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National Inventory and Current Status of Echinodermata in Libyan Marine Waters

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Abstract

Libyan extensive coastline along the southern Mediterranean Sea is characterized by diverse marine habitats and rich biodiversity. Among the key components of this ecological wealth are echinoderms, which play important roles in benthic ecosystems. This study provides the first comprehensive inventory of echinoderm species documented in Libyan waters, compiled from a range of field surveys conducted over the past several decades. A total of 48 species have been identified, spanning all five echinoderm classes: Crinoidea (1 species), Asteroidea (15 species), Ophiuroidea (12 species), Echinoidea (13 species), and Holothuroidea (7 species). Significantly, this work includes the first recorded occurrences of *Ophidiaster ophidianus* and *Tethyaster subinermis* (Asteroidea), as well as *Ophiactis virens* and *Ophiactis macrolepidota* (Ophiuroidea) in Libyan waters. These findings enhance our understanding of echinoderm biodiversity along the southern Mediterranean and establish an important baseline for future ecological and conservation efforts in the region.

القائمة الوطنية والوضع الحالي للجلد شوحيات في المياه البحرية الليبية

سارة بن زقلام¹، نجلاء ابوشعالة¹، امانى الفتيوري²، نيروز بك بنغازي¹ واسماعيل الشقمان^{1*}

يتميز الشاطئ الليبي الواسع على طول جنوب البحر المتوسط بتنوع الموائل البحرية وغنى التنوع البيولوجي. ومن بين المكونات الرئيسية لهذا الثراء البيئي قنفذيات الجلد، التي تلعب أدوارًا مهمة في النظم البيئية القاعية. تقدم هذه الدراسة أول جرد شامل لأنواع قنفذيات الجلد الموثقة في المياه الليبية، تم تجميعه من مجموعة من المسوحات الميدانية التي أجريت خلال العقود الماضية. تم تحديد ما مجموعه 48 نوعًا، تنتمي إلى جميع طوائف قنفذيات الجلد الخمس: زنابق البحر (Crinoidea) نوع واحد، نجمات البحر (Asteroidea) 15 نوعًا، نجم البحر المش (Ophiuroidea) 12 نوعًا، قنفاذ البحر (Echinoidea) 13 نوعًا، وخيار البحر (Holothuroidea) 7 أنواع. ومن الجدير بالذكر أن هذا العمل يتضمن أول تسجيل لوجود نوعي *Ophidiaster ophidianus* و *Tethyaster subinermis* (من طائفة نجمات البحر)، بالإضافة إلى *Ophiactis virens* و *Ophiactis macrolepidota* (من طائفة نجم البحر المش) في المياه الليبية. تسهم هذه النتائج في تعزيز فهمنا لتنوع قنفذيات الجلد البيولوجي على طول جنوب البحر المتوسط، كما تُشكل مرجعًا مهمًا للجهود المستقبلية في مجال البحث البيئي والحفاظ على الحياة البحرية في المنطقة.

Introduction

The Libyan coastline remains one of the few regions in the Mediterranean with relatively low human impact and a well preserved marine ecosystem (Foulquie, Mathieu et al., 2011). Despite this ecological richness, there has been

limited research on the distribution of echinoderms in Libyan waters. Among Mediterranean countries, Libya boasts one of the largest, most ecologically significant, yet -studied marine areas (Coll et al., 2010).

Globally, approximately 13,000 fossil species and 7,000 extant species of echinoderms have been identified

(Pawson, 2007). In the Mediterranean Sea, around 154 living species are recorded, representing five classes: Crinoidea (5 species), Asteroidea (3 species), Ophiuroidea (36 species), Echinoidea (26 species), and Holothuroidea (54 species) (Koukouras et al., 2007). The first documented study of Libyan echinoderms, conducted by Contransimex & Sogreah in 1977, reported 33 species.

Echinoderms are characterized by a pentameric radial body plan, although some echinoids and holothurians exhibit bilateral symmetry, and certain asteroid species may possess more than five arms (Nielsen, 2011). As deuterostomes, they are more closely related to chordates than to most other invertebrate phyla (Hyman, 1955; Smith, 2004).

These marine invertebrates provide a range of ecological and economic services. However, echinoderm populations are increasingly threatened by human activities such as overharvesting for consumption, the ornamental trade, and tourism. These pressures have led to the decline of some species and a general reduction in biodiversity (Micael et al., 2009). Despite their ecological significance, the diversity and distribution of echinoderms along the Libyan coast remain poorly understood.

This study aims to address this gap by compiling a checklist of echinoderm species reported in Libyan waters, drawing on both a comprehensive review of the existing literature and recent field observations.

awareness campaigns conducted over the past five decades. Specimens were also collected during specific survey periods: from January 2005 to March 2006 and from January 2013 to January 2017.

Scientific names used in this study follow the nomenclatural standards set by the World Register of Marine Species (WoRMS, 2020; <http://www.marinespecies.org>). Selected specimens were preserved and catalogued at the Natural History Museum, Zoology Department, University of Tripoli. Species distribution data were derived from both the aforementioned sources and direct field observations.

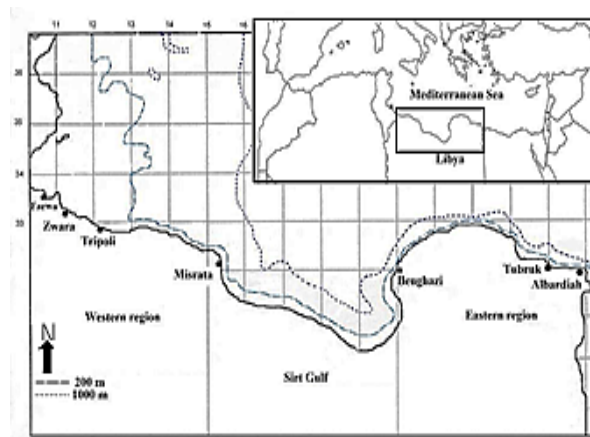


Figure 1. Sampling: Eastern region, Sirt Gulf and Western region on the Libyan coast.

Martials and Methods

A total of 118 echinoderm specimens were collected from multiple stations along the Libyan coast, encompassing three main regions: The West, the Gulf of Sirt, and the East. Each specimen was measured, photographed, and preserved in 70% ethanol. Identification was carried out using both external morphological features and internal anatomical structures, following the taxonomic frameworks established by Tortonese (1965), Mortensen (1927), and Clark & Downey (1992).

Additional records of marine echinoderms were compiled from a wide range of sources, including published literature, technical reports, grey literature, and unpublished data obtained during field surveys and public

Results and Discussion

The checklist of the echinoderm fauna of Libya includes different echinoderm species, grouped into five classes. A total of 48 echinoderm species have been reported along the Libyan coast (Fig. 2), of which one is from Crinoidea, 15 are from Asteroidea, 12 are from Ophiuroidea, 13 are from Echinoidea, and seven are from Holothuroidea. four species are new for the echinoderm fauna of Libya (Fig. 3), which are: The Asteroidea, *Ophidiaster ophidianus*, *Tethyaster subinermis*; the Ophiuroidea, *Ophiactis virens*, *Ophiactis macrolepidota* (Table 1).

Table 1. Echinodermata and their distribution in certain geographical areas of the Libya, with reference to their presence in the Libya. W=Western, S=Sirt gulf, E= eastern coast of Libyan * were found in the present study as first recorded.

No	Class	Family	Species	References	Distribution
1	Crinoidea	Antedonidae	<i>Antedon mediterranea</i> (Lamarck, 1816)	Sogreah 1977	W+E
2	Asteroidea	Anseropodidae	<i>Anseropoda placenta</i> (Pennant, 1777)	Sogreah 1977	E
3	Asteroidea	Astropectinidae	<i>Astropecten aranciacus</i> (Linnaeus, 1758)	Sogreah 1977	E+W
4	Asteroidea	Asterinidae	<i>Asterina gibbosa</i> (Pennant, 1777)	Sogreah 1977 ,Hadoud 1999	E

5	Asteroidea	Asterinidae	<i>Asterina pancerii</i> (Gasco, 1876)	Shakman E (2017)	E
6	Asteroidea	Astropectinidae	<i>Astropecten irregularis</i> (Pennant, 1777)	Sogreah 1977	E
7	Asteroidea	Astropectinidae	<i>Astropecten jonstoni</i> (Delle Chiaje, 1827)	Sogreah 1977, Huni 1984	W
8	Asteroidea	Astropectinidae	<i>Astropecten spinulosus</i> (Philippi, 1837)	Sogreah 1977	E
9	Asteroidea	Asterinidae	<i>Coscinasterias tenuispina</i> (Lamarck, 1816)	Sogreah 1977	E
10	Asteroidea	Echinasteridea	<i>Echinaster sepositus</i> (Retzius, 1783)	Sogreah 1977	E
11	Asteroidea	Ophidiasteridae	<i>Hacelia attenuata</i> (Gray, 1840)	Sogreah 1977	E
12	Asteroidea	Asterinidae	<i>Marthasterias glacialis</i> (Linnaeus, 1758)	Contransimex 1977 Sogreah 1977	W
13	Asteroidea	Asterinidae	<i>Ophidiaster ophidianus</i> (Lamarck, 1816)*	Present study	W
14	Asteroidea	Goniasteridae	<i>Peltaster placenta</i> (Müller & Troschel, 1842)	Sogreah 1977	W&E
15	Asteroidea	Paraniidea	<i>Porania pulvillus</i> (O.F. Müller, 1776)	Hadoud 1999	E
16	Asteroidea	Astropectinidae	<i>Tethyaster subinermis</i> (Philippi, 1837)*	Present study	W +E
17	Ophiuroidea	Amphiuridae	<i>Acrocrida brachiata</i> (Montagu, 1804)	Huni 1984	W
18	Ophiuroidea	Amphiuridae	<i>Amphiura chiajei</i> (Forbes, 1843)	Sogreah 1977	E
19	Ophiuroidea	Gorgonocephalidae	<i>Astrospartus mediterraneus</i> (Risso, 1826)	Fitori et al 2022	W
20	Ophiuroidea	Ophiuridea	<i>Ophiura albida</i> (Forbes, 1839)	Sogreah 1977, Huni 1984	W
21	Ophiuroidea	Ophiuridea	<i>Ophiura lacertosa</i> (Lamarck, 1801)	Sogreah 1977, Huni 1984	W
22	Ophiuroidea	Ophiactidae	<i>Ophiactis macrolepidota</i> (Marktanner-Turneretscher) 1887	Present study	W
23	Ophiuroidea	Ophiotrichitae	<i>Ophiothrix fragilis</i> (Abildgaard in O.F. Müller, 1789)	Sogreah 1977	E
24	Ophiuroidea	Ophiuridea	<i>Ophiura texturata</i> (Lamarck, 1816)	Sogreah 1977	E
25	Ophiuroidea	Ophiactidae	<i>Ophiactis virens</i> (M. Sars, 1859)*	Present study	W
26	Ophiuroidea	Ophiodermatidae	<i>Ophioderma longicauda</i> (Bruzellius, 1805)	Sogreah 1977	E
27	Ophiuroidea	Ophiotrichidae	<i>Ophiothrix quinque maculata</i> (Delle Chiaje, 1828)	Sogreah 1977	E+W
28	Ophiuroidea	Ophiocomidae	<i>Ophiocoma scolopendrina</i> (Lamarck, 1816)	Zaouali et al. 2007b	E
29	Echinoidea	Arbaciidae	<i>Arbacia lixula</i> (Linnaeus, 1758)	Sogreah 1977	E+W
30	Echinoidea	Brissidae	<i>Brissus unicolor</i> (Leske, 1778)	Sogreah 1977	E
31	Echinoidea	Diadematidae	<i>Centrostephanus longispinus</i> (Philippi, 1845)	Sogreah 1977	E
32	Echinoidea	Cidaridae	<i>Cidaris cidaris</i> (Linnaeus, 1758)	Contransimex 1977 Sogreah 1977	E+W
33	Echinoidea	Diadematidae	<i>Diadema setosum</i> (Leske, 1778) Non indigenous	Nour et al 2022	E
34	Echinoidea	Loveniidae	<i>Echinocardium cordatum</i> (Pennant, 1777)	Contransimex 1977	W
35	Echinoidea	Fibulariidae	<i>Echinocyamus pusillus</i> (O.F. Müller, 1776)	Contransimex 1977	W
36	Echinoidea	Echinidae	<i>Gracilechinus acutus</i> (Lamarck, 1816)	Sogreah 1977	E
37	Echinoidea	Parechinidae	<i>Paracentrotus lividus</i> (Lamarck, 1816)	Sogreah 1977	E+W
38	Echinoidea	Parechinidae	<i>Psammechinus microtuberculatus</i> (Blainville, 1825)	Sogreah 1977	E
39	Echinoidea	Toxopneustidae	<i>Sphaerechinus granularis</i> (Lamarck, 1816)	Contransimex 1977	W
40	Echinoidea	Spatangidae	<i>Spatangus purpureus</i> (O.F. Müller, 1776)	Sogreah 1977	E
41	Echinoidea	Cidaridae	<i>Stylocidaris affinis</i> (Philippi, 1845)	Sogreah 1977	E+W
42	Holothuroidea	Cucumariidae	<i>Cucumaria planci</i> von (Marenzeller, 1893)	Sogreah 1977	E
43	Holothuriidae	Holothuriidae	<i>Holothuria tubulosa</i> (Gmelin, 1791)	CAR/ASP - PNUE/PAM, 2010	E

44	Holothuroidea	Holothuriidae	<i>Holothuria (Panningothuria) forskali</i> Delle Chiaje, 1823	CAR/ASP - PNUE/PAM, 2010	E
45	Holothuroidea	Holothuriidae	<i>Holothuria (Platyperona) sanctori</i> Delle Chiaje, 1823	CAR/ASP - PNUE/PAM, 2010	E
46	Holothuroidea	Phylloporidae	<i>Phylloporus urna</i> (Grube, 1840)	Sogreah 1977	E
47	Holothuroidea	Stichopodidae	<i>Parastichopus regalis</i> (Cuvier, 1817)	Sogreah 1977	E
48	Holothuroidea	Phylloporidae	<i>Thyone fusus</i> (O.F. Müller, 1776)	Hadoud 1999	E

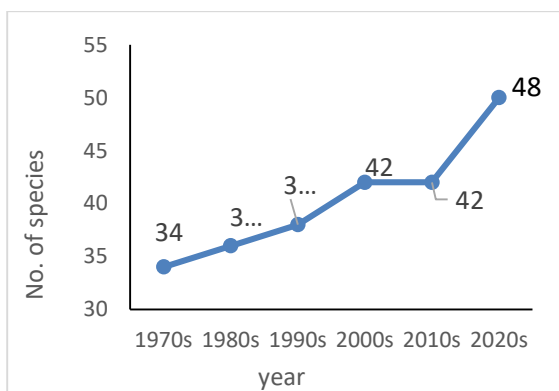


Figure 2: Number of Echinoderm Species in Libya Over Time

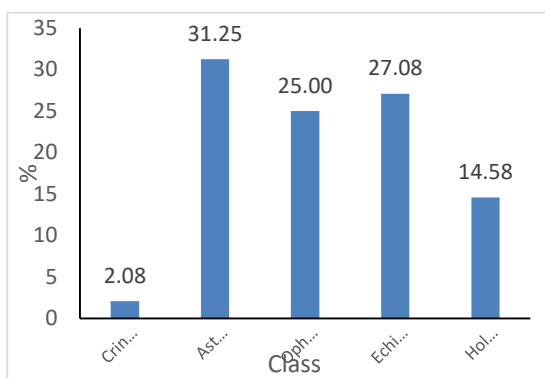


Figure 3: Abundance of Echinoderm Classes in the Libyan coast

Most of these species are distributed in the eastern region (over 56%), followed by the western region (25%), and more than 18% are found in both the eastern and western regions (Figure 4).

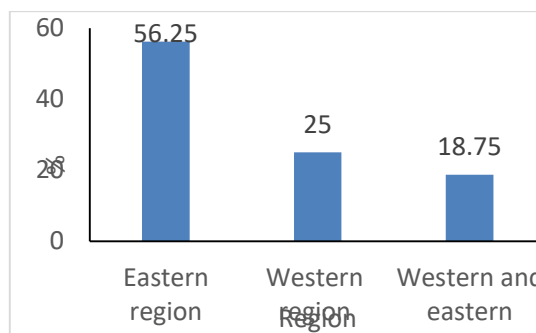


Figure. 4 Distribution of the Echinoderms along the Libyan coast

New record

The four new species recorded for the first time in the present work (Fig. 5, Table 1)

I. *Ophidiaster ophidianus* (Lamarck, 1816) (The purple starfish)

Classification

- Echinodermata (Phylum)
- Asteroidea (Class)
- Ophidiasteridae (Family)
- Ophidiaster (Genus)
- Ophidiaster ophidianus* (Species)

Original name: *Asterias ophidiana* Lamarck, 1816

- Synonymised names: *Asterias ophidiana* Lamarck, 1816 ·
- Ophidiaster aurantius* Gray, 1840 ·
- Ophidiaster canariensis* Greeff, 1872 ·

Description

This starfish has a striking appearance, with a dark carmine, red, or orange coloration that may be dotted with brown spots. It has a small disc-shaped body that is covered with irregular plates, and five long, thin arms that have respiratory papillae on their surfaces. The arms are cylindrical and taper slightly near the disc. The diameter of this starfish 34 cm.

According to the Barcelona Convention (92/43/CEE), the species is under strict protection in the Mediterranean Sea and is classified as vulnerable in Spain (Cata'logo Nacional de Especies Amenazadas, 2007) (Micael *et al.* ,2014).

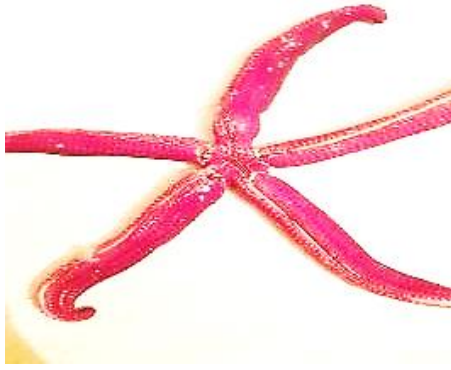


Figure 5. *Ophidiaster ophidianus* (Lamarck, 1816)

II. *Tethyaster subinermis* (Philippi, 1837)*

Asteroidea (Class)

Astropectinidae (Family)

Tethyaster (Genus)

Tethyaster subinermis (Species)

Orig. name : *Asterias subinermis* Philippi, 1837

Synonymised names : *Archaster subinermis* (Philippi, 1837)

Asterias subinermis Philippi, 1837 .

Astropecten subinermis (Philippi, 1837)

Goniopecten subinermis (Philippi, 1837)

Plutonaster subinermis (Philippi, 1837) .

Tethyaster subinermis (Fig. 6) is an Atlanto-Mediterranean species, inhabiting muddy bottoms, from 40 to 1400 m depth. It has been reported from the Northern Evvoikos Gulf (Koukouras et al., 2007) and the Levantine Sea, the Eastern Aegean Sea (Koukouras et al., 2007; Öztoprak et al., 2014) and one time from the Hellenic Ionian coasts (Peloponnisos: Kaspiris & Tortonese, 1975). In present study collected about 12 specimen from western area. The marginal plates of *Tethyaster subinermis* are well-developed and distinct. The upper marginal plates lack spines, while the lower marginal plates have spines along their edges. The lower and upper marginal plates are similar in size. *Tethyaster subinermis* can be identified by these features.



Figure 6 *Tethyaster subinermis* (Philippi, 1837) (Left: ventral view Right dorsal view)

III. *Ophiactis virens* (M. Sars, 1859) (Fig. 7)

Ophiuroidea (Class)

Ophiactidae (Family)

Ophiactis (Genus)

Ophiactis virens (Species)

Original name *Amphiura virens* M. Sars, 1859

Synonymised name *Amphiura virens* M. Sars, 1859 .

The small disc, rounded and convex, covered by small irregular plates, is the central part of the body that contains the mouth and the internal organs. This brittle star is tiny. The dorsal disc of this species has a distinctive pattern of plates that form six triangular radial shields along the margin.



Figure 7: *Ophiactis virens* (M. Sars, 1859) (Left:

IV. *Ophiactis macrolepidota* Marktanner-Turneretscher, 1887 (Fig. 8)

Classification

Ophiuroidea (Class)

Ophiactidae (Family)

Ophiactis (Genus)

Ophiactis macrolepidota (Species)

Original name *Ophiactis macrolepidota* Marktanner-Turneretscher, 1887

Synonymised names *Ophiactis acosmeta* H.L. Clark, 1938 .

Ophiactis delicata H.L. Clark, 1915.

Ophiactis parva Mortensen, 1926 .

The Mediterranean Sea hosts five Erythrean echinoderms that have colonized its waters: the sea star *Asterina burtoni* (Gray, 1840), and the brittle stars *Amphioplus laevis* (Lyman, 1874), *Ophiactis parva* Mortensen, 1926, and *O. savignyi*. These species are native to the Red Sea and the Indian Ocean, and have entered the Mediterranean through

the Suez Canal. (Yokes, B. and Galil, B.S., 2006)



Figure 8 *Ophiactis macrolepidota* Marktanner-Turneretscher, 1887

Discussion

A comprehensive survey of echinoderm fauna along the Libyan coast has documented 49 species spanning five classes: Crinoidea, Asteroidea, Ophiuroidea, Echinoidea, and Holothuroidea. This study represents the first extensive inventory of echinoderms in Libyan waters and provides essential baseline data on species composition and distribution. These findings offer a valuable foundation for future biological and environmental research in the region.

In comparison, a 2014 survey along the Turkish coast recorded 91 echinoderm species from the same five classes (Öztoprak et al., 2014), highlighting the comparatively lower species richness observed in Libya. This disparity likely reflects both the limited extent of previous research efforts and the shortage of taxonomic expertise focused on Libya's marine biodiversity.

Similarly, the echinoderm fauna of Montenegro, as documented in 2009, includes 57 species: one crinoid, 18 asteroids, nine ophiuroids, 15 echinoids, and 14 holothurians (Kascelan et al., 2009). This composition is broadly comparable to that recorded in Libya. In the Aegean Sea, a 2006 survey identified 20 asteroid species, 14 ophiuroids, 21 echinoids, and a single holothuroid, also reporting several new regional records such as *Monaphiura apicula* (ophiuroid), *Arbaciella elegans*, *Echinus melo*, and *Hemiaster expergitus* (echinoids), with the latter previously known only from the Western Mediterranean (Koukouras et al., 2007).

A study conducted along the Maltese coast in 2006 reported 65 echinoderm species, including two crinoids, 16 asteroids, 15 ophiuroids, 20 echinoids, and 12 holothurians (Tanti and Schembri, 2006). In northern Tunisia, research carried out between 2012 and 2016 updated the regional

checklist to 45 species and reported four new additions: *Asterina pancerii*, *Luidia atlantidea*, *Ophiactis virens*, and *Leptopentacta tergestina* (Chammem et al., 2019).

In the Adriatic Sea, a 2017 review documented a notably higher diversity, with 108 echinoderm species recorded: two crinoids, 23 asteroids, 22 ophiuroids, 22 echinoids, and 39 holothurians (Despalatovic et al., 2017). Compared to these regions, the echinoderm diversity along the Libyan coast appears relatively low, a difference likely attributable to the limited number of systematic surveys particularly those targeting deep-sea zones and ecologically important habitats such as coralligenous assemblages.

To advance the understanding of Libya's marine biodiversity, further dedicated research is essential. Expanding survey efforts to include underexplored habitats and deeper marine environments will be critical to achieving a more comprehensive assessment of the country's echinoderm fauna.

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