Lake Ohrid

Experience and Lessons Learned Brief

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1. Description of Lake Ohrid and Its Watershed

1.1 Introduction and Background

Lake Ohrid is an ancient lake, formed by tectonic forces 2-3 million years ago, in the Tertiary period. Because the lake is so old and is isolated by surrounding hills and mountains, a unique collection of plants and animals have evolved. These include a number of relict species, or "living fossils," and many endemic species, found only in Lake Ohrid (Stankovic 1960). For example, 10 of the 17 identified fish species of the Lake Ohrid are endemic, as are many of the lake's snails, worms, and sponges. The lakeshore reed beds and wetlands provide critical habitat for hundreds of thousands of wintering water birds, including rare and threatened species such as the Dalmatian pelican, ferruginous duck, spotted eagle, and imperial eagle.

People too have made the Lake Ohrid watershed their home for thousands of years. The ancient Illyrians maintained settlements in the Ohrid-Prespa region in the 4th and 5th centuries BC and in mediaeval times, the town of Ohrid was the cultural center of the former Yugoslav Republic of Macedonia. The Cyrillic alphabet was developed here and a thriving university, the oldest in Europe, educated over 3,500 students on the hilltop in Ohrid in the 9th and 10th centuries AD. Today the Ohrid watershed includes three countries—Albania, FYR Macedonia and Greece—and numerous cities, towns and villages.

Because of their high biodiversity and unique cultural heritage, Lake Ohrid and the Prespa Lakes (Figure 1) are lakes of tremendous local, regional, and international significance. They are also threatened by a variety of forces (Watzin et al. 2002). Since the end of World War II, there has been a rapid increase in the number of people living in the watershed. The population of the area now approaches 200,000 permanent residents. These numbers increase in the summer time as tens of thousands of tourists, both domestic and foreign, come into the region. In FYR Macedonia, Lake Ohrid is the number one domestic tourism destination. In Albania, it is the second most important domestic destination for recreation on lakes.

Population growth and development have impacted the lakes in many ways. These include intense fishing pressures, natural habitat destruction in the littoral zone, and the introduction of pollutants, especially phosphorus, into lake waters. The eutrophication that is resulting from this phosphorus threatens the character of the lakes, their unique biodiversity, and the crystal clear water that is Lake Ohrid's major tourist attraction.

In 1980, UNESCO declared the Macedonian side of Lake Ohrid as a "site of cultural and natural values of the global patrimony." In 1994, the World Bank, in cooperation with the Republics of Albania and FYR Macedonia, began preparation for a Global Environment Facility (GEF) grant to fund the incremental costs of a Lake Ohrid Conservation Project (LOCP). A Feasibility Study for the project was funded by Switzerland and carried out in 1995 (Erst Basler and Partners 1995).

On 20 November 1996, in Tirana, representatives of the governments of Albania and FYR Macedonia concluded a Memorandum of Understanding (MOU) concerning the Lake Ohrid Conservation Project. The MOU established a joint Lake Ohrid Management Board (LOMB) that was "responsible for the preparation of the regulations related to its activities" and authorized to approve projects "based on the previously prepared Feasibility Study." The Parties agreed to "coordinate and adopt laws and regulations necessary for the protection of Lake Ohrid with regard to pollution prevention, water use and fisheries management, etc.;" to follow appropriate international pollution prevention regulations and standards; to develop a long-term plan to establish separate monitoring facilities; and to strengthen and develop protection institutions. The Parties also agreed carry out the activities needed to implement the LOCP.

The LOCP is providing a total of US$1.84 million in funding to the Republic of Albania and US$2.26 million to FYR Macedonia. The objective of the LOCP is to conserve and protect the natural resources and biodiversity of Lake Ohrid by developing

and supporting effective cooperation between Albania and FYR Macedonia for the joint environmental management of the watershed. The project began in late 1998 and early 1999, with an expected duration of three years. Positive mid-term reviews later led to an extension to 31 December 2003. An additional extension to 31 December 2004 has been implemented.

Despite a variety of implementation problems, the LOCP has been remarkably successful in stimulating and facilitating transboundary communication between FYR Macedonia and Albania. New environmental laws and regulations are being developed and implemented in both nations. Water quality and biological monitoring programs are also underway in both nations. At the end of 2002, a comprehensive "State of the Environment Report," the first to combine Macedonian and Albanian data in a single analysis, was released (Watzin et al. 2002). Watershed Management Committees have been formed and have succeeded in creating comprehensive multi-stakeholder forums and in initiating pilot projects that have helped to develop a Strategic Action Plan for the Lake. Through activities such as Lake Ohrid Day (21 June) and many events sponsored through a growing network of environmental NGOs, public awareness is increasing. In its final year, the LOCP is laying the groundwork for a new era of environmental cooperation on Lake Ohrid.

1.2 The Watershed

Lake Ohrid has 87.5 km of shoreline and covers an area of 358.2 km². Although the average depth of the lake is 164 m, it has a maximum depth of 289 m. The watershed of Lake Ohrid includes steep mountains, as well as both Big and Small Prespa Lakes (Figure 1). The total area of the watershed is about 3,921 km². A little less than half of the water in Lake Ohrid comes from its tributaries. On the Macedonian side, the Sateska and Koselska Rivers are the largest contributors (Naumoski 2000). On the Albanian side, river flow is substantially less, but the Pogradec and Verdova Rivers are the largest contributors (Watzin et al. 2002). The remaining inflow comes from the springs that flow into the southern part of the lake, at St. Naum, Drilon and Tushemisht. These springs are fed by water flowing out of the porous karst mountains to the east, Galicica and Mali i Thate. Over thousands of years, holes and channels have formed within the mountain rock. These channels carry water that originates in the Prespa watershed to Lake Ohrid. Because Lake Prespa sits about 150 m above Lake Ohrid, its waters run "downhill" to Lake Ohrid through the channels in the karst.

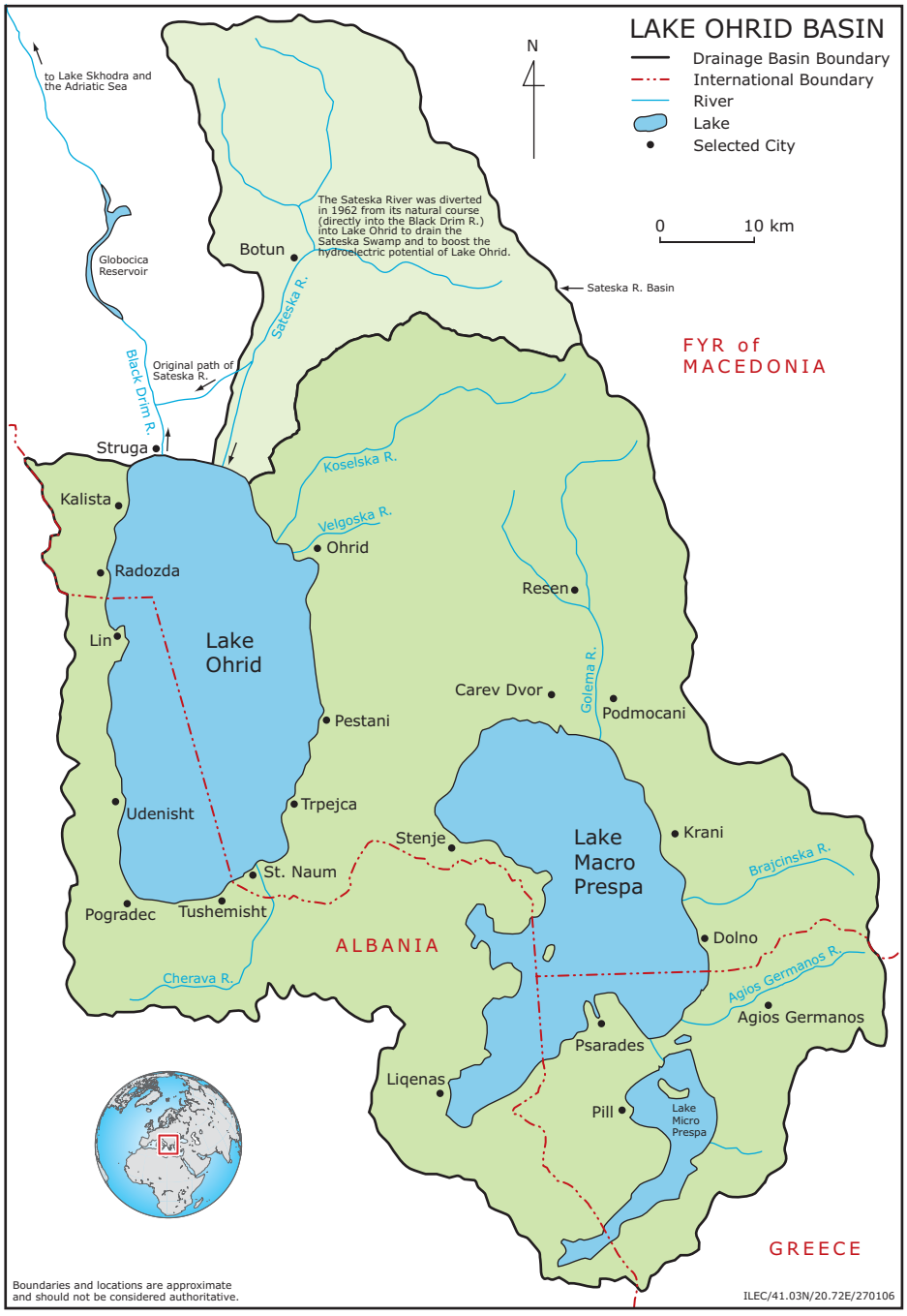

Figure 1. The Lake Ohrid Basin.

Big and Small Prespa Lakes are filled mostly by the rivers flowing into them. About every 11 years, all the water in Lake Prespa is replaced by new water. In contrast, it takes about 70 years for all the water in Lake Ohrid to be replaced (Watzin et al. 2002). Water flows out of Lake Ohrid near Struga, into the Black Drim River. This river eventually runs all the way to Lake Skhodra and the Adriatic Sea.

1.3 Socioeconomics of the Basin

There are about 106,000 residents in the Macedonian part of the watershed, about 61,000 residents in the Albanian part of the watershed, and about 25,600 residents in the Greek part of the watershed. This population is 5 or 6 times as large as it was at the end of World War II. Most residents live in several large towns—Ohrid, Struga, and Resen in FYR Macedonia and Pogradec in Albania—but there are also many small villages and communities scattered throughout the watershed in all three countries.

According to the World Bank (using IMF estimates), the GDP per capita in 2001 was US$1,196 in Albania and US$1,678 in FYR Macedonia. Internal figures in both countries show relatively steady upward growth in these figures over the last several years.

Employment statistics are kept differently in each country, but it is clear that unemployment and/or underemployment are high in both nations. In Albania, according to data compiled by the Albanian Institute of Statistics in 1998, between 28 and 46% of the working age population in the Ohrid basin is practically unemployed. In FYR Macedonia, employment data collected by the Macedonian Institute for Statistics for the working age population in 1994 suggested that more than half the population in the administrative units of Ohrid, Belcista, Kosel, Meseista, Resen, and Struga may be unemployed or underemployed (working in seasonal or other positions without benefits).

Pressures on the environment are greatest when socioeconomic conditions are difficult and unemployment rates are high. Yet effective water and other natural resource management is essential for both sustainable growth and poverty reduction. There are many causes for the socioeconomic problems in the region, but as the political transition continues, solving these problems is central to healthy communities and healthy environments.

1.4 Land Use in the Basin

There are 27,323 hectares in the watershed in Albania. Land use in this area is approximately as follows:

Arable land	2,500 ha
Pasture	1,367 ha
Forest	10,248 ha
Economic enterprises	1,396 ha
Built land (building, roads)	672 ha
Water	11,140 ha

Land use data on the Macedonian side are incomplete. According to the Macedonian Institute for Statistics and information provided by the forest enterprises, the land area in forest, pasture and agricultural uses in the six municipalities in the watershed are approximately as follows:

Arable land	53,303 ha
Pasture	27,319 ha
Forests	61,225 ha
Water (lakes only)	41,000 ha

In Albania, about 55% of the GDP comes from agriculture. Fruit (orchards and vineyards), wheat, corn and vegetables are the primary agricultural products. The pastureland in Albania is used for a variety of livestock, most importantly, sheep, goats, and cattle, as well as for harvesting valuable medical plants. There are about 100 species of plants that are gathered for medical uses.

In FYR Macedonia, only about 12% of the GDP comes from agriculture. About 60% of the arable land is used to grow wheat and corn, and about 25% is used for orchards and vineyards. The remainder is used for vegetables, tobacco, and other crops. The pastureland in FYR Macedonia is also used for a variety of livestock, including sheep, goats, and cattle.

Land use data were not available for the Greek portion of the watershed, but the agricultural activities in this part of the watershed include intensive cultivation and animal husbandry.

In Albania, the forest has experienced heavy damages from cutting and fires. Most of the cutting is for fuel wood although lumber is also produced. In the hills above Pogradec, chestnuts are harvested from the remaining forests. There is almost no reforestation after cutting, and erosion is a serious problem in much of the forest. The use of the forest for pasturing goats has also contributed to the erosion problem by overgrazing the understory vegetation.

The forests in FYR Macedonia are in generally better condition. Cutting is regulated and the land must be left in good condition for regeneration. The volume of timber harvest has varied significantly from year to year through the last decade, from as much 100,000 m^3 to as little as 30,000 m^3 (Macedonian Institute for Statistics 2001). About 130-300 ha are reforested each year, but unfortunately, much of this reforestation is with an exotic American pine because its growth rate is 4-7 times faster than the native species. Because of the reforestation requirements, erosion in Macedonian forests is not as great as in the Albanian portion of the watershed, but there are still bare areas that require attention, especially in the Sateska watershed.

Statistics about the extent and condition of the developed land surface are incomplete on both sides of the watershed. In other areas of the world, studies have shown that catchment areas that have greater than 7% impervious surface contribute the highest load of pollutants to surface waters, including

nutrients, petroleum products and a variety of trace metals and other contaminants that come from building materials. In the future, a more complete delineation of land use could be used to estimate the magnitude of this problem in the Lake Ohrid watershed.

1.5 Human Activities in the Basin—Stresses on the Ecosystem

1.5.1 Fertilizer and Pesticide Use on Farmland

The farmland in the basin is likely a significant source of pollution to the Prespa Lakes and Lake Ohrid as fertilizers, soil particles, and pesticides wash into rivers and streams and eventually to the lakes. Much of the farmland in the watershed is irrigated, which increases the load to the lake.

In Albania, about 1,500 ha of cultivated land are irrigated using water from both the Drilon River and Lake Ohrid. Most of the drained water discharged directly or indirectly into the lake. In FYR Macedonia, about 50% of the arable land can be irrigated. The extent of irrigation each year depends on weather conditions and on the economic conditions because the irrigation tax is high. The water used for irrigation comes from Lake Ohrid, Lake Prespa and the Koselska and Sateska Rivers.

In both Albania and Macedonia, fertilizer use is high, averaging 160-200 kg/ha/yr in the 1990s (Watzin et al. 2002). A variety of pesticides are also used, including copper sulfate, lindane, organophosphates, synthetic fungicides, and other chemicals. In 2001, 8,901 kg of pesticides were applied in the Pogradec district of Albania. In FYR Macedonia, agrochemicals are regulated, but many banned substances are readily obtained illegally and used within the country. Specific data on pesticide use are not available.

Around Big Prespa Lake, agriculture is a particular problem. In part because of intensive irrigation, the fields are widespread, the lake level is dropping, and the cultivated land extends right down to the edge of the lake.

1.5.2 Sewerage

In Albania, human waste and wastewater is currently not treated in the watershed. In Pogradec, the waste generated by about 30% of the town is collected but it is simply discharged into Lake Ohrid near Tushemisht. Because Pogradec has been growing, the volume of wastewater is also increasing. In 2001, the Pogradec Water Supply, Sewerage and Drainage Management Project was implemented to design and construct a sewerage system for the city. The German Government through the Kreditanstalt für Wiederaufbau (KfW) and the Swiss Government through Staatssekretariat für Wirtschaft (SECO) provided the necessary funds for the execution of the project. Project planning and final design is almost complete and construction was to begin in 2004. Construction should be completed in 2005 or 2006, and the system is currently to go on line in 2006.

In FYR Macedonia, the Regional Sewerage System for the Protection of Lake Ohrid collects wastewater from about 65% of the Ohrid-Struga region, and delivers it to the treatment plant Vranista. After treatment, the wastewater is discharged into the Black Drim River. The first phase of the plant, which has the capacity to treat the wastes produced by about 120,000 people, has been operating since June 1988. In 2001, a general development plan for the regional sewerage system through 2025 was made. In two additional construction phases, 44 km of sewer, which will treat most of the shoreline on the Macedonian side of the lake, will be added to the system. The German DfW is financing these extensions.

In the Lake Prespa region, only the town of Resen has a sewerage collection and treatment facility. The wastewater treatment plant Ezerani has the capacity to treat the wastes of about 12,000 residents and serves about 80% of the town.

1.5.3 Industry

Industry also contributes pollution to the lake in many forms. In Pogradec, the metal parts factories discharge wastes to the lake without treatment. To the northwest of Pogradec, there are a number of old mines that used to produce chromium, nickel, iron, and coal. Only one of these remains in operation, but at the mining sites, many large piles of waste material remain and are a source of pollutants to the lake each time it rains.

Industries in FYR Macedonia include automobile spare parts, electrical parts, and textile, ceramic and metal processing plants. All of these industries produce waste that may be contaminating the Sateska, Velgoska, Koselska, and Golema Rivers. Food processing plants that discharge waste such as apple pulp are a significant problem in the Prespa watershed.

1.5.4 Tourism

A healthy tourist industry requires hotels, restaurants, and other appropriate services for the tourists. Because the tourists come to experience the water, many of these developments are right along the shoreline. The tourists also produce wastes that must be treated and disposed of properly.

Both the Macedonian and Albanian shorelines are tourist destinations, and both have suffered from the political instability in the wider Balkan region since 1991. In the town of Ohrid, the number of foreign tourist overnight stays has been reduced up to 70%. As the political situation improves, Ohrid is uniquely positioned to appeal to the growing market in cultural tourism, with the many historic sites, monasteries, and other national treasures in the area. Lake Ohrid could also be promoted within the ecotourism market, but an essential prerequisite for this kind of tourism is a healthy and unpolluted environment, with clean water.

1.5.5 Solid Waste

Solid wastes can be a source of contamination to the lake if they are not disposed of properly. As this waste material breaks down, highly contaminated liquids can seep down into the underground water and adjacent streams and make its way

to the lake. None of the landfills in Albania or FYR Macedonia are lined or have drainage systems to collect and treat the contaminated waste.

1.6 The Ecology of Lake Ohrid

There are two unique communities of plants and animals in Lake Ohrid, the near shore, or littoral zone community, and the offshore, or pelagic community in the deep waters in the middle of the lake. Each of these communities is characterized by different groups of organisms.

In the littoral zone, rooted plants grow up from muddy and sandy bottoms and algae grow on the surface of the rocks and other hard surfaces. These plants often grow in distinct zones or belts along the shoreline. In the deeper water (5-15 m), algae and rooted aquatic plants can grow in large beds. Among the more common species are *Potamogeton spp*., *Chara spp*., *Ceratophyllum spp*., and *Myriophyllum spp*. Closer to shore, the reeds (*Phragmites australis*) appear and grow right up to the edge of the water. In many places, the colonial algae *Cladophora spp.* grows on most surfaces. The reed zone is an especially important habitat for many other organisms, including young fish, frogs, and water birds.

In areas of the shoreline that receive river input, runoff from agricultural land, or sewerage, the littoral zone community can be thick with aquatic plants. Those species that thrive with higher concentrations of phosphorus are choking out the other plants. *Cladophora* in particular thrives when runoff carries phosphorus into the lake in the summertime.

Many of the bottom-dwelling animals in Lake Ohrid are endemic. For example, Lake Ohrid is the only place where the rounded sponge *Ochridospongia rotunda* is found. Its closest relatives are in Lake Baikal, another ancient lake. More than 85% of the snails in Lake Ohrid are also endemic. Over the last 20-25 years, the community of small organisms has changed significantly in areas where human pollution has entered the lake. The implications of these changes for the fish and wildlife that feed on these organisms are not yet known.

Fishes in the shallow water include a variety of minnows, as well as fishes sought by anglers like bleak (*Alburnus alburnus alborella*) and carp (*Cyprinus carpio*). During spawning, many other fishes come into the littoral zone, including the Lake Ohrid trout (*Salmo letnica*). These fish are a link between the shallow water habitats and the deeper water.

In the pelagic community, the plankton form the base of the food web. Monitoring data collected over the last several years suggest that both the phytoplankton and zooplankton communities in Lake Ohrid are changing. New species more characteristic of nutrient enriched conditions have been discovered, and the species composition in locations close to river inputs and near the towns and villages is changing to one that is dominated by more eutrophic species. These changes reflect the changes in water quality in the lake, and underscore the need to control the pollution coming into the lake.

The fish in Lake Ohrid are an important part of the economy of both Albania and FYR Macedonia. There are six species that are regularly harvested by fishermen, including the famous Lake Ohrid trout (*Salmo letnica*), the smaller belvica (*Acantholingua (Salmothymus) ohridana*), the bleak (*Alburnus alburnus alborella*), carp (*Cyprinus carpio*), eel (*Anguilla anguilla*), and roach (*Rutilus rubilio ohridanus*). Over the last decade, between 200,000 and 300,000 kg of fish have been taken from the lake each year. Recent data suggest that this level of harvest may be more than the lake can sustain (Watzin et al. 2002). The numbers of fishes on the wintering grounds and returning to the spawning grounds each year are declining noticeably. In decades past, large schools of bleak wintered in Ohrid Bay and near Peshtani and Trpejca in the east and Radozda in the northwest. Today, bleak only winter near Trpejca and Radozda. The number of Lake Ohrid trout on the spawning grounds on the Macedonian side of the lake has also changed dramatically. The average size and number of the fish has decreased and the gender balance is changing.

The shoreline and watersheds of Lake Ohrid and Lake Prespa also provide critical habitat for a great variety of wildlife. These include frogs, turtles, and birds that are directly dependent on the lake, and many inland species that rely on the forests and plains. The coastal wetlands provide critical habitat for hundreds of thousands of wintering water birds, including rare and threatened species such as the Dalmatian pelican, ferruginous duck, spotted eagle, and imperial eagle.

1.7 A Chronology of Major Lake Management Issues and Activities

In both Albania and FYR Macedonia, the major management efforts have focused on designating protected areas. For example, in 1999, the Albanian government proclaimed the Albanian side of Lake Ohrid as a "Protected Aquatic and Soil Scenery" and established Prespa National Park for the rehabilitation and protection of critical ecosystems of the Prespa Lakes area. In December 2002, the Albanian Government established the Nature Monuments of Albania. Fourteen of these monuments are in the District of Pogradec.

In FYR Macedonia, there is a longer history. Pelister National Park was established in 1948 and Galicica National Park was established in 1958. In 1979/80, the Macedonian side of Lake Ohrid was identified as a mixed cultural/natural world heritage site by UNESCO's World Heritage Committee. The Bird Sanctuary Ezerani (a Ramsar site), on the north shore of Big Prespa Lake, was established in 1996 for the protection of migratory waterfowl and other waterbird species. In an international effort, the Prime Ministers of Albania, FYR Macedonia, and Greece issued a Declaration on 2 February 2000 announcing the creation of the "Prespa Park" as the first transboundary protected area in southeastern Europe.

In 1978, the first Law for Protection of Lakes Ohrid, Prespa and Dojran was passed in FYR Macedonia. The law was revised in 1993. This law regulates construction and prohibits the introduction of non-native species. It also controls water use and sand removal. Binational cooperation on Lake Ohrid began in 1996, when the Memorandum of Understanding establishing the Lake Ohrid Management Board was signed by Albania and FYR Macedonia. In 1998, the LOCP was initiated by the World Bank, providing a total of US$1.84 million in funding to Albania and US$2.26 million in funding to FYR Macedonia.

The LOCP seeks to provide a transboundary, comprehensive approach to the management of the Lake Ohrid watershed, combining restoration, conservation and protection of the lake with sustainable use of its natural resources. The project has four major components (Figure 2). Component A, the institutional strengthening component, focused on increasing the capacity of public officials at all levels in the Lake Ohrid watershed for effective enforcement of each country's environmental laws, regulations, standards and policies. Component B, the monitoring component, focused on establishing a comprehensive binational monitoring program to inform the public and local officials about the condition of the lake and to provide the environmental information necessary for effective and rational planning and decision-making. Component C, the participatory watershed management component, aimed to mobilize groups within the watershed to create a strategic action plan. Component D, the public awareness and participation component, aimed to create public awareness and increase community participation to enable the effective and sustainable implementation of the LOCP.

The LOCP is the first GEF project of its kind in Southeastern Europe. At a conference hosted by Greece, during its Presidency of the European Union, and the World Bank in Athens in May 2003, the LOCP was recognized as a successful model of bilateral management of transboundary resources in the region. In its "Athens Declaration," the conference recommended that future programs in the region use the lessons learned in the LOCP to help guide their projects, especially noting how joint activities at the local level had significantly strengthened the collaboration between the two countries (World Bank 2003).

2. Threats to Sustainable Use of the Lake

2.1 Eutrophication

One of the most serious threats to the sustainable use of Lake Ohrid and the Prespa Lakes comes from nutrient loading. Lake Ohrid and the Prespa Lakes are being fertilized by nutrients in detergents and human and animal waste, and by nutrients in runoff from the land. As a result, the lakes are becoming more eutrophic. Historically, Lake Ohrid was known as an "oligotrophic" or clear water lake. It is likely that Lake Ohrid may have "aged" by thousands of years in just the last few decades because the actions of people have greatly accelerated eutrophication.

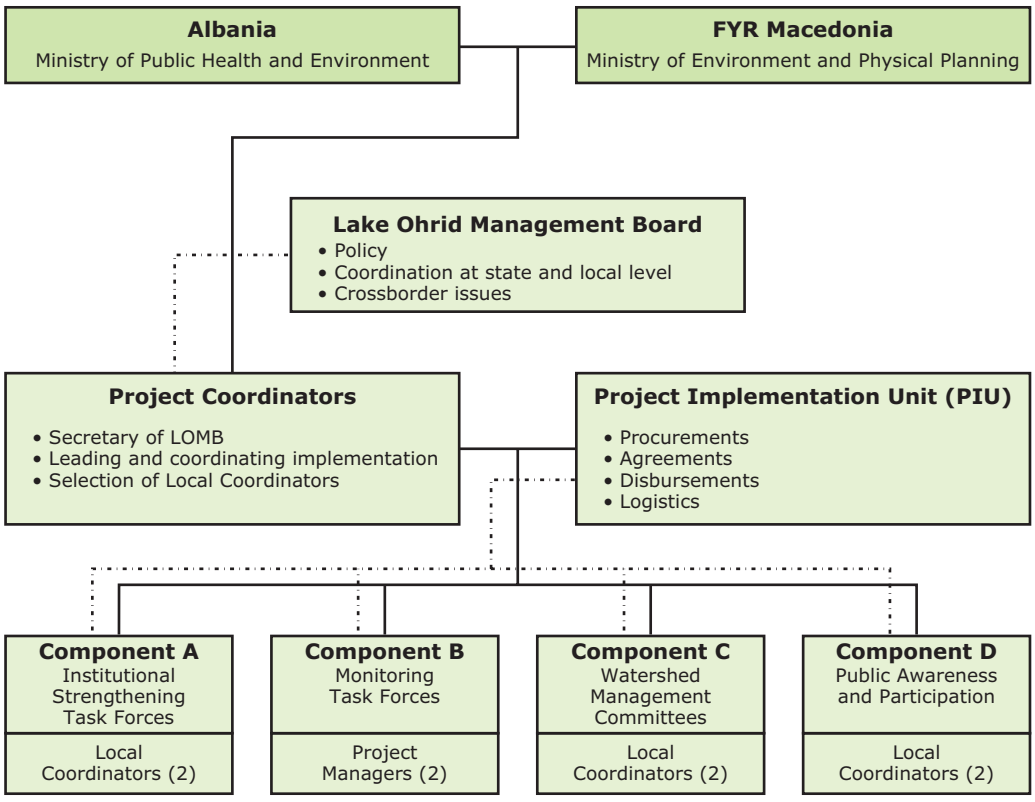

Figure 2. The Organization of the Lake Ohrid Conservation Project.

The Monitoring Component of the LOCP has been tracking the eutrophication rate in Lake Ohrid and Big Prespa Lake, starting by measuring the concentration of phosphorus in the lakes. The concentration of phosphorus in Big Prespa Lake shows that this lake is already eutrophic. The concentration of phosphorus in the middle of Lake Ohrid is still low enough for this lake to be considered "oligotrophic," but the amount has been increasing over time. The concentration now may be 3 or 4 times the concentration measured before World War II. Considering the very large volume of water in Lake Ohrid, this is a very significant change. If this trend is verified by additional monitoring, Lake Ohrid can be expected to change dramatically in the next few decades.

The water in the area around Pogradec represents the single largest source of phosphorus, as untreated sewage flows directly into the lake. The new sewerage system being developed for the Pogradec area will treat the wastewater of about 60% of the homes and businesses in the region. A possible extension after 2010 would add a second plant and would allow the treatment of all the wastewater produced in the Pogradec area.

The total phosphorus load delivered to the treatment plant from all sources when it opens in 2006 is estimated to be 166 kg P/day, or about 60.6 tons/year. The treatment plant has been designed to remove about 80% of the phosphorus that is delivered to it (about 48.5 tons), therefore, the annual load from these sources to Lake Ohrid after treatment would be reduced to 12.1 tons.

In 1999, representatives of the Macedonian and Albanian governments signed a joint statement endorsing the plans for the Pogradec wastewater treatment project. Although the Macedonian delegation would have preferred that the wastewater be pumped outside of the Ohrid basin, this option was not judged feasible in the first phase. The parties agreed that if the necessary improvements in the water quality of Lake Ohrid do not occur after the new system has come on line, then both parties will join their efforts to find additional funding for the construction of additional measures to take the waste outside the catchment area. The parties further agreed that the discharge of treated water shall comply with European Community discharge requirements for treated wastewater in sensitive water bodies (EU 91/271/EWG). These requirements specify a discharge concentration ‹2 mg/L, which is the current design specification.

Preliminary estimates of the total load of phosphorus to Lake Ohrid made in 1995 suggest that the lake's total load may be 3-5 times greater than it should be to keep Lake Ohrid in an oligotrophic state (Ernst Basler and Partners 1995), therefore, other sources of phosphorus loading will also require reduction to protect the lake. On the Albanian side of the lake, other important sources of phosphorus include the Cerava and Pogradec River basins, and Drilon Springs. On the Macedonian side, the Velgoska, Koselska, and Sateska Rivers and the springs at Saint Naum deliver the most phosphorus to Lake Ohrid. The load of phosphorus coming from the Sateska River may be about the same as that currently coming from the sewerage of Pogradec (Watzin et al. 2002).

The rivers in the Prespa basin, including Golema, Brajcinska, and Kranska, also carry very high phosphorus loads. Because of all the nutrient loading, the oxygen concentration in the Prespa lakes decreases dramatically in summer. The waters in much of the lakes are also green with phytoplankton in the summer. Submerged plants also grow thick in the nearshore zone. This situation will not change until the phosphorus inputs to the lakes are reduced substantially.

The near shore waters of Lake Ohrid adjacent to Pogradec and Tushemisht also show obvious phytoplankton and aquatic plant growth in the summer. In fact, in many near shore locations on both the Albanian and Macedonian sides of the lake, these plants have been responding to fertilization by phosphorus. In the last several years, both Albanian and Macedonian scientists have documented a shift in the composition of the plants to favor those species that grow well in more eutrophic conditions. Species that prefer oligotrophic conditions are becoming less abundant (Watzin et al. 2002). These changes provide further evidence that the Lake Ohrid ecosystem is changing and underscore the need to reduce the phosphorus inputs to the lake.

2.2 Bacterial Pollution

One of the biggest potential risks to human health for the communities living along Lake Ohrid is contamination with disease-causing bacteria and viruses that enter the lake in human sewage. In 1988, the first phase of the sewage collection and treatment system was completed along the shoreline in Ohrid Bay, FYR Macedonia. After this system began operating, there were dramatic improvements in the water quality in Ohrid Bay. The number of harmful bacteria in the water decreased one thousand fold. The water in Ohrid Bay is now generally safe for both drinking and swimming (Watzin et al. 2002). These improvements make a strong case for continuing to implement sewage treatment systems along the entire shoreline of the lake.

On the Albanian side of the lake, the highest level of bacterial pollution occurs near the town of Pogradec, where raw sewerage flows directly into the lake. Large numbers of harmful bacteria have been found up to 200 m from the shoreline. In the years 1996 to 2000, Albanian scientists found an increase in the abundance of harmful bacteria in Lake Ohrid waters close to shore. This is probably because the population has been increasing in Pogradec. This situation will not improve until the sewerage collection and treatment facility is constructed for the town. But once the system is completed, the improvement along the Pogradec shoreline should be rapid, mirroring the improvements found in Ohrid Bay in the late 1980s.

Away from the major towns, bacteria pollution is most commonly found where streams and rivers discharge into

the lake. These streams carry human waste and animal waste from the inland villages to the lake. All of these sources must be considered in order to keep Lake Ohrid waters clean for everyone's use and enjoyment.

2.3 Metal Pollution from Old Mining Sites

In addition to eutrophication, Lake Ohrid also shows metal pollution near the sites of the old chromium, iron, nickel and coal mines outside Pogradec. The preliminary samples that Albanian scientists have collected at the Guri i Kuq mine show concentrations of metals in the near shore lake water that are very high. It is likely that the muds and sands in these near shore locations are also contaminated, and this may pose a risk to the invertebrates, fish and birds living in this section of the lake. People who catch and eat fish in the area may also be at risk and it is possible that local drinking water sources have been contaminated. Long-term exposure to elevated levels of chromium, copper, cobalt, nickel, and other metals have been shown to have harmful effects on human health.

2.4 Zones of Pollution and Habitat Destruction along the Lake Shoreline

Because the littoral zone receives the direct impacts of the population living along the shoreline, it tends to be the most impacted environment in most lakes. Lake Ohrid is no exception to this pattern. The habitat destruction and water quality impairment is most severe in the littoral zone, especially in those areas adjacent to the population centers in both FYR Macedonia and Albania.

In Albania, the littoral zone adjacent to the town of Pogradec is heavily impacted. Impacts are also apparent to the northeast, to Tushemisht, and to the west and northwest to Lin. In the region around Pogradec, the nutrients and bacteria in the untreated sewage that is discharged directly into the lake compromise the water quality and threaten the health of all who use the water. The shoreline around Pogradec is also the prime area for tourism on the Albanian side of the lake, so the water pollution from sewerage has significant economic, as well as ecological impacts.

Evidence of the ecological impacts of human activities is apparent in both the aquatic plant community and the phytoplankton in the near shore waters. In the region of Pogradec, phytoplankton densities are much higher than elsewhere along the shoreline, and the submerged plant community has high densities of pollution tolerant taxa. In the mining area of Memelisht and Guri i Kuq, these plants show evidence of metal contamination and stunted growth.

The population in the Pogradec areas has been growing rapidly, and as this growth continues, the pressures on the lake will continue to increase. To accommodate this growth, and the economic development necessary to improve the quality of life in the region, aggressive management actions will be needed. A coordinated approach that manages urban growth, agricultural impacts, and industry must be developed.

In FYR Macedonia, problems in the littoral zone are evident in the regions of Struga, Ohrid, and the shoreline to the south to Saint Naum. Impacts are also apparent where the larger tributaries discharge into the lake, especially the Sateska, Velgoska, and Koselska Rivers. Where nutrient inputs are high, the growth of submerged plants is much greater. At the mouth of the Sateska River, sedimentation is filling in the littoral zone.

The plankton and benthic invertebrates also show altered communities in these developed littoral zone areas. Both the phytoplankton and the zooplankton species compositions are changing to ones dominated by mesotrophic and eutrophic taxa. These changes will have significant impacts for the rest of the biota in Lake Ohrid that depend on the plankton as food.

The shoreline of Lake Ohrid once contained long stretches of reeds, but it has been greatly altered by the human populations living around it. Historically, the reeds were used for many purposes. One of the best-known uses was for roofing material for houses. Despite the changes in lifestyle and the predominance of new materials and technology, the reeds continue to be used in a variety of ways in the modern era. They are also simply burned or cut away to provide better views and to provide beaches and easier recreational access to the lake. Around Lake Prespa, old land practices such as grazing, cutting and burning the reeds have also had impacts. In all these areas, sediment erosion and loss of wildlife are common.

Several laws passed between 1973 and 1996 now protect the reed zones on the Macedonian side of the lake, but there are no such laws on the Albanian side of the lake. Population growth and socioeconomic pressures are leading to continued destruction of the reeds, especially in the areas around Pogradec and Tushemisht village. The importance of these environments for both wildlife and human welfare is still not reflected in economic planning and decision-making.

2.5 Significant Declines in the Fish Catch from Lake Ohrid

It is very clear that the fisheries in Lake Ohrid are in immediate danger and rapid management action is required. All the data suggest that the trout populations are severely stressed and the bleak and carp populations are also threatened. Overfishing seems to be the major cause of the decline of the trout population. The socio-economic pressures that have led to overfishing have impacted the trout more than other fish stocks because of the greater demand and higher economic value of this fish.

Although the overall catch of trout has only declined slightly in the last several years, there has been a dramatic shift in the harvest. Beginning in 1992, the landings in Albania increased

dramatically, while those in FYR Macedonia began to fall (Figure 3). The differences in fishing pressures in the two countries are the results of differences in the social and political situation in each country and the fishing regulations in each country. While there have been limits on the catch in FYR Macedonia for the last decade through concessions and licenses granted by the government, in Albania, such limits have just begun with the establishment of the Association for Fishery Management in Pogradec in 2002.

In addition to harvest pressures and habitat loss, especially of the reed beds, the native fish of Lake Ohrid are also threatened by the introduction of non-native species into the lake. Rainbow trout represents a particular concern because it may displace the native trout. Although this fish was first introduced in the 1970s, the development of fish farms in the basin offer new potential threats.

There is also some preliminary evidence that the pesticides used by farmers in the watershed may threaten fish in the lake. These pesticides have been found in the tissues of fish collected from the lake. Not only are these pesticides harmful to the fish themselves, but they also pose hazards to the people who eat the fish, especially women of childbearing age and small children.

2.6 Altered Flow of the Sateska River

Before 1961, the Sateska River flowed into the Black Drim River, about 3 km beyond the latter's outflow from Lake Ohrid. In 1962, it was diverted to drain the Struga marshland, which is used for farming, and to make use of Lake Ohrid water for hydroelectric power generation. The diversion of the Sateska increased the size of the Lake Ohrid subwatershed by about 174%. It drained about 2,500 ha and regulated the course and slope of Black Drim River through the town of Struga and the agricultural area around the town. An overflow structure that controls the flow of water out of Lake Ohrid and into the Black Drim River was constructed in Struga, and water flows were controlled in order to develop the potential of the "Globocica" and "Spilje" electrical power generation stations in FYR Macedonia.

Currently, extraction of sand and gravel from the riverbed is uncontrolled. This extraction influences water flow and the sediment load, and the resulting erosion of riverbed is substantial. When the Sateska was diverted, antierosion measures intended to reduce sediment suspension in the river and the input of sediment to Lake Ohrid were put in place. These measures were initially effective, but they were later terminated. Since then, sediment has since accumulated in the constructed riverbed, the channel has degraded, and shoreline vegetation has been lost.

The suspended load into Lake Ohrid is large and a delta has formed the in the receiving waters. The load also includes a lot of organic material. Decomposition of this organic matter has reduced the dissolved oxygen concentrations in the receiving waters and changed the distribution of flora and fauna in this section of the lake.

In 1988, a study to investigate the impacts of sediment from the Sateska on Lake Ohrid, on the lowlands in the vicinity of Struga, on the Black Drim River channel, and on the power stations on the Black Drim River was undertaken by the Institute of Energetics in Skopje. This study looked at rediverting the Sateska River back into the Black Drim and the "Globocica" Reservoir. Implementation of the project would both improve the ecological health of the river and reduce the impacts on Lake Ohrid.

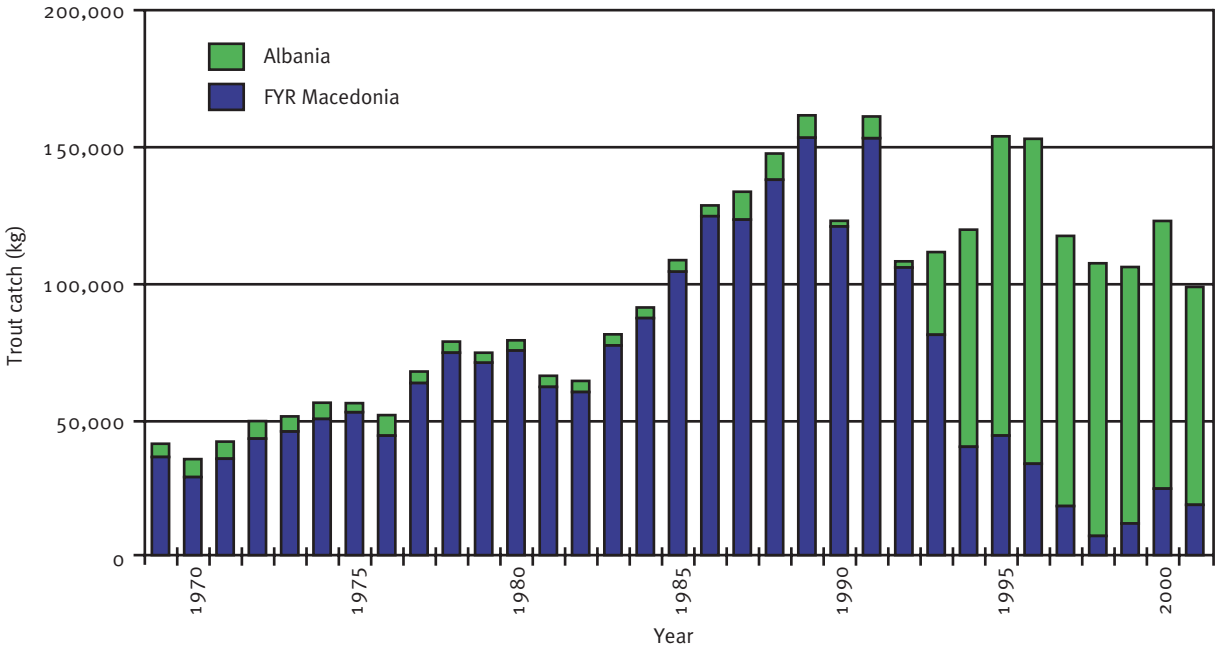

Figure 3. Annual Trout Catch by Country.

Based on this work, the Water Development Institute of FYR Macedonia has prepared a project proposal for restoration of the Sateska River. Although it is currently unclear as to when or if the full rediversion project might be implemented, some erosion control measures were implemented in the Sateska River bed in November 2002 as part of the LOCP. This reforestation is designed to stabilize the riverbanks and reduce the sedimentation rate in the middle reaches of the Sateska.

3. Policy, Legislative, and Institutional Reforms to Address These Threats

From the beginning, one of the principal goals of the LOCP was to establish an appropriate legal framework for better management of Lake Ohrid and its watershed. The Institutional Strengthening Task Force focused its activities on assessing what legal and institutional reforms were needed and on mobilizing stakeholder support for these reforms. Both the government of Albania and FYR Macedonia recognized the extraordinary opportunity that the LOCP provided for integrating their separate legal and institutional approaches with international agreements that would strengthen transboundary cooperation.

In 2000, a preliminary draft "Agreement for the Protection and Sustainable Development of Lake Ohrid and its Watershed" was developed and both Ministries began working to present a mutually acceptable refined version for adoption by their respective Governments. The intent of this agreement is to acknowledge very explicitly that Lake Ohrid and its watershed constitutes a single ecosystem and thus must be managed jointly by all the jurisdictions in the watershed. The draft agreement calls for international management through a "Lake Ohrid Management Agency" that would cover the whole watershed area, including, in the future, Greece, as a full partner in the management regime. This draft Agreement is now in final review in the Ministries in Albania and FYR Macedonia and should move forward into the bilateral policy dialogue soon.

Environmental regulation and enforcement are currently weak in both Albania and FYR Macedonia. Within each country, a variety of legislative reforms have helped decentralize the environmental enforcement functions and given limited authority to the local governments. Although the LOCP has initiated a number of environmental enforcement actions over the last few years, there is general agreement that additional measures are needed. These might include updating regulations, educating the public about key legal provisions and the appropriate enforcement agents in their areas (including judges, administrators, educators, NGOs, and others), and establishing clear and enforceable requirements for environmental reporting, the right of access to environmental information, and an effective sanctioning process to deter or punish violators.

Both countries are also drafting and/or implementing new Environmental Impact Assessment legislation that will create the infrastructure for more systematic enforcement of environmental legislation. In January 2003, the Albania Government adopted its new Law on Environmental Impact Assessment. This law aims to provide: a) a general, integrated and timely assessment of environmental impacts from proposed projects or other activities in order to prevent or mitigate the negative impacts on the environment; and b) a process of open assessment, managed with equitability, through participation of central and local authorities, the public, NGOs, and representative of the project. Plans for energy, mining, industrial, transportation, agricultural, forestry, waste management, and other natural resources projects are subject to the EIA process. Decisions based on the EIA will be made by the Ministry of the Environment.

Both countries need land use planning initiatives urgently. These are the only tools that will help stem the tide of inappropriate development and the destruction of natural habitats and nonpoint source pollution that can result from that development. Unguided development can also threaten other goals, such as designation as a UNESCO World Heritage site of significance. In Albania, an international consultant recently submitted a legal analysis and draft "Law on the Preparation of a Land Use Plan for the Lake Ohrid Watershed Region." Both the report and the draft law will be submitted to the appropriate Ministries for comments. On 17 May 2003, the Territory Adjustment Council of the Municipality of Pogradec adopted Terms of Reference for preparation of a new Urban Plan for the Central Area of the town of Pogradec. This plan will include 55 ha, more than 50% of the total area of the town.

Because the increasing eutrophication of Lake Ohrid is a major management concern and water current mix nutrients across the international borders, negotiations and commitment concerning the loadings reductions needed to protect the water quality of Lake Ohrid are needed to mitigate this threat. These negotiations have not yet begun. Likewise, for Lake Prespa, negotiations about not only pollutant loads, but also water withdrawals are urgently needed to protect this lake.

Coordinated fisheries regulations are urgently needed to deal with the decline in the fisheries of Lake Ohrid. Controls on the number and size of fish must be implemented and coordinated on both sides of the lake. Because the fish in the lake are one single, linked population, they must be managed collectively, with similar requirements in both FYR Macedonia and Albania. Government officials and fisheries experts in both countries have agreed to a unification of some of the fisheries regulation; in 2001, both countries agreed to keep the same allowable net size.

In FYR Macedonia, the fishing industry is managed through five-year concessions granted by the government to fishing companies. A company that is granted a concession must restock the lake through an approved plan and must pay 10% of the wholesale value of the catch to the government for the purposes of improving the fishing conditions on the lake.

Fishing inspectors in the Ministry of Agriculture, Forestry, and Water Works enforce the fishing regulations.

In Albania, the fishing industry is in the process of being organized into fishing associations by village. An Association has been formed in Pogradec, and others will be formed in Lin, Hudenischt and Tushemischt. The regulations that will govern these associations are still being developed. In 2002, the Ministry of Agriculture and Food gave permits through the Association for Fishery Management in Pogradec to only 137 boats.

To set appropriate fishery limits, stock estimates based upon a jointly conducted, independent sampling effort must be prepared. Discussions about how to conduct this stock assessment are underway. It must include an evaluation of the spawning population and as well as the forage base available to support the trout population. With this information a sustainable level of harvest might be estimated and the harvest regulations in both Albania and FYR Macedonia can be harmonized to ensure that these levels are achieved. Vigorous enforcement of the appropriate regulations will also be necessary.

Both countries have pursued implementation of appropriate international environmental conventions, which bring international credibility, and support the core objectives of the LOCP. Albania is a party to the UNECE Convention on the Protection and Use of Transboundary Watercourses and International Lakes and the UNECE Convention on Transboundary Accidents. Both Albania and FYR Macedonia are signatories to the Stockholm Convention on Persistent Organic Pollutants. The Macedonian side of Lake Ohrid has been designated as a mixed cultural/natural world heritage site by UNESCO's World Heritage Committee, and FYR Macedonia is working to preserve this designation. Albania is hoping to add old town Pogradec to this designation.

Although Albania signed the Aarhus Convention on Access to Information, Public Participation in Decision-making, and Access to Justice in Environmental Matters in 1998, and ratified it in 2000, FYR Macedonia has not yet done the same. Both countries are still struggling with public access to information and public input, but as new laws are implemented, hopefully this situation will improve. The new Law on Environmental Impact Assessment in Albania has specific provisions that emphasize public and NGO participation in all steps of the environmental impact assessment process, including decision-making.

Both Albania and FYR Macedonia are working towards future admission into the European Union (EU). In Albania, new environmental legislation has been prepared based on the EU Directives. For example, the new Albanian Law on Air Protection from Pollution has been based the emission standards in the EU Directives for new industrial activities. A new draft law on Environmental Management of Urban Wastewater is being prepared, and the discharge limits for the new sewage treatment plant in Pogradec were specified based on the EU Standards for Sensitive Waters. In FYR Macedonia, a review of the capacities of the Ministry of the Environment and Planning are underway to meet EU requirements. A draft version of a new Law on Waters, which has been prepared based on the EU Water Framework Directive, is under review. According to this draft law, all waters in FYR Macedonia will be managed on a watershed or river basin level. Also, changes in the Law on Air and the Law on Nature provide a basis for qualitative management of these natural resources.

4. Lessons Learned

A transboundary resource needs an international board or agency to establish priorities, facilitate cross-boarder communication, and coordinate an integrated action plan. From the beginning, the LOCP has served as a vehicle to bring officials from the governments of Albania and FYR Macedonia together, and it continues to do so. Before the LOCP was initiated, a MOU was signed to bring the governments together in a Management Board focused on the lake. However, as the project has unfolded, it has become clear that the current membership and authority of the Management Board is insufficient. The Board needs to be expanded, peopled with high-level representatives of all major stakeholders on the lake, including Greece, and empowered with specific authorities. The representatives of both the Ministries and the municipalities must be able to participate in Board meetings and the activities of the LOCP on a regular basis in order to understand the complexity of the issues on the lake to make the difficult decisions that must be made.

The draft "Joint Agreement for the Protection and Sustainable Develop of Lake Ohrid and Its Watershed" would be a major step forward by establishing an international Lake Ohrid Management Agency and empowering it with legal authority in Albania, FYR Macedonia, and in the future, Greece, as a full partner in the management regime.

To be effective, a management program needs a long-term vision and a comprehensive management plan with specific goals and objectives. This plan must be prepared with the input and concurrence of all the major stakeholders in the basin so that all parties recognize where they have roles and responsibilities. The Joint Watershed Committee of the LOCP has developed a "Transboundary Watershed Action Plan" that outlines some of the actions needed and the roles of the stakeholders at both the national and local levels. This Action Plan was endorsed by the Lake Ohrid Management Board in October 2003.

The Action Plan stresses working in partnership, using an ecosystem-based, watershed approach that integrates environmental and economic goals, pollution prevention, a consensus-based, collaborative approach to management, and flexibility. The four primary action items include:

- Reduction of point source pollution through actions that stress septic system management and maintenance, homeowner education, and management of solid waste;

- Reduction of non-point source pollution through actions that focus on implementing conservation practices on farms and restoring impaired stream reaches;

- Habitat protection and restoration through wetlands inventory and the establishment of a no-net-loss policy, identification and protection of fish spawning habitat, and inventories of the native flora and fauna in the watershed; and,

- Comprehensive planning through the establishment of micro-watershed planning committees, and by creating a GIS system and building the planning capabilities within the municipalities.

Implementation of the plan will begin in 2004.

Stakeholder involvement and public participation are key to effective action. The LOCP has been highly effective in raising public awareness about the ecology of the lake and some of the threats to sustainable use. In the critical first years of the project, considerable effort went into increasing the number and capability of citizen groups in the basin. Workshops were held to build the capacity of the NGOs, focusing on organization skills, meeting facilitation skills, public outreach and involvement, and other topics. "Green Centers" were established in Struga and Ohrid in FYR Macedonia and Pogradec in Albania. The Centers serve as clearinghouses to connect the NGOs to each other and to provide the critical information they need to mobilize public interest and public action. As a result of this effort, the number of NGOs on the Albanian side has increased from 13 to 19, and on the Macedonian side, from 19 to 42.

Early in the program, the LOMB declared 21 June as "Lake Ohrid Day." Beginning in 2000, a variety of activities to raise public awareness and to clean up the lake have been held, and thousands of citizens have been involved.

Build local capacity and use local groups for implementing watershed management projects. To bring local groups together and involve them in implementation of the LOCP, Watershed Management Committees were established in both Albania and FYR Macedonia to develop a series of pilot projects and catalytic measures designed to test and demonstrate affordable and cost-effective measures for improving the environmental conditions in the watershed. Because the LOCP was the first of its kind in the Balkan region, there was little or no experience in watershed management in the region. This was initially a challenge, requiring repeated consultation and cultivation, but also an opportunity for new groups to learn from each other and to grow as they learned about each others perspectives of the problems, how their communities contributed to the problems, and their sense of values, priorities, and potential contributions to solutions (Avramovski 2002).

With the financial support of the Lake Ohrid Project, the NGOs in both FYR Macedonia and Albania have carried out a variety of activities including summer eco-camps, education in the schools, clean-ups along the shoreline of Lake Ohrid, reforestation on tributary streams in the watershed, the production and distribution of public education materials, hosting round table discussions and workshops, and marking hiking trails in Galicica National Park in FYR Macedonia. In Albania, 51 grants were made. In FYR Macedonia, 49 grants were made. Nine projects involved participating NGOs from both Albania and FYR Macedonia, but no projects included Greece.

Several larger scale pilot projects have been planned by the Watershed Management Committees, but implementation has been slow because of administrative challenges. In Albania, a video "Ohrid, Pearl of the Centuries" was produced and distributed, but other projects focused on reducing pollution from nonpoint sources, improving solid waste management and disposal, and promoting the use of phosphate free detergents have not yet been implemented. In FYR Macedonia, projects to reduce the use of agro-chemicals, establish a nursery to produce local tree seedlings for riparian reforestation, and other pollution reduction projects are also awaiting implementation.

Ultimately, the success of the LOCP hinges on the involvement of all the citizens of the basin. While the grants to NGOs publicized the NGO sector, they were only moderately successful in involving a wider cross section of the public in their activities. Since the last grant session within the LOCP has ended, there has been a decrease in NGO activities in the region. If appropriate ongoing support is provided, the momentum and interest that has been established will carry into future efforts. In large part, it is the actions of these citizens that will determine the future state of the environment.

Administrative training and capacity building to meet World Bank, GEF, Ministry and other administrative requirements is critical as early as possible in the project. The administration of the LOCP was established through Project Implementation Units in both Albania and FYR Macedonia. Project Directors were hired to coordinate the administration of all four components of the project. Progress in the early years of the LOCP was slowed because these administrators were not familiar with World Bank, GEF, and other administrative policies and requirements. Because these officials had to work both within their respective Ministries and within the frameworks established by the World Bank, many challenges were encountered.

A required early, intensive training program for project administrators could be established that would greatly reduce these problems and help to get new projects and project

directors off to a stronger start. If possible, a consistent responsible party with the Ministry would also greatly reduce implementation problems within each country.

Research and monitoring is essential to assess baseline conditions in the ecosystem and provide the information necessary to guide decision-makers. From the beginning, the monitoring program was considered essential to provide a scientific basis for guiding the work of other project components. For a transboundary resource, only joint monitoring makes sense because both jurisdictions must trust the data and agree on its interpretation. This was recognized immediately in the LOCP and Monitoring Task Forces were established in both FYR Macedonia and Albania to develop such a joint program. As a result, a joint sampling plan was prepared and endorsed by both sides in the first year of the project.

There were significant delays in collecting data, however, because infrastructure improvements were needed in both countries. In FYR Macedonia, the Hydrobiological Institute was already located on the lake, in Ohrid, but infrastructure improvements and equipment purchases were urgently needed to support the new work. In Albania, there was no on-lake laboratory, so one had to be established in Pogradec. First, a suitable building was located, and then laboratories for chemical, physical, and biological analysis were established. In both FYR Macedonia and Albania, these laboratory improvement efforts proved challenging and there were significant delays in developing specifications and acquiring the necessary equipment. In both cases, an early emphasis on capacity-building and training for the scientists would help surmount these problems in future projects.

It is essential that a research and monitoring program established to support management provides the data needed by policy-makers to make key decisions. In order to do this, the lead scientists collecting the data must communicate regularly with the managers. This communication has been challenging in the LOCP. In the early years of the project, data were not interpreted and presented to the managers in ways that were easy for them to understand. To solve this problem, considerable time and attention were directed to preparing a "State of the Environment" report in 2002, including hiring an outside expert to facilitate communication between the Macedonian and Albanian teams and to focus the analysis on key management concerns. This effort culminated in the publication of "Lake Ohrid and its Watershed: A State of the Environment Report" in October 2002. This report represents the first time that Albanian and Macedonian data were used in a common assessment of the ecological conditions in the basin. Forty-nine Albanian and Macedonian scientists and other specialists contributed to this report and through its preparation, got to know each other and learned to work together more effectively. This kind of collaboration is essential for the ecosystem-level assessments needed for comprehensive management of a large watershed and lake system. As the project was moving into its final year, plans were underway to restructure the monitoring program so that it could become part of the state monitoring effort in each country and that it is sustainable over the long term.

As the Lake Ohrid Management Board is reorganized into an International Management Agency, the Ministries should consider adding a scientist to the Agency that can communicate effectively with managers. The goals of the monitoring project should be refined to focus on the data needed to answer critical management questions, and funding must be sufficient to ensure that high quality data that can withstand legal review are being collected. This is not a trivial task when trends detection is required. An ecological indicators program could also be developed to track management effectiveness.

An ongoing mechanism should be established to publish monitoring and research results, both in the technical literature (to build the credibility of the program) and in the popular or layperson's press. Public understanding of their unique resource builds pride and is key to mobilizing support for protection and management. Likewise, managers must understand the magnitude and causes of environmental problems in order to address them and eventually solve them.

Use early successes to draw new investments. Seek a broad base of support and funding, capitalizing on a transboundary awareness and constituency. To build sustainability, a broadly based and strategic program of investments and commitments must be developed so that funding levels are stable from year to year. Potential investors need to see successes; therefore, a program that is constructed in discrete pieces, each with achievable short term as well as long term goals, will be most successful. These pieces must include administrative, institutional and technical components. Funders must see a strong political will, institutional capacity, and real results among the population and in the environment.

In the LOCP, administrative challenges have been great, and institutional capacity building has been slow to come. However, a number of small on-the-ground efforts to improve environmental awareness and public participation have been very successful. Larger demonstration projects have struggled, but a baseline state of the environment report can now inform some of the critical choices that must be made. There has been a shift in emphasis to the long term, and there is a clear focus on implementing the newly completed watershed action plan.

As transboundary communication and collaboration improves, a whole basin, ecosystem understanding that spans the political boundaries of the three countries may develop. The development of such a transboundary public, where all citizens recognize their connections and work as a single constituency, will ignite investments at all levels for a sustainable long term program.

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