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Ichthyopopulation Structure as a Function of Critical Habitat Assessment in Lower Catchments of Neretva River

[1] Ridanovic Lejla, [2] Jurica Damir

[1] Department of Biology, Dzemal Bijedic University of Mostar, Univerzitetski Kampus, Mostar, Bosnia and Herzegovina
[2] Agency for Sustainable Development Altus Mostar, Mostar, Bosnia and Herzegovina

Corresponding Author: **Ridanovic Lejla**

Abstract
This assessment identifies and demarcates areas which can be considered critical habitats for ichthyofauna within the researched catchment zone. By definition, a critical habitat is an area which contains features that are essential for the conservation of a species or habitat of high biodiversity value that may require targeted protection. Critical habitats include at least one or more of the five values specified in paragraph 16 of Performance Standard 6 (PS6) and/or other recognized high biodiversity values in assessing the biodiversity importance of an area. Performance Standard 6 represents international best practice for biodiversity management. The objectives of this paper are to encourage the implementation of mitigation and promote sustainable management of living natural resources that sustain thriving communities.

Keywords: Ichthyofauna, Habitat Assessment, Endangered Species

1. Introduction

Aquatic ecosystems may be defined hydrologically, physiographically, or zoogeographically (e.g., based on the occurrence of fish). It is most relevant when aquatic ecosystems are split up by barriers such as dams. For example, dams have profoundly altered the middle catchments of Neretva, where artificial accumulations foster greater abundance of invasive and introduced species. Hydrologically, our research area can be defined as nine separate aquatic ecosystems, which are all parts of the same basin and zoogeographically can be considered one region as they are populated by same fish species. A Discrete Management Unit (DMU) is an area with a clearly demarcated boundary. The delineation of a DMU can vary depending on the species, subspecies or biodiversity feature of concern. The unit of analysis used in this CHA was a discrete management unit (DMU), which amounted to a surface of 3000 km^2, Fig 1.

It is important to note that assessment in this report will be performed from the aspect of ichthyofauna, to highlight importance of conserving these species as essential part of aquatic biodiversity. According to Water Framework Directive (WFD 2000) and EU Habitat Directive, fish are biological element for determining ecological status of water. As the area has been highly degraded over the years, the aquatic ecosystems assessed are largely considered ‘modified’ with sporadic natural habitats remaining according to the definition given by the IFC. The presence of endemic and critically endangered fish species and their reliance on these habitats justifies award of “critical habitat” title and warrants further concerted conservation efforts. The research area is located within internationally recognized area of high biodiversity, which encompass Important Bird and Biodiversity Areas.

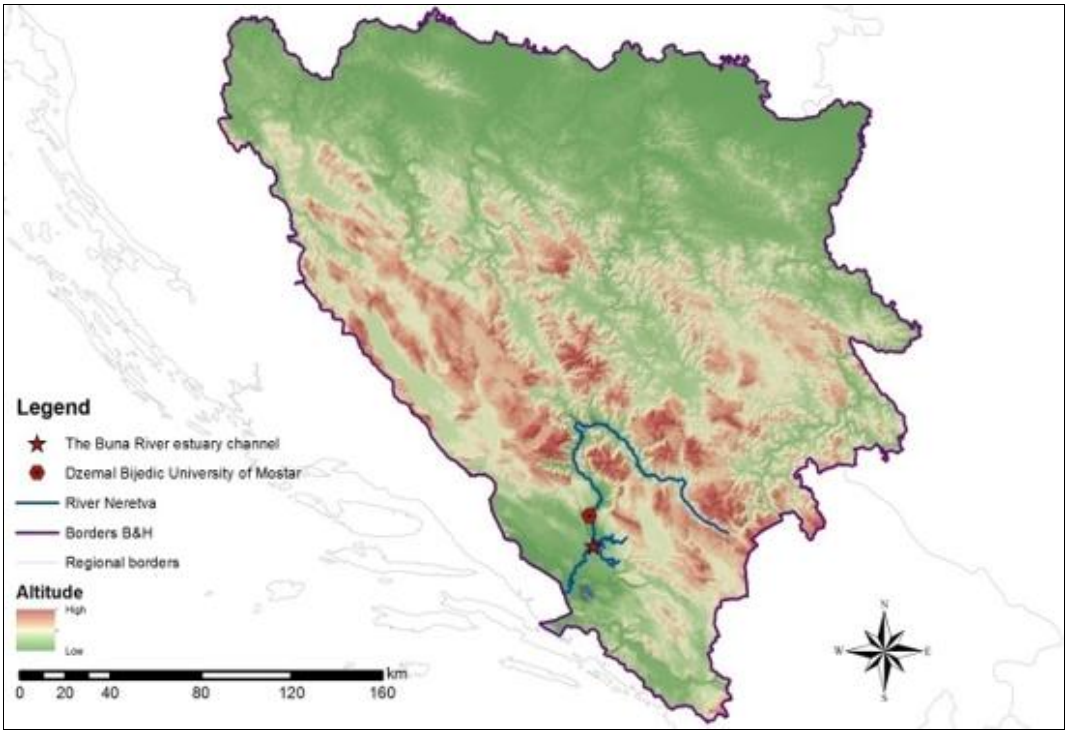

Fig 1: The project area

2. Materials and methods

The methodology followed to assess compliance with critical habitat criteria is as described in Performance Standard 6. All criteria are equally important for making critical habitat designations or for determining compliance with PS6. Each criterion is described in detail.

- Criterion 1: Habitat of significance for globally or nationally Critically Endangered (CR) and/or Endangered (EN) species
- Criterion 2: Habitat of significance for endemic or restricted-range species
- Criterion 3: Habitat of significance for migratory or congregatory species
- Criterion 4: Highly threatened and/or unique ecosystems
- Criterion 5: Areas associated with key evolutionary processes

The assessment was based on initial literature review and in-field data collection and verification of existing information. Field data were collected to describe diversity, distribution, abundance and habitat associations of aquatic ichthyofauna. Species of conservation concern were found. Field data were collected by taxa experts over two years.

3. Results and discussion

Criterion 1: Globally or nationally Critically Endangered (CR) and/or Endangered (EN) species

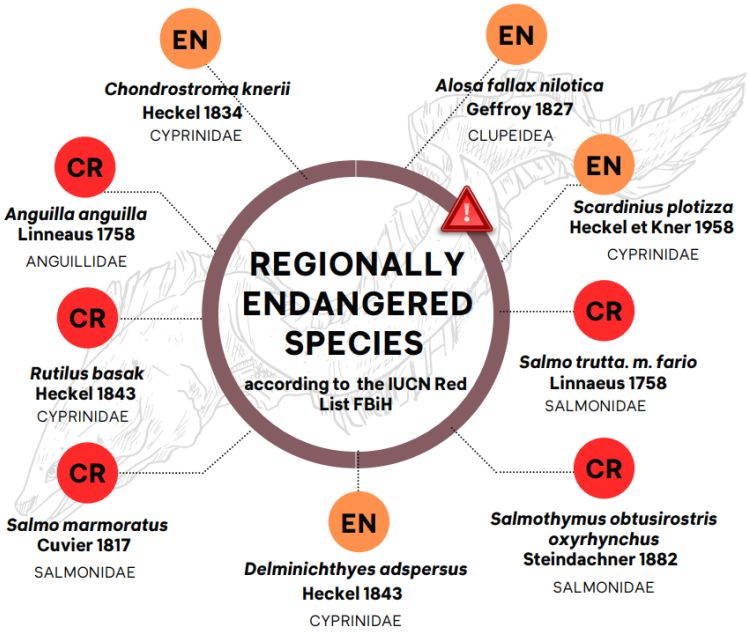

Fig 2: Regionally Critically Endangered (CR) and Endangered (EN) species

Fig 3: Globally Critically Endangered (CR) and Endangered (EN) species

A total of 9 species that could trigger Critical Habitat Criterion 1 were recorded during biodiversity baseline surveys conducted between May 2020 to December 2021. The extent of occurrence of these species within the DMU was then compared to their global distribution range using thresholds provided by the IFC Performance Standards 6. Five fish species are categorized as CR *(Anguilla anguilla, Linneaus 1758; Rutilus basak, Heckel 1843; Salmo marmoratus, Cuvier 1817; Salmo trutta. m. fario, Linnaeus 1758; Salmothymus obtusirostris oxyrhynchus, Steindachner 1882)* and four are listed as EN *(Alosa fallax nilotica, Geffroy 1827; Chondrostroma knerii, Heckel 1834; Delminichthyes adspersus, Heckel 1843; Scardinius plotizza, Heckel et Kner 1958)* on the regional Red List of FBiH (Fig 2). Two of these species are found on the global IUCN Red List. *Anguilla anguilla, Linneaus 1758* is listed as CR and *Salmothymus obtusirostris oxyrhynchus, Steindachner 1882* is marked as EN (Fig 3). Discrepancy is due to IUCN assessments not being conducted regularly in this area as well as the lack of experts in IUCN assessment process.

Criterion 2: Endemic or restricted-range species

According to IFC GN79, 'an endemic species is defined as one that has ≥ 95 percent of its global range inside the country or region of analysis'. Six fish species were identified as endemic to Neretva basin during baseline biodiversity surveys, Fig 4, hence triggering Criterion 2. Quantification of Critical Habitat extent and residual losses relating to the pollution and general ecosystem and habitat loss need to be undertaken.

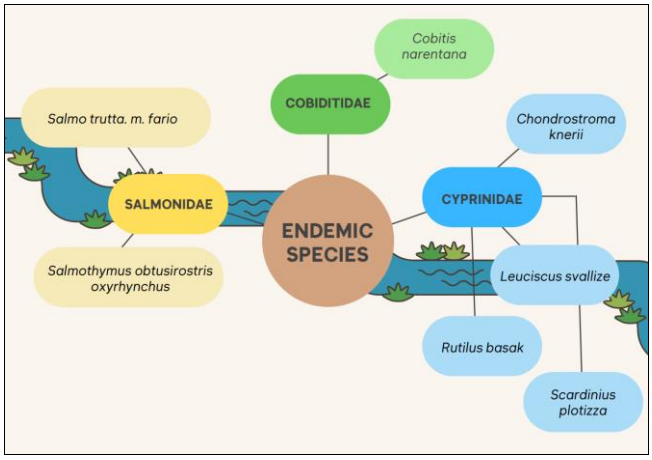

Fig 4: Endemic and restricted range species in Neretva basin

Restricted range species - for freshwater species, standardized thresholds follow those set out by the IUCN, which applies thresholds of 20,000 km^2 for fish. The baseline biodiversity surveys conducted also allowed us to assess extended distribution range of fish species within the researched catchment zones. Distribution range of these species is largely restricted to Neretva and its tributaries, while some species as Adriatic lineage endemics extend to rivers Krka and Cetina in Croatia and Zeta in Monte Negro. Their distribution and range are further restricted by hydro power plants on Neretva, which prevent migration of fish upstream. It is important to note that although brown trout is regarded as cosmopolitan species, its Adriatic lineage can only be found in Neretva basin, hence *Salmo truta m. fario* (Adriatic) can be regarded as a restricted range species.

Table 1: Endemic and restricted-range fish species

Species	Distribution range
Salmo trutta m. fario	Adriatic lineage, restricted range species
Cobitis narentana	Endem of Neretva and its tributaries, Krka
Salmothymus obusirostris oxyrhynchus	Endem of Neretva and its tributaries, Krka
Chondrostroma knerii	Endem Adriatic basin
Leuciscus svallize	Endem Adriatic basin highly threatened by habitat loss
Rutilus basak	Endem Adriatic basin
Scardinius plotizza	Endem Adriatic basin

Criterion 3: Habitat of significance for migratory and/or congregatory species

Migratory species are species that move from one habitat to another during different times of the year or during their life span, depending on availability of food and habitat conditions. Fish can be regarded as migratory species in context of this CHA. Majority of habitats in this area have been modified and few have maintained their original natural state. Buna and Bunica are essential spawning sites for endemic fish. E.g., *Chondrostroma knerii* has not been recorded nor observed to hatch in Neretva in this or any previous research. Younglings then migrate to Neretva to continue their life cycle, entering calmer waters of tributaries to spawn. This area is a part of the Dinaric migratory corridor and important site for resting and breeding. The vicinity of Hutovo blato, Mediterranean wetland and RAMSAR site, a well-known resting site for migratory birds, clearly demarcates this area as habitat of significance for numerous migratory species.

Criterion 4: Highly threatened and/or unique ecosystems

During fieldwork, three sites have stood out from the rest due to their unique geomorphological features, degree of endangerment and their importance for sustainability of biodiversity, Buna channels, Source of Bunica, and Bregava upstream from Stolac. These sites stood out with their

unique geomorphological features and their significance for biodiversity and general ecosystem functioning.

Criterion 5: Key evolutionary processes
Evolutionary processes include three basic elements: genetic variation, recurrence and selection. Each is necessary and together they suffice to ensure evolutionary change. Variation occurs within population gene pool. As Neretva is fragmented by dams, which prevents migration of fish, communities existing in lower catchments of Neretva and its tributaries are nucleus of healthy population, where natural gene pool is maintained. Sensitive fish species tend to spawn in quieter waters of tributaries and then migrate to Neretva. Hence it is essential to maintain free water flow and prevent barriers to fish migration. Recurrence and selection as key evolutionary processes pertain to individual fitness and biological characteristics of species. Natural habitats are essential to conserving and maintaining healthy robust fish population, especially considering high percentage of endemic and restricted range species.

Habitat loss risk assessment
Habitat fragmentation involves two processes, reduction of the total habitat area and the formation of separate and isolated parts of one continuous whole. Habitat fragmentation leads to a reduction population size of most species and a reduction in migration (gene flow) between fragments of the population. Dams on the Neretva and tributaries represent artificial barriers to salmonid migration and prevent gene flow between emerging local populations. The genetic impact of population fragmentation depends on gene flow between fragments. With the absence of gene flow, fragmentation usually leads to increased inbreeding and loss of genetic diversity in population fragments. This results in genetic differentiation in fragments and a higher risk of extinction, in a long term, in relation to one population of the same total size. Mutational meltdown refers to the process by which small populations accumulate deadly mutations that lead to a decrease in fitness and a decrease in population size, which in turn can lead to further accumulation of deadly mutations. A population experiencing mutational melting has been caught in a downward spiral trap and will experience extinction if the phenomenon persists for some time. Destructive mutations can be easily removed by selection, but during mutational melting, the number of individuals experiencing early death is too large relative to the total population size and therefore mortality exceeds birth rate. There are indications that some fragments of salmonids (and other fish species in the Neretva) are experiencing this process (short and genetically isolated parts of the flow between dams), and some isolated small populations of *Salmo marmoratus* and *Salmo obtusirostris* may have become extinct due to mutational melting.

4. Conclusion
Relatively small deviations from natural norms can lead to imbalances of homeostasis and homeoresis in the ecosystem. Disruption of at least one link in the food chain can cause complete collapse of the entire system, and due to the complexity of the food network, the consequences can possible also be felt in parts of the ecosystem that are not directly affected. Many fish species depend on the speed of water flow that carries them downstream in the early stages of life, and later guides them for upstream migration to hatcheries. Any reduction in flow rate and water level disorients them and significantly prolongs migration time, causing stress and reduced fertility. Life in the river revolves around and is adjusted to a flow rate, timing of the flow, and amount of water. Any disturbance and change in the flow cause serious and severe consequences. Even small changes in the quantity and timing of flows affect aquatic and coastal ecosystems, and can significantly disrupt the ecological network and the food chain of the river system. Barriers significantly impede and slow down water flow.

5. Acknowledgement
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6. References
1. Campbell G. Esia Report, Yaoure Gold Project Appendix 18 Critical Habitat Assessment, 2015
2. IUCN Draft Test Guide to Biodiversity Assessment, April, 2000
3. The biodiversity consultancy, Critical Habitat: a concise summary 2012.
4. Stefan CI., Robichaud C., Knopff K., Nielsen D., Carvet C., Melton D., Novy R. Critical Habitat Assessment using IFC PS6 Criteria. Golder Associates Ltd. Canada. 2013
5. IFC (International Finance Corporation). Guidance Note 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. World Bank Group, Washington, DC. 69pp. 2012
6. IUCN (International Union for the Convention on Nature). IUCN Red List Categories and Criteria: Version 3.1. 2001
7. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK. IUCN. 2013.
8. IUCN Red List of Threatened Species. http://www.iucnredlist.org. Accessed May 30, 2022.