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Fish and Fisheries
Lake Ohrid

Implementing the EU Water Framework Directive in South-Eastern Europe

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Conservation and Sustainable Use of Biodiversity at Lakes Prespa, Ohrid and Shkodra/Skadar (CSBL)

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Fish and Fisheries

Lake Ohrid

Implementing the EU Water Framework Directive in South-Eastern Europe

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Michael Pietrock, Project Manager, Institute of Inland Fisheries, Potsdam, Germany

Disclaimer

Content

List of Abbreviations

BPUE	catch (in biomass /m² of net) per unit of effort
CPUE	catch per unit of effort
CSBL	Conservation and Sustainable Use of Biodiversity at Lakes Prespa, Ohrid and Shkodra / Skadar
EQR	ecological quality ratio
EU	European Union
fem.	female
FSA	Fish stock assessment
HIO	Hydrobiological Institute Ohrid
ind.	individuals
JLOFC	Joint Lake Ohrid Fishery Commission
juv.	juvenile
LFI	Lake Fish Index
MEFWA	Ministry of Environment, Forestry and Water Administration (Albania)
MMG	multi-mesh gillnet
NPUE	catch (in numbers /m² of net) per unit of effort
SB	sub-basin
TACQ	total allowable catch quota
temp.	temperature
UNESCO	United Nations Educational, Scientific and Cultural Organization
WFD	Water Framework Directive

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Foreword

The fish fauna of the three great lakes of the Western Balkans is one of the richest and most diverse in Europe. Lake Ohrid alone is home to seventeen indigenous fishes, including endemics such as Ohrid trout and belvica, which are, furthermore, of high commercial value. In addition, six non-native species are believed to have been introduced, either deliberately or through negligence.

The management and sustainable use of the lake's fishes poses manifold challenges to competent authorities and small-scale fishers alike. First, vulnerable species are protected under national and EU nature conservation legislation and require special conservation efforts. Second, economic species such as trout or bleak are exploited with little if any knowledge on the status of stocks and maximum sustainable yields. Third, fisheries regulations differ among countries and are, in any case, poorly implemented. Lastly, fishes are one of four so-called biological elements – or indicators – that determine the ecological status of lakes according to the EU Water Framework Directive (WFD). The Directive requires that good ecological status, i.e. the status of the fish fauna (and other biota) under nearly undisturbed conditions, has to be maintained or restored, and that specific measures are to be taken to fulfil this requirement.

However complex and variable these challenges may be, they have one thing in common: the need for data and up-to-date information on the status of the fish fauna of the lake. Yet sampling fish is anything but a small undertaking in terms of both effort and finance. The last comprehensive stock assessments had been made during communist times in both countries. In those days, annual catch statistics were collated by fishing authorities, providing a fairly sound basis for the management of stocks. Unfortunately, such statistics are no longer collected, let alone data from independent monitoring campaigns.

It is from this perspective that German Development Cooperation supported partner countries in conducting multi-annual fish sampling pursuant to fishing standards set by the European Committee for Standardization, of which Albania is an affiliate and Macedonia a full member. In 2013 and 2015, standardized sampling using multi-mesh gillnets was carried out jointly by Albanian, German and Macedonian experts, yielding a prolific data base on more than 30,000 specimens of fish and an outline of the present-day composition and abundance of fish assemblages in Lake Ohrid. Stocks of commercial species such as bleak were found to be in relatively stable condition, while the situation of salmonid fishes is more critical: Even though multi-mesh gillnetting is particularly suited to catching salmonids, surprisingly few specimens were caught, providing strong evidence that both Ohrid trout and belvica are currently being under significant pressure. In addition to assessing fish assemblages, a first-ever Fish Index for Lake Ohrid was derived to define tentative reference conditions and assess the ecological status of the lake according to the WFD, using fish as biological element. Fortunately – and despite the critical status of salmonids – the assessment leads to the overall conclusion that the ecological status of Lake Ohrid is good.

The present investigation generated the most comprehensive data set since communist times. Investigators and authors are acknowledged not only for gathering and analysing this wealth of information but also for doing it collaboratively and compliant with recognized methods. Fishing authorities in turn are encouraged to make best use of the data, and to ensure that adequate resources are allocated for future monitoring, including collation of catch statistics.

Dr Ralf Peveling
Program Manager CSBL

1 SUMMARY

Lake Ohrid[1] is a transboundary waterbody located in the Western Balkans and shared between the FYR of Macedonia[2] and Albania. Considered to be an ancient lake, it harbours many relic and endemic species, among which are also several fish species. Because of its natural and cultural values, both Lake Ohrid and the town of Ohrid were declared Natural and Cultural World Heritage Sites by UNESCO in 1979 and 1980, respectively.

In 2013, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) started implementing a Technical Assistance program (*Conservation and Sustainable Use of Biodiversity at Lakes Prespa, Ohrid and Shkodra/Skadar (CSBL)*) which, among others, aimed at improving the management of the transboundary aquatic resources in the three Balkan lakes in agreement with the EU's environmental and biodiversity protection objectives. Amongst others, fishing campaigns for the purpose of this project at both Macedonian and Albanian territories of Lake Ohrid were performed according to the requirements of the Water Framework Directive (WFD).

In both 2013 and 2015, multi-mesh gillnets (MMG) were set in seven sub-basins (SB 1-7) of the lake following the recommendations of the European standard EN 14757 (*Water quality – Sampling of fish with multi-mesh gillnets*). Altogether, 375 MMG were employed resulting into a total catch of over 30,000 fish. All specimens were analysed to species level and the species composition, relative fish abundance, biomass (expressed as catch per unit of effort, CPUE) and size structure of the fish assemblages were determined. Concurrently, the data were used to conduct a preliminary analysis of the ecological status of the lake compliant to the WFD.

The main findings of the sampling campaigns and subsequent analyses are as follows:

- A total of 17 fish species (*Alburnoides ohridanus, Alburnus scoranza*, *Barbus rebeli*, *Cyprinus carpio*, *Gobio ohridanus*, *Pachychilon pictum*, *Pelasgus minutus*, *Phoxinus lumaireul*, *Pseudorasbora parva*, *Rhodeus amarus*, *Rutilus ohridanus*, *Scardinius knezevici*, *Squalius squalus, Barbatula sturanyi*, *Cobitis ohridana*, *Salmo ohridanus* and *S. letnica*) was caught, which corresponds to about 75 % of the presently occurring fishes.
- Spirlin (*A. ohridanus*), bleak (*A. scoranza*), Ohrid roach (*R. ohridanus*), moranec (*P. pictum*) and stone moroko (*P. parva*) were the most abundant species in contrast to carp (*C. carpio*), belvica (*S. ohridanus*) and stone loach (*B. sturanyi*), which occurred with only few individuals in the catch.
- Out of the presently existing six alien fishes, only two species (stone moroko, bitterling) were sampled. In view of numbers both species combined amounted to about 15 % in the annual catches. Adult specimens occurred at all littoral sampling sites, indicating that these fishes are widely distributed in the lake.
- Spatial differences in species occurrence and abundance were noticed, which may indicate that local (small-scale) conditions are of greater importance for structure and diversity of fish community than large-scale (general) environmental factors.
- In both sampling years, adult and juvenile bleak were found in relatively high numbers at almost all littoral sampling sites, suggesting that the bleak stock of Lake Ohrid is currently in good condition and relatively stable.

[1] For similar reports on Lakes Prespa and Shkodra/Skadar, see Ilik-Boeva et al. (2017) and Mrdak et al. (2017), respectively.

[2] Upon decision of the General Assembly of the United Nations in 1993, Macedonia is provisionally referred to as "The former Yugoslav Republic of Macedonia", pending settlement of the difference that had arisen over its name. For the ease of reading and without prejudice, henceforth the name Macedonia is used.

- No carp of marketable size (and other big fishes too) have been collected in the course of the sampling. Presumably, the maximum mesh size used herein (55 mm) was not sufficient to catch larger specimens, which supports findings from former studies in other European waters. The use of further panels (with mesh sizes of 70 or 90 mm knot to knot) is advised for future fish monitoring.
- A small number of salmonid fishes (belvica, Ohrid trout) were caught during the project, which is in accordance with the presently low catches of the commercial fishers.
- A preliminary fish-based assessment of the ecological status of Lake Ohrid according to the WFD indicated a good status of the lake.

A standardized fish monitoring across territorial borders has never been conducted at Lake Ohrid. Therefore, the current report for the first time provides qualitative *and* quantitative information on fish populations of Lake Ohrid. Overall, fish sampling with MMG provides reasonably good information on fish assemblages with regard to species composition, relative abundance and biomass (CPUE), and size structure of the individual fish populations (Appelberg 2000, Emmrich et al. 2012). For future monitoring, however, fish sampling should be complemented by additional nets of larger mesh sizes as well as by further gear to sample species (such as European eel) which are not commonly collected by use of gillnets.

Furthermore, current results show that not all fishes of Lake Ohrid are under significant pressure and, therefore, generalizations are treated with caution and a species-specific view is recommended instead. Ideally, coordinated transboundary management is advised to preserve ecologically important (endemic) species and to sustainably use the economically interesting ones.

2 INTRODUCTION

Ancient Lake Ohrid, the oldest extant lake in Europe (Wagner et al. 2009), is an oligotrophic waterbody located in the Western Balkans and shared by the riparian countries Albania and Macedonia. Its large size, geographical isolation, depth, water quality and long geological history provided excellent preconditions for development of a diverse and unique fauna and flora. Many animal and plant species inhabiting Lake Ohrid are endemic to this locality or region and the relic fauna has earned it the calling of a "museum of living fossils" (Stankovic 1960). Fauna and flora make this lake a valuable natural treasure of European and global significance. Both Lake Ohrid and the town of Ohrid were declared Natural and Cultural World Heritage Sites by UNESCO in 1979 and 1980, respectively. The existing Heritage is planned to be extended into a new transboundary Natural and Cultural Heritage of the Ohrid Region which also includes the Pogradec Protected Landscape in Albania. The Ohrid-Prespa watershed became a Transboundary Biosphere Reserve under the UNESCO Man and Biosphere programme (MAB) in 2014 (UNESCO 2017 b).

Fish and fishery have always played an important role in the Lake Ohrid region. Historic records about life in ancient settlements at the Bay of the Bones located at the east coast of the lake point to the vast abundance of fish (Figure 1) in those days. Nowadays fishing is still of high importance to fishers and their families living in neighbouring cities and villages in Albania and Macedonia. The present situation of the lake's fish stocks, however, is very different compared to the past, as the fishes are exposed to manifold stressors, such as environmental pollution and habitat degradation, unsustainable fishery, invasive species and others (Spirkovski et al. 2001, Watzin 2003, Spirkovski 2004 a, Talevski et al. 2009 a, Kostoski et al. 2010). The exact status of the individual species, however, is not clear in most instances, as published information is scarce and outdated (Spirkovski & Talevski 2002, Avramoski et al. 2003).

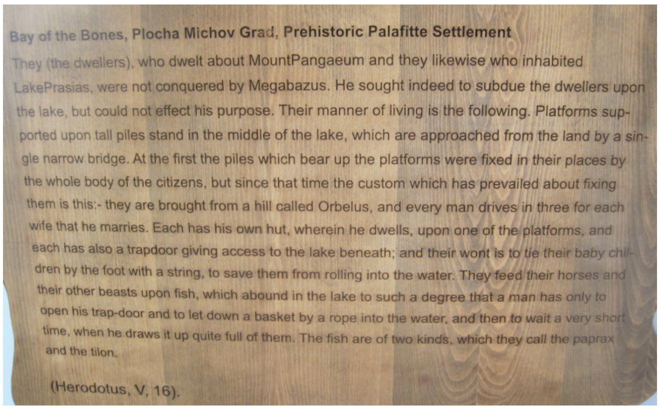


Figure 1. Tablet bearing an inscription about ancient living at Bay of the Bones (Lake Ohrid, Macedonia)

Beginning in 2012, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) on behalf of the German Federal Ministry of Economic Cooperation and Development has been implementing a Technical Assistance program entitled *Conservation and Sustainable Use of Biodiversity at Lakes Prespa, Ohrid and Shkodra/Skadar* (CSBL) in the European Union (EU) candidate countries Albania, Macedonia and Montenegro. A major goal of this program is the improvement of transboundary natural resources management of the three lakes in accordance with the EU's environmental and biodiversity protection objectives. The program also envisaged transboundary fishing campaigns compliant to requirements of the Water Framework Directive (WFD) (Anonymous 2000). While the employed fish sampling method (application of multi-mesh gillnets according to the European standard EN 14757) was developed mainly to generate information on the ecological status of a waterbody (European Committee for Standardization 2015), it also provides insights into composition of the fish community, the relative abundance of the species as well as the length frequencies of the fishes. All these parameters are also of interest from fisheries perspective and potentially, allow conclusions regarding the status of the fish stocks. In consequence, the results obtained from the fishing campaigns conducted on Lake Ohrid during fall of 2013 and 2015 will be presented in more detail in the current report.

Additionally, a method for using fish as a biological quality element to assess the ecological status of Lake Ohrid according to WFD standards is presented. The WFD aims at establishing or preserving a good ecological status in all water bodies (Anonymous 2000). In order to estimate the necessity of measures, the current ecological status has to be evaluated. The evaluation needs to be done on the basis of so called biological quality elements, with fish being one element (the others are phytoplankton, macrophytes and macrozoobenthos). The fishing campaigns conducted under the CSBL program provided data obtained with a standardized and comparable methodology. Based on this data, a system for the assessment of the ecological status of Lake Ohrid based on fish was developed (Lake Fish Index – LFI). The development of the LFI followed the principles of the WFD, accompanying documents and existing systems (CIS 2003 a, b, 2011, Gassner et al. 2014, Olin et al. 2014, Ritterbusch et al. 2017 a). It needs to be outlined, however, that the LFI presented here is highly preliminary. It provides a first basis for future actions to adopt the WFD, but is not approved by any official instances.

3 LAKE OHRID, ITS FISHES AND FISHERIES

3.1 The lake

Lake Ohrid is of tectonic origin and, having an estimated age of about two to three million years (reviewed in Albrecht & Wilke 2008), is considered the oldest lake in Europe. The lake is located between Macedonia and Albania. Its catchment area (combined with Lake Prespa) comprises about 2,600 km^2 (Matzinger et al. 2006 a) and the lake's surface is about 358 km^2. Lake Ohrid is fed primarily by spring water from the two main surface springs at the southern shores: St. Naum's in Macedonia and Tushemisht in Albania. In addition, there are numerous sub-lacustrine (underwater) springs, which are located at the eastern and, in part, western coasts. The water of the southern (and eastern) surface and underwater springs originates from the nearby Lake Prespa. The four permanent tributaries (rivers Cerava, Velgoska, Koselska and Sateska) influence the lake's water balance to a small degree (mainly in late spring or at times of heavy rainfall). Also there are around 40 temporary creeks and trickles entering from around the lake. At its northern shore, Lake Ohrid drains via River Crn Drim/Drin into the Adriatic See. Significant amounts of water (about 40%) leave the lake by evaporation (Matzinger et al. 2006 b).

A remarkable characteristic of Lake Ohrid (Figure 2) is its enormous depth of about 289 m; the mean depth is 151 m (Popovska & Bonacci 2007). In view of nutrient loading, the water is categorized as oligotrophic (Sarafiloska & Patceva 2012, Patceva et al. 2009, Peveling et al. 2015). There are no anoxic layers in the water column and even in the deepest part of the lake, oxygen levels never drop below 6 mg/l (Matzinger et al. 2006 b). Furthermore, the water is exceptionally clear with transparency to a depth of as much as 20 meters (Popovska & Bonacci 2007). According to Stankovic (1960) estimated retention time of the lake water volume is 83 years.

Three cities are situated around the lake, two in Macedonia, Ohrid and Struga, and Pogradec in Albania. Together with the inhabitants of smaller villages, about 150,000 people live around the lake. Additionally, several thousands of tourists visit the lake and its surroundings every year. Tourism, small and medium enterprises are the main sources of income for the majority of the citizens. Intensive industry and agriculture have been of diminishing importance over the last three decades.

Figure 2. View at Lake Ohrid

3.2 Fish fauna and fishery

The fish fauna of Lake Ohrid is represented by 17 autochthonous species from four families: Salmonidae (2), Cyprinidae (12), Cobitidae (1), Nemacheilidae (1) and Anguillidae (1) and 6 allochthonous species (belonging to four families) (Table 1). With the exception of eel, none of them is a migratory species.

A special characteristic of Lake Ohrid is its high degree of endemism (Albrecht & Wilke 2008). This also applies to the fishes. According to Talevski et al. (2009 b) there are seven[3] endemic fish species in the lake, namely *Salmo ohridanus* Steindachner, 1892; *S. aphelios* Kottelat, 1997; *S. balcanicus* (Karaman, 1927); *S. letnica* (Karaman, 1924); *S. lumi* Poljakov, Filipi, Basho & Hysenaj, 1958; *Barbatula sturanyi* (Steindachner, 1892) and *Gobio ohridanus* Karaman, 1924. Furthermore, occurrence of *Alosa fallax* (La Cepède, 1803) has been recorded by Tocko (1959, cited in Talevski et al. 2009 a, Pavlova et al. 2012) and the finding of a single Drin brook lamprey (*Eudontomyzon stankokaramani*) has been reported by Talevski et al. (2009 a).

A comprehensive fish inventory and also fish stock assessments have never been performed on Lake Ohrid fish. As in other intensively exploited water bodies, most of the attention has been directed towards commercially valuable species, which are Ohrid trout, Ohrid belvica, eel, carp, bleak and (to lesser degree) roach, nase and chub (Spirkovski & Talevski 2002, Watzin 2003, Bianco & Ketmaer 2016). Additional information on the lake's fishes derive from studies driven by species conservation and taxonomic interests (Bănărescu 2004, Sell & Spirkovski 2004, Snoj et al. 2009, Talevski 2009, Talevski et al. 2009 b, Marková et al. 2010, Milošević et al. 2011, Velkova-Jordanoska et al. 2013, Milošević & Talevski 2015, Simić et al. 2016, Stierandová et al. 2016).

[3] The taxonomic status of some of the salmonid species, however, is still under debate.

Table 1. Fish species of Lake Ohrid. Status shows if species is native or alien (for the latter with year of introduction)

Scientific name	common name	Status
Cyprinidae		
Alburnoides ohridanus	Ohrid spirlin	native
Alburnus scoranza	Bleak	native
Barbus rebeli	Barbel	native
Carassius gibelio	Prussian carp	alien, 1983
Chondrostoma ohridanus	Ohrid nase	native
Cyprinus carpio	Carp	native
Gobio ohridanus	Ohrid gudgeon	native
Pachychilon pictum	Moranec	native
Pelasgus minutus	Ohrid minnow	native
Phoxinus lumaireul	Minnow	native
Pseudorasbora parva	Stone moroko	alien, 1970's
Rhodeus amarus	Bitterling	alien, 1990's
Rutilus ohridanus	Ohrid roach	native
Scardinius knezevici	Rudd	native
Squalius squalus	Ohrid chub	native
Salmonidae		
Oncorhynchus mykiss	Rainbow trout	alien, 1974
Salmo letnica	Ohrid trout	native
Salmo ohridanus	Ohrid belvica	native
Anguillidae		
Anguilla anguilla	European eel	native
Centrarchidae		
Lepomis gibbosus	Pumpkinseed	alien, 1990's
Cobitidae		
Cobitis ohridana	Spined loach	native
Nemacheilidae		
Barbatula sturanyi	Stone loach	native
Poeciliidae		
Gambusia holbrooki	Mosquitofish	alien, 1940's

Prior to World War II and shortly thereafter, the mosquitofish was introduced into Lake Ohrid in order to combat malaria disease. In 1974 the rainbow trout was recorded for the first time in the lake and specimens were found regularly in the fish catches until 1994. The fish originated from a then existing rainbow trout farm on the Albanian shore, which however was closed later on. The fish farm was converted to a hatchery and nursery station for breeding of Ohrid trout (*S. letnica*) fingerlings. Nowadays rainbow trout specimens can still sporadically be found in the fish catches. In 1983 first individuals of Prussian carp were found. Just a few years later, catches of this species reached more than 20 tons annually. In the second half of the 90's bitterling (*R. amarus*) was introduced accidently during the transport of silver carp stocking material for fish farms in Albania. In the same decade (and most likely together with the bitterling) the pumpkinseed (*L. gibbosus*) was introduced. These small-bodied alien species are still present in different habitats and with different abundances. Their impact on the native fish fauna (and ecosystem as a whole), however, has not been investigated yet.

In the beginning of the 1960's at the River Drim/Drin (i. e. the outflow of Lake Ohrid), two dams were built on the Macedonian side to use hydropower for generation of electricity. Subsequently, on the Albanian side three more hydropower stations were constructed. The dams had severe effects on eel fishery as the constructions entirely inhibited natural migration of the fish into the lake. Similarly, diversion of the River Sateska (which used to be naturally connected with the River Drim/Drin) resulted into extensive damages to large trout spawning grounds on the northern shore of the lake, as River Sateska introduced nutrients, pollutants and materials from its 463 km^2 big catchment into Lake Ohrid and thereby eroded important salmonid habitats (Kostoski et al. 2010, Vogel et al. 2010).

Modifications in the ecology of Lake Ohrid fish have been noticed during the last years. For example, until 2003 bleak (*A. scoranza*) used to form large schools in front of the villages Trpejca, Pestani, Radozda (all on the Macedonian side) and Lin and Memlisht (on Albanian territories) during winter (Watzin 2003). In present times, bleak rarely schools any longer at these localities but is spread all over the lake in both littoral and pelagic parts.

Information about Lake Ohrid fish stocks and condition of the fish is scarce. While many papers refer to an overfishing of the stocks (UNESCO 2004, Watzin 2003, Spirkovski 2004 a, Kostoski et al. 2010), there is rarely any quantitative data in the scientific literature supporting this statement (Spirkovski 2004 b). Nonetheless, beginning at about 1990 declining Ohrid trout catches of Macedonian commercial fishers were noticed (Spirkovski & Talevski 2002) which in subsequent years, however, were accompanied by a corresponding increase in Albanian commercial trout landings (Avramoski et al. 2003). Still, even at Albanian waters a decrease in numbers of trout caught became evident towards the end of the last century (Prifti 2016). At present, both Macedonia and Albania undertake high efforts to support the Ohrid trout stock in the lake. Stocking with fingerlings and/or alevins raised at fish breeding stations in Ohrid (Macedonia) and Lin (Albania) (Figure 3 and Figure 4), respectively, takes place for decades now, but full success of the stocking programs may presently partially be thwarted by illegal fishing practices of poachers.

Figure 3. Ohrid trout fingerlings (right) raised at fish breeding facility of the Hydrobiological Institute Ohrid (left)

Figure 4. Fish breeding facility in Lin (Albania)

3.3 Fisheries

In Lake Ohrid fishing has been performed by local people from both riparian countries for many years. At present eleven fish species are commercially used, of which Ohrid trout, belvica, eel, carp, and bleak receiving special interest. Of these named species, the latter (*A scoranza*) is of lowest commercial value.

In the period from 1960 until 1990 a Joint Fishery Commission Albania – Macedonia governed fishery affairs of transboundary concern on Lake Ohrid. This commission, for example, regulated quotas per country per species, oversaw restocking programs (with Albania focusing primarily on stocking with carp and Lake Ohrid trout, and Macedonia conducting stocking with Lake Ohrid trout and eel) and proposed minimum allowed catchable sizes per species as well as closed seasons etc. After the 1990s, the collaboration between the two countries on fishery matters continued on scientific and ministerial levels but has not yet received an official status again.

According to fisheries laws of Albania and Macedonia the fishing season is closed during the spawning of individual species, apart from regulated fishing activities to supply the hatcheries with sexual products (eggs, milt) for artificial breeding of Ohrid trout. Subsequent restocking of the lake is conducted with different age/size classes of fish. Over the years, various types of restocking material has been used simultaneously:

- fry,
- alevins (of 95 days since fertilization),
- fingerlings (six months after hatch), and
- 12 months old juveniles.

The success of restocking is still uncertain, but it is a fact that every spawning season fish of spawning size are caught by use of nets having a mesh-size of 50-60 mm. In the past, these specimens were typically sold on the fish market after their sexual products were taken for on-site egg fertilization and transfer to the hatcheries. Since 2005 (Macedonia) and 2009 (Albania), respectively, all adult fish caught for artificial breeding are released into the lake after stripping (acquisition of sexual products), so that the fish can participate in reproduction in future years as well. Due to the uncertainty regarding the success of trout stocking it is recommended to conduct mark-and-recapture experiments with hatchery-reared trout.

3.3.1 Albania

During the communist regime (before 1990), the Albanian fishery at Lake Ohrid was managed by a state enterprise which employed about 35 fishers. After the collapse of the political system, there were an estimated 800 legal and illegal fishers on the lake. During those times the legal fishers were organized in different groups or cooperatives. Since 2002, all licensed fishers are organized in a Fisheries Management Organization (FMO) which has the responsibility and duty to manage a landing site, and to participate in the co-management of fisheries resources. The FMO has a restricted number of 110 licenses.

The FMO is involved in the preparation and implementation of the Co-management Plan. This plan considers a maximum management period of ten years and aims to:

- promote utilization of fishery resources based on a sustainable development,
- maintain the quality and biological diversity of fisheries resources,
- encourage the use of appropriate fisheries technology, and
- avoid the creation of excess fishing capacity.

The FMO, based on implementation of the law "On Fishery and Aquaculture" and its specific regulations, has to apply corresponding management measures.

Fish catches of Albanian fishers for the period of 1947-1993 are shown in Table 2. The increase in belvica and bleak catches starting in 1962 is due to bottom trawl and purse seine fishery. Chub catches shown in that table also include other species, such as barbel (approx. 20.5 %), gudgeon (approx. 1.5%) and rudd (about 0.5 %). Similarly, from 1947 to 1988 bleak catches also embraced roach individuals (12-15 %).

Table 2. Total commercial catches for the period 1947-1993 (in t, Source: MEFWA)

	1947	1950	1955	1960	1965	1970	1975	1980	1985	1986	1987	1988	1989	1990	1991	1992	1993
Ohrid trout	10	10	3	3.8	9.3	6.1	3	3.8	3.7	3.6	10	9.2	8	1.6	7.7	1.6	2.2
Belvica	4	3.2	1	12.5	30.1	11.6	12	9	9	7.8	11.7	12	10.5	6.6	1.7	1.3	1.2
Carp	8	26.9	11.7	4	8.7	2.4	2.9	11.9	4.5	3.5	4.5	17.3	11.5	12.5	5.7	4.4	1.5
Nase	6.5	10	8.4	7	8.4	10	13	4.5	1	0.9	0.3	1.3	0.3	0.2	0.4	0.1	0.2
Chub	7.3	10.4	15	13.6	11	17.7	8.8	6	10	9.9	10	8.7	4.7	6	4.8	0.5	0.8
Bleak	17.7	3	25	17.5	68.9	63	86.2	81.6	58.5	10.6	70.3	63	41	7.4	24.7	36.7	21.8
Roach	0	0	0	0	0	0	0	0	0	0	0	0	0	5	4.2	2.9	2.8
Total	53.5	63.5	64.1	58.4	136.4	110.8	125.9	116.8	86.7	36.3	106.8	111.5	76	39.3	49.2	47.5	30.5

It is estimated that the annual fish catch during the last years amounts to 220-260 tons, of which 75-80% bleak and 5-10% Ohrid trout and belvica. The rest comprises roach and barbel. According to Woynarovich (2013, cited in Diffey et al. 2015) recent catches of Albanian Lake Ohrid fishers sum up to about 90 tons.

Restocking at the Albanian side started in the second half of the 1960's with annually 250-300 thousand Ohrid trout fry (alevins). This program lasted until 2003. In addition, from 1980 to 2005, about 300 thousand carp (*Cyprinus carpio*) fingerlings having an average body weight of 5 g were put into the lake every year. From 2003 onwards, restocking (in both countries) is performed during the autumn zooplankton peak in the lake using Ohrid trout fingerlings which are nine months old from fertilization (i. e. six months fed). Every year about 750-900 thousand fingerlings are stocked into Albanian part of the lake.

Legislation in the Albanian fishery sector, in overall, is complete and contemporaneous. The legislation addresses not only fishery matters but also deals with other related topics, such as biodiversity, socio-economic aspects, environmental pollution etc.

There are several legislative acts regulating the fishing activity, including the new Law No. 64/2012 which sets the basis for a good management of the fishery sector and explains many of the terms and concepts related to the fishery. It should be stressed that the main intention of the law is to:

- ensure a rational and accountable exploitation of aquatic biological resources and development of aquaculture;
- provide conservation measures in order to secure the protection of aquatic biological resources,
- support the sustainable development of fishery and aquaculture sectors, as well as create better socio - economic conditions for the producers.

Further relevant laws are:

- the Law "On the Land" (1991),
- the Law "On Forests and Forestry Police" (1992),
- the Law "On Protection of Wild Fauna and Hunting" (1994),
- the Law "On Fishing and Aquatic Life" (1995),
- the Law "On Water Reserves" (1996),
- the Law "On the Regulatory Framework of the Water Supply Sector and of Disposal and Treatment of Waste Water (1996),
- the Law "On Environment Protection" (2011),
- the Law "On Protected Areas" (2002),
- the Law "On Protection of Marine Environment from Pollution and Damage" (2002),
- the Law "On Protection of Trans-border Lakes" (2003), and
- the Law "On Environmental Impact Assessment" (2011).

3.3.2 Macedonia

In the period from 1945 to 1994 commercial and recreational fishery were organized and performed by two state enterprises, each responsible for one part of the lake because the Macedonian lake area was divided into fishery sub-basins Ohrid and Struga. These enterprises employed professional fishers – licenced by the state after passing fishery exams at the Hydrobiological Institute Ohrid, which had been the authorised institution for fisheries. Total number of professional fishers on Macedonian part of the lake ranged from 80-120 altogether.

In addition, two associations of recreational fishers existed. People interested in recreational fishing had to obtain daily fishing licences from the fishery enterprises. The main object of recreational fishery was Ohrid trout, and the fishing was performed by boats (4-5 m in length) using nylon ropes with spinner hooks. In some periods, more than 2,000 licences were issued per day. The catch per person (or licence) was limited to four specimens of Ohrid trout per day, but this limit was often highly exceeded. In some years, catches of the recreational fishery equalled more than 50 % of the annual catch of the commercial fishers. These numbers, however, were never included in the fishery statistics. In 1994, both state fishery enterprises were privatized (FAO – Macedonia Country report, 2005). The total annual catches of commercial fishery are depicted in Figure 5.

Composition of fish catches differed between the first half and the end of the 20th century (Figure 6), suggesting a shift from salmonid to cyprinid species. In 2002 and 2003, however, commercial fishers were primarily targeting trout again (Figure 7).

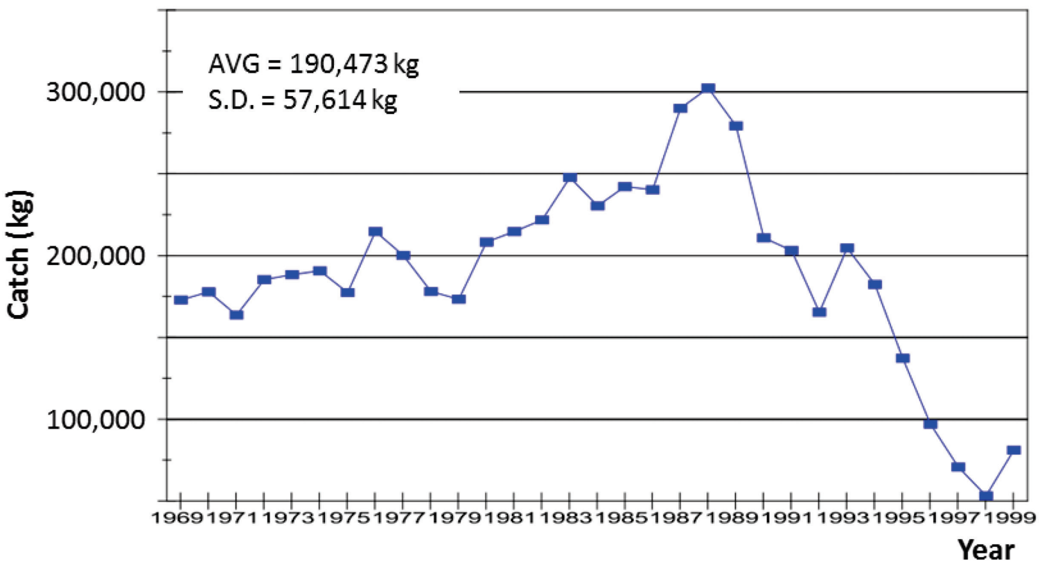


Figure 5. Total annual fish catch in the period 1969-1999 at the Macedonian part of Lake Ohrid (modified after Spirkovski & Talevski 2002)

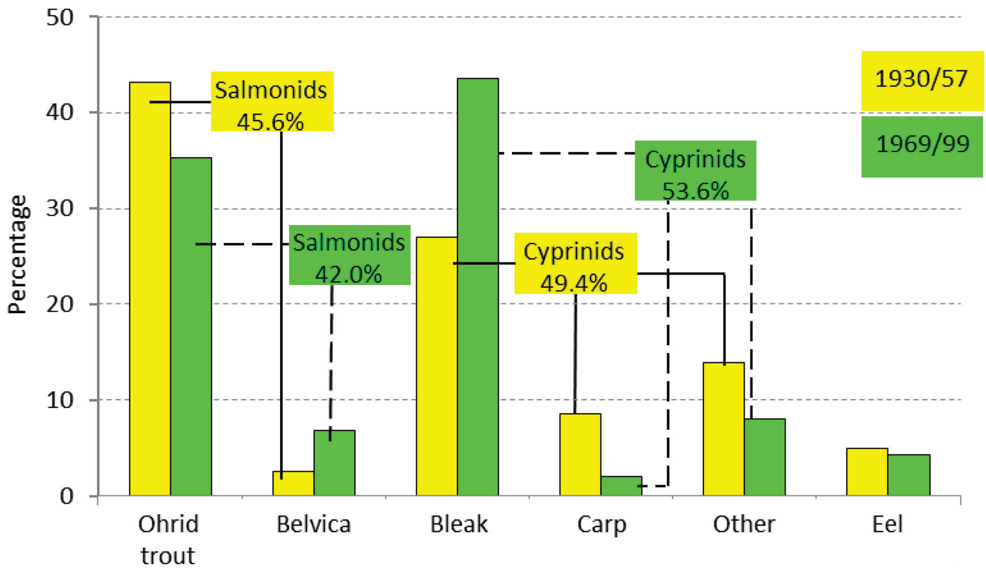


Figure 6. Comparison between two fishery statistics periods 1930/1957 and 1969/1999 for Lake Ohrid (modified after Spirkovski & Talevski 2002)

Because of unsustainable fishery, the concession for the Lake Ohrid fish stocks was withdrawn by the state government in April 2004. A total moratorium on fishing was declared lasting until September 2012. During this period only fishing on scientific grounds (collection of Lake Ohrid trout spawners for artificial breeding purposes) was performed.

After 8.5 years of total moratorium on fishery at Lake Ohrid, in September 2012 a new concession was tendered and signed. Currently, 47 fishers are employed by the present concessionaire. The following graph reflects species composition of the total catch of the new concession period (Figure 8). It represents a period of adaptation of the company to the specific conditions in the lake, training of fishers, learning about fish habitats as well as a relatively short fishing period.

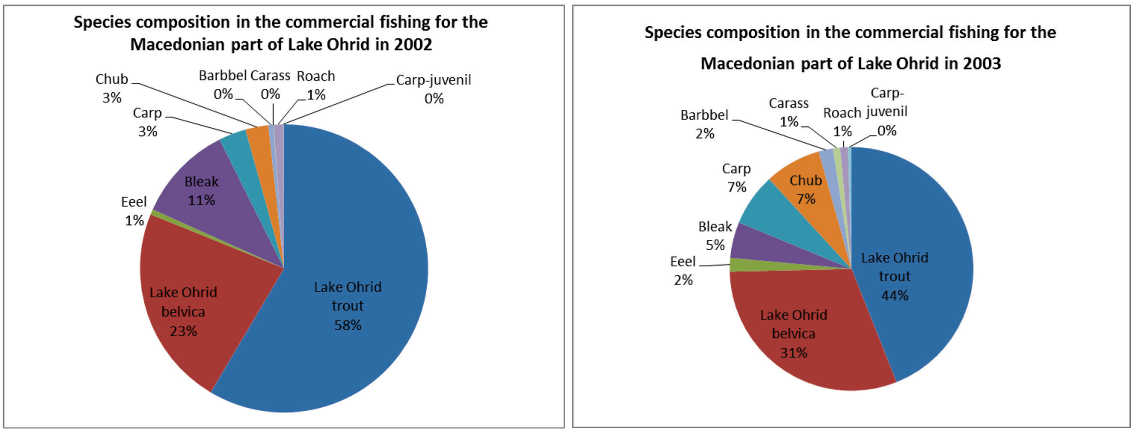


Figure 7. Species composition of the total annual fish catch in 2002 and 2003 at the Macedonian part of the Lake Ohrid (Source: Fisheries statistics AD Ohridska Pastrmka – Fishery company Macedonia)

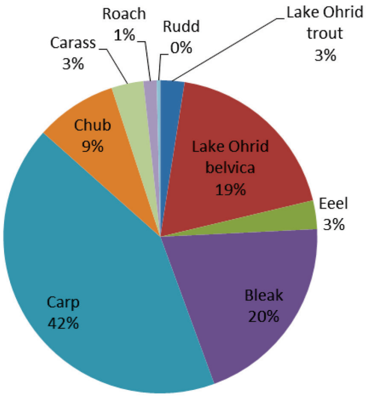


Figure 8. Species composition of the total fish catch in the period September 2012 – December 2013 at the Macedonian part of the Lake Ohrid (Source: Fisheries statistics Pastrmka 2012 Ohrid – Fishery company Macedonia)

Similar to Albania, Macedonian restocking activities have also been undertaken with fish of different ontogenetic stages (Figure 9). Nowadays restocking of the Macedonian part of Lake Ohrid takes commonly place with fingerlings that are nine months old. The number of stocked individuals is determined anew year by year.

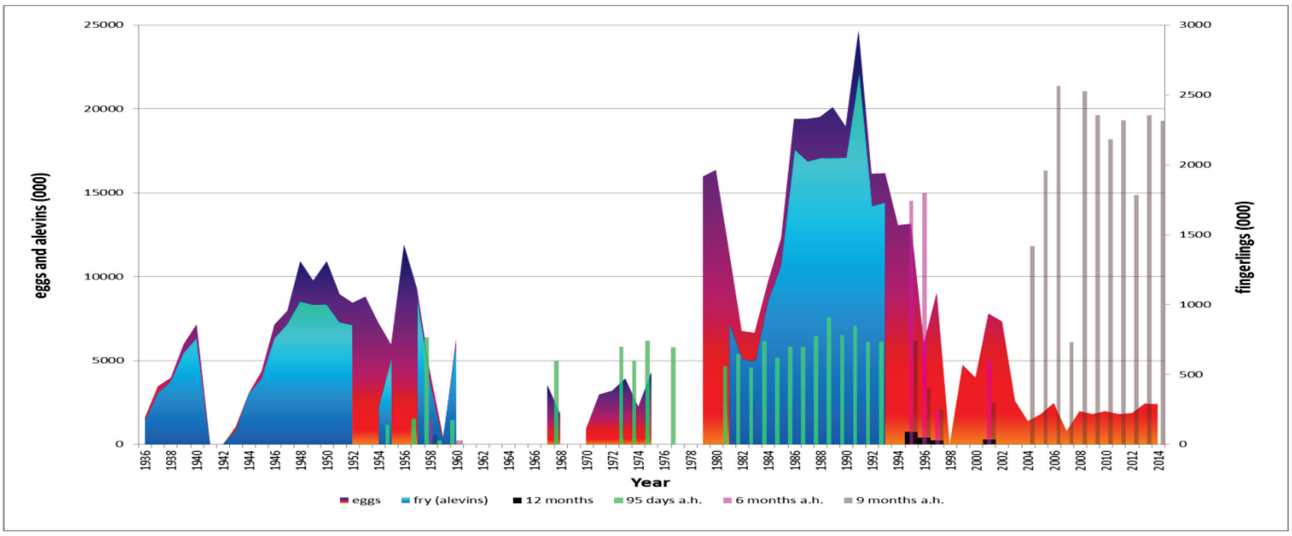


Figure 9. Ohrid trout restocking on the Macedonian side of the lake (Source: HIO Statistics)

In 2007, the existing Macedonian "Law on Fishery" (1993) was replaced by the "Law on Fishery and Aquaculture" (LFA, Official Gazette 7/2008, dated 15.01.2008). This law has several amendments (Official

Gazette of Macedonia 67/2010, 47/2011 and 53/2011; Official Gazette 95/2012; Official Gazette 164/2013; Official Gazette 116/2014; Official Gazette 154/2015 and 193/2015and Official Gazette 39/2016).

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

- Law on the protection of Ohrid, Prespa and Dojran Lakes (Official Gazette 45/1977, dated 09.09.1977). This law has four amendments (Official Gazette 08/1980, 51/1988, 10/1990 and 62/1993).
- Law on nature protection (Official Gazette 67/2004, dated 04.10.2004). This law has five amendments (Official Gazette 14/2006, 84/2007, 35/2010, 47/2011 and 148/2011).
- Law for the environment (Official Gazette 53/2005, dated 05.07.2005). This law has seven amendments (Official Gazette 81/2005, 24/2007, 159/2008, 83/2009, 48/2010, 124/2010 and 51/2011).

The first Fishery Master Plan for Lake Ohrid for the period 2011-2016 was made public in the Official Gazette 145/2011, while the current plan (for the period 2017-2022) was made publicly available in the Official Gazette 55/2017.

The following **regulations** are of importance to Macedonian fishery and have to be considered too:

- “Regulation on the Form, Content and 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 Landing Sites” (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 and 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 below which it Cannot be Taken by Commercial and Recreational Fishing” (2011),
- “Regulation on the Quality, Size and Weight, as also the Way of Declaring the Fish for Traffic Market” (2013),
- “Regulation for Amendments of Regulation on the Allowed Fishing Gears and Equipment and their Use for Commercial and Recreational Fishing” (2013),
- “Regulation for Changes of the Length of the Fish below which it Cannot be Taken by Commercial and Recreational Fishing” (2013).

3.3.3 Comparative overview of fishing/fishery rules in Albania and Macedonia

Fishing ban season for cyprinid species at the Macedonian part of Lake Ohrid comprises 30 days of the spawning period which can differ from year to year, but has to be in the stated timeframe shown in Table 3. Table 4 shows the minimum body length which the individual species must have reached before they can be legally taken.

Table 3. Fishing ban season by species and by countries

Common name	Scientific name	ALBANIA		MACEDONIA	
Ohrid trout	*Salmo letnica*	1st December	28th February	1st December	20th March
Ohrid belvica	*Salmo ohridanus*	1st November	31st January	1st December	20th March
carp	*Cyprinus carpio*	20th May	15th June	20th May	19th June
chub	*Squalius squalus*			1st May	31st May
nase	*Chondrostoma ohridanus*			15th April	15th May
rudd	*Scardinius knezevici*			1st May	31st May
barbel	*Barbus rebeli*			20th May	19th June
bleak	*Alburnus scoranza*	20th April	15th June	1st May	30th June
moranec	*Pachychilon pictum*			20th May	19th June

Table 4. Minimum legal size of catch for some commercial species at Lake Ohrid

Common name	Scientific name	ALBANIA	MACEDONIA
Ohrid trout	*Salmo letnica*	32 cm	35 cm
Ohrid belvica	*Salmo ohridanus*	30 cm	22 cm
carp	*Cyprinus carpio*	30 cm	40 cm
chub	*Squalius squalus*	15 cm	30 cm
roach	*Rutilus ohridanus*	12 cm	
nase	*Chondrostoma ohridanus*		25 cm
bleak	*Alburnus scoranza*	10 cm	12 cm
rudd	*Scardinius knezevici*	12 cm	20 cm
eel	*Anguilla anguilla*	25 cm	60 cm
Prussian carp	*Carassius gibelio*	15 cm	unlimited
pumpkinseed	*Lepomis gibbosus*		unlimited

As can be seen from the tables above there are differences in fish protection measures (timing and duration of fishing ban period, minimum size of fish) between Albania and Macedonia. This applies not just to a single species but to several, including rare and endemic taxa. In view of species conservation and sustainable use of aquatic resources it is evident that the legal framework needs to be harmonized between the two riparian countries.

3.4 Valuable fish habitats

As mentioned above, Lake Ohrid is a unique waterbody which is a biodiversity hotspot of international significance considered natural and, together with the town of Ohrid, cultural heritage. In consequence, the entire lake (and adjacent areas) are worth of protection from anthropogenic disturbances such as environmental degradation and pollution. Previous research has shown that fishes (including endemic and commercially exploited species) spawn in many (if not all) areas along the shorelines (Talevska & Talevski 2015). Nonetheless, there are specific zones in the lake which are of particular importance to the local fish fauna as certain places seem to be exceptionally good spawning sites or, because of the composition of aquatic vegetation, provide shelter from predators. Some of these ecologically valuable fish habitats are shown in Figure 10, Figure 11 and Figure 12. In-depth information (including shorezone and littoral vegetation) about these habitats is given by Blinkov et al. (2017) who conducted a CSBL-commissioned study on the shorezone functionality of Lake Ohrid. Among others, the study distinguishes several shorezone typologies and identified homogeneous shorezone stretches which, based on occurring vegetation, are differentially suited for reproduction of the individual fish species.

Figure 10. Important habitats (spawning and nursery grounds) of Ohrid trout (*Salmo letnica*, orange), bleak (*Alburnus scoranza*, yellow) and carp (*Cyprinus carpio*, green) on the Albanian side of Lake Ohrid

Figure 11. Selected habitats of particular importance for salmonid fishes on the Macedonian side of Lake Ohrid

Figure 12. Selected habitats of particular importance for cyprinid fishes on the Macedonian side of Lake Ohrid

4 MATERIALS AND METHODS

4.1 Multi-mesh gillnetting

During fall of 2013 and 2015, multi-mesh gillnet (MMG) fishing was performed on Lake Ohrid following recommendations of the EU standard EN 14757 (European Committee for Standardization 2015). This technique is a random sampling method which enables that every fish living in the investigated waterbody, in theory, has the same chance of getting caught. The Standard was developed to fulfil the needs of the Water Framework Directive (Anonymous 2000), i. e. was elaborated to obtain information on the ecological status of a lake using various descriptors of the examined fish community. The standard EN 14757 provides a whole-lake estimate for species occurrence, quantitative relative fish abundance, biomass (expressed as catch per unit effort, CPUE) and size structure of fish assemblages. Furthermore, its proper application also enables temporal and spatial comparisons.

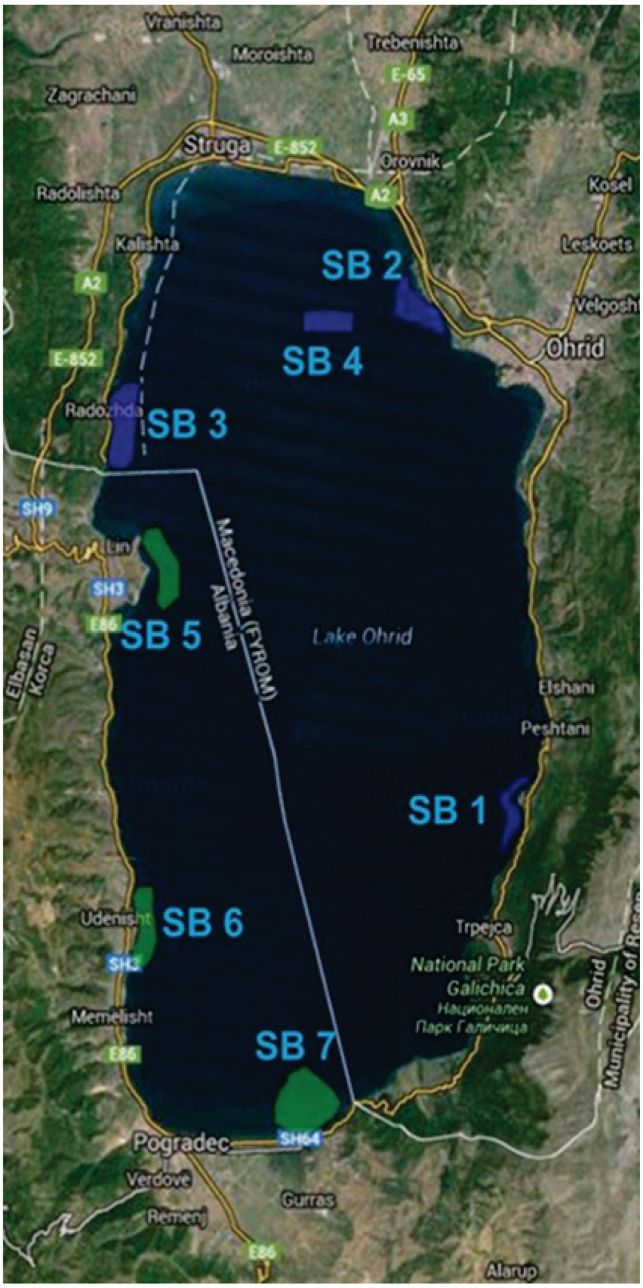


Figure 13. Lake Ohrid sampling sites (SB 1-7)

Fishing campaigns were executed by use of benthic multi-mesh gillnets. Each individual net is 30 m long and 1.5 m deep and is composed of 12 single panels. The mesh sizes of the panels differ and range from 5 mm to 55 mm (knot to knot) in the following order: 43 mm, 19.5 mm, 6.25 mm, 10 mm, 55 mm, 8 mm, 12.5 mm, 24 mm, 15.5 mm, 5 mm, 35 mm and 29 mm. The nets were set before dusk, stayed in water overnight and were taken out after dawn (i. e. 12 hours of sampling) to cover both highest activity circadian peaks. Detailed information about setting dates, depths and coordinates can are given in the annex; Table 11 and Table 12 for Macedonia, and Table 13 and Table 14 for Albania.

Fishing campaigns were executed each in October / November to avoid periods of fish grouping (such as during spawning and winter shoaling). For MMG fishing the lake was divided into seven individual sub-basins (SB 1-7) of which six were littoral and one (SB 4) was a pelagic sampling site (Figure 13).

The two SB 1 (Veli Dab) and SB 5 (Lin – Bakalicë) can be described by the following habitat characteristics:

- The slope of the lake bottom at these two localities is steeper than at all other areas of the lake.
- From the lake shore up to 6 meters depth the ground is covered with solid substrate. Gravel and stones of different dimensions are predominant, and the spaces among them are filled with sand and fine detritus. At the lake shore (at SB 5) there are some areas with *Phragmites* and *Scirpus,* while *Potamogeton* and *Myriophyllum* grow further apart from the shore.
- If not rocky, at 4-16 meters of depth begins a zone of Charophyta vegetation.
- The area between 16-50 meters of depth (sublittoral) is composed of sand, fine sediments and mollusk shell deposits.
- Below 50 meters of depth, the substrate is composed of sand and fine sediments.

The sub-basins SB 2 (Andon Dukov) and SB 7 (Tushemisht) have similar habitat traits and ecological conditions, which are as follows:

- From the lake shore up to 6 m of depth the bottom of the lake is made of fine substrate (a mixture of sand and mud). Decaying plant material (detritus) is also present.
- The zone between 6 and 16 m of depth is a muddy area with extensive fields of Charophyta vegetation.
- At 20-50 meters of depth there is a sandy area with mollusc shell deposits (which, however, are less prominent than in the Lin area).
- Below 50 meters of depth the bottom substrate consists of sand and detritus.

The habitats of SB 3 (Radozda) and SB 6 (Hudënisht) can be described as follows:

- From the shore up to 6 meters of depth the lake's ground is sandy and shows small-sized stones and gravel. Aquatic vegetation is widely present and dominated by Charophyta up to a water depth of 16 m.
- The area between 20-50 meters of depth is sandy and shows extensive deposits of mollusk shells.
- Below 50 meters of depth the bottom is made of sand and detritus.

The open water (pelagial) was sampled in 2013 at SB 4 (Central plate) whereas in 2015, collection of fish was performed at the deepest point of the lake.

The numbers of nets used varied between years and sampling sites (Table 5). Typically, 8-16 nets were set per night, depending on weather conditions.

Table 5. Net numbers set in the different depth strata of the sub-basins (SB)

Depth	SB 1		SB 2		SB 3		SB 5		SB 6		SB 7	
stratum (m)	2013	2015	2013	2015	2013	2015	2013	2015	2013	2015	2013	2015
0-3	2	16	2	16	3	16	6	6	4	4	4	4
3-6	4	16	3	16	4	16	3	3	1	4	3	4
6-12	4	8	4	8	3	8	3	3	4	4	3	4
12-20	3		4		2		5	5	8	5	2	3
20-35	3		3		3		2	3	3	3	5	4
35-50			3		2		4	4	4	4	6	5
50-75			1				1				1	
Total	**16**	**40**	**20**	**40**	**17**	**40**	**24**	**24**	**24**	**24**	**24**	**24**

At SB 4, collection of fish took place by use of one pelagic and ten benthic nets in 2013. A total of 50 MMG were employed in 2015, cascading from surface to bottom.

All nets per strata followed a randomization scheme and were placed in different directions related to the shoreline (Figure 14). So, for example in one particular stratum, some nets were positioned near the shore starting with the panel of 43 mm while others ended even closer to the shore but with the panel of

29 mm. Similarly, in some cases nets were placed perpendicular or parallel to the shore while in others the nets were set in an angle of about 45° or 60° to the shore. GPS coordinates of each net, net setting depth, air and water temperatures, pH, oxygen concentration, transparency (Secchi depth) and weather conditions were registered (Table 11, Table 12, Table 13, Table 14, Table 15, Table 16, Table 17). On the Albanian territory, boats of fishers were deployed for the work and the research vessel of PSI Hydrobiological Institute was used on Macedonian sampling sites (Figure 15).

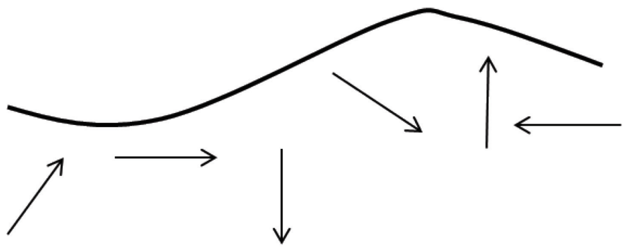


Figure 14. Sketch of randomly positioned nets (shoreline above)

Figure 15. Sampling of Lake Ohrid fish

4.2 Data analysis and management

Separately for each net and panel, all captured fish were identified to species level, counted, weighed (to nearest gram), and total length was taken (to nearest mm). When less than 50 specimens per panel were sampled, all fish were treated individually (i. e. identified, measured, weighted etc.) In cases where several hundreds of fish per species and panel were collected, a subsample of 50 individuals was taken and processed. In addition, total weight and total number of remaining individuals was recorded (Figure 16).

Figure 16. Fish catch processing

Data analysis was performed in terms of species composition per sub-basin and species abundance per depth stratum in the respective SB. The catch per unit effort (CPUE) expressed as biomass of species (g/m^2) per net surface (1.5 m x 30 m = 45 m^2, BPUE) and individuals of species ($ind./m^2$) per net surface (1.5 m x 30 m = 45 m^2, NPUE) was calculated.

4.3 Preliminary Lake Fish Index

The development of the preliminary Lake Fish Index (LFI) for Lake Ohrid was mostly achieved during a meeting of Albanian, Macedonian, and Montenegrin fishery experts participating in the CSBL project. The index development was accompanied by a member of the Institute of Inland Fisheries having long-time experience in the European harmonization of fish based systems.

Generally, an LFI which is compliant with the requirements of the WFD includes a typology, a selection of metrics and a certain scoring procedure. A typology summarizes lakes with comparable geographic, morphometric or physico-chemical characteristics. Possible factors for characterization are ecoregion, altitude, depth, size, geology, water residence time, temperature, or mixing characteristics (Annex II of the WFD). Lakes of a common type should have a comparable fish community, at least under undisturbed conditions.

Metrics are traits of the fish community that are likely to be influenced by human impact. For example, certain cyprinids might be more abundant in eutrophic water bodies. If the eutrophication is of anthropogenic origin, the abundance of these cyprinids can be used as a metric. An LFI needs multiple metrics in order to be safer against accidental results; usually 5 - 10 metrics are applied. In Annex V, the WFD provides normative descriptions of what a high, a good and a moderate status are in terms of fish traits. Three categories of traits are used in this description: fish abundance, species composition and development/reproduction. To follow the WFD as close as possible, fish metrics of each of these categories should be part of the index.

To obtain an index value, each metric is first scored individually. The ranges for metric scoring are not prescribed. However, scores are frequently set in accordance with the WFD classification of 1 to 5. In this case 1 is a very high impact (bad status) and 5 is a negligible impact (high status). Finally, the metrics are combined to a total score, e.g. as sum or mean. This final score needs to be transferred to the range from 0 to 1 in order to be comparable with other systems. The final score is then termed EQR (ecological quality ratio) and a five-step normative category is assigned: high, good, moderate, poor, or bad.

A major problem in the development of the LFI was the uniqueness of Lake Ohrid and its fish community in combination with the lack of comparable data. There was no dataset that could have served as a basis for essential steps like establishing a typology or testing the pressure-impact relationship between anthropogenic impacts and metrics. For this reason, many steps in the development of a LFI for Lake Ohrid had to be based on expert judgement.

5 RESULTS

5.1 Lake Ohrid total

In the course of the project 7,534 fishes were caught and analysed in 2013 and 22,956 fishes were collected and processed in 2015, totalling up to a sample size of over 30,000 specimens. By use of MMG, 17 fish species were detected (Figure 17), which is almost 75 % of the fishes known to inhabit the lake.

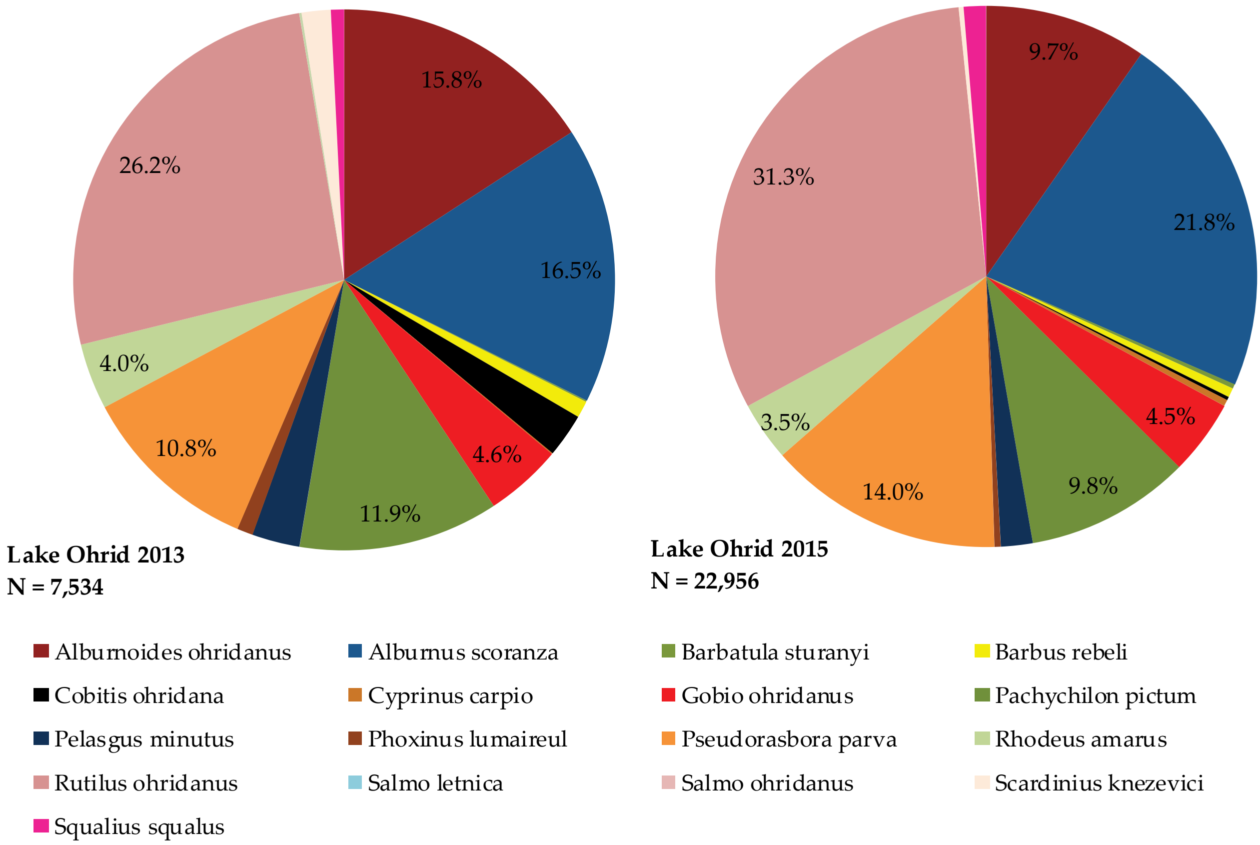
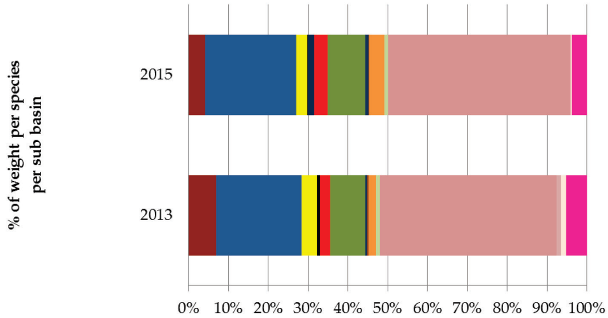


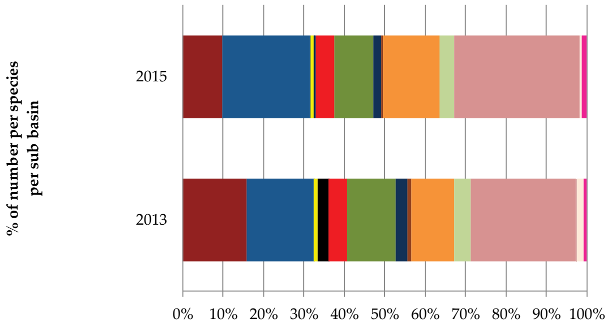
Figure 17. Relative fish species composition based on numbers in the total catches of Lake Ohrid (2013 on the left and 2015 on the right). Data is based on benthic multi-mesh gillnets only (i. e. SB 4 is not included)

In 2013, the total catch was composed of 16 species (*Alburnoides ohridanus, Alburnus scoranza, Barbus rebeli, Cyprinus carpio, Gobio ohridanus, Pachychilon pictum, Pelasgus minutus, Phoxinus lumaireul, Pseudorasbora parva, Rhodeus amarus, Rutilus ohridanus, Scardinius knezevici, Squalius squalus, Barbatula sturanyi, Cobitis ohridana, Salmo ohridanus*). The most abundant species were spirlin, bleak, Ohrid roach, moranec and stone moroko whereas carp, belvica and stone loach occurred only with single individuals in the catch.

In 2015 a similar catch composition was noticed as in 2013. In addition to the species found during the previous sampling campaign a single Ohrid trout (*Salmo letnica*) was caught in 2015. Spirlin, bleak, Ohrid roach, moranec and stone moroko were the most common species and also spined loach, Ohrid minnow and bitterling occurred in numbers worth mentioning again (Figure 17).



	2013	2015
Alburnoides ohridanus	0.77	0.83
Alburnus scoranza	2.44	4.45
Barbatula sturanyi	0.00	0.01
Barbus rebeli	0.44	0.54
Cobitis ohridana	0.08	0.02
Cyprinus carpio	0.01	0.33
Gobio ohridanus	0.30	0.66
Pachychilon pictum	0.99	1.85
Pelasgus minutus	0.06	0.16
Phoxinus lumaireul	0.02	0.02
Pseudorasbora parva	0.23	0.76
Rhodeus amarus	0.10	0.18
Rutilus ohridanus	5.03	9.00
Salmo letnica		0.01
Salmo ohridanus	0.12	
Scardinius knezevici	0.16	0.05
Squalius squalus	0.59	0.75



	2013	2015
Alburnoides ohridanus	0.20	0.26
Alburnus scoranza	0.21	0.58
Barbatula sturanyi	0.00	0.01
Barbus rebeli	0.01	0.01
Cobitis ohridana	0.03	0.01
Cyprinus carpio	0.00	0.01
Gobio ohridanus	0.06	0.12
Pachychilon pictum	0.15	0.26
Pelasgus minutus	0.04	0.05
Phoxinus lumaireul	0.01	0.01
Pseudorasbora parva	0.13	0.37
Rhodeus amarus	0.05	0.09
Rutilus ohridanus	0.32	0.83
Salmo letnica		0.00
Salmo ohridanus	0.00	
Scardinius knezevici	0.02	0.01
Squalius squalus	0.01	0.04

Figure 18. Standardized catches (CPUE) for Lake Ohrid (total) during the sampling campaigns of 2013 and 2015. Left: biomass per unit of effort (BPUE in g/m²). Right: number of individuals per unit of effort (NPUE in ind./m²). Bars show the corresponding percentages of species. Calculations are based on benthic nets only

Similar to catch composition data, also differences in both standardized biomass (BPUE) and number of individuals (NPUE) varied only slightly between the two sampling years (Figure 18). In terms of biomass, *Rutilus ohridanus* showed highest values with 5.03 and 9.0 g/m² of net in 2013 and 2015, respectively, followed by bleak and moranec. Total biomass was 11.3 g/m² of net in 2013 and 19.6 g/m² in 2015.

With regard to numbers of individuals (NPUE) the picture about contribution of each species to total annual catch is a little more even, but also almost identical in 2013 and 2015 (Figure 18). Ohrid roach, bleak, stone moroko, spirlin and minnow occurred in high numbers in each sampling year. The maximum NPUE of 0.83 ind./m² of net was reached by Ohrid roach in 2015.

Further details on species composition, biomass (BPUE) and number of individuals per square meter of net (NPUE), as well as on length-frequency distributions separately for each species and sub-basin are shown in Annex II.

5.2 Macedonia

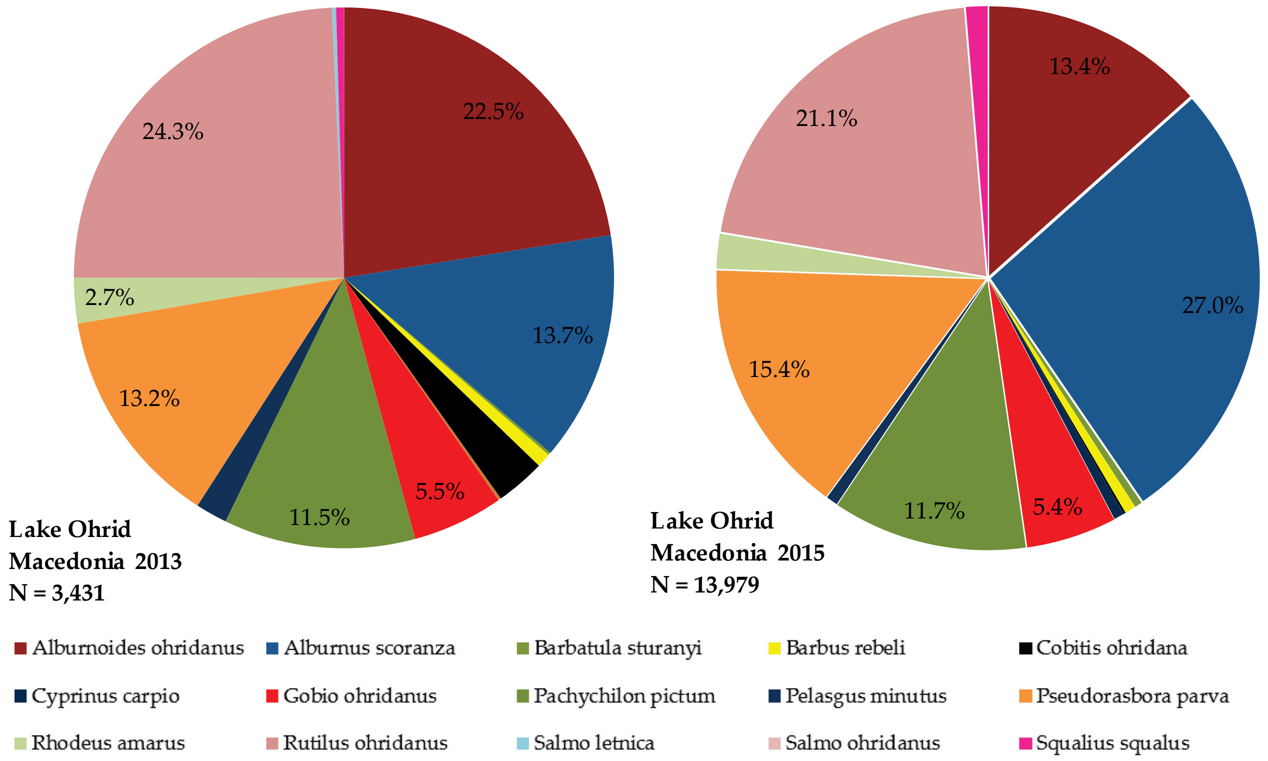
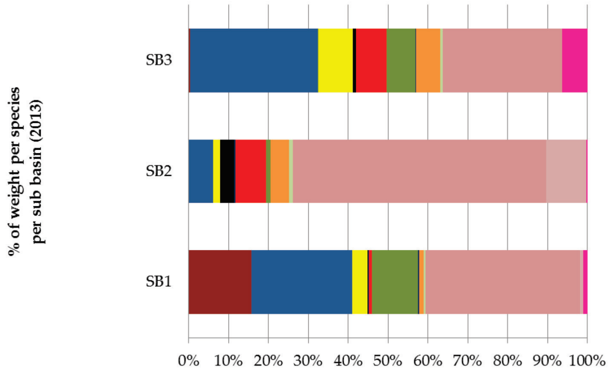


Figure 19. Relative fish species composition based on numbers in total catch at Macedonian side of Lake Ohrid (2013 on the left and 2015 on the right). Data is based on benthic multi-mesh gillnets only (i. e. SB 4 is not included)

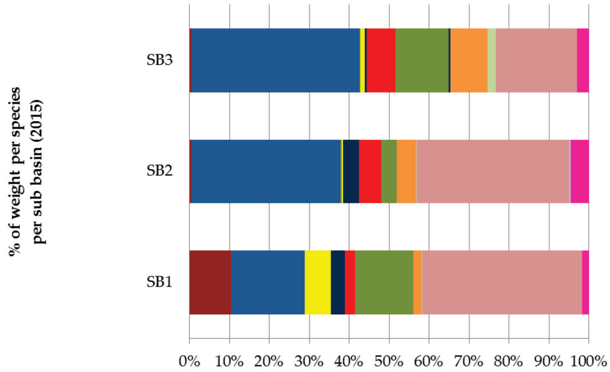
At the Macedonian sampling sites a total of 15 species was collected in the course of the project (Figure 19). As has been seen for the total lake, spirlin, bleak, moranec, stone moroko and Ohrid roach were most common in both years. Bleak (*A. scoranza*) was a little more abundant in 2015 compared to 2013 in contrast to spirlin which reached higher shares on total catch in the first year of sampling than in the second. Minnow (*Phoxinus lumaireul*) and rudd (*Scardinius knezevici*) did not show up in the Macedonian catches. On the contrary, the only Ohrid trout (*Salmo letnica*) caught in the course of the project was sampled at Macedonian territory.

With regard to biomass (BPUE) in all three sub-basins, mean biomass values were generally higher in 2015 than in 2013. In 2013, the highest mean biomass (all fishes) was recorded in SB 1, followed by SB 3 and SB 2 (Figure 20). In 2015, the highest mean biomass was again recorded in SB 1, whereas corresponding values for SB 2 and SB 3 were lower and almost identical in both SB. Bleak and Ohrid roach reached the highest BPUE in all three sub-basins (SB 1-SB 3) in both sampling years. In 2013, Ohrid roach biomass reached values up to 9.73 g/m^2 of net whereas the corresponding maximum for bleak was 6.39 g/m^2. In 2015, the maximum BPUE was 12.1 g/m^2 of net for Ohrid roach and 5.56 g/m^2 of net for bleak (Figure 20).

In terms of abundance (NPUE), spirlin reached the highest values in SB 1, in particular, where about one individual per square meter of net was caught in both years (Figure 21). Bleak, moranec, Ohrid roach and, in part, stone moroko showed as well relatively high NPUE compared to all other fish species present. In 2015, bleak revealed constantly higher NPUE at all three Macedonian sampling sites relative to 2013 (Figure 21).

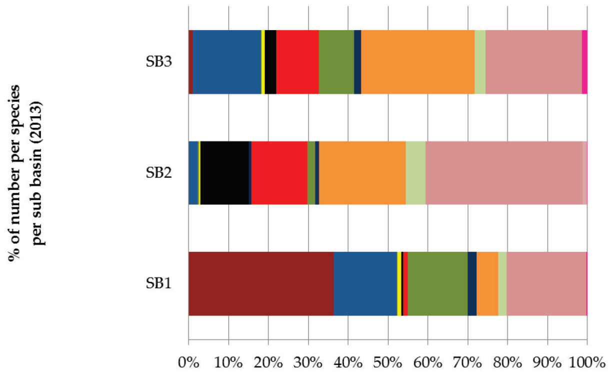


	SB1	SB2	SB3
Alburnoides ohridanus	3.95		0.03
Alburnus scoranza	6.39	0.29	2.14
Barbatula sturanyi	0.01	0.01	0.00
Barbus rebeli	0.96	0.08	0.58
Cobitis ohridana	0.02	0.17	0.05
Cyprinus carpio	0.04	0.02	
Gobio ohridanus	0.22	0.36	0.51
Pachychilon pictum	2.91	0.05	0.48
Pelasgus minutus	0.05	0.01	0.01
Pseudorasbora parva	0.30	0.22	0.41
Rhodeus amarus	0.13	0.05	0.04
Rutilus ohridanus	9.73	3.02	1.99
Salmo letnica			
Salmo ohridanus	0.22	0.48	
Squalius squalus	0.26	0.01	0.43

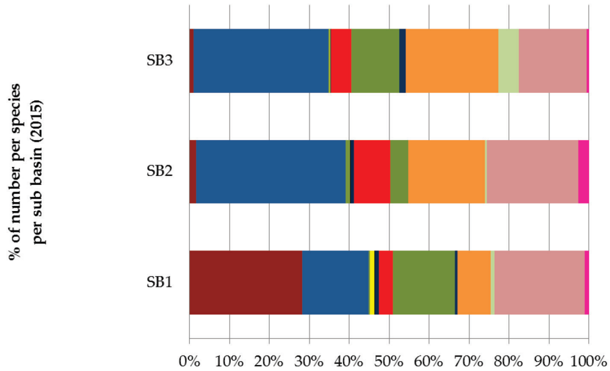


	SB1	SB2	SB3
Alburnoides ohridanus	3.15	0.05	0.05
Alburnus scoranza	5.56	4.46	4.41
Barbatula sturanyi	0.01	0.03	0.02
Barbus rebeli	1.98	0.04	0.11
Cobitis ohridana	0.02	0.01	
Cyprinus carpio	1.06	0.47	0.05
Gobio ohridanus	0.78	0.67	0.76
Pachychilon pictum	4.43	0.45	1.40
Pelasgus minutus	0.02	0.00	0.04
Pseudorasbora parva	0.62	0.58	0.97
Rhodeus amarus	0.05	0.02	0.22
Rutilus ohridanus	12.10	4.56	2.14
Salmo letnica		0.04	
Salmo ohridanus			
Squalius squalus	0.53	0.54	0.31

Figure 20. CPUE expressed in biomass (BPUE, g/m^2) and corresponding percentage of species on total catch itemized separately for individual sub-basins (SB) at the Macedonian side of Lake Ohrid. Sampling campaign of 2013 on the left and of 2015 on the right



	SB1	SB2	SB3
Alburnoides ohridanus	1.06		0.01
Alburnus scoranza	0.46	0.02	0.16
Barbatula sturanyi	0.00	0.00	0.00
Barbus rebeli	0.03	0.00	0.01
Cobitis ohridana	0.01	0.08	0.03
Cyprinus carpio	0.00	0.00	
Gobio ohridanus	0.03	0.09	0.10
Pachychilon pictum	0.44	0.01	0.08
Pelasgus minutus	0.06	0.01	0.02
Pseudorasbora parva	0.16	0.15	0.27
Rhodeus amarus	0.06	0.03	0.03
Rutilus ohridanus	0.58	0.26	0.23
Salmo letnica			
Salmo ohridanus	0.00	0.01	
Squalius squalus	0.01	0.00	0.01



	SB1	SB2	SB3
Alburnoides ohridanus	0.99	0.03	0.02
Alburnus scoranza	0.59	0.75	0.76
Barbatula sturanyi	0.01	0.02	0.01
Barbus rebeli	0.04	0.00	0.01
Cobitis ohridana	0.01	0.00	
Cyprinus carpio	0.03	0.02	0.00
Gobio ohridanus	0.12	0.18	0.12
Pachychilon pictum	0.55	0.09	0.27
Pelasgus minutus	0.02	0.00	0.04
Pseudorasbora parva	0.29	0.38	0.52
Rhodeus amarus	0.04	0.01	0.11
Rutilus ohridanus	0.79	0.46	0.38
Salmo letnica		0.00	
Salmo ohridanus			
Squalius squalus	0.04	0.05	0.01

Figure 21. CPUE expressed in number of individuals (NPUE, ind./m^2) and corresponding percentage of species on total catch itemized separately for individual sub-basins (SB) at the Macedonian side of Lake Ohrid. Sampling campaign of 2013 on the left and of 2015 on the right

5.3 Albania

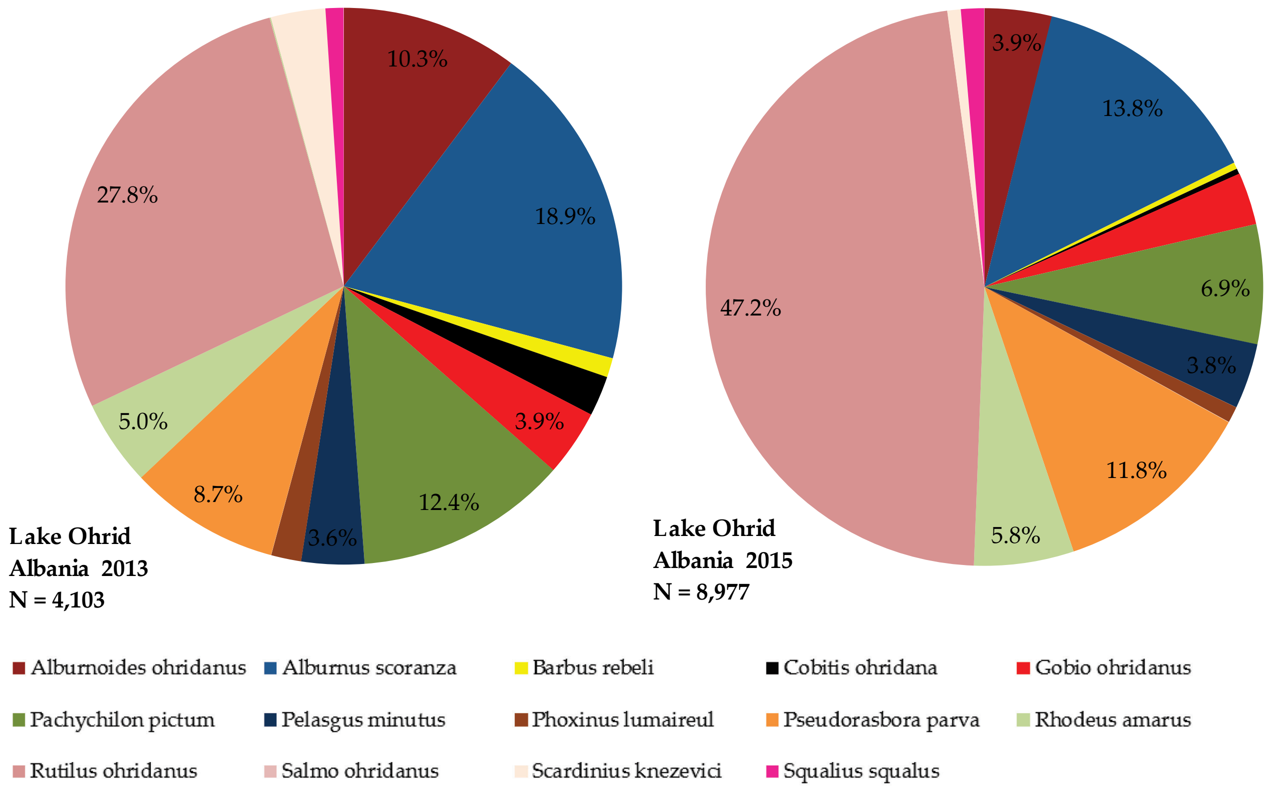
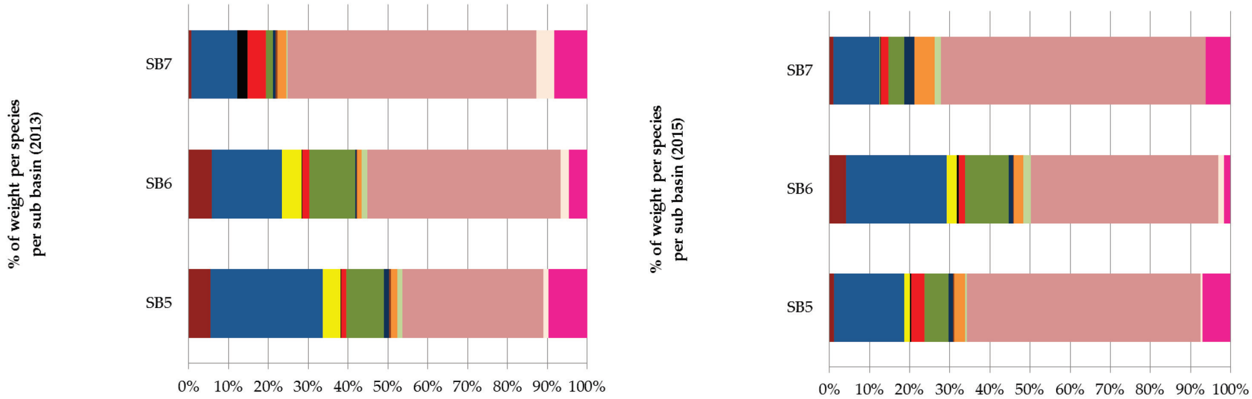


Figure 22. Relative fish species composition based on numbers in total catch at Albanian side of Lake Ohrid (2013 on the left and 2015 on the right)

At the Albanian sites a total of 14 species was collected in the course of the sampling campaigns (Figure 22). All species were caught in both sampling years with, however, slightly different shares of the individual species on total catches in 2013 and 2015. For example, relative numbers of spirlin, bleak, rudd and moranec in annual catches decreased somewhat from 2013 to 2015 whereas the share of Ohrid roach increased during that period. (Note that absolute numbers may nonetheless show a different trend.)

Mean biomass (BPUE) values (± S.D.) in the Albanian sub-basins were 12.7 (± 3.3) g/m^2 of net in 2013 and 23.0 (± 7.1) g/m^2 of net in 2015 (Figure 23). This distinct increase in biomass per m^2 of net was primarily attributable to increased biomasses of Ohrid roach in the latter year. However, other species, such as bleak, Ohrid gudgeon and stone moroko showed also an increase in mean standardized biomass (BPUE) over time (Figure 23). Further information on individual species and sub-basins are shown in (Figure 23).

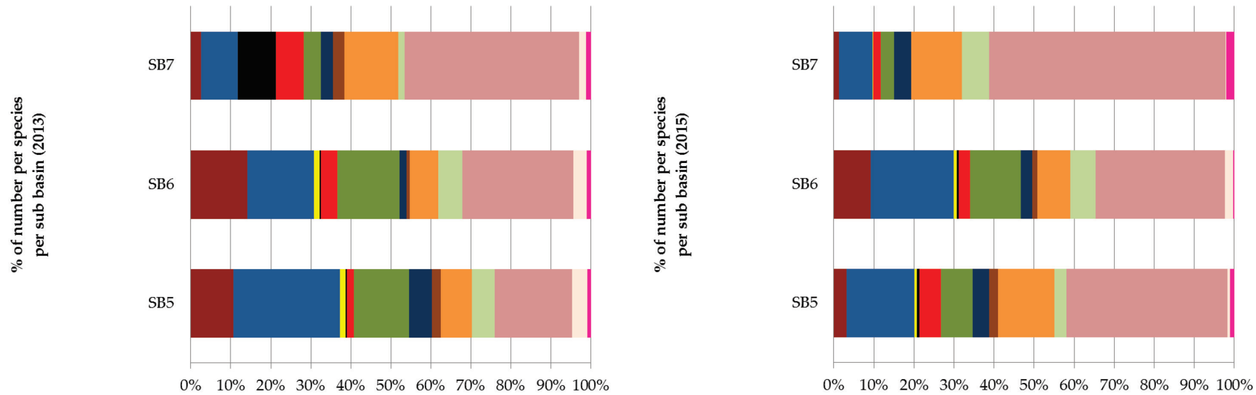
Similar to standardized biomass also the mean numbers of individuals per m^2 of net (NPUE) rose between 2013 and 2015 (Figure 24). NPUE of bleak, stone moroko, bitterling and Ohrid roach, in particular, were distinctly lower in the first sampling campaign than in the second one. In the individual sub-basins (SB 5-7), on average (± S.D.), 1.2 (± 0.3) fishes were caught per square meter of MMG in 2013, whereas in 2015 the mean number of fish/m^2 of net was 2.7 (± 1.1). Details on individual species and sub-basins are given in (Figure 24).



	SB5	SB6	SB7
Alburnoides ohridanus	0.76	0.88	0.06
Alburnus scoranza	3.90	2.75	1.04
Barbus rebeli	0.62	0.76	
Cobitis ohridana	0.02	0.03	0.22
Gobio ohridanus	0.18	0.27	0.42
Pachychilon pictum	1.30	1.79	0.15
Pelasgus minutus	0.18	0.05	0.06
Phoxinus lumaireul	0.07	0.01	0.05
Pseudorasbora parva	0.22	0.19	0.19
Rhodeus amarus	0.18	0.22	0.03
Rutilus ohridanus	4.88	7.39	5.62
Salmo ohridanus		0.13	
Scardinius knezevici	0.18	0.31	0.40
Squalius squalus	1.35	0.71	0.75

	SB5	SB6	SB7
Alburnoides ohridanus	0.25	0.70	0.29
Alburnus scoranza	3.66	4.29	3.60
Barbus rebeli	0.32	0.44	0.05
Cobitis ohridana	0.07	0.06	0.00
Gobio ohridanus	0.68	0.28	0.61
Pachychilon pictum	1.28	1.86	1.21
Pelasgus minutus	0.23	0.16	0.79
Phoxinus lumaireul	0.07	0.04	0.04
Pseudorasbora parva	0.55	0.40	1.53
Rhodeus amarus	0.10	0.33	0.52
Rutilus ohridanus	12.25	7.96	20.42
Salmo ohridanus			
Scardinius knezevici	0.11	0.24	0.03
Squalius squalus	1.47	0.29	1.92

Figure 23. CPUE expressed in biomass (BPUE, g/m^2) and corresponding percentage of species on total catch itemized separately for individual sub-basins (SB) at the Albanian side of Lake Ohrid. Sampling campaign of 2013 on the left and of 2015 on the right



	SB5	SB6	SB7
Alburnoides ohridanus	0.16	0.21	0.02
Alburnus scoranza	0.39	0.25	0.08
Barbus rebeli	0.02	0.02	
Cobitis ohridana	0.00	0.01	0.08
Gobio ohridanus	0.03	0.06	0.06
Pachychilon pictum	0.20	0.23	0.03
Pelasgus minutus	0.09	0.03	0.03
Phoxinus lumaireul	0.03	0.01	0.02
Pseudorasbora parva	0.12	0.11	0.11
Rhodeus amarus	0.08	0.09	0.01
Rutilus ohridanus	0.29	0.41	0.36
Salmo ohridanus		0.00	
Scardinius knezevici	0.06	0.05	0.01
Squalius squalus	0.01	0.02	0.01

	SB5	SB6	SB7
Alburnoides ohridanus	0.07	0.20	0.05
Alburnus scoranza	0.34	0.46	0.34
Barbus rebeli	0.01	0.02	0.00
Cobitis ohridana	0.01	0.01	0.00
Gobio ohridanus	0.11	0.06	0.08
Pachychilon pictum	0.16	0.28	0.14
Pelasgus minutus	0.08	0.06	0.17
Phoxinus lumaireul	0.04	0.03	0.01
Pseudorasbora parva	0.29	0.18	0.51
Rhodeus amarus	0.06	0.14	0.28
Rutilus ohridanus	0.81	0.72	2.39
Salmo ohridanus			
Scardinius knezevici	0.01	0.04	0.01
Squalius squalus	0.02	0.01	0.08

Figure 24. CPUE expressed in number of individuals (NPUE, ind./m^2) and corresponding percentage of species on total catch itemized separately for individual sub-basins (SB) at the Albanian side of Lake Ohrid. Sampling campaign of 2013 on the left and of 2015 on the right

5.4 Preliminary Lake Fish Index

5.4.1 Typology

A typology for Lakes Ohrid, Prespa and Shkodra could not be established. The lakes are unique with outstanding surface areas, depths and a very ancient genesis. They are not comparable with other lakes in the immediate and further surroundings. Additionally, no comparison between the lakes is possible. Lake Shkodra is located at lower altitude and is much shallower than Lakes Prespa and Ohrid. The latter are both located at higher altitudes but differ considerably in area and depth. The fish communities are characterized by endemic species. Therefore, using similar metrics for all three lakes would be ill-founded. It was decided that individual assessments of the lakes would be necessary. This decision is supported by the thresholds supposed for typologies in Annex II of the WFD.

5.4.2 Metrics and metric scoring

The metrics were selected by expert judgment. Most of them were based on the catches of benthic multi-mesh gillnets (MMG) according to the standardized procedure EN 14757 in 2013 and 2015. Data from fishery statistics and long-term scientific investigations were also used. The following list provides the selected metrics and their rationale:

- Percentage of weight for ***Alburnus scoranza*** (%W bleak): The percentage of weight of bleak in the catches with MMG is a metric of the category 'species composition'. The bleak is a tolerant cyprinid species. High percentages indicate an increase of the species as a consequence of anthropogenic influences, e.g. eutrophication.
- Percentage of weight of **salmonids** (%W trout): The percentage of weight of salmonids (*Salmo ohridanus* and *S. letnica*) in the fishery statistics is a metric of the category 'species composition'. The two trout species are native and intolerant to oxygen deficient situations. Low percentages indicate anthropogenic influences, e.g. lack of reproduction due to eutrophication or overfishing.
- Percentage of number of **native species** (%N native): The percentage of number of native species in the catches with MMG is a metric of the category 'species composition'. If native species are replaced by non-native species, a deterioration of the natural fish composition takes place. As non-natives are or were introduced by humans, this equals an anthropogenic ecological degradation of the lake. The status of the fish species (native/alien) is shown in Table 1. Dominant alien species in Lake Ohrid are *Pseudorasbora parva* and *Rhodeus amarus*.
- Percentage of **female *Salmo letnica*** (% fem. letnica): The percentage of females in the specific catches for the HIO reproduction program is a metric of the category 'reproduction and development'. The Ohrid trout is an important target species of the local fishery. A deviation in the percentage of females shows anthropogenic impacts, e.g. the specific overfishing of females.
- **Percentage of number of juvenile *Alburnoides ohridanus* (%N juv. spirlin)**: The percentage of spirlin individuals smaller than 10 cm is a metric of the category 'reproduction and development'. In an intact ecological situation, smaller individuals should be found in high numbers compared to bigger individuals. If mortality or lack of reproductive success lead to an underrepresentation of small individuals, a degraded ecological status can be assumed. The metric is not scored quantitatively but derived from the length-frequency distributions (Annex II of this report).
- **Percentage of number of juvenile *Alburnus scoranza* (%N juv. bleak):** As for juvenile spirlin.

Preliminary class boundaries were set by expert judgment based on data (Table 6). Three classes were assigned: high/good (5 points), moderate (3 points) or poor/bad (1point). The reference values shown in the table are the expected values for a theoretical situation without anthropogenic impact. Metric values above the good/moderate boundary are scored with 5 points, values between the boundaries score with 3 points and values below the moderate/poor boundary get 1 point.

Table 6. Metrics and class boundaries selected for a preliminary assessment LFI for Lake Ohrid

Metric	Reference[a]	good/moderate	moderate/poor
%W bleak (MMG)	30	35	50
%W trout (statistics)	40	30	10
%N native (MMG)	100	95	90
% fem. letnica (special)	50	45	30
%N juv. spirlin	high	low	absent
%N juv. bleak	high	low	absent

[a] Reference shows a theoretical value for an un-impacted situation, the boundaries good/moderate and moderate/poor are relevant for scoring

5.4.3 Total scoring

The metric scores were combined by summation to a total score. The total score was transformed to an EQR between 0 and 1 with the following equation: $EQR = (X-X_{min})/(X_{max}-X_{min})$.

X is the sum of the scores, X_{min} is the smallest possible sum (all metrics score 1 point) and X_{max} is the highest possible sum (all metrics score 5 points).

Finally, the five ecological status classes of the WFD were assigned to the EQR values. As a first approach, an equidistant division was chosen: High: ≤ 1.0 / Good: ≤ 0.8 / Moderate: ≤ 0.6 / Poor ≤ 0.4 / Bad ≤ 0.2.

5.4.4 Preliminary assessment results

The preliminary LFI for Lake Ohrid was calculated for the years 2013 and 2015. For the metrics based on MMG (% bleak and % native), pelagic nets were not included and the data from Albania and Macedonia were combined. The information for the percentage of trout in the fishery statistics and for the percentage of females in the HIO restocking program originates from Macedonian data. The numerical percentage of juveniles was visually estimated with the length-frequency distributions (see Annex II). Ohrid spirlins below 10 cm were abundant in all sub-basins and in all years. Ohrid bleaks below 10 cm were underrepresented in the sub-basins 1 to 3 in 2013, but abundant in 2015. Therefore, a lower score was given for 2013. The preliminary assessment results are shown in Table 7.

Table 7. Results of a preliminary LFI for Lake Ohrid. The "Value" columns show the corresponding values of the metrics for the two years of assessment. The "Score" columns show the scores of the specific metrics. Lower lines show the total assessment results for each year and the corresponding ecological status

Metric	Value 2013	Value 2015	Score 2013	Score 2015
%W bleak (MMG)	21.5	22.7	5	5
%W trout (statistics)	26.5	58.2	3	5
%W native (MMG)	85.3	82.4	1	1
% fem. letnica (special)	51.3	38.0	5	3
%N juv. spirlin	high	high	5	5
%N juv. bleak	low	high	3	5
		EQR	0.67	0.75
		Status	good	good

6 DISCUSSION

6.1 Fisheries

Although fishery research has a long history at Lake Ohrid there is not much quantitative data on fish available. Some information exists from the grey literature (Spirkovski & Talevski 2002, Avramoski et al. 2003, Anonymous 2004), however, it is often outdated or relates to catches only. Catch data *per se* are difficult to interpret in view of composition and/or condition of fish stocks as amount of fish caught can either mirror the size of a stock, but is also influenced by market demand, fishing effort, type of deployed fish gear, fishing interests etc. For this reason, for proper fish monitoring purposes standardized techniques shall always be given preference. Alternatively, fishing effort should be recorded at all times and taken into consideration when analyzing catch data.

In the course of the present project a standardized random sampling procedure (EN 14757) was used to generate information on fish community composition, relative abundance and biomass of species, as well as on length classes of the fishes. Despite this standard has been developed for WFD purposes, application of MMG is a common fishing technique which is widely employed for fish monitoring throughout Europe and beyond (Jeppesen et al. 2000, Snucins et al. 2001, Emmrich et al. 2012). At Lake Ohrid a total of 17 fish species has been caught by MMG, which represents about 75 % of species known to inhabit the lake. Given that some species (such as eel, *Anguilla anguilla,* and mosquitofish, *Gambusia holbrooki*) can typically not be caught by gillnets, it can be concluded that MMG fishing is a useful method for fish monitoring at Lake Ohrid too. This also applies for Lakes Prespa and Skadar/Shkodra (Ilik-Boeva et al. 2017, Mrdak et al. 2017) where MMG fishing according to the standard EN 14757 lead to similar good results. Nonetheless, in order to obtain information on all species and/or age classes, monitoring of Lake Ohrid fishes with MMG should be supported by other fishing gear like beach seines, electrofisher, larvae traps or fyke nets. Furthermore, standard MMG fishing has occasionally been criticised for not adequately reflecting the abundance of larger specimens and/or species (Deceliere-Vergès & Guillard 2008, Prchalová et al. 2009). It has been suggested, therefore, to add further panels (with mesh sizes of 70 or 90 mm knot to knot) to the net. Indeed, only a few larger individuals were caught at all during the current project and Ohrid trout and belvica (which can grow to a large size as well) appeared rarely in the catches which may either suggest a rare presence of big fish or support the need for further net panels, or both, for a comprehensive fish monitoring. This topic, thus, deserves further investigation. To specifically collect data on Lake Ohrid trout and/or belvica, a non-random sampling design (which can also include different gears, depths and seasons) can be applied.

Lake Ohrid (and its surrounding areas too) is of amazing beauty. The crystal-clear lake water may raise the impression that the waterbody is undisturbed and, therefore, can be home to plenty of fishes. However, extremely high transparency of the water is rather indicative of comparatively low nutrient loads, which results in low densities of phytoplankton, which in turn via food-web interactions translates into comparatively low fish biomass. Indeed, Lake Ohrid is considered oligotrophic and as such its carrying capacity of fish is low relative to mesotrophic and/or eutrophic waterbodies. This predication is also supported by the present data. Maximum total fish biomass of Lake Ohrid was 19.6 g/m² (in 2015) which is distinctly lower than corresponding values from Skadar/Shkodra Lake and also lower than in Prespa Lake (Mrdak et al. 2017, Ilik-Boeva et al. 2017). Nonetheless, standardized fish biomass values (BPUE) from Lake Ohrid are very similar to those of other oligotrophic lakes (Deceliere-Vergès & Guillard 2008).

Available fishery statistics for Lake Ohrid shows that, in the past, Ohrid trout (*Salmo letnica*) and belvica (*S. ohridanus*) contributed considerably to the total annual catches of commercial fishers (Spirkovski & Talevski 2002, Anonymous 2004). For this reason, the lake has occasionally been characterised as typical salmonid water or “lake of trout” (Spirkovski et al. 2001, Spirkovski 2004 a). While the physico-chemical water parameters (especially its relatively low temperature and high oxygen concentration) and morphology (e.g. bottom structure) of the lake still provide excellent conditions for salmonid fishes, the current data show that, both in terms of biomass and abundance, the fish community is currently dominated by cyprinids (like Ohrid roach, bleak, Ohrid chub, minnow, spirlin) (Figure 18). This fact underlines the need for ongoing protection and support of Ohrid trout and belvica. A prerequisite for the re-establishment of self-sustaining salmonid stocks, however, is to uncover the main reasons (bottlenecks) that hamper the stocks to thrive. Poaching and/or overfishing may be important reasons, but environmental degradation (e.g. land use) affecting availability and access to suitable spawning grounds, as well as pollution compromising health of juveniles and spawners may be others (Vogel et al. 2010, Jordanova et al. 2016).

Among the species caught there were only two (stone moroko, bitterling) which are non-native. With regard to numbers, together they accounted for about 15-20 % of fishes caught (Figure 18). It, therefore, seems that these two species are widely distributed in the lake. As mentioned earlier, the alien mosquitofish, most probably, did not appear in the samples because of its small body size and preferred habitat (aquatic vegetation in shallow water) (Spirkovski et al. 2012 a), which make it impossible to catch by gillnets. On the contrary, the remaining aliens known to populate the lake, Prussian carp, rainbow trout and pumpkinseed, were not sampled either although in terms of body size these species are large enough to get caught with this gear. It is conceivable that in Lake Ohrid populations of these three species are not big and, therefore, chances of catching them are slim. Alternatively, species may also occur in particular habitats of the lake only, which means that they are not evenly distributed in the water and, consequently, were not sampled with the random sampling technique.

The fish community at Macedonian sampling sites was relatively constant between the two sampling years, with five species (spirlin, bleak, moranec, stone moroko, Ohrid roach) dominating the catch and other species adding to it to various degrees (Figure 19). At Albanian sites the situation was a little different (Figure 22). First of all, the species seemed to be more evenly distributed in total catch with only Ohrid roach and bleak being somewhat more abundant that the other species. The 2015 catch at Albanian sites was dominated by Ohrid roach; all other species, however, were more or less evenly distributed again. In conclusion, it seems that there are moderate spatial differences in relative species abundance between Macedonian and Albanian sampling sites.

At smaller spatial scale, differences in species occurrence and abundance become more obvious. As can be seen from Figure 20, there were distinct differences in standardized biomass values (BPUE) among SB 1, SB 2 and SB 3 at Macedonian territory. The differences were also noticeable with regard to standardized species abundance (NPUE, Figure 21). Interestingly, these differences in fish community parameters at the various sampling sites were relatively stable over time, meaning that differences existed among sites and remained through the years. As the Macedonian sampling sites were relatively far away from each other it seems that small-scale (i.e., locally acting) environmental parameters and conditions are of greater importance for structure and diversity of fish community than large-scale factors. This, in turn, may have also implications for fishery management, in particular for fish with limited home ranges, as local actions may immediately translate into local consequences. Furthermore, this can also mean that negative effects on fish fauna resulting from locally-constraint deteriorative activities may not necessarily be "buffered" by other lake habitats as conditions vary among different sites.

At the pelagic site (SB 4) only gudgeon were collected by use of benthic nets, which underlines the distinctiveness of the various habitats. To sum up, for a fish monitoring it needs to be taken into account that there a differences in species composition and abundance/biomass among various sampling sites. Neglecting particular spots (or the substitution of one site by another) may lead to modified results and conclusions. Number and location of monitoring sites, therefore, need to be chosen wisely.

Similar to findings on Macedonian territory, at Albanian sites (SB 5-7) differences in standardized biomass and abundance values (BPUE, NPUE) were found between sampled sub-basins whereas variations between years were minor (Figure 23 and Figure 24). In view of NPUE and BPUE, the SB 7, in particular, differed markedly from the other two sampling sites. Again, it seems that environmental variables acting at relatively small scale have a measurable impact on structure and diversity of the local fish fauna. According to Watzin (2003) waste is discharged into Lake Ohrid near the town of Tushemisht (i. e. SB 7) and thus it is conceivable that pollution stress favours comparatively undemanding species (like Ohrid roach) over other fishes.

The European standard EN 14757 has been prepared to implement the Water Framework Directive (WFD) (Anonymous 2000). It provides an estimate for species occurrence, relative fish abundance, biomass (CPUE) and size structure of fish communities (European Committee for Standardization 2015). Nonetheless, the quantitative information (data) generated with this standard to certain extent enables the assessment of the status of fish species. With regard to **bleak** (*Alburnus scoranza*) the present data suggest that the stock is doing well. In both sampling years (and in 2015 in particular) reasonably good numbers of fish were found at most littoral sampling sites (Figure 25, Figure 27, Figure 29, Figure 31, Figure 33, Figure 35, Figure 38, Figure 40, Figure 42, Figure 44, Figure 46, Figure 48). Additionally, as bleak from Lake Ohrid becomes mature at a body size of about 8 cm it can be concluded that good shares of adult fish (i. e. potential spawners) were found in the catches from nearly all littoral sites (Figure 28, Figure 32, Figure 36, Figure 41, Figure 45, Figure 49).

Only a few **carp** (*Cyprinus carpio*) were sampled during the project (Figure 18) although this species is part of the regular catches of commercial fishers (Table 2, Figure 7 and Figure 8). Carp typically prefer warm (shallow) waters which is in contrast to conditions at Lake Ohrid having relatively cool temperatures at most times of the year (and average depth of over 150 m) (Matzinger et al. 2006 b). As a consequence, environmental conditions for the occurrence of carp are not ideal and, therefore, one cannot expect large numbers of carp during random samplings of this lake. Noteworthy though is that carp appeared in the catches only at selected sites (SB 1, 2 and 3) and that sampled specimens were all small (≤ 20 cm in size) (Figure 28, Figure 32, Figure 36). It is conceivable that employed standard MMG did not catch bigger individuals as has been proposed during other studies (Deceliere-Vergès & Guillard 2008, Prchalová et al. 2009). Alternatively, it cannot be excluded that numbers of spawners are very small and chances of getting caught by random sampling are low. Further investigations are needed to find out about the reasons for the lack of big carp in the present samples. However, specimens collected during this project indicate, at least, that carp spawners are present and that successful reproduction takes place in this lake.

During the whole sampling period, only one single **Ohrid trout** (*Salmo letnica*) was caught. Generally, gillnets are commonly employed to catch trout in large lakes and the MMG standard is based on long-term investigations in Swedish lakes where trout and other salmonids are common (Appelberg 2000). Furthermore, as Lake Ohrid, in general, offers good conditions for existence of this species (such as cold temperature zones throughout the year, high oxygen concentrations, suitable spawning sites) (Matzinger et al. 2006 b) and as trout used to form a noteworthy part of annual commercial catches (Figure 6), higher numbers of Ohrid trout in the MMG catches were to be expected. On the other hand, share of Ohrid trout on recent catches is low (Figure 8) and the commercial catches currently sum up to the level of about 15 t per annum for the Macedonian part of the lake (Milošević & Talevski 2015) and about 5-10 t at the Albanian side (Diffey et al. 2015). In former decades, annual catches used to reach the level of around 80-100 t and thus were much higher than today (Avramoski et al. 2003), indicating that the lake, in overall, supports a larger stock. Taken together, the current MMG catches mirror nicely the low fish numbers in the commercial catches and presumed low abundance (i.e. number of individuals per area and volume, respectively) in the lake too. As mentioned above, further protection and support of Ohrid trout (by e.g., harmonization of fishing regulations and strict enforcement thereof) is proposed. Moreover, research on factors that limit the build-up of a self-sustaining larger stock is advisable.

Similar to Ohrid trout, only relatively few **Ohrid belvica** (*Salmo ohridanus*) were caught during the years. Most of the fish were collected in 2013 which indicates that this species too is currently not very abundant in the lake. Therefore, the same recommendations regarding protection and research needs as given for Ohrid trout apply.

Ohrid Roach (*Rutilus ohridanus*) was widely distributed in the lake. It was found at any littoral site and any depth stratum sampled (Figure 26, Figure 30, Figure 34,Figure 39, Figure 43, Figure 47). Moreover, good numbers of both small and large individuals were collected during each fishing campaign (Figure 28, Figure 32, Figure 36, Figure 41, Figure 45, Figure 49), which in combination with its wide spatial distribution indicated that the roach stock is presently in good condition.

The native **barbel** (*Barbus rebeli*) is of certain ichthyologic interest and several studies have been undertaken in the past to unravel its taxonomic status (Marková et al. 2010, Velkova-Jordanoska et al. 2010, 2013). In the course of the current investigation barbel was found in all littoral sub-basins. Its relative abundance was low although somewhat higher CPUE were noticed at SB 5 and SB 6 (Figure 39, Figure 43) where it also occurred in several length classes. The presence of the barbel in nearly all sampled areas can be seen as a positive sign of population recovery.

Stone moroko and **bitterling** are both non-native to the lake. Current data show that these two species in terms of numbers amount to about 15% of the annual catches (Figure 18). They were found in good numbers at all littoral sampling sites which indicates that they are widely distributed in the lake (Figure 25, Figure 29, Figure 33, Figure 38, Figure 42, Figure 46). Adult specimens were well represented in the catches (Figure 28, Figure 32, Figure 36, Figure 41, Figure 45, Figure 49) and, as no further stocking of Lake Ohrid with these species takes place, it can be concluded that stone moroko and bitterling have established self-sustaining populations in this waterbody.

A few **spined loach** (*Cobitis ohridana*) and **stone loach** (*Barbatula sturanyi*) were collected during the sampling, especially at SB 2 and SB 7 in 2013. Neither in terms of biomass nor in view of numbers were these species of great significance.

6.2 Fish-based ecological status assessment

The development of a preliminary assessment system demonstrated the general possibility to use the existing data for future ambitions towards implementing the WFD in riparian countries of Lake Ohrid. The procedure of index development was compliant with the WFD and based on the following descriptions (among others):

- for typology: Ecostat (2004), Poikane (2009), Ritterbusch et al. (2014),
- for the theoretical background of system development and scoring: Birk et al. (2013), CIS (2003 a, b, 2009, 2011, 2015), Lyche-Solheim et al. (2013), Poikane et al. (2015),
- for overviews of existing systems with descriptions of typology, metrics, and scoring: Argillier et al. (2013), Gassner et al. (2014), Olin et al. (2014), Ritterbusch et al. (2017 a, b).

Lake Ohrid is more or less incomparable to other lakes concerning biogeography, morphometry, and fish community. Expert judgment played a major role in the development of the fish-based assessment system, especially in the setting of class boundaries. However, comparable procedures are not uncommon in Europe (Gassner et al. 2014, Ritterbusch et al. 2017 a).

The preliminary assessment system indicated a good ecological status of Lake Ohrid. For 2013, the index score is close to the good/moderate boundary while for 2015 the index is higher. The results are influenced by the abundance of non-native species. Non-native species are a very controversial topic in the context of WFD-compliant lake assessment. Non-native species are absent in reference conditions and can have significant impacts on the fish community. However, the WFD aims at evaluating the ecological status of the lake and not the pristine nature of the fish stock. There are arguments that non-native species should be evaluated as a significant anthropogenic stressor. On the other hand, there are arguments that a fish community with significant shares of non-native species cannot be used for the assessment of ecological status (Vandekerkhove & Cardoso 2010). The situation at Lake Ohrid, therefore, has to be clarified in the course of the future improvement of the fish-based assessment system.

For the future development of the index, the inclusion of additional metrics is recommended. Two additional metrics were proposed as promising. The total weight per unit of effort (BPUE) is a widespread metric that is positively correlated with eutrophication and shoreline degradation. For Lake Ohrid, the percentage of *Pachychilon pictum* in the catches with MMG was also suggested. However, as experiences with values of these metrics for MMG were missing, the setting of preliminary class boundaries based on expert judgment had to be postponed.

7 PROPOSED FISH MONITORING SCHEME

Based on the experience of fishery experts and scientists from Albania and Macedonia and in consideration of the findings from the current investigation, a fish sampling scheme was developed to monitor the stock development of Lake Ohrid fishes. The proposed plan embraces the territories of both riparian countries. The selected fishing gear targets the collection of economically valuable species (such as Ohrid trout and bleak), as well as of fishes that deserve particular consideration because of their ecology (invasive species) and/or conservation status (e.g. Ohrid gudgeon). Furthermore, the use of the recommended gears enables collection of data from larval, juvenile and adult fishes. In short, depending on the information that is needed for management purposes or research questions asked, the corresponding fishing gear(s) should be employed at the indicated locations and at time intervals varying in dependence on the respective topic, fish species, age class etc.

For the assessment of fish stock condition and development it is crucial to always record the fishing effort (e.g. number of nets, fishing hours, fished areas etc.) Temporal and spatial comparisons can be made and meaningful conclusions be drawn if standardized sampling protocols are followed and accurate catch-per-unit-efforts (CPUE) determined. Ideally, fishing shall be performed in accordance with existing standards (such as MMG fishing in line with EN 14757). For example, the European Standard EN 14962: 2006 ("Guidance on the scope and selection of fish sampling methods") gives a methodological overview about the estimation of fish abundance and evaluation of fish populations. It also informs about existing fishing methods and evaluates their appropriateness in relation to characteristics of the various water bodies (European Committee for Standardization 2006). Similarly, the European Standard EN 14011: 2003 ("Sampling of fish with electricity") is a guideline for the estimation of composition, abundance and diversity of fish using electric fishing gear. The norm includes details on gear and methods, but also safety standards. The minimum sampling effort (i.e. the shoreline length that needs to be sampled) is described in dependence on the waterbody type, and information about fish handling and measurement is given (European Committee for Standardization 2003).

The fyke nets shown to be employed (Table 8 and Table 9) shall have wings with mesh sizes of 10 and 5 mm (knot-to-knot). Use of larvae traps is foreseen in periods shortly after species recruitment to specifically collect 0^{+} of cyprinid and salmonid fishes in the lake to subsequently assess recruitment success.

Table 8. Proposed sampling scheme for transboundary fish monitoring at Lake Ohrid (Macedonian territory)

Method	MACEDONIA											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
Benthic MMG (EN 14757)							Veli Dab, Andon Dukov, Radozda			Veli Dab, Andon Dukov, Radozda		
Pelagic MMG (EN 14757)								pelagial (240 m)				
Fyke net							Andon Dukov, Radozda			Andon Dukov, Radozda		
Electrofishing transects									Andon Dukov, Radozda			
Fish larvae trap				Veli Dab, Andon Dukov, Radozda, pelagial			Veli Dab, Andon Dukov, Radozda, pelagial					
Beach seine						Andon Dukov, Radozda			Andon Dukov, Radozda			
Catch data	x	x	x	x	x	x	x	x	x	x	x	x

Table 9. Proposed sampling scheme for transboundary fish monitoring at Lake Ohrid (Albanian territory)

Method	ALBANIA											
	Jan.	Feb.	Mar.	Apr.	May	Jun.	July	Aug.	Sept.	Oct.	Nov.	Dec.
Benthic MMG (EN 14757)							Lin, Hudënisht, Tushemisht			Lin, Hudënisht Tushemisht		
Fyke net							Lin, Hudënisht, Tushemisht			Lin, Hudënisht, Tushemisht		
Electrofishing transects												
Fish larvae trap	Lin, Hudënisht, Tushemisht	Lin, Hudënisht, Tushemisht					Lin, Hudënisht, Tushemisht		Lin, Hudënisht, Tushemisht			Lin, Hudënisht, Tushemisht
Beach seine								Lin, Hudënisht, Tushemisht	Lin, Hudënisht, Tushemisht			
Catch data	x	x	x	x			x	x	x	x	x	x

8 CONCLUSIONS

The MMG standard EN 14757 was developed to fulfil the requirements of the Water Framework Directive. Specifically, data obtained from the randomized fish sampling enable subsequent assessment of the ecological status of a temperate waterbody. However, the findings of such a sampling are also useful for fishery purposes as MMG fishing generates information on species occurrence, relative share of individual species in terms of numbers (NPUE) and biomass (BPUE) on fish community, and about size structure of fish populations. Application of MMG fishing at Lake Ohrid lead, among others, to detection of 17 species (i.e. approximately 75% of occurring species) and provided related fish community data. It, therefore, can be stated that MMG fishing is a useful tool to generate information on Lake Ohrid fishes.

Like any other method, MMG fishing also has some limitations. For a comprehensive fish monitoring MMG fishing should be complemented by other methods and gears. For example, in the current study only a few large fish (e.g. carp) were sampled. It, therefore, is proposed to expand the number of net panels and to incorporate panels with mesh-sizes of 70 or 90 mm (knot-to-knot). Similarly, no eel (*Anguilla anguilla*) was collected, which however, does not surprise as eel is typically caught by use of fyke nets or electrofisher. Factual information about eel, however, is needed to elaborate an eel management plan in line with the EU Eel Regulation (Council of the European Union 2007), which in turn is part of the *Acquis communautaire* and, thus, of significance for EU accession of the partner countries.

Spatial comparisons and assessment of stock developments over time require detailed information on the effort undertaken for data collection. It is crucial, therefore, to not only report on catches but to also calculate the catch per unit of effort (CPUE). Recording the fishing effort should become part of each monitoring program.

The stock of bleak (*Alburnus scoranza*) seems to be in good condition on either side of the lake. There is currently no indication for a reduction of bleak fishery.

Only a few salmonid individuals were caught throughout the sampling period, which is in accordance with the currently low catches of commercial fishers. To foster stock development of Ohrid trout and Ohrid belvica, existing fishery laws of both riparian countries need to be enforced. This, in particular, applies to the adherence to fishing ban periods and minimum legal size of collected fish.

Spatial and/or temporal protection of fishes from fisheries exploitation can be an effective tool for sustainable resource management. Protection measures, however, have to be founded on data, need to be species-specific and limited to defined periods. The success of protection measures has subsequently to be evaluated.

Using nets with small mesh sizes (panels of 5, 6.25 and 8 mm) showed the noteworthy presence of some alien species (such as stone moroko and bitterling) which would otherwise only rarely be recorded in the regular catches of commercial fishers. The data indicate that non-native species are widely occurring. Their potential impact on native fishes deserves, therefore, further investigation.

Lake Ohrid is an oligotrophic waterbody (Sarafiloska & Patceva 2012; Patceva et al. 2009; Peveling et al. 2015) and, thus, a relatively low fish production can be expected. The current investigations resulted in comparatively low standardized biomass (BPUE) relative to the other great lakes of the Western Balkans (Mrdak et al. 2017, Ilik-Boeva et al. 2017) and, therefore, confirm the low productivity.

Lake Ohrid has occasionally been described as salmonid water. Yet, the present findings show that the lake both in terms of numbers and biomass is at present dominated by cyprinid species.

For the proper management of aquatic resources, fishery regulations of both riparian countries should be harmonized. Ideally, identification and regular adjustment of suitable protection measures shall be conducted in a joint effort of a transboundary fishery commission. Representatives of the competent ministries, scientists, FMOs, concessionaires, local authorities, civil society (NGOs) of both countries should be considered for membership (Palluqi et al. 2009).

9 ADDITIONAL RECOMMENDATIONS

As a transboundary waterbody, Lake Ohrid is a shared resource, and no management action can be taken by one riparian country without impacting the resources and conditions of the other. A regular exchange of information, data and intended measures as they relate to the lake and its immediate surroundings, therefore, is advisable.

In view of the sustainable use of fishery resources it is of utmost importance to re-establish and reactivate the bilateral co-management authority ("Lake Ohrid Fisheries Commission"), which already existed in the previous century to manage the lake's fisheries and related resources. Representatives from competent ministries, local authorities, fishers' organizations, research institutions, civil society etc. are recommended to be considered for membership.

This authority (technical and political) could be (re-)established in the frame of the *Agreement between the Council of Ministers of the Republic of Albania and the Government of the Republic of Macedonia for the protection and sustainable development of Lake Ohrid and its watershed*, signed in 2004. According to this agreement, the riparian countries will take the necessary measures, among others, to protect biodiversity (particularly endemic species), to ensure the sustainable use of natural resources, and to prevent and control economic activities from seriously damaging (and polluting) the environment. In the light of these goals it is important that the fishing pressure on salmonid fishes be reduced to conserve biodiversity and restore the balance of the fish fauna as a prerequisite for its sustainable use.

The Lake Ohrid fish fauna is part of the World Heritage and, thus, deserves adequate research resources for its protection. The joint monitoring of fish stock, spawning grounds and habitats is one of the necessary important actions. As well, fish stock assessments based on long-term data series collected with all necessary fishing gears (and other surveying techniques) are required for determination of appropriate catch quota. Lastly, due to the uncertainty regarding the success of present trout stocking activities, it is recommended to conduct mark-and-recapture experiments with hatchery-reared trout.

Proposed measures and actions stated in the following Table 10 are adopted from the Transboundary Fish and Fisheries Management Plan for Prespa Lakes Basin (Spirkovski et al. 2012 b) modified to improve fisheries management at Lake Ohrid.

Table 10. Proposed measures and actions for future fishery management of Lake Ohrid (Spirkovski et al. 2012 b)

No	Measures	Actions
1	Bilateral fishery management	Establishing a Joint Lake Ohrid Fishery Commission (JLOFC) Joint Fishery Master Plan for Lake Ohrid
2	Monitoring of water quality and fish stocks	Reinforcement of local monitoring stations in both countries in cooperation with scientific institutions and other relevant stakeholders
3	Joint technical monitoring protocol	Quality assurance and data acquisition (created by designated implementing bodies in charge of fishery)
4	Improved fish statistics	Use of uniform software to facilitate data exchange Establishing a computer-based fishery database
5	Fish stock assessment	Integrated actions (open cross border expeditions and surveillances with joint resources), FSA
6	Guarding of fish stocks	Establishing national guarding bodies (state and private) Improving the infrastructure of fishery inspectorates
7	Conservation	Conservation action plans specified for individual fish species Implementing new fishery techniques to minimize by-catch Stocking program only with autochthonous fish adapted to specific habitats
8	Control of alien fishes	Selective and ameliorative fishing
9	Fishing limits	Determining and harmonizing the minimum catchable size of fishes Determining the spawning periods and harmonizing closed fishing season per species
10	Spawning grounds, habitats	Defining strict natural fish spawning grounds (where any activities without special permission from the national management bodies and JLOFC are not allowed) Improving the conditions at spawning grounds Ghost-net removal and habitat restoration
11	Catch quotas	Determination of annual Total Allowable Catch Quotas (TACQ) per country / per species
12	Fishing regulations	Maximum allowed fishing gears and fishing equipment for commercial and recreational fishery
13	Fish stocking	Designing a Joint Fish Stocking Program (JFSP) based on monitoring data

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ANNEXES

Annex I. Sampling points and additional sampling data

Table 11. Sampling points (sub-basins) at Macedonian part of Lake Ohrid in 2013

Sub-basin	Net Nr.	Date	Stratum (m)	Depth (m)	Longitude	Latitude
SB 1 VELI DAB	1	19.10.2013	0 - 3	1.0 - 3.5	E 20° 47′ 941	N 40° 59′ 250
	2		0 - 3	1.5 - 3.5	E 20° 47′ 903	N 40° 59′ 212
	3		3 - 6	5.0 - 5.0	E 20° 47′ 964	N 40° 59′ 304
	4		6 - 12	6.5 - 6.5	E 20° 47′ 946	N 40° 59′ 367
	5		6 - 12	6.5 - 13.0	E 20° 47′ 953	N 40° 59′ 408
	6		6 - 12	6.0 - 15.0	E 20° 47′ 939	N 40° 59′ 464
	7	04.11.2013	3 - 6	3.4 - 3.4	E 20° 48′ 026	N 40° 59′ 950
	8		3 - 6	3.5 - 10	E 20° 47′ 993	N 40° 59′ 937
	9		6 - 12	6.0 - 14.0	E 20° 47′ 886	N 40° 59′ 968
	10		20 - 35	18.0 - 40.0	E 20° 47′ 966	N 41° 00′ 028
	11		12 - 20	13.0 - 15.0	E 20° 48′ 061	N 41° 00′ 075
	12		20 - 35	17.0 - 35.0	E 20° 48′ 108	N 41° 00′ 121
	13		20 - 35	23.0 - 23.0	E 20° 48′ 132	N 41° 00′ 968
	14		3 - 6	3.0 - 6.0	E 20° 48′ 207	N 41° 00′ 308
	15		12 - 20	12.0 - 15.0	E 20° 48′ 190	N 41° 00′ 339
	16		12 - 20	12.0 - 20.0	E 20° 48′ 061	N 41° 00′ 397
SB 2 ANDON DUKOV	17	08.11.2012	3 - 6	3.5 - 6.3	E 20° 45′ 568	N 41° 07′ 933
	18		0 - 3	1.5 - 1.9	E 20° 45′ 561	N 41° 08′ 030
	19		3 - 6	3.5 - 4.8	E 20° 45′ 472	N 41° 08′ 043
	20		6 - 12	6.5 - 14.0	E 20° 45′ 385	N 41° 08′ 065
	21		20 - 35	16.0 - 28.0	E 20° 45′ 345	N 41° 08′ 045
	22		20 - 35	22.0 - 25.0	E 20° 45′ 214	N 41° 08′ 171
	23		35 - 50	40.0 - 48.0	E 20° 45′ 124	N 41° 08′ 175
	24		6 - 12	7.2 - 8.2	E 20° 45′ 195	N 41° 08′ 294
	25		6 - 12	9.0 - 13.0	E 20° 45′ 124	N 41° 08′ 283
	26		21 - 35	20.0 - 22.0	E 20° 45′ 134	N 41° 08′ 273
	27	11.11.2013	12 - 20	16.0 - 16.0	E 20° 44′ 392	N 41° 09′ 197
	28		12 - 20	17.0 - 19.0	E 20° 44′ 392	N 41° 09′ 200
	29		12 - 20	19.0 - 18.0	E 20° 44′ 411	N 41° 09′ 212
	30		6 - 12	13.0 - 10.0	E 20° 44′ 165	N 41° 09′ 119
	31		0 - 3	1.0 - 3.0	E 20° 44′ 452	N 41° 09′ 348
	32		12 - 20	18.0 - 28.0	E 20° 44′ 328	N 41° 09′ 077
	33		35 - 50	33.0 - 43.0	E 20° 44′ 536	N 41° 08′ 553
	34		3 - 6	5.0 - 5.3	E 20° 44′ 489	N 41° 09′ 239
	35		35 - 50	45.0 - 57.0	E 20° 44′ 307	N 41° 08′ 558
	36		50 - 75	68.0 - 75.0	E 20° 44′ 106	N 41° 08′ 469
SB 3 RADOZDA	47	05.11.2013	0 - 3	2.5 - 3.5	E 20° 38′ 214	N 41° 05′ 530
	48		3 - 6	3.7 - 4.2	E 20° 38′ 107	N 41° 05′ 573
	49		6 - 12	6.0 - 14.0	E 20° 38′ 107	N 41° 05′ 370
	50		12 - 20	18.0 - 22.0	E 20° 38′ 231	N 41° 05′ 347
	51		20 - 35	25.0 - 28.0	E 20° 38′ 320	N 41° 05′ 414
	52		20 - 35	30.0 - 30.0	E 20° 38′ 198	N 41° 05′ 548
	53		35 - 50	39.0 - 42.0	E 20° 38′ 265	N 41° 05′ 565

SB 3 RADOZDA (contd.)	54		3 - 6	5.0 - 6.0	E 20° 38′ 150	N 41° 05′ 633
	55		3 - 6	5.0 - 5.5	E 20° 38′ 190	N 41° 05′ 684
	56		35 - 50	50.0 - 50.0	E 20° 38′ 409	N 41° 05′ 634
	57	06.11.2013	0 - 3	2.2 - 2.3	E 20° 38′ 836	N 41° 05′ 132
	58		0 - 3	2.5 - 3.2	E 20° 38′ 215	N 41° 05′ 736
	59		12 - 20	7.6 - 22.0	E 20° 38′ 303	N 41° 05′ 747
	60		20 - 35	30.0 - 43.0	E 20° 38′ 340	N 41° 05′ 654
	61		3 - 6	5.4 - 5.0	E 20° 38′ 251	N 41° 05′ 825
	62		6 - 12	3.8 - 11.0	E 20° 38′ 280	N 41° 05′ 883
	63		6 - 12	7.5 - 14	E 20° 38′ 353	N 41° 05′ 831
SB 4 CENTRAL PLATE	37	12.11.2013	120 - 125	123.0 - 124.0	E 20° 43′ 576	N 41° 08′ 273
	38		120 - 125	123.0 - 124.0	E 20° 43′ 500	N 41° 07′ 450
	39		130 - 135	133.0 - 134.0	E 20° 43′ 350	N 41° 07′ 600
	40		130 - 135	133.0 - 134.0	E 20° 43′ 180	N 41° 07′ 725
	41		130 - 135	133.0 - 134.0	E 20° 42′ 950	N 41° 07′ 515
	42		120 - 125	123.0 - 124.0	E 20° 42′ 870	N 41° 07′ 400
	43		120 - 125	123.0 - 124.0	E 20° 42′ 525	N 41° 07′ 135
	44		165	167.0 - 163.0	E 20° 42′ 194	N 41° 06′ 527
	45		165	167.0 - 163.0	E 20° 42′ 010	N 41° 06′ 300
	46		165	167.0 - 163.0	E 20° 41′ 920	N 41° 06′ 229
PELAGIC	64	19.10.2013	0 – 6 surface	0.0 – 6.0	E 20° 47′ 754	N 40° 59′ 366

Table 12. Sampling points (sub-basins) at Macedonian part of Lake Ohrid in 2015

Sub-basin	Net Nr.	Date	Stratum (m)	Depth (m)	Longitude	Latitude
SB 1 VELI DAB	1	06.10.2015	0 - 3	1.5 - 2.2	E 20° 47′ 045	N 40° 59′ 910
	2		0 - 3	1.9 - 1.7	E 20° 48′ 953	N 40° 59′ 951
	3		0 - 3	2.0 - 3.0	E 20° 48′ 066	N 40° 59′ 962
	4		0 - 3	3.1 - 2.1	E 20° 48′ 141	N 40° 00′ 065
	5		0 - 3	2.3 - 1.6	E 20° 48′ 166	N 40° 00′ 054
	6	08.10.2015	0 - 3	2.2 - 2.3	E 20° 48′ 210	N 41° 00′ 120
	7		0 - 3	1.1 - 3.0	E 20° 48′ 273	N 41° 00′ 247
	8		0 - 3	1.1 - 1.5	E 20° 48′ 264	N 41° 00′ 260
	9		0 - 3	2.6 - 2.6	E 20° 48′ 258	N 41° 00′ 310
	10		0 - 3	1.8 - 2.5	E 20 ° 48′ 263	N 41° 00′ 353
	11	10.10.2015	0 - 3	1.9 - 4.5	E 20 ° 47′ 970	N 40° 59′ 461
	12		0 - 3	1.5 - 3.5	E 20 ° 47′ 950	N 40° 59′ 252
	13		0 - 3	1.8 - 2.5	E 20 ° 48′ 263	N 41° 00′ 353
	14	12.10.2015	0 - 3	1.3 - 5.1	E 20 ° 47′ 810	N 40° 59′ 692
	15		0 - 3	1.5 - 4.0	E 20 ° 47′ 771	N 41° 59′ 788
	16		0 - 3	1.2 - 3.6	E 20 ° 48′ 263	N 41° 00′ 353
	17	06.10.2015	3 - 6	5.0 - 5.0	E 20° 47′ 966	N 40° 59′ 963
	18		3 - 6	5.3 - 4.5	E 20° 48′ 114	N 41° 00′ 076
	19	08.10.2015	3 - 6	3.0 - 9.0	E 20° 48′ 203	N 41° 00′ 150
	20		3 - 6	4.1 - 5.0	E 20° 48′ 239	N 41° 00′ 201
	21		3 - 6	3.6 - 5.0	E 20° 48′ 235	N 41° 00′ 362
	22	10.10.2015	3 - 6	3.0 - 7.0	E 20° 47′ 968	N 40° 59′ 414
	23		3 - 6	3.2 - 12.8	E 20° 47′ 959	N 40° 59′ 386
	24		3 - 6	3.1 - 5.0	E 20° 47′ 970	N 40° 59′ 339
	25		3 - 6	2.9 - 8.0	E 20° 47′ 957	N 40° 59′ 306
	26		3 - 6	3.1 - 11.0	E 20° 47′ 911	N 40° 59′ 194
	27	12.10.2015	3 - 6	4.5 - 4.8	E 20° 47′ 765	N 40° 59′ 737
	28		3 - 6	4.8 - 5.3	E 20° 47′ 765	N 40° 59′ 753
	29		3 - 6	5.1 - 7.0	E 20° 47′ 785	N 40° 59′ 808
	30		3 - 6	5.4 - 6.0	E 20° 47′ 794	N 40° 59′ 829
	31		3 - 6	3.8 - 5.2	E 20° 47′ 804	N 40° 59′ 849
	32		3 - 6	4.5 - 9.0	E 20° 47′ 861	N 40° 59′ 911
	33	06.10.2015	6 - 12	6.0 - 15.0	E 20° 47′ 875	N 40° 59′ 965
	34		6 - 12	10.1 - 6.0	E 20° 47′ 916	N 40° 59′ 979
	35		6 - 12	6.0 - 19.0	E 20° 48′ 050	N 41° 00′ 046
	36	08.10.2015	6 - 12	6.0 - 20.0	E 20° 48′ 174	N 41° 00′ 195
	37		6 - 12	6.2 - 13.1	E 20° 48′ 165	N 41° 00′ 404
	38	10.10.2015	6 - 12	6.0 - 20.0	E 20° 47′ 930	N 40° 59′ 452
	39		6 - 12	6.0 - 24.0	E 20° 47′ 881	N 40° 59′ 209
	40	12.10.2015	6 - 12	6.1 - 12.0	E 20° 47′ 789	N 40° 59′ 698
SB 2 ANDON DUKOV	41	17.10.2015	0 - 3	1.9 - 1.9	E 20° 46′ 354	N 41° 07′ 262
	42		0 - 3	1.8 - 2.0	E 20° 46′ 321	N 41° 07′ 272
	43		0 - 3	1.4 - 1.9	E 20° 46′ 084	N 41° 07′ 611
	44		0 - 3	2.9 - 1.3	E 20° 46′ 321	N 41° 07′ 476
	45	18.10.2015	0 - 3	1.9 - 1.8	E 20° 46′ 073	N 41° 07′ 679
	46		0 - 3	1.6 - 2.4	E 20° 46′ 034	N 41° 07′ 702
	47		0 - 3	1.4 - 1.8	E 20° 45′ 529	N 41° 07′ 624
	48		0 - 3	3.0 - 2.7	E 20° 45′ 825	N 41° 07′ 806

SB 2 ANDON DUKOV (contd.)	49	19.10.2015	0 - 3	1.0 - 1.5	E 20° 45′ 596	N 41° 08′ 016
	50		0 - 3	1.4 - 2.6	E 20° 45′ 542	N 41° 08′ 027
	51		0 - 3	1.3 - 1.6	E 20° 45′ 438	N 41° 08′ 154
	52		0 - 3	1.3 - 1.8	E 20° 45′ 392	N 41° 08′ 190
	53	20.10.2015	0 - 3	1.5 - 1.6	E 20° 45′ 290	N 41° 08′ 277
	54		0 - 3	1.6 - 2.8	E 20° 45′ 260	N 41° 08′ 321
	55		0 - 3	2.9 - 2.0	E 20° 45′ 215	N 41° 08′ 464
	56		0 - 3	1.4 - 2.3	E 20° 45′ 213	N 41° 08′ 504
	57	17.10.2015	3 - 6	3.4 - 4.8	E 20° 46′ 256	N 41° 07′ 257
	58		3 - 6	5.3 - 7.4	E 20° 46′ 142	N 41° 07′ 386
	59		3 - 6	5.4 - 3.3	E 20° 46′ 111	N 41° 07′ 460
	60		3 - 6	3.5 - 4.8	E 20° 46′ 109	N 41° 07′ 500
	61	18.10.2015	3 - 6	5.3 - 3.2	E 20° 45′ 630	N 41° 07′ 691
	62		3 - 6	3.2 - 4.1	E 20° 45′ 888	N 41° 07′ 733
	63		3 - 6	3.0 - 6.0	E 20° 45′ 670	N 41° 07′ 845
	64		3 - 6	5.9 - 3.3	E 20° 45′ 595	N 41° 07′ 912
	65	19.10.2015	3 - 6	6.0 - 3.4	E 20° 45′ 530	N 41° 07′ 982
	66		3 - 6	3.6 - 6.6	E 20° 45′ 466	N 41° 08′ 039
	67		3 - 6	5.4 - 3.0	E 20° 45′ 404	N 41° 08′ 124
	68		3 - 6	4.3 - 5.9	E 20° 45′ 330	N 41° 08′ 188
	69	20.10.2015	3 - 6	5.2 - 2.9	E 20° 45′ 298	N 41° 08′ 232
	70		3 - 6	3.6 - 5.6	E 20° 45′ 230	N 41° 08′ 536
	71		3 - 6	3.8 - 4.7	E 20° 45′ 165	N 41° 08′ 476
	72		3 - 6	4.6 - 4.8	E 20° 45′ 117	N 41° 08′ 544
	73	17.10.2015	6 - 12	7.7 - 8.4	E 20° 46′ 102	N 41° 07′ 418
	74		6 - 12	6.1 - 7.4	E 20° 46′ 014	N 41° 07′ 526
	75	18.10.2015	6 - 12	7.1 - 9.2	E 20° 45′ 612	N 41° 07′ 845
	76		6 - 12	7.1 - 9.3	E 20° 46′ 845	N 41° 07′ 649
	77	19.10.2015	6 - 12	7.0 - 12.0	E 20° 45′ 510	N 41° 07′ 932
	78		6 - 12	6.5 - 12.0	E 20° 45′ 340	N 41° 08′ 047
	79	20.10.2015	6 - 12	6.1 - 7.2	E 20° 45′ 155	N 41° 08′ 360
	80		6 - 12	6.1 - 6.8	E 20° 44′ 935	N 41° 08′ 557
SB 3 RADOZDA	81	28.10.2015	0 - 3	2.7 - 2.7	E 20° 38′ 043	N 41° 05′ 328
	82		0 - 3	2.2 - 2.4	E 20° 38′ 040	N 41° 05′ 439
	83		0 - 3	1.8 - 2.1	E 20° 38′ 052	N 41° 05′ 475
	84		0 - 3	2.9 - 3.0	E 20° 38′ 070	N 41° 05′ 563
	85	29.10.2015	0 - 3	1.8 - 2.2	E 20° 38′ 115	N 41° 05′ 707
	86		0 - 3	2.8 - 2.3	E 20° 38′ 239	N 41° 05′ 930
	87		0 - 3	1.8 - 2.9	E 20° 38′ 143	N 41° 06′ 082
	88		0 - 3	1.6 - 2.8	E 20° 38′ 134	N 41° 06′ 539
	89	02.11.2015	0 - 3	1.7 - 2.9	E 20° 38′ 218	N 41° 06′ 771
	90		0 - 3	3.0 - 2.1	E 20° 38′ 287	N 41° 06′ 896
	91		0 - 3	2.0 - 1.7	E 20° 38′ 369	N 41° 07′ 112
	92		0 - 3	1.9 - 2.4	E 20° 38′ 432	N 41° 07′ 234
	93	03.11.2015	0 - 3	2.8 - 2.3	E 20° 38′ 484	N 41° 07′ 807
	94		0 - 3	2.7 - 2.6	E 20° 38′ 497	N 41° 07′ 890
	95		0 - 3	2.0 - 2.3	E 20° 38′ 654	N 41° 08′ 040
	96		0 - 3	2.3 - 1.8	E 20° 38′ 775	N 41° 08′ 141
	97	28.10.2015	3 - 6	3.1 - 3.5	E 20° 38′ 020	N 41° 05′ 241
	98		3 - 6	4.0 - 4.7	E 20° 38′ 072	N 41° 05′ 279

SB 3 RADOZDA (contd.)	99		3 - 6	5.4 - 5.3	E 20° 38′ 133	N 41° 05′ 403
	100		3 - 6	3.4 - 4.9	E 20° 38′ 095	N 41° 05′ 593
	101	29.10.2015	3 - 6	3.5 - 5.5	E 20° 38′ 197	N 41° 05′ 767
	102		3 - 6	3.2 - 3.5	E 20° 38′ 211	N 41° 06′ 853
	103		3 - 6	5.3 - 4.8	E 20° 38′ 160	N 41° 06′ 490
	104		3 - 6	3.2 - 4.5	E 20° 38′ 150	N 41° 06′ 582
	105	02.11.2015	3 - 6	3.7 - 4.1	E 20° 38′ 432	N 41° 07′ 234
	106		3 - 6	5.8 - 4.9	E 20° 38′ 464	N 41° 07′ 004
	107		3 - 6	3.2 - 3.5	E 20° 38′ 424	N 41° 07′ 152
	108		3 - 6	3.5 - 5.3	E 20° 38′ 487	N 41° 07′ 174
	109	03.11.2015	3 - 6	3.0 - 3.3	E 20° 38′ 490	N 41° 07′ 714
	110		3 - 6	4.5 - 3.9	E 20° 38′ 713	N 41° 07′ 990
	111		3 - 6	3.5 - 4.0	E 20° 38′ 701	N 41° 08′ 033
	112		3 - 6	4.0 - 4.8	E 20° 38′ 815	N 41° 08′ 158
	113	28.10.2015	6 - 12	12.0 - 5.8	E 20° 38′ 181	N 41° 05′ 387
	114		6 - 12	6.0 - 26.0	E 20° 38′ 190	N 41° 05′ 610
	115	29.10.2015	6 - 12	12.0 - 5.5	E 20° 38′ 161	N 41° 06′ 175
	116		6 - 12	6.0 - 10.2	E 20° 38′ 302	N 41° 06′ 637
	117	02.11.2015	6 - 12	6.1 - 7.8	E 20° 38′ 460	N 41° 06′ 917
	118		6 - 12	7.0 - 13.0	E 20° 38′ 604	N 41° 07′ 274
	119	03.11.2015	6 - 12	6.1 - 6.5	E 20° 38′ 885	N 41° 07′ 858
	120		6 - 12	6.3 - 6.9	E 20° 39′ 075	N 41° 08′ 137
PELAGIC SITE (all nets set in cascade, surface to bottom)	1	07.10.2015	0.0 - 6.0	0.0 - 6.0	E 20° 45′ 280	N 41° 00′ 694
	2		6.0 - 12.0	6.0 - 12.0	E 20° 45′ 280	N 41° 00′ 694
	3		12.0 - 18.0	12.0 - 18.0	E 20° 45′ 280	N 41° 00′ 694
	4		18.0 - 24.0	18.0 - 24.0	E 20° 45′ 280	N 41° 00′ 694
	5		24.0 - 30.0	24.0 - 30.0	E 20° 45′ 280	N 41° 00′ 694
	6		30.0 - 36.0	30.0 - 36.0	E 20° 45′ 280	N 41° 00′ 694
	7		36.0 - 42.0	36.0 - 42.0	E 20° 45′ 280	N 41° 00′ 694
	8		42.0 - 48.0	42.0 - 48.0	E 20° 45′ 280	N 41° 00′ 694
	9	09.10.2015	48.0 - 54.0	48.0 - 54.0	E 20° 45′ 280	N 41° 00′ 694
	10		54.0 - 60.0	54.0 - 60.0	E 20° 45′ 280	N 41° 00′ 694
	11		60.0 - 66.0	60.0 - 66.0	E 20° 45′ 280	N 41° 00′ 694
	12		66.0 - 72.0	66.0 - 72.0	E 20° 45′ 280	N 41° 00′ 694
	13		72.0 - 78.0	72.0 - 78.0	E 20° 45′ 280	N 41° 00′ 694
	14		78.0 - 84.0	78.0 - 84.0	E 20° 45′ 280	N 41° 00′ 694
	15		84.0 - 90.0	84.0 - 90.0	E 20° 45′ 280	N 41° 00′ 694
	16		90.0 - 96.0	90.0 - 96.0	E 20° 45′ 280	N 41° 00′ 694
	17	11.10.2015	96.0 - 102.0	96.0 - 102.0	E 20° 45′ 280	N 41° 00′ 694
	18		102.0 - 108.0	102.0 - 108.0	E 20° 45′ 280	N 41° 00′ 694
	19		108.0 - 114.0	108.0 - 114.0	E 20° 45′ 280	N 41° 00′ 694
	20		114.0 - 120.0	114.0 - 120.0	E 20° 45′ 280	N 41° 00′ 694
	21		120.0 - 126.0	120.0 - 126.0	E 20° 45′ 280	N 41° 00′ 694
	22		126.0 - 132.0	126.0 - 132.0	E 20° 45′ 280	N 41° 00′ 694
	23		132.0 - 138.0	132.0 - 138.0	E 20° 45′ 280	N 41° 00′ 694
	24		138.0 - 144.0	138.0 - 144.0	E 20° 45′ 280	N 41° 00′ 694
	25	13.10.2015	144.0 - 150.0	144.0 - 150.0	E 20° 45′ 280	N 41° 00′ 694
	26		150.0 - 156.0	150.0 - 156.0	E 20° 45′ 280	N 41° 00′ 694
	27		156.0 - 162.0	156.0 - 162.0	E 20° 45′ 280	N 41° 00′ 694
	28		162.0 - 168.0	162.0 - 168.0	E 20° 45′ 280	N 41° 00′ 694

PELAGIC SITE (contd.)	29		168.0 - 174.0	168.0 - 174.0	E 20° 45´ 280	N 41° 00´ 694
	30		174.0 - 180.0	174.0 - 180.0	E 20° 45´ 280	N 41° 00´ 694
	31		180.0 - 186.0	180.0 - 186.0	E 20° 45´ 280	N 41° 00´ 694
	32		186.0 - 192.0	186.0 - 192.0	E 20° 45´ 280	N 41° 00´ 694
	33	14.10.2015	192.0 - 198.0	192.0 - 198.0	E 20° 45´ 280	N 41° 00´ 694
	34		198.0 - 204.0	198.0 - 204.0	E 20° 45´ 280	N 41° 00´ 694
	35		204.0 - 210.0	204.0 - 210.0	E 20° 45´ 280	N 41° 00´ 694
	36		210.0 - 216.0	210.0 - 216.0	E 20° 45´ 280	N 41° 00´ 694
	37		216.0 - 222.0	216.0 - 222.0	E 20° 45´ 280	N 41° 00´ 694
	38		222.0 - 228.0	222.0 - 228.0	E 20° 45´ 280	N 41° 00´ 694
	39		228.0 - 234.0	228.0 - 234.0	E 20° 45´ 280	N 41° 00´ 694
	40		234.0 - 240.0	234.0 - 240.0	E 20° 45´ 280	N 41° 00´ 694
	41	15.10.2015	240.0 - 246.0	240.0 - 246.0	E 20° 45´ 280	N 41° 00´ 694
	42		246.0 - 252.0	246.0 - 252.0	E 20° 45´ 280	N 41° 00´ 694
	43		252.0 - 258.0	252.0 - 258.0	E 20° 45´ 280	N 41° 00´ 694
	44		258.0 - 264.0	258.0 - 264.0	E 20° 45´ 280	N 41° 00´ 694
	45		264.0 - 270.0	264.0 - 270.0	E 20° 45´ 280	N 41° 00´ 694
	46		270.0 - 276.0	270.0 - 276.0	E 20° 45´ 280	N 41° 00´ 694
	47		276.0 - 282.0	276.0 - 282.0	E 20° 45´ 280	N 41° 00´ 694
	48		282.0 - 288.0	282.0 - 288.0	E 20° 45´ 280	N 41° 00´ 694
	49	16.10.2015	288.0 - 294.0	288.0 - 294.0	E 20° 45´ 280	N 41° 00´ 694
	50		294.0 - bottom	294.0 - bottom	E 20° 45´ 280	N 41° 00´ 694

Table 13. Sampling points (sub-basins) at Albanian part of Lake Ohrid in 2013

Sub-basin	Net No.	Stratum (m)	Longitude	Latitude
SB 5 LIN	1	0 - 3	E 20° 38′ 450	N 41° 03′ 020
	2	0 - 3	E 20° 38′ 465	N 41° 03′ 030
	3	3 - 6	E 20° 38′ 463	N 41° 03′ 035
	4	3 - 6	E 20° 38′ 475	N 41° 03′ 031
	5	>35	E 20° 38′ 473	N 41° 03′ 039
	6	>35	E 20° 38′ 484	N 41° 03′ 043
	7	20 - 35	E 20° 38′ 456	N 41° 03′ 022
	8	12 - 20	E 20° 38′ 471	N 41° 03′ 028
	9	6 - 12	E 20° 38′ 454	N 41° 03′ 024
	10	3 - 6	E 20° 38′ 480	N 41° 03′ 029
	11	0 - 3	E 20° 38′ 467	N 41° 03′ 021
	12	0 - 3	E 20° 38′ 469	N 41° 03′ 016
	13	0 - 3	E 20° 38′ 452	N 41° 03′ 012
	14	0 - 3	E 20° 38′ 455	N 41° 03′ 018
	15	6 -12	E 20° 38′ 482	N 41° 03′ 010
	16	6 -12	E 20° 38′ 451	N 41° 03′ 008
	17	6 - 12	E 20° 38′ 568	N 41° 03′ 014
	18	20 - 35	E 20° 38′ 561	N 41° 03′ 030
	19	>35	E 20° 38′ 472	N 41° 03′ 043
	20	>35	E 20° 38′ 485	N 41° 03′ 065
	21	>35	E 20° 38′ 445	N 41° 03′ 045
	22	12 - 20	E 20° 38′ 314	N 41° 03′ 038
	23	12 - 20	E 20° 38′ 324	N 41° 03′ 036
	24	12 - 20	E 20° 38′ 495	N 41° 03′ 032
SB 6 HUDËNISHT	1	0 - 3	E 20° 38′ 152	N 40° 59′ 501
	2	0 - 3	E 20° 38′ 154	N 40° 59′ 503
	3	0 - 3	E 20° 38′ 158	N 40° 59′ 504
	4	0 - 3	E 20° 38′ 163	N 40° 59′ 505
	5	3 - 6	E 20° 38′ 165	N 40° 59′ 507
	6	6 - 12	E 20° 38′ 166	N 40° 59′ 511
	7	6 - 12	E 20° 38′ 171	N 40° 59′ 515
	8	6 - 12	E 20° 38′ 172	N 40° 59′ 512
	9	6 - 12	E 20° 38′ 173	N 40° 59′ 506
	10	12 - 20	E 20° 38′ 175	N 40° 59′ 513
	11	12 - 20	E 20° 38′ 177	N 40° 59′ 508
	12	12 - 20	E 20° 38′ 178	N 40° 59′ 516
	13	12 - 20	E 20° 38′ 179	N 40° 59′ 512
	14	12 - 20	E 20° 38′ 174	N 40° 59′ 518
	15	12 - 20	E 20° 38′ 176	N 40° 59′ 510
	16	12 - 20	E 20° 38′ 181	N 40° 59′ 518
	17	12 - 20	E 20° 38′ 179	N 40° 59′ 516
	18	20 - 35	E 20° 38′ 180	N 40° 59′ 503
	19	20 - 35	E 20° 38′ 181	N 40° 59′ 504
	20	20 - 35	E 20° 38′ 183	N 40° 59′ 506
	21	>35	E 20° 38′ 185	N 40° 59′ 499
	22	>35	E 20° 38′ 187	N 40° 59′ 500
	23	>35	E 20° 38′ 190	N 40° 59′ 501
	24	>35	E 20° 38′ 193	N 40° 59′ 498

SB 7 TUSHEMISHT	1	0 - 3	E 20° 43′ 207	N 40° 54′ 164
	2	0 - 3	E 20° 43′ 204	N 40° 54′ 167
	3	0 - 3	E 20° 43′ 202	N 40° 54′ 170
	4	0 - 3	E 20° 43′ 198	N 40° 54′ 178
	5	3 - 6	E 20° 43′ 195	N 40° 54′ 180
	6	3 - 6	E 20° 43′ 193	N 40° 54′ 183
	7	3 - 6	E 20° 43′ 190	N 40° 54′ 187
	8	6 - 12	E 20° 43′ 185	N 40° 54′ 190
	9	6 - 12	E 20° 43′ 181	N 40° 54′ 193
	10	6 - 12	E 20° 43′ 180	N 40° 54′ 198
	11	12 - 20	E 20° 43′ 177	N 40° 54′ 195
	12	12 - 20	E 20° 43′ 176	N 40° 54′ 202
	13	20 - 35	E 20° 43′ 175	N 40° 54′ 204
	14	20 - 35	E 20° 43′ 174	N 40° 54′ 205
	15	20 - 35	E 20° 43′ 172	N 40° 54′ 203
	16	20 - 35	E 20° 43′ 170	N 40° 54′ 210
	17	20 - 35	E 20° 43′ 173	N 40° 54′ 206
	18	>35	E 20° 43′ 145	N 40° 54′ 211
	19	>35	E 20° 43′ 141	N 40° 54′ 215
	20	>35	E 20° 43′ 137	N 40° 54′ 208
	21	>35	E 20° 43′ 132	N 40° 54′ 214
	22	>35	E 20° 43′ 130	N 40° 54′ 218
	23	>35	E 20° 43′ 128	N 40° 54′ 216
	24	>35	E 20° 43′ 125	N 40° 54′ 210

Table 14. Lake Ohrid sampling dates at Albanian part in 2013

Nr	LIN	Nr	HUDËNISHT	Nr	TUSHEMISHT
1	0-3 m/6.11.2013	25	0-3 m/5.11.2013	49	>35 m/8.11.2013
2	0-3 m/6.11.2013	26	0-3 m/5.11.2013	50	>35 m/8.11.2013
3	3-6 m/6.11.2013	27	6-12 m/5.11.2013	51	>35 m/8.11.2013
4	3-6 m/6.11.2013	28	6-12 m/5.11.2013	52	20-35 m/8.11.2013
5	>35 m/8.11.2013	29	6-12 m/5.11.2013	53	20-35 m/8.11.2013
6	>35 m/8.11.2013	30	6-12 m/5.11.2013	54	20-35 m/8.11.2013
7	20-35 m/8.11.2013	31	12-20 m/5.11.2013	55	6-12 m/8.11.2013
8	12-20 m/8.11.2013	32	12-20 m/5.11.2013	56	0-3 m/8.11.2013
9	6-12 m/8.11.2013	33	20-35 m/5.11.2013	57	0-3 m/9.11.2013
10	3-6 m/8.11.2013	34	20-35 m/5.11.2013	58	0-3 m/9.11.2013
11	0-3 m/8.11.2013	35	>35 m/6.11.2013	59	3-6 m9.11.2013
12	0-3 m/8.11.2013	36	3-6 m/6.11.2013	60	3-6 m/9.11.2013
13	0-3 m/9.11.2013	37	12-20 m/6.11.2013	61	6-12 m/9.11.2013
14	0-3 m/9.11.2013	38	12-20 m/6.11.2013	62	20-35 m/9.11.2013
15	6-12 m/9.11.2013	39	0-3 m/13.11.2013	63	>35 m/9.11.2013
16	6-12 m/9.11.2013	40	0-3 m/13.11.2013	64	>35 m/9.11.2013
17	6-12 m/9.11.2013	41	12-20 m/13.11.2013	65	0-3 m/12.11.2013
18	20-35 m/9.11.2013	42	12-20 m/13.11.2013	66	3-6 m/12.11.2013
19	>35 m/13.11.2013	43	12-20 m/13.11.2013	67	6-12 m/12.11.2013
20	>35 m/13.11.2013	44	12-20 m/13.11.2013	68	12-20 m/12.11.2013
21	>35 m/13.11.2013	45	20-35 m/13.11.2013	69	12-20 m/12.11.2013
22	12-20 m/9.11.2013	46	>35 m/13.11.2013	70	20-35 m/12.11.2013
23	12-20 m/13.11.2013	47	>35 m/13.11.2013	71	>35 m/12.11.2013
24	12-20m/13.11.2013	48	>35 m/13.11.2013	72	>35 m/12.11.2013

Table 15. Additional sampling data at Macedonian part of Lake Ohrid in 2013

Sub-basin	Sampling date	Air temp. (°C)	Water temp. (°C)	Secchi depth (m)	pH	Oxygen ($mg \cdot l^{-1}$)	Conduct.[1] (μS)	Weather, Moon
SB 1 VELI DAB	19.10.2013	9.5	16.7	14.20	8.35	9.4	191.8	clear, calm, full moon
	04.11.2013	13.5	16.1	14.70	8.30	9.7	195.2	clear, calm, no moon
SB2 ANDON DUKOV	08.11.2013	11.5	15.9	16.40	8.75	10.3	220	clear, calm, no moon
	11.11.2013	11.1	15.8	16.00	8.55	10.1	224	strong wind, waves, no moon
SB 3 RADOZDA	05.11.2013	15.6	16.2	9.56	8.32	9.9	192.7	rain, storm; wind 22 m/s, cloudy, no moon
	06.11.2013	19.9	16.1	9.80	8.50	10.3	197	waves, at lifting time calm; cloudy, no moon
SB 4 CENTRAL PLATE	12.11.2013	Due to the storm no possibility for taking measures						storm, strong winds, waves

[1] Conduct: conductivity

Table 16. Additional sampling data at Albanian part of Lake Ohrid in 2013

Sub-basin	Sampling date	Air temp. (°C)	Water temp. (°C)	Secchi depth (m)	pH	Oxygen ($mg \cdot l^{-1}$)	Weather	Moon
SB 5 LIN	06.11.2013	19.5	16.2	16.2	8.4	9.8	waves	No
	08.11.2013	13.5	16.1	15.7	8.50	9.7	calm	No
	09.11.2013	13.0	16.0	16.1	8.65	10.2	calm	No
	13.11.2013	11.0	15.7	15.8	8.55	9.8	waves	No
SB 6 HUDËNISHT	05.11.2013	17.5	16.1	15.8	8.4	9.9	rain	No
	06.11.2013	19.0	16.1	15.7	8.3	9.6	waves	No
	13.11.2013	11.5	15.8	14.3	8.5	10.1	calm	No
SB 7 TUSHEMISHT	08.11.2013	13.0	16.2	11.3	8.4	9.6	calm	No
	09.11.2013	13.0	16.1	11.5	8.5	9.5	calm	No
	12.11.2013	Not measured due to storm					strong waves	cloudy

Table 17. Additional sampling data at Macedonian part of Lake Ohrid in 2015

Sub-basin	Sampling date	Air temp. (°C)	Water temp. (°C)	Secchi depth (m)	pH	Oxygen (mg·l-1)	Conduct.[1] (µS)	Weather, Moon
SB 1 VELI DAB	06.10.2015	16.1	19.1	16.90	8.16	9.8	172	Partly cloudy, calm; last quarter of moon
	08.10.2015	13.3	18.7	17.80	8.20	9.4	183	S[2]: partly cloudy, waves 0.2 m L[3]: sunny, clear, calm; last quarter of moon
	10.10.2015	16.7	19.1	16.50	8.35	9.18	211	S: cloudy, calm, overnight rain L: sunny, calm; last quarter of moon
	12.10.2015	13.5	18.4	16.80	8.32	9.7	232	S: partly cloudy L: sunny, calm; no moon
SB 2 ANDON DUKOV	16.10.2015	13.6	18.1	12.55	8.18	8.6	233	S: cloudy, rain, waves 0.3 m overnight rain L: partly cloudy, calm
	18.10.2015	15.8	17.4	12.10	8.50	8.8	223	S: partly cloudy, wind S, waves 0.2 m; L: sunny, calm; first quarter of moon
	19.10.2015	17.8	18.3	12.50	8.38	9.2	225	S: partly cloudy, wind SW, waves 0.5 m; L: partly cloudy, waves 0.2 m, first quarter of moon
	20.10.2015	16.6	18.0	12.95	8.24	8.3	221	S: cloudy, rain, wind SW/NW, waves, overnight rain; L: cloudy, rain, wind NW, waves 0.3 m
SB 3 RADOZDA	28.10.2015	12.1	16.2	15.6	8.43	8.7	215	S: sunny, calm L: sunny, calm, full moon
	29.10.2015	12.4	16.0	15.50	8.38	8.7	217	S: sunny, waves 0.2 m; L: partly cloudy, wind N, waves 1 m; full moon
	02.10.2015	13.0	15.2	13.63	8.40	8.5	212	S: sunny, calm L: sunny, calm; last quarter of moon
	03.10.2015	12.6	15.2	13.45	8.32	9.2	215	S: sunny, calm L: sunny, calm; last quarter of moon

PELAGIC SITE	05.10.2015	19.7	19.5	17.30	8.25	9.2	222	S: cloudy, wind W, waves 0.5 m
	07.10.2015	19.3	19.5	18.00	8.22	9.3	226	S: cloudy, rain, calm; L: clear, calm
	09.10.2015	20.9	19.3	11.90	8.10	8.9	197	S: cloudy, rain, calm; L: cloudy, rain, waves 0.3 m
	11.10.2015	18.6	19.5	15.60	8.43	9.2	228	S: partly cloudy, calm; L: partly cloudy, calm
	13.10.2015	20.0	19.4	15.05	7.90	9.4	219	S: partly cloudy, calm; L: sunny, clear, calm
	14.10.2015	13.5	18.4	15.20	8.38	9.2	227	S: cloudy, rain, waves 0.3 m; L: partly cloudy
	15.10.2015	14.7	18.0	15.15	8.27	9.1	224	S: cloudy, calm L: partly cloudy
	16.10.2015	13.3	18.0	13.63	8.24	9.1	224	S: cloudy, waves 0.3 m, overnight rain; L: partly cloudy, calm

[1] Conduct: conductivity
[2] Setting time
[3] Net lifting time

Annex II. Details (relative fish species composition, CPUE, length-frequency distributions) of individual sub-basins

SB 1 – Veli Dab

The SB 1 is spawning ground for a lot of cyprinid fishes during spring and summer, and for the salmonids during autumn and winter. Interesting for this sub-basin is the presence of numerous sub-lacustrine springs.

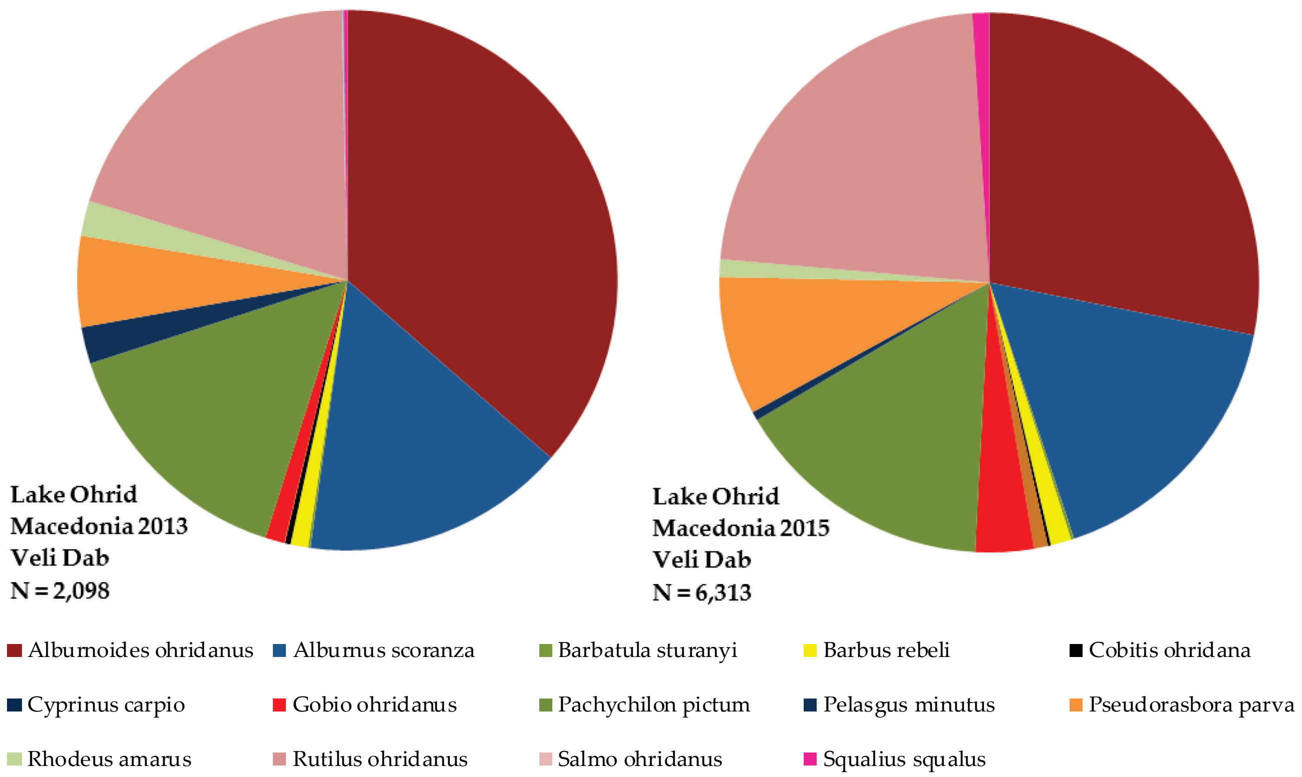
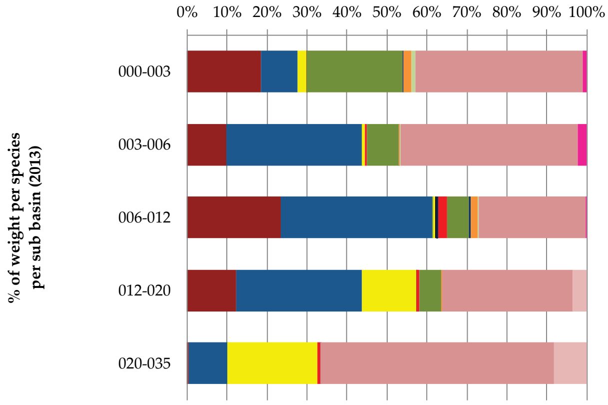


Figure 25. Relative fish species composition in total catch at SB 1 in the sampling campaigns 2013 (left) and 2015 (right)

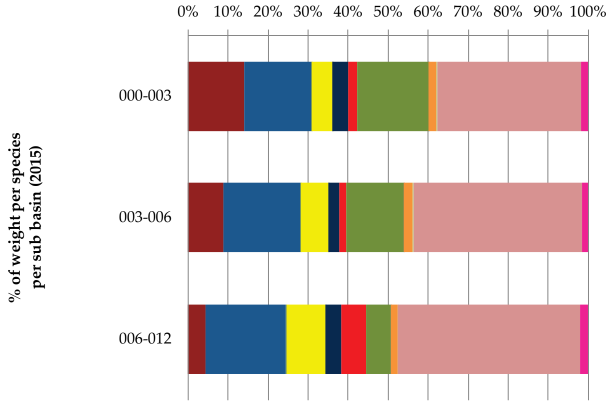
At this sub-basin, a total of 14 fish species were caught. The species composition was very similar in 2013 and 2015. Fishes of non-commercial value (such as spirlin and moranec) dominated in the catches. As well, Ohrid roach and bleak, which are both of relatively low value for fishers, also reached high shares in the samples (Figure 25). Although fishing was performed at rather deep strata, the catch of the commercially valued species was negligible – only two individuals of the endemic Lake Ohrid belvica and one carp were caught.

Regarding CPUE, roach was dominant in 2013 and 2015 in almost all sampled strata (Figure 26), followed by bleak and spirlin. In 2013, fishing took place in five depth strata, whilst in 2015 only three depth strata were sampled. However, the dominance of roach and bleak was evident in both cases.

In terms of fish numbers (NPUE), roach again was very prominent (Figure 27). However, spirlin too was highly abundant and large numbers of individuals/m² were caught in both years. Spirlin was found to occur at this site up to 20 m of depth, in particular.

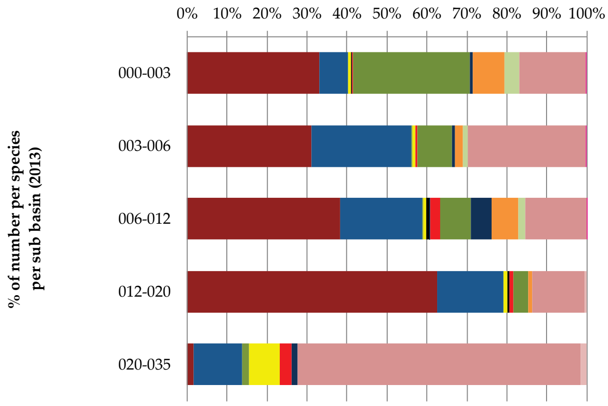


	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus	0.02	1.59	6.24	2.47	11.75
Alburnus scoranza	0.89	4.07	10.17	8.71	5.90
Barbatula sturanyi	0.01		0.02	0.01	
Barbus rebeli	2.07	1.74	0.15	0.15	1.36
Cobitis ohridana		0.01	0.07		0.02
Cyprinus carpio			0.15		
Gobio ohridanus	0.05	0.10	0.60	0.11	0.09
Pachychilon pictum		0.70	1.42	2.05	15.32
Pelasgus minutus	0.00		0.14	0.01	0.11
Pseudorasbora parva		0.02	0.45	0.06	1.38
Rhodeus amarus			0.11	0.08	0.64
Rutilus ohridanus	5.37	4.25	7.12	11.26	26.67
Salmo ohridanus	0.74	0.44			
Squalius squalus			0.09	0.61	0.68

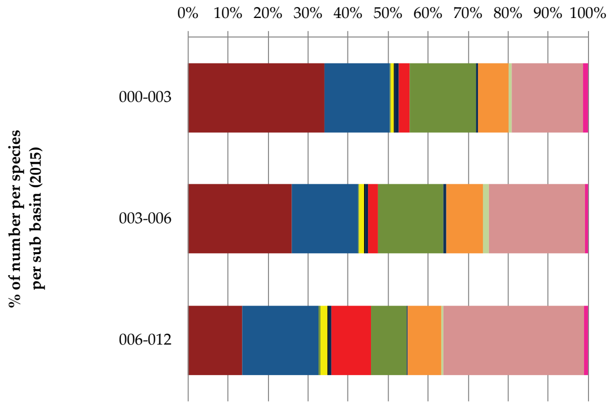


	006-012	003-006	000-003
Alburnoides ohridanus	0.92	2.83	4.58
Alburnus scoranza	4.41	6.11	5.59
Barbatula sturanyi	0.03	0.01	0.01
Barbus rebeli	2.15	2.20	1.66
Cobitis ohridana	0.01	0.03	0.01
Cyprinus carpio	0.86	0.87	1.34
Gobio ohridanus	1.35	0.55	0.72
Pachychilon pictum	1.31	4.59	5.82
Pelasgus minutus	0.01	0.02	0.02
Pseudorasbora parva	0.40	0.68	0.67
Rhodeus amarus	0.01	0.07	0.05
Rutilus ohridanus	9.96	13.44	11.83
Salmo ohridanus			
Squalius squalus	0.42	0.51	0.60

Figure 26. CPUE expressed in biomass (BPUE in g/m² of net) for sub-basin 1 (Veli Dab) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata



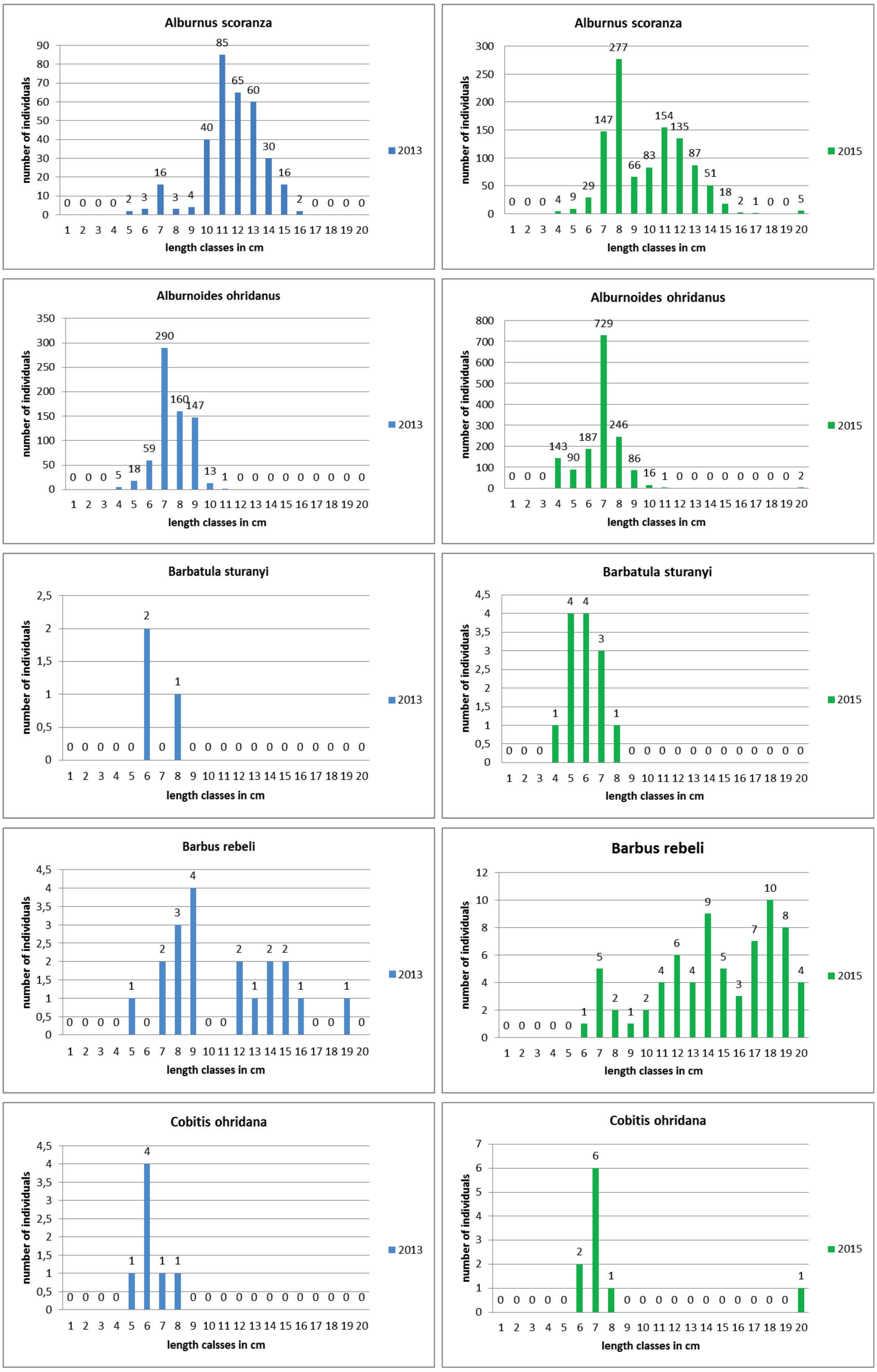
	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus	0.01	0.98	1.42	0.67	2.82
Alburnus scoranza	0.06	0.26	0.76	0.54	0.60
Barbatula sturanyi	0.01		0.01	0.01	
Barbus rebeli	0.04	0.01	0.03	0.02	0.08
Cobitis ohridana		0.01	0.03		0.01
Cyprinus carpio			0.01		
Gobio ohridanus	0.01	0.01	0.09	0.01	0.01
Pachychilon pictum		0.06	0.28	0.19	2.49
Pelasgus minutus	0.01		0.19	0.02	0.08
Pseudorasbora parva		0.01	0.25	0.04	0.67
Rhodeus amarus			0.06	0.03	0.31
Rutilus ohridanus	0.34	0.21	0.57	0.64	1.41
Salmo ohridanus	0.01	0.01			
Squalius squalus			0.01	0.01	0.03



	006-012	003-006	000-003
Alburnoides ohridanus	0.29	0.95	1.37
Alburnus scoranza	0.41	0.61	0.65
Barbatula sturanyi	0.01	0.00	0.01
Barbus rebeli	0.04	0.05	0.04
Cobitis ohridana	0.01	0.01	0.00
Cyprinus carpio	0.02	0.02	0.04
Gobio ohridanus	0.21	0.09	0.11
Pachychilon pictum	0.19	0.61	0.67
Pelasgus minutus	0.01	0.03	0.02
Pseudorasbora parva	0.18	0.33	0.31
Rhodeus amarus	0.01	0.06	0.03
Rutilus ohridanus	0.76	0.88	0.72
Salmo ohridanus			
Squalius squalus	0.02	0.03	0.05

Figure 27. CPUE expressed in number of individuals/m² (NPUE, ind./m² of net) for sub-basin 1 (Veli Dab) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata

Length-frequency distributions of the fish species caught during the survey at the SB 1 are shown in Figure 28 (a-n).



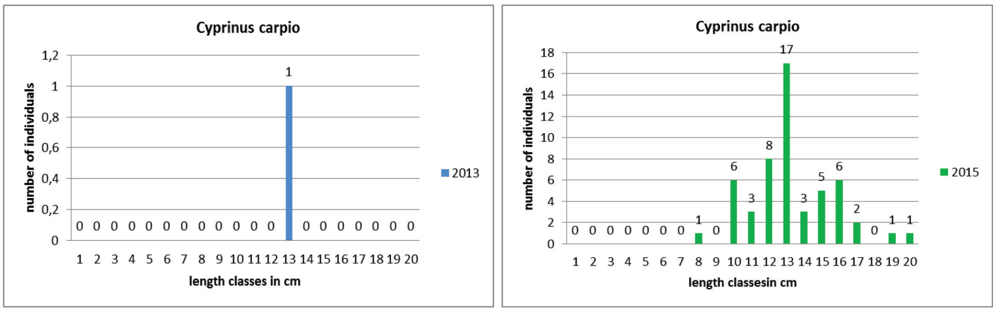
a)

b)

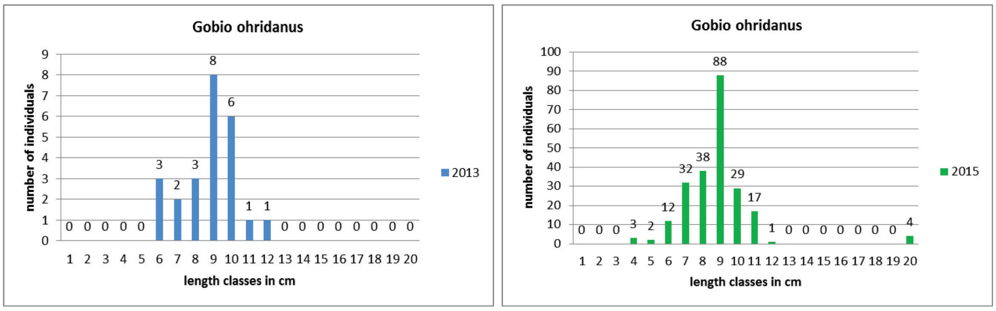
c)

d)

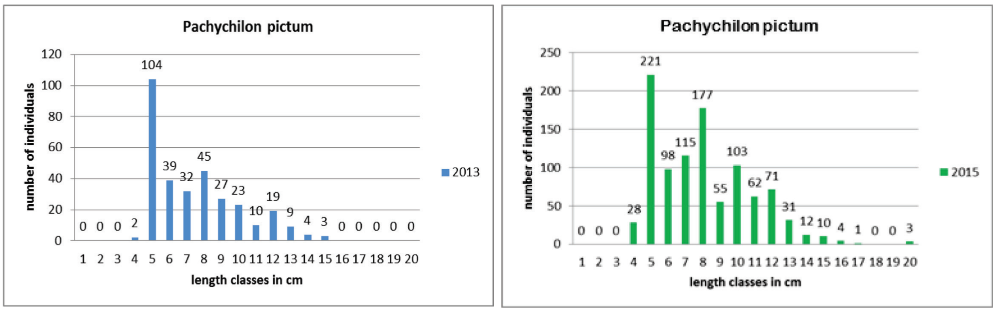
e)


Cyprinus carpio
number of individuals
length classes in cm
2013
Cyprinus carpio
number of individuals
length classesin cm
2015

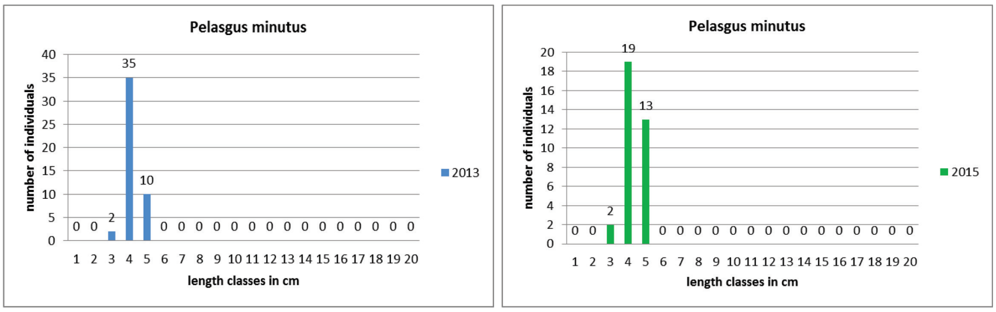
f)


Gobio ohridanus
number of individuals
length classes in cm
2013
Gobio ohridanus
number of individuals
length classes in cm
2015

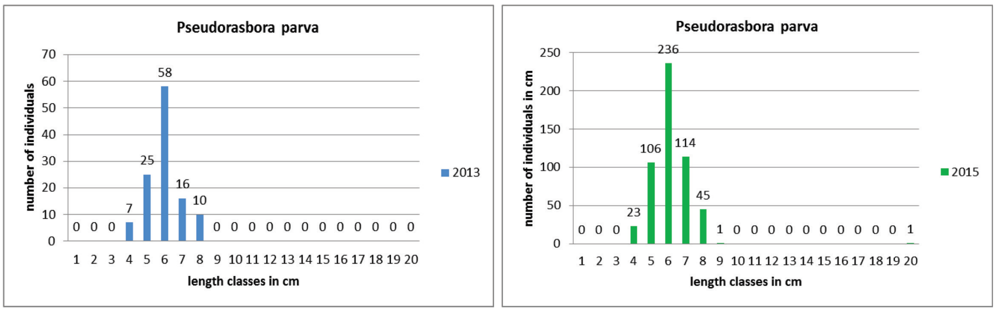
g)


Pachychilon pictum
number of individuals
length classes in cm
2013
Pachychilon pictum
number of individuals
length classes in cm
2015

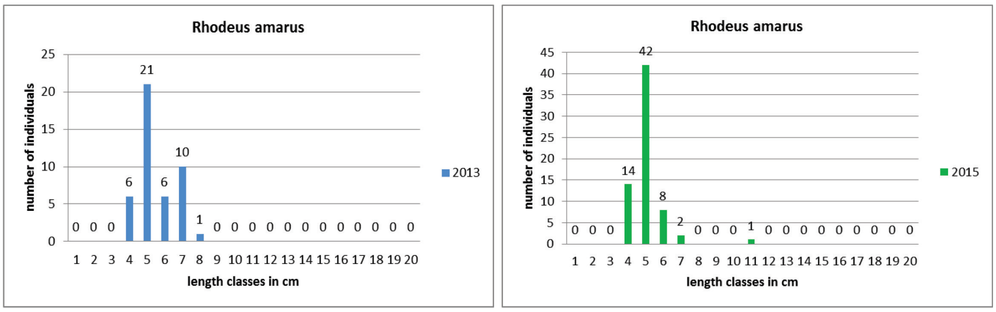
h)


Pelasgus minutus
number of individuals
length classes in cm
2013
Pelasgus minutus
number of individuals
length classes in cm
2015

i)


Pseudorasbora parva
number of individuals
length classes in cm
2013
Pseudorasbora parva
number of individuals in cm
length classes in cm
2015

j)


Rhodeus amarus
number of individuals
length classes in cm
2013
Rhodeus amarus
number of individuals
length classes in cm
2015

k)

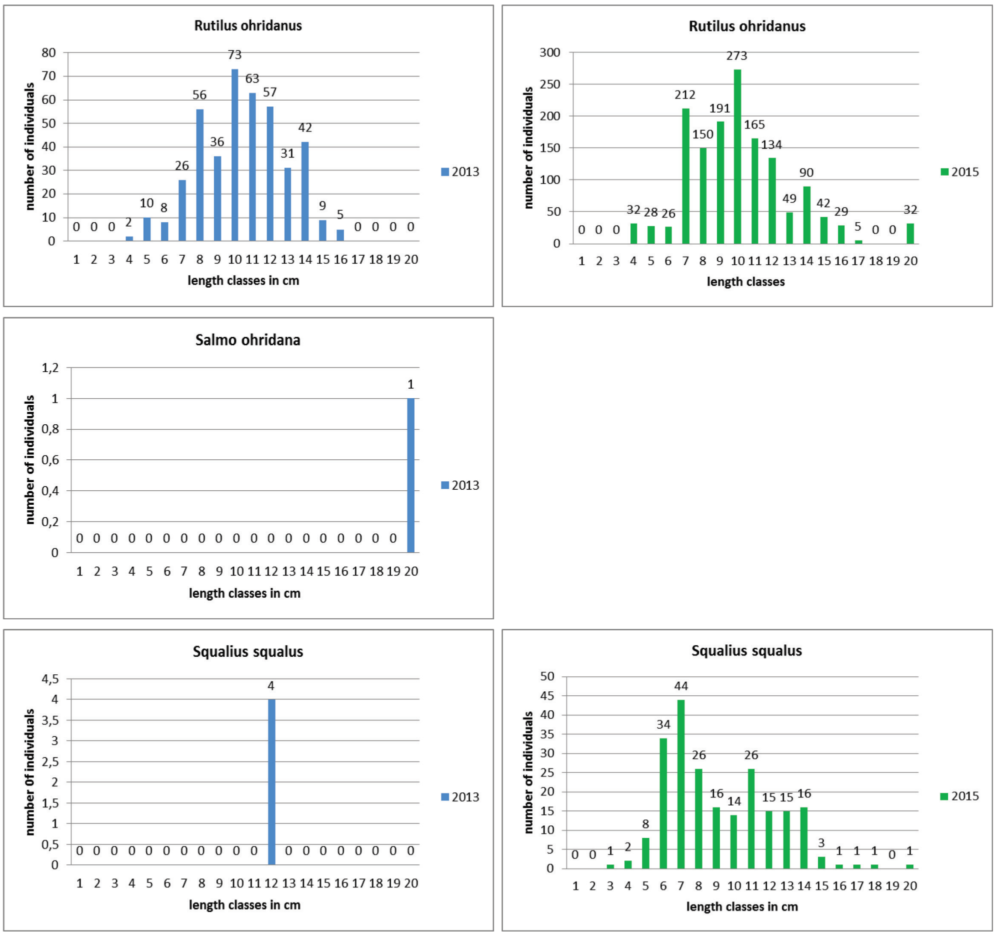


Figure 28. Length-frequency distributions of fish species caught during the survey at SB 1 in 2013 (left) and 2015 (right)

As can be seen from the above graphs, the native minnow was present in all its size classes. Furthermore, it seems that barbel is improving at this location. Stone moroko and bitterling had never been found here before.

SB 2 – Andon Dukov

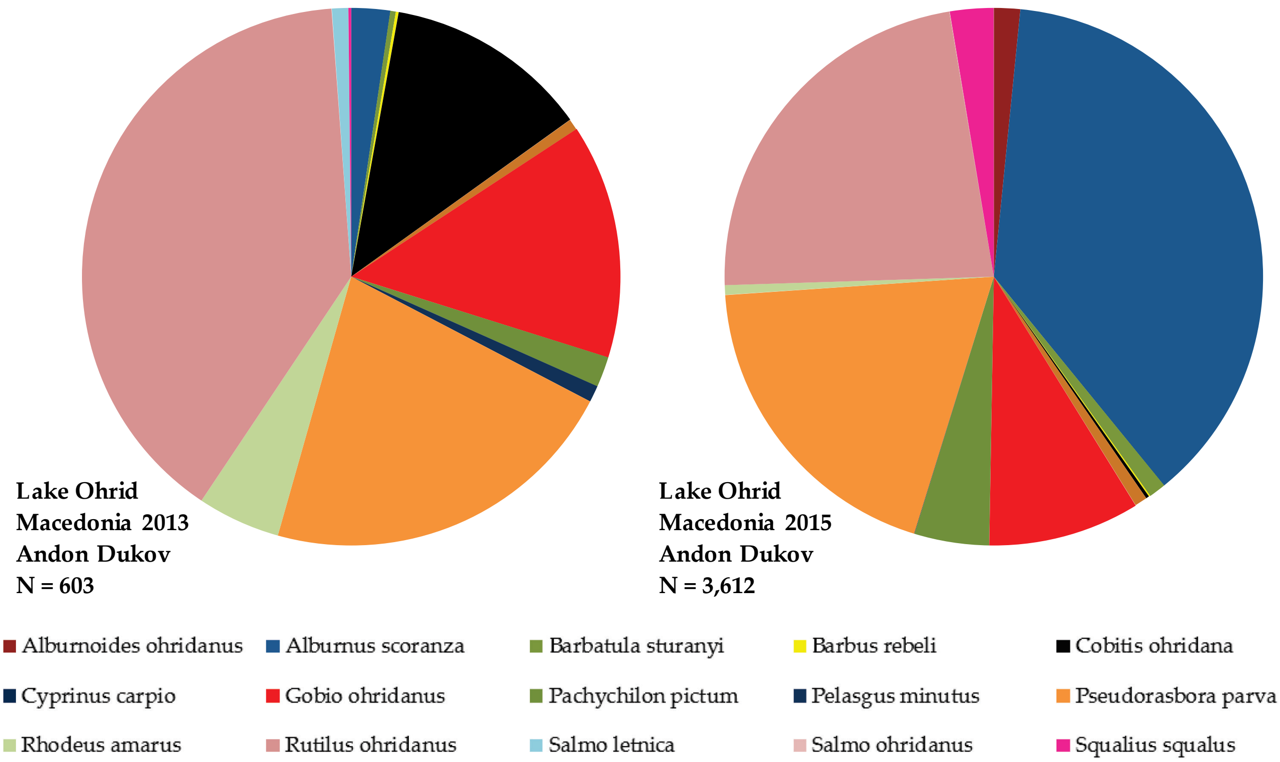
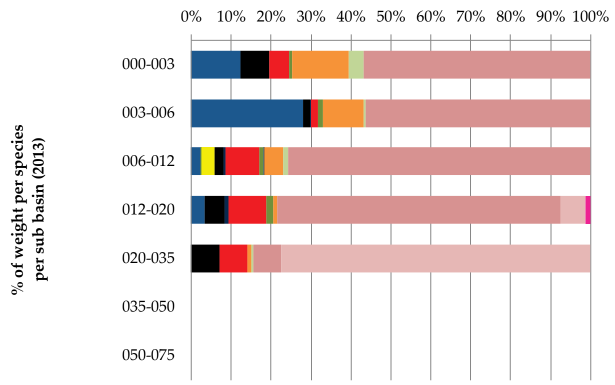


Figure 29. Relative fish species composition in total catch at SB 2 in the sampling campaigns 2013 (left) and 2015 (right)

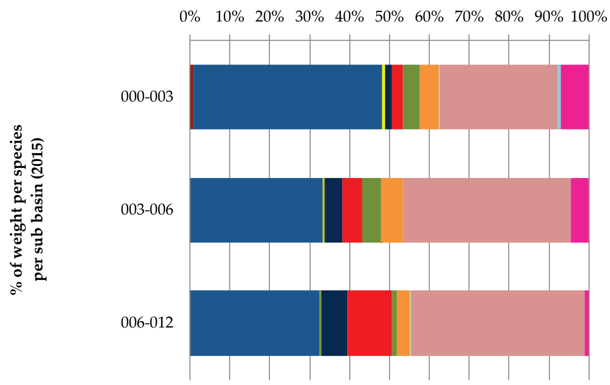
At sub-basin 2, a large part of the catch was made of the two alien species stone moroko and bitterling (Figure 29). The relative share of bleak (*A. scoranza*) increased distinctly from 2013 to 2015. Overall, a total of 15 species were collected at this site.

In view of standardized biomass, roach contributed to a large extent to the annual BPUE in any one year (Figure 30). Moreover, in 2013 six individuals of Ohrid belvica were caught (especially at a depth of ≥ 20 m) resulting in a noteworthy share of the biomass in the first sampling year. On the contrary, biomass of bleak became a significant part of the 2015 catch only.

In terms of numbers of individuals/m² of net (NPUE), a slightly different pattern emerged. The spined loach as well as the alien stone moroko occurred in significant numbers in 2013, in particular. Ohrid gudgeon was also found in high abundance (Figure 31). No fish were caught at a depth > 35 m.

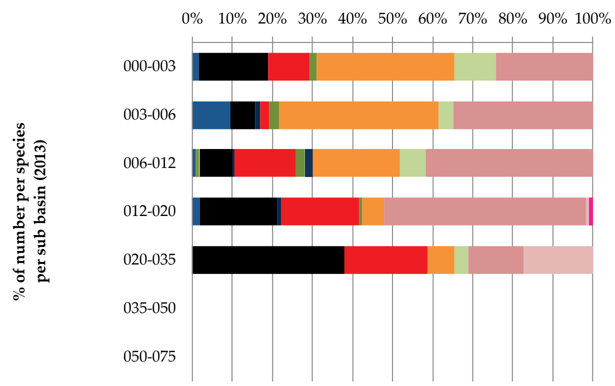


	050-075	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus							
Alburnus scoranza				0.17	0.29	1.11	0.30
Barbatula sturanyi					0.03		
Barbus rebeli					0.39		
Cobitis ohridana			0.25	0.25	0.27	0.08	0.17
Cyprinus carpio				0.05	0.03	0.01	
Gobio ohridanus			0.26	0.48	1.03	0.07	0.12
Pachychilon pictum				0.10	0.12	0.05	0.02
Pelasgus minutus					0.03		
Pseudorasbora parva			0.03	0.04	0.57	0.40	0.34
Rhodeus amarus			0.02		0.15	0.02	0.09
Rutilus ohridanus			0.25	3.57	8.99	2.24	1.37
Salmo letnica							
Salmo ohridanus			2.79	0.32			
Squalius squalus				0.06			

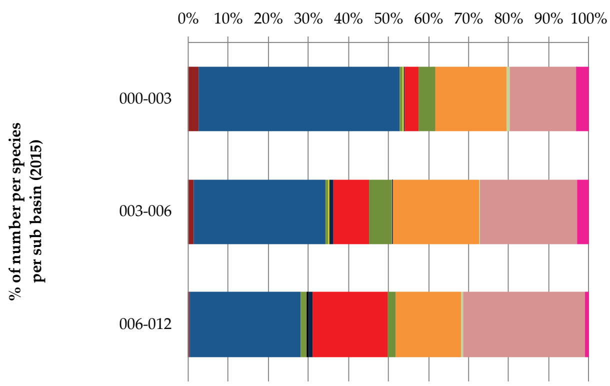


	006-012	003-006	000-003
Alburnoides ohridanus	0.02	0.03	0.08
Alburnus scoranza	4.18	4.56	4.49
Barbatula sturanyi	0.06	0.03	0.01
Barbus rebeli		0.04	0.06
Cobitis ohridana	0.01	0.01	
Cyprinus carpio	0.82	0.59	0.18
Gobio ohridanus	1.47	0.69	0.25
Pachychilon pictum	0.14	0.65	0.41
Pelasgus minutus		0.00	
Pseudorasbora parva	0.44	0.77	0.46
Rhodeus amarus	0.02	0.01	0.02
Rutilus ohridanus	5.64	5.78	2.80
Salmo letnica			0.09
Salmo ohridanus			
Squalius squalus	0.14	0.63	0.66

Figure 30. CPUE expressed in biomass (BPUE in g/m² of net) for sub-basin 2 (Andon Dukov) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata



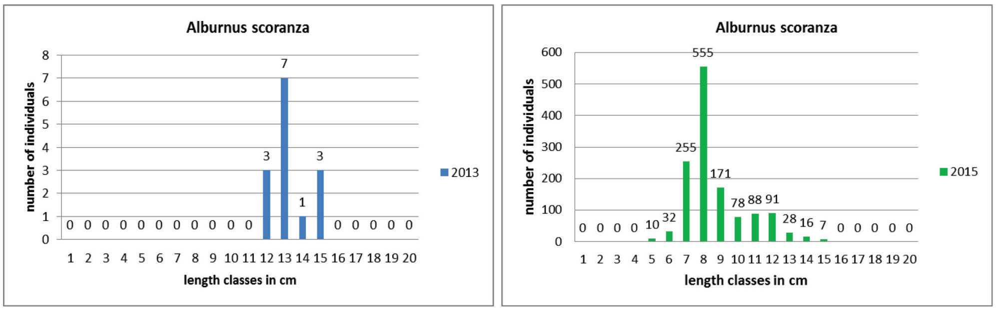
	050-075	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus							
Alburnus scoranza				0.01	0.02	0.06	0.01
Barbatula sturanyi					0.01		
Barbus rebeli					0.01		
Cobitis ohridana			0.08	0.12	0.14	0.04	0.11
Cyprinus carpio				0.01	0.01	0.01	
Gobio ohridanus			0.04	0.12	0.27	0.01	0.07
Pachychilon pictum				0.01	0.04	0.01	0.01
Pelasgus minutus					0.03		
Pseudorasbora parva			0.01	0.03	0.39	0.24	0.22
Rhodeus amarus			0.01		0.11	0.02	0.07
Rutilus ohridanus			0.03	0.32	0.74	0.21	0.16
Salmo letnica							
Salmo ohridanus			0.04	0.01			
Squalius squalus				0.01			



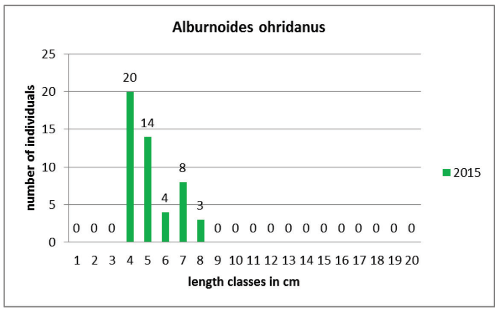
	006-012	003-006	000-003
Alburnoides ohridanus	0.01	0.03	0.05
Alburnus scoranza	0.58	0.75	0.84
Barbatula sturanyi	0.03	0.02	0.01
Barbus rebeli		0.00	0.00
Cobitis ohridana	0.01	0.01	
Cyprinus carpio	0.03	0.02	0.01
Gobio ohridanus	0.39	0.20	0.06
Pachychilon pictum	0.04	0.13	0.07
Pelasgus minutus		0.00	
Pseudorasbora parva	0.34	0.49	0.30
Rhodeus amarus	0.01	0.01	0.02
Rutilus ohridanus	0.64	0.55	0.28
Salmo letnica			0.00
Salmo ohridanus			
Squalius squalus	0.02	0.07	0.05

Figure 31. CPUE expressed in number of individuals/m² (NPUE, ind./m² of net) for sub-basin 2 (Andon Dukov) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata

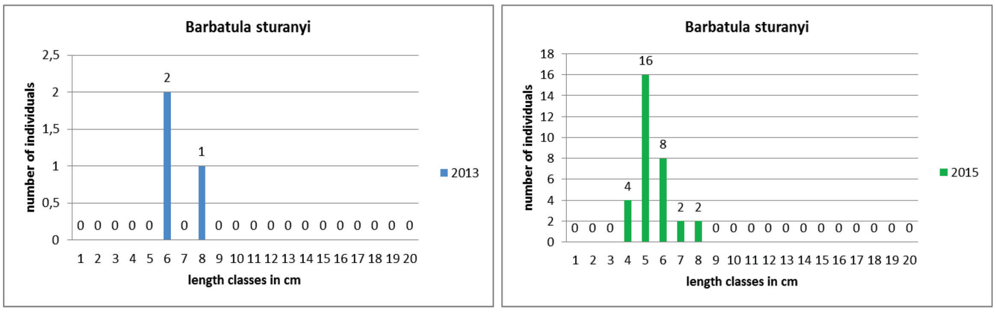
Length-frequency distributions of the fish species caught during the survey at the SB 2 are presented in the following Figure 32 (a-o).



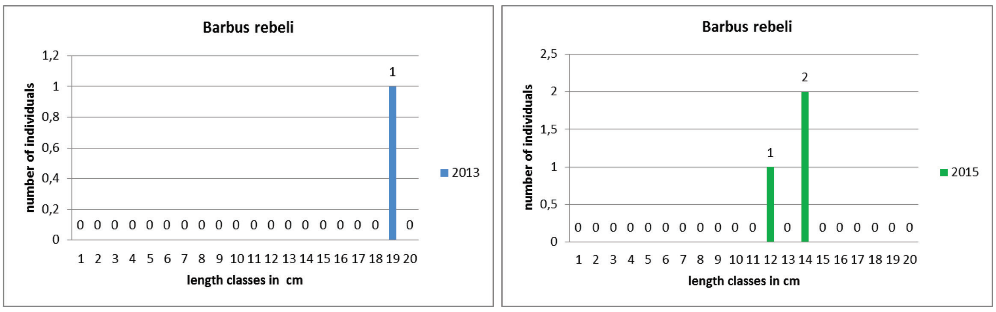
a)



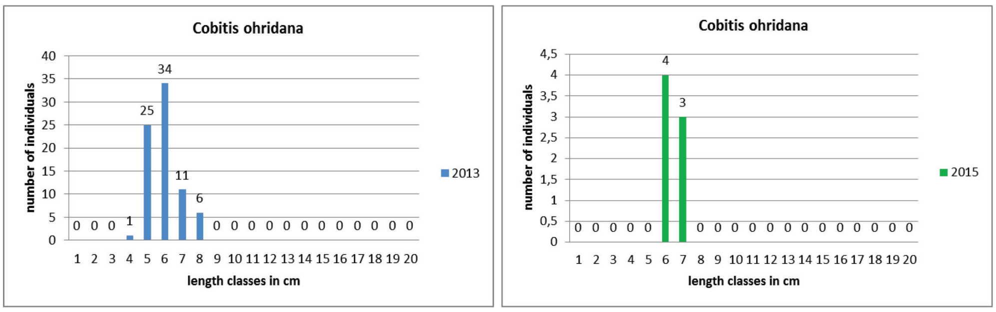
b)



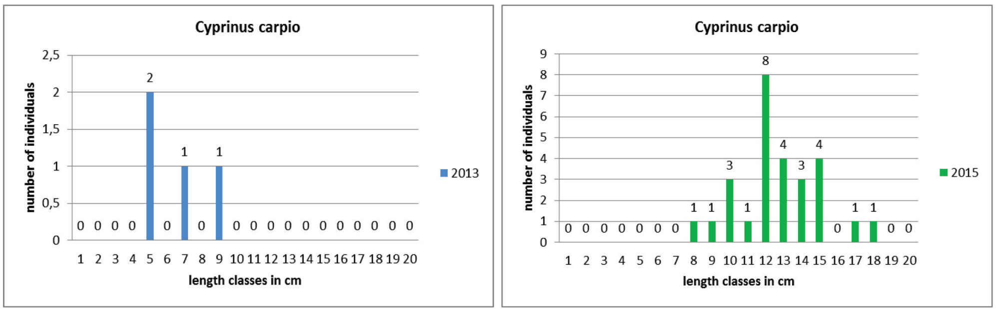
c)

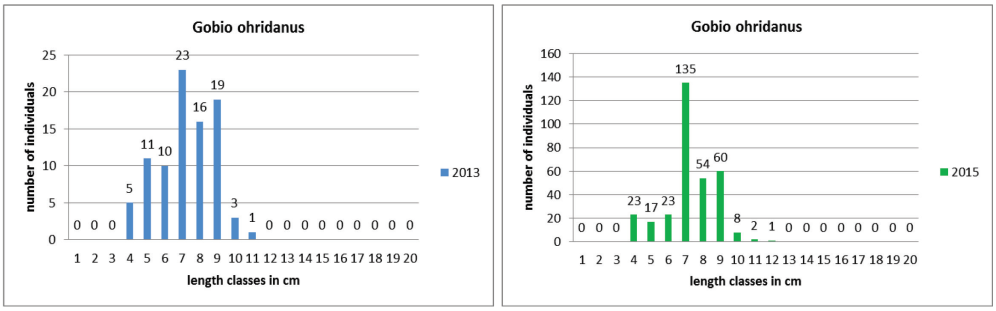


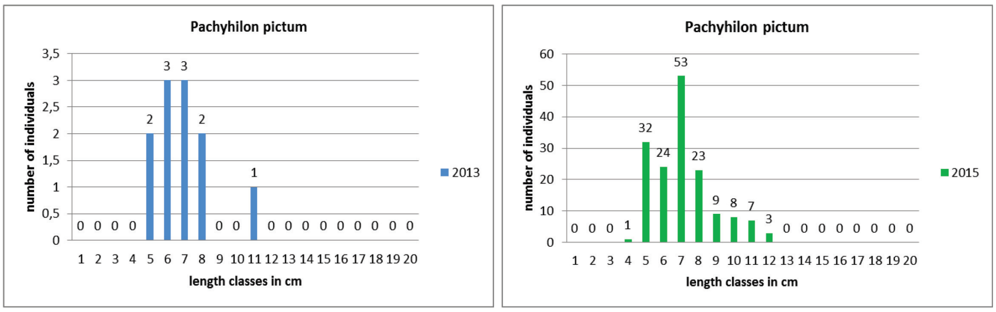
d)

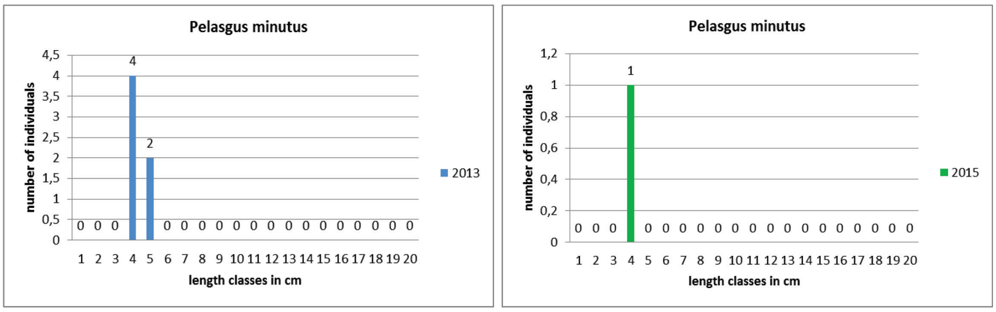


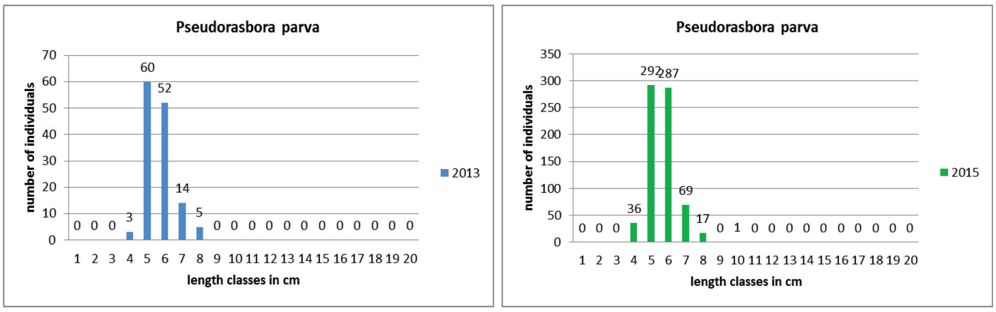
e)

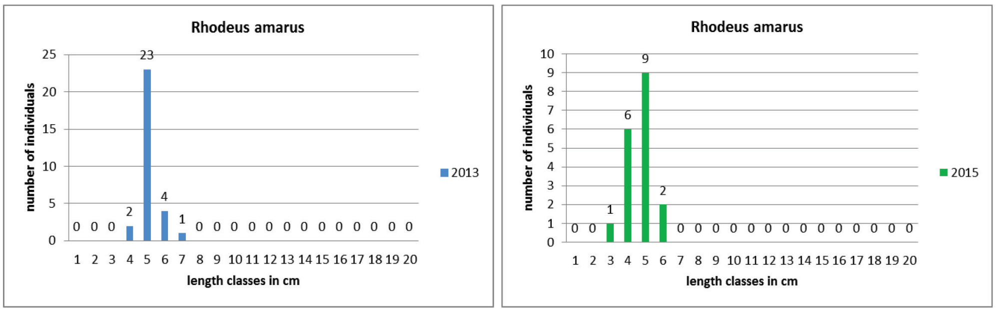

Cyprinus carpio
number of individuals
length classes in cm
2013
Cyprinus carpio
number of individuals
length classes in cm
2015
f)


Gobio ohridanus
number of individuals
length classes in cm
2013
Gobio ohridanus
number of individuals
length classes in cm
2015
g)

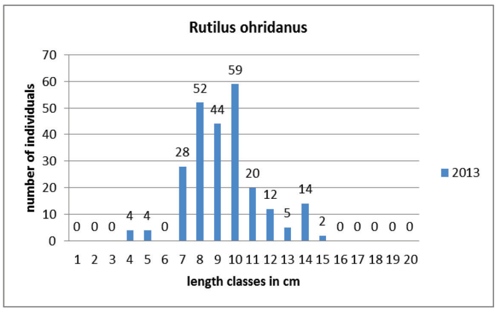

Pachyhilon pictum
number of individuals
length classes in cm
2013
Pachyhilon pictum
number of individuals
length classes in cm
2015
h)

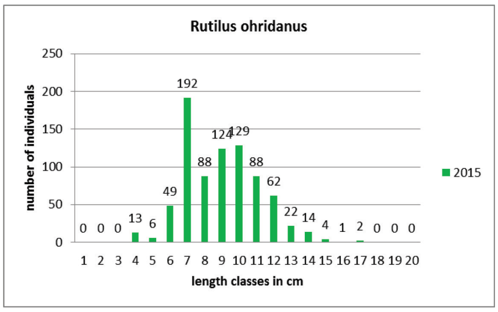

Pelasgus minutus
number of individuals
length classes in cm
2013
Pelasgus minutus
number of individuals
length classes in cm
2015
i)


Pseudorasbora parva
number of individuals
length classes in cm
2013
Pseudorasbora parva
number of individuals
length classes in cm
2015
j)

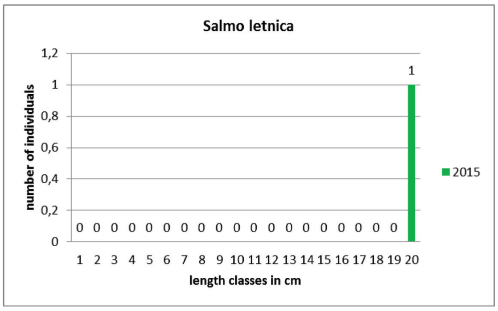

Rhodeus amarus
number of individuals
length classes in cm
2013
Rhodeus amarus
number of individuals
length classes in cm
2015
k)

l)

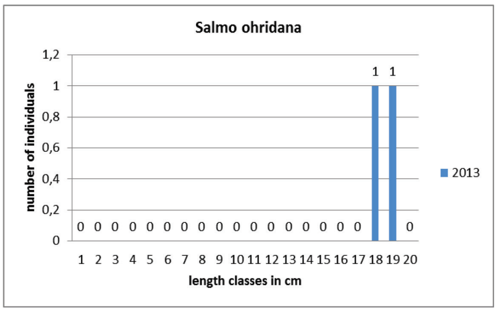




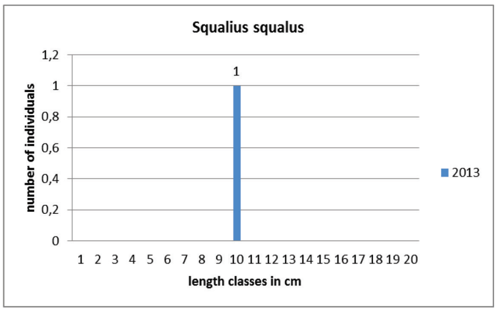
m)



n)



o)



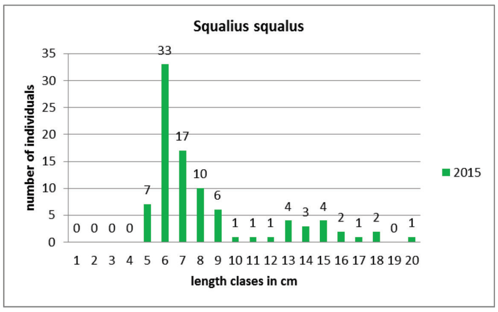


Figure 32. Length-frequency distributions of the fish species caught during the survey at SB 2 in 2013 (left) and 2015 (right)

SB 3 – Radozda

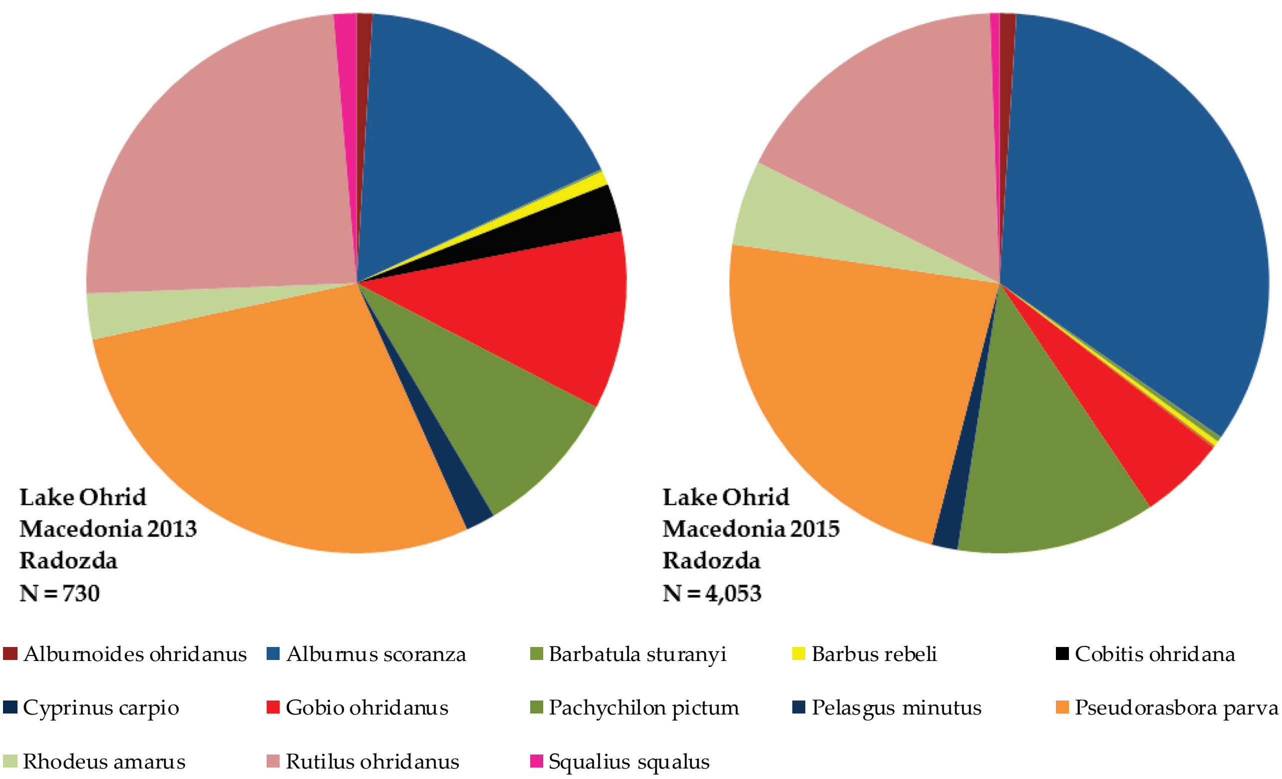
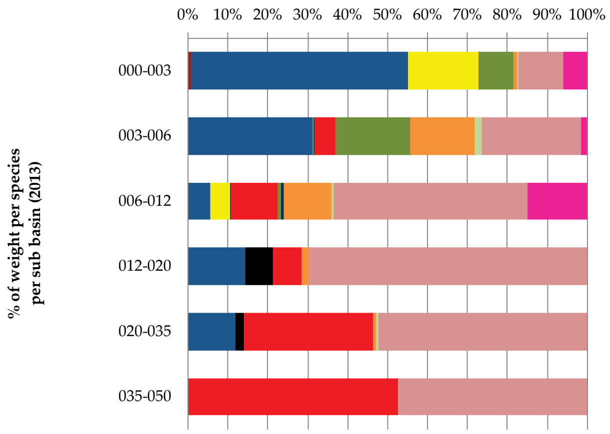


Figure 33. Relative fish species composition in total catch at SB 3 in the sampling campaigns 2013 (left) and 2015 (right)

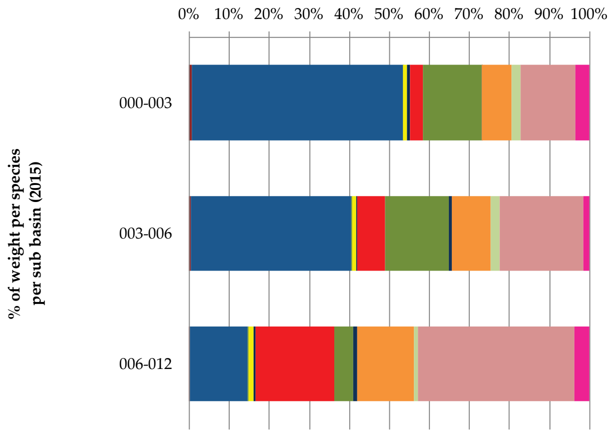
At this sub-basin, 13 fish species were sampled in total, many of which are either of no or low commercial interest (such as minnows, stone moroko, roach). Noteworthy is the occurrence of barbel (*Barbus rebeli*) (Figure 33). Differences in species composition and relative abundance of species were minor between the two sampling years.

Regarding standardized biomass, roach generally contributed significantly to the annual BPUE. At greater depth (≥ 20 m), Ohrid gudgeon too formed important part of the biomass (accounting for over 50 % at the deepest water stratum sampled in 2013) (Figure 34). On the contrary, roach dominated in the shallower parts of the water where also Ohrid chub was recorded. In 2015, dominance of biomass at this sub-basin was shared by bleak and roach.

In terms of numbers of individuals per m^2 of net (NPUE), the relative shares of the individual species resemble those of the BPUE (Figure 35).

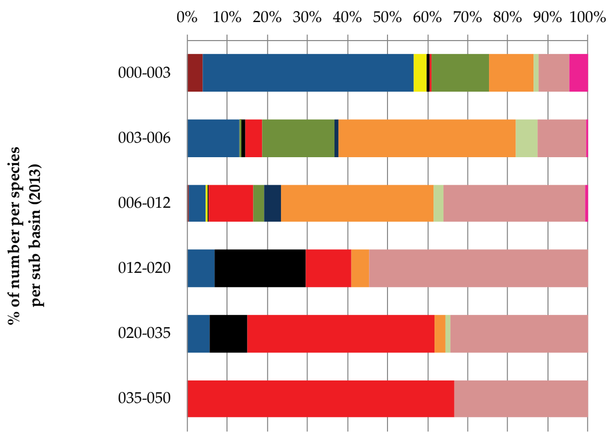


	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus				0.01		0.14
Alburnus scoranza		0.47	0.44	0.47	1.56	8.80
Barbatula sturanyi					0.01	
Barbus rebeli				0.45		2.84
Cobitis ohridana		0.10	0.21	0.02	0.01	0.02
Cyprinus carpio						
Gobio ohridanus	0.14	1.29	0.22	1.01	0.26	0.02
Pachychilon pictum				0.08	0.93	1.40
Pelasgus minutus				0.06	0.01	
Pseudorasbora parva		0.03	0.05	1.05	0.80	0.16
Rhodeus amarus		0.01		0.04	0.09	0.04
Rutilus ohridanus	0.12	2.09	2.11	4.26	1.25	1.80
Squalius squalus				1.33	0.08	0.99

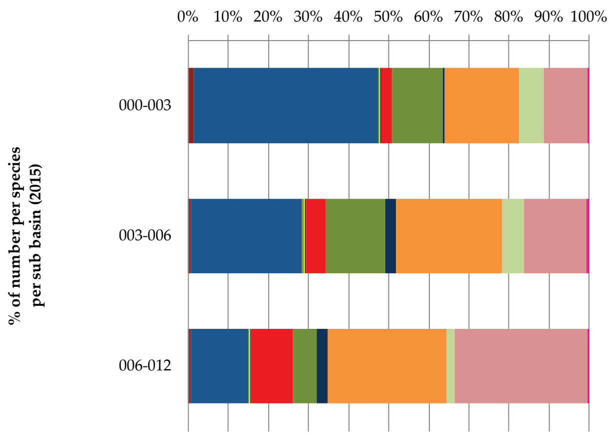


	006-012	003-006	000-003
Alburnoides ohridanus	0.02	0.03	0.10
Alburnus scoranza	1.31	3.27	7.11
Barbatula sturanyi	0.03	0.02	0.01
Barbus rebeli	0.10	0.09	0.14
Cobitis ohridana			
Cyprinus carpio	0.07	0.02	0.08
Gobio ohridanus	1.77	0.57	0.45
Pachychilon pictum	0.45	1.30	1.97
Pelasgus minutus	0.08	0.06	0.01
Pseudorasbora parva	1.29	0.78	1.00
Rhodeus amarus	0.10	0.18	0.32
Rutilus ohridanus	3.54	1.70	1.87
Squalius squalus	0.36	0.13	0.47

Figure 34. CPUE expressed in biomass (BPUE in g/m² of net) for sub-basin 3 (Radozda) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata



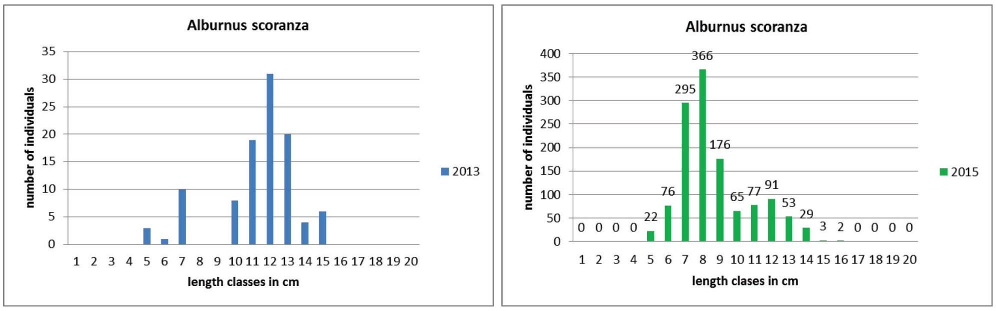
	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus				0.01		0.04
Alburnus scoranza		0.03	0.03	0.08	0.14	0.60
Barbatula sturanyi					0.01	
Barbus rebeli				0.01		0.04
Cobitis ohridana		0.05	0.11	0.01	0.01	0.01
Cyprinus carpio						
Gobio ohridanus	0.02	0.25	0.06	0.21	0.04	0.01
Pachychilon pictum				0.05	0.20	0.16
Pelasgus minutus				0.08	0.01	
Pseudorasbora parva		0.01	0.02	0.73	0.49	0.13
Rhodeus amarus		0.01		0.04	0.06	0.01
Rutilus ohridanus	0.01	0.19	0.27	0.67	0.13	0.09
Squalius squalus				0.01	0.01	0.05



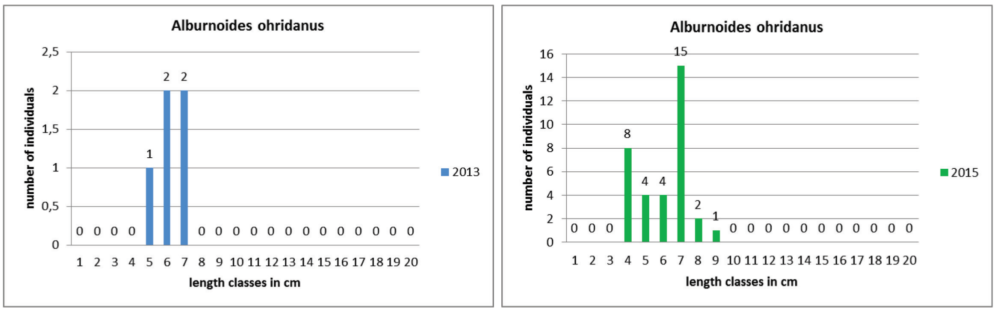
	006-012	003-006	000-003
Alburnoides ohridanus	0.01	0.01	0.04
Alburnus scoranza	0.35	0.46	1.26
Barbatula sturanyi	0.01	0.01	0.01
Barbus rebeli	0.01	0.00	0.01
Cobitis ohridana			
Cyprinus carpio	0.01	0.00	0.00
Gobio ohridanus	0.26	0.09	0.08
Pachychilon pictum	0.14	0.25	0.35
Pelasgus minutus	0.07	0.04	0.01
Pseudorasbora parva	0.71	0.44	0.51
Rhodeus amarus	0.05	0.09	0.17
Rutilus ohridanus	0.80	0.27	0.30
Squalius squalus	0.01	0.01	0.02

Figure 35. CPUE expressed in number of individuals/m² (NPUE, ind./m² of net) for sub-basin 3 (Radozda) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata

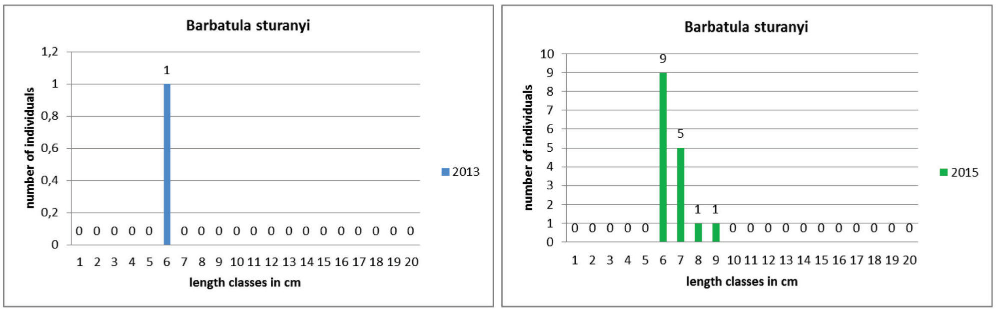
Length-frequency distributions of the fish species caught at SB 3 are depicted in Figure 36 (a-m). The roach was present with 12 length classes, followed by moranec (10) and bleak (9).



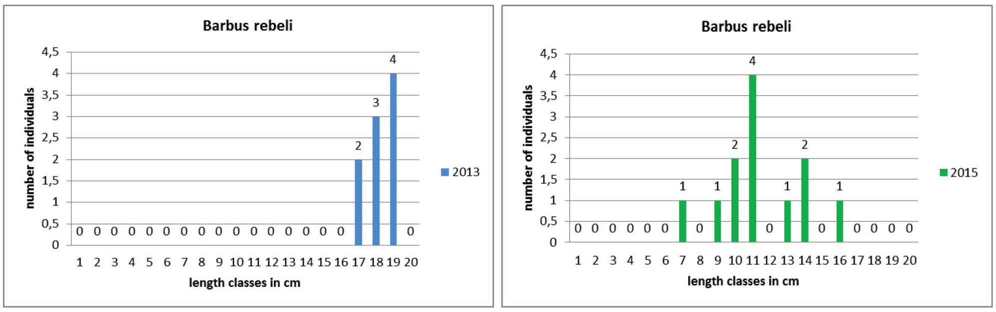
a)



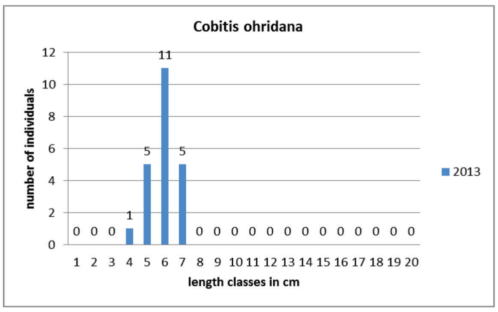
b)



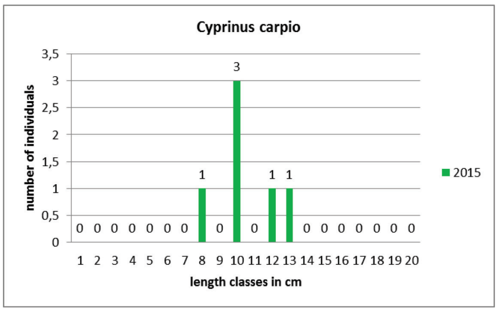
c)



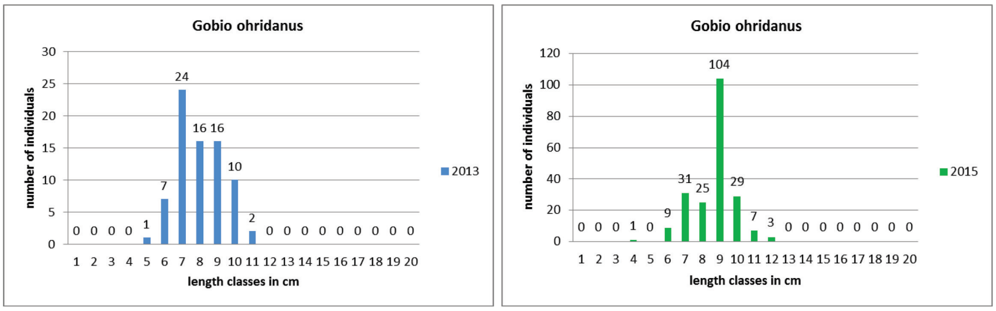
d)



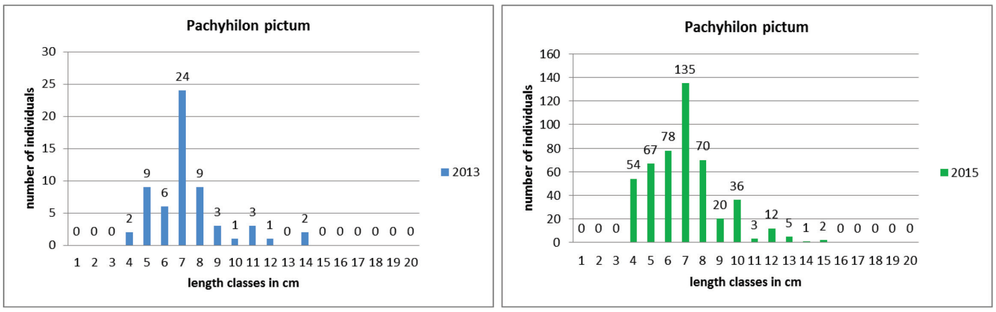
e)


Cyprinus carpio
number of individuals
length classes in cm
2015
0 0 0 0 0 0 0 1 0 3 0 1 1 0 0 0 0 0 0 0

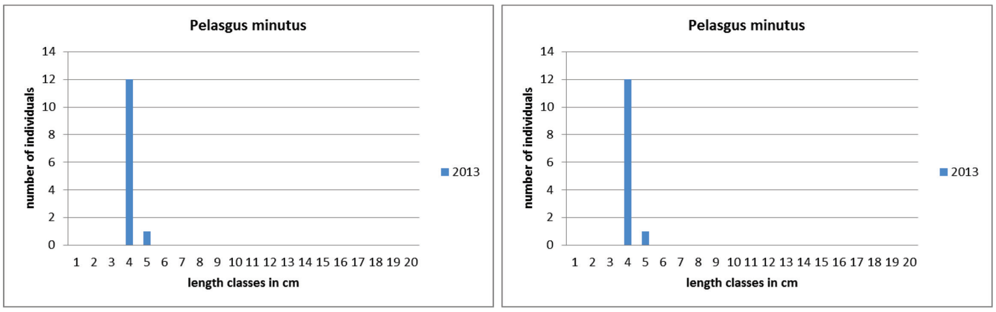
f)


Gobio ohridanus
number of individuals
length classes in cm
2013
0 0 0 0 1 7 24 16 16 10 2 0 0 0 0 0 0 0 0 0
Gobio ohridanus
number of individuals
length classes in cm
2015
0 0 0 1 0 9 31 25 104 29 7 3 0 0 0 0 0 0 0 0

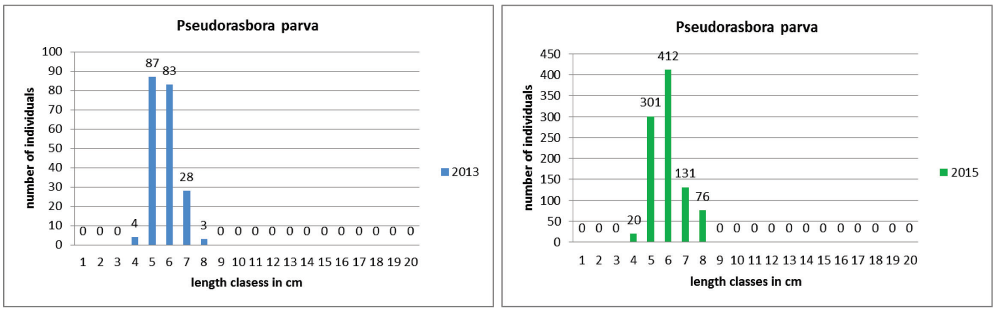
g)


Pachyhilon pictum
number of individuals
length classes in cm
2013
0 0 0 2 9 6 24 9 3 1 3 1 0 2 0 0 0 0 0 0
Pachyhilon pictum
number of individuals
length classes in cm
2015
0 0 0 54 67 78 135 70 20 36 3 12 5 1 2 0 0 0 0 0

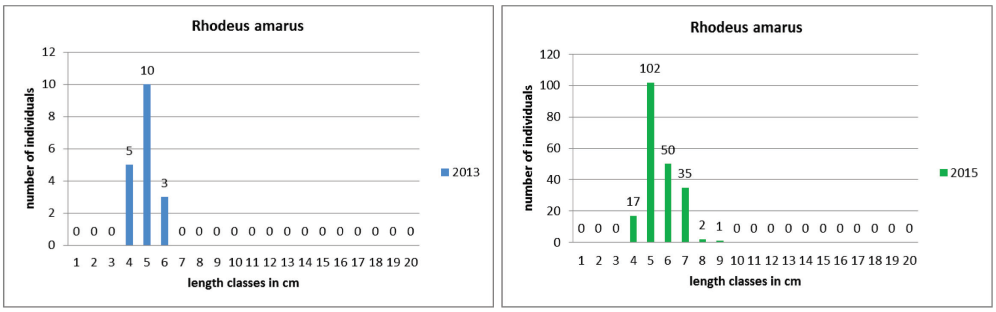
h)


Pelasgus minutus
number of individuals
length classes in cm
2013
Pelasgus minutus
number of individuals
length classes in cm
2013

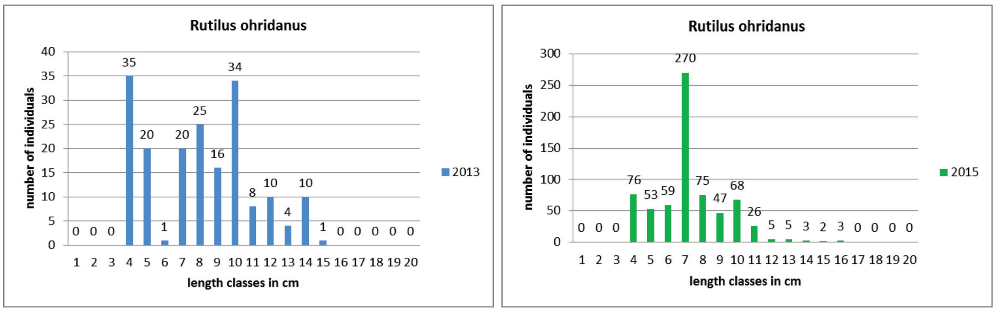
i)


Pseudorasbora parva
number of individuals
length clasess in cm
2013
0 0 0 4 87 83 28 3 0 0 0 0 0 0 0 0 0 0 0 0
Pseudorasbora parva
number of individuals
length clasess in cm
2015
0 0 0 20 301 412 131 76 0 0 0 0 0 0 0 0 0 0 0 0

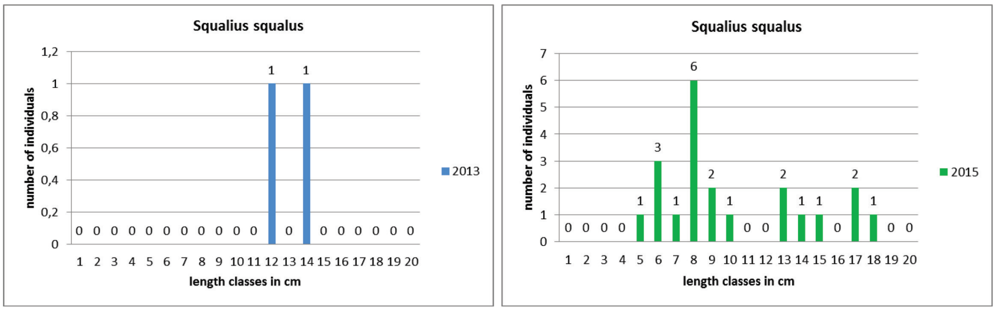
j)


Rhodeus amarus
number of individuals
length classes in cm
2013
0 0 0 5 10 3 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Rhodeus amarus
number of individuals
length classes in cm
2015
0 0 0 17 102 50 35 2 1 0 0 0 0 0 0 0 0 0 0 0

k)



l)



m)

Figure 36. Length-frequency distributions of the fish species caught during the survey at SB 3 in 2013 (left) and 2015 (right)

SB 4 – Central plate

In 2013, only one species, Ohrid gudgeon, was sampled at the pelagic sub-basin. In total, 23 individuals were caught in 10 benthic nets. The length-frequency distribution of this species is presented in Figure 37.

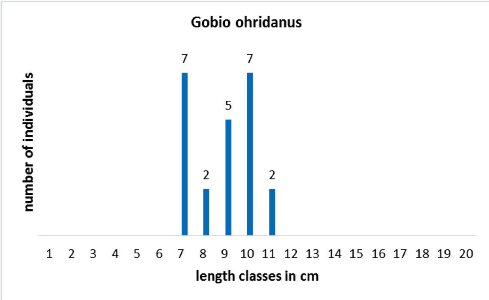


Figure 37. Length-frequency distribution of Ohrid gudgeon caught during the survey at SB 4 in 2013

In 2015, at the pelagic sampling site, only one species - Ohrid belvica (*Salmo ohridanus*) with only **one** individual was caught, despite the fact that 48 pelagic nets were set in cascades from surface to the bottom.

SB 5 – Lin–Bakalice

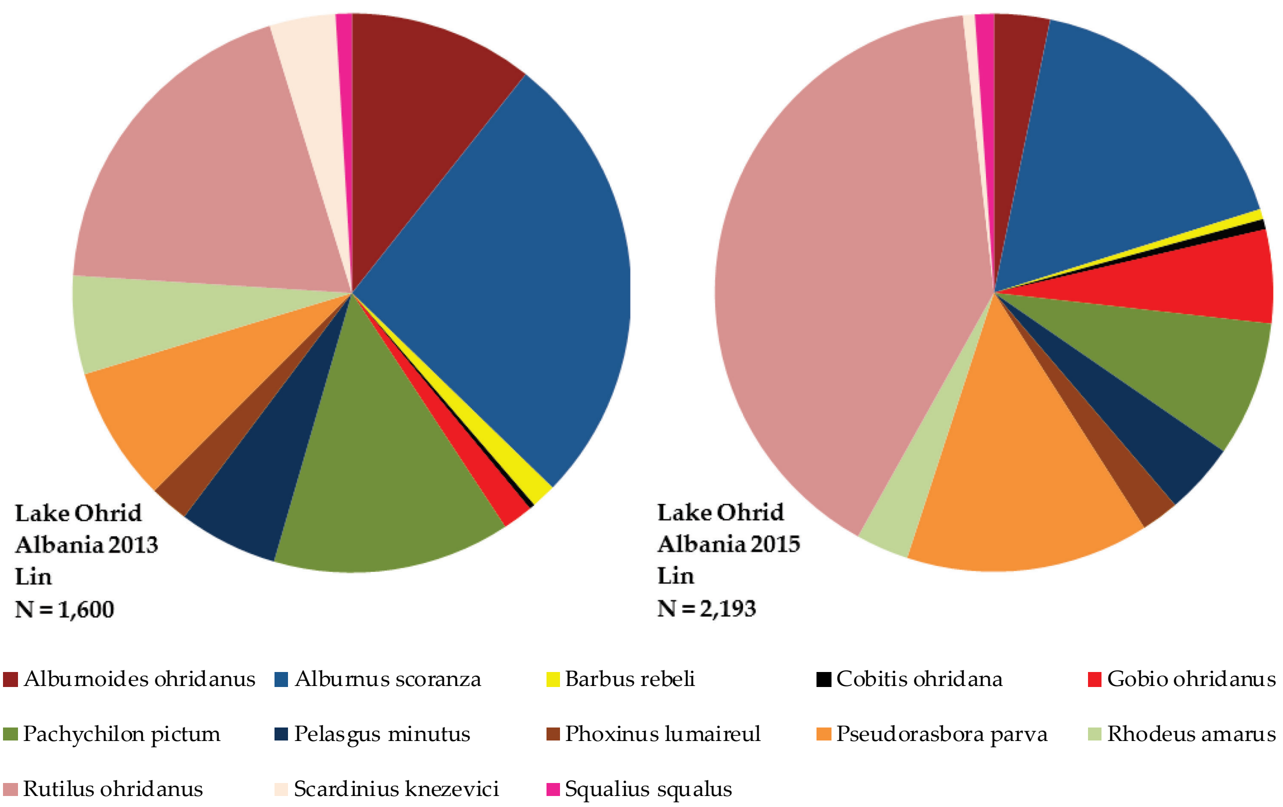
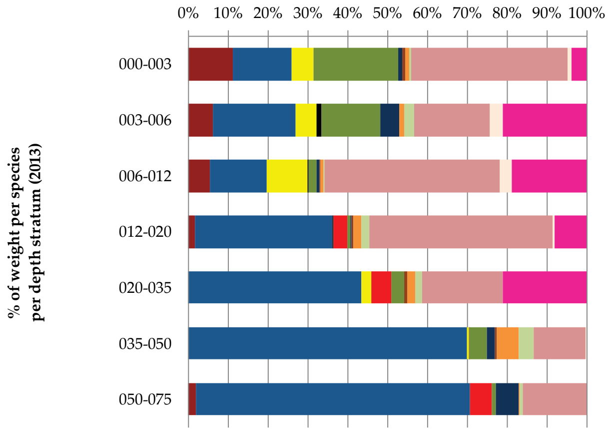


Figure 38. Relative fish species composition in total catch at SB 5 in the sampling campaigns 2013 (left) and 2015 (right)

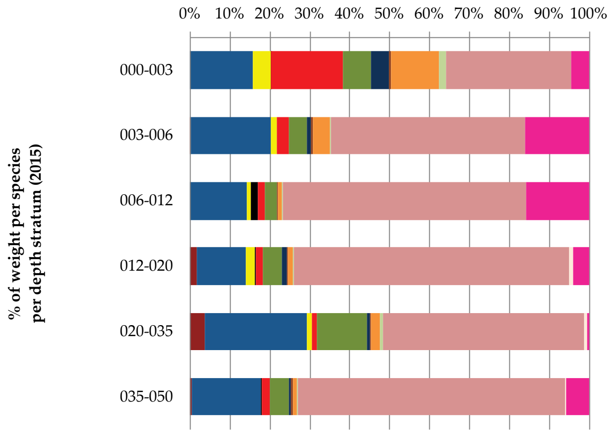
The sampling site Lin-Bakalice represents a main spawning ground for salmonid fishes during winter and for carp and other cyprinids during spring and summer. Sampling at this site resulted into collection of 13 species (Figure 38). Although, the fishing was also performed at rather deep strata, no commercially valuable species were found. Unlike the SB belonging to the Macedonian part of the lake, at this sub-basin rudd (*Scardinius knezevici*) appeared in the catches.

In view of standardized biomass, bleak and roach contributed largely to the BPUE in 2013 whereas in 2015 the latter species became even more dominant (Figure 39). Also chub (*Squalius squalus*) contributed noteworthy to fish biomass in both years. Another interesting fact for this locality is the presence of Ohrid spirlin in deep waters (50-75m).

With regard to abundance (NPUE), bleak and roach contributed the most to NPUE at SB 5. Up to 6 m of depth, moranec occurred in high numbers in 2013, in particular, whereas stone moroko became more frequent in 2015 (Figure 40).

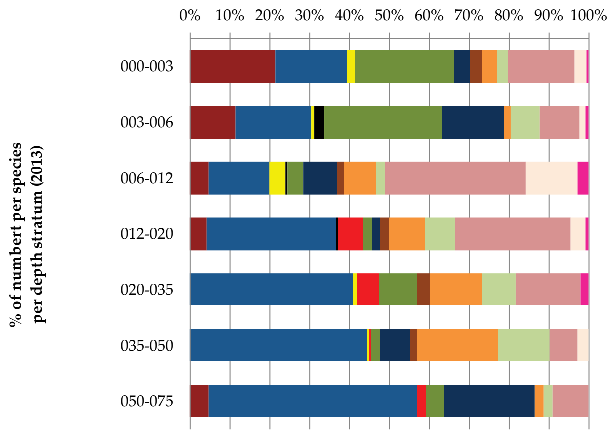


	050-075	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus	0.20			0.20	1.13	0.46	2.05
Alburnus scoranza	7.25	5.35	6.05	4.49	3.05	1.59	2.74
Barbus rebeli		0.03	0.36		2.18	0.40	1.03
Cobitis ohridana				0.01	0.04	0.09	
Gobio ohridanus	0.56	0.00	0.70	0.45			
Pachychilon pictum	0.13	0.34	0.46	0.10	0.44	1.13	3.95
Pelasgus minutus	0.60	0.16		0.06	0.17	0.37	0.20
Phoxinus lumaireul		0.03	0.08	0.06	0.04		0.15
Pseudorasbora parva	0.03	0.43	0.30	0.26	0.17	0.09	0.16
Rhodeus amarus	0.06	0.27	0.22	0.26	0.08	0.19	0.11
Rutilus ohridanus	1.70	1.01	2.84	5.93	9.36	1.45	7.26
Scardinius knezevici		0.02		0.07	0.66	0.26	0.19
Squalius squalus			2.95	1.06	4.01	1.60	0.73

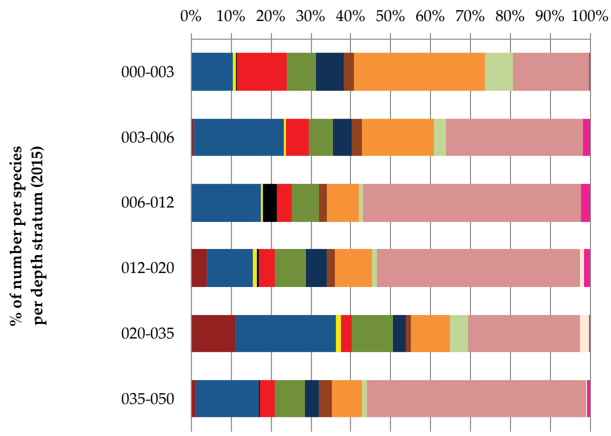


	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus	0.08	1.17	0.41		0.03	
Alburnus scoranza	4.40	8.35	3.11	3.70	4.10	1.06
Barbus rebeli		0.39	0.58	0.21	0.32	0.31
Cobitis ohridana	0.03		0.04	0.47		0.01
Gobio ohridanus	0.54	0.45	0.45	0.49	0.62	1.22
Pachychilon pictum	1.19	4.03	1.19	0.76	0.90	0.48
Pelasgus minutus	0.12	0.26	0.36		0.24	0.29
Phoxinus lumaireul	0.11	0.10	0.04	0.07	0.07	0.04
Pseudorasbora parva	0.26	0.68	0.36	0.29	0.89	0.81
Rhodeus amarus	0.04	0.31	0.06	0.02	0.07	0.12
Rutilus ohridanus	16.89	16.39	17.46	15.79	9.96	2.13
Scardinius knezevici	0.07	0.27	0.31			
Squalius squalus	1.46	0.13	0.99	4.13	3.27	0.30

Figure 39. CPUE expressed in biomass (BPUE in g/m^2 of net) for sub-basin 5 (Lin-Bakalice) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata



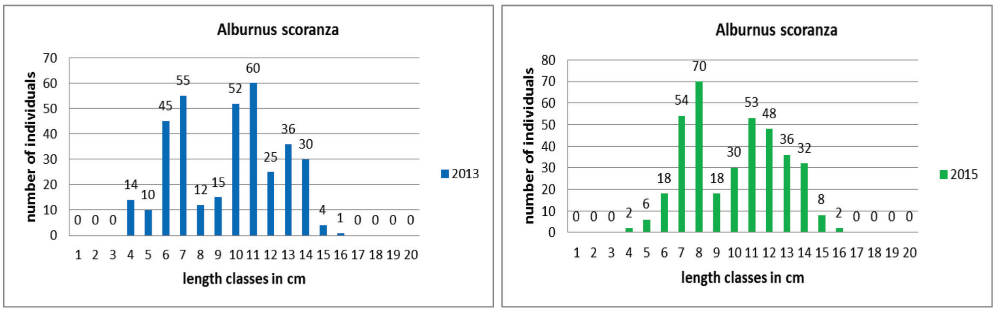
	050-075	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus	0.04			0.06	0.06	0.10	0.50
Alburnus scoranza	0.51	0.53	0.42	0.47	0.20	0.17	0.42
Barbus rebeli		0.01	0.01		0.05	0.01	0.05
Cobitis ohridana				0.00	0.01	0.02	
Gobio ohridanus	0.02	0.01	0.06	0.09			
Pachychilon pictum	0.04	0.03	0.10	0.03	0.05	0.27	0.57
Pelasgus minutus	0.22	0.09		0.03	0.11	0.14	0.10
Phoxinus lumaireul		0.02	0.03	0.04	0.02		0.07
Pseudorasbora parva	0.02	0.24	0.13	0.13	0.10	0.01	0.09
Rhodeus amarus	0.02	0.16	0.09	0.11	0.03	0.07	0.06
Rutilus ohridanus	0.09	0.08	0.17	0.42	0.46	0.09	0.39
Scardinius knezevici		0.03		0.05	0.17	0.01	0.07
Squalius squalus			0.02	0.01	0.04	0.01	0.01



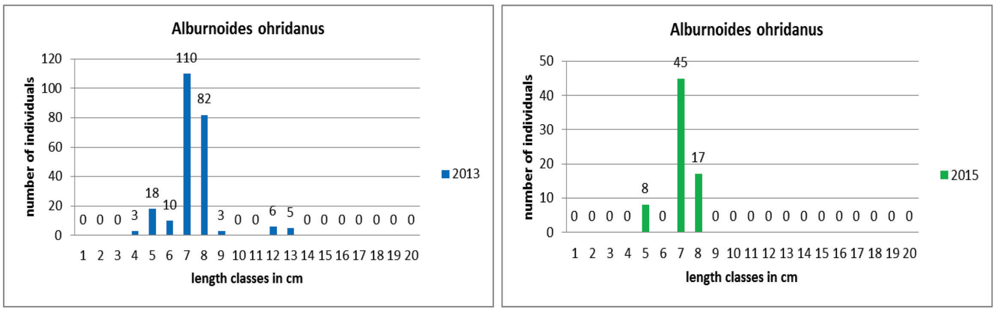
	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus	0.02	0.35	0.08		0.01	
Alburnus scoranza	0.34	0.79	0.24	0.34	0.47	0.14
Barbus rebeli		0.04	0.02	0.01	0.01	0.01
Cobitis ohridana	0.01		0.01	0.07		0.00
Gobio ohridanus	0.08	0.09	0.08	0.07	0.12	0.17
Pachychilon pictum	0.16	0.33	0.16	0.13	0.13	0.10
Pelasgus minutus	0.07	0.10	0.11		0.10	0.10
Phoxinus lumaireul	0.07	0.04	0.04	0.04	0.05	0.03
Pseudorasbora parva	0.16	0.31	0.20	0.16	0.38	0.45
Rhodeus amarus	0.03	0.14	0.03	0.02	0.06	0.10
Rutilus ohridanus	1.18	0.88	1.06	1.06	0.71	0.26
Scardinius knezevici	0.01	0.07	0.02			
Squalius squalus	0.02	0.01	0.04	0.04	0.04	0.00

Figure 40. CPUE expressed in number of individuals/m^2 (NPUE, ind./m^2 of net) for sub-basin 5 (Lin-Bakalice) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata

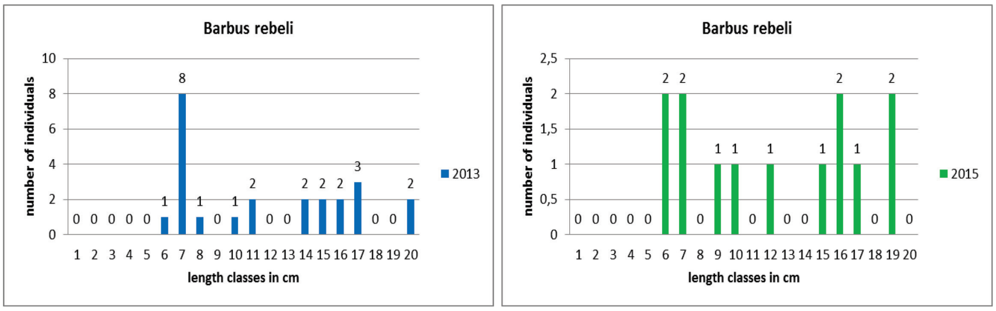
Length-frequency distributions of the fish species sampled at SB 5 are shown in Figure 41 (a-m).



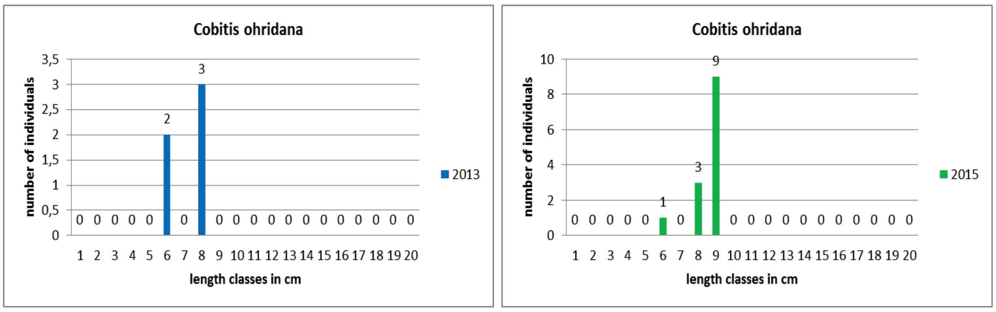
a)



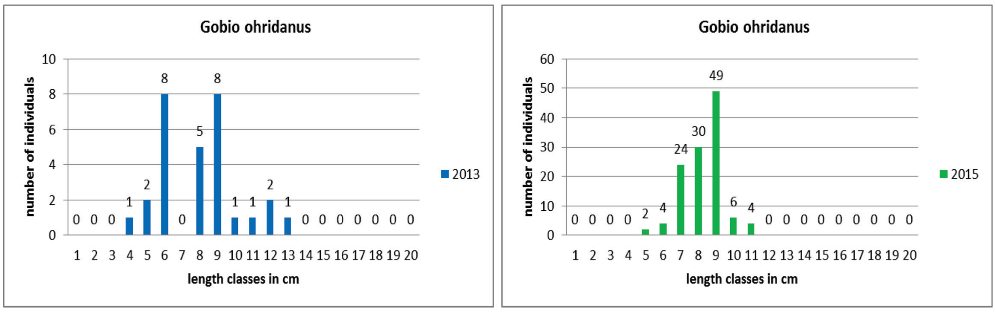
b)



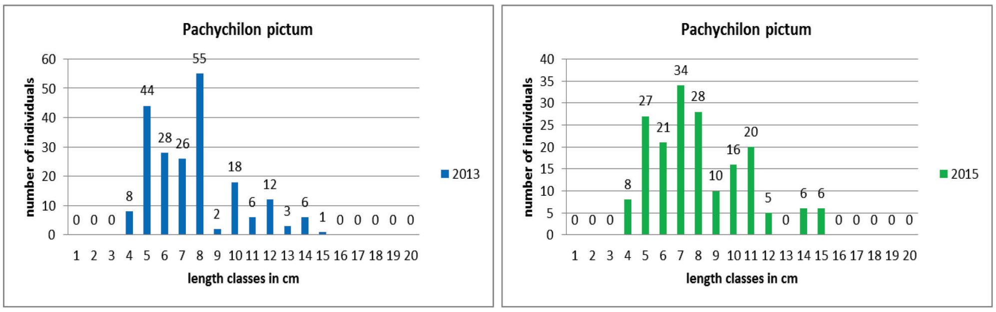
c)



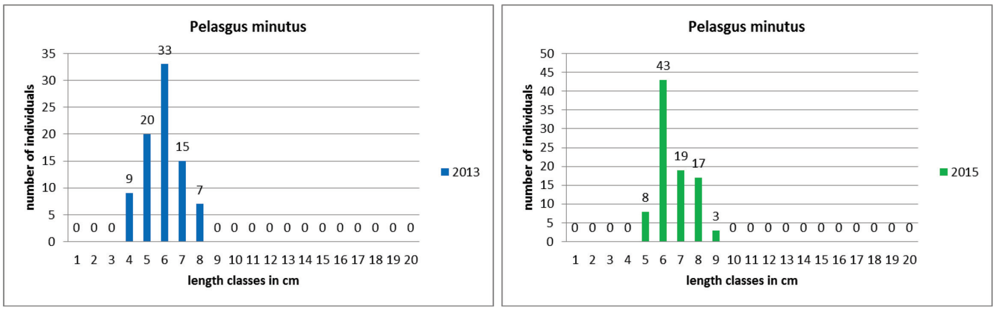
d)



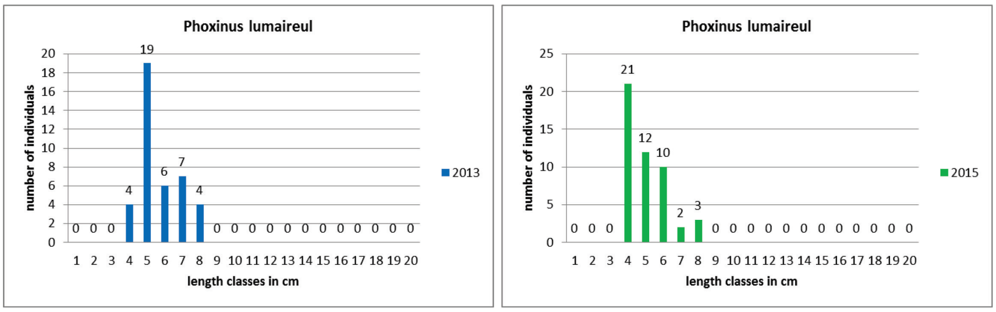
e)


Pachychilon pictum
number of individuals
length classes in cm
2013
Pachychilon pictum
number of individuals
length classes in cm
2015

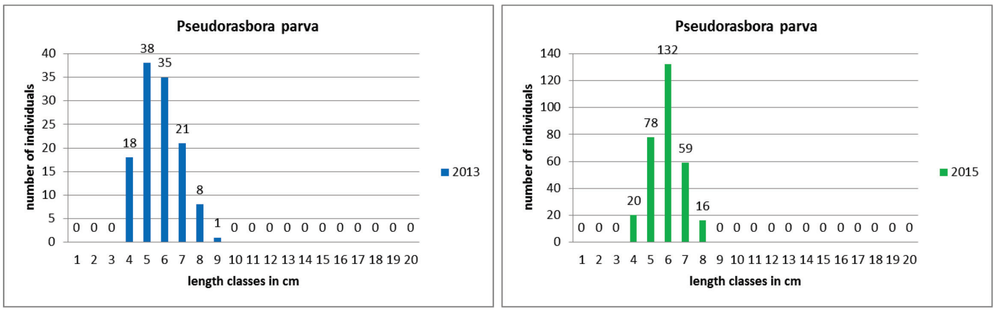
f)


Pelasgus minutus
number of individuals
length classes in cm
2013
Pelasgus minutus
number of individuals
length classes in cm
2015

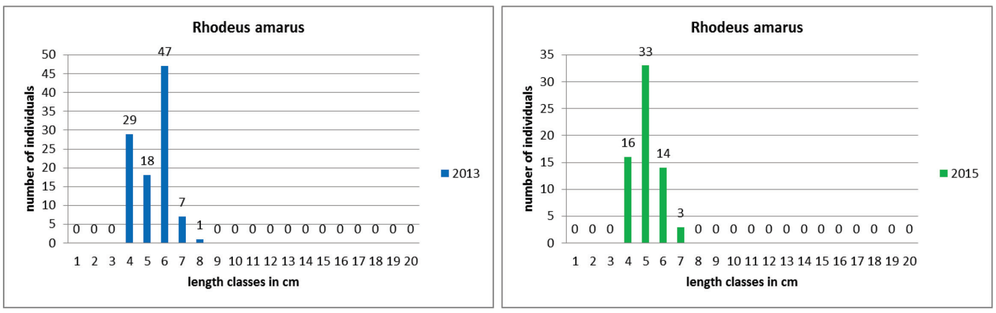
g)


Phoxinus lumaireul
number of individuals
length classes in cm
2013
Phoxinus lumaireul
number of individuals
length classes in cm
2015

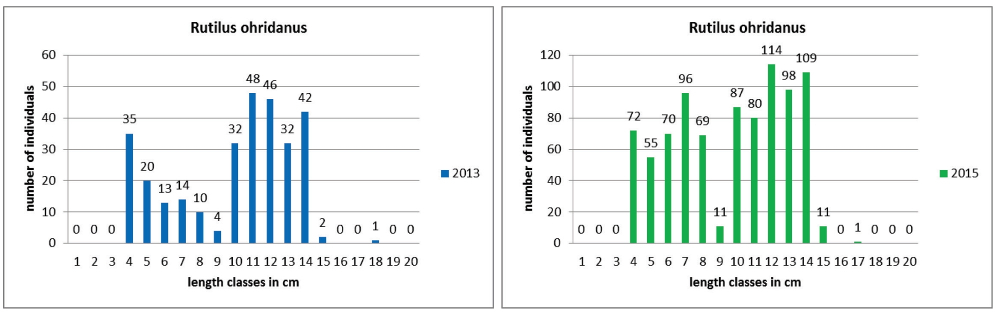
h)


Pseudorasbora parva
number of individuals
length classes in cm
2013
Pseudorasbora parva
number of individuals
length classes in cm
2015

i)

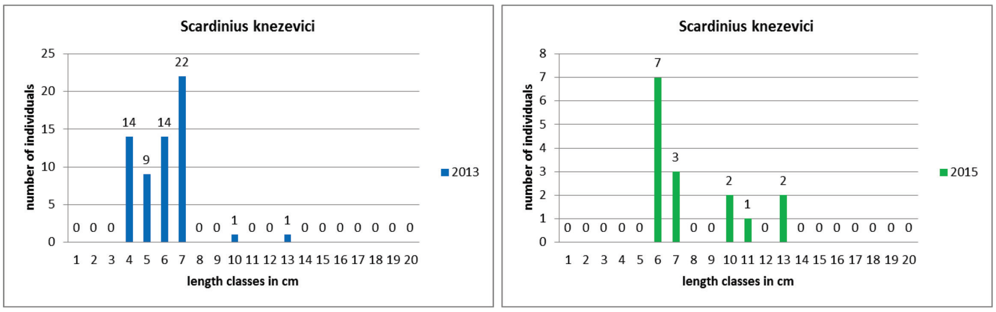

Rhodeus amarus
number of individuals
length classes in cm
2013
Rhodeus amarus
number of individuals
length classes in cm
2015

j)


Rutilus ohridanus
number of individuals
length classes in cm
2013
Rutilus ohridanus
number of individuals
length classes in cm
2015

k)

l)



m)

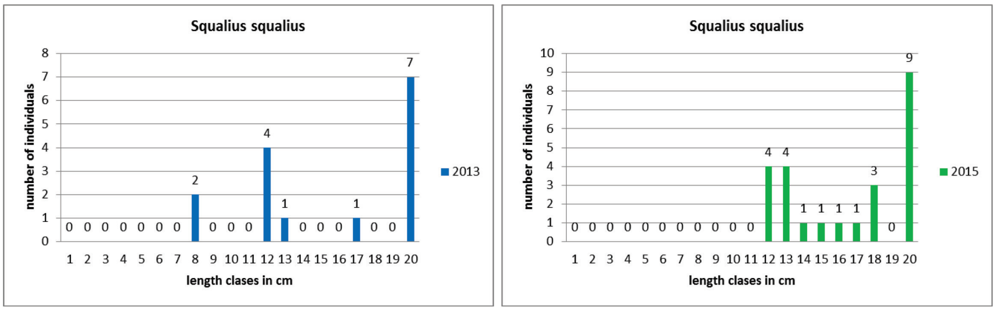


Figure 41. Length-frequency distributions of the fish species caught during the survey at SB 5 in 2013 (left) and 2015 (right)

SB 6 – Hudënisht

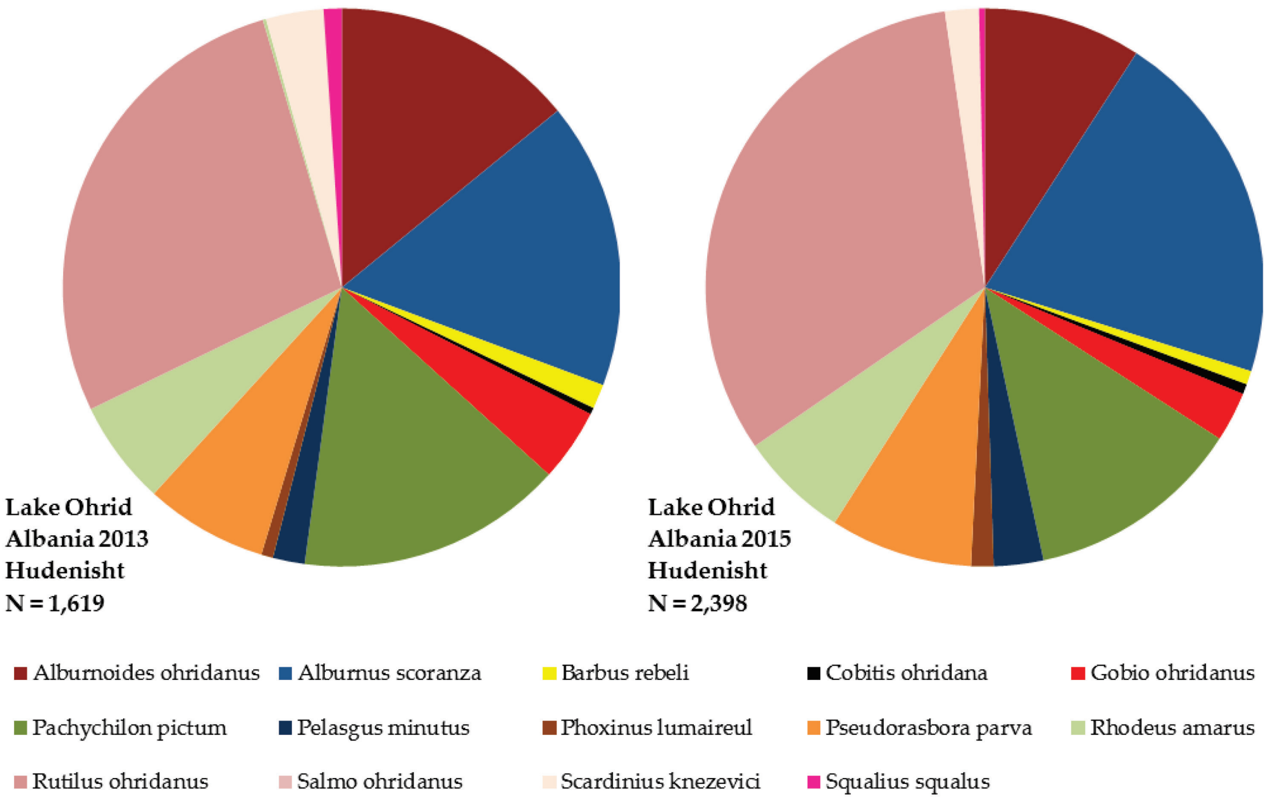
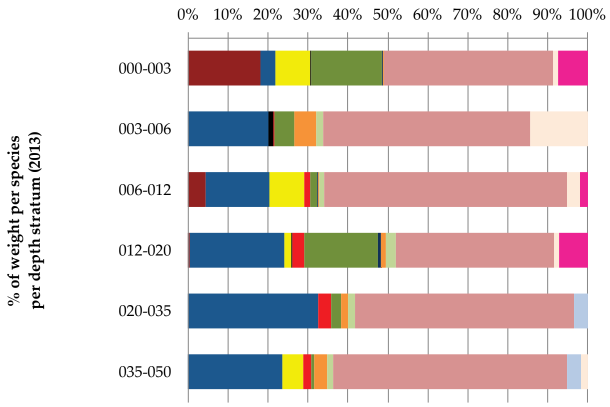


Figure 42. Relative fish species composition in total catch at SB 6 in the sampling campaigns 2013 (left) and 2015 (right)

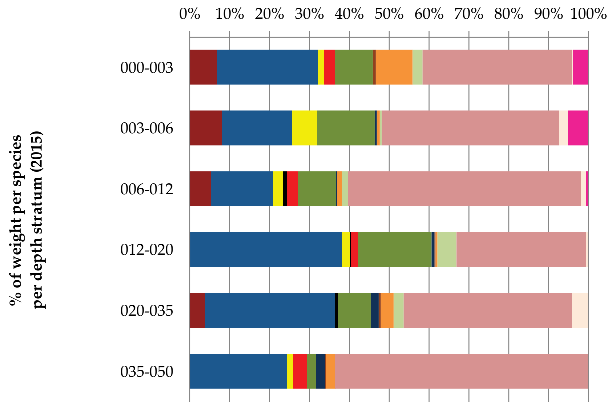
The SB 6 represents one of the most productive fishing areas of the lake and 14 species were found in total at this site. At this sub-basin, also three individuals of the endemic Ohrid belvica were caught and the differences in relative abundance of the individual species were rather low between years (Figure 42).

Temporal comparison of the standardized biomass also revealed only minor differences between 2013 and 2015 (Figure 43). In both years, roach and bleak contributed most to the annual BPUE. As well, moranec and, to lesser degree, chub added to overall biomass.

In terms of numbers (NPUE) quite identical results were obtained in 2013 and 2015. Roach, bleak and moranec appeared in relatively high numbers in the catches, but stone moroko and spirlin contributed noteworthy to overall fish numbers too (Figure 44).

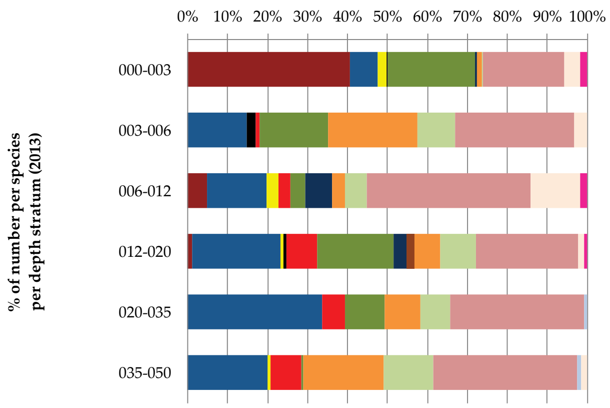


	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus			0.05	0.58		4.62
Alburnus scoranza	2.83	3.85	3.48	2.04	3.20	0.98
Barbus rebeli	0.63		0.28	1.10		2.25
Cobitis ohridana			0.02		0.23	0.05
Gobio ohridanus	0.26	0.36	0.44	0.20	0.04	
Pachychilon pictum	0.09	0.30	2.71	0.22	0.80	4.59
Pelasgus minutus			0.11	0.05		0.04
Phoxinus lumaireul			0.03			
Pseudorasbora parva	0.39	0.20	0.16	0.04	0.86	0.06
Rhodeus amarus	0.17	0.23	0.38	0.14	0.27	0.01
Rutilus ohridanus	7.07	6.45	5.81	7.80	8.31	10.92
Salmo ohridanus	0.45	0.40				
Scardinius knezevici	0.19		0.20	0.39	2.32	0.32
Squalius squalus			1.04	0.25		1.90

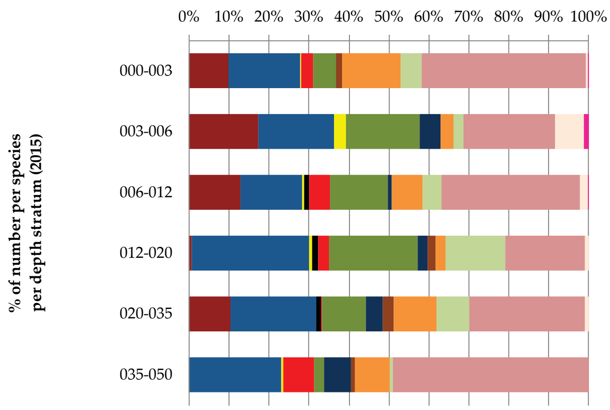


	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus		0.79	0.01	0.95	1.83	0.79
Alburnus scoranza	3.93	6.55	5.74	2.82	3.96	2.94
Barbus rebeli	0.25		0.30	0.44	1.42	0.16
Cobitis ohridana		0.14	0.07	0.19		
Gobio ohridanus	0.57	0.02	0.24	0.48		0.34
Pachychilon pictum	0.36	1.66	2.81	1.70	3.27	1.08
Pelasgus minutus	0.35	0.40	0.11	0.03	0.16	
Phoxinus lumaireul	0.05	0.08	0.04			0.10
Pseudorasbora parva	0.35	0.69	0.09	0.25	0.13	1.06
Rhodeus amarus	0.02	0.50	0.69	0.26	0.15	0.31
Rutilus ohridanus	10.24	8.54	4.95	10.53	10.07	4.32
Salmo ohridanus						
Scardinius knezevici		0.80	0.07	0.23	0.50	0.04
Squalius squalus				0.11	1.16	0.44

Figure 43. CPUE expressed in biomass (BPUE in g/m² of net) for sub-basin 6 (Hudënisht) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata



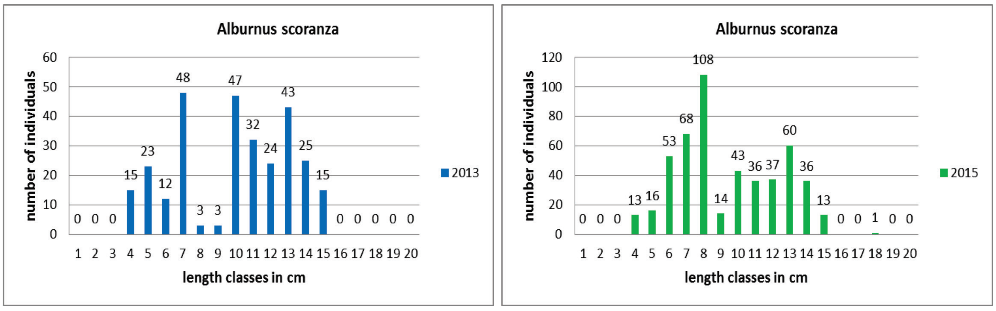
	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus			0.02	0.04		1.19
Alburnus scoranza	0.22	0.30	0.32	0.13	0.31	0.20
Barbus rebeli	0.01		0.01	0.03		0.07
Cobitis ohridana			0.01		0.04	0.01
Gobio ohridanus	0.08	0.05	0.11	0.03	0.02	
Pachychilon pictum	0.01	0.09	0.28	0.03	0.36	0.64
Pelasgus minutus			0.04	0.06		0.02
Phoxinus lumaireul			0.03			
Pseudorasbora parva	0.22	0.08	0.09	0.03	0.47	0.03
Rhodeus amarus	0.13	0.07	0.13	0.05	0.20	0.01
Rutilus ohridanus	0.39	0.30	0.37	0.37	0.62	0.60
Salmo ohridanus	0.01	0.01				
Scardinius knezevici	0.02		0.02	0.11	0.07	0.11
Squalius squalus			0.01	0.02		0.06



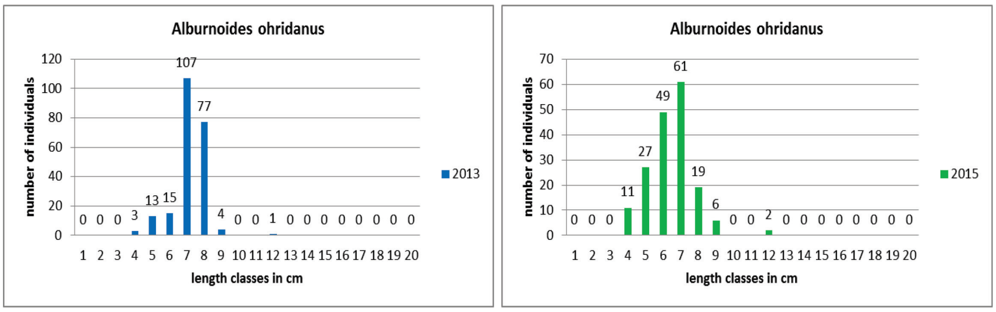
	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus		0.30	0.01	0.28	0.39	0.31
Alburnus scoranza	0.33	0.62	0.52	0.34	0.43	0.56
Barbus rebeli	0.01		0.01	0.01	0.07	0.01
Cobitis ohridana		0.03	0.02	0.03		
Gobio ohridanus	0.11	0.01	0.05	0.11		0.09
Pachychilon pictum	0.03	0.32	0.39	0.32	0.42	0.18
Pelasgus minutus	0.09	0.12	0.04	0.02	0.12	
Phoxinus lumaireul	0.02	0.08	0.04			0.05
Pseudorasbora parva	0.12	0.31	0.04	0.17	0.07	0.46
Rhodeus amarus	0.01	0.24	0.26	0.11	0.06	0.17
Rutilus ohridanus	0.69	0.83	0.35	0.75	0.52	1.28
Salmo ohridanus						
Scardinius knezevici		0.03	0.02	0.04	0.16	0.01
Squalius squalus				0.01	0.03	0.01

Figure 44. CPUE expressed in number of individuals/m² (NPUE, ind./m² of net) for sub-basin 6 (Hudënisht) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata

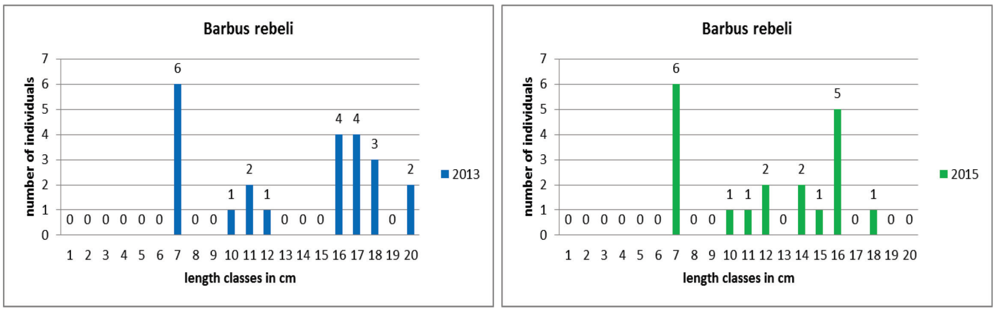
Length-frequency distributions of the individual species sampled at SB 6 are presented in the Figure 45 (a-n).



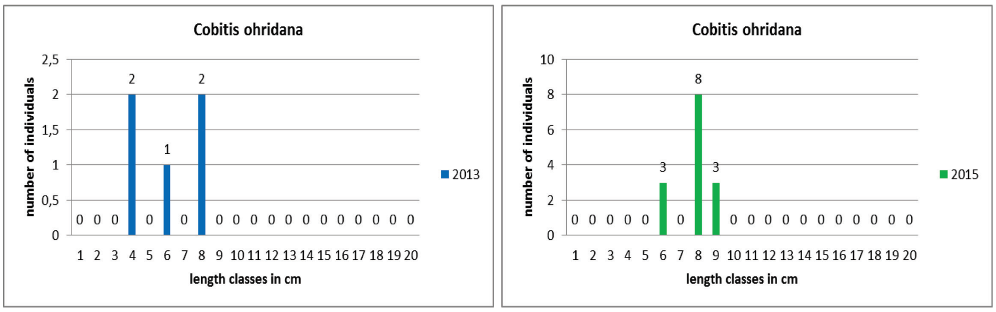
a)



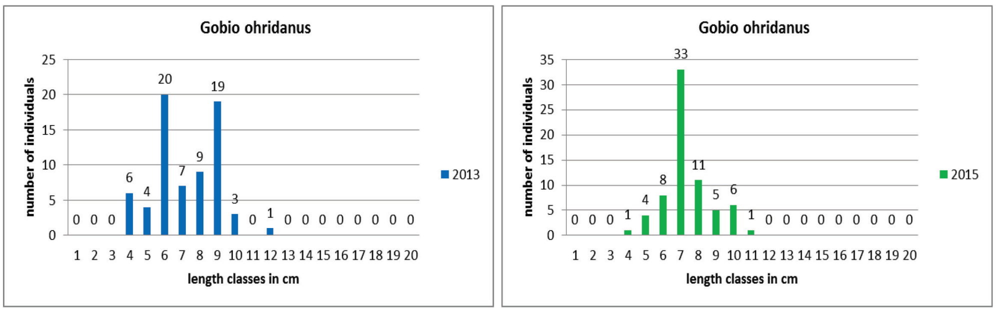
b)



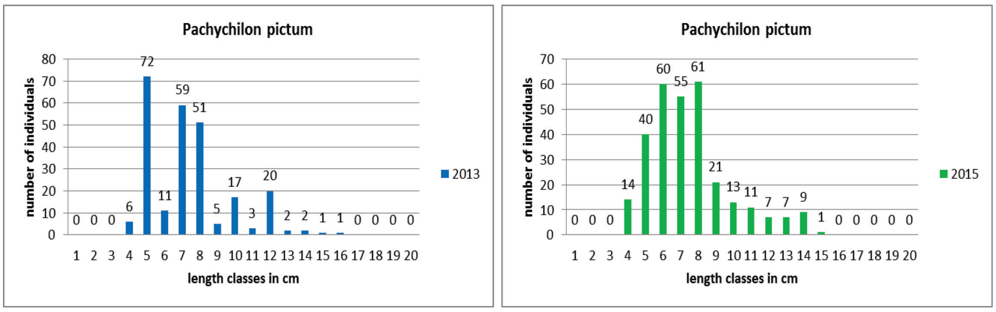
c)



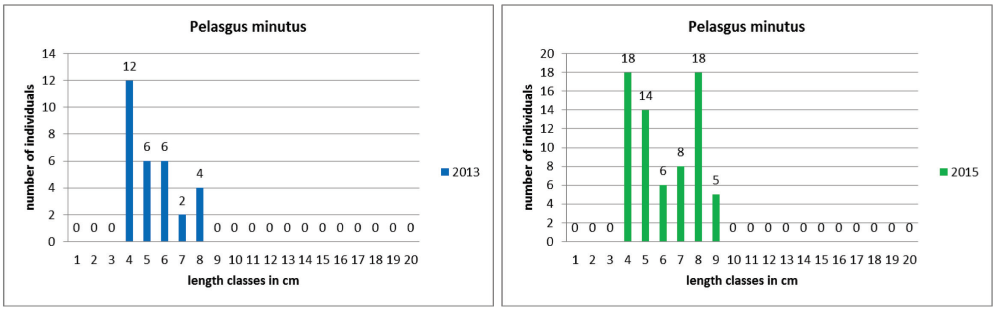
d)



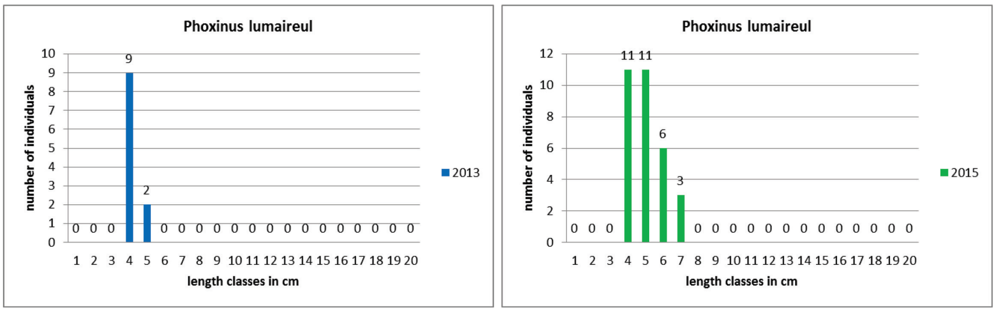
e)


Pachychilon pictum
number of individuals
0 0 0 6 72 11 59 51 5 17 3 20 2 2 1 1 0 0 0 0
length classes in cm
2013
Pachychilon pictum
number of individuals
0 0 0 14 40 60 55 61 21 13 11 7 7 9 1 0 0 0 0 0
length classes in cm
2015

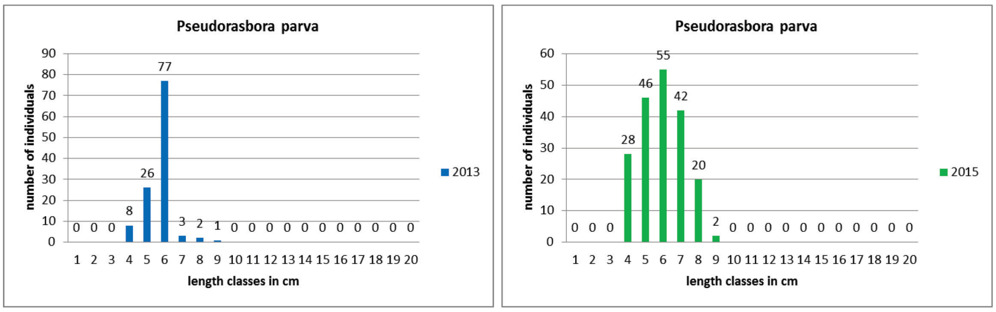
f)


Pelasgus minutus
number of individuals
0 0 0 12 6 6 2 4 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2013
Pelasgus minutus
number of individuals
0 0 0 18 14 6 8 18 5 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2015

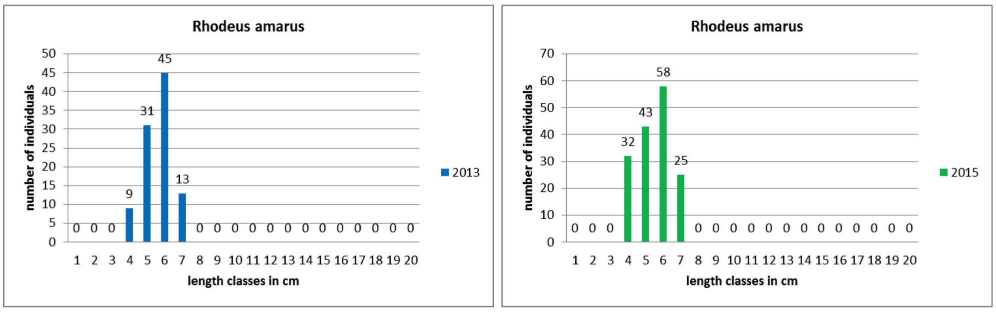
g)


Phoxinus lumaireul
number of individuals
0 0 0 9 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2013
Phoxinus lumaireul
number of individuals
0 0 0 11 11 6 3 0 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2015

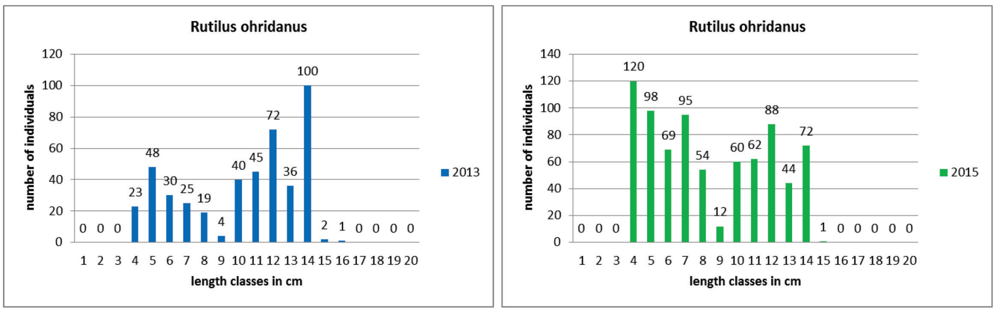
h)


Pseudorasbora parva
number of individuals
0 0 0 8 26 77 3 2 1 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2013
Pseudorasbora parva
number of individuals
0 0 0 28 46 55 42 20 2 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2015

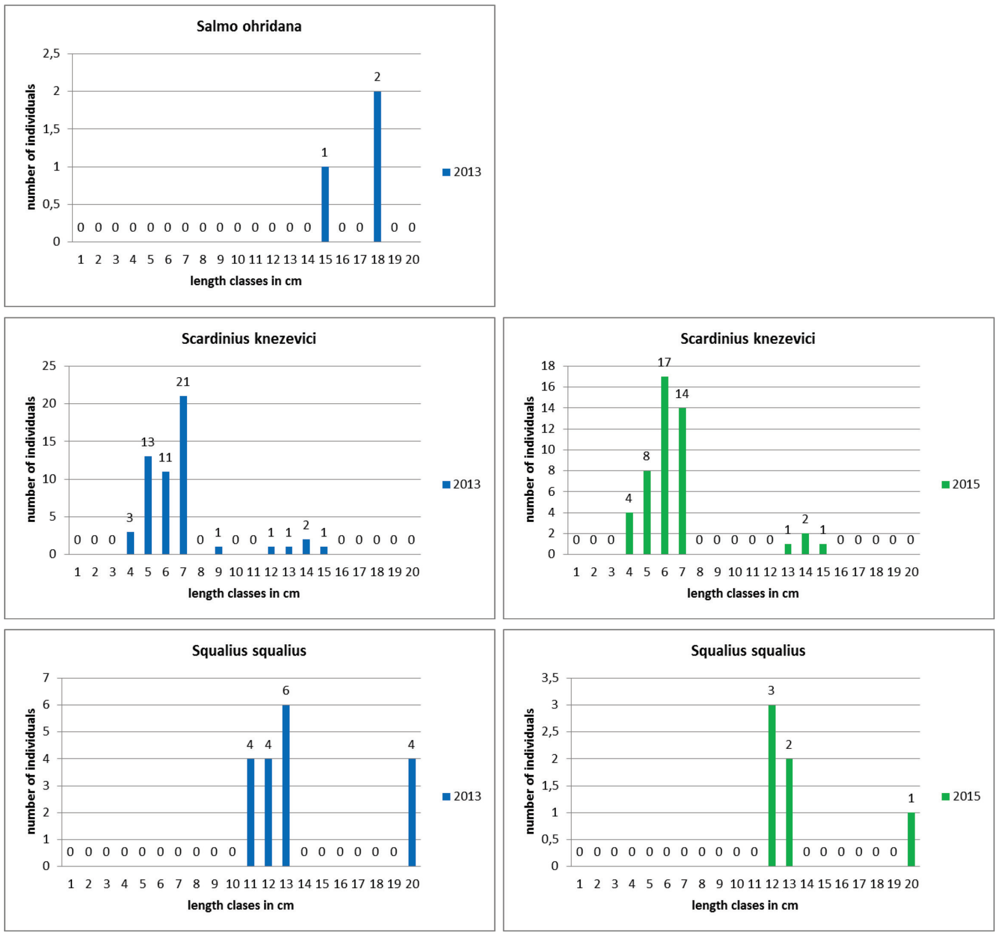
i)


Rhodeus amarus
number of individuals
0 0 0 9 31 45 13 0 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2013
Rhodeus amarus
number of individuals
0 0 0 32 43 58 25 0 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2015

j)


Rutilus ohridanus
number of individuals
0 0 0 23 48 30 25 19 4 40 45 72 36 100 2 1 0 0 0 0
length classes in cm
2013
Rutilus ohridanus
number of individuals
0 0 0 120 98 69 95 54 12 60 62 88 44 72 1 0 0 0 0 0
length classes in cm
2015

k)



l)

m)

n)

Figure 45. Length-frequency distributions of the fish species caught during the survey at SB 6 in 2013 (left) and 2015 (right)

As can be seen from the figure above, moranec occurred with 13 length classes (from 4 to 16 cm), followed by bleak (12 length classes, 4 to 18 cm) and barbel (9 length classes, 7 to 20 cm).

SB 7 – Tushemisht

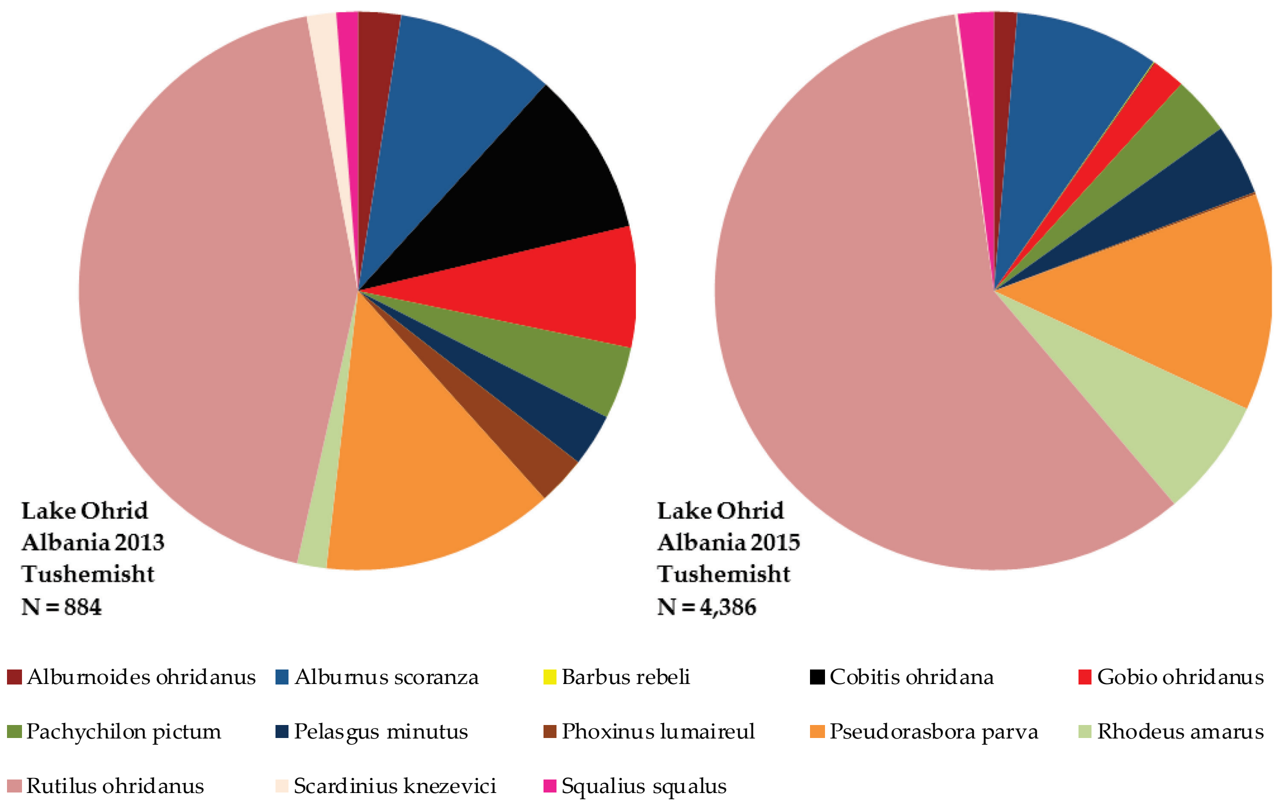


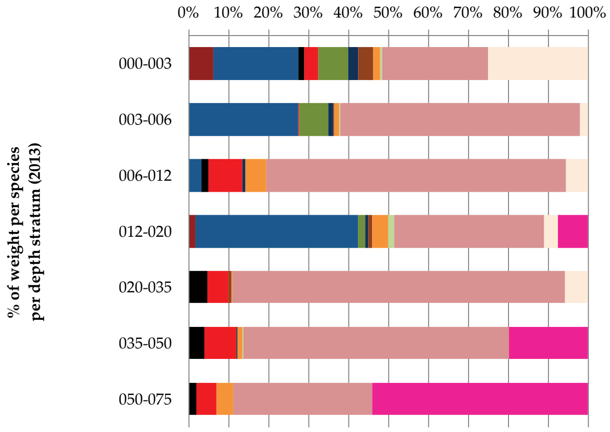
Figure 46. Relative fish species composition in total catch at SB 7 in the sampling campaigns 2013 (left) and 2015 (right)

A total number of 13 species were caught in Tushemisht area in both sampling campaigns in 2013 and 2015. Some species such as spirlin, rudd, and chub were more prevalent in certain depth strata than in others. Unlike in the other sub-basins, the dominant species was clearly roach, while presence of bleak was distinctly lower than at other sites (Figure 46).

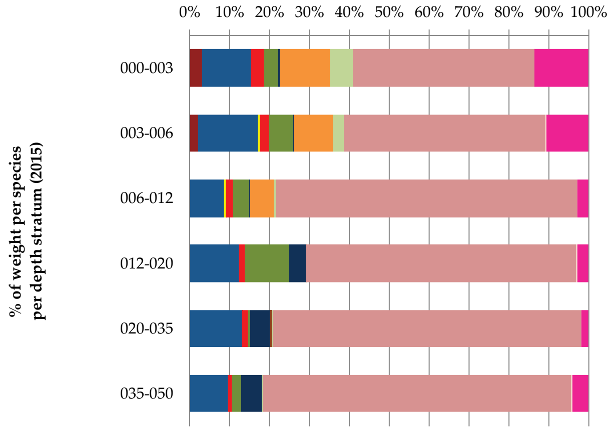
In 2015, the situation was similar with high dominance of Ohrid roach. The alien stone moroko and bitterling combined added up to 20%.

The dominance of Ohrid roach was apparent at all depth strata (Figure 47) whereas chub reached relevant biomasses at a depth of ≥ 35 m, in particular. In addition to bleak, roach and chub, also Albanian roach and Ohrid minnow added notably to BPUE of 2015.

As for BPUE, Ohrid roach also contributed the most to the NPUE at SB 7 (Figure 48). Interestingly, species were relatively evenly spread in shallow waters whereas numbers of roach (compared to other fishes) increased consecutively with increasing depth.

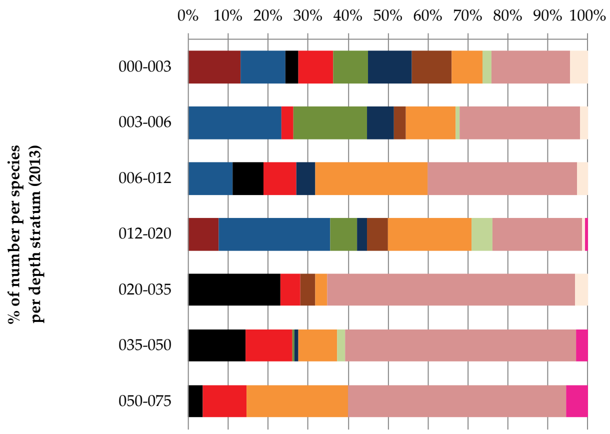


	050-075	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus				0.28			0.22
Alburnus scoranza				6.61	0.28	2.70	0.72
Barbus rebeli							
Cobitis ohridana	0.17	0.33	0.49		0.16		0.05
Gobio ohridanus	0.48	0.69	0.52		0.76	0.04	0.13
Pachychilon pictum		0.01		0.27		0.70	0.25
Pelasgus minutus		0.01		0.15	0.07	0.14	0.09
Phoxinus lumaireul			0.09	0.14		0.02	0.12
Pseudorasbora parva	0.41	0.12	0.02	0.66	0.47	0.12	0.07
Rhodeus amarus		0.02		0.25		0.03	0.01
Rutilus ohridanus	3.33	5.80	8.57	6.07	6.75	5.93	0.91
Scardinius knezevici			0.60	0.56	0.50	0.20	0.87
Squalius squalus	5.17	1.72		1.24			

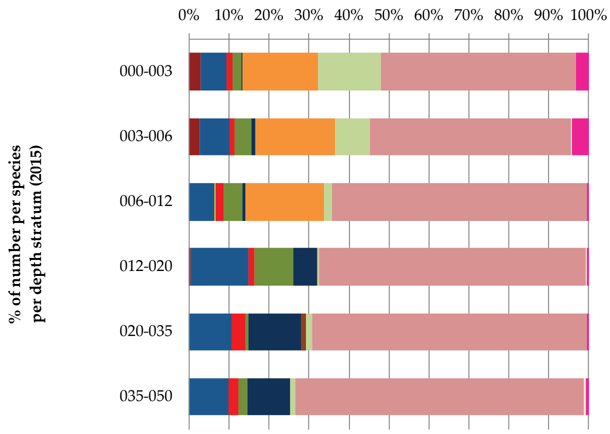


	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus			0.03		0.65	1.08
Alburnus scoranza	2.95	4.09	2.99	2.88	4.60	4.09
Barbus rebeli				0.16	0.17	
Cobitis ohridana		0.01		0.02		
Gobio ohridanus	0.38	0.51	0.36	0.65	0.64	1.10
Pachychilon pictum	0.66	0.12	2.67	1.29	1.85	1.16
Pelasgus minutus	1.65	1.56	0.97	0.12	0.11	0.16
Phoxinus lumaireul		0.21				
Pseudorasbora parva			0.01	2.04	2.92	4.22
Rhodeus amarus	0.06	0.07	0.01	0.15	0.88	1.97
Rutilus ohridanus	23.95	24.21	16.37	25.43	15.42	15.28
Scardinius knezevici	0.05		0.04		0.08	0.03
Squalius squalus	1.29	0.59	0.70	0.95	3.25	4.58

Figure 47. CPUE expressed in biomass (BPUE in g/m^2 of net) for sub-basin 7 (Tushemisht) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata



	050-075	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus				0.11			0.07
Alburnus scoranza				0.40	0.09	0.18	0.06
Barbus rebeli							
Cobitis ohridana	0.04	0.13	0.16		0.06		0.02
Gobio ohridanus	0.13	0.10	0.04		0.07	0.02	0.04
Pachychilon pictum		0.00		0.10		0.14	0.04
Pelasgus minutus		0.01		0.03	0.04	0.05	0.06
Phoxinus lumaireul			0.03	0.08		0.02	0.05
Pseudorasbora parva	0.31	0.09	0.02	0.30	0.22	0.10	0.04
Rhodeus amarus		0.02		0.08		0.01	0.01
Rutilus ohridanus	0.67	0.51	0.44	0.32	0.30	0.23	0.10
Scardinius knezevici			0.02	0.01	0.02	0.01	0.02
Squalius squalus	0.07	0.03		0.01			

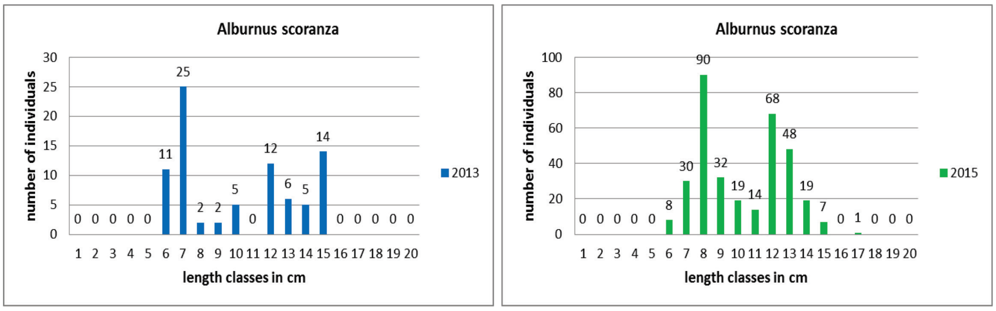


	035-050	020-035	012-020	006-012	003-006	000-003
Alburnoides ohridanus			0.01		0.13	0.19
Alburnus scoranza	0.31	0.29	0.39	0.24	0.36	0.46
Barbus rebeli				0.01	0.01	
Cobitis ohridana		0.01		0.01		
Gobio ohridanus	0.08	0.09	0.04	0.08	0.06	0.11
Pachychilon pictum	0.07	0.02	0.26	0.17	0.20	0.15
Pelasgus minutus	0.34	0.36	0.16	0.03	0.04	0.02
Phoxinus lumaireul		0.03				
Pseudorasbora parva			0.01	0.75	0.98	1.33
Rhodeus amarus	0.04	0.04	0.01	0.08	0.42	1.08
Rutilus ohridanus	2.27	1.89	1.80	2.43	2.44	3.42
Scardinius knezevici	0.01		0.01		0.02	0.01
Squalius squalus	0.03	0.02	0.01	0.02	0.20	0.22

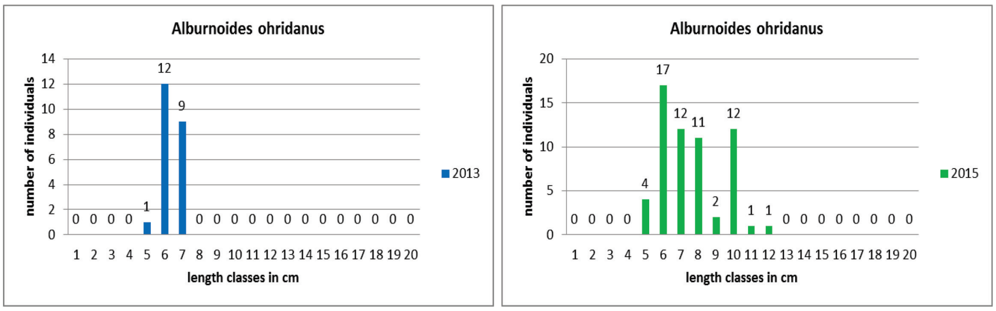
Figure 48. CPUE expressed in number of individuals/m^2 (NPUE, ind./m^2 of net) for sub-basin 7 (Tushemisht) of Lake Ohrid during the sampling campaigns of 2013 (left) and 2015 (right). Upper bars show the respective percentage of species. Data are given separately for the depth strata

Length-frequency distributions of the respective species of this sub-basin are given in Figure 49 (a-m). Despite of fewer numbers, the distribution for bleak and spirlin was similar to other sub-basins. In this SB, most of the bleak belonged to the 6-7 cm and 12-13 cm length classes, respectively, while the majority of the spirlin were in the 6-7 cm length class. As well, it should be noted that, in Tushemisht, roach specimens were more or less evenly distributed among the 4-14 cm length classes in contrast to Lin and Hudënisht, where the 8 and 9 cm length classes were almost non-existent.

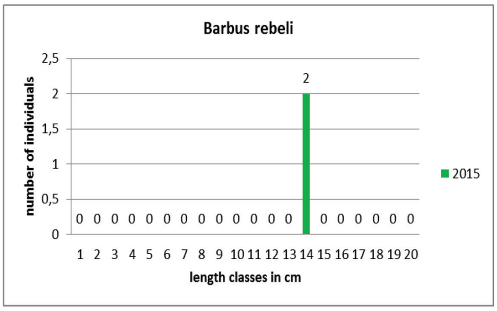
a)



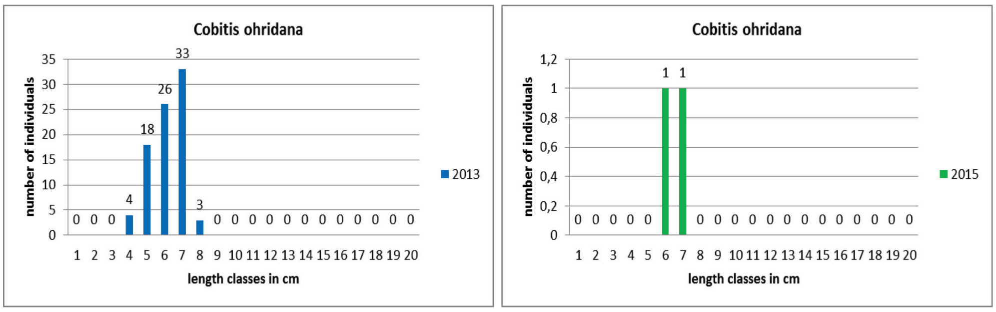
b)



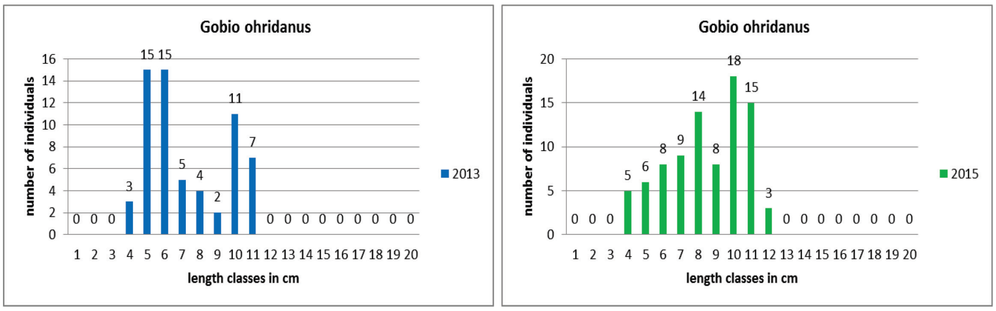
c)

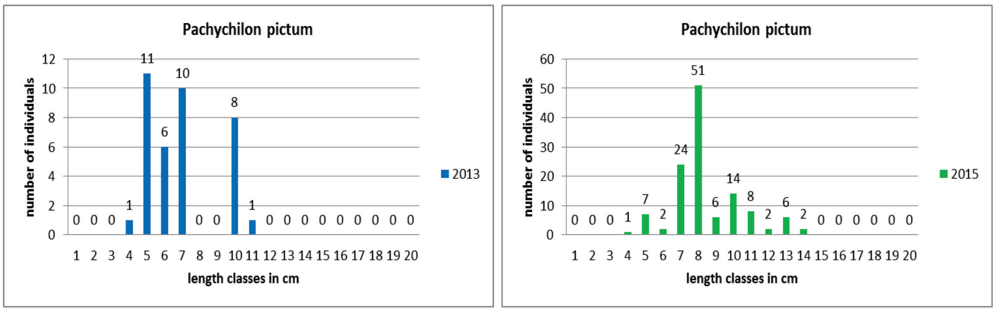


d)

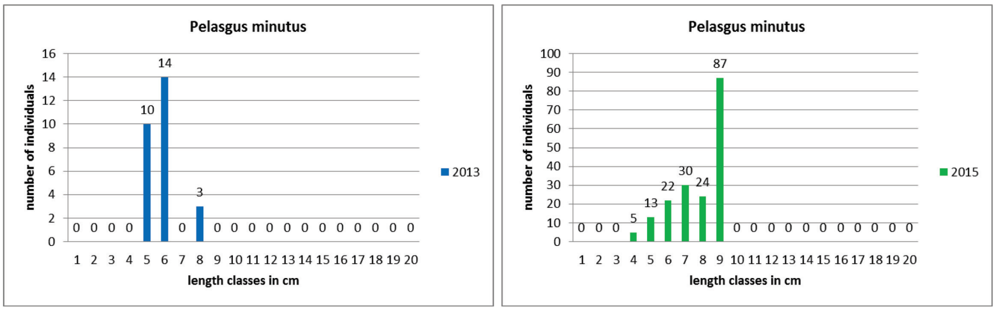


e)

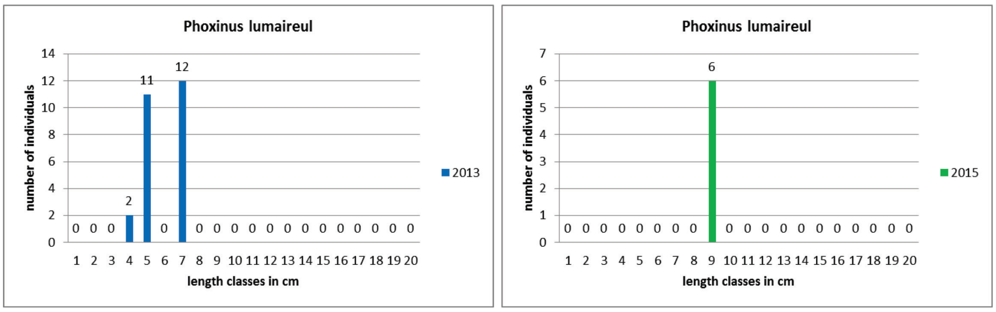



Pachychilon pictum
number of individuals
0 0 0 1 11 6 10 0 0 8 1 0 0 0 0 0 0 0 0 0
length classes in cm
2013
Pachychilon pictum
number of individuals
0 0 0 1 7 2 24 51 6 14 8 2 6 2 0 0 0 0 0 0
length classes in cm
2015

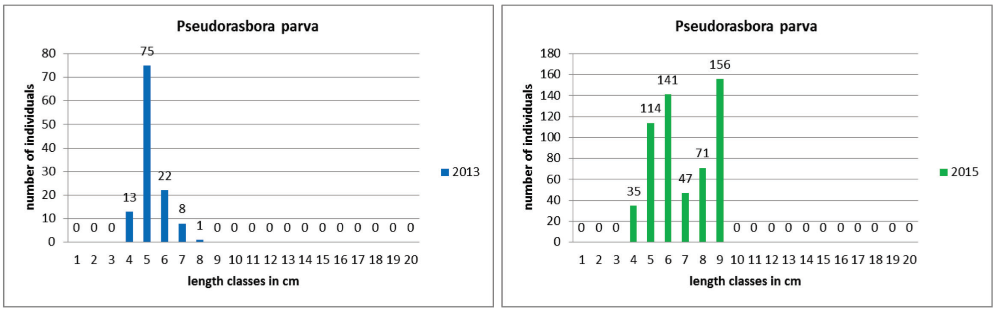
f)


Pelasgus minutus
number of individuals
0 0 0 0 10 14 0 3 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2013
Pelasgus minutus
number of individuals
0 0 0 5 13 22 30 24 87 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2015

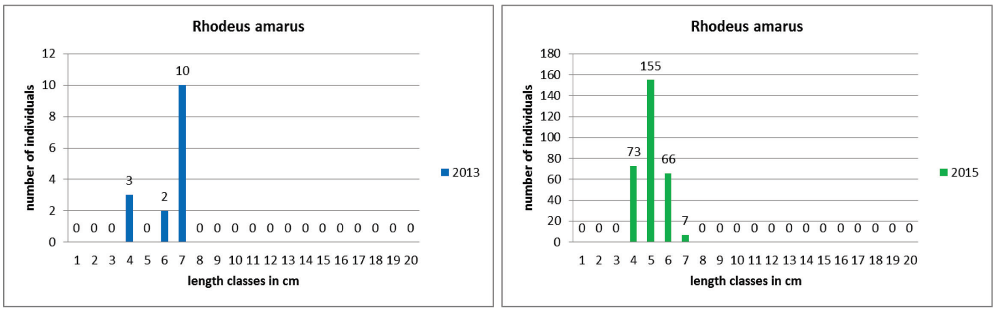
g)


Phoxinus lumaireul
number of individuals
0 0 0 2 11 0 12 0 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2013
Phoxinus lumaireul
number of individuals
0 0 0 0 0 0 0 0 6 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2015

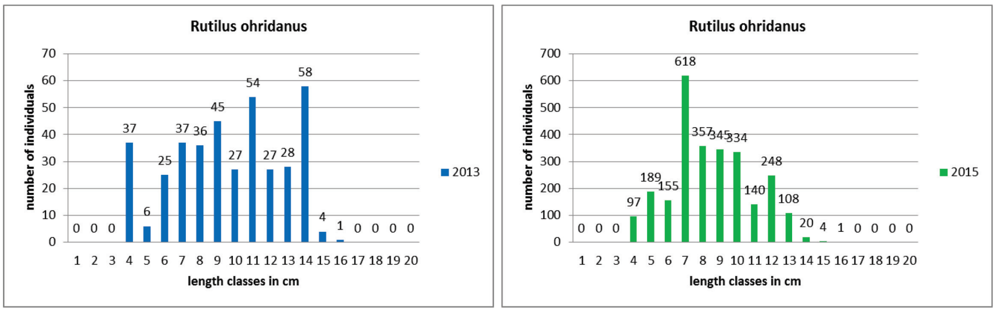
h)


Pseudorasbora parva
number of individuals
0 0 0 13 75 22 8 1 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2013
Pseudorasbora parva
number of individuals
0 0 0 35 114 141 47 71 156 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2015

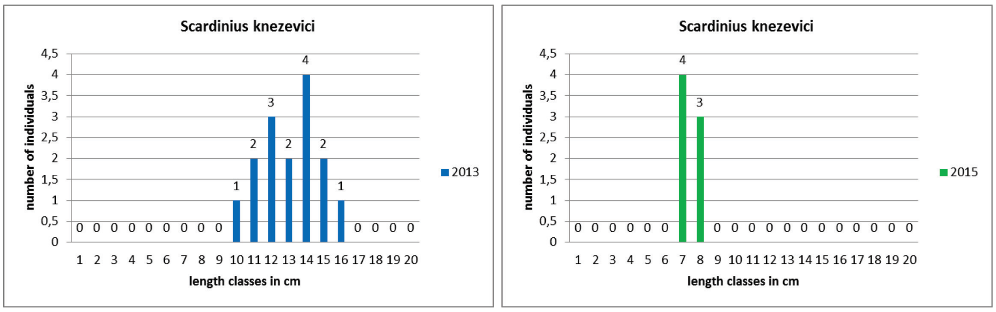
i)


Rhodeus amarus
number of individuals
0 0 0 3 0 2 10 0 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2013
Rhodeus amarus
number of individuals
0 0 0 73 155 66 7 0 0 0 0 0 0 0 0 0 0 0 0 0
length classes in cm
2015

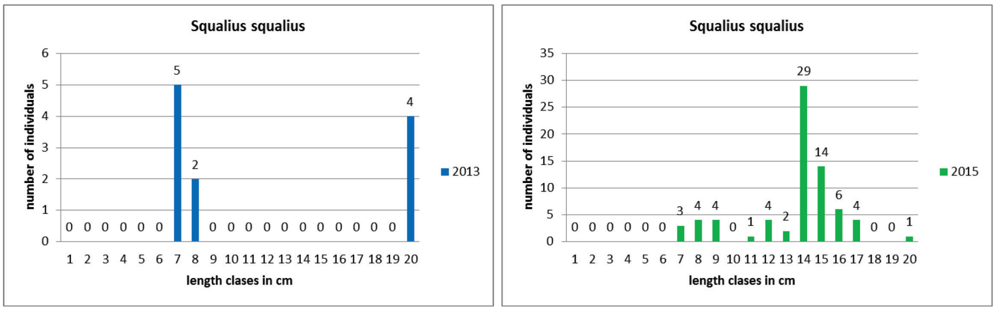
j)


Rutilus ohridanus
number of individuals
0 0 0 37 6 25 37 36 45 27 54 27 28 58 4 1 0 0 0 0
length classes in cm
2013
Rutilus ohridanus
number of individuals
0 0 0 97 189 155 618 357 345 334 140 248 108 20 4 1 0 0 0 0
length classes in cm
2015

k)



l)



m)

Figure 49. Length-frequency distributions of the fish species caught during the survey at SB 7 in 2013 (left) and 2015 (right)