

Fish Biodiversity in Ain Al-Ghazala Lagoon

Amani Fitori^{1*} , Alia Salem² 

¹Department of Marine Resources, Faculty of Natural Resources, Tobruk University, Libya

²Department of Zoology, Faculty of Science, Derna University, Libya

Corresponding Email. amani.fitori@tu.edu.ly

Abstract

Ain Al-Ghazala Lagoon, located along the northeastern Mediterranean coast of Libya, is a key coastal ecosystem with rich biodiversity. This study aims to assess the fish species composition and their ecological roles within the lagoon. Fish samples were collected in summer and winter of 2024, with the assistance of local fishermen, and analyzed based on their morphological characteristics. The findings revealed a diverse range of species from the class Actinopterygii, occupying various habitats, including brackish and rocky reef environments. Several species, such as *Atherina boyeri* and *Mugil cephalus*, serve as important prey for higher trophic-level predators, while apex predators like *Epinephelus marginatus* play a key role in maintaining the food web balance. Many species, including *Dicentrarchus labrax* and *Sparus aurata*, have significant economic value in regional fisheries and aquaculture. However, the lagoon also faces ecological threats from invasive Lessepsian species, such as *Siganus luridus* and *Pterois miles*, which disrupt local ecosystems and pose risks to biodiversity. The study underscores the need for effective management strategies to conserve the lagoon's biodiversity and ensure sustainable fisheries. Further research is required to assess the impact of invasive species and to address the combined challenges of overfishing, climate change, and habitat degradation.

Keywords. Fish Biodiversity, Ain Al-Ghazala, Mediterranean Coast, Libya.

Introduction

Lagoons and the Libyan coast serve as crucial habitats that support the productivity and biodiversity of Mediterranean marine life. Marine Protected Areas (MPAs) play a vital role in ensuring sustainable development and preserving marine ecosystems [1]. In many developing countries, local communities rely heavily on lagoons for essential activities such as cooking, washing, fishing, transportation, and irrigation. Ain Al-Ghazala, located on Libya's eastern coast, is a prominent lagoon characterized by a rocky shoreline and minimal tidal variation. Despite the absence of significant tidal movements, the lagoon features extensive shallow areas that sustain a rich diversity of natural species, including mudflats and *Zostera* beds [2-4]. The lagoon's ichthyofaunal diversity makes it an ecologically significant site within the Mediterranean marine environment. Numerous fish species inhabit the lagoon, each contributing to the ecological balance and biodiversity of the region. The survival and distribution of these species are influenced by the lagoon's unique environmental conditions, including water quality and nutrient composition [5].

The fish community in Ain Al-Ghazala Lagoon comprises various species with distinct feeding preferences. For instance, the cuttlefish (*Sepia orbignyana*) exhibits a diverse diet that includes fish remains, seagrass, and crustaceans, with feeding intensity peaking in summer and autumn [6]. Similarly, the diet of the common two-banded sea bream, *Diplodus vulgaris*, varies seasonally and consists of crustaceans, polychaetes, and green algae [7]. Another key species in the lagoon, the thin-lip grey mullet (*Liza ramada*), primarily feeds on diatoms and polychaetes, with feeding activity fluctuating throughout the year [8].

The water quality of Ain Al-Ghazala Lagoon plays a crucial role in supporting the growth and survival of these fish species. It is characterized by high concentrations of various ions and nutrients, which contribute to the lagoon's productivity. However, elevated levels of certain pollutants, such as nitrates and chlorides, highlight the need for effective management strategies to protect this valuable ecosystem [5] (Fitori et al., 2022). The biodiversity of Ain Al-Ghazala Lagoon underscores its ecological significance and the necessity of sustainable conservation measures to safeguard its unique aquatic life. The primary objective of this study is to assess the species richness, abundance, and distribution of fish populations within the lagoon, providing essential insights for future management and conservation efforts.

Methods

Study area

Ain Al-Ghazala Lagoon is located along the Mediterranean coast in northeastern Libya, between latitudes 32.05°–32.15° N and longitudes 23.14°–23.26° E. The lagoon is bordered by sandy beaches interspersed with rocky shorelines, creating a distinctive coastal landscape. Covering an area of approximately 180 hectares, the lagoon extends 6 kilometers in length and 1.5 kilometers in width, with water depths ranging from 3.5 to 5 meters.

At the lagoon's entrance, Almarakeb (Ulbah) Island serves as a natural barrier, reducing the impact of northern winds and wave action, thereby helping to maintain the bay's ecological stability. The surrounding region exhibits diverse topographical features, including narrow coastal plains, low hills to the south with

elevations reaching up to 192 meters above sea level, expansive dunes, and several prominent bays, with Ain Al-Ghazala Bay being the most significant (Fig. 1).

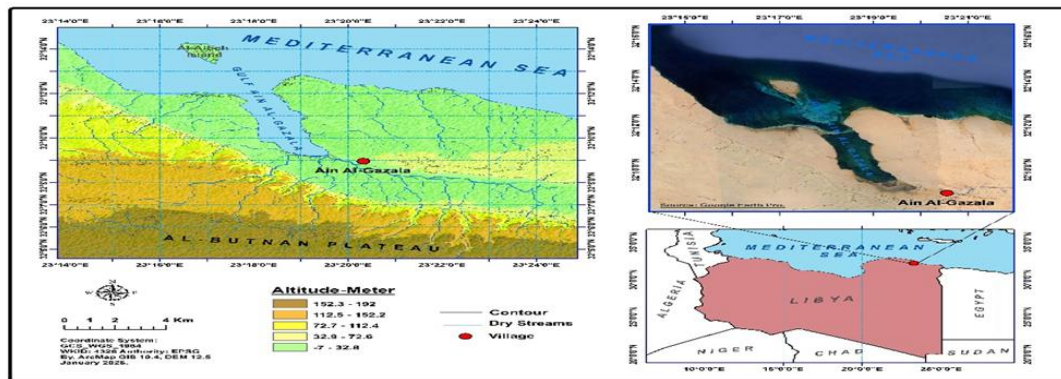


Figure 1. Location of Ain Al-Ghazala Lagoon on the northeastern coast of the Mediterranean Sea in Libya

Sampling

Fish samples were collected during the summer and winter seasons of 2024 with the assistance of local fishermen. The collected specimens were transported to the Marine Resources Department laboratory for identification based on their morphological characteristics. Each species was classified according to its respective phylum, class, and family.

Results and Discussion

Many fish species belonging to the phylum Chordata and the class Actinopterygii, commonly known as ray-finned fishes, are listed in Table 1. The Mediterranean Sea and its adjacent waters, particularly along the Libyan coastline, serve as habitats for most of these species. Their taxonomic diversity highlights the complexity of marine ecosystems and their ecological functions in the region. The fish species in Ain Al-Ghazala Lagoon, characterized by diverse feeding and reproductive strategies, exemplify this ecological complexity. Each species contributes uniquely to the lagoon's biodiversity and productivity, playing a crucial role in maintaining ecological balance. Understanding these roles is essential for the conservation and sustainable management of this vital marine environment [7,9,10,6]. All recorded species belong to the diverse class Actinopterygii, distinguished by the presence of ray-finned structures. Their classification into multiple families suggests a broad range of ecological adaptations. These species occupy various habitats, including demersal, pelagic, and coastal environments. Some species, such as *Atherina boyeri* and *Mugil cephalus*, thrive in brackish and estuarine waters, where they serve as important prey for higher trophic-level predators. Conversely, species such as *Epinephelus marginatus* and *Sphyrna chrysotaenia* are commonly found in rocky reef habitats and deeper waters, functioning as apex predators within the marine food web. The presence of numerous fish species with distinct dietary preferences and ecological roles underscores the biodiversity of Ain Al-Ghazala Lagoon. A thorough understanding of their feeding behaviors and ecological interactions is fundamental for effective biodiversity conservation and management in the lagoon [6,7,10,11].

Many of the species listed hold significant economic value in commercial and recreational fisheries, as well as in aquaculture. Notably, species such as *Dicentrarchus labrax*, *Sparus aurata*, and *Solea solea* are highly valued in Mediterranean fisheries, contributing substantially to the regional economy and playing a crucial role in both artisanal and industrial fishing practices.

Aquaculture has emerged as a key sector for species such as *Sparus aurata* and *Dicentrarchus labrax*, which are extensively farmed to meet growing market demand. The Ain Al-Ghazala Lagoon serves as an essential economic resource for Libya, with fish species like *Sardinella aurata* playing a pivotal role in sustaining local economies. Ensuring the sustainable management and exploitation of these resources is critical for maintaining their economic benefits and securing the long-term livelihoods of the communities that rely on them [12]. However, the list also includes invasive species, many of which have been introduced into the Mediterranean Sea via the Suez Canal. These Lessepsian migrants, such as *Siganus luridus* and *Siganus rivulatus*, have significantly impacted local marine ecosystems. As herbivores, these species overgraze seagrass beds and algal communities, leading to ecological imbalances. Other invasive species, including *Pterois miles* (lionfish) and *Lagocephalus sceleratus*, are toxic and pose risks to both biodiversity and human health.

The rapid expansion of these species presents an increasing threat to native marine life, underscoring the urgent need for effective management and control measures. The eastern coast of Libya has emerged as a hotspot for Lessepsian migrant species, with many of these species recorded exclusively in this region. Despite this, eco-biological studies on the Libyan coast remain scarce, and limited attention has been given

to fish stock assessments and population dynamics. There is no doubt that the opening of the Suez Canal has triggered significant biological and ecological changes in both the Red Sea and the Mediterranean Sea, including the Libyan coastline. Consequently, further research is required to better understand these changes and assess the impact of non-indigenous species on Libya's marine ecosystems. Additionally, fostering collaboration between researchers and fishermen is essential for the early detection of newly introduced species in Mediterranean coastal waters, enabling timely intervention and mitigation efforts [13]. More than 37% of the Lessepsian fish species recorded in Libya have commercial value, with *Siganus* spp. (rabbitfish) being particularly important for local fisheries. The presence of these species has significant implications for both local economies and marine ecosystems, highlighting the necessity for continuous monitoring and research to ensure effective population management.

The species listed also emphasize the importance of trophic dynamics in Mediterranean ecosystems. Apex predators like *Epinephelus marginatus* and *Sphyraena chrysotaenia* play a crucial role in maintaining the balance of marine food webs. The trophic dynamics in Ain Al-Ghazala Lagoon are characterized by diverse diets and ontogenetic shifts in feeding habits among fish species. These dynamics are crucial for understanding the ecological roles of these species and managing the lagoon's ecosystem effectively. The seasonal variations in feeding intensity further underscore the complexity of trophic interactions in this coastal lagoon. However, these species are particularly vulnerable to overfishing and habitat degradation. The combined pressures of overexploitation, climate change, and habitat loss threaten their populations, further compounding the challenges to marine conservation.

Table 1. List of fish collected in the study area.

Phylum	Class	Species
Chordata	Actinopterygii	<i>Atherina boyeri</i>
		<i>Chelon auratus</i>
		<i>Chelon labrosus</i>
		<i>Chelon ramada</i>
		<i>Dicentrarchus labrax</i>
		<i>Diplodus annularis</i>
		<i>Diplodus sargus</i>
		<i>Diplodus vulgaris</i>
		<i>Epinephelus marginatus</i>
		<i>Mugil cephalus</i>
		<i>Parablennius sanguinolentus</i>
		<i>Sardinella aurita</i>
		<i>Scomber japonicus</i>
		<i>Siganus luridus</i>
		<i>Siganus rivulatus</i>
		<i>Solea solea</i>
		<i>Sparus aurata</i>
		<i>Sphyraena chrysotaenia</i>
		<i>Pterois miles</i>
		<i>Lagocephalus scleratus</i>

Conclusion

The findings of this study confirm the biological richness of Ain Al-Ghazala Lagoon, highlighting a diverse array of fish species with both economic and ecological significance. However, the presence of invasive species raises concerns regarding future conservation efforts. Therefore, further research is recommended to monitor biodiversity trends and develop sustainable management strategies to safeguard the lagoon's ecosystem.

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Conflicts of Interest

No conflicts of interest influence the representation or interpretation of reported research results.

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