

# Status of Fisheries at Megali Prespa Lake and Mikri Prespa Lake, Greece, Based on a Census of Fishermen's Opinions

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**Abstract** Prespa is a remote mountain area in NW Greece, with two lakes shared between three countries. Monitoring data about fish and fisheries are absent. This paper presents the results of a census, designed to explore the socio-economic status of commercial capture fisheries based on data obtained from fishermen themselves. Interviews were held in 2012 with 51 persons owning or participating in the 53 fishing businesses of the area. Fisheries importance for local economy has shrunk but its role in employment, especially for the tertiary sector and its cultural dimensions retain some significance. Differences in fisheries between the two lakes were attributed mainly to environmental and physical differences. Fishermen number declines and age increases. Initial investment for starting a business was close to the average for other European countries. Fishing methods used are mostly passive and less demanding in investment and effort. The average yield (2.06 tonnes / fishing business) were close to the average values for Greece and other European countries. Income from fisheries represented c. 1.4% of the local annual gross product. Fishing has a good potential to survive as a supplementary occupation. The main issue that relates to the transboundary nature of the two lakes is the need for harmonised management measures and restrictions.

**Keywords** Commercial Inland Capture Fisheries, Local Economy, Fish, Transboundary, Management

## 1. Introduction

Commercial inland capture fisheries, especially in lakes and rivers, are in decline across almost all of Europe [1,2,3] but still have a considerable importance for local and regional economies [4,3]. The European Union's Common

Agricultural Policy does not include provisions for inland fisheries (except for diadromous fish), and the drafting of national policies for inland fisheries comes under the exclusive jurisdiction of each member state [4]. In addition, inland capture fisheries around the world suffer from poor catch information, poor statistics and reporting and a poor integration of socio-economic and ecological dimensions [2].

In Greece, commercial inland capture fisheries are found mainly in the lakes and coastal lagoons of the north-eastern and western mainland. Regional and municipal authorities are responsible for managing the lakes and leasing fishing rights to fishermen, particularly to commercial fishing co-operatives. As inland fisheries do not generate a high income and are of marginal importance, the Greek state is not very interested in this occupation, which in practice is neither properly monitored nor managed, nor controlled [2,4]. Relevant legislation and regulations are in place, but, as in some other areas of Europe, are either deficient or confusing [3]. Moreover, they are also not well enforced, with fishermen facing only "loose" restrictions on types of equipment and on annual closed seasons. Consequently, a large part of the income from such fisheries remains undeclared to the tax authorities. Some lakes, such as the Prespa lakes, are no longer leased to the local fishermen, private companies or fishery associations by the state, an action which in the past, at least in theory, curtailed annual quota and imposed obligations for monitoring catches. In fact, today, individually licensed fishermen are allowed to fish freely. Moreover, the lack of reliable -or any- statistics on annual catches, in contrast to most other EU member states [1,2], impedes proper management planning for fisheries, at a local scale at least.

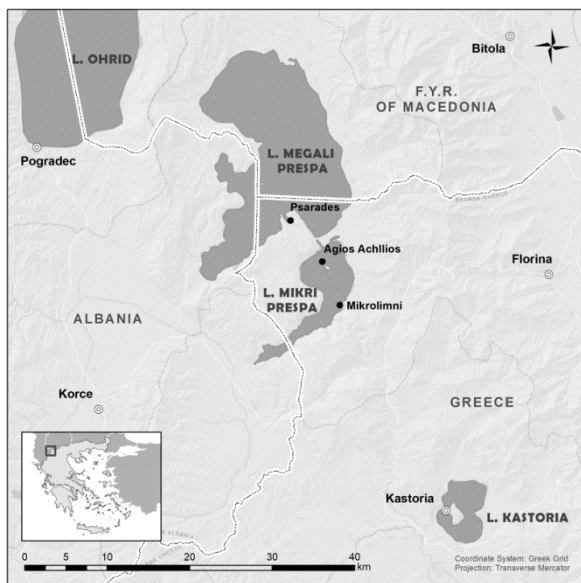
This was not the case in the past, especially up to the 1980s, when, in remote and marginal areas in particular, fisheries were quite important for a large part of the littoral populations, both as a principal and as a supplementary

income-generating occupation.

In general there is a scarcity of reliable information on the sector, which hampers any clear decision making, and carrying out of national or regional in-depth studies is a necessity [2].

This paper presents the results of a census, aiming to explore the status of fisheries as an income-generating occupation in Prespa, based on data obtained from fishermen themselves. The study was carried out as part of the project LIFE09 INF/GR/000319 “Fish, Fisheries and European Policy in the Prespa Basin”. Prespa is a remote mountain area in NW Greece, protected as a national park for its rich biodiversity, endemism and landscapes. Prespa is also interesting because its two lakes are transboundary, shared between Greece, Albania and the FYR of Macedonia. Thus effective fisheries management is more challenging, as it demands a degree of co-ordination and collaboration between the three littoral countries and has several particularities stemming up from the sharing of the basic resource, the lake ecosystems.

Being aware that reliable monitoring data about fish and fisheries in Prespa are absent, and that all available past data are obsolete [5], we designed a study which aimed to collect basic data that would allow us to obtain a reliable -to the maximum possible degree- snapshot of the status of fisheries, which could inform management and policy decisions for fisheries in the future.



**Figure 1.** Map of the region around Megali Prespa Lake and Mikri Prespa Lake

## 2. Study Area

Mikri Prespa Lake is situated at c. 850 m a.s.l., is eutrophic and c. 47.4 km<sup>2</sup> in area, with a mean depth of 4.1 m and a maximum depth of 8.4 m. Major part of the

lake is located in Greece, while a small section belongs to Albania. Its small size and depth result in regular freezing, especially in the Albanian section. Megali Prespa Lake is mesotrophic, varying between 245-270 km<sup>2</sup> in area depending on water levels, and has a maximum depth of c. 55 m and a mean depth of 14-18 m [6]. It is shared by Albania, the FYR of Macedonia and Greece. The two lakes should be considered as a functional unit, as, although they are separated by a narrow, alluvial strip of land, they are connected hydrologically. When Mikri Prespa Lake has high water levels, water may flow to Megali Prespa Lake through a controlled sluice. During the last decade periods of water-flow have, however, been few and short. Some of the water of Megali Prespa Lake flows through underground karstic channels to the lower lying Lake Ohrid. Both Prespa lakes are cyprinid-dominated, with the more abundant species in terms of numbers and biomass being Prespa bleak *Chalcalburnus belvica* and Prespa roach *Rutilus prespensis* (both species endemic to the Prespa lakes), while the most valuable commercial species is the common carp *Cyprinus carpio*. The lakes host nine endemic fish species in total (among them Prespa nase *Chondrostoma prespensis* and Prespa barbel *Barbus prespensis*) [7]. Four national parks are wholly or partly situated within the catchment of the two lakes, and both lakes (except for a small part on the Greek side) are designated as Wetlands of International Importance under the Ramsar Convention. The Prespa Park, a transboundary protected area was recently (2017) proclaimed after two decades of efforts. The Greek part of the catchment also contains two Sites of Community Importance (SCIs) and Special Protection Areas (SPAs) in accordance with European Union legislation. More information on the Prespa Lakes can be found in [8-10].

The Greek part of the Prespa basin (33814 ha) is located within the Municipality of Prespa (51528 ha), the jurisdiction of which extends beyond the borders of the actual watershed.

## 3. Terminology and Methods

According to Greek law, and following adaptation to the local conditions, a person is considered as a commercial capture fisherman if they fulfil the following requirements: a. they own or lease a professional licensed fishing boat/vessel and they own a commercial license to sell fish; b. they are covered by a social / health insurance granted by the Farmers Insurance Organisation, and c. they purchase fuel intended for their professional boat at least once every three years.

In Prespa there are only capture fisheries. Hereafter the term “fishermen” refers only to commercial capture fishermen and fisherwomen unless otherwise stated. “Principal fishermen” denotes fishermen for whom fishing

is their sole profession, plus those for whom it is their principal but not sole occupation, through which they earn more than half of their income. “Sideline fishermen” employ fishing as a supplementary occupation, from which they earn less than half of their income.

Face-to-face, semi-structured interviews were held in 2012 with 51 persons owning or participating in the 53 fishing businesses active in the area. All the data presented below refer to the fishermen’s own statements, and are indicative of the actual state of the fishery. A fishing business is defined as one consisting of one or two persons who fish to obtain an income and/or food, at least one of whom owns a fishing boat, as well as some fishing equipment, and at least one of whom owns, or has owned in the past, a commercial fishing license, i.e. a license to sell fish, issued by the state, which is the owner of the lakes resource.

The questionnaire contained three sets of questions: a. a socio-demographic and economic data set, b. a professional activity data set, and c. an opinion and perception data set.

The majority of fishermen do not keep a logbook for data such as daily catch, number and types of equipment used, fishing duration, sites, etc. Thus, data on Catch Per Unit of Effort (CPUE) are not available and most of the interviewees’ answers related to qualitative and quantitative aspects of the questionnaire relied largely on data drawn from their memories and were partly based on subjective knowledge, while only the 12% who keep logbooks with such data and the 4% who keep only economic data were able to consult their notes. Throughout the text means are given with  $\pm 1$  Standard Deviation.

## 4. Results

### 4.1. Demographic and Socio-Economic Data, Fishing Equipment, Practices and Yields

#### 4.1.1. Number of Fishermen and Fishing Businesses

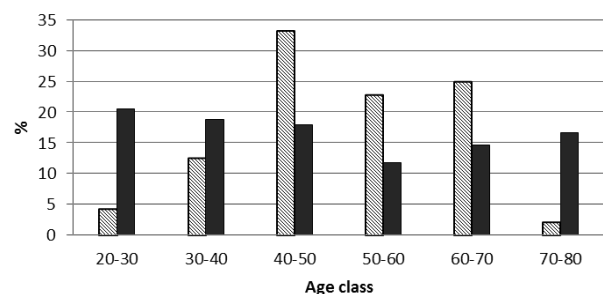
There are 53 boats in total on the two lakes, with one or two fishermen in each, who fish on a regular basis and can be considered to be occupied in the commercial fisheries sector, irrespective of whether fishing is their principal or sideline occupation. About half of the 51 interviewees are principal fishers, with only 10 making a living exclusively by fishing and a further 16 having fishing as their main income-generating activity. For the remaining 25, fishing is a sideline occupation. Out of the sideline fishermen, most are farmers, and a few are self-employed business owners or pensioners.

#### 4.1.2. Demography and Geographic Distribution of Fishermen

In 31 out of the 51 cases (60.8 %) fishermen fish with a

colleague/assistant. Four of them sometimes fish with a different assistant than usual. Out of 51 different businesses, 21 fish with an assistant of the same sex (male), 10 fish with an assistant of a different sex and 20 fish alone.

It is estimated that, in total, about 86 people are occupied in the commercial fisheries sector in Prespa. The Municipality of Prespa has 1650 inhabitants, with 833 people aged between 20 and 80, but for this study only the population of 1060 inhabitants within the Prespa basin (Hellenic Statistical Authority, 2011 National Population Census, online available from <http://www.statistics.gr/el/statistics/-/publication/SAM03/2011>) has been taken into consideration, as no professional fishermen are registered outside the watershed. Thus, the overall proportion of commercial fishermen in the population of the Prespa basin is 8.1%, while the proportion in the corresponding age-class range is 10.3%. A comparison of the age-class distribution of fishermen to the age-class distribution of the inhabitants of the Municipality of Prespa [Hellenic Statistical Authority, 2011 National Population Census, online available from <http://www.statistics.gr/el/statistics/-/publication/SAM03/2011>] shows that fishermen are much less represented among young people (20-40 years), (Figure 2) and comparatively more in the older age classes (40-70 years). In particular, fishermen from Psarades village are on average older than the rest.



**Figure 2.** Proportion of age classes of fishermen (striped bars) compared to proportions of age classes in the total municipal population (filled bars). [Hellenic Statistical Authority, 2011 National Population Census, online available from <http://www.statistics.gr/el/statistics/-/publication/SAM03/2011>]

Almost 39.2% of fishermen live in the village of Psarades (Psarádes = “fishermen” in Greek). The villages of Psarades and Agios Achillios have a higher proportion of fishermen in relation to their population than other villages (15% and 14.2% respectively).

Three women fish actively and can be considered commercial fisherwomen, while three just hold a professional fishing licence in their names because their husbands, whom they assist in fishing and support in several other professional issues, cannot fulfil the necessary legal requirements to be considered regular commercial fishermen. All fisherwomen fish with a male colleague, their spouse or son, and all are between 40-70

years old. The overall number of women involved as license holders or assistants in fishing businesses in Prespa is 6-10, representing up to 11.7% of all fishermen.

Young fishermen are few in number. More fishermen of an older age tend to fish alone than younger fishermen. When fishermen fish with assistants of the same sex, most of these colleagues are also older. Principal fishermen fish more frequently with their spouse, in comparison to all others.

The average age of fishermen in Mikri Prespa Lake is 48.6 years (n=27), while for Megali Prespa Lake it is 54 years (n=23). The average age of fishermen for both Prespa lakes is  $51.2 \pm 11.4$ , n=51), or  $49.6 \pm 14.3$  if all those involved in fishing businesses are taken into account (n=86).

Principal fishermen are also older than all the rest. Younger fishermen tend to carry out fishing as a sideline occupation. Principal fishermen are on average comparatively older than farmers and older still than private business owners. This fact alone clearly denotes a decline in the fishing profession.

#### 4.1.3. Proportion of Licence Holders

To get a commercial license a fisherman must own or lease a licensed professional fishing boat and be a member of a local professional fishing association, which officially certifies that they devote more than 50% of their professional time to fishing and that more than 50% of their income comes from fishing. In Prespa there are two active professional fishery associations: "Prespa", with 32 members, all from Psarades village, and "Carp" with 47 members from all the other villages. Out of the 51 interviewees, only 35 (68.6%) have a licence. The proportion is higher among those mainly fishing on Megali Prespa Lake (78%) than those fishing on Mikri Prespa Lake (61%). Fishermen fishing with an assistant are more likely to have a professional licence than those who fish alone. All fishing couples of a different sex hold at least one professional licence between them.

#### 4.1.4. Initial Investment and Annual Maintenance Cost

Fishermen's estimates for the initial capital needed by a recruit to the profession vary greatly (Table 1). The average estimation is ca  $12016 \pm 5616$  € while the median is 10000 € (n=50, range 800-30000 €). Even higher variability is observed in their estimations for the annual maintenance, repair and renovation costs, the mean of which is  $1364 \pm 1433$  €/year (n=49, range 50-8000 €) with a median of 1000 €

**Table 1.** Average estimated investment required for launching professional fishing activity (initial capital) in the Prespa area and average estimated annual cost for maintenance and consumables (not including fuel) as assessed by the fishermen themselves

Lake	Initial investment (€)	Annual maintenance and renovation cost (€)
Mikri Prespa	9279	2014
Megali Prespa	14826	1406

As shown in Table 1, initial capital estimates for those fishing on Megali Prespa Lake are higher than for those fishing on Mikri Prespa Lake, while the opposite is observed for the annual maintenance costs. No significant differences are observed between licensed and unlicensed fishermen. However, principal fishermen do estimate the necessary initial capital (mean 13800 €) to be much higher than sideline fishermen (mean 9900 €). The same is observed for the annual maintenance cost, which is estimated to be higher (mean 2220 €) by the principal fishermen than the rest (mean 1430 €), which is consistent with principal fishermen investing more in their sole, or main, income-generating occupation.

#### 4.1.5. Fishing Grounds, Boats, Fishing Equipment

Out of the 51 fishing businesses, 26 (51%) fish only in Mikri Prespa Lake; 18 only fish in Megali Prespa Lake; while seven fish in both lakes, making the decision according to target species and convenience. Both fibreglass (polyester resin) and traditional wooden boats are used. At Mikri Prespa Lake only one fisherman owns and uses both types of boat, while all the remaining 28 (97%) own and use only fibreglass boats.

At Megali Prespa Lake 35% of fishermen use traditional boats and 65% use fibreglass ones. Wooden boats are heavier, more stable and safer in difficult conditions, but are costlier to build (they are not commercially available) and need annual maintenance. Only one local craftsman who knows the art of building a traditional boat remains. These boats have also a sentimental value for many fishermen and are considered to be an irreplaceable cultural heritage by several. On the other hand, polyester boats are commercially available, cheaper, easier and quicker to build and require minimal and cheaper maintenance.



**Figure 3.** The two types of boat in use in the Prespa lakes, Greece. The traditional wooden boat (left) and the modern one made of fibreglass (right)

#### 4.1.6. Power of Motors and Fuel Cost

All fishing boats at the Prespa lakes are equipped with

engines, varying from 4 to 40 HP, (average 17.3 HP ± 6.9, n=51). Five fishermen use a second engine, usually more powerful, to cover exceptional needs. Half of the boats use 15 HP and 25 HP engines.

Respondents' estimations of the annual cost of engine fuel were highly variable, ranging from 500 to 9000 € The average value given was 1752 ± 1900 €, n=50, and the median value was 1100 € Those fishing Megali Prespa

Lake use more powerful engines than those fishing Mikri Prespa Lake (average power 20 vs 15.4 HP. The estimated annual fuel cost for Megali Prespa Lake is higher than for Mikri Prespa Lake (2330 vs 1300 € / year), apparently due to the greater distances that have to be covered in the larger lake.

4.1.7. Types of Fishing Equipment and Use per Season

Fishermen mostly use passive equipment, i.e. trammel and gill nets. Long lines baited with corn are also used for carp. A traditional active method, which is unique to the area, is that of cast nets equipped with small lights, which are used on winter nights over the deepest parts of Megali Prespa Lake to catch bleak, which congregate in the karstic depressions of the lake bottom.

“Carp nets” (Figure 4) are mainly trammel nets 50-100 m in length and 70-100 mm in mesh size. “Nase nets” are mainly gill nets (70%), 50 m in length and 24-26 mm in mesh size. “Bleak nets” are 10 m in length and 14 mm in mesh size. Finally, long lines are usually 1000 m in length with hooks every metre. Each fisherman (or fishing business) owns 40 carp nets on average, while the average mesh size for the carp nets used is ca 75 mm (75.3 ± 9.8 mm, range 55-100 mm, n=49) with no differences in mesh size and number of nets between the two lakes.

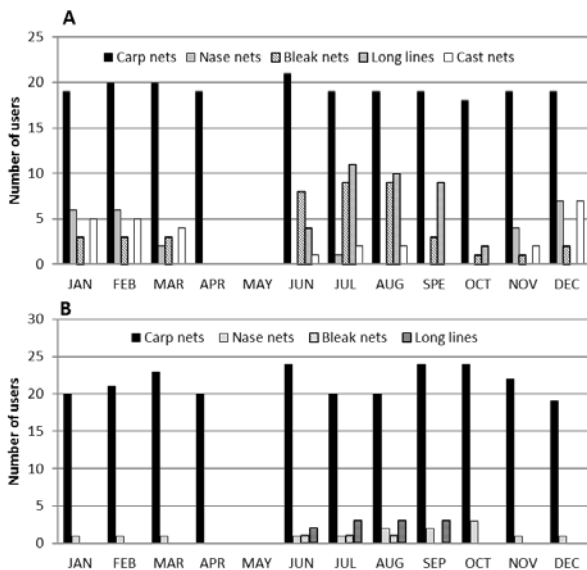


Figure 4. Monthly numbers of fishermen using different fishing equipment in Megali Prespa Lake (A) and Mikri Prespa Lake (B)

4.1.8. Yields

Neither logbooks nor catch reports are kept by the vast

majority of fishermen (84%, or 42 individuals), so there is almost no kind of catch reporting whatsoever. Consequently, there is also no monitoring of catches by value. Respondents estimated the quantities of their personal annual catches empirically, either based on their experience and memory, or with the help of their logbook notes (only five fishermen). Carp is the main target species in both lakes. Annual catches per fisherman vary greatly (30 to 5000 kg), the mean being 1550 kg, with 1651 kg for Mikri Prespa Lake and 1416 kg for Megali Prespa Lake. The median catches are 1000 and 900 kg respectively.

Principal fishermen have a catch per year (2083 kg) which is almost double that of the others (1024 kg). Furthermore, licensed fishermen have higher catches (1739 kg) than unlicensed fishermen (1102 kg).

The average annual catch of bleak per fisherman is 1090 kg. However, in some years there is a high demand for bleak for export, and in those years very large quantities can be caught with cast nets, dramatically increasing the overall yield statistics, a situation which has been observed many times in the past.

Table 2. Empirical estimations of total annual catches for each target species, as calculated by adding the personal annual yield estimations of each respondent (in kg). In brackets, the percentage of each species in the total yield

SPECIES	Mikri Prespa Lake	Megali Prespa Lake	Total
Common carp	45250 (94.9)	29330 (51.1)	74580 (71.0)
Prespa bleak	50 (0.1)	17360 (30.3)	17410 (16.6)
Prespa roach	-	5300 (9.2)	5300 (5.0)
Prespa nase	2115 (4.4)	5350 (9.3)	7465 (7.1)
Prussian carp	250 (0.5)	-	250 (0.2)
All	47665	57340	105005
Yield in kg / ha	10.95	15.25	

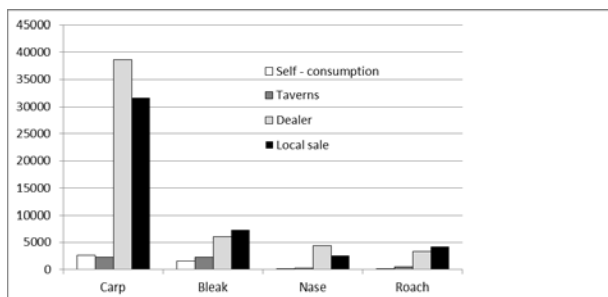
The average annual catch of nase per fisherman is 834 kg. Almost twice the quantity of nase is caught in Megali Prespa Lake than in Mikri Prespa Lake. Young fishermen ignore nase. Roach is targeted only by five fishermen in Megali Prespa Lake and the average annual catch per fisherman is 1060 kg. Prussian carp *Carassius auratus gibelio* is an unwanted species which appears in the catches of only two fishermen.

4.1.9. Marketing

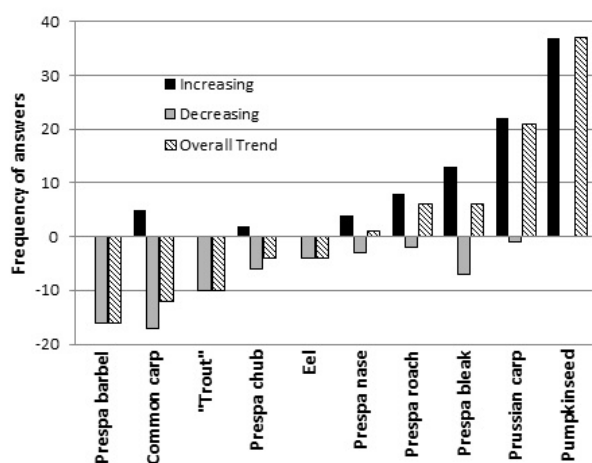
On average 37% of the yield is sold to regional dealers and wholesalers, 34% is sold locally through direct private sales, 20% is used to meet personal needs and 8% is sold to local fish restaurants. The pattern varies according to demand and local ad hoc circumstances. These proportions may also be used to characterise the Prespa fisheries as 80% “commercial” and 20% “subsistence” (sensu Anonymous [2]).

Most carp is sold to wholesalers to be forwarded to regional markets (51.4%), but a large proportion (42%) is sold locally, while 3.1% is sold to the local restaurants and 3.5% is consumed by the fishermen (Figure 5). Bleak are

mainly sold privately and locally (42.1%), though a large proportion goes to wholesalers (35%), while 13.6% is sold to local restaurants and 9.1% retained for personal consumption. Outside Prespa, private sales target markets in the largest towns of the region of Western Macedonia: Florina, Kastoria, Ptolemaida, Kozani, Edessa and, less so, Giannitsa. Besides these towns, wholesalers also sell the fish in Thessaloniki, Greece's second largest city.



**Figure 5.** Proportions of four different destinations of the main catch according to species



**Figure 6.** Perceptions of fishermen with regard to population trends of the main fish species caught in Mikri Prespa Lake and Megali Prespa Lake. The "Overall trend" index is the net difference of answers for increase minus answers for decrease

#### 4.1.10. Income

For 2011 the prices for each species according to fishermen were: carp: 2.5-7 €/kg (varying according to size, demand and buyer), bleak: 1 €/kg, roach, nase and Prussian carp: 0.6-0.8 €/kg. Based on these prices and the annual catches according to fishermen's estimations, it was estimated that, on the whole, fishing generates an average annual income (gross) of about 7175 € for each of the 53 fishing businesses in Prespa.

## 4.2. Perceptions

### 4.2.1. Fish Stock Trends

Despite minor differences in individual perceptions of stock trends for the two lakes, there is a fair consensus

amongst fishermen that Prespa barbel, carp and trout have declined, while sunfish and Prussian carp have increased. For all other species less strong trends appear.

### 4.2.2 Stock Enhancement and Enhancement of Reproduction

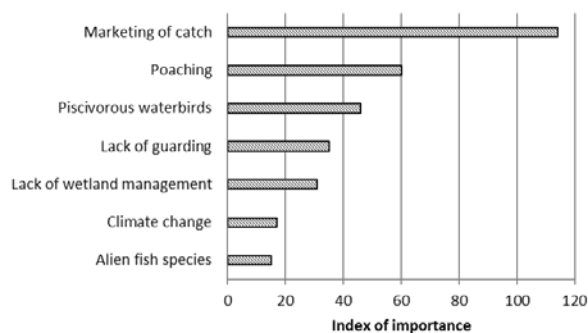
The majority (96%) of respondents consider stock enhancement and stocking as beneficial (to fisheries), while almost 2/3 of them believe that only stock enhancement with carp is beneficial. Exotic species like trout, perch, pike (all predatory species) and whitefish are also quite popular among fishermen for potential stocking.

Fishermen were also asked, without prompting, to suggest management interventions that could improve the spawning success of fish and thus enhance their reproduction. Almost 2/3 of all respondents (35 of 51) focused on improvement of wardening to minimise poaching. Twenty respondents emphasized the need for adequate wetland management, while a few mentioned the need for awareness raising of fishermen on issues of sustainability, as well as enhancement of wardening in the Albanian parts of the lakes to reduce dynamite fishing and equipment theft.

### 4.2.3. Crucial Problems/Threats for the Profession

For a variety of reasons the vast majority of respondents (88%) do not consider their fishing business to be viable.

Fishermen were asked to name the problems/threats facing the profession and to prioritise them as "critical", "important" or "secondary". An overall index of importance was produced based on these answers. Figure 7 shows only the higher ranking seven problems/threats according to this index. The answers were unprompted but a short indicative list of potential problems was provided to them for assistance.



**Figure 7.** Ranking of the most important problems/threats faced by the Prespa lakes fisheries, Greece, according to an index of importance based on the ranking of threats by fishermen as "critical", "important" or "secondary". Index of importance = frequency of critical issue x 3 + frequency of important issue x 2 + frequency of secondary issue

The need to ensure the marketing of their catches is by far the most crucial issue, followed by poaching and piscivorous birds, with particular reference to pelicans *Pelecanus* spp. and less so to great cormorants

*Phalacrocorax carbo*. Less important problems identified, and not appearing in Figure 7 above, were lack of awareness amongst fishermen, equipment theft (by people from the other two countries sharing the lakes, particularly Albania), smuggling (fish caught in Greece sent to markets in Albania and vice versa) and the eutrophication of both lakes.

#### 4.2.4. Suggestions for Improvement

Law enforcement is considered crucial by a higher percentage of unlicensed fishermen (13 of 16) compared to licence holders (22 of 35). This enforcement pertains to wardening to stop poaching during spawning, preventing the use of illegal fishing equipment such as transparent monofilament nylon nets, and limiting the use of smaller mesh sizes.

Wetland management appears more important to fishermen on Mikri Prespa Lake (16 of 29, 55.2%) compared to those fishing in Megali Prespa Lake (4 of 22, 18.1%). This is perceived as including: use of fire (a traditional method) to control reedbed expansion and keep wet meadows free of emergent helophytes; operation of an abandoned fish breeding station to provide fish for stocking; modification of the sluice gate between the two lakes to prevent fish loss from Mikri Prespa Lake to Megali Prespa Lake, and reduction of chemicals used in agriculture to improve water quality, as well as minimise litter. It is also interesting that the management of the lake/wetland was considered more important among sideline fishermen (16 of 26, 61.5%) than others, while wardening is more important for licence-holders (14 of 35, 40%) than the rest. As expected, improvement of marketing status was far more important to fishermen on Megali Prespa Lake, than all the others.

## 5. Discussion

### 5.1. Demographic and Socio-Economic Data, Fishing Equipment, Practices and Yields

The total number of fishermen continues to decline, as has been observed since World War II [7]. In 1939, there were 190 commercial fishing businesses (families) from 6 villages, and 170 boats [11]. Today, the age range of fishermen also shows a declining profession, soon to be only a sideline occupation of a supplementary nature. Even 20 years ago fishermen on Mikri Prespa Lake were already 8-9 years older than in other large lakes of northern Greece [12]. In 1988, fishing had been the main or exclusive occupation for 8 of 19 fishermen (42.1%, but the sample was not random, [12], while at present only 10 of 51 (19.6%) active commercial fishermen consider fishing to be their exclusive occupation.

The initial investment in a boat, engine and equipment for inland fishermen from ten European Union countries

was assessed to be in the range of 2500-25000 € in 2008-2009, thus the estimated initial investment for Prespa for 2011 (between 9279 and 14826 €) seems to be close to the average values [2]. The average boat engine power in 1988 was  $3.6 \pm 3.2$  HP for Mikri Prespa Lake [12] compared to the current 15.4 HP, a difference clearly demonstrating the improvement in infrastructure. No comparisons can be made for equipment owned and used, because there are no detailed historical data.

All active, traditional and arduous fishing methods, such as the "pelaizia" [13,7], have been completely abandoned since the early 2000s. The equipment used now is mostly passive and less demanding in terms of investment and effort. Of traditional active equipment only cast nets have survived, though they have strongly declined in use. Fibreglass boats have almost entirely displaced traditional wooden ones over the last 20 years.

The minimum net mesh size used in Mikri Prespa Lake in 1988 was  $38.6 \pm 15.1$  mm [12], much smaller than current mesh size ( $75.3 \pm 9.8$  mm), which is almost double, reflecting the neglect of smaller-sized species of lower value and an almost exclusive focus on carp, but also the adoption of restrictive regulations in the meantime [7].

The annual fish catch per fisherman in 1988 for Mikri Prespa Lake was  $1731 \pm 1603$  kg (n=19, [12] compared to  $1616 \pm 2029$  kg (n=28) in 2011, which was very similar, although the older data included fish species other than carp, while the recent data refer only to carp. Thus, at least for carp and for Mikri Prespa Lake, there are indications of an increasing yield per fishing business, though the personal assessments of fishermen should be certainly considered to be underestimations. Of course, as there are no data on effort, the value of such comparisons is negligible.

In total, for the whole area, the average annual yield was 2.06 tonnes/fishing businesses while for the period 2007-2008 average annual yields were estimated to be 2.2 tonnes/fishing business for Greece and 2.4 tonnes/fishing business for 21 European Union Member States [2]. This indicates that the fisheries in Prespa do not show strong signs of decline, and that they are close to the average values both for Greek inland fisheries and for those in other European countries.

In 1988, the proportion of catch marketed in the village was  $4.6 \pm 11.9$  %, in the local district  $50.3 \pm 25.1$  %, and in other districts  $43.1 \pm 25.5$  % [12]. The results for 2010s show that these proportions have not changed substantially since that time.

The average annual turnover for the 53 fishing businesses in Prespa was estimated to be close to 7175 € which is the apparent income assessed through the overall value of catch /number of businesses. For the period 2007-2008 this figure was assessed as being 6203 € for Greece and 7279 € for the 21 Member States [2]. Given the extremely likely underestimation of the data given by fishermen, it would be quite reasonable to conclude that for

Prespa the average annual turnover in 2011 may well be above the average for Greece and other European countries. Net income cannot be easily estimated but given the estimated average cost of maintenance plus fuel for both Lakes Prespa (3525€) it can be estimated to a pre-tax amount of approximately 3650 €

For 2012 the Annual Gross per Capita Income for the Region of Florina (in which Prespa belongs) was estimated to be 16333 € [Hellenic Statistical Authority, online available from <http://www.statistics.gr/el/statistics/-/publication/SAM03/>]. Based on this figure it was estimated that the income from fisheries represents c. 1.4% of the annual gross product of the Prespa Municipality, which is much lower than that which was estimated for 1994 (3-4%, [14]).

There have been two studies [15, 16] that have attempted to provide an integral picture of the status and the transboundary dimensions of the fisheries in the Prespa area. Though the data are very uncertain, from both studies it was estimated that there were between 60 and 115 fishermen in Albania and 85 in the FYR of Macedonia, almost all of whom are part-time fishermen. Hartmann [15] claims that actual numbers of fishermen in the FYR of Macedonia may reach as many as 240, and in Albania 500.

The annual yield/productivity was estimated by Spirkovski [16] to be 22 kg/ha in the FYR of Macedonia and 39.3 kg/ha in Albania, but in both countries Prespa bleak varied hugely between years and on average represented 65-84% of annual catches. This confirms that annual catches in the Prespa lakes, both at present and in the past, are being governed by the demand for bleak and thus cannot be used to assess the yield trends in any kind of meaningful and unbiased ways, and certainly not indicating connections to the productivity and/or capacity of the lakes. Both productivity estimates, however, are much higher than those for the Greek part (10.95 - 15.25 kg/ha), which are also much lower than previous estimates for the Greek part: 38 kg/ha for Mikri Prespa Lake, 1963 - 1989 and 33.5 kg/ha for Megali Prespa 1973-1990 Lake [7,5], but of course in these estimates Prespa bleak also comprised 67-70% of the catches.

The main issue that relates to the transboundary nature of the two lakes is the need for harmonised management measures and restrictions, such as a closed season, size limits, common policies for stocking, wardening, law enforcement, etc., with these kinds of measures being emphasised in a number of relevant documents and studies [17,15,16]. The extent of the use of illegal fishing methods is, of course, connected to the degree of law enforcement capacity in each state. According to Grazhdani et al. [18] and Grazhdani [19], for the Albanian parts of Megali Prespa Lake and Mikri Prespa Lake statistical data were, and are, not reliable, however for the period of the 1980s and 1990s fishing contributed more than 15% to the local annual per capita income. But according to best available data, the average annual yield of all fishermen in Prespa varied from 3 to 129 kg/ha, and for both lakes (1987-1990)

from 2.3 to 63.6 kg/ha, thus clearly indicating that this is again governed by the demand for bleak (82 - 96.5% of all catch between 1960 and 1995), fishing pressure or other ad hoc parameters and conditions which do not have much to do with capacities of the ecosystem. Most fish are marketed either locally or in Korça, the closest large town. During the last few decades local fishermen have over-exploited the resources in an illegal and/or uncontrolled way. In some cases, even dynamite fishing has been used [20]. In comparison to the four licensed and controlled fishing groups prior to 1991, there were only two organised and licensed fishing groups in 1997 equipped with fishing boats. But there were many other individuals aiming to earn some money by fishing, selling the fish in Korça, or beyond the state border. Smuggling to and from Greece is still not an uncommon practice, as is also testified to by Greek fishermen.

For the part of Megali Prespa Lake belonging to the FYR of Macedonia, the data are much less clear and detailed, but Spirkovski [16] has estimated the annual income per family (fishing business) to be c. 2500-3000 € for 2010.

## 5.2. Perceptions

It is noteworthy that the average fisherman's opinions about trends in fish stocks are in agreement with the results of scientific monitoring. Fish stocks have been monitored almost every year since 1984, [7, SPP unpublished data] in both lakes. According to the monitoring results, carp showed an increasing trend in 1984-2015, though with fluctuations in both lakes, for reasons similar to these analysed in detail by Crivelli et al. [7]. What is apparent, though, is a clear declining trend for both lakes in the period 2006-2015, which obviously correlates with what the fishermen have perceived and noted. The Prespa barbel has shown a dramatic decline in the period 1984-2015 and this is also reflected in fishermen's estimations. The sunfish, too, is clearly increasing according to monitoring results. The Prussian carp appeared in the mid-1980s, showed a sharp increase for ten years, then declined, but has recently showed signs of recovery, and this is clearly what has been perceived by fishermen. Prespa nase and Prespa bleak show unclear trends in fishermen's assessments, and exhibit stable, or even slightly increasing, populations in the monitoring results.

Fishermen in Prespa believe that stocking, a widespread fisheries management practice with both carp and other species, is very good. Regular stocking and exploitation is something common and is carried out across Europe by both commercial and recreational fisheries. There is a huge literature about various negative aspects of this type of management -though much less about its positive aspects- which should all be considered carefully before implementation [21, 22, 23]. It is apparent that there is a need for raising the awareness of fishermen about the pros and cons of stocking enhancements.

Amongst the problems facing the fishery, the lack of



good marketing of products is crucial. It is noteworthy, however, that fishermen exhibit a strong “statist” approach, in contradiction to the free market environment in which they live. Despite a low degree of tax compliance, they argue that the state, rather than themselves, should strive to ensure the sale of their catches and cover the damage done to stocks by fish-eating birds! It is also interesting that Prespa fishermen have a moderately negative attitude towards piscivorous birds, but in contrast to everywhere else in Greece and Europe where the great cormorant is considered to be the most significant competitor, in the Prespa lakes it is the pelicans which are accorded this rank. And this is apparently due to the fact that the Prespa lakes host the largest breeding colony of the Dalmatian pelican *Pelecanus crispus* in the world, numbering around c. 1300 br. pairs in recent years, and several hundred breeding pairs of great white pelicans *Pelecanus onocrotalus* [24]. Thus, it seems that fishermen direct their dislike to the most numerous species and not necessarily those most effective in fishing. In accordance with Pyrovetsi & Daoutopoulos [24], who found that principal fishermen in Mikri Prespa Lake had less positive attitudes to pelicans, while those who fished as a sideline occupation had more positive attitudes to the above issues, this study also had similar results.

Two local particularities, connected to the transboundary nature of the lakes, are the problem of equipment theft and the illegal transboundary fish trade.

Proposals for improvement by the fishermen have not been very specific in suggesting ways for improvement, and again pinpointed problems without providing solutions (“the state must find a solution to the marketing problem of our products” is what is implied). They acknowledge the problem that no one is really effectively dealing with wetland management and wardening, and they also acknowledge the need for promotion of collaborative solutions. In comparison, the two main problems identified for Greek inland fisheries in Anonymous [2] were: a. lack of incentives for young people to start a business, and b. ecosystem degradation, while the two basic needs had been: fleet renewal (restricted to the River Evros fisheries, though) and marketing strategies. In the case of Prespa the future of the profession seemed very gloomy, so the issue of young people lacking incentives was not raised at all. Ecosystem degradation was indeed mentioned by fishermen in Prespa but was categorised as of secondary importance, and in fact it is very much associated with the identified lack of wetland management. The main need remained the same, i.e. a solution to the marketing problem.

## 6. Concluding Remarks

The character of fisheries in the Prespa lakes, Greece, is approximately 80% commercial and 20% subsistence. Perhaps the actual ratio could be even more weighted towards a commercial nature, but still Prespa has fisheries

of a mixed character.

Fisheries’ importance for the local economy has shrunk considerably in relation to the past but it retains some significance, as does fisheries’ role in employment and their cultural dimensions. Especially noteworthy is the role of fisheries for the tertiary sector in an area visited by thousands of people annually, as the gastronomic dimension of tourism is crucial and is mainly related to local fish dishes.

Differences in fisheries between the Megali and Mikri Prespa lakes can be attributed to both environmental and physical differences (size, depth, mixing of waters, variability of target species, variability of tools used, longer distances), but also to social-historical and cultural reasons. The village of Psarades has a much stronger tradition in the fishing industry than all others in Greek Prespa. The village never owned much cultivable land and it survived for centuries by relying mainly on fishing.

Traditional wooden boats are on the brink of extinction and the traditional knowledge of how to construct them should not be left to perish.

Fishing is close to ceasing to exist as an exclusive occupation, but it has a good potential to survive as a supplementary source of income.

Fishermen must be further encouraged to keep logbooks, so that data on CPUE can be produced and reliably inform future management decisions.

As in other areas in Europe [3], in Prespa little consideration has been given so far to fish and fisheries in development proposals. This is only partly due to the difficulties inherent in integrated management of the lakes owing to their transboundary nature and the different socio-economic conditions prevailing in the three littoral countries. The harmonised management of fisheries is a challenge, but it seems that the multi-faceted potential of fisheries in these lakes deserves a chance.

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