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Hidden treasure of biodiversity in Afghanistan: Ichthyofauna

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Abstract

We have been preparing, via deskwork, an updated checklist of Afghan fish species. Therefore, except for Coad (1981), all studies, including our updated checklist study, are desk-based studies. Based on our literature review, according to tentative figures, a total of 123 fish species live in six river basins in Afghanistan. The confirmed ichthyofauna of Afghanistan comprises 123 species belonging to 12 orders and 23 families and 70 genera (Kelzang et al., 2021; Çiçek et al., 2023; Majidi & Mansoor, 2023). Among these, 23 species (18.7%) are alien and 7 species (5.7%) are considered as endemic to Afghanistan. By excluding the 48 species from the checklist. In particular, it should be clarified whether species known to be distributed in neighboring countries within the same basin are also found in Afghanistan. Some of these species are likely to be present. However, even if there is a connected basin, it is a fact that it will not be possible to find some species in high-altitude rivers originating from Afghanistan due to the bioecological differences of fish. This literature review provides a discussion of the diversity of known species, as well as some controversial issues that need to be clarified.

Keywords: Afghanistan, biodiversity, freshwater fish, flora, fauna, conservation

Introduction

A comprehensive assessment of available information on a country's biodiversity status and threats is essential for scientists, policymakers, resource managers, and the public to effectively evaluate the impact of anthropogenic activities on national biodiversity (Maldonado-Ocampo et al., 2008). Under these circumstances, it is critical for countries to develop comprehensive checklists of their flora and fauna. These checklists can provide valuable recommendations for further research on the nation's biodiversity. Since these checklists are primarily based on earlier data from previous compilations, future research will contribute to the expansion and refinement of our knowledge of species-level diversity, many components of which remain poorly understood or, in numerous instances, unknown. The lists of flora and fauna in Afghanistan are still incomplete. It is important to interpret this ratio cautiously, considering the numerous uncertainties regarding

the number of flora and fauna species residing in Afghanistan and the significant gaps in our knowledge of their actual geographic distributions.

Afghanistan is a landlocked country located at the crossroads of Central Asia and South Asia. It is bordered by Pakistan to the east and south, Iran to the west, Turkmenistan to the northwest, Uzbekistan to the north, Tajikistan to the northeast, and China to the northeast and east. Historically, Afghanistan has been a focal point of invasions and conflicts due to its strategic location on significant trade routes. More recently, the war and conflict that started with the Russian occupation in 1979 have evolved into a civil war. Since the late 1970s, Afghanistan's history has been dominated by extensive warfare, including coups, revolutions, invasions, insurgencies, and civil wars. Up to date, the governments have changed hands after working for a short time, and stability could not be achieved.

The prolonged effects of war have subjected Afghanistan to high levels of conflict, poverty, and child malnutrition. Consequently, biodiversity and conservation efforts have been largely neglected. Afghanistan's biodiversity is being degraded as immediate needs, ongoing conflict, internal displacement, high population growth rates, poverty, and low levels of education prioritize survival over the long-term sustainability of natural resources (Anonymous, 2008). The direct and indirect damages inflicted by wars on Afghanistan's environmental resources may represent the second most significant loss after human resources (Formoli, 1995). Over decades of discord and power struggles, the country's natural landscapes and resources have suffered immensely, resulting in large swathes of degraded land and declining wildlife populations (Kanderian et al., 2011). Additionally, the lack of security across the country has hindered field researchers from accessing remote areas and surveying the wildlife that still inhabits these regions.

The historical collections, museum materials, records, and data on Afghanistan's flora and fauna have been lost or destroyed, significantly reducing the technical capacity that once existed within the country's government and academic institutions (Dehgan et al., 2007; Scott, 1995). Analyzing recorded species in Afghanistan is challenging due to taxonomic confusion and questionable record-keeping practices. Despite these challenges, the country serves as a critical stopover for many migratory birds along the Central Asian flyway. However, there is limited knowledge about the reptile, fish, and amphibian life in Afghanistan, with minimal research conducted on insects, vascular plants, lichen, or fungi (Kanderian et al., 2011).

As a result of civil wars and various conflicts, actions were taken in the early 2000s to protect biodiversity. Although these conflicts have diminished in intensity, the National Environmental Protection Agency, with technical and advisory inputs from relevant government agencies, non-governmental organizations, international organizations, and user groups at national and provincial levels, has prepared the National Biodiversity Profile and National Biodiversity Strategy and Action Plan for Afghanistan (Anonymous, 2014). The primary objective of this action plan is to conserve all aspects of Afghanistan’s biodiversity and ensure the sustainable utilization of the country's natural resources. These programs focus on several components: wildlife and rangeland assessments and monitoring, community conservation, wildlife trade, wildlife health, protected area management and policy, and governance. Despite these efforts, the reports emphasize the lack of comprehensive species lists. It has been noted that the available lists are based on outdated data and may also include species distributed in neighboring countries. Consequently, there remains a significant number of unspecified species in the current lists.

The current status of wildlife and conservation in Afghanistan has been evaluated and discussed by Kanderian et al. (2011). In this context, significant efforts to protect Afghanistan’s biodiversity have been driven by an intensive strategy aimed at building capacity and technical skills within government institutions. Training and capacity development are fundamental to conservation work and are expected to eventually enable the country to independently manage its wildlife preservation programs. In the field, government staff have been trained to conduct public outreach and environmental education programs that raise awareness and strengthen government relations with local communities. Additionally, staff

have received technical training on conducting wildlife surveys and assimilating data for conservation planning purposes (Stevens and Rahimy, 2009). Despite notable improvements towards a healthier environment and the rehabilitation of wildlife populations, several threats to Afghanistan's wildlife persist. Without proactive measures, these threats are likely to undermine many of the advances made and exacerbate the country's environmental crisis. Despite decades of conflict and subsequent environmental damage, Afghanistan has made remarkable progress in a relatively short period towards implementing modern systems for the conservation and sustainable management of its wildlife and other natural resources. However, substantial efforts are still required to ensure the survival of Afghanistan's unique assemblage of wildlife.

With scarce data, establishing the numbers of species and the status of wildlife populations in Afghanistan is challenging. Nonetheless, a picture of the country's biodiversity can be pieced together from previous expeditions, as well as recent data from neighbouring countries, and those collected data will be combined with new fieldwork that will begin in Afghanistan.

A country's biodiversity is one of its most valuable assets. However, when considered globally, biodiversity should be regarded as the common heritage of humanity (Çiçek et al., 2020). Considering this situation, it is crucial to reveal the biodiversity of any country, determine the distribution areas of species, assess their protection status and threats, and take measures to ensure their continuity. Biodiversity holds significant value for Afghans, primarily through the tangible goods and services it provides. Direct uses include traditional crops, fruits, grazing, fuel, timber harvesting, fishing, and hunting. Additionally, biodiversity offers crucial indirect "ecosystem services" such as soil fertility, erosion control, crop pollination, and climatic stability. These ecosystem services are often overlooked and taken for granted, yet their loss has historically contributed to the decline and collapse of societies, as argued by Diamond (2005).

Political boundaries, drawn by people, have no importance in the distribution of living species. Therefore, it is vital to produce data by conducting studies on biodiversity at certain standards in each country. Missing such data in a country means that the puzzle cannot be completed due to missing pieces, making it impossible to present a general picture. If such studies cannot be carried out in any country due to reasons such as political turmoil, financial inadequacy, a lack of human resources, or a lack of technical capacity, it is a responsibility on behalf of humanity to seek support from the international community in this regard.

Science is above all political strife. It is important not to ignore the support of biodiversity studies because of the way a country is governed or the governing powers. For this reason, it is necessary to support the scientific field studies that are desired to be carried out in Afghanistan under the Taliban administration. The Taliban, who are in control of Afghanistan, should not ignore the importance of studies on biodiversity in the process of shaping the country's government. In addition, legal regulations for the protection of biodiversity should be prepared and put into effect in accordance with international norms. Afghanistan has an important role to play in global biodiversity conservation (Kanderian et al., 2011). Thanks to the work to be supported by international funds, it will be possible to uncover Afghanistan's hidden and lost biodiversity treasure. In addition, it will be possible to contribute to the development of human resources in this field in the country. However, an acute shortage of technical expertise and institutions specializing in biodiversity is among the primary concerns for biodiversity conservation in Afghanistan today, alongside other pressing issues (Saidajan, 2012).

Under these circumstances, the ichthyofauna of Afghanistan is used as an example.

Exploring Fishes of Afghanistan

Afghanistan's relatively rich water resources depend mainly on the high mountain ranges such as the Hindu Kush and Kuh-e-Baba, which function as natural water storage with snow during the winter and snowmelt in the summer, supporting perennial flow in all the major rivers. Almost all major rivers in Afghanistan originate in the central highland's region or the north eastern mountains. There are five watersheds in the country and four non-drainage areas (Favre, 2004). The five major river basins are: Amu Darya/Panj, Northern River Basin, Hari Rud Basin, Kabul River Basin, and Helmand-Siestan Basin. Additionally, many rivers are shared with Afghanistan's neighboring countries.

An obvious starting point and fundamental step to conserving biodiversity and developing conservation and management strategies is the correct identification and delineation of the taxonomic units (populations/species) and their distributions, especially for endemic and native fish fauna Çiçek et al. (2015, 2018, 2020). Studies, both formal and informal, conducted during the last decade have significantly increased the knowledge of the world's freshwater fish diversity. There are currently 36,345 valid fish species, with roughly half of them restricted to freshwaters. From 2003 to 2022, a total of 8,029 new species were described (Fricke et al. 2022). Despite the abundance of publications on freshwater fish taxonomy in many parts of the world, the data set for Afghanistan remains exceptionally poor.

Except for the little and outdated information available in the literature, our knowledge of the fish fauna of Afghanistan is severely limited. Coad (1981) published the first comprehensive checklist of Afghanistan fishes. Coad (1981) reviewed the literature published since 1842 by McClelland and listed a total of 84 species, plus 18 species that are possible to distribute in the country, living in contiguous or confluent drainages. Coad (2014) wrote the first comprehensive book on Afghanistan's freshwater ichthyofauna, including identification keys, ecology, and distribution. The book includes 85 native fish species, 17 exotic species, and list of species living in confluent drainages. Then the revised checklist was prepared by Coad (2015), with 85 native species belonging to 10 families.

In the Biodiversity Profile of Afghanistan prepared by the United Nations Environment Programme, a Coad's checklist was further updated in Fish Base (Anonymous 2023). The current checklist contains 101 species of known Afghan fish species, with another 38 species suspected to occur in the country. However, the information provided in Fish Base is ambiguous and needs to be verified with fieldwork. Essentially, there has been no ichthyological research in Afghanistan for the past four decades. The most recent field-based studies on the fish fauna of Afghanistan have been conducted by Coad (1981). Therefore, all this information needs to be verified with up-to-date field studies. Therefore, it can be said that the current state of freshwater fish biodiversity in Afghanistan is unknown. Indeed, Coad (1981, 2014) believes that the checklist underestimates, perhaps to a significant degree, the actual richness of that freshwater ichthyofauna. Kottelat & Whitten (1996) have similarly noted that the Afghan ichthyofauna has not been well studied and is probably more diverse than indicated by previous checklists.

We have been preparing, via deskwork, an updated checklist of Afghan fish species. Therefore, except for Coad (1981), all studies, including our updated checklist study, are desk-based studies. Based on our literature review, according to tentative figures, a total of 123 fish species live in six river basins in Afghanistan. The confirmed ichthyofauna of Afghanistan comprises 123 species belonging to 12 orders and 23 families and 70 genera (Kelzang et al., 2021; Çiçek et al., 2023; Majidi & Mansoor, 2023). Among these, 23 species (18.7%) are alien and 7 species (5.7%) are considered as endemic to Afghanistan. By excluding the 48 species from the checklist. In particular, it should be clarified whether species known to be distributed in neighboring countries within the same basin are also found in Afghanistan. Some of these species are likely to be present. However, even if there is a connected basin, it is a fact that it will not be possible to find some species in high-altitude rivers originating from Afghanistan due to the bioecological differences of fish. This literature review provides a discussion of the diversity of known species, as well as some controversial issues that need to be clarified.

Endemic Species

Endemic fishes are an important part of the natural heritage of each country. Their conservation has implications on a world-wide basis since, by definition, an endemic taxon is found nowhere else. Areas with significant numbers of endemics and/or systematically significant endemics are prime candidates for conservation. On this basis, these areas can be useful indicators to show priorities in the management and protection of natural biodiversity (Coad, 2006).

A total of seven species of fish are endemic to Afghanistan viz.: *Glyptosternon akhtari*, *Paracobitis ghazniensis*, *Triplophysa akhtari*, *Schizothorax edeniana*, *Schizocypris ladigesi*, *Triplophysa farwelli*, and *Triplophysa kullmanni*. By the way, the validity of some fish whose type locality is Afghanistan is still doubtful due to the lack of detailed studies on them. These are *Cirrhinus burnesiana* McClelland 1842, *Schizothorax barbatus* McClelland & Griffith 1842, *Schizothorax gobioides* (McClelland 1842), and *Salmo orientalis* McClelland 1842. Whether the current status of these species is valid or not remains to be clarified with specimens from type localities. Unfortunately, there is not much information on the biology, ecology, distribution, threats, etc. of these species, and even photographs of these species are not available. Additionally, the IUCN threatened category has not been determined for any endemic species.

Conservation

The IUCN Red List criteria and threats for the endemic fish species are presented in Figure 1. Among 123 listed fishes, 19 species (15.5%) are categorized as threatened extinction, with 4 (3.3%) CR, 6 (4.9%) EN and 9 (7.3%) VU. Out of the total number of taxa assessed, 4.9% (6 species) is NT, and 51.2% (63 species) LC (Figure 1). A total of 29 species are (23.6%) not assigned (NE) and 5 species (4.1%) classified as DD with i.e. with no insufficient knowledge. Therefore, the evaluation of these species, classified as DD or NE, must be done as soon as possible. No formal assessment has been made of species at risk at the national scale, but many species, in particular large mammals, are obviously at risk of extinction within Afghanistan. One Afghan taxon (species or subspecies) is considered globally extinct (the Caspian tiger), 7 are critically endangered, 8 are endangered, and 31 are vulnerable (UNEP, 2008).

Alien Species

The introduction of some exotic fishes, particularly into inland waters, has had catastrophic ecological and economic consequences such as competition, predation, habitat change, genetic change and transmission of pathogens. Introductions of exotic fishes are always considered risky for the native fish fauna (Çiçek et al., 2020, 2022). To date, a total of 23 exotic species have been deliberately or accidentally introduced into Afghanistan's inland waters (Çiçek et al., 2023). There is lack of information about whether some exotic species have been naturalized in the wild or not. The establishment of some species is controversial. The current presence of some species in Afghanistan needs confirmation by specimens. Exotic species and their distribution in the country should be determined. In addition, their effects on the ecosystem should be revealed. If there are adverse effects on the ecosystem and natural species, management plans should be established in order to reduce and eliminate these effects.

Controversial Species

A serious problem in the recent ichthyological literature is the citation of doubtful records without any effort to verify them that had been led to a great number of errors until very recently (Kottelat & Freyhof, 2007). Hence when we were preparing this checklist, we re-checked every record to verify their presence or absence, which was quite a difficult task (even for experienced taxonomists) particularly because of scarcity of ichthyological collections/museums in Afghanistan and prevalent inaccuracies in some older literature i.e. these errors were accumulated over long periods of time.

A total of 48 species recorded in Afghanistan are misidentifications or other erroneously recorded as defined (Çiçek et al., 2023). The systematic validity of four species is uncertain, these species should be clarified by field sampling. 14 species have a probable distribution in Afghanistan, but need to be confirmed by sampling. In addition, 30 species excluded from the list of country were reported to be misidentified or incorrectly.

Possible Distributed Species

The freshwater ichthyofauna of Afghanistan still incomplete. Some species are known from rivers that cross the Afghan boundary, but which lie mostly in another country, particularly Iran and Pakistan. These species have not been confirmed for Afghanistan, in some cases from absence of collections within Afghanistan and in some cases because only headwaters occur in Afghanistan and may not have the diversity recorded downstream in Pakistan where the river is larger and provides a more diverse habitat. Such species are not included here although it is expected that some will eventually prove to be part of the Afghan ichthyofauna. Presence of these species should be clarified by field sample.

Some species were first described from Afghanistan, published works give clear distributional records for Afghanistan, museum specimens record occurrence, and presence in neighbouring countries where the water body is shared with Afghanistan and there are no natural barriers to the species presence in Afghanistan (notably the Amu Darya River border in the north and the Sistan lakes straddling the border with Iran in the west).

Kottelat and Whitten (1996), in their assessment of biodiversity in Asia, note that no country-wide survey of Afghanistan has been done and virtually all fish samples are chance collections by non-specialists. Knowledge of the fauna is very fragmentary; many additional species should be expected, and, given the topography, it is likely that many species would have very restricted ranges. They estimate that the described species represent only half of the total number of species present (Coad, 2014).

Future works

Based on our literature review, we conclude that Afghanistan's fish fauna has not been fully revealed, and there are critical errors and deficiencies. The range in numbers results from uncertainty in taxonomy and the questionable validity of some records. Much more basic biological survey work and synthesis need to be done to fully understand the country's biodiversity. There has been essentially no ichthyological fieldwork done in the country for the past four decades. For this reason, new collections are needed. Only with newly collected specimens will be possible to compile and verify an up-to-date list of the country's fish fauna.

Furthermore, none of the freshwater fishes in Afghanistan have been subjected to molecular analyses to study their distinctiveness and relationships with other faunas. With respect to Afghanistan, DNA sequence data hosted by the National Center for Biotechnology Information is largely restricted to cultivated plants and domesticated animals.

In addition, recent developments in the field of genetics (e.g., next-generation sequencing of entire genomes) have made great contributions to the taxonomy and systematics in recent years. In this way, many new species have been identified, and other species have been shown to be more widespread than previously thought (e.g., widespread populations represent one instead of multiple species). For this reason, tissue samples obtained from Afghanistan will be of great value to new and ongoing studies (e.g., fishlife, https://www.fishtree.org). Studies of the genetic diversity of Afghan fishes will help clarify the status of controversial species and evaluate faunal differences between freshwater ecoregions shared with different countries.

The political history of Afghanistan, including the rise of the Taliban in 1994, their rule from 1996 to 2001, and the subsequent events leading to their return to power in 2021, has significantly impacted the country's biodiversity studies. After years of neglect, Afghanistan

is now recognized as a crucial piece of the puzzle in Central Asia in terms of global biodiversity.

After years of neglect, this country is like the missing piece of the puzzle in central Asia in terms of world biodiversity. The completion of this missing piece is important not only for Afghanistan, but also for other countries sharing the same basin, and most importantly for the world. Unfortunately, the international community has been blind and deaf to the plight of the country in the aftermath of the Russian invasion, the civil war, the American presence and the NATO Involvement. The international community needs to give up this ignorance and immediately provide technological, budgetary and human resources to reveal the country's biodiversity and take the necessary steps to protect it. In this context, the Taliban government, which aspires to rule a country, should immediately take the necessary measures to identify the country's biodiversity and then take the necessary measures for its sustainable use and protection.

Considering that biologists have hardly been able to do any fieldwork in Afghanistan for the last 45 years, this is a great opportunity to do fieldwork all over the country when conditions are relatively safe. Putting all divisions aside, tomorrow is too late, today is the time to get to work for Afghanistan's biodiversity. It is now or may be never.

In the light of the facts described above, it is essential to carry out studies on the ichthyofauna in Afghanistan in the near future on the following summarized issues.

In light of the facts described above, it is essential to conduct studies on the ichthyofauna in Afghanistan in the near future, focusing on several key issues. These include conducting fieldwork throughout the entire country to collect fish samples from various habitats, using a variety of gear and resources. It is important to take live photos of fish species in aquariums and properly preserve fish samples in formaldehyde solution. Additionally, tissue samples from various regional populations should be collected and preserved for genetic analysis.

Identifying and cataloguing voucher specimens into research collections in Afghanistan and, if possible, in museums abroad is crucial. Employing genetic analyses will aid in resolving taxonomic and systematic problems, with genetic data being deposited in the publicly available GenBank hosted by the National Centre for Biotechnology Information (https://www.ncbi.nlm.nih.gov). Determining new and potentially endemic species, assembling a current faunal list based on historical records and newly collected specimens, and preparing distribution maps of fish species are also essential tasks.

Furthermore, preparing an identification key and photographic atlas of Afghan fish, recording data on ecological conditions and anthropogenic threats at all collecting sites, and determining exotic species and their adverse effects on native species are necessary steps. Determining the IUCN category for not yet evaluated species, prioritizing species that need protection, estimating population status using habitat information and niche modeling, and gathering information essential for future conservation plans are all critical for the conservation of Afghanistan's ichthyofauna.

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