CONFERENCE PAPER

PRELIMINARY CHECKLIST OF ICHTHYOFAUNA AND MARINE MAMMALS OF BOSNIA AND HERZEGOVINA'S COASTAL WATERS: A BASELINE FOR CONSERVATION, MONITORING, AND ONE HEALTH APPROACHES

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ABSTRACT

Bosnia and Herzegovina's (B&H) limited coastal zone along the Adriatic Sea represents a unique and understudied marine ecosystem. This study presents the first structured preliminary inventory of marine fish and mammal species in the country's territorial waters, compiling 110 species (106 fish, 4 marine mammals) from historical records, grey literature, and local knowledge sources. Using a standardized Observation Quality Index (OQI), species were categorized into high, medium, or low confidence tiers based on data quality criteria. The checklist identified 21 bony fish and three marine mammals with high-confidence presence, while most elasmobranchs (13 species) and bony fish (69 species) fell into the medium-confidence category, reflecting regional data scarcity and underreporting. The findings offer a critical biodiversity baseline for future research, marine conservation, and environmental management in the region. Moreover, the study highlights the value of integrating data quality assessment and the One Health approach, recognizing the interconnectedness of marine ecosystem health, biodiversity conservation, and human well-being. This inventory supports national and regional efforts to meet international biodiversity monitoring commitments and underscores the need for continued marine research and cross-border collaboration in the Adriatic Sea.

Keywords: Checklist inventory, marine ichtyofauna, marine mammals, One Health

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INTRODUCTION

In the context of accelerating climate change and increasing anthropogenic pressures on the world's oceans, inventories of fish species and marine mammals have become indispensable tools for ocean monitoring and conservation. Fish and marine mammals serve as keystone and sentinel species within marine ecosystems, indicating that changes in their populations often signal broader ecological shifts. By systematically recording the presence, abundance, distribution, and health status of these species, scientists are better equipped to detect and understand ecosystem-level responses to stressors such as rising ocean temperatures, acidification, overfishing, and pollution (Bianchi et al., 2022; Plon et al., 2024).

Fish species are vital not only for ecological balance but also for global food security. Many communities, particularly in coastal and island regions, rely heavily on fish for dietary protein and economic stability. Inventories help detect declines in key commercial species, allowing for evidence-based fisheries management that can prevent overexploitation and ensure long-term sustainability (Copernicus Marine Service, n.d.; McQuatters-Gollop et al., 2019). Moreover, data on species range shifts caused by warming waters - such as poleward migrations or changes in spawning patterns enable scientists and policymakers to anticipate and adapt to emerging ecological and economic challenges.

Marine mammals, on the other hand, act as critical sentinel species-organisms whose health reflects the state of the broader marine environment. Changes in their behavior, reproductive success, or disease prevalence often serve as early warning signals of ecosystem distress. For example, increases in marine mammal strandings or disease outbreaks may indicate rising levels of pollution, harmful algal blooms, or shifts in prey availability (Frontiers in Marine Science, 2023; Plon et al., 2024). As long-lived, top-level predators, marine mammals also integrate the effects of multiple environmental stressors across time and space, offering a holistic view of ocean health.

Importantly, the collection and integration of this data are central to the One Health paradigm, which underscores the interconnectedness of human, animal, and environmental health. By informing conservation actions, public health planning, and sustainable resource management, inventories of fish and marine mammals provide a critical foundation for climate-resilient decision-making. Without accurate and regularly updated species inventories, efforts to maintain healthy marine ecosystems and safeguard human well-being in a changing climate would be severely undermined (Frontiers in Marine Science, 2023).

B&H is located in the western part of the Balkan Peninsula, in Southeastern Europe. It borders Croatia to the north, west, and southwest, Serbia to the east, and Montenegro to the southeast. Although it is predominantly a landlocked country, B&H has limited access to the sea, with a coastline of about 24 kilometers and the town of Neum on the Adriatic Sea. This narrow coastal strip represents the country's only maritime connection to open waters, which is important for tourism and trade, but also limits the development of maritime infrastructure and access to international sea routes.

A total of 207 species of fauna were found in the sea of B&H during the last century, of which 97 were species of fish, which is slightly more than a quarter of the total number of 380 species of fish for the Adriatic Sea (Šoljan, 1948). If we consider that the number of fish species in the Adriatic has increased over the past thirty years from 407 to 456 and the new six that were registered by the authors of the book Ichthyofauna of the Adriatic Sea (Šoljan, 1980; Jardas, 1996; Dulčić and Kovačić 2020; Kovačić, 2023), we can assume that the number of species in the B&H sea has also increased proportionally. More serious research that would result in a comprehensive or taxon-specific inventory of the marine flora and fauna of B&H has not been done so far.

Although comprehensive research covering all taxonomic groups has not yet been conducted in B&H's marine area, certain groups have been explored sporadically since 2011, primarily due to the efforts of individual scientist who initiated targeted studies on sharks and rays. Between 2011 and 2022, a series of publications (Gajić and Lelo, 2011a; Gajić and Lelo, 2011b; Gajić and Lelo, 2014; Gajić, 2014; Gajić, Kahrić and Dedić, 2014; Kahrić and Gajić, 2015; Kahrić, Gajić, Dedić and Hadžić, 2015; Gajić and Kahrić, 2015; Kahrić, 2016; Gajić, Kahrić and Lelo, 2017; Kahrić, 2017; Kahrić, 2018; Kahrić, Gajić and Muhamedagić, 2018; Kahrić and Gajić, 2018; Kahrić, 2019; Kahrić, 2020; Kahrić, 2022) have contributed to the most consistent and structured documentation of cartilaginous fish in B&H territorial waters. These studies significantly enriched the knowledge of local elasmobranch populations, highlighting their occurrence, distribution, and ecological relevance. In contrast, bony fishes have received considerably less attention, with only occasional investigations conducted in the 21st century, thus leaving notable gaps in the understanding of their current status and trends (Kahrić and Gajić, 2016; Karalić, 2022).

This discrepancy underlines the importance of compiling and reviewing existing data to establish a unified biodiversity baseline, as presented in this work. The synthesis of previously scattered records enables a more accurate assessment of species richness, data reliability, and potential knowledge gaps. Moreover, it provides a reference point for future monitoring and management efforts.

Other marine taxonomic groups, particularly marine mammals, remain underexplored. Their presence in B&H's territorial waters is mostly occasional, often linked to prey availability or proximity to fish farms, with documented occurrences of individuals entering the area sporadically (Kahrić, 2016). Despite their ecological significance, no systematic surveys have been conducted so far.

Moreover, the study highlights the value of integrating data quality assessment and the One Health approach, recognizing the interconnectedness of marine ecosystem health, biodiversity conservation, and human well-being. In this context, recent histopathological research on elasmobranchs has identified liver and spleen lesions (Gajić et al., 2020), which are likely linked to bioaccumulated contaminants such as heavy metals, persistent organic pollutants, and remnants of war-related debris - indicating early signs of ecosystem degradation with potential implications for food safety and public health. Furthermore, the high prevalence of microplastics in both fish digestive tracts and benthic sediments-particularly in species like *Mullus barbatus* - underscores the pervasive nature of pollution in B&H's coastal zone (Kahrić et al., 2019). Microplastics in marine sediment primarily affect benthic or demersal fish species, such as skates, rays, and the aforementioned *Mullus barbatus* (Kahrić et al., 2016).

These findings illustrate how environmental stressors may compromise the ecological integrity of marine populations and, by extension, affect human communities reliant on seafood resources and coastal ecosystem services. Complementing this perspective, B&H participated in the regional IPA-Adriatic De Fish Gear project, which represented the first comprehensive, harmonized assessment of marine litter across the Adriatic and Ionian Seas. The project included monitoring of various environmental matrices.- such as beach litter, surface water, seafloor, and biota - within the Neum-Klek Bay, contributing valuable data on the distribution and composition of marine debris in the country's coastal zone (Vlachogianni et al., 2017). This initiative further supports the One Health framework by recognizing marine litter, especially microplastics, as a cross-cutting pressure with ecological, economic, and human health implications. The integration of such monitoring efforts with biodiversity assessments is essential for designing evidence-based management strategies and mitigating long-term impacts on both marine ecosystems and local communities.

In light of these findings, adopting a coordinated, One Health-oriented strategy - aligned with regional and international frameworks - is essential for addressing ecological risks and reinforcing the resilience of B&H's marine ecosystems.

In regions where marine biodiversity is poorly documented and financial or technical resources are limited, compiling a preliminary checklist using existing literature, historical records, and grey sources is not only a pragmatic approach-it is also a scientifically valid and strategically valuable one. This foundational step is particularly important for countries like B&H, where marine biodiversity remains underrepresented in global biodiversity databases (Convention on Biological Diversity, n.d.).

Despite limitations in completeness or timeliness, the creation of a preliminary checklist plays a critical role in establishing a baseline for biodiversity research. Even when data are derived from older publications, student theses, local monitoring programs, or technical reports, such syntheses consolidate fragmented knowledge into a structured, accessible format. This allows researchers and decision-makers to assess what is already known and to identify key knowledge gaps that future studies should address (Corsi, 2004; Bianchi et al., 2022).

One of the most important benefits of this approach is its ability to fill critical data gaps. In the absence of recent or comprehensive field surveys, preliminary checklists may represent the only available organized source of marine species data for a given region. This is particularly relevant in emerging or post-conflict countries, where biodiversity research has not kept pace with environmental or conservation challenges (Copernicus Marine Service, n.d.; Frontiers in Marine Science, 2023).

Additionally, drawing on grey literature-including student dissertations, unpublished monitoring reports, and environmental consultancy documents-helps to recognize and integrate valuable local knowledge that is often overlooked in conventional peer-reviewed sources. While these materials may not always undergo formal publication, they often contain methodologically robust and context-specific observations that enhance regional biodiversity assessments (Corsi, 2004).

The preliminary checklist approach is also notably cost-effective. It enables scientists and conservation professionals to make meaningful progress without large budgets or the logistical burdens of full-scale fieldwork. When properly documented, these compilations can meet accepted scientific standards and serve as credible references for marine conservation and management planning (McQuatters-Gollop et al., 2019). Moreover, these checklists provide a solid foundation for future research, collaboration, and funding. A well-documented checklist can support grant applications, justify detailed field-based surveys, or serve as a baseline for reassessing species distributions or conservation statuses in the future (Corsi, 2004).

Finally, even preliminary biodiversity data play a crucial role in conservation planning and environmental policy. In contexts where data are sparse, structured information—even from older or grey sources-can inform marine spatial planning, environmental impact assessments, and conservation prioritization under international frameworks such as the Convention on Biological Diversity or the EU Marine Strategy Framework Directive (Convention on Biological Diversity, n.d.; Bianchi et al., 2022).

In summary, while inherently limited, the development of preliminary marine species checklists using existing resources represents a scientifically grounded, resource-efficient, and strategically powerful approach. It allows under-resourced countries to actively participate in the global marine biodiversity dialogue and lays the groundwork for long-term monitoring and marine stewardship

MATERIAL AND METHODS

This research employed a comprehensive inventory approach to assess marine fauna biodiversity in the target region, integrating historical records with contemporary data sources. The foundational dataset originated from a fauna inventory conducted in the 1980s by Dr. Tonko Šoljan, which served as a critical baseline for species presence and distribution (Bianchi et al., 2022). Recognizing the limitations of relying solely on historical data, this inventory was systematically updated and validated through a multi-source verification process (Corsi, 2004). All species names have been verified and standardized according to the World Register of Marine Species (WoRMS) for marine invertebrates and mammals, and FishBase and Eschmeyer's Catalog of Fishes for fish taxa (WoRMS, 2025; Froese & Pauly, 2025; Fricke et al., 2025).

To ensure the reliability and scientific value of species occurrence data collected from diverse sources, this study implemented a standardized framework for assessing the quality of observations. Given that the data originate from both historical and contemporary sources-ranging from peer-reviewed literature to interviews with local fishers-it was essential to establish a transparent method for evaluating the credibility, accuracy, and taxonomic consistency of each record. This methodology follows established practices in biodiversity monitoring and ecological data quality assessment (Yoccoz et al., 2001; Fletcher et al., 2019; OBIS, 2021). The marine species inventory compiled in this study draws from historical scientific records (e.g., Šoljan, 1980s baseline fauna checklist), peer-reviewed literature and regional biodiversity assessments, grey literature (e.g., student theses, environmental reports, unpublished surveys), online media (e.g., news portals, forums), community knowledge (e.g., fisher interviews, oral history).

The Observation Quality Index (OQI) is a quantitative tool used to measure the reliability and scientific confidence of species occurrence data-especially useful in biodiversity studies where data come from mixed sources like old records, interviews, and non-peer-reviewed reports. In the context of marine species inventories, where resources and field observations might be limited, the OQI helps researchers assess the credibility of each species record, prioritize which records to verify or monitor further, filter out unreliable data from conservation or policy analysis, and document limitations transparently in biodiversity baselines. This method draws on best practices from ecological monitoring (Fletcher et al., 2019), data quality management in biodiversity databases (Costello et al., 2013), and data validation principles from the Ocean Biodiversity Information System (OBIS, 2021). In many countries-especially those with limited marine research infrastructure (like Bosnia and Herzegovina)-available biodiversity data may be old or incomplete, collected from local communities, spread across unpublished reports, theses, or grey literature. The OQI provides a structured way to integrate and evaluate all these sources fairly and scientifically. Instead of discarding lower-quality data outright, you score it transparently and make decisions accordingly.

The OQI works by assigning numerical scores to each observation across multiple quality criteria (such as source type, date, frequency of reports, and location accuracy). Each criterion is scored individually (e.g., 1-4 points), and the final OQI is calculated as the average of these scores:

OQI = Sum of all criteria scores / Number of criteria

Each observation was assigned a score for all six criteria (Table1).

Table 1 Scoring system and interpretation of OQI score

Criterion	Scoring System
1.Source reliability	4 = Peer-reviewed article 3 = Grey literature (e.g., reports, theses) 2 = News/media 1 = Interviews/community knowledge

Criterion	Scoring System
2. Temporal Relevance	4 = Recent (<10 years) 3 = Medium-term (10–30 years) 2 = Historical (>30 years) 1 = Unknown
3. Taxonomic Certainty	4 = Expert-identified with clear documentation 3 = Matched in WoRMS 2 = Field ID without expert 1 = Unverified/local names
4. Geographic Precision	3 = Exact location (e.g., GPS or named site) 2 = Approximate region 1 = Unknown or vague
5. Observation Frequency	4= ≥5 independent sources 3 = 3–4 sources 2 = 2 sources 1 = 1 source
6. Cross-Validation	3 = More than two different source types confirm 2 = Two types confirm 1 = One type only

OQI Score	Interpretation	Action
3.5–4.0	High Confidence	Include in baseline, usable for policy
2.5–3.4	Moderate Confidence	Use cautiously, prioritize for re-check
<2.5	Low Confidence	Flag for verification, not used for trend analysis

This scoring helps prioritize which species records need further validation, and which can be used confidently in decision-making, such as marine spatial planning or environmental reporting under frameworks like the EU Marine Strategy Framework Directive (McQuatters-Gollop et al., 2019).

RESULTS

After we have taken into account all available data, the preliminary list contains a total of 110 species, of which 4 are mammals, 3 of which have high reliability of presence and one has low reliability. Of the ichthyofauna, all 13 species belonging to the class Elasmobranchii are with medium confidence, while in bony fishes, 21 species are present with high confidence, 69 with medium confidence and 3 species with low confidence according to Observation Quality Index (Table 2).

Table 2 Preliminary checklist of marine mammals and ictyofauna

N	Species Name	Source Reliability	Temporal Relevance	Geographic Precision	Taxonomic Certainty	Obs. Freq.	Cross-Val.	OQI	Confidence
	Klasa MAMMALIA Linnaeus, 1758								
1	*Balaenoptera physalus* (Linnaeus, 1758)	2	4	3	2	1	1	2,17	L
2	*Delphinus delphis* (Linnaeus, 1758)	4	4	3	4	4	2	3,50	H
3	*Monachus monachus* (Hermann, 1779)	4	4	3	3	3	3	3,33	H
4	*Tursiops truncatus* (Montagu, 1821)	4	4	3	4	4	2	3,50	H
	Klasa ELASMOBRANCHII Bonaparte, 1838								
1	*Dasyatis pastinaca* (Linnaeus, 1758)	4	4	3	4	2	2	3,17	M
2	*Mustelus asterias* (Cloquet, 1819)	4	4	3	4	2	2	3,17	M
3	*Mustelus mustelus* (Linnaeus, 1758)	4	4	3	4	2	2	3,17	M
4	*Mustelus punctulatus* (A. Risso, 1827)	4	4	3	4	2	2	3,17	M
5	*Myliobatis aquila* (Linneaus, 1758)	4	4	3	4	2	2	3,17	M
6	*Prionace glauca* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
7	*Raja clavata* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
8	*Raja miraletus* (Linnaeus, 1758)	4	4	3	4	2	2	3,17	M
9	*Scyliorhinus canicula* (Linnaeus, 1758)	4	4	3	4	2	2	3,17	M
10	*Scyliorhinus stellaris* (Linnaeus, 1758)	4	4	3	4	2	2	3,17	M
11	*Squalus acanthias* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
12	*Squatina squatina* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
13	*Torpedo marmorata* (Risso, 1810)	4	4	3	4	1	1	2,83	M
	Klasa ACTINOPTERYGII Klein, 1885								
1	*Acipenser sturio* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
2	*Aidablennius sphynx* (Valenciennes, 1836)	4	2	3	4	1	1	2,50	M
3	*Alosa fallax* (Lacepède, 1803)	4	2	3	4	1	1	2,50	L
4	*Aphia minuta* (Risso, 1810)	4	2	3	4	1	1	2,50	M
5	*Arnoglossus kessleri* (Schmidt, 1915)	4	2	3	4	1	1	2,50	M
6	*Arnoglossus laterna* (Walbaum, 1792)	4	2	3	4	1	1	2,50	M
7	*Arnoglossus thori* (Kyle, 1913)	4	2	3	4	1	1	2,50	M

N	Species Name	Source Reliability	Temporal Relevance	Geographic Precision	Taxonomic Certainty	Obs. Freq.	Cross-Val.	OQI	Confidence
8	*Atherina (Hepsetia) boyeri* (Risso, 1810)	4	2	3	4	1	1	2,50	M
9	*Atherina hepsetus* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
10	*Belone belone* (Linnaeus, 1760)	4	4	3	4	4	4	3,83	H
11	*Microlipophrys dalmatinus* (Steindachner & Kolombatovic, 1883)	4	2	3	4	1	1	2,50	M
12	*Blennius ocellaris* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
13	*Parablennius sanguinolentus* (Pallas, 1814)	4	2	3	4	1	1	2,50	M
14	*Boops boops* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
15	*Callionymus maculatus* (Rafinesque, 1810)	4	2	3	4	1	1	2,50	M
16	*Cepola macrophthalma* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
17	*Chelidonichthys lastoviza* (Bonnaterre, 1788)	4	2	3	4	1	1	2,50	M
18	*Chromis chromis* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
19	*Citharus linguatula* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
20	*Conger conger* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
21	*Coris julis* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
22	*Coryphoblennius galerita* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
23	*Dentex dentex* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
24	*Dentex gibbosus* (Rafinesque, 1810)	4	2	3	4	1	1	2,50	M
25	*Dicentratchus labrax* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
26	*Diplodus annularis* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
27	*Diplodus puntazzo* (Cetti, 1777)	4	4	3	4	4	4	3,83	H
28	*Diplodus sargus* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
29	*Diplodus vulgaris* (Geoffroy Saint-Hilaire, 1817)	4	2	3	4	1	1	2,50	M
30	*Engraulis encrasicolus* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	L
31	*Eutrigla gurnardus* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M

N	Species Name	Source Reliability	Temporal Relevance	Geographic Precision	Taxonomic Certainty	Obs. Freq.	Cross-Val.	OQI	Confidence
32	*Gobius bucchichi* (Steindachner, 1870)	4	2	3	4	1	1	2,50	M
33	*Gobius cobitis* Pallas, 1814	4	2	3	4	1	1	2,50	M
34	*Gobius cruentatus* Gmelin, 1789	4	2	3	4	1	1	2,50	M
35	*Gobius geniporus* Valenciennes, 1837	4	2	3	4	1	1	2,50	M
36	*Gobius niger* Linnaeus, 1758	4	2	3	4	1	1	2,50	M
37	*Hippocampus guttulatus* (Cuvier, 1829)	4	4	3	4	4	3	3,67	H
38	*Hippocampus hippocampus* (Linnaeus, 1758)	4	2	3	4	2	2	2,83	M
39	*Labrus merula* Linnaeus, 1758	4	4	3	4	4	4	3,83	H
40	*Lepidopus caudatus* Euphrasen, 1788	2	4	3	4	1	1	2,50	L
41	*Lepidotrigla cavillone* (Lacepède, 1801)	4	2	3	4	1	1	2,50	M
42	*Lesueurigobius suerii* (Risso, 1810)	4	2	3	4	1	1	2,50	M
43	*Lichia amia* Linnaeus, 1785	4	2	3	4	1	1	2,50	M
44	*Lithognathus mormyrus* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
45	*Merluccius merluccius* (Linnaeus, 1758)	4	4	3	4	2	2	3,17	M
46	*Mola mola* (Linnaeus, 1758)	4	4	3	4	1	1	2,83	M
47	*Monochirus hispidus* Rafinesque, 1814	4	2	3	4	1	1	2,50	M
48	*Mugil cephalus* Linnaeus, 1758	4	4	3	4	2	2	3,17	M
49	*Mullus barbatus* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
50	*Mullus surmuletus* Linnaeus, 1758	4	4	3	4	4	4	3,83	H
51	*Oblada melanurus* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
52	*Oedalechilus labeo* (Cuvier, 1829)	4	2	3	4	1	1	2,50	M
53	*Ophidion barbatum* Linnaeus, 1758	4	2	3	4	1	1	2,50	M
54	*Pagellus acarne* (Risso, 1827)	4	2	3	4	1	1	2,50	M
55	*Pagellus bogaraveo* (Brünnich, 1768)	4	2	3	4	1	1	2,50	M
56	*Parablennius gattorugine* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
57	*Parablennius tentacularis* (Brunnich, 1768)	4	4	3	4	2	2	3,17	M

N	Species Name	Source Reliability	Temporal Relevance	Geographic Precision	Taxonomic Certainty	Obs. Freq.	Cross-Val.	OQI	Confidence
58	*Pagellus erythrinus* (Linnaeus, 1758)	4	4	3	4	2	2	3,17	M
59	*Platichthys flesus* (Linnaeus, 1758)	4	4	3	4	2	2	3,17	M
60	*Salaria pavo* (Risso, 1810)	4	2	3	4	1	1	2,50	M
61	*Sardina pilchardus* (Walbaum, 1792)	4	4	3	4	4	4	3,83	H
62	*Sarpa salpa* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
63	*Sciaena umbra* Linnaeus, 1758	4	2	3	4	1	1	2,50	M
64	*Scomber scombrus* Linnaeus, 1758	4	2	3	4	1	1	2,50	M
65	*Scorpaena notata* Rafinesque, 1810	4	2	3	4	1	1	2,50	M
66	*Scorpaena porcus* Linnaeus, 1758	4	2	3	4	1	1	2,50	M
67	*Scorpaena scrofa* Linnaeus, 1758	4	4	3	4	4	4	3,83	H
68	*Seriola dumerili* (Risso, 1810)	2	4	3	3	2	2	2,67	M
69	*Serranus hepatus* (Linnaeus, 1758)	4	4	3	4	4	3	3,67	H
70	*Serranus scriba* Linnaeus, 1758	4	4	3	4	4	4	3,83	H
71	*Solea solea* (Linnaeus, 1758)	4	4	3	4	2	2	3,17	M
72	*Sparus aurata* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H
73	*Sphyraena sphyraena* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
74	*Spicara flexuosum* (Rafinesque, 1810)	4	2	3	4	1	1	2,50	M
75	*Spicara maena* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
76	*Spondyliosoma cantharus* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
77	*Symphodus cinereus* (Bonnaterre, 1788)	4	2	3	4	1	1	2,50	M
78	*Symphodus mediterraneus* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
79	*Symphodus ocellatus* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
80	*Symphodus roissali* (Risso, 1810)	4	2	3	4	1	1	2,50	M
81	*Symphodus tinca* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
82	*Synapturichthys kleinii* (Risso, 1827)	4	2	3	4	1	1	2,50	M
83	*Syngnathus tenuirostris* (Rathke, 1837)	4	2	3	4	1	1	2,50	M

N	Species Name	Source Reliability	Temporal Relevance	Geographic Precision	Taxonomic Certainty	Obs. Freq.	Cross-Val.	OQI	Confidence
84	*Trachinus draco* Linnaeus, 1758	4	4	3	4	2	2	3,17	M
85	*Trachinus radiatus* Cuvier, 1829	4	2	3	4	1	1	2,50	M
86	*Trachurus mediterraneus* (Steindachner, 1868)	4	2	3	4	1	1	2,50	M
87	*Trachurus trachurus* (Linnaeus, 1758)	4	2	3	4	1	1	2,50	M
88	*Tripterygion melanurus* Guichenot, 1850	4	2	3	4	1	1	2,50	M
89	*Tripterygion tripteronotum* (Risso, 1810)	4	4	3	4	3	3	3,50	H
90	*Uranoscopus scaber* Linnaeus, 1758	4	2	3	4	1	1	2,50	M
91	*Xiphias gladius* Linnaeus, 1758	4	2	3	4	1	1	2,50	M
92	*Zeugopterus regius* (Bonnaterre, 1788)	4	2	3	4	1	1	2,50	M
93	*Zeus faber* (Linnaeus, 1758)	4	4	3	4	4	4	3,83	H

DISCUSSION AND CONCLUSION

The preliminary inventory of marine mammals and ichthyofauna biodiversity in B&H, comprising 110 species including 4 marine mammals and 106 fish species provides a foundational assessment of species presence and data reliability through the application of the Observation Quality Index (OQI). This tool enabled us to categorize the confidence level of species occurrences into high, medium, and low, thus offering a structured method to evaluate the quality of the existing biodiversity records.

The detection of four marine mammal species, with three identified with high confidence, underscores their credible and likely recurring presence within the limited marine territory of B&H, specifically the Adriatic Sea near Neum. This is in line with regional cetacean distributions noted in the central and southern Adriatic basins (Holcer et al., 2015; Fortuna, 2006). The single low-confidence mammal record, however, signals a potential knowledge gap or rare vagrancy that requires targeted verification through future surveys or citizen science efforts. Within ichthyofauna, the classification of all 13 Elasmobranchii (sharks and rays) species under medium-confidence status reflects the general scarcity and patchiness of elasmobranch data in the Adriatic Sea, a concern previously highlighted by Ferretti et al. (2013). Elasmobranchs are known to be under-reported due to their elusive behavior, low abundance, and limited fisheries data in this region (Dulčić and Dragović, 2017), making the medium-confidence categorization consistent with regional patterns of data deficiency.

Bony fishes presented a more detailed distribution across the confidence spectrum, with 21 species confidently confirmed, 69 species marked with medium confidence, and only three species categorized with low confidence. This skew toward medium confidence highlights moderate uncertainty, possibly due to inconsistencies in species identification, underreporting, or outdated records. Nevertheless, the relatively high number of high-confidence records may reflect better documentation of commercially relevant or commonly observed species. This result supports previous findings that coastal fish biodiversity in the Adriatic region is relatively well documented, especially in the northern and central sectors (UNEP/MAP, 2012), although data may still be sparse for certain microregions like B&H's limited coastline. Our result of 106 total species, with 13 Elasmobranchii, could suggest that the studied area harbors about 25-30% of the total known fish biodiversity of the Adriatic Sea, Elasmobranchii species also indicates a relatively healthy representation of these often vulnerable taxa, particularly given their slow growth rates, late maturity, and low reproductive rates.

The use of the Observation Quality Index proved essential in assessing not just species richness but the reliability of each record. This tiered approach enables prioritization in future research and conservation. High-confidence species can form the core of national biodiversity monitoring programs, while medium- and low-confidence species highlight areas where further survey effort is urgently needed. Additionally, these results stress the importance of integrating citizen science platforms and harmonizing data standards across borders to enhance the spatial and temporal resolution of biodiversity data (Boero et al., 2015).

Overall, this inventory, though preliminary, reveals a diverse but unevenly documented marine biota in Bosnia and Herzegovina. Continued efforts to improve data quality, particularly for elasmobranchs and low-confidence taxa, are crucial for informed conservation planning, fisheries management, and reporting obligations under international biodiversity frameworks such as the EU Marine Strategy Framework Directive and the Convention on Biological Diversity.

From a One Health perspective, maintaining accurate and high-quality marine biodiversity inventories is not only essential for ecosystem conservation but also for safeguarding human and animal health. Marine mammals and fish serve as indicators of ocean health, and their well-being is closely linked to environmental conditions, pollution levels, and anthropogenic pressures-all of which can have direct or indirect impacts on human populations. In this context, the quality and reliability of species occurrence data become critical for early detection of ecological imbalances, zoonotic risks, and food safety issues related to fisheries. Strengthening biodiversity monitoring through a One Health lens supports a more integrated and preventative approach to environmental management, public health, and sustainable development in Bosnia and Herzegovina and the wider Adriatic region.

Given the limited marine area of Bosnia and Herzegovina and its ecological connection to the greater Adriatic Sea, continued regional cooperation, capacity building, and the integration of standardized monitoring methods are essential. Strengthening biodiversity inventories with verified, high-quality data will be vital for supporting sustainable marine resource management and fulfilling international conservation obligations.

CONFLICT OF INTEREST

The authors declared that there is no conflict of interest.

CONTRIBUTIONS

Conception: MČ, AK; Design: MČ, AK; Supervision: AA; Materials: MČ,AK; Data Collection and/or Processing: MČ, AK; Analysis and/or Interpretation: MČ, AK; Literature Search: MČ, AK; Writing– Original Draft: MČ, AK; Critical Review: MČ, AK, AA

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PRELIMINARNA LISTA IHTIOFAUNE I MORSKIH SISARA U PRIMORSKIM VODAMA BOSNE I HERCEGOVINE: OSNOVA ZA ZAŠTITU, MONITORING I PRISTUP "ONE HEALTH"

SAŽETAK

Ograničena obalna zona Bosne i Hercegovine duž Jadranskog mora predstavlja jedinstven i nedovoljno istražen morski ekosistem. Ova studija prikazuje prvi preliminarni strukturirani popis morskih vrsta riba i sisara u teritorijalnim vodama zemlje, obuhvatajući 110 vrsta (106 riba i 4 morska sisara), prikupljenih iz historijskih izvora, sive literature i lokalnog znanja. Korištenjem standardizovanog Indeksa kvaliteta opažanja (OQI), vrste su svrstane u kategorije visoke, srednje ili niske pouzdanosti na osnovu kriterija kvaliteta podataka. Spisak je identificirao 21 vrstu košljoriba i tri vrste morskih sisara s visokim stepenom pouzdanosti, dok je većina hrskavičavih riba (13 vrsta) i košljoriba (69 vrsta) svrstana u kategoriju srednje pouzdanosti, što odražava nedostatak regionalnih podataka i slabu dokumentaciju. Nalazi predstavljaju ključnu osnovu biodiverziteta za buduća istraživanja, očuvanje mora i upravljanje okolišem u regiji. Pored toga, studija naglašava važnost integracije procjene kvaliteta podataka i pristupa „One Health", prepoznajući međusobnu povezanost zdravlja morskih ekosistema, očuvanja biodiverziteta i ljudskog blagostanja. Ovaj inventar podržava nacionalne i regionalne napore za ispunjavanje međunarodnih obaveza u praćenju biodiverziteta i ističe potrebu za kontinuiranim istraživanjima mora i prekograničnom saradnjom u Jadranskom moru.

Ključne riječi: Inventar vrsta, morska ihtiofauna, morski sisari, One Health