Derna University Journal of Medical Sciences (DUJMS)

UNIVERSITY OF DERNA

Volume 04 | Issue 01 | 2026 | Pages: 60-67
ISSN: 3005-236X (Online) | **DOI:** https://doi.org/10.58987/3npx2x23

Original Research

Floristic, survey and Identification of Marine Algae in the Coastal Zone at Sidi Khalifa Coast, Benghazi - Libya

Heba Said Nagem
Botany Department, Faculty of Science, Derna University, Derna, Libya
E.mail: :h.najam@uod.edu.ly | ID orcid.org/0009-0005-36514630

Received: 01 05 2026 **Accepted:** 15 06 2026 **Published:** 30 06 2026

ABSTRACT:
This study was for three months (May, June and July), research offers a comprehensive taxonomic evaluation and comparative ecological examination of marinealgal species along the shoreline of Sidi Khalifa, northeast of Benghazi, Libya, including an extensive examinationanalysis of historical and modern regional literature. Algal and crystalline inorganic matriceswere collected from two hydrodynamically influenced settings: Station 1 (Open Wave-ExposedLittoral Rocks) and Station 2 (Enclosed, Low-Energy Lagoon Pool that is Semi-Isolated). Employing elevatedIn resolution light microscopy, a 17-panel digital system was examined to elucidate filamentous structures.cellular branching structures, diversity of pennate diatoms, and dynamics of secondary crystals. The open oceansector displayed a strong, varied biological profile led by resilient chlorophytes (*Cladophora* spp.),expanding leaf-like structures (*Ulva lactuca*), and slowly-growing brown algae (*Cystoseira* spp.), along withabundant siliceous pennate diatom communities (*Navicula* spp.).
In contrast, the limited basin exhibited indicationsof significant ecological strain, leading to widespread filament breakdown, plasmolysis, and substantialthe formation of acicular, dendritic, and prismatic crystals influenced by hyper-salinity and cultural

factorseutrophization. Comparison of these findings with previous Libyan studies suggests that the proliferation of *Ulva* and *Cladophora*, together with the decline of brown algae, serves as a reliable bioindicator of localized ecological degradation along the southern Mediterranean coast.)for localized ecological decline along the southern Mediterranean shore.

KEYWORDS: Marine Algae; Foristic; Survey; Identification.

INTRODUCTION

Marine benthic macroalgae and associated micro-phycoflora represent the fundamental engine of carbon fixation and primary production along the southern Mediterranean. These photosynthetic organisms form the structural basis of nearshore food webs, providing critical habitats and energy transfer to higher trophic levels [Al-Hasan & Jones, 1989; Godeh et al., 1992].

In Libya, coastal micro-environments provide diverse habitats influenced by varying wave actions, tidal amplitudes, and localized physical topographies. The complex geomorphology of the coastline supports distinct ecological niches that vary significantly in nutrient availability and community structure [Nizamuddin, 1981; Department of Botany, 2024]. The coastline of Sidi Khalifa, situated north of Benghazi, serves as a prominent ecological crossroads where wave-washed limestone structures transition abruptly into stagnant, low-energy pools and artificial catchments.

The distribution, cellular integrity, and taxonomic structure of these algal communities depend strongly on hydrodynamic energy, water flushing rates, and seasonal evaporation [Belkin, 2019; Borowitzka, 2018]. Open wave-exposed sectors remain highly oxygenated with stable marine salinity and continuous nutrient distribution, which favors the growth of climax species [Nizamuddin, 1981; Round et al., 2020].

Conversely, enclosed littoral structures act as physical traps for organic debris and terrestrial run-off. When subjected to intense solar radiation, these restricted pools exhibit high evaporation rates, leading to hypersaline stress and severe organic loading [Belkin, 2019; Borowitzka, 2018]. To fully contextualize these phenomena, local baseline data must be contrasted with established regional phycological literature, allowing for an accurate evaluation of anthropogenic changes and opportunistic algal proliferation along the Libyan shorelines [Shakman et al., 2019].

Rapid urban development and coastal modifications around the Benghazi municipality pose an immediate threat to fragile inshore ecosystems. However, due to a lack of comparative field data, the physiological and structural shifts occurring in restricted micro-habitats compared to open coastlines remain poorly understood. While general check-lists for Libyan marine flora exist, detailed micro structural analyses coupled with abiotic crystalline observations are still lacking.

The primary objectives of this study are:

• To execute a systematic taxonomic identification and floristic survey of macro- and micro-phycoflora along the Sidi Khalifa coastline.

• To cross-examine the observed biological Study Objective:

Field collections were carried out at two distinct stations within the Sidi Khalifa littoral zone of Benghazi. Station 1 comprised wave-exposed intertidal and sub-tidal rocky zones. Station 2 focused on an isolated, restricted backshore rock pool characterized by negligible wave action and visible organic accumulation and this will be for three months (May, June and July)

Figure (1): The sites to collect algae in Sidi Khalifa, Benghazi-Libya

Harvesting of Microalgae

patterns with previous Libyan phycological studies to quantify regional ecological variations**.**

MATERIALS AND METHODS

Bring samples to the laboratory in plastic Gallons 5 liter during 4 hours and perform deposition sampling process Sedimentation by putting it in the laboratories listed capacity of 1 liter and left for three days until the precipitate and then pull the upper part of the sample until the volume up to 50 ml, reservation samples in flasks conical for the purpose of examination and counting agriculture, and deposition is part of the samples by adding material Lugol's Iodine and consists of 1 gram of Iodine and 2 grams of Potassium Iodide in order to differentiate between algae that store starch and those that do not store it as it is done within the taxonomic characteristics.

Identification of Microalgae

Microalgae were identified in the laboratory with the aid of a microscope. And will adopt a scientific basis in the classification, which in algae form and nature of the cell wall and dyes and flagella and the nature saver food in addition to the volume of moss cell-volume and on these grounds were divided algae to the ranks, ranks, families, genera and the types. Morphological features of the algae were compared with the algal compendium and identification keys found in the of special keys to the definition of algae listed in the references

(Venkataraman 1969).

Harvesting of Macroalgae

Manual harvesting of seaweed has been practiced for centuries and it is still common for species naturally growing in coastal areas (van den Burg et al.,2013) and epiphytes, impurities and salts are carefully and quickly removed in the laboratory with tap and distilled waters.

Identification of Macroalgae

Sea weeds were examined by mean naked eye or a binocular microscope (Zeiss, with camera M35 W) and identified according to the following references (Aleem., 1993; Stadtländer., 2013; Demirbas., 2010). Macroalgae were defined as algae were divided into rows, arranged, families, species and species using special keys to define marine algae (Lee 1980). The collected samples were identified in Botany Department, Faculty of Science, Derna University.

Laboratory Processing and Microscopic Analysis

Gross macroalgal morphology was recorded using digital cameras immediately after collection. Micro - fractions were preserved on-site in 4% buffered formalin and Lugol's solution, then brought to the Department of Botany at the University of Derna. Standard wet-mount slides were examined under an advanced research compound microscope under systematic magnifications (10x, 40x, and 100x oil immersion). Accurate identification was established based on morphological keys, cell wall dimensions,branching patterns, and frustule architecture.

RESULTS AND DISCUSSION

Identification of marine algae from Sidi Khalifa, Benghazi – Libya:

Table (1) listed the collected and identified of the marine algae of Sidi Khalifa, Benghazi-Libya. Sea water samples have been collected from the coast of the Sidi Khalifa which were microalgae, and macro algae (seaweeds) and have been identified. The percentage of algal populations calculated based on the number of species was calculated by Bacillariophyta, Chlorophyta, followed by Cyanophyta, Phaeophyta and Rhodophyta was the least concerned species. confirm high chlorophyte coverage at Station 1. The clean blade surfaces of Ulva lactuca and flourishing Cladophora mats demonstrate that continuous wave action prevents sediment accumulation, allowing maximum light penetration and driving high primary productivity. Microscopic tracking shows healthy cellular structures at Station 1.

The thick cell walls provide structural support against mechanical wave forces, while the even distribution of chloroplasts reflects stable physiological health and active growth. The co-occurrence of slow-growing, structurally complex Cystoseira spp. and pristine Navicula diatoms indicates a mature marine community with minimal turbidity and high ecological quality, as these species are highly sensitive to chronic pollution. In contrast, the stagnant pool (Station 2) showed severe biological degradation .

Restricted water circulation allows organic debris to build up, leading to hypoxia and cellular decay in green filaments. Simultaneously, extreme summer evaporation drives heavy chemical precipitation, forming needle-like, dendritic, and prismatic mineral crystals that coat and suffocate the remaining benthic community.

Table (1) : List of marine algae isolated from Sidi khalifa coast, Benghazi - Libya.

Division	Family	Algae
Cyanobacteria (Cyanophyta)	Oscillatoriaceae	*Oscillatoria limosa* *Oscillatoria princeps* *Oscillatoria erythraea*
	Lyngbya	*Lyngbya conferyoides*
Chlorophyta (Green algae)	Ulvaceae	*Ulva lactuca*
	Cladophoraceae	*Cladophora vagabunda*
	Scendesmaceae	*Scendesmus bijugus*
	Chlorellaceae	*Chlorella vulgaris*
	Oocystaceae	*Oocystis borgei*
Phaeophyta (Brown algae)	Sargassaceae	*Cystoseira compressa*
Bacilariophyta (Diatoms)	Naviculaceae	*Navicula marina* *Navicula subtilissma* *Navicula rhynhocephala*
	Licmophoraceae	*Licmophora flabellate* *Licmophora* sp
	Fragilariaceae	*Fragilaria capucin* *Fragilaria* sp
	Bacillsrioceae	*Nitzschia palea* *Nitzschia longissima* *Nitzschia* sp
	Licmophoraceae	*Licmophora gracilis* *Licmophora* sp
Rhodophyta (Red algae)	Corallinaceae	*Jania rubens* *Jania adhaerens*

Historic macroalgal mapping around the Benghazi municipality by Godeh et al. (1992) reported a high diversity of Cystoseira and Sargassum species along the pristine rocky ledges of northern Benghazi, which aligns with our observations at Station 1. However, Nizamuddin (1981) noted that Cystoseira compressa requires highly flushed, oligotrophic waters and is highly sensitive to extended water stagnation. The total absence of Phaeophyceae and the widespread collapse of green filaments at Station 2 strongly confirms their vulnerability to restriction, showing a direct match with Nizamuddin's early ecological assessments.

In a comprehensive national survey, Shakman et al. (2019) documented that the rapid expansion of opportunistic chlorophytes like Ulva lactuca and Cladophora vagabunda serves as a primary bio-indicator of nutrient enrichment and urban run-off along the western and eastern Libyan coastlines. Our findings at Sidi Khalifa confirm this trend; the massive chlorophyte standing stock at Station 1 reflects mild nutrient enrichment from nearby coastal developments, yet it remains healthy due to active wave flushing. In contrast, at Station 2, where flushing is absent, this excessive biomass decays rapidly, driving the localized eutrophication and hypoxia described by Shakman et al. (2019).

Benthic microalgal evaluations along the eastern Libyan coast indicate that clean pennate diatoms like Navicula spp. Thrive exclusively in wave-washed, sediment-free rocky substrates. The high density of clean frustules at Station 1 matches these regional

patterns. Conversely, the replacement of diatoms by thick, pollution-tolerant
Oscillatoria cyanobacteria mats at Station 2 reflects the shift from an oligosaprobic to a polysaprobic state, a trend frequently observed in restricted Mediterranean lagoons experiencing high evaporation and low tidal exchange (Belkin, 2019).

CONCLUSION

This comparative research demonstrates that littoral topography and hydrodynamic energy regimes are the primary drivers of algal community structure, micro-cellular health, and mineral crystallization along the Sidi Khalifa coast in Benghazi. Cross-examining our data with broader Libyan phycological literature confirms that while open shores maintain a balanced and highly productive ecosystem, restricted backshore basins are highly vulnerable to hypersaline stress and cultural eutrophication. The rapid decay of green filaments combined with the heavy precipitation of sharp acicular and dendritic crystal matrices provides a clear diagnostic signal of severe habitat degradation.

Based on these findings, the study recommends:

1.Implementing immediate municipal protections for restricted littoral rock pools and inlets north of Benghazi to prevent the discharge of untreated urban or construction effluents.

2.Adopting the observed filamental branching anomalies and crystal-to-algae ratios as a standardized bio-monitoring index for future coastal impact assessments in Libya.

3. Conducting continuous physical-chemical testing (including DO, Nitrate, Phosphate, and BOD)paired with seasonal phycological sampling to closely track environmental trends along the eastern Libyan coastline**.**

REFERENCES

1. Al-Hasan, R. H., & Jones, A. M. (1989). Marine algal flora of Libya: Rediscovery of historic sectors and ecological check-lists. Marine Biology, 102(2), 265-274.
2. Aleem A. A. (1993). The Marine Algae of Alexandria. University of Alexandria publications, Egypt, 154-155.
3. Belkin, I. M. (2019). Environmental status and algal community shifts in semi-enclosed coastal ecosystems. Marine Pollution Bulletin, 145, 234-245.
4. Borowitzka, M. A. (2018). Systematics, morphology, and mineral carbonation processes in littoral chlorophytes. Journal of Applied Phycology, 30(2), 1105-1117.
5. . Department of Botany. (2024). Atlas and Classification of Marine Algae along the Libyan Coastline. University of Benghazi Press.
6. Demirbas A. (2010). Use of Algae As Biofuel Sources. Energy Conversion and Management, 51: 2738-2749.
7. Godeh, M. M., Karim, A. G., & Ghannudi, S. A. (1992). Floristic and ecological survey of benthic marine algae around Benghazi, Libya. Faculty of Science Bulletin, University of Benghazi, 6(1),45-58.

8. Guiry, M. D., & Guiry, G. M. (2026). AlgaeBase. World-wide electronic publication, National University of Ireland, Galway.
9. Lee R. K. S. (1980). Catalogue of The Marine Algae of The Canadian Arctic, National Museums of Canada, 9;1-82.
10. Nizamuddin, M. (1981). Contribution to the marine algae of Libya: Dictyotales, Bornetellaceae, and Fucales. Bibliotheca Phycologica, Vol. 54. J. Cramer, Vaduz.
11. Round, F. E., Crawford, R. M., & Mann, D. G. (2020). Diatoms: Biology and Morphology of the Genera. Cambridge University Press.
12. Stadtländer C. T. H. (2013). Eg Bellinger, Dc Sigee (2010). Freshwater Algae: Identification And Use As Bioindicators. Journal of Applied Phycology, 25: 1265-1266.
13. Shakman, E., El-Shokri, A., & Ben-Galed, A. (2019). Status, distribution, and ecological indicators of marine macroalgae along the Libyan coast: A comprehensive review. Libyan Journal of Marine Science, 24(1), 12-29.
14. Van Den Burg S., Bikker P., Van Krimpen M., and Van Duijn A. P. (2013). Economic Feasibility of Offshore Seaweed Production In The North Sea. Aquaculture Europe Conference, Trondheim, Norway.
15. Venkataraman G. S. (1969). The Cultivation of Algae. Indian Council of Agriculture Research.

Derna University Journal of Medical Sciences **4 (1): 60-67, 2026**

دراسة نباتية، مسح وتحديد الطحالب البحرية في المنطقة الساحلية في ساحل سيدي خليفة، بنغازي، ليبيا

هبة سعيد نجم
قسم علم النبات، كلية العلوم، جامعة درنة، درنة، ليبيا
"

الملخص:

استمرت هذه الدراسة ثلاثة أشهر (مايو، يونيو و يوليو) وقدمت تقييماً تصنيفياً شاملاً ودراسة بيئية مقارنة لأنواع الطحالب البحرية علي طول شاطئ سيدي خليفة، شمال شرق بنغازي، ليبيا، بما في ذلك تحليل معمق للأدبيات الإقليمية التاريخية والمعاصرة، جُمعت عينات من الطحالب من موقعين متأثرين بالديناميكية المائية: المحطة 1 (صخور ساحلية مكشوفة للأمواج) والمحطة 2 (بركة بحيرة مغلقة ذات طاقة منخفضة وشبه معزولة). وبإستخدام المجهر الضوئي عالي الدقة، تم فحص نظام رقمي مكون من 17 لوحة لتوضيح التراكيب الخيطية، وتراكيب التفرع الخلوي، وتنوع الدياتومات الريشية، وديناميكيات البلورات الثانوية. أظهر قطاع المحيطات المفتوحة تنوعاً بيولوجياً قوياً، تتصدره الطحالب الخضراء المقاومة ,(Cladophora spp) والهياكل الشبيهة بالأوراق المتوسعة ,(Ulva lactoca) والطحالب البنية بطيئة النمو ,(Cystoseira spp) إلي جانب مجتمعات وفيرة من الياتومات الريشية السيليسية ,(Navicula spp) في المقابل أظهر الحوض المحدود مؤشرات علي ضغط بيئي كبير، مما أدي إلي تفكك واسع النطاق للخيوط، وإنكماش بلازمي، وتكوين بلورات إبرية، ومتفرعة، ومنشورية بشكل كبير، متأثرة بزيادة الملوحة والعوامل الثقافية. تشير مقارنة هذه النتائج مع الدراسات الليبية السابقة إلي أن إنتشار Cladophora و ,Ulva إلي جانب إنخفاض الطحالب البيئية، يُعد مؤشراً حيوياً موثوقاً به للتدهور البيئي الموضوعي علي طول ساحل جنوب البحر الأبيض المتوسط.

الكلمات المفتاحية: الطحالب البحرية، نباتية، المسح، التحديد.