Conservation Leadership Programme

Final Report

Fishes of Montenegro

Survey of Endangered Fish Species of the Morača River System

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Bronze Award 2002

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Survey of Endangered Fish Species of the Morača River System

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Summary

A survey of the freshwater fish fauna of the River Morača system in Montenegro and an awareness campaign was carried out in the period 2002-2009. The field work was conducted in this drainage in July and September 2002 and in July 2003. Altogether 20 localities were sampled. To be able to reliably assess the taxonomic status of the fish species in the River Morača system, it was necessary to collect additional comparative DNA material from the surrounding areas (Albania, Bosnia and Herzegovina, Croatia, Macedonia, Serbia), which has been done subsequently in the period 2003-2008.

We have recorded a presence of 28 species, of which 23 native. Eighteen of the native species are listed in the IUCN Red List, of which 14 are evaluated as Least Concern, one as Vulnerable, two as Endangered and one as Critically Endangered. The most important result of this study is a discovery and description of two new species of gobies, *Knipowitschia montenegrina* and *Pomatoschistus montenigrensis*. Further, one species was found for the first time in Montenegro (lamprey *Lampetra zanandreai*) and another for the first time in the River Morača system (introduced cyprinid *Pseudorasbora parva*). The most widespread and common species are cyprinids *Barbus* sp., *Phoxinus lumaireul* and *Telestes montenigrinus*. Other species have a more limited distribution. The rarest species are salmonids *Salmo marmoratus* and *Salmo obtusirostris*. Our study revealed a considerable reduction of the distribution area of some cyprinids (e.g., *Squalius squalus*, *Rutilus* sp., *Pachychilon pictum* and *Alburnus scoranza*), eel (*Anguilla anguilla*) and especially salmonids (*Salmo farioides*, *S. marmoratus* and *S. obtusirostris*) in comparison with the situation in the early 1980s.

We have observed that the most serious threat to fish of the River Morača drainage is uncontrolled exploitation. Illegal fishing has risen to a dangerous extent. Numerous methods, some of which threatening the whole ecosystem, are used: explosives, electrofishing, nets, spearfishing. Most influenced are populations of top predators, which are represented mostly by salmonids.

The River Morača system, unlike many other drainages in the eastern Adriatic basin, represents a well-preserved ecosystem in the following respects: the level of anthropogenic pollution is relatively low and there are no constructions on the rivers, which would spoil its natural character. However, there is a serious threat by a plan to construct a system of dams and reservoirs on the River Morača in the near future.

An awareness campaign was organised in order to raise awareness of general public through environmental education lectures in schools and kindergartens, articles in local press, interviews in radio and television and talks to local people, members of the sport fishery organisations and scientific and conservational institutions. Environmental education of young people and children was particularly emphasised.

The most important recommendations emerging from the results of our project are to implement the protection of all native fish species, important habitats and the River Morača system as a whole in legislation; to prevent from the damming of the rivers; to control the illegal fishing; to promote relevant eco-touristic activities along the rivers, from which the local community could benefit and to focus on raising environmental awareness among the general public.

Contents

1. Introduction

The knowledge of biology and taxonomy of many fish species, especially the ones with a small body size and a low economical importance, is rather fragmentary (Lelek 1987). Sound taxonomic data are important for conservation. Without accurate taxonomy, it is impossible to identify the species and evaluate their conservation status (Kottelat 1998). Moreover, there is no doubt that the key to the effective protection of threatened species is the knowledge of their life history; unfortunately, most of these data are lacking (Gilpin et Soule 1986, Simberloff 1988, Kottelat 1998).

The Mediterranean basin, which has been identified as one of the "Biodiversity hotspots", maintains specific freshwater ichthyofauna, consisting of numerous endemic species with restricted distribution areas (Crivelli et Maitland 1995, Kottelat et Freyhof 2007). There has been a considerable progress in the knowledge about taxonomy and phylogenetic relationships of the Mediterranean freshwater fishes during several last years. The area of the northern part of the Adriatic Sea basin was not an exception in this respect and several new species were recognised here (Mrakovčić et al. 1996, Zupančič et Bogutskaya 2000, 2002, Bogutskaya et Zupančič 2003, Kovačić 2005, Economidis 2005). Two species were described also from the Lake Skadar basin in Montenegro (Šorić 2000, Bianco et Kottelat 2005).

Generally, data on diversity and distribution of freshwater fish from Montenegrin freshwaters of the Adriatic Sea slope have been insufficient. Altogether 52 fish species (39 autochthonous, 13 introduced) had been previously reported from these waters (Ivanović 1973, Knežević 1981, Drecun et al. 1985, Marić 1995). However, taxonomic status of some species (some cyprinids, loaches, gobies or salmonids) has been unclear. Further, some species, like all species of sturgeons and *Chondrostoma scodrense* probably have become extinct (Marić 1995). The conservation of freshwater fishes is insufficient. The only fish species protected by the law in Montenegro is softmouth trout (*Salmo obtusirostris*). The only other existing legislation dealing with fish protection in Montenegro is the fisheries legislation. It protects several fish species in some aspects (e.g., minimum legal size, restriction of catching during spawning season), but most of them are non-native commercial species!!

2. Aims

The aims of this project were to evaluate the up-to-date status of fish populations of the River Morača system, to help preparing conservation strategy for threatened species and to raise awareness of general public.

2.1. Objectives

1. To map out the current distribution of threatened fishes in the River Morača system.

2. To check and resolve taxonomic status of the fish species and to collect data on threatened fish species.

3. To raise awareness of general public through environmental education lectures in schools and kindergartens, articles in local press, interviews in radio and television and talks to local people, members of the sport fishery organisations and scientific and conservational institutions.

3. Description of the project location

The River Morača drainage belongs to the Adriatic Sea slope (Fig. 1). It is the main inflow of Lake Skadar, which is the largest lake of the Balkan Peninsula. It has an area varying between 370 – 600 km^2, of which one-third lies in Albania (Beeton 1981). Lake Skadar is one of the National Parks of Montenegro. Together with Lake Ohrid and the River Drim, Lake Skadar composes a unique river system in the western Balkan zoogeographic region (Banarescu 1992).

The River Morača (Figs 2-4) is 99 km long and has an area of only 390 ha (Drecun et al. 1985). The total area of all rivers and streams belonging to the River Morača system is not greater than 700 ha. The spring of the River Morača lies at an altitude of 975 m above sea level, while its mouth's altitude is only 6 m above sea level. The River Morača provides about 62 % of the Lake Skadar water (Lasca et al. 1981). This is a typical karstic Mediterranean river. It flows through a limestone and dolomite bedrock. In some areas it flows through steep and narrow canyons. The width of the river varies between 20 – 250 m and depth between a few centimetres to 10 m. Water temperature ranges between 5 – 19°C and conductivity between 200 – 300 $\mu S.cm^{-2}$. Concentration of dissolved oxygen is high (7.5-14 $mg.l^{-1}$). pH varies between 7.5 - 8.5. Discharge fluctuates greatly during the year. Mean discharge in Podgorica is 163 $m^3.s^{-1}$ (Drecun et al. 1985), while in the upper part it varies between 1 – 30 $m^3.s^{-1}$ (Jacobi 1981). The middle part of the river, the area between the Monastery Duga and the mouth of the River Zeta, could be waterless during very dry summers (Drecun et al. 1985).

The River Morača has several inflows, of which the rivers Zeta (Fig. 5), Mrtvica and Cijevna (Figs 6, 7) are the most important. These three rivers are permanent, whereas other inflows often dry out during summer. The biggest inflow is the River Zeta (about 50 km long) with the mean discharge in its mouth around 74 $m^3.s^{-1}$ (Martinović-Vitanović et Kalafatić 1995).

We have found that the River Morača in its whole flow has the ground composed of gravel or stones, which is in the lower course of the river covered by fine sediment. Water velocity is in general high and there is a lack of macrophytae. The depth reaches at least three meters at most studied sites. The character of the River Zeta is different: the ground is mostly sandy and muddy, water velocity is low, and there are huge tracts of aquatic macrophytae. The River Zeta is very deep, commonly reaches six meters, and sometimes even ten meters. The whole River Zeta has the lowland character, while the Morača retains mountainous character even in its lowest part, where it flows through the lowland. The River Cijevna, the second largest inflow of Morača, often dries out in its lowermost part. However, the upper part has a permanent water flow and its character is very similar to that of the River Morača. The part of the middle course of the River Cijevna flows through a very narrow and deep canyon cut in the dolomite bedrock (Fig. 7). Its depth is up to ten meters and a width only a few meters.

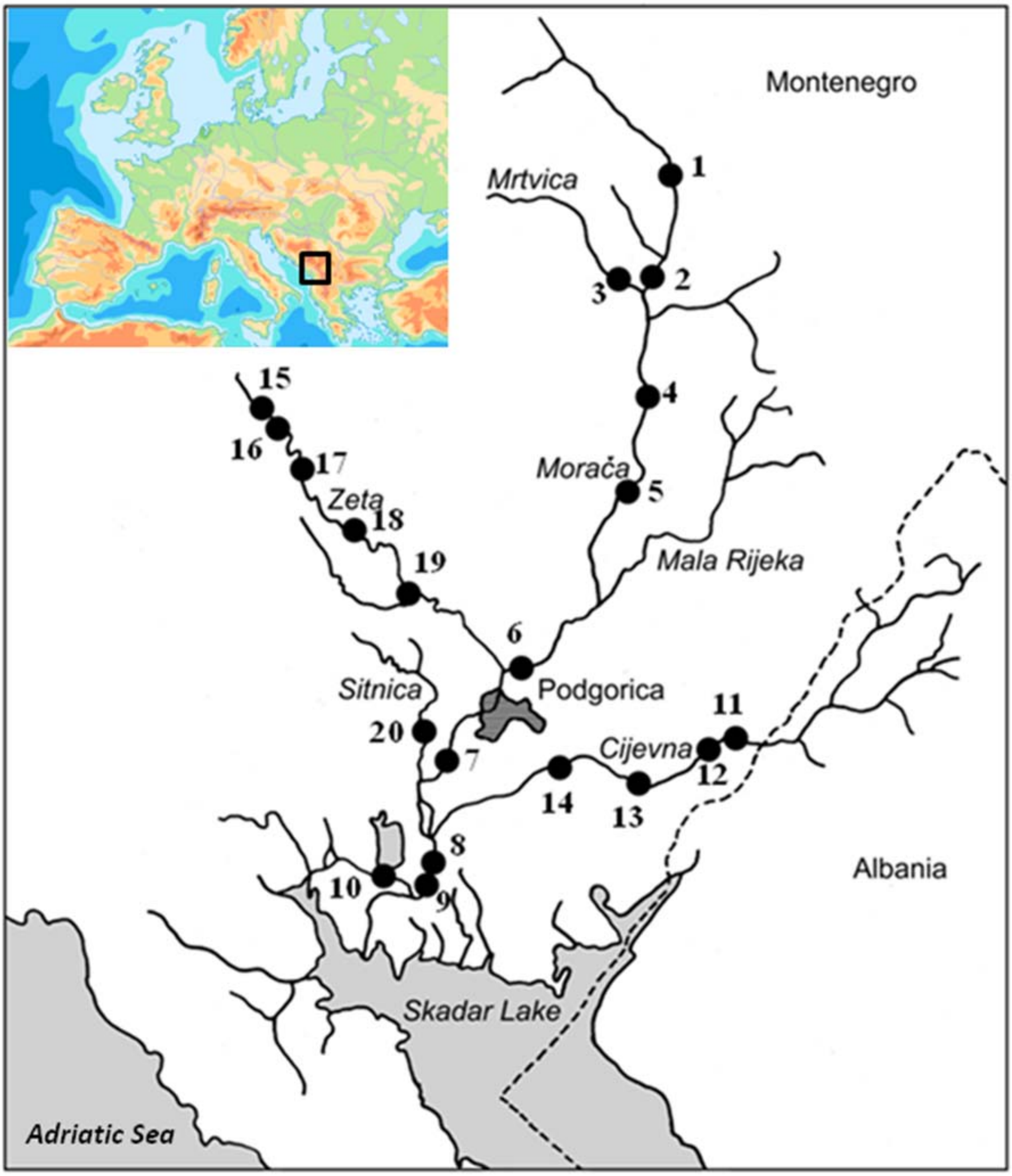

Fig. 1. River Morača system with the localisation of sampling sites. Numbers of localities correspond to the numbers of localities in text.

Fig. 2. River Morača – loc. 4.

Fig. 3. River Morača – loc. 1.

Fig. 4. River Morača – loc. 8.

Fig. 5. River Zeta – loc. 16.

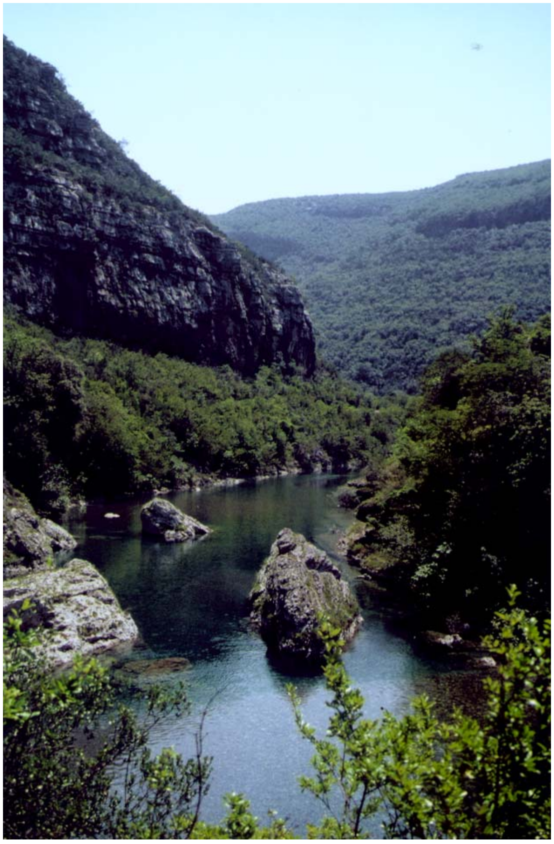

Fig. 6. River Cijevna – loc. 12.

Fig. 7. River Cijevna, canyon near loc. 14.

4. Methods

The field work in the River Morača drainage was conducted in July and September 2002 and in July 2003. Altogether 20 localities were sampled (Fig. 1), some of them repeatedly. Fish were caught mostly by electrofishing (Figs 8-11) along the shore and in shallow areas, by hand nets and occasionally by angling. In some localities, underwater observation during snorkelling was used to record species composition. The caught fishes were held in special cages in the river and handling was reduced as much as possible. Each specimen was determined and its length and weight was measured. Scales were taken for determination of age. For determination of food, stomach flushing was done in a part of the collected salmonids. Samples for DNA extraction (small fin clip) was taken from a part of the caught specimens of each species. Some of the caught fish were marked with visible implant elastomers. Afterwards, fish were released to the river. A neglected part of the collected specimens of each species was euthanized with an overdose of anaesthetic Quinaldine and fixed in 4 % formaldehyde solution for later detailed laboratory examination. A detailed morphological determination was applied to all collected specimens to reveal their specific status.

Fig. 8. Electrofishing at loc. 3.

Fig. 9-11. Electrofishing at localities 4 (left), 17 (upper right), and 10 (lower right).

Physical parameters of water were measured and samples of benthos were collected. Our activities were photographically documented. GPS was used for a determination of the co-ordinates of each sampling locality.

To be able to reliably assess the taxonomic status of the fish species in the River Morača system, it was necessary to collect a comparative DNA material from the surrounding areas (Albania, Bosnia and Herzegovina, Croatia, Macedonia, Serbia).

Mitochondrial gene for cytochrome *b* was analysed to assess the relationships of the populations from the River Morača and surrounding areas. This part of the analyses was done predominantly in the Museo Nacional de Ciencias Naturales in Madrid, Spain. DNA was extracted from a fin tissue using JETQUICK Tissue DNA Spin Kit (GENOMED) following manufacturer instructions. The amplification primers, reaction conditions and amplification protocol were the same as described in Machordom et Doadrio (2001). PCR products were purified using ethanol precipitation. Sequencing was carried out by the Macrogen Service Centre (Seoul, South Korea) with the use of internal primers. Sequences were aligned manually and revised in BioEdit (Biological sequence alignment editor v.5.0.9). Prior to analysing the sequence data, the best fitting model of nucleotide substitution was assigned using Modeltest 3.06 (Posada et Crandall 1998). Two different approaches were used for evaluation of the phylogenetic relationships of studied taxa: neighbour-joining (NJ) algorithm and Bayesian inference (BI). The NJ trees were constructed in PAUP* v. 4.0b10 (Swofford 2002) with parameter settings as estimated by Modeltest. A Bayesian tree was constructed using MrBayes v. 3.0 (Huelsenbeck et Ronquist 2001). Phylogenetic trees were valuable tool for identification of the relationships of the fishes from the River Morača basin and they will be used in detail in scientific publications, which are in preparation.

For each species recorded during the survey, the following data are provided: a scientific name and the author of the taxon description, the localities where the species was found during the project, the indication of its abundance in the catch, the evaluation in the IUCN Red List (IUCN 2009), and remarks. The taxonomy follows Kottelat et Freyhof (2007). In three cases, information on species occurrence was taken from the personal communication with a reliable person. The locality numbers correspond to Fig. 1.

NOTE: Based on distribution of freshwater fishes, especially that of cyprinids, the Mediterranean catchments may be divided into twelve ichthyological districts (Bianco 1990). The Ohrid-Drim-Skadar system, and thus also the River Morača drainage, belongs to the Albanian ichthyological district sensu Bianco (1990). The term “Albanian ichthyological district”, indicates the area delimited by the Ohrid-Drim-Skadar system in the north and the River Vjose basin in the south.

4.1. Itinerary of the project

2002 field work in Montenegro; awareness campaign

2003 field work in Montenegro; molecular analyses of the material in Madrid, Spain

2004 first systematic collecting of comparative samples from surrounding areas (Bosnia and Herzegovina, Albania)

2005 second phase of molecular analyses in Madrid, Spain

2006 continuation of the collecting of comparative samples from surrounding areas (Croatia, Bosnia and Herzegovina, Serbia, Macedonia)

2007 description of a new species published; starting of molecular analyses in the National Museum in Prague

2008 description of a new species published; third phase of molecular analyses in Madrid, Spain; collecting of missing comparative samples from surrounding areas (Croatia, Bosnia and Herzegovina)

2009 preparation of the Final Report

Scientific results were continuously presented in the course of the project on scientific meetings and published in scientific journals (see 8.1. Publicity and talks & conferences).

We will consider our work completely finished when all questions regarding the taxonomic status of the species, where the revision is necessary, are answered. This is very important for conservation of these taxa. This is a long-time process, which requires analyses of material of all closely related taxa and the use of the newest molecular and morphological methods, which are being rapidly developed at present.

5. Results

A re-evaluation of the taxonomic status of the freshwater fishes from the River Morača basin, based on morphological determination and analyses of mtDNA marker, and with the use of the data from recently published studies, brought very interesting results. The most important result of our project is that we discovered and described two new species.

The species list of freshwater fishes prepared in 2001 for the application, which was based on data available at that time, changed considerably. Most changes were caused by changing the taxonomic status of the populations. Some species had been originally described as valid taxa. Later, these taxa were synonymised with widespread taxa. Recently, these taxa have been treated as valid taxa again. Moreover, the status of some populations has been changed from a subspecies to a valid species. Also, a generic status was changed in some taxa.

5.1. List of species recorded in the River Morača basin during the course of the project

<u>Cypriniformes: Cyprinidae</u>

Rutilus ohridanus (Karaman, 1924)

Distribution: recorded in the lower Morača and Zeta (loc. 8, 9, 10, 15, 18), not abundant

IUCN Red List of Threatened Species: Least Concern

Remarks: There are two species of roach recorded from the Lake Skadar basin (Kottelat et Freyhof 2007). All roach specimens caught in the Ohrid-Drim-Skadar system (during our surveys in Montenegro, as well as during our subsequent surveys in Albania and Macedonia) belong to *Rutilus ohridanus*. The second roach species, *Rutilus karamani* Fowler, 1977, probably occurs mostly in the lacustrine environment of large lakes, as suggested by Marić (1995), who stated that in Lake Skadar *R. karamani* is much more abundant than *R. ohridanus*. The molecular analyses of Ketmeier et al. (2008) supported the hypothesis about a presence of two *Rutilus* taxa in this lake.

Pachychilon pictum (Heckel & Kner, 1858), Fig. 12

Distribution: recorded in the lower Morača and Zeta (loc. 7, 8, 16, 17, 18), common

IUCN Red List of Threatened Species: Least Concern

Remarks: This species occurs in all rivers of the Albanian ichthyologic district, from the Ohrid-Drim-Skadar system to the River Vjose drainage (own unpublished data).

Fig. 12. *Pachychilon pictum* from River Zeta, loc. 18.

Phoxinus lumaireul (Schinz, 1840), Fig. 13

Distribution: recorded in majority of the investigated localities (loc. 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19), very abundant

IUCN Red List of Threatened Species: Least Concern

Remarks: According to Kottelat et Freyhof (2007), this species occurs in the Adriatic basin from the northern Italy to the Ohrid-Drim-Skadar basin. However, *P. lumaireul* is most probably an artificial assemblage of several taxa, belonging to different evolutionary lineages (own unpublished data). The taxonomy of *Phoxinus* from the periadriatic basin requires a careful revision.

Fig. 13. *Phoxinus lumaireul* from River Zeta, loc. 16.

Squalius squalus (Bonaparte, 1837), Fig. 14

Distribution: recorded in the lower Morača and Zeta (loc. 8, 9, 10, 15, 16, 17, 18, 19), abundant

IUCN Red List of Threatened Species: Least Concern

Remarks: According to Kottelat et Freyhof (2007), this species occurs in the Adriatic basin from the northern Italy to the Ohrid-Drim-Skadar basin. However, *S. squalus* most probably represents a complex of several species (own unpublished data). The taxonomy of *S. squalus* complex requires a careful revision.

Fig. 14. *Squalis squalus* from River Zeta, loc. 16.

Chondrostoma ohridanus Karaman, 1924

Distribution: recorded only in the River Zeta (loc. 18), according to local fishermen locally abundant

IUCN Red List of Threatened Species: not included in the list

Remarks: According to Elvira (1997), two species of *Chondrostoma* occur in the Ohrid-Drim-Skadar system: *Chondrostoma scondrense* Elvira, 1987 (believed to be extinct) and *Chondrostoma nasus* (Linnaeus, 1758). Kottelat et Freyhof (2007) report only *C. scondrense* in this river system. On the other hand, Karaman (1924) described *Chondrostoma* from the Ohrid-Drim-Skadar system as *C. nasus ohridanus* (type locality Lake Ohrid), which was suggested by Banarescu (1992) to represent a distinct species. Our molecular analyses of the northern Mediterranean *Chondrostoma* populations strongly support the distinctiveness of *Chondrostoma* in the Ohrid-Drim-Skadar system from *C. nasus* (own unpublished data). Thus, we adopted the name *C. ohridanus* for *Chondrostoma* in this river system. This species actually occurs in the whole Albanian ichthyological district, from the Ohrid-Drim-Skadar system to the River Vjose drainage (own unpublished data).

Telestes montenigrinus (Vuković, 1963), Fig. 15

Distribution: recorded in the upper and the middle parts of the Morača and Zeta rivers and in the River Cijevna (loc. 4, 5, 6, 7, 8, 11, 12, 13, 14, 15, 16, 17, 18, 19), abundant

IUCN Red List of Threatened Species: Least Concern

Remarks: *T. montenigrinus* is endemic to the River Morača and Lake Skadar. Although there were reported records from the White Drim River (Šorić 1983), they are doubtful. This species was not recorded by a recent investigation of the River Bojana and the River Drim system in Albania (own unpublished data, Crivelli, pers. comm.). Although it is a highly endemic species, with very limited distribution area, it has a high intrapopulation genetic diversity (14 cytochrome *b* haplotypes identified within 31 specimens). This indicates that the species is in a good state and is highly resistant to the reduction of the population size.

Fig. 15. *Telestes montenigrinus* from River Zeta, loc. 15.

Gobio skadarensis Karaman, 1937, Fig. 16

Distribution: recorded in the lower Morača and Zeta (loc. 9, 16, 17, 18, 19), not abundant

IUCN Red List of Threatened Species: Endangered B1ab(ii,iii)+2ab(ii,iii)

Remarks: The gudgeons from the Ohrid-Drim-Skadar system were for long time believed to represent one taxon, usually called *Gobio gobio ohridanus* Karaman 1924. Our first investigation, based on allozyme analyses, did not distinguish studied specimens of gudgeon from the River Zeta from the central European populations of *Gobio gobio* (Linnaneus, 1758). This led to the conclusion that the population in the River Zeta (and in general in the Ohrid-Drim-Skadar system) is identical with *Gobio gobio* (Šanda et al. 2005). However, later re-analyses of the same material with other markers (mitochondrial D-loop and nuclear S7) showed that gudgeons from the River Zeta represent a separate evolutionary lineage, for which the name *Gobio skadarensis* is available (Mendel et al. 2008). Moreover, the analyses revealed that there is one more gudgeon species in the Ohrid-Drim-Skadar system, *G. ohridanus* (Mendel et al. 2008). Also Kottelat et Freyhof (2007) distinguish the two above mentioned species in the Ohrid-Drim-Skadar system. Finally, a presence of *G. skadarensis* is not restricted to the Lake Skadar basin in Montenegro, as it was previously thought; we identified it also in the River Mat drainage in Albania (Mendel et al. 2008).

Fig. 16. *Gobio skadarensis* from River Zeta, loc. 18.

***Barbus* sp. undescribed species**, Fig. 17

Distribution: recorded in the whole Morača drainage (loc. 1, 2, 4, 5, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19), very abundant

IUCN Red List of Threatened Species: not included in the list

Remarks: Barbels from the Ohrid-Drim-Skadar system were identified by Kottelat et Freyhof (2007) as *Barbus rebeli* Koller, 1926. However, our detailed molecular analyses of *Barbus* from all rivers of the Albanian ichthyological district revealed that the population from the Ohrid-Drim-Skadar system represents a new, unnamed species (Marková et al., submitted).

Fig. 17. *Babus* sp. from River Zeta, loc. 18.

Alburnus scoranza Heckel & Kner, 1858, Fig. 18

Distribution: recorded in the lower Morača and Zeta (loc. 8, 10, 15, 17, 18), common

IUCN Red List of Threatened Species: Least Concern

Remarks: This species inhabits the whole Ohrid-Drim-Skadar system, being the most abundant in the lakes Ohrid and Skadar, where it is economically important for the local fishery industry. It occurs also in the drainage of the River Mat in Albania (own unpublished data). It is possible, that its distribution area is even greater, as there are records of *Alburnus* from the Albanian rivers Shkumbini (Cake et Miho 2005) and Vjose (Ahnelt et Elvira 1991).

Fig. 18. *Alburnus scoranza* from River Zeta, loc. 15.

Alburnoides ohridanus (Karaman, 1928), Fig. 19

Distribution: recorded in the middle section of the River Morača (loc. 6, 7, 8), rare

IUCN Red List of Threatened Species: Vulnerable D2

Remarks: Although it was suggested to occur only in Lake Ohrid in Albania by Kottelat et Freyhof (2007), we identified the specimens of *Alburnoides* from the River Morača as *A. ohridanus*. Moreover, genus *Alburnoides* is common in all rivers of the Albanian ichthyological district (own unpublished data). The taxonomic status of Albanian populations is unclear, so it is possible that the distribution area of *A. ohridanus* is not restricted only to the Ohrid-Drim-Skadar system.

Fig. 19. *Alburnoides ohridanus* from River Morača, loc. 6.

Rhodeus amarus (Bloch, 1782)

Distribution: recorded in the part of Lake Skadar called Malo Blato (loc. 10), common, but limited to the lower stretch of the River Morača and Lake Skadar

IUCN Red List of Threatened Species: Least Concern

Remarks: This species occurs most probably in suitable localities within the whole Ohrid-Drim-Skadar system. We have found it in the lakes Skadar and Ohrid and in the outflow of Lake Skadar, the River Bojana, in Albania (own unpublished data). Bohlen et al. (2006) analysed material from both lakes and showed that it belongs to the western lineage of *R. amarus*.

Carassius auratus (Linnaeus, 1758)

Distribution: recorded in the lower Morača and in the part of Lake Skadar called Malo Blato (loc. 8, 10), rare

Introduced species

Remarks: This species is very abundant in Lake Skadar, where it is economically important for the local fishery industry. On the other hand, it represents a potential threat to native species, as it is highly invasive and is a strong competitor (Szczerbowski 2001).

Pseudorasbora parva (Temminck & Schlegel, 1846)

Distribution: recorded in the lower Morača and in the part of Lake Skadar called Malo Blato (loc. 8, 10), rare

Introduced species

Remarks: This species was previously known only from Lake Skadar (Cakic et al. 2004). Our finding of several specimens in the lower Morača is the first record for the river and suggests that the species spreads upstream from the lake. This species represents a potential threat to smaller native species, as it is highly invasive and is a strong competitor (Banarescu 1999).

Cyprinus carpio Linnaeus, 1758

Distribution: recorded in the lower Morača and Zeta (loc. 9, 19), rare

Introduced species

Remarks: This species is very abundant in Lake Skadar where it is economically important for the local fishery industry. On the other hand, it represents a potential threat to native species, as it is a strong competitor (Baruš et al. 2001) and it can cause environmental degradation (Winfield et Townsend 1991).

Cypriniformes: Balitoridae

Barbatula zetensis (Šorić, 2000), Fig. 20

Distribution: recorded in the lower Morača and Zeta (loc. 6, 7, 8, 9, 16, 18), abundant

IUCN Red List of Threatened Species: Least Concern

Remarks: It was described by (Šorić 2000) as a subspecies of *Barbatula barbatula* (Linnaeus, 1758). However, Kottelat et Freyhof (2007) recognised stone loach from the River Morača basin as a valid species. Molecular data support the distinctiveness of this population (Šedivá et al. 2008). The sister species of *B. zetensis* is *Barbatula sturanyi* (Steindachner, 1892) from the upper Drim River basin in Albania (Šedivá et al. 2008). The exact distribution area of *B. zetensis* is unclear. So far, it was found only in the River Morača system. It probably rarely occurs also in Lake Skadar (Ivanović 1973). However, it might occur also in the Drim River basin in Albania.

Fig. 20. *Barbatula zetensis* from River Morača, loc. 7.

Cypriniformes: Cobitidae

Cobitis ohridana Karaman, 1928, Fig. 21

Distribution: recorded in the lower Morača and Zeta (loc. 7, 8, 9, 10, 18, 19, 20), abundant

IUCN Red List of Threatened Species: Least Concern

Remarks: This species occurs in all rivers of the Albanian ichthyological district (Šanda et al. 2008). However, in the Ohrid-Drim-Skadar system we found the specimens with *Cobitis sensu stricto* haplotype, related to the haplotype of *C. elongatoides* from the River Danube basin (Perdices et al. 2008, Šanda et al. 2008). Currently, it is not clear whether this haplotype belongs to a different species of *Cobitis*, or it is a case of past introgression, or that an even more complicated diploid-polyploid complex exists in the Ohrid-Drim-Skadar system.

Fig. 21. *Cobitis ohridana* from River Morača, loc. 7.

Petromyzoniformes: Petromyzonidae

Lampetra zanandreai (Vladykov, 1955)

Distribution: recorded in the lower Morača and Zeta (localities 9, 16, 17, 18), rare

IUCN Red List of Threatened Species: Least Concern

Remarks: It is the first record for Montenegro and it represents considerable extension of the known southward range of this species. However, taxonomic status of freshwater lampreys from the River Morača drainage is not completely resolved, yet. Our material from the River Morača basin was determined independently by experienced specialists, Claude Renaud (Canadian Museum of Nature, Ottawa, Canada) and Juraj Holčík (Slovak Academy of Science, Bratislava, Slovakia), as *L. zanadreai*. However, Šorić (1998) mentioned a presence of *L. planeri* in the River Morača drainage, while according to Kottelat et Freyhof (2007), *Eudontomyzon stankokaramani* Karaman, 1974, is the only freshwater lamprey species inhabiting the Ohrid-Drim-Skadar system.

Petromyzon marinus Linnaeus, 1758

Distribution: An adult specimen of sea lamprey was caught in the River Zeta at the beginning of the 21st century. A dermoplastic of this specimen should have been deposited in the University of Nikšić (Šćepanović, pers. comm.).

IUCN Red List of Threatened Species: Least Concern

Remarks: This species is probably a rare vagrant in this area. Holčík et al. (2004) reported the information about three specimens known up to date from the Lake Skadar basin in Montenegro. There are no records of reproduction of this species in Lake Skadar basin, neither in the East Adriatic coastal rivers (Holčík et al. 2004).

Salmoniformes: Salmonidae

Salmo farioides (Karaman, 1938), Fig. 22

Distribution: recorded in the upper parts of the investigated rivers, as well as in the middle part of the River Morača (loc. 1, 2, 3, 4, 5, 6, 11, 15, 16, 17), not abundant

IUCN Red List of Threatened Species: not included in the list

Remarks: This species is under a high pressure due overfishing, including the use of illegal methods (Marić 1995, own observations). The taxonomy of trouts from the Adriatic basin is far to be solved. Six trout species are suggested to occur in the River Morača basin in Montenegro (Kottelat et Freyhof 2007): *Salmo farioides*, *Salmo taleri* (Karaman, 1932), *Salmo montenigrinus* (Karaman, 1933), *Salmo marmoratus* Cuvier, 1829, *Salmo dentex* (Heckel, 1852) and *Salmo obtusirostris* (Heckel, 1851). The three last mentioned species are morphologically distinct from each other, but status of *S. farioides*, *S. montenigrinus* and *S. taleri* is unclear. A suggested harmful effect of introduction of *Salmo trutta* / S. *labrax* stock (Marić 1995) was not confirmed by a recent molecular study, as the study did not reveal hybridisation of native salmonids with introduced non-Adriatic trout (Sušnik et al. 2007a).

Fig. 22. *Salmo* cf. *farioides* from River Mrtvica, loc. 3.

Salmo marmoratus Cuvier, 1829

Distribution: not recorded during our sampling, but several specimens were caught in May 2004 in a tributary of the River Zeta (Snoj, pers. comm.) and recently recorded also in the River Cijevna (Sušnik et al. 2007a). It seems to be very rare.

IUCN Red List of Threatened Species: Least Concern

Remarks: This species is under a high pressure due overfishing, including the use of illegal methods (Marić 1995, own observations). It is probably one of the most rapidly declining species in the River Morača basin. Its taxonomic status needs further investigation, as molecular data suggests that populations identified as *S. marmoratus* from the central and southern Adriatic basin are different from the northern Adriatic populations (Kottelat et Freyhof 2007). The north Adriatic *S. marmoratus* is threatened by hybridisation with brown trout (Crivelli 1995). Given that the effective population size of *S. marmoratus* in the River Morača basin is very low, there is a high potential for hybridization with more common brown trout.

Salmo obtusirostris (Heckel, 1851), Fig. 23

Distribution: not recorded during the sampling, but several specimens were caught in May 2004 in a tributary of the River Zeta (Snoj, pers. comm.). It seems to be extremely rare.

IUCN Red List of Threatened Species: Endangered B2ab(v)

Remarks: This species is under a high pressure due overfishing, including the use of illegal methods (Marić 1995, own observations). It is probably one of the most rapidly declining species in the River Morača basin, restricted recently only to the River Zeta. Given that the effective population size of *S. obtusirostris* in the River Morača basin is very low, there is a high potential for hybridization with more common brown trout. The apparent introgression of Adriatic brown trout mtDNA into the softmouth lineage in the River Zeta exemplifies this perspective (Sušnik et al. 2007a) and parallels the results from the River Jadro in Croatia (Sušnik et al. 2007b).

Fig. 23. *Salmo obtusirostris* from River Zeta. Photo by a courtesy of Aleš Snoj.

<u>Salmoniformes: Thymallidae</u>

Thymallus thymallus (Linnaeus, 1758)

Distribution: recorded in the upper Morača (loc. 4), rare

Introduced species

Perciformes: Gobiidae

Knipowitschia montenegrina Kovačić & Šanda, 2007, Fig. 24

Distribution: recorded in the lower Morača (loc. 8, 9, 10), locally common

IUCN Red List of Threatened Species: not included in the list

Remarks: **Discovered and described during work on this project.** Detailed examination of material of freshwater gobies from the River Morača, conducted in co-operation with an experienced specialist, resulted in the description of this species published in the Journal of the National Museum (Prague), Natural History Series (Kovačić et Šanda 2007). Its known distribution is at present limited to the Lake Skadar basin in Montenegro.

Fig. 24. *Knipowitschia montenegrina* from River Morača, loc. 9.

Pomatoschistus montenigrensis Miller & Šanda, 2008, Fig. 25

Distribution: recorded in the lower Morača and Zeta (loc. 8, 9, 10, 19), locally abundant

IUCN Red List of Threatened Species: not included in the list

Remarks: **Discovered and described during work on this project.** Detailed examination of material of freshwater gobies from the River Morača, conducted in cooperation with an experienced specialist, resulted in the description of this species published in the Journal of Fish Biology (Miller et Šanda 2008). We have recently recorded this species also in the River Bojana in Albania (Šanda et Kovačić 2009). Its known distribution is at present limited to the Lake Skadar basin in Montenegro and Albania.

Fig. 25. *Pomatoschistus montenigrensis* from River Morača, loc. 9.

Perciformes: Blenniidae

Salaria fluviatilis (Asso, 1801), Fig. 26

Distribution: recorded in the lower Morača (loc. 6, 7, 9, 10), common

IUCN Red List of Threatened Species: Least Concern

Fig. 26. *Salaria fluviatilis* from River Morača, loc. 7.

<u>Anguilliformes: Anguillidae</u>

Anguilla anguilla (Linnaeus, 1758), Fig. 27

Distribution: recorded in the lower Morača and Zeta (loc. 7, 16, 17, 18, 19), common in the Zeta, rare in the Morača

IUCN Red List of Threatened Species: Critically Endangered A2bd+4bd

Remarks: Drecun et al. 1985 had found *Anguilla anguilla* to be abundant in the whole River Morača basin, including its upper course. We have found it commonly only in the River Zeta. This indicates a decline of the local population. In general, eel populations have declined dramatically during last decades and this species is regarded as a Critically Endangered species in its whole range.

Fig. 27. *Anguilla anguilla* from Rijeka Crnojevića.

<u>Gasterosteiformes: Gasterosteidae</u>

Gasterosteus gymnurus Cuvier, 1829, Fig. 28

Distribution: recorded in the lower Morača and Zeta (loc. 7, 8, 9, 16, 17, 18), common

IUCN Red List of Threatened Species: Least Concern

Fig. 28. *Gasterosteus gymnurus* from River Morača, loc. 7.

Cyprinodontiformes: Poeciliidae

Gambusia holbrooki (Girard, 1859)

Distribution: recorded in the part of Lake Skadar called Malo Blato (loc. 10), common introduced species

5.2. General notes on the ichthyofauna of the River Morača basin

We have recorded a presence of 28 species in the River Morača drainage. A half of them are cyprinids. 23 species are native and five introduced. Introduced species were always found only in small numbers. Two species are new for the science (gobies *Knipowitschia montenegrina* and *Pomatoschistus montenigrensis*), one species was found for the first time in Montenegro (*Lampetra zanandreai*) and one for the first time in the River Morača system (introduced east Asian cyprinid *Pseudorasbora parva*).

The most widespread and common species are *Barbus* sp. (recorded at 17 localities), *Phoxinus lumaireul* and *Telestes montenigrinus* (both found at 14 localities). Other species seem to have more limited distribution in the River Morača drainage. The rarest species of the River Morača drainage are apparently *Salmo marmoratus* and *Salmo obtusirostris*.

Drecun et al. (1985) found altogether 33 species in the River Morača and its inflows during their investigation in 1983-84. This is the only available reference, where the distribution of some species is given in more detail. Marić (1995) reports a presence of 19 native species from the River Morača system, but only roughly indicates their range. Although we have found less species than Drecun et al. (1985) (28 species vs. 33 species), we recorded 5 species, which they had not. Ten species, which were not found in our study, occur probably mainly in Lake Skadar and enter the lowest part of the River Morača only occasionally.

Some differences were found in the recent species distribution, comparing with the situation at the beginning of the 1980s. Drecun et al. (1985) had found some cyprinids much further upstream (e.g., *Squalius squalus*, *Rutilus* sp., *Pachychilon pictum* and *Alburnus scoranza*) while *Salmo farioides* much further downstream. Further, they had found *Anguilla anguilla* to be abundant at all studied localities. A disappearance of *Salmo marmoratus* from the River Morača, where it had been quite common in its middle and lower parts, is alarming. An extreme reduction of the population size of *Salmo obtusirostris* is another alarming fact.

Although there is not a big difference in species composition in the two main rivers (Morača and Zeta), a dominance and abundance of the present species is different. In the both rivers, *Phoxinus lumaireul*, *Telestes montenigrinus*, *Barbus* sp. and *Gasterosteus gymnurus* are common species. In the Zeta, *Gobio skadarensis*, *Pachychilon pictum* and *Anguilla anguilla* are relatively common, while in the Morača these species are rare. On the other hand, gobies (*Knipowitschia montenegrina* and *Pomatoschistus montenigrensis*), *Salaria fluviatilis*, *Barbatula zetensis* and *Cobitis ohridana* are common in the River Morača, whereas rare or not found in the River Zeta. The River Cijevna, the third large river in the River Morača drainage, is less species rich, with only five species records (*Phoxinus lumaireul*, *Telestes montenigrinus*, *Barbus* sp., *Salmo farioides* and *Salmo marmoratus*).

5.3. Notes on conservation status of the ichthyofauna of the River Morača basin

Of 23 native species recorded in our study, 18 are listed in the recent IUCN Red List (IUCN 2009), of which 14 are evaluated as Least Concern, one as Vulnerable, two as Endangered and one as Critically Endangered. According to our findings, the evaluation of most of the species in the IUCN Red List is realistic also with respect to the situation in the River Morača basin. However, status of several taxa should be changed as follows:

Chondrostoma ohridanus should be categorised as Vulnerable at the national level, because, although it is still locally common, its distribution seems to be limited to the lower River Zeta. Globally, it should be included in the category Least Concern.

Knipowitschia montenegrina should be categorised as Least Concern at the national level. The same applies for the global point of view. This newly described species is abundant in suitable habitats and its distribution area is probably much larger than so far confirmed.

Pomatoschistus montenigrensis should be categorised as Least Concern at the national level. The same applies for the global point of view. This newly described species is abundant in suitable habitats and its distribution area is probably much larger than so far confirmed.

Salmo farioides should be categorised as Vulnerable at the national level, because its range has been considerably reduced during last decades and it is under a high pressure of illegal fishing. Its taxonomic status needs to be resolved.

Salmo marmoratus should be categorised as Critically Endangered at the national level, because its range and population size has been alarmingly reduced during last decades and it is under a high pressure of illegal fishing. Its taxonomic status needs to be resolved.

Salmo obtusirostris should be categorised as Critically Endangered at the national level, because its range and population size has been highly reduced during last decades and it is under a high pressure of illegal fishing. Its taxonomic status needs to be resolved.

Fish are still not included in the Red Data List of Montenegro. We recommend that all native fish species occurring in the River Morača system are listed in the national red data list and their protection is implemented in legislation. They should be categorised according to the IUCN categorisation, unless stated differently above.

5.4. Evaluation of threats

There are several main threats to fish, which have serious effects on fish populations (Maitland 1987, Miller et al. 1989, Lowe-McConnell 1990, Beverton 1992, Witkowski 1992, Maitland 1995, Crivelli 1996, Kottelat 1998). These threats were observed also in the River Morača basin.

A) Excessive depletion by fishing

Extirpation of sturgeons from the Lake Skadar basin and decline of the migration of anadromous fish species should be ascribed to the overfishing (Stein et al. 1981, Marić 1995) (*Alosa*, *Anguilla*, *Mugil* etc.).

Probably the most serious threat to fish of the River Morača drainage is uncontrolled exploitation. Illegal fishing has risen to dangerous extent. We have seen a heap of nets and an electrofishing machine, confiscated from poachers by members of the local fishery guard. Members of the guard confirmed that explosives are commonly used, even among teenagers. Almost nobody, who fishes on a rod, has a licence although it is officially required. Spearfishing is a popular entertainment for a lot of local people. The largest marble trout (*Salmo marmoratus*) caught during last years, was caught on a spear by a police officer(!). Local fishery organisations do not know how to solve the problem of illegal fishing. Unfortunately, the government does not help. Nobody does anything with it and everybody is scared to do something. Most influenced are populations of top predators, which are in the River Morača system represented mostly by salmonids. Especially the situation in the River Morača system is alarming – we have found only small (and young) specimens of prey species and almost no predatory fish species. Fish population in the River Zeta seems to be in the better state than that in the River Morača. The abundance of smaller species is not so striking and larger predatory species, such as eel, chub (*Squalius squalus*) or even larger trouts (*Salmo farioides*) were present in the Zeta. A rare occurrence of marble trout (*Salmo marmoratus*) and softmouth trout (*Salmo obtusirostris*) was also confirmed.

B) Deterioration of water quality (through toxic effluents, lack of O_2, or euthrophication)

The upper and the middle parts of the rivers Morača and Cijevna are in a very good condition with respect to pollution. Habitats of the lower flow of the rivers Morača and Zeta are exposed to varying degrees of pollutions from various sources (pollution of agricultural, industrial or domestic origin). However, even in the past, although there have not been domestic or industrial sewage treatments (Drecun et al. 1985, Marić 1995), concentrations of pollutants were not alarming (Filipović 1981, Drecun et al. 1985). During last two decades the situation has improved. Paradoxically, it was caused by the Civil war taking place in other parts of the former Yugoslavia. Heavy economical sanctions have caused that 90 % of the industry have stopped working, and thus much less pollutants have been released to the environment. The pollution does not seem to be recently a serious threat, although it represents a potential danger for some areas (Fig. 29). However, a solid domestic waste can be often found on the banks of the rivers, sometimes in an excessive degree (Figs 30, 31).

Fig. 29. River Morača, loc. 7. In background, the biggest pollution source, Aluminium works.

Figs 30-31. Solid waste at banks of River Morača, localities 8 and 5.

C) Adverse effects of introduced species (through ecological or genetic disturbance)

Altogether 13 fish species have been introduced to Lake Skadar and its inflows. We have found five introduced species during our survey, none of them in high numbers. Thus, for the River Morača, introduced species do not seem to be currently a serious threat. However, the situation in Lake Skadar could be different, as some of the introduced species, like *Cyprinus carpio*, *Carassius auratus*, *Perca fluviatilis*, *Ctenopharyngodon idella* or *Hyphochthalmychthys nobilis* are abundant there. Some of this species are strong competitors, able to replace autochthonous species; some can negatively influence macrophytes or reduce the amount of plankton. Furthermore, introduced species can bring in parasites or diseases hitherto unknown in the area of introduction (Welcomme 1992).

Inappropriate stocking of brown trout (*Salmo trutta* / S. *labrax*) was expected to represent a serious threat to the native salmonid species in the River Morača system (Marić et Krivokapić 1991), as it is known that its hybridisation with other salmonids caused destruction of the genetic structure of native populations. This was well documented for example in Slovenia, where the population of marble trout (*Salmo marmoratus*) from the River Soča catchment was almost totally destroyed after the introduction of brown trout (Povž et al. 1996). Fortunately, recent study of the population genetic of salmonids from the Ohrid-Drim-Skadar system, including material from the River Morača drainage, does not reveal traces of hybridisation with a non-native trout (Sušnik et al. 2007a).

D) Partial or complete habitat destruction (including blockage of migration route)

Although fish species may seem to have a wide distribution, the area of the aquatic habitat where the species can be found is limited; the area critical for the survival of the species, where it actually lives most of the time, feeds and reproduces, is often a few hundreds of m^2 or km^2 (Kotellat 2000). Habitat destruction therefore belongs to the most serious threats to freshwater fishes. So far, the situation in the River Morača system is still very good. This river system represents a well-preserved ecosystem; there are no constructions on the rivers (dams, weirs, etc.), which would spoil its natural character. However, there is a serious threat, as a system of dams is planned to be constructed in the near future.

6. Conclusions

A detailed field work and exact species identification is necessary for evaluation of conservation status of freshwater fishes. Even in a well-known area it is possible to find new taxa for the given area or even new species for the science. Molecular analyses could identify unique evolutionary lineages. This is important for conservation actions.

The observed changes in species composition and distribution in the River Morača drainage, when compared with the situation in the 1980s, were caused mainly by the excessive pressure of illegal fishing, which currently represents a serious problem. Most influenced are populations of top predators, which are in the River Morača system represented by salmonids. There is an urgent need for a direct conservation action to protect and re-establish marble trout (*Salmo marmoratus*) and ancient softmouth trout (*Salmo obtusirostris*). If this is not done, these species could easily cross the edge, from which a return is impossible, and next generations of Montenegrins will know them only from the stories.

In general, most of the freshwater fish species from the River Morača system do not seem to be directly endangered. However, due to their limited area of distribution, any large scale change of the environment or accidental poisoning of the river could lead to a drastic decrease of population sizes or even to extinction of many fish species.

The most important act for the fish conservation in the River Morača system is to incorporate a conservation of fish species and their habitats in legislation and to create instruments for adhering the legislation.

7. Local and international involvement and co-operation

Students and employees of the University of Montenegro, local people, students from the Czech Academy of Science and Charles University (Czech Republic), as well as one student from Banja Luka (Bosnia and Herzegovina) and one scientist from Poland participated in the fieldwork. Further, members of the local sport fishery organisations joined us on every fieldwork and with interest watched our activities and some of them participated in our work (Fig. 32). We made good relations with the local sport fishery organisations, employees of Natural Museum of Montenegro and the Agency for Nature Protection.

Due to molecular part of the work we developed a co-operation with researchers from the Museo Nacional de Ciencias Naturales in Madrid, Spain. The description of two new species was done in co-operation with scientists from the Natural History Museum in Rijeka, Croatia, and the University of Bristol, U.K.

As our research area extended to adjacent areas of the Adriatic Sea drainage, we set a co-operation with the scientists and students from the University of Tirana, Albania, the University of Mostar, Bosnia and Herzegovina, the University of Osijek, Croatia, the University of Belgrade, Serbia, the University of Skopje, Macedonia, and local sport fishery organisations of these areas.

Fig. 32. Members of local sport fishery organisation watching and helping in the fieldwork.

8. Awareness campaign

During autumn and winter of 2002, lectures were held in primary and secondary schools and in kindergartens (Figs 33-38) in the three biggest and most important towns of Montenegro (Podgorica, Nikšić, and Cetinje) – altogether eleven schools and kindergartens and twelve talks. The new member of our team, Sanja Kaludjerović (former secondary school teacher of biology), was responsible for running the lectures. In this part of the awareness campaign, members of the NGO Zeleni pravac (12 secondary school pupils from Cetinje) and employees of the Agency for Nature Protection were involved. Lectures also included questionnaires, games and creative activities for the children and teachers. Posters were prepared for schools and T-shirts with endemic fish *Telestes montenigrinus* were made for the students who helped with the lectures.

In Montenegro, talks about the project or the results of the project were given at the University of Montenegro, the Natural Museum of Montenegro, the Agency for Nature Protection, to members of local sport fishery organisations and local people. We found discussions with members of local sport fishery organisations and local people very important: we learnt a lot from each other. Further, talks about the project were given to students at the Charles University, Prague, Czech Republic and students and employees of the Museo Nacional de Ciencias Naturales in Madrid, Spain.

Four articles about the project were published in local Montenegrin daily newspapers (see Appendix 1). There were several interviews for a local radio and the BBC, and one interview for the Montenegrin Television Channel 2.

Results of the project were presented at seven international and two Czech conferences, both as posters (4) and as speeches (7). Five scientific papers were published (Appendix 2) and two more have been recently submitted to scientific journals. Eight abstracts and three papers from conference proceedings were published. Project leader's paper, "Save Morača!" has been selected at the first entry in the American Fisheries Society student writing competition. In recognition of the AFS Student Writing Contest award this paper was published in an issue of Fisheries magazine.

Figs 33-35. Lectures were held in schools and kindergartens.

Figs 36-38. Lectures were held in schools and kindergartens. Volunteers from NGO Zeleni pravac (down).

8.1. Publicity and talks & conferences

Radio

- interview for BBC, April 19th, 2002, London
- interviews for Radio Cetinje, October 26th, November 2nd, 9th and 16th, 2002 (covers around two thirds of the Montenegrin territory, ~450,000 inhabitants)

Television

- interview in "Jutarnji program" of Montenegrin Television Channel 2, September 24th, 2002 (covers whole Montenegro, ~ 680,000 inhabitants)

Newspapers - Montenegrin daily newspapers (see Appendix 1)

- Glas Crnogorca, September 18th, 2002
- Dan, October 22nd, 2002 (circulation 27,000)
- Publika, October 26th, 2002
- Pobjeda, November 2nd, 2002

Talks were given to

- Agency for Nature Protection in Podgorica, July 31st and September 20th, 2002, July 15th, 2003
- Natural Museum of Montenegro, July 31st and September 20th, 2002, July 15th, 2003
- University of Montenegro, July 8th and September 23rd, 2002
- local sport fishery organisations and local people, all the time during the fieldwork in July and September, 2002 and July, 2003
- Charles University, Prague, Czech Republic, April 8th, 2003, April 5th, 2005
- Museo Nacional de Ciencias Naturales, Madrid, Spain, March 5th, 2008

- kindergartens
  - Zagorka Ivanović, Cetinje, October 22nd, 2002
  - Ljubica Popović, Podgorica, October 29th, 2002
  - Lastavica, Nikšić, November 5th, 2002

- primary schools
  - Njegoš, Cetinje, October 22nd, 2002
  - Lovćenski partizanski odred, Cetinje, October 22nd, 2002
  - Savo Pejanović, Podgorica, October 30th, November 19th, 2002
  - Maksim Gorki, Podgorica, November 12th, 2002
  - Olga Golović, Nikšić, November 5th, 2002

- secondary schools
  - J.U. Gimnazija, Cetinje, October 22nd, 2002
  - Slobodan Škerović, Podgorica, October 29th, 2002
  - J.U. Gimnazija, Nikšić, November 5th, 2002

Publications in scientific journals (see Appendix 2)

- Bohlen, J., Šlechtová, V., Šanda, R., Kalous, L., Freyhof, J., Vukić, J. et Mrdak, D. 2003. *Cobitis ohridana* and *Barbatula zetensis* in the River Morača Basin, Montenegro: distribution, habitat, population structure and conservation needs. Folia Biologica (Krakow) 51 (Suppl.): 147-153.
- Šanda, R. 2003. Save Morača! Fisheries, 28 (2): 28.
- Šanda, R., Lusková, V. et Vukić, J. 2005. Notes on the distribution and taxonomic status of *Gobio gobio* from the Morača River basin (Montenegro). Folia Zoologica 54 (Suppl.1): 73-80.
- Kovačić, M. et Šanda, R. 2007. A new species of *Knipowitschia* (Perciformes: Gobiidae) from southern Montenegro. Journal of the National Museum (Prague), Natural History Series 176 (5): 81-89.
- Miller, P.J. et Šanda, R. 2008. A new West Balkanian sand-goby (Teleostei: Gobiidae). Journal of Fish Biology 72: 259-270.

Publications submitted to scientific journals

- Buj, I., Šanda, R., Perea, S., Ćaleta, M., Marčić, Z., Bogut, I., Vukić, J., Povž, M. et Mrakovčić, M. Morphological comparison of bleaks (*Alburnus*, Cyprinidae) from the Adriatic Basin with the description of a new species. Folia Zoologica (resubmitted with revisions following the referees' comments).
- Marková, S., Šanda, R., Crivelli, A., Shumka, S., Wilson, I.F., Vukić, J., Berrebi, P. et Kotlík, P. Nuclear and mitochondrial DNA sequence data reveal the evolutionary history of *Barbus* (Cyprinidae) in the ancient lake systems of the Balkans. Molecular Phylogenetics and Evolution (under review process of the journal).

Publications in conference proceedings

- Šanda, R. et Vukić, J. 2003. Diversity of freshwater fishes of the Adriatic Sea slope in the area of former Yugoslavia. Pp. 127-129 *In* Švátora, M. (ed.): Proceedings of the 6th Czech Ichthyological Conference. Prague. (In Czech with English summary)
- Šanda, R. et Machordom, A. 2005. Phylogeography of the genus *Telestes* (Cyprinidae). Pp. 122-127 *In* Spurný, P. (ed.): Proceedings of the 8th Czech Ichthyological conference, Brno. (In Czech with English summary)
- Šanda, R., Křížek, J., Vukić, J. et Wilson, I. 2005. Distribution of freshwater fishes in Albania. Pp. 90-96 *In* Spurný, P. (ed.): Proceedings of the 8th Czech Ichthyological conference, Brno. (In Czech with English summary)

Abstracts in conference abstract books

- Bohlen, J., Šlechtová, V., Šanda, R., Kalous, L., Vukić, J. et Mrdak, D. 2002. Data on *Cobitis* cf. *ohridana* and *Barbatula* cf. *sturanyi* in the Morača river basin, Montenegro. Abstract book, 2nd International Conference on Loaches of the genus *Cobitis* and related genera, Olsztyn.
- Šanda, R. et Lusková, V. 2003. Notes about the taxonomic status of *Gobio gobio ohridanus* (Karaman, 1924) and about its distribution in running waters of Montenegro. Abstract book, p. 31. International Conference on Distribution, Taxonomic and Genetic Status of the European Species of the Genus *Gobio*, Brno.
- Šanda R. et Machordom A. 2004. Revised phylogenetic relationships of the genus *Telestes*, with emphasis on the *Telestes montenigrinus* diversity. Abstract book, p. 25-26. XI European Congress of Ichthyology, Tallinn.
- Šanda, R., Vukić, J., Bohlen, J., Mrdak, D., et Miller, P.J. 2004. New data about the composition of the ichthyofauna of the Morača River System. Abstract book, p. 126. XI European Congress of Ichthyology, Tallinn.
- Šanda, R., Vukić, J., Bohlen, J., Mrdak, D., et Miller, P.J., 2004. New data about the composition of the ichthyofauna of the Morača River System. Abstract book, p. 4. 1st Symposium of ecologists of the Republic of Montenegro, Tivat.

- Šanda, R., Vukić, J., Bohlen, J., et Mrdak, D. 2005. Status and conservation of freshwater fishes of the Morača River system, Montenegro, south-eastern Europe. Abstract book, p. 187. 19th Annual Meeting of the Society for Conservation Biology, Brazilia.
- Šanda, R., Vukić, J., Křížek, J., et Wilson, I.F. 2007. Division of Albania into ichthyological districts based on the distribution of freshwater fishes. Abstract book, p. 17. XII European Congress of Ichthyology, Cavtat.
- Šanda, R. et Shumka, S. 2009. Biodiversity of freshwater fishes from the eastern Adriatic Sea slope. Abstract book, p. 95-96. International Conference on Lakes and Nutrients loads, Pogradec.

Conferences

- International Conference on Loaches of the genus Cobitis and related genera, September 9-13, 2002, Olsztyn, Poland (poster)
- VI Czech Ichthyological Conference, September 3-4, 2003, Prague, Czech Republic (oral presentation)
- International Conference Distribution, Taxonomic and Genetic Status of the European Species of the Genus *Gobio*, September 7-11, 2003, Brno, Czech Republic (oral presentation)
- XI European Congress of Ichthyology, September 6-10, 2004, Tallinn, Estonia (oral presentation and poster)
- 1st Symposium of ecologists of the Republic of Montenegro, October 14-18, 2004, Tivat, Montenegro (poster)
- 19th Annual Meeting of the Society for Conservation Biology, July 15-19, 2005, Brasilia, Brasil (poster)
- VIII Czech Ichthyological conference, September 14-15, 2005, Brno, Czech Republic (two oral presentations)
- XII European Congress of Ichthyology, September 9-19, 2007, Cavtat, Croatia (oral presentation)
- International Conference on Lakes and Nutrients loads, April 24-25, 2009, Pogradec, Albania (oral presentation)

9. Recommendations:

- To list all native species of the River Morača system in the National Red Data List and implement their protection in legislation
- To implement the protection of habitats within the River Morača system into legislation
- To protect the whole River Morača system, as it is a well preserved river system unlike many others in the eastern Adriatic basin, as well as because it is inhabited by numerous endemic species
- To prevent from the damming of the flow (especially from the planned construction of the system of the reservoirs and dams on the River Morača) and to keep the natural character of all the rivers in the system
- To control the illegal fishing and to penalise rigorously fishing by prohibited methods
- To penalise rigorously deposition of wastes
- To strictly control the adhering of legislation
- To make an efficient monitoring strategy of the control of the quality of the water in the river system, especially at industrial and agricultural sources of pollution
- To build more sewage plants
- To regularly organise cleaning of the rivers and their banks by local people, e.g., by primary and secondary schools
- To monitor fish populations in the river system
- To continue with a research of a life history of endemic species as it is the key to their effective protection
- To focus on raising awareness among the general public through environmental education and media
- Catch and release sport fishing as a source of income for the local people
- Eco-tourism as a source of income for the local people (to mark paths around the rivers, souvenirs, booklets)
- Rafting as a source of income for the local people

10. Future perspectives

The research has been extended to and continues in the surrounding countries (Albania, Bosnia and Herzegovina, Croatia). Our perspective is to focus on the research of freshwater fishes, as well as on the raising awareness of the local communities, in a broader area of the eastern Adriatic basin. Unfortunately, local people are still not aware of the invaluable treasure that is kept in the nature. The results of the research will be used for the preparation of the effective conservation strategy for the threatened species and their habitats.

For the effective conservation it is fundamental to know the taxonomic status of the species. In some cases of freshwater fish species of the eastern Adriatic basin, the taxonomic status is still unclear to the science. This is a long-time process, which requires analyses of material of all closely related taxa and the use of the newest molecular and morphological methods, which are being rapidly developed at present.

11. Budget

For our project we received a financial support from the Conservation Leadership Programme (former BP Conservation Programme): Bronze award 2002 (Fig. 39). For the fieldwork, additional financial support was obtained from the Fund of mobility of the Charles University and the Hlávkova Nadace Foundation. The molecular analysis part of the project was funded by the EU projects SYNTHESYS and BIODIBERIA. Further support was obtained from the National Museum in Prague. The conferences attended were funded from the Conservation Leadership Programme as a CLP alumni grant, the National Museum in Prague, the Literary Foundation and the Hlávkova Nadace Foundation. The total income from the Conservation Leadership Programme was 3.686 £ (2,625 £, i.e., 75 % of the Bronze Award of 3,500 £, and 1,061 £ as a CLP alumni grant) and from other organisations 18,465 € (see Tab. 1).

NOTE: The part of the project extended to other surrounding areas received additional financial support from the Fisheries Society of the British Isles and the University of Mostar.

Tab. 1. Budget of the Fishes of Montenegro project.

Funding organisation	Amount received	Expenditure
Conservation Leadership Programme	2,625 £ (75 % of 3,500 £)	3,500 £
CLP alumni grant	1,061 £	1,061 £
National Museum Prague	1,429 €	1,429 €
EU (BIODIBERIA and two SYNTHESYS projects)	15,000 €*	15,000 €*
Fund of Mobility of the Charles University	714 €	714 €
Hlávkova Nadace Foundation	1,072 €	1,072 €
Literary Foundation	250 €	250 €

NOTE: * the support for the molecular projects went directly to the Museo Nacional de Ciencias Naturales in Madrid, who provided us with all necessary for the work in the museum and our stay in Madrid. The exact amount is not known to the team.

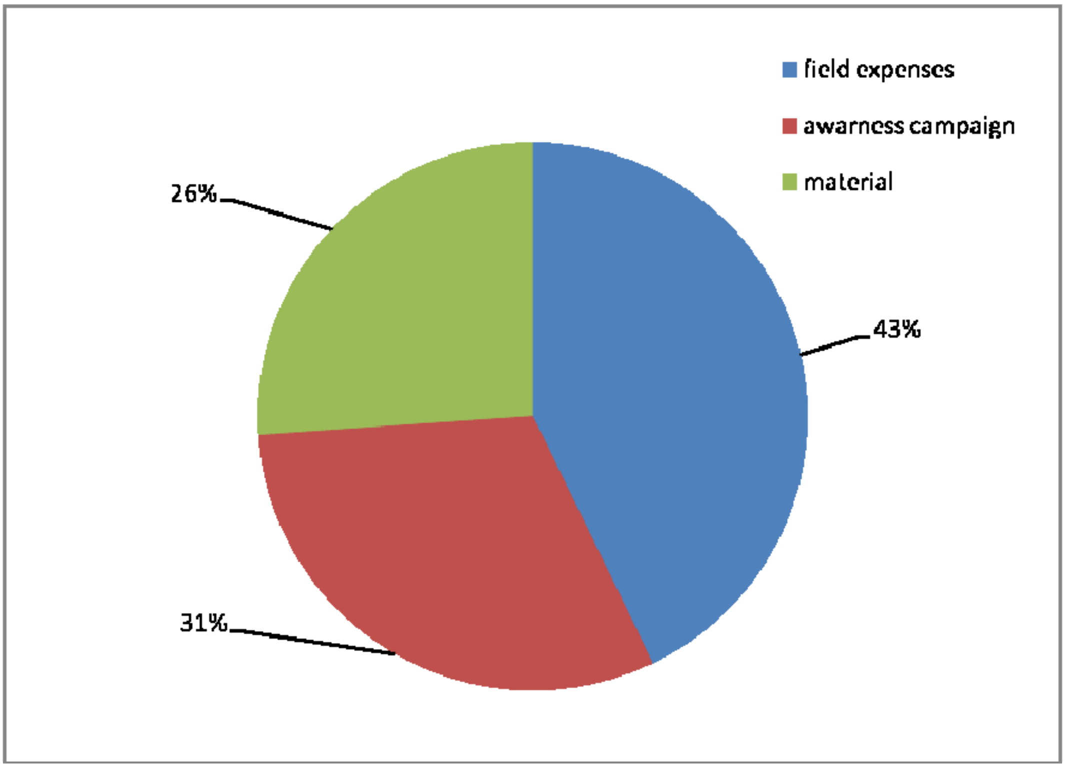

Fig. 39. Analysis of the expenditure of 3,500 £, CLP Bronze Award.

12. Acknowledgements

We are highly grateful to all organisations that supported our project. The project was primarily funded by the Conservation Leadership Programme (at the time of the approval of the project, the BP Conservation Programme), organised by the BirdLife International, the Fauna & Flora International, the BP, the Wildlife Conservation Society and the Conservation International, from which we received a Bronze Award and a CLP alumni grant. The additional funding was provided by the National Museum Prague, Fund of Mobility of the Charles University, Hlávkova Nadace Foundation, and Literary Foundation. Due to the support by the EU projects SYNTHESYS (financed by European Community Research Infrastructure Action under the FP6 "Structuring the European Research Area" Programme, projects ES-TAF-3770 and ES-TAF-1187) and BIODIBERIA (financed by European Community Research Infrastructure Action under the FP5 "Structuring the European Research Area" Programme, project "Phylogenetic relationships within the genus *Telestes* with special emphasis on *Telestes montenigrinus*") it was possible to include very expensive molecular phylogenetic methods in the project. The project could have been extended to the areas adjacent to Montenegro thanks to the support by the Fisheries Society of the British Isles (project Diversity and phylogenetic relationships of Albanian freshwater gobies) and the University of Mostar.

We are very grateful to the kind and helpful staff of the Conservation Leadership Programme, namely Marianne Carter, Kate Stokes, and Robyn Dalzen, who helped and supported us during various stages of the project.

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Appendix

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Appendix 1.1. Glas Crnogorca, September 18th, 2002.

ИСТРАЖИВАЊЕ ПРИРОДНИХ ЉЕПОТА БИВШЕ СФРЈ

Заштита угрожених врста

Британски програм заштите животне средине, организован у сарадњи са „BP", „Bird life international" i „Fauna", „flora international", по први пут је одобрио финансијску помоћ за истраживање природе на територији бивше Југославије, један пројекат ће се реализовати и у Црној Гори.

Овај пројекат има циљ да се утврди садашње стање риба у Морачи и њеним притокама, као и да пружи допринос припремању стратегије заштите угрожених врста. Истраживање ће трајати до јула 2003. године, док предвиђени буџет износи 3.500 фунти.

Први дио теренског посла обављен је у јулу, када је утврђено да је криволов достигао огромне размјере, јер се прибјегава коришћењу веома деструктивних техника које уништавају све живо у води. Посебан проблем је загађење, које има све већи негативни тренд

Ми. Б.

Appendix 1.2. Dan, October 22nd, 2002.

ПРОГРАМ „ДИЗАЊЕ СВИЈЕСТИ"

Предавања о заштити животне средине

Средином ове године тим стручњака из Прага, повезаних са колегама са факултета биологије, почели су да спроводе програм за заштиту животне средине „Дизање свијести". Програм ће, планирано је, трајати до јуна наредне године.

Од 22. октобра до 11. новембра серију предавања у Подгорици, Никшићу и на Цетињу одржаће професор биологије **Сања Калуђеровић**. Циљ предавања је да се укаже младој популацији значај окружења у којем живимо.

У оквиру овог програма је пројекат испитивања рибље популације ријечног система Мораче, и утврђивање стратегије за заштиту слатководних риба. **М.К.**

Appendix 1.3. Publika, October 26th, 2002.

PREDAVANJA U OKVIRU PROJEKTA "PODIZANJE EKOLOŠKE SVIJESTI"

O životu riba u rijeci Morači

Podgorica - U okviru projekta "Podizanje ekološke svijesti", koji se radi u saradnji asistenata i profesora češkog Karlovog univerziteta i Prirodno-matematičkog fakulteta u Podgorici, profesor cetinjske Gimnazije **Sanja Kaluđerović** održaće niz edukativnih predavanja. Prema riječima biologa **Danila Mrdaka**, predavanja će se održavati u vrtićima, osnovnim i srednjim školama u Podgorici, Cetinju i Nikšiću.

- Projekat obuhvata istraživanje populacije riba rijeke Morače sa posebnim osvrtom na endeme. U okviru projekta planirana je edukacija mladih radi podizanja ekološke svijesti, pa će se u tom cilju održati predavanja o rijekama i njihovom značaju - rekao je Mrdak i dodao da je za utorak predviđeno predavanje u podgoričkoj Gimnaziji. On je istakao da je projekat u toku i trajaće do juna sljedeće godine. Projekat finansiraju međunarodne ekološke organizacije "Bird-life International" i "Flora and Fauna International".

N.J.

Appendix 1.4. Pobjeda, November 2nd, 2002.

ПРОЈЕКАТ ЗАШТИТЕ УГРОЖЕНИХ ВРСТА РИБА У МОРАЧИ

Дјечја еколошка радионица

ЕКО-РАДИОНИЦА: „Ланац исхране"

Из године у годину тема заштите животне средине је све више актуелна. Тим поводом је под покровитељством BP Conservation Programme који је организован британским институцијама BP, Bird Life International i Fauna and Flora International, покренут Пројекат „Заштита угрожених врста риба у ријеци Морачи". Пројекат има за циљ да утврди садашње стање популација риба у овој ријеци и њеним притокама и да допринесе припремању стратегије заштите угрожених врста. Вођа тима је Санда Радек, професор Карловог универзитета у Прагу, а за организацију низа еколошких активности у циљу едукације младих на ову тему задужена је Сања Калуђеровић, професор биологије у Цетињској гимназији, као и њени ученици, чланови еколошке секције. Програм обухвата образовне установе у Подгорици, Никшићу и Цетињу, а активности примјерене предшколском узрасту реализоване су и у „Буба-мари", једном од објеката ЈПУ „Љубица Поповић". Едукација се одвија у неколико нивоа, који укључују приказивање слајдова биљних и животињских врста, ликовне активности и формирања ланца исхране којим се малишанима сликовито објашњава колико је важан сваки његов члан.

У посљедње вријеме рибе су неконтролисано експлоатисане, а криволовство је достигло огромне размјере. Колико ендемита још има и колико ће дуго бити ту прије него што се потпуно истријебе", запитала се Калуђеровићева уз наду да ће ова врста едукације допринијети повећању нивоа еколошке свијести код нас.

M. J.

Appendix 2. Papers published in scientific journals.

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A new West Balkanian sand-goby (Teleostei: Gobiidae)

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A new species of West Balkanian freshwater sand-goby *Pomatoschistus montenegrensis* sp. nov. (Teleostei: Gobiidae) is described from the Morača River, southern Montenegro, and shown to be related to the euryhaline Adriatic *Pomatoschistus canestrinii*. The generic status of these two species is discussed with reference to the limits of *Pomatoschistus* (type *Gobius minutus*) and the status of a subgenus [*Ninnigobius* (type-species *Gobius canestrini*)]. The habitat and the local distribution of the new species are described.

Key words: Gobiidae; Montenegro; new species; *Ninnigobius*; *Pomatoschistus*.

INTRODUCTION

The 'sand-gobies' (as defined by McKay & Miller, 1997; Miller, 2004) of the West Balkanian zoogeographic area are beginning to be seen as a complex of freshwater or euryhaline populations, typically differentiated by catchment, with, in recent years, the designation of a number of separate species. They are currently assigned to three phenetic genera: *Pomatoschistus* Gill, *Knipowitschia* Iljin and *Economidichthys* Bianco, Bullock, Miller & Roubal as defined by Miller (1986, 2004) and Economidis & Miller (1990). The present paper describes a new gobiid recently collected in southern Montenegro from the Morača River that drains into Lake Skadar on the Adriatic coast.

The new Morača gobiid resembles the middle and northern Adriatic *Pomatoschistus canestrinii* (Ninni, 1883), the 'Ghiozetto cenerino' of north-east Italy and Croatia, found typically in oligohaline habitats (Gandolfi *et al.*, 1982; Miller, 2004; Franco *et al.*, 2005; Kovačić, 2005), but is here distinguished as a separate species. Features of this goby, and a comparison with *P. canestrinii*, however, have raised a wider question about generic limits within the endemic Adriatic and West Balkanian sand-gobies. The validity of elevating these two species to separate generic rank is discussed in relation to diagnoses employed

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for *Pomatoschistus* and other related genera but, for the present, this step is not considered to be desirable. The name *Ninnigobius* Whitley, a replacement name for *Ninnia* De Buen, originally proposed for *Gobius canestrinii* by De Buen (1930) but preoccupied among molluscs, is already available should this be deemed necessary in the future.

MATERIALS AND METHODS

COLLECTIONS

NMP, National Museum, Prague; NMW, Naturhistorisches Museum, Vienna; MSNV, Museo Civico di Storia Naturale, Venice.

MERISTICS

A, anal fin; C, caudal fin; D1, D2, first and second dorsal fins; P, pectoral fin; V, pelvic disc. Last bifid ray of D2 and A counted as one. Vertebral counts include urostyle; DP, dorsal pterygiophore sequences begin behind third neural spine and indicate number of pterygiophores for each interneural space to first two elements of second dorsal fin.

MORPHOMETRICS

Body proportions are given in Table I. Fish size is given as standard (L_S) + caudal fin length (L_C) in the text. Sex was determined from the shape of the urogenital papilla (Miller, 1984).

SQUAMATION

To display scales, preserved material (including paratype NMP 80368) was bleached where necessary with dilute hydrogen peroxide in 0·5% potassium hydroxide solution, and then stained with alizarin red in 0·5% KOH; for vertebral and pterygiophore counts, material was further cleared using a solution of trypsin in sodium tetraborate buffer, based on the methods described by Taylor (1967) and Economidis & Miller (1990).

LATERAL-LINE SYSTEM

Head pores and papillae were highlighted using a fibre-optic light cable, directing from an acute angle to bring these minute structures into relief. The terminology is that used and illustrated by Miller (1986), with free neuromast organs (sensory papillae) listed by innervation categories as indicated by results for generalized gobioids (Wongrat & Miller, 1991).

RESULTS

POMATOSCHISTUS MONTENEGRENSIS SP. NOV. (FIG. 1)

Material

Pomatoschistus montenegrensis: Holotype, male 27·0 + 5·5 mm (NMP6V 80388), and 18 paratypes, 16 males, 22·0 + 4·8 to 28·0 + 6·0 mm [NMP6V 80368 (cleared and stained), 80372, 80374, 80375, 80377, 80378, 80380, 80386,

TABLE I. Body proportions in *Pomatoschistus montenegrensis* sp. nov. from River Morača, Montenegro. Values are range and, in parentheses, mean ± S.D.

Sex	Male holotype	Males	Females
n		12	2
L_S (mm)	27·0	20·0–28·0	19·5, 22·5
$\%L_S$			
Hl	24·3	23·4–28·0 (26·3 ± 1·6)	23·0, 28·9
Hw	12·8	12·7–15·5 (13·4 ± 1·1)	11·8, 13·4
SN/D1	34·0	34·0–39·4 (36·9 ± 1·8)	36·2, 38·4
SN/D2	52·6	51·2–56·3 (53·9 ± 1·6)	54·3, 55·7
SN/AN	50·3	50·3–58·7 (53·7 ± 2·7)	52·6, 53·6
SN/A	57·9	54·2–60·6 (57·9 ± 2·2)	58·9, 58·9
SN/V	29·0	25·8–34·3 (29·6 ± 3·1)	29·0, 30·7
CP	25·7	23·4–28·5 (26·2 ± 1·8)	27·0, 28·6
D1b	9·9	9·1–12·9 (10·5 ± 1·5)	9·2, 9·8
D2b	20·1	16·0–22·4 (18·3 ± 2·4)	15·8, 18·2
Ab	17·8	12·0–17·8 (14·7 ± 2·3)	13·2, 11·3
L_C	20·4	18·1–23·0 (20·5 ± 2·0)	21·7, 20·8
Pl	21·1	16·0–21·3 (19·2 ± 8·0)	19·7, 20·8
Vl	21·4	19·1–22·1 (20·9 ± 1·0)	21·7, 23·2
Vd	20·4	18·9–21·9 (20·1 ± 1·1)	19·7, 23·2
Ad	13·8	12·7–16·0 (14·6 ± 1·2)	13·2, 15·8
CPd	6·7	6·7–9·0 (8·1 ± 0·9)	7·9, 8·0
%CP			
CPd	28·2	24·3–35·9 (31·2 ± 4·2)	29·3, 28·1
%Hl			
SN	22·9	16·3–24·4 (21·8 ± 3·0)	27·1, 20·6
E	28·6	25·9–31·3 (28·7 ± 1·9)	28·6, 27·8
PO	48·6	41·8–50·0 (47·1 ± 3·0)	45·7, 51·6
CHd	28·4	19·4–28·4 (22·2 ± 3·4)	21·4, 18·6
Hw		45·9–58·2 (51·0 ± 5·3)	51·4, 46·4
I		9·2–14·1 (11·9 ± 1·8)	12·9, 5·2

Ab, anal fin base; Ad, body depth at anal fin origin; CHd, cheek depth (lower border of eye to level of angle of jaws); CP and CPd, caudal peduncle length (end of A base to origin of C) and depth (minimum); D1b and D2b, first and second dorsal fin bases; E, eye diameter; Hl, Hw, head length (snout to midline opposite upper origin of opercle) and width (between upper origin of opercles); I, interorbital width; L_C, caudal fin length; L_S, standard length; n, number of fish; Pl, pectoral fin length; PO, postorbital length (rear edge of orbit to upper origin of opercle); SN, snout length; SN/A and SN/AN, distance from snout to vertical of anal fin origin and anus; SN/D1 and SN/D2, distance from snout to origin of first and second dorsal fins; SN/V, distance from snout to vertical of pelvic spinous ray origin; Vd, body depth at origin of V I; Vl, distance from V I origin to tip of longest pelvic ray.

80389–91, 80393, 80395, 81164–66] and two females, 19·5 + 3·5 mm (NMP6V 80367) and 22·5 + 4·5 mm (80387), all from Golubovci (42°18′55·3″ N; 19°12′3·5″ E), on River Morača, above Lake Skadar, southern Montenegro, 18 and 22 July 2002. Additional material: 179 specimens, 14·0 + 3·0 to 24·0 + 5·0 mm, Golubovci, River Morača, 22 July 2002, collector R. Šanda (including eight cleared and stained).

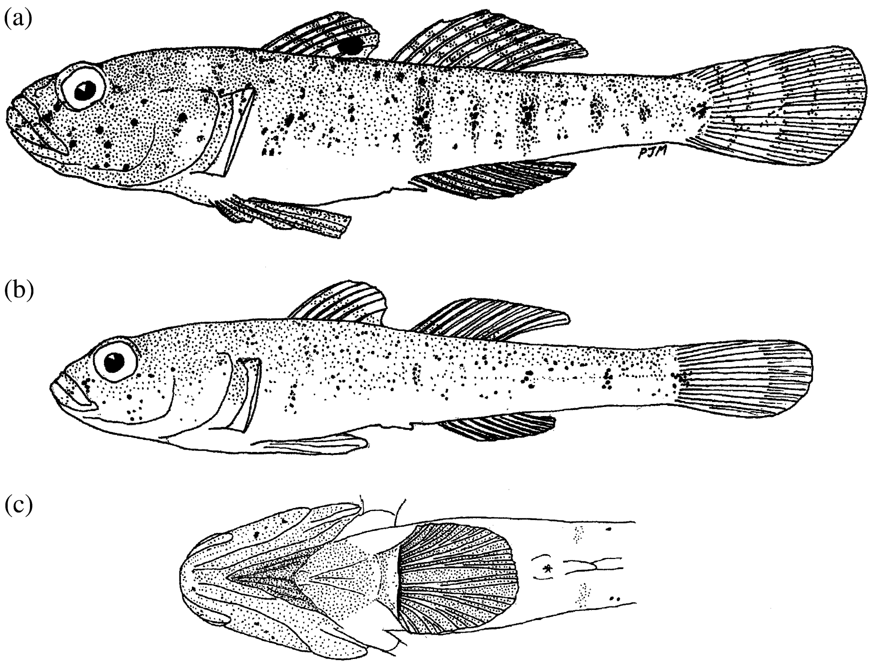

FIG. 1. *Pomatoschistus montenegrensis* sp. nov. (a) Holotype, male, NMP6V 80388, 27·0 + 5·5 mm (standard + caudal fin length) (b) paratype, female, NMP6V 80367, 19·5 + 3·5 mm and (c) underside of holotype.

Comparative material: *Pomatoschistus canestrinii*

Croatia: Five males, 45·0 + 10·0 to 56·5 + 11·0 mm, and one female, 42·5 + 9·5 mm, (NMW 30631), Split; one male, 37·5 + 7·0 mm (MSNV 5469), Split; five males, 22·5 + 5·0 to 35·0 + 7·0 mm, and five females, 27·0 + 6·0 to 33·0 + 7·0 mm, River Zrmanja, R. Šanda. Italy: two females, 31·0 + 7·0 and 34·0 + 7·0 mm (NMW 28817/818), Venezia; North East Italy, collector G. Gandolfi: two males, 31·0 + 7·0 and 33·0 + 7·0 mm, and one female, 28·0 + 6·0 mm, Fiume Tagliamento, 7 April 1977; three males, 23·0 + 4·5 to 27·0 + 6·0 mm, and one female, 29·5 + 5·5 mm, Fiume Stella, 7 April 1977; five males, 32·0 + 7·0 to 40·0 + 8·0 mm, and eight females, 23·0 + 5·0 mm to 32·5 + 6·5 mm, Sacca Canarin, 16 March and 16 December 1977.

Knipowitschia sp. (aff. *croatica*): Three males, all 26·0 + 5·5 mm (including NMP6V 80369, 81167, 81168), three females, 18·5 + 4·0 to 27·0 + 5·0 mm (NMP6V 80366, 80369, 81169), and many other examples (including female, 19·0 + 3·5 mm, Golubovci, River Morača, Montenegro, 18 and 22 July 2002, collector R. Šanda.

Etymology

The specific name is derived from that of Montenegro, where the type material was collected.

Generic identification

Pomatoschistus, *Knipowitschia*, *Economidichthys* and *Hyrcanogobius* Iljin are sand-goby genera characterized by the common possession of short transverse infraorbital cheek papillae rows (forming series *c*), between the levels of longitudinal hyomandibular rows *b* above and *d* below (Miller, 1986, 2004). Although head canals are more or less reduced in all the material, the present new species may be placed in *Pomatoschistus* by occurrence, in specimens with the greatest retention of head canals, of a single interorbital canal, with a single anterior interorbital pore λ, rather than the diverging paired canals seen in *Knipowitschia*. The new taxon does not possess a perianal organ, found in *Economidichthys*, from western Greece, or the long vertical papilla row (*tra*) on the rear cheek seen in the Caspian *Hyrcanogobius*, features diagnostic for these genera (Miller, 2004).

Populations of *P. montenegrensis* sp. nov. and *P. canestrinii*, however, differ markedly from other *Pomatoschistus* species in (1) reduction of the head canal system, ranging from merely occlusion of preopercular pore δ to loss of all canals noted in an individual of *P. montenegrensis* (Miller, 2004; Kovačić, 2005; see below), (2) a wide range in body squamation, from continuous lateral cover more or less narrowed along the midline to separation of axillary and caudal areas in *P. canestrinii* [Kovačić, 2005; Fig. 2(c), (d)] and complete loss of the caudal patch in *P. montenegrensis* [see Fig. 2(a), (b)], (3) colouration with numerous small but intense black spots, conspicuous over the head and body in *P. canestrinii*, especially in males (Gandolfi *et al.*, 1982; Kovačić, 2005), but more evident on the head in male *P. montenegrensis* (Fig. 1) and (4) occurrence of exclusively freshwater populations (Kovačić, 2005).

These features, putative synapomorphies peculiar to *P. canestrinii* and *P. montenegrensis*, raise the question of retaining these two species within *Pomatoschistus* or separating them under the available name of *Ninnigobius* for which *Gobius canestrinii* is the type-species. As currently defined, *Pomatoschistus* is a paraphyletic assemblage but *Knipowitschia* and the other genera appear to represent monophyletic lines (Miller, 2004).

The combination of derived characters listed above, unique to *P. canestrinii* and *P. montenegrensis* within *Pomatoschistus*, suggest their closest common ancestry among the *Pomatoschistus* species, but the distinctive colouration of black spots is the only unequivocal morphological feature that could be used in a formal generic diagnosis, given the range of head canal variation found within *canestrinii*. Features of pigmentation, however, are hardly equatable with the lateral-line criteria used to define other associated genera. Consequently, while the two species form an obvious clade within the present limits of *Pomatoschistus*, the present generic classification has been retained to concur with Kovačić (2005) pending further study.

Species identification

As noted in the generic discussion, *P. montenegrensis* and *P. canestrinii* differ from all other *Pomatoschistus* species in the features of canal reduction, squamation, colouration and potential for colonization of fresh water. *Pomatoschistus montenegrensis* may be distinguished from *P. canestrinii* by (1) the presence of scales only on the axilla, behind the pectoral fin, (2) occurrence of dark

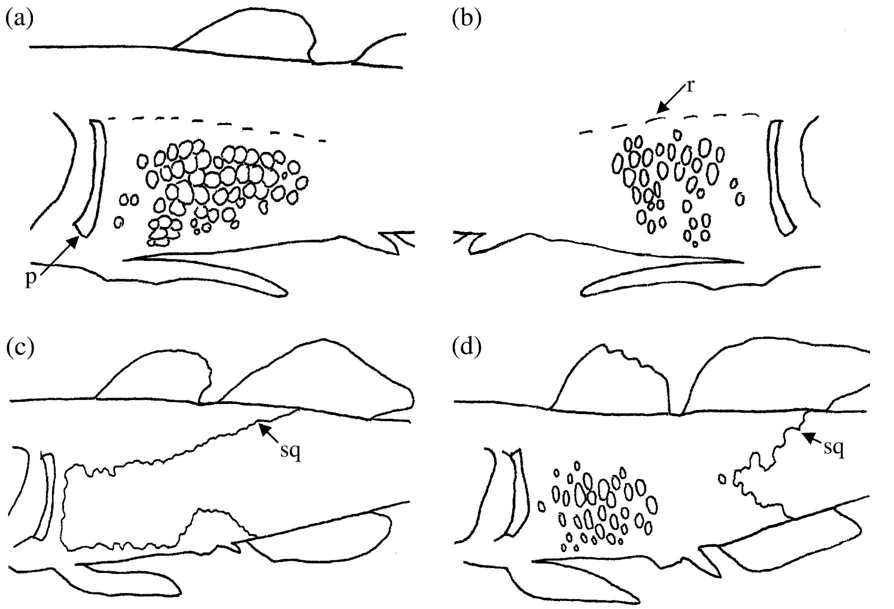

FIG. 2. Body squamation in *Pomatoschistus montenegrensis* sp. nov. (a) left and (b) right sides of male (NMP6V 80368), 25·5 + 5·0 mm (standard + caudal fin length) and in *Pomatoschistus canestrinii*, (c) male 32·7 + 7·0 mm, Fiume Tagliamento, Venezia, coll. G. Gandolfi and (d) male 32·5 + 5·0 mm, Zrmanja River, Croatia, coll. R.Š.; p, pectoral fin removed; r, ribs; sq, anterior limit of continuous squamation.

spots chiefly on the head, most distinct in males and (3) consistent loss of the preopercular and posterior oculoscapular head canals.

Description

Meristics: D1 VI (VI–VII; VI:25, VII:3); D2 I/8-9 (8:9, 9:21); A I/8 (7–9; 7:5, 8:20, 9:1); P 16–17 (15–18; both sides: 15:1, 16:24, 17:25, 18:5); vertebrae 30 (29–30; 29:1, 30:8); DP 12210011 (12210011:8, 12211002:1). Holotype: D1 VI, D2 /8, A I/8, P 16.

Morphometrics as in Table I: Morphology as generic and specific diagnoses, and Fig. 1. Body moderately elongate, anteriorly robust with slender caudal peduncle; scales present only in lateral axillary patch behind root of pectoral fin, mostly contiguous but not fully imbricate; angle of jaws to below anterior pupil; males with first dorsal fin rays to origin of second dorsal fin when depressed, rear tip of second dorsal and anal fin to not more than half distance to upper and lower origins of caudal fin, respectively; pectoral fin extends posteriorly to below rear end of first dorsal fin; interdorsal space narrow; pelvic disc rounded, not reaching anus; anterior transverse membrane with smooth free edge; axial musculature to near rear margin of orbit.

Colouration (preserved; Fig. 1): Body fawn, with thin vertical dark bands below (1) anterior and (2) posterior base of first dorsal fin, (3) anterior end of second dorsal fin and (4) immediately to rear of second dorsal base; caudal fin base with midline dark marking; head with scattered small but intense dark spots; first dorsal fin with conspicuous dark blotch on D1 V/VI interradial membrane and smaller mark on postdorsal membrane; rest of fin and second dorsal fin with three oblique more or less dark bands, darkening towards distal margin of second dorsal; pectoral fin origin with upper oblique dark mark; anal fin and pelvic disc pale or grayish; caudal fin with three or four dark striae. Limited female material displays paler colouration, fainter dark spots and shorter lateral markings, with pale breast, underside of head and pelvic disc.

Lateral-line system (Fig. 3): As generic diagnosis. Head canals reduced, not more than anterior oculoscapular canal at best development, ending anteriorly at a single pore λ (no pores σ) when this canal extends into the interorbit (three specimens) but otherwise [Fig. 3(c)] paired interorbital papillae, *p* (six specimens); pore κ single (in four specimens) or double (three); preopercular canal and posterior oculoscapular canals absent.

Rows and number of free neuromast organs (sensory papillae) from holotype (27 + 5·5 mm) and male paratype (28 + 6 mm). Anterior lateral-line innervation: (1) supraorbital: dorsal *n* (5–7); rostral *s* (2–6); *p* (2, when interorbital canal absent); (2) infraorbital: longitudinal row *a* (4–9) with two short transverse rows (each 3–5) above row *b*; transverse rows *c* with first in two parts (each 2–3), then three or four rows (3–7), and last row (12–14) descending posterior and ventral to row *d*; caudal fork on anterior edge of snout 2–5, *r* (4–5); rostral fork papillae on lateral preorbital area in two to four rows (3–5 each); (3) hyomandibular: transverse *z* (6–11), longitudinal *i* (30–38); median mandibular *b* (9–15) and *d* (11–24); ventral mandibular *e* (43–57); rostral mandibular *f* (3–7); ventral opercular *ot* (19–24) and *oi* (8–9); dorsal opercular *os* (10–15); (4) otic: *tra* (7–8). Posterior lateral-line innervation: (1) supratemporal: accessory *x1* (3–7), *x2* (4–8), *g* 2–7, *m* 3–5; (2) posterior lateral: primary three longitudinal rows *la* (3–6) and trunk three transverse rows *as* (3–7). In a male, 21·5 + 4·5 mm (NMP6V 80376), lacking all canals, there were two well-separated papillae along the rear border of each eye, a transverse row of three papillae in the rear interorbit and a pair of papillae in the anterior interorbit, immediately behind the commencement of rows *r* on the snout.

Biology

Distribution (Fig. 4): Found in the Morača River and its tributary, the Zeta, of southern Montenegro, as well as in Lake Skadar, where the species was observed in a large natural channel that connects Lake Malo Blato with the main body of Lake Skadar. This distribution corresponds well with previous records of freshwater gobies identified as *Knipowitschia panizzae* Verga in Lake Skadar (Ivanović, 1973; Marić, 1995) and the lower Morača (Marić, 1995). The latter species may well occur throughout the whole Ohrid-Drim-Skadar system, Vinciguerra (1933) having noted a freshwater goby in Lake Ohrid, although later authors do not mention gobies from Ohrid or the River Drim.

Habitat: At the type-locality, *P. montenegrensis* was caught in the shallows of the Morača and in pools remaining in gravel pits after river flooding. The substratum was gravel, covered with fine sediment and overgrown by dense filamentous algae, within which gobies were concealed. Current in the shallows was slow, *c.* 0·1 m s^{-1}. Non-gobiid fishes in this microhabitat were the cobitids

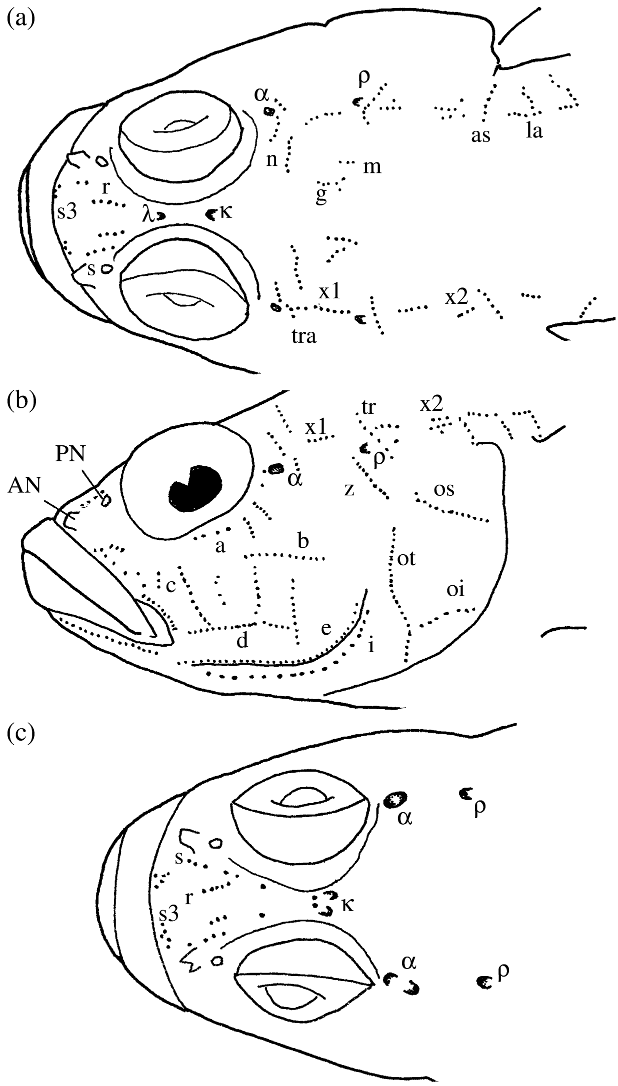

FIG. 3. *Pomatoschistus montenegrensis* sp. nov. Head lateral-line canal pores and sensory papillae in (a) dorsal and (b) lateral views of male, 27·0 + 5·5 mm (standard + caudal fin length) (NMP6V 80388) and (c) dorsal view of male paratype, 24·0 + 5·0 mm (NMP6V 80380). AN, anterior nostrils; PN, posterior nostrils; symbols for canal pores (Greek letters) and papillae rows (Roman) as used by Miller (1986) and Wongrat & Miller (1991).

Barbatula zetensis (Šorić) and *Cobitis ohridanus* Karaman, cyprinids *Barbus rebeli* Koller, *Phoxinus phoxinus* (L.), *Squalius cephalus* (L.), *Cyprinus carpio* L., *Gobio gobio* (L.), *Rutilus ohridanus* (Karaman), *Pseudorasbora parva* (Temminck & Schlegel), *Carassius auratus* (L.), *Alburnus scoranza* Heckel & Kner, *Telestes montenigrinus* (Vuković), *Pachychilon pictum* (Heckel & Kner), gasterosteid *Gasterosteus aculeatus* L., blenniid *Salaria fluviatilis* (Asso) and a lamprey, *Lethenteron zanandreai* (Vladykov) (some of these species have been listed as junior synonyms by other authors but the original names are retained here

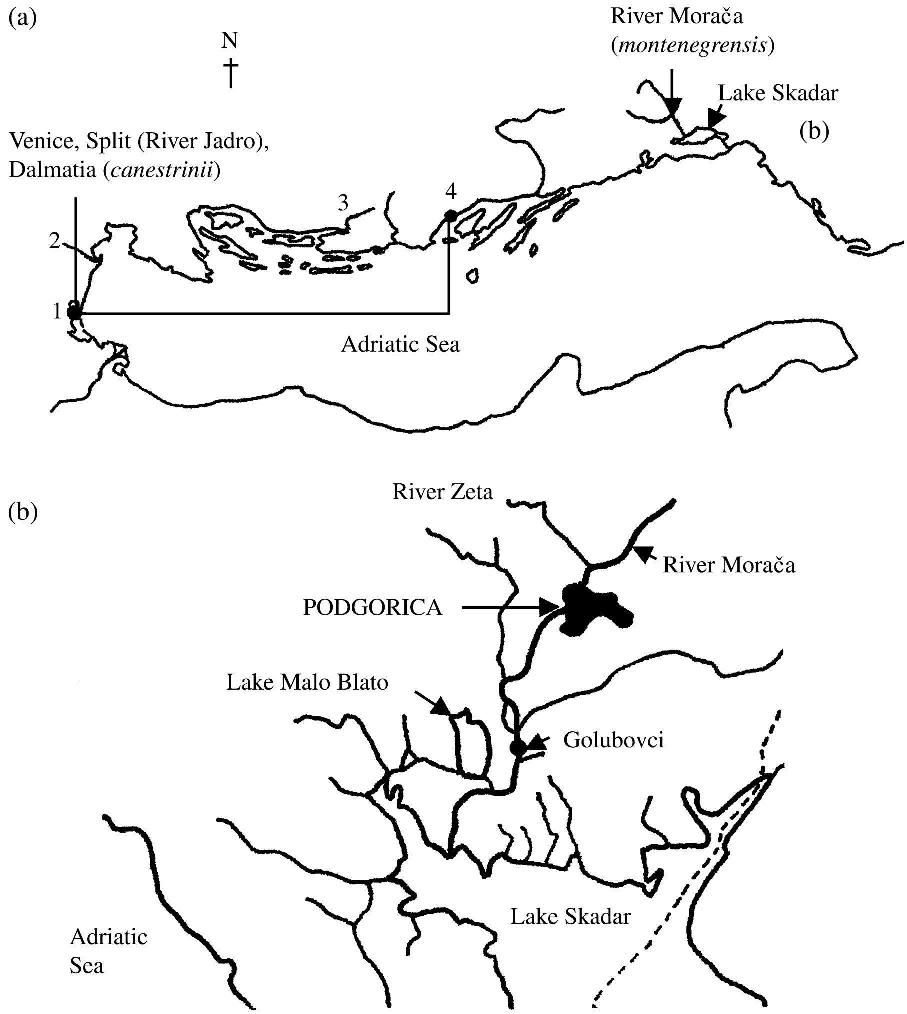

FIG. 4. (a) Type-localities of *Pomatoschistus canestrinii* and *Pomatoschistus montenegrensis* sp. nov. and localities for material noted in text. 1, Venice; 2, Fiume Tagliamento; 3, Zrmanja River; 4, Split. (b) Upper Lake Skadar and Rivers Morača and Zeta, with Golubovci, type-locality of *P. montenegrensis*.

because recent studies indicate a greater degree of regional differentiation in European freshwater taxa hitherto believed to be of wide geographical distribution). As well as *P. montenegrensis*, another gobiid was also common and is provisionally placed near *Knipowitschia croatica* Mrakovčić, Kerovec, Misetic & Schneider, using the tentative key to *Knipowitschia* species provided by Miller (2004). Juveniles of the two species can be distinguished by the differences in pigmentation shown in Fig. 5. Young *P. montenegrensis* have well-spaced, vertical lateral bars, sparse melanophores along the base of the anal fin and incipient diagnostic cheek spots in contrast to the more numerous and closer lateral blotches, anal base melanophores and denser cheek pigmentation in the *Knipowitschia* species.

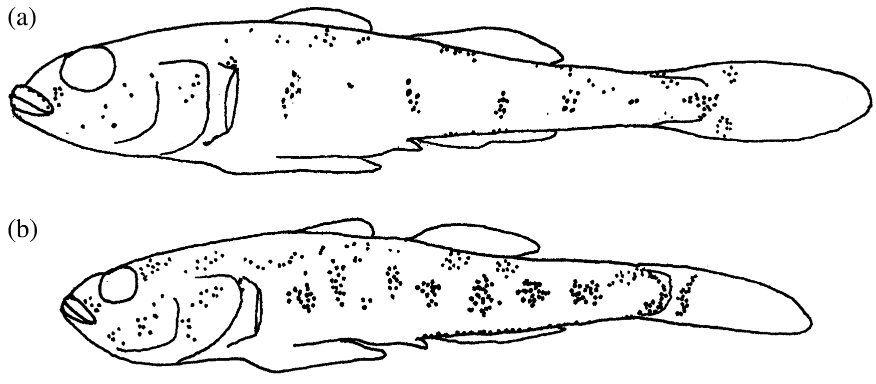

FIG. 5. Diagrams of main juvenile pigmentation in (a) *Pomatoschistus montenegrensis*, male, 21·0 + 4·5 mm (standard + caudal fin length) and (b) *Knipowitschia* sp., female, 19·0 + 3·5 mm.

To estimate population density, 12 transects of 13–15 m were taken parallel to the shoreline, using a hand-net of 600 mm width and kick-sampling (as described by Bohlen *et al.*, 2003). The observed density of gobiids ranged from 310 to 1141 individuals per 100 m^2, with a mean of 595. In the field, *P. montenegrensis* appeared to be more numerous than the *Knipowitschia*. At other localities, *P. montenegrensis* was found in conditions of slow current, fine sediment and associated with macrophytes.

Size: Maximum total length among males, 32·5 mm; largest female 27·0 mm. The smallest male with nuptial colouration is 22·5 + 4·5 mm.

Biology: in Skadar it breeds March–July (Kottelat & Freihof, 2007, as *Pomatoschistus* sp.).

DISCUSSION

Reconstructing the phylogeny of the *P. montenegrensis* and *P. canestrinii* clade is highly speculative at present (Miller, 2004). Within *Pomatoschistus*, these species are synapomorphic with *Pomatoschistus bathi* Miller, *Pomatoschistus microps* (Krøyer) and *Pomatoschistus tortonesei* Miller in lacking a pore ω on the anterior oculoscapular canal, a pore also missing in *Knipowitschia* with canals (Miller, 1986). In sharing a tendency for canal reduction, Miller (2004) suggested that *P. canestrinii* might be the sister line to the *Knipowitschia* species complex of Adriatic, Aegean and Ponto-Caspian catchments. Following this putative dichotomy, differentiation within the resulting *P. canestrinii* and *P. montenegrensis* stock may well have resulted from the Quaternary hydrographic events in the Adriatic basin that could also have played a role in the formation of local freshwater populations of *Knipowitschia* and those of another gobiid, *Padogobius* Berg (Bianco & Miller, 1990). Marine regression during the last (Würmian) glaciation led to exposure of the continental shelf as a fluvio-lacustrine plain southwards to the region of the present middle Adriatic (Colantoni *et al.*, 1979). Marshy conditions must have promoted the extension of a euryhaline lagoonal fauna, including *P. canestrinii* stock, along the coastline of a much shorter Adriatic basin, where the Meso-Adriatic Depression (Fossa Meso-Adriatica) remained a flooded basin that may have facilitated the dispersal of euryhaline fishes between catchments that are now separate (Bianco & Miller, 1990). Subsequent postglacial changes involved a peak freshwater influx *c.* 13 500 years ago, with ensuing sapropel formation, and a marine ingression of the shelf that culminated in a Holocene maximum at 2000–3000 years ago (Colantoni *et al.*, 1979; Ariztegui *et al.*, 2000). In the absence of major estuaries on the southern Adriatic, this rise in sea level and creation of marine conditions in the modern basin might have served to isolate estuarine and freshwater populations of *P. canestrinii* from a riverine *P. montenegrensis* population whose survival and further differentiation could have been promoted by the formation of the large Skadar Lagoon and the development of a transitional ecosystem facilitating adaptation to fresh water. It should be noted, however, that this scenario is set in present postglacial times and such allopatric speciation could have been initiated by comparable hydrographic cycles in previous interglacials.

For *Knipowitschia* species, Economidis & Miller (1990) suggested that incomplete squamation might be a derived character indicating an early clade stemming from the Lago Mare phase of the early Pliocene Mediterranean. The occurrence of the same progenetic features in some *P. canestrinii* forms and in *P. montenegrensis*, however, casts some doubt on such scale reduction as a reliable indicator of common ancestry within *Knipowitschia*. The likelihood of homoplasy is further supported by the fact that this condition is also found in unrelated West Balkanian fishes like cyprinids such as *Aulopyge huegeli* Heckel, all *Phoxinellus* Heckel and some species of *Delminichthys* Freyhof, Lieckfeldt, Bogutskaya, Pitra & Ludwig (Ladiges & Vogt, 1978; Šorić & Bănărescu, 1999; Bogutskaya & Zupančič, 2003; Freyhof *et al.* 2006), so that this ontogenetic change may well have occurred independently in isolated freshwater teleost stocks, perhaps as a convergent response to some ionic peculiarity of karstic waters. It might also be significant that brackish and freshwater populations of Balkanian sand-gobies, represented by the two *Pomatoschistus* species, as well as those of *Knipowitschia* and *Economidichthys*, have shared a trend for head canal reduction, in some cases with complete loss (Miller, 2004).

Recent findings with West Balkanian sand-gobies fully endorse the view of Kottelat (1997) that the European freshwater fish fauna embraces a diversity belatedly realized and still requiring much elucidation. In the case of the sand-gobies, comprehensive molecular studies are urgently needed to address questions of phyletic relationships and evolutionary age.

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Notes on the distribution and taxonomic status of *Gobio gobio* from the Morača River basin (Montenegro)

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A b s t r a c t . The occurrence of common gudgeon in the River Morača drainage of southern Montenegro was investigated. Low numbers of specimens were recorded in four out of five localities investigated on the Zeta River and at a single locality on the lower part of the River Morača. Allozyme analysis revealed that the specimens examined belong to the species *Gobio gobio* (Linnaeus, 1758). The lower number of lateral line scales in common gudgeon from the Ohrid-Drim-Skadar system, as compared with other European populations, probably indicates clinal variability. The results also demonstrate that the subspecies *Gobio gobio ohridanus* Karaman, 1924 is not a valid taxon.

Key words: common gudgeon, distribution, taxonomy, Adriatic Sea drainage, Zeta River

Introduction

The common gudgeon**,** *Gobio gobio* (Linneaus, 1758), is a species widely distributed in Europe. A number of subspecies and lower categories of *Gobio gobio* have been described (K o t t e l a t 1997, B ă n ă r e s c u et al. 1999). Three subspecies have been described from the hydrological system Ohrid-Drim-Skadar (Adriatic Sea drainage) in the western part of the Balkan Peninsula: *Gobio gobio ohridanus* Karaman, 1924 from Ohrid Lake, *Gobio gobio skadarensis* Karaman, 1936 from Skadar Lake, and *Gobio gobio albanicus* Oliva, 1961 from the River Kir in Albania. G r u p č e & D i m o v s k i (1975) and Š o r i ć & I l i ć (1988) concluded that all populations from the Ohrid-Drim-Skadar system belong to the subspecies *Gobio gobio ohridanus*. K o t t e l a t (1997) included this subspecies in the synonymy of the species *Gobio gobio* (Linneaus, 1758). However, B ă n ă r e s c u et al. (1999) recognised *Gobio gobio ohridanus* as one of five valid European subspecies.

G. gobio in Montenegro inhabits both Skadar Lake (I v a n o v i ć 1973) and its tributary, the Morača River drainage (M a r i č 1995). Nevertheless, the details of the distribution of this species have been inadequate. The River Morača is the main tributary of Skadar Lake, which is the largest lake of the Balkan Peninsula, with an area varying between 370 and 600 km^2 (B e e t o n 1981). Lakes Skadar and Ohrid and the River Drim, compose the largest river system (Fig. 1) in the western Balkan zoogeographic region (B ă n ă r e s c u 1992), and drains in to the Adriatic Sea basin. The Morača River is 99 km long but has an area of only 390 ha. The spring of the River Morača lies at an altitude of 975 m a.s.l., while its mouth is at only 6 m a.s.l. It is a typical karstic Mediterranean river, flowing through limestone and dolomite bedrock. Discharge fluctuates greatly during the year. Its mean value in Podgorica is

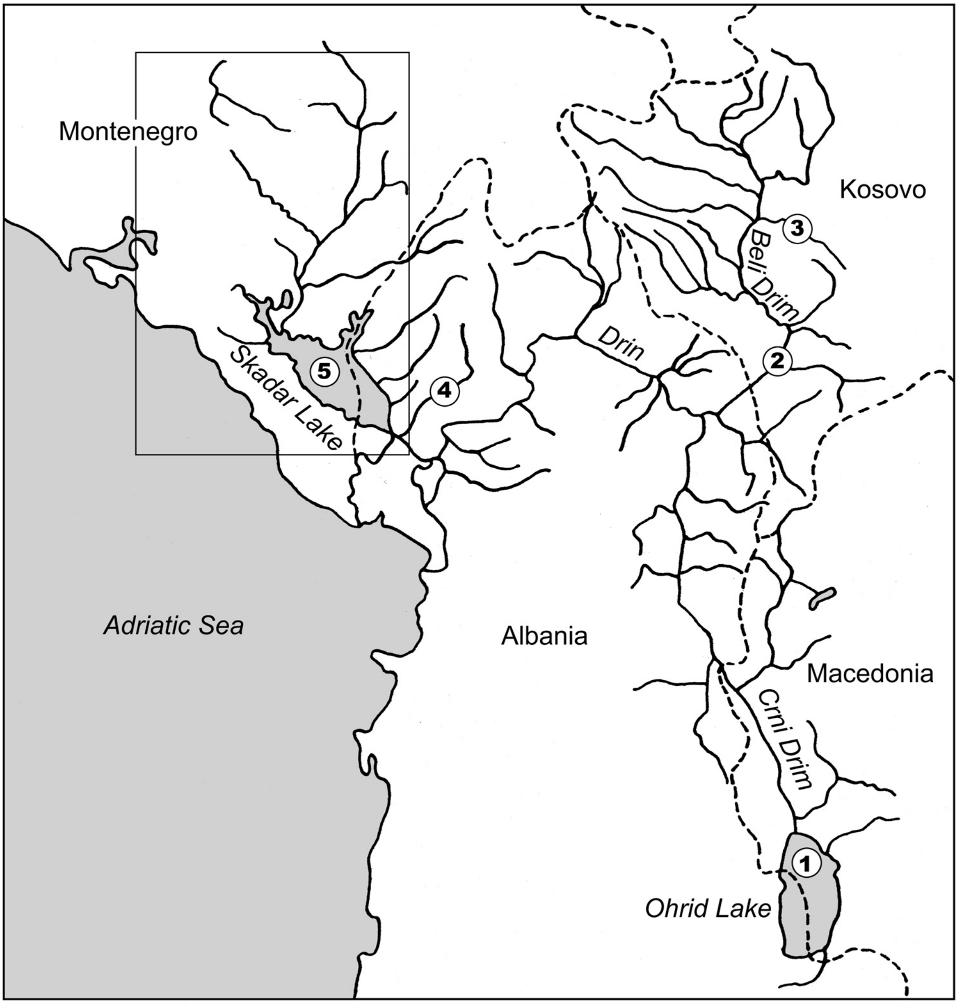

Fig. 1. A map of the Ohrid-Drim-Skadar system. Localities with confirmed occurrence of *Gobio gobio* are indicated by numbers.

163 m^3 s^{-1} (D r e c u n et al. 1985). The River Morača has several tributaries, of which rivers Zeta, Mrtvica and Cijevna are the most important (Fig. 2). These three rivers are permanent, whereas other inflows often dry out during summer. The largest tributary is the River Zeta (about 50 km long) with a mean discharge in its mouth of 74 m^3 s^{-1} (M a r t i n o v i ć – V i t a n o v i ć & K a l a f a t i ć 1995).

The aim of this study is to present the up-to-date information on the distribution of *G. gobio* in the Morača River system and to discuss the taxonomic status of this population.

Materials and Methods

Fishes were caught at 20 localities in the Morača River system (Fig. 2) by electrofishing and, at some places, also by hand nets in the summer 2002 and 2003. Three specimens of *G. gobio*

Table 1. Description of localities with occurrence of *Gobio gobio*. The locality numbers correspond to numbers in Fig.2. Sampling was conducted in 2002. * At locality 3, additional data about species composition were obtained in 2003. Species found in 2003 are underlined and number of specimens is not shown. ** At locality 5, only one juvenile *Gobio gobio* was found in a pit, which remained on the bank after gravel mining. Most of the other species were found in the river. Due to different habitat, number of specimens is not shown.

Locality (no. of captured *G. gobio* is in parentheses)	Coordinates	Width (m) Depth (m)	Velocity ms^{-1}	Substratum	Vegetation	Species composition (no. of specimens is in parentheses)
1. River Zeta in village Glava Zete (4)	N 42°39´20.7´´ E 19°00´22´´	20-30; up to 3	~ 0.5	mostly stone and gravel with sand, wooden debris	moss on stones	*Barbus rebeli* (2), *Phoxinus phoxinus* (14), *Leuciscus cephalus* (7), *Telestes montenegrinus* (4), *Pachychilon pictum* (1), *Barbatula zetensis* (1), *Salmo trutta* (3), *Gasterosteus aculeatus* (9), *Anguilla anguilla* (2)
2. River Zeta under village Glava Zete (3)	N 42°39´04´´ E 19°00´26.4´´	20-30; up to 5	0.3 - 1	stones and gravel in the mainstream, sand around banks, abundant wooden debris	no vegetation	*Barbus rebeli* (1), *Phoxinus phoxinus* (46), *Leuciscus cephalus* (9), *Alburnus alburnus* (5), *Telestes montenegrinus* (11), *Pachychilon pictum* (19), *Gasterosteus aculeatus* (2), *Salmo trutta* (1), *Anguilla anguilla* (1), *Lethenteron zanandreai* (2)
3. River Zeta in town Danilovgrad (4 spec. caught in 2002; 3 spec. caught in 2003)*	N 42°33´24.4´´ E 19°06´35.3´´	30-40; up to 6	0.3	sand, abundant wooden debris	dense macrophytes	*Barbus rebeli* (5), *Phoxinus phoxinus* (18), *Leuciscus cephalus* (9), *Alburnus alburnus* (1), *Telestes montenegrinus* (4), *Pachychilon pictum* (7), <u>*Rutilus sp.*</u>, <u>*Chondrostoma nasus*</u>, <u>*Barbatula zetensis*</u>, <u>*Cobitis ohridana*</u>, *Gasterosteus aculeatus* (1), <u>*Salmo trutta*</u>, *Anguilla anguilla* (1), *Lethenteron zanandreai* (1)
4. mouth of the river Sušica into the Zeta River (1)	N 42°30´50.9´´ E 19°10´22´´	8; up to 1.8	stagnant	silt with gravel and small stones	scattered macrophytes, floating leaves of *Nymphea*	*Cobitis ohridana* (3), *Pomatoschistus sp.* (3), *Phoxinus phoxinus* (2), *Leuciscus cephalus* (4), *Barbus rebeli* (6)
5. River Morača in village Golubovci (1)**	N 42°18´55.3´´ E 19°12´03.5´´	40-150; up to 3, pools on the bank	0.1 - 0.6	gravel covered by fine sediment	dense filamentous algae	*Barbatula zetensis*, *Cobitis ohridana*, *Pomatoschistus sp.*, *Knipowitschia croatica*, *Barbus rebeli*, *Phoxinus phoxinus*, *Leuciscus cephalus*, *Cyprinus carpio*, *Salaria fluviatilis*, *Lethenteron zanandreai*

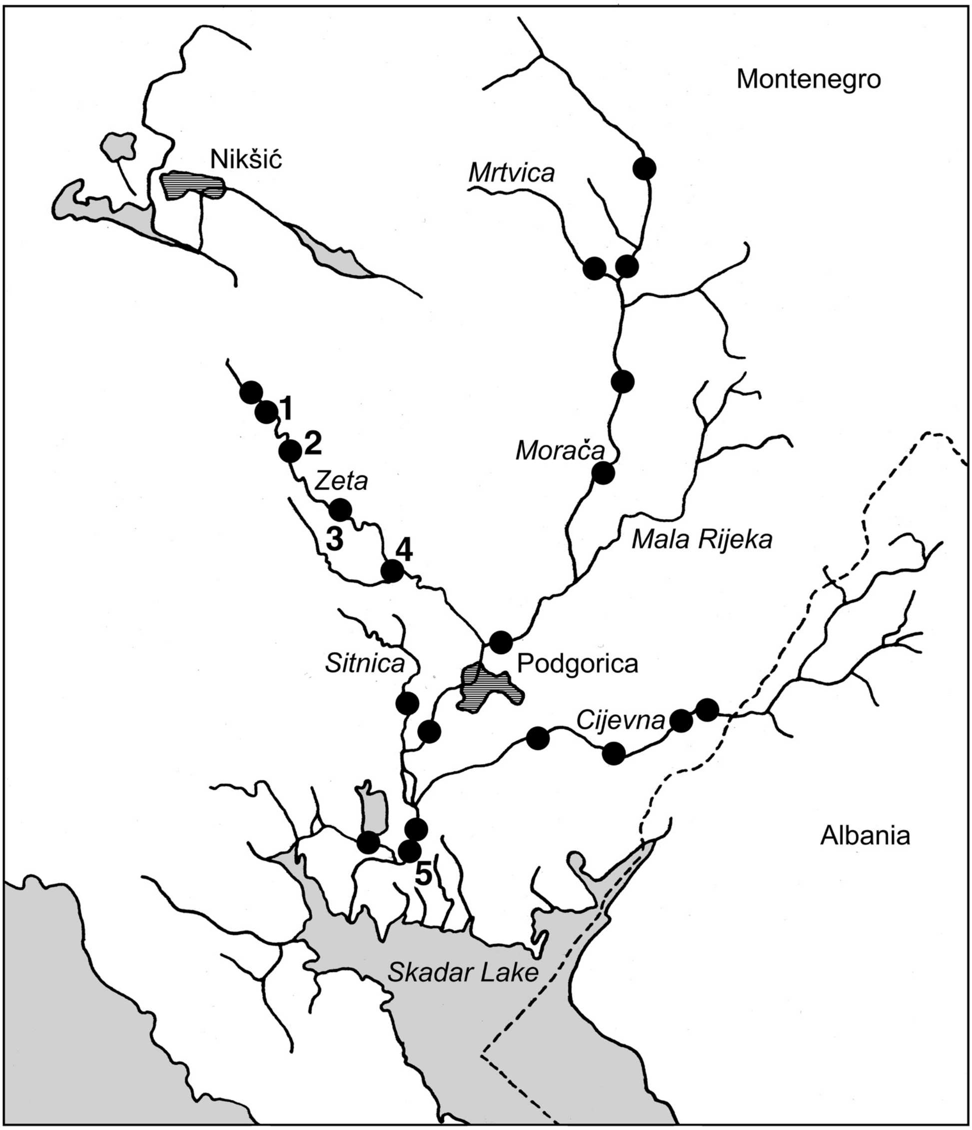

Fig. 2. A detailed map of the Morača River drainage. Full circles indicate sampled localities. The sites with occurrence of *Gobio gobio* are numbered. The numbers correspond to numbers in Table 1.

Table 2. Genetic variability at 20 loci in population of the *Gobio gobio* from the River Zeta (Montenegro) and rivulet Haná (Czech Republic) (standard errors are given in parentheses)

Locality	% of polymorphic loci P	Mean aleles/locus A.D.	Mean expected H_e	Heterozygosity observed H_o
River Zeta	10	1.03 (0.18)	0.028 (0.085)	0.033 (0.103)
Rivulet Haná	23.5	1.50 (0.20)	0.121 (0.052)	0.131 (0.056)

from the Zeta River were examined for allozyme patterns by electrophoresis. The classical method (L u s k o v á et al. 1997, Š l e c h t o v á et al. 2000) on starch gels using liver and muscle tissue homogenates was used. 14 protein systems by specific enzyme staining were detected. Basic statistics were performed using Genetix software. The values obtained for the population of *Gobio gobio* from the rivulet Haná (Danube basin, Czech Republic) were used for comparison.

Results

G. gobio occurrence was recorded at five of the 20 localities investigated within the Morača River system (Fig.1, No. 1 to 5). This species was not found in the rivers Cijevna, Mrtvica and Sitnica. In the River Morača, it was found at only one locality in the lower part of the river. The single specimen, in this case juvenile, was caught in a pit on the bank formed by gravel mining. Gudgeon occurred mainly in the Zeta River where the species was caught at four out of five sites studied, but still in very low numbers. Gudgeon represented from 2 to 8.5 % of all fishes caught at these localities. In total, 15 specimens were caught in this river (see Table 1), with total lengths ranging from 48 to 145 mm. Of 12 specimens, in which the number of scales on the lateral line was counted, seven had 40 and five had 39 scales (mean 39.58). The main characteristics of the localities where gudgeon occurred, together with the fish species composition are presented in Table 1.

By specific staining in 14 enzyme protein systems, 20 loci were found. The following 18 loci were monomorphic: *LDH-A** (100); *LDH- B** (100); *sAAT** (100); *mAAT-1** (100); *mAAT-2** (100); *sMDH-A** (100); *sMDH-B** (100); *mMDH** (100); *PGM-1** (100); *mIDHP** (100); *GPI-A** (100); *AK** (100); *6PGDH** (100); *ADH** (100); *MPI**(100); *sMDHP-1** (075); *GPI-2** (175); *CK** (120). Heterozygosity was found in two individuals, one having *G3PDH-2** enzyme with alleles 080 and 100, and the other *SOD** alleles 072 and 100. Estimates of observed (H_o) and expected heterozygosity (H_e), percentages of polymorphic loci (P) and allele numbers per locus (A.D.) at samples from the River Zeta in comparison to samples from the rivulet Haná (Czech Republic, Morava River basin) are given in the Table 2. All alleles found in individuals from the River Zeta are also present in *Gobio gobio* from the Czech Republic and Slovakia (Š l e c h t o v á et al. 2005).

Discussion

One of the main factors influencing the distribution of gudgeon in the Morača River drainage is most probably the much more diversified substratum, providing more suitable microhabitats for this species in the Zeta River in comparison with the Morača River and its other inflows. In the Zeta, the bed was very variable, even on a local scale, and was composed of stones, gravel of different sizes, and sand. Aquatic macrophytes were abundant and submerged trunks and branches of trees, as well as other wooden debris, were plentiful; banks were indented and undercut. In contrast, the bottom of the Morača was uniform, with small stones and pebbles. Finer sediment and vegetation, composed solely of filamentous algae, were found only in the lowest part of the river below Podgorica.

Several subspecies of *Gobio gobio* have been described from the Ohrid-Drim-Skadar system: *Gobio gobio ohridanus* Karaman, 1924 from Ohrid Lake, *Gobio gobio skadarensis* Karaman, 1936 from Skadar Lake, and *Gobio gobio albanicus* Oliva, 1961 from the River Kir in Albania. However, comparative morphological and meristic analyses have shown that all gudgeon populations within the Ohrid-Drim-Skadar system are conspecific (G r u p č e & D i m o v s k i 1975, Š o r i ć & I l i ć 1988). The small differences between populations within the system do not exceed the range of interpopulation variability and could be caused by different ecological conditions at each locality (Š o r i ć 1990). According to G r u p č e & D i m o v s k i (1975), Š o r i ć & I l i ć (1988), and B ă n ă r e s c u et al. (1999) the Ohrid-Drim-Skadar system is inhabited by *Gobio gobio ohridanus* Karaman, 1924. In contrast, V i n c i g u e r r a (1933) described the specimens from Skadar Lake as identical to the nominotypical form of *Gobio gobio*. K o t t e l a t (1997) too did not recognize *Gobio gobio ohridanus* to be a valid taxon. The results of our allozyme analyses support the opinion of K o t t e l a t (1997) that gudgeon from the system Ohrid-Drim-Skadar is not a valid taxon and that the name *Gobio gobio ohridanus* is a junior synonym of *Gobio gobio gobio* (Linnaeus, 1758).

The main difference between gudgeon populations from the Ohrid-Drim-Skadar system and other European sites is the lower number of scales in the lateral line, varying from 33 to 43, with an average of 38–39 (K a r a m a n 1924, 1936, O l i v a 1950, 1961, I v a n o v i ć 1973, G r u p č e & D i m o v s k i 1975, Š o r i ć & I l i ć 1988). The number of scales on the lateral line of gudgeon from Skadar Lake ranged from 33 to 41 (mean 38.5) (I v a n o v i ć 1973). The number of scales on the lateral line in specimens from the Morača River drainage now studied falls in the range reported for gudgeon populations from the Ohrid-Drim-Skadar system, although the mean number is slightly higher (39.58).

Lower number of scales in the lateral line of gudgeon from the Ohrid-Drim-Skadar system in comparison with other European sites (average usually more than 40; B ă n ă r e s c u et al. 1999) could be an effect of clinal variability, the southern populations of widespread species having fewer lateral line scales (H o l č í k & J e d l i č k a 1994). Thus, the number of lateral line scales could not be used as a taxonomic criterion in variable species with continuous distribution such is the case of common gudgeon.

Gudgeon probably reached the Ohrid-Drim-Skadar system from the Danube system by river capture of those two systems in the area of Kosovo (K a r a m a n 1971). River capture is known to be an important process for dispersion of freshwater fishes (B ă n ă r e s c u 1989, E c o n o m i d i s & B ă n ă r e s c u 1991, D u r a n d et al. 1999, T s i g e n o p o u l o s & B e r r e b i 2000). A Dalmatian route of dispersion (E c o n o m i d i s & N a l b a n t 1996) is not probable, because *Gobio gobio* does not occur in rivers of the Dalmatian coast (M r a k o v č i ć et al. 1995).

Recent distribution of common gudgeon in the eastern and southern Adriatic Sea drainage is not restricted only to the Ohrid-Drim-Skadar system, as has been stated in the latest revision of B ă n ă r e s c u et al. (1999). This species is distributed more widely in the whole Albanian ichthyogeographic district (*sensu* B i a n c o 1990). It has also been reported in other Albanian rivers, the Mat (R a k a j 1995), Skumbini (C a k e & M i h o 1999) and Vjose (A h n e l t & E l v i r a 1991) and the occurrence of *G. gobio* in these rivers was confirmed in summer 2004 (Š a n d a , unpublished data). Taxonomic status of Albanian populations and their relationships to populations from the Ohrid-Drim-Skadar are under investigation at the present time.

A c k n o w l e d g e m e n t

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Cobitis ohridana and *Barbatula zetensis* in the River Morača Basin, Montenegro: distribution, Habitat, Population Structure and Conservation Needs

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In this paper, we report on the distribution, habitat, population structure and conservation needs of *Cobitis ohridana* and *Barbatula zetensis* in the basin of the River Morača in Montenegro. Our data show both species to be mainly distributed in the lower stretch of the main river and some tributaries in lowland habitats. *Cobitis ohridana* preferred more shallow water with a higher abundance of filamentous algae, while *Barbatula zetensis* was more numerous in slightly deeper water with more stones as a bottom substrate. Slight differences in the habitat preference were also observed between juveniles and adults in both species. Although both species are abundant in suited habitat, they have a small distribution area in the Morača basin due to the natural rarity of the habitat. According to our data, they are not endangered.

Key words: Balitoridae, Cobitidae, Mediterranean, conservation, habitat preferences, outecology.

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The River Morača is the main tributary of Lake Skadar, together with the Drim River and Lake Ohrid forming one of the major water basins in the northern Mediterranean (BIANCO 1990). This independent basin is well known to house several endemic fish species and to have a unique ichthyocoenosis (MARIC 1995; ŠORIĆ 1990). From the Morača-Skadar system, three species of loach fish were listed, namely *Cobitis ohridana* KARAMAN, *Barbatula sturanyi* (STEINDACHNER) and *B. zetensis* (ŠORIĆ), but little information about these fishes is available (MARIC 1995). The former two species were originally described from Lake Ohrid and were later assumed to occur in the whole Drim-Skadar-Ohrid system, while *B. zetensis* was described from the Zeta River, the main tributary of the River Morača. While working on a project on the situation of freshwater fishes in the Morača basin in Montenegro, we had the opportunity to investigate the distribution, habitat, population structure and conservation needs of loaches in the Morača basin.

Material and Methods

Fishes were caught at 12 localities in the Morača basin using a portable electroshocker (500 V, 4 A, pulsed D.C.) and a hand net of 60 cm width (4 mm mesh size). Upon occurrence, loaches were counted

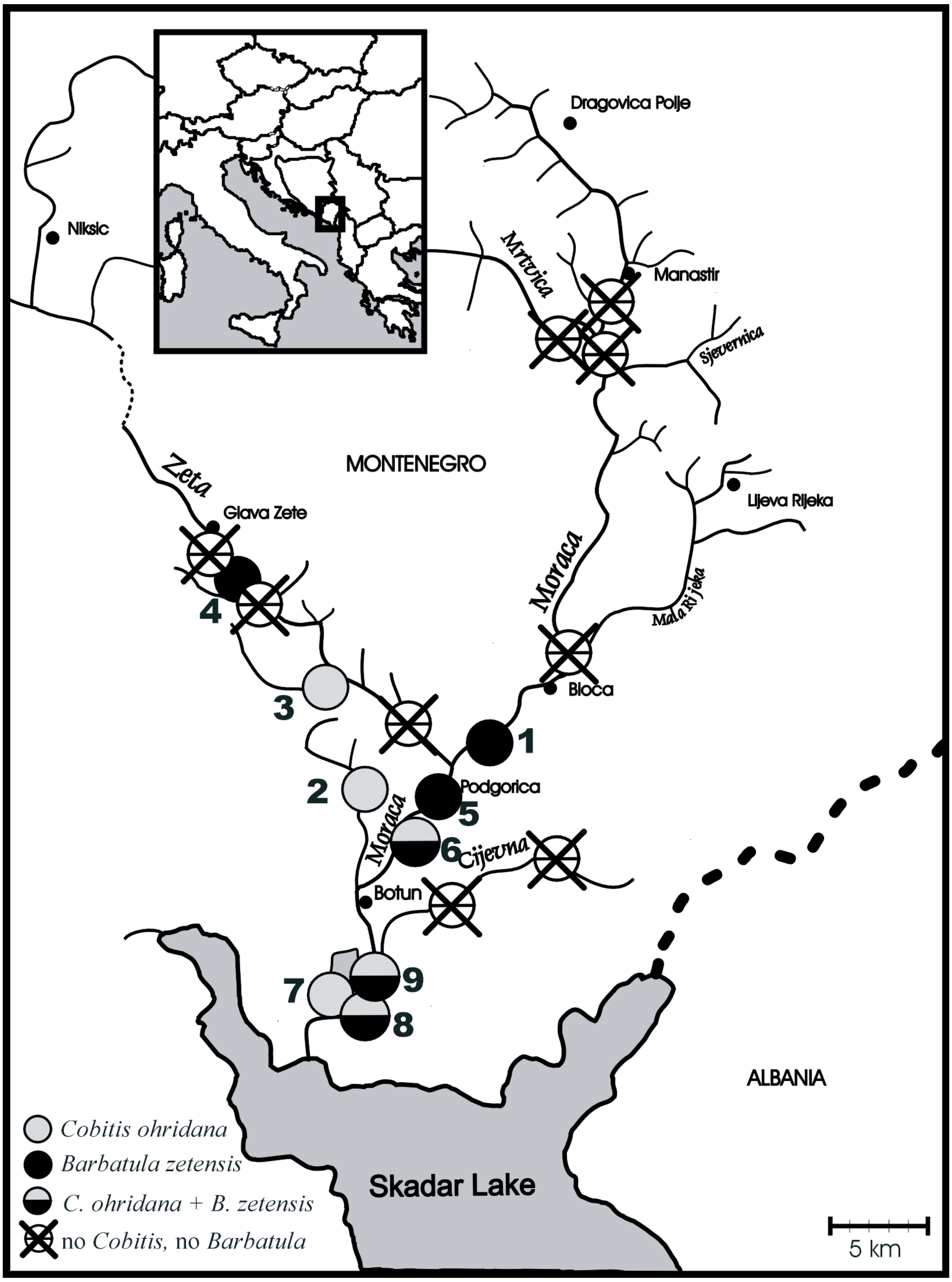

Fig. 1. Map of the River Morača system in Montenegro with the sampled localities

and measured to the nearest mm TL. In adult specimens of *C. ohridana* the sex was determined by checking the presence of a lamina circularis on the base of the second pectoral fin ray. Specimens of *C. ohridana* smaller than 38 mm total length (the minimum length for the occurrence of a lamina circularis) were taken as juvenile. In *B. zetensis*, specimens of the first age class (27-49 mm total length) were considered as juvenile. The habitat was characterized by the following parameters: river width, river depth, type of bottom substrate, current speed and type of vegetation present.

For a finer analysis of the habitat of the loaches, 12 transects of hand net catching were carried out in the shallow parts of the river section at locality 8. Locality 8 was most suitable for such a quantitative investigation because (I) both loach species occurred here, (II) population density was high enough to obtain a sufficient amount of fish, and (III) habitat diversity was large enough to promote a habitat choice by the fish. The transects were straight, 13 to 15 m long, parallel to the shoreline and ensured a quantitative catch of occurring loaches. Each four transects were arranged parallel to each other in different water depth and distance from the shore. In total, three groups of replicates were carried out. For each transect, the environmental parameters depth, distance from shore, bottom substrate and vegetation were recorded. Pearson correlation coefficient was used to analyse the relationship between environmental parameters and loaches abundance.

The loaches caught in locality 8 were used for an analysis of length-frequencies, length-weight relationship and for calculation of the von-Bertalanffy growth model. The age of each specimen was determined from body scales. For this, scales from the right body side under the dorsal fin were scratched from the fish, distributed on an objective slide in a drop of ethanol and after drying embedded in DPX mount under a cover glass. The number of annuli rings was estimated at magnification 40 x.

Results

The authors found *B. zetensis* only in the lower and middle stretch of the River Morača and in the Zeta River, but not in other tributaries of the River Morača (Fig. 1). In contrast, *C. ohridana* was present not only in the lower Morača but also in two of its tributaries, and a tributary of the Zeta River. The habitat parameters of the localities with occurrence of loaches and the co-occurring fish species are given in Table 1. Most specimens of *B. zetensis* were caught in less vegetated area with the highest current speed and most gravel at the bottom, while *C. ohridana* was most common in shallow waters with a dense growth of filamentous algae. In both species, there was a tendency for the adult fish to occur in deeper water than the juveniles.

In the analysis of the microhabitat in locality 8, the density of *C. ohridana* ranged from 11 to 449 Ind/100m^2, while the density of *B. zetensis* varied between 0 and 295 Ind/100m^2 (Table 2). No significant correlation between the abundance of *B. zetensis* and any habitat parameter was found (Table 3). On the other hand, the abundance of *C. ohridana* was significantly correlated to all four analysed habitat parameters.

In locality 8, the largest female *C. ohridana* measured 75 mm of total length, the largest male 46 mm (Fig. 2). The maximum age observed for females was 3.5 years; for the oldest male it was 1.5 years. According to the von-Bertalanffy model, the theoretical maximum length of females is 89.5 mm. Males can reach sexual maturity (presence of Canestrini's scale) at a minimum length of 38 mm. In locality 4, slightly larger specimens than in locality 8 were caught, the largest female measured 83 mm, the largest male 66 mm (data not shown). The overall sex ratio (combining specimens from all localities) was 1 male: 2.8 females. The largest specimen of *B. zetensis* had a length of 84 mm TL (Fig. 3). The theoretical maximum length of this population was estimated to be 117 mm.

Discussion

In our investigation we found *B. zetensis* and *C. ohridana* in the Morača system, but failed to find *B. sturanyi*. This is most likely due to the very recent description of *B. zetensis* (Šorić 2000) and general difficulties with the taxonomic agreement in loaches. Since it seems unlikely that one species of *Barbatula* recently replaced another in all sampled localities, we tentatively consider former records of *Barbatula* to refer to *B. zetensis*. Within the Morača system, records of *Barbatula* came from the lower course of the River Morača, its main tributary, the Zeta River, and Lake Skadar (Maric 1995; Šorić 1990).
C. ohridana was originally described from Lake Ohrid and later assumed to be distributed through out the whole Skadar-Drim-Ohrid system. Similar to *B. zetensis*, it was recorded within the Morača system from the lower course of the River Morača, its main tributary, the Zeta River, and Lake Skadar (Maric 1995; Šorić 1990).

Both species were mainly found in localities with lowland characteristics. These localities strongly contrasted with the cold-mountainous character of the localities in the upper stretch of the Morača and its tributaries. Most of the Morača basin is a typical salmonid habitat with very high current velocity (up to 2.5 m s^{-1}), cold water (max. 17^{o}C) and a gravel to rocky bottom. That is why we assume the distribution of habitat to be responsible for the observed pattern of occurrence of *C. ohridana* and *B. zetensis* in the River Morača basin. Therefore, the distribution of both species seems to represent a natural situation.

C. ohridana was more closely bound to the lowland habitats than *B. zetensis*, as *C. ohridana* did not occur in localities without a sand fraction in the bottom substrate and submerged vegetation. Similar habitat requirements were reported for other *Cobitis* species (Ritterbusch & Bohlen 2000; Slavík *et al.* 2000). In contrast, the habitat requirements of *B. zetensis* include a gravel fraction, but not necessarily vegetation. Due to these general differences in habitat between the two loach species, little interspecific competition is to be expected. The broadness of the correlation between abundance and habitat parameter in *C. ohridana*

Table 1

Habitat characteristics and a list of occurring fish species in nine localities in the Morača system with occurrence of loaches. The numbers of the localities correspond to the numbers in Figure 1

Description	Date of collecting	Width and depth	Bottom substrate	Current speed	Vegetation	Fish species found
Loc. 1: mainstream Morača at Smokovac	July 2002	About 40 m width, pools up to 2 deep	Rapids and main rim with stones and rocks, shallows with gravel	On shallows about 0.4 m s^{-1}	No vegetation	*Alburnoides bipunctatus*, ***Barbatula zetensis***, *Barbus rebeli*, *Phoxinus phoxinus*, *Salaria fluviatilis*, *Salmo* spec., *Telestes montenegrinus*
Loc. 2: Sitnica River	July 2002	About 10 m width, up to 1 m deep	Silt bottom with sand and few gravel	About 0.25 m s^{-1}	Dense submerse vegetation covered by filamentous algae	***Cobitis ohridana***, *Leuciscus cabeda*
Loc. 3: Sušice River	July 2002	About 20 m width, up to 1.8 m deep	Silt bottom with sand and few gravel	About 0.25 m s^{-1}	Scattered submerse vegetation and floating leaves of *Nymphea*	*Barbus rebeli*, ***Cobitis ohridana***, *Leuciscus cabeda*, *Knipowitschia* spec.
Loc. 4: River Zeta under Glava Zete	September 2002	About 15 m width, up to 3 m deep	Bottom partly sandy, partly stony	About 0.5 m s^{-1}	Moss on some stones	*Anguilla anguilla*, ***Barbatula zetensis***, *Barbus rebeli*, *Gasterosteus gymnurus*, *Gobio gobio*, unidentified Ammocoetes larvae, *Leuciscus cabeda*, *Pachychilon pictum*, *Phoxinus phoxinus*, *Salmo* spec., *Telestes montenegrinus*
Loc. 5: mainstream Morača at Podgorica	September 2002	About 40 m width, pools up to 2,5 m deep	Rapids and main rim with stones and rocks, shallows with gravel	About 0.5 m s^{-1}	Dense filamentous algae on the gravel	***Barbatula zetensis*** (no regular collecting point, therefore no other fishes caught here)
Loc. 6: mainstream Morača below Podgorica	September 2002	About 40 m width, pools up to 2,5 m deep	Rapids and main rim with stones and rocks, shallows with gravel	About 0.5 m s^{-1}	Dense filamentous algae on the gravel	***Barbatula zetensis***, *Barbus rebeli*, ***Cobitis ohridana,*** *Gasterosteus gymnurus*, *Leuciscus cabeda*, *Pachychilon pictum*, *Phoxinus phoxinus*, *Telestes montenegrinus*
Loc. 7: effluent of lake Malo Blato	July 2002	About 20 m width, up to 3 m deep	Silt bottom with sand and few gravel	About 0.5 m s^{-1}	Scare to dense stands of *Pomatogeton*	***Cobitis ohridana***, *Carassius 'gibelio'*, *Leuciscus cabeda*, *Knipowitschia* spec., *Rhodeus amarus*, *Rutilus ohridanus*, *Salaria fluviatilis*
Loc. 8: mainstream Morača at Golubovci	July 2002	About 40 m width, main rim up to 2 m deep	Silt bottom with sand and gravel	In shallows 0.1 m s^{-1}, in main rim 0.6 m s^{-1}	Scattered to dense filamentous algae on the bottom	***Barbatula zetensis***, *Barbus rebeli*, ***Cobitis ohridana,*** *Cyprinus carpio*, *Gasterosteus gymnurus*, *Leuciscus cabeda*, *Knipowitschia* spec., *Phoxinus phoxinus*, *Rutilus ohridanus*, *Salaria fluviatilis*
Loc. 9: mainstream Morača at Golubovci	September 2002	About 100 m width, main rim up to 3 m deep	Silt bottom with sand and gravel	In shallows 0.1 m s^{-1}, in main rim 0.6 m s^{-1}	Scattered to dense filamentous algae on the bottom	*Alburnus scoranza*, ***Barbatula zetensis***, *Barbus rebeli*, ***Cobitis ohridana,*** *Carassius 'gibelio'*, *Gasterosteus gymnurus*, *Leuciscus cabeda*, *Knipowitschia* spec., *Pachychilon pictum*, *Pseudorasbora parva*, *Rutilus spec.*, *Telestes montenegrinus*

Table 2

Environmental parameters and abundance of loaches on locality 8 (Morača at Golubovci)

Transect number	Length (m)	Distance from shore (m)	Depth (cm)	Thickness of algae layer (cm)	Coverage by algae (%)	Abundance *C. ohridana* (Ind/100m^2)	Abundance *Barbatula* (Ind/100m^2)
A 1	15	2.5	15	4	100	67	11
A 2	15	5	35	4	60	22	67
A 3	15	7.5	50	2	70	67	11
A 4	15	12	80	2	35	11	11
B 1	14	2.5	15	10	100	250	0
B 2	14	5	27	9	100	238	48
B 3	14	7.5	40	3	50	48	202
B 4	14	10	80	2	40	24	12
C 1	13	0.5	13	13	100	449	0
C 2	13	5	32	10	100	218	295
C 3	13	7	50	2	25	77	167
C 4	13	10	70	2	25	103	128

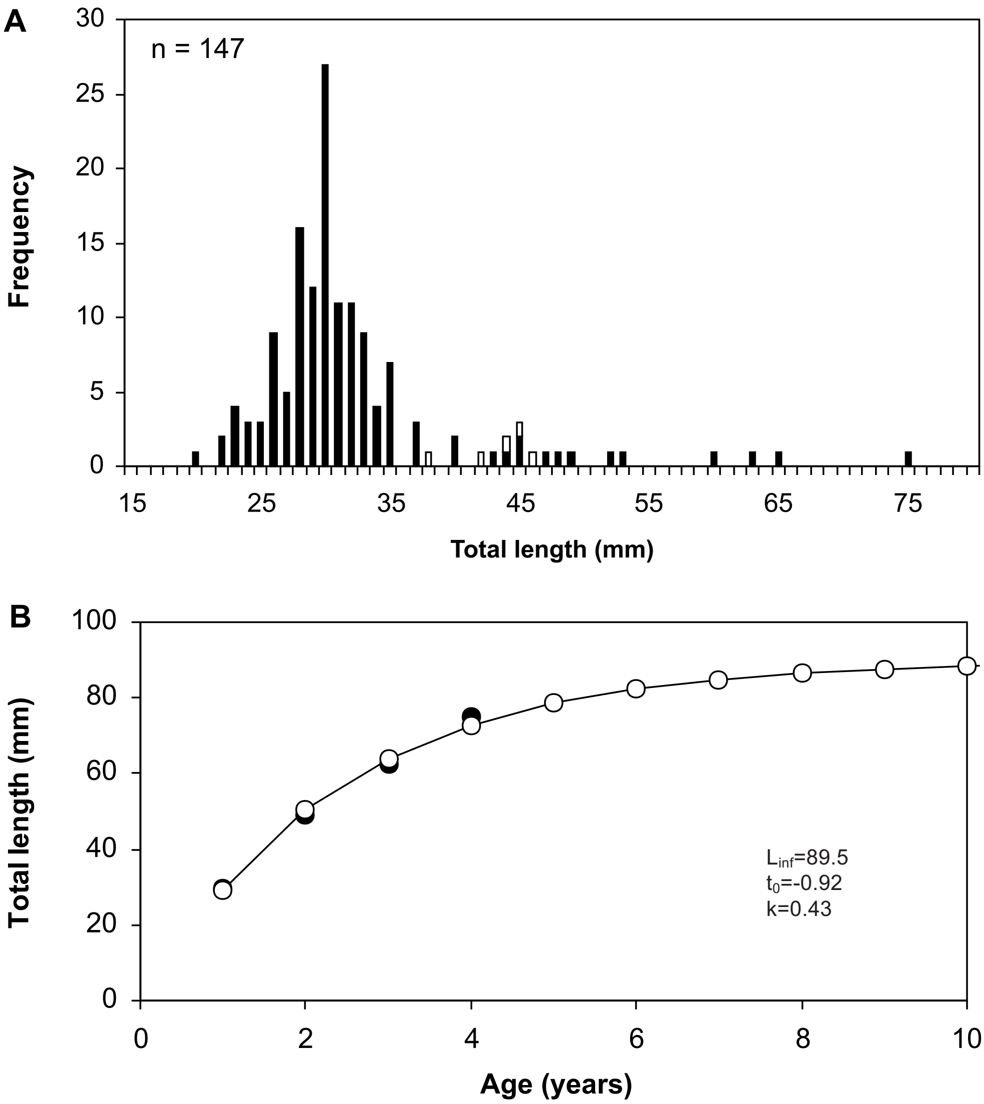

Fig. 2. Population structure of *C. ohridana* at locality 8 (main Morača at Golubovci). (A) length-frequency distribution; black bars indicate juvenile and female fish, white bars indicate males, (B) von-Bertalanffy model of growth; black dots indicate the observed values, white dot the estimated values.

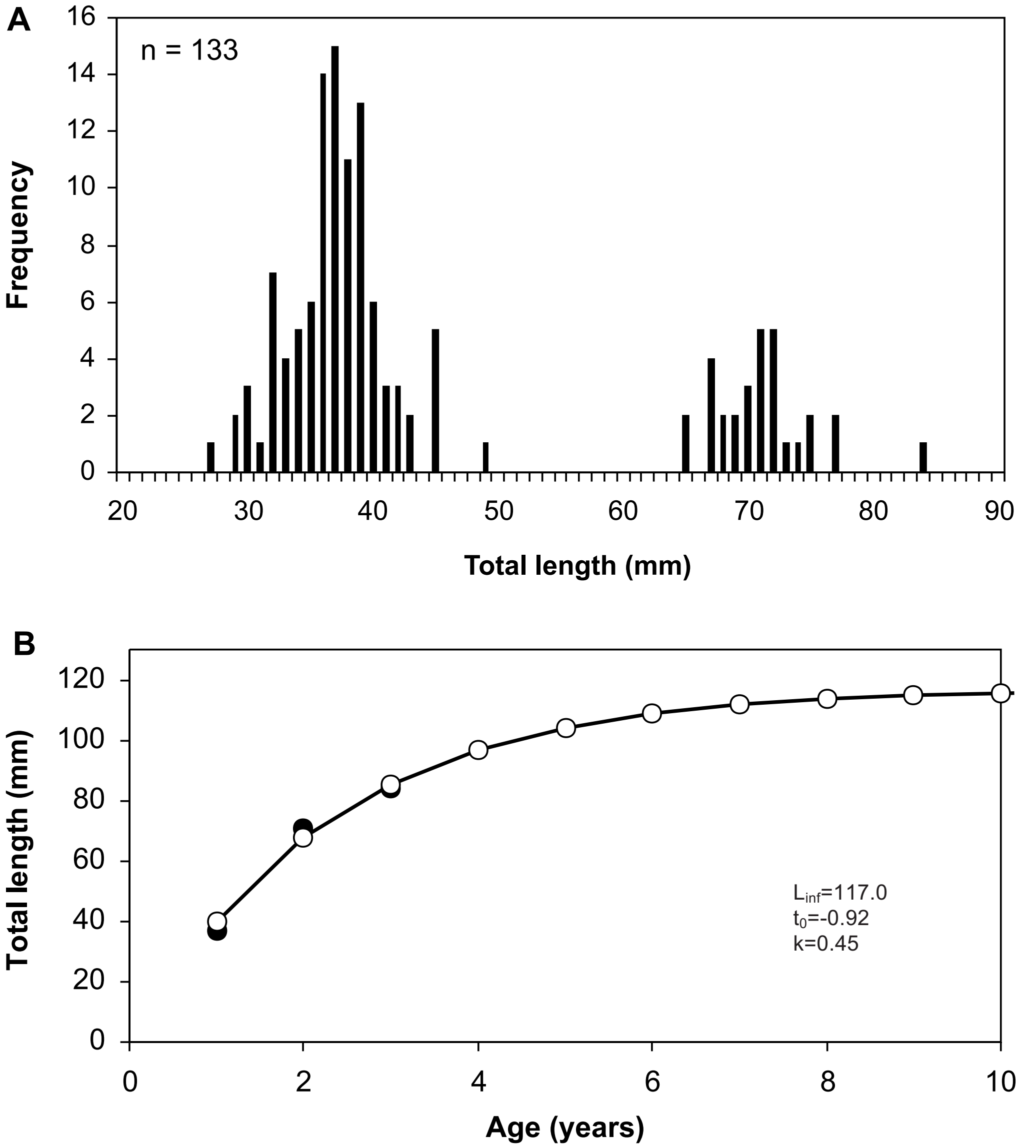

Fig. 3. Population structure of *B. zetensis* at locality 8 (main Morača at Golubovci). (A) length-frequency distribution, (B) von-Bertalanffy model of growth; black dots indicate the observed values, white dot the estimated values.

(Table 3) can be explained by the natural dependence among habitat parameters like current speed and bottom substrate. Nevertheless, it became evident that *C. ohridana* was more abundant in shallow, densely vegetated areas with a sand fraction in the bottom substrate and low current speed.

Juvenile fish made up a major part of the population of both species, which indicates a successful

Table 3

Pearson correlation coefficients for abundance of loaches and environmental parameters at locality 8 (Morača at Golubovci)

Abundance	Distance from shore	Depth	Thickness of algae layer	Coverage by algae
C. ohridana	-0.71*	-0.64*	0.93*	0.67*
B. zetensis	0.13	0.03	-0.01	-0.16

* P<0.05

recruitment in the locality. Specimens of three (*C. ohridana*) or two (*B. zetensis*) age classes were present, therefore the population structure does not suffer from a lack of age classes, which in *Cobitis* was shown to be connected to disturbances in the suitability of the habitat (RITTERBUSCH & BOHLEN 2000). The presence of several age classes in a pyramidal pattern of frequency (with the youngest age class as the most frequent) is generally taken as an indicator for an undisturbed long-term dynamics of fish populations (JOHNSON 1994). Growth is similar as reported for populations of related species (MARCONATO & RASOTTO 1989; SLAVÍK & RÁB 1995). In contrast, CRIVELLI and LEE (2000) reported an annual, rapidly growing population of *Cobitis meridionalis* from Lake Prespa. In comparison to the findings in other populations of *Cobitis*, this conclusion is rather outstanding and may have been affected by difficulties to estimate the age of *C. meridionalis* together with a disappearance of the species from shallow waters during winter. Such seasonal migratory behaviour was described from Lake Müggelsee in Germany (RITTERBUSCH & BOHLEN 2000). In the Morača basin, the sex ratio of *C. ohridana* was slightly biased towards the females. This is a character that may be caused by a variety of reasons (BOHLEN & RITTERBUSCH 2000). At present, we cannot decide whether the shift in sex ratio was caused by ecological or genetic reasons; further studies to clarify this phenomenon will be undertaken.

Looking on the state of the populations of *C. ohridana* and *B. zetensis* in the light of conservation, the observations from this study have to be looked on in a more general pattern. The distribution of both loach species in the Morača basin goes together with the distribution of suitable lowland habitat. Once a locality has a suitable habitat of considerable size, both species are abundant and show a natural population structure, but due to the natural rarity of suitable habitat, they have a small distribution area in the Morača basin. Both species were most abundant in the lower part of the River Morača. In other localities, only a few specimens were found. This distribution pattern represents the natural situation. Since there is no evidence for a reduction of area of occurrence or population number and since reproduction takes place regularly and abundance was locally high, *C. ohridana* and *B. zetensis* at present do not meet any criterion of threat (IUNC 2000). However, these fish highly depend on the presence of suitable habitat. Once the habitat changes, the loaches will disappear. Two of the five localities that contained loaches were obviously under strong negative impact by human activity: The Sitnica River (Point 2 in Fig. 1) is canalised and highly polluted by rubbish and organic wastewater. Only very few fish were caught in this locality. The River Morača below the city of Podgorice, the capital of Montenegro, with 150000 inhabitants, is strongly affected by agricultural, municipal and industrial wastewater (MARIC 1995). At our sampling localities 8 and 9 at Golubovci (Points 8 and 9 in Fig. 1), intense gravel digging destroyed natural shore vegetation and disturbed the habitat by increasing turbidity and sedimentation. Such massive habitat alterations may easily affect the occurring fishes. Further more, *B. zetensis* seems to be endemic to the Morača-Skadar system and more restricted in distribution than *C. ohridana*. Therefore, any alterations that make part of the inhabited area less suitable may easily threaten this species. The only conclusion can be to try to keep the habitats in their most natural stage to ensure a further maintenance of *B. zetensis*, *C. ohridana* and other fish species in the Morača system.

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student writing contest

1st place winner

Save Moraca!

Radek Sanda

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The limpid blue-green water of a swift river struggles through karstic mountains, where it has cut out a steep-sided canyon through the ages. After several tens of kilometers its character changes completely, when it turns into a lowland river flowing into a large lake. Its name is the River Moraca and it is the biggest inflow to Skadar Lake, the largest lake of the Balkan Peninsula. You can find the river in Montenegro. This is a small country lying in the southern part of the former nation of Yugoslavia, a country that has been in the throes of wars for past decade.

The whole area of the former Yugoslavia is well known for its beautiful and well-preserved natural resources with rich flora and fauna. Favorable conditions during glacial periods enabled the survival and consequent evolution of many species. This caused the area to become one of the most important European centers of biodiversity and endemism., especially freshwater fish fauna, which is extremely diverse. Every river system is inhabited by several endemic species, that cannot be found anywhere else. However, human activities caused most of the species to become critically endangered or become extinct. Unfortunately, neither the Moraca River nor Skadar Lake was spared this tragedy.

Thirty-eight native fish species were found in the Moraca River basin and Skadar Lake. They were both freshwater and migratory marine species. Nevertheless, two species of sturgeon, which spawned in the lake, have disappeared. In 1987, an endemic species of cyprinid fish *Chondrostoma scodrense* was described using specimens from collection of the Natural History Museum in Vienna caught in Skadar Lake at the end of nineteenth century. It was never found again. Other species face extinction. Only three specimens of the small cyprinid fish *Pseudophoxinus stymphalicus montenegrinus* have ever been found. Marble trout (*Salmo marmoratus*), growing up to 130 cm, has probably disappeared because it easily hybridized with introduced brown trout (*Salmo trutta*). Softmouth trout (*Salmothymus obtusirostris zetensis*), an ancient inhabitant of this drainage, looking like a hybrid of nase carp, grayling, and trout, occurs only in some parts of the River Zeta, the biggest inflow of the River Moraca.

This unsatisfactory situation was caused by several factors. Construction of a weir on Albanian part of the River Bojana, which connects Skadar Lake and the Adriatic Sea, caused the disappearance of the sturgeon. Moreover, this obstacle in the river negatively influences all migratory species.

In the course of the twentieth century, 13 fish species were introduced into the lake. Some of them adapted very well and became important for the local fishing community. On the other hand, they represent a serious threat to native species. Extinction of endemic *Chondrostoma scodrense* could have been caused by introduction of common carp (*Cyprinus carpio*) and Prussian carp (*Carassius auratus*), extremely strong competitors, now very numerous in the lake. The negative impact of brown trout has already been mentioned.

The economy of the country was completely destroyed by wars and sanctions. Freshwater fish, as an easy source of food, faced high pressure from uncontrolled exploitation. Illegal fishing methods, like using of explosives, electrofishing, or spearfishing, has risen to dangerous extent. However, a plan for building of a cascade of four hydroelectric dams on the Moraca River poses the most serious threat to the whole ecosystem.

We are staring face-to-face with a difficult task. Our team, composed of students from Montenegro, Czech Republic, and Germany, set itself a goal to conduct research on ichthyofauna of the Moraca River and evaluate the state of the river ecosystem. The river, so far free of any artificial constructions, and exposed to only a low degree of pollution, is a perfectly preserved biotope. It is necessary to take pains to re-establish native fish species and prepare accurate conservation actions for their protection. We are preparing an extensive awareness campaign covering general public, scientific community, as well as local conservation organizations. Environmental education of young people and children will be particularly emphasized; as Confucius said, "If you think hundred years ahead, educate people." We hope that our project, supported by BP Conservation Programme, is the first step for conservation of freshwater habitats of Montenegro, wonderful and wild country in the south of Europe, and that we will manage to save this river for the next generations.