

## Ecological importance of Al-Gara Marine Protected Area (MPA) in the eastern part of Sirte Gulf, Libya

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### ABSTRACT

Islands are important ecosystems for biodiversity and also represent a refuge area for many species, often threatened, that live on them. The Libyan coastline is characterized by the presence of many islands. In term of biodiversity hotspots, eight important sites have been identified in Libya. Al-Gara is one of these sites as important island ecosystem; it was declared as Marine Protected Area (MPA) according to the resolution of the Minister of Environment No. 272 of 2021, which includes the area surrounding the island. This island is annually hosting the biggest colony of the Lesser crested tern *Thalasseus bengalensis* (Lesson, 1831), the main breeding site for this species in the Mediterranean, and it is also a breeding ground for the European shag *Phalacrocorax aristotelis* (Linnaeus, 1761). Fieldwork was conducted on February and May 2023. Eleven (11) species of Macrophytes have been collected during this study, 17 species of Molluscs, four Crustaceans and 16 Fish species including five non indigenous species. Illegal fishing and illegal fishing gears, fishing in critical ecosystems, invasive species, overfishing and oil pollution are the most important threats to Al-Gara MPA.

### KEY WORDS

Al-Gara Island; MPA; ecosystems; biodiversity and threats.

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### INTRODUCTION

Islands are important ecosystems for biodiversity and also represent a refuge area for many species, often threatened, that live on them. The islands represent about 5.3% of Earth's land area, with a percentage of 17% of plant species, 19% bird species, and 17% of rodent species present in this area (Bernie et al., 2015). In the Mediterranean Sea, there are approximately 15,000 small islands, and in the Western Basin there are more than 1000 small Islands (Meininger et al., 1994). These ecosystems are considered habitats with high biodiversity compo-

nents. Moreover, the study of Azafzaf & Defose (2010) confirmed the importance of these islands as a breeding ground for many rare and endangered species. In addition to the importance of these areas in term of conservation of biodiversity, they have other values in cultural heritage, landscape, historical heritage, fishing possibilities, and tourism. However, small islands do not receive enough attention in addressing environmental challenges (Zenati & Etayeb, 2022). In this context, The French Conservatoire du littoral, was created to take care of coastal islands, and then the International Initiative for the Protection of Small Islands (PIM) was launched

which aims to improve the management of these islands and unify the methodology to protect them through the exchange of information and experiences with local partners (Azafzaf & Defose, 2010).

The Libyan coastline is characterized by the presence of many islands. Of these, eight important sites in Libya have been identified, with Al-Gara being an important island ecosystem (EGARAC/SPA, 2012). In 1993, a team from the International Foundation for Waterbird and Wetlands Research (WIWO), in cooperation with the Marine Biology Research Center in Tajoura, presented research on waterbirds. They visited a colony of the Lesser crested tern *Thalasseus bengalensis* (Lesson, 1831) in Al-Gara and reported 1,700 pairs (Meininger et al., 1994). In August 2006, the total number of colony birds was estimated at 1551 pairs. It was concluded that Al-Gara island hosts the most important colony of *T. bengalensis* in Libya and the Mediterranean region (Azafzaf et al., 2006). Moreover, studies, researches and visits to the island continued, focusing on birds and their nesting, as well as tagging of the Lesser crested terns and monitoring the nesting of other species such as the yellow-legged gull and the Shag (Hamza et al., 2007, 2008, 2012; Hamza & Azafzaf, 2012; Hamza, 2014; Hamza et al., 2016).

After gathering the data about Al-Gara island and its ornithological importance, it was declared as Marine Protected Area (MPA) according to the resolu-

tion of the Minister of Environment No. 272 of 2021, which includes the area surrounding the island.

As mentioned above, the island has been subject to extensive bird studies, and there are no comprehensive data on the rest of the components of marine biodiversity on and around the island. Therefore, this study aimed to demonstrate the diversity of marine organisms in the area, which are considered within the reserve's environment.

## MATERIAL AND METHODS

### Study area

Al-Gara island (alternative name: Jazirat Garah) is located within the Gulf of Sirt, about 12 km off the coast (30°48'N - 19°54'E), 20 km SW to Zwaytinah harbour. Administrative district: Baladīyat Ajdābiyā.

This island is annually hosting the biggest colony of the Lesser Crested Tern (*Thalasseus bengalensis*), being the main breeding site for this species in the Mediterranean. It is also a breeding ground for the European shag *Phalacrocorax aristotelis* (Linnaeus, 1761) (Hamza et al., 2008). It is an island of modest altitude (max. c. 8 m a.s.l.) (Fig. 1), with low sandstone cliffs or gentle slopes surrounding modest hills with scattered rocks and low halophytic vegetation (mainly *Suaeda*) growing on sandy substrate. A few taller *Balanites* bushes are present. The surface area is about 5 ha.

### Sampling

Fieldwork was conducted on February and May 2023, using divers.

Samples have been collected from different two locations, two transect sets of three lines, each one for identifying NIS species and habitat use (Fig. 1).

For Macrophytes, Mollusca and Crustaceans the Quadrata sampling (50x50 cm) have been used.

Benthic macroalgae have been counted directly as clusters of the same species, followed by the estimation of the Braun-Blanquet cover index for a standard number of clusters of the same macroalgal species could be performed.

Fish were visually counted by direct counting in a fixed time interval of 15 minutes at each site.

Individuals of Mollusca have been counted di-

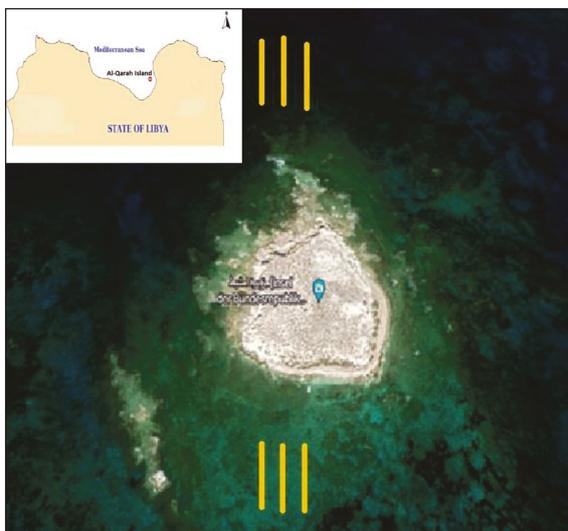


Figure 1. Al-Gara island area (Sirt Gulf, Libya).

rectly over a pre-determined time span (10–15 minutes). Several parameters have been recorded such as Temperature, salinity and dissolved oxygen.

The samples have been preserved and trans-

ported to the marine lab in Marine biology research center and marine biology lab at the Department of Zoology, Tripoli University in order to be sorted and classified.

March 2023				
Phylum	Class	Species	Coverage	Total Cover
Rhodophyta	Florideophyceae	<i>Laurencia obtusa</i> (Hudson) J.V. Lamouroux, 1813	16%	37%
Rhodophyta	Florideophyceae	<i>Jania rubens</i> (Linnaeus) J.V. Lamouroux, 1816	6.00%	
Rhodophyta	Florideophyceae	<i>Amphiroa rigida</i> J.V. Lamouroux, 1816	0.30%	
Ochrophyta	Phaeophyceae	<i>Dictyota linearis</i> (C. Agardh) Greville, 1830	4.10%	
Ochrophyta	Phaeophyceae	<i>Padina pavonia</i> (Linnaeus) J.V. Lamouroux, 1816	2.20%	
Chlorophyta	Ulvophyceae	<i>Dasycladus vermicularis</i> (Scopoli) Krasser, 1898	2.40%	
Tracheophyta	Monocots	<i>Posidonia oceanica</i> (Linnaeus) Delile, 1813	5.60%	
May 2023				
Rhodophyta	Florideophyceae	<i>Laurencia obtusa</i> (Hudson) J.V. Lamouroux, 1813	15%	22%
Rhodophyta	Florideophyceae	<i>Jania rubens</i> (Linnaeus) J.V. Lamouroux, 1816	0.45%	
Rhodophyta	Florideophyceae	<i>Gigartina acicularis</i> (Roth) J.V. Lamouroux, 1813	0.09%	
Rhodophyta	Florideophyceae	<i>Polysiphonia</i> sp.	0.31%	
Rhodophyta	Florideophyceae	<i>Ceramium</i> sp.	0.09%	
Ochrophyta	Phaeophyceae	<i>Dictyota linearis</i> (C. Agardh) Greville, 1830	0.36%	
Ochrophyta	Phaeophyceae	<i>Padina pavonia</i> (Linnaeus) J.V. Lamouroux, 1816	2.30%	
Ochrophyta	Phaeophyceae	<i>Sphacelaria fusca</i> (Hudson) S.F. Gray, 1821	0.05%	
Tracheophyta	Monocots	<i>Posidonia oceanica</i> (Linnaeus) Delile, 1813	3.13%	

Table 1. Macrophytes have been collected in Al-Gara island area during the study period.

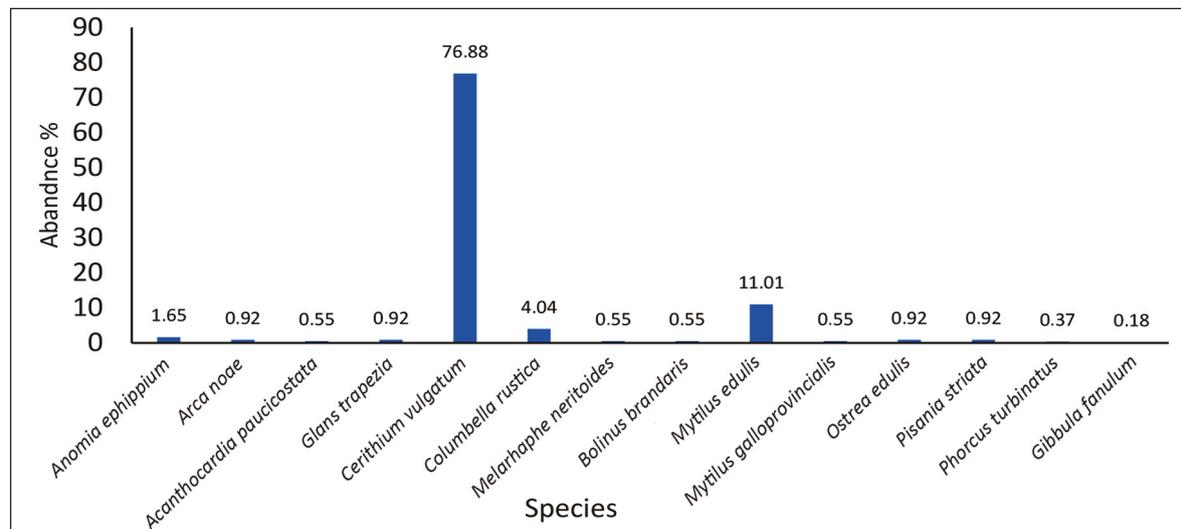


Figure 2. Mollusca species collected in May 2023 from Al-Gara island area.

## RESULTS AND DISCUSSION

### Macrophytes

Seven species of Macrophytes have been collected in March while nine species have collected in May at this area and the total cover percentage was 37% in March and 22% in May (Table 1).

### Invertebrates

Three molluscan species were collected in February 2023 and fourteen species have been collected in May in this area (Figs. 2, 3). In addition, two crustacean species were collected in February and also two crustacean species in May (Figs. 4, 5).

Other invertebrate species were recorded in this study area.

#### *Diadema setosum* (Leske, 1778)

*Diadema setosum* (Echinoidea Diadematidae) has been recorded at Al-Gara island area and the first record was in Libya and Egypt, through the input by citizens' science, the expansion of this invasive sea urchin in the Mediterranean basin is briefly discussed. *Diadema* species are mainly omnivorous grazers and detritus feeders, ingesting substrate and scraping algae off hard substrata. In the Red Sea, the needle-spined urchin, although usually nocturnal, has also been observed to be active diurnally (Young & Bellwood, 2011). The most notable predators of *Diadema* in the tropical Indo-Pacific are finfish species such as balistids, carangids, diodontids, labrids, ostraciids, pomadasyids, sparids, and tetraodontids, as well as some invertebrates (gastropods, spiny lobsters and starfish) (Muthiga & McClanahan, 2020).

### Fishes

Eight fish species were collected in February 2023, with *Sarpa salpa* (Linnaeus, 1758) being more abundant (40.37%), while thirteen fish species have been collected in May with *Siganus rivulatus* (Rüppell, 1828) being more abundant (47.52%) (Fig. 6). Five alien fishes have been recorded in this area: *Siganus luridus* (Rüppell,

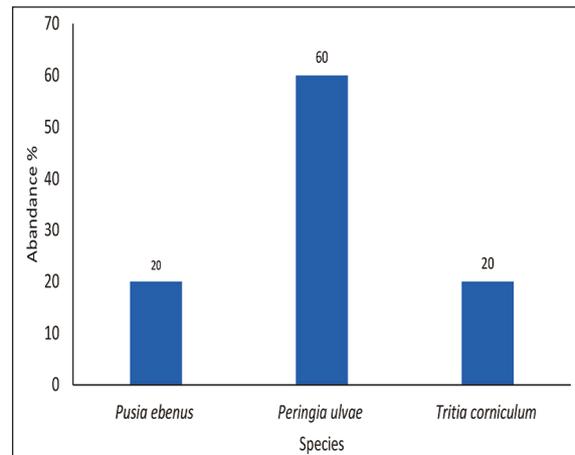


Figure 3. Mollusca species collected in February 2023 from Al-Gara island area.

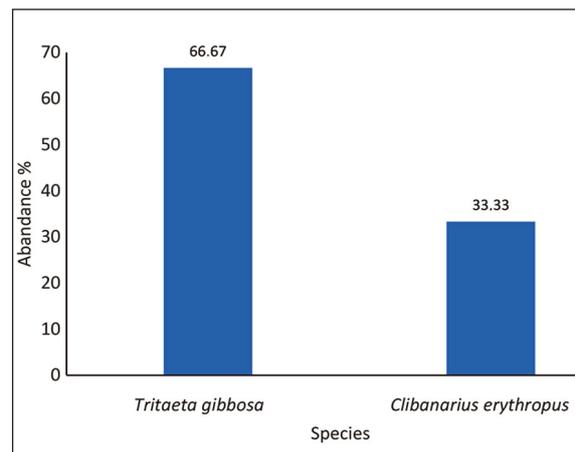


Figure 4. Crustacean species collected in February 2023 from Al-Gara island area.

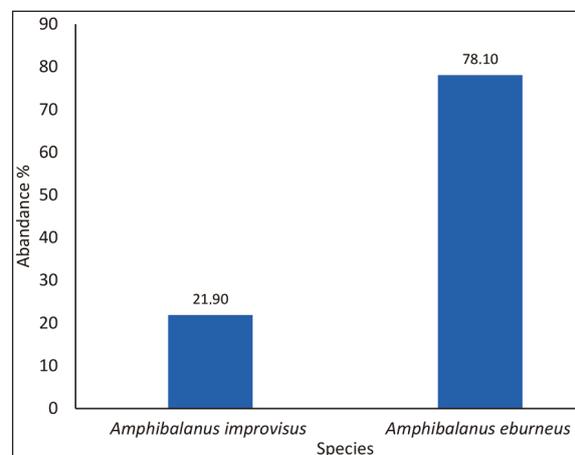


Figure 5. Crustacean species collected in May 2023 from Al-Gara island area.

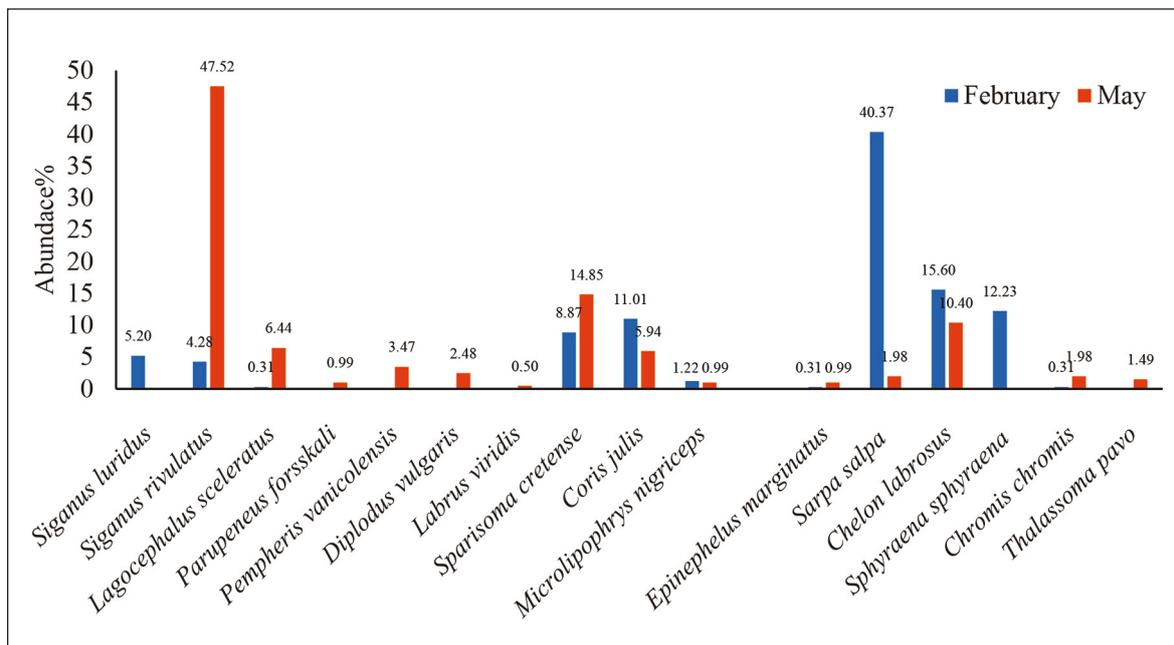


Figure 6. Fishes collected in 2023 from Al-Gara island area.

1828), *S. rivulatus*, *Lagocephalus sceleratus* (Gmelin, 1789), *Parupeneus forsskali* (Fourmanoir et Guezé, 1976) and *Pempheris vanicolensis* Cuvier, 1831).

#### *Lagocephalus sceleratus* (Gmelin, 1789)

During the last survey (June 2018), a population explosion of puffer fish *Lagocephalus sceleratus* (consisting mostly of juveniles) was observed in Tubruk Gulf in the eastern coast of Libya while, on the western coast of Libya, *Lagocephalus sceleratus* obviously showed a successful adaptation following its westward migration into the Mediterranean Sea. After its first occurrence in the Mediterranean Sea, it has become one of the most common Lessepsian species in the eastern basin and has shown to expand to the point of reaching the northern parts of the Aegean and Adriatic seas and west to Spanish Coast It has been listed as one of the 100 “worst invasive species” of the Mediterranean Sea (Streftaris & Zenetos, 2006).

#### *Parupeneus forsskali* (Fourmanoir et Guézé, 1976)

The goatfish *Parupeneus forsskali* is a tropical

fish endemic to the Red Sea and Gulf of Aden belonging to the family Mullidae and is readily identified by the black spot present on the upper side of the caudal peduncle and the black stripe, extending from the tip of its snout, through the eye, along the lateral line, ending under the rear of the second dorsal fin (Randall, 2004). Since the first recording in Turkey (Çinar et al., 2006), it has successfully invaded wide parts of the eastern Mediterranean Sea, and, currently it is one of the most common invasive species along the eastern coast (Ergüden et al., 2018). This species has also spread along the Libyan coast.

#### *Pempheris vanicolensis* Cuvier, 1831

The sweeper fish *Pempheris vanicolensis* is an Indo-Pacific species from the family Pempheridae that invaded the Mediterranean Sea through the Suez Canal. It was first recorded in Lebanon in 1979 (Mouneimné, 1979). In Libya, it was first reported in 2004 (Ben Abdallah et al., 2004), *P. vanicolensis* is frequently observed in relatively high abundance (Shakman & Kinzelbach, 2007). In the surveyed area, the species formed small schools in cracks and underwater caves. Locally, the species has no economic value.

## CONSIDERATIONS AND CONCLUSIONS

For better protection of natural areas such as the one examined in this work it is necessary to eliminate or reduce important “key pressures” such as:

- Illegal fishing and Illegal fishing gears.
- Fishing in critical ecosystems.
- Invasive species.
- Overfishing.
- Pollution (Oil Pollution).

Recommendations:

- Capacity building in the Marine Protected Areas (MPA) is important.
- Study the impact of NIS (Non Indigenous Species) in the coastal areas, it needs to working regarding to the Libyan action plan of NIS.
- Collaboration between organizations and researchers in the Mediterranean Establish a national and regional network and collaboration platforms to exchange the information and experiences.
- Public environmental awareness about the MPAs and NIS.

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