, especially in summer. This will require improvements and modernization of roads like Ulcinij-Ostros-Virpazar-Rijeka Crnjevica-Kruc and Dodosi-Zabljak-Vkovic-Bjelo Polje-Podhum. The government of Montenegro plans to build some new highways: the Podgorica – Bar highway (Sozina tunnel) and the Jadransko – Jonskog highway running northwest of the national park boundary. The airport at Gulobovci in Podgorica is being improved and modernised.

In Albania, the tourism development is regulated through a special legal act - Law nr. 7665 dated 23.01.1993 on the Development of Tourism Priority Zones. The decision nr. 88 dated 01.03.1996 of the Council of Ministers for the implementation of the law has designated (a part) of Lake Shkodra as tourism priority area. Since the late 1990s tourism activities are increasing, but the development activities do not show coordination.

2.12 Environmental policies and legislation

2.12.1 Introduction

Lake Shkoder and its surrounding areas, by virtue of its unique biodiversity, ecosystem and wintering sites for migratory birds, is considered an area of international importance. In 1983, as an important step towards environmental conservation, Montenegro declared its side of the lake area a National Park. The lake area has been identified by Ramsar Convention as one of the 25 transboundary wetlands. In 1995-96, Skadar Lake National Park (*Skadarsko Jezero*) was included in the List of Wetlands of International Importance and became a Ramsar Site (No. 784).

However, the national and international recognition of the importance of the lake area alone is not sufficient for its conservation. The conservation of its biodiversity requires

coordinated efforts by both countries. Recognising this, the two countries have gradually adopted structural changes in their policies and have created new legislation for the protection and management of the lake's environment.

An environmental policy should establish priorities, set strategies and provide long-term directives. For its effective implementation, a sound legislative base is essential. The prevalent environmental policies, laws, acts and regulations in the two countries are described below.

2.12.2 Data availability

Data on environmental policies, plans and legislation of both Albania and Montenegro are available, but mostly in the form of fragmentary reports and declarations of the governments. Environmental policies are still being developed. In March 2004 the Ministry of Environment of Albania published a Compendium of Environmental Legislation in English. The policy documents of the two governments, water resources master plans and the country (strategy) papers & reports of international organizations like WB, EU, WHO, UNDP, REC are primary sources of the data for this section.

2.12.3 Description Montenegro

- Policies

At the federal level there are several regulation and policy documents related to nature protection and international waters:

- Resolution on Environmental Protection Policy in Yugoslavia (1993);
- Resolution on Biodiversity Conservation Policy in FRY (1994);
- Law on the Basic Principles for Environmental Protection (1998).

The Biodiversity Conservation Policy Resolution of the FRY defines the goals and the principles of biodiversity conservation in the country. Also, the resolution contains the priority programs and projects which should be implemented.

The declaration of Montenegro as an 'Ecological State' by the country's National Assembly in 1991 (Article 1 of the 1994 Constitution) shows a commitment of the government at the highest level to protect the environment. As mentioned earlier, the Ministry of Environmental Protection and Physical Planning (MEPPP) is responsible for the formulation and implementation of policies and legislation related to the environment. In 2001, the Montenegrin Government adopted the 'Directions for Development of the Ecological State of Montenegro' which represents their long-term development strategy.

In the last decade, the government has adopted a policy framework that prioritizes protected areas (e.g. National Parks) and provides for environmental conservation through various management plans and programmes at national, regional and local level. The country's environmental policy is directed towards the protection and conservation of its natural environment by:

- Giving due considerations to EIA and sustainable conservation of environment in all development plans;
- Following EU/GEF guidelines on environmental protection measures;
- Building and reinforcing institutions and services relevant to environmental protection (this includes intersectoral cooperation);
- Regular monitoring of surface water, groundwater, air, soil and rain quality, and noise pollution;
- Strengthening cooperation with neighbouring countries on sustainable conservation of the transboundary natural environment.

While the MEPPP is entrusted with the overall formulation and implementation of the country's environmental policies and legislations, natural resources management is the task of two other Ministries: the Ministry of Agriculture, Forests and Water Resources Management (MAFWR) and the Ministry of Economy and Energy (in charge of mineral resources). The MAFWR is responsible for protected area management, agricultural development and the management of the water resources. As such, its responsibilities overlap with those of the MEPPP. Some of the responsibilities of MAFWR have been described in Section 2.9.3.

Within the Lake Shkoder basin, management of the forest is particularly important, as it provides habitat for many species, prevents erosion and helps maintain fresh water regimes. The Forest Sector within the MAFWR is responsible for the forestry policy. The Forest Management Directorate, established by the new Law on Forests (2001), implements the country's forest management and development plans through its fifteen forest management services, located in municipalities. The Directorate manages state-owned forests and approves concessions to the forest enterprises on tender. Forest enterprises (previously a part of Crna Gora Sume) are being privatized.

The national strategy of sustainable development for Montenegro (NSOR-CG) is being developed by the Government of Montenegro under the Environmental Protection Program with the assistance of UNEP and UNDP.

- Legislation

The basic legislation for environmental protection and biodiversity in Montenegro can be said to be in place and is gradually strengthened by acts, regulations and decisions. The Environmental Law published in 1996 in the official gazette no.12 of the Republic of Montenegro states all provisions related to the assessment and conservation of the environment within the Republic. The legal provision to identify Montenegro as an 'ecological state' and to institute an environmental logo under Article 2, "Basic provisions of the law", illustrates the importance given to the environment. Article 6 of the "Basic provisions of the law" gives the policy guidelines on protection and conservation of the environment.

Next to the Environmental Law, the following laws are most important for environmental conservation:

- Law on Environmental Protection ('Sl. List SRCG', No. 36/77, 27/94);
- Law on National Parks ('Sl. list RCG', No. 47/91);
- Law on Fresh Water Fishery ('Sl. list RCG', No. 39/76, 34/88, 4/92);
- Law on Waters ('Sl. list RCG', No. 16/95, 22/95).

Other relevant laws, acts and decisions that support environmental protection are:

- Law on Spatial Planning and Settlement ('Sl. List RCG', No. 16/95);
- Law on Object Constructions ('Sl. List RCG', No. 55/2000);
- Law on Cultural Monuments Protection ('Sl. List RCG', No. 47/91);
- Law on Forests 'Sl. List RCG', No. 55/00);
- Law on Hunting ('Sl. List RCG', No. 47/99);
- Law on Air (Pollution) Protection 'Sl. List RCG', No. 4/82);
- Regulations on water classification and categorization ('Sl. List RCG', No. 14/96, 15/96, 19/96);
- Regulations on the criteria for the selection of sites, methods and procedures for depositing waste materials ('Sl. List RCG', No. 56/00);
- Regulations on permitted amount of hazardous and harmful substances in soil and water for irrigation and methods for their testing ('Sl. List RCG', Nos. 23/94);
- Decision on establishment of a Council for the sustainable development ('Sl. List RCG', No. 53/02);
- Guidelines on wastewater quality and ways of their disposal into natural recipient ('Nat. Her. List RCG', No. 10/97, 21/97);
- Regulations on the content and ways to keep water records book, cadastre surface, erosion areas, water(power) objects and plants ('Sl. List RCG', No. 5/96);
- Decree on the protection of natural objects ('Sl. List RCG', No. 30/68);
- Decree on the protection of rare, endemic and endangered flora and fauna species ('Sl. List RCG', No. 36/82);
- Decree/order on the fishing bans, restrictions and measures for the fish fund protection ('Sl. List RCG', No. 53/00, 14/01, 31/01, 24/02);
- Decree on the amount and methods of payment for using National Parks' goods, for working and providign services ('Sl. List RCG', No. 21/02);
- Decree on ban to all types of boats on Lake Shkoder, having power above 4.5 HP (Nat. Her. RCG, No. 9/86);
- Regulations on environmental impact assessment ('Sl. List RCG', No. 14/97);
- Guidelines for the content and report for environmental impact assessment ('Sl. List RCG', No. 21/97);
- Guidelines on emmission of polluting matters in to air ('Sl. List RCG', No. 25/01).

Further, there are discussions on the provision of three new laws: (draft) laws on Environmental Impact Assessment (EIA), Strategic Environmental Assessment (SEA) and Integrated Pollution Prevention and Control (IPPC). These laws are developed in conformity with EU Directives.

While the Environmental Law of 1996 states the principles regarding impact assessment, payment by the polluters, data transparency etc, few by-laws have been developed to implement these principles. Law enforcment and implementaion of the government decisions need improvement.

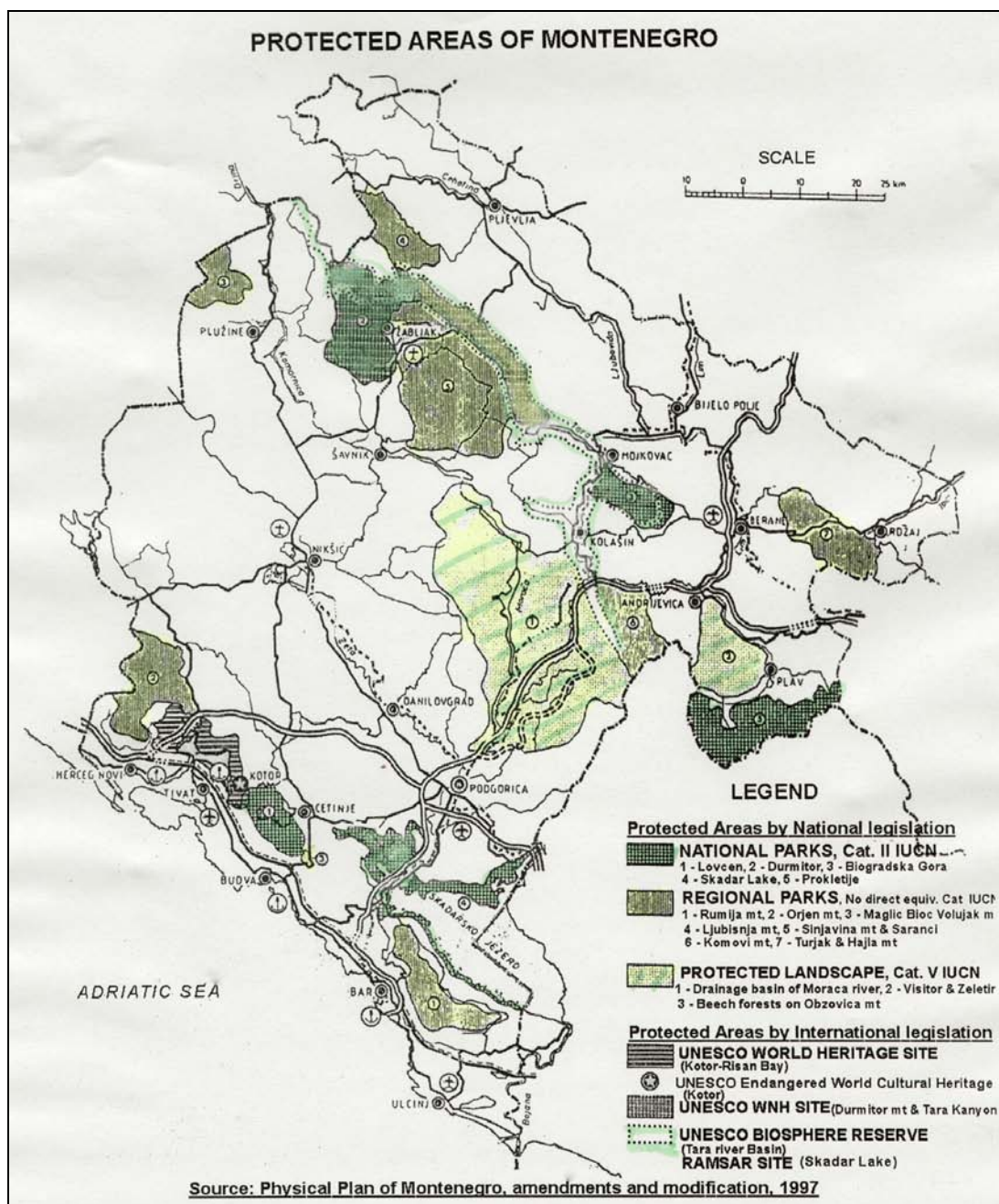


Figure 2.50 Protected areas in Montenegro

2.12.4 Description Albania

- Policies

The Constitution of Albania gives a special place to the environment. In Chapter IV it is clearly defined that every citizen has the right to be informed about the environmental protection.

The Ministry of Environment (MoE), established in 2001, is the main policy-making public institution in the country. Until recently, the Ministry of Agriculture and Food, Forests and Waters had some responsibilities for environmental protection and biodiversity conservation. The General Directorates of Fishery, Forest and Pastures under this

Ministry are responsible for fishing (a.o. in Lake Shkoder), national parks and protected areas. The MoE has been given the additional responsibilities of forest and water administration sectors and is now the Ministry of Environment, Forests and Water Administration.

The Albanian environmental policy identifies the following priority objectives: strengthening environmental management capacities at national and local level, developing the necessary legal framework, ensuring the integration of environmental considerations into sector policies and programmes, improving the environmental situation in identified 'hot' areas, promoting environmental awareness, and integrating the sustainable development principle in the use of natural resources.

The policy of the Albanian Government in the field of environmental protection was made for the first time in the basic law "On Environment Protection" (in 1993) and in the National Action Plan for Environment (1992-93), approved in January 1994. This plan, which was prepared in assistance with the World Bank, laid the foundation for improving environmental management and aimed at the integration of environmental protection in the country's development programs, and assigned many duties to various Ministries and institutions. It also envisioned the undertaking of organisational, administrative, legal and technical steps for the administration of the environment. Since then, the Government of Albania has made noteworthy progress in the development and implementation of environmental policy in the country. In 1999 the first Biodiversity Strategy and Action Plan (BSAP) was made. One of the goals of the BSAP was the enlargement and enforcement of the network of protected areas.

The updated National Environment Action Plan (NEAP) of 2002 elaborates the present environmental policies of the country. The NEAP was approved by the Council of Ministers on 28 January 2002 (Decision no. 34) and was published in the official gazette no. 3/1 of February 2002. This updated plan envisages measures to be taken for the protection of different environmental mediums, and normative acts to be approved. It will have an impact on the management of the Lake Shkoder environment. In 2003 an intersectorial committee has been established for the implementation of the NEAP. This committee is chaired by the Prime Minister, and comprises 12 members, at the level of minister or deputy-minister, of the concerned ministries.

Recently, the Albanian government has proclaimed its part of Lake Shkoder a "Managed Natural Reserve" through the Council of Ministers' decision No. 684 dated 02.11.2005. See below for two more recent decisions related to protected natural areas.

- Legislation

In Albania, the legislation for the environmental protection and management can be said to be mostly in place. The law (No. 8934 of 5 September 2002) entitled "On Environmental Protection" is the legal act which regulates the protection and conservation of the environment in the country (Compendium of Environmental Legislation of Albania, March 2004, p. 279). Article 7 of Chapter II of the law lays down the policy guidelines on environment to be followed by the State.

In addition to the law on Environmental Protection (2002), most important for waters resources and biodiversity conservation are the following laws:

- On Forestry and Forestry Police, Law nr. 7623 dated 13.10.1992, amended by Law No. 7838 of 10.06.1994 and Law No. 8906 dated 06.06.2002;
- On Protection of Wild Game and Hunting, Law No. 7875, dated 23.11.1994;
- On Fishing and Aqua-Culture, Law no. 7908, dated 5.04.1995, amended by Law no. 8763, dated 02.04.2001, and Law no. 8870, dated 21.03.2002;
- On Pastures and Meadows, Law No. 7917 dated 13.04.1995;
- On Water Resources, Law no. 8093, dated 21.03.1996. This law is yet to be implemented;
- On Protected Areas, Law No. 8906, dated 06 .06.2002;
- On Environmental Impact Assessment, Law No. 8990 dated 23.01.2003.

Further, various acts and regulations have been passed by the government to enforce environmental protection in the country. Most relevant are:

- On Planting Material, Law No. 8732 dated 24.01.2001;
- On Protection of Horticulture Trees, Law No. 7929 dated 11.05.1995;
- On the Service of Plant Protection, Law No. 19.01.1993, ammendment proposed by the government decision (No. 442 dated 09.10.2004);
- On Protection of Transboundary Lakes, Law No. 9103 dated 10.07.2003;
- On Urban Planning, Law No. 8405 dated 17.09.1998;
- On Public Disposal of Waste, Law No. 8094 dated 21.03.1996;
- On Environmental Administration of Solid Waste, Law No. 9010, dated 13.02.2003;
- On Regulatory Framework of Water Supply Sector and Disposal & Treatment of Wastewater, Law No. 8102 dated 28.03.1996;
- On Irrigation and Drainage, Law No. 8518 dated 30.07.1999;
- On Development of Areas with Priority for Tourism, Law No. 7665 dated 21.01.1993;
- On protection of air from pollution, Law No. 8897 dated 16.05.2002;
- Government Decision No. 103 dated 31.03.2002, "On Environmental Monitoring in the Republic of Albania". This decision states, among others, the indicators to be used in monitoring the environments of the country;
- Government decision No. 103 dated 31.03.2002 on "Environmental Monitoring";
- Government decision No. 676 dated 20.12.2002 on "Declaration of Nature's Monuments as Protected Zones";
- Government decision No. 266 dated 24.04.2003 on "Administration of Protected Areas";
- Government decision No. 86 dated 11.02.2005 on "Creation of the Management Committee for Protected Areas";
- Articles 201-207 of the Albanian Penal Code provide for the penal acts related to the violation of the environmental laws.

Most recent legislative and administrative decisions, noteworthy with respect to the environment conservation are:

- Council of Minister's decision No. 682 dated 02.11.2005 on "Proclamation of Buna river and the Surrounding Wetlands Protected Water/ Land Landscape";
- Council of Minister's decision No. 683 dated 02.11.2005 on "Proclamation of Shkodra Lake and Buna river Wetland Complex, Natural Area especially protected and its inclusion in the list of internationally important wetlands, especially as waterfowl habitats";
- Council of Minister's decision No. 684 dated 02.11.2005 on "Proclamation of the Albanian Part of Shkodra Lake as Managed Natural Reserve".

Clearly, the Albanian government have taken legislative measures which reflect its desire to towards environment conservation and management in the country. But the enforcement of the laws and regulations and implementation of the government decisions are still weak.

2.12.5 Transboundary and international cooperation

- Transboundary collaboration

Lake Shkoder area is a common resource to Albania and Montenegro. The dialogue between the two governments on issues related to the lake environment began in 1995. However, it was only in May 2003 that the Memorandum of Understanding (MoU) for the Protection and Sustainable Development of Lake Shkoder was formally signed by the Ministers of Environment of Albania and Montenegro. By doing so, the two countries commit to conserve the natural resources of Lake Shkoder in a coordinated and integrated manner, to establish a bilateral Lake Management Commission and to improve the relevant national level regulatory and institutional capacities. The text of this memorandum is given in Annex XVIII.

In the last few years the governments of the two countries have acknowledged the possible impact of further degradation of the lake's natural resource base in their development goals, and have plans for the conservation of Lake Shkoder and its basin. Both governments show their willingness to cooperate in improving the protection and management of the lake and its resources. Lake Shkoder Strategic Action Plan will be prepared under the framework of the 2003 MoU.

A recent development in bilateral co-operation is the joint inauguration by the Prime-ministers of the two countries of the international workshop on "Lake Skadar international designations for territorial development" on 18-19 October 2005 in Vranjina and Shkodra. This workshop was organised by the "Dinaric Arc Initiative", a framework of collaboration between offices of UNESCO, WWF, IUCN, UNDP and the Council of Europe and was attended by the Environment Ministers of both countries and other important stakeholders. The main objective of the workshop was to discuss with all major stakeholders the future development scenarios of the transboundary territory of Skadar Lake and its basin (for a short report on the event see: www.ramsar.org/wn/w.n.skadar_mtg_2005.htm).

At the workshop the Environment Minister of Albania, Mr. Xhuvli, announced that the Albanian part of the lake and the downstream floodplain along the Buna/ Bojana river (the border between the two countries), including the lagoon at the Adriatic Sea next to Velipoja village, will receive national protection (see the recent Albanian government decisions above) and will be designated for inclusion in the Ramsar List of Wetlands of International Importance. A transboundary Ramsar designation would help the two countries in their endeavour towards integrated management and conservation.

- International agreements and conventions

Both countries have signed, with most of them ratified, a number of international agreements and conventions related to transboundary waters and protection of the environment. The international agreements made previously during the period of the FYR at federal (now Union of State) level are *de jure* valid for Montenegro as well. However, problems associated with such agreements are that institutions responsible for their implementation have not been clearly identified in most cases, particularly for

those ratified before 1978. Some of the institutions do not exist anymore and some obligations related to international agreements are regulated by different provisions.

Important international agreements and conventions signed (ratified) by the former Federal Republic of Yugoslavia (FRY), and respectively Montenegro are:

- Convention on Trade of Endangered Species of Wild Flora and Fauna (Washington, 1973);
- Convention Concerning the Protection of the World Cultural and Natural Heritage;
- Ramsar Convention on Wetlands of International Importance, Waterfowl Habitats (ratified in 1977);
- United Nations Framework Convention on Climate Change, (ratified in 2001);
- UNECE Convention on Long-range Transboundary Air Pollution (ratified in 1986, carried over in 2001);
- Convention on International Trade of the Endangered Wild Flora and Fauna Species (CITES), (accession on 27.02.2002 and enforced/ratified in 28.05.2002);
- Stockholm Convention on Persistent Organic Pollutants (signed in May 2002, not yet ratified);
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (ratified in 2000);
- World Heritage Convention (not yet ratified but declaration of succession on 11.09.2001);
- Bern Convention on the Conservation of European Wildlife and Natural Habitats (not yet ratified);
- Earth Summit Convention on Biological Diversity, Rio de Janeiro (ratified in March 2002).

International Conventions signed (ratified) by the Government of Albania are:

- World Heritage Convention (ratified on 10.07.1989);
- Cartagena Protocol on Biosafety to the Rio Convention, 2000, (ratified on 23.09.2004);
- Earth Summit Convention on Biological Diversity, Rio de Janeiro, 1992 (ratified on 05.04.1994);
- Espoo Convention on Environmental Impact Assessment in a transboundary context, Finland (ratified on 04.10.1991);
- Convention on International Trade of Endangered Wild Flora and Fauna Species (CITES), (accession on 27.06.2003 and enforced/ratified on 25.09.2003);
- Bern Convention on the Conservation of European Wildlife and Natural Habitats (signed on 31.10.1995 and ratified on 02.03.1998);
- Convention on the Conservation of Migratory Species of Wild Animals, Bonn, 1997 (ratified on 16.11.2000);
- Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (ratified on 29.06.1999);
- Convention on the Transboundary Effect of Industrial Accidents (ratified on 13.05.1997);
- Ramsar Convention on Wetlands of International Importance, Waterfowl Habitats (accession on 29.11.1995 ratified on 29.03.1996.; The Albanian side of Lake Shkoder is yet to be included);
- UNECE Convention on the Protection and Use of Watercourses and Transboundary Lakes, Helsinki, 1992 (ratified on 05.01.1994);
- UNECE Protocol on Water and Health (ratified on 08.03.2002).

Further, legislatively the Government of Albania, by the Decision of its Council of Ministers no. 337 of 15.07.1999, has provided a special state-level commission to deal with water-related issues with the neighbouring countries. However, this Commission has been inactive to date.

Article 27, Chapter IV of the Albanian Law "On environmental protection", makes provisions for environmental impact assessment (EIA) in a transboundary context. The second clause of this article states: "Special law regulates the procedures of EIA in transboundary context". But no such law has been prepared to date.

A two-years project that aims to match (approximate) Albania's environmental legislation with that of the EU has recently started. The Directorate of Approximation of the Albanian Legislation, under the Ministry of (European) Integration, is responsible for the assimilation of the country's environmental regulations with those of the EU. In this regard, the directorate advises the Ministry of Environment.

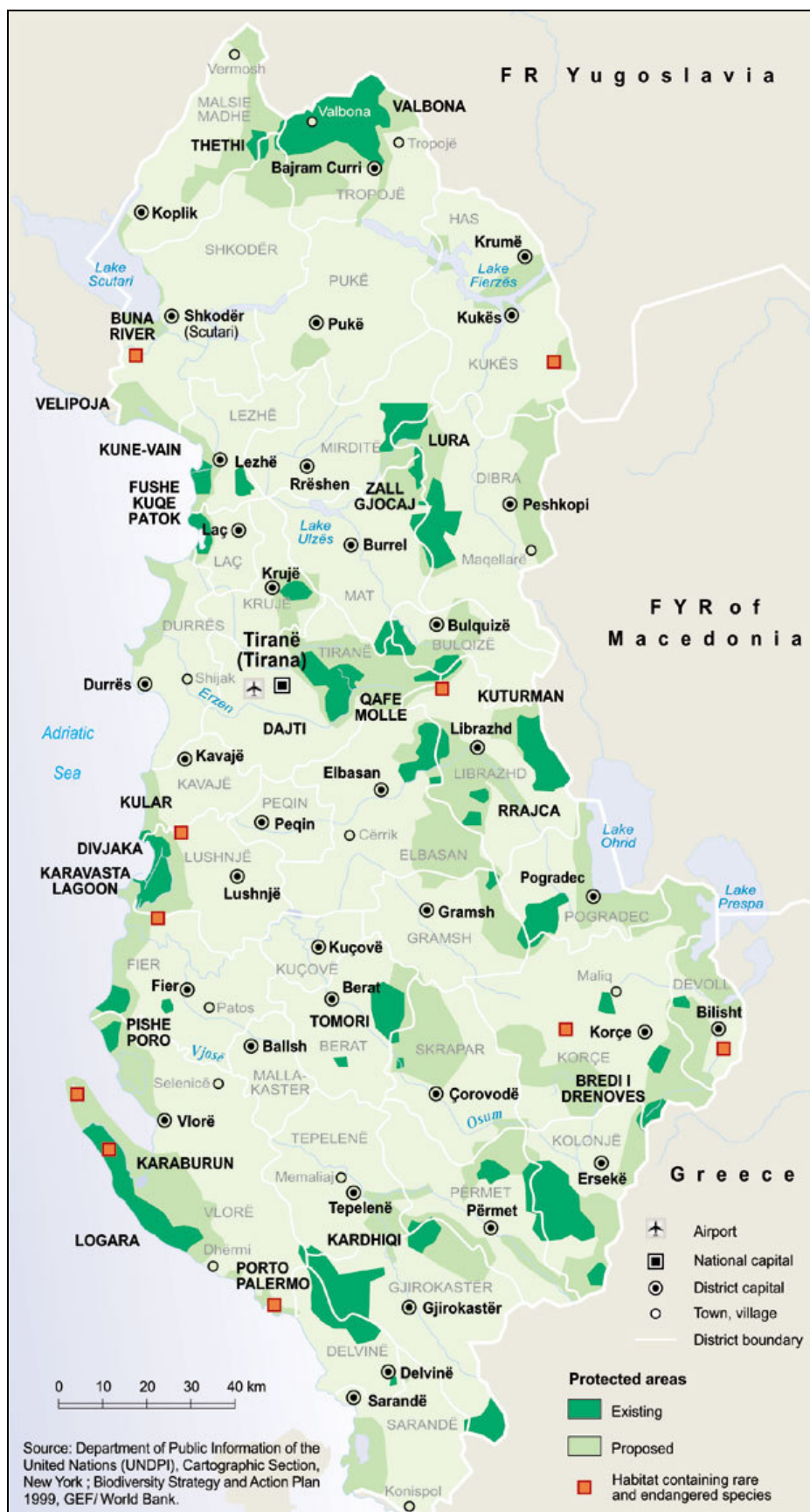


Figure 2.51 Protected areas in Albania

3 ANALYSES OF PRESSURES AND THREATS

3.1 Introduction

The Transboundary Diagnostic Analysis (TDA) calls for the assessment of the state of the environment and the trends in natural resource use and condition in Lake Shkoder and its watershed. In this chapter this assessment is made on the basis of the analysis of the data collected and described in the previous chapters and annexes. Based on this assessment the main environmental pressures and threats are discussed.

3.2 Knowledge gaps

There is in all fields of environment, treated in this report, quite some data available, but data collection has often been uncoordinated, irregular in time and space, and using different methods and standards. The dramatic political changes and bad economic situation in both Albania and Montenegro in the past 15 years contributed to this. The result is that parameters and variables are difficult to compare and trends hard to assess.

Since a few years, with institutional strength increasing, monitoring programmes are being developed (both by governmental and non-governmental organisations) in most environmental fields. One problem is that the objectives of the programmes are often not clear and the resulting strategy and design possibly not adequate. A structured approach to set up a monitoring programme may help: see Figure 3.1.

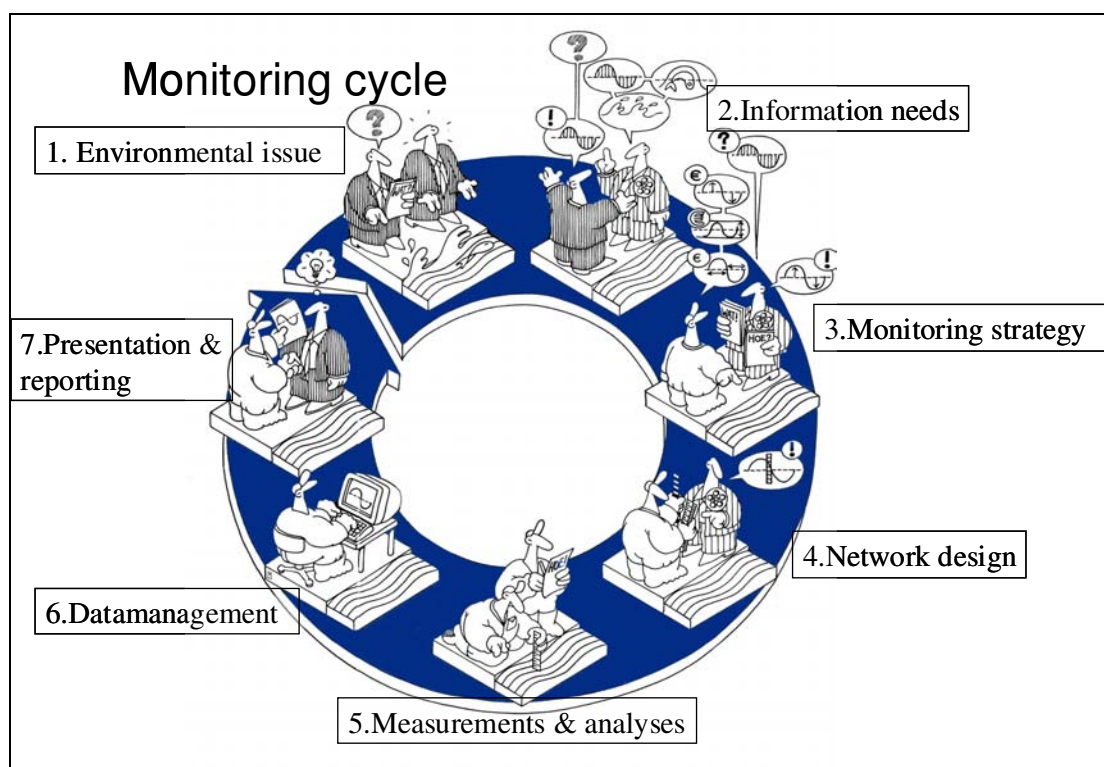


Figure 3.1 The monitoring cycle in a water environment (source: Royal Haskoning)

The main problem today, however, is financing the often expensive programmes. A related issue is that, because of both the cost of data collection and the value and 'power' that data represent, access to the data may be restricted. Institutes and people are often not willing to share their data, unless high prices are being paid.

3.3 Ecological situation (state of the environment)

3.3.1 Pollution

- Pollution sources and influencing factors

The environment in the Lake Shkoder basin is influenced by the various pollutant sources described in Chapter 2. The pollution of the lake and its surroundings is a combined result of a growing population producing municipal solid and liquid wastes (from cities like Podgorica, Niksic, Cetinje and Shkodra), industries like the KAP and Niksic Steelworks, traffic, and various other human activities in the basin.

As early as 1981, analysis presented by Petrovic and Beeton (p.67-94) indicated that the physical-chemical characteristics of the lake water are the result of inflow from its main tributaries (the Moraca and Crnojevisa Rivers), inflow from the karstic springs, exchange between the sediments and overlying waters, and the chemical exchange between the waters and the extensive beds of aquatic macrophytes. Recent data on the quality of water in the lake and the tributary rivers (presented in Chapter 2 and the annexes) supports their arguments. The 1981 study, the first overview of environmental data on Lake Shkoder, serves as the basis for evaluation of the pollution in the lake,

Data presented in this report show that during the past three decades the lake and its basin have experienced varying states of pollution. A well defined pollution trend for the basin as a whole is difficult to establish on the basis of the fragmented and inconsistent data sets.

The water quality in the lake varies in space and time. Most pollutants are brought by the Moraca and Crnojevisa Rivers that are common places of disposal for poorly treated waste and wastewater. The concentration of pollutants like ammonia is high in the northern and north-western part of the lake and near the entry points of the Moraca. Further, the concentrations of pollutants show seasonal variation, depending upon the weather and the flow in the tributary rivers. For example, the dissolved oxygen is lower in the summer period. During peak flows, the Moraca River water influences most the water quality of the lake.

In general, the quality of the lake water appears to be within the acceptable limits as specified in the classification and categorization of watercourses in Montenegro, Ls. List RCG no.14/96. However, lake sediment and dry soil quality in some locations is a concern.

- Trend in basic parameters

Table 2.16 indicates that most basic parameters of the lake water quality have remained more or less the same, but e.g. nitrates and oxygen have deteriorated. The increase in nitrates and reduction in oxygen, in particular near the Moraca Delta and the Zeta Plain, may indicate an increase in organic pollution (e.g. by urban wastewater). Eutrophication is not (yet) an issue as a result of the high 'turn-over rate' of the lake water, but stagnant corners near the Moraca Delta and Zeta Plain are at risk.

- Trend in PCB-s and PAH-s

Concentrations of PCB in surface water were above the detection limit in the Moraca River between 1990 and 1995. Recent measurements of PCB and PAH concentrations

are below the detection limit and are currently no reason for concern for surface water quality (as long as the measures taken by KAP remain effective). However, in the groundwater and sediments these parameters were reason for concern. The values measured in 2005 decreased to acceptable levels, probably due to the measures taken at the KAP. In the dry soils of the Zeta Plain PCB and PAH show concentrations harmful for biota.

- Trend in heavy metals

The analysis of metals in the water of the Moraca River, Crenojevica River and in the Shkoder Lake by Filipovic (The Biota and Limnology of Lake Skadar, 1981, p.99) showed minimum concentrations of Na, K, Cu, Zn, Cr, Pb, Mn, Co, As, Hg, Cd and Fe. The comparison between their concentrations upstream of the rivers and at the lake showed little difference, except for some insignificant increased concentrations of Na and Fe at a specific site in the Moraca River. This implies that the lake water at that time was hardly polluted by the existing industries within the lake basin. Note that the KAP began its first production at its full capacity in 1973. Further, all analyzed metals were below the Montenegrin MDK standards for drinking water.

The recent analysis of lake water and sediments show an increase in concentrations of heavy metals. The concentrations are higher at the mouth of the Moraca River, mainly due to the industrial wastes originating from the KAP. The highest Hg content in July 2005 was 1.77 mg/kg in sediments (0.40 mg/kg in fish), while it was undetectable in 1974-1977 (Filipovic, 1981, p.99). The heavy metals accumulate in the sediments, while the water is refreshed about twice a year. The Hg in the sediment exceeds the EU standards on four of eight locations and of Ni on two out of eight locations in 2005. On the Albanian side of Lake Shkoder in 2003, at 7 out of 10 locations the concentration of Ni exceeded the EU standards.

- Air, soil and springs

While increased air and soil pollution is highest in the vicinity of the KAP, Steelworks Niksic and the landfills, pollutants from the industrial and municipal wastes and waste-waters are transported to Lake Shkoder through ground- and surface waters.

The current analysis of Albanian spring waters (Shegani and Viri) near the lake show that their quality is good and within the permissible limits of the EU standards. Although data are missing on spring water quality in Montenegro, one can expect that these are also of good quality, by lack of pollution sources in their areas of origin.

3.3.2 Flora and fauna

- In general

The current status of the ecology in the Shkoder basin is a mixed picture for the various flora and fauna groups. The good status of some flora and fauna species and habitats is partly the result of the turmoil in the previous decade that halted the economic development in the area, and the slow recovery in recent years. The limited number of pollution sources in combination with the high refresh rate (2-3 times a year) of the lake water and the inflow of clean karstic groundwater are the main reasons that the water quality remains good. The low population pressure and the inaccessibility of the higher parts of the catchment contributed also. On the other hand, hunting has continuously affected wildlife, in particular birds, fish and mammals. The Skadar Lake National Park organised

until 2003 hunting trips. The recent decline in bird numbers is a serious concern (see below). Autochthonous fish is recovering after a decline in a period of uncontrolled fishing (1980's), but migratory species seem still to be affected by fishing, but not necessarily within the basin. Exotic species are expanding rapidly. Data on the status of other faunal species is limited by lack of monitoring. The flora remains relatively undisturbed to date; illegal logging in forests occurs.

Now that the economies of Albania and Montenegro are recovering, the grip of the government is still weak and the government programmes and projects are in their initial stages. Uncontrolled building activities, development plans on the lake shores (e.g. marinas), industrial growth and increasing municipal waste production threaten the ecology. Lack of financial means and institutional 'infancy' hampers the governments to execute effectively programmes and protect the environment. However, with the political situation stabilised, international support gives opportunities to face the threats.

- Birds

Lake Shkoder is an important area for bird migration in the Mediterranean region. Every year large numbers of waterfowl depend on the open water, wetlands and bays as a habitat for living, feeding, breeding and resting. However, in recent years bird numbers have declined drastically. Only 35,000 aquatic birds were counted on Shkoder Lake (Montenegrin part) in 2005, whereas some years ago more than 200,000 birds had been observed: see Figure 3.2. Migrant birds attractive for hunters (as most duck species) are particularly affected; non-migrant species of little value for hunters (as cormorant) maintain their numbers.

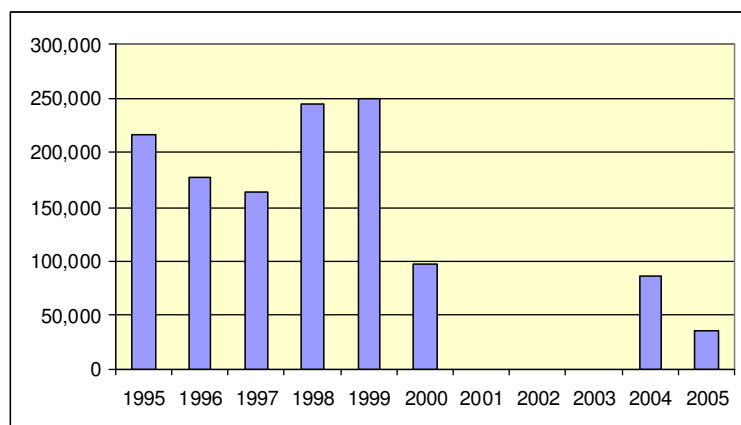


Figure 3.2 Decline in number of wintering birds in Shkoder National Park (Montenegro); in 2001-2003 no counts, in 2004 both Albania and MN included (M. Jacoby-Schneider, EuroNatur and D. Saveljic, Inst. for Prot. of Nature)

Uncontrolled hunting is suspected to be a major cause for the decline in waterfowl is; not only within the Shkoder basin by local people, but also in the Buna-Bojana Delta, where Italian hunters come to hunt. Theoretically, the Italian hunters in the delta could hunt up to 190,000 birds in one season ! (7 months x 30 days x 30 hunters x max. 30 birds). Although actual figures are unavailable, biologists have observed hunting practises very frequently on and around the lake and in the delta. The impact of hunting and disturbances is explained by Van den Tempel (1992) en Schneider-Jacoby (2000b and 2001). According to EU regulations hunting of birds migrating back to their breeding grounds is forbidden, for it would mean killing of birds which successfully survived winter and now

required for reproduction. Hopefully the local hunting laws will soon be adapted so as to be in agreement with the EU Birds Directive. Recent hunt bans because of bird flu is expected to have a positive impact on the bird population.

The population of the Dalmatian Pelican of Shkoder Lake, *Pelicanus crispus*, is still highly endangered, although showing some growth. The main adverse impact on this species is caused by flooding of nests and human disturbance (Saveljic et al., 2004).

- Fish

The status of various ichthyofauna species is discussed in detail in Section 2.8.10. There are big differences in status between the various species, depending on whether they migrate or not, their habitat type, economic value, reproduction requirements etc. Figure 3.3 generalizes the developments for the categories autochthonous fish, migratory fish and exotic fish. The strong decline in autochthonous fish between 1980 and 1990 is blamed to uncontrolled fishing, but they have recovered since. Migratory fish is particularly vulnerable for being caught, as they often swim large distances; their numbers in catches in Lake Shkoder are low. Exotic fish are doing very well in their new environment, as most of them can live in a broad habitat spectrum.

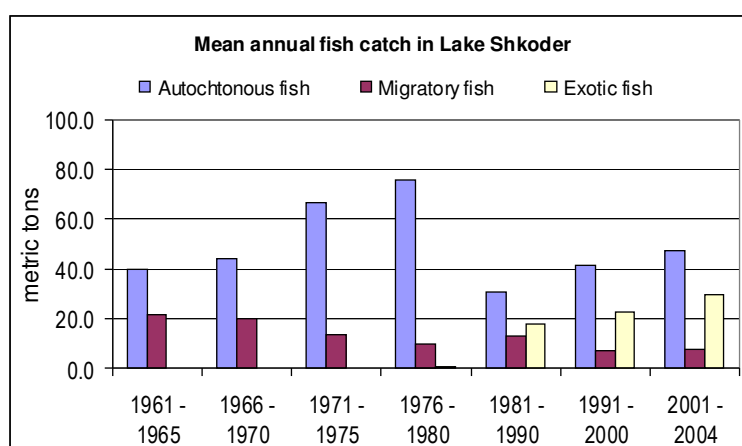


Figure 3.3 Annual fish catch on the Albanian side of Lake Shkoder (several sources combined)

3.3.3 Impacts of pollution on biota

Pollution has effects on flora and fauna in various ways. The health of a species may decline, habitats may become uninhabitable, food sources may disappear, reproduction may be affected etc. In Lake Shkoder basin there are, generalized, two major types of pollution: chemical pollution by factories as the KAP and Steelworks Niksic, and organic pollution by the wastewaters from the cities and towns. Pollutants entering surface waters and groundwater have the biggest impact on the flora and fauna in the basin.

Toxic and carcinogenic substances as PCB-s, PCT-s, PCDD-s, PCDF-s, PAH-s, Phenols, F and CN that enter the ecosystem accumulate in fat tissue of species (PCB-s from 0.008 µg/kg in man to as much as 14,000 mg/kg in fat tissue of fishes and birds). These substances are extremely stable and their decomposition by chemical means or by micro-organisms is very difficult. The combined discharge of pollutants may increase their impact. For example, the solubility of PAHs (and especially benzo-a-pyrene) in water is drastically increased in the presence of phenol and organic solvents or mineral

oils. This is the case with groundwater polluted by the anode factory of the KAP, which eventually reaches Lake Shkoder. The 'red mud', originating from the KAP bauxite processing, contains high concentrations of fluorides, phenols, PAH-s, As and CN. These are also present in the surroundings of the factory.

Concentrations of PCB-s and other pollutants in tissue samples from various fish species living in Lake Shkoder have been analyzed during the last 15 years: see Annexes VI to XI. The concentrations of PCB's exceeded in some cases in the period 1990-1996 the permitted US EPA values for food consumption (2 ppm or mg/kg).

A study from 2005, by the Universities of Heidelberg (Germany) and Shkodra (Albania), showed that the highest concentration of total PCB-s was found in Rudd (*Scardinius erythrophthalmus scardapha*) being 200 µg/kg and that the lowest concentration was found in perch (*Perca fluviatilis*) being 35 µg/kg (see Annex XI).

Recent data from Montenegro on PCB-s in fishes (analyzed in 2004 and 2005) show that concentrations of PCB-s decreased strongly since the 1990s. This is the result of a combination of the following (source: CETI):

- the removal of the source of pollution: all barrels and soil contaminated with Piralen from the KAP are put in a special bunker;
- pollutants are transported quickly into the lake due to the high permeability of the soil in the Zeta Plain;
- the high precipitation in the region during the last 15 years;
- the high 'refresh' rate of the water in the lake.

PCB-s end up partly in the lake sediments, where they can remain for a long time. This was confirmed during a project carried out by Heidelberg University with the Universities of Montenegro and Shkodra in 2001-2002, applying passive sampling using Semi-permeable Membrane Devices (SPMD), simulating long-time exposure of an organism to pollutants. Benthic fauna (e.g. worms, eels) are in particular exposed to pollutants in the sediments.

A thesis by A. Nuro and E. Marku (2002) presents the result of a study on organochlorous pesticides in sediments and biota of Lake Shkoder. Concentrations met in fishes and aquatic fowl (coot) are given in Annex XI.

The decline in numbers of the fish *Condrostoma nasus ohridanus* is attributed to pollution from wastewaters originating from a former paper factory [Hoxha, 1994].

3.4 Main pressures and threats

Lake Shkoder and its basin are experiencing various impacts from different sources and facing numerous threats, as discussed above and in Chapter 2. The following threats for the deterioration of the soil, water and sediment quality and biodiversity of Lake Shkoder and its basin have been identified:

- 1) Pollution (industries, municipalities, solid waste, liquid waste);
- 2) Hunting and fishing;
- 3) Lakeshore development;
- 4) Water management measures.

The quantitative impacts of these causes cannot be assessed in the absence of a comprehensive set of data concerning soil quality, water quality, sediment quality and biodiversity on one side, and pertinent data related to these causes on the other side. However, for the development of a strategy aiming at the conservation of the lake and its biodiversity it is important that the relative importance of the causes are assessed so that adequate policies can be formulated for the reduction of the impacts of the different causes.

A first attempt of such assessment is given in Table 3.1. In this table a first qualitative assessment is made, using the following impact levels:

- - severe
- moderate
- o neutral

Table 3.1 Main pressures and threats and their impact on flora, fauna and habitats

Cause	Impact	
	habitats	flora & fauna
<i>Pollution</i>		
Industrial waste (solid and liquid)	-	-
Domestic wastewater	-	-
Solid domestic waste	-	-
Agricultural pollution	o	o
<i>Hunting</i>	o	- -
<i>Fishing</i>	o	-
<i>Lakeshore development</i>		
Tourism	-	-
Small scale developments	-	-
Planned large scale developments	- -	- -
<i>Water management measures (if implemented)</i>		
Hydropower development	-	-
Dredging Buna-Bojana/ Lowering lake level	- -	- -

This first assessment considers the actual ecological situation and the ongoing developments and projects under study without taking into account ongoing and planned mitigating measures. The background of the impact qualification is given below Table 3.2 for each of the identified causes.

The considerations to predict short- and long-term impacts are summarised in Table 3.2.

Table 3.2 Main pressures and threats and their expected short- and long-term impact on flora, fauna and habitats; government policies are expected to become more effective on long-term

Factor	Trend and impact on flora, fauna and habitats		
	Current	Short-term (1- 10 years)	Long-term (> 10 years)
Current and continuing activities			
Chemical pollution by industries	Slow increase: lake sediments are of concern	Strong increase: lake water may become a concern	Decrease: sediments remain a concern
Organic pollution/ wastewater by cities/ towns	Increase: surf. water locally of concern	Stabilisation: surf. water locally of concern	Decrease: surf. water locally of concern
Solid waste by cities/ towns	Increase: groundwater locally of concern ?	Stabilisation: groundwater locally of concern ?	Decrease: groundwater locally of concern ?
Hunting	Unsustainable	Unsustainable	Sustainable ?
Fishing	Unsustainable	Sustainable ?	Sustainable
Tourism	Slow increase	Strong increase	Stabilisation
Small constructions on the lake shore (e.g. houses)	Increase: little impact	Strong increase: impacts are a concern	Stabilisation: impacts mitigated ?
Potential developments	If realised now	Short-term (1- 10 years)	Long-term (> 10 years)
Big development projects on/near lake (e.g. marinas)	Big impact	Big impact	Big impact
Projects lowering lake level, but maintaining dynamics	Huge impact	Big impact	Considerable impact
Projects lowering lake level and reducing dynamics	Huge impact	Huge impact	Big impact
Projects maintaining level, but reducing dynamics	Huge impact	Huge impact	Big impact

1) Pollution

Pollution is likely to increase with growing economies, increasing prosperity, and a steady population growth. The government is developing programmes and projects to keep pollution within acceptable limits (e.g. for new landfills and wastewater treatment plants), but it will take some years before these will be effective. Accession to the EU will lead to implementation of EU Directives as the IPPC (Integrated Pollution Prevention Control). On the long-term the actual implementation of the programmes and project will result in a reduction in pollution and cleaner water. Most pollutants in sediments are immobilised and remain at the deposition location for a long period, in particular in sediments with a high content in clay and organic matter.

2) Hunting and fishing

Hunting will have an impact on fauna for a long period, as it requires a change in mentality, growth in prosperity in the rural areas and an effective system of control. This will be the most difficult issue to tackle of all threats and impacts.

The fishing sector is already being restructured by projects in both countries. On short terms one can expect it will become sustainable for most commercial species, assuming the reforms and policy changes are further effectuated.

3) Unsustainable tourism

Tourism is now limited to mainly local people, but the area has the potential to become an international destination. Its location close to the Adriatic Sea beaches, the cultural heritage and natural beauty are the main attractions. Economic growth will allow in time the development of a tourism infrastructure and the rehabilitation of historic sites and buildings. Accession to the EU will stimulate investments and tourism from current EU countries. If the tourist facilities and attractions are set up in an ecologically sustainable way, negative impacts on flora and fauna may be limited. Impacts can even be positive if tourism earnings are invested in nature protection and development. Tourism in countries like New Zealand can serve as an example.

4) Small constructions on the lake shore

The growing economy allows (some) people to build a place outside the city in attractive areas, like the shores of Lake Shkoder. If this continues unregulated, habitats will be destroyed and the wildlife disturbed by human influence. A sound spatial development plan of the area, supported by mechanisms to prevent and penalize unauthorised building activities, is needed. Growing power of the government institutions will improve supervision of implementation, compliance and enforcement.

5) Big development projects on/ near the lake

Ideas are being launched by both private investors and government agencies for development project like marinas, tourist resorts and recreational areas along the lake shore. The environmental awareness of the proponents is in general low and economic benefits seem to be the main driver. The negative impacts of these projects are likely to be big and irreversible on flora and fauna. For a sustainable development of the area an ecological approach as suggested under point 3 is advisable.

6) Projects changing the lake level and level dynamics

Plans like the Bushati hydropower plant combined with dredging of the Buna-Bojana will change the lake level and/or level dynamics (depending on the option chosen).

Lowering the lake level will initially have an enormous impact on flora, and thus on fauna, as the vegetation has to 'migrate' with the retreating shoreline. Species with a narrow niche or ecotone and low reproduction speed will not be able to survive. Groundwater and (karstic) springs will change (some fish species completely depend on sub-lacustrine springs), lake sections will be disconnected, river morphology will change, water temperature will rise, etc. (see Section 2.11). On the long-term a new hydrological and ecological equilibrium will be set, but recovery may take very long for some species and there is the risk that certain species will disappear from the area.

Reducing the dynamics of the lake level is also disastrous on the long-term. Most wetland flora and aquatic fauna need the seasonal fluctuations in water level for their survival and reproduction. Other animals like most waterfowl depend on their turn on mentioned flora and fauna. Without the fluctuations, large wetland areas will disappear. With the reduction in wetland area also the cleaning capacity provided by the wetland macrophytes will reduce, resulting in a more polluted lake.

Arguments like the increase in agricultural area, 'clean' and cheap energy, and access to the lake by bigger boats, have to be balanced with the disastrous impacts on flora and fauna. A proper EIA including a multi-criteria analysis is needed to establish the impacts of a proposed plan.

3.5 Institutional and legislative issues

After the drastic political and economic changes in Albania and Montenegro in the 1990s, a new institutional infrastructure was created in both countries, similar to those in other democracies with open market economies. The structures are new, not yet fully settled and the inter-institutional relations and responsibilities are still developing.

There has been some collaboration between the two countries concerning Lake Shkoder, but this was and is mainly realised at scientific level (e.g. between the Universities of Shkodra and Montenegro, the two Academies of Science, biological institutes) and through the REC offices in the two countries. A frequent exchange between the two Ministries of Environment is still lacking. This is probably due to the situation described above, asking full attention at national level (e.g. the ministries in Albania have been re-structured after the recent elections in summer 2005), but probably also the historical and cultural background of the two countries plays a role.

Albania has some experience with the set-up of a bilateral management structure for Lake Ohrid, in collaboration with Macedonia, which can serve as a base for Lake Shkoder: see next Chapter.

The environmental legislation of Albania is in transition from the pre-1990s situation to full compatibility with the EU legislation. Also in Montenegro EU legislation is being integrated into the national laws and the promotion of Montenegro as an 'ecological state' is reflected in its efforts to enhance its legislation. So both Albania and Montenegro give ample attention to the legal aspects of the environment, but 'translation' into practise and enforcement is in both countries a major problem.

4 IMPROVEMENT OPTIONS

4.1 Introduction

To reach an acceptable and sustainable environmental situation in the Lake Shkoder basin is a long-term matter. The World Bank intends to prepare a strategic action plan for the lake and its basin and initiate small projects and activities that will have a direct impact or trigger developments that improve the environment. Also other donors, as the EU and USAID, are implementing projects with environmental components. The risk is that uncoordinated projects at this stage may upset a long-term integral approach. On the other hand, small-scale activities showing immediate results will motivate the local people.

To support the overall strategy for more sustainable use of the natural resources of Lake Shkoder and its watershed, a number of support mechanisms or policies should be formulated. The policies that are considered most relevant for the sustainable use of the natural resources of Lake Shkoder and its watershed are to be established and agreed between the key stakeholders involved in the development and implementation of the strategy. In this TDA relevant policies for achieving the sustainable use of the natural resources of Lake Shkoder and its watershed are suggested in Section 4.3. The Strategic Action Plan should define the institutional structures and include a roadmap and actions to give effect to these supporting policies.

Regarding the institutional structures a distinction is to be made between the structures at national level and the bilateral management structure. The latter structure can only be effective when at the national level the institutions are well equipped for the planning and management of the use of the natural resources in the lake and catchment areas.

A preliminary assessment of the institutional capabilities in both countries indicate that still much is to be done to achieve an effective institutional structure that could form the basis for an effective bilateral management structure. It is, therefore, recommended to focus on the strengthening of the relevant Albanian and Montenegrin institutions before a full fledged Lake Shkoder Water Management Committee is established. In the meantime, however, it is very important that lines of communication between the two countries with respect to the Lake Shkoder environmental issues are formalised. The first step would be the creation of a bi-lateral working group for Lake Shkoder as stipulated in the Memorandum of Understanding in the field of environment between Albania and Montenegro, signed on the 9th of May 2003 (see Annex XVIII). This working group should, at least, prepare a draft agreement on environmental protection and sustainable development, including the preferred institutional set-up of a Lake Shkoder Water Management Committee. In the following sections an outline is presented of the terms of reference of the bilateral working group, and options for the eventual bilateral management structures.

Strategic recommendations for the lake's conservation refer to the above-mentioned supporting policies for achieving the sustainable use of the natural resources of Lake Shkoder and its watershed. These support mechanisms (policies) to achieve the goals of the strategy have been elaborated in Section 4.3.2. Activities required for giving effect to these support mechanisms, and that could be incorporated into the Strategic Action Plan, are presented in Section 4.4.

4.2 Pathway to a bilateral water management organisation

4.2.1 In general

With the Memorandum of Understanding (MoU) between the Ministry of Environment in Albania and the Ministry of Environmental Protection and Physical Planning in Montenegro the basis exists for cooperation and establishment of a body for water management the Lake Shkoder basin (see annex XVIII). This MoU stipulates that working groups will be created and an action plan prepared for its implementation. Although signed in May 2003, no working group has been created yet, let alone an action plan prepared.

A primary goal of The Lake Shkoder Integrated Ecosystem Management Project (LSIEMP) is "to put in place a sound [...] institutional framework for joint management of the lake and its watershed [...]". The Lake Shkoder Strategic Action Plan (SAP) is intended to be the vehicle to achieve this goal. On the other hand, this SAP is assumed to be prepared jointly by the both countries. Such joint preparation requires a minimum bilateral management structure.

It is proposed that this initial bilateral management structure will consist of a Steering Committee (SC), supported by a joined secretariat. This joined secretariat could function as the bilateral working group (BWG) as mentioned in the MoU. The main task of the SC during the project preparation stage will be:

- the approval of the staffing, work plan and budget of the BWG;
- to supervise the BWG's progress;
- coordination of SAP preparation with other regional programmes and activities.

The SC should be composed under the jurisdiction of the respective governments and should include representatives of:

- Ministries of Environment (Albania & Montenegro);
- National Parks of Montenegro and Skadar Lake National Park (Montenegro);
- Main municipalities (at least Shkodra and Podgorica).

It is recommended that the GEF participates in the SC as an observer and that the directors of the national PPU's¹ will participate as advising members of the SC.

The BWG is in charge of the daily activities related to:

1. the preparation of a draft agreement between Albania and Montenegro for the sustainable use of the natural resources of the lake Shkoder and its watershed,
2. the design of a bilateral water management committee,
3. the coordination of the preparation of the Lake Shkoder SAP.

The actual implementation of the Lake Shkoder SAP would then be supervised and monitored by the bilateral water management committee, once the bilateral agreement and corresponding management structure has been ratified by the two countries. The BWG could eventually merge into the bilateral management committee serving as its secretariat.

¹ The implementation arrangements for the LSIEMP call for the national Project Preparation Units (PPU's) to be operational for the preparation of the SAP.

It is envisaged that the preparation of the Lake Shkoder SAP will take about a year. The same period will then be available for the drafting and ratification of the bilateral agreement.

For the design of the bilateral water management committee the BWG should make a comprehensive stakeholder analysis in the whole basin and establish an inventory of opinions and ideas of all parties. Main stakeholders to be addresses are:

- Hydro-Meteorological Institutes (Albania & Montenegro);
- Nature Protection Institute (Montenegro);
- Natural History Museum (Albania & Montenegro);
- Fisheries organisations (Albania & Montenegro);
- Center for Ecotoxicological Research (CETI, Montenegro);
- NGO's like REC (Albania & Montenegro);
- Universities (Shkodra, Podgorica, Tirana);
- Academies of Science (Albania & Montenegro);
- Institute of Geological Research (Albania & Montenegro);
- Maize and Rice Institute (Albania);

The design of the bilateral water management committee should include:

- Legal basis for the organisation and its activities;
- The objectives of the organisation;
- The responsibilities and 'decision power' of the organisation;
- Structure of the basin organisation, including committees, work/ project/ study/ advisory groups, secretariat etc. and their tasks and responsibilities;
- In case of one secretariat, its location and tasks;
- Permanent and non-permanent members, voting and non-voting members;
- Financing mechanisms for both the organisational costs and, possibly, investments related to water management in the basin;
- Connection and coherence of the organisation's activities with other national and international water and environmental policies and conventions.

Consultation with existing watershed management committees in other countries is advisable: committees in EU countries, having experience with the WFD (like the ICPR and CIPEL), would be a logical choice, considering the prospect of EU accession.

It is recommended that in the framework of the preparation of the Lake Shkoder SAP, the BWG will initiate:

1. the creation of a data base for the biodiversity and the economic activities in the Lake Shkoder basin;
2. the preparation of a monitoring programme of surface and groundwater.

These activities are essential for the integrated management, irrespective of the institutional structure.

4.2.2 Lake Ohrid Watershed Management Committee

In Albania there is some experience with the bilateral approach of a transboundary lake: Lake Ohrid. Macedonia and Albania went through the initial stages of setting up a cooperation framework, that resulted in an "Agreement [...] for the protection and sustainable development of Lake Ohrid and its watershed"; see Annex XIX for the full text. In this agreement the objectives and obligations are described in brief, but it also defines the

set-up of a Watershed Management Committee and the Committee's secretariat (Article 5 and 8): see Figure 4.1.

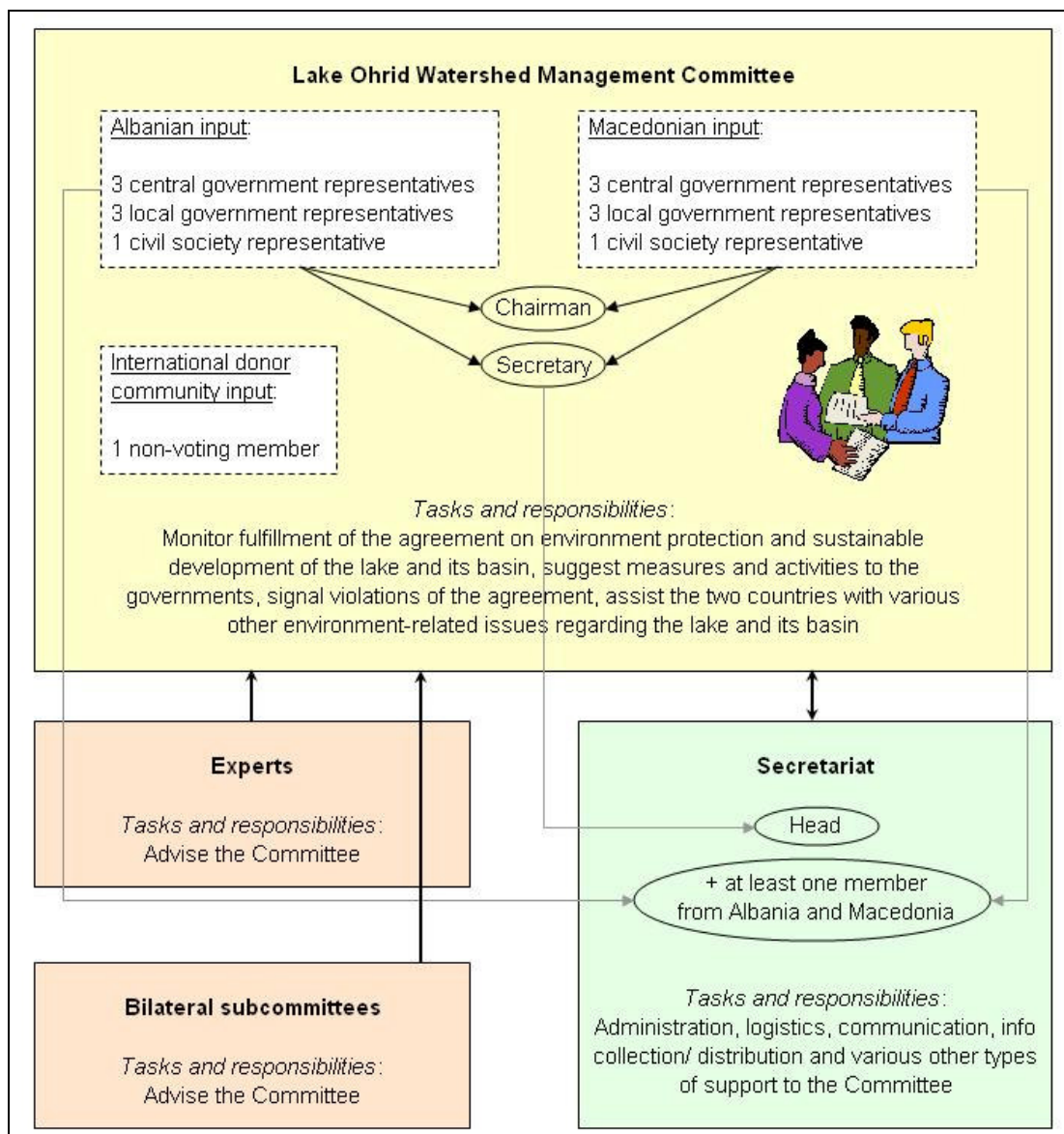


Figure 4.1 The structure of the Lake Ohrid Watershed Management Committee

The legal basis for cooperation on a transboundary lake, as has been created in Albania for Lake Ohrid, can be used for Lake Shkoder as well. Although the creation of the Watershed Management Committee and the Committee's secretariat for Lake Ohrid is very recent, the experiences by Albania should be used for Lake Shkoder.

4.2.3 The ICPR and CIPEL as long-term examples

There exist several internationally known approaches, rules and listings related to the management of lakes. Some of these may give ideas and opportunities for the management of Lake Shkoder and its basin. The ones that already apply to or are considered for the basin are discussed in Chapter 2. Some more options are given in Annex III. Below two examples of cross-boundary waters, River Rhine and Lake Geneva, supervised by a commission, the ICPR and CIPEL respectively.

With many cross-boundary waters worldwide, there is ample experience with management of such waters. For the River Rhine the basin countries started as early as 1950 with cooperation, and in the following decennia the dirty river was converted into a relatively clean river. The organisation created for the Rhine, the International Commission for the Protection of the Rhine (ICPR), functions effectively.

Lake Geneva (Léman), on the Swiss – French border, is an example of a transboundary lake with an experienced bilateral management organisation since 1962: the International Commission for the Protection of Lake Geneva ('la Commission Internationale pour la Protection des Eaux du Léman': CIPEL).

The set-up of the ICPR and CIPEL could serve as a long-term example for a 'Watershed Management Committee for Lake Shkoder'. Initially the structure for the Lake Shkoder basin will be simpler, like the one for Lake Ohrid, but with increasing economic development and pressures in the basin, more elaborate structures as ICPR and CIPEL may be required.

ICPDR:

The structure of the ICPR is given in Figure 4.2 **Error! Reference source not found..**

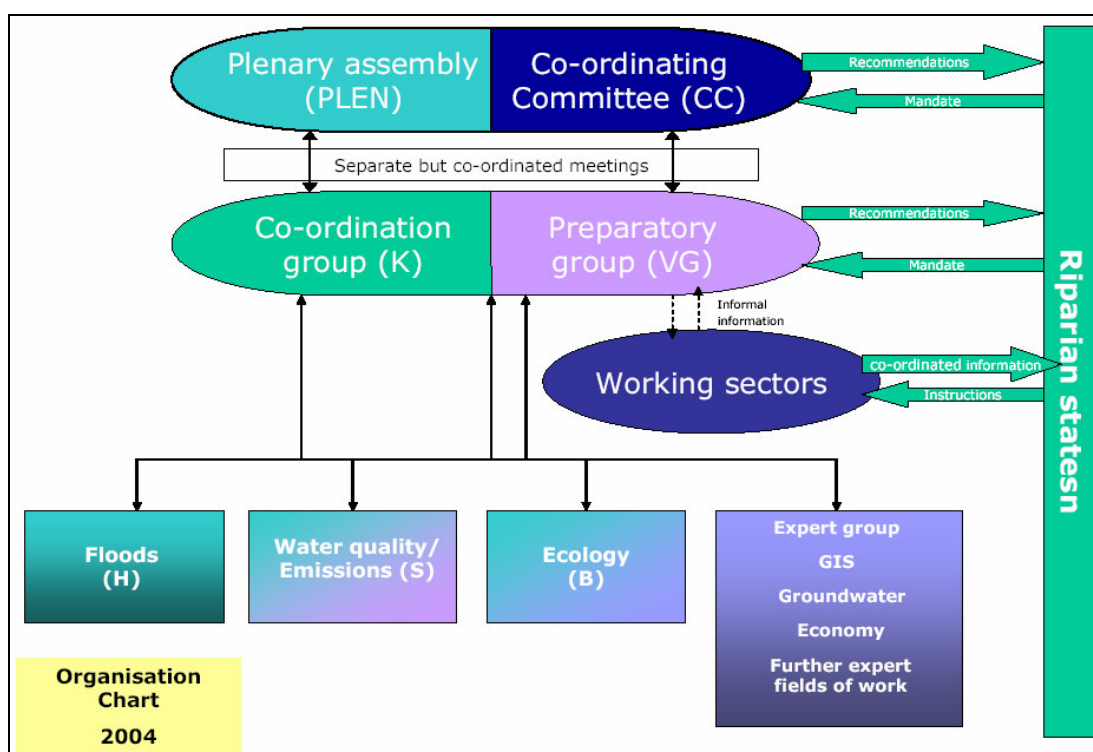


Figure 4.2 Management structure of the International Commission for the Protection of the Rhine (source: ICPR website)

The targets of the ICPR Commission are:

- Sustainable development of the entire Rhine ecosystem;
- Guarantee the use of Rhine water for drinking water production;
- Improvement of the sediment quality in order to enable the use or disposal of dredged material without causing environmental harm;
- Overall flood prevention and environmentally sound flood protection;
- Improvement of the North Sea quality in accordance with other measures aimed at the protection of this marine area.

The working method of the ICPR Commission is:

- The tasks for the Commission and the Member States are based on Ministers' decisions;
- Implementation of the decisions taken by the Commission is the responsibility of the Member States; decisions taken by the Commission are not legally binding;
- Preparation and elaboration of Commission's decisions in 3 permanent working groups and 2 project groups;
- Specific tasks are dealt with by expert groups;
- Composition of the groups: national senior officials and experts;
- A small secretariat supports the work of the Commission.

CIPEL:

The task of the CIPEL is to ensure the long-term ecological restoration of the lake, the Rhône and their tributaries. The principal objectives of the CIPEL are to guarantee:

- The use of lake water as drinking water after basic treatment;
- The predominance of noble fish species in the lake and rivers in order to restore the fish population to a near-natural state;
- The practice of water sports in favourable conditions by assuring excellent microbiological water quality.

The International Commission is composed of Swiss and French members of parliament and high-ranking civil servants. The French delegation includes a representative of the Ministry of the Environment, the prefect for the Rhône-Alpes region, the prefects for the Ain and Haute Savoie departments, the director of the "Rhône-Méditerranée-Corse" Water Agency and representatives of the Rhône-Alpes regional council and the Ain and Haute-Savoie county councils. The Swiss delegation is made up of a representative of the Swiss Agency for the Environment, Forests and Landscape, a representative of the Federal Department of Foreign Affairs and two members of the Council of State for each canton concerned (Vaud, Valais and Geneva).

A technical subcommittee of scientists and experts assesses the state of pollution and water treatment in the Lake Geneva catchment area. It comprises an Executive Committee which is responsible for the realisation of the plans of action and a Scientific Council which coordinates study and research programmes concerning Lake Geneva water and ensures scientific supervision.

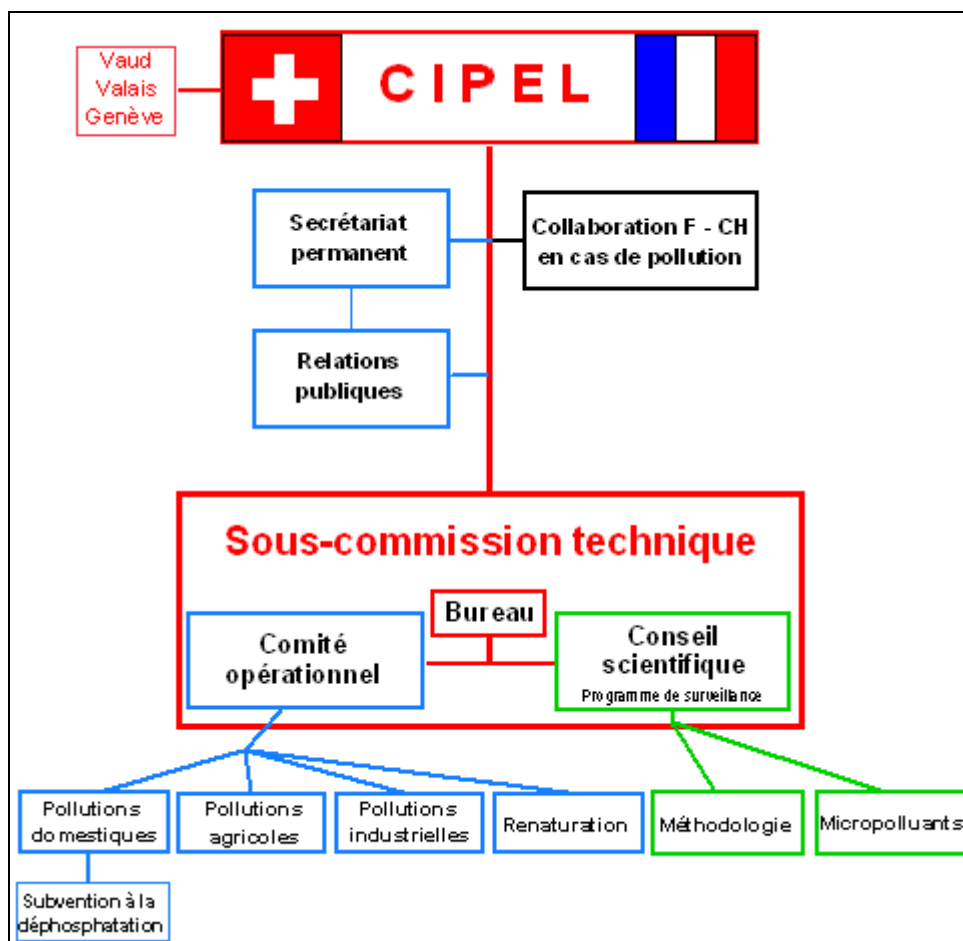


Figure 4.3 Management structure of the 'Commission Internationale pour la Protection des Eaux du Léman contre la pollution' (source: CIPEL website)

Specific teams deal with the different aspects of water protection: renaturation, domestic pollution, agricultural pollution, industrial pollution, methodology, public relations, and French-Swiss collaboration in case of pollution.

A permanent secretariat attends to the coordination of tasks and the administrative, financial, technical and scientific management.

4.3 Policies to support the Lake Shkoder Basin Management Strategy

4.3.1 River Basin Management Plans

The European Union member states are currently working on the creation of River Basin Management Plans (RBMP) for each river basin 'district', which is an obligation set by the Water Framework Directive. With the likely future accession of Albania and Montenegro to the EU, the WFD approach is an important guide. A RBMP is a detailed account of how the objectives set for the river basin (ecological status, quantitative status, chemical status and protected area objectives) are to be reached within the timescale required. The plan will include the analysis results of the river basin's characteristics, a review of the impact of human activity on the status of waters in the basin, an estimation of the effect of existing legislation and the remaining "gap" to meet these objectives; and a set of measures designed to fill the gap. One additional component is that an economic analysis of water use within the river basin must be

carried out. This is to enable a rational discussion on the cost-effectiveness of the various possible measures. It is essential that all interested parties are fully involved in this discussion, and indeed in the preparation of the river basin management plan as a whole. Further information on this subject can be found at the EU-website (http://europa.eu.int/comm/environment/water/water-framework/index_en.html)

The policies to support a RBMP for the Lake Shkoder basin are essentially the same policies that are needed to support the Lake Shkoder management strategy and that will form the skeleton of the Strategic Action Plan. The way this skeleton is built up is illustrated in Table 4.1. First the goals of the strategy are defined. Each of these can be subdivided in several components. By describing for each goal and its components the current situation (column II), pressures and threats (= future/ expected pressures, column III), it becomes clear whether action is required. The supporting policy (column IV) indicates the way the action should be channelled. These are elaborated in Section 4.3.2.

Table 4.1 First set-up of a Lake Shkoder Basin Management Strategy

I) Goals		II) Current status	III) Pressures and threats	IV) Approach for improvement
Main objectives	Components			
1 A healthy ecosystem (flora, fauna, habitats) of the lake and its surroundings	A) Valuable flora and fauna are in good state: both qualitative and quantitative	Birds: strong decline; Fish: mixed developments; Mammals: unknown; Flora: good (in general)	Hunting, overfishing, uncontrolled constructions; Various plans for works that will affect the ecosystems	Education and awareness raising Information and knowledge development Legal framework Livelihood support Nature development
	B) Valuable flora, fauna and habitats are protected	Legal protection exists, but enforcement inadequate Links between protected areas underexposed	Lack in enforcement, mainly due to insufficient finances Ecological exchange limited and coherent management could be improved	Institutional development and coordination Nature development
	C) Protected areas (habitats) provide the required conditions for flora and fauna	Habitats in general in good condition, but protection is limited	Inadequate management, mainly due to insufficient finances and institutional experience	Legal framework Institutional development and coordination
	D) Infrastructural works do not affect the ecosystem, in particular protected areas	Environmental considerations are limited in activities and plans	Uncoordinated, independent activities/ projects not with little or no environmental considerations	Institutional development and coordination Environmental impact evaluation Education and awareness raising (especially within governmental institutes)
	E) Extraction of non-renewable mineral resources (incl. <i>treset</i>) does not upset the ecology	Environmental considerations are limited in plans		
	F) Safe fish consumption	Bio-accumulation of pollutants (a.o. PCB's) do not threaten health	Uncontrolled disposal and accidental spills by industries; pollution by waste from cities	Pollution reduction (IPPC) Investment support
	H) Safe water for swimming and recreation	Within WHO and EU limits		



I) Goals		II) Current status	III) Pressures and threats	IV) Approach for improvement
Main objectives	Components			
2 Sustainable use of the renewable natural resources of the lake and its basin	A) Hunting (birds, mammals) and fishing do not affect faunal population sizes and composition on the long-term	Hunting: birds affected, others unknown; Fishing: mixed picture	Continuation of hunting and overfishing of certain species	Education and awareness raising
	B) Logging of trees and harvesting of flora do not affect floral population sizes and composition on the long-term	Illegal unsustainable logging in mountains; near Lake Shkoder stable	Continuation of illegal logging; risk of overexploitation of certain floral species	Information and knowledge development Legal framework Livelihood support
	C) Extraction of sand and gravel does not affect the ecosystem	No significant impacts	With growing building activities demand for sand and gravel will increase: risk of impacts downstream	Environmental impact evaluation
	D) Surface water export or retention and ground-water use do not affect the ecosystem	Not an issue yet, but execution of existing plans may upset the equilibrium	Several plans include changes in hydrology; when realised, ecology will be altered	Environmental impact evaluation
3 Access for all to the lake and its environs, without endangering its ecosystem	A) International and regional tourists can visit the natural attractions of the lake and its surroundings, without harming flora, fauna and habitats	Access and tourist facilities limited; no 'ecological' approach yet	Uncontrolled development of tourism without ecological considerations	Education and awareness raising Livelihood support
	B) The lake and its shores are accessible for recreation by the local population and the recreation facilities promote protection of the environment	Access and recreation facilities limited; no 'ecological' approach yet	Uncontrolled development of recreation without ecological considerations	Nature development
	C) Infrastructural works related to transport and access do not affect the ecosystem (see also 1 D)	Limited environmental considerations included; several road construction plans exist	Plans for major road constructions that will harm the ecosystem (habitat loss/ division, noise, pollution)	Environmental impact evaluation Education and awareness raising (within governmental institutes)
	D) Research is possible on/ in the lake and its surroundings	No restrictions	No pressures or threats	See 4 G

I) Goals		II) Current status	III) Pressures and threats	IV) Approach for improvement
Main objectives	Components			
4 Collaboration and exchange in the field of ecosystem and water management: at national, bilateral (Albania - Montenegro) and international level	A) Infrastructural and other projects, that will change the lake's ecosystem, are agreed upon	Limited coordination/ collaboration nationally and bilaterally (Alb.-M.N.)	Projects and activities that will have large impacts on the environment by lack of coordination and collaboration (national, international)	Institutional development and coordination Environmental impact evaluation
	B) Use of natural resources within the lake basin with transboundary impacts are agreed upon	Limited communication bilaterally (Alb.-M.N.), but talks are initiated		
	C) Issues affecting migratory birds and fish are dealt with internationally	Limited coordination/ collaboration between governments, but efforts by NGO's	Further decline in bird and fish numbers due to illegal hunting and overfishing	Institutional development and coordination
	D) International contacts are established and maintained for exchange regarding management of natural resources (in particular water, flora, fauna)	Initial steps taken by Alb. and M.N.; support by international projects/ donors	Inadequate management of the natural resources by lack of institutional knowledge and experience	Institutional development and coordination Investment support
	E) The natural values of the lake and its basin are protected, extended and promoted in international context	The whole lake is Ramsar site	International interest in the lake and basin could be increased	Institutional development and coordination Investment support
	F) Coordinated environmental support by international donors	Support by donors is present, but activities overlap	There are overlapping and competing activities, reducing the efficiency	Institutional development and coordination
	G) Coordinated research with shared use of facilities and equipment	Coordination and sharing is minimal	Inefficient use of resources (finance, manpower, facilities, equipment) affecting results	Information and knowledge development
	H) Information concerning the environment is public and accessible without restrictions or fees; data exchange is common practise	Key government institutes (a.o. HMI's) do not allow data access for free	Insufficient information is available to stakeholders for adequate management of the lake and basin	Information and knowledge development Institutional development and coordination

4.3.2 Approaches for improvement

Based on Table 4.1, column IV, 'approach for improvement', the following approaches or policies can be distinguished:

Institutional development and coordination	Assist the institutions involved in policy making, planning and managing development of the lake basin to develop their capacity and capability and systems for integrated and participatory management.
Nature development	Promote a coherent set of protected areas, well managed.
Pollution reduction	Promote Integrated Pollution Prevention and Control (IPPC).
Legal framework	Establish an appropriate legislative framework for integrated and participatory management, which promotes self-reliance, co-management and enforcement to the greatest feasible extent.
Education and awareness raising	Raise awareness of institutions and communities for sustainable use of natural resources.
Information and knowledge development	Support applied research and appropriate technology application. Improve information collection, storage, dissemination and accessibility.
Environmental impact evaluation	Improve environmental assessment, management and procedures.
Livelihood support	Assist in poverty alleviation in the lakeshore zone through supporting sustainable livelihoods development.
Investment support	Promote local and external investment in lakeshore areas for a sustainable economic and ecological development. Recognize the role and encourage involvement of private sector in all aspects of lake zone and basin management.

The relative importance of these support policies are tentatively illustrated in Figure 4.4. For each of the policies various small projects or investment opportunities can be identified to put the policy into action. The following sections give some ideas that are used as input for small investments and the Strategic Action Plan in the next phase of the World Bank project. The suggestions included originate a.o. from local communities and municipalities, fisheries organisations, Shkodra prefecture, REA Shkodra, the Ministries of Environment in Albania and Montenegro, universities, National Parks Montenegro, REC and the Institute for Nature Protection in Podgorica. After a preliminary selection, careful evaluation of the feasibility and costs is required.

4.3.3 Institutional development and coordination

Within each of the two countries, as well as between the two countries, collaboration between the various governmental and non-governmental institutes and organisations is limited. At NGO level there are forums for sharing and exchange, but a set-up with stronger backing by both governments is needed. Several options exist to improve coordination and promote collaboration, requiring small investments.

The CETI in Podgorica is well equipped and has ample knowledge in physical-chemical monitoring. In Albania, the University of Shkodra and the Maize & Rice Institute have skilled staff, but lack equipment, materials and maybe up-to-date knowledge. A carefully selected project could bring the parties together. A combination with the proposed activity in Section 4.3.8 is an option: development of master plan for environmental monitoring with a baseline assessment, including (partial) execution. The experiences with the Heidelberg programmes of 2001-2002 should be used.

In Albania in particular better facilities for environmental research in the proximity of the lake are badly needed. However, if assigned to an existing institute, access by others will be difficult. A small lab with basic equipment, materials and consumables in neutral premises would bring research within reach of many Albanian scientists (chemists, biologists). The set-up would be similar to the CETI in Montenegro (but smaller). The new

premises of the fisheries cooperation in Shiroka have been suggested as a suitable and neutral location.

Data access and exchange is a major issue. Institutes are unwilling to release their information to other institutes and organisations. An exchange mechanism should be developed to improve this situation, set up in a way that data release is beneficial to the data collector. One could also think of a forum or data centre that manages the environmental data of the basin.

A Lake Shkoder Basin Management Committee is needed for the environmental management of the area. If the set-up of the Lake Ohrid Watershed Management Committee would be chosen by both countries, then the legal basis in Albania is ready. Creation of the legal basis for a Basin Management Committee in Montenegro could be a project option.

Several organisations are involved in the management of the lake and its basin. Most of them are limited in their activities because of a lack in budget. This affects both the management in material and immaterial sense. Several support options are possible:

- Procurement of field equipment for the wardens/ guards of the national parks;
- Development and execution of a training programme for wardens/ guards;
- Invitation of experts in park management from parks similar to the ones in the Lake Shkoder basin, to give training and assist in the elaboration of management plans;
- Visits of Albanian and Montenegrin people, involved in the Lake Shkoder basin management, to experienced institutions managing similar type of areas;
- Review of the key laws relevant for the management of natural areas;
- Elaboration of the roles of existing nature and water management organisations in relation to the future Lake Shkoder Basin Management Committee.

4.3.4 Nature development

Recently the Albanian part of Lake Shkoder and the Buna-Bojana Delta received a protection status. The various protected areas within the basin are today treated as independent and autonomous units. Relations and potential links between these areas, corridor options etc. should be investigated, facilitating biological exchange and enabling a more coherent management. If useful, additional areas should be proposed for protection, or the current protection status could be changed to a more appropriate one.

4.3.5 Pollution reduction (IPPC)

Major industrial pollution in the basin is limited to the Steelworks in Niksic and the KAP in Podgorica. Both are changing ownership, which gives the opportunity to discuss with the (potential) new owners measures to reduce pollution of the environment. Cleaner production processes, better waste treatment, waste recycling options and better waste storage facilities are options to reduce the waste output. Support on governmental side by international experienced IPPC specialists during the talks/ negotiations with the polluters could be an investment option.

The landfills and wastewater treatment plants of the main cities in the basin will be upgraded through support by international donors. Waste collection, waste disposal sites and wastewater treatment of the villages and communities however are primitive or non-existing. Treatment of organic wastewater by helophyte filters, the creation of a small

waste disposal with lining, and introduction of recycling facilities/ methods, in combination with an awareness programme, can be considered for one or two villages upstream of a vulnerable ecological location. A study of affordable wastewater treatment options for restaurants and hotels on the shorelines is another option.

Most karstic springs around the lake provide locally good quality drinking water. To make an inventory of the springs of importance to local communities, their water quality and the options to protect the threatened ones, would be a useful investment.

4.3.6 Legal framework

Law enforcement in both Albania and Montenegro is weak, due to (among others) the limited financial means, a lack of training and the frail institutional setting. Uncontrolled building activities in protected areas, illegal hunting and logging are examples of the limited power of the law. The development of a training programme and execution of the programme for inspectors and other law enforcing staff is an option, in particular wardens/ guards/ rangers working for the National Parks, fishery inspectors and forestry inspectors. A case-study followed by legal action and publicity may work to deter people with illegal intentions.

4.3.7 Education and awareness raising

Part of the environmental problems is related to the ignorance of the general population, but also a lack of awareness with some government staff and project developers involved in environmental issues. Awareness raising and promotional activities could be financed with small grants. Various options are possible: training courses and workshops for government staff and project developers, school projects, road signs, banners, folders, advertisements, demonstration projects etc. The expected effectiveness of the various options has to be evaluated beforehand.

Waste can be found everywhere, in particular plastic bags, bottles and cans along roads, river banks and the lake shore. An awareness campaign could be executed in some communities and at schools, combined with cleaning activities.

4.3.8 Information and knowledge development

The information on the environmental situation of Lake Shkoder and its basin is scattered. Many studies are done in most of the environmental fields, but methods, timing, locations, parameters/ variables etc. are not consistently chosen. It would be useful to have a master plan for environmental monitoring with a baseline assessment as a reference for comparing future inventory results. The existing data and provisional monitoring plans already in place are a good point of departure. Funding options to guarantee continuing monitoring should be investigated.

If the above is considered too ambitious, thematic assessments on poorly investigated themes could be funded; e.g. the status of the mammals in the basin, the impact of hunting on the basin's fauna, or the status of the various fish species in the lake and rivers. All biologists agree that continuation of the annual bird counts is of high importance.

4.3.9 Environmental impact evaluations

There exist many plans for infrastructural works in the basin that are likely to have a big impact on the environment. These plans, before their implementation is considered, have to be subject to an independent and properly executed Environmental Impact As-

assessment. An EIA will elaborate the positive and negative impacts, balance the two, and look at options to mitigate or compensate the negative impacts. Acceptance by the main stakeholders after public consultation is a prerequisite for execution of a project.

If a project receives the environmental clearance, it can be executed. The conditions set in the EIA for the period during and after execution should be assured by the implementation of an environmental management plan (EMP).

Project developers and government staff involved in major infrastructural works have to be aware of the existence and contents of an EIA, the correct procedures to obtain environmental clearance, and execution of an EMP. A training programme should be developed to realise this.

4.3.10 Livelihood support

Many people and families living around the lake, but also elsewhere in the basin, exploit the natural resources, e.g. through fishing, hunting, logging. This is not always done in a sustainable way. Alternative resources of income, food, materials, etc. can relieve the pressure on nature, although it should be accompanied by awareness programmes and guidance to be effective, as 'old habits die hard'.

A wide range of projects have been suggested by stakeholders (communities, local specialists): creation of tourist facilities to exploit the cultural heritage and natural beauty of the basin (see also Section 4.3.11), reintroduction of agricultural plant species (e.g. vineyard, olives), development of apiculture, production of medicinal plants, harvest improvement by applying biological methods, reintroduction of silk production, reintroduction of fish ponds, improved marketing of agricultural products, etc.

There are options for setting up small businesses with support by local banks; these have shown their interest. The World Bank could assist some enterprising and active local communities and NGO's with feasibility studies and developing business plans for their ideas.

4.3.11 Investments support

Some habitats in the basin have been degraded by overexploitation or by natural causes, like erosion (Sterbeq, Dobre, Palvar in Albania). Restoration of these habitats gives opportunities for species to resettle, may give opportunities for recreation/ tourism and even sustainable exploitation. Many locations have been suggested by stakeholders for in particular reforestation: small lake islands, on sections of the lake shore, along roads and near villages. Protection of karstic springs has been mentioned already in Section 4.3.5.

Recreation and tourism are considered by the stakeholders the sectors with the most development perspective. The lake basin offers both nature and culture, and the Adriatic coast is nearby. Both local recreation, as regional and international tourism can be targeted. Croatia and Turkey have been able to attract in a relatively short time large numbers of tourists. For the Lake Shkoder basin the ecological tourism approach, as has been applied by e.g. New Zealand, could be successful.

Three components are essential for (eco)tourism development: attractive places to visit, a good infrastructure (access, stay) and promotion. All three components give opportuni-

ties for support by the World Bank. The following have been suggested by the stakeholders: sign posts (indicating attractions), information boards, information centres (e.g. as is being created in the premises of Lake Shkoder National Park, next to the lake), folders/ leaflets/ maps, boat landings/ jetties/ ramps, tramping tracks, camp sites (tourists, schools camps), observation towers for bird/ animal watching, removal of waste on the lake shores/ river banks and floating waste (boat), waste disposal sites and garbage bins at recreation areas, etc.

4.4 Strategic actions

4.4.1 Recommendations by stakeholders

A list of strategy support actions that eventually could be incorporated into the Strategic Action Plan has been derived from recommendations obtained from consulted stakeholders (see Annex I and II, and Section 4.3.2) that have been asked to recommend activities for improving the environmental situation in the Shkoder basin. In preparing this list also the following recommendations, previously made by REC and the BALWOIS Conference, have been taken into account.

The REC offices in both Albania and Montenegro are strongly involved in programmes and projects to improve the environmental and socio-economic situation of the lake and its basin. They promote cross-boundary cooperation and know well all the stakeholders. According to them, the most important areas of cooperation among relevant institutions on Montenegrin and Albanian side of the lake include:

- Identification of processes and activities which have, or are likely to have, a significant adverse impact on nature conservation and sound use of biological diversity;
- Setting up of a comprehensive monitoring and information system that will capture all the necessary data on trends and processes affecting the lake's ecosystem;
- Discussion of legislative, administrative and policy measures necessary to improve the protection status of species, habitats, and eco-system of Skadar Lake NP, and to ensure compliance with international standards;
- Implementation of measures to address root causes of biodiversity and ecosystem degradation;
- Enhancement of the lake's protection status on the Albanian side, and preparation of protected area management plans; the plans (including a joint management plan) should be based on best available practices and be prepared through the involvement of all the lake's stakeholders;
- Further development and enhancement of information and knowledge exchanges;
- Institutional strengthening and capacity building for all the institutions involved in the lake's management through training, information exchange and by facilitating access to international knowledge and appropriate techniques; and
- Raising awareness and promotion of the lake's values.

In May 2004 the BALWOIS Conference took place in Ohrid: "Conference on Water Observation and Information System for Balkan Countries". In April 2005 the Final Report of this conference was published, which contains recommendations by the stakeholders on various topics. Four of these are of direct relevance for Lake Shkoder: Hydrological regimes and water balance (topic 2), Integrated Water Resources Management (topic 4), Water resources protection and ecohydrology (topic 5), and Lakes (topic 6). The details are given below.

The two general messages that can be derived from the recommendations are:

- 1) sharing and dissemination of information, and
- 2) transboundary collaboration.

Topic 2: Hydrological regimes and water balance

It was underlined that more efforts must be done for the Balkan area:

- To regionalize the hydrological regimes of rivers according the climate variability and the geomorphologic characteristics of the basins concerned;
- To process the water balance of the main catchments which implies the implementation of regional databases shared between the national research teams;
- Uniform methodology must be introduced for water balance components including all meteorological and hydrological aspects (surface and ground water components);
- Reference instead of “representative” period must be accepted for the regionalization;
- The most important are water balances for the transboundary catchments and groundwater bodies.

Topic 4: Integrated Water Resources Management

The recommendations on the topic of IWRM are as follows:

- To improve the building of hydrological and water related databases on transboundary basins to be shared between the actors of integrated water management;
- To transform water related data in information, knowledge and decision support tools;
- To dissemination this water related information towards large public, NGO's and Decision makers through the Web in order to reduce the gap between science and policy makers;
- To set up experimental projects comparing different approaches in compromising between the controversial demands of the users on transboundary basins in South-East Europe like Danube, Maritza, Drin, Vardar, etc.

Topic 5: Water resources protection and ecohydrology

The following conclusions were formulated:

- The participants agree that the Ecohydrology concept provides a new useful hypothesis and supporting empirical evidences for development of integrated approach for sustainable basin management and implementation of the Water Framework Directive. As a core of the concept was the consideration that the biological components can be regulated by hydrology toward improvement of quality of water resources. On the other hand the biological components of freshwater ecosystem are not only indicators but can be also used as regulatory tools in basin scale management. This provides background for development of new low cost high technologies in IWM.
- There was constituted ad hoc initiative group which postulated follow up actions.
- The first step should be a workshop on potential applications of Ecohydrology in the Balkan countries region. During the Workshop the plans for strategic action should be elaborated, also draft proposal for EU Projects should be prepared. The Chairmen declare to prepare proposal for UNESCO UVO ROSTE Office to support the workshop.
- The mutual cooperation with FRIEND AMHY programme should be continued and developed on four stages;
- Hydrologists in FA group: Analysis of flow regime differences between natural and influenced flow regimes in the AMHY climatic area. Definition of a set of dedicated hy-

drological indices of perturbation based on frequent or infrequent flows, predictability and duration under or above seasonal thresholds.

- Ecologists: Generation of hypothesis on the probable influence of such flow modifications on the live cycles completion and water related fluxes, like nutrients.
- Hypothesis validation and well already studied and instrumented sites.
- Implementation of EH principle and evaluation.

Topic 6: Lakes

Recommendations:

- To create a network of experts working on Balkan lakes;
- To create joint data bases for the Balkan lakes;
- To invite stake holders to participate to events like BALWOIS 2004 and to attract more donors in the region;
- To use BALWOIS to promote the significance of the Balkan lakes and their integrate protection;
- To establish closer links among the relevant scientific institutions in the region and with other scientific institutions from the world;
- To find, through BALWOIS, mechanisms for generating young scientific workers and attracting other researchers in the Balkan region;
- To launch project on water balance of the complex Ohrid/ Prespa hydro system from the existing data;
- To launch a joint project on integrated and sustainable management of Drin River involvement of research teams of Macedonia, Albania, Serbia and Montenegro including Kosovo.

4.4.2 Recommended strategic actions

In order to come to a priority list of support actions and investments, a ranking has been carried out of the strategy support actions presented in the previous sections. Only investments up to \$100,000 (as indicated in the ToR) are considered (one exception). For this ranking the following set of criteria has been used:

- **Constraints:** Constraints may exist that reduce the success of an action or investment. Insurmountable constraints lead to elimination of an action from the list, minor potential or actual constraints are mentioned. Less serious constraints means higher ranking.
- **Efficiency:** Actions/ investments that reduce the impact of a serious pressure or threat score better, i.e. have a higher priority, than actions with less impact reduction. Table 3.1 indicates the seriousness of a threat or pressure. Impacts may be direct or indirect. Indirect impacts are not necessarily rated lower.
- **Links:** Some investments are part of a chain or process, and need to be done before next steps can be taken towards the integrated management of the lake/ basin. Essential or important investments in a chain are rated higher than investments of less importance. Often these refer to legal or institutional aspects.

The ranking is indicative only, as no exact weights can be assigned to each of the criteria. Some proposed investments are a requisite for other investments, ranked lower. The list is clearly not a complete inventory of all possible actions or investments; some 17 ideas are presented here.

The costs are given in four classes: 1) less than \$10,000; 2) \$10,000 – \$30,000; 3) \$30,000 - \$60,000; and 4) \$60,000 - \$100,000. Exact costs can not be given at this stage; further details on the specific situation and envisaged implementation are needed. Also the involvement of external (non-government) local or international consultants will influence the costs.

- 1) Policy: Pollution reduction.
 Action: MEPPP in Montenegro starts talks with KAP and Steelworks Niksic on IPPC measures (details: <http://europa.eu.int/comm/environment/ippc/>). A covenant between the MEPPP and each of the two factories is the first step towards a detailed IPPC implementation plan.
 Costs: Time input MEPPP staff, local transport, office materials; less than \$10,000 (up to the covenants).
 Constraints: Steelworks Niksic is for sale; future owner unknown yet. For KAP: no constraints.
 Efficiency: As soon as measures are implemented, improvements can be expected in water and air quality, groundwater and sediment quality (depending on measures taken).
 Links: No direct links with other management processes/ lineages.

- 2) Policy: Institutional development and coordination.
 Action: Analysis of the institutional and knowledge/ experience weaknesses within the Ministries of Environment in Albania and Montenegro, and the weaknesses in institutional settings in each of the two countries. Set-up and implementation of an improvement and training programme for the involved staff of the Ministries of Environment.
 Costs: \$10,000 - \$30,000 for each ministry, plus time input ministerial staff.
 Constraints: Potentially resistance within the Ministries of Environment.
 Efficiency: No direct impacts on the environmental situation of the lake and basin; only long-term and indirect.
 Links: Essential step for obtaining a sound ecosystem management basis.

- 3) Policy: Institutional development and coordination.
 Action: Set-up of bilateral working group to implement the MoU between Albania and Montenegro, and creation of a draft agreement on the implementation and the institutional set-up.
 Costs: Time input of staff, travel and office costs, external consultants; \$60,000-\$100,000.
 Constraints: Potentially resistance by both Albanian and Montenegrin Governments.
 Efficiency: Long-term and indirect.
 Links: Essential initial step in the process towards integrated ecosystem management.

- 4) Policy: Pollution reduction.
 Action: Support to landfill developments/ initiatives for the main cities: Podgorica, Niksic, Cetinje and Danilovgrad in Montenegro and Shkodra in Albania. If the process is delayed, identify bottlenecks and take appropriate action to remove hold-up. If no measures have been taken yet, initiate the process for an upgrade.
 Costs: Time input by the Ministries of Environment staff; less than \$10,000. Bottleneck removal may require investments or input by external consultants, in which case the costs are likely to be higher.
 Constraints: Limited influence by the Ministries of Environment, political network.
 Efficiency: As soon as an upgrade is realised, pollution by the landfill (of mainly groundwater and surface water) will stop or strongly reduce.
 Links: No direct links with other management processes/ lineages, but increases understanding by the involved staff of institutional processes.

- 5) Policy: Pollution reduction.
 Action: Support to wastewater treatment developments/ initiatives for the main cities: Podgorica, Niksic, Cetinje and Danilovgrad in Montenegro and Shkodra in Albania. If the process is delayed, identify bottlenecks and take appropriate action to remove hold-up. If no measures have been taken yet, initiate the process for an upgrade.
 Costs: See previous action.
 Constraints: See previous action.
 Efficiency: As soon as the upgrade is realised, pollution by wastewater (of mainly surface water) will strongly reduce.
 Links: See previous action.

- 6) Policy: Legal framework.
 Action: Create the legal basis for a transboundary Lake Shkoder Water Management Committee in Albania and Montenegro. If the Lake Ohrid Management Committee in Albania will be used as the example structure, only in Montenegro the legislation needs to be created. In Albania minor changes may be required.
 Costs: Time input MEPPP staff plus staff from legal department only; less than \$10,000. If external support is required, more budget may be needed.
 Constraints: Potentially non-collaboration by the departments needed for input.
 Efficiency: No direct environmental improvements.
 Links: Essential step towards a management organisation for the lake and its basin.

- 7) Policy: Institutional development and coordination.
 Action: Set-up an organisation that will manage the protected area on the Albanian side of Lake Shkoder, with support by the National Park Lake Shkoder (Montenegro)
 Costs: \$30,000-\$50,000 for a mixed international/ local consultant team guiding the set-up.
 Constraints: Potentially resistance to create the organisation.
 Efficiency: Medium-term; will be the base for protection and conservation of the protected area on the Albanian side.
 Links: Essential step towards bilateral management of the protected lake area.

- 8) Policy: Nature development.
 Action: Support the National Park Lake Shkoder (Montenegro) and the organisation that will manage the Albanian protected area of Lake Shkoder with field equipment and materials to facilitate law enforcement within the two protected areas.
 Costs: Each country \$10,000-\$30,000 for materials and equipment, as prioritised by the park management on both sides.
 Constraints: None.
 Efficiency: Will have immediate results for the environment, as it will allow better protection of the natural resources.
 Links: No direct links with other management processes/ lineages.

- 9) Policy: Nature development.
 Action: Set up and execute a training and bilateral collaboration programme for the Albanian and Montenegrin park wardens to improve law enforcement, coordination and communication.
 Costs: One combined programme for both Albania and Montenegro for two weeks: \$10,000-\$30,000 (combined international/ local consultant).
 Constraints: Potentially non-willingness to collaborate between the wardens of the two countries.
 Efficiency: Will have immediate results for the environment, as it will allow better execution of the wardens' tasks.
 Links: Improvement of bilateral collaboration at the lowest organisational level. No other direct links with other management processes/ lineages.

- 10) Policy: Pollution reduction; education and awareness.
 Action: Pilot project for the management of the solid waste of a motivated community in an environmentally friendly way (collection, processing, disposal).
 Costs: \$30,000-\$60,000.
 Constraints: Potentially non-willingness of a local community.
 Efficiency: Will have immediate positive impact on pollution at local scale.
 Links: After successful implementation may motivate other communities and may be elaborated into a general pollution reduction policy.

- 11) Policy: Information and knowledge development.
 Action: Set-up and execution of a baseline inventory of flora, fauna and habitats within the lake and its basin, covering the taxons/ groups and habitats considered important, but where information, essential for understanding the ecosystem, lacks. The inventory should provide the information for the definition of a monitoring programme. The inventory should be executed by a mixed Albanian-Montenegrin team.
 Costs: \$60,000-\$100,000.
 Constraints: Potentially disagreement between the involved institutes/ scientists on the set-up of the inventory and the division of tasks.
 Efficiency: No direct reduction in pressures.
 Links: Policies and management are only efficient when data are available. The inventory will be the point of departure for the monitoring programme.

- 12) Policy: Information and knowledge development.
 Action: Data sharing agreement between the main data collectors in Albania and Montenegro and the set-up of a data information system that will eventually be managed by the Lake Shkoder Water Management Committee (but up to that time by the Ministries of Environment).
 Costs: Time input of staff involved, travel and office costs, hardware and software for the information system, external assistance in the set-up of the system; \$30,000-\$60,000.
 Constraints: Potentially unwillingness of the parties to share their data.
 Efficiency: No direct environmental impacts, but considerable gain for most stakeholders through data access.
 Links: Data will facilitate policy and management development.
- 13) Policy: Information and knowledge development.
 Action: Definition of a monitoring programme for indicator species (flora and fauna), fish catch (quantity per species, pollutants contents), water quality (main rivers discharging into the lake, the lake itself, the main karstic springs, groundwater in the Zeta Plain), sediment quality of the lake and of River Moraca, and air quality in the main cities within the basin (Podgorica, Niksic, Cetinje, Danilovgrad and Shkodra). The monitoring definition will be based on the synchronisation of current measurement programmes, the baseline inventory (see above) and specific (completed) studies. Options for funding its execution need to be investigated.
 Costs: \$10,000-\$30,000; involvement of specialists required.
 Constraints: None (draft proposals exist already).
 Efficiency: Monitoring will show trends or trend discontinuities that can be followed on short-terms by mitigating action, if required.
 Links: Basis for environmental policy and management.
- 14) Policy: Livelihood support.
 Action: Inventory of legal and illegal hunting and fishing activities/ practices and their scale (catch composition and sizes) in the basin. Socio-economic background of hunters and fishermen and options for alternative sources of incomes or food.
 Costs: \$10,000 - \$30,000 (local consultants).
 Constraints: Accurate information will be difficult to obtain.
 Efficiency: Indirect improvement of environment, through policy development and investments based on inventory outcome.
 Links: Policy and management of the basin.
- 15) Policy: Livelihood support.
 Action: Pilot project for the creation of a fish pond in a fishing community. Selection of a suitable (experienced) community, pond location, fish species and methodology. Creation of the pond, procurement of materials, set-up of logistics and organisation, training.
 Costs: \$60,000-\$100,000.
 Constraints: Requires intensive guidance.
 Efficiency: Will reduce the pressure on the fish population in the lake when implemented in various communities.
 Links: Eventually may affect positively the fishing regulations/ policies.

- 16) Policy: Nature development; Education and awareness; Information and knowledge development.
- Action: Observation towers for bird watching at strategic points for the annual winter counts or near special habitats. May serve for tourism or recreational purposes.
- Costs: Less than \$10,000 each tower.
- Constraints: Careful selection of the sites is required in order not to disturb the wildlife.
- Efficiency: Facilitating the waterfowl and bird monitoring.
- Links: Policy and management related to birds.
- 17) Policy: Information and knowledge development.
- Action: Creation of an independent environmental laboratory for the Albanian side of Lake Shkoder, similar to the CETI in Montenegro.
- Costs: \$300,000-\$500,000, assuming premises are available (e.g. fishery organisation).
- Constraints: Independent management allowing all parties to do their analyses; set-up and operational costs.
- Efficiency: Indirect, by supporting the monitoring and research programme.
- Links: Support of the Albanian monitoring and research programme, which will improve policy and management.

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5.3 Other references

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MedWet [wetlands database Albania]

Personal communications with various specialists

See DVD attached to this report for digital files and data sources

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