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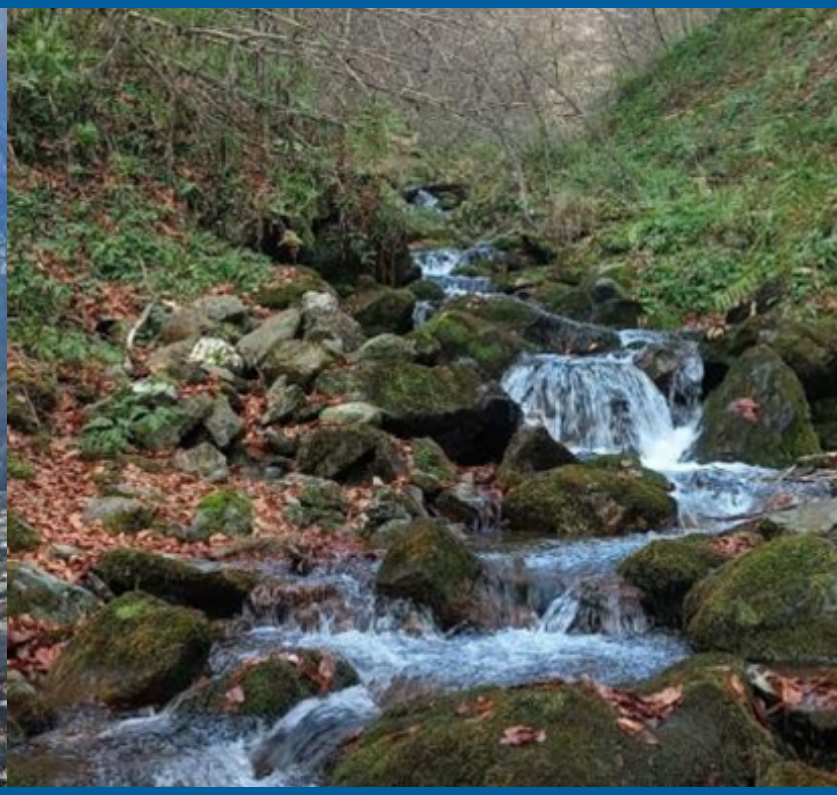
RAPID FIELD ASSESSMENT REPORT



PRISHTINA, 2024

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Freshwater biodiversity impacted by hydropower plants in the Sharr Mountains National Park - Rapid Field Assessment Report

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This study was carried out in the frame of the "Save the Blue Heart of Europe" campaign, an initiative run by Riverwatch and EuroNatur.

Prishtina, January 2024

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EXECUTIVE SUMMARY

The following conclusions are attained from this rapid assessment field study and from screening of the Environmental Impact Assessment (EIA) documentation for Hydropower Plants (HPPs) in the Sharr Mountains National Park:

- The two Environmental Impact Assessment Reports (2013 and 2014) for hydropower plants in the Shtërpce Municipality do not fulfill fundamental requirements as requested by the Kosovo law and scientific requirements.
- The absence of freshwater biodiversity data in the EIA reports for hydropower plants in the Sharr National Park has caused all activities damaging freshwater species go unmonitored.
- Four intake sites for hydropower plants, located in the Sharr National Park have already critically altered aquatic habitats.
- Hydropower plant activities have critically endangered fish and macroinvertebrate populations of species protected by law. A significant population decline or a total extinction at stream segments below the intakes was observed for important species such as fish *Salmo farioides* and aquatic insects such as *Drusus sharrensis* and *Potamophylax humoinsapeins*. One fish species and 8 aquatic insect species are directly endangered by dam activities, while 4 other fish species inhabiting upstream and midstream sections of the Lepenc River are indirectly threatened through changes in upstream habitats.
- All intake sites and associated dams are located inside National Park and their current impact on environment is against the goals of protected areas. It is of special concern that the intake 4 and associated dam is located in the Zone 2 of protection in the Sharr National Park. According to the Management Plan for Sharr National Park, Zone 2 is defined as an area with exceptional ecosystem, biodiversity and landscape values where is forbidden any activity that modifies landscape, except of the basic road infrastructure for the needs of visitors of the Park. The other 3 dams are located within a Zone 3 of protection but the water diversion effects the nearby Zone 2 as well. According to the current definition by the Management Plan, zone 3 represents zone of sustainable use. Most probably in the next review cycle of Sharr Mountains National Park this area will be designated as Zone 2 due to the biodiversity values registered in meantime.
- Water quality undergoes a discernible decline below the intakes, reflecting the direct impact of intake sites on water quality. This is against the principles of the Water Framework Directive.
- Fish routes exist at dam 3 and 4 but are completely dysfunctional as they are constructed outside the water flowing area. There are no fish routes at dams 1 and 2.
- Communication interruptions between tributaries and the main Lepenc River, caused by HPP intake sites, likely affects the distribution and abundance of native fish species and especially of *Barbus* cf. *macedonicus, Oxynoemacheilus bureschi*, and *Squalius platyceps* which inhabit middle section of the Lepenc River.
- The study underscores an immediate need for halting all activities related to hydropower plants in the National Park area and immediate targeted conservation measures to restore the deteriorated nature.

The following recommendations are essential based on the current legal framework in Kosovo for protected species, including the Red Book of Fauna of Kosovo, Administrative Instruction no. 12/2020, the Law on Nature, and others:

- Since the current EIA's do not fulfill the legal and scientific criteria, it is necessary to retract all permits for hydropower plants inside Sharr National Park in Shtërpce Municipality and to immediately stop all activities of HPP's in this area.

- Urgent assessment of the environmental damage caused by hydropower plants in the Sharr National Park during the past years with included targeted conservation measures for species identified in the study, particularly those with legal protection status as per the Administrative Instruction 12/2020, and current legislation in force in Kosovo.
- Immediate restoration measures for species of particular interest such as *Drusus sharrensis, Potamophylax humoinsapeins, Salmo farioides,* etc., which are in danger of extinction around the intake sites.
- Immediate moratorium on all activities inside National Park which are against the principles of protection and conservation, since this study showed that there may be still unrecorded biodiversity values and areas.

These recommendations aim to address the identified challenges and provide a foundation for sustainable practices, balancing the energy needs with the conservation of Sharr Mountain National Park's unique aquatic biodiversity.

INTRODUCTION

In Kosovo, most of the existing hydropower plants (HPP) are predominantly small-scale, run-of-river facilities, with HPP Ujman being the primary exception featuring accumulating lakes and reservoirs. These plants utilize water from streams and long pipelines in areas, mainly mountainous, characterized by unlevelled terrain and a higher potential for downfall. Notably, many of these facilities are situated in national parks, such as Sharri and Bjeshkët e Nemuna.

A significant concern is that high number of existing and planned small hydropower plants are located within zones of particular natural importance[1], such as national parks and strict nature reserves. This poses a risk of permanent damage to these areas and potential degradation of the country's natural landscapes and water resources. To address this, in May 2018, the Ministry of Environment and Spatial Planning initiated a moratorium on hydropower plant construction until a new assessment of ground and surface water is completed. This step aims to evaluate the overall state of the sector and protect the environment. The moratorium also includes a full review of permits for new hydropower plants. This decision was prompted by the need to replace the outdated 1984 groundwater assessment that had been used to authorize hydropower plant construction to date. However, up to date no important step towards this assessment was carried out and the existing hydropower plants continue to operate.

The contribution of energy produced by hydropower plants in the overall energy production in Kosovo during 2023 was 1.52%, a slight decrease from 2022 when it was 1.79%[2]. Despite hydropower's limited contribution to Kosovo's energy sector, the construction of hydropower plants within protected areas raises significant environmental challenges.

Sharr Mountains National Park

It is of special concern the impact of hydropower plants on rich biodiversity, as well as the technical aspects of transparency and environmental standards associated with these projects. For example, in several cases it was observed that **ecological minimum of river flow was not respected**[3]. Moreover, in recent years, there has been a substantial increase in data related to freshwater biodiversity, unveiling numerous newly discovered species across various regions in Kosovo. Simultaneously, this expanded dataset has shed light on the endangered status of these species, primarily due to anthropogenic pressures, including the impact of hydropower plants.

Over the recent years, the implementation of hydropower projects in Kosovo, particularly within the Sharr region, has given rise to notable protests by citizens and civil society. These expressions of concern underscore a growing awareness and engagement in environmental issues within the local communities. Their concern lies in the potential consequences of hydropower projects on

[1] Balkan Green Foundation & INDEP, 2019, "Hydropower Plants in Kosovo – The problems and their real potential", 28 pp.
[2] Agjencioni i Statistikave të Kosovës, 2023, Statistikat e Energjisë, 9 pp.
[3] https://prishtinainsight.com/the-fight-for-kosovos-vanishing-rivers-mag/

the surrounding environment, ranging from ecological disturbances to broader environmental implications.

In addition to this, scientists from Kosovo have raised from time-to-time concerns about the effectiveness and comprehensiveness of the environmental impact assessment reports, which serve as a precondition for obtaining permits for hydropower plants. These assessments are expected to provide a detailed evaluation of the potential environmental consequences, offering insights into the project's impacts on ecosystems, water quality, and biodiversity as well as social impacts. Civil society, communities around the hydropower plants and scientists argue that a more stringent and transparent evaluation process is essential to ensure that the environmental impact assessments adequately capture and address the potential risks associated with hydropower development. Their concerns reflect a desire for a more robust regulatory framework that not only evaluates the environmental impact comprehensively but also includes meaningful public participation in the decision-making process. All these activities, particularly in the Sharr region, highlight the importance of scrutinizing the environmental impact assessment procedures for hydropower projects and filling the gaps in these documents related to exceptional biodiversity values and associated impact of hydropower plants. Addressing these concerns not only aligns with the growing environmental consciousness within the society but also contributes to the broader goal of balancing energy development with the preservation of the local environment.

Water intake sites inside the Sharr National Park

GOAL AND SCOPE OF THE REPORT

The initial goal of this study was to address a notable deficiency identified in the Environmental Impact Assessment (EIA) reports for the constructed dams and intake sites, which are integral components of hydropower schemes in the mountainous rivers of the Sharr Mountain National Park. This deficiency specifically relates to the absence of detailed freshwater biodiversity data in the existing reports.

Related to this, the main goal of this study is to examine the impact of HPP intake sites and associated facilities on the populations of fish, macroinvertebrates, and especially aquatic insects within the park's aquatic ecosystems. By concentrating on these essential elements of freshwater biodiversity, the study aims to rectify the data gap observed in the EIA Reports. Through this technical investigation, the aim was to address the deficiency in the existing documentation and provide precise information for informed decision-making and sustainable environmental management. Through this we aim at addressing key aspects which are important for protection of otherwise rich biodiversity and ecosystem values of the Sharr National Park.

Sharr Mountains National Park

METHODOLOGY OF THE STUDY

This report is based on a six days of field investigations conducted during the autumn of 2023, supplemented by data from a two days field trip in the spring of the same year. Consequently, it is acknowledged that the report may be incomplete, as further field efforts are likely to reveal additional target species impacted by Hydropower Plant (HPP) activities.

The rapid field assessments conducted encompassed an extensive evaluation of fish and macroinvertebrates, with a specific focus on aquatic insects, in the Lepenc River and its tributaries.

1. Assessment of macroinvertebrates:

·Comprehensive surveys were executed upstream and downstream of the intake sites and dams to analyze macroinvertebrate assemblages.

·Macroinvertebrate nets, entomological nets, and UV light traps were utilized for sample collection, allowing for a thorough examination of macroinvertebrate composition.

·Taxonomic identification of macroinvertebrates to the family level was conducted to discern changes in composition and structure in response to intake site activities.

·Special emphasis was placed on the distribution of Trichoptera species, including endemic and legally protected species, in different segments of the Lepenc River and its tributaries. The goal was to assess whether their presence and distribution were influenced by the disturbances caused by intake sites.

2. Assessment of fish populations:

·Fish populations were assessed both upstream and downstream of the intake sites and dams.

·Techniques such as electrofishing and visual observations were employed to capture a comprehensive picture of the fish communities.

·Data on fish species diversity, abundance, and size distribution were collected to gauge the potential impact of hydropower plants on fish populations and their habitat.

This comprehensive methodology facilitated a thorough examination of the ecological status of the Lepenc River system, providing a holistic understanding of how hydropower plant construction might impact the aquatic insect, macroinvertebrate, and fish communities in this vital ecosystem.

Coordinates of the starting points for the eight study sites inside Sharr National Park as well as three sites in the main course of the Lepenc River

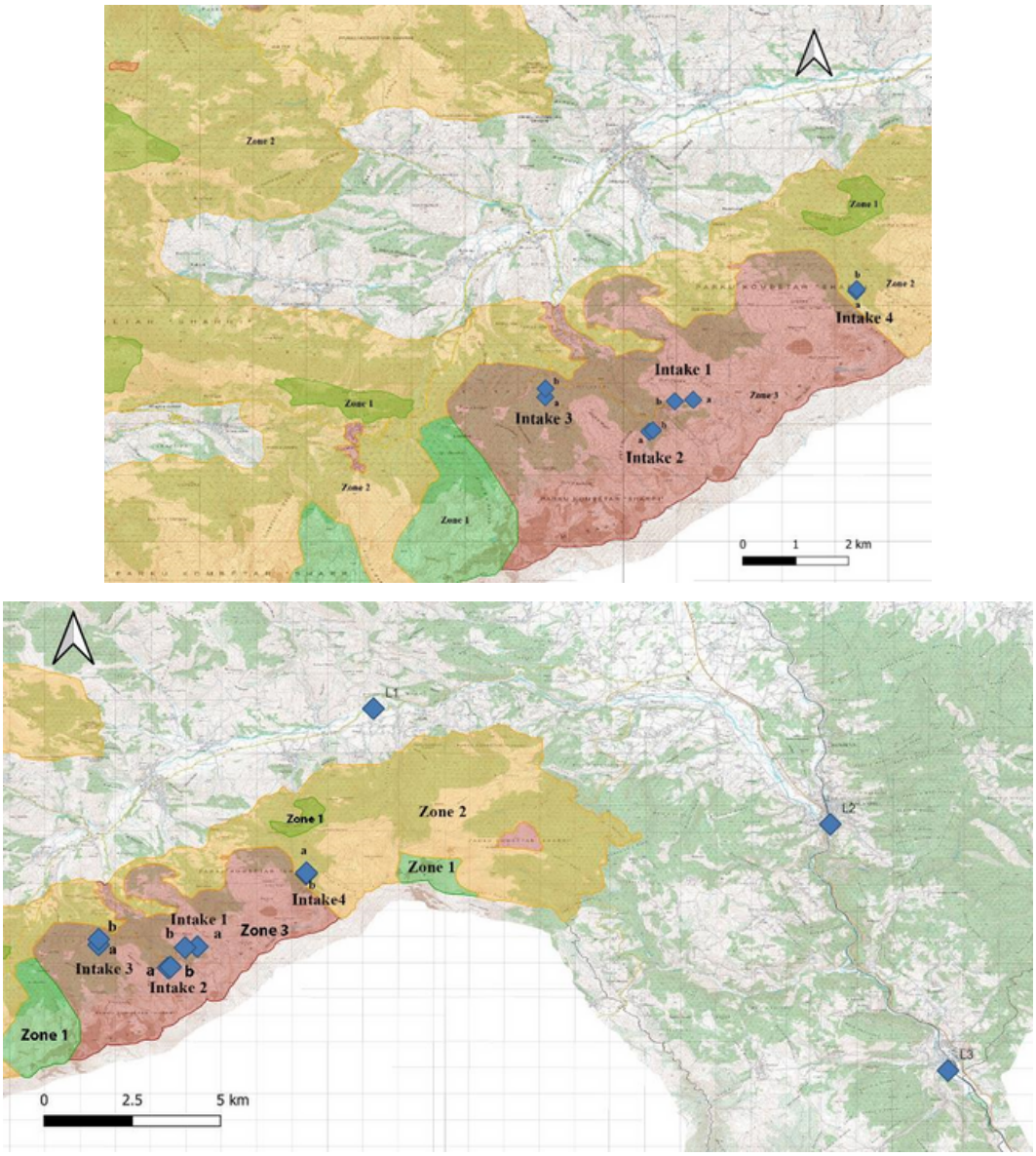
Monitoring Station	Latitude° N	Longitude° E	Altitude m
Above the Intake 1	42.18395	21.04011	1808
Below the intake 1	42.1836	21.035911	1730
Above the Intake 2	42.176661	21.0300744	1764
Below the intake 2	42.176967	21.030901	1747
Above the intake 3	42.18455	21.00629	1466
Below the intake 3	42.1865	21.00633	1428
Above the intake 4	42.20881	21.07737	1470
Below the intake 4	42.209272	21.07751	1461
Lepenc L1	42.265611	21.100469	708
Lepenc L2	42.225944	21.256974	477
Lepenc L3	42.141447	21.297305	354

The rapid field assessment took place from October 26, 2023, to November 15, 2023. This carefully chosen timeframe ensured data collection during a critical autumn period, capturing various ecological factors influencing aquatic life. Some data collected during July 2023 are also included.

The assessment focused on intake sites for the Shtërpce, Sharri, and Brezovica hydropower plants, strategically selected due to their significant impact in the ecosystem. Sampling sites were designated upstream and downstream of the intake facilities to capture a broad range of ecological conditions.

Upstream sites represented the initial interaction of water with hydropower infrastructure, providing a baseline understanding of ecological conditions before potential alterations caused by hydropower plants. Downstream sites, situated below intake locations and associated dams, allowed for an examination of the immediate aftermath of intake sites, considering potential changes in water quality, flow dynamics, and sediment transport affecting aquatic communities.

The chosen methodology was applied to four intake sites used for three hydropower plants, all located within the Sharr National Park area. Additionally, the assessment included the main course of the Lepenc River for the sake of comparison of especially fish data from this area with our study sites. The 8 study sites (Table 1, Figure 1) actually constitute a larger areas around these coordinates.



Location of 4 studied intake sites for HPPs and starting points of investigation above (a) and below (b) the intake sites as well as three additional investigated sites for fish (L1, L2 and L3) in the Lepenc River.

RESULTS: MAIN FINDINGS RELATED TO THE IMPACT OF HPP'S IN FRESHWATER BIODIVERSITY OF THE SHARR MOUNTAINS

Analysis of the Environmental Impact Assessment reports for Hydropower Plants in the Sharr Mountains

The absence of fundamental freshwater biodiversity data in the Environmental Impact Assessment reports (EIAs) specifically tailored for hydropower plants (HPPs) within the Sharr Mountains is of special concern. This stems from the recognition of the critical role that freshwater biodiversity plays in maintaining ecosystems and ecological balance. The absence of essential data pertaining to freshwater biodiversity in the EIAs raises questions about the thoroughness and comprehensiveness of the assessments conducted for HPPs in Sharr. This than would nullify all the following legal steps related to the HPP's operations. This information gap is considered crucial, as it directly impacts the accuracy of predictions regarding potential ecological disturbances, habitat alterations, and the overall health of aquatic ecosystems associated with hydropower developments.

Without a robust foundation of freshwater biodiversity data, the environmental impact assessments may lack the precision needed to accurately gauge the potential consequences of HPPs on the Sharr region's aquatic ecosystems. This absence not only hinders a thorough understanding of the ecological ramifications but also impedes the development of informed mitigation strategies to address any adverse effects on biodiversity and water quality.

There are two Environmental Impact Assessment reports related to hydropower plants in Sharr Mountains in Shtërpce Municipality, the first one is a preliminary report during the feasibility period of the project and the second one is the final impact assessment report. The first one is drafted during the feasibility period on February 2013 by Engineering Company "MegaWat" from Tirana-Albania for Investor "Matkos Group", titled "Hydroenergetical usage of Lepenc River, Shtërpce Municipality, Republic of Kosovo, Environmental Impact Assessment Report" (in Albanian "Shfrytëzimi hidroenergjetik i lumit Lepenc, Komuna Shterpce, Republika e Kosovës, Raporti mbi vlerësimin e ndikimit në mjedis"). The second report is drafted on July 2014 by "Geo-Mining" Company from Prishtina for investor Matkos Group, titled "Report on the environmental impact assessment for the hydropower construction along the Lepenc River on Municipality of Shtërpce" (in Albanian "Raport i vlerësimit të ndikimit në mjedis për ndërtimin e hidrocentraleve përgjatë lumit Lepenc në Komunë e Shtërpces"). The first report will be referred to as EIA Feasibility Report 2013 while the second one will be referred to as EIA Report 2014.

Since there is a report produced in 2021[1] which evaluates the EIA Report 2014 as well as impacts of Sharr hydropower plants, here we will only shortly mention shortcomings of EIA Feasibility Report 2013 and EIA Report 2014 related to biodiversity and especially freshwater biodiversity.

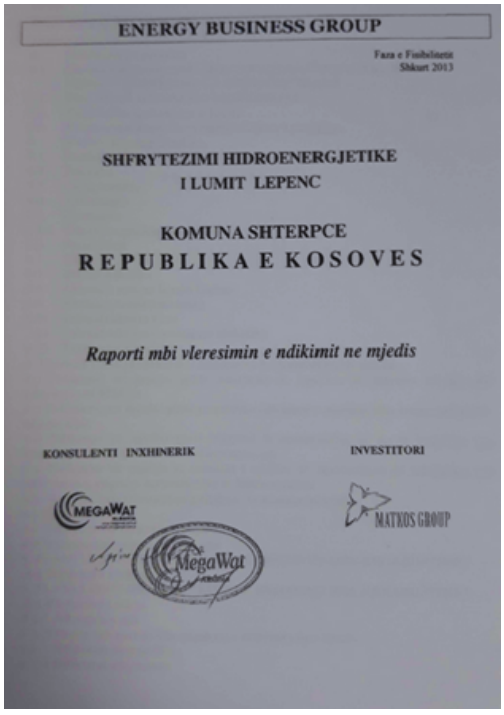
EIA Feasibility Report of 2013

- The EIA Feasibility Report 2013, on pages 66-69, provides an overview of plant and animal diversity. However, it is evident that this information is extracted from previous reports related to the Sharr Mountains in general and does not represent data specific to the areas of the hydropower plants or data generated in field for the purpose or the report.
- The listed plant species claimed to be present in the Sharr Mountains include among other the following: Balkan pine (*Pinus peuce*),

[1] Olsi Nika, 2021 "Assessment of the Environmental Impact of Hydropower in Sharri National Park", Tirana, 41 pp.

Heldreich's pine (*Pinus heldreichii*), Balkan maple (*Acer heldreichii*), Dwarf Mountain pine (*Pinus mugo*), Yarrow (*Ahillea millefolium*), Kinnikinnick (*Arctostaphilos uva-ursi*), Deadly nightshade (*Atropa belladonna*), St John's wort (*Hypericum perforatum*), etc. **It remains unclear why many widespread species irrelevant to the project are included, and why there is no description of the composition of plant species specific to the project area. Much more, this report does not take into the account many endemic and rare plant species of the Sharr Mountains as a such, as well.**

- **Similarly, the report describes faunal diversity for the Sharr Mountains in general and not for the project area.** The listed terrestrial fauna species include among other: European hedgehog (Erinaceus europaeus), European mole (*Talpa europaea*), horned viper (*Vipera ammodytes*), Brown bear (*Ursus arctos)*, Wolf (*Canis lupus*), Red fox (*Canis vulpes*), European wildcat (*Felis silvestris*), European badger (*Meles meles*), etc. Additionally, a list of aquatic species is provided for the Sharr Mountains, including *Salmo trutta m. faro* (West Balkan Trout), *Barbus fluviatilis, Anguilla vulgaris (Eel), Esox lucius* (Northern pike), and *Cyprinus carpio* (Common carp).
- Once again, it is unclear why there is no description of the composition of animal species, both terrestrial and aquatic, specific to the project area.
- In addition to this, some of the fish species given in this report (e.g. *Esox lucius*) are highly dubious as being present in the Lepenc River and its tributaries, which constitute the project area. The current study, conducted for the purpose of this report in the main course of the Lepenc River and its tributaries, revealed a distinct composition of fish fauna: West Balkan Trout (*Salmo farioides*), Macedonian barbel (*Barbus cf. macedonicus*), Schneider (*Alburnoides bipunctatus*), Gudgeon (*Gobio* sp.), Skadar chub (*Squalius platyceps*), Common minnow (*Phoxinus phoxinus*), Common bleak (*Alburnus alburnus*) and Struma stone loach (*Oxynoemacheilus bureschi*).
- The omission of information regarding aquatic insect species and other macroinvertebrates is a significant concern, as these species groups play a crucial role in the functioning of freshwater ecosystems and are highly susceptible to habitat alterations. Additionally, there is a lack of details concerning other essential animal groups in the surrounding areas, such as butterflies, amphibians, etc.
- **Furthermore, a fundamental mistake is made in describing the aquatic habitats of the Sharr Mountains by stating that rivers and streams in the Sharr Mountains belong to the Adriatic basin.** While this statement holds true for the Lumbardhi i Prizrenit River and its tributaries, it is entirely false for the project area itself, specifically the Lepenc River, which belongs to the Aegean basin.
- On pages 70-71, the Feasibility EIA Report outlines the anticipated impact of the project during the construction phase on flora and fauna. Surprisingly, the report asserts that there would be no impact, attributing this conclusion to the fact that a biological minimum of 40% of stream flow will allegedly remain unaffected.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MEGAWAT

MATKOS GROUP

MegaWat

- The document further claims that the absence of aquatic plants eliminates any impact on flora, and likewise, it suggests that no impact is expected on fauna during this phase. Notably, there is a glaring omission as the report fails to address the potential impact that channel constructions may have on nearby vegetation—an aspect crucial for maintaining surrounding biodiversity.
- Moreover, there is a notable absence of discussion regarding alterations in the aquatic habitat, a critical factor for freshwater biodiversity, which raises concerns about the comprehensiveness of the environmental impact assessment.
- On page 88, under the impacts during the operational phase, it is mentioned that hydropower plants will have a negative impact on water flow and habitat due to the deposition of inert material. The document also highlights that modifications to river flow will alter habitats for fish and nearby vegetation. It is surprising, however, that no detailed description of the impact on fish and vegetation is provided. In the event of habitat damage, the populations of these species would undoubtedly be adversely affected.
- Furthermore, there is no data which fish species or other plant and animal species will be impacted and what are the mitigation measures for reduction of the impact.

The overall assessment of this EIA report is that it fails to meet the fundamental prerequisites for an environmental assessment. The provided biodiversity data are entirely unrelated to the intended purpose of the Environmental Impact Assessment (EIA). Notably, there are substantial errors, encompassing both biodiversity inaccuracies and geographic discrepancies. Importantly, there is an absence of any data originating from the actual project area. Instead, all biodiversity information is derived from various previous reports, predominantly from the Spatial Plan for Sharr National Park[1], often perpetuating mistakes present in these reports. A specific example is the error of incorrectly categorizing Sharr's freshwaters solely within the Adriatic basin, a mistake perpetuated through direct copy-pasting[2].

EIA Report of 2014

EIA Report of 2014 is technically and scientifically with more mistakes than the EIA Feasibility Report of 2013.

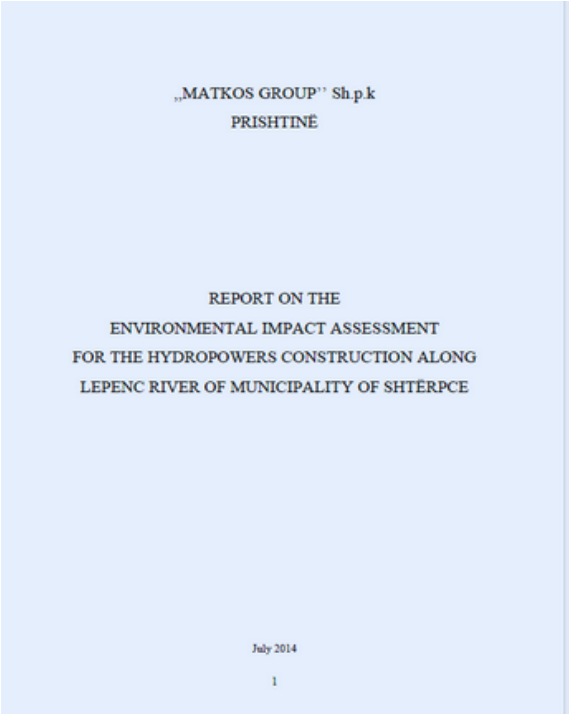
- Pages 29-32, provide an overview of plant and animal diversity. Similar to the EIA Feasibility Report of 2013, it is evident that this information is extracted from previous reports related to the Sharr Mountains in general and does not represent data specific to the areas of the hydropower plants or data generated in the field purportedly for the report.
- The listed plant species claimed to be present in the Sharr Mountains are copied from the EIA Feasibility 2013 Report, often with mistakes.
- Many widespread species irrelevant to the project are included, and there is no description of the composition of plant species specific to the project area.
- Furthermore, this report does not take into account many endemic and rare plant species of the Sharr Mountains. In this regard, the EIA Report of 2014 neglects totally the Red Book of Vascular Flora of Kosovo which gives information about the presence and distribution of many rare plant species in the Sharr Mountains, and which was published during 2013, a year before the production of the EIA Report itself.
- Similarly, the report describes faunal diversity for the Sharr Mountains in general and not for the project area. The listed terrestrial fauna species include among other: Eurasian lynx (*Lynx lynx*), Eurasian otter (*Lutra lutra*), Brown bear (*Ursus arctos*), Roe deer (*Capreolus capreolus*), Chamois (*Rupicapra rupicapra*), Wolf (*Canis lupus*), Red fox (*Vulpes vulpes*), Wild boar (*Sus scrofa*), European wildcat (*Felis*

[1] Instituti i Planifikimit Hapësinor, 2013, "Plani Hapësinor për Parkun Kombëtar Sharri", 177 pp.
[2] Instituti i Planifikimit Hapësinor, 2013, "Plani Hapësinor për Parkun Kombëtar Sharri", p 38.

silvestris), Eastern imperial eagle (Aquila heliaca), Golden eagle (Aquila chrysaetos), Bonelli's eagle (Hieraaetus fasciatus), Eurasian griffon vulture (Gyps fulvus), etc.·For some other groups, no species are given at all, and they are only mentioned as a group, e.g., fish, amphibians, reptiles, etc.

- Once again, there are some mistakes in the names of species, and it is unclear why there is no description of the composition of animal species, both terrestrial and aquatic, specific to the project area.
- The report doesn´t mention any fish species, aquatic insect species, and other macroinvertebrates. These species play a crucial role in the functioning of freshwater ecosystems and are profoundly affected by habitat alterations.
- Likewise, there is a lack of information about other critical groups in the surrounding areas, such as butterflies, amphibians, etc.
- On page 81, the EIA Report 2014 surprisingly states, that there is no significant impact on flora while fish fauna will be permanently damaged, but this damage will be compensated. It is not mentioned which fish species will be impacted and what is exactly meant by compensation. Permanent damage to native species cannot be compensated! Notably, there is a glaring omission as the report fails to address the potential impact of all HPP activities on nearby vegetation—an aspect crucial for maintaining surrounding biodiversity.
- Moreover, there is a notable absence of discussion regarding alterations in the aquatic habitat, a critical factor for freshwater biodiversity, which raises concerns about the comprehensiveness of the environmental impact assessment.
- On page 84, the EIA Report 2014 gives measures for the protection of flora and fauna, but this chapter is weak and without any concrete data. This chapter is difficult to understand, and offers no specific measures for any particular species.
- However, this chapter stipulates that the investor has a legal and moral obligation to "take part in fund shares added fish," which is not clear what is really meant. Probably, it means that the investor will participate in investments for adding fish (???), but even in this case, this is totally controversial, as it is not mentioned what fish will be added after possible permanent damage of fish.
- Having in mind that the EIA Report of 2014 stipulates that all fish will be permanently damaged, it is highly controversial as to how this EIA Report gave a positive review for building hydropower plants and how the competent authorities supplied owners of HPPs with permits if these constructions would permanently damage fish.

The overall conclusion of this report is that it fails to meet the fundamental prerequisites for an environmental assessment. The provided biodiversity data is entirely unrelated to the intended purpose of the Environmental Impact Assessment (EIA). Notably, there are substantial errors, encompassing both biodiversity inaccuracies and logical inconsistences.



„MATKOS GROUP'' Sh.p.k
PRISHTINË

REPORT ON THE
ENVIRONMENTAL IMPACT ASSESSMENT
FOR THE HYDROPOWERS CONSTRUCTION ALONG
LEPENC RIVER OF MUNICIPALITY OF SHTËRPCE

July 2014

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Importantly, there is no freshwater biodiversity data and there is actually an absence of any data originating from the actual project area. Instead, all biodiversity information is derived from various previous reports, predominantly from the Spatial Plan for Sharr National Park[1], often perpetuating mistakes present in these reports. As such, this EIA shouldn't have never been approved or used for the purpose of initiating a large-scale activity, such as are HPPs, in a protected area.

A The impact of HPP's intakes on aquatic habitats

Run-of-the-river (ROR) (derivation type) hydropower plants present notable challenges to freshwater ecosystems, contributing to connectivity loss, fish injuries, and degradation of aquatic habitats. These ecosystems, crucial for providing food, shelter, and a multitude of ecosystem services, rely heavily on the natural flow regime to support biological processes and ensure the long-term ecological vitality of aquatic habitats.

The exploitation of water resources, particularly through anthropogenic structures like weirs and dams, poses a threat to these ecosystems. These structures, alter the natural flow regime either seasonally or throughout the year. This alteration, vital for freshwater biodiversity well-being and the operation of regulation-based hydropower plants, involves damming the entire river width and integrating turbine stocks directly into or beside the facility. Typically lacking water storage, these plants directly tie electrical generation to river flow.

The challenges associated with run-of-the-river plants extend to fish passage issues, both upstream and downstream, disturbances in sediment transport, sedimentation and flushing of reservoirs, altered groundwater levels, and the promotion of invasive species.

Additionally, the focus on the impact of hydropower plant intake facilities on sediment and riverbed dynamics is crucial. The intake facilities contribute to interruptions in sediment transport, potentially leading to sedimentation issues downstream. This interference can alter the natural equilibrium of the riverbed, affecting sediment deposition patterns and, consequently, the overall geomorphology of the river. These alterations further influence the habitat structure for aquatic organisms and may exacerbate the negative impacts observed in the broader context of run-of-the-river hydropower operations.

The impact of HPP's intake sites on aquatic habitats at the intake 1

Water intake dam 1 serves as barrier to the natural distribution of sediment, and natural continuity of physical, chemical and biological conditions. The presence of a water intake dam has led to a disturbance in stream connectivity, creating ecological challenges. Our field visit revealed observable changes in the streambed around the dam facilities, indicating that, despite the likelihood that the water from the stream was not actively utilized during our assessment, the structural impact of the water intake dam was evident. This suggests that even without active water extraction, the mere presence of the dam has induced alterations in sediment dynamics and overall streambed morphology.

The construction of this water intake dam has hindered the natural movement of sediments downstream, impacting the geomorphological processes essential for maintaining a healthy

Pictures of the site area above the intake 1

[1] Instituti i Planifikimit Hapësinor, 2013, "Plani Hapësinor për Parkun Kombëtar Sharri", 177 pp.

aquatic ecosystem. Furthermore, the potential interruption of fish migration routes and the dispersal of macroinvertebrates could have broader ecological implications, affecting the biodiversity and ecological balance of the stream.

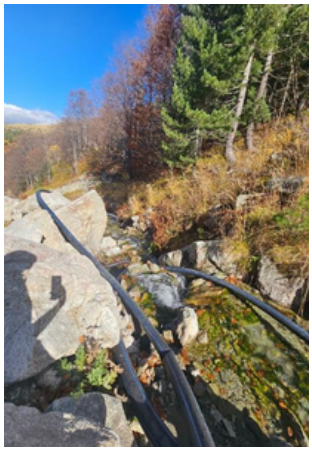
It is crucial to recognize that the effects of water intake dams extend beyond immediate water extraction activities. Even in cases where water usage appears minimal during field visits, the alteration in sediment distribution and disruptions to stream connectivity underscore the far-reaching consequences of these structures on the overall health and functionality of aquatic and other ecosystems.

Pictures of the site area below the intake 1

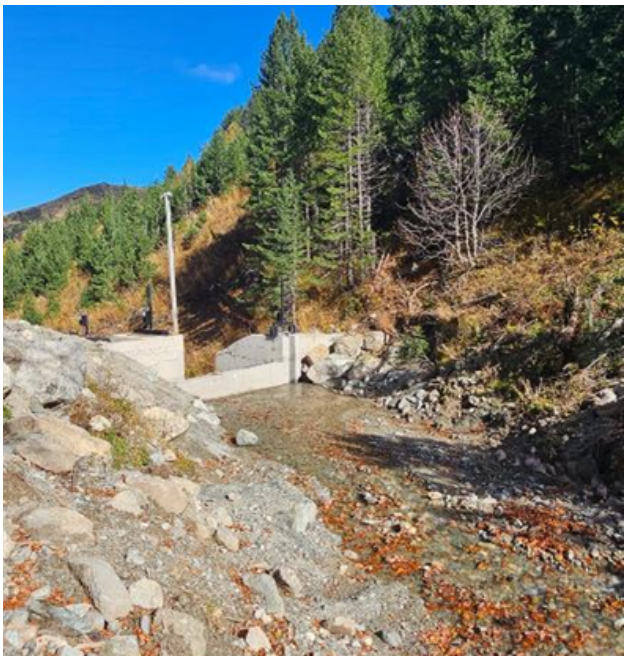
The impact of HPP's intake sites on aquatic habitats at the intake 2

Water intake dam 2 serves as barrier to the natural distribution of sediment, and natural continuity of physical, chemical and biological conditions. Our field visit revealed observable changes in the streambed, indicating structural impacts despite minimal or no water extraction at that moment. Even without active water use, the dam induces alterations in sediment dynamics and overall streambed morphology, hindering the natural movement of sediments downstream and impacting crucial geomorphological processes essential for a healthy aquatic ecosystem. A notable change of sediment composition around and below the intake site included large depositions of fine sediment and total absence or burial of stones and pebbles. These changes adversely affect distribution of freshwater organisms.

Pictures of the site area above the intake 2



Pictures of the site area below the intake 2



Pictures of the site area below the intake 2

The impact of HPP's intake sites on aquatic habitats at the intake 3

Water intake dam 3 serves as barrier to the natural distribution of sediment, and natural continuity of physical, chemical and biological conditions. This dam's presence has led to a disturbance in stream connectivity, as observed during our field visit. Despite minimal water extraction, the dam induces changes in sediment dynamics and overall streambed morphology.

Pictures of the site area above the intake 3

The construction of this water intake dam hampers the natural movement of sediments downstream, affecting vital geomorphological processes necessary for a healthy aquatic ecosystem. This disturbance poses potential challenges to fish migration routes and the dispersal of macroinvertebrates, impacting the broader biodiversity and ecological balance of the stream.

A notable change of sediment composition around and below the intake site included large depositions of fine sediment and total absence and burial of stones and pebbles. These changes adversely affect distribution of freshwater organisms.

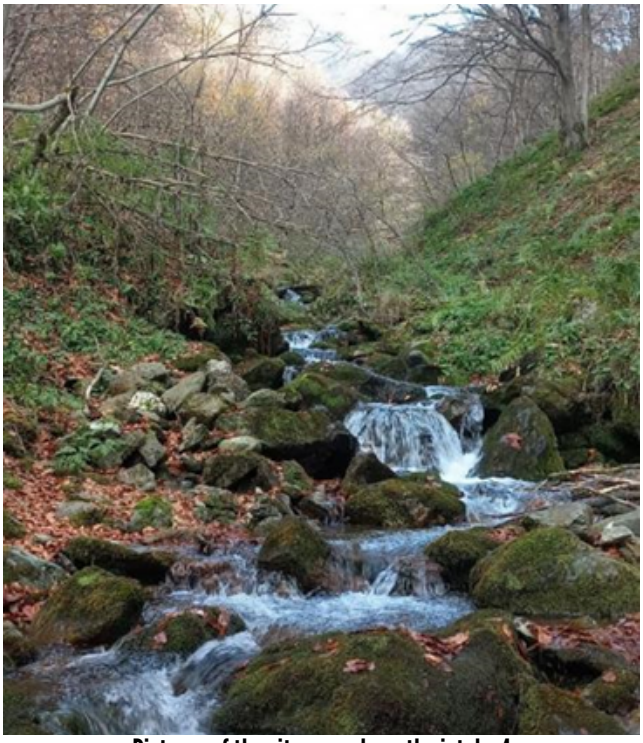
Pictures of the site area below the intake 3

The impact of HPP's intake sites on aquatic habitats at the intake 4

Water intake dam 4 serves as barrier to the natural distribution of sediment, and natural continuity of physical, chemical and biological conditions. This dam's presence has caused a disturbance in stream connectivity, as evident during our field visit. Given the substantial water extraction, as observed during the field visit, the dam induces alterations in sediment dynamics and overall streambed morphology.

A crucial problem exacerbated by the construction of this water intake dam is the decrease in water quantity downstream. This not only hampers the natural movement of sediments but also affects vital geomorphological processes essential for a healthy aquatic ecosystem. The disturbance poses challenges to fish migration routes and the dispersal of macroinvertebrates, significantly impacting the broader biodiversity and ecological balance of the stream.

A notable change of sediment composition around and below the intake site included large depositions of fine sediment and total absence and burial of stones and pebbles. These changes adversely affect distribution of freshwater organisms.



Pictures of the site area above the intake 4

Pictures of the site area below the intake 4

B The impact of HPP's intake sites on macroinvertebrate communities

The impact on aquatic species at the intake 1

The rapid field assessment conducted in and around intake 1 has revealed the presence of eight species of aquatic insects, with one species, *Rhyacophila obtusa*, enjoying Strict Protection status by Administrative Instruction 12/2020[1] in Kosovo. Additionally, three other species (*Rhyacophila obliterata, Annitella triloba* and *Chaetopteryx stankovici*) benefit from protection under the same Administrative Instruction as Protected species. All these species are notably susceptible to habitat deterioration and are adversely affected by changes reflected in the water and sediment regime induced by hydropower plants and intake facilities.

These species have been evaluated in Kosovo in accordance with IUCN requirements[2]. As a result, one species has been designated as a Vulnerable species, while the remaining three carry the status of Near Threatened species.

During our rapid field assessment of 2023, a discernible spatial pattern emerged, with the majority of these species concentrated upstream from the intake. Notably, less impacted species were observed downstream from the intake (such as *Hydropsyche* spp. for example), indicating a potential influence of intake facilities on the distribution and abundance of aquatic taxa. An additional noteworthy observation pertains to *Rhyacophila obliterata*, which, although present after the intake, exhibits considerably lower abundance compared to its pre-intake population. Our assessment further identifies that three out of the six identified threats[1] to these legally protected species are present in the vicinity of the intake 1: Dams & water management/use, Human intrusions & disturbance and Pollution.

This underscores the urgency of implementing targeted conservation measures to address these threats and ensure the continued well-being of these protected species in this area.

During this study we found at this area two species currently lacking legal protection, specifically *Drusus bigutatus* and *Psilopteryx montanus*, which are rare in Kosovo, important in terms of endemism and both susceptible to habitat deterioration. Both species meet the criteria for protection in Kosovo, attaining at least the Near Threatened status according to IUCN categorization and will be suggested as a such in next cycle of assessment for the Red Book of Fauna of Kosovo.

Drusus discolor **collected above the intake 2**

Rhyacophila obtusa **collected above the intake 1**

[1]Ministry of Environment and Spatial Planning of Kosovo, 2020, "Administrative Instruction 12/2020 for proclamation of wild species protected and strictly protected"

[2] Ibrahimi H., Gashi A., Regjepaj D., Zhushi F., Grapci-Kotori L., Feher Z., Bino T., Jelaska L. S., Theou Ph, Mesaros G. The Red Book of Fauna of the Republic of Kosovo. In: Ibrahimi H., editor. The Red Book of Fauna of the Republic of Kosovo. Ministry of Environment and Spatial Planning; 2019.

List of aquatic insect species of the order Trichoptera present above and below the water intake 1.
CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concerned, NE – Not Evaluated

	Species	IUCN status in Kosovo	Protection status in Kosovo	Comment	Abundance
Above the intake					
1	*Rhyacophila obliterata* McLachlan, 1863	NT	Protected	Rare in Kosovo	Abundant
2	*Rhyacophila obtusa* Klapálek, 1894	VU	Strictly Protected	Rare in Kosovo, Balkan and Asia Minor endemic	Abundant
3	*Annitella triloba* Marinkovic-Gospodnetic, 1957	NT	Protected	Rare in Kosovo, Balkan endemic	Scarce
4	*Chaetopteryx stankovici* Marinkovic, 1966	NT	Protected	Rare in Kosovo, Balkan endemic	Scarce
5	*Drusus biggutatus* (Pictet, 1834)	NE	NA	Rare in Kosovo	Scarce
6	*Psilopteryx montanus* Kumanski, 1968	NE	NA	Rare in Kosovo, Balkan endemic	Scarce
Below the intake					
1	*Rhyacophila obliterata* McLachlan, 1863	NT	Protected	Rare in Kosovo	Scarce
2	*Philopotamus montanus* (Donovan, 1813)	NE	NA	Widespread in Kosovo	Abundant
3	*Hydropsyche* sp.	NE	NA	Widespread in Kosovo	Abundant

The impact on aquatic species at the intake 2

The rapid field assessment conducted in and around intake 2 has revealed the presence of ten taxa, with one species, *Rhyacophila obtusa*, enjoying Strict Protection status by Administrative Instruction 12/2020[1] in Kosovo. Additionally, four other species (*Rhyacophila balcanica, Rhyacophila obliterata, Annitella triloba* and *Chaetopteryx stankovici*) benefit from protection under the same Administrative Instruction as Protected species. All these species are notably susceptible to habitat deterioration and are adversely affected by changes reflected in the water regime induced by hydropower plants and intake facilities. These species have been evaluated in Kosovo in accordance with IUCN requirements[2]. As a result, one species has been designated as a Vulnerable species, while the remaining four carry the status of Near Threatened species.

During our rapid field assessment of 2023, a discernible spatial pattern emerged, with the majority of these species concentrated upstream from the intake. Notably, less impacted taxa were observed downstream from the intake, such as *Rhyacophila fasciata, Philopotamus montanus* and *Hydropsyche* sp., indicating a potential influence of intake facilities on the distribution and abundance of aquatic taxa. Our assessment further identifies that three out of the six identified threats to these four legally protected species in Kosovo are present in the

[1] Ministry of Environment and Spatial Planning of Kosovo, 2020, "Administrative Instruction 12/2020 for proclamation of wild species protected and strictly protected"

[2] Ibrahimi H., Gashi A., Regjepaj D., Zhushi F., Grapci-Kotori L., Feher Z., Bino T., Jelaska L. S., Theou Ph, Mesaros G. The Red Book of Fauna of the Republic of Kosovo. In: Ibrahimi H., editor. The Red Book of Fauna of the Republic of Kosovo. Ministry of Environment and Spatial Planning; 2019.

vicinity of intake 1: Dams & water management/use, Human intrusions & disturbance and Pollution. This underscores the urgency of implementing targeted conservation measures to address these threats and ensure the continued well-being of these protected species in the area.

The presence of *Potamophylax humoinsapiens* raises significant conservation concerns, demanding immediate attention considering the fact that habitat deteriorations due to intake sites may hamper populations of sensitive species even upstream. This species was observed to be highly sensitive to changes in water regime. Despite being a newly described species in 2023, this species fulfills the criteria for both Strictly Protected status under the Administrative Instruction 12/2020 and the classification of Critically Endangered according to IUCN criteria. Its endemism to Kosovo, and more importantly to the Sharr Mountains only, adds to its ecological significance, emphasizing the need for prompt protective measures.

Given its recent discovery, *Potamophylax humoinsapiens* currently lacks legal protection, creating an urgent need to incorporate it into regulatory frameworks. Previous research[1] on this and related species has highlighted their vulnerability to habitat deteriorations caused by hydropower plants, underscoring the potential threats faced by *Potamophylax humoinsapiens*. Field assessments have revealed a predominant presence of this species above the intake, suggesting a potential environmental preference for undisturbed sites. The discovery of only one specimen below the intake clearly shows that habitat deteriorations has interrupted distribution of this species and this necessitates the urgency of addressing the impact of intake facilities on its distribution and abundance. This observation underscores the necessity for a thorough investigation into the dynamics of *Potamophylax humoinsapiens* in relation to intake structures.

List of aquatic insect species of the order Trichoptera present above and below the water intake 2.
CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concerned, NE – Not Evaluated

	Species	IUCN status in Kosovo	Protection status in Kosovo	Comment	Abundance
Above the intake					
1	*Rhyacophila balcanica* Radovanovic, 1953	NT	Protected	Rare in Kosovo, Balkan endemic	Abundant
2	*Rhyacophila obliterata* McLachlan, 1863	NT	Protected	Rare in Kosovo	Abundant
3	*Rhyacophila obtusa* Klapálek, 1894	VU	Strictly Protected	Rare in Kosovo, Balkan and Asia Minor endemic	Scarce
4	*Annitella triloba* Marinkovic-Gospodnetic, 1957	NT	Protected	Rare in Kosovo, Balkan endemic	Abundant
5	*Chaetopteryx stankovici* Marinkovic, 1966	NT	Protected	Rare in Kosovo, Balkan endemic	Scarce
6	*Drusus discolor* (Rambur, 1842)	NE	NA	Rare in Kosovo	Scarce
7	*Potamophylax humoinsapiens* Ibrahimi & Bilalli, 2023	NE	NA	Sharr Mountain endemic	Scarce
Below the intake					
1	*Rhyacophila fasciata* Hagen, 1859	NE	NA	Widespread in Kosovo	Scarce
2	*Philopotamus montanus* (Donovan, 1813)	NE	NA	Widespread in Kosovo	Abundant
3	*Hydropsyche* sp.	NE	NA	Widespread in Kosovo	Abundant

[1] Ibrahimi H, Bilalli A, Gashi A, Grapci Kotori L, Slavevska Stamenkovic V, Geci D (2023). Potamophylax humoinsapiens sp. n. (Trichoptera, Limnephilidae), a new species from the Sharr Mountains, Republic of Kosovo. Biodiversity Data Journal 11: e97969. https://doi.org/10.3897/BDJ.11.e97969

Potamophylax humoinsapiens collected above the intake 2

The impact on aquatic species at the intake 3

The rapid field assessment conducted in and around intake 3 has revealed the presence of 12 taxa, with 4 species (*Rhyacophila bosnica, Rhyacophila obtusa, Glossosoma discophorum* and *Drusus sharrensis*), enjoying Strict Protection status by Administrative Instruction 12/2020[1] in Kosovo. Additionally, 4 other species (*Rhyacophila balcanica, Rhyacophila obliterata, Annitella triloba* and *Chaetopteryx stankovici*) have the status of Protected species under the same Administrative Instruction. All these species are notably susceptible to habitat deterioration and are adversely affected by changes induced by hydropower plants and intake facilities. These species have been evaluated in Kosovo in accordance with IUCN requirements[2]. As a result, one species has been designated as a Critically Endangered species, three carry the status of Vulnerable species, while four species are Near Threatened Species.

During our rapid field assessment, a discernible spatial pattern emerged, with the majority of these species concentrated upstream from the intake. Notably, fewer impacted species were observed downstream from the intake, indicating a potential influence of intake facilities on the distribution and abundance of aquatic taxa. Few species were present before and after intake as well, but notably with lower abundance after the intake.

Our assessment further identifies that three out of the six identified threats to these four legally protected species in Kosovo are present in the vicinity of intake 1: Dams & water management/use, Human intrusions & disturbance and Pollution. This underscores the urgency of implementing targeted conservation measures to address these threats and ensure the continued well-being of these protected species in the area.

The presence of *Drusus sharrensis* and *Potamophylax humoinsapiens* raises significant concerns, demanding immediate attention. *Drusus sharrensis* as a Strictly Protected species and Critically Endangered is endemic to Kosovo and endemic to Sharr Mountains. The current locality around intake 3 has already been reported as one of the localities from where the new species *Potamophylax humoinsapiens* has been described[3]. As noted earlier and confirmed by the current rapid field assessment study, both species are highly impacted by changes in the freshwater habitat where they live.

Field assessments have revealed a predominant presence of this species above the intake, suggesting a potential environmental preference. However, the discovery of only few specimens below the intake necessitates the need for urgent actions related to the impact of intake facilities on their distribution and abundance. This observation underscores the necessity for a thorough investigation into the dynamics of *Potamophylax humoinsapiens* in relation to intake structures.

[1] Ministry of Environment and Spatial Planning of Kosovo, 2020, “Administrative Instruction 12/2020 for proclamation of wild species protected and strictly protected”

[2] Ibrahimi H., Gashi A., Regjepaj D., Zhushi F., Grapci-Kotori L., Feher Z., Bino T., Jelaska L. S., Theou Ph, Mesaros G. The Red Book of Fauna of the Republic of Kosovo. In: Ibrahimi H., editor. The Red Book of Fauna of the Republic of Kosovo. Ministry of Environment and Spatial Planning; 2019.

[3] Ibrahimi H, Bilalli A, Gashi A, Grapci Kotori L, Slavevska Stamenkovic V, Geci D (2023) Potamophylax humoinsapiens sp. n. (Trichoptera, Limnephilidae), a new species from the Sharr Mountains, Republic of Kosovo. Biodiversity Data Journal 11: e97969. https://doi.org/10.3897/BDJ.11.e97969

Salmo farioides above the intake 3

List of aquatic insect species of the order Trichoptera present above and below the water intake 3.
CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concerned, NE – Not Evaluated

	Species	IUCN status in Kosovo	Protection status in Kosovo	Comment	Abundance
Above the intake					
1	*Rhyacophila balcanica* Radovanovic, 1953	NT	Protected	Rare in Kosovo, Balkan endemic	Abundant
2	*Rhyacophila bosnica* Schmid, 1970	VU	Strictly Protected	Rare in Kosovo, Balkan endemic	Abundant
3	*Rhyacophila obliterata* McLachlan, 1863	NT	Protected	Rare in Kosovo	Abundant
4	*Rhyacophila obtusa* Klapálek, 1894	VU	Strictly Protected	Rare in Kosovo, Balkan endemic	Abundant
5	*Glossosoma discophorum* Klapálek, 1902	VU	Strictly Protected	Rare in Kosovo, Balkan endemic	Abundant
6	*Annitella triloba* Marinkovic-Gospodnetic, 1957	NT	Protected	Rare in Kosovo, Balkan endemic	Abundant
7	*Chaetopteryx stankovici* Marinkovic, 1966	NT	Protected	Rare in Kosovo, Balkan endemic	Scarce
8	*Drusus discolor* (Rambur, 1842)	NE	NA	Rare in Kosovo	Scarce
9	Drusus sharrensis Ibrahimi, Previsic & Vitecek, 2015	CR	Strictly Protected	Endemic of Sharr Mountains	Abundant
10	*Potamophylax humoinsapiens* Ibrahimi & Bilalli, 2023	NE	NA	Endemic of Sharr Mountains	Abundant
11	*Psilopteryx montanus* Kumanski, 1968	NE	NA	Rare in Kosovo, Balkan endemic	Abundant
Below the intake					
1	*Rhyacophila balcanica* Radovanovic, 1953	NT	Protected	Rare in Kosovo, Balkan endemic	Scarce
2	*Rhyacophila obliterata* McLachlan, 1863	NT	Protected	Rare in Kosovo	Abundant
3	*Philopotamus montanus* (Donovan, 1813)	NE	NA	Widespread in Kosovo	Abundant
4	*Annitella triloba* Marinkovic-Gospodnetic, 1957	NT	Protected	Rare in Kosovo, Balkan endemic	Scarce
5	*Potamophylax humoinsapiens* Ibrahimi & Bilalli, 2023	NE	NA	Endemic of Sharr Mountains	Scarce

The impact on aquatic species at the intake 4

The rapid field assessment conducted in and around intake 4 has revealed the presence of nine taxa, with 4 species (*Rhyacophila balcanica, Rhyacophila obliterata, Annitella triloba* and *Chaetopteryx stankovici*), enjoying Protection status by Administrative Instruction 12/2020[1] in Kosovo. All these species are notably susceptible to habitat deterioration and are adversely affected by changes induced by hydropower plants and intake facilities. These species have been evaluated in Kosovo in accordance with IUCN requirements as Near Threatened species[2].

During our rapid field assessment, a discernible spatial pattern emerged, with the majority of these species concentrated upstream from the intake. Notably, fewer impacted species were observed downstream from the intake, indicating a potential influence of intake facilities on the distribution and abundance of aquatic taxa. Few species were present before and after intake as well, but notably with lower abundance after the intake. Our assessment further identifies that three out of the six identified threats to these four legally protected species in Kosovo are present in the vicinity of intake 1: Dams & water management/use, Human intrusions & disturbance and Pollution. This underscores the urgency of implementing targeted conservation measures to address these threats and ensure the continued well-being of these protected species in the area.

The presence of *Potamophylax humoinsapiens* raises significant concerns, demanding immediate attention. Field assessments have revealed a predominant presence of this species above the intake, suggesting a potential environmental preference for undisturbed sites.

Salmo farioides above the intake 4

Drusus sharrensis

Psilopteryx montanus

[1] Ministry of Environment and Spatial Planning of Kosovo, 2020, "Administrative Instruction 12/2020 for proclamation of wild species protected and strictly protected"

[2] Ibrahimi H., Gashi A., Regjepaj D., Zhushi F., Grapci-Kotori L., Feher Z., Bino T., Jelaska L. S., Theou Ph, Mesaros G. The Red Book of Fauna of the Republic of Kosovo. In: Ibrahimi H., editor. The Red Book of Fauna of the Republic of Kosovo. Ministry of Environment and Spatial Planning; 2019.

List of aquatic insect species of the order Trichoptera present above and below the water intake 4.
CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concerned, NE – Not Evaluated

	Species	IUCN status in Kosovo	Protection status in Kosovo	Comment	Abundance
Above the intake					
1	*Rhyacophila balcanica* Radovanovic, 1953	NT	Protected	Rare in Kosovo, Balkan endemic	Abundant
2	*Rhyacophila obliterata* McLachlan, 1863	NT	Protected	Rare in Kosovo	Abundant
3	*Philopotamus montanus* (Donovan, 1813)	NE	NA	Widespread in Kosovo	Abundant
4	*Allogamus auricollis braueri* Kolenati, 1859	NE	NA	Rare in Kosovo, Balkan endemic	Rare
5	*Annitella triloba* Marinkovic-Gospodnetic, 1957	NT	Protected	Rare in Kosovo, Balkan endemic	Abundant
6	*Chaetopteryx stankovici* Marinkovic, 1966	NT	Protected	Rare in Kosovo, Balkan endemic	Scarce
7	*Potamophylax humoinsapiens* Ibrahimi & Bilalli, 2023	NE	NA	Endemic of Sharr Mountains	Scarce
8	*Psilopteryx montanus* Kumanski, 1968	NE	NA	Rare in Kosovo, Balkan endemic	Abundant
Below the intake					
1	*Rhyacophila obliterata* McLachlan, 1863	NT	Protected	Rare in Kosovo	Abundant
2	*Philopotamus montanus* (Donovan, 1813)	NE	NA	Widespread in Kosovo	Abundant
3	*Hydropsyche* sp.	NE	NA	Widespread in Kosovo	Abundant

C The impact of HPP intake sites on impoverishment of macroinvertebrate communities and decrease in biological water quality

Our study clearly indicates a depletion in macroinvertebrate communities downstream of all four water intake sites. The assessment of water quality, gauged through biological macroinvertebrate indicators, reveals a discernible decline in water quality transitioning from a High status above the intakes to a Good status below the water intake sites. This pattern is consistently reflected across all four intake locations. This is against the principles set up by Water Framework Directive and such a deterioration of water quality upstream affects in long term the whole stream and adjacent habitats.

In our evaluation, we employed five indices of macroinvertebrates to assess water quality, and the results from each index align with one another. The convergence of multiple indices strengthens the reliability of our findings. The observed decrease in water quality, coupled with alterations in macroinvertebrate community abundance and taxon composition, can be attributed to shifts in the water regime and modifications in the aquatic habitat of the streams.

These changes underscore the interconnectedness between water quality, macroinvertebrate communities, and the overall health of aquatic ecosystems. The decrease in water quality, as indicated by macroinvertebrate indicators, serves as an early warning signal for potential ecological impacts resulting from alterations in water regimes and habitat conditions. Recognizing these trends is essential for effective environmental management and conservation efforts, emphasizing the need for strategies to mitigate the adverse effects on aquatic ecosystems associated with water intake sites.

It is obvious from this study that taxa intolerant to pollution and habitat deterioration are mostly located upstream from the intake sites, while below the intake sites we have dominance of taxa which are tolerant to pollution and freshwater habitat deteriorations. Most of the species which are ecologically crucial, important in terms of endemism and which enjoy legal protection belong to the group of taxa intolerant to pollution and habitat changes. The impact of intake sites on these legally protected and important taxa is obvious at all four intake sites.

Water quality in streams above and below the intake sites based on 5 indices of macroinvertebrates. EPT – Ephemeroptera – Plecoptera – Trichoptera; FBI – Family Biotic Index; BMWP – Biological Monitoring Working Party; ASPT – Average Score Per Taxon; SWRC – Stroud Water Research Center

Monitoring Station/ Indices	EPT	FBI	BMWP	ASPT	SWRC	General Assessment (Ecological status)
L1 (above intake I)	14 - Very good	2.66 - Excellent	125 - Very good	8.33 - Clean water	2.63 - Excellent	HIGH
L1 (below intake I)	6 - Good	3.80 - Very good	62 - Moderate	6.20 - Clean water	4.10 - Good	GOOD
L2 (above intake II)	13 - Very good	2.62 - Excellent	120 - Very good	7.50 - Clean water	2.81 - Excellent	HIGH
L2 (at and below intake II)	6 - Good	4.05 - Very good	59 - Moderate	6.56 - Clean water	3.86 - Good	GOOD
L3 (above intake III)	12 - Very good	1.81 - Excellent	118 - Very good	7.87 - Clean water	2.59 - Excellent	HIGH
L3 (below intake III)	6 - Good	3.77 - Very good	55 - Moderate	6.88 - Clean water	3.21 - Excellent	GOOD
L4 (above intake IV)	16 - Very good	2.25 - Excellent	149 - Very good	8.76 - Clean water	2.61 - Excellent	HIGH
L4 (below intake IV)	8 - Good	4.41 - Very good	77 - Good	6.42 - Clean water	4.38 - Good	GOOD

Macroinvertebrate larvae collected at study sites: Trichoptera

Composition of macroinvertebrate larval communities in and around intake 1.

No.	Class/Order	Family	No. of organisms
		Above intake 1	
1	Trichoptera	Rhyacophilidae	3
2		Philopotamidae	6
3		Limnephilidae	4
4		Polycentropodidae	4
5		Leptoceridae	1
6	Plecoptera	Capniidae	4
7		Chloroperlidae	1
8		Taeniopterygidae	2
9		Leuctridae	2
10		Nemouridae	8
11		Perlidae	6
12		Perlodidae	5
13	Ephemeroptera	Baetidae	2
14		Heptagenidae	12
15	Diptera	Tipulidae	2
		Below intake 1	
1	Trichoptera	Rhyacophilidae	6
2		Limnephilidae	2
3	Plecoptera	Leuctridae	2
4		Nemouridae	11
5		Perlodidae	4
6	Ephemeroptera	Baetidae	25
7	Diptera	Tipulidae	4
8		Chironomidae (other)	13
9	Amphipoda	Gammaridae	8
10	Hirudinea	Erpobdellidae	6

Macroinvertebrate larvae collected at study sites: Plecoptera

Composition of macroinvertebrate larval communities in and around intake 2

No.	Class/Order	Family	No. of organisms
		Above intake 2	
1	Trichoptera	Rhyacophilidae	6
2		Philopotamidae	3
3		Limnephilidae	2
4		Polycentropodidae	2
5		Psychomyiidae	2
6	Plecoptera	Capniidae	5
7		Taeniopterygidae	2
8		Leuctridae	2
9		Nemouridae	14
10		Perlidae	8
11		Perlodidae	6
12	Ephemeroptera	Baetidae	8
13		Heptagenidae	10
14	Diptera	Tipulidae	2
15		Limoniidae	1
16	Hirudinea	Erpobdellidae	3
		Below intake 2	
1	Trichoptera	Limnephilidae	2
2	Plecoptera	Leuctridae	2
3		Nemouridae	6
4		Perlodidae	4
5	Ephemeroptera	Baetidae	31
6		Heptagenidae	8
7	Diptera	Athericidae	5
8		Chironomidae (other)	11
9	Hirudinea	Erpobdellidae	5

Macroinvertebrate larvae collected at study sites: Epehemeroptera

Composition of macroinvertebrate larval communities in and around intake 3

No.	Class/Order	Family	No. of organisms
		Above intake 3	
1	Trichoptera	Rhyacophilidae	8
2		Philopotamidae	2
3		Limnephilidae	4
4		Polycentropodidae	1
5		Glossosomatidae	6
6		Odontoceridae	9
7	Plecoptera	Taeniopterygidae	2
8		Leuctridae	2
9		Nemouridae	12
10		Perlidae	5
11		Perlodidae	4
12	Ephemeroptera	Heptagenidae	10
13	Diptera	Athericidae	5
14		Tipulidae	2
15		Limoniidae	1
		Below intake 3	
1	Trichoptera	Rhyacophilidae	6
2		Philopotamidae	4
3	Plecoptera	Nemouridae	5
4		Perlodidae	2
5	Ephemeroptera	Baetidae	25
6		Heptagenidae	15
7	Diptera	Tipulidae	4
8		Limoniidae	10

Macroinvertebrate larvae collected at study sites: Diptera

Composition of macroinvertebrate larval communities in and around intake 4

No.	Class/Order	Family	No. of organisms
		Above intake 4	
1	Trichoptera	Rhyacophilidae	4
2		Philopotamidae	2
3		Limnephilidae	8
4		Polycentropodidae	1
5		Glossosomatidae	6
6		Phryganeidae	4
7		Brachycentridae	3
8		Sericostomatidae	2
9	Plecoptera	Capniidae	3
10		Chloroperlidae	1
11		Taeniopterygidae	2
12		Leuctridae	2
13		Nemouridae	10
14		Perlidae	6
15		Perlodidae	4
16	Ephemeroptera	Heptagenidae	10
17	Diptera	Tipulidae	3
		Below intake 4	
1	Trichoptera	Rhyacophilidae	5
2		Philopotamidae	10
3		Limnephilidae	3
4		Polycentropodidae	2
5	Plecoptera	Taeniopterygidae	2
6		Leuctridae	2
7		Perlodidae	4
8	Ephemeroptera	Baetidae	22
9	Diptera	Tipulidae	3
10		Chironomidae (white)	13
11	Oligochaeta	Lumbriculidae	8
12	Hirudinea	Erpobdellidae	6

Macroinvertebrate larvae collected at study sites: Amphipoda

Macroinvertebrate larvae collected at study sites: Hirudinea

D The impact of HPP's intake sites on fish communities

During our rapid field assessment, we noted the presence of the fish species West Balkan Trout *Salmo farioides* above intake 3, albeit in a limited number of specimens. Despite multiple field visits in November 2023, we were unable to sample any specimens of this species below intake 3. Similarly, we found *Salmo farioides* above intake 4, but our attempts to locate specimens below the intake site were unsuccessful. The species *Salmo farioides*, which is native to this area is also present in the main course of the Lepenc River. However, we noted that the intake sites are significantly decreasing the areas of distribution for this species in the Lepenc watershed due to the disruption of river connectivity. It is evident that the communication between the tributaries and the main Lepenc River course has been interrupted by the hydropower plant (HPP) intake sites. Otherwise, the river connectivity is essential for prevalence of this species.

In the main course of the Lepenc River, we encountered various fish species, including Macedonian barbel (*Barbus* cf. *macedonicus*), Schneider (*Alburnoides bipunctatus*), Gudgeon (Gobio sp.), Skadar chub (*Squalius platyceps*), Common minnow (*Phoxinus phoxinus*), Common bleak (*Alburnus alburnus*) and Struma stone loach (*Oxynoemacheilus bureschi*). While these species are not expected in the high altitudes of the tributaries where the HPP intake sites are located, changes in habitat destruction and water regime at intake sites may impact the distribution and abundance of these species downstream. Several native fish species such as *Barbus* cf. *macedonicus, Oxynoemacheilus bureschi,* and *Squalius platyceps* are especially impacted. These species are native to small areas in Southeastern Europe or the Balkans, and any alterations in water regime and aquatic habitats may significantly affect their distribution.

It is worth noting that the identification of the fish taxon as *Gobio* sp. in the Lepenc River based on morphological and meristic characteristic raises uncertainties, and molecular analyses are required for a precise identification of its status. Same is valid for the population of Barbel, which although resembling closely *Barbus macedonicus*, it remains to be resolved.

List of aquatic insect species of the order Trichoptera present above and below the water intake 4.
CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concerned, NE – Not Evaluated

No	*Species name*	Distribution	IUCN category in Kosovo
1	*Salmo macedonicus* (Karaman, 1924)	Reported in the Lepenc River in the Red Book of Fauna of Kosovo. It remains to be confirmed its distribution or delineation of distribution with *Salmo farioides*	DD-Protected
2	*Salmo farioides* Karaman, 1938	Above intake 3 and 4, L1, L2, L3	NE
3	*Barbus* cf. *macedonicus* Karaman, 1928	L1, L2	NE
4	*Alburnoides bipunctatus* (Bloch, 1782)	L3, L4	NE
5	*Gobio* sp.	L2, L4	NE
6	*Squalius platyceps* Zupančič, Marić, Naseka & Bogutskaya, 2010	L3, L4	NE
7	*Phoxinus phoxinus* (Linnaeus, 1758)	L2, L4	NE
8	*Alburnus alburnus* (Linnaeus, 1758)	L3, L4	NE
9	*Oxynoemacheilus bureschi* (Drensky, 1928)	L2, L3, L4	NE

Several small-scale endemics of both genera are known in the Balkans[1], and the destruction of habitats in the Lepenc River due to HPP activities could hinder the distribution of these important taxa. From Lepenc River was also reported[2]*Salmo macedonicus*, another endemic species of the Balkan Peninsula. It remains to be delineated the exact population and areas of this and the other species, *Salmo farioides*.

In summary, the impact of HPP intake sites extends beyond the evident disruption in the communication between tributaries and the main Lepenc River. It has the potential to affect the distribution and abundance of various native fish species, highlighting the importance of comprehensive assessments and conservation strategies to mitigate these ecological consequences.

***Barbus* cf. *macedonicus* sampled at Lepenc River L1**

***Squalius platyceps* sampled at Lepenc River L3**

***Alburnoides bipunctatus* sampled at Lepenc River L3**

***Phoxinus phoxinus* sampled at Lepenc River L2**

***Gobio* sp. sampled at Lepenc River L2**

***Alburnus alburnus* sampled at Lepenc River L3**

[1]Weiss S, Apostolou A, Đug S, Marčić Z, Mušović M, Oikonomou A, Shumka S, Škrijelj R, Simonović P, Vesnić A, Zabric D. (2018). Endangered Fish Species in Balkan Rivers: their distributions and threats from hydropower development. Riverwatch & EuroNatur, 162 pp

[2] Ibrahimi H., Gashi A., Regjepaj D., Zhushi F., Grapci-Kotori L., Feher Z., Bino T., Jelaska L. S., Theou Ph, Mesaros G. The Red Book of Fauna of the Republic of Kosovo. In: Ibrahimi H., editor. The Red Book of Fauna of the Republic of Kosovo. Ministry of Environment and Spatial Planning; 2019.

Oxynoemacheilus bureschi sampled at Lepenc River L3

CONCLUSIONS AND RECCOMENDATIONS

The following conclusions are attained from this rapid assessment field study and from screening of the Environmental Impact Assessment (EIA) documentation for Hydropower Plants (HPPs) in the Sharr Mountains National Park:

- The two Environmental Impact Assessment Reports (2013 and 2014) for hydropower plants in the Shtërpce Municipality do not fulfill fundamental requirements as requested by the Kosovo law and scientific requirements.
- The absence of freshwater biodiversity data in the EIA reports for hydropower plants in the Sharr National Park has caused all activities damaging freshwater species go unmonitored.
- Four intake sites for hydropower plants, located in the Sharr National Park have already critically altered aquatic habitats.
- Hydropower plant activities have critically endangered fish and macroinvertebrate populations of species protected by law. A significant population decline or a total extinction at stream segments below the intakes was observed for important species such as fish *Salmo farioides* and aquatic insects such as *Drusus sharrensis* and *Potamophylax humoinsapeins*. One fish species and 8 aquatic insect species are directly endangered by dam activities, while 4 other fish species inhabiting upstream and midstream sections of the Lepenc River are indirectly threatened through changes in upstream habitats.
- All intake sites and associated dams are located inside National Park and their current impact on environment is against the goals of protected areas. It is of special concern that the intake 4 and associated dam is located in the Zone 2 of protection in the Sharr National Park. According to the Management Plan for Sharr National Park, Zone 2 is defined as an area with exceptional ecosystem, biodiversity and landscape values where is forbidden any activity that modifies landscape, except of the basic road infrastructure for the needs of visitors of the Park. The other 3 dams are located within a Zone 3 of protection but the water diversion effects the nearby Zone 2 as well. According to the current definition by the Management Plan, zone 3 represents zone of sustainable use. Most probably in the next review cycle of Sharr Mountains National Park this area will be designated as Zone 2 due to the biodiversity values registered in meantime.
- Water quality undergoes a discernible decline below the intakes, reflecting the direct impact of intake sites on water quality. This is against the principles of the Water Framework Directive.
- Fish routes exist at dam 3 and 4 but are completely dysfunctional as they are constructed outside the water flowing area. There are no fish routes at dams 1 and 2.
- Communication interruptions between tributaries and the main Lepenc River, caused by HPP intake sites, likely affects the distribution and abundance of native fish species and especially of *Barbus* cf. *macedonicus, Oxynoemacheilus bureschi*, and *Squalius platyceps* which inhabit middle section of the Lepenc River.
- The study underscores an immediate need for halting all activities related to hydropower plants in the National Park area and immediate targeted conservation measures to restore the deteriorated nature.

The following recommendations are essential based on the current legal framework in Kosovo for protected species, including the Red Book of Fauna of Kosovo, Administrative Instruction no. 12/2020, the Law on Nature, and others:

- Since the current EIA's do not fulfill the legal and scientific criteria, it is necessary to retract all permits for hydropower plants inside Sharr National Park in Shtërpce Municipality and to immediately stop all activities of HPP's in this area.

- Urgent assessment of the environmental damage caused by hydropower plants in the Sharr National Park during the past years with included targeted conservation measures for species identified in the study, particularly those with legal protection status as per the Administrative Instruction 12/2020, and current legislation in force in Kosovo.
- Immediate restoration measures for species of particular interest such as *Drusus sharrensis, Potamophylax humoinsapeins, Salmo farioides,* etc., which are in danger of extinction around the intake sites.
- Immediate moratorium on all activities inside National Park which are against the principles of protection and conservation, since this study showed that there may be still unrecorded biodiversity values and areas.

These recommendations aim to address the identified challenges and provide a foundation for sustainable practices, balancing the energy needs with the conservation of Sharr Mountain National Park's unique aquatic biodiversity.

ANNEX 1. THE LIST OF FRESHWATER SPECIES IN THE SHARR MOUNTAINS, PUBLISHED DURING THE PAST YEARS

At this annex we provide a compilation of freshwater species documented in the Sharr Mountains over recent years (Dauti, 1980; Ibrahimi et al., 2012, 2014, 2016a, b, 2017, 2019a, b, 2023; Kuriqi et al., 2021; Sivec, 1980; Xërxa et al., 2019), along with their respective legal protection statuses. It is imperative that any current or proposed activities in the Sharr Mountains account for the potential presence of these species. Recognizing the ecological preferences of freshwater species, it is anticipated that many as-yet-unrecorded species may inhabit the Sharr Mountains.

CR – Critically Endangered, EN – Endangered, VU – Vulnerable, NT – Near Threatened, LC – Least Concerned, NE – Not Evaluated, DD – Data Deficient

#	Species	IUCN status, legal protection
Trichoptera		
1	*Rhyacophila armeniaca* Guerin-Meneville, 1843	NT-Protected
2	*Rhyacophila balcanica* Radovanovic, 1953	NT-Protected
3	*Rhyacophila bosnica* Schmid, 1970	VU-Strictly protected
4	*Rhyacophila fasciata* Hagen, 1859	NE
5	*Rhyacophila fischeri* Botosaneanu, 1957	NT-Protected
6	*Rhyacophila laevis* Pictet, 1834	NT-Protected
7	*Rhyacophila loxias* Schmid, 1970	NT-Protected
8	*Rhyacophila mocsaryi* Klapalek, 1898	NT-Protected
9	*Rhyacophila nubila* Zetterstedt, 1840	NE
10	*Rhyacophila obliterata* McLachlan, 1863	NT-Protected
11	*Rhyacophila obtusa* Klapalek, 1894	VU-Strictly protected
12	*Rhyacophila palmeni* McLachlan, 1879	EN-Strictly protected
13	*Rhyacophila polonica* McLachlan, 1879	NE
14	*Rhyacophila tristis* Pictet, 1834	LC-Protected
15	*Glossosoma conformis* Neboiss, 1963	NE
16	*Glossosoma discophorum* Klapalek, 1902	VU-Strictly protected
17	*Glossosoma bifidum* McLachlan, 1879	NE
18	*Glossosoma intermedium* (Klapalek, 1892)	NE
19	*Synagapetus iridipennis* McLachlan, 1879	NE
20	*Philopotamus montanus* (Donovan, 1813)	NE
21	*Philopotamus variegatus* (Scopoli, 1763)	NT-Protected
22	*Wormaldia occipitalis* (Pictet, 1834)	NE
23	*Hydropsyche incognita* Pitsch, 1993	NE
24	*Hydropsyche instabilis* (Curtis, 1834)	NE
25	*Hydropsyche modesta* Navas, 1925	NT-Protected
26	*Hydropsyche peristerica* Botosaneanu and Marinkovic-Gospodnetic, 1968	NE
27	*Hydropsyche saxonica* McLachlan, 1884	NE
28	*Hydropsyche tabacarui Botosaneanu, 1960*	NE
29	*Plectrocnemia brevis* McLachlan, 1871	NE
30	*Plectrocnemia geniculata* McLachlan, 1871	NE
31	*Polycentropus excisus* Klapalek, 1894	NE
32	*Lype reducta* (Hagen, 1868)	NE
33	*Psychomyia pusilla* (Fabricius, 1781)	NE
34	*Tinodes pallidulus* McLachlan, 1878	NE
35	*Tinodes rostocki* McLachlan, 1878	NE
36	*Micrasema minimum* McLachlan, 1876	NE
37	*Annitella triloba* Marinković-Gospodnetić, 1955	NT-Protected
38	*Allogamus auricollis braueri* Kolenati, 1859	NE
39	*Chaetopteryx stankovici* Marinkovic-Gospodnetic, 1966	NT

40	***Drusus botosaneanui* Kumanski, 1968**	**NE**
41	*Drusus discolor* (Rambur, 1842)	NE
42	*Drusus sharrensis* Ibrahimi, Vitecek & Previšić, 2016	CR
43	*Limnephilus affinis* Curtis, 1834	NE
44	*Limnephilus auricula* Curtis, 1834	NE
45	*Limnephilus bipunctatus* Curtis 1834	NE
46	*Limnephilus hirsutus* (Pictet, 1834)	NE
47	*Limnephilus lunatus* Curtis 1834	NE
48	*Limnephilus sparsus* Curtis, 1834	NE
49	*Limnephilus petri* Marinkovic, 1966	CR-Strictly protected
50	*Limnephilus vittatus* (Fabricius, 1798)	NE
51	*Potamophylax cingulatus* (Stephens, 1837)	NE
52	*Potamophylax lattipenis* (Curtis, 1834)	NE
53	*Potamophylax goulandriorum* Malicky, 1974	NE
54	*Potamophylax humoinsapiens* Ibrahimi & Bilalli 2023	NE
55	*Potamophylax luctuosus* (Piller and Mitterpacher, 1783)	NE
56	*Patamophylax latipenis* Pictet 1834	NE
57	*Potamophylax pallidus* Klapalek, 1899	NE
58	*Psilopteryx montanus* Kumanski, 1968	NE
59	*Micropterna caesareica* Schmid, 1959	NE
60	*Micropterna nycterobia* McLachlan, 1875	NE
61	*Micropterna lateralis* Stephens, 1837	NE
62	*Micropterna sequax* McLachlan, 1875	NE
63	*Halesus digitatus* (Schrank, 1781)	NE
64	*Chaetopteroides kosovarorum* Ibrahimi & Oláh, 2013	CR-Strictly protected
65	*Stenophylax meridiorientalis* Malicky, 1982	NE
66	*Allogamus auricollis* braueri Kolenati, 1859	NE
67	*Thremma anomalum* McLachlan, 1876	NE
68	*Odontocerum hellenicum* Malicky, 1972	CR-Strictly protected
69	*Lepidostoma basale* (Kolenati, 1848)	NE
70	*Leptocerus interruptus* (Fabricius, 1775)	NE
71	*Notidobia vaillanti* Olah, Vincon and Ibrahimi, 2023	CR-Strictly protected
72	*Oecismus monedula* (Hagen, 1859)	NE
73	*Oecismus mucidus* McLachlan 1876	NE
74	*Ernodes articularis* (Pictet, 1834)	NE
Plecoptera		
1	*Brachyptera seticornis* (Klapálek, 1902)	NE
2	*Brachyptera risi* (Morton, 1896)	NE
3	*Leuctra nigra* (Olivier, 1811)	NE
4	*Leuctra inermis* Kempny 1899	NE
5	*Leuctra rauscheri* Aubert, 1957	NE
6	*Leuctra rosinae* Kempny 1900	NE

7	*Capnia vidua* Klapálek, 1904	NE
8	*Amphinemura sulcicollis* (Stephens, 1836)	NE
9	*Amphinemura triangularis* (Ris, 1902)	NE
10	*Nemoura marginata* Piciteta 1836	NE
11	*Protonemura autumnalis* Raušer, 1956	NE
12	*Protonemura auberti* Illies, 1954	NE
13	*Protonemura intricata intricata* (Ris, 1902)	NE
14	*Perla marginata* Panzer, 1779	NE
15	*Perla bipunctata* Pictet, 1833	NE
16	*Dinocras megacephala* (Klapálek, 1907)	NE
17	*Dinocras cephalotes* (Curtis, 1827)	NE
18	*Perlodes microcephalus* (Pictet, 1833)	NE
19	*Perlodes intricatus* (Pictet, 1841)	NE
20	*Isoperla grammatica* (Poda, 1761)	NE
21	*Isoperla tripartita* Illies, 1954	NE
22	*Isoperla oxylepis balcanica* Raušer 1962	NE
23	*Perla marginata* (Panzer, 1799)	NE
24	*Brachyptera graeca* Berthélemy, 1971	EN
25	*Nemoura zwicki* Sivec 1980	CR-Strictly protected
Ephemeroptera		
1	*Baetis alpinus* (Pictet, 1843)	LC-Protected
2	*Baetis melanonyx* Pictet,1843	NT-Protected
3	*Epeorus assimilis* Eaton, 1885	NE
4	*Epeorus yougoslavicus* (Šamal, 1935)	EN-Strictly protected
5	*Ecdyonurus starmachi* Sowa, 1971	NE
6	*Rhithrogena braaschi* Jacob, 1974	NE
7	*Rhithrogena gr. sowai* Puthz, 1972	NE
8	*Rhithrogena cf. bulgarica* Braasch, Soldán & Sowa, 1985	NE
9	*Rhithrogena gr. hercynia* Landa, 1969	NE
10	*Rhithrogena gr. semicolorata* (Curtis, 1834)	NE
11	*Rhithrogena gr. diaphana* Navàs, 1917	NE
12	*Paraleptophlebia submarginata* (Stephens, 1836)	NE
13	*Quatica ikonomovi* (Puthz, 1971)	NE
Fish		
1	*Salmo macedonicus* (Karaman, 1924)	DD- Protected
2	*Salmo farioides* Karaman, 1938	NE
3	*Barbus* cf. *macedonicus* Karaman, 1928	NE
4	*Alburnoides bipunctatus* (Bloch, 1782)	NE
5	*Gobio* sp.	NE
6	*Squalius platyceps* Zupančič, Marić, Naseka & Bogutskaya, 2010	NE
7	*Phoxinus phoxinus* (Linnaeus, 1758)	NE
8	*Alburnus alburnus* (Linnaeus, 1758)	NE
9	*Oxynoemacheilus bureschi* (Drensky, 1928)	NE

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