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Species-Level Coral Inventory of Abu Al Abyad and Al Yasat Islands, United Arab Emirates

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KEYWORDS

Coral reefs;
species identification;
Abu Al Abyad;
Al Yasat Islands;
benthic ecology; coral monitoring.

ABSTRACT

Coral reefs in the Arabian Gulf are among the most thermally and saline-tolerant ecosystems globally, yet they face increasing pressures from climate change and coastal development. Coral colonies were surveyed using belt transects and photo quadrats, while environmental parameters such as depth (6-10m), water temperature (20.4-36.7 °C), salinity (40.76 PSU), and substrate type (rocky, sandy, or rubble) were recorded. A total of 13 coral species belonging to 10 genera and 8 families were identified by the measurements of the colony and corallites, including Acropora pharaonis, Porites lutea, Psammocora stellata, Siderastrea savignyana, Cyphastrea serailia, Leptastrea transversa, Dipsastraea matthaii, Platygyra daedalea, Plesiastrea versipora, Coscinaraea monile, Turbinaria reniformis, Cyphastrea microphthalma, and Pseudosiderastrea tayamai. Species distributions were influenced by environmental conditions, particularly substrate type and depth. This study presents a comprehensive species-level assessment of coral communities in Abu Al Abyad and Al Yasat Islands, western Abu Dhabi, conducted between July 2023 and October 2025 and is the first comprehensive species-level coral inventory for these islands, incorporating photographic evidence to support future taxonomic verification and comparative assessments. The findings serve as essential baseline data for long-term monitoring, reef conservation, and ecological management in the UAE.

INTRODUCTION

Coral reefs are among the most biologically diverse and ecologically valuable ecosystems on the planet, providing essential ecological functions such as habitat formation, shoreline protection, nutrient cycling, and substantial economic value through fisheries and tourism [7] [9].

The Arabian Gulf stands out as one of the most environmentally extreme regions supporting coral reef development, characterized by pronounced temperature fluctuations (18-36 °C) and salinity levels exceeding 40 PSU [24] [11] [5]. Despite these harsh conditions, coral communities in the United Arab Emirates (UAE) have evolved remarkable physiological and ecological adaptations, exhibiting exceptional tolerance to both thermal and saline stress [17] [13]. The coral reefs of the UAE, particularly those located around the western offshore islands of Abu Al Abyad and Al Yasat, are of high ecological and socio-economic significance [19] [16. These reefs provide critical ecosystem services, functioning as nursery habitats, fishery resources, and natural barriers against coastal erosion. However, they are increasingly subjected to multiple anthropogenic and natural stressors, including coastal development, sedimentation, marine pollution, and recurring mass bleaching events associated with rising sea surface temperatures[10] [20] [21] .Although several regional studies have examined coral cover, community structure, and general reef health across the southern Arabian Gulf, species-level identification and distributional data for Abu Al Abyad and Al Yasat Islands remain limited [8] [23] [2]. Detailed taxonomic inventories are vital for detecting shifts in species assemblages, identifying thermally tolerant or vulnerable taxa, and informing targeted management and restoration strategies [12] [6] [1]. especially under the rapidly changing climate scenario.

The present taxonomic study aims to provide a comprehensive assessment of coral diversity and distribution at the species level within Abu Al Abyad and Al Yasat Islands focussing on (1) documenting the coral species present and develop a photographic reference archive; (2) assessing spatial patterns of species richness and abundance across sites and depths; and (3) examining environmental factors influencing coral presence and condition. This study establishes the first detailed, species-level baseline for these offshore reef systems, thereby contributing valuable information for long-term monitoring, regional biodiversity assessments, and coral reef conservation initiatives in the UAE and the wider Arabian Gulf.

MATERIALS AND METHODS

Study Area

Field surveys were conducted at six sites within the Al Yasat Islands and ten sites around Abu Al Abyad Island (Table 1). The benthic environment of Abu Al Abyad is characterized by fringing coral reefs interspersed with sandy patches and rocky substrates, providing a mosaic of habitat types. In contrast, the Al Yasat Islands are relatively more exposed to open-sea conditions, exhibiting shallower reef structures and greater variability in substrate composition. Environmental parameters measured during the surveys included depth, seawater temperature, and salinity. Coral reef is found at a depth of 3 to 8m, but was severely degraded due to the 1996, 1998 catastrophic bleaching event [18] [15]. Survey depths ranged from 3 to 8 m, with water temperatures between 28 and 34 °C and mean salinity values averaging approximately 40 PSU

Sampling Methods

Coral community assessments were conducted using belt transects measuring 20 m × 2 m, replicated three times at each sampling station to ensure statistical robustness and spatial representativeness across the surveyed habitats (depth range: 3-8 m) [17] [13]. Within each transect, all Scleractinian coral colonies were recorded and identified to the lowest possible taxonomic level based on gross morphology and skeletal characteristics. Colony abundance and percentage cover were quantified to evaluate species composition and relative dominance within the reef assemblage. To complement the field observations, photo quadrats of 1 m^2 were systematically captured at 5 m intervals along each transect using a high-resolution digital underwater camera. These images were later analyzed using standardized image analysis software to verify field identifications, quantify coral cover with higher precision, and establish a permanent visual archive for future temporal comparisons and monitoring [13] [8].

Coral Identification

Species identification was performed following the diagnostic frameworks outlined by [8] [23] [21] [8]. employing a combination of morphological and skeletal

criteria to ensure taxonomic accuracy. Identification was primarily based on key diagnostic characters such as colony growth form, corallite arrangement, septal structure, wall thickness, and surface texture, which were examined in situ under Nikon SMZ800N stereo zoom microscope conditions. Representative colonies were photographed in high resolution using standardized imaging protocols to capture diagnostic features, including close-up views of corallites and overall colony architecture. All photographic records were subsequently cross-referenced with regional Coral ID databases (Corals of the world- https://www.coralsoftheworld.org/) and taxonomic monographs for verification and to resolve potential ambiguities among morphologically similar taxa. In cases of uncertainty, multiple diagnostic characters and inter-observer consensus were used to confirm identification at the species level.

Environmental Parameters

Environmental parameters at each survey site were systematically recorded to contextualize coral community structure and assess potential abiotic influences on species distribution. Depth measurements were obtained using a calibrated dive computer and ranged between 3 and 8 m across transects. Water temperature was continuously monitored using a handheld digital thermometer, with recorded values spanning 28-34 °C, reflecting the thermal extremes characteristic of the Arabian Gulf. Salinity levels were measured in situ using a refractometer and averaged approximately 40 PSU, consistent with the hyper-saline conditions of this region. Substrate composition was characterized by direct observation and classified into broad categories- rocky, sand, rubble, and consolidated coral framework- to evaluate the influence of benthic habitat heterogeneity on coral settlement and colony distribution. These environmental measurements, coupled with detailed habitat descriptions, provided critical context for interpreting species abundance patterns and community assemblages, as well as for comparing the resilience and spatial distribution of corals between Abu Al Abyad and Al Yasat Islands.

RESULTS

Species Composition

Field surveys conducted at Abu Al Abyad and Al Yasat Islands documented a total of 13 hard coral species belonging to 10 genera and 8 families. For each species, measurements of colony size, growth form, and corallite characteristics were recorded (Figures 1-4; Table 2). Coral assemblages at both locations were primarily composed of massive and sub-massive growth forms. Species richness and overall colony density were noticeably higher at Abu Al Abyad Island compared to Al Yasat Island. The most abundant species across the surveyed reefs were *Porites lutea*, *Platygyra daedalea*, and *Cyphastrea serailia*, which together represented a major portion of the observed live coral cover.

Environmental Conditions

Surveyed reefs occurred at depths between 4 and 10 m, with an average depth of 5.6 m, characteristic of shallow subtidal reef environments in the southern Arabian Gulf. Seawater temperatures showed strong seasonal variability, ranging from 20.4 °C during winter to 36.7 °C in summer, with an annual mean of approximately 31 °C. Mean monthly temperatures recorded at depths of 6, 8, and 10 m exceeded 35 °C during the summer period (June-September) and declined below 22 °C in winter (December-February) (Figure 5).

Salinity levels were consistently elevated throughout the study period, ranging from 36 PSU in winter to more than 46 PSU during late summer, with a mean value of 40.76 PSU (Figure 6). Live coral cover and average colony size were greater at Abu Al Abyad Island than at Al Yasat Island, particularly on stable rocky substrates (Figure 7).

Discussion

The dominance of massive and sub-massive coral morphologies observed in this study reflects adaptation to the extreme thermal and salinity conditions typical of the southern Arabian Gulf. These growth forms are known to provide greater resistance to temperature stress, sedimentation, and salinity fluctuations, enabling long-term persistence under harsh environmental regimes [19] [16] [4]. The frequent occurrence of *Porites lutea*, *Platygyra daedalea*, and *Cyphastrea serailia* further highlights the ecological importance of thermally tolerant taxa capable of sustaining reef structure under environmental stress.

The higher species richness and coral density recorded at Abu Al Abyad Island suggest more favourable local conditions for coral settlement and growth. These conditions may be linked to greater substrate stability, increased habitat heterogeneity, and localized

hydrodynamic processes that enhance larval retention and nutrient availability [23] [12] [2]. Although Al Yasat Island supported fewer species, the presence of resilient massive and branching corals indicates that these reefs retain the capacity to persist despite stronger environmental constraints [14] [6].

Species distribution patterns were closely associated with environmental variables, particularly depth and substrate type. Massive corals such as *Porites* and *Platygyra* were more common on deeper, consolidated substrates, while encrusting species including *Cyphastrea* and *Psammocora* were frequently observed in shallower areas dominated by mixed rubble and sand. These habitat-specific patterns emphasize the role of physical reef complexity in supporting coral diversity and align with previously reported ecological preferences of Arabian Gulf corals [7] [4] [14].

Offshore reefs in the UAE have been identified as potential refuges for heat-tolerant coral populations and may act as important sources for recovery following large-scale bleaching events [2] [3] [5]. The species composition documented in this study provides a robust baseline for detecting future changes in coral communities associated with climate warming, coastal development, or episodic thermal stress [22]. In addition, photographic records collected during surveys enhance taxonomic accuracy and support long-term ecological monitoring efforts.

CONCLUSION

This study recorded thirteen coral species from ten genera and eight families, with Abu Al Abyad Island supporting higher coral diversity, live cover, and structural complexity than Al Yasat Island. The dominance of stress-tolerant species such as *Porites lutea*, *Platygyra daedalea*, and *Cyphastrea serailia* demonstrates the remarkable adaptive capacity of corals in the Arabian Gulf. Depth, substrate type, and extreme temperature variability were identified as key drivers shaping coral community structure. These findings reinforce regional evidence of exceptional thermal resilience among Gulf corals and provide essential baseline information for long-term monitoring, reef restoration planning, and sustainable management of coral ecosystems in the UAE and the wider Arabian Gulf.

Compliance with Ethical Standards

This research did not involve field sampling of wild corals and therefore did not require collection permits from external authorities. All coral materials used in this study were obtained from and maintained within the authors' in-house departmental facilities. All procedures were carried out in accordance with institutional regulations and applicable national guidelines. The authors declare that they have no conflict of interest.

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Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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Tables:

Table 1. GPS coordinates of sampling sites

SN	Island	Latitude (N)	Longitude (E)
1	Al Yasat	24°11'16.86"	52°00'14.84"
2	Al Yasat	24°08'31.95"	52°00'41.67"
3	Al Yasat	24°08'31.55"	52°00'34.96"
4	Al Yasat	24°09'04.32"	51°59'49.62"
5	Al Yasat	24°09'00.68"	51°59'43.22"
6	Al Yasat	24°08'54.99"	51°59'43.19"
7	Abu Al Abyad	24°16'37.86"	53°42'54.36"
8	Abu Al Abyad	24°20'30.97"	53°49'52.81"
9	Abu Al Abyad	24°20'57.06"	53°50'17.22"
10	Abu Al Abyad	24°23'10.50"	53°48'34.05"
11	Abu Al Abyad	24°21'11.46"	53°49'34.20"
12	Abu Al Abyad	24°20'56.76"	53°50'17.40"
13	Abu Al Abyad	24°19'38.10"	53°47'33.00"
14	Abu Al Abyad	24°19'6.30"	53°44'49.86"
15	Abu Al Abyad	24°18'28.32"	53°43'6.72"
16	Abu Al Abyad	24°15'9.78"	53°39'39.06″

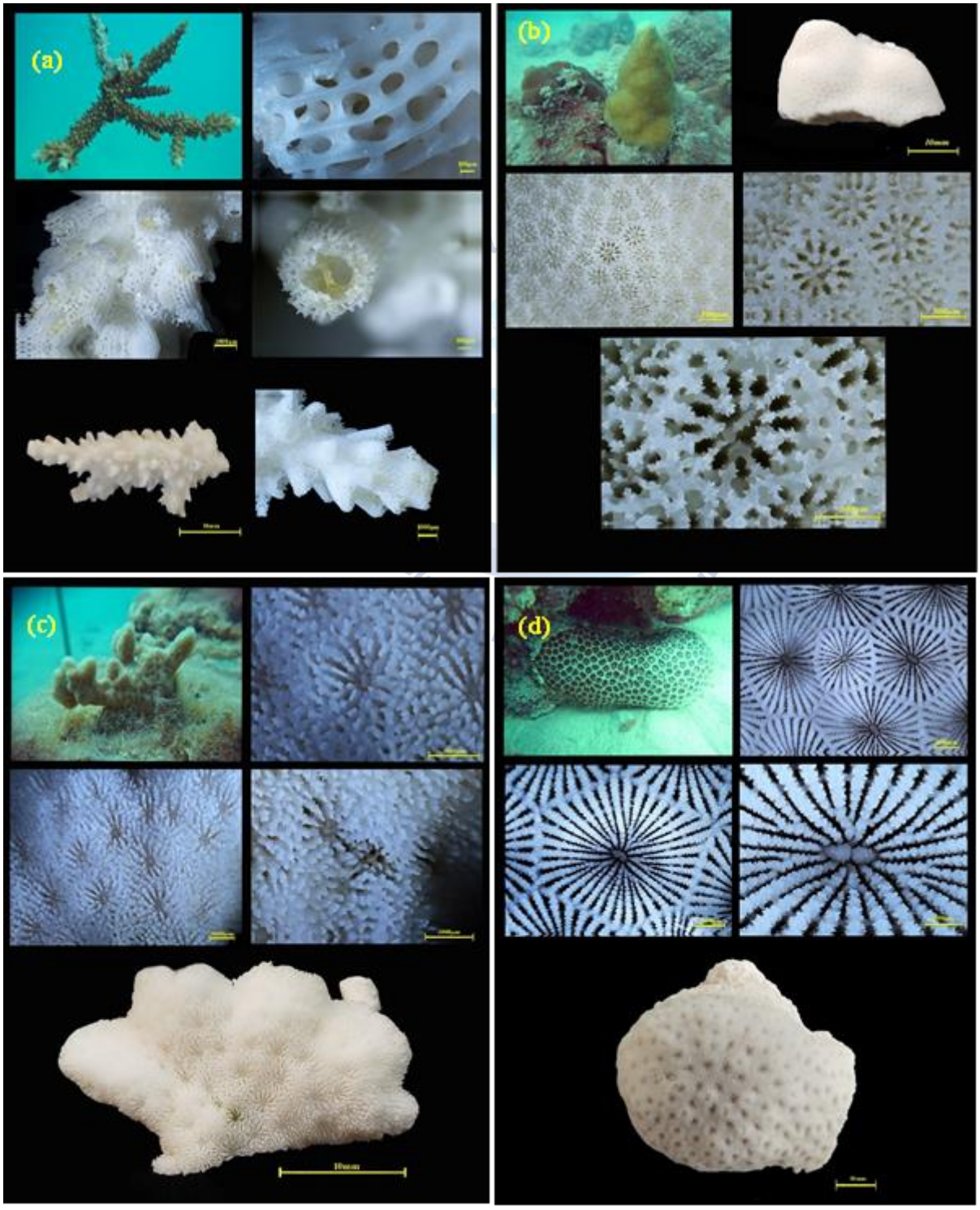
Table 2. Coral species recorded in Abu Al Abyad and Al Yasat islands

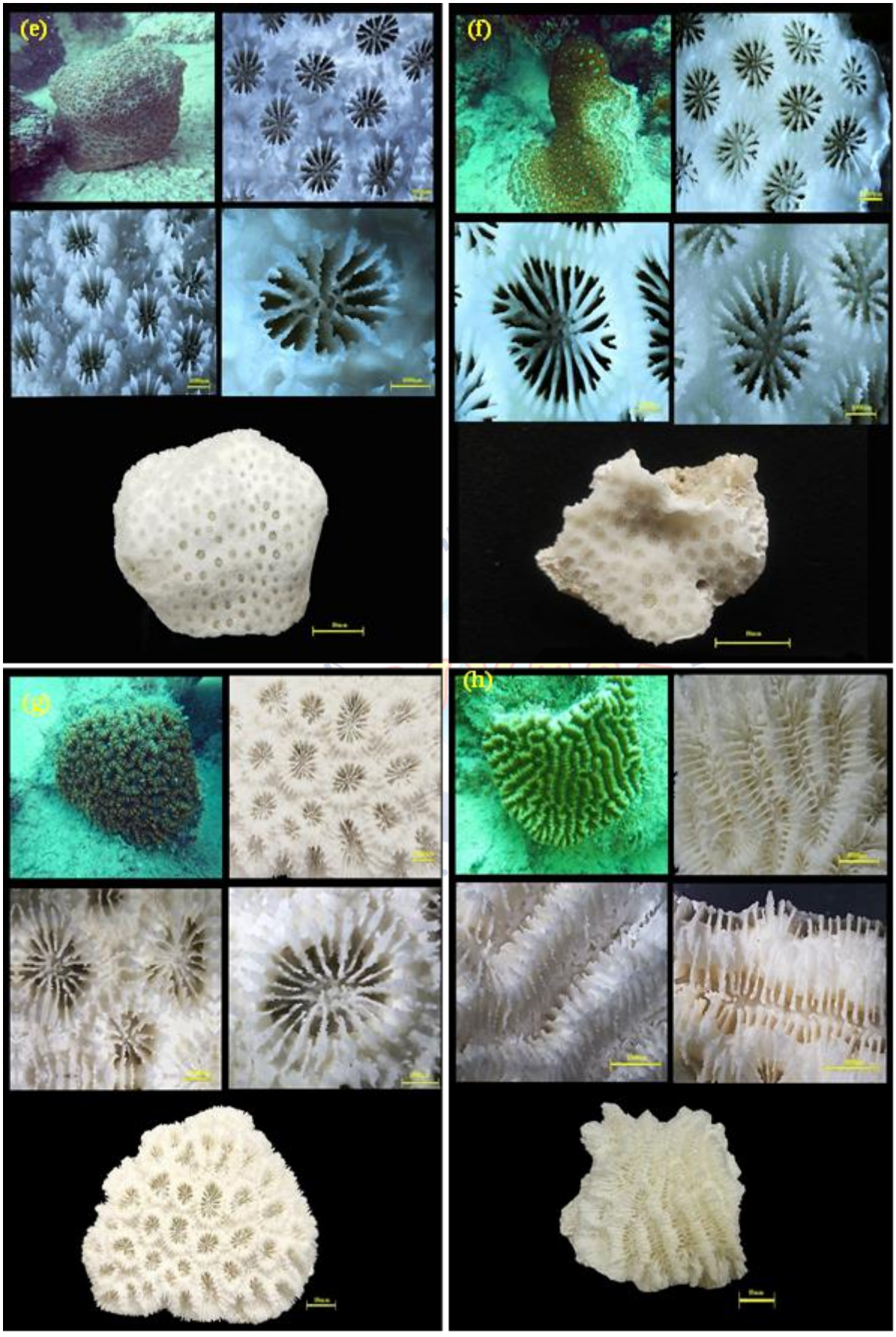
S.No.	Species	Family	Growth Form	Abu Al Abyad	Al Yasat
1	*Acropora pharaonis*	Acroporidae	Branching	✓	✓
2	*Porites lutea*	Poritidae	Massive	✓	✓
3	*Psammocora stellata*	Psammocoridae	Encrusting	✓	✓
4	*Siderastrea savignyana*	Siderastreidae	Massive	✓	✓
5	*Cyphastrea serailia*	Merulinidae	Encrusting	✓	✓
6	*Leptastrea transversa*		Massive	✓	✓
7	*Dipsastraea matthaii*		Massive	✓	✓
8	*Platygyra daedalea*		Meandroid	✓	✓
9	*Plesiastrea versipora*	Plesiastreidae	Massive	✓	✓
10	*Coscinaraea monile*	Coscinaraeidae	Submassive	✓	✓
11	*Turbinaria reniformis*	Dendrophylliidae	Foliose	✓	-
12	*Cyphastrea microphthalma*	Merulinidae	Encrusting	✓	✓
13	*Pseudosiderastrea tayamai*	Siderastreidae	Encrusting	✓	-

Figure legends:

Figure 1. *Acropora pharaonis* (Milne Edwards & Haime, 1860) **(a)**, *Porites lutea* (Milne Edwards & Haime, 1860) **(b)**, *Psammocora stellata* (Verrill, 1866) **(c)**, *Siderastrea savignyana* (Milne Edwards & Haime, 1850) **(d)**.
Figure 2. *Cyphastrea serailia* (Forsskal, 1775) **(e)**, *Leptastrea transversa* (Klunzinger, 1879) **(f)**, *Dipsastraea matthaii* (Vaughan, 1918) **(g)**, *Platygyra daedalea* (Ellis & Solander, 1786) **(h)**.
Figure 3. *Plesiastrea versipora* (Lamarck, 1816) **(i),** *Coscinaraea monile* (Forsskal, 1775) **(j)**, *Turbinaria reniformis* (Bernard, 1896) **(k)**, *Cyphastrea microphthalma* (Lamarck, 1816) **(l).**
Figure 4. *Pseudosiderastrea tayamai (Yabe & Sugiyama, 1936)* ***(m)***.
Figure 5. *Seasonal seawater temperature variations at 6, 8, and 10 m depths in coral survey sites of Abu Al Abyad and Al Yasat Islands (July 2023 – October 2025)*
Figure 6. Seasonal salinity variations were recorded at 6–10 m depths in Abu Al Abyad and Al Yasat Islands (July 2023–October 2025
Figure 7. Showing dense coral growth and large colonies, indicating a stable substrate in Abu Al Abyad Island

Figures or Plates

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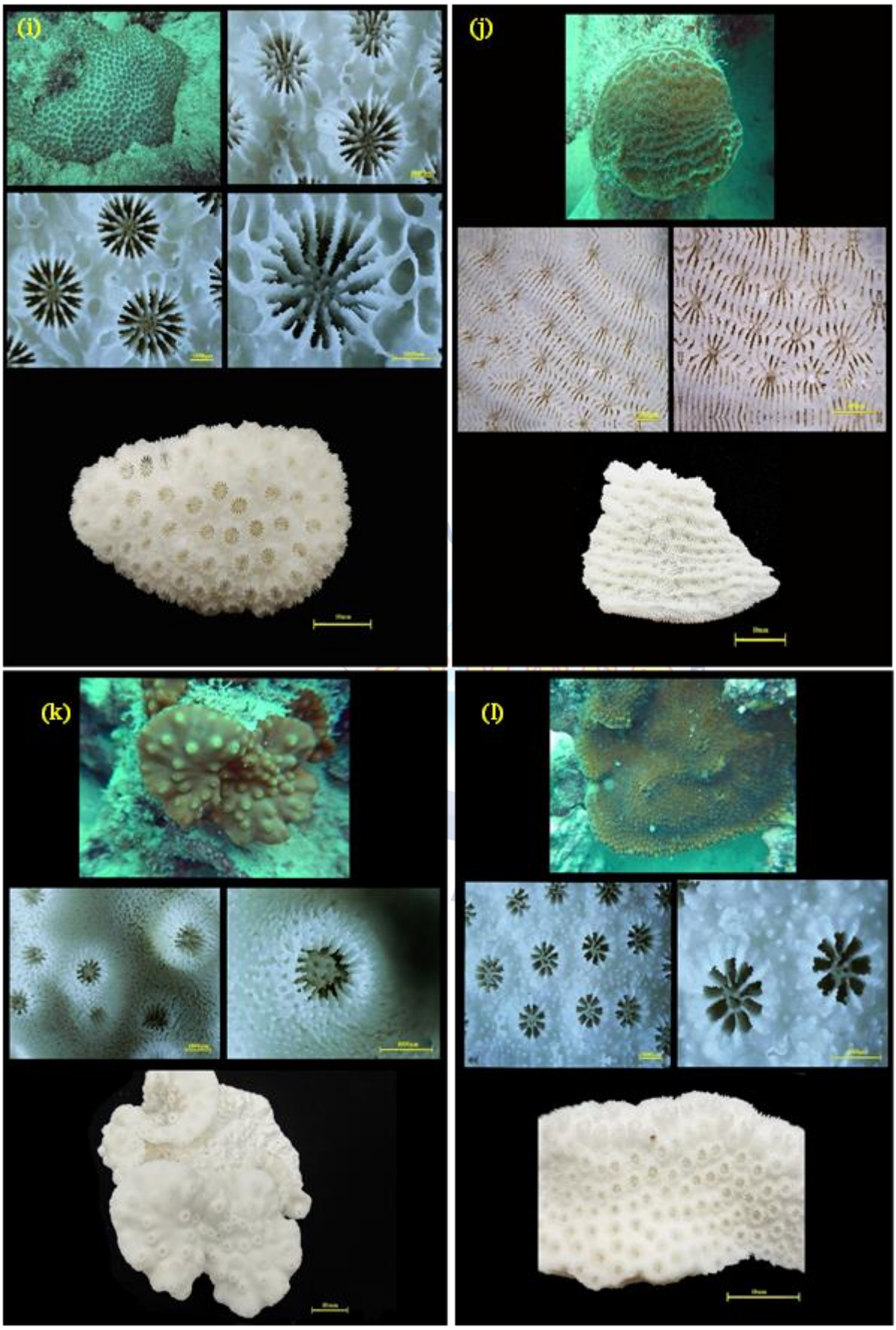
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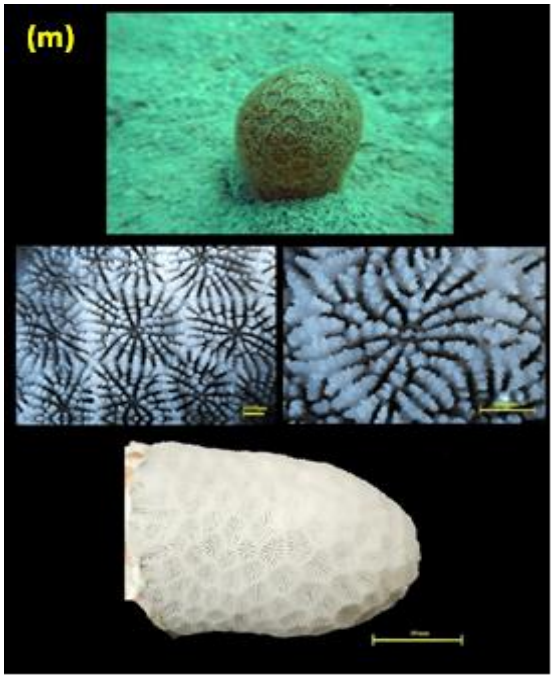
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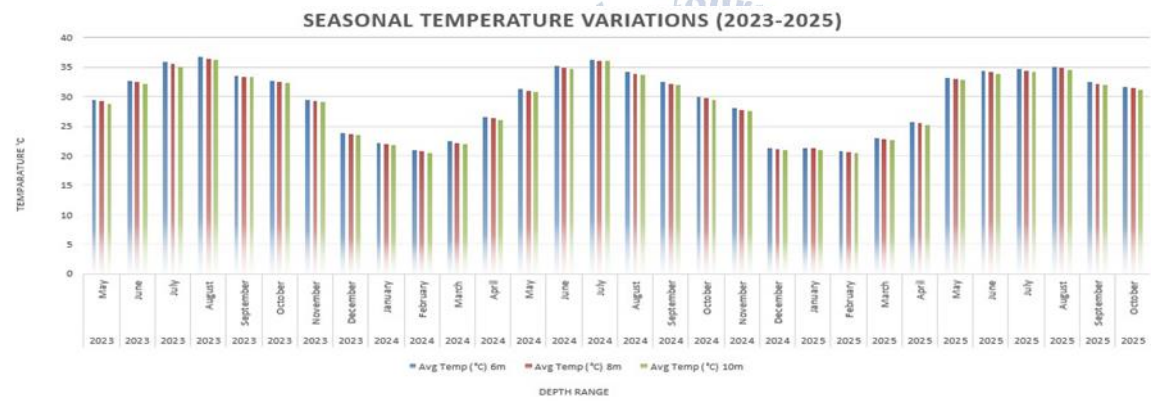
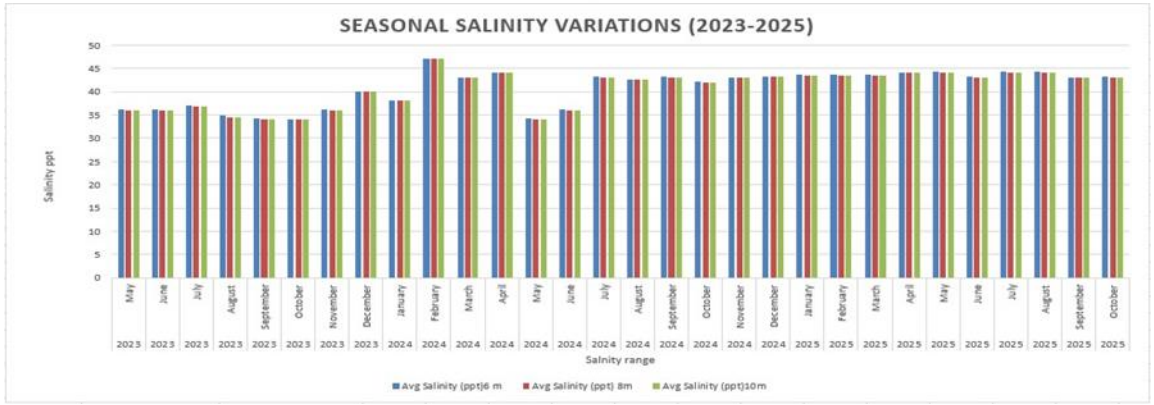

SEASONAL TEMPERATURE VARIATIONS (2023-2025)
TEMPARATURE °c
DEPTH RANGE
Avg Temp (°C) 6m
Avg Temp (°C) 8m
Avg Temp (°C) 10m


SEASONAL SALINITY VARIATIONS (2023-2025)
Salinity ppt
Salnity range
Avg Salinity (ppt)6 m
Avg Salinity (ppt) 8m
Avg Salinity (ppt)10m