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BOOK OF ABSTRACTS

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POPULATION STRUCTURE, STATE AND PERSPECTIVES, OF BLEAK (*ALBURNUS SCORANZA* BONAPARTE, 1845) FROM THE SKADAR LAKE (MONTENEGRO)

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Abstract:

The bleak (*Alburnus scoranza* Bonaparte, 1845) inhabits the waters of the Adriatic basin. Its distribution includes a system Ohrid-Drim-Skadar. In Montenegro it inhabits Skadar Lake, middle and lower course of Morača River, Zeta River and its lowland tributaries as well as Šasko Lake. During the winter, bleak migrates to the sub-lacustrine springs. In economic terms it is the most important freshwater fish in Skadar Lake. The annual catch of this species amounts to 250 tones, while in the past the catch amounted to 600 tons. Bleak catching takes place from October to March. Catching season is closed from March to September. Our study was conducted from December 2012 to November 2014. Researching area included three localities Raduš, Karuč and Virpazar. Analysis of length and weight ratio showed that the values of average length and weight of individuals from Karuč are higher than in individuals from Raduš. This means that the specimens from Raduš were smaller in length and weight, and the specimens from Karuč were greater in length and weight. By analyzing the age structure of the population, it was concluded that the structure was disturbed. In a certain way, the prevalence of the younger age groups is that they did not spawn or flew once, up to two times.

Keywords: Bleak, Skadar Lake, age structure of the population, Karuč, Raduš



TAXONOMIC REVISION OF *BARBUS LORTETI* SAUVAGE 1882

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Abstract:

Barbus lorteti was described by Sauvage in 1882. According to Krupp (1985) the collecting site was given as Orontes Channel at Antakya by Sauvage and two years later author redescribed the species and revised collecting site as Lake Amik and Asi River. After the description of *B. lorteti*, Fang (1943) identified *Bertinus* as a monospecific species, in terms of the location, shape and size of pharyngeal teeth and the low number of scales in the prepelvic region, and valid as *Bertinus lorteti* in the literature. After that, a *Barbus lorteti* was reported from Asi Basin by some studies (Ladiges, 1960; Beckman, 1962). Karaman (1971) reported *B. lorteti* as a synonym of *B. longiceps*, without examining any sample. Krupp (1985) conducted a redescription on his research by examining six museum materials. According to this redescription, the species is again considered as *B. lorteti*.

In this study, it had been seen that the individuals from Asi River have similar metric and meristic characteristics with the literature. *B. lorteti* differs from the other species of the *Barbus* by having an undeveloped lower lip and different pharyngeal teeth number and formula. For all these reasons, *B. lorteti* should be evaluated within the genus *Luciobarbus*. It is therefore recommended *Luciobarbus lorteti* to be validated and *Barbus lorteti* should be considered junior synonym.

Keywords: *Barbus lorteti*, *Luciobarbus*, taxonomic revision



VALIDATION AND PHYLOGENETIC POSITION OF *BARBUS NILUFERENSIS* TURAN, KOTTELAT & EKMEKÇI, 2009

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Abstract:

The genus *Barbus* is characterized by a complex taxonomical structure, due to high number of species and its morphological plasticity. Twenty one taxons from *Barbus* genus including *Barbus niluferensis* was used in phylogenetic analysis. A phylogenetic tree (Bayesian analysis) was reconstructed based on the sequences of COI, with *Aulopyge huegelii* and *Luciobarbus mursa* as an outgroup. As a result, five clades are distinguished from the constructed tree and *Barbus niluferensis* was identified to be the sister group of *Barbus pergamonensis*. *B. niluferensis* and *Barbus oligolepis* are distributed in the same basin, but member of different lineages, and therefore identified to be paraphyletic species. *B. oligolepis* is found to be a member of Ponto-Caspian lineage which originated from the Black Sea, while *B. niluferensis* is found to be a member of Aegean lineage which is dominated by European species and is the sister group of *B. pergamonensis*. According to these results, it has been confirmed that *Barbus niluferensis* is a valid species.

Keywords: *Barbus niluferensis*, phylogenetic position, validation



PHYLOGENETIC RELATIONSHIPS OF THE GENUS *SQUALIUS* IN THE ADRIATIC SEA BASIN

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Abstract:

Squalius is a genus of freshwater fish from Cyprinidae family and Leuciscinae subfamily. *Squalius* species are widespread in the Mediterranean area, with 7 described species inhabiting the Adriatic watershed in Croatia. Even though phylogenetic relationships inside Leuciscinae family have already been investigated, molecular phylogeny of species from Istria, Dalmatia and Herzegovina is still unresolved. Molecular analysis was based on mitochondrial gene for cytochrome b sequences. Phylogenetic trees were created with maximum parsimony and Bayes analysis. Phylogenetic network was constructed using statistical parsimony and neighbor joining method. Results from all analyses have shown separation of 2 independent, genetically distinct groups. *Squalius svallize*, *Sq. zrmanjae*, *Sq. illyricus*, *Sq. microlepis* and *Sq. tenellus* species form Adriatic lineage, while *Cephalus* lineage include *Sq. sp.*, *Sq. squalus* and *Sq. cephalus* species. Adriatic lineage show good separation of species, while *Cephalus* lineage has more complex relationships. *Sq. cephalus* species appeared as paraphyletic. *Sq. squalus* species show large intraspecies diversity, but there is no evidence for separation of species like *Sq. janae*. Species from the Trebišnjica River completely separated from other taxa in *Cephalus* lineage with *Sq. prespensis* as a sister taxon. It seems that colonization of Adriatic rivers and lakes happened at least twice by representatives of two distinct *Squalius* species. Inside of Adriatic lineage species form monophyletic groups, which implies that current taxonomy reflects molecular systematics. *Cephalus* lineage is more complicated group and it needs further systematic revision. The paraphyly of *Sq. cephalus* needs to be confirmed with other genes. *Sq. squalus* has fragmentary distribution reflected in complex phylogenetic relationships and further effort is needed in defining their taxonomic status. The genetically isolated species from Trebišnjica from *Cephalus* group needs further revision and description. Interestingly, we have found *Sq. illyricus* in new localities in Istria (Boljunščica) and Dalmatia (Zrmanja), previously described in Cetina, Krka and Soča.

Keywords: *Squalius* species, cytochrome b, phylogeny, taxonomy



ANCIENT CONNECTIONS AMONG THE EUROPEAN RIVERS AND WATERSHEDS REVEALED FROM THE EVOLUTIONARY HISTORY OF THE GENUS *TELESTES* (ACTINOPTERYGII; CYPRINIFORMES)

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Abstract:

In order to better understand the complex geologic history of the Mediterranean area, we have analyzed evolutionary history, phylogeographic structure and molecular diversity of freshwater fishes belonging to the genus *Telestes*. As a primary freshwater fishes distributed largely the Mediterranean basin, this genus represents a suitable model system for investigating the historical biogeography of freshwater drainage systems in southern Europe. In this investigation we have included samples representing all *Telestes* species and we base our analyses on one mitochondrial and one nuclear gene. We have investigated phylogenetic structure inside the genus *Telestes*, estimated divergence times, reconstructed ancestral distribution ranges and described intraspecific molecular diversity. Diversification of *Telestes* started in the Early Miocene, when the ancestors of *T. souffia*, lineage comprising *T. croaticus* and *T. fontinalis*, and the one comprising *T. pleurobipunctatus* and *T. beoticus* got isolated. The remaining species are genetically more closely related and form a common cluster in the recovered phylogenetic trees. Complex geological history of southern Europe led to complicated biogeographical pattern of this genus, caused by multiple colonization events and passovers between ancient rivers and water basins. Significant intraspecific structuring is present in *T. souffia*, *T. muticellus*, *T. croaticus* and *T. pleurobipunctatus*. Besides in well-structured species, elevated levels of genetic polymorphism were found inside *T. turskyi* and *T. ukliva*, as a consequence of their old origin and unconstrained evolutionary history.

Keywords: diversity, genus *Telestes*, Mediterranean Area, phylogeographic structure



ARTIFICIAL REPRODUCTION ATTEMPT OF *SALMO OBTUSIROSTRIS* L., 1758 (OSTEICHTHYES, SALMONIDAE): EXPERIENCES IN CAPTIVITY

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Abstract:

Soft-muzzled trout is an endemic vulnerable species protected in Croatia. It is well known that in aquaculture history many attempts have been made to culture Soft-muzzled trout. Unfortunately, very few written documents exist on those attempts. It was surprising that no biology on such things as incubation time at the hatchery, hatching time, food or other biological parameters were ever recorded. Soft-muzzled trout is a very interesting endemic fish found naturally in five rivers of the Adriatic Sea, especially the rivers Neretva, Vrljika, Jadro, Krka, and the Morača. Every subspecies is morphologically, and to some extent, ecologically different. Soft-muzzled trout prefers rivers with sand, gravel, and a deeper river with more water and a wide riverbed. It is interesting that Adriatic and brown trout have different spawning times, which probably overlaps every few years. All Soft-muzzled trout are threatened by similar factors such as excessive damming, hybridization with other *Salmo* species and mostly overfishing. On the Vrljika River a small spawning pond was made and by standard artificial fertilization, eggs were obtained which were incubated for 41 days at 10°C. The fish were basically cultured for 5 months and when they were 5 cm long were released into the river Vrljika. Cultured fish provided more knowledge about the incubation phase, hatching, re-absorption of the vitelline sac and the initial phases of growth, which can be used to develop optimal management for the fish of this resource. The basic idea was, for conservation purposes, to raise fry in the hatchery and repopulate the river Vrljika, to obtain a self-sustainable population level which will keep the species outside of the endangerment categories. Accidentally, it was discovered that *Salmo obtusirostris* is a good candidate for aquaculture. We provide here core scientific and useful information on the biology of the species.

Keywords: endemic soft-muzzled trout, reproduction



ACOUSTIC REPERTOIRE OF BIGHEAD GOBY *PONTICOLA KESSLERI* (GÜNTHER 1861) (GOBIIDAE), AND IMPLICATIONS ON SOUND PRODUCTION WITHIN PONTO-CASPIAN SPECIES

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Abstract:

Among the sound producing fishes, gobies are amongst the most studied families. Acoustic communication has been recorded for 22 species to date, primarily belonging to the genera *Gobius*, *Padogobis*, *Zosterisessor*, *Knipowitschia* and *Pomatoschistus*. Within the Ponto-Caspian lineage, few species have been acoustically tested. We recorded agonistic sounds of the Ponto-Caspian bighead goby (*Ponticola kessleri*) in the laboratory and analyzed the spectral and temporal characteristics of acoustic signals emitted by males. Overall, 191 sounds were recorded from five males. *P. kessleri* produced amplitude-modulated tonal sounds, which on the oscillogram correspond to a sinusoidal-like waveform. Vocalizations were composed of 17-72 pulses (44.6 ± 9.8) and lasted from 189.1 to 879.8 ms (473.7 ± 121.4 ms). Most of the energy ranged from 100 to 400 Hz, with a maximum amplitude at the peak frequency, which ranged from 80 to 210 Hz (105 ± 15.4 Hz). Peak frequency was the fundamental frequency. In some cases, additional spectral harmonic components were also present on the spectrogram (< 400 Hz). Moreover, pulse repetition rate corresponded to peak frequency and ranged from 68 to 128 Hz (95.8 ± 12.2 Hz), suggesting that these sounds are tonal. Frequency modulation ranged from -23.4 to 38.3 Hz (-6.6 ± 12.7 Hz), indicating slight downward modulation. On the spectrogram, *P. kessleri* sounds corresponded to vocalizations produced by the soniferous Atlantic-Mediterranean species, i.e. rock goby (*Gobius paganellus*). Both species produce frequency-modulated sounds (*G. paganellus* emits upward-modulated sounds) with a high pulse repetition rate (> 40 Hz), which appears phylogenetically to be the most important property in species discrimination. This acoustic affinity parallels molecular and morphological affinity revealed by recent studies. Tonal sounds of *P. kessleri* indicate that acoustic communication may contribute to resolving phylogenetic relationships and systematic position of Ponto-Caspian gobies, since *P. kessleri* acoustically clusters with other European gobies.

Keywords: *Ponticola kessleri*, tonal sounds, acoustic communication, phylogeny



REPRODUCTIVE PREFERENCES OF THE BITTERLING *RHODEUS AMARUS* (BLOCH, 1782) AMONG FIVE BIVALVE SPECIES FROM THE FAMILY UNIONIDAE

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Abstract:

The reproductive cycle of bitterling includes oviposition in a live freshwater bivalve from the family Unionidae, with the bitterling eggs and embryos developing inside the shell. Although the number of native freshwater mussels in Europe is declining, in Croatia, the bitterling is currently very abundant and is widely distributed throughout the Danube drainage. Furthermore, it is considered invasive at several sites in the Adriatic basin. On the other hand, *Sinanodonta woodiana* is an invasive freshwater mussel that has entered Croatia and is rapidly expanding its range. We conducted an experiment to test the reproductive preferences of bitterling among five species of freshwater mussels (four native: *Anodonta anatina*, *Unio crassus*, *U. tumidus* and *U. pictorum*; and one invasive: *Sinanodonta woodiana*). Four males and 16 female bitterlings were kept in an aquarium with four equal territories, each containing all five investigated mussel species. After 20 days, mussels were recovered and the number of eggs and embryos in the gills was counted. A total of 319 eggs and embryos were recovered with most (95) in *A. anatina*, followed by *U. crassus* (89), *U. tumidus* (80) and *U. pictorum* (55). Not a single egg or embryo was found in the invasive *S. woodiana*. These results indicate a future potential threat for bitterling survival, as the suppression of native mussel species by the competing invasive species could hinder its reproduction.

Keywords: invasive freshwater mussel, bitterling reproduction



REPRODUCTION OF THE PACIFIC OYSTER *CRASSOSTREA GIGAS* IN THE BIZERTE LAGOON IN NORTHERN TUNISIA

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Abstract:

In Tunisia, shellfish farming dates back to 1963, mainly with Mussel farming (*Mytilus galloprovincialis*) and Pacific Oyster (*Crassostrea gigas*). This activity is located exclusively in the lagoon of Bizerte Located in northern Tunisia (37°08'-37°17'N/9°46'-9°55'E). The Mussel breeds naturally in the lagoon whereas for the Pacific oyster there is no natural settlement at this ecosystem and its rearing has always depended on spat produced artificially in hatcheries. The reproductive cycle of *C. gigas* is composed of two distinct phases: a phase of seasonal maturation of the sexual products, gametogenesis, and a phase of larval life. Complete gametogenesis can be carried out, resulting in egg laying, and sometimes recruitment when the thermal and saline conditions are favorable. The "salinity" appears to be the main factor limiting reproduction in the natural environment. The growth and reproduction phases are simultaneous. The 1-year oyster breeding cycle shows an asynchronous evolution of gametogenesis with a metabolism oriented mainly to growth. Conversely, older individuals show a synchronous maturation leading to 1 or 2 massive laying, with a metabolism oriented as a priority towards reproduction. Reproductive effort increases with age to reach a weight of 65% and 80% of the dry weight of flesh at the age of 2 and 3 years, respectively. *C. gigas* is generally considered to be a species with successive hermaphroditism. However, sex reversals are observed in adult animals.

Keywords: oysters, shellfish, spat, gametogenesis, limiting factor



RECENT DISTRIBUTION OF NON-NATIVE FISH SPECIES LARGEMOUTH BASS, *MICROPTERUS SALMOIDES* IN CROATIA

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Abstract:

The Largemouth bass (*Micropterus salmoides*) has been widely introduced worldwide as a popular recreational fishing species. The species was introduced to the freshwaters of Croatia in the early 20th century. This study assessed the distribution and status of Largemouth bass using field surveys, literature data and data collected by sport fisherman. The results indicate a wide distribution of *M. salmoides* in the Danube watershed and just one record in the Adriatic watershed (Neretva River). The species mostly inhabits oxbows, artificial lakes, reservoirs and channels with aquatic and riparian vegetation.

Keywords: non-native species, distribution, largemouth bass, Croatia



POPULATION GENETIC CHARACTERISTICS OF EASTERN-SERBIAN *SALMO TRUTTA* (L.) POPULATIONS

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Abstract:

Five brown trout (*Salmo cf. trutta*) haplogroups of mitochondrial DNA control region have been defined at the end of 20th century: Danubian, Atlantic, Mediterranean, Adriatic and *marmoratus*. The most common haplotypes in Serbia are of Danubian, Adriatic and Atlantic haplogroups. Unlike the Atlantic, haplotype that is probably introduced by stocking, the Danubian haplogroup for Western Balkans is considered autochthonous. Brown trout populations from nine streams (Mirovštica, Radovanska and Lukovsko vrelo from Crni Timok drainage area and Mala Boljetinska, Kožica, Zlatica, Vratna, Zamna and Rečka from broader Iron Gate area) in Eastern Serbia were analyzed, with four mtDNA haplotypes already detected in them. All populations from broader Iron Gate area had indigenous Da23c haplotype, except Rečka River population with Da1 haplotype and Vratna with both Da23c and haplotype of AT haplogroup. Since mtDNA expresses only maternal inheritance, nuclear gene lactate dehydrogenase was used to reveal paternal lineage. The analysis showed that sympatric individuals of two haplogroups from Vratna River most probably interbreed. Structure analysis of eight microsatellite loci showed grouping of populations from three rivers of Crni Timok drainage area (Mirovštica, Radovanska and Lukovsko vrelo), from Rivers Vratna and Zamna, and from Rivers Mala Boljetinska and Zlatica, indicating a gene flow between those rivers. Despite small streams were with estimated small population size, observed heterozygosity values in majority of them were high, indicating great genetic variability. No significant bottlenecks were detected by SMM and TPM models, but in four streams mode shift test showed unstable genetic structure. The presence of brown trout of the autochthonous and unique Da23c haplotype in this area combined with good genetic variability could be of a great conservational importance. Considering that individuals of Atlantic haplotype occurring in particular rivers can pose a serious threat to indigenous populations, the urgency in taking conservational steps is even greater.

Keywords: microsatellites, brown trout, conservation, Đerdap, Timočka Krajina



NEW RECORDS ABOUT HAPLOTYPE DIVERSITY OF BROWN TROUT (*SALMO TRUTTA* L.) FROM ADRIATIC SLOPES IN MONTENEGRO

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Abstract:

Data from several rivers in the Adriatic slopes of Montenegro using the Control Region (CR) of mitochondrial DNA as a molecular marker enriched the current knowledge about the genetic diversity of brown trout *Salmo trutta* L. occurring there. Fin clips of 68 fish: 12 from the River Mrtvica, River Sjevernica and River Nožica each, and 32 from the River Gornja Zeta, were sampled. In total, six CR haplotypes were recorded: Da1 and Da2; At1-H3 and A17; and Ad+Prz and ADcs11, from the Danubian (Da), Adriatic (AD) and Atlantic (At) brown trout lineages, respectively. All populations native to the lost rivers (Rivers Nožica, Sjevernica and Gornja Zeta) feature brown trout of the Da1 haplotype. Other haplotypes were found in the following order: Da2 and At1-H3 in the River Gornja Zeta, Ad+Prz in the River Sjevernica, A17 in the River Mrtvica and ADcs11 in the Rivers Sjevernica and Mrtvica. The presence of Da1 haplotype in the lost rivers of the Adriatic Sea slopes upstream of the abyss they flow into the most likely is a consequence of the introgression from the adjacent River Drina drainage area of the Danubian, i.e., the Black Sea slopes, by interconnections at the drainage captures that occurred during the Pleistocene. In contrast to that, the presence of Da2 haplotype and those of the AT lineage is due to the stocking events. The complex dispersal pattern in occurrence of particular Ad haplotypes in streams of the Adriatic slopes suggests the still scarce knowledge about their phylogeographic history in the region.

Keywords: brown trout, mtDNA, haplotype diversity



FIRST APPLICATION OF BENTHIC MULTI-MESH SIZED GILL NETS (MMG NETS) ON BIG BALKAN LAKES – MONTENEGRIN PART OF LAKE SKADAR

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Abstract:

Multi-mesh sized gill net (MMG nets) were applied for the first time on Lake Skadar Lake in 2013 sampling campaign. The whole sampling campaign last additional two years in 2014 and 2015. For the first-time data collected with such standard nets, relative biomass (CPUE) and relative abundance (NPUE), are comparable with data obtained with same sampling gear from other European lakes. With MMG we netted 18 fish species while application of this sampling gear showed that average CPUE for this three-year period were: 69.13 gr/m² in 0-3m depth stratum, 42.11 gr/m² for 3-6m depth stratum and 58.93 gr/m² for 6+ m depth stratum. For the same period average NPUE values were as follows: 3.00 ind./m² for 0-3m depth stratum, 1.46 ind./m² for 3-6m ind./m² depth stratum and 2.79 for 6+m depth stratum. Although MMG nets showed excellent catchability for small- and middle- body sized fish species (e.g. bleak, perch, roach, chub), for large-body sized fish species (such is highly abundant common carp) they were almost useless.

Keywords: Lake Skadar, MMG nets, relative biomass, relative abundance



GROWTH, MORTALITY AND FECUNDITY OF LAKE SKADAR BLEAK (*ALBURNUS SCORANZA BONAPARTE, 1845*)

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Abstract:

Length-weight relationship calculated on total sample size was $W_t = 3.3 \times 10^{-3} L^{3.3442}$ indicating positive allometric growth in weight. Growth of females and males was different showing higher allometric growth in weight of females than males ($b_f = 3.4577$; $b_m = 3.3324$). Highest mortality (q_x) was detected in 1+ and 2+ cohort, 0.71 and 0.91 respectively. Mean absolute fecundity (F) was 4356.54 ± 1765.62 while relative fecundity (F_{tw}) was 187.16 ± 51.16 .

Keywords: Lake Skadar, bleak, growth, mortality, fecundity



DECREASING OF LAKE SKADAR BLEAK (*ALBURNUS SCORANZA* BONAPARTE, 1845) ABUNDANCE AND BIOMASS IN 2013-2015 PERIOD CAUSED BY OVER-FISHING

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Abstract:

Being one of the most important fishery species on Lake Skadar, bleak is under strong and constant fishing pressure. During 2013-2015 sampling campaign, we detected dramatic drop in both, abundance and biomass. In 2013 average CPUE and NPUE were 78.14 gr/m² and 3.47 ind./m² while in 2014 we detected dramatic drop. The values were 43.87 gr/m² and 1.72 ind./m² respectively. In 2015, we noticed slight recovery with CPUE and NPUE values of 53.92 gr/m² and 2.65 ind./m². In 0-3m stratum there were biggest differences among sampling years and in this stratum we detected almost three times lower NPUE and CPUE values in 2014 than those we found in 2013. In terms of population structure, in 2014 we had almost all population consisted of oldest adults while in 2015 we again had occurrence of juveniles in our samples. Presented situation is dominantly driven by combination of over-fishing that occurred in 2013/2014 winter period and low spawning efficiency which happened in 2012 spring season.

Keywords: Lake Skadar, bleak, CPUE, NPUE, overfishing



MOLECULAR VARIABILITY AND IDENTIFICATION OF *TELESTES METHOHIENSIS* (STEINDACHNER, 1901) AND *TELESTES DABAR* BOGUTSKAYA, ZUPANCIC, BOGUT & NASEKA, 2012

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Abstract:

Bosnia and Herzegovina abounds in unique heterogeneous karstic ecosystems that present habitats of numerous rare, endemic and also endangered species. One of these are also two cyprinid species *Telestes methohiensis* and recently described *T. dabar* that inhabits temporal karstic streams, subterranean cavities and springs in a restricted area in Eastern Herzegovina. *Telestes dabar* was recognized using morphological data of isolated geographical populations of fishes identified earlier as *T. methohiensis*. In order to resolve taxonomic uncertainties resulted by overlap of morphological variation of these two species, it is necessary to implement molecular based taxonomy (DNA taxonomy). DNA approach contributes to establishing the species boundary in taxonomic sense and genetic variation of populations. We analyzed the populations from the Dabarsko (the rivers Opačica and Pribitul) and Nevesinjsko (river Zalomka) fields. Using molecular markers of both nuclear (S7 ribosomal protein gene introns) and mitochondrial (cytochrome b and cytochrome c oxidase subunits 1) DNA two species were clearly identified and delimited. On the basis of the analyzed populations it can be concluded that *T. methohiensis* inhabits watercourses in the Nevesinjsko field and *T. dabar* in the Dabarsko field. Thus, clearly identification of species boundary provides better insight into species range, which is very important step for the implementation of the conservation management plan.

Keywords: endemic species, Eastern Herzegovina, *Cyt B* mtDNA, *COI* mtDNA, *S7* rDNA



NORTH-EASTERN INDIA: A NATURAL REPOSITORY OF STONE LOACHES, *SCHISTURIDS* (CYPRINIFORMES: NEMACHEILIDAE)

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Abstract:

The Eastern Himalayan (North-eastern) Region of India is drained by four major drainages viz. the Ganga-Brahmaputra, the Barak-Surma-Meghna, the Chindwin-Irrawaddy and the Kaladan/ Kolodyne. These drainages are the repository of nemacheilid loaches, holding more than 53 nemacheilid species under five genera viz. *Aborichthys*, *Acanthocobitis*, *Neonoemacheilus*, *Physoschistura* and *Schistura*, representing about 16% of total fish species of the region. Of the total nemacheilid species of the region, the present study recognizes 34 species under genus *Schistura* from different drainages of the northeastern India; of which 11 schisturid species are described recently viz. *Schistura aizawlensis*, *S. fasciata*, *S. ferruginea*, *S. koladynensis*, *S. paucireticulata*, *S. porocephala*, *S. liyaiensis*, *S. maculosa*, *S. nebeshwari*, *S. phamhringi* and *S. scyphovectata*. The Barak-Surma-Meghna drainage harbored with 11 species; the Brahmaputra with 10; the Chindwin-Irrawaddy with 9 species; and the Koladyne with 4 species (described recently) only. Low species representation in the Koladyne drainage is due to lack of exploration to the entire stretch of the river basin, inaccessible to reach various areas due to hostile geo-morphological features, and various river and land laws for each and every tribes inhabited along the river basin that prohibit the entry of non-local people for exploration. High degree of endemism is reported from the upper reaches of the river basin of the region. Of the 11 species reported from the Barak-Surma-Meghna drainage of the region, six species viz., *Schistura aizawlensis*, *S. fasciata*, *S. ferruginea*, *S. liyaiensis*, *S. maculosa* and *S. paucireticulata*, are described recently to the world. Six new *Schistura*, two each from Arunachal Pradesh, Meghalaya and Nagaland, have been collected recently from Brahmaputra drainage of North-eastern India. In view of the prevalent threats to the freshwater biodiversity of the region, proper exploration and evaluation of the ichthyofaunal resources is essential for taking up conservational measures for future generation.

Keywords: Nemacheilid Loach, *Schistura*, species richness, Eastern Himalaya, biodiversity, conservational measures



RECENT STATUS OF ADRIATIC TROUT, *SALMO OBTUSIROSTRIS* IN THE RIVER NERETVA CATCHMENT

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Abstract:

Adriatic trout, *Salmo obtusirostris* have disappeared from most of their historical distribution range in the River Neretva (Bosnia and Herzegovina), while remnant populations are highly fragmented and distribution of the species is restricted to only 15% of historical areal. The research on population status was executed during 2015 and 2016 with use of different nets and electro-fishing. The most abundant fish lengths were 20 to 40 cm, with a significant decrease in the number of bigger specimen. Age population structure was dominated with fish aged 2, 3 and 4 years. Maturation of gonads happened in December-March period, while ripe eggs were found in late February and March. Average fecundity per one kilogram of fish weight was 3230 eggs. Weight of eggs averaged 0.05 grams, ranging from 0.045 to 0.056 grams. Food of Adriatic trout from Lower Neretva flow was dominated with benthic organisms and the most abundant and frequent were larvae of insect *Hydropsyche incognita* (Trichoptera). The River Neretva Adriatic trout population is under heavy pressure including human habitat alterations and fishery, provoking disappearance in number of formerly inhabited areas. The Lower Neretva and Buna tributary are only areas where this population is still abundant, but with early warning syndromes (i.e. decrease of older specimens number) of pathway to extinction of wild population. Two other areas of the Neretva flow, above town of Konjic and bellow Salakovac dam including Mostarski reservoir, are still populated with Adriatic trout, but in low number with questionable future population destiny.

Keywords: Adriatic trout, *Salmo obtusirostris*, distribution, population structure, food



COMPOSITION OF FISH JUVENILE'S ASSEMBLAGE AT MOUTHS OF RIVERS IN MONTENEGRO (SOUTH ADRIATIC SEA)

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Abstract:

Monitoring of fish juveniles' assemblages has proven to be of great significance in the monitoring of fish communities in general, as some influences that can have an effect on later developmental stages of fish can sometimes already be seen in juveniles, such as new/alien species' establishing a population in a given area and their detrimental effect on existing native fish communities. Qualitative and quantitative composition of fish juvenile's assemblages at mouth of rivers was examined along the Montenegrin coast (South Adriatic Sea). Fish juveniles were sampled at 4 different locations, two of them are facing the open sea of Montenegro (Bojana river and Jaz river), while the other two were located inside the Boka Kotorska Bay, which has specific ecological characteristics (Sutorina and Morinj rivers). Samplings were performed in the area of brackish water, where rivers inflow into the sea, with experimental beach seine net of 30 meters in length and 1 meter height, codend mesh size 4 mm stretched. At each location two hauls were performed, and the collected specimens were preserved in 96% ethyl-alcohol and subsequently processed at the laboratory. Each individual specimen had the species determined (or genus, in cases where it was not possible to determine the species) and length (to the nearest mm) and weight (with 0.01 g precision) measured. Obtained results were compared to the results of previous years monitoring at the same sites in order to determine possible changes in the fish juveniles' assemblage composition under the climate change and anthropogenic influences, as well as the possible appearance of new species, an increasingly common event in the Adriatic.

Keywords: fish juveniles, composition, assemblages, Montenegro, South Adriatic



PRELIMINARY DATA ON FISH FAUNA IN SMALL MARINE LAKE ON LOKRUM ISLAND – SPECIAL RESERVE AND NATURA 2000 SITE, CROATIA

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Abstract:

Fish assemblage of small and shallow marine lake called the Dead Sea, on Lokrum Island (Dubrovnik, Croatia) were investigated from March to July 2017 by using visual census. This salt lake is actually a cave that collapsed in the geological past and is connected to the sea by a submerged channel. Lokrum Island is a special reserve of forest vegetation since 1948. Today the island (72 ha) and the sea-belt (approx. 150 m) are also Natura 2000 site which includes eight Natura 2000 habitat types. Geomorphological phenomenon Dead Sea with its pit hole and the channel that connects the marine lake to the open sea is a Natura 2000 habitat type - Submerged or partially submerged sea caves. In spite of long natural history tradition in this area, there are no data on the biodiversity of Dead Sea. At least 15 fish species were recorded, of which some are listed on the IUCN Red list of Threatened Species: *Chromis chromis*, *Tripterygion melanurum*, *Muraena helena*, *Scorpaena porcus*, *Microlipophrys dalmatinus*, *Diplodus vulgaris*, *Diplodus puntazzo*, *Sparus aurata*. The main geostructural characteristic of Dead Sea (openness to light) significantly affect the species richness and fish assemblage structures inside. The species richness generally displayed a similar pattern with the nearby outer sea, whereas the patterns of fish abundance varied among species. Rare and cave-exclusive species were not reported from this preliminary study. Although the natural values of the Lokrum Island represent unique whole of land and sea, Public Institution Lokrum Reserve does not currently manage the entire sea area of Natura 2000 Lokrum site. Therefore, this preliminary data represent guidelines not only for fish fauna conservation, but also with implications for conservation and management of Natura 2000 marine habitat types of Lokrum Island.

Keywords: fish fauna, conservation, Natura 2000, Lokrum Island



CRUSTACEAN DECAPOD DIVERSITY ASSOCIATED WITH *CYMODOCEA NODOSA* MEADOWS FROM THE NORTH AEGEAN SEA (EASTERN MEDITERRANEAN SEA)

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Abstract:

Seagrass meadows and the associated invertebrate fauna have been considered as important ecological biodiversity indices for coastal marine environments. Even though increasing anthropogenic stress and climate change have made these habitats priority targets for monitoring and conservation, relevant information is poor for the eastern Mediterranean Sea. The present study aims at describing and comparing decapod assemblages associated with four shallow *Cymodocea nodosa* beds from the northern Aegean Sea (Greece). Sampling was carried out in Kavala Gulf during April and May 2017. Decapods were collected by means of a beach seine (mesh size of 2 mm), and were preserved in situ in 4% neutralized formalin. For the morphological study of *Cymodocea nodosa*, three 25 x 25 cm quadrates were randomly sampled, while biometric (leaf length and width, total leaf length) and structural (shoot density, above and below ground biomass and above/below ground biomass) parameters were assessed in the laboratory. Finally, physicochemical parameters (temperature, dissolved oxygen, salinity, conductivity, density and pH) were measured on site, while water samples were collected for nutrient and chlorophyll *a* analyses. In total, 606 crustacean decapod specimens belonging to 13 species and 7 families were collected and measured. Among the study sites, the higher decapod richness and abundances were found in the western Kavala Gulf, with the same dominant species and with *Hippolyte sapphica* form A (Hippolytidae) being the characteristic species of *Cymodocea nodosa* habitat. A clear correlation between seagrass morphometry and nutrient concentrations was witnessed, with smallest shoot size and higher densities in the less impacted areas (western stations). While decapod abundances were not correlated to any other factor, species richness was correlated to the number of leaves per shoot. The variation in species composition among the different Mediterranean areas are compared and discussed.

Keywords: *Cymodocea nodosa*, *Hippolyte sapphica*, decapods, diversity, Aegean Sea, Eastern Mediterranean Sea



CONGRIDAE LEPTOCEPHALI IN THE OPEN WATERS OF MIDDLE AND SOUTH ADRIATIC

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Abstract:

Individuals of *Congridae leptcephali* were accidentally caught during targeted research of small pelagic fish with small pelagic trawl nets (Italian-type otters) in the open waters of middle and south Adriatic during September 2010-2014. A total of 51 *Conger conger*, 19 *Ariosoma balearicum* and 3 *Gnathophis mystax leptcephali* were identified on the basis of their morphology, morphometric and meristic characteristics and pigmentation. 41 *C. conger leptcephali* were in premetamorphic stage, while 10 were in metamorphosis. The total number of myomeres ranged from 148 to 156, while the numbers of preanal myomeres differ for premetamorphic and metamorphic ones (75-81 and 55-57 respectively). According to morphometric and meristic characteristics of *A. balearicum* and *G. mystax*, all were in the premetamorphic stage. The total number of myomeres for *A. balearicum* varied between 125 and 134 and preanal myomeres from 108 to 112, while for *G. mystax* ranged from 134 to 137 and 114 to 117, respectively. The hatching dates back-calculated from the otolith microstructure of the field-caught *C. conger leptcephali* (8 to 11 months old) indicate a spawning season from late December through late August, with one annual peak occurring in August - September at the end of the warm season. Based on the age and distribution of *leptcephali*, as well as the upper-layer circulation and modelled mean current fields, a possible scenario of retention and dispersion of larvae suggesting South Adriatic Pit (SAP) as spawning area of *Congridae* species is explained.

Keywords: *Congridae*, *Leptocephali*, South Adriatic pit, spawning area



JUVENILE FISH ASSEMBLAGES IN THE ZADAR AREA (EASTERN ADRIATIC SEA, CROATIA), SPATIAL AND TEMPORAL PATTERNS OF SETTLEMENT AND HABITAT USE; A PRELIMINARY APPROACH

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Abstract:

Spatial and temporal patterns of distribution and abundance were examined for post-settlement fish assemblages collected from different habitats in the Zadar area, Croatia. The specimens were caught using a small beach seine at six stations from samples taken on May and June 2017. Most diverse family were Sparidae comprising 8 species, followed by Gobiidae with 7 and Labridae with 4 species. The most abundant juvenile taxa were the atherinid *Atherina boyeri* accounting with 77.27% of the total catch. Differences in fish assemblages were observed with respect to sampling dates and station mostly due different temporal and spatial distribution of settlers. Studied juveniles settled to well defined habitats with characteristically distinctive substrate types. Sparid species settled primarily in the shallowest zone (0 to 3 m), and most of them prefer varied bottoms (sand, gravel or rocky; vegetated or unvegetated). Labrid species are normally found on rocky substrates with high algal cover, while atherinids show no clear link with the substrate type. Species richness was significantly higher in well structure habitats (i.e. vegetated areas), as well as differences in abundance and biomass of fishes between vegetated and unvegetated habitats depended on the location of sampling. In general, abundance and biomass in the vegetated areas were higher than in unvegetated habitats. Marine nursery is defined as a juvenile habitat for a particular species that contributes a greater than average number of individuals to the adult population when compared to other habitats used by juveniles. For many fishes these areas are found in/or restricted to coastal shallow-waters with structurally complex habitats. Such locations generally are highly productive and afford protection to smaller fish by restricting access and/or impeding the foraging capability of piscivorous fish predators.

Keywords: infralittoral fish assemblages, nursery areas, juveniles, distribution, habitat



PHYLOGEOGRAPHY OF WHITING (*MERLANGIUS MERLANGUS*) ALONG THE TURKISH COASTAL WATERS WITH COMPARISONS TO THE ATLANTIC

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Abstract:

In this study, the effect of the Turkish Straits System (TSS), comprising a biogeographical boundary that forms the connection between the Mediterranean and the Black Sea, on the evolutionary history, phylogeography and intraspecific gene flow of the whiting (*Merlangius merlangus*) a demersal fish species, was investigated. For these purposes, the mitochondrial DNA (CO1, cyt-b) genes and nuclear DNA (RAG 1) were used. In addition, genetic comparisons samples collected from other regions such as, Greece and France, Atlantic obtained from GenBank were made to better understand the phylogeographic history of the species at a larger geographic scale. Within this study, high level of genetic differentiation was observed along the Turkish coastal waters based on cyt-b gene, suggesting that TSS is a barrier to dispersal. Two different sub-species were also observed based on mitochondrial DNA, one found in Turkish coastal waters and Greece (*M.m. euxinus*) and other (*M.m. merlangus*) in Atlantic, France.

As opposed to mtDNA results, *M.m. merlangus* samples from Atlantic and *M. m. euxinus* from Black Sea, TSS populations could not be distinguished in the haplotype network and phylogenetic trees based on the RAG1 gene. However, genetic structure between populations of *M.m. euxinus* from Greece and Turkish coastal waters was observed due to restriction of gene flow in Dardanelles.

Keywords: TSS, phylogeography, whiting, mtDNA, GenBank



ECO-MORPHOLOGICAL DIVERSITY OF FRESHWATER FISHES AS A TOOL FOR CONSERVATION BIOGEOGRAPHY: A CASE STUDY FROM A BALKAN HOTSPOT

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Abstract:

Conservation biogeography studies commonly focus on a taxonomic perspective using diversity measures such as species richness and abundance. However, alternative measures based on eco-morphological traits may be a more powerful currency for unveiling the processes shaping biodiversity. Herein, using advanced multivariate techniques, we study freshwater fish species' trait distributions in Louros River (NW Greece, Ionian biogeographical region) to understand trait-based community assemblage structure and the role of local environmental conditions in explaining the eco-morphological trait structure of fish assemblages. All available indices of species' originality were applied to identify the most eco-morphologically distinct species and highlight the role of eco-morphology in functional uniqueness in order to provide a hierarchical classification of species' priority to protection measures. Our results show that the riverine upstream habitats that are related to shallow mean depth and coarse substrate are associated with fish species with a more streamlined body shape, swimming endurance and a forked caudal fin. In conclusion, this functional diversity assessment is essential both for the adequate study of biodiversity and the effectiveness of conservation efforts for rare species that showed the highest functional uniqueness [*Valencia letourneuxi* (Sauvage, 1880) and *Cobitis hellenica* Economidis & Nalbant, 1996] and thus require immediate management actions, since any destruction of their habitat may have direct and significant impact on their populations' size and survival ability. From a conservation perspective, this study emphasizes the need of focusing on species traits, rather than on taxonomic species for understanding patterns in assemblage structure and the protection of eco-morphologically distinct species.

Keywords: Balkan Peninsula, conservation, eco-morphology, freshwater fishes, functional diversity, originality indices



MOLECULAR-GENETIC CHARACTERIZATION OF FARMED *SALVELINUS FONTINALIS* (MITCHILL, 1814) BASED ON MTDNA CONTROL REGION

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Abstract:

Native North American brook trout, *Salvelinus fontinalis* (Mitchill, 1814) has been introduced in Europe in the 19th century and, according to FishBase, to the rivers of Bosnia and Herzegovina in 1892. During the 20th century, brook trout farming was launched in number of fish farms throughout the country. In 1980's, some sustainable populations were found in nature, such as one in the river Pištica. However, despite the stocking, there have been no reports of wild populations of brook trout in Bosnia and Herzegovina in the last 20 years. The aim of this study was to assess the genetic diversity of farmed brook trout from three fish farms on the river Neretva using PCR-RFLP and sequencing analysis of mtDNA control region. PCR-RFLP reactions with *AccI*, *BamHI*, *BanI*, *DraI* and *NdeI* restriction enzymes revealed the same enzymatic profiles in all analyzed individuals. Multiple sequence alignment of all obtained mtDNA control region sequences displayed no polymorphisms, indicating that all brook trout specimens are of the same evolutionary lineage. Both this and previous studies revealed very low genetic diversity in farmed populations of brook trout in B&H due to extreme inbreeding. Given that there are no self-sustaining *S. fontinalis* populations in BH waterways, the current impact of this invasive species is insignificant for autochthonous and endemic salmonid species in B&H. In order to maintain this status, we do not recommend introduction of the brook trout in the BH rivers.

Keywords: brook trout, *Salvelinus fontinalis*, mtDNA, RFLP, sequencing



SENSITIVITY ANALYSIS OF LACTATE DEHYDROGENASE (LDH) MARKER IN THE DETECTION OF INTRASPECIFIC HYBRIDS OF BROWN TROUT (*SALMO TRUTTA* L.)

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Abstract:

Brown trout (*Salmo trutta* L.) is one of the most broadly distributed fish species in the world whose populations harbor diverse genetic make-up. Generally, brown trout can be grouped into four distinct phylogenetic lineages which concur with the geographic origin: Adriatic (Ad), Mediterranean (Me), Danube (Da) and Atlantic (At). In Bosnia and Herzegovina, Adriatic lineage is indigenous in the river Neretva drainage, while Danubian lineage is autochthonous for the drainage of the river Sava. Natural areal of *S. trutta* has been expanded by human-assisted introductions worldwide. As a result of translocations, further enhanced by other anthropogenic activities in brown trout's habitat, an occurrence of hybridization between different genetic lineages is ever increasing. The correct detection of such hybrids is especially important for controlled stocking of natural autochthonous populations. A number of different genetic markers have been previously used in order to differentiate hybrids from "pure lineages". One of such markers is lactate dehydrogenase (LDH). The aim of this study was to assess the sensitivity of LDH marker in detection of brown trout individuals of Atlantic origin and their hybrids with other lineages. The assessment of marker's sensitivity was made by comparison of the results of LDH analysis using Sanger sequencing method and PCR-RFLP with *Bse*LI enzyme. Both applied methods practically displayed the same results: out of 14 analyzed specimens, two were of Atlantic origin; six were characterized as hybrids between Atlantic and other lineages, while the rest were of either Adriatic or Danube origin, or were the hybrids of these two. Though not suitable for differentiation of other evolutionary lineages of brown trout, our results show that PCR-RFLP analysis of LDH, as fast and affordable method, can be used in the detection of hybrids of Atlantic brown trout with high confidence.

Keywords: brown trout, lactate dehydrogenase (LDH), PCR-RFLP, sequencing



BODY PIGMENTATION AND MERISTIC CHARACTERISTICS OF *SABANEJEWIA BALCANICA* FROM THE WATER CATCHMENT AREA OF THE RIVER SAVA

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Abstract:

The taxonomic research of 8 populations of *Sabanejewia balcanica* from the water catchment area of the river Sava included the analysis of the meristic characteristics and pigmentation of their bodies. The analyzed sample contained 98 specimens collected in the areas of the rivers Turija, Gostelja, Brka, Suturlija, Suha, Tinja and Trebačka. The aim of this paper was to specify the meristic and pigment characteristics of this species at the location of the water catchment area of the river Sava, which are frequently used in describing subspecies or new species. The meristic research included the analysis of the number of rays in fins. In the analysis of body pigmentation, the number and arrangement of certain thorns, blotches or spots were determined. The results of this research indicated that there were no interpopulation differences in *Sabanejewia balcanica* from the water catchment area of the river Sava in terms of meristic characteristic and body pigmentation.

Keywords: *Sbanejewia balcanica*, meristic, Sava



MORPHOLOGICAL CHARACTERS OF *SCARDINIUS DERGLE* AND *SCARDINIUS PLOTIZZA* POPULATIONS IN BOSNIA AND HERZEGOVINA AND CROATIA

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Abstract:

Genus *Scardinius* (Cypriniformes, Actinopterygii) belongs to the family Cyprinidae, subfamily Leuciscinae, and it includes 10 species. Nominal species, Rudd (*S. erythrophthalmus*), is widespread, while other species have a narrow geographic distribution. Phylogenetic and morphometric research conducted so far show a great taxonomic complexity within this genus. Therefore, the aim of this research was to determine morphological diversity and clarify relationships and status of *S. dergle* and *S. plotizza* in Bosnia and Herzegovina and Croatia. For the purpose of this research, specimens of *S. dergle* were collected from Vransko Lake on the Cres Island, Visovac Lake on Krka River, Ruda River, Guduča River and Vransko Lake near Biograd in Croatia, and channel Veliki Ždralovac in Bosnia and Herzegovina. Specimens of *S. plotizza* were collected from Kuti Lake in Croatia and Hutovo blato and Ravno locations in Bosnia and Herzegovina. For the comparison with the nominal species, specimens of *S. erythrophthalmus* were collected from Plitvice Lakes in Croatia. Methods used for collecting specimens were electrofishing and gill nets. On each individual twenty five morphometric characters were measured, standardized and analysed using descriptive and inferential statistics (ANOVA and PCA). Descriptive statistics shows a great amount of overlapping in morphometric relationships between populations of the same species, as well as between the two species. However, ANOVA results show significant differences in morphometric characters between populations of the same species as well as between species. In addition, PCA results show distinct grouping of populations of each species and partial overlapping of some populations of both species, reflecting their possible relationships. Although this research has given indications of relationships and status of populations of *S. dergle* and *S. plotizza*, in order to confirm the results and determine the exact taxonomic status, phylogenetic relationships and genetic diversity of these species, additional phylogenetic research is being conducted.

Keywords: *Scardinius dergle*, *Scardinius plotizza*, morphology, Bosnia And Herzegovina, Croatia



THE FIRST REGIONAL DATABASE OF BIODIVERSITY - REBIDA AND REBIDA SCANNER

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Abstract:

Institute for Genetic Engineering and Biotechnology (INGEB), University of Sarajevo, in cooperation with the NGO «GENOFOND», is developing the regional database on biodiversity – REBIDA, with the support of the Federal Ministry of Education and Science (Project Number 0101-7552-22/15). This internet-based database represents a comprehensive, searchable and open access platform for general public. This database is planned to contain all known biological data on wild and domesticated natural resources of Bosnia and Herzegovina. Besides its scientific value, REBIDA will serve as an educational tool on the diversity and importance of natural resources, with special emphasis on indigenous and endemic flora and fauna from the Balkans. It is the only such database in the country, consisting of three segments: tissue database, DNA database and digital genetic database on plant, animal and human samples. Each specimen in the database will be represented with the tissue sample, isolated DNA and digital data containing the following information: 1) taxonomic information of the sample; 2) GPS sampling points; 3) area of distribution; 4) digital images of the sample; 5) DNA barcoding data; 6) all available genetic information associated with a sample; 7) conservation status of the species; 8) bibliographic data related to molecular genetic analysis of the sample. To compliment REBIDA, a mobile application, called REBIDA SCANNER, is also being developed. It will be free for download from the IOS and Android platforms and will enable nature enthusiasts as well as professionals to contribute to REBIDA through data collection, field sampling and documenting B&H wild life.

Keywords: REBIDA, REBIDA Scanner, biodiversity, database



LAMPETRA SOLJANI, A NEW BROOK LAMPREY FROM THE SOUTHERN ADRIATIC SEA BASIN (PETROMYZONTIFORMES: PETROMYZONTIDAE)

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Abstract:

Lampetra soljani, new species of nonparasitic lamprey, is described from the lower Neretva River in the Adriatic Sea basin. Previously it was identified as *L. zanandreaei*. Based on morphological similarity and mitochondrial genetic data, it is related to *L. lanceolata* and *L. ninae* from the Black Sea basin. *Lampetra soljani* is distinguished from all other species of *Lampetra* by having a marmorate flank pattern in live, fully grown ammocoetes, and in some adults (vs. plain color pattern), by having three velar tentacles, 54–57 trunk myomeres between the last branchial opening and the anus, no posterial teeth and a bicuspid middle endolateral tooth. Also is well distinguished by COI barcode data from its congeners. The new species is widespread in the Neretva River drainage and lampreys from Lake Skadar basin are likely to belong to this species also.

Keywords: freshwater biodiversity, Mediterranean Basin, Dinaric biodiversity hotspot, Neretva River Basin, Bosnia And Herzegovina, Croatia



LIFE HISTORY TRAITS OF THE NERETVA ROACH, *RUTILUS BASAK* HECKEL, 1843 (PISCES, CYPRINIDAE): BIOLOGICAL – ECOLOGICAL CONTRIBUTION FOR THE CONSERVATION OF FRESHWATER FISH BIODIVERSITY

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Abstract:

The present status, distribution, habitat, population structure, threats and conservation needs of the freshwater Neretva roach, *Rutilus basak* Heckel, 1843 are presented. Although inhabiting a restricted area which includes the Adriatic Sea watershed in Croatia and Bosnia and Herzegovina, only some biological and ecological population parameters are available. Lately, this species also faced with significant changes of taxonomy status raising the question of whether name changes have an impact on conservation status. Therefore more information about its biology is essential to develop appropriate conservation status and strategies. In this paper, we address these cases with a review of the relevant scientific literature. Our review speculates about possible outcomes of taxonomic change, primarily an impact on conservation efforts or affecting on reducing protection. Our study revealed that taxonomic change may have no predictable effects on conservation, while better understanding of biological-ecological status is always an important addition to our knowledge about the organisms that we want to protect. The combination of biological-ecological information and taxonomic status can be a useful tool for indicating failures in conservation management, but also for suggesting more effective actions. Finally, this study shows how this species can be good indicators for monitoring the success of biodiversity management in distributional areas.

Keywords: Adriatic Sea watershed, *Rutilus* Spp., present status, distribution, threats, conservation



THE SPAWNING, AGE STRUCTURE AND CONDITION OF BALTIC SPRING SPAWNING HERRING (*CLUPEA HARENGUS* L.) IS SIGNIFICANTLY MODIFIED BY WINTER CONDITIONS PRIOR SPAWNING

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Abstract:

Baltic herring (*Clupea harengus* L.) is a total spawner with a group-synchronous ovarian organization. Age polymodality in total spawners is considered as an important factor assuring strong population that is sustainable under intensive harvesting regime and different climatic conditions. Therefore, we studied number of characteristics related to seasonal spawning regularities and analyzed mechanisms that affects Baltic spring herring spawning seasonality in the Gulf of Riga (Baltic Sea) in 1999-2015. The beginning of the Gulf of Riga spring herring spawning season varied in a large amplitude and was significantly affected by the previous winter air temperature. Significantly older individuals dominated in the spawning shoals in the beginning of the spawning season and age of spawners decreased throughout the spawning season. Such change in herring age diversity was closely significantly affected by previous winter air temperature. In the coldest winters there was a strong significant correlation between the spawners mean age and calendar week of spawning, while after the mild winters spawning age did not correlated with the previous winter air temperature. Further, we investigated whether significant differences between young and old herring condition factor are driven by winter air temperature prior spawning. We found that young herring after cold winters experienced significantly lower condition compared to other studied groups, except old herring after cold winters. Results of the present study indicate the importance of variable winter conditions in Baltic Sea region for spring herring spawning regularities. Therefore, knowledge regarding age polymodality and spawning regularities of local herring population should be considered in implementation of fish regulations that assure stable and sustainable herring fishery in the region.

Keywords: Baltic Herring, age polymodality, stock diversity, winter air, spawning regularity



BARCODING THE INVASIVES

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Abstract:

Routine reports of newly discovered Indo-Pacific marine biota in the Eastern Mediterranean are continuously proving that the magnitude of 'Lessepsian migration' is far from being exhausted, with more than a hundred documentations of alien fish species at present. The majority of these reports, however, relies mainly on traditional morphological identifications, providing at best distinguishing keys with vouchered specimen in a registered natural history depository. Nevertheless, our confidence in pure traditional taxonomy is occasionally challenged when documenting taxa with difficult distinguishing characters or in early life stages organisms. Moreover, alien species with high morphological resemblance to the indigenous fauna may be erroneously overlooked in their newly invaded habitat. Adopting DNA-based tools, such as the global 'DNA barcoding campaign' can frequently overcome such limitations by providing accurate identifications where morphology fails. By using DNA barcodes in our recent reports of invasive fish species in the Israeli Mediterranean coast, we were able to reveal an overlooked invasive sardine, to detect a second invasive cornetfish and to confirm the Suez Canal as the pathway for the invasion of a Red Sea grouper. However, the use of barcodes to identify species should be carefully practiced as it does contain several drawbacks, e.g., where the relevant reference sequences in the genetic databases is missing or when geographical comparisons reveal a shallow genetic divergence throughout the taxon's distribution. As such, although genetic information contributes greatly to our knowledge in biological invasion dynamics, traditional taxonomy of the studied taxon remains vital in any molecular taxonomy act. This integration of methodologies ensures minimal taxonomic errors, while maximizing available information that can be extracted from the investigated alien species.

Keywords: Lessepsian migration; DNA barcoding; Red Sea; biological invasion



THE STATE OF THE ART OF THE ADRIATIC SEA FISH BIODIVERSITY

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Abstract:

The marine biodiversity of the Mediterranean Sea is nowadays facing substantial the structural changes in flora and fauna. Such changes were recorded in the Adriatic Sea, as well. During the last few decades, various factors including climate change, anthropogenic activity and lessepsian migration have altered the composition of Adriatic ichthyofauna. Furthermore, extensive investigations carried out in the last decades allowed us to recognize species previously not recorded or reported in this area. These changes are reflected in the number of species quoted in the checklist of Adriatic fishes, from 407 in 1996 (sensu Jardas, 1996) to 440 in 2010 (Agnatha 1, Elasmobranchii 52, Holocephali 1 and Actinopterygii 386) (sensu Lipej and Dulčić, 2010). The present updates (and extensions) for the period 2010-2014, were compiled from: a) survey of the main scientific journals, b) doctoral thesis. Only those species which were reported and appropriately documented in scientific literature were taken into consideration. In the period of 2010-2014, sixteen new fish species have been recorded in the Adriatic Sea and these findings number of recorded fish species in the Adriatic Sea increase the total number of fish species up to date recorded in the Adriatic to arise to 456 (Elasmobranchii 54, Actinopterygii 402). Certain fish species were related to recent processes in the Adriatic Sea, such as bioinvasion and tropicalisation. Of the 14 Lessepsian migrants that were recorded in the Adriatic, *Lagocephalus sceleratus*, *Fistularia commersonii* and *Siganus luridus* proved to be successful invaders for its southern part. Some neglected fish species were recorded for the very first time by performing new approaches and techniques in the area.

Keywords: status, fish, biodiversity, changes, Adriatic Sea



CROATIAN ICHTHYOLOGIST DR. TONKO ŠOLJAN (1907-1980) AND HIS CONTRIBUTIONS TO ICHTHYOLOGY

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Abstract:

The author presents the biography and scientific work of Academician Tonko Šoljan, the Croatian natural scientist. He was an internationally renowned scientist, ichthyologist and expert in fishery matters, especially in the Adriatic. Born on April 18, 1907 in Rudine, Hvar, he tutored many generations of biologists. Prof. Šoljan began his university studies in the Department of Natural Sciences (Biology) at the University of Zagreb (1925–1926), and continued them in Vienna (1927–1929) as well as Graz (1929–1930) where he received his PhD (in zoology). One of his most significant works is the monography „Ribe Jadrana“ (Fishes of the Adriatic), being reprinted no less than five times. Prof. Šoljan initiated and led the scientific Expedition M. V. Hvar and contributed to the marine research and advancement of fisheries on the Adriatic coast. He was also a member of numerous scientific national and international associations, in which he carried out a number of responsibilities. He was the president of organizing committee of the First European congress of ichthyology (ECI) held in Sarajevo in 1973. Unfortunately, his admirable life ended suddenly on February 18, 1980 in a road accident in Sarajevo.

Keywords: ichthyology, Tonko Šoljan, contributions, fishes, Adriatic Sea



REPRODUCTIVE BIOLOGY OF *PAGELLUS ACARNE* (RISSO, 1827) FROM THE EASTERN ADRIATIC SEA

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Abstract:

Reproductive cycle of *Pagellus acarne* from the eastern Adriatic Sea was investigated on the basis of 800 specimens collected in the period from June 2007 until May of 2008. This species inhabits coastal regions of the eastern Adriatic Sea although larger specimens can be found at greater depths far from the coast. It is a protoandric hermaphroditic species and sex reversing specimens were found in relatively broad length interval from 16,6 cm to 25,5 cm. Sexual maturity (L50) is attained at length of 16,6 cm for males. Due to hermaphroditism, estimated L50 for females was based on intersection point of male to female ratio with value of 19 cm. Peak of yearly variation of gonadosomatic index was observed in September with peak of presence of spawning individuals in October. Histological analysis of gonads revealed presence of ovotestes with functional male and inactive female gonads, functional females with regression of testes and female gonads without testicular tissue. Additionally, hermaphroditic specimens with resting female and male parts were also detected. Fecundity analysis was based on 21 prespawning female gonads (19-26 cm) and number of eggs varied between 16 472 – 67 439.

Keywords: sequential hermaphroditism, fecundity, maturity, histology



MICROSATELLITES AS A GOOD APPROACH FOR DETECTING TRIPLOIDY IN AQUACULTURE BROWN TROUT

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Abstract:

Mediterranean brown trout (*Salmo trutta*) populations have been extensively supplemented with genetically divergent North-eastern Atlantic stocks to enhance recreational fishing, and the displacements of native gene pools are well documented. Because of the great difficulty to breed native Mediterranean brown trout in the farm, the introduction of Atlantic sterile individuals such as triploid has been proposed as an alternative to the traditional hatchery stocks. A protocol of optimization and production of triploid individuals in *S. trutta* have been described, nonetheless triploidy is not always induced. Then, a cost-effective and rapid method is necessary for triploid verification. Various methods have been used to confirm triploidy, many of them costly in time and effort, and some providing approximate results. Here, we validated highly polymorphic DNA markers –microsatellites– as a rapid, useful and easy method to detect triploids. A total of 16 putative triploids, induced by a shock-heat treatment that suppressed the formation of either the first or the second polar body, were genotyped by eight microsatellites. All but two individuals showed a pattern of three peaks that corresponded to three alleles at least at one locus, and thus were confirmed as triploids. Triploidy of the two remaining individuals could not be verified although they could be false negatives because of the limited diversity of the used loci. The success of triploidy identification relies in the amount of heterozygosity per locus, as a heterozygote egg and a spermatozoon carrying a different allele are necessary to get a three alleles pattern. We proved the utility of microsatellites to validate triploids but looking for more high polymorphic loci is necessary to optimize this technique and minimize false negatives. Because a large number of microsatellites have been described in brown trout the improvement of our method to detect triploidy is a promising task.

Keywords: Brown Trout, hatchery stock, microsatellites, triploid



EPIPHYTIC DIATOMS AS BIOINDICATORS OF TROPHIC STATUS OF LAKE MODRAC (BOSNIA AND HERZEGOVINA)

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Abstract:

Diatoms are important bioindicators recognized as biological quality elements in the Water Framework Directive (WFD). The environmental legislation in Bosnia and Herzegovina still does not provide detail instructions on using diatoms in biological assessment expressed in a frame of Ecological Quality Ratios (EQRs). Results presented here are part of the ongoing study about the possibility of using epiphyton samples in the water quality assessment of Lake Modrac. This paper also gives first insight in the total biodiversity of epiphytic diatoms on stems reeds of Lake Modrac. Diatoms were taken throughout spring and summer of 2017 from *Phragmites australis* stems, during which physical and chemical parameters of water were measured. The diversity of diatoms was high and reached up to 29 species per sample in the springtime. The most frequent genera were *Gomphonema*, *Navicula* and *Cymbella*. In the absence of national procedures, Trophic Diatom Index (TDIL) developed for epiphytic diatoms in Hungary, and Croatian Trophic Index (TIDHR) were used in the data evaluation. In the results for the springtime, epiphytic diatoms indicated a good status of littoral region of Lake Modrac, which was compatible with the data obtained from nutrient status. The ongoing study will provide data for the seasonal dynamics in diatom epiphytic assemblages of Lake Modrac and more detailed information about trophic status in the summer period

Keywords: epiphyton, diatoms, water quality, Lake Modrac, trophic indices, biodiversity



NURSERY ROLE OF TRANSITIONAL WATERS FOR JUVENILE FISH SPECIES ALONG THE EASTERN ADRIATIC COAST

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Abstract:

The importance of transitional water ecosystems as nursery habitats and feeding grounds for juvenile fish species is well-known. However, detailed studies of colonization patterns of juvenile fish in specific ecosystem types are still missing. One hundred taxa ranging across more than 30 families (both marine and freshwater) were collected. Each taxon is characterized by trophic category, spawning area, ecological requests and determined as potential indicator/ new/ or alien species. The modified Estuarine Fish Index (M-EFI), which each aim to assess a different functional aspect of the estuarine fish assemblages and the integrated quality of the ecosystem (general degradation) was used. Also, assessment of anthropogenic pressure on coastal zone by calculating the LUSI index using the publicly available data was done. Pooling all species together, the structural features of the assemblages, relative abundance of families, and abundance of individual species all showed significant temporal patterns. Temporal segregation of species belonging to the same family or genus was obtained, suggesting that they avoid competition for space and resources by timing inward migration and peak occurrence differently. Of the environmental driving forces, salinity was the main factor affecting the distribution of individuals and species. The catch of a number of juvenile marine species confirmed the role of transitional waters as a nursery and feeding areas. With higher eutrophication, the transitional waters are more productive allowing more food both for resident and juvenile marine fishes. Also, productive waters offer more complex habitat providing micro niches and shelters for juveniles. The land impact, as sum of urban, agricultural and industrial pressures, is still low enough to encourage good ecological status. Low m-EFI values, obtained for low LUSI values is rather reflection of existing hydrographic and meteorological situation and seasonal variations than indicator of profound ecological changes in the transitional waters.

Keywords: nursery habitats, fish, transitional waters, Adriatic Sea



ASSESSMENT OF PREDATOR (DOLPHINS) DAMAGE ALONG THE EASTERN ADRIATIC COAST

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Abstract:

Interactions between dolphins and fishery have been reported for more than a century. However, this topic permanently attracts world attention due its influence on a survival of the wild dolphins and life of fisherman through economic consequences, especially in coastal fisheries. The dolphins conflicts along the eastern Adriatic coast have been usually reported by the fisherman working with gillnets and trammel nets although damages exist also at bottom trawling and purse seine fisheries. The greatest damage recorded at passive gears is expected because fisherman lay them in sea overnight which leaves plenty of times for dolphins to locate nets and prey over the catch. The investigation was done in cooperation with local fisherman. They recorded daily damages, both on gears and catches, in specific log books. The total damage, consisting of direct and indirect ones, is assessed. Direct damage includes those determined on fishing gears and catch, while indirect damage refers on ability of achieving potentially increased catch or a greater number of fishing days at sea in case of reduced activity of dolphins. However, fisherman consciously shortens the number of fishing days in the period when they have few days continually high damage, although the weather conditions allow work at sea. Thus, the indirect damage is estimated to be 15%-20% of the total catch depending on the fishing gear. Direct damage is different within different fishing gears so in gillnets and trammel nets estimated damage was 15% to 55% of reported catch and varies depending on the number of fishing days while in bottom trawling and purse seine fishing, we estimated lower direct damage on catch and gears because the dolphins chase away fish and do not damage the fishing gear. By that the direct damage is estimated to be 3% of reported catch.

Keywords: assessment of predator damage, dolphins, fishing gears, direct and indirect damage



CATCHING EFFICIENCY OF ARTISANAL FISHING NETS TARGETING CUTTLEFISH, *SEPIA OFFICINALIS*

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Abstract:

Cuttlefish, *Sepia officinalis*, is one of the commercially highly valued species of Mediterranean artisanal fishery. In this research we analyzed the catches of 4 different types of fishing nets commonly used to exploit this species to determine their relative catching efficiency. Fishing experiments were carried out throughout the cuttlefish season (February-June) of 2015 with trammel nets (TRN) and combined nets (CON), each in a version of small (32 mm) and large (40 mm) mesh size of the inner panel. Clear difference was found in catching efficiency with the effect of mesh size overriding the effect of net construction for both the abundance and biomass of cuttlefish catch. The highest catch rates were obtained with small mesh sized CON, followed by 32 mm TRN, while abundance and biomass of caught cuttlefish in large mesh sized TRN and CON were comparable and on average at least two times lower compared to their small mesh size versions. Differences in the structure of the whole catch were also predominantly determined by variations in cuttlefish abundance and biomass. Cuttlefish contributed with as high as 60% to differences in small vs. large mesh size, while catch differences of net types were up to 30% conditioned by cuttlefish. This research gives the basis upon which technical regulations of fishing gears can be adapted in order to obtain the sustainability of artisanal fisheries yields.

Keywords: cuttlefish, artisanal, fishing, efficiency



ANTIMICROBIAL SUSCEPTIBILITIES OF *AEROMONAS* SPECIES ISOLATED FROM FISH IN CROATIAN RIVERS

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Abstract:

The genus *Aeromonas* consists of Gram-negative rods, ubiquitous in the aquatic environment and is common constituents of the microbial community of fish. However, they are also capable of causing serious infections, as opportunistic pathogens in humans and as a serious economic threat to fish farming worldwide. Occurrence of the antibiotic-resistant bacteria is increasing in the aquatic environments. The problem has become more serious when inappropriate use of antibiotics causes an unnecessary impact on the environment and development of resistant bacteria, thereby reducing the efficacy of antibiotic treatment of diseases. The aim of this study was to investigate antimicrobial susceptibility profiles of *Aeromonas* species isolated from fish in Croatian rivers. A total of 32 fish were collected from the rivers: Dobra, Kupa and Mrežnica for the isolation of *Aeromonas*. Isolates were obtained onto Tryptic soy agar and identified using MALDI TOF spectrometry. Identified *Aeromonas* were represented as *A. caviae*, *A. ichtiosmia*, *A. sobria* and *A. veronii*. Fifteen antibacterial agents were used for in vitro sensitivity testing of 32 selected isolates by disc diffusion method. All *Aeromonas* isolates were susceptible to nitrofurantion, norfloxacin, ofloxacin, floron and flumequine. All isolates were resistant to novobiocin, ampicilin and penicillin. Resistance to antibiotics may be strain dependent, but variations of resistance to some antibiotics has occurred between isolates of the same *Aeromonas* species within the same river, and it may become a problem and a sign of changes of resistance.

Keywords: antibiotic-resistance, fish microbiota, *Aeromonas*, pathogens, fish farming



STUDYING SALMONIDS IN BOSNIA AND HERZEGOVINA: PAST, PRESENT AND FUTURE

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Abstract:

Even from the 17th century, the richness of BH fish fauna has been documented and praised. First comprehensive list of fish species and fishing methods was published in 1915 by Ćurčić, in the Journal of the National Museum of Bosnia and Herzegovina. The serious investigative approach to studying salmonids was evident in the 19th and the 20th century, with focus on biometric characteristics, conditions of their habitats, and ecological interactions between species. The work of the scientists from the Biological Institute of the University of Sarajevo in late 1960's and early 1970's brought more extensive morphological and ecological investigations of BH salmonids. Cytogenetic studies from the second half of the 20th century provided the first genetic data on salmonids in B&H, their chromosomic structures, polyploid affinity, and the possibility of hybridization in natural and artificial conditions. The application of molecular genetic markers such as mitochondrial DNA and STRs in the analysis of populations from different river basins, as well as in comparisons with other European waterways provided a clearer insight into the genetic structure of salmonids in Bosnia at the beginning of this century. Field observations of the state of salmonids in B&H rivers and the results of molecular-genetic analysis point to the necessity of guiding future activities towards revitalization and genetic conservation using highly selective breeding of indigenous resources.

Keywords: salmonids, mtDNA, STR, revitalization, conservation



CONTEMPORARY POPULATION GENETIC ANALYSES IN THE ASSESSMENT OF FRESHWATER ENDEMIC SPECIES DIVERSITY

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Abstract:

Population genetics methods played pivotal role in the clarification of taxonomic ambiguities as well as in the assessment of the diversity of ichthyological resources. As recent, more advanced technologies, provide highly complex data, the standard population genetics methods based on DNA fragments' variation continuously undergo upgrades in order to incorporate specific DNA sequences, an abundance of SNPs and finally partial or complete genomes. Such an upscale requires novel methodological approaches to the assessment of autochthonous populations and endemic species in both freshwater and marine ecosystems. Accordingly, population genetics has evolved into population genomics, thus eliminating clear line between population genetics and bioinformatics. Therefore, in the domains of diversity assessment, conservation as well as the clarification of taxonomic ambiguities, the training in population genetics/genomics methodology is more significant than ever.

Keywords: population genetics methods, SNPs, diversity assessment, endemic species



EFFECTS OF HYPERTERMY ON ERITROCYTIC PARAMETERS OF CARP, *CYPRINUS CARPIO* (LINNAEUS, 1758), FROM BARDACA SWAMP

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Abstract:

Individual carp (*Cyprinus carpio* L.) from swamp Bardača near Srbac were subjected to the thermal stress. The experiment was conducted on two groups: control and experimental ones. Both fish groups were adapted in a special aquarium, while the experimental group of specimens was subjected to thermal stress for 30 minutes at the temperature of 28°C. After this the direct puncture of the heart for both groups of individuals was done, and the hematological parameters from collected blood were determined, furthermore also determined morphometric characteristics of the individuals. Statistical analysis showed that there is an increase of hematological parameters, with noted significant differences for concentrations of hemoglobin and red blood cell by females and males.

Keywords: thermal stress, hematology, morphometric parameters, carp



ADDITIONAL RECORD OF THE BLUNTHEAD *SPHOEROIDES PACHIGASTER* (TETRAODONTIFORMES: TETRAODONTIDAE) IN MONTENEGRIAN WATERS: SOUTH ADRIATIC SEA

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Abstract:

The bluntheaded puffer *Sphoeroides pachigaster*, (Müller & Troschel, 1848) is a tropical benthic species that lives on sandy and rocky bottoms, at 50-550 m depths. Its geographical distribution is the tropical and subtropical Atlantic, in Hawaii, Japan, Australia as well as the Western Mediterranean. First record in Adriatic Sea was in the North Adriatic Sea in front of Velestovo Island in 1992. First record in Montenegro waters was in front of Budva, at depth of 80 m, on 5 January 2008. Additional record in the Montenegrin waters (TL = 430 mm, W = 1611.20 g, female), was recorded on 21 January 2017, also in front of Budva, with trammel net, at a depth of 85 meters, coordinates N 42° 08' 43.2" and E 18° 50' 00.9".

In this case this new record for this part of the Adriatic Sea could indicate the influence of global climate changes and tendency of entrance of new, particularly tropic, species in this part of the Mediterranean Sea, from the Atlantic Ocean through the Strait of Gibraltar.

Keywords: *Sphoeroides pachigaster*, alien species, Montenegro coast, South Adriatic



ASSESSMENT OF LONG-TERM TRENDS IN THE STRUCTURE AND THE DYNAMICS OF THE ICHTHYOPOPULATIONS IN THE BUŠKO BLATO RESERVOIR

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Abstract:

Buško blato reservoir, the third largest reservoir in Europe, is situated in the southeastern part of the karstic field Livanjsko polje. This aquatic ecosystem is distinguished by a very rich ichthyofauna and the presence of four endemic species: Dalmatian barbelgudgeon - *Aulopyge huegelii* Heckel, 1843, Minnow-nase - *Chondrostoma phoxinus* Heckel, 1843, Dalmatian Ruud - *Scardinius dergle* Heckel & Kner, 1858, and Livno Masnica - *Squalius tenellus* Heckel, 1843. Ichthyological investigations of Buško blato reservoir have been in the focus of numerous researchers, since its ichthyofauna has been exposed to changes of ecological factors which in turn reflected on the structure and composition of fish populations. Main objective of this paper is to assess the current state and predict future trends in the ichthyofauna structure and dynamics on the basis of the original field data and comprehensive analyses of the data from literature sources. The results of our investigations have shown the presence of 11 fish species from four families, which is the largest number of fish species ever recorded in this ecosystem. Pike-perch, Pumpinseed, False Harlequin, and Tench have been for the first time recorded in this ecosystem, while some previously recorded species are not found. The results of the analyses clearly indicate presence of natural interspecific competition and significant level of threat of endemic ichthyopopulations caused by human activities. Since autochthon species in Buško Blato reservoir ecosystem are under treat it is necessary to take urgent action for their protection.

Keywords: Buško blato reservoir, endemic ichthyofauna, interspecific competition



EFFECTS OF FISH FARMS ON THE ECOLOGICAL STATE OF HYDROACCUMULATION SALAKOVAC

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Abstract:

Hydroaccumulation Salakovac was formed in 1987. At the same water body has been installed six (to eight) cage fishponds which have the largest production in the Federation of Bosnia and Herzegovina. One-year monitoring determined the pressure on the ecological state of the HA Salakovac through parameters BPK5, TP, ammonia, copper and zinc, and periodically through suspended solids and dissolved oxygen. A one-off analysis of the silt-sediment quality has pointed to high concentrations of nutrients, nitrogen and phosphorus. Besides the parameters determines as reliable in monitoring ecological status/potential of water ecosystem, and according to the regulations of ODV, particular emphasis is put on the effect on changes of the composition of aquatic fauna. Hydroaccumulation Salakovac is, by introduction and breeding of various allochthonous fish populations, recently a habitat of an invasive species of shells, *Dreissena polymorpha*, which grow expansively which somewhat indicates to slight increase in water temperature, which, in turn, favors the development of this species. Multiple determined effects to the state of this water body (formed for the production of electricity) do not limit the development of aquaculture, but rather point to the need for control of it.

Keywords: fish farm, invasive species, degradation



TROPHIC INTERACTIONS OF *LEPOMIS GIBBOSUS* (LINNAEUS, 1758) IN HYDROELECTRIC POWER PLANT RESERVOIR OF NERETVA RIVER IN BOSNIAN AND HERZEGOVINA (ACTINOPTERYGII: PERCIFORMES)

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Abstract:

In this paper we investigated local ecological adaptation of *Lepomis gibbosus* in Jablanica power plant reservoir. We investigated feeding behavior and population structure of *Lepomis gibbosus* in artificial lake. The effect of introduction on prey and other fishes in Neretva hydroelectric power plant reservoir was discussed by analyzing trophic position of *Lepomis gibbosus* and other autochthon fishes. We analyzed content of digestive tract of *Lepomis gibbosus* and find that population is omnivorous adapted to feeding on benthic organisms, dominantly snails from genus *Valvata*. In comparison to other food items in digestive tract of *Lepomis gibbosus* snails *Valvata piscinalis* and *V. cristata* were most dominant (95.43%). Beside gastropods in digestive tract of *Lepomis gibbosus* insects, crustaceans and annelids were recorded. Relative condition index (Kn) was used to calculate typical average weights for fishes of specific length in order to estimate degree of nutrition. Relative condition index indicated malnutrition in smallest body length category (Kn = 0.98) while all other body length categories were with (Kn > 1.00). Our investigations show that population of *Lepomis gibbosus* from Jablanica reservoir is molluscivorous, adapted on feeding in littoral and pelagic zone where *Valvata* species are present on algae. The negative effects of *Lepomis gibbosus* feeding behavior on autochthon fishes of Jablanica reservoir should be analyzed in case of the fish species that are laying eggs in pelagic zone on plant and algae where this fish dominantly feed.

Keywords: *Lepomis*, pumpkinseed, feeding, local adaptations, Neretva



GEOGRAPHIC VARIATION OF *ALBURNUS ALBURNUS* (LINNAEUS, 1758) FROM BOSNIA AND HERZEGOVINA

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Abstract:

In this paper geographical variation of *Alburnus alburnus* (Linnaeus, 1758) from Bosnia and Herzegovina was analyzed. Analysis based on 21 standard measurements and six meristic characters indicated that highest variation had distance between pelvic (ventral) fins and anal aperture; lowest variation was recorded for eye diameter. ANOVA analysis indicated statistically significant differences that were detected between six samples. Differences between meristic characters were tested by Multiple Comparisons Kruskal-Wallis test and indicated statistically significant difference between samples for number of branched rays for caudal fin, lateral line scales and number of gill rakers. Discriminant function analysis indicated characters that had strongest contribution to the geographical variation between *Alburnus alburnus* samples from Bosnia and Herzegovina. Characters that had strongest discriminant power were: preanal distance, length of pectoral fin, length of ventral (pelvic) fin, minimum body height, caudal fins branched rays, pelvic fins branched rays. In our investigation we analyzed intraspecific variability of *Alburnus alburnus* from Bosnia and Herzegovina and determined significance of branched rays in anal fin for interspecific discrimination of *Alburnus alburnus*.

Keywords: *Alburnus*



COMPARATIVE STUDY OF GROWTH AND TESTICLE DEVELOPMENT OF RAINBOW TROUT (*ONCORHYNCHUS MYKISS*) FED WITH FOOD FROM MANUFACTURERS COPPENS AND SKRETTING

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Abstract:

Aquaculture in Bosnia and Herzegovina is in constant development, representing the fastest growing sector of animal agriculture. Production results are in high degree of dependence on microclimate breeding environment as well as the quality of food. This study was carried out to compare growth and development of testicles in rainbow trout (*Oncorhynchus mykiss*) grown in Royal fish and Magazin Maprim fish farms, where pelleted fish food from different manufacturers was used. Two groups of 30 individuals of the same age were examined. Males from Royal fish farm were fed with Skretting food, while in Magazin maprim fish farm, Coppens food was used. Fish were fed twice a day at 5% of their body weight. Physicochemical parameters of water were within acceptable values for this species. Values of total length and total body weight of males from Royal fish farm fed with Skretting, showed statistically significant differences when compared to males from Magazin Maprim fish farm, fed with Coppens food. Gonadosomatic index (2.39 ± 0.58) of males from Royal fish farm did not differ statistically from gonadosomatic index (3.47 ± 1.06) values for males from Magazin Maprim fish farm. Average testicular weight (13.56 ± 4.18 g) for males fed with Skretting did not show significant difference as compared to testicular weight of males fed with Coppens (8.38 ± 3.96 g). Histological analysis of the testicles of rainbow trout, fed with food from different manufacturers, showed normal development and spermatogenesis intensity in both examined groups. Our results indicate that there are differences in rainbow trout growth (*Oncorhynchus mykiss*) between analyzed groups, in favor of Skretting food. This should be taken into account when selecting food for the purpose of more productive breeding.

Keywords: *Oncorhynchus mykiss*, growth, gonadosomatic index, testicular weight, pelleted fish food Coppens and Skretting



GENETIC STRUCTURE AND HEMATOLOGICAL STATUS OF THE POPULATION OF *SANDER LUCIOPERCA* (LINNAEUS, 1758) FROM THE RIVER NERETVA BASIN

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Abstract:

Sander lucioperca (Linnaeus, 1758), which was introduced into the Adriatic Sea basin at the end of 19th century, has extremely negative impacts on biodiversity of autochthon ichthyofauna in this basin. This predator species does not have any natural enemies, and it is extraordinary successful in competition with other species from this basin. Knowledge of the mechanism of adaptability of allochtone populations represents great challenge in assessment of possibilities for spreading of invasive species, and definitions of protection measures for autochthon species. Therefore, the main objective of this paper, as a contribution to the understanding of these mechanisms, is to explore genetic structure and hematological status of the populations of pike perch, and to give conclusions on dynamics and stability of populations of pike perch introduced into the river Neretva basin. The investigations have included 97 specimens of *Sander lucioperca* (Linnaeus, 1758) from the river Neretva basin. Nine microsatellite loci have been analyzed within population-genetic investigations. Mean values of observed (0,249) and expected (0,398) heterozygosity have been recorded, with average number of effective alleles was 2,338. Also, a relative high coefficient within group inbreeding (0,545) has been observed, while bottleneck effect has not been recorded in populations of pike perch from this basin. The analyses of hematological parameters have included: concentration of hemoglobin, number of erythrocytes, value of hematocrit, Mean Cell Volume (MCV), mean cell hemoglobin (MCH), Mean Corpuscular Hemoglobin Concentration (MCHC) and number of leucocytes. The results of statistical analyses have shown statistically significant difference of the results for number of leucocytes by investigated sites in the river Neretva basin, number of erythrocytes, value of hematocrit, mean cell hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC)

Keywords: pike perch, introduction, genetic markers, heterozygosity, inbreeding, hematological status



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