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LAKE SKADAR/SHKODER MONITORING PROGRAMME DEVELOPMENT

Consultant:
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1 INTRODUCTION

Lake Skadar/Shkoder is the largest lake on the Balkan Peninsula in terms of water surface. The drainage area of the lake is about 5,500 km^2 (4,470 km^2 in Montenegro and 1,030 km^2 in Albania). The lake's area varies between 353 km^2 in dry periods and 500 km^2 in wet periods (at maximum level, 335 km^2 in Montenegro and 165 km^2 in Albania). The lake's volume ranges from 1.7 km^3 in dry periods to 4.0 km^3 during wet periods. The distance between the mouth of the Crnojevića River (at the northwestern edge of the lake) and the lake's outlet (Buna-Bojana River) is 44 km (maximum length); its greatest width is 13 km. The lake is a cryptodepression, filled by the Morača River and drained into the Adriatic by the 41 km long Bojana River. The lake's water changes completely 2 to 2.5 times per year.

The Montenegrin part of the lake and its surrounding area were declared a national park in 1983. It is one of the largest bird reserves in Europe, having 270 bird species, among which are some of the last pelicans ileft n Europe. The lake also contains the habitats of seagulls and herons and is abundant in fish, especially in carp, bleak and eel. Lake Skadar/Shkoder is characterised by a highly noticeable and developed macrophyte region. In 1995, through the Ramsar Convention on Wetlands, it was included in the Ramsar list of wetlands of international importance.

The Albanian government has proclaimed the Albanian part of Lake Shkodra a "Managed Natural Reserve" through the Council of Ministers' decision, No. 684 dated 2nd November 2005. The Albanian part of Lake Skadar/Shkoder and the Bojana/Buna River wetland complex was also approved as a Ramsar site in 2005 (included in the list of internationally important wetlands, especially as waterfowl habitat). The enforcement of the laws and regulations and the implementation of these government decisions are still weak. Inter-ministerial and inter-sectoral cooperation is required for the suitable management of Lake Skadar/Shkoder on the spot.

The aim of the present assignment is to draft and implement of consistent and functional monitoring programme for Lake Skadar/Shkoder, because recent monitoring activities, including both water and biodiversity monitoring, have mostly been un-coordinated and sporadic. They have not been harmonised and did not include all the relevant parameters and sampling locations. At the national level, monitoring of Lake Skadar/Shkoder in Montenegro is conducted by the Hydrometeorological Institute, but research on the lake is also carried out by the The Skadar Lake National Park Administration, the National Institute for the Protection of Nature and the Centre for Ecotoxicological Research (CETI). Research has also been made by the Faculty of Natural Sciences and Mathematics, the Biotechnical Institute, the Department of Biology and the Institute of Technical Investigations of the University of Montenegro. Monitoring of Lake Skadar/Shkoder in the Republic of Albania is conducted by the Research Institute of Energy, Water and Environment. Researche has been also made by the University of Shkodra, the Faculty of Natural Sciences Department Biochemistry, and the University of Tirana, the Faculty of Natural Sciences Department of

Biology. Mechanisms for data collection, exchange and publishing are not established between the two countries.

The objectives of the assignment are:

(i) to assess the current condition of the Lake Skadar/Shkoder and its immediate surrounding area, taking into account on-going monitoring activities in both Montenegro and the Republic of Albania;
(ii) to present a joint monitoring programme for Lake Skadar/Shkoder and its near surrounding area;
(iii) to propose platform for exchanging of data between the two countries to inform local residents about the quality of the lake ecosystem.

We would like to give thanks to people from different institutions, who helped us with valuable informations at preparation of this joint monitoring program:

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2 CURRENT STATE OF THE LAKE SKADAR/SHKODER ECOSYSTEM AND ITS SURROUNDING AREA

2.1 ONGOING MONITORING ACTIVITIES IN LAKE SKADAR/SHKODER AND ITS SURROUNDING AREA

Taking into account the development of inter-state relations between Montenegro and Albania, there is no permanent joint monitoring of Lake Skadar/Shkoder in any segment: water quality, sediments quality, biodiversity, etc. There is some cooperation between institutions from both sites in some sporadic projects (For more details please see Chapter 2.3. Data availability and data exchange between the countries).

2.1.1 MONTENEGRO

2.1.1.1 Monitoring of water quality

From 1990 onwards, efforts in regular monitoring of the water quality of the Lake Skadar/Shkoder have been initated. Before that some monitoring activities were done at the sampling locations of Vranjina, Virpazar and Plavnica. To make a start on 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, fish and vegetation in the lake were analysed. During Phase I (1992-1993) and Phase II (1993-1996) of the environmental study in the Zeta Plain, groundwater, river water, soil, lake sediments and air quality were examined, especially in the areas affected by the KAP. Table gives the history of the sampling and measurements on the Lake by different institutions.

Table 1: History of sampling and measurements of water, sediment and biota in the Lake Skadar/Shkoder in Montenegro.

	Period	Institution	Sampling locations	Measured parameters
WATER	1974-1979		Vranjina, Virpazar, Plavnica	Nitrite, nitrate, phosphate
	1980	HMI	Vranjina, Virpazar, D. Plavnica	O_2 dissolved, % sat. O_2, BOD_5, COD, susp. solids, dry residue, pH, visible waste, colour and smell, evap.phenol matter, NBKK
	1984	HMI	Vranjina, Virpazar, Plavnica	Nitrite, nitrate, phosphate
	1986	HMI	Vranjina, Virpazar, D. Plavnica	O_2 dissolved, % sat. O_2, BOD_5, COD, susp. solids, pH, visible waste, phenol, Fe
	1994	HMI	Vranjina, Virpazar, D. Plavnica	Nitrite, nitrate, phosphate
	1990-1995	CETI	First right arm of Morača, First left arm of Morača,	Depth, temperature of air, temeperature of water, real colour, pH, turbidity, CO_2, dissolved CO_2, BOD_5, $KMnO_4$, oxygen sol., COD from $K_2Cr_2O_7$, susp. Solids, conductivity,

	Period	Institution	Sampling locations	Measured parameters
			Crni Žar, Bay of Hum, Raduš, Plavnica, Murići	alkalinity (P, M), bicarbonate HCO_3, total hardness, Ca, Mg, Na, K, phosphates PO_4, ammonia, NO_2, NO_3, F, Cl, CN, SO_4, detergents – TBS, detergents triton X, phenols, mineral oils, oil and grease, As, Cu, B, Zn, Pb, Cr, Cr^{6+}, Fe, Mn, Cd, Hg, Mo, Ba, Ni, Se, pesticides, PAH-s, PCBs & congeners, TOC, H_2S
	1995-2000	HMI	Various locations	Temperature, pH, conductivity, alkalinity, total hardness, dissolved oxygen, dry residue, $KMnO_4$, Ca, Mg, Cl, sulphate, ammonium, nitrite, nitrate, phosphate
	1998-2002	CETI	Kamenik, Vranjina, Virpazar, Middle of the Lake, Podhum, Ckla, Plavnica	Depth, temperature of air, temeperature of water, real colour, pH, turbidity, CO_2, dissolved CO_2, BOD_5, $KMnO_4$, oxygen sol., COD from $K_2Cr_2O_7$, susp. Solids, conductivity, alkalinity (P, M), bicarbonate HCO_3, total hardness, Ca, Mg, Na, K, phosphates PO_4, ammonia, NO_2, NO_3, F, Cl, CN, SO_4, detergents – TBS, detergents triton X, phenols, mineral oils, oil and grease, As, Cu, B, Zn, Pb, Cr, Cr^{6+}, Fe, Mn, Cd, Hg, Mo, Ba, Ni, Se, pesticides, PAH-s, PCBs & congeners, TOC, H_2S
	2005	CETI	Morača river right arm, Karuc, Bisevina, Kamenik-Raduš Vučki, Bijana- Kravarski potok, Bojana - Lisna Bori	Depth, temperature of air, temeperature of water, real colour, pH, turbidity, CO_2, dissolved CO_2, BOD_5, $KMnO_4$, oxygen sol., COD from $K_2Cr_2O_7$, susp. solids, conductivity, alkalinity (P, M), bicarbonate HCO_3, total hardness, Ca, Mg, Na, K, phosphates PO_4, ammonia, NO_2, NO_3, F, Cl, CN, SO_4, detergents – TBS, detergents triton X, phenols, mineral oils, oil and grease, As, Cu, B, Zn, Pb, Cr, Cr^{6+}, Fe, Mn, Cd, Hg, Mo, Ba, Ni, Se, pesticides, PAH-s, PCBs & congeners, TOC, H_2S
	2002-2010	HMI	Kamenik, Vranjina, Virpazar, Middle of the Lake, Starčevo, Moračnik, Podhum, Ckla, Plavnica	Water T, pH, conductivity, transparency, dry residue, suspended substances, oxygen consumption, chemical oxygen demand (COD), biological oxygen demand (BOD), hydrogen carbonate (HCO_3^-), water hardness, concentration of O_2, % of O_2 saturation, calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), nitrite (NO_2^-), ammonium (NH_4^+), chloride (Cl^-), sulphate (SO_4^{2-}), phosphate (PO_4^{3-}), nitrate (NO_3^-), phenols, detergents, total coli bacteria, total faecal bacteria and total aerobic bacteria
SEDIMENT	1990-1996	CETI	Vranjina, Morača-left arm, Plavnica,	PCBs, PAHs
	1993-1996	CETI	First right arm of Morača, First left arm of Morača, Crni Žar, Bay of Hum, Raduš, Plavnica, Murići	Cu, Cd, Cr, Pb, Mn, Fe, Zn, Ni, Al, F, pH, mineral oils,
	2005	?	Skadar (2 SHa, " SH), Nat. Park (5 M, 5 Ma), river Bisevina, Karuc, Kamenik – Modro oko, river Morača	PAHs, Pb, Cd, Zn, Cu, Hg, As, PCB, Cr, Al, Co, Ni, B, Mo, F, mineral oils, org. chlor. Pesticides, cogeners of PCB

	Period	Institution	Sampling locations	Measured parameters	
BIOTA	1993-1996	CETI	Morača river, Cmi Žar, Bay of Hum, Raduš, Plavnica, Murići	Cu, Cd, Cr, Pb, Mn, Ni, Fe, Zn, Al, , F, Fe, oil and grease, mineral oils, SiO_2, PAH, PCB	macrophytes
	1990-1996	CETI	Vranjina, Morača L, D, Palvnicqua, Raduš, Bridge, Grmozur	PCB	macrophytes, human milk, cow milk, eggs, fish, cow meat
	2005	Shkodra University	Bisevina, karuc, Morača river – right arm	Pb, Cr, Al, Hg, Zn, PAH, PCB, histamins	macrophytes

Monitoring of the Montenegro waters is now a part of national environment monitoring in Montenegro and is based on the Regulation on classification and categorisation of surface and underground waters (Official Gazette of the RM, No. 02/07) (Annex 2 to this Report). This regulation is not in complete accordance with Water Framework Directive, which makes the comparison of results with other countries impossible; the Water Framework Directive gives normative definitions of high, good or moderate ecological status of water bodies, while the Regulation on classification and categorisation of surface and underground waters divides waters into water that can be used for:

- beverage and food industry;
- fishing and shellfish farming;
- swimming (except for pool water and water used for therapeutic purposes).

Another important difference is the selection of parameters, which have to be monitored in the water. The list of parameters in the Regulation on classification and categorisation of surface and underground waters is different from the list of parameters defined in the Water framework Directive.

The institution responsible for the monitoring of water characteristics (qualitative and quantitative) is the Hydrometeorological Institute of Montenegro (HMI), determined by Article 58 of the Water Law, The Official Journal of RM, No. 27/07). Monitoring of Lake Skadar/Shkoder is done by the annual Programme for the systematic analysis of the quantity and quality of underground and surface waters, which is carried out by the competent Ministry of Agriculture and Rural development/Water Directorate. Sampling locations, parameters, and sampling frequency are regulated by the afore mentioned annual Programme (which is done in accordance with the Regulation on water). This monitoring programme lacks a basin-approach, which means it does not provide sufficient data for future planning and activities. Analyses of the sediment are not included in the monitoring programme. There have been only a few sporadic analyses of sediment provided by some research institutions in the past (Table 1) (CETI, University of Skodra, University of Tirana).

Figure 1: Sampling points on the lake determined by the Programme for the systematic analysis of the quantity and quality of underground and surface waters in Montenegro (source: HMI Montenegro).

The programme for systematic analysis of the quality of underground and surface waters of Montenegro defines 9 sampling points on the lake (Kamenik, Vranjina, Virpazar, Plavnica, Podhum, Middle of the Lake, Starčeva gorica, Moračnik and Ckla) where 55 parameters in the water should be measured. The sampling network has existed since 1990 (3 stations have existed since 1980 – Vranjina, Virpazar and Plavnica). The network of sampling points is mainly based on the assessement of the impact on the Lake from the land (inflow of tributaries and groundwater), as well as on the pelagial water quality.

Table 2: Sampling points on Lake Skadar/Shkoder defined in the Programme for systematic analysis of the quantity and quality of underground and surface waters annual monitoring programme of Montenegro.

Sampling point	Criteria for selection	Coordinates	Frequency of sampling
Vranjina	Inflow of left arm of Morača River	42° 16´ 32.79˝N 19° 07´ 12.12˝E	4 – 6 times/year - monthly from May to October
Virpazar	Inflow of canal Virpazar	42° 15´ 22.12˝N 19° 06´ 19.85˝E	4 – times/year - monthly from June to September
Plavnica	Discharge of waste waters and influence of underground waters	42° 15´ 40.26˝N 19° 11´ 54.02˝E	8 - times/year - monthly from February to December
Kamenik	Inflow of Crnojevića River	42° 17´ 32.63˝N 19° 06´ 03.10˝E	4 – 6 times/year - monthly from May to October
Podhum	Influence of KAP, surface waste waters and underground waters	42° 16´ 2.58˝N 19° 21´ 44.53˝E	4 - times/year - monthly from June to September
Starčevo	Dilution of pollutants in the distance from the source of the pollution	42° 11´ 19.82˝N 19° 12´ 29.42˝E	4 - times/year: - monthly from June to September
Moračnik	Dilution of pollutants in the distance from the source of the pollution	42° 08´ 18.12˝N 19° 15´ 25.76˝E	4 – times/year - monthly from June to September
Ckla	Important transboundary outlet point	42° 51´ 8.20˝N 19° 22´ 46.30˝E	4 – times/year - monthly from June to September
Middle of the Lake	Pelagial water quality	42° 10´ 47.50˝N 19° 16´ 26.67˝E	8- times/year - monthly from February to December

However, in total 29 parameters from the proposed 55 in the Programme have in recent years been measured in the water samples of Lake Skadar/Shkoder by HMI of Montenegro: water T, pH, conductivity, transparency, dry residue, suspended substances, oxygen consumption, chemical oxygen demand (COD), biological oxygen demand (BOD), hydrogen carbonate (HCO_3^-), water hardness, concentration of O_2, % of O_2 saturation, calcium (Ca^{2+}), magnesium (Mg^{2+}), sodium (Na^+), potassium (K^+), nitrite (NO_2^-), ammonium (NH_4^+), chloride (Cl^-), sulphate (SO_4^{2-}), phosphate (PO_4^{3-}), nitrate (NO_3^-), phenols, detergents, total coli bacteria, total faecal bacteria and total aerobic bacteria. Other parameters, determined in the Programme: fluorides (F^-), cyanides (CN^-), total phosphorus (TP), copper (Cu), zinc (Zn), nickel (Ni), total arsenic (As), iron (Fe), cadmium (Cd), total chromium (Cr), lead (Pb), mercury (Hg), selenium (Se), mineral oils of petrol origin, total polyaromatic hydrocarbons (PAH), organochlorine pesticides (OCP), total polychlorinated biphenyls $(PCB)_s$ organic substances, total organic carbon (TOC), quality and quantity of phytoplankton, saprobiological parameters and total α, β radioactivity, were not measured.

There are two automatic hydrological stations, with on-line data on the website of HMI, on the Lake Skadar/Shkoder: Plavnica and Ckla, where the parameters of water level, discharge and water temperature are measured. In the Lake Skadar/Shkoder catchments area hydrological stations are also on the rivers Morača, Bojana, Rijeka Crnojevića and Orahovstica.

Water samples are taken at one depth - 50 cm below water level. There were not any data about vertical profiles. Location points are interconnected with sampling locations (on the Bojana and Morača rivers).

2.1.1.2 Monitoring of biodiversity

The monitoring of biodiversity in Montenegro has been carried out in since 2000 in a limited manner by the Institute for the protection of Nature of MNE, within the framework of the National Environmental Monitoring Programmeme. Due to the limited financing for this Programme, the data gathered so far do not offer the possibility for complex analyses of trends in the condition of indicator species populations, or changes in selected habitats and the overall living environment.

The monitoring of birds (winter census) has been regularly carried out since the beginning of '90s. From the beginning of the 2000s, an extreme decline of bird species and the number of individuals has been detected. From 2007, birds started returning to the lake (International wintering counting (IWC results), but in 2009 the number of birds in Montenegro was one of the smallest since the census had been implemented (1991) (Saveljić, 2009).

IWC shows that Lake Skadar/Shkoder is an important wintering site for birds. The fluctuation in the numbers of wintering birds could be a consequence of global changes in the biodiversity of bird species and climate change. Several factors influence the quantitative and qualitative state of the ornitofauna of Skadar-Skhoder Lake (antropogenic factors, climate and water regime, nest destroying in spring months) and because of this, the National Park, regarding its Skadar Lake National Park Management Plan, provides these activities on the lake:

- Monitoring of nesting birds in ornithological reserves Crni žar and Pančevo oko
- Monitoring of whiskered tern (*Chlidonias hybrida*) on the whole lake
- Monitoring of grey heron (*Ardea cinerea*)
- Annual monitoring: distribution and number of birds during spring and autumn
- Monitoring of breeding in pelicans
- IWC

Within these activities there was no cooperation with the Albanian side. Monitoring was conducted with the cooperation of the Nature Museum Podgorica.

From 2009, the main institution in Montenegro working on environmental monitoring is the newly established Agency for Environmental Protection EPA), under the Ministry of Sustainable Development and Tourism. This institution prepares a Programme for the Monitoring of Biodiversity, and this includes the Programme of biomonitoring of Lake Skadar/Shkoder, and then through tender procedures, qualified legal persons conduct the monitoring. Monitoring of biodiversity is based on the Law of Environment (Official Gazette of the RM 48/08) and Law of Nature Protection (Official Gazette of the RM 51/08).

This programme includes the monitoring of birds and some specific animal and plant species but there is a lack of some other indicators (propositions for them can be found in Chapter 3.2.2.2 of this Report), which should be monitored in order to detect changes in the lake's ecosystem. The new Proposal of Biodiversity Programme for 2011 for Lake Skadar/Shkoder is improved (EPA Montenegro, 2010), but a lack of financial resources does not allow the carrying out of all the activities included in the programme.

A lot of information about the status of biodiversity remains unpublished, or if published (for example Lakusić and Pavlović, 1981; Ristić and Vizi, 1981; Lakusić, 1983; Talevski et al., 2009; Pulević et al., 2001; Mrdak et al., 2001; Miller and Šanda, 2008; Marić, 1995; Kovačić and Sanda, 2007; Knežević, 1985; Ivanović, 1973; Bianco and Kottelat, 2005; Saveljić, 2009; Saveljić, 2010; etc.), it usually does not reach the public (publicly not available information, such as internal reports within institutions, the results of research projects, master and doctoral theses, specialist articles/works in professional publications or other publications that are not for general public distribution). On the other hand, the country experienced a period of isolation during the 90's that also affected the scientific community, causing breaks in the cooperation with similar institutions abroad, and exclusion from wider (global, regional) initiatives related to biodiversity conservation. On the website of the Environmental Protection Agency, residents have access to the Annual Reports of the State of Environment in Montenegro (for 2009 and 2010).
Both Departments of Biology from the University of Podgorica and the University of Shkodra and the Institute for the Protection of Nature of Montenegro were involved in the project "Promotion of networks and exchanges in the countries of South Eastern Europe", where the result was the publication (not an electronic database) "Biodiversity Database of the Shkodra/Skadar Lake (Checklist of species)" (Pulević at al., 2001) and in the project "Trans-boundary Cooperation through Management of Shared Natural Resources – Skadar Lake Site" - a list of species and evaluation of Lake Shkodra/Skadar's potentials.
The EMERALD Network of sites, with species and habitats given in Resolution 4 and Resolution 6 of the Bern Convention, were identified in 2008 in Montenegro. The database is available in the National Institute for the Protection of Nature, Podgorica. The creation of the EMERALD Network in Montenegro started in 2005 within the project funded by the Council of Europe and implemented by the Ministry of Environmental Protection and Physical Planning in cooperation with the Council of Europe and Montenegrin experts. During 2008, the project was completed and the standard forms were completed for most of the Emerald Network sites in Montenegro (the central EMERALD database is in the National Institute for the Protection of Nature) (Busković and Kapa, 2010).

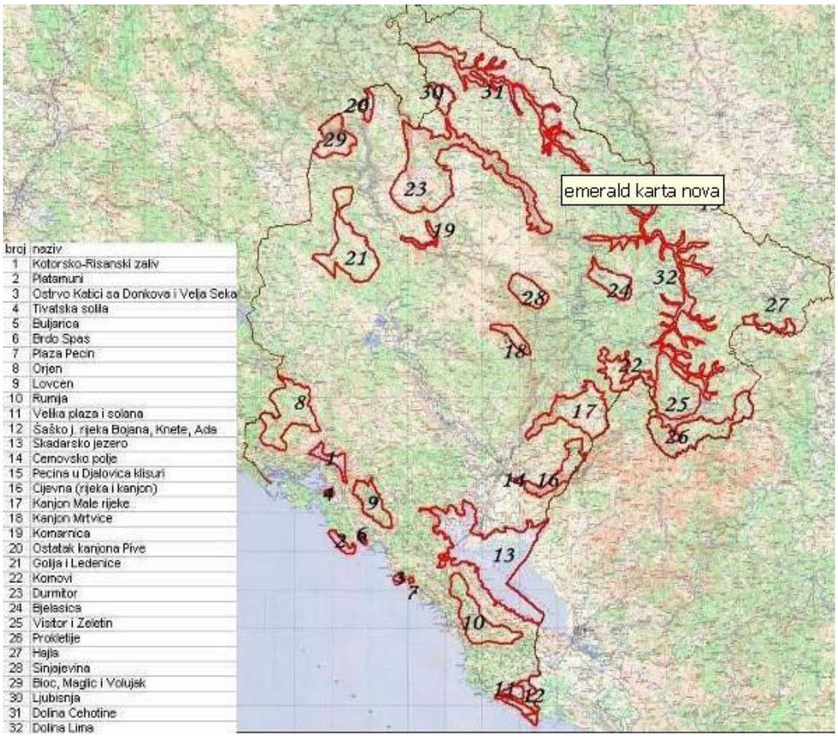

Figure 2:EMERALD Network in Montenegro.

2.1.2 REPUBLIC OF ALBANIA

2.1.2.1 Monitoring of quality of water

Data on the water, sediment and biota quality on the Albanian side of the lake watershed is limited. Most of the available data, indicating the main physical-chemical characteristics of the water, were carried out by the Hydrometeorology Institute (HMI), now the Institute of Energy, Water and Environment, but there was a lack of cooperation with it in the frame of this project. Consequently, data about previous monitoring activities on the lake is missing. Table 3 gives the history of sampling and measurements on the Lake by different institutions after the year 2000 (University of Skadar; University of Tirana; TDA, 2006).

Table 3: History of sampling and measurements of water, sediment and biota in the Lake Skadar/Shkoder in Albania.

	Period	Institution	Sampling locations	Parameters in water	
WATER	2001-2002	Shkodra University & University of Graz, Austria	Ura e bunes, Ura e bahcal, Dajlon, Zus, Shiroka, Peshkimi,	Ammonium, nitrite, nitrate, phosphate, total N, Total P	
	2002	Shkodra University	Shiroke, Zogaj, Bajza	Temperature, pH, DO, N-NH_4, N-NO_2, N-NO_3, P-PO_4, total P, conductivity	
	2003	Shkodra University & University of Graz, Austria	Ura e bunes, Ura e bahcal, Dajlon, Zus, Shiroka, Peshkimi,	Cr, Co, Ni, Cu, Zn, As, Cd, Sn, Hg, Pb	
	2003	Shkodra University	?	Cu, Zn, Cd, Pb, Cr, Mn, Co, Fe	
	2004-2005	Shkodra University	Shegani spring, Viri sping	Temperature, pH, DO, conductivity, alkalinity, total hardness, COD, nitrite, nitrate, ammonium, phosphate	
	2004-2008	Tirana University	3 (?)	HM, phys.-chem. parameters	
	2007-2009	Tirana University	3 (?)	Free HM ions, phys.-chem. parameters	
	2003-2005	Tirana University	12	Nutrients, phys.-chem. parameters	
SEDIMENT	2003	Shkodra University	?	Cu, Zn, Cd, Pb, Cr, Mn, Co, Fe	
	2003	Shkodra University	Peshkimi, Kamice, Dajlon, Ura e Bah, Ura e Bun, Zues, Sterbeq, Shiroka, Zogaj,	Cr, Co, Ni, Cu, As, Cd, Sn, Hg, Pb	
	2004-2008	Tirana University	3 (?)	HM, phys.-chem. parameters	
	2006-2009	Tirana University	5(?)	HM, phys.-chem. parameters	
	2003-2005	Tirana University	12	Nutrients, phys.-chem. parameters	
BIOTA	1993-1996	CETI			
	2001	Shkodra University	Whole lake	Pb, Cd, As, Cr, Ni, Fe, Al, Mn	Fish
	2002	Shkodra University	Vrakes river, Shiroke, Buna River	a-HCH, HCB, b-HCH, lindane, d-HCH, heptachlor, aldrin, heptaetoxi, 2,4 DDE, endoxan 1, dieldrin, 4,4 DDE, endrin, endoxan 2, 4,4 DDD, 4,4 DDT, metoxychlor, mirex	Fish
	2005	Shkodra University	Zogaj, Kamic, 5 M, Dajlon, 1B, 2 SH, 3 C, 4 K, 6 P, National park, Shirok	Pb, Cr, Al, Hg, Zn, PAH, PCB, histamins	Fish
	2003-2005	Tirana University	12	Nutrients, phys.-chem. parameters	?

Monitoring the quality of the water at the Lake Skadar/Shkoder should be done in accordance with the National annual Programme, which is the competence of the Ministry for Agriculture, Forestry and Water Management/Water Directorate. In the annual reports of the Environmental Ministry the sampling points that are monitored in Lake Skadar/Shkoder and the rivers Buna and Drini are: Shiroka, Zogaj, Bajze, Buna Bridge and Bahcallek (Table 4, Fig. 3).

Table 4: Sampling points on Lake Skadar/Shkoder defined in National Monitoring Programmeme for surface water of Albania.

Sampling point	Criteria for selection	Coordinates	Frequency of sampling
Shiroka	Direct discharge of untreated sewage and domestic wastes from Shiroka village and from numerous restaurants	42º 03' 34.59" N 19º 27' 16.92" E	4-times/year (seasonally)
Zogaj	Direct discharge of untreated sewage and domestic wastes from Zogaj village.	42° 04´ 24.0″N 19° 24´ 16.0″E	4-times/year (seasonally)
Bajze	Pesticides were deposited near this region for twenty years	42° 13´ 32.0″N 19° 21´ 22.0″E	4-times/year (seasonally)
Buna Bridge	Outflow of the lake Direct discharge of untreated sewage and domestic waste from Shkodra town)	42º 03' 02.20" N 19º 29' 31.40" E	4-times/year (seasonally)
Bahcallek	Inflow of Drini River	42º 02' 33.22" N 19º 29' 31.52" E	4-times/year (seasonally)

Figure 3:Sampling points on Lake Skadar/Shkoder defined in National Monitoring Programmeme for surface water of Albania.

The ptarameters, which are measured are ransparency, pH, DO, DO%, COD, conductivity, alkalinity, hardness, PO_4^{3-}, NO_2^-, NO_3^-, NH_4^+, Total coliformes, Faecal coliformes, Strept. faecal, *Pseudomonas aeruginosa*. The measurements are done at two depths: at 0 m and at 5 m. The analyses of heavy metals and organic substances are made only sporadically by the University of Skhodra and the University of Tirana. For surface waters, underground waters and sea waters near sources of industrial pollution and agriculture, the following parameters should be measured in accordance wirth the national monitoring programme of surface waters: (a) heavy metals; (b) pesticides and (c) hydrocarbons compounds.

2.1.2.2 Monitoring of biodiversity

Some partial monitoring of biodiversity is made by different departments of Shkodra University. The main data are related to the phytoplankton, vegetation, birds, etc. Results are published in different publications (Kashta et al., 2001; Rakaj, 2010; Rakaj, 2009; Paparisto et al., 2010; Grazhdani and Zyfi, 2010; Striniqi et al., 2010; etc.), but so far most of the collected data are rather qualitative than quantitative. The activity is related to the lack of funds also. On DCM no. 1189 date 18th November 2009 on "Rules and procedures for composing and implementation of National Environmental Monitoring in Albania" indicators for monitoring biodiversity were defined: (a) genetic diversity for agriculture and farming; (b) areas under organic agriculture; (c) diversity of ecosystems and habitats; (d) diversity of ecosystems and forests habitats; (e) diversity of ecosystems and habitats in protected areas; (f) diversity of ecosystems and water habitats; (g) fragmentation of ground, land and forests; (h) affinity of the transport infrastructure nearby protected areas; (i) non- native species in rivers and lakes; (j) ecosystem’s exposure to acidification, eutrophication and ozone; (k) protected species and liable species and (l) diversity of species.

2.2. LEGAL AND INSTITUTIONAL FRAMEWORK FOR MONITORING PROGRAMME CONDUCTING OF LAKE SKADAR/SHKODER

2.2.1 MONTENEGRO

Montenegro, accepting international principles and standards, with the emphasis on European Union rights, works intensively on the harmonisation and upgrading of its own legislation, as a prerequisite for necessary accession, not only to the legal and institutional system, but to the practices of the EU members.

The Montenegrin legislation regarding the monitoring of Lake Skadar/Shkoder:

- Montenegrin Law on Waters (Official Gazette of the RM, No.27/07)
- Montenegrin Law on Environment (Official Gazette of the RM, No. 48/08)
- Montenegrin Law on Nature Protection (Official Gazette of the RM, No. 51/08)
- Montenegrin Law on National Parks (Official Gazette of the RM, No. 56/09)

Monitoring of waters in Montenegro is based on the Regulation on the classification and categorisation of surface and underground waters (Official Gazette of the RM, No. 02/07).

The institution responsible for the monitoring of water characteristics (qualitative and quantitative) is the Hydrometeorological Institute of Montenegro (HMI), determined by Article 58 of the Water Law, The Official Journal of RM, No. 27/07).

2.2.1.1 Stakeholders in Montenegro

1. The Ministry of Agriculture and Rural development is responsible for, among other things, the management of water resources (including their protection against pollution), agricultural land, forests, hunting and fishing. It is also responsible for the development of projects that regulate the water levels of the lake. The Programmeme of monitoring surface and ground water is the responsibility of the Ministry of Agriculture and Rural development and its subordinate institution – the Directorate for water. The Directorate for water is a state administration body in charge of water management, which was already established in December 2004, by governmental Decree on amendments and alterations of the Decree on organisation and procedure for the functioning of the state administration (The Official Journal of RM, No 78/04).

2. The Ministry of Sustainable Development and Tourism of Montenegro is an 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; it is also responsible for the promotion of National Parks 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.

The **Environmental Protection Agency**, which is part of the Ministry of Sustainable Development and Tourism of Montenegro, prepares a National Monitoring Programme for each segment of the environment (air, soil, marine ecosystem, biodiversity), except inland water (the Programme for this part is written by the Directorate of Water). The Environmental Protection Agency prepares the Programme for the Monitoring of Biodiversity, and that includes the Programme of biomonitoring of Lake Skadar/Shkoder.

3. Local governments play an important role because of their direct involvement in the physical planning and implementation of urban development, and in acts that regulate the use of areas adjacent to the National Parks. They can have a considerable impact on the park's 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 the local administration.

4. Municipalities Podgorica, Bar and Cetinje – bordering the lake, these have a two-fold role in the management of the Skadar Natioanl Park. They act as protection institutions as well as resource users. These local authorities are directly related to the park's management and preservation because of their responsibility for managing municipal solid waste and wastewater (through public enterprises). They are also the sources of funding for public enterprises. However, they have limited budgets and, as a consequence, shift their interests towards the use of the lake's resources through different economic activities.

5. The National Parks Public Enterprise is responsible for protecting, promoting and managing the five Montenegrin national parks: Biogradska Gora, Lovčen, Durmitor, Lake Skadar/Shkoder and Prokletije. **The Skadar Lake National Park** management authority is directly involved in the protection and management of the lake and its shores. It controls and prevents all illegal activities, most importantly illegal fishing, hunting, etc. The NP SL has a 5 year Management plan (2011-2015) with Skadar Lake National Park and annual plans for the conservation and development of the park. The 5-year plan for the period 2011-2015 has already been established.

6. National Institute for Protection of Nature 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 and endangered species. They are also involved in the implementation of nature protection policies. National Institute for Protection of Nature conducted the Programme for the biomonitoring of Lake Skadar/Shkoder in previous years.

7. The Centre 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 Ministry of agriculture, forestry and water management.

8. Educational and scientific institutions include the University of Podgorica, the Faculty of natural Sciences and Mathematics, the Department of Biology, the Biotechnical Institute, and the Academy of Science.

9. (Inter)national environmental **non-governmental organisations** (NGOs) and societies, active in promoting Lake Skadar/Shkoder and its environment: Environmental Consultancy of Montenegro (ECOM), Podgorica; Sempervivum, Podgorica; Lynx Animal World Preservation Society, Podgorica; Kalimera, Ulcinj; Open World, Podgorica; Society for the Protection of Animals, Podgorica; Environmental Centre Dolphin, Kotor; Centre for Bird Protection and Research, Podgorica; Centre for Environmental Campaigns, Podgorica; Njegos Scout Club, Podgorica; NGO Godinje, NGO Expeditio, NGO Skadar Lake, NGO Green Home, The Regional Environmental Centre for Central and Eastern Europe (REC) field office Shkodra, etc.

10. Several **international organisations** have been involved in the preservation of Lake Skadar/Shkoder and its ecosystem. The activities of these organisations were with the support of the NGO sector, providing technical assistance to the official institutions with the funding of a certain amount of research, promotional and investment projects. A greater number of NGOs and institutions for the protection of nature have led to permanent cooperation with the various international organisations, whether they are organisations from neighbouring Albania or those that have headquarters all over the world. International cooperation is especially important bearing in mind the global significance of the Skadar Lake eco-system and the low domestic ability for nature protection and biodiversity management.
The international organisations that have supported projects related to Skadar Lake in recent years include the Regional Environmental Centre (REC), the European Agency for Reconstruction (EAR), the World Bank, USAID, UNDP, GTZ and others. Other important organisations are the World Conservation Union - IUCN, OSCE, WWF, UNESCO-ROSTE (Regional Bureau for Science in Europe), IRD, and the Council of Europe.

11. Private enterprises and **local businesses** such as hotels, handicrafts shops, tourist agencies, fish markets, hunting clubs, restaurants, catering services, etc.

2.2.2 REPUBLIC OF ALBANIA

The Albanian legislation regarding the monitoring of Lake Skadar/Shkoder:

- Decision of Ministerial Council for pollution control (1974)
- Law "On Environmental Protection" (2002)
- Law for Resources Management (1996; revised in 2000)
- Law "On Protected Areas" (2002)
- Law "On Protection of Transboundary Lakes" (2003)
- National Water Strategy (2004)
- Law "On Biodiversity" (2006)

Environmental monitoring in Albania is based on:

- Law on "Environmental Protection (no. 8934 of 5 September 2002), amended by law no. 9890, date 20.3.2008;
- DCM no.103 of 31 March 2002 on "Environmental Monitoring in Albania". In DCM are determined the environmental indicators and also relevant institutions to perform environmental monitoring.
- In DCM no. 1189 date 18.11.2009 on "Rules and procedures for composing and implementation of National Environmental Monitoring in Albania" new rules are established for environmental monitoring.

Monitoring of biodiversity is based on the Law "On Biodiversity" (2006) and on its Regulation No. 84 laying down the criteria for the establishment of the network for biodiversity monitoring and inventorying - 27 January 2009.

In Albania, the legislation for nature protection and management is in the process of being harmonised with the EU environmental legislation, which is in accordance with its action plan for the EU approximation of all the environmental legislation. Most of the efforts to prepare the laws have been assisted by international experts and most of them are based on European legislation. Albania has also ratified many of the most important environmental conventions on an international scale.

Despite the good progress, the implementation of the laws is not at a high level. More institutional strengthening is needed and clarifications of competencies are recommended to avoid overlapping between institutions. A special issue is the Law on transboundary lakes. It is still not very clear the responsibility of different authorities in managing the transboundary lakes, concretely between the fishery, forestry (administrators of PA) and water management authorities.

According to Law No. 8934 dated 05/09/2002 "On Environment Protection" and Council of Minister Decision No.1189, dated 18/11/2009, the Ministry of Environment, Forestry and Water Administration (MoEFWA) is the responsible authority for drafting the administration regulations, the management plan and the National Monitoring Programmeme (NMP) of the managed natural reserve of Albanian surface waters in cooperation with local government, non profitable organisations, community representatives and scientific institutions. The MoEFWA, through the Agency of Environment and Forestry (AoEF), makes on a yearly basis an agreement with a scientific institution in order to implement the surface waters NMP. The AoEF acts as a supervisor of the contracted research institutes and the MoEFWA is the main beneficiary of the data provided by the implementation of the NMP by these institutes. The AoEF supervises controls and evaluates the work of the relevant institutes on monitoring activities, and collects and elaborates the environmental data provided by relevant institutes and line ministries. Upon the Council of Minister Decision No.1189, dated 18/11/2009, the AoEF acts as a monitoring unit on water, air and other environmental issues. The monitoring data are collected by the AoEF as semi-annual and annual reports.

The institutions which have been already involved in Shkodra/Skadar Lake monitoring are: the AoEF under the MoEFWA, the Institute of Energy, Water and Environment (IEWE) (ex-Hydrometeorological Institute) under Polytechnic University of Tirana, Public Health Institute, University of Tirana and Shkodra (Faculty of Natural Sciences) and the Albanian Geological Service. The Institute of Energy, Water and Environment has been in previous years the only institute responsible for the monitoring of surface waters in Albania (also for Lake Skadar/Shkoder). After the reforms in science the role and the activity of the new institute has gone down and actually the monitoring activity is very low.

2.2.2.1 Stakeholders in the Republic of Albania

1. The Ministry of Environment, Forests and Water Administration (MoEFW) is responsible for environmental protection in the country. MoEFWA is responsible for drafting and proposing policies, strategies and action plans for the protection and administration of the environment, forests, waters and fisheries in order to achieve sustainable development, and to improve the quality of life and enable the country to join the European Union. Under its guidance, other ministries are responsible for ensuring the implementation of the national programme on environmental protection. The Ministry of Environment, Forest and Water Management includes the **Fishery Inspectorate of Shkodra and Malesia e Madhe**, which collects and processes statistical information with regard to fishing, defines methods of cultivation, controls the operations of fishing establishments and their geographical location and maintains the registers of fishing vessels. The Inspectorate of Fishing activity consists of controlling, monitoring, licensing and having a penalty for illegal fishing in the lake area.

2. The Ministry of Tourism, Culture, Youth and Sports 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.

3. The Ministry of Agriculture, Food and Consumer Affairs has, among other things, the authority to ensure the sustainable use of Lake Shkoder's resource potential such as fishing and preservation of aquaculture.

4. The Council of Ministers is the highest body entrusted with approval of the urban planning studies, master plans and regional plans, needed to account for environmental planning, and the procedures for the proclamation of protected and buffer zones. Other government institutions and inter-ministry committees involved in the lake's development and management are the **National Council of Waters, Council of Auriferous (River) Basins, the Council of Territorial Regulation, the Albanian Geological Service, the Academy of Sciences, the Institute of Energy, Water and Environment and the Institute of City Planning and Design.**

5. The National Council of Waters is the central decision making body for the development and management of water resources in the country. It is headed by the Prime Minister and its members include the Ministries of Environment, Tourism, Foreign Affairs, Energy, Agriculture, Health, and the 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 group of river basins a Council of Auriferous (River) Basin is formed.

6. The Council of Territorial Regulation of the Republic of Albania is responsible for the approval of urban studies concerning the development of National Parks, and the development of tourism, ports and physical infrastructures, mostly at the national level.

7. The government institutions that are responsible for the implementation of plans and programmes related to the conservation and management of the environment at local level are a.o. the Prefectures of the **Shkodra Region**, **the Directorate of the Drin-Buna Basin, the Directorate of Agriculture and Food (Shkoder/ Malësia e Madhe), the Regional Environmental Agency** and **the Directorate of Forest Service (Shkoder/ Malesia e Madhe).**

8. 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 the **Council of the Region of Shkoder, the Municipality of Shkoder** and **the Council of Territorial Regulation of Shkoder**. These institutions are responsible for the design of local environmental action plans in accordance with national environmental strategies.

9. The educational and scientific bodies involved in the protection and preservation of the lake's environment are **the Faculty of Natural Sciences** (**University of Shkodra), Museum of Natural Sciences, the Faculty of Natural Sciences (University of Tirana), the Polytechnic University of Tirana,** and **the High Forestry School (Shkodra).**

10. International organisations that have been supporting the lake's preservation and management include the **World Bank**, **German Technical Cooperation (GTZ)**, **the Global Environment Facility (GEF)** and various embassies. Community organisations, non-profit organisations and **NGOs** play a role by supporting local communities (for example **REC field office Shkodra**).

2.2.3 EUROPEAN LEGISLATION AND INTERNATIONAL AGREEMENTS

- EU Water Framework Directive (2000/60/EC)
- EU Bird Directive (2009/147/EC)
- EU Habitat Directive (92/43/EEC)
- UN Convention on Biological Diversity
- Ramsar Convention on Wetlands
- Bern Convention on the Conservation of European Wildlife and Natural Habitats
- Bonn Convention on Migratory Species
- UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes (UNECE Water Convention)

While the EU Water Framework Directive will be the main document for preparing the chemical and ecological monitoring of Lake Skadar/Shkoder, the EU Bird Directive, EU Habitat Directive, UN Convention on Biological Diversity, Ramsar Convention on Wetlands, Bern Convention on the Conservation of European Wildlife and Natural Habitats and Bonn Convention on Migratory Species will be the main documents for preparing the program for monitoring biodiversity. All these conventions were ratified in Montenegro and the Republic of Albania, except UNECE Water Convention, which was not ratified by Montenegro.

2.2.3.1 EU Water Framework Directive

The Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy is a European Union directive. It commits European Union member states to achieve the good qualitative and quantitative status of all water bodies (including marine waters up to a kilometre from the shore) by 2015. It is a framework in the sense that it prescribes steps to reach a common goal rather than adopting the more traditional limit value approach.

The directive defines 'surface water status' as the general expression of the status of a body of surface water, determined by the poorer value of its ecological status and its chemical status. Thus, to achieve 'good surface water status' both the ecological status and the chemical status of a surface water body need to be at least 'good'. Ecological status refers to the quality of the structure and functioning of the aquatic ecosystems of the surface waters. Water is an important facet of all life and the water framework directive sets standards, which ensure safe access to this resource.

The documents that amending Directive 2000/60/EC:
1. Decision No 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC.
2. Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council. This Directive lays down environmental quality standards (EQS) for priority substances and certain other pollutants as provided for in Article 16 of Directive 2000/60/EC, with the aim of achieving good surface water chemical status and in accordance with the provisions and objectives of Article 4 of that Directive.

2.2.3.2 EU Bird Directive

Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (this is the codified version of Directive 79/409/EEC as amended) is the EU's oldest piece of nature legislation and one of the most important, creating a comprehensive scheme of protection for all wild bird species naturally occurring in the Union. Its was adopted unanimously by the Members States in 1979 as a response to increasing concern about the decline in Europe's wild bird populations resulting from pollution, loss of habitats and unsustainable use. It was also in recognition that wild birds, many of which are migratory, are a shared heritage of the Member States and that their effective conservation required international co-operation.
The directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It therefore places great emphasis on the protection of habitats for endangered as well as migratory species (listed in Annex I), especially through the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species.

2.2.3.3 EU Habitat Directive

Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora is a European Union directive adopted in 1992 as an EU response to the Bern Convention. It is one of the EU's two directives in relation to wildlife and nature conservation, the other being the Birds Directive. The main aim of the EU Habitat Directive is to protect biodiversity in Europe. It aims to protect some 220 habitats and approximately 1,000 species listed in the directive's Annexes. Annex I covers habitats, Annex II species requiring designation of Special Areas of Conservation, Annex IV species in need of strict protection, and Annex V species whose taking from the wild can be restricted by European law. These are species and habitats, which are considered to be of European interest, following criteria given in the directive.

2.2.3.4 UN Convention on Biological Diversity

The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives: (1) The conservation of biological diversity, (2) the sustainable use of the components of biological diversity, (3) the fair and equitable sharing of the benefits arising out of the utilisation of genetic resources. In its Article 7 (Identification and Monitoring) it states that each Contracting Party shall, as far as possible and as appropriate, in particular for the purposes of conservation of species and their habitats:
(a) Identify components of biological diversity important for its conservation and sustainable use having regard to the indicative list of categories set down in Annex I;
(b) Monitor, through sampling and other techniques, the components of biological diversity identified pursuant to subparagraph (a) above, paying particular attention to those requiring urgent conservation measures and those which offer the greatest potential for sustainable use;
(c) Identify processes and categories of activities which have or are likely to have significant adverse impacts on the conservation and sustainable use of biological diversity, and monitor their effects through sampling and other techniques; and
(d) Maintain and organise, by any mechanism data, derived from the identification and monitoring activities pursuant to subparagraphs (a), (b) and (c) above.

2.2.3.5 Ramsar Convention on Wetlands

The Convention on Wetlands (Ramsar, Iran, 1971) - called the "Ramsar Convention" - is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their Wetlands of International Importance and to plan for the "wise use", or sustainable use, of all of the wetlands in their territories. Unlike the other global environmental conventions, Ramsar is not affiliated with the United Nations system of Multilateral Environmental Agreements, but it works very closely with the other MEAs and is a full partner among the "biodiversity-related cluster" of treaties and agreements.

2.2.3.6 Bern Convention on the Conservation of European Wildlife and Natural Habitats

The Bern Convention is a binding international legal instrument in the field of nature conservation, which covers most of the natural heritage of the European continent and extends to some States of Africa. Its aims are to conserve wild flora and fauna and their natural habitats and to promote European co-operation in that field. The Convention places a particular importance on the need to protect endangered natural habitats and endangered vulnerable species, including migratory species.

2.2.3.7 Bonn Convention

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention, not to be confused with the Bonn Agreement) aims to conserve terrestrial, marine and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. The Convention was signed in 1979 in Bonn and entered into force in 1983.

Migratory species threatened with extinction are listed on Appendix I of the Convention. CMS Parties strive towards strictly protecting these animals, conserving or restoring the places where they live, mitigating obstacles to migration and controlling other factors that might endanger them. Besides establishing obligations for each State joining the Convention, CMS promotes concerted action among the Range States of many of these species.

Migratory species that need or would significantly benefit from international co-operation are listed in Appendix II of the Convention. For this reason, the Convention encourages the Range States to conclude global or regional Agreements. In this respect, CMS acts as a framework Convention. The Agreements may range from legally binding treaties (called Agreements) to less formal instruments, such as Memoranda of Understanding, and can be adapted to the requirements of particular regions.

2.2.3.8 Convention on the Protection and Use of Transboundary Watercourses and International Lakes

Among the conventions stipulating comprehensive water monitoring activities, the most important is the Convention on the Protection and Use of Transboundary Watercourses and International Lakes. This Convention was adopted by the European Commission of the United Nations in Helsinki in 1992. The Convention is a very important regional international agreement in this area. Emphasising that cooperation among member countries in regard to the protection and use of trans-boundary waters should be implemented primarily through the elaboration of agreements between countries bordering the same waters, especially where no such agreements have yet been reached, by the Convention are establishes obligations important for preventing, controlling and reducing any trans-boundary impact; to ensure sustainable management of waters; to ensure that trans-boundary waters are used with the aim of ecologically sound and rational water management, conservation of water resources and environmental protection; related bilateral and multilateral cooperation, consultation, monitoring, etc.

2.2.4 AGREEMENTS BETWEEN MONTENEGRO AND THE REPUBLIC OF ALBANIA

Between Montenegro and the Republic of Albania different inter-state documents were elaborated:
1. Memorandum of Understanding in the field of environmental protection and sustainable principle implementation, signed between the line ministries of environmental protection of Montenegro and Albania in 2003,
2. Memorandum for cooperation, defining the establishment of the Montenegrin-Albanian Commission for Waters,
3. Agreement for protection and sustainable development of Shkodra/Skadar Lake, signed between the line ministries of environmental protection of Montenegro and Albania in 2008,
4. Memorandum of understanding on cooperation in the field of environmental protection and sustainable management of natural resources signed between the Ministry of spatial planning and environment of Montenegro and the Ministry of environment, forestry and water administration of the Republic of Albania in 2010.

The first document - Memorandum of Understanding in the field of environmental protection and sustainable principle implementation - calls for the establishment of working groups for certain activities - including water monitoring, pollution control, environmental impact assessment etc., but it has never been practically realised. The new memorandum was signed in 2010 - the Memorandum of understanding on cooperation in the field of environmental protection and sustainable management of natural resources (Document under point 4), where both countries agreed that they will develop bilateral cooperation in the field of environmental protection and sustainable management of natural resources, based on mutual and equal benefits, and will further strengthen the cooperation in specific areas.
The objective of the most important document for sustainable management of Lake Skadar/Shkoder - Agreement for protection and sustainable development of Shkodra/Skadar Lake (Document under point 3) - is that, individually and in collaboration, both countries will work to assure equal and integrated protection for the Lake Skadar/Shkoder and its watershed as well as sustainable development according to the norms and standards of the European Union.

2.3 DATA AVAILABILITY AND DATA EXCHANGE BETWEEN THE COUNTRIES

Residents have access to the Annual Report of the State of Environment in Montenegro for the years 2009 and 2010 on the website of the Environmental Protection Agency Montenegro (http://www.epa.org.me/index.php/en/sector-for-monitoring-analysis-and-reporting), except for the quality of waters. Annual reports of the quality of waters in Montenegro are available on the website of the Hydrometeorological Institute (http://www.meteo.co.me/misc.php?text=57&sektor=3) for the period 2006-2010 and are in the Montenegrin language.

Reports of water quality monitoring on the Lake Skadar/Shkoder and the river Buna and Drini for the period 2005-2008, are available on the web site of the Ministry of Environment, Forests and Water Administration (MoEFWA) Republic of Albania - www.moe.gov.al. They are in the Albanian language. 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 (now Institute of Energy, Water and Environment, Tirana).

Mechanisms for data collecting, exchanging and publishing are not established between the two countries. Besides baseline monitoring, several pieces of research have been carried out on the lake. The results of this research are published in different publications – national and international. The list of all references till the year 2007 regarding research on Lake Skadar/Shkoder is given in the publication “Bibliography on Skadar/Shkodra Lake” (Kashta et al., 2007). This bibliography on Skadar/Shkodra Lake is a specific result of the project “Trans-boundary Cooperation through Management of Shared Natural Resources” jointly made by environment-related specialists from Albania and Montenegro.

Some institutes are unwilling to release their information to other institutes and organisations and they demand payment for it.

2.3.1 COOPERATION BETWEEN INSTITUTIONS

CETI cooperated with the HMI on the Monitoring programme of surface and ground water in the period from 1998 to 2002. CETI also cooperated with the Department of Biology (University of Podgorica, Faculty of Natural Sciences and Mathematics) within the Project of Integral Management of Skadar Lake organised by the Haidelberg Rector Conference - HRK in the years 2001 and 2002. Both institutions also cooperate in the project: "An Integrated Ecotoxicological Investigation of the Lake Shkodra/Skadar Ecosystem - Holistic Toxicological Profiling of Local Contamination Hotspots with SPMD devices. The Ecotoxicological laboratory of the Faculty of Natural Sciences (Shkodra University) was included in that project as well and cooperated with the Faculty of Natural Sciences (University of Tirana) Department of Chemistry in the project “The application of a passive sampling system for

heavy metals and organic pollutants monitory in the natural waters of Scutari Lake" in the period September 2006 - July 2009. The Faculty of Natural Sciences (University of Tirana) Department of Chemistry also cooperated with the University of Podgorica, Faculty of Natural Sciences and Mathematics, Department of Biology in one project with participants from Albania, Croatia, Montenegro and Serbia). Cooperation was also with the Institute of Energy, Water and Environment Tirana within the MEDPOL project.
University of Shkodra also closely cooperates with the University of Podgorica. The different researchers of both institutions (most of them are employed in Departments of Biology) have been included in a project entitled: "Integrated Monitoring and Research of Lake Shkodra/Skadar" from 2001 to 2004 and after that (in the period 2004 to 2006) in the project "Ecological Integrated Monitoring and research of Lake Shkodra/Skadar - Eulimnos", financed by HRK (Highschools of Rectors Conference) of Germany. The topic, on which they cooperated, was the monitoring of physic-chemical, microbiological and biological parameters, as well as organic pollution, microbial pollution, heavy metals, phytoplankton, macrophytes, fish potential and main fish populations. Both Departments of Biology from the University of Podgorica and the University of Shkodra and the Institute for the Protection of the Nature of Montenegro were involved (2001) in the project "Promotion of networks and exchanges in the countries of South Eastern Europe" and in the project "Trans-boundary Cooperation through Management of Shared Natural Resources – Skadar Lake Site" – the compilation of a list of species and the evaluation of Lake Shkodra/Skadar's potential. Both projects were financed by the Swiss Agency for Development and Cooperation (SDC) and the Regional Environmental Center for Central and Eastern Europe (REC).

In recent times two International Conferences about Lake Skadar/Shkoder were organised. In the period of October 2005 in Vranjina an international conference on the theme "Lake Skadar international designations for territorial development" was held. The meeting was organised by the "Dinaric Arc Initiative", a framework of collaboration between the relevant offices of UNESCO, WWF, IUCN, UNDP and the Council of Europe. The International Conference "Introducing RAMSAR principles towards integrated management of Lake Shkodra/Skadar & Buna/Bojana River natural resources" was held in Shkodra, Albania, from 5-6 June 2010. The Conference was organised within the framework of the project with the same title, supported by the RAMSAR Convention.
Skadar Lake National Park offers logistical support to the HMI and CETI when they conduct monitoring on the Lake. Skadar Lake National Park cooperates with the Department of Biology of the Faculty of Natural Sciences and Mathematics of Podgorica in different activities, which are obliged by the Management plans of NP Skadar Lake or by research projects on the Lake. The cooperation with the Institute for the Protection of the Nature is not good, although the Institute for the Protection of the Nature conducts monitoring of biodiversity on Skadar Lake. Skadar Lake National Park has had very good cooperation with the Natural History Museum for 20 years in monitoring of ornitofauna and other research on the biodiversity of Lake Skadar/Shkoder. There is a lack of cooperation with the Albanian side.

There have been lots of joint projects so far, which brought a lot of experience for all parties and, moreover, lots of data. This cooperation in the past should be a guide for all future cooperation, which is not only welcome, but is very necessary.

Table 5: Cooperation between different institutions of Montenegro and the Republic of Albania.

	MONTENEGRO						**ALBANIA**		
	HMI	CETI	FNSM BI	INP	NP SL	NHM	FNS S	FNS T	IEWE
HMI									
CETI	+								
FNSM BI		+							
IPN									
NP SL	+	+	+						
NHM					+				
FNS S		+	+	+					
FNS T			+				+		
IEWE								+	

Legend: + cooperation exists

HMI - Hydrometeorological Institute, CETI - Centre for Ecotoxicological Researches, FNSM BI - University of Podgorica, Faculty of Natural Sciences and Mathematics, Biotechnical Institute, Department of Biology, INP - Institute for Protection of Nature, NP SL - Skadar Lake National Park, NHM - Natural History Museum, FNS S - The Faculty of Natural Sciences (Shkodra University), FNS T - The Faculty of Natural Sciences (University of Tirana), IEWE - Institute of Energy, Water and Environment Tirana.

2.4 RECOMMENDATIONS FOR IMPROVEMENT OF BASELINE MONITORING OF LAKE SKADAR/SHKODER

This chapter contains a summary of recommendations for the improvement of monitoring of water quality and monitoring of biodiversity. The details of this can be ascertained from our recommendation for the structure of the joint Lake Skadar/Shkoder monitoring programme that appears in the following chapters of this report.

2.4.1 WATER QUALITY

Both countries carry out annual (Montenegro) or periodic chemical monitoring (Albania) of Lake Skadar/Shkoder. However, the results of monitoring are not comparable between the two countries and also do not give satisfactory information about the quality status of the lake due to several reasons:

- There is no cooperation between the countries.
- Samples were taken at different times and at different frequencies.
- Samples were taken at different depths.
- Analyses of sediment are not included in the monitoring programme. There were only a few sporadic analyses of sediment provided by research institutions in the past (CETI, University of Skodra, University of Tirana).
- The number of sampling points on the Albanian site is too low.
- Different and reduced set of chemical parameters are measured.
- Laboratories use different analytical methods for determining concentration of a single parameter.
- Laboratories use different limits of quantification (LOQ) for a single parameter or the laboratories do not have LOQ values for some parameters.
- The results of monitoring are available at different web sites (In Albania only available till 2008) and only in their national languages. It is very difficult to recognise the quality of the water from the reports in Montenegro if you do not know the regulations regarding the classification and categorisation of surface and underground waters (Official Gazette of the RM, No. 02/07) very well.

For this reason we recommend a joint monitoring programme which will ensure the quality and comparability of all results. Samples must be taken on the same days, with the same frequency and at the same depths; the same methods should be used (harmonisation amongst institutions from both countries). Unified sets of chemical parameters must be analysed. Selected laboratories, which will be included in the monitoring, must ensure quality assurance (the validity and comparability of all analytical results). Laboratories should use comparable analytical methods for determining the concentration of a single parameter. An equal limit of quantification (LOQ) for a single parameter must exist. The reports of the quality of the Lake Skadar/Shkoder should be available from one web site in all three languages (English, Albanian and Montenegrin) and the results should be presented in a way that is understandable to residents.

2.4.2 BIODIVERSITY

In Chapters 2.1.1.2 (Monitoring of biodiversity in Montenegro) and 2.1.2.2 (Monitoring of biodiversity in the Republic of Albania) the monitoring of biodiversity in the area of Lake Skadar/Shkoder is addressed. Although monitoring of biodiversity in this area (to a limited extent) already exists in Montenegro, in the Republic of Albania the proposition of monitoring of biodiversity is only in some legal documents. The cooperation amongst research institutions is not at a very high level – inside each country and between countries. There are many individual research projects, the results of which are not published for public access or are published in scientific papers or diplomas. Although many studies have been conducted on the flora and fauna of Lake Shkoder, up to now no programme has been implemented that comprises monitoring of different groups of organisms in the same localities over a long period of time. Therefore there is a need to conduct a monitoring programme to examine the current status of the flora and fauna of the lake. Indicators (species and their habitats) should be monitored in order to detect changes in the lake ecosystem resulting from natural processes and from anthropogenic impacts.

As in the case of monitoring the quality of water, also in the case of monitoring of biodiversity we recommend a joint monitoring programme, which will ensure the quality and comparison of the results between both countries (details are in the next chapters of this report). The same enlistment of indicators should be taken into consideration in the both countries, which should be monitored with the same international recognised methodologies. For this reason institutions from both countries should harmonize their work (time and methods of monitoring). The selection of indicators should firstly consider national and European legislation, international agreements and also the characteristics of the lake and the level of threats to biodiversity in the area of Lake Skadar/Shkoder as well as benefits and economic aspects. The biodiversity reports relating to Lake Skadar/Shkoder should be available from one web site in all three languages (English, Albanian and Montenegrin) and the results should be available in a way that is understandable to residents. We also recommend the inclusion of public (especially educational institutions through awareness campaigns and support for establishing protective areas and education programmes about the importance of biodiversity and harmful effects brought to it by a variety of different human activities.

2.5 ANALYSIS OF TRENDS BASED ON RECENT MONITORING DATA OF LAKE SKADAR/SHKODER

2.5.1 WATER QUALITY

2.5.1.1 Basic physico-chemical elements

Period to the year 2005 (source: THE STRATEGIC ACTION PLAN (SAP) FOR SHKODRA / SKADAR LAKE ALBANIA & MONTENEGRO, 2007, TDA, 2006)

Transparency in Lake Skadar/Shkoder varied seasonaly between 1.8 m and 7.0 m. The highest temperatures are in June (ranging from 22-27 ºC) and lowest in December (8-17 ºC). The small vertical differences in temperature ranging from 0.2 to 1.7°C can be explained by the absence of thermal stratification in Lake Skadar/Shkoder (Rakočević-Nedović and Hollert, 2005). The content of dissolved oxygen in the lake waters varies between 7 and 12 mg/l in the surface water layers and between 5 and 12 mg/l in the bottom water layers. The lake's water is not saturated with O_2, its saturate index is about 80%. Carbonates vary between 2 and 19 mg/l, while bicarbonates vary between 86.6 and 254 mg/l. The high variation of bicarbonates may be the main reason for the high variation of conductivity (100–343 µmhos) (Dhora 2005). Water alkalinity varies between 1.47 and 4.18 mval/l, while pH between 7.1 and 8.5, but it usually remains between 7.9 and 8.2. These pH values are within the optimum (6 – 8.5). The total content of the dry residuals has been assessed between 98 and 164 mg/l in the pelagic waters and between 102 and 240 mg/l in the littoral waters. The values of phosphates in the lake waters are between 0.002 and 0.004 mg/l. In certain periods, in the littoral parts near the river mouths, these values increase by up to 150–1000 times, for example, near Crnojevića and Morača rivers mouths. The average value of the total phosphorous varies from 0.004 and 0.040 mg/l, but near Crnojevića River these values reach 0.100–0.350 mg/l. The content of nitrates in pelagic waters is 0.012–1.200 mg/l, but its variation is high between seasons. Chlorines have content from 6 to 9.8 mg/l in most of the lake area, but very low content in the "eyes" (wells). The silica content is between 1.3 and 3.45 mg/l, magnesium between 4.8 and 74.8 mg/l and sulphates between 3.2 and 30 mg/l.

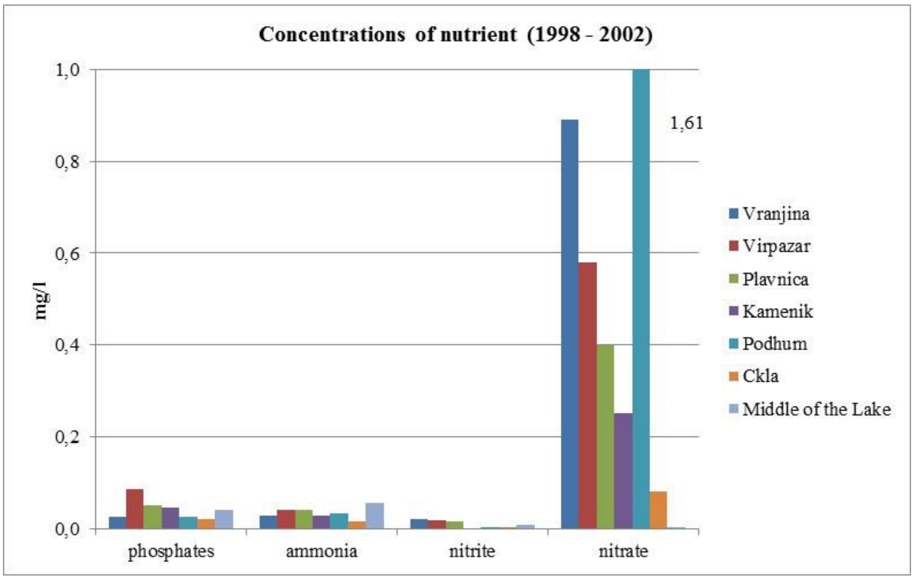

Figure 4: Average concentrations of nutrients on Montenegrin site of Lake Skadar/Shkoder (source: CETI).

The highest concentrations of nitrates were measured at the locations Vranjina (influenced by th Morača River and settlements) and Podhum (underground connection with the Podgorica area). Concentrations of other nitrogen and phosphorus substances (phosphates, ammonium and nitrites) were very low, thus a difference between locations cannot be defined.

Period 2006 – 2010

Table 6 shows the results of monitoring some parameters (phosphates, nitrites, ammonium and detergents) during the period 2006 to 2010, which at sampling points in different years exceed permissible levels regarding Montenegrin low (Source of data: Annual Reports of HMI Montenegro). Classes of water regarding to Montenegrin regulation (Off. Gazette of RM, no. 2/07) are present in Annex 2 of this Report.

Table 6: Average level of some parameters (ammonium, nitrites, phosphates and detergents at different sampling points in different years.

Ammonium (mg/l)

Year	Vranjina	Virpazar	Plavnica	Kamenik	Podhum	Starčevo	Moračnik	Ckla	Middle
2006	>1	>1	>1	>1	>1	>1	>1	>1	>1
2007	>1	>1	>1	>1	<0.05	>1	>1	>1	>1
2008	0.10	0.12	0.10	0.14	0.028	0.06	0.06	0.08	0.04
2009	>0.05 -1	>0.05 -1	>0.05 -1	>0.05 -1	>0.05-1	>0.05-1	>0.05-1	<0.05	<0.05
2010	0.08	0.07	0.15	0.09	0.07	0.04	0.03	0.01	0.01

VK (>1 mg/l) – Level is out of recommended classes, following Montenegrin legislation (Off. Gazette of RM, no. 2/07)
A3 (>0.05-1 mg/l) – Water with that concentration of ammonium can be used for the drink and food industry after intensive physical, chemical and biological treatments, with prolonged disinfection and chlorination.

Nitrites (mg/l)

Year	Vranjina	Virpazar	Plavnica	Kamenik	Podhum	Starčevo	Moračnik	Ckla	Middle
2006	>0.02	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
2008	0.008	0.03	0.006	0.006	0.003	0.003	0.002	0.001	0.002
2009	>0.02	>0.02	>0.005-0.02	>0.005-0.02	<0.005	<0.005	<0.005	>0.005-0.02	<0.005
2010	0.012	0.009	0,008	0,007	0.005	0.006	0.005	0.001	0.006

VK (>0.02 mg/l) - Level is out of recommended classes, following Montenegrin legislation (Off. Gazette of RM, no. 2/07)
A3 (>0.005 - 0.02 mg/l) - Water with that concentration of nitrites can be used for the drink and food industry after intensive physical, chemical and biological treatments, with prolonged disinfection and chlorination.

Phosphates (mg/l)

Year	Vranjina	Virpazar	Plavnica	Kamenik	Podhum	Starčevo	Moračnik	Ckla	Middle
2006	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2007	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2008	0.08	0.18	0.13	0.06	0.05	0.14	0.17	0.14	0.07
2009	>0.05-0.1	>0.05-0.1	>0.1	>0.05-0.1	>0.05-0.1	>0.05-0.1	>0.05-0.1	<0.05	<0.05
2010	0.04	0.02	0.02	0.04	0.04	0.06	0.01	0.02	0.02

VK (>0.1 mg/l) - Level is out of recommended classes, following Montenegrin legislation (Off. Gazette of RM, no. 2/07)
A3 (>0.05-0.1 mg/l - Water with that concentration of phosphates can be used for the drink and food industry after intensive physical, chemical and biological treatments, with prolonged disinfection and chlorination

Detergents (mg/l)

Year	Vranjina	Virpazar	Plavnica	Kamenik	Podhum	Starčevo	Moračnik	Ckla	Middle
2006	-	-	-	-	-	-	-	-	-
2007	-	-	-	-	-	-	-	-	-
2008	>0.02-0.5	< 0.02	< 0.02	< 0.02	>0.02-0.5	>0.02-0.5	< 0.02	< 0.02	>0.02-0.5
2009	>0.02-0.5	>0.02-0.5	< 0.02	>0.02-0.5	>0.02-0.5	< 0.02	< 0.02	< 0.02	< 0.02
2010	0.012	0.023	0.008	0.009	0.003	0.002	0.009	0.00	0.003

VK (>0.5 mg/l) - Level is out of recommended classes, following Montenegrin legislation (Off. Gazette of RM, no. 2/07)
A3 (>0.02-0.5 mg/l - Water with that concentration of detergents can be used for the drink and food industry after intensive physical, chemical and biological treatments, with prolonged disinfection and chlorination.
- - parameter was not measured

Table 7 presentsthe results of monitoring of some parameters in Albania during the period 1999 to 2007. The data was derived from the annual reports of water quality monitoring on the Lake Skadar/Shkoder and rivers Buna and Drini and are very general. Different parameters were emphasised in the reports during different periods, thus a comparison between the different periods is impossible.

Table 7: Review of data regarding monitoring on Lake Skadar/Shkoder during the period 1999 – 2007.

Period	Sampling points	Parameters	Level
1999- 2002	??	Chemical oxygen demand	High values*
		Biological oxygen demand	
		Ammonium	
		Phosphates	
		Nitrates	Low concentration*
2003-2005	Shiroke Bajze Zogaj	Transparency	3.5–7.0 m
		Saturation with O_2	Water is not saturated with O_2
		Conductivity	221-328 ųS/cm
2005- 2007	Shiroke Bajze Zogaj	Transparency	1.8-6 m
		Disolved oxygen	6.4-9 mg/l
		Ammonium	0.01-0.085 mg/l
		Nitrates	0.04-0.28 mg/l
		Nitrites	0.015-0.030 mg /l
		Phosphates	0.007-0.009 mg/l
		Total P	0.008-0.030 mg/l

*Only this data was in report.

The results show that water quality in the lake varies in space and time. Most pollutants are brought by the Morača and Crnojevića Rivers as these are common places of disposal for poorly treated solid waste and waste water. The concentration of pollutants like ammonia and nitrites are high in the northern and north-western parts of the lake and near the entry points of the Morača (Vranjina, Virpazar, Plavnica). The concentration of pollutants shows seasonal variation, depending upon the weather and the flow of the tributary rivers. Different parameters change during different periods (from year to year), towards better or worse values. Eutrophication is not (yet) an issue as a result of the high turnover rate of the lake water, but stagnant corners near the Morača Delta and Zeta Plain are at risk. In recent years, a spreading of macrophytes has been determined, especially in the area of the mouth of the Morača river (increased area under floating willow trees), and in Bay Hum (reserves Pančeva oka and Crni žar). The reason for this phenomenon could be increased eutrophycation, as can be seen from the results of the measurement of levels of chlorophyll *a* (Fig. 5).

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 in Albania (Table 7).

Chlorophyll *a*

From the summarised results of the content of chlorophyll *a* in the Lake Skadar/Shkoder in the years 2004, 2007 and 2008 some general conclusions can be drawn (Perović, 2009):

- Chlorophyll *a* concentration was in the range: 0.15-39.8 μg/l.
- The open part of Lake Skadar/Shkoder (middle lake) had lower chlorophyll concentration in comparison with the shallower, more or less littoral parts.

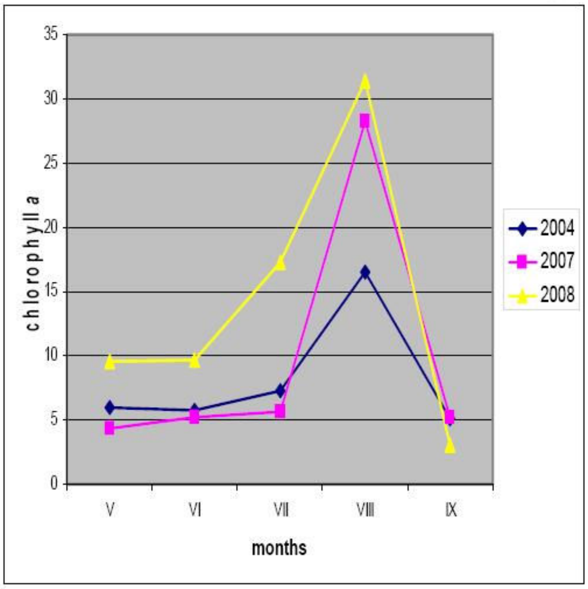

Figure 5: Chlorophyll *a* concentration (μg/l) in Lake Skadar/Shkoder during warm period of year (May-September) in different years: 2004, 2007 and 2008 (http://www.drimon.no/diversevedlegg/enduserworkshop2009vedlegg/3_skadar_shkodra_drimon.pdf).

- The average concentration of chlorophyll *a* (8 μg/l) ranks Lake Skadar/Shkoder as meso-eutrophic (OECD, 1982). But the warm period of the year (April–September) had average chlorophyll concentration of 10 μg/l, with the highest concentration in August (August monthly average is 23.98 μg/l), which indicates that generally during the warm period of the year Lake Skadar/Shkoder is on a eutrophic level.
- The concentration of the chlorophyll *a* in the lake is increasing with the years. From that it can be concluded that eutrophycation of the Lake Skadar/Shkoder is increasing.

2.5.1.2 Trends in PCB-s and PAH-s

Concentrations of PCB-s and PAHs in lake water, river water, groundwater, lake sediments and in tissue samples from various fish species living in Lake Skadar/Shkoder have been analysed during the last twenty years. Concentrations of PCB in surface waters were above the permitted limit in the Morača River between 1990 and 1995. **Recent measurements of PCB and PAH concentrations in water samples have been below the detection limit.** The reason for this is that these contaminants are hydrophobic (have low solubility in water) but it can concentrate in sediment and organisms. Results showed that the most contaminated sediment is from the deepest places in the lake (for example, Zogaj on the Albanian side). Recent investigations with the new passive sampling applications in Lake Skadar/Shkoder (as membrane enclosed silicone collector (MESCO II) and bare silicone collector (SR)) during the period 2006-2009, confirmed the presence of a number of PAHs in the Lake Skadar/Shkoder water. For some of them the concentrations in water ranged from 0.12-4.33 ng/l (source: University of Shkodra). These investigations were done in cooperation with the UFZ Centre for Environmental Research, Leipzig, Germany.

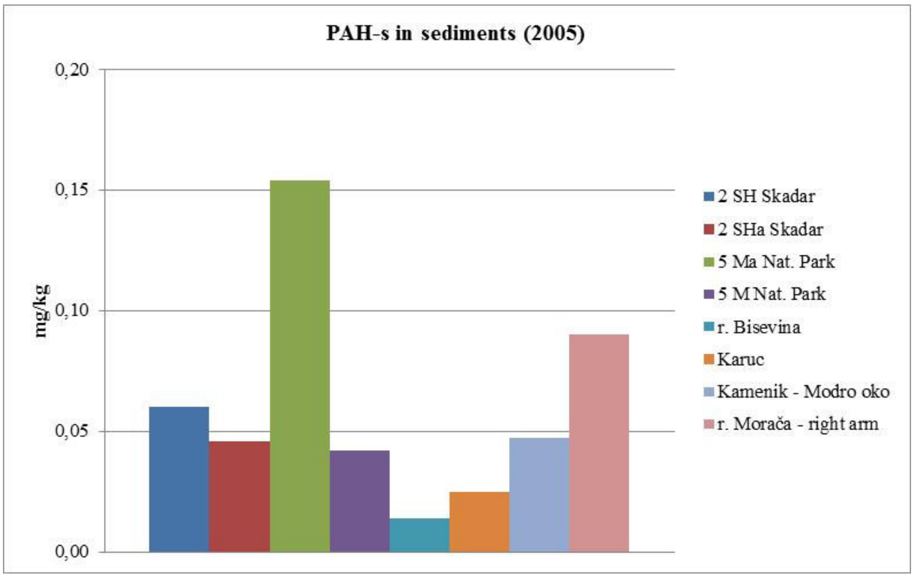

Figure 6: PAH-s in sediments at Montenegrin site of Lake Skadar/Shkoder and its tributaries in 2005 (source: TDA, 2006).

The concentrations of PCBs in fish meat, measured during the period 1990-1996, exceeded in some cases the permitted US EPA values for food consumption (2 ppm or mg/kg). A recent study from 2005, carried out within the joint project by the Universities of Heidelberg (Germany), Podgorica (Montenegro) and Shkodra (Albania), showed that the highest concentration of total PCBs was found in Rudd (*Scardinius erythrophtalmus scardapha*) being 200 µg/kg and that the lowest concentration was found in perch (*Perca fluviatilis*) being 35 µg/kg. (TDA, 2006)

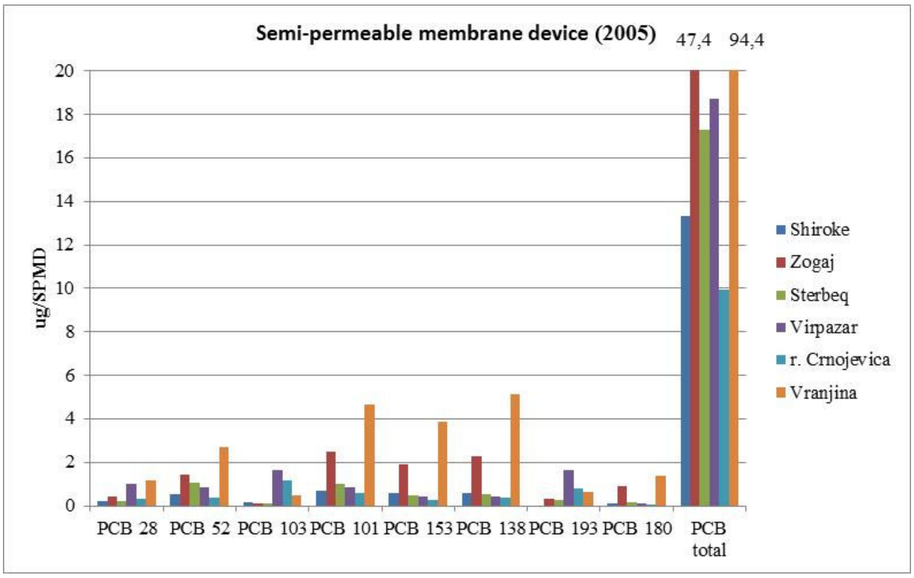

Figure 7:Average concentration of PCB-s in semi-permeable membrane device samples from Lake Skadar/Shkoder in 2005 (source: University of Shkodra).

The highest concentrations of PCBs in SPMD were measured at the locations Vranjina and Zogaj (Figure 7).

Recent data from Montenegro regarding PCBs in water and fishes (analysed in 2004 and 2005) show that concentrations of PCBs have decreased strongly since the 1990s. This is the result of a combination of the following: 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 by groundwaters due to the high permeability of the soil in the Zeta Plain, the high precipitation in the region during the last fifteen years and the high refresh rate of the lake water. PCBs end up partly in the lake sediments, where they can remain for a long time (TDA, 2006). 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. But these sporadic analyses without the same protocol (considering time of sampling, equipment, frequency of sampling, analysing methods etc.) cannot be used for determining a trend. The results are useful for defining the sampling points for future joint monitoring.

Concentrations of PAHs and PCBs cannot be compared with “European permissible values”, because they are not officially set. In accordance with the WFD, each member state of the EU has to establish in its legislation precise criteria (permissible limits for certain parameters) for assessing the ecological status of surface waters. Because of different geographical positions, geological background and other characteristics of certain countries, it is impossible to set a uniform threshold value for the EU. Consequently we can not compare the results of past monitoring measurements in Montenegro and Albania to "European permissible values”. The same finding is concluded for other pollutants.

2.5.1.3 Trends in trace elements

2.5.1.3.1 Water and sediment

The analysis of trace elements in the water of the Morača River, Crnojevića River and in the Lake Skadar/Shkoder in 1981 (and the years before) showed minimum concentrations of Na, K, Cu, Zn, Cr, Pb, Mn, Co, As, Hg and Fe. All analysed trace elements were below the Montenegrin MDK standards for drinking water (TDA, 2006).

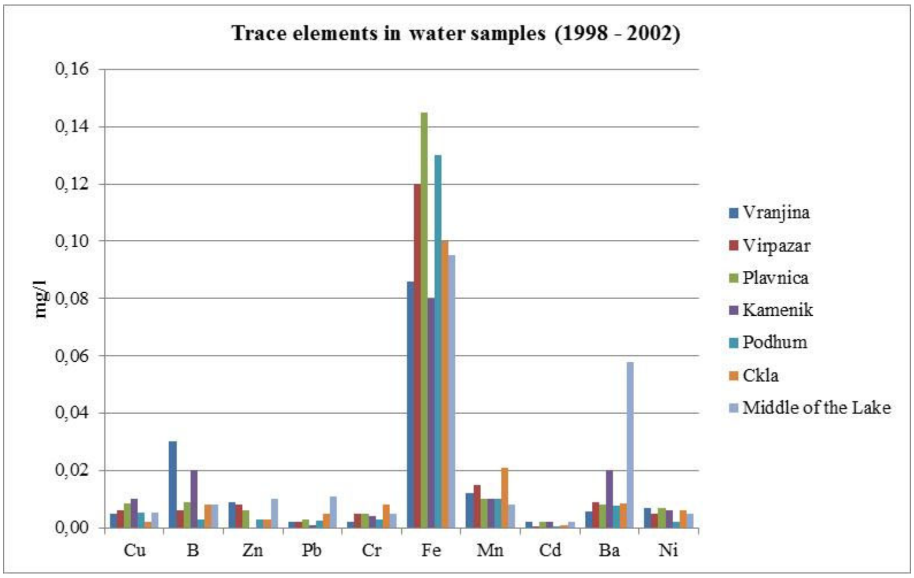

Figure 8:Average concentration of trace elements in water samples on Montenegrin site of Lake Skadar/Shkoder in the period 1998 – 2002 (source: CETI).

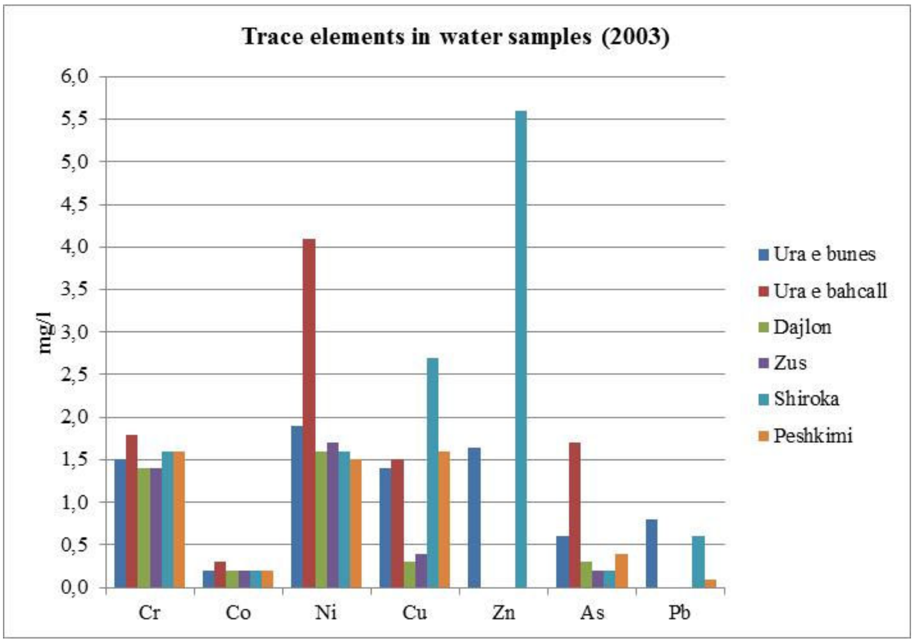

Figure 9:Average concentration of trace elements in water samples on the Albanian site of Lake Skadar/Shkoder in the year 2003 (source: University of Shkodra).

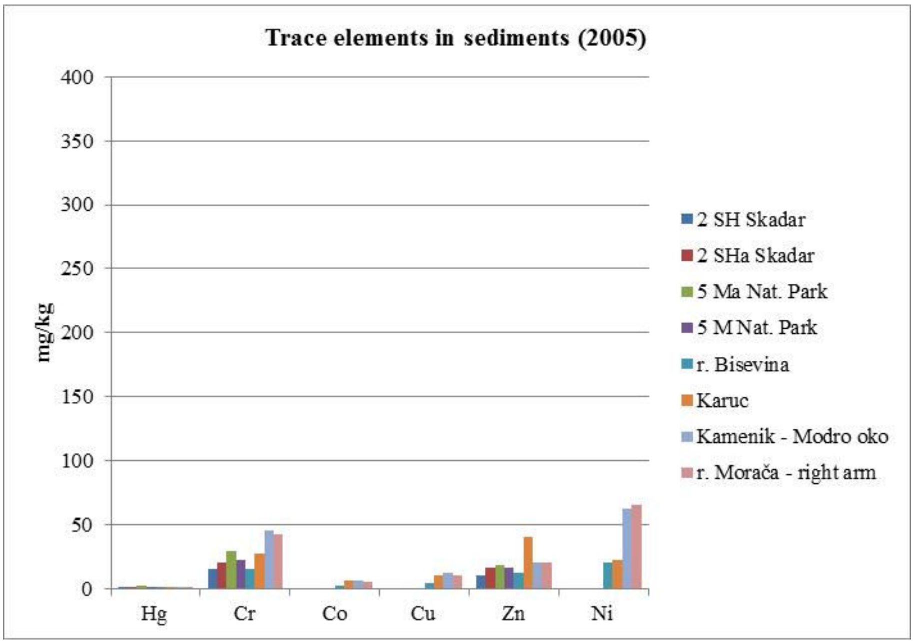

Figure 10: Average concentration of trace elements in sediments on the Montenegrin site of Lake Skadar/Shkoder in the year 2005 (source: CETI).

On the basis of the results shown in Figures 8 and 9 it can be concluded that the Albanian part of the lake is more polluted with trace elements. Because of the fact that there is no industry in the Albanian part of the lake, the most likely reason for this was the use of different methodologies and a lack of validations of methods. The validation of methods is therefore very important in order to determine the concentrations of substances as well as for the comparison of results. The same finding applies to sediments (see Figures 10 and 11).

On the Albanian side of Lake Skadar/Shkoder, the concentrations of Ni and Cr exceeded the EU background concentration, which is 100 mg/kg for Ni (Bowman and Harlock, 1998) and 62 mg/kg for Cr (Salomons and Forstner, 1984), while others were within EU background concentrations (Fig. 11). As was already emphasised, those results cannot be taken as accurate, because of the lack of validation of methods.

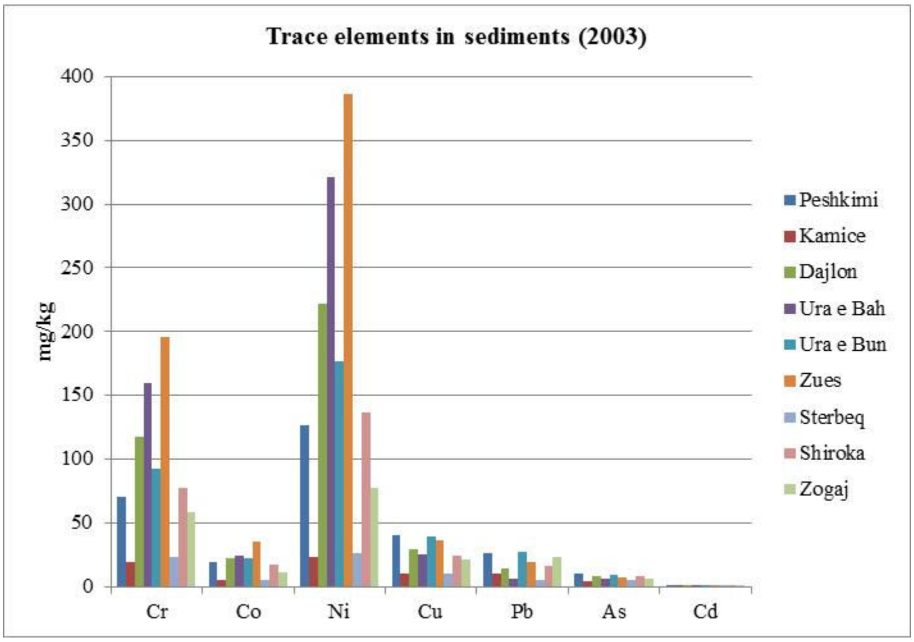

Figure 11: Average concentration of trace elements in sediments on the Albanian site of lake Skadar/Shkoder in the year 2003 (source: University of Shkodra).

Based on both recently collected and past data, the quality of the lake waters is at a satisfactory level according to the regulations on classification and categorisation of surface and underground waters (Official Gazette of the RM, No. 02/07) and previous legislation of Montenegro and Directives of European Community (Council Directive 75/440/EEC, Council Directive 78/659/EEC) in Albania, with certain exceeding of pollutants (locality as mouth of Morača River), which are more season dependent than a sign of permanent pollution. When making a comparison between Montenegrin legislation and the above mentioned European Directives used in Albania, it was found that limit values for a single parameter are equal or even more rigorous (for example for Ni, Co, Pb, SO4, etc.) in Montenegrin legislation.

2.5.1.3.2 Biota

In the past some macrophytes biotests were conducted and they revealed distinct changes in the growth behaviour of the two macrophytes subsequent to exposure to the investigated natural sediments of Lake Skadar. The *Myriophyllum* sediment contact test revealed significant toxicity in the sediment samples from Radus and Kamenik, whereas the aquatic Lemna test showed inhibition effects for the samples from Sterbeq, Plavnica and Kamice. Analyses of the heavy metal content in the sediments revealed low or moderate contamination levels. Correlation analyses between the content of heavy metals in the sediments and growth inhibition of *Myriophyllum aquaticum* showed a significant correlation between Cr concentrations and growth inhibition (Stešević et al., 2005).

2.5.2 STATUS OF BIODIVERSITY

2.5.2.1 Micro algae

The newest explorations of the phytoplankton community of Lake Skadar/Shkoder (last six years) affirm the presence of 214 genera with 1069 taxa, 98 of which belong to Cyanophyta/Cyanobacteria and 421 to Bacillariophyta (Rakaj, 2010). Regarding the trophy valences of the bioindicator species of Lake Skadar/Shkoder diatoms, the highest number belong to the oligo-mesotrophic and tolerant groups, which shows the lake to be in a good position for life.

2.5.2.2 Macrophytes

Macrophyte vegetation of the lake presumably plays an important role in nutrient cycling and provides shelter and substratum for the development of most animal and plant species. The dominant species are: *Phragmites communis* Trin., *Scirpus lacustris* (L.) Palla, *Nuphar lutea* (L.) Smith, *Nymphea alba* L. and *Trapa natans* L. (Lakusic and Pavlovic 1981; Ristic and Vizi 1981; Lakusic 1983).
The total number of aquatic macrophytes for the whole area of Lake Skadar is 164 species belonging to 66 genera and 43 families. Macrophyte vegetation is distinguished in zones (belts), which are more or less continued around the lake. In the zone of emerged plants the dominant plant species are: *Phragmites communis*, *Scirpus lacuster*, *Typha angustipholia* L.
Floating macrophytes which are dominant in Lake Skadar are: *Nymphaea alba* L., *Nuphar lutea* (L.) Smith., *Nymphoides peltata* (S.G.Gmel) O. Ktze., *Trapa natans* L., *Polygonum amphibium erectum* L., *Potamogeton natans* L., *Lemna minor* L., *Lemna major* L., *Lemna trisulca* L., and others. Three global and European threatened species (*Trapa natans*, *Marsilea quadrifolia* and *Caldesia parnassifolia*) and eight Balkan or local endemic species are evidenced (Rakaj, 2010) .
Submerged macrophytes which are dominant in the lake are: *Potamogeton perfoliatus* L., *Potamogeton lucens* L., *Potamogeton crispus* L., *Potamogeton pectinatus* L., *Potamogeton pusilus, Myriophillum spicatum* L., *Myriophillum verticilatum* L., *Ceratophyllum demersum* L., *Ceratophyllum submersum* L., *Vallisneria spiralis* L., *Najas marina* All., *Najas minor* All., *Chara* sp., *Nitella* sp. and others (Talevski et al., 2009).

2.5.2.3 Terrestrial vegetation

Around the lake, stands of willow (*Salicetum albae*) form the most abundant forests, mainly on the northern shore and in the flooding area. They are used by the local population for the production of wood for heating, construction and for wooden handicraft products. Forests of Skadar's oak (*Quercus robur* ssp. *Scutariensis*), which were widespread in the past, have substantially degraded. The most significant forest communities are domestic chestnut (Castanea sativa) and oak (*Querceto castanetum montenegrinum*), and European Turkey oak (*Quercetum confertae ceris*), as well as hornbeam (*Carpinetum orientalis*) with several sub-communities. Only degraded stands remain from the once well developed forests. According to the Habitat Directive, wet forests on the coast of the lake (44.4325 Montenegrin ash-oak-alder forests) constituted from endemic Skadar Oak *Quercus robur* ssp. *Scutariensis* are very important in the territory of the Skadar Lake National Park.

2.5.2.4 Invertebrates

The majority of Lake Skadar/Shkoder invertebrate groups have not been well researched. 257 species were described prior to 2001 (Pulević at al., Biodiversity database of the Lake Skadar/Shkoder, 2001).

2.5.2.5 Amphibian and Reptiles

15 amphibians and 30 reptile species have been identified in the area of the lake so far (Pulević at al, Biodiversity database of the Lake Skadar/Shkoder, 2001). The amphibian and reptile fauna of Lake Skadar/Shkoder 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 tesselata*), grey lizard (*Lacerta agilis*), wall lizard (*Podarcis muralis*), and green lizard (*Lacerta viridis*),
- Mediterranean endemic species: marsh turtle (*Emys orbicularis*), land turtle (*Testudo hermani*), *Hemydactylus turcicus*, karst lizard (*Lacerta melisellensis*), coastal lizard (*Lacerta sicula*), dark lizard (*Algyroides nigropuncatus*), lizard fish (*Ophisaurus apodus*), *Zemenis dahlii*, coastal Aesculapius' snake (*Zamenis gemmonensis*), coloured Aesculapius' snake (*Elaphe situla*), striped Aesculapius' snake (*Coluber quatrolineatus*), dark Aesculapius' snake (*Coelopeltis monspessulanus*), *Tarbophis fallax*, viper (*Vipera ammodytes*),
- Former Yugoslav endemic species: sharp-headed lizard (*Lacerta oxycephala*).

2.5.2.6 Fish

On the basis of the reference data of Lake Skadar/Shkoder about 50 fish species have been identified so far (Karaman and Beeton, 1981, Talevski et al., 2009). Other data show that the lake has 60 fish species belonging to 17 families (TDA, 2006). Autochthonous fauna is composed of 36 species. Among them are several marine migratory species. Alochthonous fauna is presented with 14 species, mainly from the so-called "Chinese complex", while only three species from European fauna were introduced here. The main economic species of fish in Lake Skadar/Shkoder is bleak, and also carp and eel. Participation of bleak in total annual catches is up to 50%. According to 1947–1977 statistics, the annual catch averaged 500 tons, and decreased to only 100 tons in recent years.

An assessment of fish stock has not been undertaken for three decades, so the extent of fishing and over exploitation are unknown, but the experience of fishermen and individual researchers indicates that changes in the composition of fish communities have occurred. There is evidence that some of the lake’s most valuable fish species are threatened and are declining due to over exploitation by increasing numbers of active fishermen and due to habitat degradation. Autochthonous fish is recovering after a decline in a period of uncontrolled fishing (1980s), but migratory species seem still to be affected by fishing, although not necessarily within the basin. Exotic invasive species are expanding rapidly. Because of that the assessment of the fish stock is a prerequisite to acquire accuiring insight into the ichtiofauna of the lake.

In the frame of Lake Skadar/Shkoder Integrated Ecosystem Management Project (LSIEMP), the Fishery Assessment is planned to be done in the next two years. This fishery assessment will analyze the state of the fishery of Lake Skadar/Shkoder, and provide information and guidance for achieving long-term protection and sustainable use, as well as achieving optimal short- and longer-term economic effects. The objective of the assignment is to survey and analyse the population dynamics of important fish species and the fisheries activities of Lake Skadar/Shkoder with a view towards establishing a long-term fisheries monitoring programme to inform and guide fishery management.

On the basis of the reference data of Lake Skadar/Shkoder, about 50 fish species have been described to date (Karaman and Beeton, 1981, Talevski et al., 2009). Other data shows that the lake has 60 fish species belonging to 17 families (TDA, 2006). Autochthonous fauna is composed of 36 species. Among these there are several marine migratory species. Alochthonous fauna is presented with 14 species, mainly from the so-called "Chinese complex", while only three species from European fauna were introduced here. The main economic species of fish in Lake Skadar/Shkoder is bleak, and also carp and eel. Participation of bleak in total annual catches amounts to 50%. According to 1947 – 1977 statistics the annual catch averaged 500 tons to decrease to only 100 tones in recent year.

Lake Skadar/Shkoder is the greatest fresh water lake with a short connection to Mediterranean Sea via the short and wide Bojana/Buna River in the eastern Mediterranean region. This is of great importance for anadromy fishes (fishes that live and grow in salt sea water and migrate to fresh water for spawning) such as in the case of Lake Skadar/Shkoder species *Acipenser nacarii*, *Acipenser sturio* and *Alosa fallax nilotica*. *Acipenser sturio* is on the list of Appendix I and II of the Bonn Convention while *Acipenser naccarii* is on the list of Appendix II of the Bonn Convention. Those two species are also listed as endangered or threatened species in Annex II of Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean. A very important migratory species in Lake Skadar/Shkoder is *Angulila anguilla* – because of its decreased population in Europe and Montenegro.

The anthropogenic influence on biodiversity of ichthyofauna in the Lake Skadar/Shkoder has been strongly expressed in the last 50 years of the twentieth century (overfishing, introduction of alochtonous species etc.). The changes that have occurred in Lake Skadar/Shkoder after new species introduction are enormous – the consequence was ichthyofauna reconstruction and with some species population volume has drastically dropped, and these species may vanish (Salmonidae, for instance). *Acipenser naccarii* and *Acipenser sturio* have not been caught in the lake for more than fifteen years and *Salmo marmoratus* for more than 20 years (sources: information from the field, from the MNE experts and management of Skadar Lake National Park and also a local fisherman).

Not all introduced species have adapted in the same way. German carp (*Carassius gibelio*) and perch (*Perca fluviatilis*) have because of the small number of their predators and competitors, and they have increased to the level that they have become economically interesting. Both of those species should be consider as invasive fish species. Perch are very abundant in the littoral area of the lake and they feed on smaller fishes and juvenile fish of bigger fishes. The littoral area is important for the fish fauna of the lake as a whole because it represents the growing region of almost all species. The new assessment of fish species' richness and abundance will show, if other alien fish species are also invasive in the lake at such a level that threatens the biodiversity of autochthonous fish species and other organisms in the lake, or if it contributes towards the low quality of the lake ecosystem. Those species must be then included in monitoring programmes that measure (for example increase fishing of those fish species) so that further damage on the ecosystem can be prevented in a timely fashion.

2.5.2.7 Birds

The lake is located on one of the major migratory flyways for Eurasian birds marked as the Adriatic Flyway. Ninety percent of 281 bird species are regionally and intercontinentally mobile, linking the region to neighbouring countries, Asia and Africa. Around 73 species of migratory nesting birds inhabit the lake in spring and summer, leaving in autumn, about 18 species fly over the area during autumn and spring, 45 species are regular winter guests and 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. More than 80 out of 281 bird species registered on the lake so far have breeder status (TDA, 2006).The richness of species and the large number of populations is caused by the geological and ecological specifics as well as by the relatively undisturbed ecosystem (http://www.nparkovi.co.me/NP%20Skadar%20lake%20Fauna.htm).

Lake Skadar/Shkoder is ilisted by the Ramsar Convention in The World's List of Wetlands of International Importance, as a birds' nesting site. One of the most important criteria for a so-called 'Ramsar site' is the so-called 1% criterion. This states that any site which regularly holds 1% or more of a population of wate rbirds qualifies as a wetland of international importance. Another Ramsar criterion which can only be met if regular, high quality counting takes place states that a wetland is Internationally Important if it regularly holds 20,000 or more water birds. According to Ramsar Convention criteria, wetland areas are of international importance, when they regularly support 20,000 water birds or 1% of the world population of any water bird species or subspecies. The 600 km^2 large shallow Lake Skadar/Shkoder with its large oscillations (Beenton 1981), fulfils the Ramsar Criteria for 10 water bird species (Great Crested Grebe (*Podiceps cristatus*), Black-necked Grebe (*Podiceps nigricollis*), Dalmatian Pelican (*Pelecanus crispus*), Great Cormorant (*Phalacrocorax carbo*), Pygmy Cormorant (*Phalacrocorax pygmeus*), Squacco Heron (*Ardeola ralloides*), Ferruginous Duck (*Aythya nyroca*), Common Coot (*Fulica atra*), Black-headed Gull (*Larus ridibundus*) and Whiskered Tern (*Chlidonias hybridus*) at present (Adriatic Flyway, 2010).

The capacity of Lake Skadar is more than 350,000 wintering water birds, with 220,000 counted in the 1990s in Montenegro alone (for example, Vasic et al. 1992). For fish-eating water birds, Lake Skadar is a very important site; especially Grebes and Cormorants are still present there in large numbers, while the Pygmy Cormorant reaches 16% of the European sides and Turkish population. Another specific value of the lake concerns species preferring large macrophyte carpets, such as Squacco Heron (*Ardeola ralloides*), Ferruginous Duck (*Aythya nyroca*) and Whiskered Tern (*Chlidonias hybridus*), as at least 30 km^2 are covered with macrophytes with floating leaves for example, *Trapa natans*, *Nymphaea alba* and *Nuphar luteum*. While the costal Albanian wetlands have lost most of their water birds at the end of the 20th century (Nowak 1980, Hagemeijer 1994, Vangeluwe et al. 1996, Zekhuis & Tempelman 1998), Lake Skadar/Shkoder has still preserved most of its values as a wetland for nonbreeding and breeding water birds along the Eastern Adriatic coast. Nevertheless, the actual midwinter numbers of 60,000–130,000 are much lower than 20 years ago, and disturbance is still increasing in the former inaccessible area (Iron Curtain) at the border and due to uncontrolled tourism based on motor yachting in Montenegrin National Park. Illegal hunting is widespread on both sides of the border.

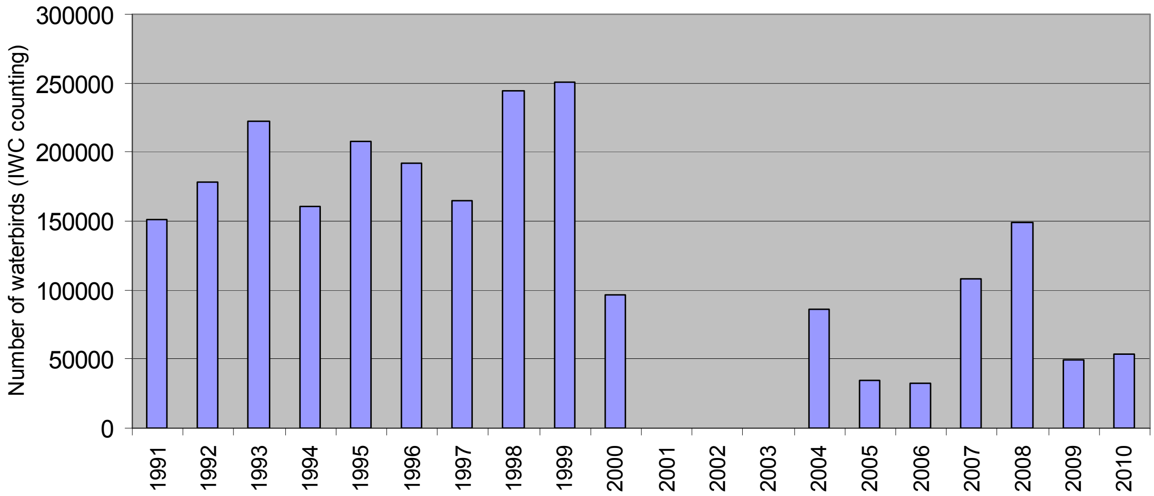

Figure 12: Result of IWC of Lake Skadar/Shkoder in the period 1991 - 2009. During 2001, 2002 and 2003 IWC was not conducted. (Data source: Saveljić, 2009).

Until 1999, approximately 150,000 birds wintered on the lake. However during the last 8 years an average of 76,000 birds were counted during winter. Nevertheless, many species still make several percentages of European population of wintering birds. Eleven species of aquatic birds in some years of IWC counting have crossed the census of 1% of regional populations (*Fulica atra*, *Phalacrocorax pygmeus*, *Podiceps nigricollis*, *Aythya fuligula, Aythya ferina, Bucephala clangula, Chlidonias hybrida, Tachybaptus ruficollis, Anas crecca*, *Anas plathyrhynchos*). This census is most pronounced at *Fulica atra*, with numbers during the winter throught the last 11 years reaching almost 9% of regional population (Saveljić, 2010). This data indicates that the significance of Lake Skadar/Shkoder for the wintering of some birds species is crucial for the survival of their populations in the region. However, the IWC results showed a drastic decrease in the number of all water species of birds in January 2010, so in counting in 2010 only *Phalacrocorax pygmeus* (1%) and *Fulica atra* (1.5%) have been wintering in significant number in comparison to regional populations (Saveljić, 2010).

More than one million birds fly over the lake in winter and thus during migrations we recommend to have evidences of the number of birds be on the lake during winter period and during the warmer period of the year. Amongst the bird species described in the lake, we suggest more detailed monitoring of significant breeding species, which have the status of threatened species according to the IUCN "red list" classification.

More than 80 of 281 bird species registered on the lake so far have the status of breeder. 40% of all breeding species in Montenegro breed on Lake Skadar/Shkoder. The most important breeding species on the lake are *Pelecanus crispus, Phalacrocorax pygmeus* and *Aythya nyroca* (Saveljić, 2009) and they could be used as indicator species of different disturbances. ***Pelecanus crispus*** is a globally endangered species and it is a trade mark of

Lake Skadar Shkoder. It breeds in colonies on islands in large reed beds. The breeding success of this bird on Lake Skadar/Shkoder is not at an appropriate level (Table 8).

Table 8: Number of breeding pairs of bird species *Pelecanus crispus* on the Lake since 1965 with breeding success, type of disturbances (F – flooding, H – hunting, E – egg collecting, P – predators, S – setlement, T – turism) and location of breeding (Saveljić, 2009).

Year	Number of pairs	Number of young birds	Breeding* success	Type of disturbance	Breeding place
1965	21	-	-	H	Pančeva oka
1967	30	-	-		-
1972	20	16 - 18	0.8 – 0.9		Pančeva oka
1973	24	18	0.7		Pančeva oka
1974	16	0	0.0	P	Pančeva oka
1975	29	11	0.4		Crni Zar
1977	52	46	0.9		Crni Zar
1978	-	0	0.0	F	Crni Zar
1979	-	3	?		-
1983	11	6	0.5		Crni Zar, Pančeva oka
1984	11	5	0.4		Crni Zar, Pančeva oka
1986	8	9	1.1		Crni Zar
1987	14	19	1.4		Crni Zar
1989	29	7	0.2		Crni Zar
1990	21	0	0.0	S	Crni Zar
1991	7	2	0.3	T	Grmozur
1992	15	11	0.7	T	Grmozur
2002	5	2	0.4		Pančeva oka
2003	7	10	1.4		Pančeva oka
2004					Pančeva oka
2005					Crni Zar
2006	-	0		F	Pančeva oka
2007		13 – 16		F (first breeding)	Crni Zar
2008	5 - 7	0		F	Crni Zar
2009	14 - 15	(8, later breeding)		F	Crni Zar

*number of young birds per 1 pair.

2.5.2.8 Mammals

Mammals related to Lake Skadar/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. The other mammals live mainly in the forested areas, and are predominantly located on the south-western shore of the lake and in the mountainous areas.

3 RECOMMENDATION FOR JOINT MONITORING PROGRAMME OF LAKE SKADAR-SHKODER

3.1 METODOLOGY FOR DEFINING THE JOINT MONITORING PROGRAMME

While the EU Water Framework Directive was the main document to be consider for preparing chemical and ecological monitoring of Lake Skadar/Shkoder, EU Bird Directive, EU Habitat Directive, UN Convention on Biological Diversity, Ramsar Convention on Wetlands, Bern Convention on the Conservation of European Wildlife and Natural Habitats and Bonn Convention on Migratory Species were the main documents for preparing a programme for monitoring biodiversity. All these conventions were ratified in Montenegro and Republic of Albania, with the exception of the UNECE Water Convention, which is not ratified by Montenegro.

1. Based on relevant literature and contacts with key stakeholders we assessed present monitoring activity on the lake, institutions that have been already conducting monitoring of the lake, mechanisms of data collection, monitoring reporting, data publishing and data availability and present cooperation between two countries (Montenegro and Republic of Albania) in data exchange.

2. Based on a survey of the lake and its surrounding area, data from literature and contacts with institutes (which have been already involved in monitoring and researches on Lake Skadar/Shkoder), we defined sites along the lake banks/shorelines:

- sensitive areas,
- point and non-point pollution sources,
- areas where rivers fall into lake,
- selection of exact sampling points for monitoring,
- areas with important habitats, where monitoring of biodiversity is requested from national and international legislation.

3. On the basis of the first two points, international standards for monitoring and national and European legislation (water framework directive), we made recommendations on improvement of existing monitoring programmes and made a framework of a prioritised joint annual monitoring programme, long term monitoring programme and monitoring programme for monitoring particularly sensitive areas. For this purpose we defined the:

- Sampling locations for taking samples of water, sediment and organisms with co-ordinates in national coordinative system (connection with sampling locations in the watershed area) (including map with drawn points)
- Sampling frequency
- Prioritised and recommended parameters (physical, hydromorphological, chemical and biological)
- Method for monitoring the impact from the lake surrounding area

- Periodic monitoring of particularly sensitive areas (parameters and monitoring frequency based on existing data and trends).

For each parameter, in accordance with consisting standard methodologies, we
- Defined methodology and equipment of sampling and of analysing, and
- Provided information on methods of preservation and storage of samples as well as safety procedures during collection of samples.

4. For monitoring of biodiversity we used literature data and cooperated with institutions or researchers, that have already been involved in the research of the biodiversity of Lake Skadar/Shkoder. We investigated to what extend a survey of flora and fauna at that area has been done (existence of recent biodiversity database of the Lake Skadar/Shkoder), which taxonomic groups were more investigated and where deficiencies were. Regarding our ascertainment we assessed, where screening survey (new check list) would be requested and where there is enough recent data to define indicator species and habitats, which could be used as important indicators of environmental pressures. We also defined, regarding characteristics of lake and characteristics of chosen indicators, the period of inventories of indicator species/habitats. The monitoring of biodiversity will be done taking into consideration EU Bird Directive, EU Habitat Directive, Ramsar Convention on Wetlands, Bern Convention on the Conservation of European Wildlife and Natural Habitats and Bonn Convention on Migratory Species and national legislation.

5. For the assessment of costs for joint annual monitoring programme and long-term monitoring programme, we evaluated the costs for all necessary activities (for example sampling, analytical work, material costs, publishing, etc.).

6. We identified institutions in charge of water/ecosystem and biodiversity monitoring in Montenegro and Albania (institutions which are listed in Annex II of ToR) and defined their roles and responsibilities, their capacities and their level of expertise for conducting monitoring, and made a list of their current equipment for monitoring, certificates they have obtained etc. We got that information via direct contacts with responsible persons at those institutions. We made a list of general requirements for the operators of monitoring (certifications, education and training requirements and experiences of staff etc.), laboratory equipment requirements, requirements of LOD (limit of detection) and LOQ (limit of quantification) for individual parameters, requirements for participation in proficiency testing schemes of laboratories, etc. On the basis of institution capacities, equipment, certifications and references we defined the requirements of and the opportunities available for each institution in conducting monitoring.

3.2 PARAMETERS/INDICATORS OF MONITORING

Indicators are a way of presenting and managing complex information in a simple, clear, manner that can form the basis for future action and can be readily communicated to internal or external stakeholders as appropriate. Indicators can detect pressures on water ecosystem and also changes in the state of biodiversity. Indicators are used to check whether the trends or issues of concern are occurring: they should be objective-led, and the information they provide should indicate the success or failure of actions, and then actions changed accordingly. Thus the choice of indicators is a key issue and their subsequent use is a very important issue. Indicators are a fundamental input to management feedback loops that adapt behaviour based on the results of monitoring and evaluation.

Indicators for the joint monitoring programme have their origin in different national, European and international documents, legislation and agreements. The origin of indicators is shown in the Table 9.

Table 9: Origin of the indicators in the joint monitoring programme.

Indicator	Origin
Quality elements for the classification of ecological status of Lake Skadar/Shkoder	Water Framework Directive and other directives that amended the WFD
Parameters for classification Lake Skadar/Shkoder as bathing waters	Council Directive 76/160/EEC concerning the quality of bathing water Directive 2006/7/EC (Bathing Water Directive) concerning the management of bathing water quality and repealing Directive 76/160/EEC.
The indicators for monitoring of biodiversity	Convention on Biological Diversity SEBI 2010 indicator set National List of indicators of Montenegro (not officially adopted) DCM no. 1189 date 18.11.2009 on "Rules and procedures for composing and implementation of Nation Environmental Monitoring in Albania Rulebook on the content of Annual Monitoring Programme for State of Nature and conditions that have to be met by companies authorized for conducting that monitoring (Official Gazette of Montenegro, no. 35/10) Red List Index for European species (IUCN categories) Bern convention (Annex I, Annex II) Bonn Convention (Annex II) List of National protected and endemic species
Indicator species within fish and birds and mammals	International Union for Conservation of Nature (IUCN) Red List of Threatened Species Annex I and II of the Bonn Convention Annex II of Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean Annex II and IV of Habitats Directive 92/43/EC Appendix I and II of the Bern Convention EU Bird Directive Decree on the protection of certain flora and fauna species (OG MNE, No. 76/06) Red Lists of Albanian Flora (ANONYMOUS 1997, 2007; VANGJELI, RUCI & MULLAJ 1995)
Habitat types	Habitats Directive 92/43/EC Annex I (habitat types) Ramsar Convention Catalogue of Habitats for Montenegro (draft) EUNIS classification of habitats 2004 – 3rd level

3.2.1 WATER QUALITY

According to the Water Framework Directive (WFD; European Union 2000) the member states of the European Union are obliged to assess and report on the ecological status of all bodies of water in lakes exceeding a surface area of 0.5 km^2. Ecological status, as defined by the WFD, is an expression of the ecological structure and functioning of a water body, as assessed through a number of different indicators of ecological quality, referred to as "quality elements". This status shall be determined by the biological quality elements phytoplankton, macrophytes and phytobenthos, benthic invertebrate fauna and fish. As supporting elements, the physical and chemical properties of the water bodies are to be used as well as the hydro-morphological situation of the lakes. For each of the biological quality elements, the taxonomic composition and abundance (as well as the age structure for the fish classification tool) of the taxa have to be determined, and five status classes (high, good, moderate, poor, bad) have to be defined following normative definitions in the directive. The determination of the ecological status has to be done type-specifically, that means for each type reference conditions have to be identified, and degradation has to be described by quantifying the deviation in species composition and abundance from those present at reference conditions.

In addition to ecological status for surface water bodies, chemical status for surface water bodies is also assessed according to the Water Framework Directive by compliance with environmental standards for the concentrations of chemicals known as "Priority Substances" and "Priority Hazardous Substances". There are two class categories associated with the assessment of chemical status, which are "good" and "failing to achieve good".

3.2.1.1 Obligatory quality elements for the classification of the ecological status of Lake Skadar/Shkoder

Biological elements

1. Composition, abundance and biomass of phytoplankton
2. Composition and abundance of other aquatic flora
3. Composition and abundance of benthic invertebrate fauna
4. Composition, abundance and age structure of fish fauna

Hydromorphological elements supporting the biological elements

1. Hydrological regime:
   - quantity and dynamics of water flow,
   - residence time,
   - connection to the groundwater body.

2. Morphological conditions:
   - lake depth variation,
   - quantity, structure and substrate of the lake bed,
   - structure of the lake shore.

Physico-chemical and chemical elements supporting the biological elements

1. General:
   - transparency,
   - thermal conditions,
   - oxygenation conditions,
   - salinity,
   - acidification status,
   - nutrient conditions.

2. Specific pollutants:
   - specific synthetic substances identified as being discharged into the body of water,
   - specific non-synthetic substances identified as being discharged in significant quantities into the body of water.

The mandatory Quality Elements specified in Annex V (1.2) of the EU Water Framework Directive are presented in Figure 13.

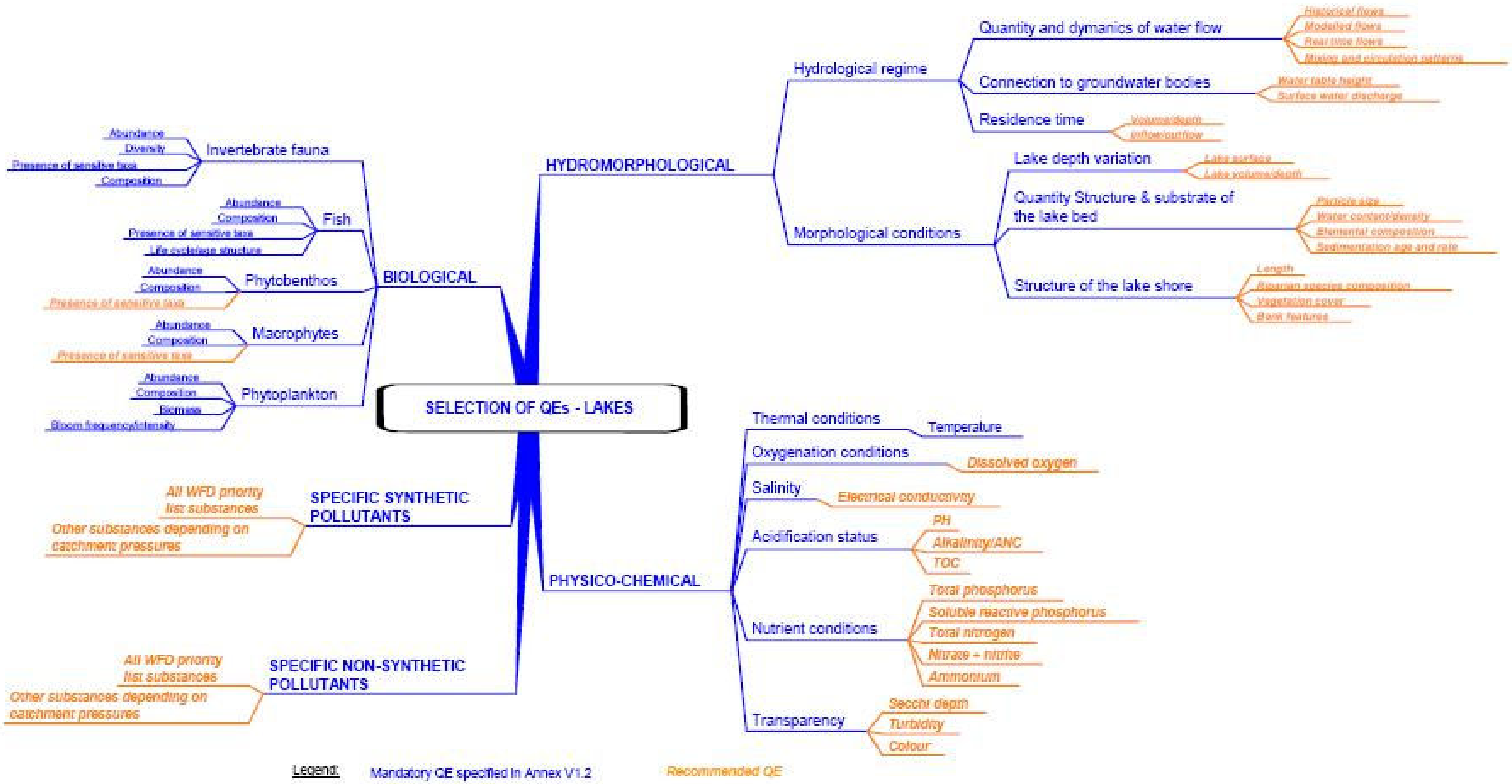

Figure 13: The mandatory Quality Elements specified in Annex V (1.2) of the EU Water Framework Directive (CIS Guidance on Monitoring 2003).

Biological quality elements

Phytoplankton is assumed to be the most essential BQE in assessment of ecological status or potential for lakes and reservoirs. The element is very dynamic and strongly dependent on nutrient concentrations, light intensity, temperature and other environmental factors.

Macrophytes and phytobenthos are an important part of the littoral system of lakes. They are primary producers and provide habitats for animals and stabilise sediments. As primary producers many of them are indicators of eutrophication; others are sensitive to acidification or salinity. According to the WFD's formulation, aquatic macrophyte flora and phytobenthos is an obligatory BEQ and its evaluation should include metrics taxonomic composition and abundance. They directly reflect the nutrient loads, transparency and sedimentation, as well as flow velocity, hydraulic parameters for rivers, depth for lakes, bottom substratum, altitude, floods, presence of herbivorous fishes, etc.

Benthic invertebrates are organisms with mainly restricted mobility and relatively long life cycles, which allows effective analysis of feedback to stress through time at a limited area. They are ideal indicative organisms, as their different taxa are related to different levels of water quality. Since being generally a well studied and ubiquitous group, reliable identification and prediction of response to stress is achievable. Benthic invertebrates play an essential role in key processes within lake ecosystems (food chain dynamics, productivity, nutrient cycling and decomposition: Reice and Wohlenberg, 1993). Benthic invertebrates form an important link between primary producers, detrital deposits and higher trophic levels in aquatic food webs (Brinkhurst, 1974; Stoffels et al., 2005). Any environmental changes in lakes, for example in nutrient concentrations, would be reflected by changes in the structure of the benthic invertebrate community (Carvalho et al., 2002).

Fish have proved their suitability as indicators of human disturbance for many reasons: 1) fishes are present in most surface waters, 2) The identification of fishes is relatively easy and their taxonomy, ecological requirements and life histories are generally better known than those of other species groups, 3) fish have evolved complex migration patterns making them sensitive to continuum interruptions, 4) the longevity of many fish species enables assessments to be sensitive to disturbance over relatively long time scales, 5) the natural history and sensitivity to disturbances are well documented for many species and their responses to environmental stressors are often known, 6) Fish generally occupy high trophic levels, and thus integrate conditions of lower trophic levels, 7) Fish occupy a variety of habitats in rivers: benthic, pelagic, rheophilic, limnophilic, etc., 8) Species have specific habitat requirements and thus exhibit predictable responses to human induced habitat alterations, 9) Depressed growth and recruitment are easily assessed and reflect stress, 10) Fish are valuable economic resources and are of public concern. Using fish as indicators confers an easy and intuitive understanding of cause/effect relationships to stakeholders beyond the scientific community.

Hydromorphological elements supporting the biological elements

Hydrologic regime - Changes with time in volume of water in lake. The hydrologic regime is closely related to seasonal changes in climate. In regions with a warm climate, the hydrologic regime is affected mainly by atmospheric precipitation and evaporation; in regions with a cold or temperate climate, the air temperature is a leading factor.

The hydrologic regime of lakes is determined by the relationship between the amount of precipitation reaching the lake's surface, evaporation, surface and underground flow into the lake, and surface and underground outflow of water from the lake, as well as by the size and shape of the lake, the pattern of change in the surface area with change in level, and wind activity, which determines the size of the waves and the extent to which the level rises and falls. Fluctuations in the lake level may be seasonal, annual, or short-term.

Morphological conditions - Morphometry relates to the shape of a lake basin and includes parameters needed to describe the shape of the lake such as volume, surface area, mean depth, maximum depth, maximum length and width, shoreline length, shoreline development (length of the perimeter, or shoreline divided by the calculated diameter of a circle of equivalent area (how convoluted the shoreline is)), depth versus volume and surface area curves. Lake morphology caused eutrophic conditions.

Physico-chemical and chemical elements supporting the biological elements

The transparency of the lake is necessary for the determination of the depth of the euphotic layer, where primary production exceeds respiration. Transparency is mainly affected by mineral turbidity, organic pollution (for example, urban discharges) and eutrophication; it can naturally vary due to local hydrodynamics, river discharge and seasonal plankton blooms. Secchi depth is a measurement of the transparency of water. Secchi depth is measured using a circular plate, known as a Secchi disk, which is lowered into the water until it is no longer visible. High Secchi depths indicate clear water; whereas low Secchi depths indicate cloudy or turbid water.

The **thermal condition** of the water column is relevant information for assessing mixing/stratification conditions, which strongly influence primary production as well as possible development of the oxygen deficiency. Temperature profiles along the water column can be easily obtained by means of in situ autographic instruments.

Oxygenation conditions - Dissolved oxygen concentration is subjected to high natural variability since its solubility depends on temperature and salinity. Deviation, in absolute value, of percentage saturation from 100 % is indicative of intense primary production and/or organic pollution.

Salinity in coastal waters can be subjected to high natural variability due to freshwater inputs and mixing of water masses, and due to tidal currents. Salinity measures in coastal waters can be used to detect freshwater ingressions from the continent. The dilution rate of near shore waters varies considerably in different areas and can be used, together with other quality elements to indicate potential pollution.

Status acidifikacije – Acidification occurs when the pH of the lake is lower than normal for that environment. Acidification of lakes is caused by nitrogen dioxide and sulphur dioxide emissions. Both gases dissolve in water producing highly acidic solutions. Rain is most acidic in areas of high population with heavy industry and with high traffic densities. Lakes which occur on limestone are able to resist acidification better than those based on harder rocks such as granite because limestone, essentially calcium carbonate, neutralises acids. Since limestone is also used as a construction material in statues, the erosion of monuments by acid rain is also commonplace, although the corrosive effect of localised pollution (foe example NO_2 produced directly or indirectly by car exhausts) may also be substantial.

Nutrient conditions - The concentration of nutrients, together with the concentration of chlorophyll *a*, is an indicator of actual production and provides information on the general trophic conditions. Natural variability of nutrient concentrations can be relevant on a seasonal basis; in coastal waters, high nutrient concentration, mainly related to riverine inputs, are indicative of eutrophication and/or organic pollution. Chlorophyll *a* concentrations can be used to determine a lake’s trophic status. Although trophic status is not related to any water quality standard, it is a mechanism for "rating" a lake’s productive state.

Specific pollutants – According to Annex II of the Directive 2008/105/EC, 33 substances or group of substances are on the list of priority substances including selected existing chemicals, plant protection products, biocides, metals and other groups like Polyaromatic Hydrocarbons (PAH) that are mainly incineration by-products and Polybrominated Biphenylethers (PBDE) that are used as flame retardants. Specific pollutants are defined as Priority substances (hazardous substances) or hazardous substance (extremely hazardous substances).

3.2.1.2 Parameters for classification of the Lake Skadar/Shkoder as bathing waters

The EU directive on the quality of bathing waters (76/160/EEC) aims to ensure that coastal and inland waters, which are commonly used for bathing, do not contain bacteriological or chemical contamination at levels that could pose a health risk. Adopted in 1976, the directive is one of the EU’s oldest environmental laws and has been the driving force behind a steady improvement in bathing water quality around Europe, as shown by the Commission’s annual bathing water reports published every spring.

- Following agreement between the Council and European Parliament in October 2006, a revised bathing water directive has been adopted which updates and simplifies the current standards. This new EU Directive on bathing water (2006/7/EC), concerning the management of bathing water quality and repealing Directive 76/160/EEC, will be implemented progressively.

Parameters:

- Intestinal enterococci (cfu/100 ml),
- *Escherichia coli* (cfu/100 ml),
- Cyanobacterial proliferation,
- Visually inspection.

When the bathing water profile indicates a potential for cyanobacterial proliferation, appropriate monitoring should be carried out to enable timely identification of health risks. When cyanobacterial proliferation occurs, and a health risk has been identified or presumed, adequate management measures should be taken immediately to prevent exposure, including offering information to the public.

Bathing waters should be inspected visually for pollution such as tarry residues, glass, plastic, rubber or any other waste. When such pollution is found, adequate management measures should be taken, including, if necessary, offering information to the public.

3.2.1.3 Proposition of joint monitoring programme of Lake Skadar/Shkoder according to EU Water Framework Directive

In order to assess the magnitude of the pressure on Lake Skadar/Shkoder, monitoring will include the following parameters:

- Parameters indicative of the biological quality element, or elements, most sensitive to the pressures to which the water bodies are subject
- All priority substances discharged, and other pollutants discharged in significant quantities
- Parameters indicative of the hydromorphological quality element most sensitive to the pressure identified

Table 10 contains a list of proposed quality elements and parameters of the ecological status of Lake Skadar/Shkoder.

Table 10: Proposed quality elements and parameters of ecological status of Lake Skadar/Shkoder.

Quality element	Parameter / Metric	Load indicated by the individual biological metrics
Biological quality elements		
phytoplankton	multimetric index of phytoplankton (MMI FPL)	nutrient loads
macrophytes and phytobenthos	trophici index (TI)	nutrient loads, salinity
benthic invertebrate	Hydromorphological littoral modification influence index (LHM)	hydromorphological changes
fish	The parameter has not been defined for lakes	
Hydromorphological quality elements		
morphological conditions	index of coast alteration	
Physico-chemical quality elements		
transparency	Secchi depth	
thermal conditions	water temperature	
oxygenation conditions	concentration of dissolved oxygen (O_2)	
	oxygen saturation value (%)	
total organic carbon	total organic carbon	
salinity	conductivity (25°C)	
acidification status	m-alkalinity	
	pH	
nutrient conditions	ammonium	
	nitrite	
	nitrate	
	total nitrogen	
	total phosphorus	
	orthophosphate	
	chlorophyll *a*	
Chemical quality elements		
specific synthetic and non-synthetic pollutants	see Table 11: List of specific pollutants involved in the monitoring programme of Lake Skadar/Shkoder	

In Table 11 the proposed list of specific pollutants involved in the monitoring programme of Lake Skadar/Shkoder is presented. The monitoring programme for Lake Skadar/Shkoder should include priority substances, which are recommended by WFD and other pollutants (those specific pollutants that could be discharged into Lake Skadar/Shkoder in significant quantities considering anthropogenic activities in the lake catchments (type of industry, settlements, agriculture etc.) and those pollutants, detected in water of Lake Skadar/Shkoder in previous analyses). Priority substances were defined as priority substances (harmful substances) or priority hazardous substances (extremely harmful substances). A list of specific pollutants involved in the monitoring programme of Lake Skadar/Shkoder is presented in Table 11. Parameters, which are recommended to be analysed in the sediment of inland waters (because of their characteristics enabling the determination of trends of pollution of chemical status, are listed in Table 11 with the letter "S".

Table 11: Proposed list of specific pollutants involved in the monitoring programme of Lake Skadar/Shkoder.

Parameter*	Definition of parameter	Assessment of trends
cadmium and its compounds	PHS	S
lead and its compounds	PS	S
mercury and its compounds	PHS	S
nickel and its compounds	PS	S
arsenic and its compounds	OP	S
zinc and its compounds	OP	S
boron and its compounds	OP	S
chrome and its compounds	OP	S
copper and its compounds	OP	S
antimony and its compounds	OP	S
molybdenum and its compounds	OP	S
aluminium	*	S
iron	*	S
polychlorinated biphenyls – PCB	OP	-
mineral oils	OP	S
adsorbable organic halogens - AOX	OP	-
chemical oxygen demand - COD	OP	-
sulphate	OP	-
fluoride	*	-
polyaromatic hydrocarbons	PHS	-
benzo(a)pyrene	PHS	S
benzo(b)fluoranthene	PHS	S
benzo(g,h,i)perylene	PHS	S
benzo(k)fluoranthene	PHS	S
indeno(1,2,3-cd)pyrene	PHS	S
anthracene	PHS	S
fluoranten	PS	S
naphthalene	PS	-
chlordane	OP	-
aldrin	OP	-
dieldrin	OP	-
endrin	OP	-
izodrin	OP	-
sum- DDT	OP	-
para-para-DDT	OP	-
izoproturon	PS	-

Parameter*	Definition of parameter	Assessment of trends
simazine	PS	-
atrazine	PS	-
diuron	PS	-
alachlor	PS	-
endosulfan	PHS	-
hexachlorobenzene	PHS	-
hexachlorobutadiene	PHS	-
pentachlorobenzene	PHS	-
hexachlorocyclohexane	PHS	-
tetrachloroethylene	OP	-
trichlorethylene	OP	-
trichlorobenzene	PS	-
trichloromethane	PS	-
benzene	PS	-
1,2-dichloroetan	PS	-
dichloromethane	PS	-
phenol	OP	-

Notes PS – priority substance according to WFD
PHS – priority hazardous substance according to WFD
OP – other pollutant according to WFD
*other possible pollutant according to pollution sources
S – parameter of chemical status, which is recommended to be analyzed in the sediment to determine trends of pollution. Those parameters will be included in the monitoring of particularly sensitive areas.

3.2.1.4 Proposition of joint monitoring programme of Lake Skadar/Shkoder according to the EU Directive on the quality of bathing waters

Table 12 proposes a list of parameters for classification of Lake Skadar/Shkoder as bathing waters according to the EU Directive on the quality of bathing waters.

Table 12: Proposed list of parameters for joint monitoring programme of Lake Skadar/Shkoder according to the EU Directive on the quality of bathing waters.

Parameter
Intestinal enterococci (cfu/100 ml)
Escherichia coli (cfu/100 ml)
Cyanobacterial proliferation
Visually inspection

3.2.2 BIODIVERSITY MONITORING

3.2.2.1 SEBI 2010 Biodiversity Indicators

One of the most widely recognised frameworks for biodiversity indicators is that of the Convention on Biological Diversity (CBD). A number of existing regional and national indicator initiatives have used the CBD framework in varying degrees to formulate their own biodiversity indicators sets. Some initiatives have used the CBD framework of focal areas and headline indicators, but have developed their own more specific indicators (measures). A good example of this is the pan-European initiative, SEBI 2010 (Streamlining European 2010 Biodiversity Indicators), where Albania and Montenegro are also included. Streamlining European 2010 Biodiversity Indicators SEBI 2010 was established to help streamline national, regional and global indicators and, crucially, to develop a simple and workable set of indicators to measure progress and help achieve the 2010 target at the European scale. SEBI indicators have subsequently been used in other policy relevant indicator sets such as the EEA Core Set of Indicators or the Environment Policy (http://biodiversity-chm.eea.europa.eu/information/indicator/F1090245995).

Table 13: SEBI 2010 indicators grouped by the Convention on Biological Diversity focal area.

Focal area	Headline indicator	SEBI 2010 specific indicator
Status and trends of the components of biological diversity	Trends in the abundance and distribution of species of main plant and animal taxonomic groups (micro algae, macrophytes, higher plants, invertebrates, fishes, amphibians, reptiles, birds, mammals)	1.Abundance and distribution of selected species
	Change in status of threatened and/or protected species - Red List Index for European species (IUCN categories), Bern convention (Annex I, Annex II), Bonn Convention (Annex II), List of National protected and endemic species	2.Red List Index for European species 3. Species of European interest
	Trends in extent of selected ecosystems and habitats	4. Ecosystem coverage 5. Habitats of European interest
	Trends in genetic diversity of domesticated animals, cultivated plants and fish species of mayor socio-economic importance	6. Livestock genetic diversity
	Coverage of protected areas - Nationally designated protected areas - Sites designated under the EU Habitats and Birds Directives	7. Nationally designated protected areas 8. Sites designated under tha EU Habitats and Birds Directives
Threats to biodiversity	Nitrogen deposition	9. Critical load exceedance for nitrogen
	Trends in invasive alien species (abundance of invasive alien species)	10. Invasive alien species in Europe
	Impact of climate change on biodiversity, on temperature-sensitive species	11. Impact of climatic change on bird population
Ecosystem integrity and ecosystem goods and services	Marine Trophic Index	12. Marine Trophic Index of European seas
	Connectivity/fragmetation of ecosystems	13. Fragmentation of natural and semi-natural areas 14. Fragmentation of river systems

Focal area	Headline indicator	SEBI 2010 specific indicator
	Water quality in aquatic ecosystems	15. Nutrients in transitional, coastal and marine waters 16. Freshwater quality
Sustainable use	Area of forest, agriculture, fishery and aquaculture ecosystems under sustainable management:	17. Forest: growing stock, increment and felings 18. Forest: deadwood 19. Agriculture:nitrogen balance 20. Agriculture:area under management practices potentially supporting biodiversity 21. Fisheries: European commercial fish stocks 22. Aquaculture: effluent water quality from finfish farms
	Ecological footprint of European countries	23. Ecological footprint of European countries
Status of access and benefits sharing	Percentage of European patent applications for inventions based on genetic resources	24. Patent applications based on genetic resources
Status of resource transfers	Funding to biodiversity	25. Financing biodiversity management
Public opinion	Public awareness and participation	26. Public awareness

The European Commission has used the SEBI 2010 indicator set to support its assessment of progress in implementing the Biodiversity Action Plan.

3.2.2.2 Proposition of joint monitoring programme of Lake Skadar-Shkoder according to EU Bird Directive, EU Habitat Directive, UN Convention on Biological Diversity, Ramsar Convention on Wetlands, Bern Convention and Bonn Convention

Modified set of SEBI 2010 indicators are suggested as appropriate for be monitoring the area of Lake Skadar/Shkoder (Table 14).

Biodiversity Indicators for monitoring biodiversity of Lake Skadar/Shkoder will cover four focal areas:

- Status and trends of the components of biological diversity,
- Threats to Biodiversity,
- Ecosystem integrity and ecosystem goods and services,
- Status of resource transfers.

Table 14: Modified set of SEBI 2010 indicators grouped by the Convention on Biological Diversity focal area according to Lake Skadar/Shkoder.

Focal area	Indicator
Status and trends of the components of biological diversity	Trends in the abundance and distribution of species of main plant and animal taxonomic groups (micro algae, macrophytes, higher plants, invertebrates, fishes, amphibians, reptiles, birds, mammals)
	Change in status of threatened and/or protected species - Red List Index for European species (IUCN categories), Bern convention (Annex I, Annex II), Bonn Convention (Annex II), List of National Protected and Endemic species
	Trends in extent of selected ecosystems and habitats
	Coverage of protected areas - Nationally designated protected areas - Sites designated under the EU Habitats and Birds Directives
Threats to biodiversity	Trends in invasive alien species (abundance of invasive alien species)
	Fragmentation of habitats
	Disturbances
	Impact of climate change on biodiversity, on temperature-sensitive species
	Pollution-eutrophication
Ecosystem integrity and ecosystem goods and services	Water quality in aquatic ecosystems
Status of resource transfers	Funding to biodiversity

3.2.2.2.1 Status and trends of the components of biological diversity

1. **<u>Trends in the abundance and distribution of species of main plant and animal taxonomic groups</u>**

Populations of all species are naturally dynamic and fluctuate over time. The degree to which they change depends on a complex interaction between the biology of the species and the ecosystem in which they live. Some changes in environmental conditions can be beneficial and lead to an increase in population size. On the other hand, extreme circumstances can result in a catastrophic decrease in abundance leading to a species becoming locally extinct. The distribution or range of a species can also change over time and either expand or contract over time. Both species abundance and species distribution are closely linked to measures of factors that affect the status of species, either positively or negatively. These include changes in the extent of habitat, habitat fragmentation, water quality, invasion by alien species, coverage of protected areas and harvesting by humans. By tracking trends in population size, indicators based on species abundance therefore not only monitor the trends within those species but also changes in the ecosystems in which they live. (http://www.twentyten.net/indicators)

Proposition of joint monitoring programme of plant and animal taxonomic groups of Lake Skadar/Shkoder

It would be too complex and expensive to measure the biodiversity of all taxonomic groups. For this reason particular species (groups) are used to represent biodiversity in general and their response to threats in the environment will be monitored.
Among a high number of species, it is necessary to make a selection of species that are considered to be of specific conservational concern, socalled "target species". Target species are defined as species of European importance, which fulfil at least one of the criteria: The Bern Convention (Emerald Network), the Habitat Directive for the conservation of wild animal and plant species and natural habitats (Natura 2000), listing on IUCN Red lists and endemism. Regarding fish also invasive and economic important species are consider.
For that reason the **statuses of phytoplankton, macrophytes, fish and birds, and the statusesof some indicator species within fish, bird and mammal species** are selected.

Fish indicator species

Amongst the fish species described in the Lake Skadar/Shkoder, we suggest monitoring of endemic species and species, which have the status of being threatened species regarding IUCN "red list" classification, migratory species, invasive alien species and economically important species. Potential species for monitoring were chosen from known lists of species in the lake (Mrdak et al., 2001; Miller and Šanda, 2008; Marić, 1995; Kovačić and Sanda, 2007; Knežević, 1985; Ivanović, 1973; Bianco and Kottelat, 2005; Mrdak, 2009; Talevski et al., 2009). Some species were determined years ago and have not been examined again since then, thus a new assessment of the fish species diversity in the lake will be a base for the improvement of the list in the future.

1. ***Salmo cf. trutta*** The Rijeka Crnojevića and Oraovštica River population is characterised with unique mitochondrial DNA haplotype, ADRc. That trout have small population size related only for those two river inflows, which are small and short. This haplotype and morphology of trout doesn't exist in other rivers of MNE Adriatic drainage.
2. ***Salmo marmoratus*** Although this species is typical for the Morača, Zeta and Cijevna rivers (Adriatic drainage), this species was previously present in Lake Skadar/Shkoder. Nowadays this fish has become extremely rare in the lake. It is an endemic species in eastern on the eastern Adriatic coast.
3. ***Salmo obtusyrostris***, formerly known as *Salmothymus obtusyrostris zetensis*. It now lives only in the Zeta River. This fish is an endemic species of the Neretva, Krka, Zrmanja and Zeta river basins. It used to live in Lake Skadar/Shkoder in the past. This fish species is protected by the Montenegrin Decree on the protection of certain flora and fauna species (OG MNE, No. 76/06) and monitoring of this species should be done on the Zeta River.
4. ***Telestes montenigrinus***, formerly known as L*euciscus souffia montenegrinus.* It is an endemic species of the MNE Ardiatic watershed. Species mainly occur in flowing water and in the nearby mouth of smaller or bigger Lake Skadar/Shkoder inflows.

5. ***Pelasgus minutus,*** formerly known as as *Phoxinellus stimphalicus montenegrinus*. It is an endemic species of the Albanian, Macedonian and Montenegrin Adriatic watersheds. It inhabits lake inflows and smaller streams, preferring still water parts.
6. ***Scardinius knezevici*** Endemic species of Lake Skadar/Shkoder lives in coastal area of whole lake and forms huge shoals in lake crypto-depressions during winter (lake deep bays) as well as in deeper habitats of lake inlets
7. ***Acipenser naccarii*** Migratory species that enters the Lake for spawning, is highly endangered in its whole living area and according to the IUCN categorisation, it is threatened as Critically Endangered A2bcde;B2ab(i,ii,iii,iv,v). This fish species is protected by the Montenegrin Decree on the protection of certain flora and fauna species (OG MNE, No. 76/06). It used to be numerous in the lake in the past, but nowadays its number has drastically decreased.
8. ***Acipenser sturio*** Migratory species that enters the Lake for spawning is highly endangered in its whole living area and according to IUCN categorisation it is threatened as Critically Endangered A2cde;B2ab(ii,iii,v). This fish species is protected by Montenegrin Decree on the protection of certain flora and fauna species (OG MNE, No. 76/06). It used to be numerous in the lake in the past but nowadays its number has drastically decreased.
9. ***Alosa agone*** formerly known as *Allosa fallax nilotica*. It is a migratory species that enters the lake for spawning in late spring. It used to be an important fishery species, but nowadays, due to its lower abundance, not any more.
10. ***Alburnoides ohridanus***, formerly known as *Alburnoides bipunctatus ohridanus.* It is endemic species in the Ohrid and Lake Skadar/Shkoder catchment areas. It inhabits lake inflows and areas near inflow mouths.
11. ***Alburnus alborella***, formerly known as *Alburnus alburnus alborella*. It lives in the Adriatic catchment area and represents one of two most important fishery species from the Lake Skadar/Shkoder.
12. ***Barbus rebeli***, sometimes reffered to as *Barbus peloponnesius* or *Barbus meridionallis*. It lives in the Adriatic catchment and the drainage area of Ohrid and Lake Skadar/Shkoder. It is a riverine and lacustrine species, which is more frequent in the lower part of Lake Skadar/Shkoder inlets and near rivers confluences.
13. ***Pachychilon pictum*** It is endemic species for Lake Skadar/Shkoder and Ohrid Lake catchment areas.
14. ***Barbatula zetensis***, formerly known as *Barbatula barbatula sturanyi*. It is an endemic fish in the Lake Skadar/Shkoder catchment area. It lives in the mouths of lake tributaries.
15. ***Anguilla anguilla*** It is a critically endangered species in Europe-wide. Lake Skadar/Shkoder is one of its main habitats for adults in this part of the Mediterranean region. This fish also represent an important fishery species on lake and due to the high price of this species, it plays an important role in the yearly incomes of Lake Skadar/Shkoder fishermen.
16. ***Perca fluviatilis*** It is an alien and highly invasive species in Lake Skadar/Shkoder. Due to the absence of any abundant carnivore fish species in the lake, the population of this fish has drastically increased in number. In the last ten years, fishermen have come to consider this species as fishery attractive due to its extremely high abundance in the littoral lake area.

17. ***Carassius gibelio***, former known as *Carassius auratus gibelio*. It is an alien and highly invasive species that reached extremely high abundance in Lake Skadar/Shkoder during 90's of the last century. Nowadays it still has high abundance in the lake, but it is significantly lower. Due to its parthenogenesis type of breeding, it is extremely invasive and resistant to fishery pressure.
18. ***Ameiurus nebulosus***, formerly known as *Ictalurus nebulosus*. It is an alien and highly invasive species, but its abundance is still relatively low in the lake. It occurs in almost all type of aquatic habitats. It is not an interesting fish for fishery.
19. ***Cyprinus carpio*** It is the most important fishery species of Lake Skadar/Shkoder. It was probably introduced into the lake centuries ago, but there are is no written data for this presumption.

Table 15: Potential fish species for monitoring of fish biodiversity (www.iucnredlist.org; Mrdak et al., 2001; Miller and Šanda, 2008; Marić, 1995; Kovačić and Sanda, 2007; Knežević, 1985; Ivanović, 1973; Bianco and Kottelat, 2005).

Species	Endemic for Lake Skadar/Shkoder	Endemic for Ohrid-Skadar lake system	[1]IUCN Red List Status (Endangered or Criticaly Endagered)	Fishery important	Migratory	Invasive alien species
***Salmo cf. trutta* (ADRc haplotype)**	+	+				
Salmo marmoratus		+				
Salmo obtusyrostris	+	+	+			
Telestes montenigrinus	+					
Pelasgus minutus		+				
Scardinius knezevici	+	+		+		
Acipenser naccarii			+		+	
Acipenser sturio			+		+	
Alosa agone				+	+	
Alburnoides ohridanus		+				
Alburnus alborella				+		
Barbus rebeli						
Pachychilon pictum		+		+		
Barbatula zetensis	+	+				
Anguilla anguilla			+	+	+	
Perca fluviatilis				+		+
Carassius gibelio				+		+
Ameiurus nebulosus						+
Cyprinus carpio				+		

In this approach, local endemism of species was used as the most important criterion for choosing fish species for biodiversity monitoring. The second criterion was that the species is Critically Endangered according to the IUCN classification, because this could lead to potential biodiversity loss. On the list of species migratory (katadromus or anadromus species) and invasive (alochthonus invasive species) species of the Lake Skadar/Shkoder were also included. Using those criteria we chose these species for the biodiversity monitoring programme:

1. *Salmo cf. trutta* (ADRc haplotype)
2. *Salmo obtusyrostris*
3. *Telestes montenigrinus*
4. *Scardinius knezevici*
5. *Acipenser naccarii*
6. *Acipenser sturio*
7. *Barbatula zetensis*
8. *Anguilla anguilla*
9. *Perca fluviatilis*
10. *Carassius gibelio*
11. *Ameiurus nebulosus*

Bird indicator species

About 90% of the Lake Skadar/Shkoder bird species belong to the migratory part of the lake's ornithofauna. The lake is located on one of the major migratory flyways for Eurasian birds marked as the Adriatic Flyway. The richness of species and the large number of populations are caused by the geological and ecological specifics as well as by the relatively undisturbed ecosystem (http://www.nparkovi.co.me/NP%20Skadar%20lake%20Fauna.htm). Lake Skadar/Shkoder is of global importance as one of the largest European wintering areas for birds and also about 18 species simply fly over the area during autumn and spring.

Significant nest birds

More than 80 of 281 bird species registered on the lake so far have the status of breeder. 40% of all breeding species in Montenegro breed on Lake Skadar/Shkoder. The most important breeding species on the lake are *Pelecanus crispus, Phalacrocorax pygmeus* and *Aythya nyroca* (Saveljić, 2009) and they could be used as indicator species of different disturbances. All those species are threatened according to the IUCN categories, *Pelecanus crispus* is categorised as a vulnerable species while *Aythya nyroca* as a near threatened species in the world (Table 10). *Pelecanus crispus* and *Aythya nyroca* are on the list of Annexes I and II of the Bonn Convention, while *Phalacrocorax pygmeus* on the list of Annex II of the Bonn Convention. *Phalacrocorax pygmaeus* and *Pelecanus crispus* are also listed as endangered or threatened species in Annex II of Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean.

Pelecanus crispus is a globally endangered species and it is a trade mark of Lake Skadar Shkoder. It breeds in colonies on islands in large reed beds. The breeding success of this bird in Lake Skadar/Shkoder is not at an appropriate level (Table 12). The main threats for successful breeding are: wetland alteration, flooding of eggs because of water level fluctuation, hunting, eggs collection, predators and disturbance by tourist, ornithologist and fishermen. The Table 12 shows that only in the years 1986, 1987 and 2003, some pairs of pelicans had nesting success of greater than one bird. *Pelecanus crispus* breed on Lake Skadar/Shkoder on floating turf islets in Pančeva oka reserve. Those islets are located in the vegetation of willow trees *Salix alba, S. fragilis* and other lake vegetation (*Typha angustifolia, T. latifolia, Phragmites australis*). The colony is always mixed with Great Cormorants, *Phalacrocorax carbo*; Pygmy Cormorants, *P. pygmeus*, Little Egret, *Egretta garzetta* and Squacco Heron *Ardeola ralloides*. Nests are located close to open water because this heavy bird needs a runway for taking off and landing. The second colony is occasionally located in Crni žar reserve (Saveljić, 2009). These are exclusively fish-eating species, feeding with small fish.

Phalacrocorax pygmeus Lake Skadar/Shkoder is one of its three breeding places in Montenegro. The species occurs in reed beds, transition zones between reed beds and open waters, extensively grazed or mowed shores and wet meadows and, in winter, in coastal wetlands, along rivers, and sometimes on inland lakes. On Lake Skadar/Shkoder, it breeds in mixed colonies with Great Cormorant, *Phalacrocorax carbo*; Little Egret, Grey Heron, Squacco Heron and Night-heron: *Ardeola ralloides*, *Ardea cinerea*, *Egreta garzetta*, *Nycticorax nycticorax*, and pelicans *Pelecanus crispus*. On the Lake Skadar/Shkoder it breeds in Panceva oka and Crni žar reserves and occasionally in Manastirska tapija reserve. In 2007, a small mixed colony with cormorants was discovered in Ckla. The colony from Pančeva oka moves on average every third year to Crni žar and back. Most probably, the reasons are disturbance by tourists, setting fire to reeds in reserves and disturbance by fishermen. Pygmy Cormorant breeds from the beginning of April until June. There are four eggs in a nest. Nests are to be found in the trees of aider, *Alnus* sp. and willow, *Salix* sp., always on a level beyond or together with the colony of its relative Great Cormorant, *Phalacrocorax carbo*. Water fluctuation can have an impact on breeding success if it is drastic, i.e. if it exceeds 30-40 cm in the period from March to June. This bird eats only fish up to 15 cm long. The species is threatened by habitat destruction (the degradation of wetlands through drainage for agriculture and changes in hydrological regime). It also suffers persecution from the aquaculture industry.

Aythya nyroca

There is less data on the ecology of breeding and movements of this bird on Lake Skadar/Shkoder. It is less studied than other waterfowl. Ferruginous duck breeds in vegetation of the northern part of the Lake Skadar/Shkoder and is not strictly connected to reserves. The number of breeding pairs of this bird on the lake is estimated and does not exceed 50 pairs (Saveljić, 2009)

Aythya nyroca inhabits shallower, well-vegetated wetlands of various kinds, with rich biodiversity and a diversity of microhabitats (Petkov 1997). According to Kantrud & Stewart (1984), the most sensitive to changes in the wetland ecosystem are those bird species that: a) nest in the periphery of the wetlands or close to water; b) forage in mudflats; c) require structured vegetation of the wetland and a certain water regime. All these are typical characteristics of the Ferruginous Duck. Research at Srebarna Lake showed that Ferruginous Duck numbers are closely related to water and limnology parameters, and reflect the ecological changes in the wetland. So far there has been no proof that a single bird species can indicate the integrity of a wetland ecosystem, but species with specific ecological requirements regarding their habitats can be used for bioindication purposes (Adamus 1996). It is probable that the specific habitat conditions in the wetland that favour the breeding requirements of the Ferruginous Duck – fairly large expanses of reed beds, mosaic vegetation etc. are favourable for other breeding species as well and thus the changes in the Ferruginous Duck population may indicate problems for other breeding species, which are more difficult to record and assess or have smaller populations. Breeding grounds are re-occupied from mid March to early May. The species forms monogamous pair bonds of seasonal duration. The nest is usually located on the ground close to water, or above water or on floating rafts of dense reeds and other aquatic vegetation. A single clutch is laid containing 7-10 eggs. The key threat is the loss of its wetland habitat of well vegetated shallow pools through drainage, abandonment or intensification of fishponds, development of dams and building of infrastructure on flood plains. Increased drought due to global climate changes may pose a problem to the species in part of its range. Hunting is also a serious threat.

In Table 16 the indicator bird species, which are also good indicators of different changes in environment, are listed. The list of species will have to change in the future regarding the changes of the status (IUCN categories) of certain bird species and changes in the biodiversity of bird species (for example, if a new endangered species or important breeder will be detected in the area of Lake Skadar/Shkoder).

Table 16: Indicator bird species and their status at the Lake Skadar/Shkoder.

	[1]SPEC status	[2]Ramsar	[3]IUCN cat	Legal protection			Endemic in EU	Status at the Lake Skadar/ Shkoder
Species				[4]Bern	[5]Bonn	[6]Bird direct		
Pelecanus crispus	1	1%	VU	II	I, II	I	1	Significant breeding bird
Aythya nyroca	1	2.3%	NT		I, II	I		Significant breeding bird
Phalacrocorax pygmeus	2 (1?)	17%	LC	II	II	I	1	Significant breeding bird

Legend:

[1]SPEC - Bird species of conservation concern in Europe on the European scale (SPEC categories: SPEC 1 – Species of global conservation concern, i.e. classified as globally threatened, Near Threatened or Data Deficient (BirdLife International 2004a; IUCN 2004), SPEC 2 – Concentrated in Europe and with an Unfavourable Conservation Status, SPEC 3 – Not concentrated in Europe, but with an Unfavourable Conservation Status. (Tucker and Heath 1994).

[2]Ramsar WCP4 – Numerical criteria of the Ramsar Convention (more than 1% of world population)

[3]IUCN categories – LC (least concern), NT (near threatened), VU (vulnerable), EN (endangered), CE (critical endangered), EW (extinct in the wild), EX (extinct), DD (data deficiencies). IUCN Red List of Threatened Species. Version 2010.4. <www.iucnredlist.org>.

[4]Bern Convention: II - Appendix II (strictly protected fauna species)

[5]Bonn Convention: I – Appendix I (Migratory species threatened with extinction)
II - Appendix II (Migratory species that need or would significantly benefit from international co-operation)

[6]Bird Directive: I: Member States should classify Special Protection Areas (SPAs) for those species listed in Annex I of Bird Directive as well as for migratory bird species.
II: Bird directive regulates the hunting of certain species listed in Annex II and sets the limits within which Member States can define their hunting season, by saying hunting should not take place during the breeding seasons or during the return migration (in the case of migratory species).

Mammal indicator species

Only a few mammals are strongly linked to the water habitat, like the otter (*Lutra lutra*). The otter has status NT (Near Threatened) and population trend is decreasing in relation to the IUCN Red List of Threatened Species. It is listed in Appendix I of the CITES, Appendix II of the Bern Convention, Annexes II and IV of the EU Habitats and Species Directives and Appendix I of the Bonn Convention. **Monitoring of biodiversity should take this species into the consideration, especially because the aquatic habitats of otters are extremely vulnerable to man-made changes**. Removal of bankside vegetation, dam construction, draining of wetlands, aquaculture activities and associated manmade impacts on aquatic systems are all unfavourable to otter populations (Reuther and Hilton-Taylor, 2004). Skadar Lake National Park, in its annual management plan for 2011, predicted otter habitat management that will be implemented through various actions.as one of the priority activities

Pollution is a major threat to the otters; the main pollutants posing a danger are the organochlorines dieldrin (HEOD) and DDT/DDE, polychlorinated biphenyls (PCBs) and the heavy metal mercury. Coastal populations are particularly vulnerable to oil spills. Organic pollution by nitrate fertilisers, untreated sewage, or farm slurry results in the decline of fish biomass and reduces the food resources of the otters.

2. Change in status of threatened and/or protected species

There is overwhelming evidence that humans have accelerated the rate of extinction, and seriously impaired the chances of survival of an increasing number of living species. To conserve such threatened species it is essential that their status in the wild is monitored and any changes are analysed and highlighted to support conservation actions.

The IUCN Red List of Threatened Species™ (www.iucnredlist.org), provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those plants and animals that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered and Vulnerable). The IUCN Red List also includes information on (i) plants and animals that are categorised as Extinct or Extinct in the Wild; (ii) taxa that cannot be evaluated because of insufficient information (i.e., are Data Deficient); and (iii) plants and animals that are either close to meeting the threatened thresholds or that would be threatened without taxon-specific conservation programme (i.e., are Near Threatened).

Indicators of the status of threatened species, such as the IUCN Red List Index can also be used to help track progress towards Millennium Development Goal 7 of the United Nations (Albania and Montenegro are member states of United Nations) by providing the information required for Indicator 7.7 (“a reduction in the proportion of species threatened with extinction”). These indicators can also help countries to track progress under various agreements such as the Ramsar Convention, Convention on the Conservation of European Wildlife and Natural Habitats and the Convention on Migratory Species as well as assessing the effectiveness of the Convention on Internationally Traded and Endangered Species (CITES). (http://www.twentyten.net/indicators/hl_statusofthreatenedspecies).

Threatened and/or protected species are also listed in Annexes I and II of the Bonn Convention, Annex II of Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean, Annexes II and IV of the Habitats Directive, Appendices I and II of the Bern Convention, EU Bird Directive, Decree on the protection of certain flora and fauna species (OG MNE, No. 76/06) and the Red Lists of Albanian Flora (Anonymous 1997, 2007; Vangjeli, Ruci and Mullaj 1995).

In Chapter 2.5.2 of this report (Status of biodiversity) it is presented that many animal and plant species living at the area of Lake Skadar/Shkoder are threatened or protected. Those species must be protected through appropriate measures.

3. Trends in extent of selected ecosystems and habitats

The aim of this indicator is to track changes in the extent of specific ecosystems and habitats. The reduction in size of natural ecosystems and habitats reflects the result of land use change, one of the recognised major threats to biodiversity. Such land use changes have a major impact on both the individual species within it and its ability to deliver ecosystem goods and services. Therefore, information about trends in the extent of ecosystems and habitat-types is a crucial part of understanding the state and trends of biodiversity as a whole.

The habitat is an ecological or environmental area that is inhabited by a particular animal or plant species. Particularly in Europe, classifications and maps of habitat types are often used interchangeably with classifications of vegetation types and ecosystems. This indicator can address not only the degree of change in ecosystem or habitat extent but also the time period and rates of change, which can be critical in determining appropriate actions.

In accordance with EU legislation, monitoring and reporting of the state, trends and pressures on the habitats is required. Monitoring and mapping of the habitats are of importance not only in relation to the implementation of the Habitats Directive itself, but they are also essential for an overall biodiversity trend assessment in Europe. Moreover, they influence management planning and conservation priorities (EC, 2005). Habitat inventory would make a major contribution towards the effective management and conservation of Lake Skadar/Shkoder biodiversity and natural heritage. Baseline information on habitats is required:

- To fulfil obligations those arise out of international directives and conventions on conservation, most notably the Habitats and Birds Directives, and the Convention on Biological Diversity. Whether stated explicitly or implicitly, these directives and conventions require that information on habitats either exists, or should be collected,

- To contribute towards the protection of the lake's biodiversity,
- To guide spatial and development planning by providing local authorities and other agencies with the necessary information about areas of ecological value in their jurisdictions.

Measurement of the extent of ecosystems or habitats is usually on the basis of aerial photography or satellite images, with analysis in a GIS. Comparable time series and classifications of data can permit monitoring and analysis of what, why and how a given area is changing (http://www.twentyten.net/indicators/hl_extentofselectedbiomes).

In the frame of EURONATUR project in 2004 habitats around Lake Skadar/Shkoder were surveyed by satellite images (Fig. 14).

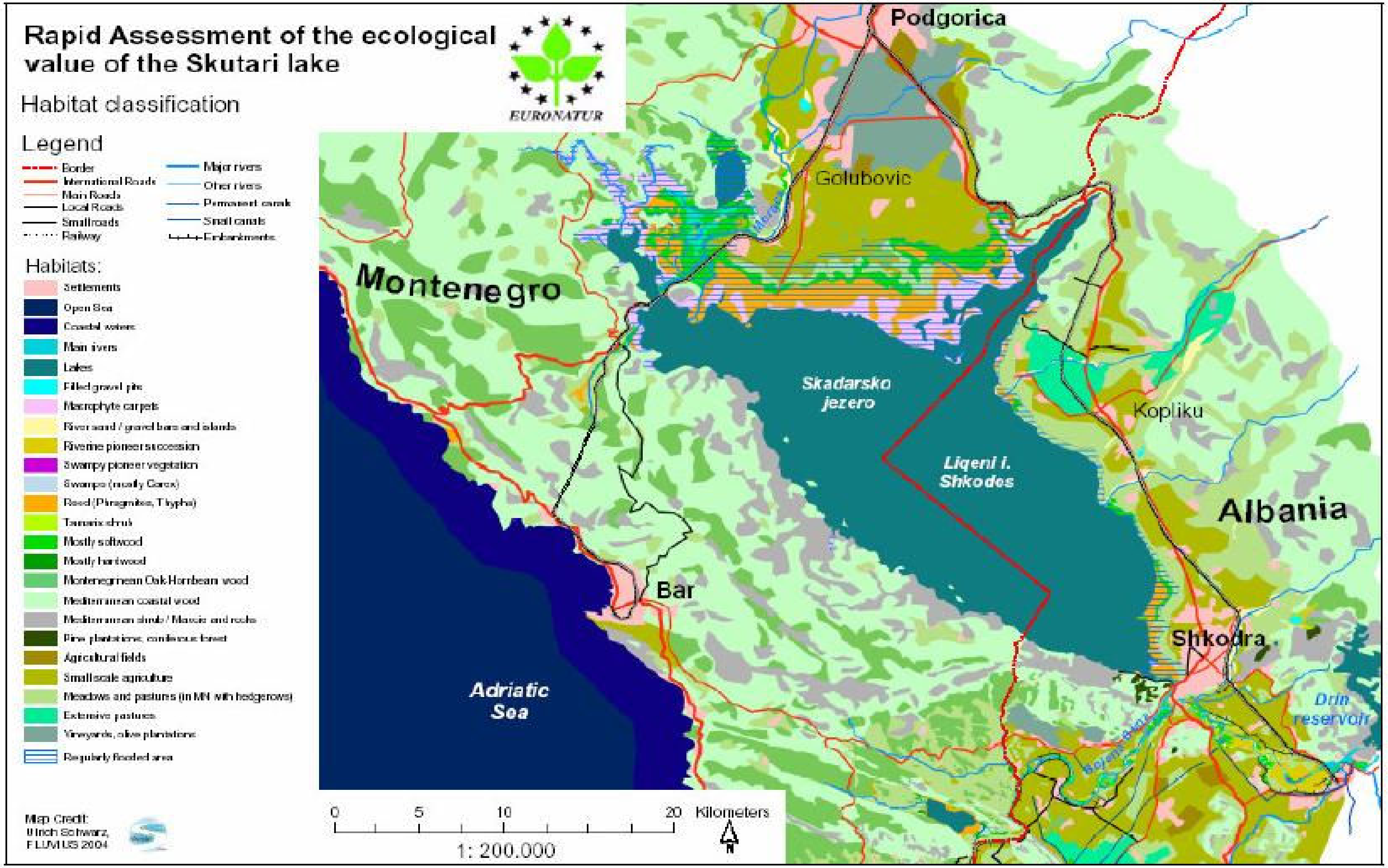

Figure 14: Habitat map of the Lake Shkoder surroundings (Source: TDA, 2006).

4. Coverage of protected areas

The protected area coverage indicator helps in the tracking progress in the establishment of a comprehensive protected area network. Protected areas can provide multiple benefits for biodiversity conservation and sustainable development. They are widely recognised as a major tool for the conservation of species and ecosystems. The Coverage of Protected Areas indicator therefore represents the degree to which components of biodiversity are formally protected. It can show the changes in the extent of protected areas.
(http://www.twentyten.net/indicators/hl_coverageofprotectedareas).

Nationally designated protected areas

Lake Skadar/Shkoder has been a National Park in Montenegro since 1983 (IUCN management category II). The National Park area has a total surface of 40,000 ha. In 1989, Lake Skadar/Shkoder was identified as an Important Bird Area (IBA – 40,000 ha). In 1995, the National Park of Lake Skadar/Shkoder was recorded in the Ramsar list (wetland area of international significance - total area in Montenegro 20.000 ha – coordinates 42^{o} 12'N 19 ^{o} 17'E). In 2006 The National Park became an Emerald habitat of the Bern Convention (40,000 ha).

The park is divided into four major zones, which differs in protected and usage regimes.
1. Central zone (Zone I)
Primeval natural habitats and areas of wilderness with high natural value on a local and global level, with high protection status, where accession and usage are prohibited. Location: Special natural reservates Pančeva oka and Manastirska tapija, and zone of 500 m from the border with reservats. Location of nesting birds Crni žar and zone of 500 m from the border with nesting location.

2. Protective zone (Zone II))
Natural habitats and wildlife protected areas, where certain activities and usage that are compatible with ecological principles (traditional fishing, grazing, limited and targeted tourism) are allowed. Location: North and northwest wetlands of the lake with narrower belt of open water to the river Karatune, Gornje Malo blato, and some islands in the south-eastern part of the Lake (Bisag, Omerova gorica, Golubovo ostrvo).

3. Tampon zone (Zone III)
Preserved semi-natural habitats, cultural heritage, villages around the lake, and recreation locations. Locations: open water, islands, land part of Park along south and southern-west coast of lake, including settlements.

4. Transit zone (Zone IV)
Urban areas and areas of intensive use, which surrounding protected area. Location: The areas outside the park, which form a natural continent of region of Lake Skadar/Shkoder. Limitation of activity in this zone should be in accordance with development strategies of municipalities.

In Albania the actual protection status of Lake Skadar/Shkoder is "Managed Natural Reserve" (IUCN Category IV), declared by the Albanian Government under decision No. 684, date 02. 11. 2005. The Albanian part of the lake area has been also declared as a Ramsar site (total 49,562 ha, coordinates 42°03'N 19°29'E) by the Ramsar Secretariat under decision No. 683, date 02. 11. 2005 of the Albanian Government.

The protected area in Albania includes three categories of protection:
a. The core zone composed by: the lake shore from the western extreme of Zogaj village to the border between Republic of Albania and Montenegro, the slope of Taraboshi Mountain from altitude 494 m in the south to 200 m within the lake waters, in the segment Zogaj-Albanian-Montenegrin border in the north. The second level of protection is applied in this area. This is the most important area in biodiversity terms.
b. Habitat Management Area composed by: the whole lake water surface, except the one included in the area mentioned above; the Albanian western shore from Bojana/Buna bridge in the east, to Zogaj village in the (bordering zone of this point) including all the latitude of this segment up to the altitude of 300 m in Taraboshi mountain slope in the south. The third level of protection is applied in this area.
c. Traditional Development Area composed by: the whole eastern surface of the lake bordering on the west with the area (b) mentioned above, of this point up to Shkodër-Hani i Hotit motorway in the east and Shkodra city in the south-eastern end. The fourth level of protection is applied in this area.

Several aquatic and wetland habitats of the Albanian part of Lake Skadar/Shkodra are considered as endangered after Dhora & Sokoli (2000). These includes: the eyes (wells) Syri i Sheganit and Hurdhana e Kosanit; underwater meadows of Shegani; floating "meadows" in the eastern coast of the lake (Shkoder, Bishti Qenise, Buze Uji, Hot); reed beds and areas of rushes (Juncus) in Shkoder, Vrake and Buze Uji; Forest areas of Shegan, Kamica, Vraka, Zogaj, Tarabosh and Shiroka; gravel and pebble habitats of Zalli i Bardhe, Zaruf – Burg, Buze Gegaj – Zogaj. All these habitats are protected under the new protection status of the Albanian part of the lake (Category IV – Managed Natural Reserve, since November 2005) (SAP for Skadar/Shkodra Lake – Albania & Montenegro, 2007).

Sites designated under the EU Habitats and Birds Directives

Lake Skadar/Shkoder is identified as an Important Bird Area (IBA) and Important Plant Area (IPA). IBAs are localities important for the protection of birds because these localities regularly accept important populations of one or more globally or regionally endangered bird species, endemic birds or certain highly representative bird aggregates. IBAs are selected according to international criteria and standards. In Europe, the criteria takes into account the requirements of regional conservation treaties such as the Emerald Network under the Bern Convention, the Helsinki Convention, the Barcelona Convention, as well as the Wild Birds Directive of the European Union. IPAs are areas of great botanical importance for threatened species, habitats and plant diversity in general that can be identified, protected and managed as sites. From seats of the Habitat directive, which are registered on the territory of Skadar Lake National Park, wet forests on the coast of the lake are very important (44.4325 Montenegrin ash-oak-alder forests) constituted from endemic Skadar Oak *Quercus robur* ssp. s*cutariensis*.

3.2.2.2.2 Threats to biodiversity

1. **Trends in invasive alien species (abundance of invasive alien species)**

Invasive alien species are plants, animals or micro-organisms outside their natural geographic range whose introduction and or spread threatens biodiversity, food security, human health, trade, transport and/or economic development. They pose the second biggest threat to biodiversity globally, and because of that are an important part of the Convention on biological diversity, Bonn and Bern Conventions:
- In the Article 8 (h) of the Convention on biological diversity it states that each Contracting Party shall, as far as possible and as appropriate prevent the introduction of, control or eradicate those alien species, which threaten ecosystems, habitats or species.
- In the Article 11 (Point 2) of the Bern Convention it states that Each Contracting Party undertakes: (a) to encourage the reintroduction of native species of wild flora and fauna when this would contribute to the conservation of an endangered species, provided that a study is first made in the light of the experiences of other Contracting Parties to establish that such reintroduction would be effective and acceptable; (b) to strictly control the introduction of non native species. In the frame of convention several recommendations, which refer on invasive alien species, were adopted. Amongst these, the most important is Recommendation No. 99 (2003) on the European Strategy on Invasive Alien Species, adopted by the Standing Committee on 4 December 2003. This Recommendation includes the "European Strategy on Invasive Alien Species".
- The Bonn Convention in Article III (paragraph 4c) defines that Parties that are Range States of a migratory species listed in Appendix I shall endeavour to the extent feasible and appropriate, to prevent, reduce or control factors that are endangering or are likely to further endanger the species, including strictly controlling the introduction of, or controlling or eliminating, already introduced exotic species.
- The Ramsar Convention does not include invasive alien species in its clauses, but Decision VII/14 Invasive species and wetlands was adopted by the Conference of the Contracting Parties in 1999 (http://www.twentyten.net/indicators).

There is no specific data and research on the invasive alien species in the area of Lake Skadar/Shkoder. Only the effect of introducing alien fish species in the past was recognized via drastic change of fish species composition in the Lake (Talevski et al., 2009). Highly invasive introduced fish species in the lake are *Perca fluviatilis, Carassius auratus gibelio, Ictalurus nebulosus* and *Gambusia affinis holbrooki*. In the area of Lake Skadar/Shkoder a systematic survey of invasive species should be carried out to recognise them and to prevent their expansion in the area through timely performed measures. There were no particular plans for controlling/eliminating major alien species (plants and animals) in both countries but in Montenegro an inventory of alien species was proposed in the National Biodiversity

Strategy and Action Plan for the period 2010-2015 (NBSAP Action plan) (measure no. 9) and also in the proposed biodiversity programme for 2011 (EPA Montenegro, 2010).

2. Habitat destruction - Fragmentation of habitats

The spatial configuration of ecosystems at a landscape scale plays a major part in determining how they function and it at least partially determines the composition of their plant and animal populations. Fragmentation is the subdivision of a habitat or ecosystem either by a natural disturbance (for example, fires or storms) or by human activities (for example roads or agriculture). Modification and fragmentation of habitats may seriously affect biodiversity (for example within the lake interrupting migration of fish, preventing access to spawning sites and impoverishing freshwater habitats; the changes in wetlands habitat can affect nesting birds, fish and other animals). An example of this is the gates on the Bojana/Buna River, with which blocking of migration of fish from Adriatic Sea with nets occurs. A good indication of this threat is the monitoring of abundance of marine species that enter the lake, such as shad (*Alosa fallax*), cipol (*Mugil cephallus*), levrek (*Dicentrarchus lakbrax*) and Acipensers (A. *nacarii* and A. *sturio*).

Lake Skadar/Shkoder is a popular tourist destination, and there are regional plans for the development of nature oriented and rural tourism. Accordingly, there are lot of activities through which natural and semi-natural habitats are modified and destroyed (construction of buildings, conversion of habitats into agricultural land, construction of transport infrastructure, gravel extraction from the Morača River and from some places at the Albanian side of the lake, etc). A serious problem is deforestation in the lake's catchment's areas. Building activities remain a problem in Albania and Montenegro. In Albania, there is ongoing construction of small, individual houses around the lake, as well as small tourist facilities. In Montenegro, within that national park borders, are examples of illegal constructions. Development of physical planning documentation is very important for lake cities and settlements. This does not directly affect the wetland space, but does create disturbance and has indirect effects by increasing the levels of pollution (SAP for Skadar/Shkodra Lake – Albania & Montenegro, 2007).

3. Disturbance

Lake Skadar/Shkoder area is extensively used by various stakeholders – fishermen, tourist (shipping and access of canoes and tourist boats to important resting, feeding or breeding areas), birdwatchers, workers, agriculturalists, etc. Owing to its attractive scenery, Lake Skadar/Shkoder has often been used for scientific and popular film recording. These influences present a threat in the form of disturbance. This is particularly important for the reproductive period of birds, when they are the most vulnerable to disturbance, and it can also cause failure to breed for other animal species. For this reason Lake Skadar/Shkoder area is in both countries divided into protected zones, which differ in their protected and usage regimes.

4. Climate change

Different animals and plants have different requirements regarding temperatures and other climate conditions. Drastic climate change can therefore have a high impact on biodiversity, because of its impact on temperature sensitive species. It is very difficult to evaluate the impact of climate change on biodiversity, because the changes occur slowly and the effects of these changes are always in interaction with other influences that have already caused certain consequences and reactions. In line with the expected climate change (for example, increased temperature, extreme events), a reduction and loss of species is expected, primarily those related to freshwater ecosystems, as well as species vulnerable to significant fluctuations in temperature and humidity (for example, amphibians). Since more than 90% of ornithofauna of the Lake Skadar/Shkoder is mobile, the climate has a strong impact on the state of wintering bird population and time frames of arrival, passage and stay of birds at the lake. Fish species living in the lake seem to be less sensitive to temperature change, because almost all of them are eury-thermal (they live in water, where the temperature range is between 12 and 30 ^{o}C).

5. Pollution - eutrophication

Some of the major towns in the region gravitate towards the Lake Skadar/Shkoder's shores due to its location. The watershed area of the lake has a total surface about 5,500 km^2 (80% in Montenegro, 20%, where live about 500,000 inhabitants, mostly in: Podgorica, Nikšič, Cetinje and Danilovgrad (Montenegro 65% of inhabitants), and in the city of Skadar (Albania 35% of inhabitants). 12,474 residents lives in the municipalies Podgorica, Bar and Cetinje. Sources of pollution on the Albanian side for Lake Skadar/Shkoder are near the settlements (solid waste and wastewaters). The main polluter is the city Shkodra with about 110,000 inhabitants, and also the villages Zogaj and Shiroke on the west part of the lake, Bajza on the east side of the lake and the villages Koplik and Sterbeq. Podgorica, Nikšić in Montenegro, Shkodra in Albania, and the surrounding industrial and agricultural lands all have an effect on Lake Skadar/Shkoder's ecosystem. This includes inorganic pollution from the industry (aluminium plant near Podgorica), as well as organic pollution (solid waste and sewage waters from major towns, as well as agricultural run-off from the plains in the northern part of the lake). Agricultural impacts on the ecosystem include increased loads of nutrients and pesticides from agricultural areas, especially vineyards. An example was given from the Koplik area, where 600 kg of phosphorus and 400 kg of nitrogen is added per hectare vineyard. Increased loads of nutrients cause increased eutrophication in the lake that is reflected in algal blooms and also an increasing abundance of aquatic weeds (macrophytes) along the shores of the lake due (Nagothu et al. 2008). The level of pollution with trace elements and organic compounds can be monitored via analysing those compounds in living organisms: bentic organisms and fish. Water quality monitoring (without analysing heavy metals and organic compounds) is done at the state level, and the water quality is still in the frame of permission levels. However, an increase in macrophyte cover in the past years is an indicator of eutrophication, and this issue should be taken into account. Eutrophication also has a large effect on the biodiversity of phytoplankton and bentic organisms and monitoring these can give us answer about the level of pollution.

6. Other threats

Fishing - In Montenegro, fisheries are regulated by the National Law on Freshwater Fisheries and a set of by laws and regulations that are enforced by the Ranger Service of the Skadar Lake National Park. Fishing on the Montenegrin side is prohibited from 15th March to 1st June (fish spawning period), while on the Albanian side prohibition lasts only for a month. In particular on the Albanian side, there are problems with illegal fishing, which presents one of the most problems for protection and has increased during the two last decades. Illegal fishing is carried out even iduring the spawning period and though illegal means. In addition, this is a very serious issue for legal fishermen due to the unequal competition from illegal fishermen. Only 100 fishermen were counted in 1990, while in 2005 around 450 legal and many more illegal were counted. Licensed fishermen appealed to the state for support to prevent illegal fishermen from ruining fish resources. (SAP for Skadar/Shkodra Lake – Albania & Montenegro, 2007). In From 2005 the administration of the Lake Skadar/Shkoder Nature Park with 10 rangers was established. They work mostly in preventing illegal fishing, but also in territory control, which means the control of negative activities around the lake. The Inspectorate of Fishing activity consists of controlling, monitoring, licensing and giving penalties for illegal fishing in the lake area (REC, 2010). An assessment of fish stock has not been done for three decades, so the extent of fishing and over exploitation are unknown. However, the experience of fishermen and individual researchers indicates that changes in the composition of fish communities have occurred. Monitoring changes in the structure of fish species- mainly population structure of bleak and carp - can provide an estimate of potential over fishing.

Bird hunting - Bird hunting was put under a ban from 2001 by the Spatial Plan for Skadar Lake National Park. However, illegal hunting still takes place, especially during bird migrations, when flocks of waterfowl use the lake for resting. This may not affect population sizes in lake to a significant level, but it does create disturbance.

Water regime - Water fluctuating is a native feature of Lake Skadar/Shkoder and organisms are adapted to it. Any changes in native water fluctuation (for example, plans for construction of dams on Morača River) can affect flora and fauna in the lake, specially species, which inhabit the littoral area and are sensitive to water level The most sensitive organisms at the water level on Lake Skadar/Shkoder are breeding birds (for example, Pelicans nest on floating turf islets. Eggs are just above the lake water. Every fluctuation of the lake water and disturbance of breeders, causes flooding and crashing the eggs, thus leading to unsuccessful breeding) (Saveljić, 2009), fish (during its spawning – for example, carp use spring flooded areas as spawning ground in the period April-June), macrophytes and consequently all organisms, which are dependent on them. A sudden increase of water level occurred twice in the year 2010 – January and November - as a consequence of heavy rain. The water level reached its maximum - 10.44 m. The main problem between Albania and Montenegro in this situation is outflow of river Drin into Lake Skadar/Shkoder. A joint programme of management with the waters Lake Skadar/Shkoder – Drim - Bojana between Albania and Montenegro is requested.

Plans for the direct use of biological resources from freshwater ecosystems, plans for their drainage (Plans for deepening of the bed of the river Bojana and regulation of the water level of the Lake Skadar/Shkoder) represent important threats to the flora and fauna, particularly fish population. Aquatic vegetation of the lakeshore has been also received an impact from the use for the livestock, industry, handicrafts etc. (collections of reeds, rushes (*Juncus sp.*), cattail (*Typha* sp.). (SAP for Skadar/Shkodra Lake – Albania & Montenegro, 2007).

3.2.2.2.3 Ecosystem integrity and ecosystem goods and services

Water quality in aquatic ecosystems

Deterioration of water quality can have serious negative impacts on aquatic ecosystems, causing things such as a loss of species and shifts from pollution-sensitive towards pollution-tolerant organisms. Water quality in rivers can be reduced by high sediment loads that interfere with fish respiration and cover spawning areas and can smother bottom-living organisms. High sediment loads may also disturb nutrient cycles in wetlands and estuaries, with resultant algal and bacterial blooms and loss of light and oxygen from the water. Various pollutants have differing effects ranging from inducing catastrophic mortality to chronic illness, in addition to the effects of bioaccumulation through the food chain (http://www.twentyten.net/indicators/hl_waterquality). This indicator will be on Lake Skadar/Shkoder monitoring during monitoring of ecological status of the Lake.

3.2.2.2.4 Status of resource transfers

Biodiversity funding

Adequate access to resources is essential for effective implementation of the Convention on Biological Diversity. Developed countries that have ratified the CBD have committed themselves through Target 11.2 of the CBD to transfer new and additional financial resources to developing country Parties, to allow for effective implementation of their commitments under the Convention.

3.3 SAMPLING LOCATIONS/IMPORTANT HABITATS TO BE MONITORED

3.3.1 QUALITY OF WATER

Monitoring points were selected regarding the WFD, which states that monitoring points shall be selected as follows:

- For bodies at risk from significant point source pressures, sufficient monitoring points within each body in order to assess the magnitude and impact of the point source. Where a body is subject to a number of point source pressures monitoring points may be selected to assess the magnitude and impact of these pressures as a whole;
- For bodies at risk from significant diffuse source pressures, sufficient monitoring points within a selection of the bodies in order to assess the magnitude and impact of the diffuse source pressures. The selection of bodies shall be made such that they are representative of the relative risks of the occurrence of the diffuse source pressures, and of the relative risks of the failure to achieve good surface water status;
- For bodies at risk from significant hydromorphological pressure, sufficient monitoring points within a selection of the bodies in order to assess the magnitude and impact of the hydromorphological pressures.

8 sampling points on the Montenegrin side and 7 points at the Albanian side are recommended to assess the magnitude and impact of the point and non-point source pressures on the lake (Tables 17 and 18). At those locations all general chemical and physico-chemical elements will be measured (transparency, thermal conditions, oxygenation conditions, salinity, acidification status, nutrient conditions).

Analysing particular specific pollutants (specific synthetic substance or specific non-synthetic substance (Table 11) will be done at the locations points on defined sensitive areas (Tables 19 and 20). The analysed parameters will depend on the source and level of pollution in the watershed.

Hydromorphological elements (water level, temperature, discharge) will be measured at the meteorological stations Plavnica, Vranjina, Karuč and Ckla, Shiroka and Buna Bridge. The level of the water will be measured at all sampling sites.

Microbiological parameters will be measured at the places important for bathing and at the places where the discharges of wastewaters from settlements and solid waste are.

3.3.1.1 Baseline monitoring

3.3.1.1.1 Montenegro

Proposed sampling points for monitoring physical-chemical and hidrological quality elements on the Montenegrin side of Lake Skadar/Shkoder are the same as in the Montenegrin National monitoring programme for surface waters.

Table 17: Recommended sampling points on the Montenegrin side for monitoring physical-chemical and hydrometerological quality elements in Lake Skadar/Shkoder.

Sampling point	Coordinates	Criteria for selection
Vranjina	42° 16′ 32.79″N 19° 07′ 12.12″E	Inflow of right arm of Morača River.
Virpazar	42° 15′ 22.12″N 19° 06′ 19.85″E	Inflow of Virpazar canal.
Plavnica	42° 15′ 40.26″N 19° 11′ 54.02″E	Discharge of waste waters and influence of underground waters.
Kamenik	42° 17′ 32.63″N 19° 06′ 03.10″E	Inflow of Crnojevića River.
Podhum	42° 16′ 02.58″N 19° 21′ 44.53″E	Influence of KAP, surface waste waters and underground waters.
Starčevo	42° 11′ 19.82″N 19° 12′ 29.42″E	Dilution of pollutants in the distance from the source of the pollution.
Ckla	42° 05′ 08.20″N 19° 22′ 46.30″E	Important transboundary outlet point.
Middle of Lake	42° 10′ 47.50″N 19° 16′ 26.67″E	Pelagial water quality.

3.3.1.1.2 Republic of Albania

Amongst proposed sampling points for monitoring physical-chemical and hidrological quality elements on the Albanian side of Lake Skadar/Shkoder, 5 are the same as in national monitoring programme for surface waters of Albania, while 2 (Sterbeq and Vraka) are newly chosen.

Table 18: Recommended sampling points on Albanian side for monitoring physical-chemical and hydrometerological quality elements in Lake Skadar/Shkoder (new sampling points appear in grey.)

Sampling point	Coordinates	Criteria for selection
Shiroka	42° 03′ 40.00″N 19° 27′ 18.00″E	Shiroka is located in the west part of the lake near the Shiroka village (direct discharge of untreated sewage and domestic wastes from village and from numerous restaurants, oil discharge from fishing boats).
Zogaj	42° 04′ 24.00″N 19° 24′ 16.00″E	Zogaj is located in the west part of the lake in the border with Montenegro (direct discharge of untreated sewage and domestic wastes from village. Loading site for the unauthorised transport of petrol and fuel oils during recent regional conflicts also oil discharge from fishing boats).
Sterbeq	42° 11′ 52.00″N 19° 23′ 14.00″E	Sterbeq is located in the east part of the lake (direct discharge of untreated sewage and domestic wastes from village)

Sampling point	Coordinates	Criteria for selection
Bajze	42° 13´ 32.00˝N 19° 21´ 22.00˝E	Bajze is located in the east part of the lake (near this region were deposited pesticides for twenty years).
Buna bridge	42° 03´ 19.00˝N 19° 28´ 59.00˝E	Buna bridge - outflow of the lake water and direct discharge of the untreated sewage and domestic wastes form Shkodra town.
Vraka	42° 05´ 52.00˝N 19° 28´ 00.00˝E	Vraka is located in the east part of the lake (direct discharge of untreated sewage and domestic wastes from village).
Bahcallek	42° 02' 33.20"N 19° 29' 31.52" E	Inflow of the Drini River. Drini River enters Lake Skadar/Shkoder during the flooding of Drini - usually in winter and spring.

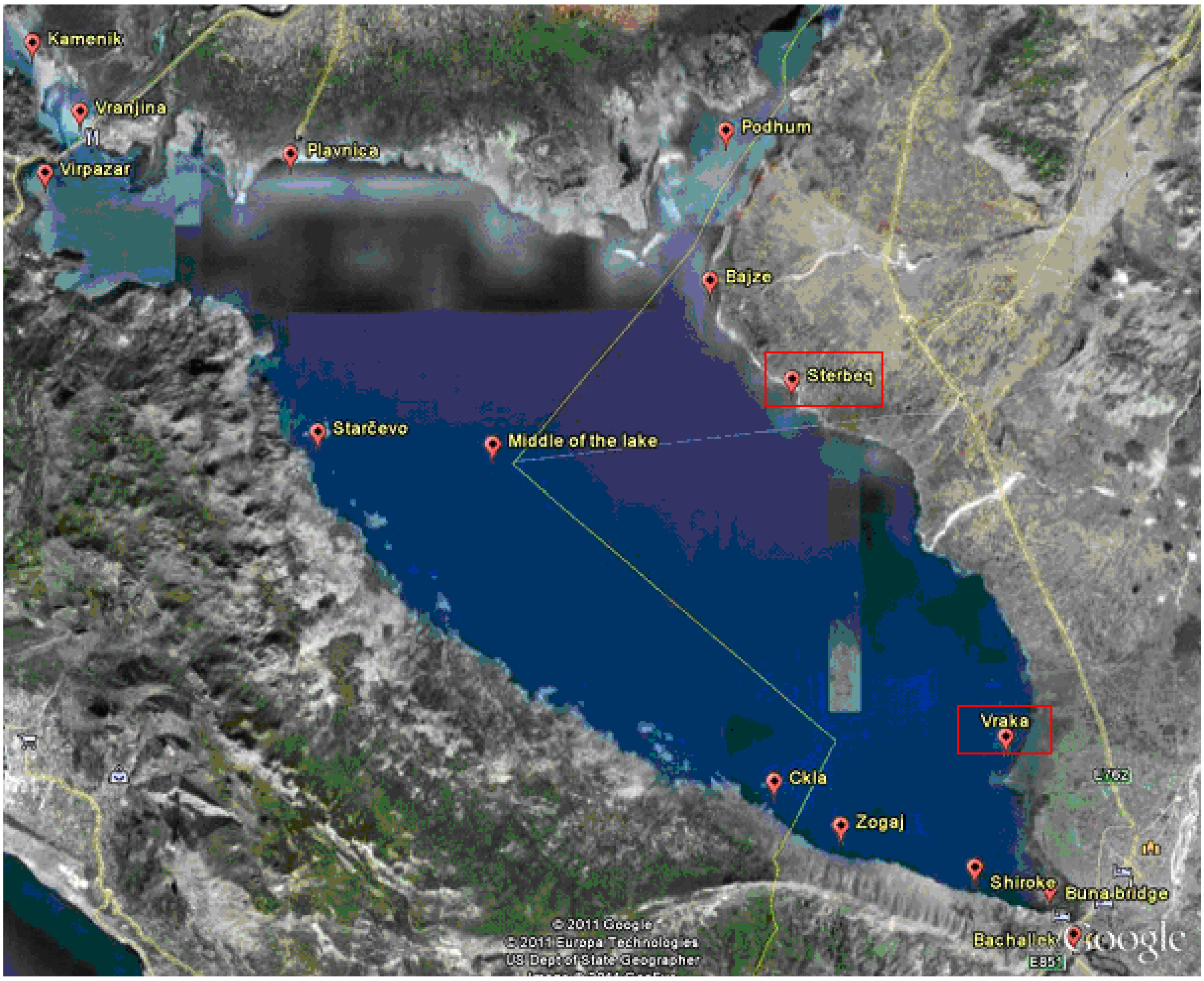

Figure 15: Sampling points at Lake Skadar/Shkoder for monitoring general physical-chemical and hydrometerological quality elements (new sampling points are marked with a red frame).

3.3.1.2 Monitoring particularly sensitive areas

There exist several sources of pollution in the Lake Skadar/Shkoder basin in Montenegrin side of the lake. Most pollutants for surface water, groundwater, soil and air in the basin originate from Podgorica, situated on the Morača river terraces in the Zeta Plain. The Moraca River, the main tributary of the lake, brings most pollutants into the lake from the aluminium industry (KAP), agricultural plantations complex Podgorica landfill, city drainage collector, etc.

The main sources of pollution on the Montenegrin side of lake are:

- Aluminium Plant Podgorica (KAP = Kombinat Aluminijuma Podgorica)
- Steelworks in Niksic
- Wastewater from the cities and towns in the basin (Podgorica, Cetinje, Danilovgrad, Virpazar, Rijeka Crnojevića, Niksić). Podgorica and Virpazar have wastewater treatment plants, but their capacities are not sufficient. Waste products from Nikšič increase the pollutant contents of the Morača through the Zeta River
- Mineral waste oils in the Zeta Plain
- Agriculture in the Zeta Plain

Table 19: Sampling points for monitoring sensitive areas on Montenegrin side of Lake Skadar/Shkoder (new sampling points appear in grey).

Sampling point	Coordinates	Criteria for selection
Rijeka Crnojevića - "Obod " Cave	42° 21′16.00″N 19° 01′ 38.00″E	Discharge of all waste water from Cetinje Plain.
Rijeka Crnojevića - sublacustrine spring " Ploce (KAMENIK)	42° 17′ 32.63″N 19° 06′ 03.10″E	Discharge of waste water from Cetinje Plain.
Malo Blato – spring of River Biševina	42° 20′ 36.00″N 19° 10′ 28.00″E	Discharge of underground water, which originates from Morača River.
Mouth of right arm of Morača River – (VRANJINA)	42° 16′ 32.79″N 19° 07′ 12.12″E	Outflow of Morača River.
Mouth of canal Virpazar (VIRPAZAR)	42° 15′ 22.12″N 19° 06′ 19.85″E	Discharge of waste waters from Virpazar.
Plavnica River - sublacustrine spring "Plavničko oko" (PLAVNICA)	42° 15′ 40.26″N 19° 11′ 54.02″E	Discharge of underground water from Zeta Plain is. In the dry soils of the Zeta Plain PCB and PAH show concentrations harmful for biota (analysis from 2005).
Gostilj River - spring	42° 15′32.00″N 19° 14′ 28.00″E	Discharge of underground water from the Zeta plain and the impact of pollution from KAP.
Spring Hum (PODHUM)	42° 16′ 02.58″N 19° 21′ 44.53″E	Trace elements were found in the past (source KAP).

Sources of pollution in Albanian side for Lake Skadar/Shkoder are near the settlements (solid waste and wastewaters).

- The main polluter is the city Shkodra with about 110,000 inhabitants
- Village Zogaj on the west part of the lake
- Village Shiroke on the west part of the Lake
- Bajza on the east side of the lake
- Villages Koplik and Sterbeq

Ariculture is developed in the eastern part of the lake (villages Sterbeq, Vrake). There is also the deposit of pesticides (mostly organochlorine), in Bajza, which has been legal since 1990. Last year a company cleaned the building from pesticides, but because of their persistence they or their degradation derivates, can be present in the lake sediment or biota. In the west part of the lake there was only fishing.

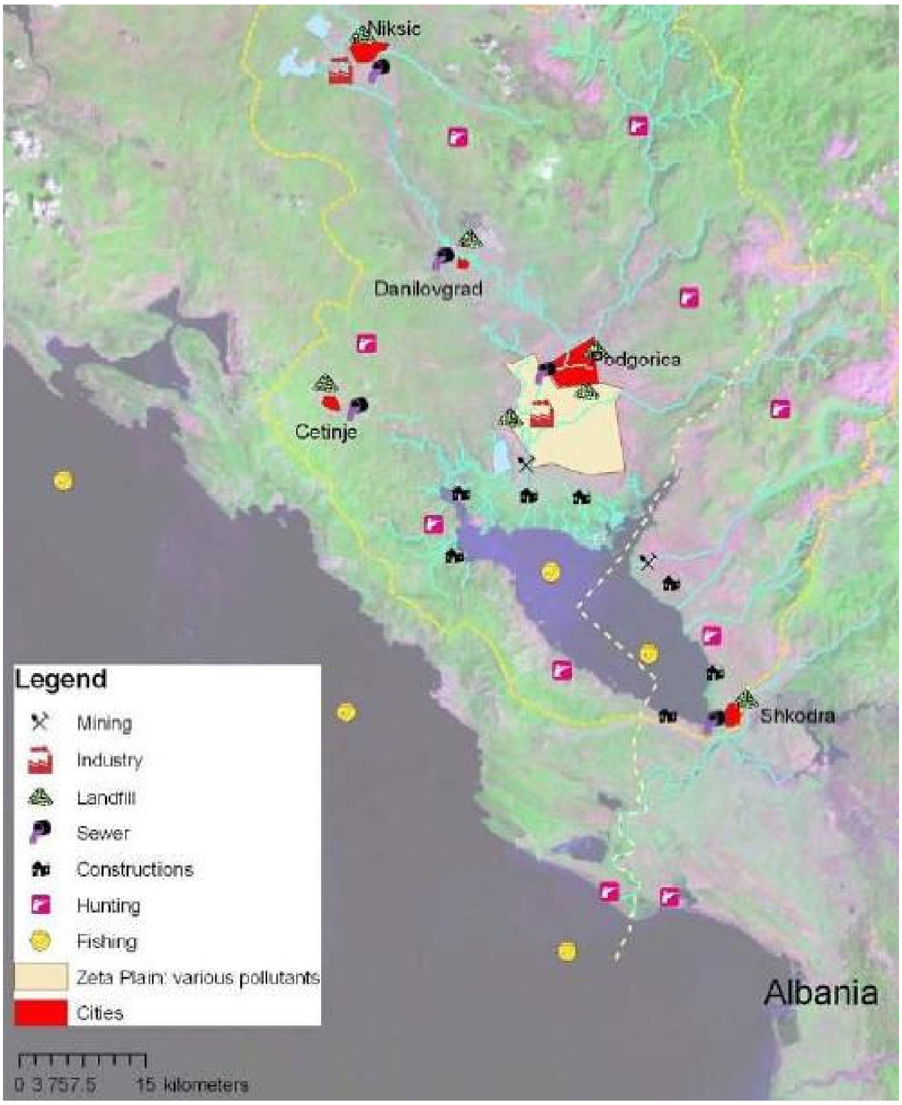

Figure 16: Indicative location of the main pollution sources and pressures in the Shkoder Basin (source: TDA, 2006).

There are some areas, Bajze and Zogaj, where the locations (ports) for illegal transport of fuels have existed. During the flooding of the lake in December 2010, a number of oil distributors were flooded in Shkodra, so the point Buna Bridge is important in terms of investigating the pollution with PAHs and mineral oils. There is also continuous pollution with oil, which is discharged from the fishing boats in different small ports (Zogaj, Shiroke).

Table 20: Sampling points for monitoring sensitive areas on Albanian side of Lake Skadar/Shkoder (new sampling points appear in grey).

Sampling point	Coordinates	Criteria for selection
Shiroka	42° 03´40.00˝N 19° 27´ 18.00˝E	– Direct discharge of untreated sewage and domestic wastes from village Shiroka and from numerous restaurants. – Oil discharge from fishing boats.
Zogaj	42° 04´ 24.00˝N 19° 24´ 16.00˝E	– Direct discharge of untreated sewage and domestic wastes from village Zogaj. – Loading site for the unauthorised transport of petrol and fuel oils during recent regional conflicts. – Oil discharge from fishing boats – At the deepest point of the lake is a collector of sludge, and there was found high level of concentration of some PAHs and heavy metals (Cu and Cd) (Neziri, 2009).
Sterbeq	42° 11´ 52.00˝N 19° 23´ 14.00˝E	– Sterbeq is located in the east part of the lake (direct discharge of untreated sewage and domestic wastes from village).
Buna bridge	42° 03´ 19.00˝N 19° 28´ 59.00˝E	– Outflow of the lake. – Direct discharge of the untreated sewage and domestic wastes from Shkodra town).
Vraka	42° 05´ 52.00˝N 19° 28´ 00.00˝E	• Direct discharge of untreated sewage and domestic wastes from village Vrake.
Bahcallek	42° 02' 33.22" N 19° 29' 31.52" E	• Inflow of Drini River. Water from Drini enters Lake Skadar/Shkoder during the flooding of Drini - usually in winter and spring. Heavy metals were found in high content in the past.
Bajze	42° 13´ 32.00˝N 19° 21´ 22.00˝E	• Bajze is located in the east part of the lake (near this region were deposited pesticides for twenty years).
Eye of Shegan	42° 16´29.00˝N 19° 23´55.00˝E	• Possibility of pollution by former illegal transport of oil and from deposit of pesticides.
Kamica	42° 15´17.00˝N 19 ° 23´15.00˝E	• Possibility of pollution by former illegal transport of oil and from the deposit of pesticides.

Sampling points will be provided in the Lake Skadar/Shkoder at places where pollutants enter the lake via rivers and sublacustrine springs and represent the possible "hot spots" (Tables 19 and 20, Fig. 17).

Figure 17: Sampling points at Lake Skadar/Shkoder for monitoring particularly sensitive areas (new sampling points are marked with a red frame).

3.3.2 MONITORING OF BIODIVERSITY

3.3.2.1 Sampling locations for monitoring phytoplankton

Phytoplankton is distributed in the open water throughout the whole of the lake. Three sampling points will be defined: one in the northern part (Montenegro), one in the middle of the lake, at the border between countries and one at the southern part of the lake (Albania). During the first year of monitoring those points will be chosen and the geographical coordinates will be defined.

3.3.2.2 Sampling locations for monitoring macrophytes

The lake will be divided into 7 transects and within each belt transect mapping of macrophytes will be conducted.

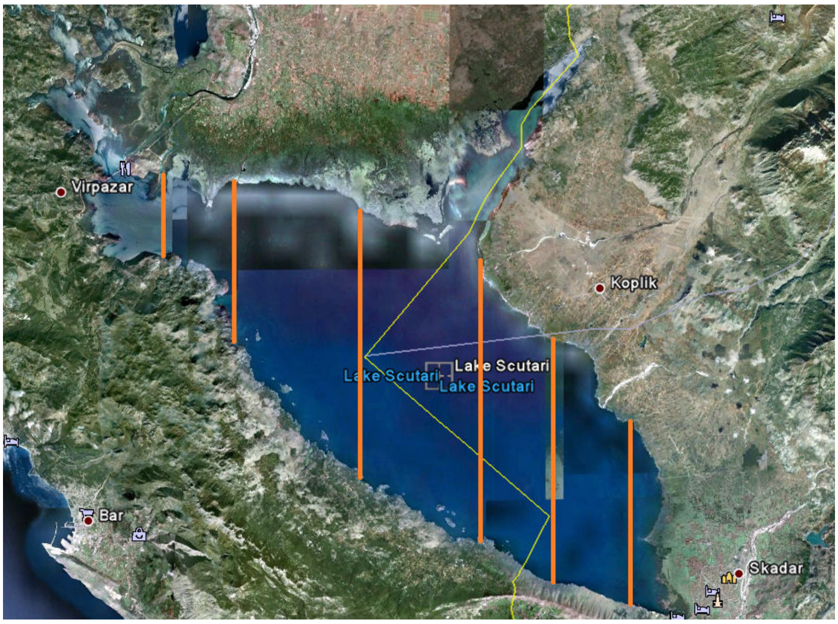

Figure 18: Map with transect, where mapping of macrophytes will occur (orange lines represent borders between transects.

3.3.2.3 Sampling locations for monitoring particular species:

3.3.2.3.1 Fish species

For detailed insight into fish population and following the Water Framework Directive for defining ecological status of the lake (species richness, abundance, biomass, age structure etc.) the whole lake has to be surveyed.

Some of the chosen species for monitoring biodiversity (Table 15) are sintopic (live in the same habitats or in the same areas) while other live in remote parts of Lake or even remote parts of the catchment area. For all fish species the best time for monitoring is during their spawn, because fish gather at already known spawning grounds during that period. In the following figures (Fig. 20- 24) the localities for single or groups of species are present.

Figure 19: Map with drawn zones with most structured habitats, most diverse ecological conditions and with highest diversity of fish species.

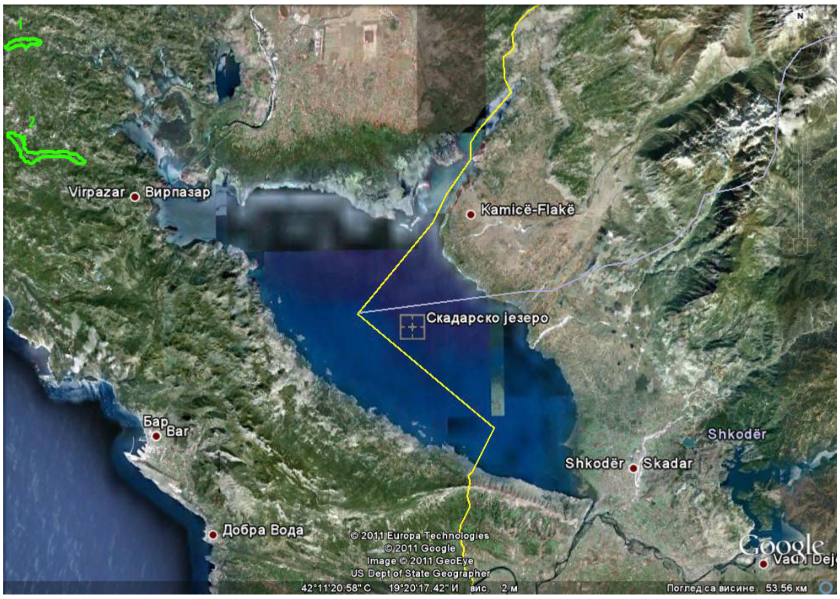

Figure 20: Map with sampling locations for trout species (1 – Rijeka Crnojevića upper part, 2 – Oraovštica River upper part).

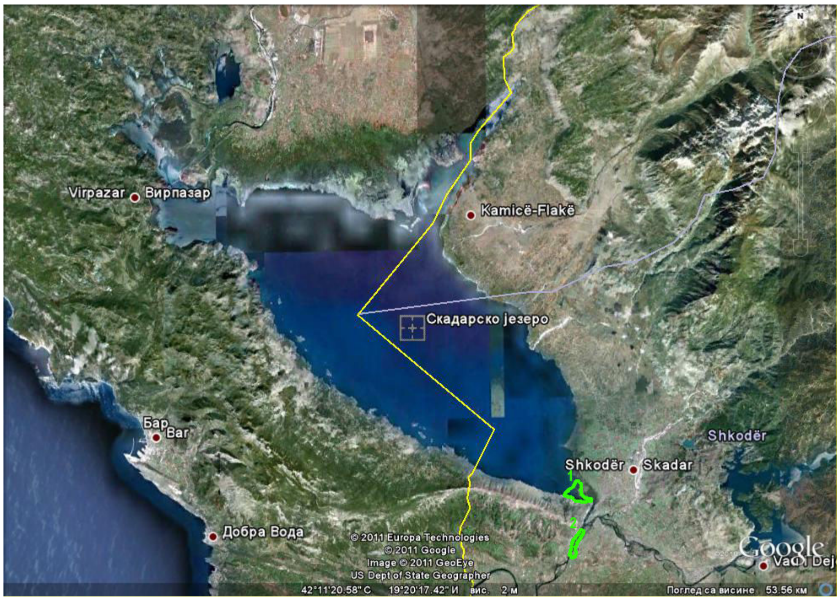

Figure 21: Map with sampling locations for sturgeon species monitoring (1 – lake near Skadar City and beginning of Bojana/Buna River; 2 – Bojana/Buna River).

Figure 22: Map with sampling locations for *Telestes montenegrinus*, *Anguilla anguilla* and *Barbatula zetensis* species monitoring (1 – lower part of Plavnica river; 2 – lower part of Crmnička river; 3 - lower part of Oraovštica river; 4 – lower part of Morača river, 5 – Veliko Blato).

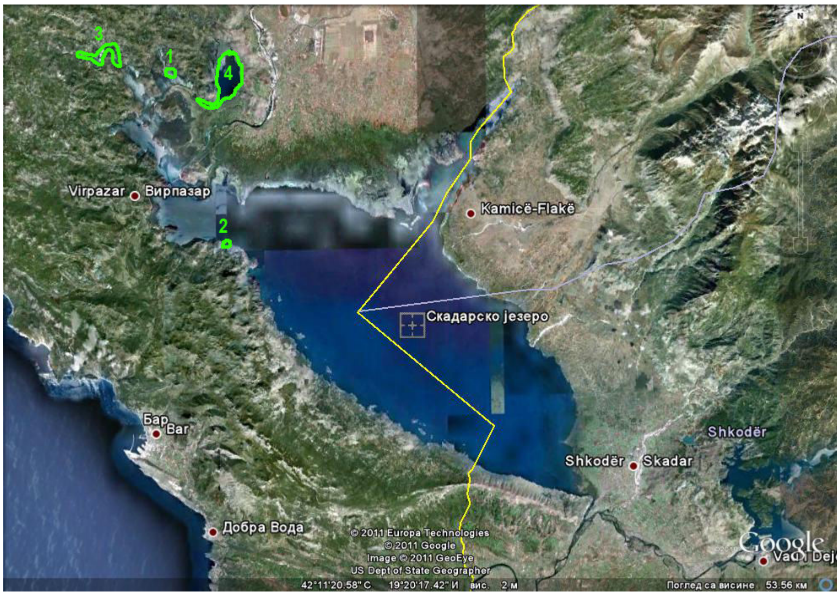

Figure 23: Map with sampling locations for *Scardinius knezevici* monitoring (1 – Karuč; 2 – Raduš; 3 – Rijeka Crnojevića; 4 – Veliko Blato).

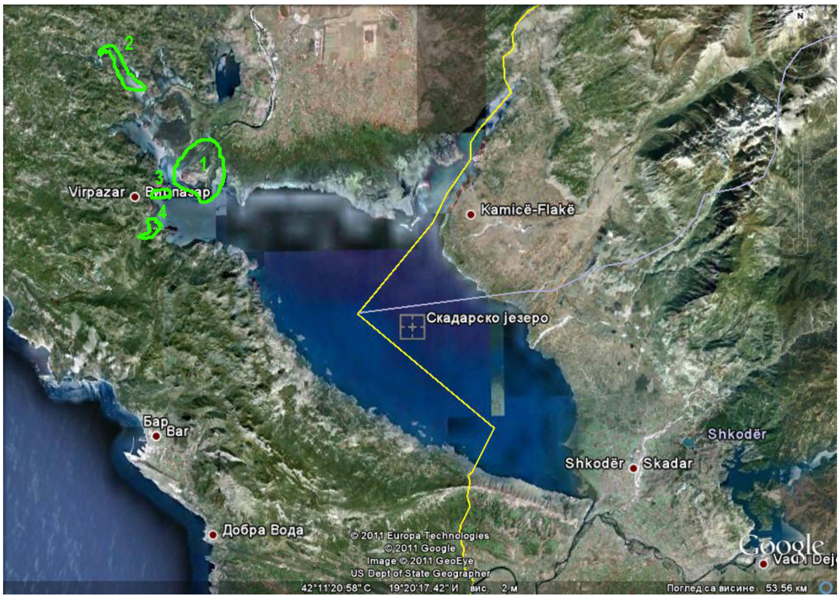

Figure 24: Map with sampling locations for monitoring of invasive species (*Perca fluviatillis, Carassius gibelio, Ameiurus nebulosus)* monitoring (1 – Morača River delta, 2 - lower part of Rijeka Crnojevića; 3 – Tanki rt; 4 – lower part of Crmnička River).

3.3.2.3.2 Bird species

Territorial waters and the lake's shore in Albania are less important for the birds than the Montenegrin side, especially considering breeders (Saveljić, 2009). The winter counting of birds and the spring-autumn counting of birds will be conducted on the whole lake. Certain species (listed in Table 21) will be surveyed in the area of their breeding or in their feeding areas.

Table 21: Sampling points and areas for monitoring indicators regarding birds.

Indicator	Sampling area on Lake Skadar/Shkoder
Winter counting of birds	Whole lake
Spring-autumn counting of birds	Whole lake
Pelecanus crispus Dalmatian Cormorant	Ornithological reserves, Previous breeding and feeding areas; Pančeva oka, Crni Žar
Aythya nyroca Ferruginous Duck	Vegetation zone of the northern part of the Lake
Phalacrocorax pygmeus Pygmy Cormorant	Ornithological reserves (breeding areas); Pančeva oka, Crni Žar, Manastirska tapija, Ckla

According to the Law on nature protection and the Law on National parks of Montenegro, reserves are the littoral or sea areas with unchanged or slightly changed overall nature, intended only for conservation of nature, scientific research without changing original elements and biological diversity, monitoring of nature and education, which is not endangering realisation of free natural processes. Skadar Lake National Park was designated as a zone of special interest for protection, primarily as a breeding area for birds. There are two ornithological reserves of Lake Skadar/Shkoder on Montenegrin side of the lake –

Pančeva oka and Manastirska tapija and nesting areas for birds Crni žar, Omerova gorica and Grmožur (Fig. 25), which will be the sampling points for monitoring nesting birds:

- **Pančeva oka** is mixed and a globally important breeding area of cormorants, pelicans, terns, and herons. Pančeva oka ("Pelican's pools" in local language) is a vast complex of dead and live flooding vegetation, a base of which is formed by up to 11 m deep layers of Sphagnum peat-moss. Pančeva oka is a complex of hardly-accessible floating peat island, freshwater pools and thick *Salix* vegetation. Among other vegetation *Salix alba*, *S. fragilis*, *Typha angustifolia*, *T. latifolia* are found there. The pelican's colony is situated on a floating island of peat on the southern edge of the Pančeva oka complex and is surrounded by big colonies of cormorant (*Phalacrocorax carbo*), Pygmy Cormorant (*P. pygmeus*), Little Egret (*Egretta garzetta*) and Squacco Heron (*Ardeola ralloides*). The pelican's colony is on the edge of a bigger pool and not far from open water.

- **Manastirska tapija** is occasionally a colony of herons, cormorants, pelicans and terns.

Figure 25: Sampling locations for nesting birds of Skadar Lake National Park. *Pelecanus crispus* (Pančeva oka, Crni Žar), *Aythya nyroca* (vegetation zone of the northern part of the Lake), *Phalacrocorax pygmeus* (Pančeva oka, Crni Žar, Manastirska tapija, Ckla).

- **Crni Žar** is breeding area of cormorants, herons, pelicans and terns. This area covers a few km^2 and lies south to the Pančeva oka. It is a complex of mostly live floating vegetation most of which is formed by *Nuphar luteum*, *Nymphea alba*, *Phragmites australis* and *Trapa natans*. Numerous small islands are formed by dead vegetation and peat. On the islands *S. alba* and *S. fragilis* are growing. The pelican's colony was situated on an island of dead vegetation, surrounded by a colony of Common Tern (*Sterna hirundo*) and Whiskered Tern (*Chlidonias hybrida*) and a few other non-colony nesting species of water birds.

- **Omerova gorica** is the most important colony of grey heron (*Ardea cinerea*) on the lake.

- **Grmožur** is an important breeding area of terns, gulls, and in the past also of pelicans (years 1991 and 1992). The rocky island is found close to the north western coast of the lake, between Virpazar and Seoca settlements. The island is not more than a few hectares big and is mostly bare. Vegetation, present mostly on the highest points of the island, consists of a few *Ficus carica*, *Punica granatum* and *Vitex agnus-castis*.

3.3.2.3.3 Lutra lutra

Since there is insufficient data relating to the otter presence in/near the lake, the starting phase is to survey the areas along the lake's tributaries in order to find otter tracks (footprints) or excrements. Sampling location for the future monitoring should be determined in the starting phase of the monitoring, i.e. during the first year of monitoring for the following years. A more detailed method appears in the Chapter 3.5.2.1 "Methods for assessing trends in the abundance and distribution of species of main plant and animal taxonomic groups".

3.4 MONITORING IMPACTS FROM THE LAKE SURROUNDING AREA

60% of the lake‘s water is provided by Morača River, which is 98 km long and gets the majority of its water from the high mountains of Montenegro. The river‘s character is swift and mountainous and floods are regular. The river‘s weekly water level variations in its middle current can be more than 6 m in floody spring period. In early spring the snow melting period in the higher mountains of Montenegro contribute towards higher water discharge of Morača River, which through sediment transportation through the Morača canyon brings a lot of material into the lake. Higher precipitation values in this period in Montenegro submediterranean regions also (where Lake Skadar/Shkoder is situated) contributed towards the erosion of the watershed (mainly pit or reed islets).

Flooded areas around Lake Skadar/Shkoder can be subdivided into several zones

- Zone I with swampy soils and peats spread below 5.5 m.a.s.l. including northern areas surrounding Malo Blato. These areas are under water, or water is right beneath the soil surface, for almost the whole year. When the soil is not flooded, groundwater is at a depth of less than 1 m, and is due to Lake Skadar/Shkoder water level (minimum water level 4.6 m). This zone is overgrown with boggy and swampy vegetation and a very important ecosystem. The total surface of this area is 6,006 ha, of which Lake Skadar/Shkoder covers 5,800 ha and Malo Blato 206 ha.
- Zone II encompasses between 5.5 and 8 m.a.s.l., and it occupies the south surroundings of Malo Blato. These soils are exposed to constant flooding during the year, because for a long period of the year the water level of Lake Skadar/Shkoder fluctuates between these two levels. Going further from the coast the habitat changes from swampy to natural meadow, rarely turning into arable land. The total surface of this zone is 4,262 ha, of which Skadar Lake covers 4,005 ha and Malo Blato occupies 257 ha.
- Zone III extends in the areas above 8 m.a.s.l. Flooding in this zone is periodical, and most often from November to February. The level of groundwater fluctuates from several tenths of centimetres in autumn and spring to 4-5 m during the summer. The total surface of this zone is 1,475 ha.
- Zone IV is the area directly affected by high floods of Morača River. It is periodically flooded and the total surface if 567 ha. In this zone the water table is shallow often at a depth lower than 1 m (Saveljić et al., 2009).

Shoreline erosion is a natural process in lakes and reservoirs that causes recession of erodible bluffs and down cutting of near shore slopes, which in turn leads to deposition of eroded shorezone material in shallow near shore and deeper offshore areas, and transport of suspended sediment downstream. Sediment production estimates from watersheds are very important, because these sediments decrease the lake capacity, to have an impact on the ecosystems in the bays and the water quality. So it is necessary to locate the areas' potentials in the watershed where major erosion exists and to establish a programme of watershed management. Processes causing shoreline erosion are complex and depend on the synergistic interaction of several factors. Generally, however, the main factors causing shore erosion are shoreline material type (specifically, the erodibility of the shoreline material), wave energy reaching the shore, and the rate of longshore drift and offshore transport of eroded sediment (JDMA, 2003).

Worldwide, a lot of different studies have been made to assess the influence of the environment or anthropogenic activity on the erosion of the areas surrounding different lakes (i. e. Vargas *et al*., 2001; Zimmer and Penner, 2004; Ekercin, 2007). So far the most appropriate and widely used methods for this research has been remote sensing combined with GIS analyses (Siripong, 2010). In the beginning, remote sensing was done using aerial photography (Zimmer and Penner, 2004; Guy, 2011) or radar imaging (Semovski *et al*., 1999), but during the last decade satellite images have been more and more accurate and widely accessible and therefore have used for the same purpose recenty (Shrimali *et al*., 2001; Heblinski, 2011). In Thailand, where more than 90% of the Gulf coast is damaged by the erosion, they used Landsat satellite data to quantify the rate of changes at the eastern part of the Southern Peninsular, recognising the changing patterns of sediment plume from the major river of the area, which strongly affected the coastline (Siripong, 2010). Changes in land use in the water catchment's area that increased erosion by wind and water were studied also in the case of Baikal Lake, Siberia (Semovski *et al*., 1999). Similarly, soil erosion trough the use of agricultural systems was studied in the lake of Patzcuaro watershed, Mexico (Vargas *et al*., 2001).

3.5 METHODOLOGY FOR CONDUCTING MONITORING

3.5.1 WATER QUALITY

Methods used for the monitoring of parameters in Lake Skadar/Shkoder shall conform to the international standards (CEN/ISO standards) listed below or such other national or international standards, which will ensure the provision of data of an equivalent scientific quality and comparability.

CEN and ISO standards are specified for classification and monitoring of the quality elements in the Water Framework Directive.

CEN is the European Committee for Standardisation, which was established in 1961 by the national standards bodies in the European Economic Community and EFTA countries. CEN is contributes towards the objectives of the EU and the European Economic Area with voluntary standards, which promote environmental protection through agreed methodologies. The CEN produces European Standards (EN), which are also national standards in EU countries.

The ISO (International Organisation for Standardisation) is the world's largest developer and publisher of international standards.

3.5.1.1 Standard methods for monitoring of quality elements

3.5.1.1.1 Phytoplankton sampling

There are no standard methods for phytoplankton sampling. Plankton can be sampled in a number of ways (http://www.aquafact.ie/plankton-sampling.php) by using a water-sampler, sample bottle (for example, Rutner bottle, Van Dorm bottle), tube sampler or towing nets. In Slovenia planktonic net with pore size 30 - 40 µm was used for qualitative sampling, while for quantitative sampling, sampler for integral sampling through depth profile and depth sampler for point sampling at particular depth, was obligatory according to Methodology for sampling and laboratory treatment of samples for evaluation of ecological status of lake with phytoplankton (ARSO, 2009).

3.5.1.1.2 Macrophyte and fish sampling

Table 22: Standard methods for Macrophyte and fish sampling.

Standard method	The tittle
EN 15460	Water quality: Guidance standard for the surveying of macrophytes in lakes
EN 14962	Water quality: Guidance on the scope and selection of fish sampling methods
EN 14011	Water quality: Sampling of fish with electricity
EN 14757	Water quality: Sampling of fish with multi-mesh gillnets

3.5.1.1.3 Standards for physico-chemical parameters

Any relevant CEN/ISO standards.

3.5.1.1.4 Standards for hydro morphological parameters

Any relevant CEN/ISO standards.

3.5.1.2 Standard methods for monitoring quality of bathing waters

Table 23: Standard methods for for monitoring quality of bathing waters.

Standard method	The tittle
ISO 5667: Part 2.	Guidance for sampling techniques
ISO 8199	Water quality - General guidance on the enumeration of micro-organisms by culture
ISO 7899-2	Water quality - Detection and enumeration of intestinal enterococci -- Part 2: Membrane filtration method
ISO 9308-3	Water quality - Detection and enumeration of *Escherichia coli* and coliform bacteria -- Part 3: Miniaturised method (Most Probable Number) for the detection and enumeration of E. coli in surface and waste water
ISO 9308-1	Water quality - Detection and enumeration of *Escherichia coli* and coliform bacteria -- Part 1: Membrane filtration method

3.5.1.3 Preservation and handling with water samples

Guidance on the preservation and handling of water samples (ISO 5667-3) gives general guidelines on the precautions to be taken to preserve and transport all water samples. These guidelines are particularly appropriate when spot or composite samples cannot be analysed onsite and have to be transported to a laboratory for analysis.

Containers holding samples should be protected and sealed in such a way that samples do not deteriorate and do not lose any of their constituents during transport to laboratory. During transportation, samples should be stored attemperatures between 1 ^{o}C and 5 ^{o}C.

The laboratory has to comply with the residues of hazardous chemicals and packaging in according to regulations on waste management. Residues of hazardous chemicals and containers that are contaminated with hazardous substances (classified as hazardous waste) shall be surrendered to an authorised person.

Table 24: Types of sampling vessels for transporting water samples for analysing different parameters.

Plastic container (PE, PTFE, PVC, PET)	Plastic container (not PTFE)	Glass container	Dark glass container	Borosilicate glass container (alkalie free)
TOC conductivity (25°C) m-alkalinity pH ammonium nitrite nitrate total nitrogen total phosphorus orthophosphate cadmium and its compounds lead and its compounds nickel and its compounds arsenic and its compounds zinc and its compounds boron and its compounds chrome and its compounds antimony and its compounds molybdenum and its compounds aluminum iron cyanides sulphate chlorophyl *a*	fluoride	mineral oils AOX COD phenol	tributyltin compounds PCB PAH pesticides volatile organic substances	mercury and its compounds

Table 25: Types of preservation for analysing different parameters.

Type of preservation	Parameter
4 °C	pH, conductivity (25°C), m-alkalinity, PAH, PCB, pesticides, cyanides, tributyltin compounds, mercury and its compounds, volatile organic substances
filtration 0.45 μm, 4 °C	sulphate, fluoride, nitrite, nitrate, orthophosphate
- 20 °C	COD, AOX, TOC, ammonium, nitrate, orthophosphate, total nitrogen, total phosphorus
H_3PO_4 → pH = 2	TOC
H_2SO_4 → pH < 2	COD, ammonium, total phosphorus
HNO_3 → pH < 2	AOX
HCl→ pH < 2	nitrate, mineral oils
ultra pure conc. HNO_3 → pH < 2	cadmium and its compounds, lead and its compounds, nickel and its compounds, arsenic and its compounds, zinc and its compounds, boron and its compounds, chrome and its compounds, antimony and its compounds, molybdenum and its compounds, aluminum, iron
HCl → pH < 1	antimony and its compounds

Type of preservation	Parameter
NaOH → pH > 12	cyanides
H_3PO_4 → pH < 4 and 1 g $CuSO_4$ x 5 H_2O / l sample, cooling 5 – 10°C	phenol
filtration and extraction with hot EtOH, extract frozen at -25 ° C	chlorophyll *a*

3.5.2 BIODIVERSITY MONITORING

There are no standards methods such as ISO or CEN for surveying biodiversity, but there are some scientifically recognized method. For joint monitoring of Lake Skadar/Shkoder, it is important that experts from both sides (Albanian and Montenegrin) chose the same methods; only with good cooperation will the comparison of the results be possible.

3.5.2.1 Methods for assessing trends in the abundance and distribution of species of main plant and animal taxonomic groups

The survey of biodiversity of phytoplankton, macrophytes and fish should follow the standard methodologies defined in Chapter 3.5.1.1. For other important taxonomic groups of the area Lake Skadar/Shkoder (birds, otters) the survey technique that is widely accepted by the scientific community should be used. Since every ecosystem is unique, the methods can be modified according the characteristics of the ecosystem, but it is important that the same methods are used in the area of the whole lake. For this reason, researchers from both countries (Montenegro and Albania) should discuss the methodologies and agree them, before the implementation of the survey.

3.5.2.1.1 Phytoplankton, Macrophytes and Fish

The survey of biodiversity of phytoplankton, macrophytes and fish should follow the standard methodologies defined in Chapter 3.5.1.1.

3.5.2.1.2 Birds

Three different methods for monitoring birds are most often used in Europe, namely: point method (50%), transect method (20%) and method of territory mapping (30%). The transect method has become recently more applicable, especially in the case of large areas.

A detailed description of methods is mainly available in scientific papers, among these are: Bibby et al. 2000; Burnham and Anderson, 1984; Fuller and Langslow, 1984; Furness and Greenwood, 1993; Järvinen and Väisänen, 1975; Järvinen and Väisänen, 1983a; Järvinen and Väisänen, 1983b; Thompson, 1989; Tiainen, 1985.

Short description of methods:

1. Method of territory or spot mapping (monitoring birds during breeding)

During the temperate zone breeding season many individual birds are restricted to relatively small areas, actively defending a territory or spending much time around a nest. If a number of visits are made to an area, and the exact location of birds plotted on maps, it becomes possible to identify clusters of sightings and to estimate directly the total number of pairs or territories of each species present. An essential component of this method is the use of activity codes to describe bird behaviour in the field. These allow observers to record simultaneous observations of territory-holding birds, different forms of territorial behaviour and other factors that later allow an analyst to approximate the boundaries between adjacent bird territories.

2. Line transects and point transects

Both, line and point transects are based on recording birds along a predefined route within a predefined survey unit. In the case of line transects, bird recording occurs continually, whereas for point transects, it occurs at regular intervals along the route and for a given duration at each point. There are variations, where birds are recorded to an exact distance (variable distance) or within bands (fixed distance) from the transect point or line. The two methods can also be combined within the same survey. While there are important differences between the line and point transects, the selection of right method is very important decision in survey design; however there are also many practical and theoretical similarities.

3. The winter counting of birds

The International Waterbird Census (IWC), standardised counts of birds in January all over the world, was established in 1967. In more than 100 countries, millions of water birds are counted each year. Wetlands International brings all this information together.

The method for counting is described in the Guidelines for Participants in the International Waterbird Census (IWC) (Simon Delany, 2005) and in Guidelines for National Coordinators of the International Waterbird Census (IWC) (Simon Delany, 2005)
http://www.wetlands.org/LinkClick.aspx?fileticket=zNosriCQP3k%3d&tabid=773&mid=5895

The results of the International Waterbird Census (IWC) have enabled to monitoring of waterfowl and wader populations (Rose & Scott 1997). On the basis of quantitative data it is possible to estimate large-scale population numbers of many species of water birds and to evaluate the importance of different wetland areas for migration and wintering on a national and international scale. The results of the International Waterbird Census have been used in the designation of nearly half of the 1,369 Wetlands of International Importance in 138 countries designated under the Ramsar Convention. The International Waterbird Census also provides strategic input to the activities of partner organisations, particularly the Red Data Book of IUCN, and Birdlife International's Important Bird Areas (IBA) programme, and to the development of Waterbird Species Action Plans such as those developed for the European Commission and European Union.

The International Waterbird Census is more than a programme to estimate the size of water bird populations, and has been conceived from the outset as a global water bird conservation tool. With the IWC it is possible to monitor changes in water bird numbers and distribution, to improve knowledge of little-known water bird species and wetland sites, to identify and monitor sites that qualify as Wetlands of International Importance under the Ramsar Convention on Wetlands, to provide information on the conservation status of water bird species, and to increase awareness of the importance of water birds and their wetland habitats at local, national and international levels.

There is a number of additional, more specialised methods, which are often used to complement or supplement these standard methods. Analyses of data from the International Waterbird Census have shown that standardised counts in January can be used to obtain adequate population estimates and trends for a majority of swans, geese and ducks (Anatidae), Common Coot *Fulica atra*, and many populations of grebes (Podicipedidae), cormorants (Phalacrocoracidae) and waders (Haematopodidae, Recurvirostridae, Charadriidae and Scolopacidae). IWC methods work particularly well for these species because their populations often congregate at a relatively small number of sites during the non-breeding season.

Roost counts

Some species, for example geese (*Anser* spp. and *Branta* spp.), waders (for example, Haematopodidae, Recurvirostridae, Charadriidae and Scolopacidae), herons and egrets (Ardeidae) and gulls and terns (Laridae), form large, concentrated roosts outside the breeding season. Counts of some roosts, (for example, waders at high tide), may be included in the IWC methodology described above.

Counts of colonially nesting species

Some species congregate at colonies during the breeding season, and closely co-ordinated counts at this time may be productive. Many species in the following families can be counted at their colonies: pelicans (Pelecanidae), cormorants (Phalacrocoracidae), herons and egrets (Ardeidae), storks (Ciconiidae), ibises and spoonbills (Threskiornithidae), flamingos (Phoenicopteridae), and gulls and terns (Laridae). Colonies in open terrain are relatively easy to count compared to colonies in trees, which are difficult to count accurately. It is extremely important to minimise disturbance of breeding birds, and approaching too close, whether on foot, in a vehicle, an aircraft or boat, should be avoided at all costs. As with all monitoring, using standardised methods and counting the same sites in the same way each season are the most important considerations.

3.5.2.1.3 Mammals - Otter (Lutra lutra)

The most common methods for monitoring otter are:

1. visual census (Kruuk 1995, Ruiz-Olmo et al. 2001),
2. main holt (=otter den) use or holt census (Kruuk et al. 1989),
3. spraint counting (Macdonald and Mason 1987, Kruuk 1992),
4. snow tracking (Erlinge 1967, Reid et al. 1987, Roche and Roche 2004),
5. radioisotope marking (Mitchell-Jones et al. 1984),
6. DNA typing from spraints (Dallas and Piertney 1998, Effenberger et al. 1999, Dallas et al. 2000, Jansman et al. 2001, Zemanová 2006),
7. measuring footprints (Hertweck et al. 2002).

Protocol for otter monitoring in Special Areas of Conservation (SACs) within publication "Monitoring the Otter *Lutra lutra*" (Chanin 2003) gives the practical information needed to undertake the monitoring of otters in SACs as required under the Habitats Directive. The directive requires not only that the status of the species should be assessed but also the condition of its habitat. In a section of the above-mentioned publication, "Review of assessment techniques and protocol rationale", existing methods available for detecting, monitoring and counting otters are reviewed and the "Standard Otter Survey" method is considered in some detail. Methods of assessing otter present: direct observation of animals (systematic watches, remote cameras), dens, tracks and spraints.

Otters can be surveyed at any time of the year, but the best time of year is probably spring (if the river level is not too high), before the vegetation becomes too dense to find otter signs, but in the case of Lake Skadar/Shkoder, surveys should be carried out, when water levels are less variable (period of low water level).

While the monitoring of otters in the area of Lake Skadar/Shkoder is just starting, the detailed methodology of tracking of otter is presented in continuation. Tracking of otters with photo-traps or sand pads are the most often used methods. While the starting cost are much higher, when deciding to use photo-traps (photo-cameras with IR sensors), the daily costs are lower, since researchers, responsible for the monitoring should replace the batteries and memory cards every 4-6 months. In addition this approach is much more likely to attract stealing or even vandalisms.

On the other hand, the starting costs for sand pads for tracking the presence of otter based on footprint recognition is very low. However, when using this method, the researchers should visit all sampling locations at least every 3 weeks during all sampling locations during the first 3 years (only during low water level). The sampling intensity can change during the monitoring, when preliminary results show lower otter activity (presence) in the area. Sand pads (dolomite sand is far the best for this kind of researches) should be placed at locations, where otters will be observed at the beginning of the monitoring; sand pads should be set under bridges or similar structures in order to be protected from rain (rain can run off the sand pads and can remove all traces – footprints can no longer be recognised and the species determination would not be possible).

Once there is enough data about otter presence (presumably after 3-5 years of intensive monitoring), otter monitoring should be done every 3 years to confirm good ecological status of the environment. Being large, mammalian predators, otters are tolerant to a wide range of habitat conditions (Chanin, 2001). In order to determine whether their habitat is in a favourable condition, only two main factors need to be considered: food supply and pollutants. Food supply may be measured directly by monitoring fish populations.

3.5.2.2 Methods for survey of habitat types – habitat mapping

Monitoring and assessment can be conducted through a variety of methods, including ground-based and remotely sensed data collection methods.
Remotely sensed images, aerial photographs and satellite images are the most important sources of information to assist in habitat survey and mapping over large areas. Both provide an overview of the survey area at a specific point in time, and can be used to identify habitats of potential ecological value among the more widespread habitats of intensive farmland or urban areas. Field surveys can then be more focused in their approach. Remotely sensed images and aerial photographs in particular greatly assist in the transfer of habitat information to maps as they enable the boundaries of habitat units to be drawn in with considerable accuracy in places where these do not follow features on a map. Hidden areas of potential interest that might go unnoticed will also show up, for example, stands of broadleaved trees or wetland areas in conifer plantations, or areas of undeveloped land in cities. Recent changes in land use that might not be evident on maps will be recorded, for example, afforestation, or new roads, buildings or quarries. Remotely sensed images may provide, or may be combined with topographical information (for example, digital elevation models) to assist interpretation. They are also particularly useful for monitoring changes in habitat extent and distribution over time.
Despite their advantages, aerial photographs and satellite images have limitations and should be seen as a complement to field survey rather than a substitute. Many of the habitats listed in the Guide to Habitats (at level 3) cannot be distinguished accurately from a distance. With some exceptions, the ability to identify species of flora or fauna is very limited. However, at various times of the year, certain plants can be identified from aerial photographs, for example, hawthorn in spring, meadowsweet in summer, or bracken in autumn. Little or no information is provided on soil type, water depth or wetness, peat depth or habitat quality in remotely sensed images. Colours or tones may vary between photographs because of processing and because of changes in vegetation at different times of year. Their usefulness is also limited by their quality, age and resolution. Clouds may obscure satellite images or give rise to shading in aerial photographs. Field visits are still necessary to verify habitat identification and to record species present.

Mapping units are habitat types according to the draft Catalogue of Habitats for Montenegro. The aim of this methodology is to prepare a methodological framework, which should help in the inventory of NATURA 2000 habitats (Habitats Directive 92/43/EC Annex I habitat types) in Montenegro. However the methodology is set up broadly, so it can be used for mapping of any valuable natural, semi-natural and even artificial habitats.
In the cases when mapped habitats are not listed in the Catalogue of Habitats for Montenegro (other natural habitats not included in the Natura 2000 classification or non-natural habitats as urban areas, planted shrub areas, intensively used grasslands and

agricultural areas, artificial water bodies, etc.) the EUNIS classification of habitats 2004 – 3rd level (for example, B2.5: Shingle and gravel beaches with scrub) should be used.

3.5.3 METHODS FOR MONITORING IMPACTS FROM THE LAKE SURROUNDING AREA

Remote sensing compiled with GIS analyses is recommended to assess the magnitude of the influence of soil erosion in the Lake Skadar/Shkoder watershed. Although the methodology of this kind could be quite demanding, it can be modified and remodelled to be suitable for the purpose of this monitoring programme. We recommend to:

- Monitoring the lake's coast/shoreline using satellite images and widely accessible GIS tools (for example, Arcview GIS). In this aspect, satellite images should at first be georeferenced and than the total shoreline should be digitalised (construction of a vector data layer) and classified (classification trough field work) in different groups regarding erosion threat/damage (Ekercin, 2007). The monitoring/classification of the coastline should be made each year; the differences between annual layers should afterwards be calculated using GIS technology (Zimmer and Penner, 2004). Changes in the lake's size or changes in the share of different 'erosion classes' of the coastline are recommended to be parameters for monitoring the influence of the erosion.
- Monitoring the watershed of the lake to recognise possible locations with higher risk of the soil erosion, using the same satellite images, as mentioned above. These locations could be identified using the modified methodology of Heblinski *et al*. (2010) or can be easily digitalised, after they are recognised in the field. The change in the share or in the total size of such locations is recommended to be one of the monitoring parameters. Another parameter that is recommended is that of total annual soil loss, calculated from the soil loss map (using GIS and statistical analyses), made on the basis of the Universal Soil Los Equation (USLE; Gonzales, 2008).
- Monitoring the influence of periodic major floods in the vicinity of the lake, using satellite images taken before and after each major flood (the "before" satellite image with which to compare the influence of the flood can also be the "annual" satellite image). The total area covered with flood and possible changes of the lake shore after the flood and its difference with the annual condition can be the next monitoring parameter.

The afore mentioned parameters for monitoring the influence of the lake surrounding to the Lake Skadar/Shkoder are all based on the satellite images, which can be also used for the assessment of the habitat types around the lake, which enables monitoring activities to be cheaper and more systematic.

4 FRAMEWORK MONITORING PROGRAMME OF LAKE SKADAR/SHKODER

4.1 FRAMEWORK PRIORITISED ANNUAL MONITORING PROGRAMME

4.1.1 QUALITY OF WATER

Regarding thecapability of institutions of Montenegro and Albania there is a joint monitoring programme, which can be realised in both countries in the very near future.

4.1.1.1 Sampling points

4.1.1.1.1 Baseline monitoring

Montenegro: Vranjina, Virpazar, Plavnica, Kamenik, Podhum, Starčevo, Ckla, Middle of the Lake
Albania: Shiroka, Zogaj, Sterbeq, Bajze, Buna Bridge, Vraka, Bahcallek

More detailed information about locations is in Tables 17 and 18.

4.1.1.1.2 Monitoring of sensitive areas

Montenegro: Vranjina, Virpazar, Plavnica, Kamenik, Podhum, Gostilj River, Malo Blato, Obod Cave
Albania: Shiroka, Zogaj, Sterbeq, Bajze, Buna Bridge, Vraka, Bahcallek, Eye of Shegan, Camica
More detailed information about locations is in Tables 19 and 20.

Some sampling points for baseline monitoring are also points for monitoring particularly sensitive areas, because of some antropogenic pressure (industry, agriculture, untreated sewage, refuse dump, etc.) in their surroundings. Monitoring of particularly sensitive areas includes monitoring of Lake Skadar/Shkoder water, sediments and biota for the presence of metals and organic pollutants. PCB-s and metals end up partly in the lake sediments, where they can remain for a long time. Bentic fauna is particular exposed to pollutants in the sediments and will be sampled beside sediment samples.

Geographic coordinates of the locations (Tables 17-20) were determined by using Google Earth, thus a definition of geographic coordinates during sampling in the field is required.

4.1.1.2 Parameters

In the frame of baseline monitoring basic physico-chemical parameters in the water should be monitored: Secchi depth, water temperature, concentration of dissolved oxygen, oxygen saturation value, total organic carbon, conductivity, m-alkalinity, pH, ammonium, nitrite, nitrate, total nitrogen, total phosphorus, orthophosphate and chlorophyll *a*.

In the frame of monitoring of particularly sensitive areas, beside basic physico-chemical parameters also the concentration of some specific pollutants in the water, sediment and biota should be measured: trace elements, polychlorinated biphenyls – PCB, mineral oils, polyaromatic hydrocarbons – PAH, organochlorine pesticide – OCP and phenol.

The potential sources of those parameters in the area of Lake Skadar/Shkoder and their environmental and health impacts are described in Table 26.

Table 26: Potential sources and environmental and health impact of different parameters.

Parameter	Environmental and Health Impact
Ammonium Nitrite Nitrate Total nitrogen	Potential sources: partially treated and untreated sewage, runoff from agricultural sites. Some nitrogen compounds are serious environmental pollutants. Nutrients cause eutrophication of lakes; the consequence of it can be rapid growth of algae and macrophytes. When they decay, their decomposition can cause a deficiency of oxygen to the level that fish can die.
Total phosphorus Orthophosphate	Potential sources: partially treated and untreated sewage, runoff from agricultural sites. Phosphate causes eutrophication of lakes (growth of algae and macrohytes).
Chlorophyll *a*	Chlorophyll *a* concentration is an indicator of phytoplankton biomass (eutrophication).
Metals and trace elements (Cd, Pb, Hg, Ni, As, Zn, B, Cr, Cu, Sn, Mo, Al, Fe)	Potential sources: industry, agriculture, waste. Some of them are environmentally hazardous (at different concentrations). Potential hazards to fish, wildlife, invertebrates, plants or other non-human biota.
Polychlorinated biphenyls – PCB	Potential sources: coal combustion, electrical equipment (capacitors and transformers). PCBs bind strongly to soil and organic particles and may persist in the environment for long periods of time. PCBs can also travel long distances by the air and be deposited far away from their source. PCBs accumulate in organisms and through the food chain, the accumulation in the organisms can increased to the level that may be many thousands of times higher than in water. Probably carcinogenic to humans.
Mineral oils	Potential sources: industry, fuels, waste. Environmentally hazardous.
Polyaromatic hydrocarbons - PAH	Potential sources: home heating, power generation, fossil fuels (traffic). One of the most widespread organic pollutants. PAH accumulate in the organisms through the food chain in fat, liver and kidneys of animals and people. Proven or probably carcinogenic.
Organochlorine pesticide - OCP	Potential sources: agriculture, waste. Persist in soils and aquatic sediments (break down slowly), can bioconcentrate in the tissues of invertebrates and vertebrates through the food chain accumulate in the fatty tissues of animals

Parameter	Environmental and Health Impact
Phenol	Potential sources: industry, waste. Non-chlorinated phenols are decomposed into harmless products by microbes in well aerated soils and water but are more persistent in environments with very low levels of oxygen, such as landfills or waterlogged soils and deep sediments. They are harmful to aquatic wildlife, depending on the exact nature of the phenol and its concentration. Chlorophenols are much more problematic as some are highly persistent, toxic and bioaccumulative.

4.1.1.3 Standard Methods

Regarding WFD, the acceptable methods are methods, which conform to the international standards (CEN/ISO standards) or such other national or international standards, which will ensure the provision of data of an equivalent scientific quality and comparability.

Institutions from both countries are capable of analysing different parameters and using different methods for analysing certain parameters. **Because of that, institutions from both countries must agree and uniform methods, so that results will be comparable.**

Regarding WFD only validated methods are permitted. CETI is the only institution in this region so far that uses validated methods for analysis, thus we recommend that laboratories, which will be included in monitoring programme, adopt the methods, which are listed in the table in Annex 6.

In Annexes 4 and 5, the methods which are used for different parameters at the Univerity of Tirana and University of Shkoder are present. We did not receive methods from the Hydrometeorological Institute of Montenegro and Institute for Energy, Water and Environment of Tirana.

4.1.1.4 Monitoring frequency

Monitoring frequencies takes into consideration the variability in parameters resulting from both natural and anthropogenic conditions. The times at which monitoring is undertaken shall be selected so as to minimise the impact of seasonal variation (for example, weather conditions) on the results, and thus ensure that the results reflect changes in the water body as a result of changes due to anthropogenic pressure. Additional monitoring during different seasons of the same year should be carried out, where necessary, to achieve this objective.

Basic physico-chemical quality elements (Secchi depth, water temperature, concentration of dissolved oxygen, oxygen saturation value, total organic carbon, conductivity, m-alkalinity, pH, ammonium, nitrite, nitrate, total nitrogen, total phosphorus, orthophosphate, chlorophyll *a* will be analysed in water, at all sampling points four times per year - twice in the period of low water level (summer time) and twice in the period of high water level (autumn-winter time) - while on the points of sensitive areas also metals and trace elements, polychlorinated biphenyls, mineral oils, chemical oxygen demand, sulphate, fluoride, polyaromatic hydrocarbons, organochlorine pesticides and phenol should be measured four times a year in the water samples. Metals and trace elements, polychlorinated biphenyl, mineral oils, polyaromatic hydrocarbons, and organochlorine pesticides should be also analysed in sediment (four times per year) and biota (bentic organisms) (four times per year – sinchronised with sediment sampling).

Because the register of pollution sources around the Lake Skadar/Shkoder has not been done so far, it is necessary that during the first year of monitoring all parameters should be monitored at all sampling points. Data of first year of monitoring will give information about the loading of those points with certain pollutants. Taking into consideration this data, in the second year of monitoring, analysing of certain pollutant in water, sediment and biota will be performed just at the points, where analyses in the first year of monitoring will show pollution with this certain pollutant. At the points, where pollution with specific pollutants are not detected in the first year, the analyses of this particular pollutant will be repeatedly done after three years.

The dates of sampling events will depend on the situation on the lake (the water level) and weather conditions. **It is important that sampling occurs at the same date at all sampling points, using the same methodologies**. Sampling of water must be carried out in accordance with standard ISO 5667-4 (Guidance on sampling from lakes, natural and man-made). Preservation, handling, transport and storing of water samples must be in accordance with standard ISO 5667-3 (Guidance on the preservation and handling of water samples). Sampling of sediment must be carried out in accordance with standard ISO 5667-12 (Guidance on sampling of bottom sediments). Preservation, handling, transport and storing of sediment samples must be in accordance with ISO 11464 (Pre-treatment of samples for physico-chemical analysis).

Table 27: Monitoring programme for Montenegrin side of Lake Skadar/Shkoder: Annual frequency of analysing parameters at sampling points.

Parameter/Sampling point	**Vranjina**	**Virpazar**	**Plavnica**	**Kamenik**	**Podhum**	**Starčevo**	**Ckla**	**Middle of the Lake**	**"Obod" Cave**	**Malo Blato**	**Gostilj River**
Secchi depth	4	4	4	4	4	4	4	4	4	4	4
Water temperature	4	4	4	4	4	4	4	4	4	4	4
Concentration of dissolved oxygen	4	4	4	4	4	4	4	4	4	4	4
Oxygen saturation value	4	4	4	4	4	4	4	4	4	4	4
Total organic carbon	4	4	4	4	4	4	4	4	4	4	4
Conductivity	4	4	4	4	4	4	4	4	4	4	4
m-alkalinity	4	4	4	4	4	4	4	4	4	4	4
pH	4	4	4	4	4	4	4	4	4	4	4
Ammonium	4	4	4	4	4	4	4	4	4	4	4
Nitrite	4	4	4	4	4	4	4	4	4	4	4
Nitrate	4	4	4	4	4	4	4	4	4	4	4
Total nitrogen	4	4	4	4	4	4	4	4	4	4	4
Total phosphorus	4	4	4	4	4	4	4	4	4	4	4
Orthophosphate	4	4	4	4	4	4	4	4	4	4	4
Chlorophyll *a*	4	4	4	4	4	4	4	4	4	4	4
[1]Metals and trace elements*	4	4	4	4	4	-	-	-	4	4	4
[2]Polychlorinated biphenyls – PCB*	4	4	4	4	4	-	-		4	4	4
Mineral oils*	4	4	4	4	4	-	-	-	4	4	4
Chemical oxygen demand - COD	4	4	4	4	4	-	-	-	4	4	4
Sulphate	4	4	4	4	4	-	-	-	4	4	4
fFuoride	4	4	4	4	4	-	-		4	4	4
[3]Polyaromatic hydrocarbons – PAH*	4	4	4	4	4	-	-		4	4	4
[4]Organochlorine pesticides – OCP*	4	4	4	4	4	-	-	-	4	4	4
Phenol	4	4	4	4	4	-	-	-	4	4	4
Hydrometerological parameters	cont	-	cont	-	-	-	cont	-	-	-	-
Microbiological parameters**	2	2	2	2	2	-	-	-	2	2	2

Sampling points for monitoring sensitive areas are emboldened.

1Metals and trace elements: Cd, Pb, Hg, Ni, As, Zn, B, Cr, Cu, Sn, Mo, Al, Fe

[2]Polychlorinated biphenyls – PCB: Ballschmitter's set (PCB-28, PCB-52, PCB-101, PCB-138, PCB-153, PCB-180).

[3]Polyaromatic hydrocarbons – PAH: benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, anthracene, fluoranten, naftalen

[4]Organochlorine pesticide – OCP: large class of multipurpose chlorinated hydrocarbon chemicals (chlordane, aldrin, dieldrin, endrin, izodrin, DDT, izoproturon, simazine, atrazine, diuron, alachlor, endosulfan, etc.)

* Analyses will be done also in sediment and biota (for bentic organisms will be used frequency as for for sediment).

** Sampling and analysis will be done in the summer time (at the beginning and at the end of summer).

Table 28: Monitoring programme for Albanian side of Lake Skadar/Shkoder: Annual frequency of analysing parameters at sampling points.

Parameter/Sampling point	Shiroka	Zogaj	Sterbeq	Bajze	Buna bridge	Bahcallek	Vraka	Eye of Shegan	Camica
Secchi depth	4	4	4	4	4	4	4	4	4
Water temperature	4	4	4	4	4	4	4	4	4
Concentration of dissolved oxygen	4	4	4	4	4	4	4	4	4
Oxygen saturation value	4	4	4	4	4	4	4	4	4
Total organic carbon	4	4	4	4	4	4	4	4	4
Conductivity	4	4	4	4	4	4	4	4	4
m-alkalinity	4	4	4	4	4	4	4	4	4
pH	4	4	4	4	4	4	4	4	4
Ammonium	4	4	4	4	4	4	4	4	4
Nitrite	4	4	4	4	4	4	4	4	4
Nitrate	4	4	4	4	4	4	4	4	4
Total nitrogen	4	4	4	4	4	4	4	4	4
Total phosphorus	4	4	4	4	4	4	4	4	4
Orthophosphate	4	4	4	4	4	4	4	4	4
Chlorophyll *a*	4	4	4	4	4	4	4	4	4
[1]Metals and trace elements*	4	4	4	4	4	4	4	4	4
[2]Polychlorinated biphenyls – PCB*	4	4	4	4	4	4	4	4	4
Mineral oils*	4	4	4	4	4	4	4	4	4
Chemical oxygen demand - COD	4	4	4	4	4	4	4	4	4
Sulphate	4	4	4	4	4	4	4	4	4
Fluoride	4	4	4	4	4	4	4	4	4
[3]Polyaromatic hydrocarbons – PAH*	4	4	4	4	4	4	4	4	4
[4]Organochlorine pesticides – OCP*	4	4	4	4	4	4	4	4	4
Phenol	4	4	4	4	4	4	4	4	4
Hydrometerological parameters	contin	-	-	-	contin	-	-	-	-
Microbiological parameters**	2	2	2	2	2	2	2	2	2

Sampling points for monitoring sensitive areas are emboldened.

[1]Metals and trace elements: Cd, Pb, Hg, Ni, As, Zn, B, Cr, Cu, Sn, Mo, Al, Fe

[2]Polychlorinated biphenyls – PCB: Ballschmitter's set (PCB-28, PCB-52, PCB-101, PCB-138, PCB-153, PCB-180).

[3]Polyaromatic hydrocarbons – PAH: benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, anthracene, fluoranten, naftalen

[4]Organochlorine pesticide – OCP: large class of multipurpose chlorinated hydrocarbon chemicals (chlordane, aldrin, dieldrin, endrin, izodrin, DDT, izoproturon, simazine, atrazine, diuron, alachlor, endosulfan, etc.)

* Analyses will be done also in sediment and biota (for bentic organisms will be used frequency as for for sediment).

** Sampling and analysis will be done in the summer time (at the beginning and at the end of summer).

4.1.1.5 Data processing

Each laboratory responsible for monitoring, should prepare their report and send it to the technical coordinator of the project (Joint monitoring programme of Lake Skadar/Shkoder) one month after sampling. The technical coordinator will gather and set down all results of one sampling, compare the results with the regulations of both countries and make a report in three languages. The report will be sent in electronic form to the administrator of the data exchange platform. Results of annual monitoring have to be established in the form of an annual report to 1st March for the preceding year.

4.1.2 BIODIVERSITY

Lake Skadar/Shkoder is a large water body thus it is very important to choose the rights indicators (parameters) to get valuable information about the status of biodiversity and environmental pressures (for example, changes in the extent of habitat, habitat fragmentation, water quality, invasions by alien species, other types of disturbances, coverage of protected areas etc.), which affect biodiversity.

4.1.2.1 Indicators

It is too complex and expensive to survey and monitor biodiversity of all taxonomic groups. For this reason indicators, which (1) are known to monitor the environmental changes (pressures and conservative measures), (2) are important for Lake Skadar/Shkoder, and (3) can be evaluated by experts from local institutions, were chosen.

Regarding fish, it will be necessary first of all make a survey of the whole lake and its tributaries (the assessment of the fish stock has not been done for three decades) to find out the species' composition and relations amongst different fish species. Regarding data, the list of important fish species (endemic, globally endangered, invasive, economical important) (Table 15), that have to be monitored in the lake, will be modified.

Table 29: Importance of chosen species to be included in monitoring of biodiversity.

Indicator		*Importance of indicator
Phytoplankton		Phytoplankton is a primary producer and good indicator of the ecological status of the lake, because of the rapid response of organisms to changes in the environment. Phytoplankton organisms have a primary role in the food web and an important influence on other organisms. It is included as a biological quality element in monitoring programme regarding WFD.
Macrophyte mapping		Macrophytes are good indicator of ecological status of the lake, because of thecomposition and abundance of macrophytes and also the depth of their appearance responding to environmental change. It is included as biological quality element in the monitoring programme regarding WFD. As primary producers, many of them are indicators of eutrophication, others are sensitive to acidification or salinity. Factors that influence the biomass and distribution of submersed macrophytes are: substratum character and water depth water chemistry, temperature, bottom slope, water level fluctuation and wave action, filamentous and planktonic algae, grazing and intra- and inter- species competition among macrophyte species. Macrophytes provide habitats for animals (fish, birds, invertabrata etc.) and stabilise sediments. Three globally and European threatened species (*Trapa natans*, *Marsilea quadrifolia* and *Caldesia parnassifolia*) and eight Balkan or local endemic species are evidenced in the area of Lake Skadar/Shkoder.
Fish	Species composition, distribution and abundance of fish	Fish is one of the most important biodiversity groups on lake (about 50 species live in Lake Skadar/Shkoder, what is more than whole Great Britain Inland waters) and fish are most important bio resource of the lake. An assessment of fish stock has not been done for three decades, so the extent of fishing and overe xploitation are unknown, but the experience of fishermen and individual researchers indicate that changes in the composition of fish communities have occurred. There is some evidence that some of the lake's most valuable fish species are threatened and are declining due to over exploitation by increasing numbers of active fishermen and habitat degradation. Autochthonous fish is recovering after a decline in a period of uncontrolled fishing (1980s), but migratory species seem to be affected by fishing, although not necessarily within the basin. Exotic invasive species are expanding rapidly.
	Scardinius knezevici	Endemic species of Lake Skadar/Shkoder live in the coastal area of the whole lake and forms huge shoals in lake crypto-depressions during winter (lake deep bays) as well as in deeper habitats of lake inlets.
	Acipenser naccarii	Migratory species that enters lake for spawning is highly endangered in its whole living area, and according to IUCN categorisation it is threatened as Critically Endangered A2bcde;B2ab(i,ii,iii,iv,v). This fish species is protected by Montenegrin Decree on the protection of certain flora and fauna species (OG MNE, No. 76/06). It used to be numerous in the lake in the past but nowadays its number has drastically decreased. Threats: overfishing (both legal and illegal), and in particular of pre-reproductive sized fish, threatens this species. It is also threatened by the creation of barriers to its migratory routes, which reduce its reproductive success.
	Acipenser sturio	Migratory species that enters the lake for spawning is highly endangered in its whole living area and according to IUCN red list, it is threatened as Critically Endangered A2cde;B2ab(ii,iii,v). This fish species is protected by Montenegrin Solution on the protection of certain flora and fauna species (OG MNE, No. 76/06). It used to be numerous in lake in the past but nowadays its number has drastically decreased. Threats: dam construction, pollution and river regulation have led to loss and degradation of spawning sites.

Indicator		*Importance of indicator
	Perca fluviatilis	It is an alien and highly invasive species in Lake Skadar/Shkoder. Due to absence of any abundant carnivore fish species in the lake, the population of this fish has drastically increased in number. In the last ten years, fishermen have considered this species as fishery attractive due to extreme high abundance in the littoral lake area. A rapid increase in its number can be a threat for other fish species.
Birds	Species composition, abundance and distribution of birds in winter, spring, summer and autumn	Lake Skadar/Shkoder is of global importance as one of the largest European wintering areas for birds and about 18 species just fly over the area during autumn and spring. Eleven species of aquatic birds in some years of IWC counting have crossed the census of 1% of regional population.
	Pelecanus crispus	It is a globally endangered species (it is categorised as a vulnerable species on the IUCN red list) and is a trade mark of Lake Skadar/Shkoder. It is on the list of Annex I and II of the Bonn Convention and it is also listed as endangered or threatened species in Annex II of Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean. The breeding success of this bird in Lake Skadar/Shkoder is not at an appropriate level. It breeds on Lake Skadar/Shkoder in only on two locations: on floating turf islets in Pančeva oka reserve and occasionally in Crni žar reserve. The main threats to successful breeding are: wetland alteration, flooding of eggs because of water level fluctuation, hunting, eggs collection, predators and disturbance by tourist, ornithologist and fishermen.
	Aythya nyroca	It is categorised as a near threatened species on IUCN red list, it is on the list of Annexes I and II of the Bonn Convention. Ferruginous Duck numbers are closely related to water and limnology parameters and reflect the ecological changes in the wetland. The number of breeding pairs of this bird on the lake is an estimation and does not exceed 50 pairs. The nest is usually located on the ground close to water, or above water or on floating rafts of dense reeds and other aquatic vegetation. The key threat is the loss of its wetland habitat of well vegetated shallow pools through drainage, abandonment or intensification of fishponds, development of dams and building of infrastructure on flood plains. Hunting is also a serious threat.
	Phalacrocorax pygmeus	It is on the list of Annex II of the Bonn Convention and is listed as endangered or threatened species in Annex II of Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean. Lake Skadar/Shkoder is one of its three breeding places in Montenegro. On Lake Skada/Shkoderit breeds in Pančeva oka and Crni žar reserves and occasionally in Manastirska tapija reserve. In 2007, a small mixed colony with cormorants was discovered in Ckla. The colony from Pančeva oka moves on average every third year to Crni žar and back. Most probably, the reasons are disturbance by tourists, setting fire to reeds in reserves and disturbance by fishermen. Water fluctuation can have impact on success of breeding if it is drastic, i.e. if it exceeds 30-40 cm in the period from March to June.
Mammals	*Lutra lutra*	It strongly linked to the water habitat. It has status NT (Near Threatened) and population trend is decreasing regarding IUCN Red List. It is listed in Appendix I of the CITES, Appendix II of the Bern Convention, Annexes II and IV of the EU Habitats and Species Directives and Appendix I of the Bonn Convention. The aquatic habitats of otters are extremely vulnerable to man-made changes.

* More detailed information about importance of indicator for Skada-Shkoder Lake is described in the chapter 3.2.2 Biodiversity monitoring.

4.1.2.2 Locations, methods and frequency of monitoring

Locations for macrophytes, particular fish and bird species are presented in Chapter 3.5.2.1 "Methods for assessing trends in the abundance and distribution of species of main plant and animal taxonomic groups". Regarding otters, sampling points will be defined after the first year of surveying. For monitoring phytoplankton, the sampling points on the open water will be defined at the first year of surveying.

In order to detect changes in biodiversity of phytoplankton, fish and macrophytes, the monitoring should be implemented every 3-5 years, but in the case of birds we recommend monitoring every year.

Since the monitoring of otters in the area of Lake Skadar/Shkoder is just at beginning, we recommend monitoring every year for the first 5 years and after that every 3 years. The time of the year, when monitoring should be conducted depends on the life cycle of the chosen species, conditions on the lake (water level) and the time of their appearing in the lake (for example, migratory species of fish and birds) (Table 30).

Experts from both countries have done different research with different/same methods at different locations. For this reason it is obligatory that experts for a particular group of organisms from both countries agree methods and regarding good knowledge of particular group of organisms made reconciliation of time of field work and processing data.

After the first year of monitoring, reference status will be defined and it will be the basis for evaluating changes and trends in the following years. This will be the basis for planning and realisation of different measures to protect fauna and flora around the lake.

Table 30: Summary of framework of prioritised annual monitoring programme of biodiversity.

Indicator		Localities	Period of the year	Methodology	Parameters
Phytoplankton		Open water	4-times per year (April, June, July, September)	Sampling by bottle (Rutner or Van Dorn)	Species compostion, abundance and distribution, seasonal dinamics
Macrophyte mapping		Whole lake	June-August	Transect method (EN 15460)	Species compostion, abundance and distribution
Fish	Species composition, abundance of fish species	Whole lake and lowest parts and mouths of tributaries[1*]	February-June	Electrofishing (EN 14011) Multi-mesh gillnets (EN 14757) EN 14962	Composition, abundance, biomass and age structure
	Scardinius knezevici	Karuč, Raduš, Rijeka Crnojevića, Veliko Blato	Februry/March	Electrofishing (EN 14011) Multi-mesh gillnets (EN 14757)	Length/Weight ratio, population structure, relative abundance, mortality, maturity, fecundity
	Acipenser naccarii	Shkodra city, beginning of Bojana/Buna River.	May/June	Multi-mesh gillnets (EN 14757)	Length/Weight ratio, population structure
	Acipenser sturio	Shkodra city, beginning of Bojana/Buna River.	May/June	Multi-mesh gillnets (EN 14757)	Length/Weight ratio, population structure
	Perca fluviatilis	Lowest part of Rijeka Crnojevića, Crmička river Tanki Rt	May/June	Electrofishing (EN 14011)	Length/Weight ratio, population structure, relative abundance, mortality, maturity, fecundity, feeding
Birds	Species abundance and distribution through all year	Whole lake	winter, spring, summer and autumn	The winter counting of birds - IWC in winter Line Transect method	Counting, distribution and abundance
	Pelecanus crispus	Pančeva oka, Crni žar	March–June	Method of territory or spot mapping during their breeding	Bird behaviour, number of pairs, number of eggs, number of nestlings (breeding successfulness)
	Aythya nyroca	Vegetation of the northern part of the Lake Skadar/Shkoder	April–June	Method of territory or spot mapping during their breeding	Bird behaviour, number of pairs, number of eggs, number of nestlings (breeding successfulness)
	Phalacrocorax pygmeus	Pančeva oka, Crni žar, Manastirska tapija, Ckla	April–June	Method of territory or spot mapping during their breeding	Bird behaviour, number of pairs, number of eggs, number of nestlings (breeding successfulness)
Mammals	*Lutra lutra*	Areas along tributaries of the lake	In the time of low level of water	Visual inspection (cameras) or track/footprints	Presents of the animals (footprints)

1* - Upper parts of Oraovštica River, River Crnojevića, Slap Zete, Lowest part of Morača and its delta, Crmička River, Plavnica River, Veliko Blato.

4.1.2.3 Data processing

Each institution/researcher responsible for monitoring should prepare their report and send it to the technical coordinator of the project (Joint monitoring programme of Lake Skadar/Shkoder) one month after sampling. The technical coordinator will gather and set down all results of one sampling, compare the results with the regulations of both countries and make a report in three languages. The report will be sent in electronic form to the administrator of the data exchange platform. Results of annual monitoring have to be established in the form of an annual report to 1st March for the preceding year

4.3 FRAMEWORK OF LONG TERM MONITORING PROGRAMME

4.3.1 QUALITY OF WATER

The long term monitoring programme can be defined after the first year of monitoring, because data of first year of monitoring will give information about the load of those points with certain pollutants. Taking into consideration this data, in the second year of monitoring analysing of certain pollutants in water, sediment and biota will be performed just at the points, where analyses in the first year of monitoring show pollution with the particular pollutant. At the points where pollution with that specific pollutant is not be detected in the first year, analyses of this pollutant should be repeated every three years.

4.3.2 BIODIVERSITY

Table 31: Long term monitoring of biodiversity.

Indicator	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year	8th year
Phytoplankton	√			√			√	
Macrophytes	√			√			√	
Fish	√			√			√	
Birds	√	√	√	√	√	√	√	√
Otter	√	√	√	√	√			√

4.4 COST ESTIMATION

4.4.1 COST ESTIMATION FOR ANNUAL MONITORING OF CHEMICAL STATUS OF LAKE SKADAR/SHKODER

4.4.1.1 Montenegro

Table 32: Cost estimation for annual monitoring of chemical status of Lake Skadar/Shkoder for Montenegrin part of the lake.

Indicator/Specification		No. of locations	No. of sampling	[1]Field work	Cost of laboratory analysis	Cabinet work	Total
General physical-chemical parameters - water		11	4	170 €[3]	100 €	700 €[4]	14 680 €
Trace elements	water	8	4	0 €	100 €	0 €	3 200 €
	sediment	8	4	0 €	150 €	0 €	4 800 €
	biota[2]	8	4	0 €	150 €	0 €	4 800 €
PCB	water	8	4	0 €	66 €	0 €	2 112 €
	sediment	8	4	0 €	70 €	0 €	2 240 €
	biota[2]	8	4	0 €	70 €	0 €	2 240 €
Mineral oils	water	8	4	0 €	25 €	0 €	800 €
	sediment	8	4	0 €	30 €	0 €	960 €
OCP	water	8	4	0 €	65 €	0 €	2 080 €
	sediment	8	4	0 €	72 €	0 €	2 304 €
PAH	water	8	4	0 €	65 €	0 €	2 080 €
	sediment	8	4	0 €	72 €	0 €	2 304 €
Phenol	water	8	4	0 €	11 €	0 €	352 €
	sediment	8	4	0 €	15 €	0 €	480 €
Microbiology	water	8	4	0 €	50 €	0 €	1 600 €
						Total	**47 032 €**

[1] sampling, field measurements
[2] benthic inverterbrates
[3] costs for sediment, water and benthic samples and parameters are included
[4] costs for report (1 time sampling at all locations)

4.4.1.2 Albania

Table 33: Cost estimation for annual monitoring of chemical status of Lake Skadar/Shkoder for the Albanian part of the lake.

Indicator/Specification		No. of locations	No. of sampling	[1]Field work	Cost of laboratory analysis	Cabinet work	Total
General physical-chemical parameters - water		9	4	170 €[3]	100 €	700 €[4]	12 520 €
Trace elements	water	9	4	0 €	100 €	0 €	3 600 €
	sediment	9	4	0 €	150 €	0 €	5 400 €
	biota[2]	9	4	0 €	150 €	0 €	5 400 €
PCB	water	9	4	0 €	66 €	0 €	2 376 €
	sediment	9	4	0 €	70 €	0 €	2 520 €
	biota[2]	9	4	0 €	70 €	0 €	2 520 €
Mineral oils	water	9	4	0 €	25 €	0 €	900 €
	sediment	9	4	0 €	30 €	0 €	1 080 €
OCP	water	9	4	0 €	65 €	0 €	2 340 €
	sediment	9	4	0 €	72 €	0 €	2 592 €
PAH	water	9	4	0 €	65 €	0 €	2 340 €
	sediment	9	4	0 €	72 €	0 €	2 592 €
Phenol	water	9	4	0 €	11 €	0 €	396 €
	sediment	9	4	0 €	15 €	0 €	540 €
Microbiology	water	9	4	0 €	50 €	0 €	1 800 €
						Total	**48 916 €**

[1] sampling, field measurements
[2] benthic inverterbrates
[3] costs for sediment, water and benthic samples and parameters are included
[4] costs for report (1 time sampling at all locations)

4.4.2 COST ESTIMATION FOR ANNUAL BIODIVERSITY MONITORING

4.4.2.1 Montenegro

Table 34: Cost estimation for annual monitoring of biodiversity on the Montenegrin side of Lake Skadar/Shkoder.

Indicator/Specification	**[1]Field work**	**[2]Laboratory and desk work**	**[3]Material costs**	**Per diems**	**Total**
Phytoplankton	320 €	560 €	3 130 €	450 €	4 460 €
Macrophytes	360 €	560 €	1 140 €	450 €	2 510 €
Fish	3 750 €	1 850€	4 000 €	1 200 €	10 800 €
Birds	2 900 €	1 660 €	2 900 €	1 100 €	8 560 €
Otter	550 €	150 €	750 €	250 €	1 700 €
				Total	**28 030€**

[1] costs for work hours spent on the field
[2] sample processing, data analysis, report writing
[3] costs for: fuel, nets, using of car, renting of boats, sand, etc.)

4.4.2.2 Albania

Table 35: Cost estimation for annual monitoring of biodiversity on the Albanian side of Lake Skadar/Shkoder.

Indicator/Specification	**[1]Field work**	**[2]Laboratory and desk work**	**[3]Material costs**	**Per diems**	**Total**
Phytoplankton	320 €	560 €	3 130 €	450 €	4 460 €
Macrophytes	360 €	560 €	1 140 €	450 €	2 510 €
Fish	3 750 €	1 850€	4 000 €	1 200 €	10 800 €
Birds	760 €	850 €	1 450 €	550 €	3 610 €
Otter	550 €	150 €	750 €	250 €	1 700 €
				Total	**23 080 €**

[1] costs for work hours spent on the field
[2] sample processing, data analysis, report writing
[3] costs for: fuel, nets, using of car, renting of boats, sand, etc.)

4.5 RECOMMENDATION FOR EXPANDING AND MODIFICATION OF MONITORING PROGRAMME IN THE FUTURE

Regarding obligations that arise out of European directives and international conventions we recommend that monitoring on Lake Skadar/Shkoder will conform to them in the future.

1. Monitoring programme of quality of water obligated by WFD
When Montenegro and Albania become a members of the EU, they should conform to its monitoring programme and all obligations to WFD (for example, including biological quality elements in assessment of ecological status of the lake). Implementation of WFD is a long lasting process, which demands strengthening of the skills of national experts and other relevant parties in the field of integrated water management, and incorporation of the WFD into Albanian and Montenegrin legislation. Regarding WFD Member states of EU must identify and characterise all surface water types - rivers, lakes, transitional waters, coastal waters, artificial and heavily modified surface water bodies - within defined “water basin districts”. They must also identify reference conditions and develop appropriate ecological monitoring systems based on the composition and/or abundance of elements of the aquatic biota plus hydromorphological, chemical and physico-chemical quality elements. Five ecological quality classes must be established (high, good, moderate, poor and bad), based on metrics that measure how far biological elements deviate from established reference conditions.

2. Habitat mapping to meet the requirements of Habitat Directive
Habitat maps are essential source of information for integrated water bodies management and the implementation of European directives (WFD and Habitat Directive) and Convention of Biodiversity. The aim of Habitats Directive (CD 92/43/EEC) is to contribute towards ensuring biodiversity through the conservation of natural habitats, wild fauna, and flora in Europe. In order to facilitate this objective, a coherent European ecological network of special areas of conservation was set up named Natura 2000. Each member state should propose a list of sites in which natural habitat types and species, native to its territory, are hosted.

3. Inclusion of other indicators suggested by the Convention of Biodiversity
Neither Albania nor Montenegro has not officially adopted a national list of indicators of biodiversity. When those lists are adopted, the indicators can also be monitored in the area of Lake Skadar/Shkoder.

In the area of Lake Skadar/Shkoder we recommend additional indicators:

- **Trends in abundance and distribution of selected species also from other taxonomic groups** (for example amphybians, reptiles, plants...).

- **Coverage of protected areas**
  Changes in the coverage of protected areas - in their expanse and in the way of their protection. The protected area coverage indicator helps in the tracking of progress in the establishment of a comprehensive protected area network.

- **Threats to biodiversity**
  Trends in invasive alien species (number and definition of such species and their area of expansion),
  Fragmentation of habitats (subdivision of habitats can occur by natural disturbances (fire, storms) or human activities (roads, agriculture, reduction of wetlands areas etc.). This can be measured via mapping of habitat types.
  Disturbances (fishing, hunting, shipping, tourism, noise). This can be measured by identification and quantification of such disturbances.
  Climate change (for example, increased temperature, drought and flooding and extreme weather events and changing weather patterns)
  Pollution – this indicator is measured by monitoring of ecological and chemical status of the lake.

- **Funding to biodiversity**
  Level of funds designed for monitoring and protection of biodiversity.

5 POTENTIAL INSTITUTIONS AND RESEARCHERS FOR IMPLEMENTATION OF JOINT MONITORING PROGRAMME

5.1 MONTENEGRO

5.1.1 HYDROMETEOROLOGICAL INSTITUTE OF MONTENEGRO

The Hydrometeorological Institute of Montenegro, founded in 1947, is a governmental institution under the competence of the Ministry of Sustainable Development and Tourism. Hydrometeorological Institute Podgorica is the Institution responsible for the monitoring of water characteristics (qualitative and quantitative) of Montenegro (HMI), determined by Article 58. of Water Law The Official Journal of RM, No. 27/07). HMI was established to carry out professional and related administrative activities with the application of scientific methods and knowledge. The HMI is responsible for dealing with all the physical and chemical processes in the atmosphere and hydrosphere, and hydrological and meteorological activities in the broadest sense.
Laboratory of HMI is acreditated for sampling methodology and analysis of water quality by Accreditation Body of Montenegro (ATCG), MEST 17 025/2006, which correspond to ISO/IEC 17025/2006.

The parameters which can be at this time analysed by the equipment at HMI in water samples are Secchi depth, temperature, conductivity, pH, DO%, DO mg/L, alkalinity, total organic carbon (TOC), ammonium, nitrite, nitrate, total nitrogen, total phosphorus, orthophosphate, chlorophyll *a*, aluminium, iron, chemical oxygen demand – COD, sulphate, fluoride, phenol. On their hydrological stations they measure water level, discharge and water temperature. The laboratory will be equipped with new equipment in the future and also new methods will be established.

Equipment:

- secchi disc,
- thermometer,
- general laboratory equipment,
- conductometer,
- titrator,
- ion-selective electrode,
- spectrometer,
- UV-vis spectrophotometer,
- turbidometer.

5.1.2 CENTRE FOR ECOTOXICOLOGICAL RESEARCH OF MONTENEGRO

The Centre for Ecotoxicological Research of Montenegro was founded in 1996 in accordance with the Government policy, for the purpose of uniting the problems of protecting the vital environment and organising the monitoring of the all segments of the environment (air, water, soils, waste, radioactivity, human and animal food), as well as to concentrate the expensive instrumental equipment that is indispensable for the toxicant diagnosis in other institutions in Montenegro.

Certification of the CETI

- CETI obtained CERTIFICATE ISO 9001:2000 (No 12 100 23651 TMS) from the certification Body of TUV Management Service GmbH, TUV SUD Gruppe, Munchen -Germany. Recertification occured in February 2008, from the TUV SUD Grouppe.
- CETI established and applies a Quality management System for: control of quality of the environment (water, air, soil, radioactivity, noise), control of quality and health correctness of groceries and life stock food, analysis of biological material, attesting groceries in import and export, radioactivity control of products and goods in import and export, categorisation of waste, testing of condition of work environment, personal TLD dosimetry, gamma spectrometry and dosimetry control, etc.
- CETI is accredited under ISO/IEC 17025 Standard from the JUAT Accreditation body from Belgrade and from SWEDAC, Sweden Accreditation Body and was re-accreditated in 2008 by the Accreditation body of Montenegro.
- In April 2008, CETI renewed accreditation under ISO/IEC 17025:2006 Standards, by the Montenegrin Accreditation body, with bordering scope of the accreditation.

In December 2010 CETI renewed its accreditation with the new methods. In relation to the environment, its scope of accreditation has been expanded with the method of determining organic compounds in soil and sediment.

CETI has equipment for performing analyses of general and inorganic parameters (pH, conductivity, turbidity, cyanides, and fluoride), organic parameters (COD, BOD, TOC, pesticides, polychlorinated biphenyls, polyaromatic hydrocarbons, mineral oils, and volatile chlorinated hydrocarbons) and heavy metals.

Existing laboratory equipment:

- portable spectrophotometer,
- conductometer,
- general laboratory equipment,
- UV-VIS spectrometer,
- TOC analyzer,
- high-performance liquid chromatograph (HPLC),

- liquid chromatograph - mass spectrometers (LC/MS, LC/MS/MS),
- gas chromatography - mass spectrometers (GC/MS),
- high-performance liquid chromatographs (HPLC, HPLC with fluorescence detectors),
- inductively coupled plasma optical emission spectrometer (ICP-AES),
- atomic absorption spectrophotometer (AAS).

5.1.3 FACULTY OF NATURAL SCIENCES AND MATHEMATIC, INSTITUTE FOR THE PROTECTION OF NATURE, NATURE HISTORY MUSEUM, FORESTRY INSTITUTE, PUBLIC ENTERPRISE NATIONAL PARKS OF MONTENEGRO

Researchers from research institution: Faculty of Natural Sciences and Mathematic, Institute for the protection of Nature, Nature History Museum, Forestry Institute, Public Enterprise National Parks of Montenegro can be involved in the biodiversity monitoring and monitoring of biological quality elements (Table 36).

Table 36: Extensive list of experts in Montenegro for biodiversity monitoring and monitoring of biological quality elements.

Name and surname	Institution	Field of expertise
Sead Hadziablahovic MSc	INP	Flora (Field Cemovsko)
Zlatko Bulic PhD	INP	Flora (Canyons - Moraca, Cijevna, Tara)
Ruza Cirovic PhD	INP	Herpetology
Saveljic Darko	INP	Ornithology
Nikcevic Jelena MSc	INP	Entomology
Dragutin Nedic MSc	INP	Limnology, Benthos
Kralj Sonja MSc	INP	Crustaceans - crabs
Milka Rajkovic MSc	INP	Freshwater Crabs
Jelena Simicevic MSc	INP	Four-footed mammals
Vizi Ondrej	NHM	Ornithology
Lidija Polovic MSc	NHM	Snakes
Vera Biberdzic M.Sc.	NHM	Algal / Charophytae
Danka Petrovic MSc	PMF	Flora (Coastal mountains, general)
Stesevic Danijela MSc	PMF	Flora (weeds and mountain flora)
Danilo Mrdak PhD	PMF	Ichtiology – Fish (rivers)
Vladimir Pešić	PMF	Entomology- water mites
Marijana Krivokapic PhD	PMF	Ichtiology – Fish (rivers)
Drago Maric PhD	PMF	Ichtiology – Fish (rivers)
Vukic Pulevic PhD	PMF	Flora - general
Kraman Gordan PhD	PMF	Gammarids - Invertebrates
Rakocevic Jelena PhD	PMF	Phytoplankton (Skadar lake)
Darko Dubak MSc	FI	Forestry
Nela Dubak MSc	PE NP MNE	Birds (Skadar lake)
Slavica Djurisic	PE NP MNE	Flora (NPs)
Aleksandar Raznatovic MSc	PZP	Fishery
Forestry GIS – Blazo Jokanovic		Forestry

Acronyms:PMF - Faculty of Natural Sciences and Mathematic, IPN – Institute for the Protection of Nature, NHM – Nature History Museum, FI – Forestry Institute, PE NP MNE – Public Enterprise National Parks of Montenegro

5.1.4 FACULTY OF NATURAL SCIENCES AND MATHEMATICS (DEPARTMENT OF BIOLOGY)

Researchers from the Department of Biology, Faculty of Natural Sciences and Mathematics were involved in different projects on Lake Skadar/Shkoder, especially in the field of biomonitoring (ecotoxicological tests), identification of eutrophycation (analysis of chlorophyll *a*, nutrients and phytoplankton composition), microbiological analyses and biodiversity (macrozoobentos, ichtiofauna, macrophytes, etc.).

The parameters which can be analysed by faculty equipment on Faculty on water samples are Secchi depth, Temperature, conductivity, pH, DO%, DO mg/L, Alkalinity, ammonium, nitrite, nitrate, total nitrogen and chlorofil *a,* Total coliformes, Streptococcus fecal, *Escherichia coli* (faecal coliformes), MPN. Methods are not validated.

The institution has researchers and equipment for monitoring biological quality elements: phtoplankton, macrophytes and phytobentos, bentic inventebrates and fish.

Existing laboratory equipment:

- general laboratory equipment,
- UV-VIS Spectrophotometer CECIL 7200 double beam scanning,
- sterilization Autoclave 75,
- sterilizator,
- incubator 240L for microbiology,
- incubator 50L for bioassays,
- incubator 75L FFT,
- microplate reader spectrophotometer,
- termal termocicler PCR equipmment,
- UV transluminator TI1, Biometra,
- microscope Nikon Eclipse 50i with fluorescence,
- stereomicroscope,
- multilab ste,
- oximeter,
- pH meter,
- photometer,
- colony counter,
- samplers for water and sediments.

5.2 ALBANIA

5.2.1 THE FACULTY OF NATURAL SCIENCES (SHKODRA UNIVERSITY)

The Faculty of Natural Sciences from Shkodra represents an important actor for the activities on Lake Skadar/Shkoder. It is an important stakeholder in respect of defining area priorities, providing expertise in different fields, as well as involving them in implementation of different projects. In the Department of Biology and Chemistry is established the scientific sector of Bio – Ecology of the Lake Skadar/Shkoder. This sector has done several scientific projects and studies regarding the chemical analyses, flora and fauna of the lake. The Microbiological Laboratory, also established in the Faculty of Natural Sciences, provides microbiological analyses including those of the lake waters as well.
The Faculty of Natural Sciences, the branch of biology-chemistry and that of geography of the Shkodra University are main contributors through their studies and research in and around the lake.

<u>Scientific Center for Bio-ecology of Lake Shkodra</u>

The Scientific Centre for Bioecology of Lake Shkodra includes these scientific laboratories: Laboratory of Microbiology, Laboratory of Water Chemistry, Laboratory of Ecotoxicology, Laboratory of Botanic, Laboratory of Bio-ecology. In the Department of Biology-chemistry at the Shkodra of University of Shkodra there are also some experts, who can be involved in the monitoring of physical - chemical monitoring, biodiversity and monitoring of biological quality elements – survey of habitat types, plankton, macrophytes, benthic fauna, invertebrates, aquatic microorganisms etc.

***Ecotoxicology laboratory* (dr. Anila Neziri)**
The ecotoxicology laboratory has the facilities for water and biota extraction for chemical analyses of organic contaminants. This laboratory is constructed with financing of the German Rectors Conference HRK, Germany during the Transboundary Cooperating Project for Lake Skadar/Shkoder between University of Podgorica and University of Shkodra (2001-2004) also in the completing of the laboratory work are the financing contributes from World Bank Project for Lake Skadar/Shkoder and University of Shkodra.

Existing laboratory equipment:

- ultrasonic bath,
- rotary evaporator,
- general laboratory equipment,
- magnetic stirrer,
- static pH-meter,
- static O_2-meter,
- portable pH-meter,
- portable O_2-meter,
- portable conductivity-meter,

- soxhlet apparatus,
- sediment sample,
- water sampler,
- GC/ECD/FID.

The parameters which can be analysed in water samples: temperature, conductivity, pH, DO%, DO mg/l, alkalinity, SPM, total hardness, Ca^{2+}, 15-PAHs and PCBs, OCPs.

The parameters, which can be analysed in sediment samples: PCBs (Ballschmitter's set: PCB-28, PCB-52, PCB-101, PCB-138, PCB-153, PCB-180), OCPs, and 15-PAHs.

The parameters, which can be analysed in biota samples: PCBs, OCPs, and 15-PAHs.
Methods are not validated.

Microbiological Laboratory **(Nevilla Bushati, PhD student)**

The Microbiological Laboratory was constructed with finance from the German Rectors Conference HRK, Germany and Institute of Hygiene of Graz, KARL-FRANZENS University, Austria since the year 2000.

Existing laboratory equipment:
- general laboratory equipment,
- incubator 37 °C,
- incubator 44 °C,
- water distillation apparatus,
- microscope,
- autoclave,
- pH meter,
- conductimeter,
- turbidimeter,
- equipment for membrane filtration,
- enzyme-linked immunosorbent assays (ELISA-Reader),
- UV-Visible Spectrophotometer.

Analysis that can be done in Microbiological Laboratory: total coliformes, *Streptococcus* fecal, *Escherichia coli* (faecal coliformes), MPN and nutrients: nitrites, nitrates, chlorines, phosphates and sulphates.

Laboratory of Bio-ecology

At the Department of Biology-chemistry of the University of Shkodra there are also some experts, who can be involved in the monitoring of biodiversity and monitoring of biological quality elements – survey of habitat types, plankton, macrophytes, benthic fauna, invertebrates, etc.
The Laboratory of Bio-ecology of Lake Shkodra has equipment for investigation of protists (phytoplankton and zooplankton) - microscopes (also inversion microscope), stereo-microscopes, digital camera, a small boat, Secchi Disc, Van Dorn Bottle, plankton nets etc.

Table 37: Extensive list of experts at the Department of Biology-chemistry of Shkodra University for biodiversity monitoring and monitoring of biological quality elements.

Name and surname	Field of expertise
Marash Rakaj PhD	Botanist - wetland and water habitats, macrophytes (flora and vegetation) and phytoplankton
Prof. Dhimiter Dhora PhD	Zoologist - aquatic molluscs
Prof. Fatbardh Sokoli PhD	Botanist - aquatic plants
Violeta Alushi PhD	Zoologist – protistologist
Rrok Smajlaj PhD	Zoologist – mammals, pisces, amphibians, reptiles
Aurora Dibra PhD	Botanist
Denik Ulqini MSc	Zoologist (pisces, amphibians, reptiles)

All experts are members of the Research Center of Bio-ecology of Lake Shkodra, which is a scientific structure inside the Faculty of Natural Sciences of the University of Shkodra.

At the Department of Biology-chemistry of Shkodra University there is no expert for ornithology, but survey of bird on Lake Skadar/Shkoder can be conducted by ornithologist Dr. Taulant Bino (Deputy Minister in Ministry for Environmental Protection of Republic of Albania).

5.2.2 THE FACULTY OF NATURAL SCIENCES (UNIVERSITY OF TIRANA)

The Faculty of Natural Sciences of Tirana University is one of the oldest institutions of higher education in Albania. In the area of this faculty there function several laboratories helping research activities or other users. There are two study centres attached to the faculty: Botanic Garden and the Museum of Natural Sciences as well as centres of teacher qualification on the fields of mathematics, physics, chemistry and biology.

Department of Chemistry (Prof. Dr. Vera Lazo)
The Department of Chemistry is an important organisation of the Faculty of Natural Sciences.
The Department of Chemistry consists of four teaching-research groups:
1. general and inorganic chemistry
2. analytical chemistry
3. organic chemistry
4. physical and colloidal chemistry

The equipment for analytical chemistry in the Department of Chemistry:

- atomic absorption spectrophotometer (AAS),
- general laboratory equipment,
- UV/VIS spectrophotometers,
- gas chromatograph mass spectrometer (GC-MS),
- gas chromatograph (GC),
- electrochemical workstation,
- pH-meters,
- conductometers,
- microwave digestion oven.

The Laboratory of Analytical Chemistry can be included in the monitoring programme of Lake Skadar/Shkoder by analysing inorganic pollution (heavy metals) in water, sediment and biota samples. The laboratory was in 2010 involved in inter-laboratories exercises organised by UNEP: GEMS/Water PE Study No. 7. The methods are not validated.

Department of Biology and the Museum of Natural Sciences
Experts from the Department of Biology and the Museum of Natural Sciences have been working on making an inventory and monitoring the flora and fauna of Albania, including in the Lake Skadar/Shkoder area. The main studies of Tirana University on Lake Skadar/Shkoder deal with herpetofauna (amphibians and reptiles), birds and mammals.

5.2.3 POLYTECHNIC UNIVERSITY OF TIRANA

The Albanian Geological Service and the Institute of Energy, Water and Environment Tirana are responsible for developing studies dealing with geology, geomorphology, hydrology, hydrochemistry and sedimentology of the lake. The majority of the existing studies on these fields have been conducted by these institutions. One of the main activities of the Institute of Energy, Water and Environment Tirana is the monitoring of hydrometeorological elements and water quality parameters in its hydrometerological network. The Institute has several water level stations on Lake Skadar/Shkoder, Buna River, Drini River, and underground waters, equipped datalogger instruments and equipment, which uses modern technology, for measuring water discharge.

6 SHORT AND LONG TERM NEEDS FOR JOINT LAKE SKADAR/SHKODER MONITORING CONDUCTING – EQUIPMENT, TRAINING

The joint monitoring programme was prepared according to European legislation and international standards in such a way that its implementation can be done in a very short time (in the year 2010), by local institutions with their knowledge and equipment.

The current list of methods, which are already used by local laboratories, is not in accordance with the requests of WFD (except CETI has validated methods). According to Directive 2009/90/EC - technical specifications for chemical analysis and monitoring of water status- laboratories should ensure that all methods of analysis, including laboratory, field and on-line methods, used for the purposes of chemical monitoring programmes carried out under Directive 2000/60/EC, are validated and documented in accordance with EN ISO/IEC-17025 standard or other equivalent standards accepted at the international level. The EN ISO/IEC-17025 standard on general requirements for the competence of testing and calibration laboratories provides appropriate international standards for the validation of the methods of analysis used.

Laboratories should ensure that the minimum performance criteria for all methods of analysis applied are based on an uncertainty of measurement of 50% or below (k = 2) estimated at the level of relevant environmental quality standards and a limit of quantification equal or below a value of 30% of the relevant environmental quality standards.

In order to fulfil validation requirements, all methods of analysis for the purposes of chemical monitoring programmes of water status should meet certain minimum performance criteria, including rules on the uncertainty of measurements and on the limit of quantification of the methods. To ensure comparability of chemical monitoring results, the limit of quantification should be determined in accordance with a commonly agreed definition. “Limit of quantification – LOQ” means a stated multiple of the “Limit of detection – LOD” at a concentration of the determinion that can reasonably be determined with an acceptable level of accuracy and precision. The limit of quantification can be calculated using an appropriate standard or sample, and may be obtained from the lowest calibration point on the calibration curve, excluding the blank.

Where there are no methods, that comply with the minimum performance criteria, monitoring should be based on best available techniques not entailing excessive costs.

It is appropriate to ensure that laboratories performing chemical analysis demonstrate their competence through the participation in internationally or nationally recognised proficiency testing programmes and through the use of available reference materials. In view of harmonising practices, the organisation of proficiency testing programmes should be based on relevant international standards. To that end, ISO/IEC guide 43-1 on proficiency testing by inter-laboratory comparisons — Part 1: Development and operation of proficiency testing schemes provides an appropriate guide. The results of those programmes should be evaluated on the basis of the internationally recognised scoring systems. In this regard, ISO-13528 on statistical methods for use in proficiency testing by inter-laboratory comparisons provides appropriate standards.

Containers for water samples, reagents or methods for preservation of samples for analysis of one or more parameters of the chemical status, distribution and storage of samples and preparation of samples for analysis should not affect the measurement results. Samples of water should be kept in containers made of materials as specified in standard ISO 5667-3 (Water quality - Sampling - Part 3: Guidance on the preservation and handling of water samples), ISO 5667-4 (Water quality - Sampling - Part 4: Guidance on sampling from lakes, natural and man-made) (Table 22).

Equipment

No local laboratory/institution has complet necessary equipment for implementation of the whole monitoring programme. However each laboratory/institution can be partly involved, what enables implementation of the monitoring programme as a whole.

Training

The main problem is that methods are not validated and they do not have determinated limits of detection (LOD) and limits of quantification (LOQ) for certain parameters. It would be necessary for staff of laboratories to participate in training on topics of quality of assurance (training in the laboratories in EU or invitation of experts from EU to Montenegrin or Albanian laboratories) and there is need for better inter-laboratory cooperation (joint workshops, joint field work, exchange of staff amongst laboratories, etc.).

7 DATA COLLECTING AND EXCHANGE PLATFORM

7.1 DATA COLLECTING

All reports of the specific samplings, inventories and analyses will be provided by each institution to the technical coordinator of the project (Joint monitoring programme of Lake Skadar/Shkoder) one month after work is completed. The technical coordinator will gathered and set down all results of samplings, inventories and analyses and if necessary make a comparison of results with the regulation of both countries and produce a report in three languages. The report will be sent in electronic form to the administrator of the data exchange platform. Results of annual monitoring have to be established in the form of an annual report to 1st March for the preceding year.

7.2 EXCHANGE PLATFORM

As an up-grade of the monitoring programme, a web Atlas is recommended. It will enable viewing of environmental data with an internet browser for a broad audience. By geographic imaging and spatial queries we obtain answers to questions about the position of a certain phenomenon in the area of Lake Skadar/Shkoder and its relationship to other elements.

By using location queries and cross-sectional layers we can gain information about, for example, position coordinates, characteristics of selected locations, the hydrogeological characteristics, biodiversity, sampling points, sampling results, etc. The marked location can be printed or sent with comment by e-mail.

Using the tools in the atlas we can create and edit layers and layers of imports and exports in Geography Markup Language and Keyhole Markup Language format. An Atlas of Lake Skadar/Shkoder can be based on any modern web platform, depending on the implementor of the solution.

Figure 26: An example from Atlas of environment of Environmental Agency of Republic of Slovenia (http://gis.arso.gov.si/atlasokolja/profile.aspx?id=Atlas_Okolja_AXL@ARSO&culture=en-US).

When we would open the Atlas of Lake Skadar/Shkoder, we could first select the language (English, Albanian or Montenegro). All subsequent information is displayed in the selected language. The screen is divided into two parts. In the left part, which is the larger, we could see the map of Lake Skadar/Shkoder with its surroundings. In the right part, which is smaller, we could see tabs containing the following options: layers, search, info, legend. In the right part we can also find buttons like select, info on selected layers, selected layer info, move map, zoom in, zoom out, zoom previous, full extent, measure distance, print, help, which enable facilitation by using this atlas.

<u>Proposition of detailed description of Tabs</u>

Tab Layers:
In this tab we can select and review different types of data, which is, after marking them, displayed on the map. These types of data are:

Monitoring points:

- on line measurements,
- hydrological measurements,
- lake water quality,
- sediment water quality,
- pollutants in biota,
- bath water quality,

- meteorological stations,
- biodiversity.

Environment:
- industrial installations,
- landfill of municipal waste,
- sensitive areas.

Water:
- concession for use of water,
- fish water segment,
- bathing water.

Flood waters:
- warning map of floods (direction),
- warning map of floods (frequent),
- warning map of floods (rare),
- warning map of floods (catastrophic).

Nature:
- protected areas,
- nesting places of important birds,
- spawning places for fish,
- living territory of Otter,
- Natura 2000,
- Emerald,
- IBA,
- IPA.

An example of using Tab Layers:
After opening the home web page of the atlas, we tick layer **monitoring points** and within it sublayer **sediment quality**. The map will show us all monitoring points, where chemical monitoring of sediment of Lake Skadar/Shkoder occurs. When we select certain monitoring point and click on it, data about location (name, geographical coordinates), results of measurements at different years (for every year separately) will displayed on the screen. For better understanding of the results, the results which will be above the limit value according to regulations will be coloured red.

Tab Search:
In this tab we can search according to different criteria such as location name or coordinates, year of monitoring, parameters/indicators, etc.

An example of using Tab Search:
After opening the home web page of the Atlas, we click on **Tab Search** and then on subTab **parameters/indicators** and all monitored parameters/indicators will display. After than you can choose certain parameter/indicator and results about this certain indicator will display on the screen.

Tab Info:
This tab displays detailed information about location, which is selected on the map depending on selected layers.

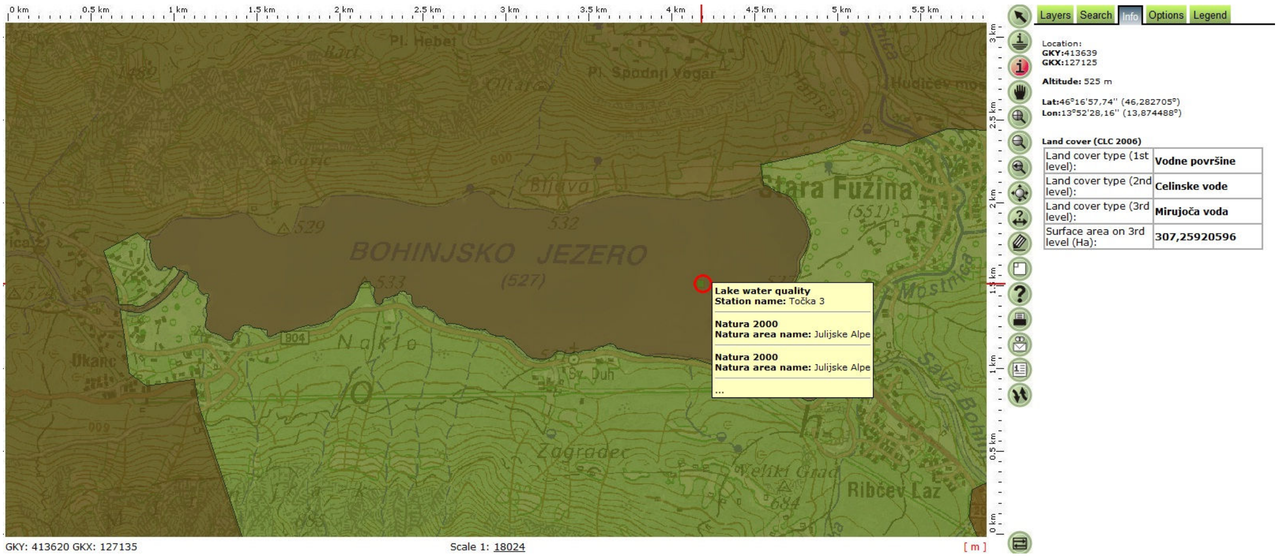

Figure 27: An example from Atlas of environment of Environmental Agency of Republic of Slovenia using Tab Info (http://gis.arso.gov.si/atlasokolja/profile.aspx?id=Atlas_Okolja_AXL@ARSO&culture=en-US).

Tab Legend:
This tab displays detailed the meaning of colours or icons displayed on the map.

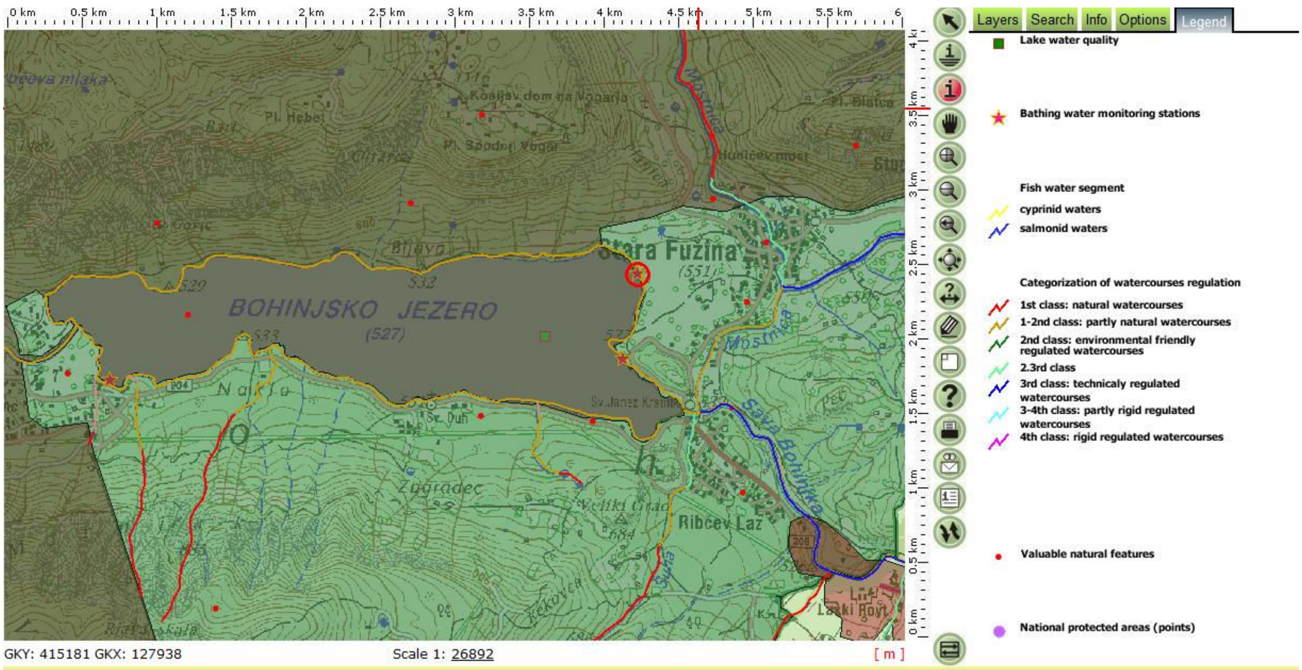

Figure 28: Example from Atlas of environment of Environmental Agency of Republic of Slovenia using Tab Legend (http://gis.arso.gov.si/atlasokolja/profile.aspx?id=Atlas_Okolja_AXL@ARSO&culture=en-US).

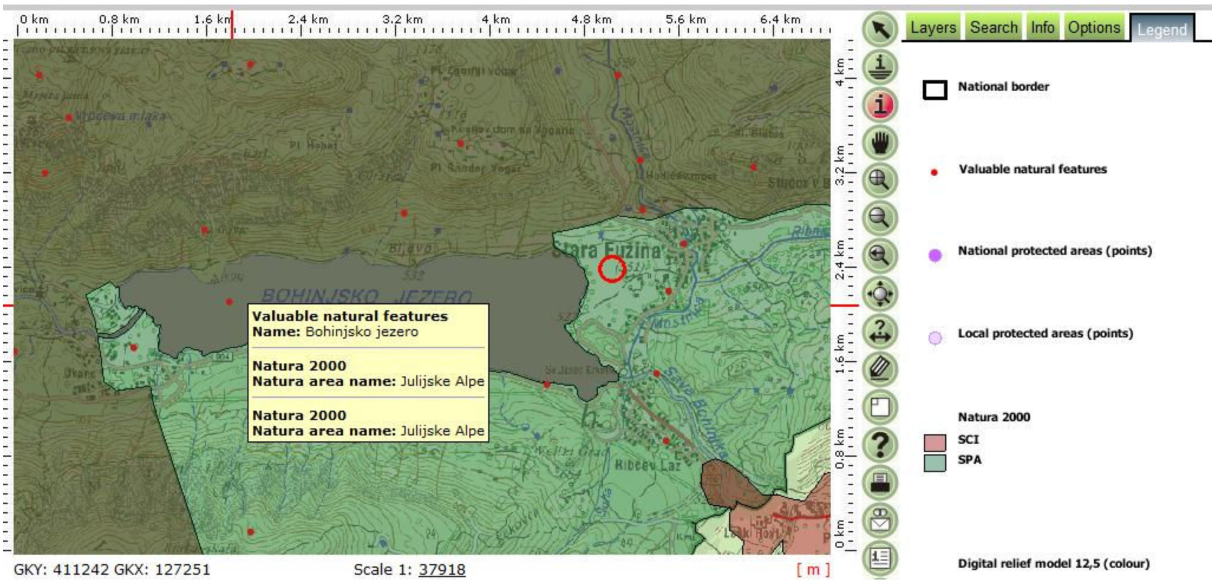

Figure 29: Example from Atlas of environment of Environmental Agency of Republic of Slovenia using Tab Legend (http://gis.arso.gov.si/atlasokolja/profile.aspx?id=Atlas_Okolja_AXL@ARSO&culture=en-US).

The data in atlas of Lake Skadar/Shkoder will be entered partly automatically (from monitoring automatic stations, etc.) and partly manually (from Albanian and Montenegro side administrator).

8 INVOLVEMENT OF CITIZEN OF BOTH COUNTRIES IN MONITORING PROGRAMME

Since monitoring of the chemical status of the lake requires educated staff and special equipment it cannot be conducted by citizen. The same conclusion can be made for monitoring of biodiversity.

Citizen can be involved in monitoring, especially in identifying threats to the ecological status of the lake and biodiversity such as identifications of illegal waste dumps, spillage of harmful fuels, invasive alien species, illegal hunting or fishing, etc. They can also inform competent authorities in the case of massive occurrence of algae or cyanobacterium, ruining of fish or other organisms, appearance of smell, etc.

Fishermen can be included via filling of log books of their catch, finding of some “new” species, registration of some extreme event, etc.

9 FINAL REMARKS

The implementation of a joint monitoring programme between Montenegro and Albania requires good organisation, cooperation amongst institutions, and consistent consideration of standards. It is very important that institutions from both countries use the same methods and perform sampling at the same time.

Despite the fact that monitoring activity has been conducted for many years in the area of Lake Skadar/Shkoder, the pollution areas with certain pollutant cannot be defined, since data about the pollution are scarce and sporadic and were obtained by using different methods. In this programme the sampling locations where pollution is expected (because of some anthropogenic activity nearby), are defined. The first year of monitoring will give the answer as to whether those sampling points are polluted with a specific pollutant. This data will be the basis for planning monitoring programme for the following years (long-term monitoring programme).

Only CETI Podgorica has validated methods for analysing proposed parameters and defined limits of detection (LOD) and limits of quantification (LOQ) for certain parameters (this is the request of WFD). For that reason those methods are chosen to be used in the monitoring of Lake Skadar/Shkoder. Using validated methods will ensure accuracy of the results and comparison between both countries and with the results in other European countries.
For other laboratories, which do not have validated methods, it would be necessary that staff of laboratories participate in training on topics of quality of assurance (training in the laboratories in the EU or invite experts from the EU to Montenegrin or Albanian laboratories) and there is need for better inter-laboratories cooperation (joint workshops, joint field work, exchange of staff amongst laboratories, etc.).

It would be too complex and expensive to measure the status of all taxonomic groups in the frame of biodiversity monitoring. For this reason, particular species (groups), that are used to represent biodiversity in general, respond for threats in the environment and are important species in the area of Lake Skadar/Shkoder, will be monitored. Phytoplankton, macrophytes and fish are very important parts of the lake's ecosystem and are included as biological quality elements in WFD. Birds represent a very important part of Lake Skadar/Shkoder's fauna, while the otter is a mammal species, linked to the water, which is very sensitive to disturbances and pollution of the environment.

10 REFERENCES

1. Developments in improving environmental observations, data Collection and reporting. Implementation of recommendations on monitoring and Information management from country environmental Performance reviews Montenegro. ECE/CEP/AC.10/2009/4 19 June 2009. http://www.unece.org/env/documents/2009/ECE/CEP/AC.10/ECE.CEP.AC.10.2009.4.e.pdf
2. Working group on environmental monitoring and assessment. Eleventh session, Geneva, 2-3 September 2010. Latest Developments in Environmental Monitoring and Assessment at the National, Subnational and Company Levels; Albania. http://www.unece.org/env/europe/monitoring/11thMeeting/Roundtable.Albania.e.pdf
3. Report on the capacity building workshop “Stakeholder involvement in Transboundary Water Resources Management”, 25-27 March 2008, Podgorica, Montenegro. http://www.watersee.net/files/montenegro/Report%20Montenegro%20workshop.pdf
4. Assessment on Current Situation of Shkodra/Skadar Lake RAMSAR Site, June 2010. http://albania.rec.org/Projects/Biodiversiteti/docs/Lake-Shkodra-Asessment.pdf
5. Lake Shkoder Transboundary Diagnostics Analysis, Albania & Montenegro, April 2006. http://www.gov.me/files/1248091671.pdf
6. Strategic action plan for the Skadar Lake - GEF/WB Skadar Lake Ecosystem Project – Montenegro. http://www.gov.me/files/1248091398.pdf
7. Montenegrin Law on Waters (Official Gazette of the RM no.27/07) and related sub law acts.
8. Montenegrin Law on Environment (Official Gazette of the RM, No. 48/08).
9. Montenegrin Law on Nature Protection (Official Gazette of the RM, No. 51/08).
10. Montenegrin Law on National Parks (Official Gazette of the RM, No.56/09).
11. Regulation on classification and categorization of surface and underground waters (Official Gazette of the RM no.2/07).
12. Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 (the Water Framework Directive).
13. Decision 2455/2001/EC of the European Parliament and of the Council of 20 November 2001 establishing the list of priority substances in the field of water policy and amending Directive 2000/60/EC.
14. Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy, amending and subsequently repealing Council Directives 82/176/EEC, 83/513/EEC, 84/156/EEC, 84/491/EEC, 86/280/EEC and amending Directive 2000/60/EC of the European Parliament and of the Council.
15. Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (EU Bird Directive).
16. Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora (EU Habitat Directive).
17. Ramsar Convention on Wetlands
18. Convention on Biological Diversity
19. Bern Convention - Convention on the Conservation of European Wildlife and Natural Habitats
20. Bonn Convention - Convention on Migratory Species http://www.cms.int/documents/convtxt/cms_convtxt.htm
21. Convention on the Protection and Use of Transboundary Watercourses and International Lakes.
22. Agreement for protection and sustainable development of Shkodra/Skadar Lake between line ministries of environmental protection of Montenegro and Albania in (2008).
23. Memorandum of understanding on cooperation in the field of environmental protection and sustainable management of natural resources between the Ministry of spatial planning and environment of Montenegro and the Ministry of environment, forestry and water administration of the Republic of Albania, 2010.
24. Albanian Water Law (Law No. 8093, dated on 21.03.1996 "on water resources")
25. Albanian Law No. 9103, dated on 10.7.2003 “on the protection of transboundary lakes”.
26. IUCN Red List of Threatened Species. Version 2010.1. http://www.iucnredlist.org (Accessed 16 December 2010).
27. Montenegrin Decree on the protection of certain flora and fauna species (OG MNE, No. 76/06).
28. The Strategic Action Plan (SAP) For Shkodra / Skadar Lake Albania & Montenegro, 2007.
29. Reports of Ministry of Environment, Forests and Water Administration (MoEFWA) - www.moe.gov.al
30. Council Directive 76/160/EEC concerning the quality of bathing water.
31. Directive 2006/7/EC (Bathing Water Directive) concerning the management of bathing water quality and repealing Directive 76/160/EEC. Microbiological parameters.
32. EEA (European Environment. Agency), 2010. The European environment — state and outlook 2010.

33. Protocol concerning Specially Protected Areas and Biological Diversity in the Mediterranean. http://www.rac-spa.org/dl/espece_danger.pdf
34. ARSO Atlas okolja (http://gis.arso.gov.si/atlasokolja/profile.aspx?id=Atlas_Okolja_AXL@ARSO&culture=en-US)
35. Bianco, P.G., Kottelat, M., 2005. *Scardinius knezevici*, a new species of rudd from Lake Skadar, Montenegro (Teleostei: Cyprinidae). Ichthyol. Explor. Freshwat. 16(3):231-238.
36. Bibby, C.J., Burgess N.D., Hill D.A., Mustoe, S.H., 2000: Bird Census Techniques. Academic Press, London: 302 pp.
37. BirdLife International, 2004. Birds in the European Union: a status assessment. Wageningen, The Netherlands: BirdLife International. UK. http://birdsineurope.birdlife.org
38. Burnham, K.P., Anderson, D.R. 1984. The need for distance data in transect counts. J. Wildl. manage. 48(4):1248-1254.
39. Busković and Kapa (eds), 2010. Fourth National Report of Montenegro to the Convention on Biological Diversita. Podgorica, September 2010, 73 pp.
40. Chanin, P., 2003. Monitoring the Otter Lutra lutra. Conserving Natura 2000 Rivers Monitoring Series No. 10, English Nature, Peterborough.
41. Denac, D., Schneider-Jacoby, M. & Stumberger, B. (eds.) (2010): Adriatic flyway – closing the gap in bird conservation. Euronatur, Radolfzell
42. Ekercin S. 2007. Coastline change assessment at the Aegean sea coasts in turkey using multitemporal Landsat imagery. Journal of Constant Research, 23, 3: 691-698.
43. Environmental protection Agency Miontenegro, 2008. Programme for monitoring of environment of Montenegro for the year 2009.
44. Environmental protection Agency Miontenegro, 2009. Programme for monitoring of biodiversity for 2010.
45. Fuller, R.J., Langslow, D.R. 1984. Estimating numbers of birds by point counts: how long should counts last? Bird study, 31: 195-202.
46. Furness, R.W., Greenwood, J.J.D. 1993. Birds as Monitors of Environmental Change. Chapman & Hall: 356 pp.
47. Gonzales A. M. R. 2008. Soil erosion calculation using remote sensing and GIS in Río
Grande de Arecibo watershed, Puerto Rico. ASPRS 2008 Annual Conference Portland, Oregon, April 28-May 2. http://www.asprs.org/publications/proceedings/portland08/0067.pdf
48. Gregory R.D., Gibbons D.W., Donald P.F., 2004. Bird census and survey techniques.
49. Guy H. P. Remote sensing techniques for evaluation of urban erosion and sedimentation. http://iahs.info/redbooks/a113/iahs_113_0145.pdf (16.2.2011)
50. Heblinski J., Schmieder K., Heege T., Kwaku Agyemang T., Sayadyan H., Vardanyan L. 2011. From theHigh-resolution satellite remote sensing of littoral vegetation of Lake Sevan (Armenia) as a basis for monitoring and assessment. Hydrobiologia, 661: 97-111.
51. Ivanović, B.M., 1973. Ichthyofauna of Skadar Lake. Institute for Biological and Medical Research in Montenegro, Biological Stattion Titograd. Titograd, p. 146.
52. Lea� er Kashta, Dhimiter Dhora, Fatbardh Sokoli, Rakaj M., Hoti M, Beka I., Bekteshi A., Ziu T., Vukić P., Hadžiablahović S. , Kasom G., Rakočević-Nedović J., Nikčević S., Pešić V., Ražnatović A., Ćirović R., Saveljić D., Bušković V., Micev B., Filipović S., Fuštić B., Radulović M., Žižić-Velimirović O., 2007. Trans-boundary Cooperation through Management of Shared Natural Resources BIBLIOGRAPHY ON SKADAR / SHKODRA LAKE. Regional Environmental Center for Central and Eastern Europe (REC), Country Office Montenegro.
53. Javno preduzeće za nacionalne parkove Crne Gore – Nacionalni park “Skadarsko Jezero. Plan upravljanja 2011 – 2015.
54. Javno preduzeće za nacionalne parkove Crne Gore – Nacionalni park “Skadarsko Jezero. Program upravljanja za 2011. godinu. Podgorica, 2010.
55. Järvinen, O., Väisänen, R.A. 1975. Estimating relative densities of breeding birds by the line transect method. Oikos. 26: 316-322.
56. Järvinen, O., Väisänen, R.A. 1983a. Confidence limits for estimates of population density in line transects. Ornis Scandinavica 14: 129-134.
57. Järvinen, O., Väisänen, R.A. 1983b. Correction coefficients for line transect censuses of breeding birds. Ornis fennica 60: 97-104.
58. Katnic A., 2007. Vascular plants as indicators of pollution in Lake Skadar, Master theses. 44 pp. Uppsala 2007.
59. Knežević, B., 1985. Fishes of Lake Skadar. General Introduction. Survey on Previous and Recent Investigations. pp. 311-316. In: Karaman, G.S. & Beeton, A.M. (Eds.): The Biota and Limnology of Lake Skadar. Univerzitet “Veljko Vlahovi}”, Institut za biološka i medicinska istraživanja u SRCG, Biološki zavod, Smithsonian Institution, Center for Great Lakes Studies Univ. Wisconsin - Titograd, Washington D.C. & Milwaukee
60. Kovačić, M., Sanda, R., 2007. A new species of Knipowitschia (Perciformes: Gobiidae) from southern Montenegro. J. Natl. Mus. (Prague), Nat. Hist. Ser. 176(5):81-89.
61. Kruuk H (1995). Wild otters: Predation and populations. Oxford University Press, Oxford.

62. Kruuk H, Moorhouse A, Conroy JWH, Durbin L & Frears S (1989). An estimate of numbers and habitat preferences of otters Lutra lutra in Shetland, UK. Biological Conservation 49, 241–254.
63. Liles G (2003). Enhancing the Status of the Otter Lutra lutra. Conserving Natura 2000 Rivers Conservation Techniques Series No. 5. English Nature, Peterborough.
64. Marić, D., 1995. Endemic fish secies of Montenegro. Biological Conservation 72: 187-194.
65. Mason CF & Macdonald SM (1987).The use of spraints for surveying otter Lutra lutra populations – an evaluation. Biological Conservation 41, 167–177.
66. Miller, P. J., Šanda, R., 2008. A new West Balkanian sand-goby (Teleostei: Gobiidae). Journal of Fish Biology, 72 (1): 259-270.
67. Mrdak, D., NIkolić, V., Joksimović, V., Simonović, P., 2001. Data collecting for sustainable fishery programme of Skadar Lake. Podgorica, Belgrade.
68. Mrdak, D., 2009. Procjena uticaja na životnu sredinu brana na Morači na riblju faunu rijeke Morače I Skadarskog jezera. Report committed by WWF MedPO and Green Home under the framework of Sharing Water Project - Skadar Lake component..
69. Nagothu, U.S., Skarbøvik E., Shumka S.; Perovich A., 2008. DRIMON Policy Brief # 2 –2008. Stakeholder perceptions of the Lake Shkodra/Skadar: Current status and future scenarios. DRIMON: Interdisciplinary assessment of water resource management in two transboundary lakes in South Eastern Europe. http://www.drimon.no/resultfiles/policybrief_shkodra_drimon_sept08_eng.pdf
70. Neziri, A., Lazo, P., Paschke A., 2008. New application of sampling methods in Shkodra Lake. Natura Montenegrina, 7: 245-252.
71. Neziri, A., Lazo, P., 2009. Application of Chemcatcher® in Lake Shkodra as a Passive Sampling Technology for Lake Water J. Int. Environmental Application & Science, Vol. 4 (3): 234-240.
72. OECD (1982): Eutrophication of waters. Monitoring, assessment and control. OEC Paris.
73. Perović, A. 2009. Interdisciplinary assessment of water resource management in two transboundary lakes in SEE. The DRIMON Project End-User Workshop June 2009, Ohrid, Macedonia. http://www.drimon.no/diversevedlegg/enduserworkshop2009vedlegg/3_skadar_shkodra_drimon.pdf
74. Petkov, N., 2006. The Ferruginous Duck Aythya nyroca as a potential indicator species for tracking ecological changes at the Srebarna Lake managed reserve (NE Bulgaria). Acrocephalus 27 (128-129): 37−43.
75. Pulević at al., 2001. Biodiversity Database of the Shkodra/Skadar Lake (Checklist of species).
76. Radović, I., Radović, D., Jakšić, P., Džukić G., Stevanović, V., Bulić, Z., Bušković, V., 200 . Skadar Lake Region and “Target species” species of European conservation concern. Natura Montenegrina 7(2): 31-44.
77. Rakaj M., Kashta L., 2010. The Threatened and Rare Plant Species of the Lake Shkodra – Delta Buna Hydrological System. BALWOIS 2010 - Ohrid, Republic of Macedonia - 25, 29 May 2010.
78. Rakaj, M., 2010. Biological Water Quality of Lake Shkodra Based on the Diatoms and cyanobacteria Bioindicator Species. BALWOIS 2010 - Ohrid, Republic of Macedonia - 25, 29 May 2010.
79. Rakočević-Nedović, J., Hollert, H., 2005. Phytoplankton Community and Chlorophyll of Lake Skadar (Montenegro, Balkan). Environ Sci & Pollut Res 12 (3) 146 – 152.
80. Ruiz-Olmo J, Saavedra D & Jimenez J (2001).Testing the surveys and visual track censuses of Eurasian Otters (Lutra lutra). Journal of Zoology London 253, 359–369.
81. Saveljic D., 2009. Environmental risk assessment of the Morača dams: ornithofauna of Morača river canyon and Skadar Lake, 67 p. Report committed by WWF MedPO and Green Home under the framework of Sharing Water Project - Skadar Lake component.
82. Saveljić D., Rubinić B., 2009. Report on Pelicans in Montenegro: Their regional link with Amvrakikos Gulf/ Mikri Prespa Lake (Greece) and Karavasta Lagoon / Narta Lagoon (Albania) Ninth Meeting of Focal Points for SPAs Floriana, Malta, 3-6 June 2009. UNEP, RAC/SPA – Tunis.
83. Saveljić, D., 2010. International importance of ornithofauna of Skadar Lake - species that cross the census of 1% of regional wintering bird population in the period 1991-2010 year international conference. Introducing RAMSAR Principles Towards Integrated Management of Lake Shkodra/Skadar & Buna/Bojana River. Natural Resources 5-6 JUNE 2010, Shkodër, ALBANIA.
84. Schaumburg J., Schranz C., Hofmann G., Stelzer D., Schneider S., Schmedtje U., 2004. Macrophytes and phytobenthos as indicators of ecological status in German lakes – a contribution to the implementation of the Water Framework Directive. Limnologica 34, 302–314.
85. Semovski S. V., Bondarenko N. A., Popovskaya G. I., Mogilev N. Y., Alpers W., Schrum C. 1999. Perspectives for monitoring of Lake Baikal ecosystem variability using remote sensing data. IEEE 1999 International Geoscience and Remote Sensing Symposyum. IGARSS’99, 2: 852-854.
86. Shrimalli S.S., Aggarwal S. P., Samra J. S. 2001. Prioritizing erosion-prone areas in hills using remote sensing and GIS – a case study of the Sukhna Lake catchment, Northern India. International Journal of Applied Earth Observation and Geoinformation, 3,1: 54-60.

87. Siripong A. 2010. Detect the coastline changes in Thailand by remote sensing. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Science, 38, 8: 992-996.
88. Stešević D., Feiler U., Sundić D., Mijović S., Erdinger L., Seiler T.-B., Heininger P., Hollert H., 2007. Application of a new sediment contact test with *Myriophyllum aquaticum* and of the aquatic *Lemna* test to assess the sediment quality of Lake Skadar Journal of Soils and Sediments Volume 7, Number 5, 342-349.
89. Talevska M., Petrović D., Milošević D., Talevski T., Marić D. and Talevska A., 2009. Biodiversity Of Macrophyte Vegetation From Lake Prespa, Lake Ohrid And Lake Skadar. Biotechnol. & Biotechnol. EQ. 23/2009/SE XI ANNIVERSARY SCIENTIFIC CONFERENCE SPECIAL EDITION/ON-LINE.
90. Talevski T., Milosevic D., Maric D., Petrovic D., Talevska M., Talevska A., 2009. Biodiversity of ichtiofauna from Lake Prespa, Lake Ohrid and Lake Skadar. BIOTECHNOL. & BIOTECHNOL. EQ. 23/2009/SE 120 YEARS OF ACADEMIC EDUCATION IN BIOLOGY SPECIAL EDITION/ON-LINE.
91. Talevski T., Milosšević D., Marić D., Petrović D., Talevska M., Talevska A., 2009. Anthrophogenic Influence on Biodiversity of Ichthyofauna and Macrophyte Vegetation from Lake Ohrid and Lake Skadar. J. Int. Environmental Application & Science, Vol. 4 (3): 317-324.
92. Thompson, J.J. 1989. A comparison of some avian census techniques in a population of lovebirds at Lake Naivasha, Kenya. Afr. J. Ecol. 27: 157-166.
93. Tiainen, J. 1985. Monitoring bird populations in Finland: Ornis Fennica. 62: 80-89.
94. http://www.nparkovi.co.me
95. Vargas L. M. T., Lopez M. T., Amador A., Fernandez D., Baez A. D. 2001. Simulation of soil erosion in the Lake of Patzcuaro watershed, trough the use of agricultural systems with remote sensing. Ingenieria Hidraulica en Mexico, 16: 107-115.
96. Zimmer T. A. M., Penner L. A. 2004. Using integrated remote sensing and GIS technology to model and project shoreline erosion around Wuskwatim Lake, Manitoba. Environmental informatics Archives, 2: 927-937.

12 ANNEXES

Annex 1: Table of results of monitoring conducting on Lake Skadar/Shkoder in the period 2006-2010.

Year/Parameter	pH	El. conductivity	Susp. snovi	Disolved O_2	Saturation % O_2	BPK_5	KPK	Iron	Ammonia
2006	A1	A1	A1S	S	A1I	A1 (A2Kamenik)	A1	A1 (A2-Kamenik, Vranjina, Ckla)	A2CVK (A3CVK-Vranjina, Plavnica)
2007	A1 (A2 I-middle)	A1	A1S	C (S – Podhum)	A1I (A2II-Kamenik)	A1	A1	A1 (A2- Ckla)	A2CVK (A3CVK-Kamenik, Plavnica, Starčevo, Moračnik; A1CII – Podhum)
2008	A1 (A – Vranjina, Virpazar, Kamenik)	A (A1 – Virpazar)	A3 (A1-Starčevo, A2-Podhum, Moračnik, Middle)		A2S (A3C-Vranjina, Plavnica, Ckla)VKVK - Virpazar	A1 (A – Starčevo, Moračnik, Middle; A2 – Vranjina, Virpazar)	A2	A (A1 – Vranjina, kamenik; A2 – Virpazar, Plavnica)	A2C (A1S – Starčevo, Middle)
2009	A1 (A-Virpazar)	A	AS (A1S – Virpazar)		A3C (A1S – Vranjina, VKVK-Plavnica)	A1 (A-Moračnik, Ckla, Middle)	A2 (A1-Vranjina, Moračnik, Ckla, Middle)	A2 (A1-Podhum, Starčevo, Ckla, Middle)	A3C (A2C – Middle)
2010	A	A	A		VK S (A3S – Virpazar, Plavnica, Ckla)	A2 (A- Ckla; A1-Podhun, Middle; A3-Starčevo, Moračnik)	A1 (A2-Plavnica)	A (A1-Vranjina, Virpazar, Kamenik, Podhum, Starčevo)	A3C (A1S-Ckla; A2S – Starčevo, Moračnik)

A – water for drinking (after disinfection), A1 – drinking water after physical postopek and disinfection; A2 – drinking water after conditioniranje; A3 – water with that concentration of phosphates can be used for drink and food industry after intensive physical, chemical and biological treatments, with prolonged disinfection and chlorination
S – water for fish breeding; Š – water for shellfish breeding; C-water for breeding of ciprinide
K1 - excellent for bathing; K2 - satisfactory for bathing
VK – water, which quality is out of recommended classes, following Montenegrin legislation

Annex 1 (contuinuing): Table of results of monitoring conducting on Lake Skadar/Shkoder in the period 2006-2010.

Year/Parameter	Chloride	Sulphates	Phosphates	Nitrates	Nitrites	Phenols	MPAS	Detergent	Coli bact.	Faecal bact.
2006	A1	A1	A1	A1	A1C (A2VK-Vranjina)	A1SI (A2SI – Kamenik, Vranjina, Moračnik	A1II		A2SII (A2CII-Kamenik, Plavnica,	A2I (A2II – Kamenik, Plavnica Vurpazar, Starčevo; A1I – middle
2007	A1	A1	A1	A1	A1C (A1S – Moračnik)	A1SI	A1II (A1 I – Starčevo, Moračnik, Ckla)		A2SII (A2CII-Vranjina, Plavnica)	A2II (A1I-Starčevo, A1II-Middle)
2008	A (A1 – Vranjina, Ckla)	A (A1 – Vranjina)	VK Plavnica, Ckla, Virpazar, Starčevo, Moračnik (A2 – Podhum, A3-Vranjina, Kamenik, Middle)	A	A2C (A3C (Plavnica, Kamenik; A1C-Moračnik, Middle; AS-Ckla, VKC-Vranjina, VKVK-Virpazar)	A2C (A1S-Vranjina; AS – Starčevo, Moračnik, Ckla)	-	A2 (A3-Vranjina, Podhum, Starčevo, Middle)	A2CK2 (A2SK2 – Kamenik, Podhum, Moračnik, Ckla, Middle), A1SK2 –Starčevo)	A2K1 (A2K2 – Virpazar, Plavnica, Podhum; A1K1 – Middle)
2009	A	A (A1 – Virpazar)	A3 (A2-Middle, VK-Plavnica)	A	A3C – Plavnica, Kamenik, Ckla; A2C-Podhum, Starčevo, A1C- Moračnik, AS-Middle, VKC-Vranjina, Virpazar	AS	-	A1 – Middle, A2- Plavnica, Starčevo, Moračnik, Ckla; A3-Vranjina, Virpazar, Kamenik, Podhum	A2SK2 (A1SK2-Starčevo; A2CK2 – Vranjina, Virpazar, Plavnica	A2K1 (A2K2-Virpazar, Plavnica, Podhum)
2010	A	A	A1 (A2-Vranjina, Kamenik, Podhum; A3-Starčevo)	A	A3C (A1S-Ckla; VKC-Virpazar, Plavnica, Kamenik; VKVK-Vranjina)	AS	-	A2 (A-Ckla; A3-Virpazar)	A1SK1 (A2SK2-Vranjina, Kamenik, Starčevo, Moračnik)	A1 (A2-Vranjina)

Legend:
A – water for drinking (after disinfection), A1 – drinking water after physical postopek and disinfection; A2 – drinking water after conditioniranje; A3 – water with that concentration of phosphates can be used for drink and food industry after intensive physical, chemical and biological treatments, with prolonged disinfection and chlorination
S – water for fish breeding; Š – water for shellfish breeding; C-water for breeding of ciprinide
K1 - excellent for bathing; K2 - satisfactory for bathing
VK – water, which quality is out of recommended classes, following Montenegrin legislation

Annex 2: Classification of waters regarding Montenegrin legislation (Off. Gazette of RM, no. 2/07).

By the Regulation on classification and categorization of surface and underground waters (Off. Gazette of RM, no. 2/07) waters are classified in the following classes:

1) Drinking water and waters for food industry

Classes of water (Article 4.)

Waters which can be used for drink and food industry are classified in 4 classes:
- Class **A** – can be used in natural state, with eventual disinfection,
- Class **A1** – can be used after simple physical treatment and disinfection,
- Class **A2** – can be used after corresponding treatment (coagulation, filtration, disinfection),
- Class **A3** – can be used after intensive physical, chemical and biological treatments, with prolonged disinfection and chlorination.

Table 1. Parameters and their limit values for certain classes:

	Parameters	Units	A	A1	A2	A3
1	pH		6.80-8.30	6.80-8.50	6.50- 8.50	5.50-9.00
2	Colour (after common filtration)	mg/l Pt scale	5	5	10	20
3	Turbidity	NTU	1	5	5	10
4	Total suspended matter	mg/l	0	<10	20	50
5	Temperature	˚C	8-12	9-12	30	30
6	El. conductivity	µs/cm at 20˚C	300	400	600	1000
7	Ca/Mg	Mol	2-3	2-3	2-4	2-6
8	Smell (at 25˚C)	Dilution Faktor	< GD*	< GD*	3	10
9	Nitrates - NO3	mg/l	10	20	25	50
10	Nitrites - NO2	mg/l	< GD*	0.003	0.005	0.02
11	Fluorides	mg/l	0.05	1	1.5	1.7
12	Dissolved iron	mg/l	0.05	0.1	0.3	1
13	Manganese	mg/l	< GD*	0.005	0.01	0.05
14	Copper	mg/l	0.005	0.02	0.05	1
15	Zink	mg/l	0.01	0.05	1	5
16	Boron	mg/l	0.5	1	1	1
17	Beryllium	mg/l	0.001	0.001	0.005	0.05
18	Cobalt	mg/l	0.001	0.001	0.010	0.050
19	Nickel	mg/l	0.002	0.002	0.050	0.100
20	Vanadium	mg/l	0.001	0.010	0.020	0.100
21	Arsenic	mg/l	0.001	0.010	0.050	0.050
22	Cadmium	mg/l	0.000	0.001	0.005	0.005

	Parameters	Units	A	A1	A2	A3
23	Total chromium	mg/l	0.000	0.000	0.05	0.05
24	Lead	mg/l	0.001	0.010	0.05	0.05
25	Selenum	mg/l	0.001	0.001	0.010	0.010
26	Mercury	mg/l	< GD*	< GD*	0.0005	0.001
27	Barium	mg/l	0.1	0.1	0.7	1
28	Cyanides	mg/l	< GD*	0.001	0.005	0.005
29	Sulphates	mg/l	20	20	50	200
30	Chlorides	mg/l	10	20	40	200
31	Uranium	µBq/l	0.000	0.010	0.050	0.050
32	Surface active matter (reacts with metil blue))	mg/l (lazri-sulfata)	0.001	0.001	0.02	0.5
33	Orto-phosphate	mg/l PO_4	0.01	0.02	0.05	0.10
34	Phenolic compounds	mg/l C_6H_5OH	0.0005	0.001	0.005	0.01
35	Total mineral oils	mg/l	< GD*	0.01	0.05	0.5
36	PAH	mg/l	< GD*	0.0002	0.0002	0.001
37	Total pesticides	mg/l	< GD*	< GD*	0.001	0.0025
38	COD	mg/l O_2	1	2	4	8
39	$KMnO_4$	mg $KMnO_4$/l	5	5	8	8
40	% saturation of O_2	% O_2	75	80-110	80-120	50-120
41	BOD	mg/l O_2	2	3	4	7
42	Ammonium ion	mg/l	0.00	0.02	0.05	1
43	Matter that is extracted by chlorophorm	mg/l	< od GD*	0.01	0.2	0.5
44	TOC	mg/l	1	1	2	2.5
45	Total coli bacteria 37˚C	/1ml	10	10	500	5000
46	Feacal coliforms	/100ml	10	20	2000	20000
47	Faecal streptococci	/100ml	< GD*	20	1000	10000
48	Salmonella		Not present in 5000 ml	Not present in 5000 ml	Not present in 1000 ml	Not present in 1000 ml
49	Saprobity		Xenosaprobi	Oligosaprobi	Beta-mezo saprobi	Beta mezo and alfa mezo saprobi
50	Saprobic Index		1.0	1.5	1.8	2.0

2) Waters for shellfish and fish breeding

Classes and parameters (Article 8.)

Waters which can be used for fish and shellfish farming are determined in following classes:

1) Class S – waters which can be used for breeding of pure breed of fish species (Salmonidae);
2) Class Š – waters which can be used for shellfish farming;
3) Class C – waters which can be used for breeding of less noble fish species (Ciprinidae).

	Parameters	Units	S	Š	C
1	Total suspended matter	mg/lSM	25	-	25
2	Nitrites - NO_2	mg/l	<0.001	<0.03	<0.03
3	Phenolic compounds	mg/l C_6H_5OH	0.002	-	0.002
4	% saturation of O_2	% O_2	50% >9 100%>7	70%> 7	50%>8 100%>5
5	Ammonium ion	mg/l	0.04	-	1
6	Total coliforms 37˚C	cfu/100ml	2000	100	10000
7	Feacal coliforms	cfu/100ml	-	<300	-
8	Residual chlorine	mg/l	0	0	<0.005
9	Salinity	‰	-	<40	-
10	Organo-halogen substances	mg/l	-	0.025	-

3) Bathing waters

Classes and parameters (Article 13.)

Bathing waters are classified in two classes:
- Class **K1** – excellent,
- Class **K2** – satisfactory.

a) for surface waters:

	Parameters	Unit	K1	K2
1	Intestinal enterococci	cfu/100ml	200	330
2	*Escherichia coli*	cfu/100ml	500	900

Annex 3: Definitions for high, good and moderate ecological status in lake regarding WFD.

Biological quality elements

Element	High status	Good status	Moderate status
Phytoplankton	The taxonomic composition and abundance of phytoplankton correspond totally or nearly totally to undisturbed conditions. The average phytoplankton biomass is consistent with the type-specific physico-chemical conditions and is not such as to significantly alter the type-specific transparency conditions. Planktonic blooms occur at a frequency and intensity which is consistent with the type specific physicochemical conditions.	There are slight changes in the composition and abundance of planktonic taxa compared to the type-specific communities. Such changes do not indicate any accelerated growth of algae resulting in undesirable disturbance to the balance of organisms present in the water body or to the physico-chemical quality of the water or sediment. A slight increase in the frequency and intensity of the type specific planktonic blooms may occur.	The composition and abundance of planktonic taxa differ moderately from the type-specific communities. Biomass is moderately disturbed and may be such as to produce a significant undesirable disturbance in the condition of other biological quality elements and the physico-chemical quality of the water or sediment. A moderate increase in the frequency and intensity of planktonic blooms may occur. Persistent blooms may occur during summer months.
Macrophytes and phytobenthos	The taxonomic composition corresponds totally or nearly totally to undisturbed conditions. There are no detectable changes in the average macrophytic and the average phytobenthic abundance.	There are slight changes in the composition and abundance of macrophytic and phytobenthic taxa compared to the type-specific communities. Such changes do not indicate any accelerated growth of phytobenthos or higher forms of plant life resulting in undesirable disturbance to the balance of organisms present in the water body or to the physico-chemical quality of the water. The phytobenthic community is not adversely affected by bacterial tufts and coats present due to anthropogenic activity.	The composition of macrophytic and phytobenthic taxa differ moderately from the type-specific communities and are significantly more distorted than those observed at good quality. Moderate changes in the average macrophytic and the average phytobenthic abundance are evident. The phytobenthic community may be interfered with, and, in some areas, displaced by bacterial tufts and coats present as a result of anthropogenic activities.

Element	High status	Good status	Moderate status
Benthic invertebrate fauna	The taxonomic composition and abundance correspond totally or nearly totally to the undisturbed conditions. The ratio of disturbance sensitive taxa to insensitive taxa shows no signs of alteration from undisturbed levels. The level of diversity of invertebrate taxa shows no sign of alteration from undisturbed levels.	There are slight changes in the composition and abundance of invertebrate taxa compared to the type-specific communities. The ratio of disturbance sensitive taxa to insensitive taxa shows slight signs of alteration from type-specific levels. The level of diversity of invertebrate taxa shows slight signs of alteration from type-specific levels.	The composition and abundance of invertebrate taxa differ moderately from the type-specific conditions. Major taxonomic groups of the type-specific community are absent. The ratio of disturbance sensitive to insensitive taxa, and the level of diversity, are substantially lower than the type-specific level and significantly lower than for good status.
Fish fauna	Species composition and abundance correspond totally or nearly totally to undisturbed conditions. All the type-specific sensitive species are present. The age structures of the fish communities show little sign of anthropogenic disturbance and are not indicative of a failure in the reproduction or development of a particular species.	There are slight changes in species composition and abundance from the type-specific communities attributable to anthropogenic impacts on physicochemical or hydromorphological quality elements. The age structures of the fish communities show signs of disturbance attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements, and, in a few instances, are indicative of a failure in the reproduction or development of a particular species, to the extent that some age classes may be missing.	The composition and abundance of fish species differ moderately from the type-specific communities attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements. The age structure of the fish communities shows major signs of disturbance, attributable to anthropogenic impacts on physico-chemical or hydromorphological quality elements, to the extent that a moderate proportion of the type specific species are absent or of very low abundance.

Hydromorphological quality elements

Element	High status	Good status	Moderate status
Hydrological regime	The quantity and dynamics of flow, level, residence time, and the resultant connection to groundwaters, reflect totally or nearly totally undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Morphological conditions	Lake depth variation, quantity and structure of the substrate, and both the structure and condition of the lake shore zone correspond totally or nearly totally to undisturbed conditions.	Conditions consistent with the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.

Physico-chemical quality elements

Element	High status	Good status	Moderate status
General conditions	The values of physico-chemical elements correspond totally or nearly totally to undisturbed conditions. Nutrient concentrations remain within the range normally associated with undisturbed conditions. Levels of salinity, pH, oxygen balance, acid neutralising capacity, transparency and temperature do not show signs of anthropogenic disturbance and remain within the range normally associated with undisturbed conditions.	Temperature, oxygen balance, pH, acid neutralising capacity, transparency and salinity do not reach levels outside the range established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements. Nutrient concentrations do not exceed the levels established so as to ensure the functioning of the ecosystem and the achievement of the values specified above for the biological quality elements.	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific synthetic pollutants	Concentrations close to zero and at least below the limits of detection of the most advanced analytical techniques in general use.	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6 without prejudice to Directive 91/414/EC (concerning the placing of plant protection products on the market) and Directive 98/8/EC (concerning the placing of biocidal products on the market). (<EQS)	Conditions consistent with the achievement of the values specified above for the biological quality elements.
Specific non-synthetic pollutants	Concentrations remain within the range normally associated with undisturbed conditions (background levels = bgl).	Concentrations not in excess of the standards set in accordance with the procedure detailed in section 1.2.6(2) without prejudice to Directive 91/414/EC (concerning the placing of plant protection products on the market) and Directive 98/8/EC (concerning the placing of biocidal products on the market). (<EQS)	Conditions consistent with the achievement of the values specified above for the biological quality elements.

(1) The following abbreviations are used: bgl = background level, EQS = environmental quality standard.

(2) Application of the standards derived under this protocol shall not require reduction of pollutant concentrations below background levels: (EQS >bgl).

Annex 4: List of methods, which are used for analysing of different parameters in water, sediment and biota at University of Shkoder.

WATER

Parameter	Standard	Method	Equipment	LOD (mg/l)	LOQ (mg/l)	Acreditation ISO/IEC 17025
sampling of water	ISO 5667-4		UWITEC device			NO
sampling of sediment			HYDROBIOS-KIEL device			NO
water temperature	ISO 6107-2	Portable multiparameter	AQUALYTIC			NO
concentration of dissolved oxygen	ISO 6107-2	Portable oxygenmeter	AQUALYTIC			NO
conductivity	ISO 6107-2	Portable conductivitymeter	AQUALYTIC			NO
m-alkalinity	ISO 9963	End point titration				NO
pH	ISO 6107-2	Portable conductivitymeter	AQUALYTIC			NO
PCB	ISO 6468	Gas- Chromatography Micro Electron Capture Detector (GC-µECD)	GC-µECD 7890 Agilent	0.000001	0.000002	NO
sulphate	APHA 1989	Measurement wavelength	Spectro 3 Photometer for aquanal tests			NO
PAHs	ISO 17993	Gas- Chromatography Flame Ionization Detector (GC-FID)	GC-FID 7890 Agilent	0.0000027	0.000004	NO
OCP	ISO 6468	Gas- Chromatography Micro Electron Capture Detector (GC-µECD)	GC- µECD 7890 Agilent	0.000002	0.000008	NO

SEDIMENT

Parameter	Standard	Method	Equipment	LOD (mg/kg)	LOQ (mg/kg)	Acreditation ISO/IEC 17025
sampling of sediment						NO
PCB	ISO 10382	Gas- Chromatography Micro Electron Capture Detector (GC-µECD)	GC- µECD 7890 Agilent	-	0.1	NO
PAHs	ISO 17993	Gas- Chromatography Flame Ionization Detector (GC-FID)	GC- FID 7890 Agilent	-	0.1	NO
OCP	ISO 10382	Gas- Chromatography Micro Electron Capture Detector (GC-µECD)	GC- µECD 7890 Agilent	-	0.1	nO

BATHING WATERS

Parameter	Standard	Method	Equipment	LOD (cfu/100 ml)	LOQ (cfu/100 ml)	Acreditation ISO/IEC 17025
Intestinal enterococci	ISO 7899-2	Membrane filtration	Microbiological equipments			NO
Escherichia coli	ISO/DIS 9308-1	Membrane filtration	Microbiological equipments			NO

BIOTA

Parameter	Standard	Method	Equipment	LOD (mg/kg)	LOQ (mg/kg)	Acreditation ISO/IEC 17025
PCB	ISO 6468	Gas- Chromatography Micro Electron Capture Detector (GC-µECD)	GC- µECD 7890 Agilent			
PAHs	ISO 17993	Gas- Chromatography Flame Ionization Detector (GC-FID)	GC- FID 7890 Agilent			
OCP	ISO 6468	Gas- Chromatography Micro Electron Capture Detector (GC-µECD)	GC- µECD 7890 Agilent			

Annex 5: List of methods, which are used for analysing of different parameters in water, sediment and biota at University of Tirana.

WATER

Parameter	Standard	Method	Equipment	LOD (mg/l)	LOQ (mg/l)	Acreditation ISO/IEC 17025
sampling of water	EPA-600/4-79-020					NO
Secchi depth						
water temperature						
concentration of dissolved oxygen	APHA 421B					NO
oxygen saturation value	APHA 421B					NO
total organic carbon						NO
conductivity	APHA 205					NO
m-alkalinity	APHA (1998) section 2320					NO
pH	APHA 423					NO
ammonium	APHA 417C					NO
nitrite	APHA 419C					NO
nitrate	APHA 418A					NO
total nitrogen	Kleidal Method					NO
total phosphorus	APHA 424 III, 424F					NO
trace elements (Cd, Pb, Hg, Ni, As, Zn, B, Cr, Cu, Fe)	APHA 304					NO
chemical oxygen demand - COD	APHA 508A					NO
sulphate	APHA 426 C					NO
phenol	SFUV/Vis					NO

SEDIMENT

Parameter	Standard	Method	Equipment	LOD (mg/kg)	LOQ (mg/kg)	Acreditation ISO/IEC 17025
sampling of sediment	# 1215 Rev. 1, 9/99 Pg. 1 of 10					NO
Cd	SA11	AAS	AAS			NO
Cu	SA11	AAS	AAS			NO
Ni	SA11	AAS	AAS			NO
As	SA11	AAS	AAS			NO
Zn	SA11	AAS	AAS			NO
Cr	SA11	AAS	AAS			NO
Fe	SA11	AAS	AAS			NO
Hg	SA11	CVAAS	CVAAS			NO
Cr	SA11	AAS	AAS			NO

NOTE: *AAS/FLAME and or ETA, dependent on the concentration of the element
**AAS/FLAME: Varan SpectrAA 10+
**AAS/ETA: NovAA 400 (Analytic Jena)
**** Soil Analysis Method 11 (SA11) Aqua Regia Extractant Determinations
LOD and LOQ depended from the technique (flame of furnace system)

FISH

Parameter	Standard	Method	Equipment	LOD (mg/kg)	LOQ (mg/kg)	Acreditation ISO/IEC 17025
Cd	AOAC(1995)	AAS	AAS			NO
Cu	AOAC(1995)	AAS	AAS			NO
Ni	AOAC(1995)	AAS	AAS			NO
As	AOAC(1995)	AAS	AAS			NO
Zn	AOAC(1995)	AAS	AAS			NO
Cr	AOAC(1995)	AAS	AAS			NO
Fe	AOAC(1995)	AAS	AAS			NO
Hg	AOAC(1995)	CVAAS	CVAAS			NO
sulphate		turbidimetric				NO

NOTE: *AAS/FLAME and or ETA, dependent on the concentration of the element
**AAS/FLAME: Varan SpectrAA 10+
**AAS/ETA: NovAA 400 (Analytic Jena)
AOAC (1995). Official Methods of Analysis of AOAC International. 16th ed., Vol. 1 (Cunnif, P. Ed.), AOAC Int. Arlington, Virginia, USA.
LOD and LOQ depended from the technique (flame of furnace system)

Annex 6: List of methods, which are used for analysing of different parameters in water, sediment and biota at Institution CETI.

WATER

Parameter	Standard	Method	Equipment	LOD (mg/l)	LOQ (mg/l)	Acreditation ISO/IEC 17025
sampling of water	JUS/ISO 5667	/	/	/	/	/
concentration of dissolved oxygen	ISO 5814:1990	titrimetric		0.2	0.5	NO
conductivity	ASTM D 1125-77	conductometry	HORIBA DA-15	0.1 µS/cm	0.1 µS/cm	YES
m-alkalinity	JUS.HZ1.124	titrimetric		2	5	YES
pH	JUS HZ1.111		pH/Ion meter Cyber Scan 510 Ion	0-14	0-14	YES
ammonium	ASTM D 1426-71	UV/VIS	UV-1601 Shimadzu	0.01	0.02	YES
nitrite	Standard Methods for examination of water and wastewater 19th edited by Andrew D. Eatonand Greenberg, 4500-NO2B, Colorimetric method	UV/VIS	UV-1601 Shimadzu	0.002	0.005	YES
nitrate	Standard Methods for examination of water and wastewater 19th edited by Andrew D. Eatonand Greenberg, 4500NO3-B. UV spectrophotometric screening method	UV/VIS	UV-1601 Shimadzu	0.02	0.04	YES
total nitrogen	Handbook for Kjeldahl digestion – a recent review of the classical method with improvements, Developed by Tecator, 2nd edition	Kjeldahl	Foss Tecator 2300	1	3	YES
total phosphorus orthophosphate	Standard methods for the Examination of Water and Wastewater 19th edition, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 1995 4500-P D	UV/VIS	UV-1601 Shimadzu	0.005 as P	0.01 as P	YES
Cd	Standard Methods for examination of Water Wastewater-19th Edition 1995, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 3500 PbB	AAS-FL AAS-GFA	AA-6701F AA-6800 Shimadzu	0.0002	0.0005	YES
Pb				0.001	0.005	
Hg	Determination of Mercury in Hg Standard Solutions at the Lower Range Limit, Organic application note Leco AMA 254, Form no. 203-823-111, Leco corporation	Mercury analyser	AMA-254 Leco	0.00005	0.0001	YES
Ni	Standard Methods for examination of Water Wastewater-19th Edition 1995, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 3500Ni B	AAS-FL	AA-6701F Shimadzu	0.002	0.005	YES
As	Atomic absorption spectrophotometry Cookbook Section 4 Measuring conditions by element of furnace analyses method, Shimadzu corporation, page 10	AAS-GFA	AA-6800 Shimadzu	0.0005	0.001	YES
Zn	Standard Methods for examination of Water Wastewater-19th Edition 1995, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 3500 Zn B	AAS-FL	AA-6701F Shimadzu	0.001	0.0025	YES

Parameter	Standard	Method	Equipment	LOD (mg/l)	LOQ (mg/l)	Acreditation ISO/IEC 17025
B	EPA 200.7 Determination of metals and trace elements in water and wastes by inductively coupled plasma-atomic emission spectrometry	ICP-OES	Termo Scientific 6300 Series	0.01	0.05	NO
Cr	Standard Methods for examination of Water Wastewater-19th Edition 1995, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 3500Cu B	AAS-FL	AA-6701F Shimadzu	0.002	0.005	YES
Cu				0.001	0.0025	
Sb	Atomic absorption spectrophotometry Cookbook Section 5a Measuring conditions of relevant elements in drinking water (according to German drinking water regulation), page 23	AAS-GFA	AA-6800 Shimadzu	0.001	0.005	YES
Mo	EPA 200.7 Determination of metals and trace elements in water and wastes by inductively coupled plasma-atomic emission spectrometry	ICP-OES	Termo Scientific 6300 Series	0.001	0.005	NO
Al						
Fe	Standard Methods for examination of Water Wastewater-19th Edition 1995, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 3500Fe B	AAS-FL	AA-6701F Shimadzu	0.002	0.005	YES
PCB	Standard Methods for examination of Water and Wastewater-19th Edition 1995, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 6431 B and 6431 C	Gas chromatography Mass spectrometry GCMS	GCMS-QP 2010 plus, Shimadzu	0.000001	0.000002	YES
mineral oils	ASTM D 3921-85	FTIR	Fourier transform infrared spektrofotometer FTIR-8700 Shimadzu	0.002	0.0025	YES
chemical oxygen demand - COD	JUS/ISO 6060	titrimetric	-	10	30	YES
sulphate	Standard Methods for examination of Water Wastewater-19th Edition 1995, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 4500SO4F	UV/VIS	UV-1601 Shimadzu	0.2	0.5	NO
fluoride	ASTM D 1179-80	Ion-selective electrode	pH/Ion Meter F-24 Horiba	0.01	0.02	YES
PAHs	Standard Methods for examination of Water and Wastewater-19th Edition 1995, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 6440 C	Gas chromatography Mass spectrometry GCMS	GCMS-QP 2010 plus, Shimadzu	0.000002	0.000005	YES
OCP	Standard Methods for examination of Water and Wastewater-19th Edition 1995, edited by Andrew D.Eaton,Lenore S.Clasceri and Arnold E.Greenberg 6630 C	Gas chromatography GC	GC-17 A, ECD, Shimadzu	0.000001	0.000002	YES
phenol	ASTM D 1783-B	UV/VIS	UV-1601 Shimadzu	0.0002	0.0005	YES

SEDIMENT

Parameter	Standard	Method	Equipment	LOD (mg/kg)	LOQ (mg/kg)	Acreditation ISO/IEC 17025
sampling of sediment	JUS /ISO 11464 (1994), JUS /ISO 10381-2 (1996), JUS/ ISO10381, NEN5753, ISO/DIS 11277					
PCB	EPA Method 8270 C	Gas chromatography Mass spectrometry GCMS	GCMS-QP 2010 plus, Shimadzu	0.0002	0.0004	YES
PAHs	EPA Method 8270 C	Gas chromatography Mass spectrometry GCMS	GCMS-QP 2010 plus, Shimadzu	0.0004	0.001	YES
Cd	Official Methods of Analysis of AOAC International 16th Edition, 3rd Revision,1997, AOAC Method 990.08	AAS-FL	AA-6800 Shimadzu	0.01	0.25	YES
Cu		AAS-FL	AA-6701F Shimadzu	0.05	1.25	YES
Ni		AAS-FL	AA-6701F Shimadzu	0.10	2.5	YES
As		AAS-GFA	AA-6800 Shimadzu	0.004	0.1	YES
Zn		AAS-FL	AA-6701F Shimadzu	0.05	1.25	YES
B	EPA method 3051a: microwave assisted acid digestion of sediments, sludges, soils, and oils	ICP-OES	Termo Scientific 6300 Series	0.05	1.25	NO
Cr				0.10	2.5	NO
Sb				0.1	2.5	NO
Mo				0.01	0.25	NO
Al				0.01	0.25	NO
Fe	Official Methods of Analysis of AOAC International 16th Edition, 3rd Revision,1997, AOAC Method 990.08	AAS-FL	AA-6701F Shimadzu	0.10	2.5	YES
Hg	Organic application note Leco AMA 254, Form no. 203-823-112, Leco corporation, 1999.	Mercury analyser	AMA-254 Leco	0.00005	0.0001	YES
OCP	EPA Method 8080 A	Gas chromatography GC	GC-17 A, ECD, Shimadzu	0.0001	0.0002	YES
mineral oils	Internal method	FTIR	Fourier transform infrared spektrofotometer FTIR-8700 Shimadzu	0.01	0.05	YES
sulphate	BS 1377-3:1990	UV/VIS	UV-1601 Shimadzu	0.5	1	YES

BIOTA

Parameter	Standard	Method	Equipment	LOD (mg/kg)	LOQ (mg/kg)	Acreditation ISO/IEC 17025
PCB	Official Methods of Analysis of AOAC International 16th Edition, 3rd Revision,1997, AOAC Methods: 983.21	Gas chromatography Mass spectrometry GCMS	GCMS-QP 2010 plus, Shimadzu	0.0005	0.001	YES
Pb	Official Methods of Analysis of AOAC International 16th Edition, 3rd Revision,1997, AOAC Methods: 972.23	AAS-FL	AA-6701F Shimadzu	0.10	0.25	YES
Cd	AOAC Official Method 999.11 Lead, Cadmium, Copper, Iron and Zinc in Foods, J. AOAC Int. 83, 1204(2000), mod.	AAS-FL	AA-6701F Shimadzu	0.01	0.02	YES
Cu				0.02	0.05	
Ni						
As	AOAC Official Method 986.15 Arsenic, Cadmium, Lead, Selenium and Zinc in Human and Pet Foods, J. AOAC 63, 485(1980).	AAS-FL	AA-6701F Shimadzu	0.02	0.06	YES
Zn	AOAC Official Method 999.11 Lead, Cadmium, Copper, Iron and Zinc in Foods, J. AOAC Int. 83, 1204(2000), mod.	AAS-FL	AA-6701F Shimadzu	0.02	0.05	YES
Fe	AOAC Official Method 999.11 Lead, Cadmium, Copper, Iron and Zinc in Foods, J. AOAC Int. 83, 1204(2000), mod.	AAS-FL	AA-6701F Shimadzu	0.02	0.05	YES
Hg	Determination of mercury in animal tissue: Organic application note Leco AMA 254, Form N0 203-823-114, Leco corporation,1999	Mercury analyser	AMA-254 Leco	0.00005	0.0001	YES
OCP	Official Methods of Analysis of AOAC International 16th Edition, 3rd Revision,1997, AOAC Methods: 983.21	Gas chromatography GC	GC-17 A, ECD, Shimadzu	0.00025	0.0005	YES

Annex 7: Proposition of joint monitoring programme for quality of water of Lake Skadar/Shkoder.

Annex 8: Proposition of joint monitoring programme for biodiversity of Lake Skadar/Shkoder.