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# CONSERVATION STATUS OF NATIVE SPECIES IN NATURAL LAKES OF DRIM SYSTEM (PRESPA, OHRID AND SKADAR LAKE) AND DANGERS OF COMMERCIAL FISHING

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## Abstract

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Prespa, Ohrid and Skadar are the largest lakes on the Balkan Peninsula. The native fish population consists, in total, of fifty species. These lakes represent centers of biodiversity of ichthyofauna of the Balkans and many fish species are strictly protected and placed on the IUCN (International Union for the Conservation of Nature) red list. In fact, one species is listed as Extinct (EX), three are Critically Endangered (CR), three are Endangered (EN), eight are Vulnerable (VU), twenty-four are Least Concern (LC), five are listed as Data Deficient (DD) and six species are Not Evaluated (NE). At the same time Prespa, Ohrid and Skadarlakes are significant fishing areas where commercial fishing is conducted. In some lakes, large quantities of fish that are caught are strictly protected species according to the IUCN red list.

*Key words:* Balkan, threatened species, IUCN red list, Drim system
*Abbreviations: EX*– Extinct; EW – Extinct in the Wild; CR – Critically Endangered; EN– Endangered; VU– Vulnerable; LR/cd – Lower Risk/conservation dependent; NT – Near Threatened (includes LR/nt – Lower Risk/near threatened); LC – Least Concern (includes LR/lc – Lower Risk, least concern); DD – Data Deficient, Has not yet been evaluated against the criteria; NE – Not Evaluated – Has not yet been evaluated against the criteria

## Introduction

IUCN Red List of Threatened Species (also known as the IUCN Red List or Red Data List), founded in 1948, is the world's most comprehensive inventory of the global conservation status of plant and animal species. The IUCN is the leading global authority on the conservation status of species. The IUCN Red List is based on precise criteria used to evaluate the extinction risk of thousands of species and subspecies. These criteria apply to all species and all regions of the world. The aim is to convey the urgency of conservation issues to the public and policy makers, as well as help the international community to reduce species extinction.

The IUCN Red List is widely considered to be the most objective and authoritative system for classifying species in terms of extinction risk.

The IUCN aims to have the category of every species re-evaluated every 5 years if possible, or at least every ten years. This is done in a peer reviewed manner through IUCN Species Survival Commission (SSC) Specialist Groups, which are Red List Authorities responsible for a species, group of species or specific geographic area.

Species are classified within nine categories; the categories are defined through criteria such as rate of decline, population size, area of geographic distribution, and degree of population and distribution fragmentation (Hilton-Taylor, 2000).

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***Prespa, Ohrid and Skadar lakes***

Prespa, Ohrid and Skadar are transboundary lakes (Figure 1). Lake Ohrid and Prespa belong to the group of Dessaret basins that originated from a geotectonic depression during the Pliocene epoch up to five million years ago on the western side of the Dinaric Alps. Lake Prespa is located on the southeast of Macedonia, and is split between Republic of Macedonia (about 65%), Greece (about 17%), and Republic of Albania (18%). It is of tectonic origin and one of the oldest lakes in the world.

Lake Prespa consists of two lakes: Great Prespa (273 km², 853 m above sea level) and Small Prespa (47 km², 857 meters above sea level). These two lakes are located between two mountains, Galicica and Baba.

Lake Prespa is the second largest lake in Macedonia after Lake Ohrid with a depth of 54 meters, an 87.5 km shoreline, a maximum length of about 28 km and a maximum width of 17 km (Stilinović, 1987). Today the maximum depth is estimated at 48 m (Stavrić and Popovska, 2008). In the preceding decades Lake Prespa was under greater anthropogenic pressure which resulted in a drastic water level decline and an increase of the water trophic status. The water level decline has continued over the last few years; causing a marked decrease in water quality as

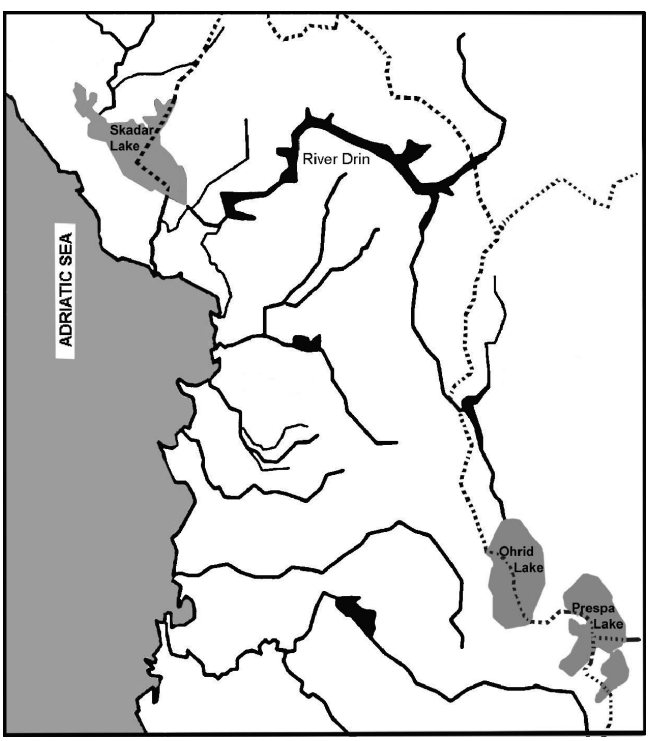


**Fig. 1. Map of the Lake Prespa, Lake Ohrid and Lake Skadar and its catchment area**

changes in the lake volume have a direct effect on the concentration of dissolved nutrients (Matzinger et al., 2006). Irrigation is one of the main causes of water loss in the lake (Löffler et al., 1998; Chavkalovski, 2000). Lake Prespa has no surface outflow and it is connected with Lake Ohrid by underground hydraulic connections and karst channels (Anovski et al., 1991; Eftimi and Zoto, 1996; Eftimi et al., 2002; Matzinger et al., 2006).

Transboundary Lake Ohrid is considered to be the oldest continuously existing lake in Europe with an estimated age of three to five million years. Located in a tectonic graben, Ohrid is a rarity amongst lakes as it has existed since the Tertiary period. Another peculiarity of Lake Ohrid is its extraordinarily high degree of endemism. Considering its size, Lake Ohrid has the highest degree of endemism worldwide. Therefore, the uniqueness of Lake Ohrid lies in the fact that it represents an evolutionary hot spot and a potential reservoir enabling the survival of relict species. As a result of its continuous existence, Lake Ohrid presents an excellent account of long and short term environmental changes in the central northern Mediterranean region.

Being the largest and deepest lake in the group (and in the Aegean lake zone) Ohrid represents are fugee for numerous species whose close relatives on the Balkan Peninsula and even wider parts of southeast Europe can be found only in fossil form (Stanković, 1960).

Lake Ohrid is located in the Sara-Pindus caustic massif. It fills the deepest part of the Ohrid valley (40,54′ – 41,10′ N and 20,38′ – 20,49′ E) in the southwest part of Republica of Macedonia, sharing its southwestern basin with Republic of Albania.

At 693.75 m above sea level it has a surface area of 358 square kilometers of which 240 belong to Macedonia and 118 to Albania. The maximum length of Lake Ohrid is 30.48 km, it is at most 15 km wide and has a mean width of 11.79 km. The maximum depth is 289 m, with a mean depth of 164 m, a volume of 58.64 cubic kilometers and retention time of about 83.6 years.

Lake Ohrid is an oligotrophic, cold oligomictic, calcareous, graben, Marl Lake, mostly fed with spring water. The lake is supplied with water from a number of springs. The most important are those near the monastery of Saint Naum, the well known Biljanini Izvori (Biljana Springs). A considerable amount of this spring water (over 56%) originates from the neighboring Lake Prespa, which is located 150 m higher (above sea level) than Lake Ohrid, The two lakes are separated by the Galicica mountain (a carstic massif). There are 40 tributaries (23 on Albanian and 17 in Macedonia side) flowing in to Lake Ohrid of which most are torrents flowing temporally. The water

flows out of the Lake through the river Crn Drim (Black Drim).

Lake Ohrid has been studied (more or less continuously) since the end of the 19th century. A great number of these studies have been directed towards the relict and endemic species which inhabit Lake Ohrid. Later studies also confirmed the relictness, endemicity and sublacustrine speciation of this unique, ancient lake and its living world.

Lake Skadar is the largest lake on the Balkan Peninsula in terms of surface area covered by water. The drainage area of the lake is about 5.500 km$^2$ (4.470 km$^2$ in Montenegro and 1.030 km$^2$ in Albania). The lake area varies between 353 km$^2$ at a minimum lake level of 4.6 m (above sea level) and 500 km$^2$ at a maximum lake level of 9.8 m (with 335 km$^2$ in Montenegro and 165 km$^2$ in Albania). Limestone and associated karstic processes determine the geomorphology. Many karstic springs can be found in the south-western part of the lake. The lake area drains through the Buna-Bojana River to the Adriatic Sea. The most important tributaries of Skadar Lake enter the lake from the north: Morača, Crnojevića River, Orahovštica, Karatuna River (in Montenegro) and Rjolska and Vraka River (in Albania). On the west side many small streams flow into Skadar Lake (Karamanand Beeton, 1981; Pano, 1984; Boškovic, 2004; Dhora, 2005).

## Materials and Methods

The biodiversity figures of native ichthyofauna from Prespa, Ohrid and Skadar Lakes were mainly obtained from the available literature (Talevski, 2009 a, b, c; Marić and Milošević, 2011; Milošević et al., 2011; Talevski and Milosević, 2013 a, b). The data regarding fish quantities harvested was obtained from the Fishing Basis of Lake Ohrid, fisheries management plan for Prespa Lake (Spirkovski et al., 2013), Fishing Basis of Lake Ohrid, and official reports of the concessionairesin the Macedonian part of the Prespa and Ohrid lake. The fishing data for Lake Skadar was used from Scott (2011) and Grazhdani (2014).

## Results and Discussion

The studies of fish populations from Lake Prespa, Lake Ohrid and Lake Skadar commenced at beginning of XIX century. The attention of many scientists during this time was drawn towards the plant and animal life from these lakes. Many Balkan scientists and indeed, scientists worldwide studied the biodiversity and the systematic belonging of ichthyopopulation in these lakes. Such studies continue to this day (Drecun, 1957; 1962; Drenski, 1922; Filipi, 1957; Heckel and Kner, 1858; Ivanović, 1973; Karaman, 1924, 1928, 1929; Kottelat and Freyhof, 2007; Poljakov, 1958; Stanković, 1960; Taler, 1954; Vladikov and Petit, 1930; Vuković and Ivanović, 1971; Talevski, 2001, 2004).

This paper presents, for the first time, a list of endangered species in the Drin system as a whole. Previously, endangered species lists were presented individually at three locations only: the Prespa Lake (Talevski et al., 2010b), Ohrid Lake (Talevski et al., 2010 a) and the River Drim (Talevski et al, 2010 c) in Macedonia. However, since the time those papers were published things changed and a need arose to re-explore this area with the new IUCN criteria.

The biodiversity of native ichthyofauna from Lake Prespa, Lake Ohrid and Lake Skadar and its catchement area is presented in Table 1.

Please note that the following classifications are all based on the IUCN Red List of Threatened Species.

In Lake Prespa fish fauna is represented by eleven native species (Table 1). Those native (autochthonic) fish species from Lake Prespa are classified into four groups: Critically Endangered (CR), Endangered (EN), Vulnerable (VU) and Least Concern (LC). *Anguilla anguilla* (Linnaeus, 1758) belongs to the Critically Endangered (CR) group. Endangered species (EN) are *Pelasgus prespensis (*Karaman, 1924) and *Salmo peristericus* (Karaman, 1938); Vulnerable species (VU) are *Alburnus belvica* (Karaman, 1924), *Alburnoides prespensis* (Karaman, 1924), *Chondrostoma prespense* (Karaman 1924)*, Cobitis meridionalis* (Karaman, 1924), *Cyprinus carpio* (Linnaeus, 1758) and *Rutilus prespensis* (Karaman, 1924). *Barbus prespensis* (Karaman, 1924) and *Squalius prespensis* (Fowler, 1977) belongs to a group of Least Concern (LC).

The major fishing harvests of commercial fisheries in Lake Prespaare Vulnerable (VU) species *Alburnus belvica*, *Rutilus prespensis* and *Cyprinus carpio*. The annual fishing harvests of these three species are greater than 250 tons. The following Vulnerable (VU) species: *Barbus prespensis* (Karaman, 1924), *Chondrostoma prespense* (Karaman, 1924) and *Squalius prespensis* are harvested at a level of approximately 50 tons per year**.**

In Lake Ohrid fish fauna is represented by twenty native species (Table 1). The Critically Endangered (CU) species is *Anguilla anguilla* (Linnaeus, 1758), Vulnerable species (VU) are: *Alburnoides ohridanus* (Karaman, 1928) *Gobio ohridanus* (Karaman, 1924), *Cyprinus carpio* (Linnaeus, 1758) and *Salmo ohridanus* (Steindachner, 1892). There are nine species classified as being Least Concern (LC): *Alburnus scoranza* (Heckel et Kner, 1858), *Phoxinus lumaireul* (Schinz, 1840), *Barbatula sturanyi* (Stein-

**Table 1**

**List of native fish of Lake Prespa, Lake Ohrid and Lake Skadar**

| N$^0$ | Species | Lake Prespa | Lake Ohrid | Lake Skadar |
|---|---|---|---|---|
| 1 | *Acipenser naccarii* Bonaparte, 1834 -1841 | | | CR |
| 2 | *Acipenser sturio* Linnaeus, 1758 | | | CR |
| 3 | *Alburnoides ohridanus* (Karaman, 1928) | | VU | VU |
| 4 | *Alburnoides prespensis* Karaman, 1924 | VU | | |
| 5 | *Alburnus belvica* Karaman, 1924 | VU | | |
| 6 | *Alburnus scoranza* (Heckel et Kner, 1858) | | LC | LC |
| 7 | *Alosa fallax* La Capede, 1803 | | | LC |
| 8 | *Anguilla anguilla* (Linnaeus, 1758) | CR | CR | CR |
| 9 | *Barbatula zetensis* (Šorić, 2000) | | | LC |
| 10 | *Barbatula sturanyi* (Steindachner, 1892) | | LC | |
| 11 | *Barbus prespensis* Karaman, 1924 | LC | | |
| 12 | *Barbus rebeli* Köller, 1925 | | LC | LC |
| 13 | *Chondrostoma ohridanus* Karaman, 1924 | | NE | NE |
| 14 | *Chondrostoma prespense* Karaman, 1924 | VU | | |
| 15 | *Chondrostoma scodrensis* Elvira, 1987 | | | EX |
| 16 | *Citharus linguatula* (Linnaeus, 1758) | | | NE |
| 17 | *Cobitis meridionalis* Karaman, 1924 | VU | | |
| 18 | *Cobitis ohridana* Karaman, 1928 | | LC | LC |
| 19 | *Cyprinus carpio* Linnaeus, 1758 | VU | VU | VU |
| 20 | *Dicentrarchus labrax* (Linnaeus, 1758) | | | LC |
| 21 | *Gasterosteus gymnurus* Cuvier, 1829 | | | LC |
| 22 | *Gobio ohridanus*, Karaman, 1924 | | VU | |
| 23 | *Gobio skadarensis* Karaman, 1936 | | | EN |
| 24 | *Liza ramada* Risso, 1826 | | | LC |
| 25 | *Mugil cephalus* Linnaeus, 1758 | | | LC |
| 26 | *Pachychilon pictum* (Heckel et Kner, 1858) | | LC | LC |
| 27 | *Pelasgus minutus* Karaman, 1924 | | DD | DD |
| 28 | *Pelasgus prespensis* Karaman, 1924 | EN | | |
| 29 | *Phoxinus lumaireul* Schinz, 1840 | | LC | LC |
| 30 | *Pleuronectes flesus* Pallas, 1811 | | | LC |
| 31 | *Pomatoschistus montenegrensis* Miler & Šanda, 2008 | | | LC |
| 32 | *Rhodeus amarus* (Bloch, 1782) | | | LC |
| 33 | *Rutilus albus* Marić, 2010 | | | NE |
| 34 | *Rutilus ohridanus* (Karaman, 1924) | | LC | |
| 35 | *Rutilus prespensis* Karaman, 1924 | VU | | VU |
| 36 | *Salaria fluviatilis* Asso, 1801 | | | LC |
| 37 | *Salmo aphelios*, Kottelat,1997 | | DD | |
| 38 | *Salmo balcanicus* Karaman, 1928 | | DD | |
| 39 | *Salmo farioides* Karaman, 1937 | | | NE |
| 40 | *Salmo letnica* Karaman, 1924 | | DD | |
| 41 | *Salmo lumi* Poljakov, Filip&Basho 1958 | | DD | |
| 42 | *Salmo marmoratus* Cuvier, 1817 | | | LC |
| 43 | *Salmo ohridanus* Steindachner 1892 | | VU | |
| 44 | *Salmo peristericus* Karaman, 1938 | EN | | |
| 45 | *Salmothymus zetensis* Hadžišće, 1962 | | | NE |
| 46 | *Scardinius knezevici* (Bianco & Kottelat, 2005) | | LC | LC |
| 47 | *Squalius prespensis* Fowler, 1977 | LC | | |
| 48 | *Squalius squalus* Bonaparte, 1837 | | LC | |
| 49 | *Squalius platyceps* Župančić, Marić, Naseka & Bogutskaya, 2010 | | | LC |
| 50 | *Telestes montenigrinus* (Vuković, 1963) | | | LC |
| | Total | 11 | 20 | 32 |

dachner, 1892), *Barbus rebeli* (Köller, 1925), *Pachychilon pictum* (Heckel and Kner, 1858), *Cobitis ohridana* (Karaman, 1928), *Rutilus ohridanus* (Karaman, 1924), *Scardinius knezevici* (Bianco and Kottelat, 2005), *Squalius squalus* (Bonaparte, 1837). Data Deficient (DD) are five species: *Pelasgus minutus* (Karaman, 1924), *Salmo aphelios* (Kottelat, 1990), *Salmo balcanicus* (Karaman, 1928), *Salmo letnica* (Karaman, 1924) and *Salmo lumi* (Poljakov et al., 1958).

The species primarily caught in major fishing harvests in Lake Ohrid is the Critically Endangered (CE) *Anguilla anguilla.* It is caught in special traps and harvests can be greater than 10 tons annualy**.** From the Vulnerable species (VU) group, professional fishermen harvest *Cyprinus carpio* at a level of approximately 40 tons and *Salmo ohridanus* at levels greater than 15 tons. *Alburnus scoranza*,which belongs to the Least Concern (LC) group is harvested at a level of 50 tons.

The other species, *Barbus rebeli*, *Pachychilon pictum*, *Rutilus ohridanus, Scardinius knezevici* and *Squalius squalus* are caught in very low quantities.

The population size of other species, of the genera Salmo, in Lake Ohrid has been greatly reduced because of extensive fishing in the last period. In the period 1990–2005, harvesting of these genera amounted to, on average, 100 tons annually (Spirkovski et al., 2009).

In Lake Skadar fish fauna is represented by thirty-two native species (Table 1). In Lake Skadar one Extinct species (EX) existed, *Chondrostoma scodrensis* (Elvira, 1987); Critically Endangered (CR) are three species: *Acipenser naccarii* (Bonaparte, 1834–1841), *Acipenser sturio* (Linnaeus, 1758) and *Anguilla anguilla* (Linnaeus, 1758); Endangered (EN) is *Gobio skadarensis* (Karaman, 1936); Vulnerable (VU) are three species *Alburnoides ohridanus* (Karaman, 1928), *Cyprinus carpio* (Linnaeus, 1758) and *Rutilus prespensis* (Karaman, 1924); Least Concern (LC) are nineteen species: *Alburnus scoranza* (Heckel and Kner, 1858), *Alosa fallax* (La Capede, 1803), *Barbatula zetensis* (Šorić, 2000), *Barbus rebeli* (Köller, 1925), *Cobitis ohridana* (Karaman, 1928), *Dicentrarchus labrax* (Linnaeus, 1758), *Gasterosteus gymnurus* (Cuvier, 1829), *Liza ramada* (Risso, 1826), *Mugil cephalus* (Linnaeus, 1758), *Pachychilon pictum* (Heckel and Kner, 1858), *Phoxinus lumaireul* (Schinz, 1840), *Pleuronectes flesus* (Pallas, 1811), *Pomatoschistus montenegrensis* (Miler and Šanda, 2008), *Rhodeus amarus* (Bloch, 1782), *Salaria fluviatilis* (Asso, 1801), *Salmo marmoratus* (Cuvier, 1817), *Scardinius knezevici* (Bianco and Kottelat, 2005), *Squalius platyceps* (Župančić et al., 2010) and *Telestes montenigrinus* (Vuković, 1963); *Pelasgus minutus* (Karaman, 1924) is Data Deficient (DD).

Lake Skadar has important commercial fisheries, which target bleak (*Alburnus scoranza*) and carp (*Cyprinus carpio*). The potential annual lake production has been estimated at some 50 kg/ha of fish, including vulnerable and threatened species. Assuming a total minimum area of 350 km$^2$, this would imply potential annual fish harvests of 1.750 tones, with 60% available to Montenegro and the remainder to Albania. However, available information suggests that Montenegrin harvests are substantially smaller than historic levels of more than 1.000 tons. While Lake Skadar has a high variety of fish fauna, the result of a good connection with the sea, and an extensive network of rivers and streams. The relatively high numbers of endemic species make the lake significant on a regional level (Scott, 2011).

From the Critically Endangered species (CR), in Lake Skadar *Anguilla anguilla* is a fish that is caught in significant quantities in Lake Skadar. From species that are in theVulnerable (VU) category(that appear in the professional fishing harvests) are *Cyprinus carpio* and *Rutilus prespensis.* The dominant species in the Least Concern (LC) category (again appearing in professional fishing harvests) is *Alburnus scoranza.* The species *Alosa fallax, Pachychilon pictum*, *Scardinius knezevici* and *Squalius platyceps* are caught in small quantities.

## Conclusion

Prespa, Ohrid and Skadar are the largest lakes on the Balkan Peninsula. The fish fauna in these lakes is composed of fifty native fish species. The eel *Anguilla anguilla* (Linnaeus, 1758) is an important part of professional fishing in Lake Ohrid and Lake Skadar, although, according to the IUCN Red List of Threatened Species, it is a Critically Endangered (CR) species. Fish that are significant in professional fishing and were placed in different categories on the IUCN Red List are: the Vulnerable (VU) species in Lake Prespa: *Alburnus belvica* and *Rutilus prespensis* in Lake Ohrid, *Salmo ohridanus* and *Cyprinus carpio* whereas in Lake Skadar it is *Cyprinus carpio.* The Least Concern species (LC) in the Ohrid and Skadar that is harvested in large quantities is *Alburnus scoranza.* Fishing plans should be adjusted with regard to the quantities of species harvested which are on the IUCN Red List of Threatened Species.

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