4. Major Issues and Problems

4.1 Drin Basin - Pressures, subsequent resulting State of the environment, and Impacts caused

There is a number of issues in the Drin Basin; the system receives a variety of pressures. The related available information including this regarding the resulting state of the environment along with the impacts caused is given in the following pages.

- ***Water Balance***

The diversion of Devolli River in Albania (in the 70's) to discharge water into the **Lake Micro Prespa** during winter months using it as an irrigation reservoir for the summer months (related activities stopped in 2001), has led to the permanent alteration of the hydrological system in this lake due to increased sedimentation. It has been reported that, because of the sedimentation, underground springs have been blocked (see "Sediment Balance" below).

A significant decrease of the water level over the years has resulted in an obvious shift in the habitats on the Albanian side and probably in some alterations in the composition of the ecosystem. It is believed that this decrease is part of the natural hydrological cycle since pressures due to irrigation are currently minimal in this part of Albania.

There has been an oscillation of the water level in **Lake Macro Prespa** during the past decades. Overall, the water level has decreased by about 9 meters over the past 60 years.

Much of the lowering of the water level is attributed to changes in precipitation patterns in conjunction with the underground water flow from Prespa to Ohrid watershed through karstic formations; this flow is not considered to be constant. Overuse of water for irrigation in The Former Yugoslav Republic of Macedonia –mostly through illegal groundwater abstractions- lead to additional losses that seem to have an impact on the water level. Water abstracted for irrigation and household use on the Albanian side has a rather insignificant effect in this regard.

The lowering of the water level has resulted in loss or shifting of priority shoreline and wetland habitats e.g. the reed biotope in The Former Yugoslav Republic of Macedonia remained on dry terrain, while a succession of other communities characterizes now the immediate shoreline belt. Spawning areas have been lost, impacting the fish population, especially this of the carp.

Additionally, it has led to exploitation of former wetlands transformed into agricultural or pasture lands, increasing the potential for pollution from agrochemicals as well as organic pollution.

The hydrology of the "extended" **Drin Basin** has been dramatically altered by the construction and use of a cascade of dams for hydropower production (HP). Dam construction results in altered flow patterns the effects of which include: erosion of land adjacent to the river downstream the dams; disturbance of the sediment distribution regime being a contributing factor with regard to the erosion phenomena at the Adriatic coast (see below under "Sediment balance") etc.

In addition, major pressure is exerted on biota by the interruption of bio-corridors and habitat fragmentation. Preventing fish from migrating upstream to spawn is one of the direct impacts of dams. A characteristic example is the Atlantic eel (*Anguilla anguilla*), which historically used the Drin River to migrate between Lake Ohrid and the Adriatic Sea. Other riverine species have also been affected by the dams and the altered flow patterns throughout the watershed. Overall, the pressures exerted upon the ecosystems are major.

Nevertheless, the significance of the water bodies in terms of electricity production is high: in Albania the capacity of the plants installed in the basin equals to about 70% of the total hydro and thermal capacity installed in the country; in The Former Yugoslav Republic of Macedonia the two dams on the Black Drin River represents 20% of the total installed hydropower capacity (accounts for 16% of the overall energy production). The countries face electricity deficits that are covered by energy imports. New dams are planned in Albania. A considerable number of small HP plants in the Black Drin watershed in The Former Yugoslav Republic of Macedonia and a cascade of dams in the Moraca River in Montenegro are either planned or are in the "pipeline". One of the planned projects in The Former Yugoslav Republic of Macedonia involves the diversion of a part of the flow of Radika River to the Vardar River (that flows in the Aegean Sea). This has raised concerns in the Albanian side.

Furthermore, the flow patterns in Drin downstream the dams are influenced by both licensed as well as uncontrolled gravel extraction.

Hydropower production is also linked to **oscillations** of the **water level** in the lakes **Ohrid** and **Shkoder/Skadar,** that impacts their ecological, economic and cultural values.

Variations in the water level in **Lake Ohrid** is linked with the operation of the Spilje and Globocica dams and the associated HP production stations downstream in The Former Yugoslav Republic of Macedonia, and occasionally with extreme precipitation incidents. Floods in the Ohrid Lake sub-basin are closely associated to the aforementioned phenomena. Lack of close coordination between Albania and The Former Yugoslav Republic of Macedonia with regard to the management of the outflow from the dams in both countries is an additional factor to be taken into account. Attempts to increase water withdrawals from Lake Ohrid in the last few years, in order to increase hydropower generation in the downstream HP plants in The Former Yugoslav Republic of Macedonia caused concern and reactions, in both countries. Permanent decrease or significant oscillations in the water level may lead to the shift of littoral zone habitats and/or deterioration or even elimination of the wetlands hence, deterioration of biodiversity. Commercial fishing will be also negatively affected since these habitats provide the spawning grounds for four commercial species, including the endemic Ohrid trout (*Salmo letnica*) – currently under protection in The Former Yugoslav Republic of Macedonia - and the smaller size B*elvica* species (*Salmo ohridana*).

In addition it should be noted, that deficiencies in the basin management in Albania could have direct and indirect impacts in upstream countries. For instance, at least in one case during 2010, the reduction of the flow of water from Ohrid to Black Drin in The Former Yugoslav Republic of Macedonia as a measure to mitigate floods in the northern part of Albania -in the Shkoder/Skadar Lake sub-basin- led to the raising of the water level in the Lake Ohrid by 50 cm, affecting negatively the anthropogenic (e.g. sewage system) and natural environment. Furthermore groundwater flooding was observed in settlements near the Ohrid Lake and Black Drin River.

The altered water flow regime both upstream and downstream of the dams affects the habitats in the **Black Drin** River. Change in the erosion patterns in the river banks is an additional outcome. Floods in the Black Drin sub-basin in The Former Yugoslav Republic of Macedonia, is partially attributed to the decrease of the forest cover in the Jablanica Mountain; the negative trend has reversed as a result of the economic crisis. Some floods that have been observed in Albania in the border with The Former Yugoslav Republic of Macedonia are attributed to the increase of the discharge from the last dam in The Former Yugoslav Republic of Macedonia.

The outflow of the **Lake Shkoder/Skadar** through Buna/Bojana River is occasionally impeded due to increased flow of the Drin River; the latter is a result of water releases from the artificial lakes upstream. Under specific conditions -e.g. favorable winds- Drin water even enters in the Shkoder/Skadar resulting in a significantly raised water level in the lake. This occurs mostly from December to February, but may also occur during other periods, depending on the water quantity released from the hydro-power dams (Vau Dejes), which, in turn, depends on both precipitation and electricity demand. Furthermore, increased flow in the Kiri, Gjadri and Drin River cause sediment deposition at the confluence point of Drin and Buna/Bojana Rivers, thereby further obstructing the flow in the latter and the outflow from the lake.

Altered patterns of oscillation of the water level of **Lake Shkoder/Skadar** exert pressures on the ecosystems and the microclimate as well as on the agriculture around the lake. Lake Shkoder/Skadar is a shallow floodplain type of lake, with regular and extensive flooding of low gradient areas. The flooded areas are an essential habitat for maintaining the overall biodiversity of the lake. They provide essential spawning grounds and nursery areas for many fish species hence they support the high fisheries productivity in the lake and the river. The flood regime, the timing and amplitude of changes in water levels, are important factors for successful fish spawning. Disturbance of this regime alter the characteristics of the habitats.

Increased frequency and intensity of flooding in the Shkoder/Skadar – Buna/Bojana area during the past two-three years has had detrimental socioeconomic effects in the region. The 2010 floods were the most severe ones recorded in the last 80 years in the Albanian side; in the Montenegrin side they resulted in the highest level of water ever recorded. While there is a need for these phenomena to be further studied, it is believed that they come as a result of the combined effect of the following:

- flow variability due to both natural and anthropogenic factors (extreme weather phenomena, water releases from the dams on Drin River);
- high sediment input through the tributaries of Drin downstream the dams due to erosion caused by gravel extraction and loss of plant coverage;
- accumulation of alluvium in the tributaries of Drin, Drin itself and Buna/Bojana. In the case of Drin this is due to the decreased sediment transport capacity as a result of the controlled outflow from the artificial lakes; in the case of Buna/Bojana the latter is combined with the low gradient of the riverbed;
- blockage of the natural secondary channels of the Buna/Bojana River that existed in the past in the delta area; the pick flows exceed the capacity of the main (existing) channel;
- poor maintenance of the drainage channels and flood preventing constructions in the Albanian side and of the embankments in the Montenegrin side.

Recent work[1] that looked into the reasons for the oscillation of the level of Lake Skadar/Shkoder concluded that the main reason for the January 2010 major floods in the Montenegrin part of the basin was the de-regulation of the hydropower production dams on Drin in Albania.

Climate change and variability leading to the increase of the frequency of extreme precipitation events should be taken into consideration as an additional possible explanation of these flooding phenomena. It is noteworthy that similar "localized" floods are becoming more frequent throughout the world, attributed by many scientists to already occurring climate change.

- ***Sediment Balance***

The diversion of Devolli River in Albania into **Lake Micro Prespa** has led to the deposition of considerable amounts of solid material causing a permanent alteration of the character and functions of the site; almost the total of the Albanian part of Micro Prespa Lake transformed from a shallow lake into a wetland. Despite their ecological significance for wildlife, in particular avifauna, and as buffer zones, extensive growth of reed belts accelerates ageing and succession processes of the lake.

Increased sediment loads entering both **Lakes Micro and Macro Prespa**, has been the outcome of deforestation and overgrazing in both Albania and The Former Yugoslav Republic of Macedonian sides and unsustainable agricultural practices in The Former Yugoslav Republic of Macedonia. Further to the increased sedimentation, nutrients and micro-pollutants can be transported in the water body adsorbed and absorbed on particulate matter.

It seems that the main problem in terms of excessive sediment loads entering the **Lake Ohrid** lies mostly with the diversion of the Sateska River to the Lake in The Former Yugoslav Republic of Macedonia. Deforestation in the watershed of Sateska is a major pressure resulting in erosion of the riverbed. Illegal extraction of sand and gravel from the riverbed influence water flow patterns and cause the increase of sediment loads entering the Lake. Overall, the load of silt entering the Lake Ohrid is large. A delta including a small island has been formed into the lake at the river mouth. Reforestation is planned. Increased sediment loads and soil erosion due to deforestation and agricultural activities is an issue in other parts of the Ohrid watershed as well.

Increased sediment loads into the **Black Drin River** in The Former Yugoslav Republic of Macedonia, is a result of uncontrolled grazing and logging. Illegal gravel extraction from rivers in the Black Drin catchment lead to disturbance of the sediment and the habitats and has an effect on the river flow patterns causing erosion of the adjacent land; the changes of the shape of the river channel undermine infrastructure, bridges and roads, and productive land.

Overall, increased fine sediment load that characterize unstable rivers may also have impacts on fish and wildlife habitats, even in the absence of other water pollution problems.

Erosion is an important and complicated issue in the **Drin River and Buna/Bojana River watersheds** that is not sufficiently studied and understood. Among its causes -the significance of each one may vary in different areas- are the: (i) deterioration and destruction of plant coverage as a result of over-grazing, logging, forest fires etc.; (ii) unsustainable agricultural practices

[1] A joint Predictive hydrological model for Skadar/Shkoder basin was developed and used for this analysis in the framework of the GEF LSIEMP project (2008-2012).

including inappropriate irrigation methods; (iii) altered flow patterns; (iv) gravel extraction along the rivers and their tributaries etc.

Damaging of the flood protection constructions (barriers) in the channels of Drin coupled with the steep gradient of their bed exacerbates erosion phenomena. Soil erosion leads to high sediment loads, in addition to normal inputs, in the Drin River. Significant loads of material transported into the lake of the Hydro-Power Station of Vau i Dejes may result in the increase of the rate of filling up of the artificial lake.

There is erosion in some parts of the Buna/Bojana Delta while there is sand deposition in other parts; the progression of the sea along some parts of the coast at the Buna/Bojana mouth has been about 500 m since 1936 and about 50 m the past 20 years.

The morphology of the Buna/Bojana deltaic complex is believed to be affected by a combination of factors:

- alteration of the water flow regime in the Drin – Shkoder/Skadar – Buna/Bojana system due to the construction of the cascade of dams on Drin;
- entrapment of sediment in the upper part of the watershed by the dams;
- reduction of the sediment transport capacity of the Drin in combination with the natural low gradient of the channel of Buna/Bojana River resulting in the deposition of alluvium (coming from erosion in the tributaries of Buna/Bojana and Drin) preventing this from reaching the Buna/Bojana mouth at the Adriatic Sea. The sediment deposition in Buna/Bojana River causes reduction of the speed of water further resulting to additional deposition of sediment;
- variability of the wave activity and sea level in combination with short-term events (storm waves and tides) and long-term processes (sea transgressions).

The changes in the coastline affect drastically the ecosystems in the Buna/Bojana Delta. For example, nesting bird habitats are being lost progressively throughout the Delta due to the disappearance of islands.

- ***Water Quality***

Diffuse and point source pollution is a matter of concern throughout the “extended” Drin River basin. It results to impacts to the ecosystems of the Drin as well as of the Adriatic Sea and poses a risk to human health.

A considerable amount of nutrients ends up in the **Drin hydrologic system** and the **Adriatic Sea**; 95% of the nutrient load is attributed to anthropogenic sources (Borgvang S. et al., 2008). The riparian countries are slowly taking measures to address urban wastewater pollution; waste water treatment plants have/are being constructed for some major towns especially in Montenegro.

Inadequate wastewater collection and lack of treatment is an issue in the Albanian part of **Micro Prespa**; wastewater is discharged in surface waters or underground. The level of diffuse pollution cannot be estimated. Macroscopic observations (according to reports from local population in Albania, water transparency has decreased to only a few centimeters) and scientific evidence (e.g. the composition of the phytoplanktonic community) suggests that the Lake is currently heading towards eutrophication; however, there is not enough information available to the authors with regard to the causes. As an outcome there is major pressure exerted on fish population and there

are impacts on the balance of the ecosystem which hosts many species including endangered ones.

The intensity and duration of human pressures resulted in the deterioration of water quality in the **Macro Prespa Lake**. This is also true for the watershed in the part of The Former Yugoslav Republic of Macedonia, except the elevated stretches of the rivers way beyond the immediate human activities. In order to prevent further deterioration of the water quality in the watershed, substantial measures have to be introduced and implemented. This is especially important for the Prespa Lake itself since it has already started to show clear signs of becoming eutrophic. According to current monitoring from The Former Yugoslav Republic of Macedonian institutions and from basic surveillance monitoring for the preparation of the watershed management plan in the The Former Yugoslav Republic of Macedonian part, the Lake can be characterized as mesotrophic. According to scientific research regarding the composition of the phytoplankton communities e.g. diatoms, the state of the lake is moderately mesotrophic to eutrophic or even eutrophic in some cases.

There are also some indications of becoming eutrophic throughout the year; there are more frequent and possibly toxic cyanobacterial 'blooms'. Nevertheless, systematic monitoring for the lake and its tributaries need to be established so as to extract safe conclusions about the status of the water bodies and follow the responsiveness of the system to pressures as well as to measures taken by the countries to address these.

Nutrients input –mainly from the The Former Yugoslav Republic of Macedonian side that hosts the biggest share of the population and economic activities in the watershed– is considered to be the main cause. This input comes as a result of mainly unsustainable agricultural activities e.g. improper use of fertilizers and irrigation techniques and insufficient wastewater management; in addition, erosion may also contribute to nutrient inputs due to the poor land management (agriculture). Organic pollution leads to depleted dissolved oxygen concentrations -particularly in summer months- contributing to degradation of water quality with a potential impact on aquatic life. The main source of organic pollution is believed to be the town of Resen and the industry in the same region. Furthermore, about 10-15% of apple production usually ends up in the streams entering the Lake or the Lake itself increasing the organic carbon loads; measures are been taken by the The Former Yugoslav Republic of Macedonian authorities to address this issue. Insufficient wastewater management leads to bacterial pollution too in certain areas of the lake and its tributaries.

Diffuse pollution from agriculture in the Albanian part is minimal and where present it should be of local character. The use of chemical fertilizers is very limited. The nutrient and organic loads entering the lake due to insufficient wastewater management is a factor of pollution that may have -data are not available- an impact of local character; it should be of less importance if compared to transboundary pollution. In contrast, the impact of wastewater discharge is major in the Albanian part in terms of bacteriological pollution; the situation becomes critical at certain locations during certain periods of the year. The health risks are high for people who use untreated water abstracted from the lake for drinking purposes or when using the lake for recreation.

There is little information available regarding the concentrations of hazardous and toxic substances in the local aquatic system (water column, sediment or biota). It is known though that inadequate treated industrial wastewater in the The Former Yugoslav Republic of Macedonian

side of the basin reach the water bodies. The use of herbicides and pesticides in this part of the watershed is substantial, mainly within the Golema River sub-watershed, affecting both the river and the northern end of the Lake. Use of inappropriate types of pesticides in The Former Yugoslav Republic of Macedonia e.g. agrochemicals banned by the law, are obtained and used in both Prespa and Ohrid sub-basins- may pose a threat to the ecosystem. As for the seriousness of the threat, while only rough estimates can be made about the quantities or the types of pesticides and herbicides used, ecotoxicology studies of runoff from fruit orchards in the region indicate significant sub-lethal impacts of insecticides on fish larvae and potential for certain herbicides to have sub-lethal effect on endocrine function in wildlife and humans, affecting sex determination, growth rates, and fecundity. There are views suggesting that hazardous substances use has resulted already to the alterations of the ecosystem structure. In Albania the use of pesticides is restricted; farming is labor intensive.

Water quality deterioration is most intense at the littoral zone of **Lake Ohrid** especially:
- in The Former Yugoslav Republic of Macedonia in the: sections adjacent to the urban areas of Struga and Ohrid; shoreline in the south of Saint Naum; areas that the larger tributaries discharge into the lake, especially the Sateska, Daljan, Grasnica and Koselska Rivers;
- in Albania in the: sections adjacent to the urban area of Pogradec and in the shoreline where recreational activities take place i.e. Drilon, Pojska, and Lin.

Ohrid is an oligotrophic lake; however, there are indications of progressing eutrophication. Nutrient loading from both littoral countries exert pressure to the system causing acceleration of the “aging” process of the lake. Concentrations of phosphorus and nitrogen have been increasing over time. Considering the very large volume of water in the lake this increase represents a very significant change. Both the phytoplankton and zooplankton communities are shifting to a species composition more characteristic of a mesotrophic condition and so do the macrophytes and benthic fauna in the shallow-water zone.

Lake Ohrid is being “fertilized” from the The Former Yugoslav Republic of Macedonian side due to inefficient infrastructure for wastewater collection -the sewerage network covers the total of the Ohrid coast but it overflows during increased precipitation- insufficient treatment, and diffuse pollution due to uncontrolled and excessive use of fertilizers. There are plans for the rehabilitation of the sewerage network as well as the treating capacity of the wastewater treatment plant in Struga.

Urban wastewater discharge has been the main input of nutrients from the Albanian side leading also to organic and bacterial pollution -of local importance- at the littoral zone. Treatment, since 2009, of urban wastewaters of the Pogradec area has had a positive effect with regard to the organic matter and phosphorous concentration trends as well as with regard to the bacterial contamination of water. According to observations some improvement in the water quality in the adjacent part of the lake is evident.

According to some information phosphorous is transported via the karstic underground connection from the Prespa watershed.

Inappropriate disposal of solid wastes and non-compliance of the existing landfills to modern standards in both sides of the basin is another threat for surface and ground water.

There is some preliminary evidence in Lake Ohrid with regard to hazardous substance pollution. In The Former Yugoslav Republic of Macedonia pesticides used by farmers in the watershed may threaten fish in the lake; traces have been found in the tissues of some fish collected. In addition, there have been inflows of toxic wastes from industrial facilities in the area of Ohrid. Economic reasons have forced the closure of many industrial plants in the past two decades thus sources of pollution have been *de facto* greatly reduced. However, studies have indicated an elevated level of PCB in edible fish.

Mining activities at the Albanian shoreline have been sources of heavy metals pollution (e.g., chromium, copper, cobalt, nickel as well as iron, etc.). The impacts to the ecosystem had been considerable. According to publications, flora and fauna (especially some fish species) of the lake had been seriously affected in the adjacent to Guri i Kuq lake area. Sediments in the littoral zone in adjacent to the mines areas are substantially polluted, presenting a potential toxic risk for the aquatic life and, through the food chain, also to humans. The closing down of mines and the removal and disposal of the site tailings in Guri i Kuq addressed to a certain extent these important pollution sources. Depositions of residual material left in open pits in abandoned mines constitute still a pollution source; the initiation of operation of some illegal mines may be an issue in this regard. A potentially significant risk to living organisms is still present.

The main sources of pollution in the **Black Drin River** in The Former Yugoslav Republic of Macedonia are considered to be: domestic sewage and solid waste; agriculture; mining activities throughout the watershed. There is no adequate information available to the authors with regard to water quality; according to some data, nutrient levels appear to be low if compared to the other sub-basins of the extended Drin River basin. According to the Spatial Plan of The Former Yugoslav Republic of Macedonia (2004) Black Drin is among the watercourses of the country that shows “permanent deterioration of its quality”.

There is also no adequate information with regard to water quality in the part of the **Drin River** watershed extending to the Albanian side. The following are among the potential sources of pollution:

- Inappropriate disposal of solid waste throughout the watershed; deposits, including of hospital waste, are present on the river banks and lake shores in residential areas;
- Domestic sewage that is discharged untreated along the course of the river as well as in the artificial lakes;
- Waste from mining and industrial activities throughout the watershed and in particular in the Kukes region where mining industries are placed.

According to some publications concentrations of nitrates and DIN are rather high compared to the values observed in the Prespa and Ohrid Lakes. According to the Albanian Ministry of Environment the overall water quality in the Drin River is good.

Despite the fact that the **Lake Shkoder/Skadar** receives pollutant loads, the quality of water appears to be reasonably good, due to the high renewal rate of 2-2.5 times per year.

Inappropriate solid waste, wastewater management as well as inappropriate agricultural activities results in pollutants entering the Shkoder/Skadar Lake – **Buna/Bojana River** system. Ammonium, nitrates, phosphates and detergents have been above threshold values in the period 2006-2010 in several monitoring stations. Improvement of related infrastructure in Podgorica and construction of infrastructure in Cetinje is underway.

In the Montenegrin side, untreated or poorly treated municipal wastewater and diffuse pollution from the Zeta Plain pollute surface water and groundwater. Pollution reaches the lake through tributaries and springs. Increased concentrations of nutrients (phosphates and nitrates) are monitored in the Lake near the river mouths, in particular these of Crnojenica and Moraca Rivers; concentration peaks are observed during summer season. The karstic geology facilitates underground movement of pollutants. The highest concentrations of nitrates in the period 1998-2005 were recorded -apart from Vranjina that is influenced by Moraca River- in Podhum that is recharged in the Podgorica area. Furthermore, water polluted from waste and wastewater from Cetinje flows through the permeable rocks down to the spring of Obodska Pećina; the Crnojenica River originates from this karstic spring the -large- recharge area of which includes also Cetinje.

In the Albanian part the pollution contributed is due to absence of wastewater treatment, insufficient solid waste management and agricultural runoff. Sewage from the Skhodra city is collected into a pool and then pumped into the Drin River at a short distance before its confluence with Buna/Bojana. Occasional failures of the sewerage system lead to spills posing a threat to the quality of the Lake. The discharged wastewater affects the Buna/Bojana River all the way down to its delta and in periods of high waters in Drin and floods, the Lake.

Bacterial pollution seems to be an issue of local importance during spring / summer in Moraca River downstream the Podgorica wastewater treatment plant; this is also true occasionally, during the summer period at the point that Moraca enters Shkoder/Skadar Lake.

The sources of toxic substances pollution lie mainly at the Montenegrin side:

- The Aluminum Plant in Podgorica (KAP: Kombinat Aluminijuma Podgorica), about 22 km from the Lake; pollutants associated with the operation of the plant include fluoride, phenols, SO_2, NO_x (emitted in the atmosphere), PCBs that had been stored under poor conditions, phenolic compounds, PAHs and mercury-containing wastes. Pollution by PCBs is currently regarded as of low concern due to the export in 2006 of accumulated waste reserves and the proper storage of newly generated PCBs since the privatization of the company in the end of 2005.
- The Steelworks Niksic that is located near one of the tributaries of the Zeta River (about 100 km from the Lake), is responsible for a range of pollutants, such as waste oils, heavy metals and toxic substances that reach the Zeta and Moraca rivers.

While hazardous substances (heavy metals, PAHs, PCBs, etc.) had been observed in the period prior to 2000 in the Lake Shkoder/Skadar, improvement of the water quality has been noticed in the last years. The pollutants that have reached the lake in the past seem to have been accumulated in the sediments. Moderate and, in few cases, high concentrations of heavy metals have been (monitored) identified at specific sites of the lake in the sediments. Concentrations of PAHs and PCBs in sediments were found to be higher at the entry points of the Moraca River than the pelagic zone, and exhibited a decreasing trend from 1993-1996 to 2005. Analysis done after 2005 showed that concentrations of PCBs and PAHs in water samples were below detection limit and that sediment from locations in the deepest areas in the lake was the most polluted. Nevertheless, according to other researchers that studied the lake in the period 2006-2009, a number of PAHs were present in the Lake Skadar/Shkoder water; for some compounds, concentrations were high. Traces of pollution from the Steelwork factory in Lake Shkoder/Skadar are minor. Trace metals were found to be relatively higher in the Albanian side of the Lake.

According to some stakeholders (information is not confirmed) Drin contributes, to some extent, trace metal pollution to the Buna/Bojana River from mining activities upstream.

Inadequate solid waste management is of particular importance and constitutes a serious pressure. While in the Albanian part there is an almost complete absence of waste management, the situation is slightly different in Montenegro where the core of the problem is that waste collection system covers mainly the urban population. Podgorica, Cetinje, Danilovgrad Bar and Ulcinj are served by an organized system of waste collection and disposal; sanitary landfills operate in all aforementioned towns. The rest of the wastes are dumped in a large number of uncontrolled disposal sites or even in the vicinity of watercourses that frequently wash litter into larger streams, the Lake and/ or the Buna/Bojana River and the sea, a situation exacerbated by floods.

Efforts to improve solid waste management in both countries, including construction of sanitary landfills, are ongoing.

There are insufficient data with regard to impacts due to pollution; nevertheless, the nature of pressures as well as their intensity in some cases, lead to the conclusion that water pollution is a threat to the ecosystem and potentially to the health of local population.

Compared to the Shkoder/Skadar Lake the nutrient levels in the Buna/Bojana River are elevated and reflect, most probably, the discharges of urban wastewater of the city of Shkodra as well as the nitrogen and phosphorus loads entering the system through agricultural runoff. Localized bacteriological contamination is also an issue. In periods of high waters in Drin and floods (see above "*Water Balance"*) the lake is affected as well.

- ***Other issues***

Unsustainable forestry management and deforestation

Illegal and abusive lodging -for commercial purposes as well as due to socioeconomic conditions- extensive collection of firewood, uncontrolled grazing coupled with poor forest management in Albania, has resulted in the deterioration of forests in most parts of the Drin Basin including the Ohrid sub-basin.

In Prespa it is estimated that 50% of the forests are significantly degraded and at about 10% of these can only be restored by extensive reforestation – in some cases the natural regeneration capacity of the forest has been lost. The declining trend of livestock is a positive development with regard to pressures related to grazing. The sub-sequent erosion has been a contributing factor for the destruction of the wetlands in Micro Prespa Lake. Nowadays, the remaining high forest habitats and undisturbed grassland in the Prespa National Park are very limited. Important habitats of several animal species (e.g. *Lynx lynx, Rupicapra rupicapra*) have been fragmented and degraded.

In Lake Ohrid sub-basin habitat fragmentation and loss constitute a threat to mammals, some of which are either threatened with extinction or are classified as vulnerable.

In the Black Drin, damages are more severe in the Lura National Park and Luzni-Bullaci Reserve. Habitat fragmentation and loss is an issue across the drainage basin.

The Diber, Kukes, Puke and Malesia e Madhe Regions in the Drin watershed host the largest areas of forest in Albania; their role in water balance and prevention of erosion is crucial. The aforementioned reasons of degradation, coupled with poor management practices (forests have been managed with a view to production of timber and firewood with only limited attention to ecosystem management) have led to direct impacts on biodiversity depending in woodland habitats and increased erosion. Socio-economic reasons lead to over-harvesting of rare medicinal plants.

In the Lake Shkoder/Skadar Basin on the Montenegrin side, in addition to reckless logging, frequent seasonal fires contribute to deforestation.

Alterations in land use also affect directly forests. For instance in Buna/Bojana the natural forests along the seashore are threatened or already damaged by constructions.

In The Former Yugoslav Republic of Macedonia forests have been managed more successfully; nevertheless, this has been done with a view to resource production, timber and firewood. Ecosystem values and watershed management considerations are not incorporated as major management objectives; there are on-going efforts to alter this approach e.g. in the Galicica Park in the Prespa sub-basin. The alteration of the structure of the forest ecosystem through the monoculture reforestation in the watershed of the Macro Prespa Lake has caused the simplification of the forest species composition and degraded forest habitats e.g. has caused the loss of nesting trees for globally threatened species such as the imperial eagle. In Ohrid and the Black Drin cutting is regulated and reforestation is practiced; there has been some concern with regard to the species used in this regard. Reforestation has significantly reduced erosion; nevertheless, there are still areas that require attention, especially in the Sateska watershed (see above “Sediment Balance”).

Unsustainable fishing practices and introduction of alien species

Further to the water regime disturbances and water pollution mentioned above that lead to degradation of shoreline habitats and habitat alterations, there are additional pressures that result in the decline of the native fish stocks as well as in the decline of biodiversity in the extended Drin watershed. The following factors are valid for all countries of focus; the significance of each one may vary among different areas in the Basin and the different countries: lack or inadequate regulation and/or enforcement with regard to over-fishing, inappropriate means of fishing (inappropriate nets), poaching during spawning periods, introduction of non-native or exotic species.

In **Lake Macro Prespa** the aforementioned pressures have led to the decline of native fish stocks, changes in the structure of fish populations and species composition, loss of biodiversity while there is a risk of potential loss of revenue for fishermen. It should be taken into account that in Albania fishing is exercised by a part of the population to complement its income or for house consumption. The statistics on fish numbers and catches are limited in the Prespa Basin as a whole. A key conclusion of a detailed study on fish stocks in the basin (in the framework of the UNDP-GEF Prespa project) is that while the overall fish biomass may be constant (or even increasing) commercial fish stocks, in particular carp and bleak, are under threat due to over-fishing. As an outcome of all three littoral countries having experimented with restocking native species and fish farming, nine (9) non-native fish species have been “introduced” to the Lake. The number of alien species mentioned during the National Consultation Meeting in Ohrid (2

November 2010) was twelve (12) against eleven (11) endemic species. The latter represent approximately 70% of the fish stock in the lake.

In **Lake Ohrid** the native fish populations are also under pressure. Overfishing seems to be the major cause of the decline of commercial species such as the carp, bleak, belvica (*Salmo ohridana*) and in particular the endemic Ohrid trout (*Salmo letnica*). With regard to the latter, it is believed that conservation measures in the The Former Yugoslav Republic of Macedonian side are more efficient and that pressures exerted in the Albanian side has an impact at transboundary level; nevertheless, the ban on the fishing of trout currently in force in The Former Yugoslav Republic of Macedonia seems not to be always respected. There is no such ban on the Albanian side. There have been at least seven (7) exotic fish species introduced during the last decades. One of these, the golden trout (*Oncorhynchus mykkis aquabonita*) represents a threat to the Ohrid trout. Fishing regulations in the two countries are not compatible.

In Albania in the **Drin River**, non-discriminatory and destructive fishing methods are being used exerting major pressures to fish stocks and the ecosystem.

Fisheries in the hydrological system including the water reservoir of **Vau Dejes on Drin, the Buna/Bojana River, tributaries of both rivers, Lake Shkoder/Skadar and the marine area from the Buna/Bojana outlet until the town of Velipoja in Albania** are subject to the total of the pressures mentioned above; in addition non-discriminatory and destructive fishing methods include the use of explosives, high voltage electrical shock and poisons. The outcome is a considerable decline of fish stocks and reduction in the number of fish species; some non-commercial fish species are also under threat.

In the case of **Buna/Bojana River** and **Lake Shkoder/Skadar** additional pressures include: destruction of reproduction sites; potential toxic contamination and; manmade barriers (nets) for fishing purposes along the migration routes to the Adriatic Sea. With regard to the latter, placing barriers along the Buna/Bojana River hinders the migration of anadromous and katadromous fish species and the reproduction of several species of Shkoder/Skadar Lake. Furthermore, overfishing at the mouth of the lake threatens the existing fish population.

The commercially valuable fish populations in Lake Shkoder/Skadar have declined in favor of less valuable species and there has been also a significant decline on migratory fish in the overall production; there have been significant shifts in the composition of fish catches from early 60’s till today.

The introduction of non-native fish had negative impacts to the populations of the native fish species, such as cyprinids, and especially the wild carp (*Cyprinus carpio*). About 1/3 of the species and subspecies of the lake are alocthone.

Growing populations in littoral and coastal settlements as well as growing tourism contribute to additional pressure on the fresh water and marine biodiversity. Lack of coordination between the two littoral countries exacerbates the situation; as the borders on the Lake are not clearly marked, there are cases that Albanian fishermen perform their activities on the Montenegrin side and vice versa. Cooperation on scientific research should also be strengthened to make it possible to better assess the fish populations in the lake, especially the most important commercial species, such as the eel, bleak and carp.

Urbanization and unsustainable tourism

Urbanization due to socioeconomic reasons and unsustainable tourism, exert pressures in areas such as the immediate littoral zone of the water bodies and the coastal area. The resulting land occupancy -due to construction- lead to soil sealing hence amplification of runoff processes into the lakes. Insufficient sanitation infrastructure, wastewater collection systems and treatment plants, exacerbate the pressures. The same is true for tourism related infrastructures such as hotels and weekend houses. Furthermore, tourism leads to a periodically increased need for wastewater treatment, waste disposal and water supply.

The outcome of the above is fragmentation and loss and/or modification of habitats, while biodiversity is directly and indirectly, threatened.

Furthermore, in all countries of focus the urbanization development as well as tourism activities concentrate close to environmentally sensitive areas or biodiversity hotspots.

Characteristic examples of areas exposed to related pressures are:

- The littoral zone of Ohrid Lake, in particular close to Ohrid and Struga cities in The Former Yugoslav Republic of Macedonia where the number of permanent residents and weekend houses, hotels, campsites, resorts, tourist and sport facilities are increasing rapidly. Pristine coastal areas, which are highly sensitive and of great importance for local endemic species, are increasingly under pressure. Coastal habitats and reed belts have been destroyed; macrophyte communities have been altered and new associations have developed in some locations; fish spawning grounds in these regions may convert from salmonid into cyprinid spawning grounds (Kostoski et al., 2010 and references therein). In the Albanian part around Pogradec and Tushemisht village the reed zones have been severely affected by uncontrolled development.
- The Kukes city in the Drin basin in Albania, where mass movement of population from rural areas and growing demands for new constructions are reported; currently, there are 0.2 km^2 of illegal constructions.
- The littoral zone of Shkoder/Skadar Lake. In the Montenegrin part there are illegal constructions even within the National Park borders. In the Albanian side 32% of the population in the area lives in illegal settlements.
- The coastal zone of Buna/Bojana which is perhaps the most affected area in this regard. In Montenegro the Velika Plaza beach, in spite of its proclamation as a Natural Monument, is degraded due to illegal building, excavation of sand and hunting. Intensive construction of buildings in the hinterland of Velika Plaza, without the appropriate infrastructure, lead to waste water pollution. In Albania, in Velipoja, immigration has led in an increase of constructions -including many illegal- at the expense of the pine forest; the forest area has been significantly reduced (presently about 0,19 km^2 remain). Uncontrolled tourism development poses a risk to the biodiversity in the area, for instance, the system of sand dunes in the coastal areas at the Buna/Bojana mouth in Albania is under threat.
- Unauthorized recreational activities take place at several protected areas of the extended Drin River basin, even at the zones of strict protection and pose significant threats to the biota. For example in Ohrid Lake there is pressure exerted at the ecosystem from boat traffic; at the Velika Plaza beach in Montenegro, off-road vehicles running on beaches and building of trails to reach remote parts of the dune landscape have been recorded. Sand dunes are also under pressure in the Velika Plaza in Montenegro due to unsustainable tourism practices.

Hunting

Unsustainable legal as well as illegal hunting is an issue for the entire ecosystem of the Lake Shkoder/Skadar and the Buna/Bojana River and delta. There are violations with regard to the:
- Protection status of certain areas i.e. hunting ban areas, such as the Ulcinj salina that is a site of outmost importance for migrating species;
- Species allowed to hunt e.g. hunting of rare and endangered breeding birds like the oyestercatcher during the breeding season in the Buna/Bojana sub-basin, the pygmy cormorant, the common redshank, the avocet etc.;
- Hunting ban period.

The long hunting season established in Montenegro should be noted among the issues of concern.

Furthermore, the insufficient control or even lack of control in some cases attracts foreigners to hunt in the area creating a phenomenon of "illegal hunting tourism". "Tourist hunters" have been reported to hunt, even endangered species, also during the breeding season and/or within protected areas; in particular in the salinas of the Buna/Bojana delta and Lake Sasko.

As a consequence the bird populations –including endangered species - and mammals have been decimated and the suitability of the Buna/Bojana delta for breeding of migrating birds has been impaired. The exact impacts cannot be assessed since data on the status of several fauna groups are limited due to the absence of a regular and coordinated monitoring at national and transboundary levels.

Sand and gravel extraction

As already mentioned, sand and gravel extraction is a matter of environmental concern throughout the extended Drin River Basin. In addition to the direct impact to the benthic communities there are also indirect effects to biodiversity; these are due to the altered water flow and sediment distribution patterns (which furthermore favors erosion).

Climate variability

Climate variability seems to be linked to the water balance and flow patterns of the Drin River in the last decades. There are already some related evidences. In **Prespa basin**, native species of trout living in the river ecosystems is reported to have changed the geographical boundaries of its habitat in Greece and Albania as it have moved higher in colder waters. In The Former Yugoslav Republic of Macedonia, parts of a Brajcino River dry-up during summer months, affecting the migration for reproduction of the endemic trout and Prespa barbell.

Should scenarios indicating that climate variability/change will affect the SEE be proven to be true there will be several effects:
- Riverine flood risk will generally increase, amplifying the threats to the riparian habitats in Albania (MEA, 2009).
- In Lake Ohrid, (Matzinger et al., 2007), increase of temperature is expected to reduce vertical mixing of the water column increasing the density difference between the surface and deep layers resulting in a decrease of dissolved oxygen in the deep water. Under the scenario of predicted atmospheric warming of 0.04°C per year, current anthropogenic phosphorus load

would have to be reduced by at least 50% to maintain sufficient oxygen conditions for the fauna at the bottom of the lake.

- The coastal area of the Buna/Bojana delta will be affected by sea-level rise; it is projected that about 1 km^2 of wetland area will be lost by 2100. The coastal floodplain is expected to increase, while the coastal forestland and the low, unvegetated wetlands are likely to decrease. Likely enlargement of lagoons is expected to increase their capacity to host migratory birds and change the composition of bird population. Changes in aquatic flora and fauna species in favor of species more tolerant to higher temperatures and salinities are likely to occur (MEA, 2009).

Under climate change scenarios, the composition of the forests in the **Drin Basin** is expected to change: evergreen species and oak forests are expected to enlarge, while areas of beech forests, which are more important to produce wood, would reduce. Common spruce forest is expected to disappear, while the alpine pasture on high mountains is expected to reduce more than ten times by 2100. Furthermore, the horizontal and vertical distribution of plant and animal species will change, as migrations to higher elevations are likely to occur, affecting the relict plant and animal species.

4.2 The Challenges (Drivers)

- **Insufficient management of the sub-basins at the national level**

Action at national level is an imperative for the establishment of integrated water and natural resources management in the Drin Basin and its sub-Basins. Available information suggests that some steps are taken, for principles of sustainability and environmental concerns to be integrated in the overall development policies in the countries concerned. Such principles are increasingly included in legislative and planning documents and some mechanisms for integrating the environment into other policies, are set mainly at strategic document level. The adoption of the Intersectoral Strategy of Environment in Albania is an instrument in this regard.

Nevertheless, these steps have not yet been translated in all cases in practice and natural resources management remains unsustainable. Although there are related legal provisions, actual management is not practiced yet at the level of catchments areas or geographical/reference areas defined using characteristics such as ecological integrity. Sectoral management still prevails.

The reasons are manifold. The existing legal frameworks and the non integrated management instruments have been proven until now weak tools for addressing the relevant difficult challenges. Sectoral organization of governments and the fragmented responsibilities among not well coordinated institutions with limited human and financial capacities have further exacerbated the situation; the low awareness in business and society in general, and weaknesses in prosecution and the judiciary, add to the picture. Furthermore, commitment to and understanding of sustainability requirements vary among different institutions. The difficult conditions of the past e.g. political instability, long transition period of the countries towards a market based economy, limited social cohesion etc. as well as the current difficult economic conditions, need also to be taken into account.

Legal frameworks

Although the progress in the drafting of new legislation in accordance, mainly, with the EU *acquis communautaire* is considerable, the new laws do not transpose all related obligations. Considerable and sustained efforts will have to be made to fully align their policies and legislation with the environmental *acquis*, and especially to implement and enforce it.

In some cases even new laws lack fundamental elements such as definitions -compliant with EC requirements- precise rights and obligations for legal and natural persons, setting of standards to be achieved and thresholds to be complied with and they fall short to determine procedural stages. As an example in The Former Yugoslav Republic of Macedonia only some management responsibilities are specified by the Law on Nature Protection; detailed precise responsibilities as well as authority, and accountability of managing bodies are not clear. The result is a variety of inconsistent and largely ineffective arrangements, ranging from total neglect, to either partial management or management by multiple agencies with different interests and differentiated strategies and/or plans. There are related examples in the other two countries as well. Many of the new horizontal laws are framework laws. These require a number of specific and detailed subsidiary laws and regulations in order to make them applicable and enforceable in practice. Some steps regarding the preparation and adoption of secondary legislation have been made.

In **Albania**, horizontal legislation is still weakly aligned with the EU acquis. The EU WFD has not been transposed yet although preparations for the related law started some years ago. The related draft by-laws have already been prepared. While efforts on adopting new legislation are being made, implementation and enforcement of already transposed legislation is falling behind. According to the 2010 EC Progress Report, this is the case for the nature protection legislation.

According to the 2009 and 2010 Reports of the EC for **The Former Yugoslav Republic of Macedonia**, progress has been made towards further transposing the EU *acquis* in the field of the environment, especially in the areas of horizontal legislation and waste management. Nevertheless, some sectors like water management and Integrated Pollution Prevention Permit (IPPC) are still lagging behind. The new Water Law transposes the EU WFD. Steps have been taken - there is a major on-going effort for the adoption of secondary legislation. However, there is still a lot to be done towards the implementation of the Law and furthermore the achievement of integrated water resources management. Its implementation remains limited, especially in areas that require major investment.

Alignment with the EU *acquis* has been accelerated in **Montenegro** during the last years but implementation in several fields, including environment, lags behind. The EIA and SEA Directives as well as the Wild Birds Directive and the Habitats Directive have been largely transposed; with regard to the first, secondary regulations have been introduced. The total transposition score regarding Urban Waste Water Treatment Directive increased to reach 62% within 2010; steps for its implementation have been made including the adoption of some secondary legislation as well as strategies. Alignment with the EU WFD and its daughter directives is in a relatively advanced stage (about 65% of all provisions) - the expected date of completion is end of 2016; a plan for the adoption of secondary legislation is in place. Nevertheless, no significant measures were taken since 2007 regarding the implementation of this Directive.

Institutional capacity

The overall administrative capacity of the institutional framework for river basin management is low despite the on-going reforms; the restructuring of the Ministry of Environment and Physical Planning in The Former Yugoslav Republic of Macedonia and the delegation of overall responsibilities regarding water resources management to it, the creation of a general directorate on waters within the Ministry of Environment (ME) in Albania, as well as restructuring of the Ministry of Environment and Spatial Planning into Ministry of Tourism and Environment and more recently into Ministry of Sustainable Development and Tourism (MSDT) in Montenegro are indicative.

Overlapping competences or even **lack of clear delegation and fragmentation of responsibilities** among different institutions and management agencies is often the case. **Ineffective communication and coordination** among the different Ministries and bodies is a major issue.

According to the 2010 EC progress report, the existing institutions in Albania are not fully operational and there are gaps and fragmentation of responsibilities, particularly in the waste and water sectors. There is a need for a more clear division of responsibilities between different administrative bodies as well as for enhancement of inter-institutional coordination.

According to EC, in Albania cooperation between the MEFWA and other ministries as well as governmental agencies needs to be improved. So is the coordination between the Ministry of Agriculture Forestry and Rural Development and the Ministry of the Sustainable Development and Tourism in the area of water resources management in Montenegro.

In The Former Yugoslav Republic of Macedonia, among positive developments is the adoption of a plan to strengthen the environmental management capacity at central and local levels for the period 2009-2014. Coordination between administrative bodies responsible for environment-related issues is not yet effective. Although the adoption of new laws and bylaws providing for greater integration of environmental management has contributed to partially overcome the fragmentation, there is still a need to streamline the management of responsibilities currently fragmented between different ministries and bodies. (EC Progress report 2010).

The situation gets more complicated while efforts are made for more **decentralization**. While in the long term decentralization is expected to assist in the enhancement of the level of management at the moment, the delegation of several competencies in relation to environment and natural resources management to local authorities have added to the institutional complexity; coordination with ministries need to be improved and so are capacities at local level.

A number of parameters constrain the ability of local authorities to assume responsibility for their competencies and address environmental and natural resources management issues. Limited financial resources and technical facilities, insufficient human resources and capacity are among them. Insufficient coordination among the ministries and the local authorities add to the picture.

Insufficient human, financial and technical resources to undertake the new competences in order for the new institutional settings to function in an effective way is also a challenge within the ministries in charge of environment and natural resources.

In Albania, environmental inspectorates lack adequate resources to carry out their duties. As an outcome, in general the use of surface and ground water remain in most cases difficult to be monitored and controlled. The Directorate of Environmental Protection within the MEFWA is seriously understaffed at least regarding the solid waste management. Insufficient human resources lead to minimal law enforcement in the field of fisheries. In the case of forestry this factor is coupled with, among others, the unclear status of forest personnel and low salaries of forest service field staff.

Lack of adequate personnel in The Former Yugoslav Republic of Macedonia with expertise to deal with related issues including monitoring of enforcement has an adverse effect on the implementation of the EIA as well as the SEA Directives, particularly at local level. The administrative capacity of the Sector for waters of the Directorate for Environment in the MEPP is very weak to deal with integrated water management, in terms of both organisational structure and number of qualified staff.

In Montenegro, both the MARD and the MSDT suffers from lack of staff. EPA is still seriously understaffed at the moment and this is one of the reasons resulting in the number of inspections carried out as well as the number of prosecutions for breaches of environmental law to remain limited. Inspection and control are weak in the field of fisheries and hunting.

Despite the continuous efforts, some with international support, to strengthen the administrative capacities competent authorities and bodies in the three countries need further capacity building.

Monitoring and research

A major concern is that the assessment of the state of the system in each of the countries is based on observations and "*ad hoc"* scientific evidence rather than on systematic and comprehensive scientific monitoring and research. The spatial and time scales as well as intensities of the pressures cannot be accurately assessed due to the lack of continuous physicochemical and biological monitoring. This is also true with regard to the overall effects on the environment and the ecosystems. This makes the designing of response measures difficult.

The aforementioned are attributed to several factors. In some cases, the scientific and research institutes responsible for the monitoring of the state of the environment, the collection and interpretation of physicochemical and biological data have undergone drastic restructurings due to the political changes of the recent past. Currently most of them suffer substantial financial shortcomings and their work is financed in large by donor countries and international organizations. In addition, availability and dissemination of information generated is an issue; institutes do not always share their data. Finally, the administration mechanisms to coordinate the various institutes, collect and integrate information so as to be used for decision making and reach out to the various sectors and stakeholders need improvement.

Overall

The environmental and natural resources administration and monitoring in particular in the water sector need to be significantly strengthened to implement the *acquis*. The overall workload involved is enormous. Reforms have started in the near past in an environment of transition, instability and limited resources. The previous conditions and the related human and technical capacities constitute an additional barrier. Nevertheless, while making this analysis someone has to keep in mind that even the European Union member states, although much ahead, are still struggling with similar issues.

- **Insufficient management of the sub-basins at the transboundary level**

Official cooperation for the management of most of the water bodies shared between the countries of focus has been initiated and is in different stages of development. Relevant Memoranda of Understanding and Agreements have been signed.

These rather encouraging developments reveal the existence of two key prerequisites for every cooperation activity in the field of shared water resources management: *Political will* of the governments and *trust* between riparian countries. These provide a basis for coordinated/cooperative and eventually joint management to be extended in the other sub-basins of the Drin basin and cover the whole system.

Nevertheless, the **current frameworks for the management of the sub-watersheds** of the Prespa, Ohrid, Drin, Shkoder and Buna need to be further strengthened, in addition to the national also at the transboundary level.