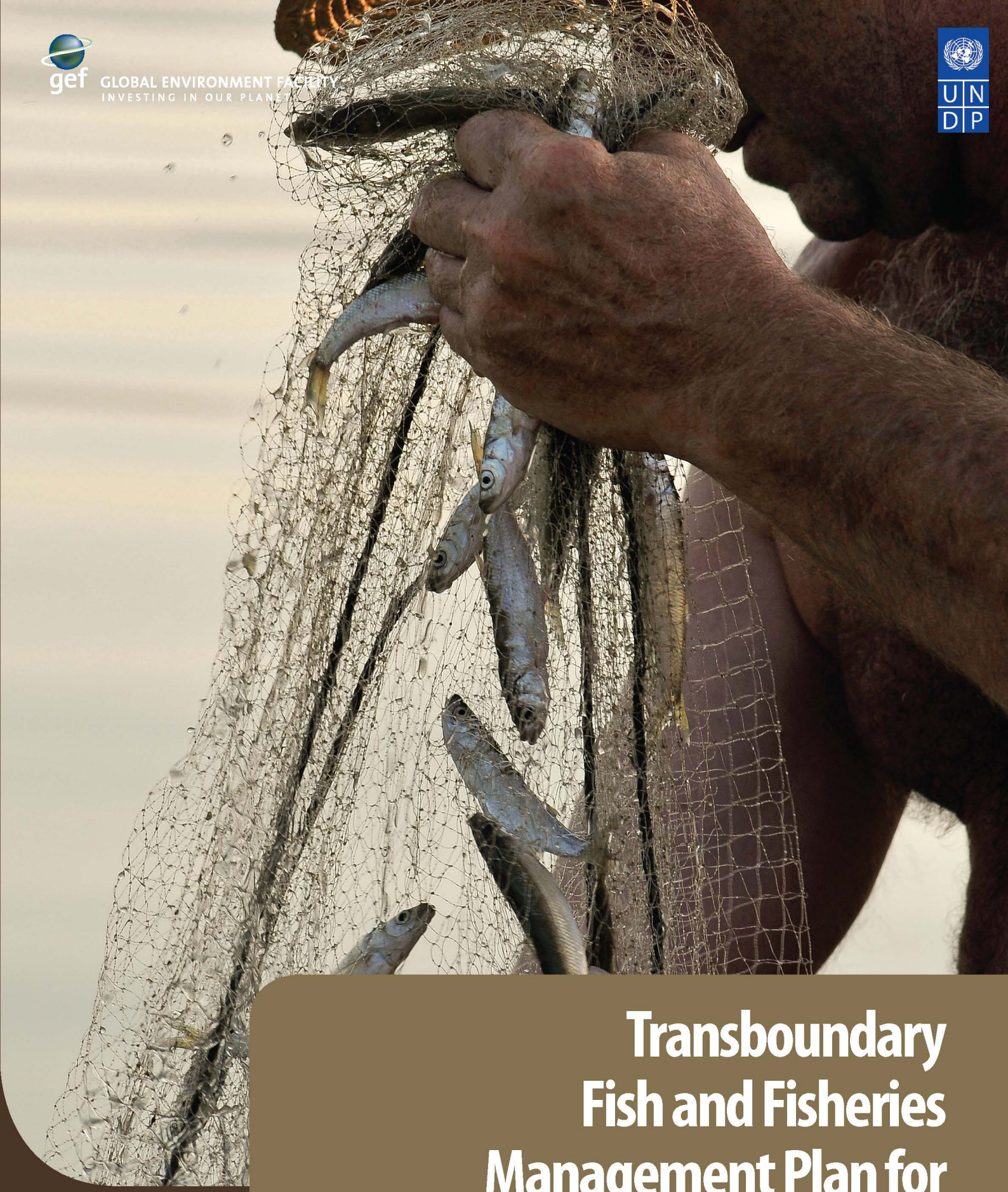

Transboundary Fish and Fisheries Management Plan for the Prespa Lakes Basin

Integrated Ecosystem Management in the Prespa Lake Basin

	Team members and areas of expertise	Name
1.	Team Leader	**Zoran Spirkovski**
2.	Ichthyology and applied fisheries sciences	**Ekerem Kapedani** Arian Palluqi Trajce Talevski Dusica Ilik-Boeva Zoran Spirkovski Vasil Kostov
3.	Fish Ecology	**Trajce Talevski** Dusica Ilik-Boeva Zoran Spirkovski Vasil Kostov Arian Palluqi
4.	Fish and Fisheries Management Planning	**Paul Farrow** Zoran Spirkovski Dusica Ilik-Boeva Arian Palluqi
5.	Socio – economic aspects of fisheries and livelihoods	**Dusica Ilik-Boeva** Trajce Talevski Zoran Spirkovski Ekerem Kapedani
6.	Veterinary Medicine	**Stojmir Stojanoski** Elvira Beli
7.	Environmental Chemistry	**Elizabeta Veljanoska - Sarafiloska** Zoran Spirkovski Trajce Talevski Dusica Ilik-Boeva
8.	Zooplankton	**Goce Kostoski**

Note:

This document is prepared for revision and comments which the whole team will appreciate for the final completion

2. EXECUTIVE SUMMARY

The Trasnsboundary Fish and Fisheries Management of the Prespa Lakes Basin (TFFMPLB) is developed within the GEF/UNDP Integrated ecosystem management in the Prespa Lakes Basin of Albania, FYR Macedonia and Greece.

It is a first attempt to regulate the fish stock on trilateral basis in the Prespa Lakes Basin in one relevant document. It is fully relaying on Ecosystem Based Approach to Fishery (EBAF) comprising the FAO Code of Responsible Fishery (CRF).

According to the UN FAO (Fisheries Technical Paper 477), the 'Ecosystem Approach to Fisheries Management' requires us to: manage fisheries to limit their impact on the ecosystem; maintain ecological relationships among species across legal and social jurisdictions and use the 'precautionary approach' with governance ensuring both human and ecosystem well-being and equity. Achieving all this requires a good understanding of freshwater ecosystems so that objectively justifiable fisheries management goals can be set for ecological stewardship. Much of this understanding is presently lacking, especially in relation to community and spatial interactions. It is now recognized that commercial fishing may affect the functioning and structure (e.g. productivity and biodiversity) of a freshwater system.

From other hand, the DIRECTIVE 2006/44/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 6 September 2006 on the quality of fresh waters needing protection or improvement in order to support fish life clearly determines the needs of integrated Watershed and Fishery management.

Hence, for the preparation of the TFFMPLB various techniques were implemented: review of the existing legislatives (plans, statutes, rules, regulations etc.) from the three countries; previous and recent research, monitoring and surveillances; involving various stakeholders – direct and indirect related to fishery; open opinion survey among the people and institutions in the basin; conducting of a limited fish stock assessment (in the lakes and the tributaries); fish health check (parasites, heavy metals and pesticides in the fish tissues); various impacts on the fish and fishery (including fish eating birds); habitat conditions; fishery statistics. These things were obtained through intensive field work and laboratory analysis.

The unique set of the fish populations inhabiting this basin together with unique specifications of the Prespa Lakes Basin urges with no doubt to more severe measures in maintaining the freshwater biodiversity.

Nineteen species of fish are present in the Prespa Lakes at the current time. Eleven of these are indigenous, while the remaining eight are alien species that have been introduced. (Five other alien species were recorded in the second half of the twentieth century but these are no longer found amongst the fish fauna of the lakes.)

There is a fishery statistics for Prespa Lakes regarding fish species dated from 1946 for the Macedonian part of the Lake, from 1954 for the Albanian part of the Lakes and from 1973 for the Greek side of the Lake.

The spawning season for most of the present fish species in the lakes is within the period April – June, with exception of the trout which spawns in the rivers from November – March. Another exception is the alien species *Lepomis gibbosus* (pumpkin seed) which spawns twice in the year – spring and autumn.

Species distribution – native species prevalence during the beginning of the summer period and prevalence of alien species during the end of the summer period which are related to the natural spawning grounds and presence of the species in the littoral area has been recorded.

Prespa trout is the tributary inhabitant present in four streams of Macro Prespa Basin : Agios Germanos (Greek part), Brajcinska, Kranska and Golema Reka (Macedonian part). In the Albanian part of Macro Prespa there are no perennial streams, and therefore no trout populations. All populations in the separated river basins are isolated from each other.

The presence of 6 parasite species is recorded for the first time in the fish parasite fauna from the Lake Prespa and Macedonia: *Dactylogyrus sp.* (in *Alburnus belvica*), *Gyrodactylus sp.* (*in Salmo peristericus*), *Diplozoon sp.* (in *Squalius prespensis*), *Diplozoon sp.* (in *Chondrostoma prespense*), *Diplostomum sp.* (larvae) (in *Rutilus prespensis*), *Diplostomum sp.* (larvae) (in *Alburnus belvica*) and *Tylodelphis clavata*.

The intermediate hosts (representatives of plankton and bottom fauna) are missing – some of them specific for this Lake. Presence of fish-eating birds is in such number that causes damages to the fish health, entire ecosystem and further eutrophication and habitat loss.

From other side the value of the relative infestation of most of the fish species as in presence of different parasite species and as well of their number on individual fish shows high fish population density.

Pollutants – heavy metals and organoclorine pesticides were registered in the fish tissues of different fish species.

Fisheries have existed on the two Prespa Lakes since ancient time. It is recognized as artisan fishery. At present fishing is allowed on the Greek and Albanian parts of the Lakes, while on the Macedonian side there is still total ban, but in March 2012 a tendering procedure for concession of the fish is opened.

The price of fish is relatively low and move from a minimum of 0.5 €/kg for bleak up to 3.5 €/kg for carp, confirmed by many sources. Normally the annual income from the fishing products is between 2500 – 3000 € per family. These means that fishery contributes to a mean of 900-1000 US$ income/year per capita. However as we mentioned before, the fishermen are also farmers which mean that they combine the income from the fishery with other modest incomes coming from, farming of cows, sheep, poultry etc.

The increased maximum values of physiological groups of bacteria, as well as high average maximum number of heterotrophic bacteria indicates increased saturation of the water in this ecosystem with organic substances which becomes mineral with the activity of bacteria. This manifestation is more expressed due to the decrease of the water level in this ecosystem whose capacity was decreasing until 2009.

According to the OECD fixed limit system of classification, Prespa Lake is in mesotrophic condition (in the period 2001 - 2011), whereas in accordance with the classification of Nurnberg (1996), which refers to the summer period, Prespa Lake is in eutrophic condition in the summer 2008 which is a worrying information. All stated parameters indicate to the fact that Prespa Lake is in process of eutrophication.

The composition of the plankton community dominated by populations of Cladocera (small crustaceans commonly called water fleas) indicates that during the summer period in the lake are present intensive processes of mineralization.

The zooplankton is favorite food for many fish species, especially for young fishes. From the development of these small shrimps to a large extent affects on the natural diet of these fish.

Fish harvesting during spawning season and harvesting beyond the sustainable levels has resulted in reduction of populations of both native and endemic species.

The changes of the fishery ecology in the lake have altered the entire biological community and possibly trophic structure of the lake ecosystem. Besides the direct impacts to the Prespa fisheries, there are many other indirect impacts which are primarily related to the detrimental effects caused by the economic activities in the Prespa Lake basin.

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The main anthropogenic factor influencing Prespa Lakes is the agricultural development and in particular the abstraction of water, application of fertilizers, and enhanced soil erosion.

At Prespa Lakes the cormorant diet mainly consists Prespa bleak (*Alburnus belvica*) with more than 99%. Other fish species present in their diet are carp (*Cyprinus carpio*), Prespa roach (*Rutilus prespensis*) and some of the minnows.

No transboundary fisheries management is likely to be effective unless it is based upon clear legal obligations and agreements that set out the rights and duties of the parties in a manner which accords with the international legal framework for fisheries management, and provides effective and efficient legal procedures and mechanisms for implementing these rules consistently

At present only ameliorative fishing of the “sunfish” (Lepomis gibosus) is foreseen which is recognized like a “fish pest”. Also, as this fish appears as a “by catch” and the fishermen are mainly returning back in the lake (where it survives again 90%), measures for financial compensation for it if brought on the landing sites should be introduced. In that way the reduction of its population will have greater effect.

From the freshwater lakes fishery management point the Prespa Lakes are one of the unique ones shared among three neighboring countries, thus just few models of transboundary fish and fisheries managements can be adopt and applied with the necessarily adjustments.

The Management Plan is organised into 4 key, mid-term objectives (i) a programme and supporting actions to strengthen the administrative structures, (ii) a programme to strengthen the organisational structures, (iii) actions supporting the operational activities, (iv) enhancing information and public awareness.

The Management Plan is intended to be implemented over a 5 year period from 2012-2016. For this reason only short-term (i.e. 1-2 years) and medium-term priorities (3-5 years) have been selected. This refers to the *starting* time frame and *not* the overall period for completion of the project proposals. Additional measures will be identified during the second half of the project period and based upon the results of the monitoring and evaluation phase.

No matter how difficult the decision-making will be, there is no getting away from the fact that the critical problem areas for the Lake Prespa Basin will have costs, especially for setting up the administrative and organisational structures, regular joint meetings, research-based activities and public dissemination of information. Such funds are limiting for any State. However, it should be remembered that these are important investments and must be made at some stage, if he States are to develop the transboundary fisheries management objectives and to meet the EU Regulations and international environmental standards.

3. BACKGROUND

The transboundary Prespa Lake basin, situated in the Balkan Peninsula, is considered to be an ecosystem of global significance and has been identified as one of Europe's major trans-boundary "ecological bricks". The entire Prespa Region hosts unique habitats and species that are important from both European and global conservation perspective.

However, the region's ecosystem has been facing serious environmental setbacks over the past decades as a result of the combined influence of both natural and anthropogenic factors. The unsustainable agricultural, ***fisheries***, water and forest management practices are causing stresses on the ecosystem health of the Prespa Basin.

The globally recognized natural values of the region, and the prolonged degradation processes were the main reasons motivating a coordinated transboundary action. The three states joined forces and launched comprehensive and intensive conservation programs to preserve the diminishing values of the ecosystem.

There are a few important documents governing the transboundary cooperation in the integrated management of the Prespa Lakes ecosystem, such as the 'Declaration for the Protection and Sustainable Development of the Prespa Lakes and their Surrounding (2000)', 'The Strategic Action Plan for the Sustainable Development of the Prespa Region (2002), the UNDP/GEF Prespa project (2006), the recently signed international 'Agreement on the Protection and Sustainable Development of the Prespa Park Area (2010), and others.

All these documents, projects and plans address, to a different extent, address the issue of transboundary fish and fisheries management. It's been recognized by the stakeholders that a well coordinated, transboundary fish and fisheries management in the Prespa basin is of critical importance to the long-term maintenance of the valuable ichthyofauna of the lakes and the tributaries.

The region's ichthyofauna is a globally significant element of the basin's biological diversity. Currently, there are nineteen species of fish in the Prespa lakes. Out of them,eleven are indigenous, eight are alien. (In the second half of the 20th century, there were five additional alien species that were recorded, but they can no longer be found in the lakes).

Various country reports address the reduction of population of endemic and native fish species over the past decades, generally attributed to the following underlying causes: a) uncoordinated fish and fisheries management practices amongst the three states; b) degradation of the basin's aquatic resources (accelerated eutrophication, and changes in the natural fish spawning grounds) ; c) fish harvests exceeding sustainable levels; d) harvesting of fish during spawning seasons (illegal fishing – poaching) and; e) inter-specific competition from exotic species, f) insufficient physical protection and etc.

Establishing a common transboundary fish and fisheries management system is clearly one of the key objectives of the overall integrated ecosystem management efforts in the Prespa Lakes basin.

The transboundary cooperation in the fisheries management is not completely new to the three co-basin states: There is an early example of a fisheries (sub)–commission for the waters shared by Albania and former Yugoslavia; there is also a network (a "Trilateral Fisheries Meeting") of mainly local level fisheries stakeholders, which mainly met to discuss closed fishing seasons for the Prespa Lakes from 2001-2007.

Lately, similar transboundary cooperation initiatives were taken to ensure direct involvement of all relevant stakeholders in the design of a process for strengthening the transboundary fish and fisheries management under the UNDP/GEF Prespa project. The ultimate objective of this process is to harmonize the fish and fisheries management practices and regimes of all states, and to gradually remove the causes of stress to the Prespa fish, in order to secure long-term maintenance of the fish stock and support people's livelihoods.

The formulation of a fisheries management plan was recognized by the stakeholders as a critical precondition for improved transboundary fisheries management. The preparation of fisheries management plans is a legal requirement for fishermen or entrepreneurs to be assigned fishing areas or fishing concessions in Albania and FYR Macedonia. In Greece no such requirements exist at the moment; however, over the last 15 years two Species Action Plans containing elements of fisheries management plans were developed for endemic species.

Building upon the existing transboundary cooperation, and acknowledging the solid basis of the existing fisheries management plans provide for improved fish and fisheries management in the region, the UNDP/GEF project intends to support the stakeholders to formulate a joint, transboundary fish and fisheries management basis (plan). The primary purpose of the document will be to provide the ground

for harmonization of the different national fish and fisheries management practices, by fully respecting the existing relevant national regulations. Such an effort, supplemented by a transboundary information management system, would create the prerequisites for an integrated fish and fisheries management in the region.

3. INTRODUCTION

EU Common Fishery Policy (CFP) and its impact upon transboundary fisheries management

The EU policies are closely linked with international practices so they are considered as the benchmark for measuring fisheries management obligations that must be carried out by Member States and those in the pre-Accession process.

However, the EU CFP is currently under structural change. In line with stakeholder demands, it is considered too complicated and not meeting the key objectives of '*sustainable fisheries for access by future generations'*. Indeed, it is agreed that the CFP requires a regional approach to the management of fish stocks and it must also be co-ordinated with environmental and development policies. This is referred to as the 'ecosystem approach'. In other words fisheries should be suitably integrated and structured within the wider context of other water activities such as transport, tourism, energy production (wind farms and solar) and aquaculture, i.e. a so-called 'cluster' of activities

There are thus several management and organizational interventions both being implemented and under discussion, which will have a direct impact on the CFP in the future. This will subsequently affect 3rd countries such as Albania and Macedonia which wish to apply the CFP rules and regulations to strengthen their own management of the fisheries sector as a whole.

No transboundary fisheries management is likely to be effective unless it is based upon clear legal obligations and agreements that set out the rights and duties of the parties in a manner which accords with the international legal framework for fisheries management, and provides effective and efficient legal procedures and mechanisms for implementing these rules consistently.

3.1. General Introduction to Prespa Lakes Basin

The system of Prespa Lakes are amongst the oldest freshwater lakes in the world. Originaing from dramatic changes in the earth's crust several million years ago, their waters have nurtured many unique forms of life. Freshwater tectonic lakes so ancient in origin are extremely rare and their endemic biodiversity is of immense interest to scientists. Surviving to such a great age, the Prespa Lakes and the life within them have endured many environmental challenges - none so

threatening to their survival, however, as the ongoing impact of human activities. The ecosystem of the lakes continues to deteriorate on a daily basis, with complex negative effects on their biodiversity. This publication presents a brief overview of the current ecological status of the lakes and a detailed survey of the different species of fish found in Prespa.

The single wetland of Macro and Micro Prespa is the third largest body of water in the Balkans. The ecological and cultural importance of the Prespa lake basin and the need to Protect this environment has been recognized by the creation of several national parks in all three countries. The Prespa lakes developed from a geotectonic depression during the Pliocene Epoch. They are part of the Dasseret group of basins in the Aegean Lake Zone - a group that includes Prespa's famous 'sister' Lake Ohrid.

Crucial to the ecological development of the lakes is their location at the juncture of two very different geological massifs: the granite massif of Baba Mountain from the east and the karst (limestone) massif of the Shara-Pind, Galicica and Suva Gora mountains from the south and west. The Prespa lakes are the highest tectonic lakes in the Balkans, both being located at 850 metres above sea level.

Macro Prespa has a surface area of 285 km2 with a maximum water depth of 54 m. Micro Prespa has a much smaller surface area of 47 km2 and a shallower maximum water depth of 9 m. This lake is almost entirely situated in Greek territory except for a smaller area within Albania.

Important changes in the characteristics of the lake water and habitat

There have been major changes in water level during the long history of the Prespa Lakes, including a significant decrease in water level over the last two decades. Research into the composition of the lake bed exposed as a result of recent reductions suggests that the water level was lower in the 10th and 11th centuries than at the beginning of the 20th century.

Oscillation of the lake water level at Macro Prespa - station Stenje "0" 847.48 m a.s.l. for the time period 1951-2010 (source: National Hydrometeorological Services – Skopje)

Basic physicochemical parameters

Since the late 20th century the ecosystem of the Prespa lakes has been subject to the dramatic impacts of over-abundant plant growth due to excessive nutrients (eutrophication); reduced water levels due to over-exploitation for irrigation; and climate change. The last two decades alone have seen significant changes in the aquatic and environmental parameters of the lakes. The water transparency of the lakes, for example, is now 30-70 per cent lower than it was only fifteen years ago.

The average winter water temperatures have decreased by approximately 4°C over the last twenty years as a result of reductions in the water level. This, in turn, has led to the freezing over of the lakes' littoral zones in winter. The dissolved oxygen concentrations now found in the Prespa lakes are typical

of eutrophic lakes. The presence of anoxia (reduced oxygen) in the water column below 15 m is a regular phenomenon during the stagnant summer period. Such low concentrations of dissolved oxygen are a restrictive factor in the distribution of plankton and nekton. The decreasing population of these organisms may mark the onset of large-scale decline.

Before several years the littoral zone was mainly composed of fine mud. This mud expands more easily in the water column during flooding, causing additional problems for fauna in the lake. With rising of the water level in these last years, the situation has improved in some parts of the lake from one hand. On the other hand all deposited material which has been on the dry parts of the previous littoral zone, returns again in the biogeochemical processes of the lake.

Over a long period, the concentration of phosphorus in Macro Prespa indicates a transition from the lake's previously medium productive (mesotrophic) state to a highly productive (eutrophic) state. The situation in Micro Prespa is worse, with even higher total phosphorous concentrations. This sudden increase in the total phosphorus concentration of the water column is a consequence of the increased internal pressure of the water on the sediments. Decreasing levels of oxygen in the deep lake water (hypolmnion) of Macro Prespa have led to a higher solubility of inorganic phosphate compounds in the water column.

The data thus shows that the Prespa Lakes are now eutrophic and undergoing traumatic changes. Conditions have become increasingly complex and the general ecosystem of the lakes is degenerating at a rapid pace, impoverishing their biodiversity.

3.2. Goals and objectives of the TFFMPPLB

In general Fishery Management Plans are resource documents, not policy. They provide context to past aquatic conditions that help inform future management strategies. Resource management decisions within the FMPs are based on the most recent scientific and ecological information available at the time of their publication. As well, the FMPs utilize relevant social, cultural, and economic information in this case for the Prespa Lakes Basin in order to help plan for a future condition.

It is written for a broad user base that goes beyond just government agencies to include citizens, angler organizations, non-governmental organizations (NGOs), developers, and regional as well as municipal governments within this specific Watershed.

(1) More specifically, the plan defines, but not limit to management aspects such as:

- Enhancement (ameliorative and selective fishing, fish stocking, sourcing of stocking material, quality control of stocking material, other sanitary measures);
- Input controls (identification of spawning periods and setting the close fishing season by species; identification of the spawning grounds of native fish and setting of closed areas by species; allowable fishing gears and fishing days; number of fishing days for recreational fishing);
- Output controls (setting allowable catch size in length per species; setting allowable catch quotas per species by country), and etc.

Particular areas to be also considered in the plan include: native and introduced fish (perceived problems and suggested solutions such as habitat changes, habitat protection, protection of native fish stocks, reducing exotic fish species); fisheries infrastructure needs (fish landing places, fish breeding and nursing centers, and the like).

3.3. Sustainable fishery harvest (SFH)

Harvest of fish population is a complex web of social, political, and biological principles. At times, social or political demands may be at odds with biological principles that govern harvest management. Managers must balance these competing interests.

"Sustainable management of fisheries cannot be achieved without an acceptance that the long-term goals of fisheries management are the same as those of environmental conservation"

Like in every branch of economy the term sustainable harvest has sometimes different meaning and different implementation. When having in mind the specification of the Prespa Lakes Basin fish fauna it is most adequate to use "wise" fishery harvest.

Anyway, both terms are relied on the ecosystem quality (health), fish stocks status per species, other direct and indirect threats, as well the socio-economic conditions affecting the fish populations.

3.4. General Problem Statement

When dealing with such water bodies like Prespa Lakes and its tributaries, with high percentage of endemism among the fish fauna, regulating conservation actions and fishery activities, represents the main problem. Quite often, looking from different single points of those two activities, one of them naturally prevails. The conservation stakeholders will put priority to their issue while the fishery stakeholder will have same priority to their issue.

Namely, in the case of Prespa Lakes fishes according to some of the IUCN conservation status of a particular species i.e. belvica (Alburnus belvica - bleak) which has criteria VU D2, due to its range of distribution limited to Prespa Lakes, appears that fishing of this species should be very restricted. From other hand, the data from the fishery statistics and the results from the monitoring of the fish populations are showing that this fish is the dominant one and quite sustainable quota can be caught each year.

Similar conflict exists for the colonies of the Dalmatian pelican and cormorants, both mainly feeding on belvica. According to some findings, the under exploited stock of the belvica make favorable conditions for this birds in extension of their populations number. These birds are also contributing in increasing the diversity and density of the fish parasites at Prespa Lakes.

Regarding general fishery problems it should be considered the fact that in the Albanian and Greek side of the Prespa Lakes fishery is operating continuously with exception of the close seasons, while on the Macedonian side since 2006 year there is total ban on fishing. But, telling the truth, the illegal fishing is present during the banned period.

Hence the estimation of the Maximum Sustainable Yield (MSY) and Maximum Sustainable Harvest (MSH) is quite difficult, but it is necessary for proper wise use of the fish stocks.

The presence of eight (8) alien species from which several can be recognized like fish pests, contributes to more complicated conditions as among the native fish fauna as well to the whole ecosystem health.

Other significant existing problems in this ecosystem are additional nutrient load, the pollution, changes of the habitats conditions (deterioration).

3.5. Interim Measures

- The Prespa trout- Species Action Plan
- The Prespa barbell – An Action Plan
- Prespa Lakes Reed Beds Action Plan
- Fishing Master Plan for Lake Prespa
- Fishing Master Plan for Lake Prespa watershed
- Current national legislative
- Fish and Fisheries Monitoring
- Water Quality Monitoring
- Watershed Management Plan
- EZERANI Natural Park

3.6. Review of the existing legislative, plans, statutes and rules

ALBANIA

The legislation framework in the fishery sector, in an overall overview is complete and contemporaneous. The legislation deals not only with fishery issues but also with other related issues such as: biodiversity, socio-economic aspects etc.

The legislation framework includes all levels of legal and normative acts, such as laws, by-laws, Regulations, Decisions of The Council of Ministers, Normative Acts etc.

Those are main legislative acts regulating the fishing activity: Law No. 7664, dated 21.01.1993 on "Environmental Protection", Law No. 7875, dated 23.11.1994 on "Protection of Wild Fauna and Hunting, Law No. 7908, dated 5.4.1995 on "Fishery and Aquaculture", Law No. 8093, dated 21.03.1996, for "Water Resources", Decision No. 80, dated 18. 02. 1999, Designation of Prespa as "National Park" and of Pogradeci as "Protected Landascape and Water Scape", Law No. 8763, dated 2. 04. 2001, concerning an addition to low No 7908, dated 5.04.1995, on "Fishing and Aquaculture", Law No. 8870 on "amendments to Law No. 7908 date 5.4.1995 on "Fishery and Aquaculture" dated 21.3.2002, Law No.8906, dated 6.6.2002, for "Protected Areas", Law No.8934, dated 5.09.2002, on "Environmental

Protection", Law No. 9103, dated 10.7.2003, on "Protection of Tranboundary Lakes", Order No.262, dated 15.05.2006 for Approve of the status of "Organisation for Fish management (OMP)", Law No.9587, dated 20.07.2006, for "Biodiversity Protection", Decision No. 146, dated 8. 5. 2007, for "Approve the Red List of Flora and Fauna"

Regulations
Regulation No 1 For application of the legislation on fishery and aquaculture date 29.03.2005

Albanian also has signed several international Conventions and Agreements. The most important related to the inland fishery sector are:

- 1993 FAO Implementation Agreement (accepted in May 2005),
- 1995 FAO Code; Code of Conduct for Sustainable Fisheries CCRF (implemented as a voluntary code in 1997),
- Advising European Committee on Inland Water Fisheries (EIFAC)

The Law No. 7908 set the basis for the good management of the fishery sector explains many of the terms and concepts related to the fishery sector

It should be stressed that the main intention of the law are:

(i) to ensure a rational and accountable exploitation of aquatic biological resources and development of aquaculture;
(ii) provide protective conservation measures in order to ensure the protection of biological water resources, and
(iii) support the sustainable development of fishery and aquaculture sectors, as well as create better social- economical conditions for producers.

The Law establishes three Consultative Organs for Fishery and Aquaculture,

(1) **Central Consultative Commission for Fishery and Aquaculture,**

(2) **Local Consultative Commissions for Fisheries and Aquaculture,** and

(3) **Commission of Scientific Research & Technology Coordination.**

Other important aspect of this law is the set of the Fishing Inspectorate as the responsible and competent body in executing fishery laws, bylaws and regulations. The coordination of the inspection activities is responsibility of the Ministry, and the fishing Inspectorate is included as a division in the Directorate of Fishery Policy.

Another commission in the fishery sector is **Administrative Contravention Examining Commission on Fishery & Aquaculture,** which is responsible for reviewing all the administrative contravention and the additional penalties.

The Law No. 8870 should not be simply seen as some amendments over the main law but it is an addition to the Law 7908 and deals with a new concept "Fishery Management Organization".

REPUBLIC OF MACEDONIA (FYR OF MACEDONIA)

As Macedonia, unlike Albania and Greece has no marine ecosystems, the fishery is concerned mainly at the three big lakes Ohrid, Prespa and Dojran, some of the reservoirs and the rivers. The commercial fishery is concerning mainly the natural lakes and, at present, there isn't any on them. Even the recreational fishery is in poor condition due to unsolved problems of concessionary.

In 2007 the existing law on fishery (from 1993) has been replaced with the **Law on Fishery and Aquaculture (LFA)** Official gazette7/2008 date15.01.2008. This law has three amendments: one in 2010 Official gazette 67/2010 date 14.05.2010 and two in 2011: Official gazette 47/2011 date 08.04.2011 and 53/2011 date 14.04.2011.

The following documents are complimentary to the Law on Fishery and Aquaculture:

Regulations:
Regulation on the form, content I the way of performing evidence of fish production as for the amount of the sold fish per species 2008
Regulation for performing the fish guarding service, the form and the content of the fish guardian legitimation,, as the way of its issuing and withdrawing 2008
Regulation of the content of the Program for examining, the form and content of the certificate, as the cost for issuing certificate for commercial fishery 2008
Regulation on the form and the content of the evidence formulary in the fishing regions 2008
Regulation of the content of the Fishery Master Plan 2008
Regulation of the content of the annual plan for protection and exploitation of the fish and the content of the annual report of realization of the plan 2008
Regulation on the technical requirements for the lending sides 2008
Regulation on the quality, size and weight, as also the way of declaring the fish for traffic market 2008
Regulation on the way of marking of the boats and tagging and evidencing of the fishing gear 2008.
Regulation on the form and the content of the document for the origin of the fish and the way of its issuing I fulfilling 2010
Regulation on the way of issuing licenses for recreational fishing, the required documentation for issuing, the form and content of the evidence formulary, the way of evidencing and delivering the data 2010
Regulation on the form and the content of the legitimation for recreational fishing and the way of its issuing.2010
Regulation on the allowed fishing gears and equipment and their use for commercial and recreational fishing 2011
Regulation on the length of the fish under which they cannot be fished for commercial and

recreational fishing 2011.

Law for the protection of Ohrid, Prespa and Dojran Lake Official gazette 45/1977 date 09.09.1977. This law has four amendments: one in 1980 Official gazette 08/1980, one in 1988 Official gazette 51/1988 and one in 1990, Official gazette 10/1990 and one in 1993, Official gazette 62/1993.

Law for declaration of Lake Prespa as natural monument Official gazette 51/2011 date 13.04.2011.

Law for nature protection Official gazette 67/2004 date 04.10.2004 This law has five amendments: one in 2006 Official gazette 14/2006, one in 2007 Official gazette 84/2007, one in 2010 Official gazette 35/2010,and two in 2011 Official gazette 47/2011 and Official gazette 148/2011.

Law for the environment Official gazette 53/2005 date 05.07.2005, This law has seven amendments: one in 2005 Official gazette 81/2005, one in 2007 Official gazette 24/2007, one in 2008 Official gazette 159/2008, one in 2009 Official gazette 83/2009, two in 2010 Official gazette 48/2010 and 124/2010 and one in 2011 Official gazette 51/2011.

Law for the waters Official gazette 87/2008 date 15.07.2008. This law has four amendments: two in 2009 Official gazette 06/2009, Official gazette 161/2009, one in 2010 Official gazette 83/2010 and one in 2011 Official gazette 51/2011.

The Pelister National Park was proclaimed on November 30, 1948 by a law endorsed by the Presidium of the People's Republic of Macedonia., and Galicica National Park in 1958 by the Law for declaration of forest areas in Galicica National Park Official gazette 31/1958.

Bird Sanctuary Ezerani was declared Ramsar Site in 1996, Official gazette 37/1965 as Strict Nature Reserve in 1998. In 2012, Ezearani was declared by the law as natural park Official gazette 24/2012 dated 17.02.2012.

Macedonia is a party of Ramsar convention. National Biodiversity Strategy (MOEPP 2004) considers wetlands (and reedbed habitats) as habitats of priority conservation importance.

National Environmental Strategies and Local Environmental Action Plans

National Environmental Action Plan II (to introduce sustainable practices of integrated water resources management through river basin management and water prevention and pollution control. Construction of wastewater treatment plants is one of the NEAP II highest priorities), 2005

- National Development Plan 2007-2009 (places wastewater collection and treatment among priorities for the forthcoming mid-term period)
- Operational Program 2007-2009,
- National Sustainable Development Strategy, 2008
- Sector Approximation Strategy (affirms that main objectives are to be achieved through cost-effective utilisation of natural resources, gradual increase in public investment in the protection of the environment and introduction of private-public partnerships – PPP).

- National Strategy for European Integration (The need for reorganisation, restructuring and capacity building, as well as the need for increased investment in the Water Sector has been recognised)
- Spatial Plan for Ohrid and Prespa Region,
- National Strategy for Waste Management, 2008
- National Waste Management Plan, 2008
- National Strategy for a sustainable development of the forestry (2007-2009)
- Thus, according the Law on Fishery and Aquaculture, for each fishing water (lakes, reservoirs and rivers) a Fishing Master Plan should be prepared before certain fishing water is going to be open for tendering on concession. Lake Prespa was considered among the first ones for these plans. Fishing Master Plan for Lake Prespa is prepared by PSI Hydrobiological Institute - Ohrid Official gazette 145/2011 date 19.10.2011, Fishing Master Plan for Lake Prespa watershed is prepared by PSI Institute for animal sciences-Skopje Official gazette 66/2011 date 12.05.2011.

Apart from the LFA in Macedonia, the fishes from Lake Prespa are protected within the laws of Nature Protection and other relevant international Conventions and Directives on Biodiversity Conservation and Habitats Protection.

The fishery legislative in Macedonia related to EU Fisheries Policy has been adjusted and evaluated like synchronized. According to that, the commercial fishery is recognized as artisan fishery.

Within this project (TFFMPPLB) an attempt of harmonizing the fishery legislation and regulations should take considerable place.

In future the fishery statistics has to be harmonized on a three lateral level. At present in FYR Macedonia, within the new Law on Fishery and Aquaculture (2007), adjusted to the EU Inland Fishery Directives, full Fishery statistics forms are adopted. This implies both fishing models: commercial and recreational.

GREECE

The Freshwater Fish Directive – 78/659/EEC of 18 July 1978 on the quality of fresh waters needing protection or improvement in order to support fish life. It has been significantly amended on several occasions, the last time on the 6 September 2006 (Directive 2006/44/EC). This directive concerns mainly the quality of waters and mandates minimal water levels for river biodiversity, it distinguishes salmonid and cyprinid waters. By the end of 2013 the Water Framework Directive (WFD; 2000/60/EC) will replace Freshwater Fish Directive – 78/659/EEC.

The WFD means continued improvement in native fish stocks through improved habitats and improved water quality and quantity. The emphasis is on achieving good overall ecological status, not just on complying with water quality standards. The WFD lists fish amongst the biological elements which should be used for classification of ecological status of surface waters (rivers, lakes and transitional waters (estuaries). “Ecological status” is an expression of the quality of the structure and functioning of aquatic ecosystems associated with surface waters, classified in accordance with Annex V of the

Directive. Water management is on the basis of River Basin Districts (RBDs). The Directive specifies that fish shall be monitored at all sites selected for Surveillance Monitoring (SM).

But, as the state of the fishery deteriorated new attempts at regulation were made; for example the use of seine nets was prohibited in the Greek part of Mikri Prespa in 1983. Later, the length of the spring close season was lengthened (from 20th of April until 20th of June) and the mesh size of nets was increased (Crivelli, 1984, 1990).

Law No. 230, dated 17.10.1936, Royal Decree No. 666, dated 1966, Decree-Law No. 142, dated 1969

The Fisheries Code of 1970, amended by Law 2538 of 1997, Presidential Order No. 373, dated 1985, "On Sport-recreational Fishing".

Common Ministerial decision 28651 Governmental gazette No 302 date 23.07.2009 (In which the area was declared as Prespa National Park, replacing the existing Prespa National Forest and including inside its borders of the protected area the mountain Varnous (also included in the Greek National List of the NATURA 200 protected sites).

Greece is signatory of international Ramsar Convention for the Protection of Wetlands of international Importance specially as waterfowl habitat (FEK 350 A '/ 20-11-1974. Mikri Prespa is characterized 21/8/1975 protected by the Ramsar Convention with code 3GR008. Mikri Prespa in 4/07/1990 entered the so-called list of Montreux (Montreux Record)-like all Ramsar sites of Greece-that was declared a threatened area due to ecological changes caused by past drainage works, the overgrazing and poor reproduction of fish in the lake, on 18/05/1999 the Prespa with the Evros Delta and I. Kerkini removed from the list of endangered sites.

INTEGRATED LEGISLATION

The transboundary PP was established by the Prime Ministerial Declaration in February 2000, on the occasion of the World Wetlands Day at Aghios Germanos in Greece (MedWet 2003). The text of this declaration sets the objectives of the PP as follows (MedWet 2003):
(Objective I) - Conservation of ecological values, functions and of the biological diversity based on the concept of the Prespa catchment basin as uninterrupted ecosystem extending beyond national borders;
(Objective II) - Development of opportunities for the sustainable economic and social development of the local communities and the wise use of the natural resources for the benefit of nature, local economies and future generations;
(Objective III) - Preservation of cultural values such as monuments, traditional settlements and raditional human activities and cultural elements that promote sustainable management of the natural resources;
(Objective IV) - Co-operation and participation of stakeholders in the three countries in decision-making and in benefit or loss sharing of stakeholders in three countries

The need of transboundary cooperation is not only a need but also a duty. The main international instruments concerning protection and management of the Prespa Park area binding on one ormore of the three countries and imposingminimum obligations on them are the following:
- 1971 Convention on Wetlands - Ramsar Convention (all three countries are Parties);
- 1992 ECE Convention on the Protection and Use of TransboundaryWatercourses and International Lakes;
- 1979 Berne Convention on the Conservation of European Wildlife and Natural Habitats;

- 1979 Bonn Convention on the Protection of Migratory Species of Wild Animals;
- 1992 UN Convention on Biological Diversity (CBD);
- 1991 Espoo Convention on Environmental Impact Assessment in a Transboundary Context;
- 1973 Convention on International Trade in Endangered Species of Flora and Fauna;
- 1985 Convention on the Protection of the Architectural Heritage of Europe

The main pieces of Community legislation applicable in the Prespa Park area (as long as Greece is a EU country and Albania and FYR Macedonia are countries that aspire to be part of the EU community)are the following:

- Directive 79/409/EEC on the protection of birds;
- Directive 92/43/EECon the conservation of natural habitats andwild flora and fauna (the Habitats/ NATURA 2000 Directive); and
- Directive 2000/60/EC (Water Framework Directive)

Another important international code is: FAO "Code of Conduct for Responsible Fisheries"

Presently, there are two transboundary bodies existing:

- The Prespa Park Co-ordination Committee (PPCC), which was formed following the "Declaration on Protection and Sustainable Development of the Prespa Lakes and their Surroundings" The PPCC is apparently a temporary, interim body that brings governmental, non-governmental and local communities together in efforts towards transboundary management.
- The UNDP/GEF Project on 'Integrated Ecosystem Management in the Prespa Lakes Basin of Albania, FYR Macedonia and Greece', which started up its operations in 2007 and its scheduled to run until 2011.

Important documents and plans concerned with transboundary management of the Prespa Lakes basin are:

The 'Declaration on Protection and Sustainable Development of the Prespa Lakes and their Surroundings', signed by the prime ministers of the three littoral states on 2 February 2000, which gave rise to the formation of the PPCC.

The 'Strategic Action Plan for Sustainable Development of the Prespa Park' (SAP), which is a cooperative effort of three national, non-governmental organization of the three littoral states (SPP 2003).

The project document of the UNDP/GEF Project, which spells out a number of objectives, outputs and activities in support of transboundary and integrated ecosystem management of the Prespa lakes basin (UNDP/GEF 2005).

A draft 'Trilateral Protocol on Collaboration' of the municipalities and communes adjacent to the Prespa lakes (i.e. Liqenas *[and Proger and Devoll?]* in Albania, Prespa in Greece and Resen in FYR of Macedonia.

4. GENERAL LIFE HISTORY

4.1. NATIVE FISH SPECIES

Alburnoides prespensis – Prespa spirlin

Etymology: The name of the genus *Alburnoides* is a diminutive Latin name for *Alburnus* (albus, meaning white or whitish), derived from the morphological similarities of spirlin and bleak. The Latin name prespensis is applied to the area of the Prespa Lakes where spirlin inhabits. **Description:** This is an endemic species of ray-finned fish in the Cyprinidae family. It is distinguished from other species of *Alburnoides* in Europe by having the following characteristics: mouth terminal, cleft only slightly slanted; anal fin with 10- 11½ branched rays; 40-43 + 2-3 lateral line scales; caudal peduncle 1.8-2.2 times longer than deep; snout longer than eye diameter and inter-orbital distance 1.2-1.4 times eye diameter. Maximum length: 130 mm. **Distribution:** Europe: Prespa Lakes. It can be found in the surface zone along lake shores. **Biology:** This is a typical species from flowing water, making it rheophilous, and thus it is normally found in rivers. In the Prespa Lakes however, it lives in the shallow waters at the edge of the lake. It is also a lithophilous species, spawning on gravelly and stony substrates in May and June. Its eggs are sticky (among themselves and to the substrate). **Fishing significance:** No significance **Threats:** Potential Threats to the species are: water abstraction, drought, pollution and introduced species which could impact the whole lake. **Conservation actions:** The numbers of Prespa spirlin are falling, which is probably related to competition from two non-native species, the stone moroko and the pumpkinseed (sunfish), which feed on similar food. Selective fishing of these two species will improve the status of *Alburnoides*.

Alburnus belvica – Prespa bleak (belvica)

Etymology: The name of the genus *Alburnus* comes from the Latin word albus, meaning white or whitish which is associated with the white-silvery colour of the scales of this fish. The name *belvica* has the same meaning – white, and it has the same common name. **Description:** This is an endemic species from the Cyprinidae family. The bleak has a laterally flat body covered with tiny scales which are bright and easily falling off. It has an upper mouth which is facing upwards. The dorsal fin begins behind the end of the pectoral fin and ends before the anal fin. The body from the upper side is greyish green, while from the side it is silverywhite and the colour of the belly is milky white. The Prespa bleak is distinguished from other species of *Alburnus* in Europe by having the following characteristics: 30-38 gill rakers; anal origin about 1-2½ anal scales behind base of last dorsal ray; anal fin with 12-15½ branched rays; 48- 58 + 3 lateral line scales; depth of caudal peduncle is 2.0-2.1 times its length; The bleak can grow up to 200 mm. **Distribution:** Europe: The Prespa Lakes. During most of the its life span it stays in the open waters. Usually it

forms large shoals which move under the water surface. During the winter period large groups of individuals are sheltered at certain places protected from the wind and waves. The bleak migrates to spawning sites in tributaries and along the lake shore (on pebbles and gravel in the surf zone) during the night in small and large shoals, where there are only one or two females. All the other are males. The number of eggs is varied and depends upon the age and weight of the individuals but it can reach 10 000. Bleak spawn from May till August. **Fishing significance:** High significance for commercial and recreational fishing. **Threats:** There is a potential threat to the species from water abstraction, drought, pollution and introduced species which could impact the whole lake. Bleak is the main prey for breeding Dalmatian pelicans (*Pelecanus crispus*) and cormorant (*Phalacrocorax carbo*) and other fish eating birds. **Conservation actions:** Strictly limited fishing quotas.

Anguila anguila- European eel

Etymology: The name *Anguilla* derives from the word for "eel" in many of the various Latin-based languages (modern Spanish: anguila; French: anguille; Italian: anguilla; Portuguese: enguia), and the Latin word anguis, all with the same meaning of 'snake shaped'. **Description:** Eel belongs to the family Anguillidae. The body is elongated and snake shaped, covered with a large number of small scales which begin to develop during the third year of life in fresh water. The skin is slimy and scales are unnoticeable. The dorsal colour is dark brown to olive green-brown and the colour of the body changes to white and silvery bluish-gray when they start their migration to the sea. The head is flat on top, the mouth is slightly upper, relatively large, bordered with multiple rows of tiny sharp teeth. There is a large fin that follows the shape of the body with more than 500 soft rays. The females reach a maximum length of 1330 mm. **Distribution:** It is found in all European rivers draining into the Mediterranean, the North and Baltic Seas and in the southern Atlantic to the Canary Islands. It rarely enters the White and Barents Seas, recorded eastward to Pechora. Small numbers enter the Black Sea, migrating east to the Kuban drainage. Occasionally individuals reach the Volga basin through canals. It is stocked in most inland waters. Large parts of the population remain at sea (north-western Atlantic and Mediterranean). Before the construction of hydropower plants on the River Drim, their migration route to Lake Ohrid was open. After the construction, regular stocking was carried out in Lake Ohrid as well as the Glabochica and Shpilje reservoirs in order to preserve the population. However, officially, the Prespa Lakes were never stocked with European eel. **Biology:** Eels live in freshwater, and spawn in sea water for which it makes a long journey followed by significant anatomical, morphological and physiological changes. The spawning peaks are from the beginning of March until July in the Sargasso Sea, in the western sub-tropical Atlantic (about 26oN 60oW) at a depth of 100-200 m and approximately 20oC. Adults die after spawning. Larvae emerging from the egg have a length of about 5 mm. As leptocephali (first eel larval stage), driven by the Gulf Stream and north Atlantic Drift they reach the continental slope at about 65-70 mm. As leptocephali (first eel larval stage), driven by the Gulf Stream and north Atlantic Drift they reach the continental slope at about 65-70 mm body length and then metamorphose into glass-eels which enter estuaries. When entering freshwater the body colour changes, pigmentation increases during upriver migration and juveniles are then called 'elvers' - young eels. In this phase they reach a length of 16 -18 cm. They can remain 5-14 years (males) and 7-18 years (females) in freshwater. Downstream migration (to the sees) starts in late summer or autumn and adults arrive at the spawning grounds the following spring. **Fishing significance:** Low. It has very low population numbers. **Threats:** There is a potential threat to the species from water abstraction, drought, pollution and introduced species which could impact the whole lake. Their high fat content and benthic feeding habits in continental waters make them vulnerable to the bio-accumulation of

pollutants, such as heavy metals and organic contaminants that may result in organ damage. **Conservation actions:** Possible stocking.

Barbus prespensis - Prespa barbell

Etymology: The name *Barbus* has a Latin origin and describes the morphological features of barbells on their mouths. The Latin name *prespensis* is applied to the area of Prespa Lakes that the fish inhabits. **Description:** This is an endemic species of ray-finned fish in the Cyprinidae family, which belongs to the Barbinae subfamily. It has two pairs of barbells, one pair is located above the upper lip and the other pair at the ends of the upper lip. The Prespa barbel is distinguished from other species of Barbus in the Balkan Peninsula by the following characteristics: distinctly concave dorsal profile of the snout, lower lip thick, fleshy, with median lobe, 50-54 + 3 lateral line scales, body covered by small, weakly marked black spots. Maximum length - 300 mm. **Distribution:** Europe: Prespa Lakes basin. The Prespa barbel spawns in tributaries, or on gravel beaches in lakes, especially near underwater springs. It spawns from April till July, and migrates to tributaries at night. The adults return to the lake in early July and juveniles start to move to the lake in late July. In Micro Prespa, barbel do not have the possibility to spawn in streams and are forced to spawn in the lake. Within the last two decades when significant water level changes of the lake occured (firstly - decrease and afterwards - increase) the spawning ecology of this species has significantly changed and at present its spawning grounds are restricted and can be found only at certain places in the lake. Barbus feeds mainly on *Gammarus* in lakes and on insects in streams. **Fishing significance:** Low. Spring hand caching in Greece allowed for specific period according to law. **Threats:** Potential threat to the species from water abstraction, drought, pollution, habitat changes, overfishing and introduced species. **Conservation actions:** Restriction on fishing barbel for a certain period of time (at least 6 years).

Chondrostoma prespense - Prespa nase

Etymology: The name of the genus *Chondrostoma* comes from the Greek words - chondro (χοντρο) that means cartilage and stoma (στόμα) - mouth, which describes their mouth.The Latin name *prespense* is applied to the area of Prespa Lakes that the Prespa nase inhabits. **Description:** It is distinguished from other species of *Chondrostoma* in the Balkan Peninsula by the following characteristics: slightly arched mouth, lower lip with thin cornified sheath; 56-66 lateral line scales; 8-9/1/5-6 scales in transverse row between dorsal-fin and pelvic-fin origins; dorsal fin with 8½ branched rays; anal fin with 8-9½; and 23-27 gill rakers. This fish can grow to 270 mm in length. **Distribution:** Europe: Prespa Lakes basin. Lacustrine, enters tributaries during the spawning season. **Biology:** It inhabits lakes and enters tributaries during the spawning season. It is mostly found in water bodies at high altitude. In Micro Prespa which has no tributary, it spawns on gravel beds, near the lake shore. In Macro Prespa it spawns on sandy beaches and in tributaries and returns directly to the lake. It migrates exclusively at night. Reproduction takes place in April and May. It feeds upon macrophytes (underwater vegetation), invertebrates (animals without back bone) and algae. **Fishing significance:** Relatively significant. **Threats:** Threatened due to water abstraction and the introduction of other species. **Conservation actions:** Regulation of the tributaries and deltas to provide undisturbed spawning migrations.

Cobitis meridionalis Prespa spined loach

Etymology: The name of the genus *Cobitis* is from the Greek word Cobitis, which means small fish. The name *meridionalis* has a Latin origin and means 'southern'. **Description:** This is an endemic species of ray-finned fish from the Cobitidae family. It is a peaceful, largely solitary and nocturnal species that likes to bury itself in the substrate with just the head and tail visible. It has 3 pairs of barbells and a suborbital spine. It is distinguished from other species of *Cobitis* in Balkan Peninsula by having a different pattern of coloured patches on the skin, with edges not sharply contrasted. Maximum length of 110 mm in females and 70 mm in males. **Distribution:** Prespa Lakes. It is found on lake shores and in streams with a sand or mud bottom and underwater vegetation. **Biology:** It is a seasonal fish species dying after reproduction, which takes place in late April and May. It needs sandy or soft substrate, clean water and submerged water plants for spawning in. This is a fast growing species, which grows only from May till October when the temperature is above 10oC. It feeds on invertebrates. **Fishing significance:** No significance. **Threats:** Potential threat to the species from water abstraction, drought, pollution, habitat loss and introduced species. **Conservation actions:** Habitat protection.

Pelasgus prespensis Prespa minnow

Etymology: The name of the genus *Pelasgus* comes from the Greek word Pelasgia which is a historical toponim for Ancient Greece. The Latin name *prespensis* is applied to the area of Prespa Lakes that the minnow inhabits. **Description:** This is an endemic species of ray-finned fishes which belongs to the Cyprinidae family. It is relatively a small-sized fish, with a small mouth placed at an angle of almost 45 degrees. It is distinguished from other species of Pelasgus by the following characteristics: scales very small, not overlapping, deeply embedded in skin, 58-73 + 2 scales in mid-lateral row, 0-7 lateral line pores along lateral line. It grows up to a maximum of 55 mm. **Distribution:** Europe: Prespa Lakes basin. Found in still waters of lakes and lake shores, with abundant aquatic vegetation and tributaries. **Biology:** The minnow spawns in the Lakes in May- June usually at water temperatures of 16-18oC. In males, anterior pectoral rays are stiff and thickened. **Fishing significance:** No significance **Threats:** Population declined in recent years, apparently threatened by introduced species (*Pseudorasbora parva, Rhodeus amarus*). **Conservation actions:** Selective fishing of alien species.

Phoxinus lumaireul - Italian minnow

Etymology: The name *Phoxinus* has a Latin origin. **Description:** This is a native species of ray-finned fish in the Cyprinidae family. It is distinguished from other species of *Phoxinus* in Europe by the following characteristics: having lateral line usually reaching beyond anal fin base, caudal peduncle depth 2.6-3.1 times in its length, patches of breast scales separated by unscaled area or (rarely) connected anteriorly by 1-2 rows of scales, anal fin origin in front of base of last dorsal ray. Caudal fin has 19 rays. Maximum length of 140 mm. **Distribution:** It can be found from the Northern parts of Italy, extending to South-East to the whole Dalmatian region and ending with the River Drim

drainage area from which lakes Skadar, Ohrid and Prespa's are terminal ones. It lives in a wide range of cold and well oxygenated habitats from small, fast-flowing streams to large rivers and from small upland lakes to large oligotrophic lakes and is usually associated with salmonid fishes. **Biology:** It spawns in April-June at temperatures above 10°C. Some individuals spawn even during autumn. They spawn in shoals, being a fractional spawner, and females deposit the sticky eggs deep into clean gravel. Spawning takes place over clean gravel areas in flowing water or on wave washed shores of lakes. It overwinters in coarse substrate or in deep pools with low current. It migrates upstream for spawning in shallow gravel areas. During the spawning it is getting more colored (green stripes bellow the back and red belly). It feeds on algae, plant debris (in rivers), molluscs, crustaceans and insects. **Fishing significance:** No significance. **Threats:** Potential threat to the species from water abstraction, drought, pollution and introduced species. **Conservation actions:** No actions needed. Stable population.

Rutilus prespensis - Prespa roach

Etymology: The name of the genus *Rutilus* comes from the Latin word Rutilus meaning red, reddish. It is associated with the reddish and orange coloration of the eyes and fins of the fish. The Latin name *prespensis* is applied to the area of the Prespa Lakes that the Prespa roach inhabits. **Description:** This is an endemic species of ray-finned fishes which belongs to the Cyprinidae family. It has an elongated body with large scales. It is distinguished from other species of *Rutilus* in the Balkan Peninsula by the following characteristics: 38-42 + 3 scales along lateral line; dorsal fin with 9½ branched rays; anal fin with 8½ branched rays; eye diameter 4-5% SL, 19-22% HL, 1.7-1.9 times in inter-orbital distance; body depth 27-31% SL; fins glassy to greyish, tip of anal and pelvic fins yellowish; snout rounded; angle between mouth cleft and horizontal about 15-250; lower profile of head smoothly rounded at lower jaw articulation. It grows up to maximum of 170 mm. **Distribution:** Europe: Prespa Lakes basin. Lacustrine species which is found along shores and in shallow, swampy areas. **Biology:** Sexual maturity in males for the Prespa roach is reached in the second year (usually in the third year), while for females it is a year later. It spawns in lakes in May- June usually at water temperatures of 16- 18oC. The eggs are sticky and cling to the substrate. The development of embryos in the eggs takes about a week. It is well adapted to fluctuations in water level and changes in the water temperature. It is an omnivorous species. **Fishing significance:** High significance for commercial and recreational fishing. **Threats:** Potential threat to the species from water abstraction, drought, pollution and introduced species which could impact the whole lake. Prespa roach as well as bleak is the second prey of breeding Dalmatian pelicans (*Pelecanus crispus*) and cormorant (*Phalacrocorax carbo*) and other fish eating birds. **Conservation actions:** Strictly limited fishing quotas.

Salmo peristericus - Prespa trout

Etymology: The name of the genus *Salmo* comes from the Latin word Salmo, meaning leap, leaping. The Latin name *peristericus* is applied to the area of Pelister Mountain where the Prespa trout inhabit the streams. **Description:** This is an endemic species of ray-finned fishes which belongs to the Salmonidae family. The Prespa Trout, also called Pelister Trout, is a small *Salmo* species, which rarely exceeds 35 cm in length and 350 gr in weight. It is distinct from other Balkan species

of trout and is characterised by a small black spot on the opercula and small black spots on the upper third part of the lateral part of the body. Red spots are scattered on the whole lateral part of the body and may vary in coloration from dark orange to dark purple. The number of gill rakers range from 16-18. It is difficult to identify but it is distinguished from all its congeners in the Balkan Peninsula by the combination of the following characteristics: small black spot on opercula and upper third of the body, oscillated red spots on whole body side; body depth 19-23% SL; 16-18 gill rakers; pre-anal length 72-75% SL. **Distribution:** Four populations have been recorded in the surrounding tributaries of Macro Prespa: River Brajcinska, River Kranska, River Leva and the River Agios Germanos. **Biology:** It is found in streams and believed originally to be an inhabitant of lakes entering streams to spawn, and then returning to the lake. The habitat modifications and water abstraction have interrupted the lower course of most streams and its **Distribution:** is confined to headwaters. It spawns mainly during November – December. **Fishing significance:** Low, recreational. Illegal fishing present. **Threats:** The main threats are from the low carrying capacity of streams (food availability), increased amounts of fine sediment in streams (reproductive failure, low recruitment), annual repeated reduction of population through direct removal of individuals, altered hydrological regime due to water abstraction and construction of small hydro power stations (dams). There is also illegal fishing. **Conservation actions:** Species Conservation Action Plan, possible implementation of artificial spawning for stocking purposes by methods of catch and release.

Squalius prespensis - Prespa chub

Etymology: The name of genus *Squalius* comes from the Latin word squaleo, squalidus which means coarse skin. Latin name *prespensis* is applied to the area of Prespa Lakes that the Prespa chub inhabits. **Description:** This is an endemic species of ray-finned fishes which belongs to the Cyprinidae family. It is distinguished from its congeners in the Balkan Peninsula by the following characteristics: head length 1.2-1.3 times body depth, 27-31% SL; mouth terminal; eye diameter 17-20% HL; scales on lateral line 41-44 + 2; body depth 21-24% SL; dorsal fin with 8½ branched rays; anal fin with 8-9½ branched rays; distal margin of anal fin convex; distance between tips of first and last branched anal rays (with fin stretched out) 1.2-1.3 times caudal peduncle depth; and greyish to blackish fins. It grows to maximum of 800 mm in length. **Distribution:** Europe: Prespa Lakes basin. Lacustrine, along shores and in streams. **Biology:** Sexual maturity is reached in males in the second year (usually in the third year), while for females it is a year later. The fecundity of females is high and they produce between 100 000 and 200 000 small eggs. The development of the embryo in the egg takes about a week. Prespa chub is well adapted to variations in water temperature so it can be seen in cold tributary waters and in the Lakes. It feeds on almost any food (plant and animal): insects and their larvae, worms, crustaceans, molluscs, fish eggs, other fish, frogs and others. Older individuals are more predatory. It spawns during the period of April-June on stony substrates. **Fishing significance:** Low. Interesting for recreational fishing. **Threats:** This species is not thought to be at significant risk from the introduction of invasive species. **Conservation actions:** Although the range of this species is relatively restricted, it is abundant, and the population is increasing over the past ten years.

Astacus astacus balcanicus - Noble crayfish

The Noble Crayfish is mentioned in fishery legislation and this is the reason why it is included in this publication. This species is found in rivers, lakes, ponds, and reservoirs, in both lowlands and hills, where shelter availability is high. This includes stones, logs, roots and aquatic and marginal vegetation. This species prefers soft bottoms with some

sand and is not usually found in water bodies with a muddy substrate. In addition, it prefers soft banks where it constructs simple burrows. The oxygen demands of this species can be quite high, leading to high mortality in shallow, eutrophic ponds during summer months. This species is capable of tolerating lower calcium levels, as low as 2-3 mgl-1 Ca, where other species of crayfish may be excluded. The optimum temperature for best growth is between 16 and 24oC, although up to 28^{o}C can generally be tolerated. In addition, oxygen content below 3-4 mgl-1 is deemed unsuitable for this species. Some measures of longevity indicate this species may live for up to 20 years. At maturation, males normally mate every year, while female reproductive activity is usually restricted to a single year between periods of sexual inactivity. Thus numbers of sexually active females may vary greatly depending on locality and year. Studies have shown that this species of crayfish is particularly susceptible to increased levels of nitrite in aquatic systems, meaning input of excess amounts of this compound, particularly through agricultural fertilizer run-off, may pose a serious risk to this species. It is known that noble crayfish females reach sexual maturity at a size which ranges from 6.2 cm total length in localities with early maturity or slow growth to 8.5 cm total length in localities with late maturity or fast growth. Males become mature at a size of 6-7 cm total length. The Noble Crayfish, *Astacus astacus*, is indigenous and widespread throughout Europe. This species range extends from Russia and the Ukraine in the east, to Finland, Sweden, Norway in the north, to Greece in the south, and the United Kingdom and France in the west. A few recently introduced subpopulations are found outside Europe, for example Morocco. The occurrence of this species within Andorra, Cyprus, the UK, Liechtenstein, Luxembourg, Morocco and possibly Montenegro and Italy, is via introductions from neighboring countries. In Prespa, due to its low population density, at present it is forbidden for catching (fishing).

4.2. PRESENT ALIEN FISH SPECIES

Carassius gibelio - Prussian carp

Description: The Prussian carp belongs to the Cyprinidae family. It was introduced into the Prespa Lakes in the 1970's and used to be regarded either as a sub-species of the goldfish (*Carassius auratus auratus*) or as its wild form, but is now considered a species in its own right. As a result, it is often described either under the scientific name *Carassius auratus gibelio*, reflecting its previously assumed connection with the goldfish, or under the name *Carassius gibelio*, emphasising its status as a separate species. In size and appearance the Prussian carp is deep-bodied and plump, its shape most reminiscent of those of the Crucian carp (*Carassius carassius*) and carp (*Cyprinus carpio*). Its sides and belly are pale yellow or silvery, rather than the golden yellow usually seen in Crucian carp. These two species also differ in the shape of their fins: the caudal (tail) fin of Crucian carp is straight, that of Prussian carp forked. The underside fins of a Crucian carp are reddish, while those of a Prussian carp are lighter in colour. The last simple anal and dorsal rays strongly serrated; 37-52 gill rakers; lateral line with 29-33 scales; freed edge of dorsal concave or straight; anal fin with 5½ branched rays. In Crucian carp the membrane lining the body cavity (the peritoneum) is light coloured, while in Prussian carp it is almost black. A Prussian carp can grow to a length of 20-25 cm and a weight of some 250 g in five years. The species has a maximum length of 45 cm and, in favourable conditions, can reach a weight of 2-3 kg. Unlike the common carp *Cyprinus carpio* – there are no barbells. **Biology:** The Prussian carp is a warm water fish, and thrives best in shallow lagoons and estuaries (with a depth of just a few metres), shallow pools and lakes, and slow-flowing rivers with muddy beds. The species is associated with dense vegetation and feeds mainly on benthic organisms. It grows rapidly, reproduces efficiently, and competes with native fishes for food and space. In some parts of central Europe it has affected the range of other indigenous and commercially more valuable fish species. The species is able to reproduce by

gynogenesis, a process which only gives rise to new females. The milt of male fish is needed to initiate the development of the eggs, but when the embryos form the chromosomes from the males are excluded. The offspring produced are thus copies of the female. It can also tolerate waters with relatively low oxygen levels. **Distribution:** Its geographical origin is Asia/South-East Asia (China, Taiwan, Korea, Japan, Kolyma River, Amur River basin). The natural range of the species is said to extend from western Siberia across into Europe, including the Ponto-Caspian region (Black and Caspian Seas) and large parts of south-eastern Europe.The wild form of Prussian carp was introduced into Germany from Asia, according to some reports as early as the 16th or 17th century. **Fishing significance:** Moderate for commercial, but interesting for recreational fishing. Possible ameliorative fishing. **Threats:** to human Fish pest. **Impact**: Interfering within the spawning of native cyprinid species. **Management:** Possible ameliorative fishing.

Cyprinus carpio - wild common carp (regarding its long term presence in the area it can be recognized as native species)

Etymology: The name of the genus *Cyprinus* comes from the Ancient Greek word kyprînos (κυπρίνος, "carp") and *carpio* from the Latin meaning the same. **Description:** The wild common carp belongs to the family Cyprinidae in the genus *Cyprinus* and is a so called "oily" fish (about 30% of oil in their tissue). Only one species *Cyprinus* is found in the Prespa Lakes. The body is relatively high and laterally flat, covered with relatively large scales. Each scale, at the top of the free end is dark spotted. The head is relatively small, compared to the body. The mouth is terminal, facing upward. At the both ends it has two pairs of barbells. It is characteristic that the carp lips can elongate like an accordion. The dorsal fin is high, little emarginated, and starts from the highest ridge of the back, before the abdominal fin, and ends after the end of the anal fin. The caudal fin is deeply emarginated. The body of carp from the top is dark graygreen and golden-yellow sides. The colour of the abdominal side is yellow white. The eyes are yellowish in colour. According to the substrate of spawning it belongs to the phytophylic ecological group of fish (spawning on aquatic vegetation). The time of spawning is quite extended and sexually mature individuals can be found at the end of April when water temperatures in the coastal regions are higher than 18oC, until the end of June. The number of eggs is quite varied and depends upon the age of the individuals and their weight. The number of eggs per female ranges from 30 000 to 1 000 000. The eggs are sticky and they attach to the submersed vegetation, and during the whole incubation period they are above the muddy bottom. The carp mature at different ages. Males reach sexual maturity in the second or third year, while females reach sexual maturity a year later. It lives up to 50 years and usually spawns every year. Carp can grow to more than 120 cm and more than 15 kg in weight. In the Prespa Lakes there is evidence of 25 kg individuals. These specimens are quite rare. The carp offspring feed with smaller zooplankton. While growing it becomes omnivorous (small benthic animals, zooplankton and vegetation). In the Prespa Lakes it spawns mainly in the reed belts. **Distribution:** The carp has perhaps the largest fish **Distribution:** – Asia to Europe in waters ranging in temperature from 3 - 350C. It has been introduced throughout the world. It is believed that in this area it was brought 2000 years ago by the Romans. Thus, although non-native by origin, according it is accepted as a domestic species. **Fishing significance:** The most valued commercial and recreational fish. **Threats:** Potential threat from water abstraction, pollution and hybridization with introduced stocks is a major threat. **Conservation actions:** Strictly limited fishing quotas and stocking program. Impact It is accepted as a domestic species with established populations.

*Gambusia holbrooki - E*astern mosquito fish

Description: This is an alien species that belongs to Poecilidae family. It is an aggressive live-bearing fish that originates from the southern United States. It has been introduced worldwide for mosquito-control. It is greenish olive to brown on the back, the sides are grey with a bluish sheen with a belly silvery-white. Females have a distinct black patch surrounded by a golden patch occurring just above the vent. Males have a highly modified anal fin, the third, fourth and fifth rays of which are elongated and thickened to form a 'gonopodium' which is used to inseminate the female. Females are also larger than males with maximum standard lengths of 60 mm and 35 mm respectively. **Biology:** It lives immediately under the surface, catching pray at or under the surface. The breeding season is between mid-spring and mid-autumn (April-October), with the peak breeding time around summer. Females can have up to nine broods per mating season, with the average number ranging from 5-100. Although it can tolerate a broad range of environmental conditions, they tend to avoid rapid currents, naturally variable creeks and rivers and areas of dense surface vegetation, that can obstruct access to feeding on the surface. **Distribution:** *Gambusia holbrooki* prefer warm, slow flowing or still waters, and occur amongst aquatic vegetation at the edge of water bodies in water depths of 10 cm or less. It can be found in estuarine habitats, lakes, ruderal/disturbed water courses and wetlands. It is native to the southeastern United States, and can be found in many of the lakes within that area, which includes lakes east of the Mississippi River. It was introduced worldwide in tropical and sub-tropical countries. It is established throughout southern Europe. In the Prespa Lakes it was introduced in the first half of the 20th century. **Fishing significance:** No. **Impacts**: This species has been implicated in damage to native fish, amphibians and invertebrate populations. Measures Since 1982 the World Health Organisation has no longer recommended the use of *Gambusia* for malaria control purposes and indicates it should not be introduced into new areas. **Management:** Ameliorative fishing.

Lepomis gibbosus - Pumpkin seed, sunfish

Etymology: *Lepomis*, in Greek, means 'scaled gill cover' and *gibbosus* means 'wide margin'. The pumpkinseed sunfish is widely recognized by its pumpkinseed shape, which is where its common name derives. **Description:** It is an alien species that belongs to the Centrarchidae family. It was first introduced into the Prespa Lakes in 1995- 1996. They are typically 6-8 inches in length, but can grow up to 10 inches. They weigh less than 0.45 kg (with the world record being 0.62 kg). They are orange, green, yellow or blue in colour, with speckles over their sides and back and a yellow-orange breast and belly. The sides are covered with vertical bars that are a faint green or blue, which are typically more prevalent in females. Orange spots may cover the dorsal, anal, and caudal fins and the cheeks have blue lines across them. The species is noted for the orange-red spot on the margin of its black gill cover. The pectoral fins can be amber or clear, while the dorsal spines are black. They have a small mouth with an upper jaw stopping right under the eye. **Biology:** Pumpkinseeds (sunfish) typically live in warm, calm lakes, ponds and pools of creeks and small rivers with plenty of vegetation. They prefer clear water where they can find shelter to hide. They tend to stay near the shore and can be found in numbers within shallow and protected areas. They are active during the day and rest near the bottom in protected or covered areas such as submerged logs during the night. They will feed at all water levels from the surface to the bottom in the daylight, and their heaviest feeding time will be in the afternoon. Among their favourites are insects, mosquito larvae, small molluscs and other crustaceans, worms, minnow fry and even other smaller pumpkinseeds. Occasionally they will feed on

small pieces of vegetation as well. They have a terminal mouth, allowing it to open at the anterior end of the snout. Pumpkinseed sunfish that live in waters with larger gastropods have larger mouths and associated muscles in order to crack the shells of the larger gastropods. This is the case in the Prespa Lakes. Once water temperatures reach 12-18oC in the late spring or early summer, the male pumpkinseeds will begin to build nests. Nesting sites are typically in shallow water on sand or gravel lake bottoms. The males will use their caudal fins to sweep out shallow, oval-shaped nesting holes that stretch about twice the length of the pumpkinseed itself. The fish will remove debris and large rocks from their nests with their mouths. Nests are arranged in colonies consisting of about 3-15 nests each. Male pumpkinseeds are vigorous and aggressive and will defend their nests by spreading their opercula. Females arrive after the nests are completed, coming in from deeper waters. The male then releases milt and the female releases eggs. Females may spawn in more than one nest, and more than one female may use the same nest. Also, more than one female will spawn with a male in one nest simultaneously. Females are able produce 1 500 to 1 700 eggs, depending on their size and age. Once released, the eggs stick to gravel, sand, or other debris in the nest, and they hatch in as little as three days. Females leave the nest immediately after spawning, but males remain and guard their offspring. The male guards them for about the first 11 days, returning them to the nest in his mouth if they stray from the nesting site. **Distribution:** Widely spread and world-wide. **Fishing significance:** Low, considered as a pest. **Impacts**: Invasive species. **Management**: Possible ameliorative fishing.

Silurus glanis – Wels, Catfish

Description: This is a large catfish found in wide areas of central, southern, and Eastern Europe, and near the Baltic and Caspian Seas. It is a scaleless fresh and brackish water fish recognizable by its broad, flat head and wide mouth. Wels catfish can live for at least thirty years and have very good hearing. It is distinguished from all other freshwater fishes in Europe by the following unique characteristics: two pairs of large barbells; anal fin with 83-91½ rays; large body, depressed head; dorsal fin with 2-4½ rays; caudal fin rounded or truncate; no adipose fin; and anal rays almost touching caudal. Caudal fin with 17 rays. It has very slippery green-brown skin. Its belly is pale yellow or white. The colour varies with the aquatic environment. Clear water will give the fish a black coloration while muddy water will often tend to produce brownish specimens. The weight and length are not correlated linearly, and also depend on the season. **Biology:** This fish inhabits large and medium sized lowland rivers, backwaters and well vegetated lakes. It occurs mainly in large lakes and rivers, though occasionally enters brackish water in the Baltic and Black Seas. The female produces up to 30 000 eggs per kilogram of body weight. The male guards the nest until the brood hatches, which, depending on water temperature, can take from three to ten days. If the water level decreases too much or too fast the male has been observed to splash the eggs with the muscular tail in order to keep them wet. With a possible total length up to 3m and a maximum weight of over 150 kg it is the largest freshwater fish in the region. Most wels catfish are about 1.3-1.6 m long; fish longer than 2 m are normally extremely rare. At 1.5 m they can weigh 15–20 kg and at 2.2 m they can weigh 65kg. They feed on worms, gastropods, insects, crustaceans, and fish including other wels catfishes; the larger ones also eat frogs, mice, rats and aquatic birds such as ducks. It attains first sexual maturity at 2-3 years of age. **Distribution:** Europe and Asia. North, Baltic, Black, Caspian and Aral Sea basins, as far north as southern Sweden and Finland; Aegean Sea basin in Maritza and from Struma to Sperchios drainages; Turkey. Absent from the rest of Mediterranean basin. It is now widely introduced and translocated through Europe and Lake Balkhash basin in Kazakhstan. Several countries report adverse ecological impacts after its introduction. It was

introduced into Macro Prespa in 1986. **Fishing significance:** Although of high commercial value, in Prespa Lakes its population is very low and thus the fishing is low rated.

Pseudorasbora parva - stone moroko

Description: Stone moroko is an alien species that belongs to the Cyprinidae - carp family. It was introduced into the Prespa Lakes in the 1970's. It has an elongate body, slightly flattened on sides, resembling that of the species of the genus *Gobio*. It has a maximum size of up to 110 mm, though most individuals are 80-90 mm in length and 17.1-19.2 g in weight. The life span is up to 3-4 years. The head is somewhat flattened in its anterior part. The mouth is clearly in the top position. The dorsal and anal fins are short. The caudal fin is large and deeply incised, with both parts of similar size. The ventral fins are located slightly anterior to the dorsal fin. The throat is covered with scales. The lateral line is complete, running in the middle of the sides. The scales are large and cycloidal. The number of scales in the lateral line are (34) 35-38 (39). The coloration is similar in both sexes, with grey back, light sides and belly, passing from yellowish-green to silver. Young individuals have a dark stripe along the body sides; it disappears with age. In the caudal part of the scales the pigment forms characteristic lunate spots. The fins are pale, light yellow, only on the dorsal fin there is a darker stripe, running obliquely backwards. **Biology:** It is zooplanktivorous fish and found in a wide variety of habitats, most abundantly in well vegetated small channels, ponds and small lakes. Adults are found in cool running water. They feed on small insects, fish and fish eggs, and plant material and usually breed in habitats with still or very slow-flowing water. It is regarded as a pest which competes with the fry of other species due to its high reproductive rate. The sexual dimorphism becomes pronounced during spawning. In males breeding tubercles appear on the head. The greatest accumulation of sharp tubercles is located in the anterior part of the head, on the front, near the nostrils and below and above the eye. Few tubercles are observed on the lower lip. In that period the males darken distinctly and their fins become black while the operculum gets violet. The females become clearly lighter. Spawning takes place when 1 year old. In the Amur River basin - Asia (its origin) the spawning starts when the water reaches the temperature of 15-19oC (May-August), whereas in Europe it spawns earlier - in April-June. It can produce from a few hundred to a few thousand eggs. The spawning is multi-litter and takes place in the littoral zone. The eggs are laid on plants, sand, stones, mollusc shells and other substrata. Before spawning the female carefully cleans the substratum for egglaying. During one act it lays up to several dozen eggs. One male may spawn with a few consecutive females. The male guards the eggs until hatching, and aggressively drives away other, often larger fishes. **Distribution:** It is originally from Asia: Amur to Zhujiang [Pearl River] drainages in Siberia, Korea and China. It was introduced to various areas in Europe and Asia. Several countries report adverse ecological impacts after introduction. In Prespa Lakes has been introduced by means of imported stocking material in the surrounding carp culture ponds. **Fishing significance:** No. **Impact**: In open waters it has probably contributed to a decrease in abundance or even disappearance of some autochthonous cyprinids. **Management**: Stocking material imported for fish farms or in order to stock open waters should be carefully checked especially to ensure the absence of this invader. Additionally, using the stone moroco as live bait for predatory fish should be stopped.

Rhodeus amarus - Bitterling

Etymology: The name is derived from the Greek word rhodeos, meaning "rose" and the Latin *amarus* meaning "bitter". **Description:** It is a relatively small fish from the carp family (Cyprinidae), introduced in Prespa Lakes in the 1990's The dorsal spines (total): 3; Dorsal soft rays (total): 8-10; Anal spines: 3; Anal soft rays: 8-10; Vertebrae: 34 - 36. Caudal fin with 19 to 20 soft rays. **Biology:** It occurs most abundantly in still or slowflowing water with dense aquatic vegetation and sandy-silty bottom as lowland ponds, canals, slow-flowing rivers, where mussels are present. It is also found amongst plants over sand and muddy bottoms in shallow waters. It is remarkable for its habit of deposing its eggs in the cavity of bivalves (Unio). It feeds mainly on plants and to a lesser degree on worms, crustaceans, and insect larvae. The life span is exceptionally up to 5 years but most individuals do not survive the year of their first reproduction and population sizes fluctuate greatly over the years. Of interest is that the fish was formerly used for pregnancy testing of humans. A urine sample from pregnant women was injected into female fish and this protruded their ovipositors if the test was positive. **Distribution:** Europe: Basins of North, southern Baltic, Black, western and southern Caspian and Aegean Seas (from Maritza to Struma drainages); Mediterranean basin, only in northern Rhône (France) and Drin drainages. Abundant and expanding in most of its range, but locally threatened by water pollution, weed clearing, and stocking of predatory fish. **Fishing significance:** No significance. In Prespa Lakes the population is very low. **Impact**: Interferes with the native fishes on food competition. **Management**: Ameliorative fishing.

Tinca tinca – Tench

Description: The tench or 'doctor fish' (*Tinca tinca*) is an alien freshwater and brackish water species of the Cyprinidae family, introduced into the Prespa Lakes in the 1980's. Tench are a heavy-built, thick-set fish with a small barbell at each corner of the mouth. The colour ranges from deep blackish-olive to pale golden tan, with a bright reddish eye. The body is slimy, with small scales being covered by a thick layer of mucus. Very large specimens may reach 800 mm. **Biology:** The tench is most often found in still waters with a clay or muddy substrate and abundant vegetation. This species is rare in clear waters across stony ground, and is absent altogether from fast-flowing streams. It tolerates water with low oxygen concentrations, being found in waters where even the carp cannot survive. Tench feed mostly at night with a preference for fauna like chironomids (insects) on the bottom of eutrophic waters and snails and pea clams in well vegetated waters. It can live up to 20 years. It spawns for the first time at 2-6 years and 70-250 mm SL, females a year later than males. The pelvic rays ape more robust, longer and extending beyond the anus in the male. It spawns in May-October, in Central Europe usually in June-July, at temperatures above 19oC, mostly at 22-24oC and as many as 300 000 eggs may be produced. Several males follow each female, which releases eggs in several portions above vegetation. Females may spawn 1-9 times each year, every 11-15 days, if suitably warm weather persists. A high embryonic mortality is observed when the temperature fluctuates strongly. The larvae and juveniles are restricted to dense vegetation. They are tolerant to low oxygen concentrations and salinities of up to 12 ‰. They feed upon detritus, benthic animals and plant material. The adults often feed predominantly on molluscs. Breeding takes place in shallow water usually among aquatic plants where the sticky green eggs can be deposited. Growth is rapid, and fish may reach a weight of 0.11 kg within the first year. **Distribution:** They are found throughout Eurasia from Western Europe including the British Isles east into Asia as far as the Ob and Yenisei Rivers. They are also

present in Lake Baikal and normally inhabit slow-moving freshwater habitats, particularly lakes and lowland rivers. They were only recently introduced into the Prespa Lakes. **Fishing significance:** No. It has very low population number. **Impacts**: Impacts specific to tench are difficult to find, as this species is often lumped together with others in the Cyprinidae family, such as koi and common carp. The ability of tench to survive in a degraded environments causes some confusion, as it is unclear whether they contribute to this degradation or simply inhabit a niche that native fish cannot occupy. Some experimental studies showed that they can increase periphyton (algal) biomass through selective predation on gastropods (clams, snails), which keep periphyton under control through grazing. This 'trickle-down' effect could have negative impacts on aquatic communities if it occurs to a significant extent in the wild. There is no evidence that they affect other fish directly, however, a number of studies have implicated them in water quality decline. **Management**: Possible ameliorative fishing.

5. STATUS OF STOCKS

5.1. Quantitative and qualitative composition of fish population

Nineteen species of fish are present in the Prespa Lakes at the current time. Eleven of these are indigenous, while the remaining eight are alien species that have been introduced. (Five other alien species were recorded in the second half of the twentieth century but these are no longer found amongst the fish fauna of the lakes.)
The most widely distributed species of fish in the Prespa lakes at the current time belong to the carp family (*Cyprinidae*). Other native species found are as follows: *Salmonidae* – trout (1); *Cobitidae* – loaches (1); Anguillidae - eels (1).
Alien species introduced into the lakes include the following: *Siluridae* – wells (1); *Poecilidae* (1); *Centrachidae* – perches (1).

The Prespa Lake, taking in consideration the composition of its fish population is typically cyprinid lake. Besides the presence of cyprinid fishes, the Lake contains exemplars of river trout *Salmo peristericus*, coming from the rivers Brajchinska, Kranska, Leva and Agios Germanos.

From the native fishes the family Cyprinidae includes 8+1 species: *Rutilus prespensis* - roach, *Pelasgus prespensis* – Prespa minnow, *Squalius prespensis* - chub, *Phoxinus lumaireul* - Eurasian common minnow, *Chondrostoma prespense* - Prespa nase, *Barbus prespensis* – Prespa barbell, *Alburnus belvica* - belvica (nivichka), *Alburnoides prespensis* – Prespa spirlin (shlunec) and *Cyprinus carpio* – carp (which anyway is introduced – alien species, but being present more than 2000 years, in the fishery practice it is accepted as native one).

The family of loaches (Cobitidae) is presented by one species, the stone loach *Cobitis meridionalis*.

The family Anguillidae is presented by one species, the European eel *Anguilla anguilla* (L.).

As far as allochthonous (introduced species) are concerned, for more than 12 years we can notice the presence of the catfish *Silurus glanis* and there are some caught exemplars weighting up to 36 kilograms.

The prucian carp, *Carassius gibelio* has been present for more than two decades and can also be fished.

The sunfish *Lepomis gibosus* is present more than one decade and it is very common since it can be caught in all fishing nets.

Also *Pseudorasbora parva* – stone moroko, *Gambusia holbrooki* – mosquito fish, *Rhodeus amarus* – bitterling and *Tinca tinca* – tench are present alien species in the Prespa fish fauna.
Apart from the above mentioned aliens, during the past another 5 species were recorded as present for a certain period of time. These are: *Salmo letnica* – Lake Ohrid trout, *Oncorhynchus mykiss* - rainbow trout, *Parabramis pekinensis* – white Amur bream, *Ctenopharingedon idella* – grass carp and *Hypophthalmichthys molitrix* – silver carp. None of them can be found at present.

From the aspect of commercial fishery the Prespa fishes are of relatively low market valued species, compared to the neighboring Lake Ohrid, where the trout species are with much

higher market prices.

As in the case with other natural lakes, the Prespa Lake has also suffered from great changes regarding the fish ecology and especially regarding the spawning of the bleak and the carp. In the past the alburnus was spawning near the coast of the Lake, nowadays the alburnus is spawning in the middle areas of the Lake. The carp is in similar situation, varying from year to year.

5.2. Fish catch statistics

There is a fishery statistics for Prespa Lakes regarding fish species dated from 1946 for the Macedonian part of the Lake, from 1954 for the Albanian part of the Lakes and from 1973 for the Greek side of the Lake.

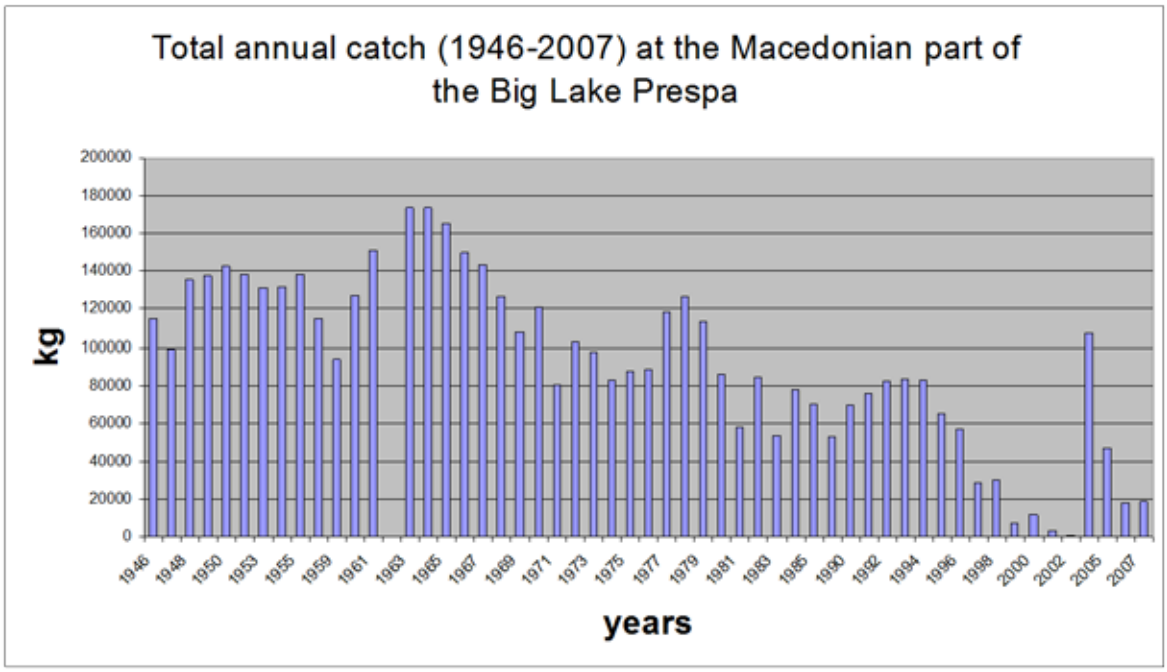


Figure ????? Total annual catch (1946-2007) at the Macedonian part of Macro Prespa.

Although fishery was very significant in the Macedonian part of the Prespa area, since 2007 there is total ban (moratorium) on it. Previosly more than 70 professional fishermen were present at Macro Prespa. There is a fishery in the Albanian part of the Macro Prespa Lake for which there are fishery statistics from 1954 until today.

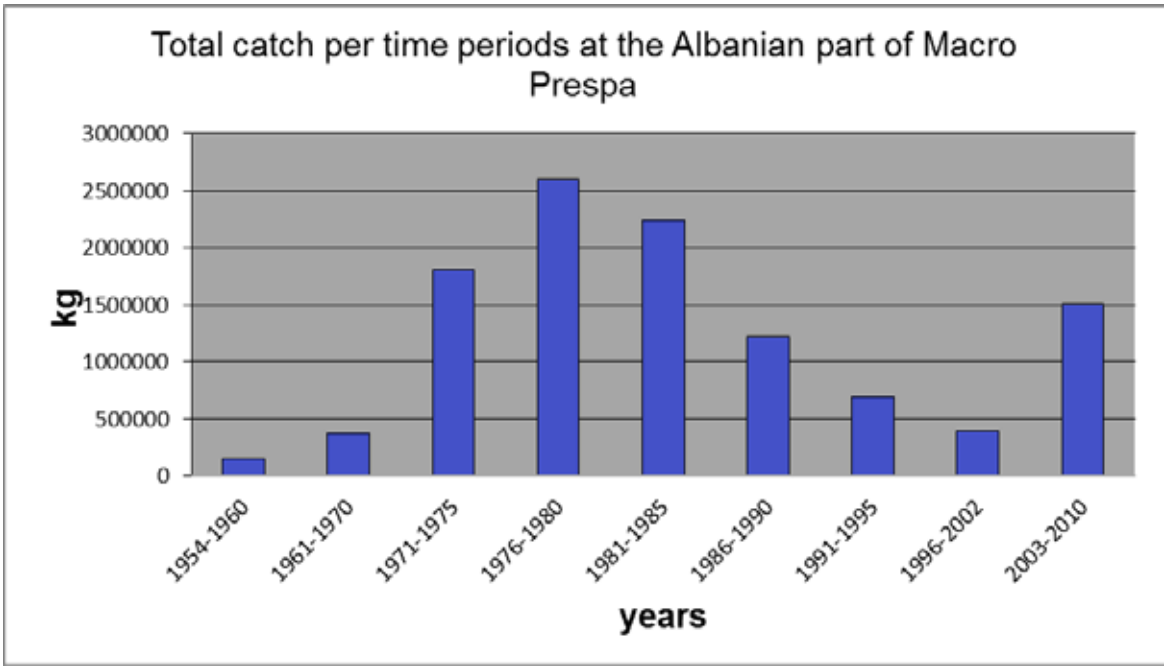


Figure ????? Total catch per time period (1954-2010) at the Albanian part of Macro Prespa.

Data (1973–1990) on the fishery in the Greek part of Lake Makro Prespa are showing that the mean production in these 17 years was 126.2 t /y (range 12.5–276.8 t/y) equivalent to a mean yield of 33.5 kg/ha/y (range 3.3–73.5). Production fluctuated enormously from one year to another, and showed a slight tendency to decrease towards the end of the 1980s.

Prespa bleak accounted for two-thirds of the catch, the remaining third consisting of four Cyprinidae (*Leuciscus, Chondrostoma, Rutilus* and *Barbus*) and carp. Prespa bleak in Makro Prespa are only caught using the 'Pezovola' fishing method during winter nights (December–March) at the deepest parts of the lake. The other fish species are caught using gill and trammel nets.

During the last twenty years, trout have always been captured in small quantities (between 5 and 100 kg /y in the Greek part of the lake.

There is a fishery in the Albanian part of the Micro Prespa Lake (500 ha) for which there are fishery statistics from 1954 until today.

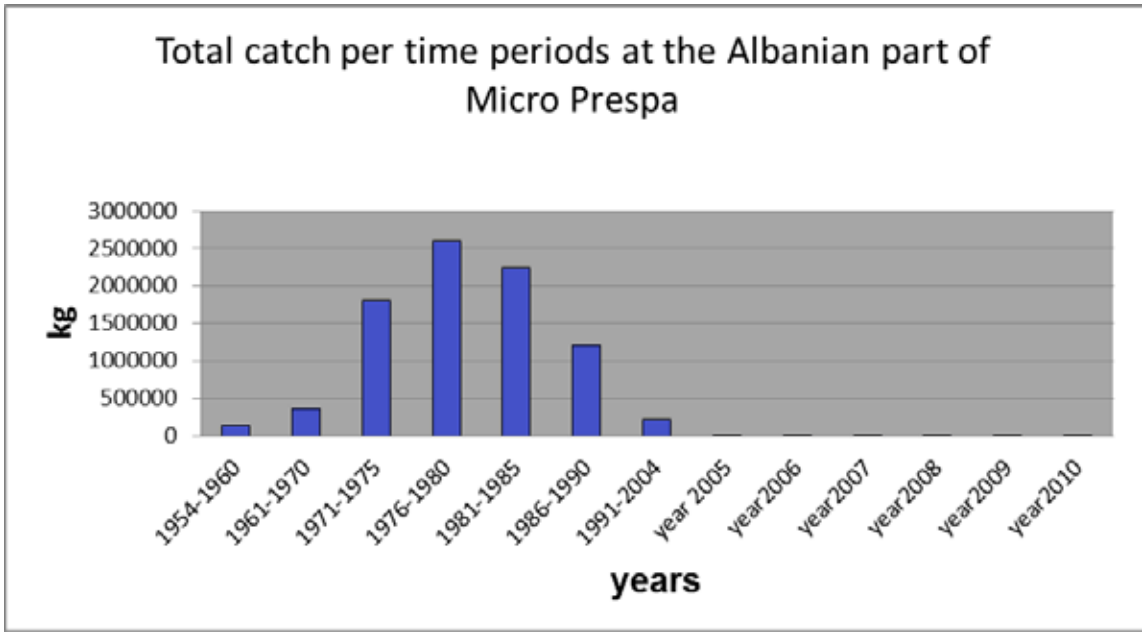


Figure ????? Total catch per time period (1954-2010) at the Albanian part of Macro Prespa.

Annual yield of the commercially most important fish species at Macro Prespa on the Macedonian part (MK) and Albanian part (AL) in kg per hectare

SPECIES	kg/ha	
	MK	AL
bleak	14.3	33.1
carp	4.4	4.2
roach	1.32	
Prussian carp	1.1	0.9
Other	0.88	1.12
TOTAL	22	39.32

Table ????? Annual yield of commercially most important species at Macro Prespa.

The production of the Mikri Prespa fishery at the Greek side, crashed in the 1960s and has continued to decline since, reaching its nadir in 1989 (34.6 t/y), the last year for which there are statistics. The mean production over 26 years was 183.8 t/y (range: 34.6–488.6) equivalent to a mean yield of 38.0 kg /ha/y (range: 7.1– 100.9).

The species composition of catches, unfortunately only available since 1973, shows that the Prespa bleak, plus four other Cyprinidae (*Leuciscus, Chondrostoma, Rutilus* and *Barbus)* and carp dominated. One of the introduced species, the goldfish, appeared in the fishery statistics in 1984, and has continually increased since.

5.3. Commercial and noncommercial species

One of the oldest used for this purpose is fishery statistics, which can give rough data about the relative abundance, but mainly on the commercial valued species. It is also adequate for population trends, but it is in direct dependence of the fishing pressure to particular fish species and market demand.

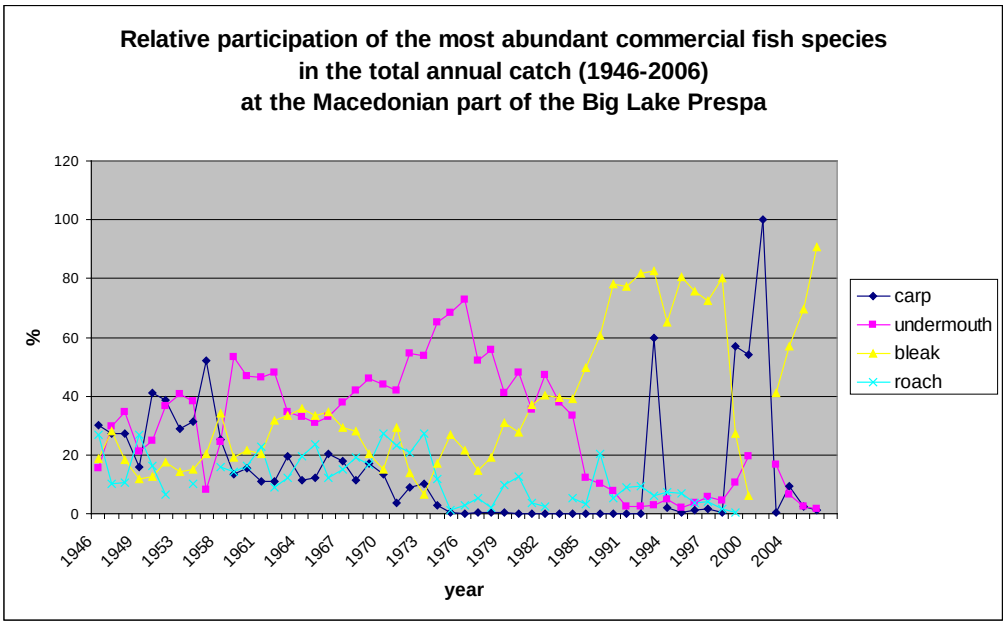


Figure ????? Relative participation of the most abundant commercial fish species in the total annual catch (1946-2006) at the Macedonian part of Macro Prespa.

As far as economically more important fishes are concerned, the bleak is dominant species with 65% of the total ichtyomass, than the carps with 20%, pearl roach 6%, prussian carp with 5%, and 4% for the other fish species. The sunfish has not been taken in consideration.

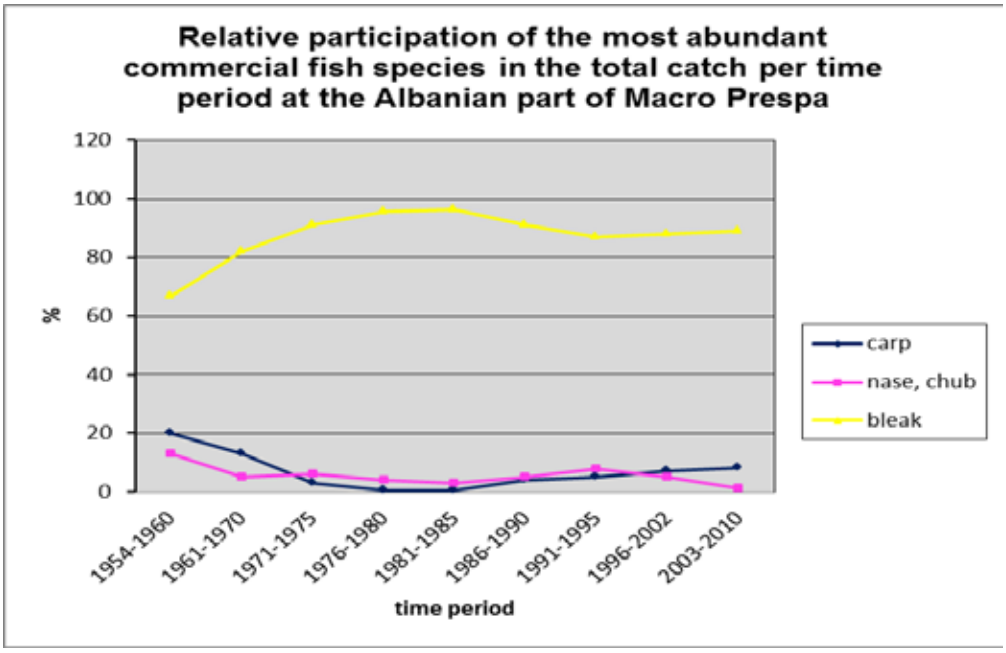


Figure ????? Relative participation of the most abundant commercial fish species in the total catch per time period (1954-2010) at the Albanian part of Macro Prespa.

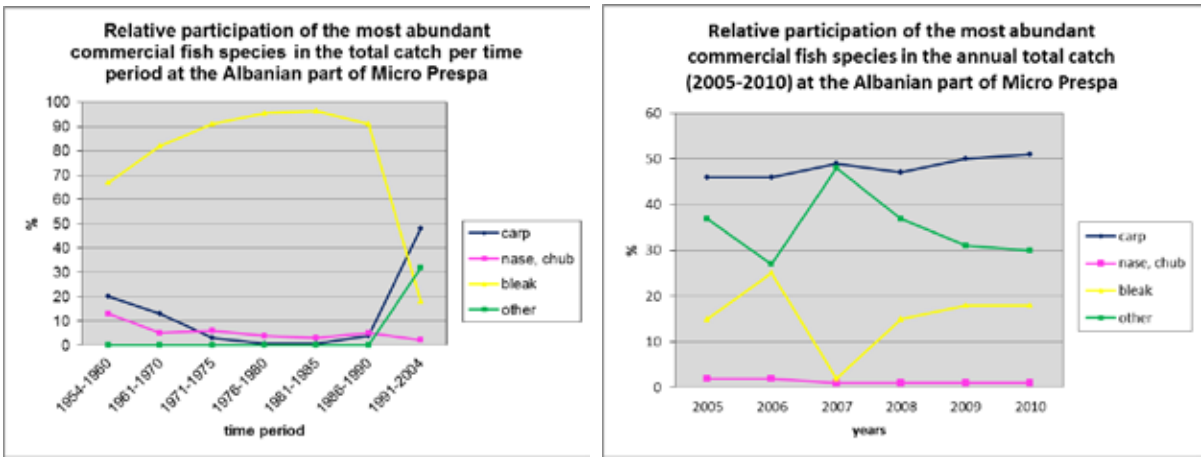
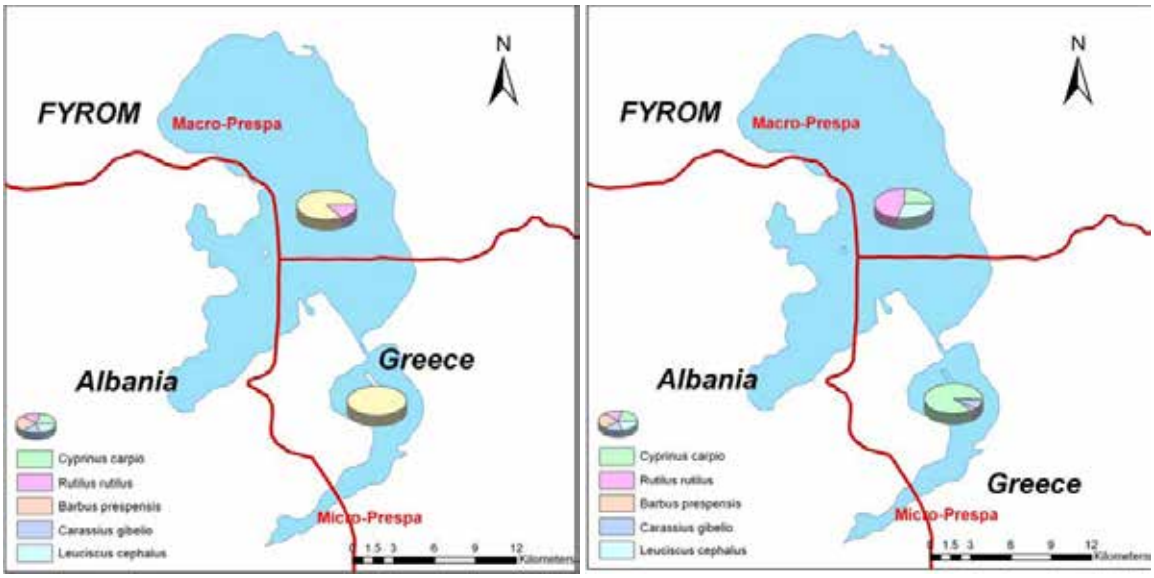


Figure ????? Relative participation of the most abundant commercial fish species in the total catch per time period (1954-2004) at the Albanian part of Micro Prespa.

Figure ????? Relative participation of the most abundant commercial fish species in the total annual catch (2005-2010) at the Albanian part of Micro Prespa.



1994 1999

Figure ????? Comparison of species composition 1994/1999 of Prespa Lakes. Source: Andreopoulou S.Z., Kokkinakis K.A., and Mallinis G., (2008)

The fisheries statistics from Fisheries Department on the Greek side that they have are inaccurate and unreliable due to the fact that there was no systematic monitoring of the fishermen's catch from Micro and Macro Prespa. The data that they have are based on their estimations and not real data. You see the two lakes never had a concessionaire (like other lakes), so the fishermen never declared their catch to anyone. The Micro Prespa was also the core area of the National Forest until 2009 and fishing wasn't allowed in the lake, though illegal fishing always existed and the Macro Prespa had a concessionaire only for a period of 4-5 years.

5.4. Stocking

In the Zvezda village (Albanian part) there is a state owned carp hatchery which uses autochthonous carp brood stock in order to produce fingerlings that are used to repopulate the lake (this hatchery produces annually nearly 300.000 fingerlings and 200.000 fry).

Figure???? The carp hatchery in Zvezda (Albania)

On the following graphs stocked quantities for Macro and Micro Prespa from 1971 are presented.

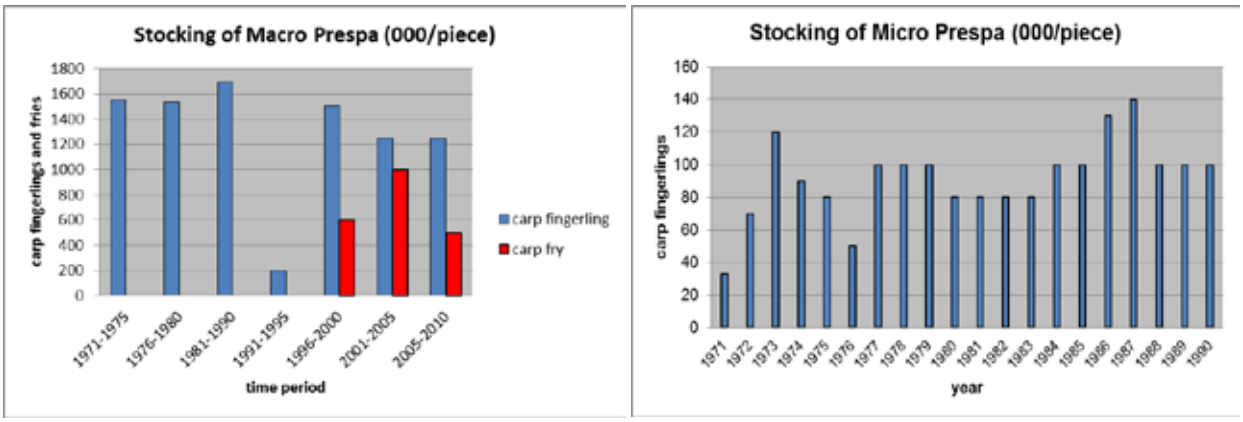


Figure ????? Macro Prespa stocked quantities of carp fingerlings and fries (1971-2010).

Figure ????? Micro Prespa stocked quantities of carp fingerlings (1971-1990).

No stocking of Micro Prespa was done after 1990.

5.5. Species distribution

Nineteen taxa of fish are present in Prespa Lakes and the proportion of endemism in the fish populations of the Prespa Lakes is remarkable.

5.5.1 Migration paterns

Related to temperature requirements, all of the other Prespa fish belongs to so called "warm water" fishes with the exception of Prespa trout, which is "cold water" species as all of the trouts.
The fish from Prespa Lakes, similar to the other lakes in the subtropical area, have three general migration patterns, which are reflected by the temperature, food availability, and life history.
Thus, with worming of the lakes temperature above 12 ^{o}C in April, most of the fish start gathering for spawning in the shallower parts of the lakes prevailing in the reed belts and zones of other submerged vegetation. In the past before the drastic shrinking of Prespa Lake water volume, significant part of the Prespa bleak (belvica, tzironka) spawns even on the sandy beaches.

The spawning season for most of the present fish species in the lakes is within the period April – June, with exception of the trout which spawns in the rivers from November – March. Another exception is the alien species *Lepomis gibbosus* (pumpkin seed) which spawns twice in the year – spring and autumn.
The summer and early fall periods are those when the second pattern of migration – moving to the pelagic waters - abandoning the shallower parts of the lakes is present among the bleak, roach, carp, barbell, nase, and chub. Unlike them, all other minnow fish and eel and wells are remaining in the littoral zone.
The offspring of all of the fish spawning in the lake remains certain time into the upper littoral zone moving along the shore.
The third pattern is the hibernating period spanning from late autumn till early spring which is affecting most of the fish species, with exception of the Prespa trout in the rivers and those rarely present in the lake.

Figure ???? Global bathymetric map of Prespa Lakes

5.5.2. Spawning grounds

Prespa bleak during most of the life span stays in the open waters. Usually it forms large shoals which move under the water surface. During the winter period large groups of individuals are sheltered at certain places protected from the wind and waves. The bleak migrates to spawning sites in tributaries and along the lake shore (on pebbles and gravel in the surf zone) during the night in small and large shoals, where there are only one or two females. All the other are males.

Figure?????? Spawning grounds of Prespa bleak (*Alburnus belvica*)

Prespa roach is a lacustrine species which is found along shores and in shalow, swampy areas. It spawns in lakes in May-June usually at water temperatures of 16- 18°C. The eggs are sticky and cling to the substrate.

Figure?????? Spawning grounds of Prespa roach (*Rutilus prespensis*)

Carp according to the spawning substrate belongs to the phytophylic ecological group of fish (spawning on aquatic vegetation). The time of spawning is quite extended and sexually mature individuals can be found at the end of April when water temperatures in the coastal regions are higher than 18°C, until the end ofJune.

Figure?????? Spawning grounds of carp (*Cyprinus carpio*)

Prespa barbell most of its life spends in the lakes except during reproduction (late April-July) when it migrates into tributaries to spawn. In the catchment basin of Macro Prespa, the Agios Germanos stream (Greek side), Brajcinska, Golema and Kranska River Bolnska River (Macedonian side) are important spawning ground for the species.

Figure?????? Spawning grounds of Prespa barbell (*Barbus prespensis*)

Regarding migration patterns among the Prespa fishes, there is another specification, which perhaps is unique in the region and wider. Namely, River Bolnska, which is situated in the East part of the Macro Prespa basin at the Macedonian side, in the past with a surface inflow into the lake, several years ago and at present seepages into the ground and it appears again on the surface (not every year) just before the entering in the lake in its old river bed. This is as a result of increasing the numbers of wells in the surroundings of the river, which are used for irrigation of the apple orchards.
In the upper part of this river has been evidenced self sustainable population of Prespa barbell in a very good population condition.

Prespa Nase, chub and loach are overlapping the spawning grounds and migration patterns with Prespa barbell, so protection of barbel offers protection of nase, chub and loach, too. This is very important especially for *Squalius prespensis*, which is as barbel for high interest for fisheries

Pumpkinseed is the most abundant and widely distributed alien species in both Macro and Micro Prespa. These fish prefer clear water where they can find shelter to hide. They tend to stay near the shore and can be found in numbers within shallow and protected areas. Nesting sites are typically in shallow water on sand or gravel lake bottoms surrounded by submerged vegetation.

Figure?????? Spawning grounds of pumpkinseed (Lepomis gibbosus)

Below is presented almost regular species distribution – native species prevalence during the beginning of the summer period and prevalence of alien species during the end of the summer period which are related to the natural spawning grounds and presence of the species in the littoral area.

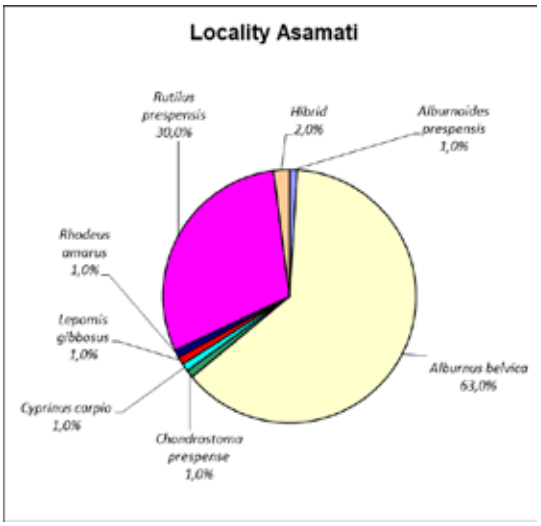


Figure ????? Species distribution –June

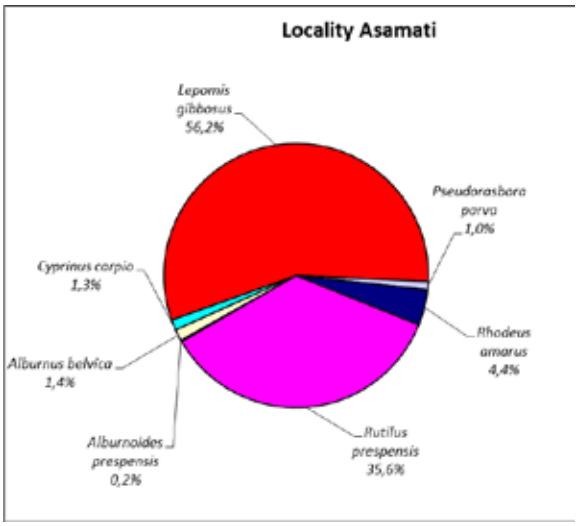


Figure ????? Species distribution -September

June		**September**	
Alburnus belvica	**0,88008**	Alburnus belvica	**0,817119**
Alburnoides prespensis	**1,027188**	Alburnoides prespensis	**1,090467**
Rutilus prespensis	**1,094072**	Rutilus prespensis	**1,042163**
Chondrostoma prespense	**0,852**	Cyprinus carpio	**1,415902**
Cyprinus carpio	**1,369547**	Squalius prespensis	**1,018356**
Rhodeus amarus	**1,066667**	Rhodeus amarus	**1,199538**
Lepomis gibbosus	**1,399737**	Lepomis gibbosus	**1,697316**
		Pseudorasbora parva	**0,969892**

Table ??? Species condition factor –June Table ??? Species condition factor –September

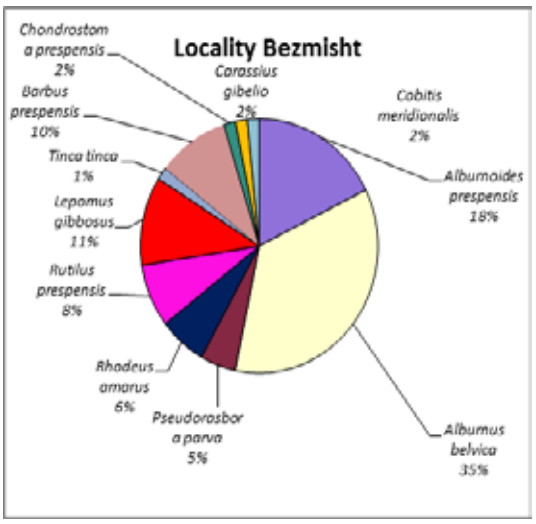


Figure ????? Species distribution –June

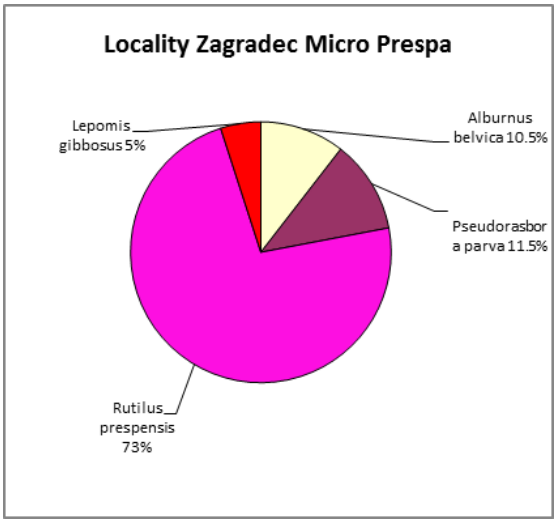


Figure ????? Species distribution –September

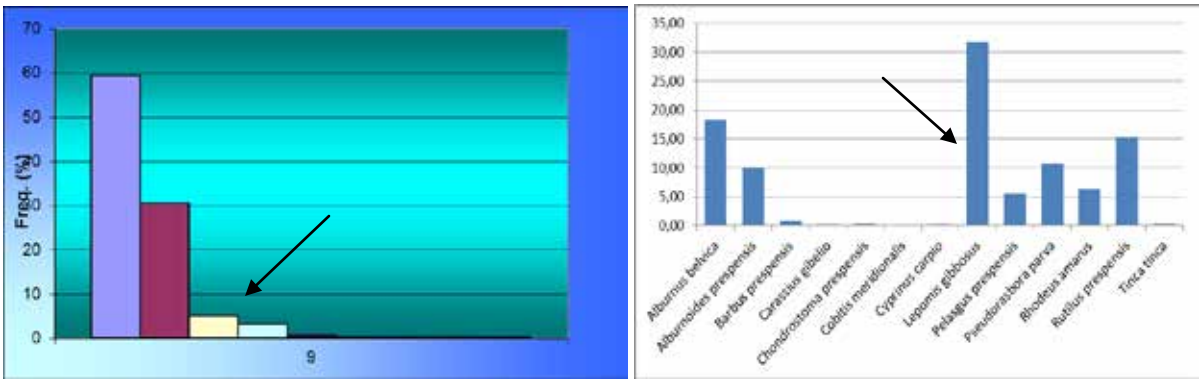


Figure ?????? Comparison of *Lepomis gibbosus* abundance (2006 –2011)

Prespa trout is the tributary inhabitant present in four streams of Macro Prespa Basin : Agios Germanos (Greek part), Brajcinska, Kranska and Golema Reka (Macedonian part). In the Albanian part of Macro Prespa there are no perennial streams, and therefore no trout populations. All populations in the separated river basins are isolated from each other.

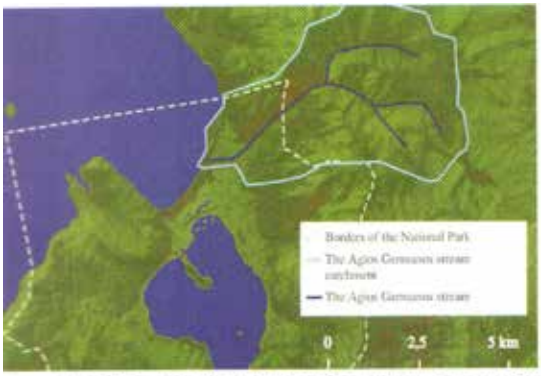


Figure 2 : Agios Germanos River Watreshed, Greece (Catsadorakis et al. 1996)

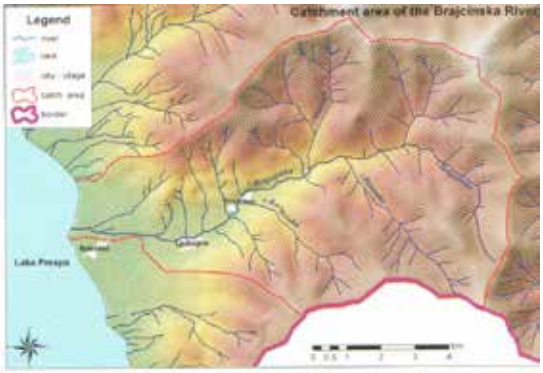


Figure 3: Brajcinska River Watershed (Petkovski et al. 2007)

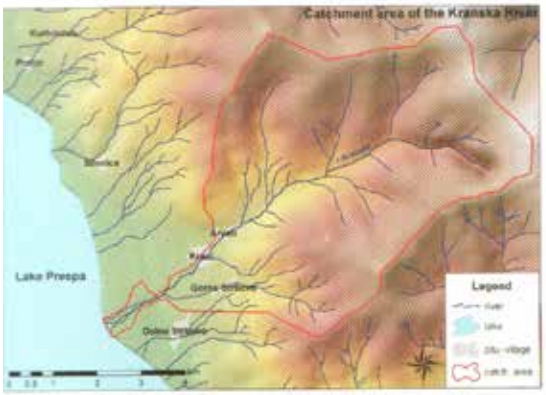


Figure 4: Kranska River Watershed (Petkovski et al. 2007)

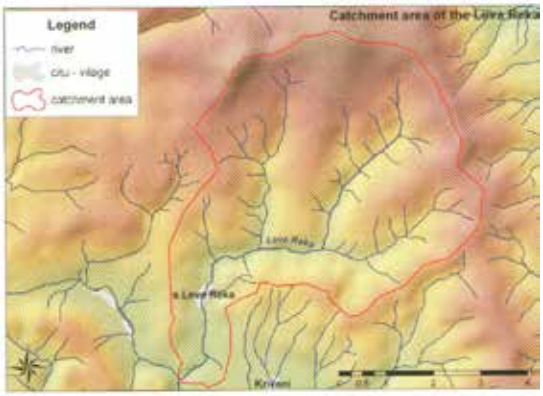


Figure 5: Leva Reka Stream Watershed (Petkovski et al. 2007)

Figure ???? Agios Germanos, Brajcinska, Kranska and Leva Reka Watersheds. (Crivelli, A. J., Koutseri, I. & Petkovski. 2008)

Site and stations	Years (number of stations)	Surface Sampled (m^2)	Length sampled (m)	Mean N trout (>1+/ha)	Mean N trout (>1+/100 m of stream)
Brajcinska basin streams and tributaries					

Main River	2006 (2)	858	205	664	28
	2007 (4)	1468	405	660	24
	2011 (2) autumn	646	200	557	18
Baltanska	2006 (1)	220	100	136*	3
	2007 (2)	474	210	42*	1
	2011 (1) autumn	215	100	604	13
Rzanska	2007 (2)	455	200	1121	26
	2011 (1)spring	325	100	769*	25
	2011 (1) autumn	154	100	2467	38
Drmisar	2007 (2)	490	210	878	20
Kriva kobila	2007 (1)	263	105	1709	43
	2011 (1)spring	400	100	325*	13
	2011 (1) autumn	180	100	1333	24
Kranska basin streams and tributaries					
Main River	2006 (1)	289	98	519	15
	2007 (4)	1298	408	593	19
	2011 (1) autumn	596	100	336	20
Reciste	2011 (1)spring	212	100	377*	8
	2011 (1) autumn	138	100	942	13
Upper Kranska	2007 (1)	287	100	174*	5
Srbina	2007 (1)	268	113	485	12
	2011 (1)spring	250	100	200*	5
	2011 (1) autumn	200	100	1750	35
Leva Reka tributaries					
Main River	2011 (2) autumn	234	200		1
Sredna	2007 (2)	431	200	186*	4
	2011 (1)spring	263	100	38	1
	2011 (1) autumn	140	100	0	0
Biglicka	2011 (1)spring	296	100	101	3
	2011 (1) autumn	100	100	0	0
Agios Germanos basin streams and tributaries					
Left arm	1998 (2)	680	200	530	18
	2000 (2)	538	200	167*	5
	2005 (2)	538	200	130*	4
	2006 (2)	538	200	205	6
	2007 (2)	538	200	74*	2

Right arm	1998 (8)	2920	813	1009	36
	2000 (8)	2476	813	343	10
	2005 (8)	2476	813	391	12
	2006 (8)	2476	813	966	29
	2007 (8)	2476	813	452	14
*The viability of populations with such low densities is questionable *Differences in the population number expressed in this table per surface stream area das not expressing the population density per water quantity.					

Table ????? Trout densities in all river/stream tributaries (1998-2007 from Crivelli, A. J., Koutseri, I. & Petkovski. 2008)

Prespa trout is found very rarely in the fishermen catch in Macro Prespa and there are no records of trout catch for Micro Prespa.

5.6. Fish health

5.6.1. Intermediate parasite host

Some of the zooplankton species are intermediate hosts of certain fish parasites, found in Prespa Lakes as well.

Identified fish parasites

One part of the established parasites has a wide range of spreading, and a wide spectrum of hosts, such as: *Myxobolus dispar, Ichthyophthirius multifilis, Dactylogyrus extensus, Diplostomum sp., Tylodelphis clavata, Posthodiplostomum cuticola, Ligula intestinalis, Cystidicoloides tenuissima, Raphidascaris acus, Ergasilus sieboldi* etc. The other part of the established parasites is stenoparasites or is on the border of stenoparasitizm, such as the majority of species from the genera *Dactylogyrus* and *Gyrodactylus.* The presence of 6 parasite species is recorded for the first time in the fish parasite fauna from the Lake Prespa and Macedonia: *Dactylogyrus sp.* (in *Alburnus belvica*), *Gyrodactylus sp.* (*in Salmo peristericus*), *Diplozoon sp.* (in *Squalius prespensis*), *Diplozoon sp.* (in *Chondrostoma prespense*), *Diplostomum sp.* (larvae) (in *Rutilus prespensis*), *Diplostomum sp.* (larvae) (in *Alburnus belvica*) and *Tylodelphis clavata*.
Findings of the following parasites in their fish hosts are the first for Lake Prespa and Macedonia: *Posthodiplostomum cuticola* (larva) in *Pseudorasbora parva* and *Pelasgus prespensis; Ergasilus sieboldi* in *Pelasgus prespensis; Ichthyophthirius multifiliis* and *Ligula intestinalis* (larva) in *Rhodeus amarus.*

Parasite species	% of infested fish
Myxobolus dispar	1.22
Ichthyophthirius multifiliis	8.54
Total infestation - Protozoa	**9.76**
Dactylogyrus alatus f. typica	2.44
Dactylogyrus elegantis	2.44
Dactylogyrus erhardovae	2.44
Dactylogyrus extensus	6.10

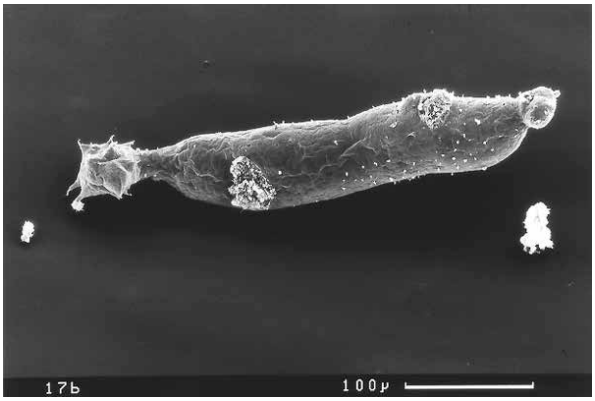
Dactylogyrus minor	3.66
Dactylogyrus sphyrna	6.10
Dactylogyrus sp. (in Alburnus belvica)	1.22
Gyrodactylus sp. (in Salmo peristericus)	6.10
Diplozoon sp. (in Squalius prespensis)	3.66
Diplozoon sp. (in Chondrostoma prespense)	1.22
Eudiplozoon nipponicum	7.32
Paradiplozoon alburni	1.22
Total infestation - Monogenea	**34.17**
Nicolla testiobliqua	1.22
Diplostomum sp. (larva, in Rutilus prespensis)	1.22
Diplostomum sp. (larva, in Alburnus belvica)	3.66
Tylodelphis clavata	17.07
Posthodiplostomum cuticola (larva)	48.78
Total infestation - Digenea	**63.41**
Ligula intestinalis (plerocercoid)	3.66
Total infestation - Cestoda	**3.66**
Cysticoloides tenuissima	2.44
Raphidascaris acus (larva)	7.32
Total infestation - Nematoda	**9.76**
Ergasilus sieboldi	15.85
Total infestation - Arthropoda	**15.85**
TOTAL INFESTATION – ALL FISH	**74.39**

Table ????. Prevalence of infestation with established species of parasites

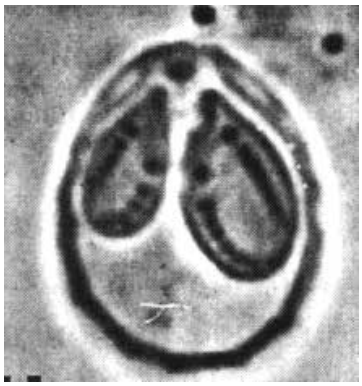
The pathological significance is associated with the following parasite species: *Myxobolus dispar, Ichthyophthirius multifiliis, Dactylogyrus extensus, Eudiplozoon nipponicum, Diplostomum sp.* (larvae), *Tylodelphis clavata* (larvae), *Posthodiplostomum cuticola* (larvae), *Ligula intestinalis* (plerocercoid), *Cystidicoloides tenuissima* and *Ergasilus sieboldi.*

The helminth fauna of cyprinid fish from Lake Prespa is characteristic for the cyprinid fish from the waters of the Black Sea, Aegean and Adriatic watershed, with some exceptions, such as *Cystidicoloides tenuissima*, which parasitize salmonids, but seldom in other fish species. Ratio between the larvae which mature in birds compared with adult forms of parasites in fish is 1 : 0,63. In total, 18 species of adult forms of fish parasites and only 5 species of fish parasitic larvae, which mature in birds *(Diplostomum sp.* - metacercaria - in *Rutilus prespensis* and *Alburnus belvica*, *Tylodelphis clavata* – metacercaria, *Posthodiplostomum cuticola* – metacercaria and *Ligula intestinalis* - plerocercoid) are found. Larval stages of parasites are present in 50,0% of fish, adult parasites are present in 51,22% of fish (approx.

equally).



Dactylogyrus erhardovae (original SEM photo)



Myxobolus dispar

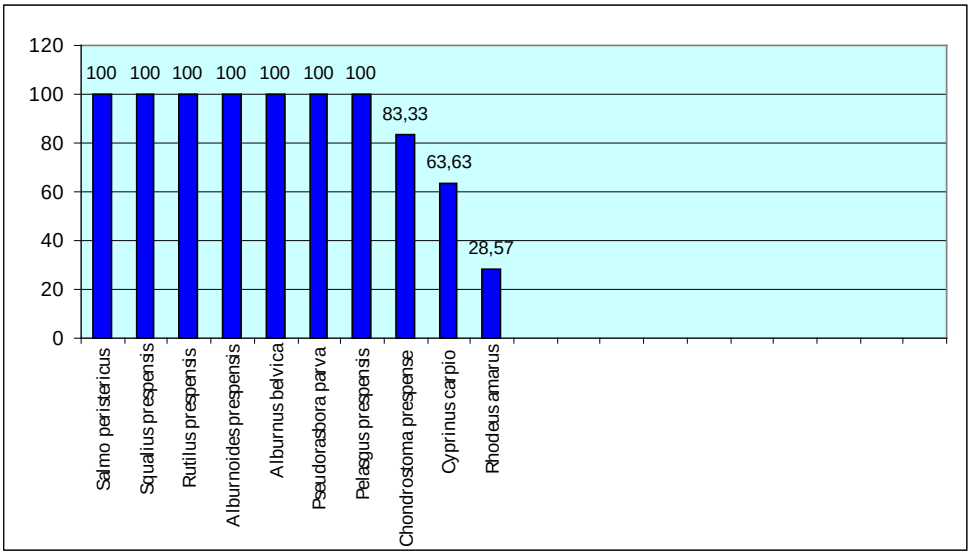


Figure ????? Prevalence of infestation with established species of parasites.

Fish species	Parasite species	Prevalence % of infested fish	Intensity of infestation
Salmo peristericus	Gyrodactylus sp.	100	45
Total infestation		**100**	**45**
Squalius prespensis	Diplozoon sp.	60	2,33
	Posthodiplostomum cuticola (larva)	100	5
Total infestation		**100**	**6,4**
Chondrostoma prespense	Dactylogyrus elegantis	33,33	1
	Diplozoon sp.	16,67	1

	Tylodelphis clavata (larva)	50	5
Total infestation		**83,33**	**3,6**
Cyprinus carpio	Dactylogyrus extensus	41,67	2
	Tylodelphis clavata (larva)	16,67	15
	Eudiplozoon nipponicum	50	8
Total infestation		**63,63**	**12,57**
Rutilus prespensis	Myxobolus dispar	7,14	1
	Dactylogyrus sphyrna	35,71	4
	Dactylogyrus erhardovae	14,29	3
	Nicolla testiobliqua	7,14	1
	Posthodiplostomum cuticola (larva)	100	12
	Diplostomum sp. (larva)	7,14	5
	Tylodelphis clavata (larva)	50	15
	Ligula intestinalis (larva)	14,29	2
	Cystidicoloides tenuissima	14,29	2
	Ergasilus sieboldi	64,29	15,44
Total infestation		**100**	**32**
Alburnoides prespensis	Tylodelphis clavata (larva)	100	3
Total infestation		**100**	**3**
Alburnus belvica	Ichthyophthyrius multifilis	42,86	1,5
	Dactylogyrus alatus f. typica	14,29	2
	Dactylogyrus minor	21,43	2
	Dactylogyrus sp.	7,14	1
	Paradiplozoon alburni	7,14	1

	Posthodiplostomum cuticola (larva)	100	30
	Diplostomum sp. (larva)	21,43	3
	Tylodelphis clavata (larva)	7,14	2
	Raphidascaris acus (larva)	42,86	2,5
	Ergasilus sieboldi	21,43	1
Total infestation		**100**	**33,57**
Pseudorasbora parva	Posthodiplostomum cuticola (larva)	100	3,33
Total infestation		**100**	**3,33**
Pelasgus prespensis	Posthodiplostomum cuticola (larva)	100	2
	Ergasilus sieboldi	100	7
Total infestation		**100**	**9**
Rhodeus amarus	Ichthyophthyrius multifilis	14,29	1
	Ligula intestinalis (larva)	14,29	1
Total infestation		**28,57**	**1**
Carassius gibelio		0	0
Total infestation		**0**	**0**
Lepomis gibossus		0	0
Total infestation		**0**	**0**
TOTAL INFESTATION – ALL FISH		**74,39**	**21,52**

Table ???????. Parasitofauna of the fish from the Lake Prespa

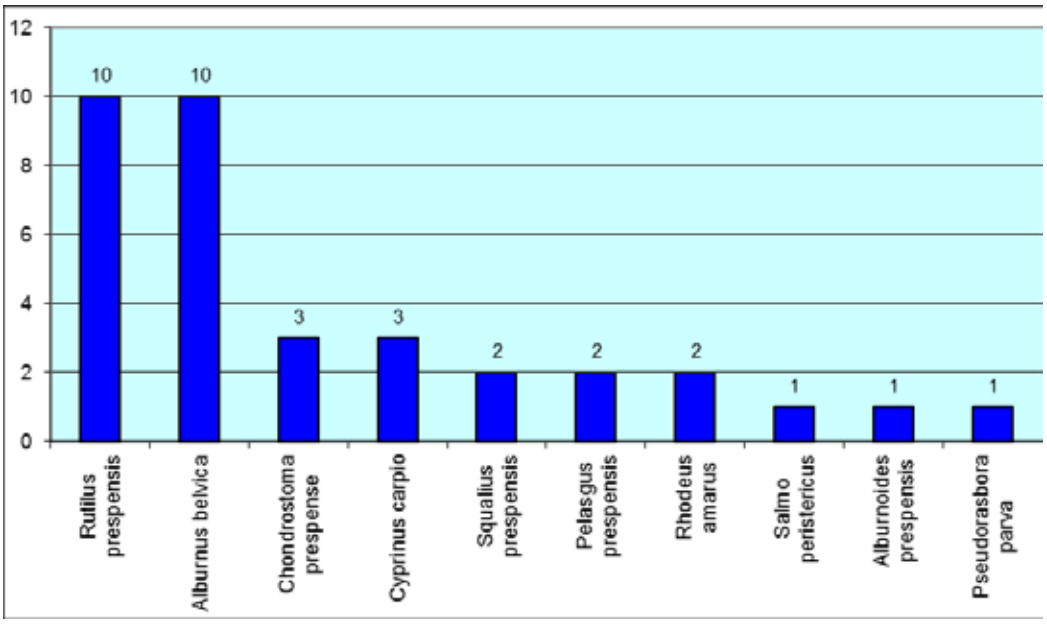


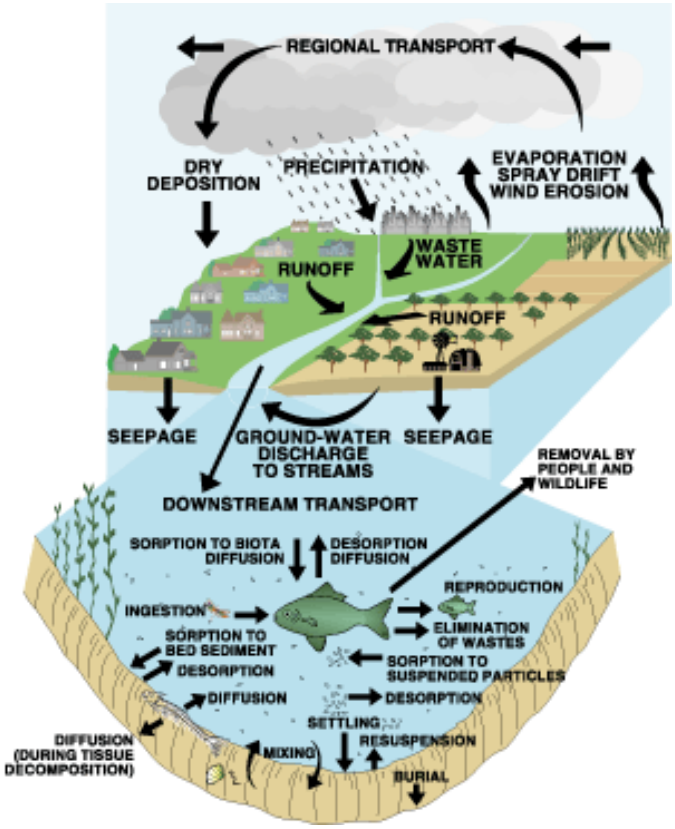
Figure ???? Number of parasite species in certain fish species Lake Prespa

Confirmed statements of Wisniewski (1958), who considers that a great number of fish parasites in eutrophic lakes are larval stages, which complete their life cycle in fish-eating birds and mammals, i.e. the ratio between fish parasitic larvae which mature in birds and adult parasites is increasing from oligotrophic to eutrophic systems; and Esch (1971), who points out the higher number of fish parasitic larvae which mature in birds from eutrophic systems, which is a consequence of different predator – prey relationships, whereas in oligotrophic waters insignificant water - terrestrial interactions exist are applicable for Prespa Lakes.

These changes in the species composition of parasites suggests on the changes in the water environment of Lake Prespa in last 5 years. The intermediate hosts (representatives of plankton and bottom fauna) are missing – some of them specific for this Lake. Presence of fish-eating birds is in such number that causes damages to the fish health, entire ecosystem and further eutrophication and habitat loss.

From other side the value of the relative infestation of most of the fish species as in presence of different parasite species and as well of their number on individual fish shows high fish population density.

5.6.2. Pollutants

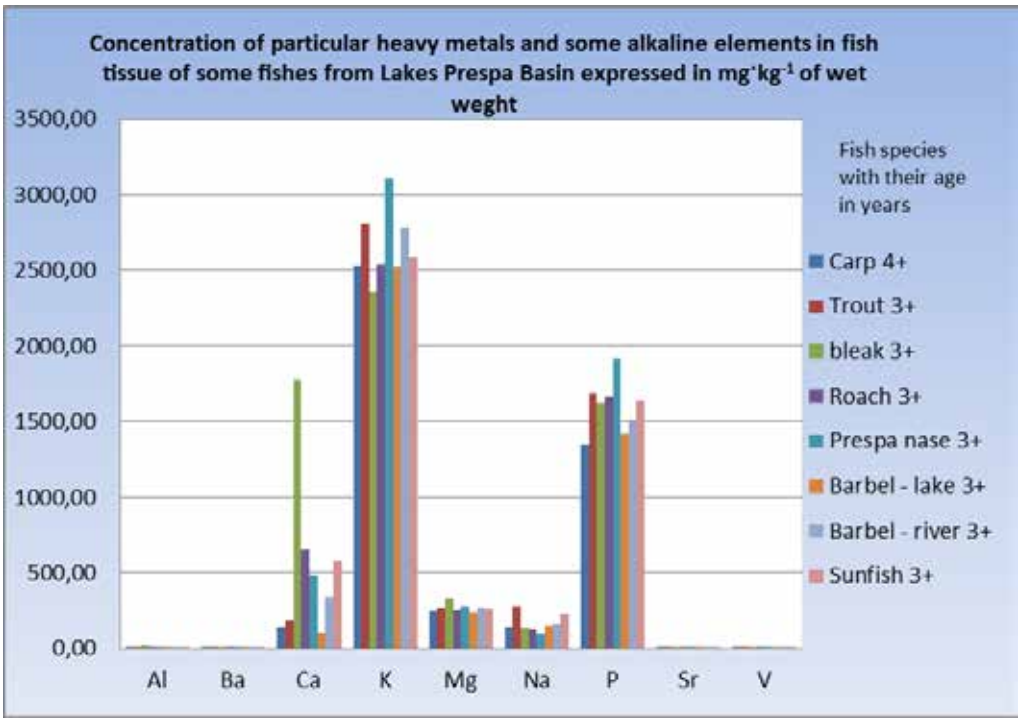


Figure????? Pollutants movement in the hydrologic cycle including the one to and from sediments and aquatic biota

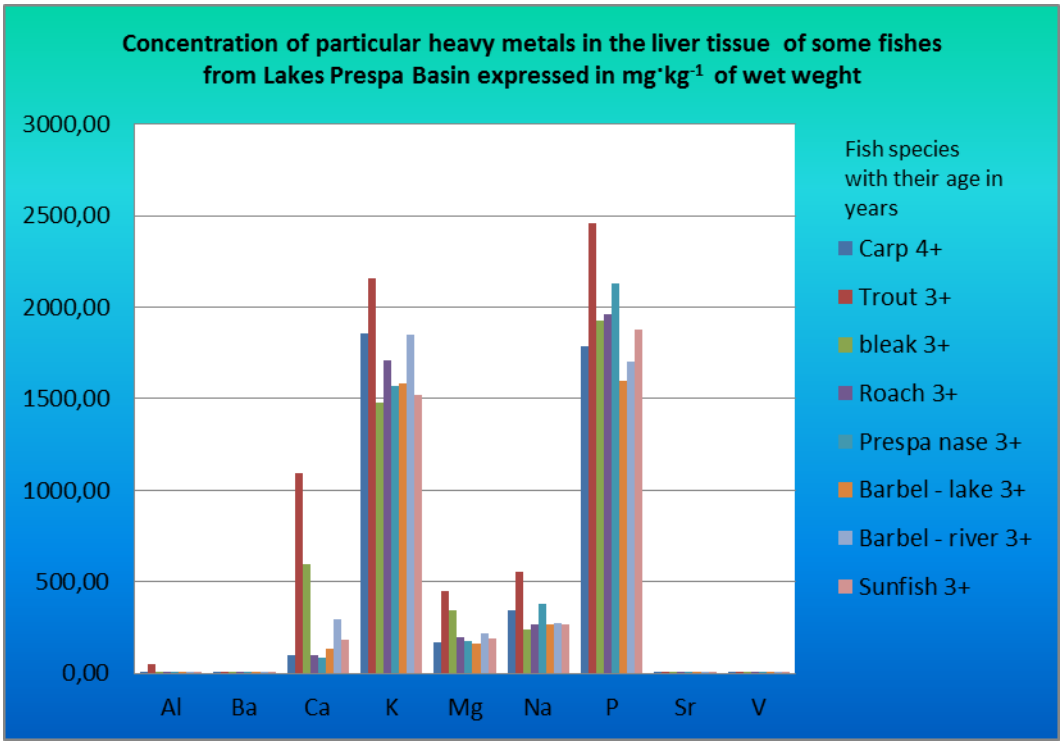
5.6.2.1. Heavy metals

Metals have different toxicity in freshwater and saltwater biota. Metals can transform and accumulate in the body (bioaccumulation, biomagnification). Different metals tend to accumulate in different storage compartments (organs and tissues).

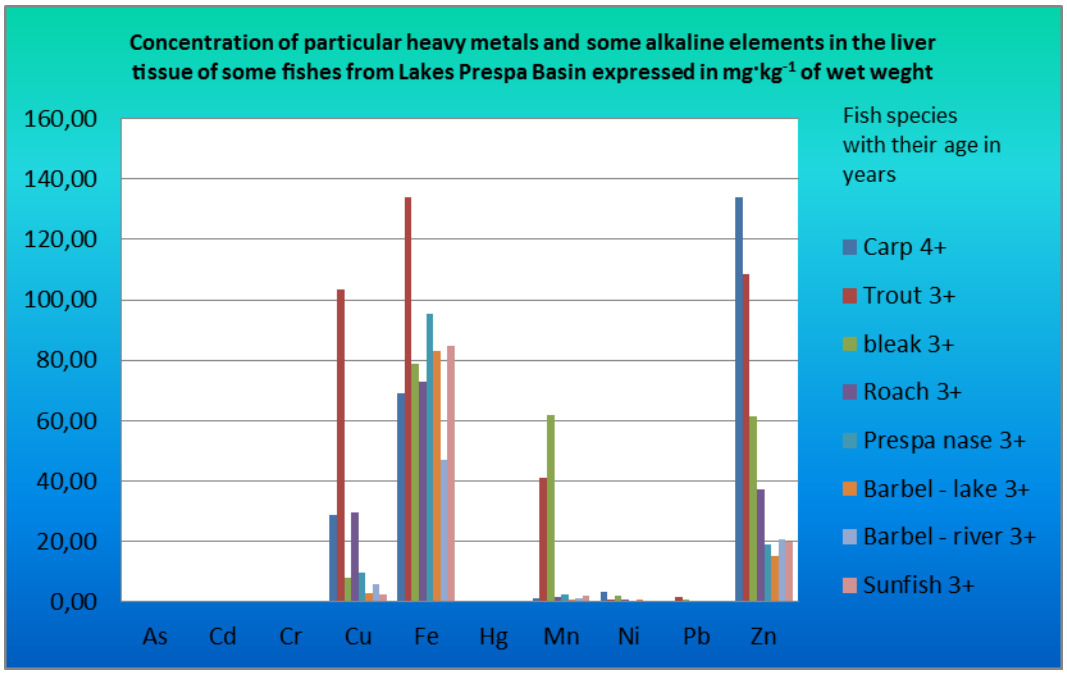
The values of heavy metals in the fish tissue among the same species increase with the age due to the process of bioaccumulation. The same situation is with the concentrations of heavy metals. The values of accumulated heavy metals in the fish are higher in the liver than in the muscles.



Figure???? Heavy metals and alkaline elements in fish tissue.



Figure???? Alkaline elements in the liver tissue of some of the Prespa Lake fishes.

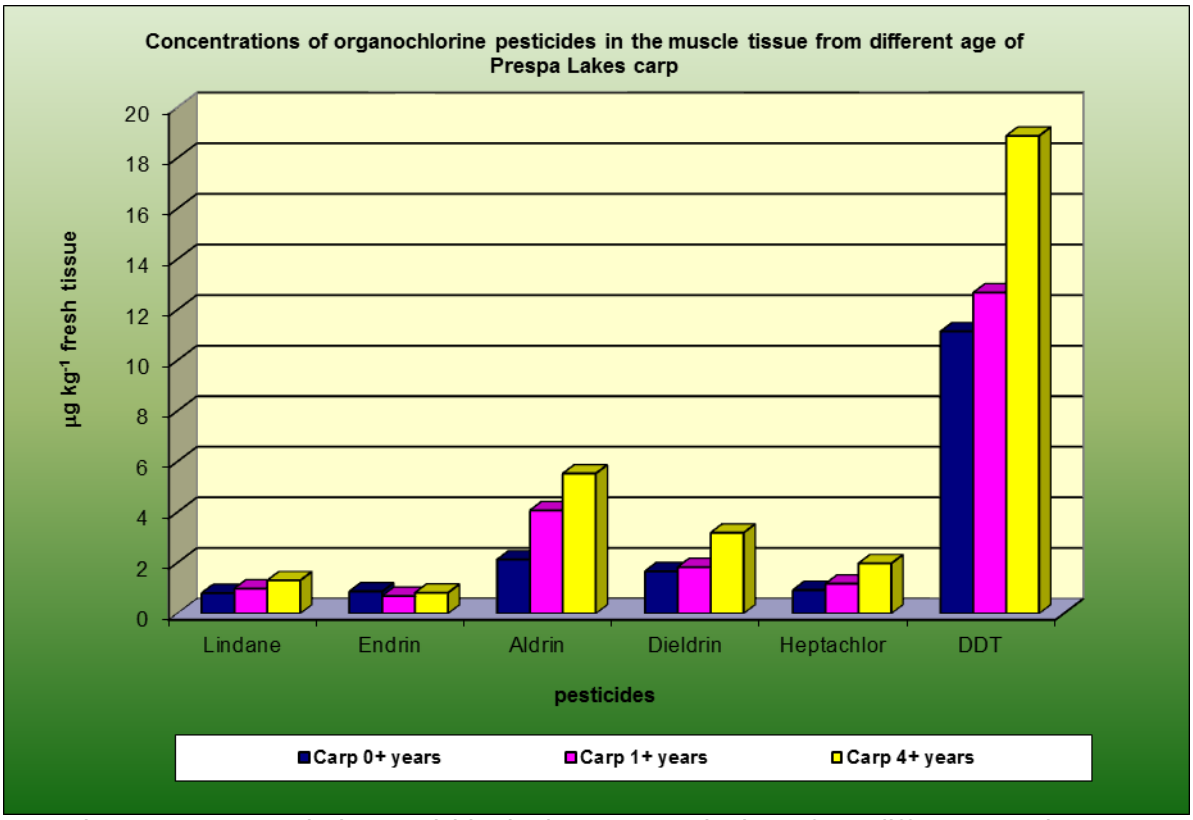


Figure???? Heavy metals in the liver tissue of someof the Prespa Lake fishes.

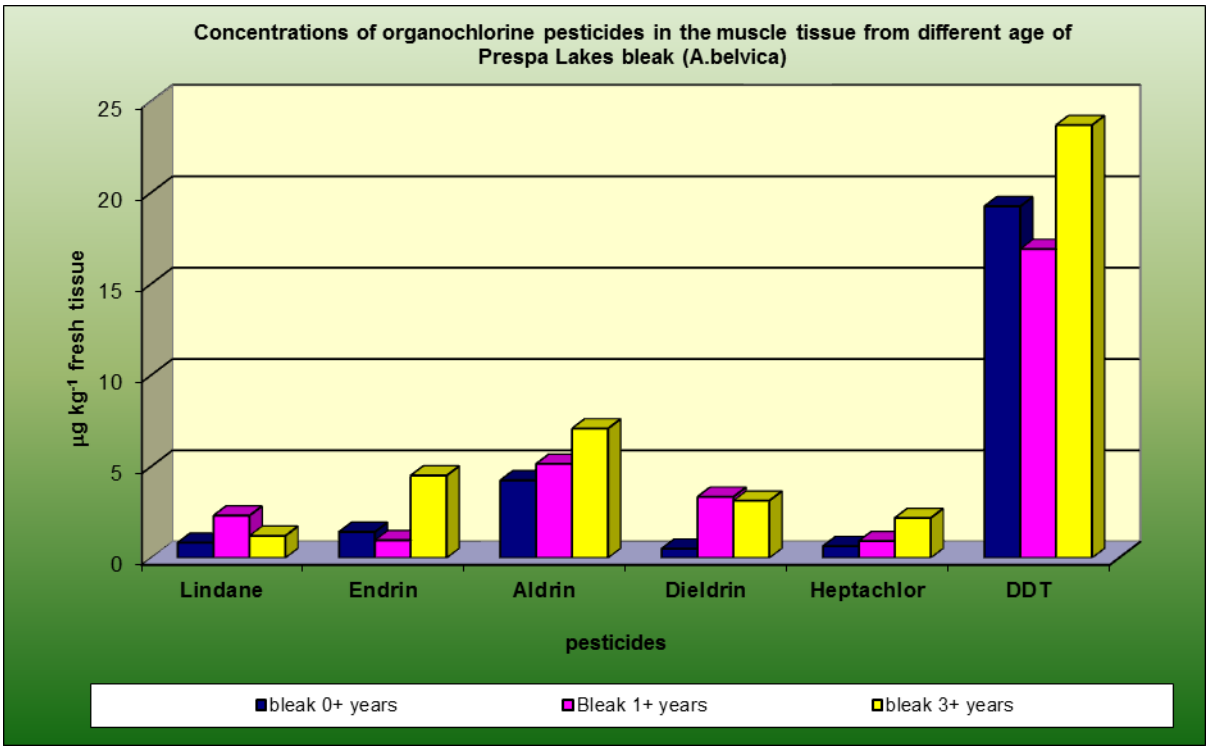
5.6.2.2. Organochlorine Pestecides

Organochlorine pesticides are contaminants with slow brake down (120 years) and together with some other organic pollutants are named like Persistent Organic Pollutants (POP), DDT is toxic to many more organisms than those it intended to kill. POPs are stored in fat and are persistent (bioaccumulation, biomagnification).The effects of POPs are broad attack on reproduction and the immune system in the aquatic animals.

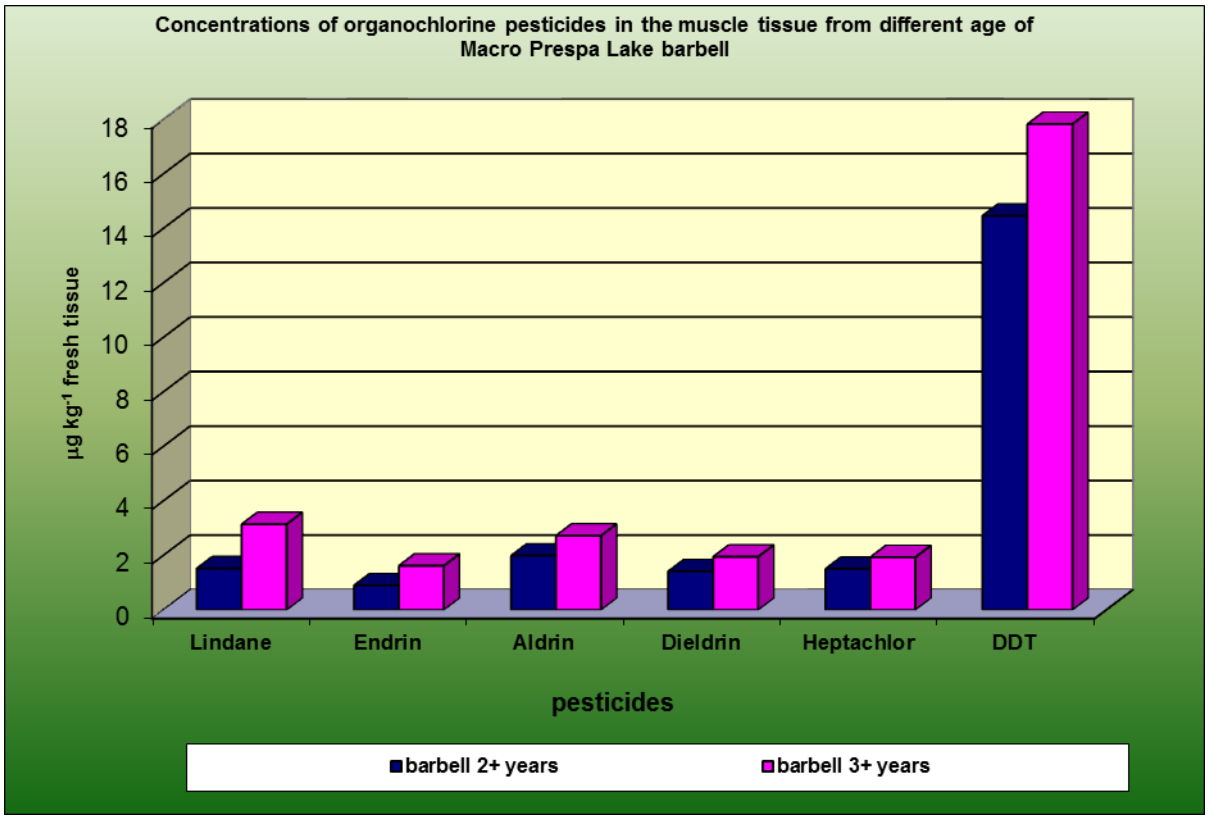
The fishes on the higher position in the food web (omnivorous and carnivorous) have also higher concentrations of pesticides, as they also produce more fats in their bodies. The values of OCPs in the fish tissue among the same species increase with the age due to the process of bioaccumulation. The values of DDT are higher than those of lindane in all of the examined fish species.



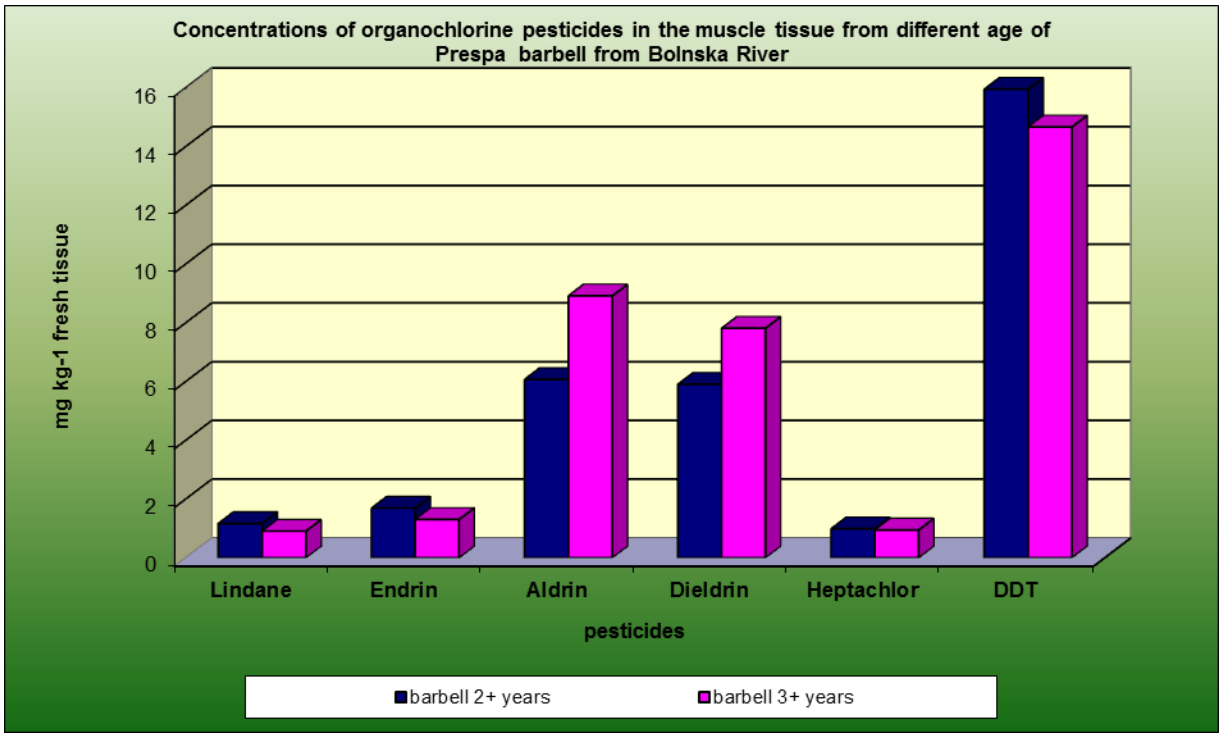
Figure???? Organoclorine pesticides in the carp muscle tissue from different age classes.



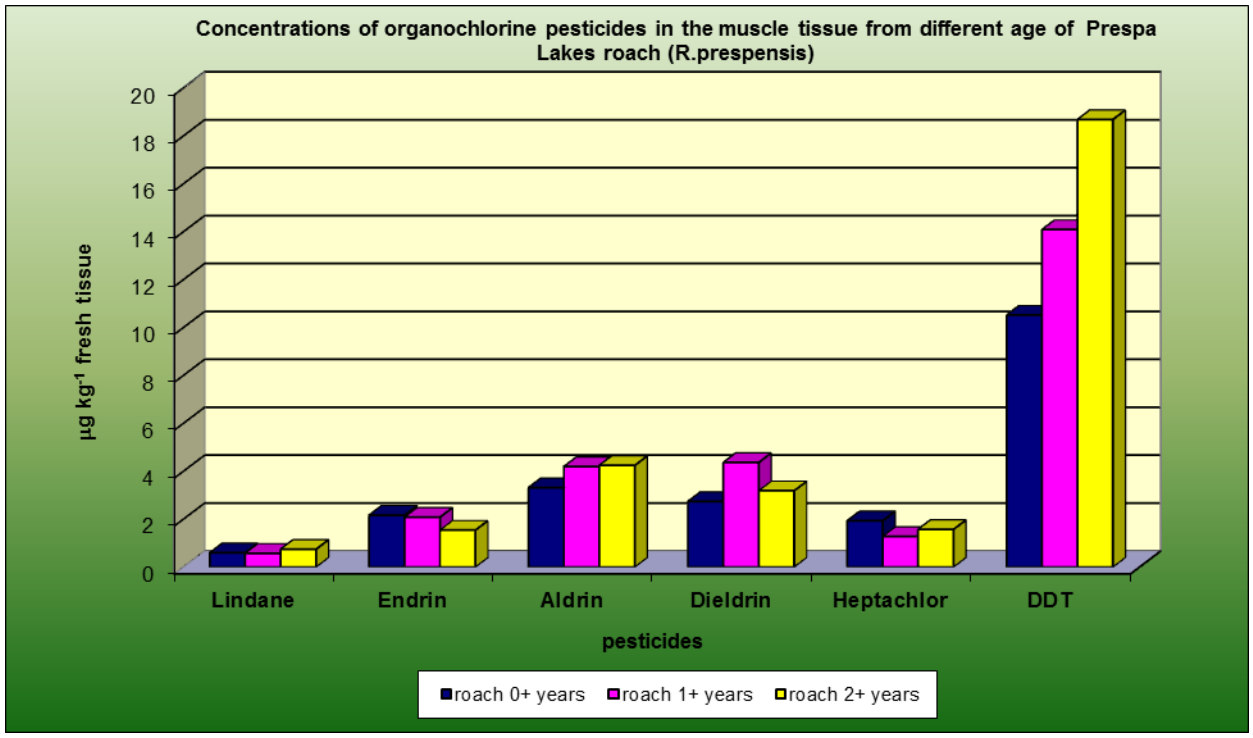
Figure???? Organoclorine pesticides in the bleak muscle tissue from different age classes.



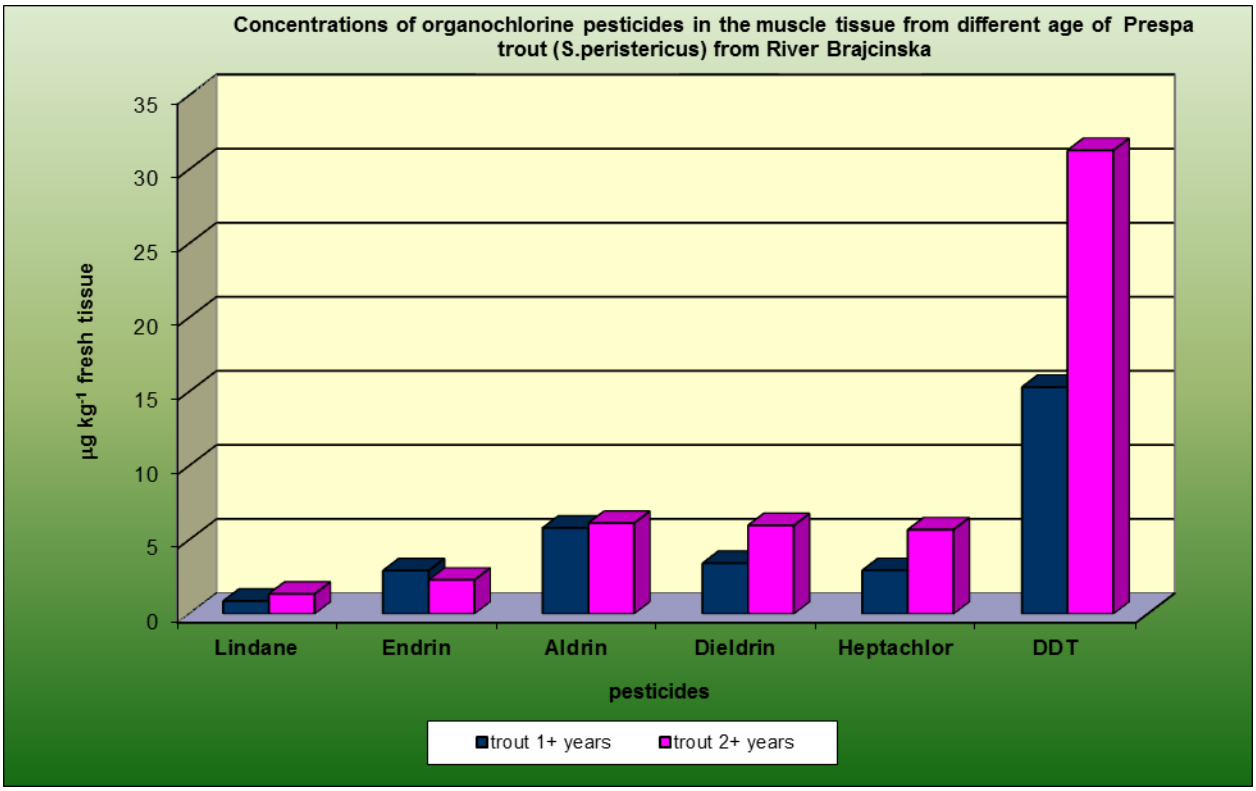
Figure???? Organoclorine pesticides in the barbell muscle tissue from different age classes (PrespaLake).



Figure???? Organoclorine pesticides in the carp muscle tissue from different age classes. (River Bolnska)



Figure???? Organoclorine pesticides in the roach muscle tissue from different age classes.



Figure???? Organoclorine pesticides in the Prespa trout muscle tissue from different age classes.

6. Description of fisheries and socioeconomic characteristics

Demographically, the Prespa Lakes Basin is characterized by a loss of its population during most of the 20th century. This was most prominently in Greek Prespa, which lost almost 75% of its population, suffering a 'demographic death', but also in Macedonian Prespa with a population decrease of 20% over the last 30 years. Presently, the population of Greek Prespa is stable or in slight decline, decreasing in Macedonian part, and stable or growing in Albania.

6.1 Fisheries

Fisheries have existed on the two Prespa Lakes since ancient time. It is recognized as artisan fishery. At present fishing is allowed on the Greek and Albanian parts of the Lakes, while on the Macedonian side there is still total ban, but in March 2012 a tendering procedure for concession of the fish is opened.

6.1.1. Commercial Fishery

Albania There are 50 professional fishermen in Macro Prespa and 10 fishermen in Micro Prespa. However it should be emphasized that even the "professional" fishermen are also engaged in agriculture activities in their village during the time they are not in the lake.

Greece In Greek Prespa, only 2% of the population lists fishing as an occupation Nowadays, the number of active fishermen has constantly decreased and it is difficult to recognize how many fishermen currently continue fishing in both Prespa Lakes. In the Greek part only the inhabitants of the village 'Psarades' on Macro Prespa are still remaining full-time fishermen. Other fishermen are mainly farmers fishing in their spare time. The main fishing methods are nets, gill and trammel nets (13–80 mm mesh), long lines and fish traps. From the 1960s onwards, outboard motors appeared, as did monofilament nylon nets, which allowed intensification of fishing effort, with considerable effects on the fish stocks. For a long time, the only regulation concerning the fishery was the close season during the spring spawning period. But, as the condition of the fishery deteriorated new attempts at regulation were made; for example the use of seine nets was prohibited in the Greek part of Micro Prespa in 1983. Later, the length of the spring close season was lengthened and the mesh size of nets was increased. The fish populations of the Prespa lakes have been altered in the last twenty years of the last century, as a result of over fishing, habitat changes and the introduction of several foreign fish species. The total biomass of the fish population in Lake Micro Prespa is stable.

Macedonia The number of professional fishermen in Macro Prespa, with artisan organized cooperation till 2007, is 65 professional and 20 part-time active fishermen; usually in fruit farming as a main occupation.

6.1.2. Recreational and Sports Fishery

In general, recreational fisheries can be defined as a non-commercial (i.e. not for sale, barter, or trade) subset of capture/harvest fisheries, motivated by catching fish for fun, pleasure, or sport. As such it is a part-time activity. Recreational fisheries activities are usually not motivated by a dependence on fish for food mention but 'recreational fisheries for household support'.

Recreational fisheries can further be categorized into amateur, tourism, and sport/competition fishing; each having its own associated goals and defined as follows:

Sport fishing usually involves competition between fishers to catch the largest fish of certain species, the largest number of specimens or the largest total weight depending on the rules of each particular competition. The first sporting event on the shores of Lake Prespa of state character at Macedonian side, was held in 1997.The contest was held on the sport lane close to the village

Stenje and the competition involved 33 teams from across the country. The contest was held in two days during which time 700 kg of fish was caught. During the competitions usual fish caught were bleak and roach, and rarely Carras and carp.

Tourism fishing may be conducted by commercial fishermen or by recreational fishing professionals. The purpose may not only be fishing, but also include eating of fish cooked in a traditional way onboard, or just enjoy a day out on the water. Within the Prespa context it appears in form of 'eco-tourism' in the village of Psarades.
Prespa Lakes are maybe the only natural lakes in which surroundings no fishing association has interest to organize recreational fishing.
Recreational fishing at Lake Prespa are mostly performed during the summer season and of course exclusively by tourists who visited the lake.The Prespa Lakes have potentials for stimulating the development of fishing tourism and promote the lakes as a recreational sport-fishing facility. The number of anglers who, especially in summer, spend days and even weeks on the shores of the lake is increasing.

6.1.3. Subsistence Fishery

Subsistence fishing is fishing for personal consumption or traditional/ceremonial purposes, where the fish caught are shared and consumed directly by the families and kin of the fishers rather than being bought by traders and sold in a market. It is usually a part-time activity and part of a diversified set of livelihood activities. This type of fisheries may be particularly important in Albania.

6.1.4. Traditional fishery

The traditional fishing is traditional skill that is the hallmark and one of the identities of the Prespa Lake. It consists of old tools, fishing accessories, fishing shacks on the water, fishing boats. It was practiced mainly by the local population of the shoreline villages in Macedonian, Albanian and Greek Prespa.
Traditional fishing in Prespa is authentic and quite different from fishing in other neighboring. More than half of the traditional fishing methods used in Prespa were applied in shallow areas of the lake, that is, up to depths of 1-2m. They involved the use of fences and traps, and a unique brush park, called *pelaizia.*
The fishing gears, tools and method of fishing is manifested through two principles (systems, methods):

1. System of labyrinths i.e. luring (stimulation) of fish entering the system stalls made of reed matting and placed vertically in shallow water areas that are exposed to higher winds. In manufacturing the matting barrier of reeds were used traditional techniques that are locally called, "knitting kochinka". Cut high dry reeds from 1.5 to two meters and spans (knit) with previously collected and blanched willow thin rods. Reeds converge in roll length from 4 to 6 meters that are easy to manipulate. The same "kochinki", locals have sold and still sells less them to shape the ceilings by means of connective mortar of lime. Thus prepared rolls fishermen using wire or willow rods were tiding them to a depth of about one meter on previously stuck stakes. The stakes were placed in a form which is called, Koca, which is compact of the two oblique lateral parts narrowed towards the side of the coast and connected with a semicircular section. This is representing the outer part of the barrier, Koca,. Inside were made several constituents named, each of them kotec. The main philosophy of fishing consists of narrow and semi-circular opening a few centimeters between each internal part that is in the form of hearts. According to the testimony of the fishermen that fish remembers only 5 seconds when it enters through the circular opening in the, "heart", it forgets to turn out and escape, so caught in shallow water, the fresh fish was ready for the market.

2. The system of raised, layered , branches on previously compacted and spaced piles in shallow shoreline waters is named, "namet" - meaning put above each other.Piles are arranged in concentric circles starting from a center pile and the outer circle has a diameter of about 5 meters. The whole area of the inside of the circle is filled with evergreen trees branches as piles of hay. Thus, we get a compact bunch in water, and between branches and bottom of the lake there is space where fish are collected. Next to this circle the fishermen are making another smaller circle with a diameter of 2-3 meters but only from stuck stakes without putting branches. Fish by curiosity, protection of birds, the warmth of the branches and the pleasant fragrance in large schools are gathered in the big round of the "namet". Twice in the season - from late fall and late winter these two rounds were visited by fishermen and than with previously, prepared "kochinka" they were circling around the two circles. Then the fishermen are jumping on the pile of branches, slamming the branches and the water and fish scared doing concentric circles to rack and leads through semi-circular opening in the lower empty circle where it is trapped and ready for the market.

Despite this traditional and environmental (sustainable) fishing fishermen made also other fishing devices called: repress, sack, vrshna, serkme. The fishermen made Prespa old fishing boats from one carved wood, monoxiles, and later of wooden plates, then fishing houses set on piles and wooden platforms in the water; other necessary objects for the fishery (such as baskets, large wooden bowls made from a tree with carving in which they kept dried fish).Unfortunately all of these are not sufficiently preserved, nurtured and promoted.Informing the local population and wider public about the values and importance of this tradition is insufficient. Until now the competent institutions and the local population hasn't taken sufficient measures to improve this situation. Therefore there is danger of its complete extinction and oblivion. They can be seen in newly built fishermen's village in Otesevo which has original items.
One method of traditional fishing on specific fish species- Prespa barbell is hand catching in the stream of Agios Germanos-Greece. It is allowed only during 14 days of the year (determined by the Management body of the Prespa National Park.

6.2. Socioeconomic aspects of fisheries

The price of fish is relatively low and move from a minimum of 0.5 €/kg for bleak up to 3.5 €/kg for carp, confirmed by many sources. Normally the annual income from the fishing products is between 2500 – 3000 € per family. These means that fishery contributes to a mean of 900-1000 US$ income/year per capita. However as we mentioned before, the fishermen are also farmers which mean that they combine the income from the fishery with other modest incomes coming from, farming of cows, sheep, poultry etc.
One part of the product is consumed within the fishermen family. Normally this part is composed by the low –value species (e.g. bleak). This product is consumed mostly fresh but sometime it is dried and salted so as to be preserved for the winter period.
Fishermen are mostly men. There are some female that enter the lake to help their familiars, but the bulk of the work in the lake is done by men.
There is no organized fishing market in all countries. Fishermen usually land their catches near their villages. In Albania the fish is marketed in the small restoring points near the area or marketed in Korça (the biggest city near the lake) and on Macedonian side is the similar situation where as a market is city of Resen (the biggest city near the lake).
In both countries fish is caught in the morning and is sold in fresh form at the same day (usually the same morning).

6.2.1. Illegal Fishery

Motives for poaching range from household consumption and commercial gain, to poaching as a recreational activity, as an act of rebellion, or as an exercise of traditional rights. It is in this

context that was argued for a restricted suspension of the prohibition of hand fishing for Prespa barbel in some Prespa tributaries, which is a traditional pastime. Moreover, the categories are not mutually exclusive: a single poacher may have multiple motivations, simultaneously or at different times in his "poaching career".

The number of illegal fishers, or 'poachers', is notoriously difficult to assess. However, various authors mention illegal fishing and its impact on the resource. Besides factors such as flow and river morphology, low densities of Prespa trout and Prespa barbel for example has been attributed to poaching and/or angling. Fish are particularly vulnerable to poaching during periods of reproduction (carp and Prespa nase). There seems to be an increase of illegal fishers in these rivers, and their control is made difficult by the fact that they come from all over the country, fishing frequently with forbidden fishing equipment.
During the moratorium at Macedonian side illegal fishing was highly expressed.

7. Environmental factors

7.1. Key fish habitats

The Prespa Lakes are host to a variety of fish habitats. This variety arises from the diverse geological composition of the basin, with karstic massif to the west and granite massif on the east, and to differing water depths (bathymetry). These factors have a direct bearing on the spawning and feeding grounds of fish.

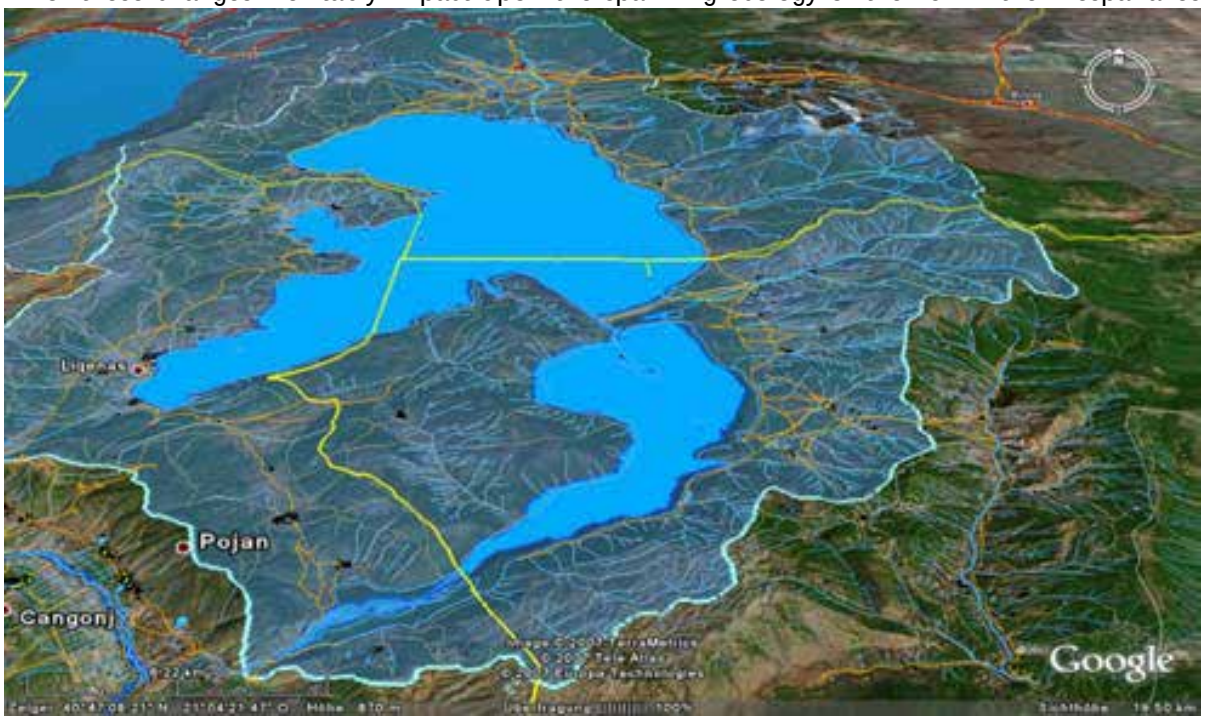
As a result of severe fluctuations in the water volume of the lakes, most of these spawning and feeding grounds have undergone considerable change.

The most important effect of decreasing water volume has been a reduction of the upper littoral zone of the lakes, which has now become beach, thus altering the ratio of **littoral-sublittoral-profundal**.

The profundal zone—the zone in which no vegetation exists—is shrinking in favour of the littoral and sub-littoral zones. The increased surface area of emerged and submerged vegetation within depths of favourable light penetration has led in turn to an increased production of aquatic plants (macrophytic vegetation).

While the nutrient load entering the lakes has remained constant, summer temperatures have increased, leading to more intensive algal blooms in more and more areas of the lakes. This problem is exacerbated by reduced water temperatures in these areas in winter that prevent full mineralization and decomposition of the vegetation biomass. As a result of these processes, additional benthic deposition appears, which leads to further oxygen depletion during summer periods. (This phenomenon was first reported in 1989 by the Ohrid Hydrobiological Institute in its *Report on Limnological investigations in the three great natural lakes of Macedonia*.)

All of these changes inevitably impact upon the spawning ecology of the fish in the Prespa lakes.



In reviewing these impacts, it is important to bear in mind the additional effects on spawning arising from the introduction of alien species of fish to the lake. Some of these introduced species are in competition with Prespa's indigenous fish, pushing these native species out of their original habitats.

Spawning grounds

The fish fauna of the Prespa Lakes can be divided into four ecological groups according to spawning substrate:

- *psamophylic*–spawning on fine sandy substrate
- *phytophilic*–spawning on macrophytic vegetation
- *litophylic*–spawning on gravel and rocky substrate
- *fluviatilic*-spawning in the tributaries

The following types of spawning grounds can be defined:

Shallow sandy bottom areas with submerged vegetation

This type of spawning ground is the most common apart from the rocky lake shore.

Before the lakes began shrinking, bleak (*Alburnus belvica)* and chub (*Squalus prepsensis)* would 'get out' during their spawning season to perform their 'sexual dance' on the beaches, i.e. in very shallow water and even on dry land.

Today, however, both chub and bleak migrate to deeper areas for spawning. These new spawning areas are quite distant from the shores of the lakes, in parts where submerged vegetation occurs as a result of the prevailing conditions mentioned above. At present, only minnow (*Pelasgus prespensis, Phoxinus lumaireul*) spawn in the very shallow areas of the lakes or in the watercourses of the swamps and marshlands.

Shallow sandy bottom areas with emerged vegetation (reed belts)

The fish most affected by the distribution and quality of reed belts in the Prespa lakes are the common carp *(Cyprinus carpio)* and endemic roach.

With changes in the water volume, some of these reed belts have dried out while in other parts (mainly in Micro Prespa) they have extended further into the littoral zone.

As confirmed by local fishermen, carp are now spawning in deeper waters outside the reed belt areas.

Figure????? Reed belts distribution. Source: Prespa reed beds action plan (UNDP, 2012)

Swamps and marshlands

These types of habitat mostly occur in Micro Prespa, especially in the south and north of the lake.

Rocky bottom areas

While few fish species in Prespa spawn in rocky bottom areas, reduced water levels have significantly affected the spawning grounds of the endemic Prespa Barbel (*Barbus prepensis*). This is because the eggs of the Barbel, unlike those of other fish in the carp (cyprinid) family, do not stick to a substrate.

Rivers

The water quality of the rivers in Prespa has most relevance to the spawning grounds of endemic trout (*Salmo peristericus)*, endemic undermouth – nase (*Chondrostoma prespense) and the Prespa Barbel.* It also affects the existence of the freshwater Noble crayfish (*Astacus astacus balcanicus*).

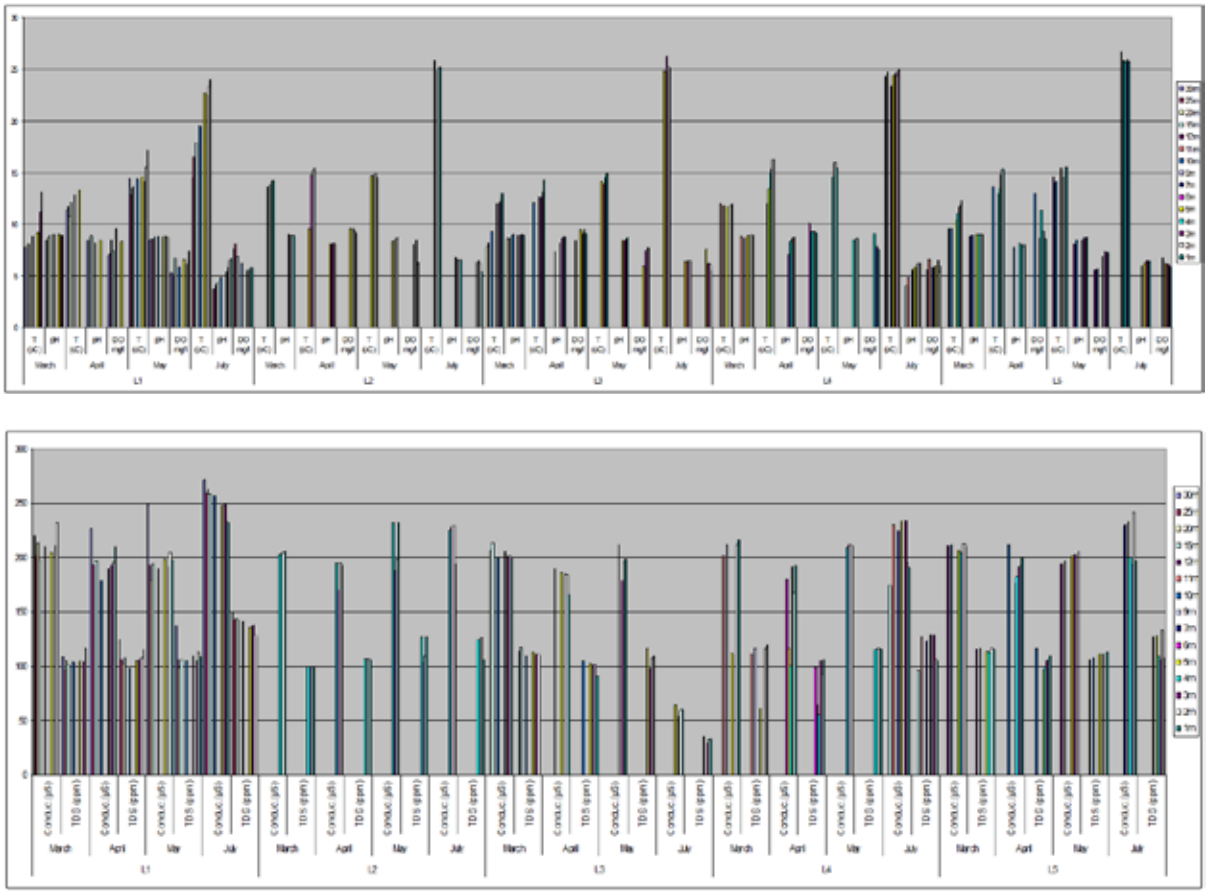
While current data shows no significant impact upon the spawning grounds of other species of fish, the declining quality of river water entering Prespa inevitably has a negative impact upon the entire ecosystem of the lakes.

7.2. Water Quality

7.2.1. Physico-chemical parameters

Detected nutrient levels in Prespa Lake fully reflect the overall conditions already established for the watershed. The lake is dominated by sulphates, the same as the rivers in the watershed, but there is also a marked presence of total N basically due to elevated concentrations of nitrates and ammonia. Regarding ammonia the whole investigated area was found to be in the III-IV category class as stated in the domestic legislation, while regarding the total presence of nitrates Prespa Lake has to be declared as Nitrate Vulnerable Zone as stated in EU legislation.

In respect to phosphorus content in the Prespa Lake waters the situation is even worse; detected total phosphorus concentrations (based on the sum of detected values for P_2O_5-P and PO_4-P) place the lake in the hyper-eutrophic conditions, both regarding domestic and EU legislation.



Figure??????? Prespa Lake – Basic physico-chemical parameters source Prespa Lake Watershed Management Plan (UNDP, 2012)

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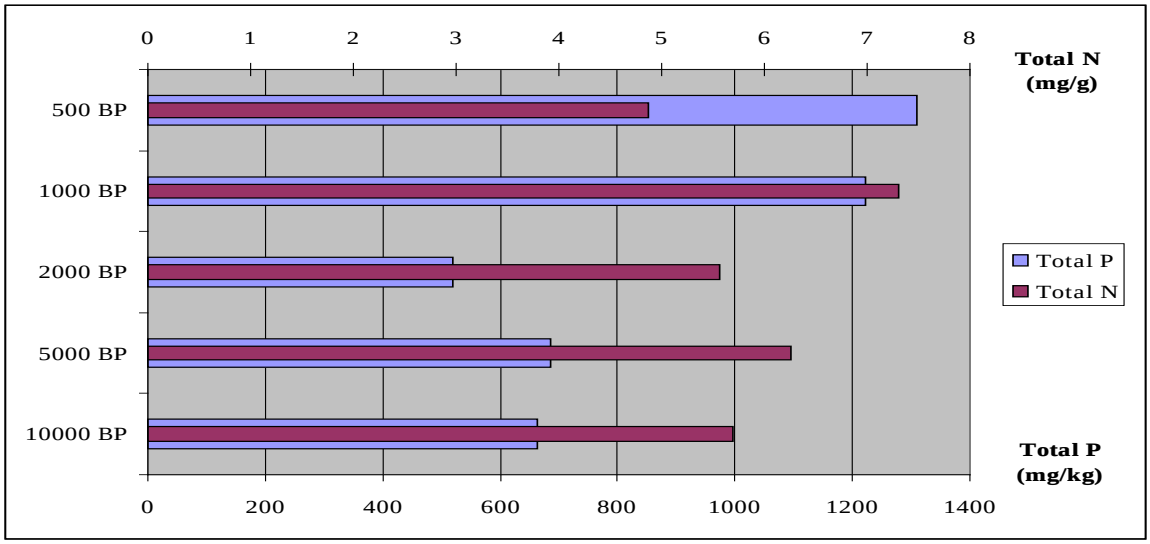


Figure??????? Prespa Lake – Basic physico-chemical parameters source Prespa Lake Watershed Management Plan (UNDP, 2012)

Surface waters of Prespa Lake watershed are found to be under an intensive human pressure. This pressure is expressed through various physical impacts like alterations of the water courses and water abstraction, chemical pollution originating from untreated waste waters or agriculture, and deterioration of natural biodiversity by introduction of alien species or over fishing. The intensity and duration of the negative human impacts on Prespa Lake natural environment have resulted in severe deterioration of the water quality in almost all water bodies, except the elevated stretches of the rivers way beyond the immediate human activities, if medium range aero deposition is regarded as negligible

7.2.2. Biological characteristics

7.2.2.1. Microbiological characteristics:

Prespa Lake hase been under monitoring for a long time, in order to monitor the condition of the water quality and how it affects the flora and fauna in the lakes. As indicators, besides physico-chemical parameters, it have also been used biological parameters. Bacterial indicators have also been analyzed from ecological and sanitary aspect.

The analysis of physiological groups of bacteria, in the pelagic water of Prespa Lake, indicates the presence of different organic substances in the water. Their quantitative representation speaks volumes about the saturation of the water with nutrients of protein, carbohydrate, oleaginous nature. This refers to the proteolytic, lypolytic, heterotrophic, amylolytic, cellulose and other types of bacteria.

The average quantitative composition of physiological groups of bacteria in the pelagic water of Prespa Lake was within: 14-4488bac•ml^{-1} water for proteolytic; of 6-4968 bac•ml^{-1} water; for amylolytic of 13-158720 bac•ml^{-1} for heterotrophic; of 4-8940 bac•ml^{-1} water for lypolitic bacteria. The values for physiological groups of bacteria, especially maximal average values, indicate increased amounts of organic substances in the said

nature. Especially large is the maximum number of heterotrophic bacteria whose value (158720 bac•ml^{-1}) indicates water with III class quality, according to the classification of surface waters by Tumpling (1969) and Sladacek (1973).

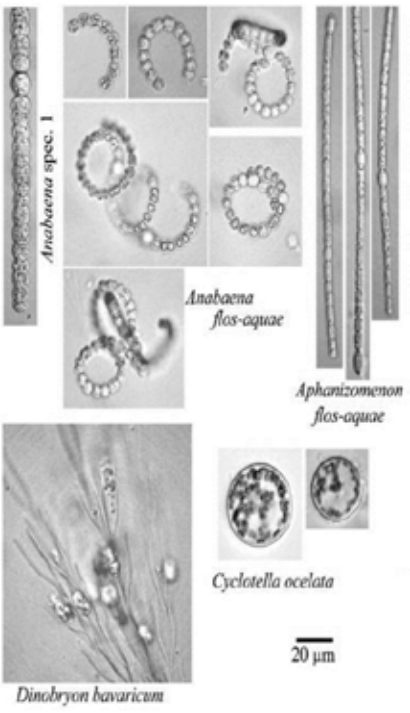
The average values for facultative olygotrophic bacteria which are the indicators for waters with low concentrations of organic substances, and as facultative can be met in areas with higher concentrations, were within range of 212-39680 bac•ml^{-1} water in the given period, in the pelagic water of Prespa Lake. Generally, their average number surpasses the number of other bacteria groups with exemption of heterotrophic bacteria. This could be seen from the average values of physiological groups of bacteria in the pelagic water of Prespa Lake.

Generally, according to the average values of heterotrophic bacteria, in the mentioned period, by the same classification, pelagic water of Prespa Lake is with **I** and **II** class capacity.

In the pelagic region of Prespa Lake no indicators have been recorded from sanitary aspect, such as total number of coliform bacteria, *Escerichia coli, Clostridium perfringens* which means that there is no fecal saturation in the pelagic water.

The increased maximum values of physiological groups of bacteria, as well as high average maximum number of heterotrophic bacteria indicates increased saturation of the water in this ecosystem with organic substances which becomes mineral with the activity of bacteria. This manifestation is more expressed due to the decrease of the water level in this ecosystem whose capacity was decreasing until 2009.

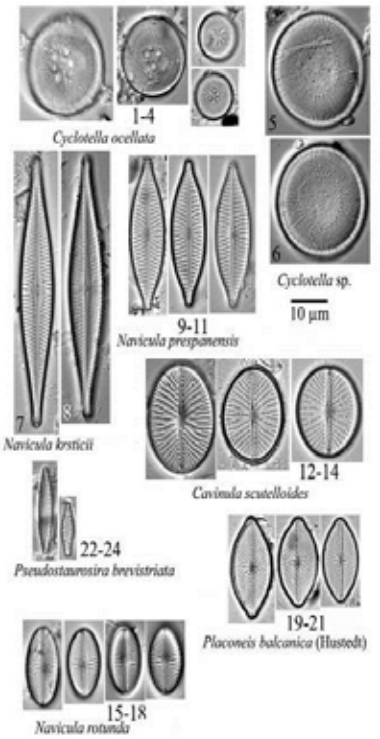
7.2.2.2. Phytoplankton characteristics:



Blue green algae and diatoms representing 95% of the phytoplanktonic density give the Prespa Lake its main mark. These two groups of algae are represented with largest number of species. Relative abundance of diatoms is bigger during the autumn, winter and spring period, and that of the cyanophytes during the summer period.

The most numerous species of the philamentose algae *Lyngbya limnetica,* and less numerous are Heterocystic cyanophites, *Anabaena flos-aquae*, *Aphanizomenon flos-aquae* and *Anabaena solitaria f. planktonica* all indicators of mesosaprobic waters.

The most numerous of Bacillariophyta is *Cyclotella ocellata*, which was or is dominant or subdominant at all depths in the overall explored period, even in the



summer. Other more numerous species are *Synedra* and *Navicula* from the rest of the diatoms. In certain periods, the species *Synedra acus var. radians* and *Fragilaria crotonensis* can be met in large numbers.

During the entire explored period of Prespa Lake, it has been recorded tendency for the increase of the relative representation of blue green algaes, from 30, 89% to 55, 6%. Diatoms were from 40, 17% to 63, 39%.

Other groups of algae compose insignificant part of the entire biomass including: Chlorophyta with procentual representation of 1,4%, Chrysophyta with 1,13%, and Pyrrophyta was represented with 1,75% of the total density, thus representing the most significant evidence that negative processes took place in the last few years in Prespa Lake, which leads to an deterioration of its trophic condition.

In Prespa Lake the density of the phytoplankton was much bigger in comparison with Ohrid Lake and in the summer period it has reached over 2.000.000 ind l^{-1}.

The vertical arrangement of the density is showing that the average phytoplankton density has reached its maximal density in the surface water and in depth of 5 m. The density is lower at 10 meters, and then largely decreasing towards the bed. The average density of the phytoplankton in Prespa Lake is reaching values of 474.117 ind l^{-1}.

Lake Prespa chlorophyll maximum is in the surface and on depth of 5 m. and in this layers maximum of phytoplanktonic density is registered, whereas the representation of chlorophyll *a* decreases with the increase of the depth. The values have reached a range between 0,91 and 17,51 µg l^{-1}. In summer months the representation of chlorophyll *a* is high, especially in the surface layer, which is a result of the developmental pick of the phytoplankton in this layer.

The average representation of chlorophyll *a* is 7,14 µg l^{-1} for the Lake Prespa water column for the period 2001-20011, the average phytoplanktonic biomass is 478,38 µg l^{-1}, and the average primary production is 187,75 g C m^{-2} god.

According to the OECD fixed limit system of classification, Prespa Lake is in mesotrophic condition (in the period 2001 - 2011), whereas in accordance with the classification of Nurnberg (1996), which refers to the summer period, Prespa Lake is in eutrophic condition in the summer 2008 which is a worrying information. All stated parameters indicate to the fact that Prespa Lake is in process of eutrophication.

Chl. *a*- mean (µg l^{-1})	Chl. *a*- max. (µg l^{-1})	Phytoplankton biomass (µg l^{-1})	Primary production g C m^2 year	Trophic category

7,14	17,51	478,38	187,75	Mesotrophic

Table ????? Trophic status of Lake Prespa in the period 2001-2011 expressed according to the fixed limit system of OECD, 1982

Chl. *a*($\mu g\ l^{-1}$)	Phytoplankton biomass (μg l-1)	Primary production $g\ C\ m^{-2}$ year	Trophic category
10,82	724,94	241,93	Eutrophic

Table ????? Trophic status of Prespa Lake in 2008 expressed according to the average summer values of the surface waters (Nürnberg 1996)

4.7.2.2.3. Zooplankton characteristics:

The results of the analysis of the qualitative composition of the zooplankton community, compared with past years, can conclude that during this year and also probably in the past few years, the Prespa Lakes eutrophication processes have intensified and accelerated the momentum going. The composition of the plankton community dominated by populations of Cladocera (small crustaceans commonly called water fleas) indicates that during the summer period in the lake are present intensive processes of mineralization.

It is known that the diversity of plankton communities and the complex factors condition the competitiveness in the diet and therefore the number of Cladocerans in different types of water bodies varies strongly. In oligotrophic lakes (low in biomass productivity), usually in those with small concentrations of bacteria and phytoplankton forms which are suitable for filtration (unicellular algae), the representatives of the order Cladocera occur with a small percentage representation, that is not the case with the recorded state of the zooplankton community of Prespa Lakes; especially in summer-autumn period of year compared with the situation from few years before.

The Cladocerans are largely active filtratiors; one *Daphnia magna* during the day is capable to filtrate 300 000 cells of the algae Chlorela; Bosmina longirostris up to 100,000; *Simocephalus vetulus* up to 125,000 cells, etc.

Higher percentage of Cladocerans present in the pelagic zooplankton community is one of the features of higher trophic stage of an aquatic ecosystems. During the period of dying of the cladocerans, the concentration of bacteria is rising and is significantly higher than during the mineralization of the blue-green and diatom algae, which is another reason for the intensification of the processes of eutrophication in Lake Prespa. This situation according to the present results can greatly impact on the composition and dominance of certain populations of the fishes.

The zooplankton is favorite food for many fish species, especially for young fishes. From the development of these small shrimps to a large extent affects on the natural diet of these fish.

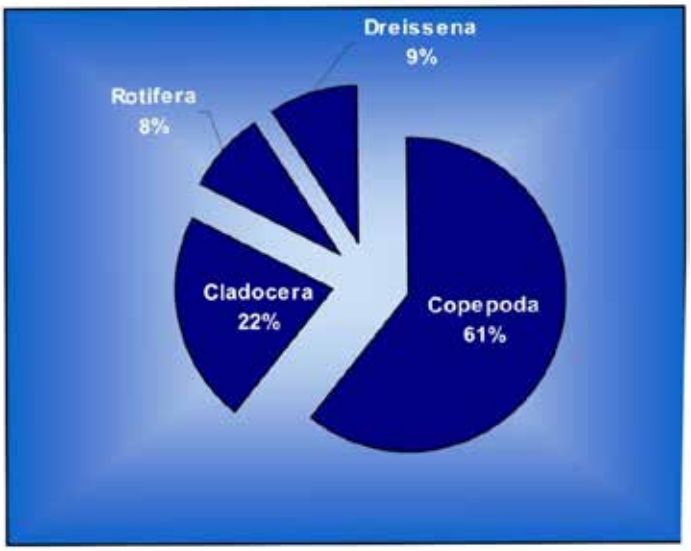
Not only fish but other aquatic animals in their diet using plankton. Generally, zooplankton is closely related to the exchange of matter and energy in aquatic ecosystems. Because of its short life cycle they quickly react to changes in the environment, and their number and species composition reflect

the quality of the water body where they are. Also, because of their small body size and often large abundance they do not only affect certain abiotic characteristics of the water, but they determine the quality thereof, which have great practical significance. This means that they are important as biological indicators of the degree of saprobity or the trophic state of water ecosystems which from other hand is direct link with the conditions of the fish stocks. Some of the zooplankton species are intermediate hosts of certain fish parasites, found in Prespa Lakes as well.

In that sense Crustacea (Copepoda and Cladocera) are important as bioindicators for monitoring the process of eutrphication in water ecosystems, which nowadays are greatly accelerated as a result of human activities.

Species	ind/m^3	Saprobic index	
Rotifera		s	h
Asplanchna priodonta Gosse, 1850	668	1,6	3
Kellicottia longispina (Kellicott,	891	1,4	3
Polyarthra vulgaris Carlin, 1943	527	2,1	3
Trichocerca capucina (Wier.-zicki et Zacharias 1893)	191	1,5	1
Kerattella quadrata (Miiller, 1786)	3376	1,7	5
Gastropus stylifer Imhof, 1891	62	1,2	1
Kerattella cochlearis (Gosse, 1851)	1017	1,9	3
Filinia longiseta (Ehrenberg, 1834)	1152	2,3	3
		1,77	
Cladocera			
Daphnia cuculata	11012	1,7	5
Bosmina longirostris O.F. Miiller	148	1,6	1
Diaphanosoma brachyurum	4227	1,6	3
Leptodora kindtii (Focke)	43	1,7	1
		1,66	
Copepoda			
Mesocyclops leuckarti (Claus, 1857)	4114	1,7	5
Arctodiaptomus steindachneri (Richard 1897)	6408	1,5	5
		1,6	
Dreissena polymorpha	10748	**1,9**	5
Total		**1,74** (I-II)	

Table?????? Qualitative, quantitative and saprobic index of Prespa Lake (pelagic 2001-2011)



Figure????? Relative distribution of the zooplankton in Prespa Lake (2001-2011)

Species	ind/m^3	biomass (µg/m^3)
Rotifera		
Asplanchna priodonta Gosse, 1850	668	293,92
Kellicottia longispina (Kellicott,	891	155,925
Polyarthra vulgaris Carlin, 1943	527	22,66
Trichocerca capucina (Wierzejski et Zacharias 1893)	191	13,37
Kerattella quadrata (Miiller, 1786)	3376	236,32
Gastropus stylifer Imhof, 1891	62	
Kerattella cochlearis (Gosse, 1851)	1017	56,952
Filinia longiseta (Ehrenberg, 1834)	1152	432
Total		1211,147
Cladocera		
Daphnia cuculata	11012	299526
Bosmina longirostris O.F. Miiller	148	116
Diaphanosoma brachyurum	4227	47705
Leptodora kindtii (Focke)	43	1720
Total		349067
Copepoda		
Mesocyclops leuckarti (Claus, 1857)	4114	28798
Arctodiaptomus steindachneri (Richard, 1897)	6408	44856
Total		73654
		0,847864 g/m3

Table????? Qualitative, quantitative composition and biomass of zooplankton in Prespa Lake (pelagic 2001-2011)

7.2.2.4. Macrophytic characteristics:

Different populations of macrophyte vegetation develop in the littoral region of Prespa Lake, and three specific zones can be found: zone of high emerging macrophytes, zone of emergent (floating) macrophytes and zone of submersed macrophytes.

From all recorded macrophytes in Prespa Lake the most numerous are the submersed macrophytes, followed by the emerged macrophytes and floating macrophytes are very little represented.

The reed *Phragmites australis* dominates within the frames of emerged macrophytes, thus forming discontinuous zone around the Lake, however, complexes of other recorded emerging plants are present.

The members of Potamogeton *(P. perfoliatus, P. pectinatus, P. lucens, P. pussilus*) dominate within the frames of the submersed macrophites, and the other submersed macrophites are less present *Zannichellia palustris, Myriophyllum spicatum, Ceratophyllum demersum, Ceratophyllum cubmersum, Vallisneria spiralis, Najas major, Najas minor* and others.

The saprobiological nature of recorded macrophyte species in Prespa Lake (according to Hofrat – Ottendorfer, 1983) indicate that macrophyte species (*Polygonum amphibium* L., *Potamogeton perfoliatus* L., *Myriophyllum spicatum* L., *Ceratophyllum demersum* L., *Najas major* All., *Spirodella polyrhyza* i *Lemna trisulca* L.) dominate in the Lake, which are the indicators for waters of second category. The given information show that the process of eutrophication already exists in some localities.

Review of recorded macrophyte species in Prespa Lake and their saprobiological nature

Reg. number	S P E C I E	saprobics - Ottendorfer
1	*Phragmites australis* (Cav.) *Trin ex Steud.*	
2	*Typha latifolia* L.	I, II
3	*Typha angustifolia* L.	
4	*Schoenoplectus lacustris* (L.) Palla *(Scirpus lacustris* L.)	I, II
5	*Polygonum amphibium* L.	II
6	*Potamogeton perfoliatus* L.	II
7	*Potamogeton lucens* L.	I, II
8	*Potamogeton pectinatus* L.	II, III
9	*Potamogeton pussilus* Link.	
10	*Myriophyllum spicatum* L.	II
11	*Ceratophyllum demersum* L.	II
12	*Ceratophyllum submersum* L.	
13	*iYallisneria spiralis* L.	
14	*Zannichellia palustris* L.	II, III
15	*Utricularia neglecta* Lehm.	I
16	*Najas major* All.	II
17	*Najas minor* All.	
18	*Spirodella polyrhyza* L.	II

19	*Lemna trisulca* L.	II
20	*Alisma plantago aquatica* L.	

8. IMPACTS ON BASIN'S ICHTIOFAUNA AND FISHERIES

The Prespa Lakes basin is considered to be an ecosystem of global significance and has been identified as one of Europe's major trans-boundary "ecological bricks". The entire Prespa Region hosts unique habitats that are important from both European and global conservation perspective. However, unsustainable agricultural, fisheries, water, waste and forest management practices are causing stresses on the ecosystem health of the Prespa Basin.

The fisheries sector is one of the most affected primary sectors in the Prespa region, because of the synergetic influence of both natural and anthropogenic factors. In the past, various detrimental activities have been reported to have severely impacted fisheries in the Prespa Lakes basin. These practices have particularly impacted several endemic fish populations. Fish-stocking exercises have also resulted in the introduction of several exotic fish species in Prespa Lake. The adverse impacts of these exotics have not yet been fully understood. Fish harvesting during spawning season and harvesting beyond the sustainable levels has resulted in reduction of populations of both native and endemic species.

In order to initiate the integration of the fisheries sector into a transboundary basin management planning, series of measures are being undertaken through a UNDP/GEF project whose main objective is to catalyse the adoption of ecosystem approaches to managing natural resources at the lake basin level.

Stress Analysis of the Prespa Fisheries

***Reduced populations of native and endemic species*;** besides the effect of the natural processes related to the decline of the water level and the loss of spawning grounds, as well as the lake's pollution and eutrophication, this is related to the general practice of harvesting during spawning season and harvesting beyond the sustainable levels of certain endemic and native fish species. The fishery management policies currently applied provide little incentive for maintaining long-term sustainability and stimulate over-harvesting and underreporting the catch. The insufficient and/or unreliable data on fish catch across the three neighboring states together with the fragmentary information on the fish species population, and the absence of mechanisms for data exchange among the three countries, imposes serious difficulties in introducing more sustainable fisheries management practices for the Prespa Lake.

***Inter-specific competition from exotic species and/or potential dilution of genetic diversity*;** this stress is mainly caused by the introduction of exotic species of fish fauna. The exclusive focus of fishery practices on short-term commercial gain, the failure to set the native and endemic fish species conservation as management objectives in the neighboring states, are amongst the key underlying causes for this stress.

***Concentration of pesticide residues in fish*;** recent investigations have shown significant concentrations of pesticide residues in fish tissues. The main source of

this stress to the fish population is the inappropriate agricultural practices in the region i.e. the uncontrolled use of pesticides.

The changes of the fishery ecology in the lake have altered the entire biological community and possibly trophic structure of the lake ecosystem. Besides the direct impacts to the Prespa fisheries, there are many other indirect impacts which are primarily related to the detrimental effects caused by the economic activities in the Prespa Lake basin.
The analysis of wide range of parameters (for e.g. dissolved oxygen, nutrients concentrations, composition of biotic communities such as phytoplankton and zooplankton), undoubtedly confirm the alteration of the lake's status from mesotrophic to eutrophic. The rapid decline of the water level supports these processes, but also contributes to the loss of spawning areas for the fish. The combined effects of both natural and anthropogenic origin pose adverse effects to the fish ecology. Typical examples of these negative effects are the changes of the spawning habits of certain fish species (for e.g. *Alburnus belvica* and *Cyprinus carpio*), and the significantly reduced (some almost extinct) populations of other fish species (*Barbus prespensis* and *Chondrostoma prespense*).
The key practices and activities at the lake's basin level contributing to the continual degradation of the lake's ecosystem and consequently the fish populations are:

- *Land-use Management:* The significant loss of lakeside shoreline, wetland and forest habitats, and the sediment transport to the lake, has occurred with the conversion to agricultural land and buildings, partly attributable to ineffective land-use planning and the development controls, as well as the insufficient level of integration of the ecosystem management objectives and practices into the planning processes.
- *Water Management:* The insufficient water quantity, the eutrophication processes, degraded aquatic habitats and increased seasonal temperatures in aquatic habitats are to a large extent attributed to the: lack of integrated water management and planning of water resources, pollution from organic waste from untreated wastewaters and fertilizer runoff (increased level of nutrients causing eutrophication), the seasonal irrigation (reducing natural flow regime in streams and increasing temperature), pollution from pesticides and industrial compounds.
- *Agriculture:* The uncontrolled use of pesticides and fertilizers has disturbed aquatic, animal and plant habitats. Significant impacts to the ecosystem are generated by the inappropriate agricultural waste management practices (organic waste and pesticide packaging).
- *Forest Management:* There has been poor management of forested areas together with the excessive harvesting of non-timber products, over-grazing in forested areas and an unsustainable level of firewood collection. Forest

management has emphasised timber production rather than sustainable use and conservation.

- *Solid Waste Management:* The inconsistency of the current solid waste management system in the region causes significant quantities of various types of solid waste to be disposed of in an uncontrolled manner. This inappropriately disposed waste has considerable negative impact on the environment, and particularly the aquatic ecosystems.
- *Wastewater Management:* Input from organic waste from untreated household and industrial wastewater as well as fertiliser run-off from farming areas stimulate pollution and eutrophication processes.

The analysis provided above shows that the Prespa fisheries have suffered serious decline due to a combination of ecological, social and economic factors.

Toward Ecosystem-Oriented Transboundary Fisheries Management in the Prespa Basin

The Prespa Lakes' ichthyofauna is a globally significant element of the basin's biological diversity. Many of the indigenous species found in the Prespa lakes are endemic. Fish populations are transboundary in nature and any management interventions must be trans-boundary as well.

Having established the development of a basis for common transboundary sustainable fisheries management, as an ultimate objective of these coordinated trilateral efforts, activities for conducting basin wide assessment of the fish resources, the related habitats and the biological demands are being designed and implemented. It has been recognized that number of priority gaps related to the institutional set-up on fisheries in the three states, the livelihoods aspects of fisheries and the fisheries ecology have to be addressed prior to any considerable intervention in the current transboundary fisheries management arrangements.

At the national levels, the efforts are being taken for strengthening the civil society's involvement in ecosystem-oriented fishery management by providing support to the local fishermen organizations. In order to create a community based approach in fisheries management, it is intended these associations to be directly involved in formulating the future fisheries management plans, including establishing the harvest limits and defining the priority habitats' protection aspects, not only for emphasizing sustainable fish production, but for the maintenance of the diversity of fish species and conservation of their habitats.

Efforts will be made so that the regional fisheries management concerns are adequately reflected into the national level fisheries management plans in the three co-basin states. Such an effort, complemented with a viable mechanism for exchange of relevant information, will yield in more coordinated approach to fisheries management, even in a situation when because of the existing barriers, no joint fisheries body and official trilateral fisheries management plan exist.

The transboundary fisheries management has to be based on a comprehensive ecological assessment which will be used in defining transboundary management

actions to conserve priority native and endemic ichthyofauna. The purpose of this assessment will be to:

- Research and document the ecological needs of the endemic fish species;
- Research and document the ecology of the exotic fish species and their impacts on native and endemic species of fish in Prespa Lakes.
- Formulate additional management actions needed to control exotic species and conserve the endemic and/or rare species of fish and increase their populations;
- Reach consensus among key stakeholders regarding cooperative transboundary fishery management, monitoring and enforcement actions and targets for habitat conservation and species management.

The ecological assessment should be focused not only to the lake ecosystem, but also to the contributing rivers in the basin, as they provide important nutrition and spawning space for many of the ecologically important species. Given that different species of fish are adapted to specific flow regimes appropriate for a natural riverine ecosystem, in-stream flow requirements should be established and incorporated in a basin-wide management plan.

Since because of the complexity and multitude of impacts generated within the lake's basin, the restoration of the fisheries does not only depend on interventions in the fisheries sector. Attention is being paid to developing comprehensive basin-wide programme for mitigating the key adverse impacts to the aquatic ecosystems and the Prespa environment in general.

These measures include developing various 'ecosystem oriented' planning documentation (land and water management plans), resolving the problems related to the management of solid waste and wastewaters, input of agrochemicals, preservation of the landscape elements contributing to the preservation of the ecological values of the area (for e.g. wetlands), erosion processes and quality of forest cover, monitoring of a range of parameters and etc.

8.1. Impact from water courses runoff

The annual sediment transport within the catchment area is 163,536 m^3 per year, while the specific sediment transport is 286 m^3 per km^2 per annum.

No.	Stream	class	F	Z	W
1	Golema River	III	166,86	0,32	71991
2	Istocka River	III	89,00	0,41	55091
3	Brajcinska River	III	71,70	0,46	49420
4	Bolnska River	IV	42,43	0,40	25246
5	Leva River	IV	31,50	0,35	15184
6	Kranska River	III	35,40	0,30	12409

Table 22: Overview of the most important streams by production of deposits Source: Spatial Plan Ohrid-Prespa Region 2005-2020 –Part Erosion,

The biggest producers of annual sediment deposits (W) are the River Golema Reka (71,991 m^3 per year), the River Istocka Reka (55,091 m^3 per year) and with significant amount of produced sediment are represented the following rivers: Brajchinska (49,420 m^3 per year), Bolnska (25,246 m^3 per year), Leva (15,184 m^3 per year) and Kranska Reka (12,409 m^3 per year).

No	Catchment	class	F	Z	G
1	Golema Reka	III	166,86	0,32	29516
2	Brajcinska Reka	III	71,70	0,46	37560
3	Istocka Reka	III	89,00	0,41	26995
4	Bolnska Reka	IV	42,43	0,40	10856
5	Istocka Reka (oposit the mouth with the Bolnska Reka)	IV	27,27	0,49	10589
6	Kranska Reka	III	35,40	0,30	10424
7	Leva Reka	IV	31,50	0,35	10325

Table 23: Overview of the most important catchments by the quantites of transported deposits Source: Spatial Plan Ohrid-Prespa Region 2005-2020 –Part Erosion.

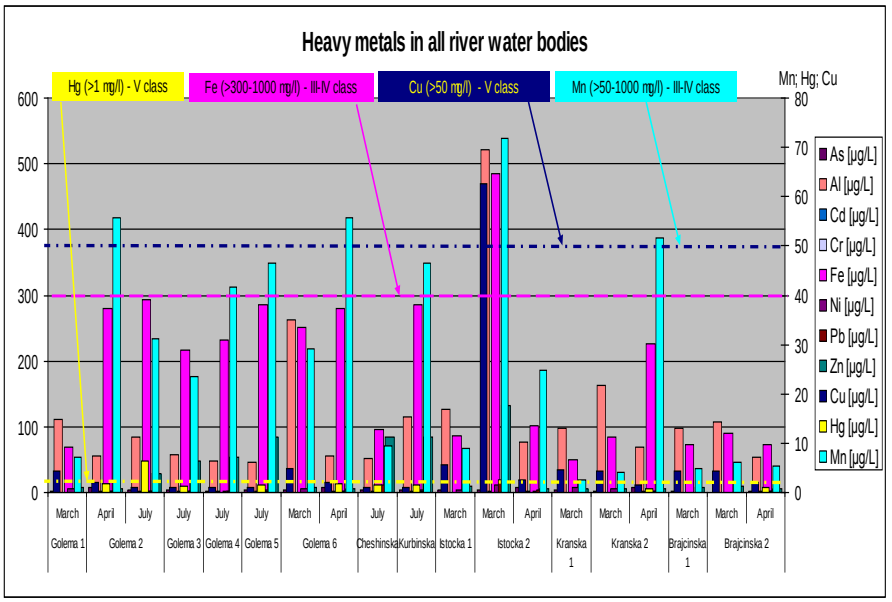


Figure ???? Heavy metals in the tributaries of Lake Prespa. Source: Development of Prespa Lake Watershed Management Plan (UNDP, 2012)

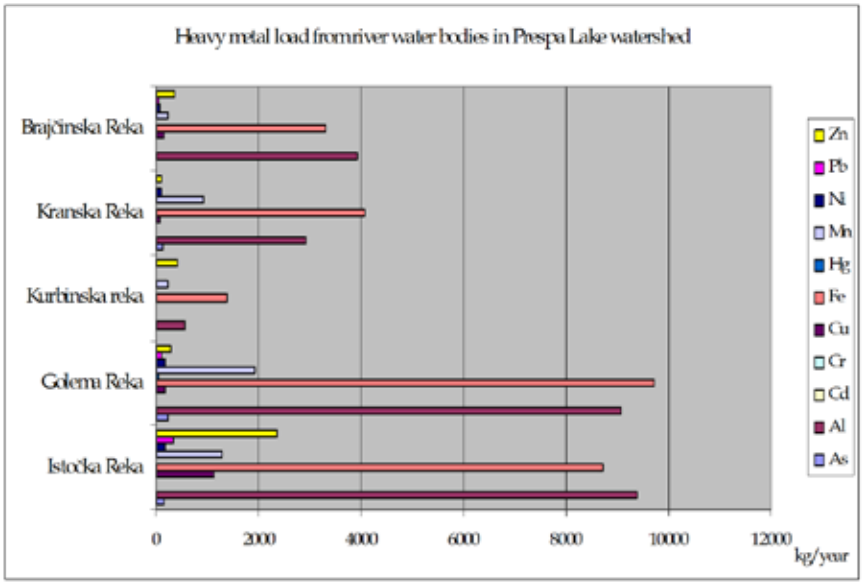


Figure ????? Heavy metal load from river water bodies in Prespa Lake watershed. Source: Development of Prespa Lake Watershed Management Plan (UNDP, 2012)

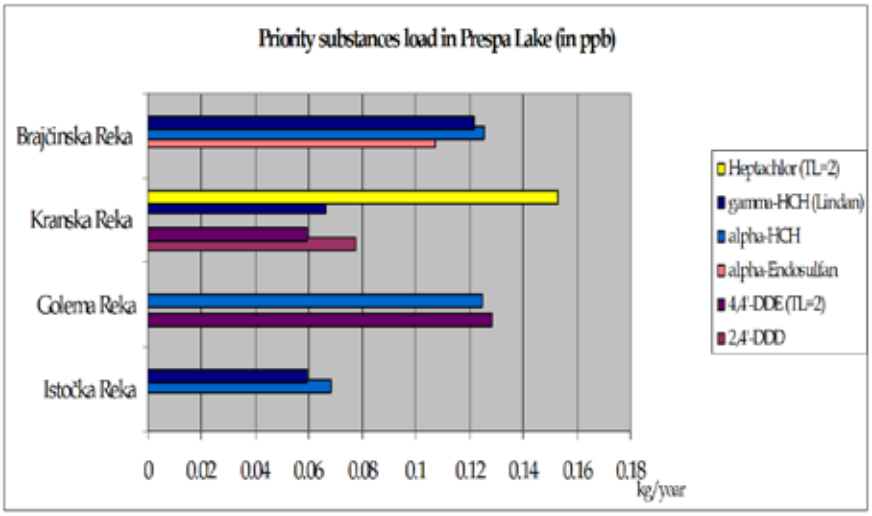


Figure ????? Pesticides load from river water bodies in Prespa Lake watershed. Source: Development of Prespa Lake Watershed Management Plan (UNDP, 2012)

8.2. Impacts to the water courses

The rivers Kranska and Brajcinska as well as Agios Germanos and Leva Reka are natural habitats for separate and isolated local populations of Prespa trout. Any deterioration of their natural habitat can be harmful having in mind that population viability is determined by the performance of individuals and that those populations have no recruitment from other populations.

Figure ???? Small HEP in river Brajchinska (No. 375, 376) and river Kranska (No. 374). Source: Development of Prespa Lake Watershed Management Plan (UNDP, 2012)

Figure ????? Deterioration of the river beds by HEP on Kranska River and the tributaries.

8.3. Impacts to the Prespa Lakes

Trophic state of Prespa Lakes during 1992 alternated between oligotrophic and mesotrophic state. For the ten years period, trophic state of the Lakes was significantly changed which indicated that Prespa Lakes are in process of eutrophication. It was found that both the development of anoxic conditions in the bottom water and the increases in sedimentary P, as well as the linear lake phosphorus balance, point towards eutrophication of Lake Prespa. The main anthropogenic factor influencing Prespa Lakes is the agricultural development and in particular the abstraction of water, application of fertilizers, and enhanced soil erosion. According to the fix boundary system of OECD (1982), Lake Prespa in 2001 was in meso-eutrophic state and in 2002 and 2003 in mesotrophic state. In the last decade Prespa Lakes trophic state progressively is changing to eutrophic.

8.4. The Conflict Between Cormorants and Fisheries

It is likely that the species is now more numerous across Europe than ever before. The geographical range of these populations has also expanded with Cormorants returning to some areas after a long absence and also moving into previously unoccupied area. The reasons for such expansion are unclear but possible causal factors include a “non-limiting food supply” and protective legislation, particularly EEC Directive 79/409 on the Conservation of Wild Birds. Cormorants are generalist fish-eating predators taking a wide variety of species in shallow coastal seas, running and standing freshwaters, and both traditional/extensive and intensive aquaculture systems. In almost all countries where Cormorants occur, their increasing numbers and geographical spread has led to a growing number of conflicts with commercial fisheries and recreational angling interests.

Reducing the conflict between Cormorants and fisheries on a pan-European scale
Report of a Concerted Action funded by the European Union. Study contract no. Q5CA-2000-31387: Reducing the conflict between cormorants and fisheries on a pan-European scale

It is likely that the species is now more numerous across Europe than ever before. The geographical range of these populations has also expanded with Cormorants returning to some areas after a long absence and also moving into previously unoccupied area. The reasons for such expansion are unclear but possible causal factors include a “non-limiting food supply” and protective legislation, particularly EEC Directive 79/409 on the Conservation of Wild Birds. Cormorants are generalist fish-eating predators taking a wide variety of species in shallow coastal seas, running and standing freshwaters, and both traditional/extensive and intensive aquaculture systems. In almost all countries where Cormorants occur, their increasing numbers and geographical spread has led to a growing number of conflicts with commercial fisheries and recreational angling interests.
REDCAFE sampled Cormorant conflicts in 24 countries and collated information on 235 conflict cases. Cormorant conflicts were reported from a wide variety of habitats and fishery types: rivers, lakes, freshwater aquaculture ponds, coasts, and coastal aquaculture sites. This demonstrated the widespread geographical distribution of conflicts. Conflicts

were reported by four different stakeholder groups representing recreational, commercial and nature conservation interests and covered a wide variety of fishery types, suggesting that the nature of conflicts also differed on a geographic scale.
Conlicts: finance - Financial information was provided by fishery-related stakeholders for 105 conflict cases, approximately 45% of those recorded in the present synthesis. Nature conservation stakeholders did not provide any financial information in relation to any of the conflict cases they recorded. Fishery stakeholders provided information on the annual financial turnover in their fishery system and the turnover loss due to Cormorants as 'actual' figures or as 'estimates'(derived by unknown means), thus care must be taken when interpreting the financial information collected in this synthesis. Nevertheless, the 105 conflict cases gave a cumulative total for annual turnover of about 154 million euro and associated losses to Cormorants were given at about 17 million euro, an overall loss of 11%. There were significant differences in the scale of financial losses reported by the relevant stakeholders for different habitats and fishery types. All three fishery stakeholder groups independently were consistent in their views on relatively low financial losses due to Cormorants, recording average values of 9-12% of annual turnover. Around 2% of aquaculturist, 13% of commercial freshwater fishermen and 31% of commercial coastal fishermen recorded losses greater then 50% of the annual financial turnover in their fishery. In contrast, recreational anglers recorded considerably higher financial losses due to Cormorants, averaging 57% of annual turnover. Furthermore, in 43% of cases, anglers recorded financial losses greater then 50% of the annual turnover in their fishery.

Conflict issues: Nine specific conflict issues were most commonly cited as being major ones for stakeholders. For both aquaculturists and commercial fishermen, the issue of **reduced catches** was most important whilst for both recreational anglers and nature conservationists the most important issue was **reduced fish stock through lowered production**. Recreational stakeholders also most frequently reported conflicts over reduced catches and **effects on fish population dynamics and community structure**, an issue that was also important to nature conservationists. Both aquaculturists and commercial fishermen were concerned over **loss of earnings from the fishery**, the former stakeholders cited conflicts over **loss of stocked fish** and the latter ones cited conflicts over reduced stock through lowered production. Finally, nature conservationists also frequently recorded concerns over **loss of juvenile fish and lowered recruitment**, **scaring/shooting disturbance**, **drowning of Cormorants in fishing gear** and **damage to vegetation and landscape**. Thus, although stakeholder groups frequently shared concerns over specific major conflict issues, some concerns were specific to particular groups. Most importantly, nature conservationists cited broader 'environmental' issues more frequently than did the three fishery-related stakeholder groups. The conflict synthesis showed considerable, and consistent, similarities between the opinions of both income-producing stakeholder groups involved in fisheries. Although recreational anglers shared many of the concerns of these other fishery-related stakeholder groups, they also recorded some different major conflict issues. However, the biggest differences were between fishery-

related stakeholders and nature conservationists. Nature conservationists, in general, were most concerned with wider (i.e. 'environmental') conflict issues.
Any successful resolution, or management, of the conflicts between Cormorants and fisheries interests on a pan-European scale must include careful consideration of the best available biological information on Cormorant populations throughout the region.

Synthesized aspects of Cormorant ecology that lead conflicts: Relevant factors were categorized into four main themes: (1) general ecology and habitat features, (2) migration and the annual cycle, (3) fish communities and Cormorant diet, and (4) Cormorant ecology and impact at fisheries.
Fish species eaten by Cormorants are, for the most part, common, widespread species. The heavy fishery pressure exerted by people in many water systems in Europe has resulted in a shift in size distribution towards the smaller classes, which enhances Cormorant foraging conditions.
At Prespa Lakes the cormorant diet mainly consists Prespa bleak (*Alburnus belvica*) with more than 99%. Other fish species present in their diet are carp (*Cyprinus carpio*), Prespa roach (*Rutilus prespensis*)and some of the minnows.

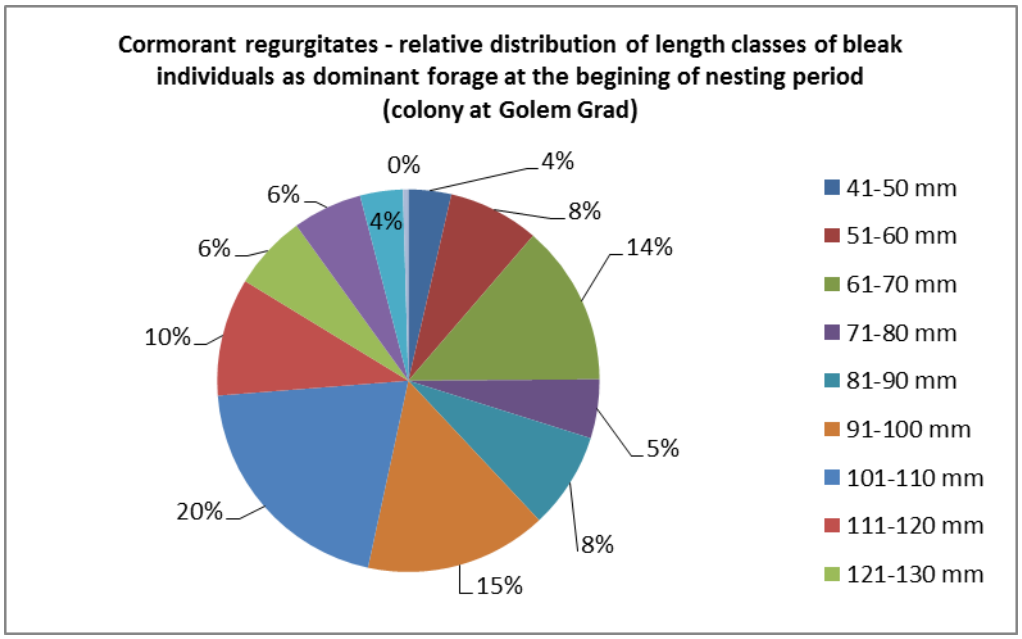
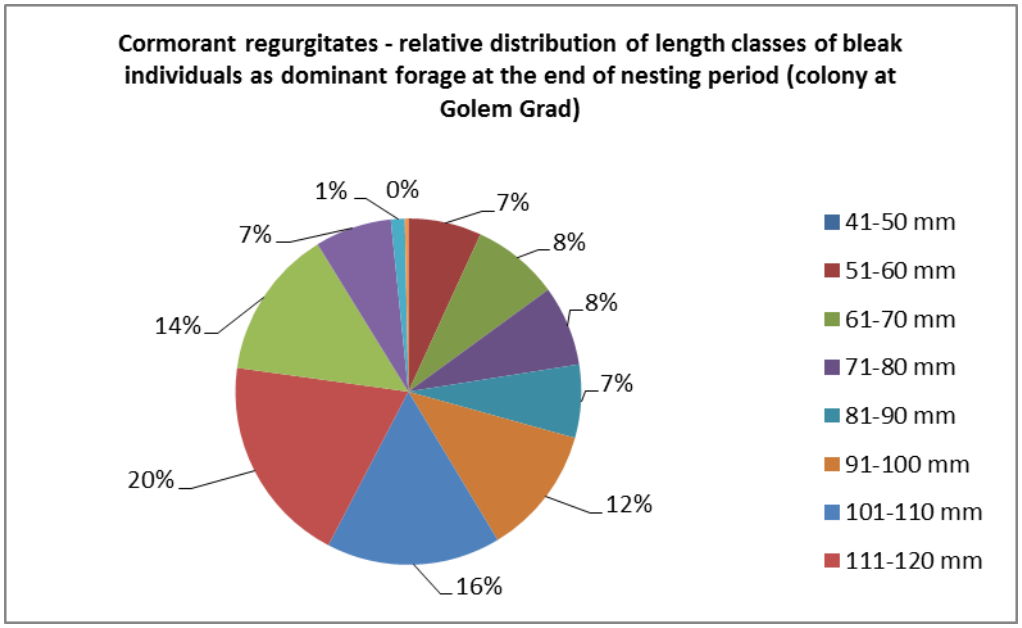


Figure ????? Fish eating birds –Cormorant diet at the beginning of the nesting period



Figure????? Fish eating birds –Cormorant diet at the end of the nesting period

Periods of large-scale Cormorant movements through Europe (e.g. March and October) require extra management attention to avoid the establishment of any tradition to visit stocked water bodies or fish farm areas. A combination of ecological, demographic, climatological and geographical data into a GIS based Decision Support System may help to predict future Cormorant 'problems' and reduce current ones through integrated management.

The watershed of Prespa Lakes is well known for its community of fish eating birds. Apart from the Cormorants, Pelicans, Herons, Grebes and Mergansers are also present. All this nesting birdshave huge impact to the reduction of fish population.

At Prespa Lakes the status of Cormorant colonies are necessarily parts of further monitoring and developing strategies for reducing the "problems" they cause.

The fish biota in the lake has been under an increasing pressure from different human activities such as water abstraction, pollution, over-fishing of certain species, but also from introduced species. The unilateral and piecemeal approach in managing of the fish resources so far is amongst the key causes of the current status of the fisheries in the region.

Therefore, the introduction of harmonized, transboundary fisheries management, but also the implementation of basin-wide ecosystem management programme aiming at improving the overall ecological status of the area, is the primary prerequisite for sustainable fish production and protection of the native, endemic and rare fish species in the Prespa Lakes and their tributaries.

Given the current political and socio – economic conditions in the region, the alternative of harmonizing the national fisheries management plans seems more viable for the sustainable management of the fish stock in the Prespa Lake,

compared to the establishment of a joint, trilateral fisheries management body, responsible for implementing a jointly prepared and adopted fisheries management plan. Such a decentralized model which would entail improved participation of the local fishermen communities and fisheries managers would be a more practical option if the sustainable fisheries management is the ultimate objective of the ongoing efforts supported by the three states.

9. MANAGEMENT PROGRAM

No transboundary fisheries management is likely to be effective unless it is based upon clear legal obligations and agreements that set out the rights and duties of the parties in a manner which accords with the international legal framework for fisheries management, and provides effective and efficient legal procedures and mechanisms for implementing these rules consistently

9.1. Data Needs

Water quality monitoring: permanent monitoring on water quality, pollution, nutrient load, agrochemical load and their impact to the fish community, as in the lakes as well on the tributaries, primary and secondary production.According to the agreed Trilateral Watershed Program and Water framework Directive.

Fish stock monitoring: fish census and fish stock assessment by using direct methods and past and present indirect methods (fish statistics, integrated primary production, etc).

-sampling methods

For the lakes: total of 9 months survey should be conducted according to the specifity of the Prespa Lakes ecosystem and theirs fish fauna. Sampling should be conducted with a monthly dynamics (at least one full sampling campaign for each month, one in the period of hibernation –February, and eight consecutive samplings in the period from April till November). The sampling should be conducted for 10 critical sampling points 4 in MK), 3 in GR and 3 in AL. Sampling points in GR should bein Macro Prespa and two in Micro Prespa and for ALtwo for Macro Prespa and one for Micro Prespa.The fish sampling in the lakes will be performed according to the Swedish standard method for sampling freshwater fish with multi-mesh size gill nets (total length of 50 m. with different mesh size of each 10 m) Type I -10, 14, 18, 23 and 27 mm. Type II – 33, 38, 45, 55 and 60 mm. adjusted to specific ecosystem characteristics. Gillnets with total length of 50 m. and following mesh size: 12, 14, 16, 18, 45, 50, 60 and 80 mm and cast nets for checkup, beach seine nets for behavioral patterns.For spawning successes and offspring survival fyke nets should be used in the littoral, both with larval traps which should be used for pelagic waters also. In the same time Hydroacustic survey and biomass estimation should be performed.
For the tributaries – The monitoring of the Prespa barbell and Prespanasepopulations–spawning period should be conducted at the sampling stations (river sections close to the estuaries) for all four critical tributaries 3 in FYR Macedonia, 1 in GR.For Prespa trout, catchment area of all four tributaries should be sampled during the autumn. Sampling should be done with standard electrofishing methods. During the sampling campaigns length and width of the tributaries will be measured, and results will be presented as species abundance per length of the tributary and species abundance per surface of the tributary.In the same time surveillance of the water courses, monitoring of the habitat conditions, spawning grounds and their protection during the spawning season etc.

-parameters

Individual fish specimen parameters: weight, length, sex, age, condition factor

Fish health status: external organ examination, internal organ examination, parasites, heavy metals, organochlorine pesticides(Haeptrachlor, Aldrin, Dieldrin, Endrin, p,p' – DDT and gamma HCH – Lindane), human hormones and their mimicries

Species population parameters: population structure, population size, condition factor, GIS for species and stock, trend of endemic species, trend of commercial species, trend of alien species
Fish species diversification: fish population structure, fish biomass, recruitment
Spawning grounds: survey in the lakes and tributaries
Fish extraction by Cormorant diet: species, individual length, fish biomass estimation
Total available catch quota: biomass production per species, allowable catch quota, fishing effort

Fish eating birds: The watershed of Prespa lakes is well-known for its community of fish-eating birds (cormorants, pelicans, herons, grebes, mergansers). All these nesting birds are extracting huge amount of fish every year, especially in the nesting period.

-sampling methods
Cormorant diet should be surveyed by assessing qualitative and quantitative fish composition consumed by cormorants. (cormorant's diet). Sampling of the cormorant regurgitates should be conducted on the colonies on the islands Golem Grad (MK) and Agios Achileos (GR).
Hatching successes should be surveyed during the whole nesting period of the fish eating birds-Cormorants and Pelicans.
Survival successes should be surveyed from hatching, juvenile and adult-nesting pairs marking
-parameters:
Individual fish specimen parameters from the cormorant regurgitates: species determination, length, weight
Individual bird specimen parameters: length, weight, bird marking – nesting pairs marking
Hatching successes: number of nests per tree, (tree marking) number of lied eggs per nest, number of hatched eggs per nest, size of the eggs, fitness of the hatchlings
Survival successes: population recruitment, birds marking, population monitoring

9.2. Principal Issues And Management Options Of The Fish Resources

For thousands of years, fish have provided an important source of animal protein for humans. More recently, the state of fish communities has been recognized as an important indicator of the health of aquatic ecosystems.
The management decisions must take into account the past, present and future contribution of role of the fisheries resource to the material, physical and cultural well-being of the people of Prespa Lakes basin.

The first priority must be to protect sufficient fish and aquatic habitat to sustain the resource. This will ensure that these benefits continue in the future.

No.	IDENTIFIED ISSUES	STRATEGIC MANAGEMENT ACTIONS
1	**Aquatic ecosystem**	· Ensure protection of healthy aquatic ecosystems and prevent further deterioration of degraded ecosystems. · Expand and improve efforts to rehabilitate degraded fish communities and habitat. · Allocate aquatic resources to provide a fair distribution of benefits to all

		stakeholders while ensuring sustainable benefits for future generations. · Provide for a variety of consumptive and non-consumptive opportunities based on naturally reproducing fish communities and stocking practices.
2	**Public involvement in decision making**	· Increase the public's understanding of resource management principles, the value of healthy ecosystems, and the results of fisheries management efforts. · Encourage communication among the public and stakeholders to foster harmony in resource use. · Develop and encourage public education and involvement programs based on the ecosystem approach to managing fisheries on a sustainable basis. · Improve consultation and involvement mechanisms for co-operative decision making and program delivery. · Work co-operatively through partnerships.
3	**The value of the aquatic resources**	· Install a broad appreciation of the value of the resources in those who benefit from them, and price access to aquatic resources, with special attention to fish, to reflect the cost of effective management.
4	**Effective program management and coordination among agencies**	· Improve effectiveness of fisheries management systems. · Expand coordination among agencies sharing responsibility for managing aquatic ecosystems. · Ensure staff receive appropriate training in the skills required to be effective aquatic ecosystem managers. · Expand cooperative programs to increase efficiency and to ensure a comprehensive approach to ecosystem management.
5	**Essential knowledge for timely and effective resource management decision-making**	· Set priorities for acquisition of new knowledge based on resource management needs. · Develop improved techniques for the

		acquisition and application of knowledge to protect and rehabilitate fish communities and habitat. · Develop better understanding of fish communities and habitat and of the socio-economics of the fisheries resources. Increase understanding of the effects of environmental and social changes, as well as the impact of management actions. · Improve communication of knowledge to managers, other agencies and the public to ensure understanding of the implications of management actions.
6	**Enforcement**	· Ensure enforcement priorities reflect protection and rehabilitation needs. · Focus efforts on regulating the harvest of naturally reproducing fish stocks. · Increase efforts to ensure compliance with legislation. · Evaluate effectiveness of enforcement efforts.

9.3. Direct Measures For Protection And Sustaining The Fish

No	Measures	Actions
1.	**Trilateral Fishery Management**	- **Establishing Joint Prespa Fishery Commission (JPFC)**
2.	**Monitoring of the water quality, fish stock monitoring**	- **Establishing local monitoring stations in the three countries in cooperation with scientific institutions and other relevant stakeholders**
3.	**Joint Monitoring Technical Protocol**	- **Quality Assurance and Data Acquisition (Designated responsible implementing bodies)**
4.	**Improved Fish Statistics**	- **Implementing unique software (Data exchange)** - **Establishing Fishery Data Base**
5.	**Fish Stock Assessment**	- **Integrated actions (open cross border expeditions and surveillances with joint resources) FSA**
6.	**Physical guarding of the fish stocks**	- **Establishing national guarding bodies (state and private)**
7.	**Conservation**	- **Conservation action plans per fish species** - **Total ban on Prespa barbell for 6 years period**
7.	**Alien fishes combat**	- **Selective and ameliorative fishing**
8.	**Fishing limits**	- **Determining the allowable smallest catchable size per species** - **Determining the spawning periods and close fishing season per species**
9.	**Spawning grounds -**	- **Defining strict natural fish spawning grounds (where any**

	habitats	**activities without special permission of the national management bodies and JPFC are allowed)** - **Improving the conditions of spawning grounds (entrances in to the rivers from the lake for Prespa nase)**
10.	**Catch quotas**	- **Determining of Annual Total Allowable Fish Catch Quotas (ATAFCQ) per country / per lake / per species**
11.	**Fishing regulations**	- **Maximum allowed fishing gears and fishing equipment for commercial and recreational fishery**
12.	**Fish Stocking**	- **Designing of Joint Fish Stocking Program (JFSP) based on obtained fish spawning individuals from the lakes or streams**

Sselective and ameliorative fishing

At present only ameliorative fishing of the "sunfish" (Lepomis gibosus) is foreseen which is recognized like a "fish pest". Also, as this fish appears as a "by catch" and the fishermen are mainly returning back in the lake (where it survives again 90%), measures for financial compensation for it if brought on the landing sites should be introduced. In that way the reduction of its population will have greater effect.

A**llowable smallest catchable size per species**

The sizes are based according the maturation of the species.

Carp	***Cyprinus carpio***	**35 cm**
Chub	*Squalius prespensis*	**25 cm**
Nase (undermouth)	*Chondrostoma prespense*	**25 cm**
Roach	*Rutilus prespensis*	**15 cm**
Alburnus (belvica)	***Alburnus belvica***	**12 cm**

The rest of the autochthonous (native) fish are not allowed for fishing, and for all alochthonous fishes there are no limits.

In the Prespa Lakes watershed fishing of the noble crayfish (Astacus) is banned.

Spawning periods per species

The natural spawning periods per species quite often vary from year to year, and here wide ranges of period are proposed:

SPECIES	Prespa Lakes Basin	
Time period	from	to
Carp	01 April	30 June
Chub	15 April	31 May
Nase	15 April	31 May
Barbell	15 April	30 June
Belvica	01 April	30 June
Prespa trout	01 November	30 March

Defining natural fish spawning grounds

The spawning grounds must be visually marked with signs on the shore and floating marks in the lake.

In the period from 01 April till June 30 at Prespa Lakes fishing and disturbing is forbidden in the areas where the fish are spawning around the reed belts and 1 km from the shore.

Stocking of the lake

At the Macedonian part of the lake within the next 6 years stocking of the lake with 1,5 million carp fingerlings is planned with weight from 5 – 10 g. This material has to be obtained from carp

spawners from the Lake Prespa. For the Albanian Part for Macro Prespa for the same period 300.000 fingerlings are foreseen.

9.4. Total Allowable Fish Catch Quotas

Annual TAFCQ for commercial fishing in kg

SPECIES	MACEDONIAN PART	ALBANIAN PART		GREEK PART	
	Macro Prespa	Macro P.	Micro P.	Macro P.	Micro P.
Carp	35.000	25.000	8.000	25.000	15.000
Chub	6.000	3.000	200	3.000	1.000
Nase	1000	1.000	200	1.000	500
Roach	14.000	7.000	400	8.000	8.000
Belvica	170.000	200.000	2.500	60.000	10.000
TOTAL	**226.400**	**236.250**	**11.350**	97.000	34.500
All other alochtonous fish	No limit	No limit	No limit	No limit	No limit

Annual TAFCQ for recreational fishing in kg

SPECIES	MACEDONIAN PART	ALBANIAN PART		GREEK PART	
	Macro Prespa	Macro P.	Micro P.	Macro P.	Micro P.
Carp	5.000	1.000	200	2.000	1.000
Chub	3.000	500	500	1.000	1.000
Nase	200	200	200	200	200
Roach	6.000	3.000	500	1.500	1.500
Belvica	18.000	5.000	500	5.000	3.000
TOTAL	**31.400**	**12.700**	**1.900**	9.700	6.700
All other alochtonous fish	No limit	No limit	No limit	No limit	No limit

At the Macedonian part of Lake Prespa for the recreational fishing, the number of fishing days for the cyprinid fishes, apart from the carp, differs and is 9485 f.d. or number of daily fishing licenses with 4 kg of total daily catch per license. For the carp there are 1000 fishing days (or licenses) with total catch of 5 kg per license.
Additional estimation of fishing days for the Greek and Albanian side have to be estimated according the interest in recreational fishing.

10. MANAGEMENT PLAN

The Management Plan is organised into 4 key, mid-term objectives (i) a programme and supporting actions to strengthen the administrative structures, (ii) a programme to strengthen the organisational structures, (iii) actions supporting the operational activities, (iv) enhancing information and public awareness.

Priorities	Period
Objective 1: *Strengthening the Administrative Structures*	
Development of transboundary fisheries management Agreement harmonised with international and national legislation	ST
Development of joint Fish and Fisheries Management Plans	ST
Development of joint Lake Basin Development Plans	MT
Agreeing common fish and fisheries development objectives (common goals)	ST
Development and harmonisation of joint aquaculture programmes for re-stocking purposes	MT
Design and implementation of joint economic instruments (e.g. international donors)	ST
Development of State economic instruments (e.g. Eco-Fund)	ST
Designation of protected areas	MT
Classifying and managing land use capacity	MT
Objective 2: *Strengthening the Organisational Structures*	
Supporting co-operation agreements between SFMOs	ST
Establishment of the RFMO and the JSC	ST
Establishment of joint Working Groups (Lake, Catchment Area, Contingency Planning)	ST-MT
Identification and support to NGOs and civil groups	ST
Identification and establishment of research sharing programmes	ST

Objective 3: *Supporting the Operational Activities*	
Development of MCS Plan and MCS Field Guide	ST
Development and implementation joint enforcement mechanisms	ST
Training of Fisheries Inspectors	ST-MT
Establishment of joint inspection teams	MT
Developing small-scale electronic VMS	MT
Training of fishers and fishing community (good practices)	ST
Supporting self-enforcement and local involvement in decision-making	ST

Objective 4: *Enhancing Information and Awareness*	
Establishment of tri-lateral fishing database (electronic)	ST
Establishment and development of joint media and public access systems	MT
Organising research-based multi-disciplinary approach for data collection	ST
Allocation of TAC, species by species and for the overall Lake Basin	MT
Management of environmental and fisheries data	MT
Public awareness and involvement in decision-making	ST
Environmental education and training	ST

Note: ST = short –term (1-2 years) MT = medium – term (3-5 years)

Objective 1. *Strengthening the Administrative Structures*

The highest priority set of actions is to make the existing structures more effective. Reform begins with a proposed programme of urgent low and no-cost actions that should be taken. This will be supported by (i) developing the transboundary Agreement based upon international and national legislation to improve the legal framework, (ii) the development of joint plans for overall management of the resources and Lake Basin with common goals and establishment of protected areas, (iii) to integrate economic instruments into the planning so that the cost/benefit analyses for co-operation is viewed as being significantly advantageous for all the States involved.

Objective 2. *Strengthening the Organisational Structures*

This will include (i) supporting the already existing SFMOs and promoting active co-operation agreements between them, (ii) establishing the RFMO, JSC and Working Groups to make them effective. The involvement of NGOs and other civil groups in fisheries management will also be promoted. Key to the Working Group activities is the Identification and establishment of research sharing programmes.

Objective 3. *Supporting the Operational Activities*

Taking the measures already being supported by the EU projects in Albania, the aim is to further develop the MCS measures as a basis for transboundary co-operation. This will include (i) training of each State Fisheries Inspectorate (with joint inspection teams) and stakeholders in the proposed transboundary Agreement and in *good practices*, (ii) supporting self-enforcement by stakeholders and local involvement in decision-making for resource protection.

Objective 4. *Enhancing Information and Awareness*

The Management Plan participatory process supports (i) establishing a tri-lateral fishing database (electronic) which can be readily accessed by the public and other interested parties, (ii) the development and efficient operation of a reliable, updatable information system, including the management of data for improving analysis, decision-making and public awareness, (iii) implementing public awareness programmes for building responsibility amongst stakeholder groups with environmental education and training conducted through both formal and non-formal channels. Better environmental information and a better-educated public could help address the key problem areas by broadening government and public perception about the risks and costs of a degraded Lake environment. This will also help the States to more efficiently focus resources on priority problems. In addition, by increasing public involvement, there will be more pressure on the decision-makers to tackle the key issues facing the transboundary management issues.

10.1. Implementation

The Management Plan is intended to be implemented over a 5 year period from 2012-2016. For this reason only short-term (i.e. 1-2 years) and medium-term priorities (3-5 years) have been selected. This refers to the *starting* time frame and *not* the overall period for completion of the project proposals. Additional measures will be identified during the second half of the project period and based upon the results of the monitoring and evaluation phase.

10.2. Monitoring and evaluation (M&E)

M&E should be based upon a set of indicators prepared by the Regional Ffisheries Management Organization with assistance from scientific institutes and other relevant organizations from all of the three countries. They will report whether the objectives and priorities are being achieved based upon the following measurements:

- Reduction and prevention of pollution;
- Improved access to fisheries infrastructure and services;
- The sustainable use of resources by stakeholders;
- The promotion of sustainable and responsible practices e.g. incorporated in into the transboundary policies, programmes and projects that sustain the environment and resources;
- Reduction and minimisation of vulnerability to accidents and hazards through contingency indicators.

These indicators must be regularly analysed if they are to be effective tools for monitoring the implementation of the Management Plan. Other important sources of monitoring information will include:

- mid and end-of-project reviews for transboundary fisheries management related programmes and investments;
- periodic and regular Management Plan performance reviews (e.g. every 12 months) to assess its relevance and effectiveness.

To enhance information dissemination and public awareness, regular publication and distribution of the indicators should be carried out. Also, the RFMO and reports prepared by the Working Groups should include these analyses. Moreover, the dedicated web-site should report the results for public access.

Indeed, dissemination of monitoring information is part of public feedback and a useful resource to improve the performance in implementing the Management Plan. Regular and formal evaluation should then take place by the RFMO. In addition, activities for environmental and fisheries protection and management require wide participation, consensus and democratic mechanisms.

10.3. Updating and revision

Stakeholder participation in updating and revising the Management Plan should be included in the transboundary fisheries management Agreement.

If the key objectives are not being met, or one State may feel that the process of co-operation is not meeting the desired results, then it is important to assess why and to jointly develop the mitigating measures.

10.4. Financing the Management Plan

The Management Plan will depend upon the following funding sources:

- Governmental resources - revenues from central government, local government resources, charges on publicly-provided services, other fees from licences and taxes;
- Private sector support - e.g. financing by industry for their fisheries expenditures, and public-private partnerships to finance improved infrastructure and services;
- International financing - credits and grants from bi-lateral donors and international NGOs, and grants and loans from international development agencies.

No matter how difficult the decision-making will be, there is no getting away from the fact that the critical problem areas for the Lake Prespa Basin will have costs, especially for setting up the administrative and organisational structures, regular joint meetings, research-based activities and public dissemination of information. Such funds are limiting for any State. However, it should be remembered that these are important investments and must be made at some stage, if he States are to develop the transboundary fisheries management objectives and to meet the EU Regulations and international environmental standards.

Furthermore, the costs and cost recovery mechanisms should be fully explored. Account should be taken of the *willingness to pay* (WTP) and *ability to pay* (ATP) criteria. Stakeholders will benefit and

regional development will be assisted and promoted. Land process should increase. In addition, it is the rate of return upon investment that is the key issue. With proper management (by the RFMO), efficient cost recovery mechanisms in place (polluter pays principle, licence fees, tourism development) *all* lake communities and industry should contribute to the cost of the fisheries (and environmental) services being provided. This will also be supported by other economic instruments and the establishment of the Eco-Fund is seen as one of the priority actions for each State. This will be important for sustainable financing in the future and can also be a *kick-start* for attracting new investments in an enriched, better managed and cleaner lake ecosystem.

ANNEX I: DIRECTIVE 2006/44/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL