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Diversity and Abundance of Invertebrates Associated with Two Macroalgal Species in the Central Red Sea Coast of Saudi Arabia

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Abstract. The diversity and abundance of the invertebrates associated with two different abundant macroalgal species (*Acanthophora* and *Padina*) north of Jeddah coastal waters on the central Red Sea were studied during summer and winter seasons. Seven major groups belonging to 18 families of invertebrates were observed during this study. The most abundant invertebrate taxa were crustaceans followed by molluscs and polychaetes. The numerical density of communities associated with the two macroalgal species was higher in summer than in winter. Acanthophora hosted higher counts than those associated with Padina during summer and winter. Significant seasonal variations were observed in the abundance of isopods and decapods. Overall, this study indicated that marine macroalgae inhabiting in Jeddah coastal waters are acting as a refugia for marine invertebrates thereby supporting the coastal biodiversity.

Keywords: Diversity, epifauna, macroalgae, marine invertebrates, Jeddah coast, Red Sea.

1. Introduction

Epibionts can be animals (epizoans) and algae (epiphytes) (Wahl, 2010). Their body length ranges from 0.5 to 10 mm as indicated by most authors in the scientific literature (Chen *et al*., 2021). Epifauna occupy macroalgal meadows as they offer them an optimal habitat with rich organic resources as many of them are herbivores and protection from predators and physical stressors (Bell, 1991; Duffy, 1990; Viejo, 1999). This in turn makes macroalgal beds important feeding sites for a wide range of tropical fishes (Tano *et al*., 2016; van Lier *et al*., 2018; Wilson *et al*., 2014). Polychaetes, amphipods, isopods, gastropods, and mussels are examples of epifaunal communities associated with macroalgal meadows.

Studying the abundance and diversity of the epifaunal assemblages yields important information to understand the status of macroalgal beds and assess any changes. Those studies in turn help to best support and manage the protection of the coastal ecosystem. Many studies have documented the factors that influence the abundance of epifauna assemblages including biotic and abiotic factors. For instance, epifaunal assemblage changes are observed in response to temperature (Gunnill, 1983; Hagerman, 1966) and tidal exposure (Gunnill, 1983). In other cases, epifaunal assemblages variability is recorded in relation to the identity of host macroalgae species (Cacabelos *et al.*, 2010) and macroalgal body size fluctuations seasonally (Ba-Akdah *et al*., 2016; Edgar & Klumpp, 2003; Tano *et al*., 2016). In general, epifaunal communities associated with macroalgal beds are poorly studied (Chen *et al*., 2020; Fraser *et al*., 2020; Gan *et al*., 2019). Reasons for this include the small size of epifauna, difficulty to quantify (Edgar, 1990; Kramer *et al*., 2012; Taylor, 1998) and lack of taxonomic specialists (Cowles *et al*., 2009; Edgar, 1994; Edgar, 1990; Taylor, 1998). In addition, a recent review reported that out of all published studies of marine epifauna worldwide, excluding polar zones, only 17% are considered tropical habitats (Chen *et al.*, 2021). This indicates that more studies of marine epifauna in tropical zone are needed including those associated with macroalgae in the Red Sea, especially along Saudi Arabia Coast (Sonnewald & El-Sherbiny, 2017). Although the Red Sea lies at the north-west corner of the Indian Ocean, with great similarity in the occurring organisms, as most of the Red Sea marine organisms occur also in the Indian Ocean (Vine, 1986), the Red Sea has the highest levels of endemism as compared to adjacent areas of the Indian Ocean (DiBattista *et al*., 2016).

The aim of this study was to evaluate the diversity and abundance of epifauna associated with two macroalgal species on Saudi Coast of Jeddah, the Red Sea.

2. Materials and Methods

Sampling was conducted in February (winter) and July (summer) 2022, from nearshore coastal waters, north of Jeddah city, Saudi Arabia (21˚19′ 09″N and 39˚06′07″E) (Fig. 1). Two different morphologically abundant macroalgae *Padina* sp. and *Acanthophora* sp. were selected for this study (Fig. 2). Three replicates of each macroalga were collected at the same time of the day (2-3 p.m.) during spring tide (time of a full moon).

The macroalgal samples were cut from their holdfasts and placed into a polyethylene bag with seawater and taken to the laboratory, where they were washed with fresh water through a 0.5 mm mesh sieve to retain epifauna. The maximum body size observed during this study was about 2 cm (20 mm), which was the shell size of gastropods. All samples were preserved in 70% ethanol.

For the taxonomical study, all isolated epifauna were identified under the microscope (Leica Microsystems Ltd., Germany) to the lowest taxonomic level (at least family level) wherever possible. Taxonomic identifications were made with reference to the World Register of Marine Species website (WoRMS, 2023). Macroalgae samples were then wiped with tissue and weighed to determine the wet weight in a digital balance.

Epifauna abundance was determined and standardized to the number of individuals per 100 g of macroalgal wet weight and expressed as the mean value ± standard deviation (SD). Variations in the abundance of epifauna associated with macroalgae were analyzed using a two-way ANOVA with macroalgal type and season as factors.

3. Results

The mean total number of invertebrates associated with the two macroalgae species during summer and winter is presented in Fig. 3. The numerical density of associated epifaunal communities was higher during summer than in winter. However, *Acanthophora* was inhibited by a higher number of invertebrates than *Padina* during the summer and winter seasons. On *Acanthophora*, the abundance of invertebrates varied from 863±592 individuals per 100 g of wet algal weight during summer to 648±349 individuals per 100 g of wet algal weight during winter. Meanwhile, *Padina* hosted 535±108 individuals per 100 g of wet algal weight during summer and 282±295 individuals per 100 g of wet algal weight during winter. However, two-way ANOVA results did not show significant variation in the mean abundance of total invertebrates between macroalgal species and seasons.

Figure 4 reported 18 families of invertebrates associated with the seaweeds, belonging mainly to seven major groups. Crustaceans were the most abundant (89% and 76%), followed by molluscs (10% and 23.5%) and polychaetes (1% and 0.5%) in both macroalgal species (*Acanthophora* and *Padina*, respectively) (Fig. 5). Crustaceans comprised five major groups which were represented by ten families (Table 1). Molluscs were represented by gastropods that included seven families, while one polychaete family was observed (Table 1).

The crustacean tanaids were the most abundant invertebrate dominated by Leptocheliidae. Their abundance on *Acanthophora* varied between 378±253 and 662±502 individuals per 100 g of wet algal weight in winter and summer seasons respectively, against 319±133 and 131±178 individuals per 100 g of wet algal weight on *Padina*, respectively for winter and summer. (Fig. 6).

Amphipods appeared as the second important crustacean group associated with *Acanthophora*, fluctuating between 68±74 individuals per 100 g of wet algal weight in summer and 155±45 individuals per 100 g of wet algal weight in winter. On *Padina*, amphipods amounted to 48±29 individuals per 100 g of wet algal weight in summer and 128±86 individuals per 100 g of wet algal weight in winter (Fig. 6). The other crustaceans were poorly represented on the studied algae, whereas cumaceans were the poorest group, found only on *Acanthophora* in summer with count of 10±9 individuals per 100 g of wet algal weight.

Isopods were found during summer only on both macroalgal species, amounting to 17±13 and 18±14 individuals per 100 g of wet algal weight respectively. Decapods recorded counts of 14±7 individuals per 100 g of wet algal weight in summer on *Acanthophora* as well as on *Padina*, while in winter decapods showed very low counts (2±2 – 5±7 individuals per 100 g of wet algal weight) on both macroalgal species. Statistically, amphipods, tanaids and cumaceans did not show significant variation in relation to macroalgae and season. The abundance of isopods and decapods revealed a significant variation ($P < 0.05$) between seasons but not between macroalgal species (Table 2).

Molluscs occupied the second order of abundance but with a pronouncedly lower count than crustaceans and the dominance of gastropods. On *Acanthophora*, gastropods amounted to 86±52 individuals per 100 g of wet algal weight in summer and 108±59 individuals per 100 g of wet algal weight in winter. In contrast, *Padina* hosted a high count during summer (133±21 individuals per 100 g of wet algal weight) and low in winter (24±26 individuals per 100 g of wet algal weight). Two-way ANOVA showed no significant variation in gastropods density between seasons and macroalgal species.

Polychaetes appeared as the poorest fauna on the two macroalgal species, attaining very low count (3±4-6±5 individuals per 100 g of wet algal weight) on *Acanthophora* while *Padina* counts 4±5 individuals per 100 g of wet algal weight in summer only.

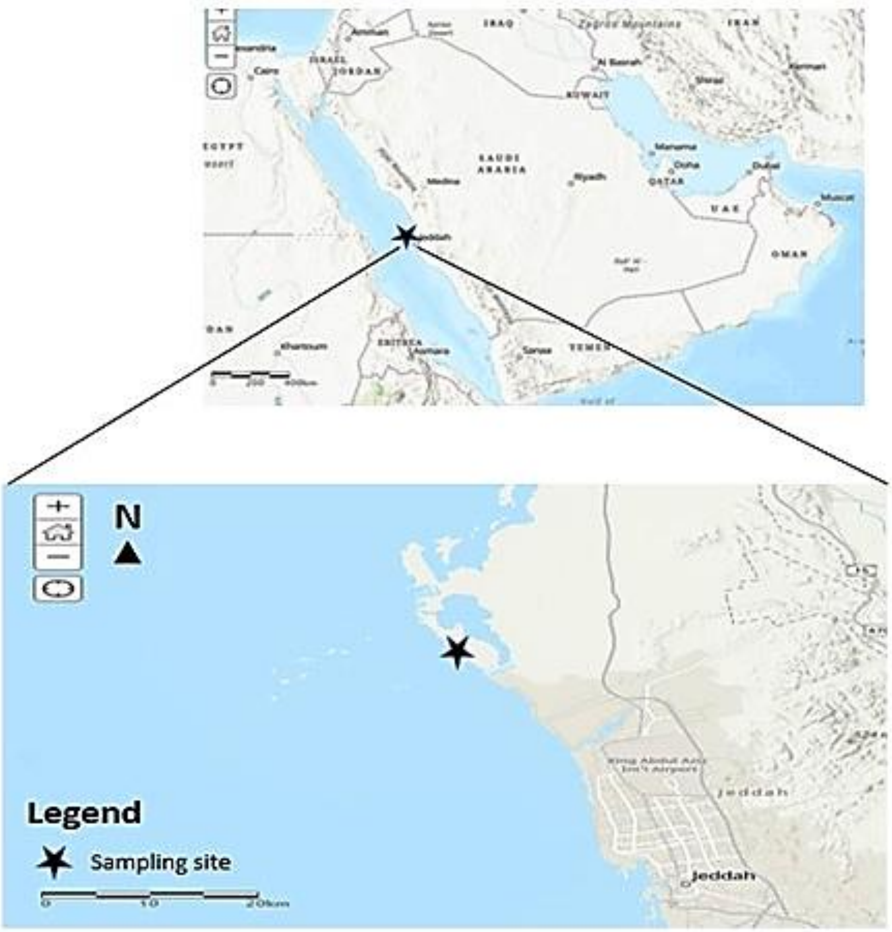

Fig. 1. Map showing the study site in the north of Jeddah coastal waters of the central Red Sea region of Saudi Arabia.

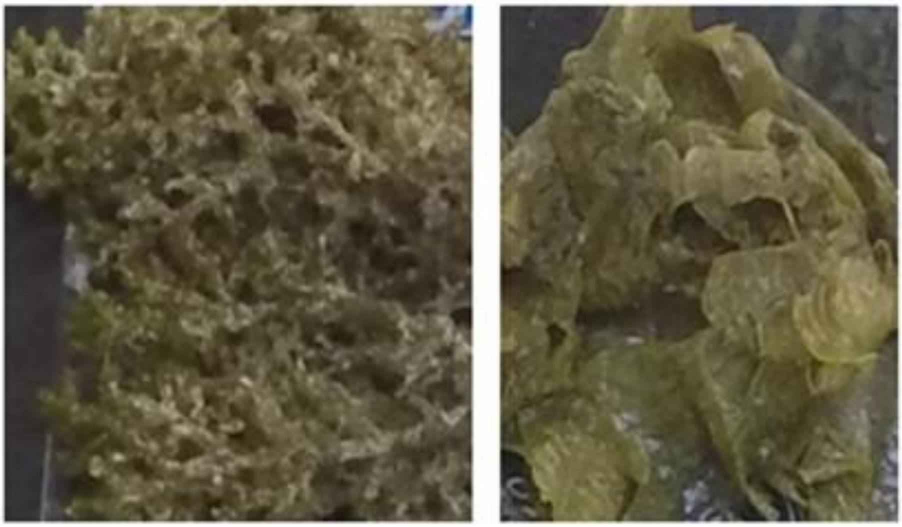

Fig. 2. The two selected macroalgae species in this study *Acanthophora* sp. (left) and *Padina* sp. (right).

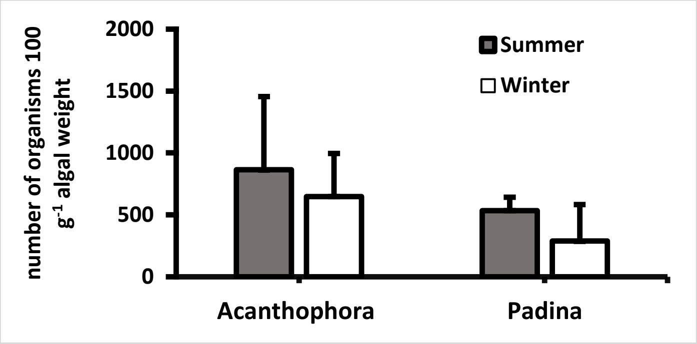

Fig. 3. The mean total number of invertebrates associated with *Acanthophora* and *Padina* seaweeds during summer and winter. Error bars indicate standard deviation (n = 3).

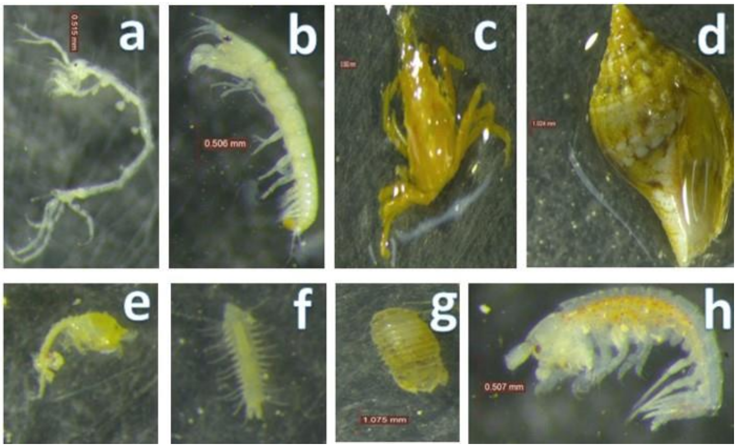

Fig. 4. Microscope photographs showing major invertebrates taxa found associated with seaweeds species. a) Amphipods (*Caprella* sp., Caprellidae), b) Tanaids (*Leptochelia* sp., Leptocheliidae), c) Decapods (*Menaethius monoceros*, Majidae), d) Gastropods (*Turbinella* sp., Turbinellidae), e) Cumaceans (*Nannastacus* sp., Nannastacidae), f) Polychaetes (*Syllis* sp., Syllidae), g) Isopods (*Cymodoce* sp., Sphaeromatidae), h) Amphipods (*Peraamphithoe* sp., Ampitoidae).

Table 1. List of invertebrate taxa associated with *Acanthophora.* and *Padina* seaweeds during this study (+ indicates the presence).

Phylum/Taxa/Family	Species	Macroalgae	
		Padina	*Acanthophora*
Crustaceans			
Amphipoda			
Family: Caprellidae	*Caprella* sp.	+	+
Family: Ampitoidae	*Peraamphithoe* sp.	+	+
Family: Corophidae	*Corophium* sp.	+	+
Family: Stenothoidae	*Stenothoe* sp.	+	+
Family: Gammaridae	*Gammarus* sp.	+	+
Tanaidacea			
Family: Leptocheliidae	*Leptochelia* sp.	+	+
Isopoda			
Family: Sphaeromatidae	*Cymodoce* sp.	+	+

Cumacea			
Family: Nannastacidae	*Nannastacus* sp.		+
Decapoda			
Family: Paguridae	*Pagurus* sp.	+	+
Family: Majidae	*Menaethius monoceros*	+	+
Molluscs			
Gastropoda			
Family: Strombidae	*Canarium* sp.	+	
Family: Cerithiidae	*Rhinoclavis* sp.	+	+
Family: Hydrobiidae	*Hydrobia* sp.		+
Family: Turbinellidae	*Turbinella* sp.	+	
Family: Marginellidae	*Volvarina* sp.	+	
Family: Columbellidae	*Columbella* sp.	+	+
Family: Nassariidae	*Nassarius* sp.	+	+
Polychaetes			
Family: Syllidae	*Syllis* sp.	+	

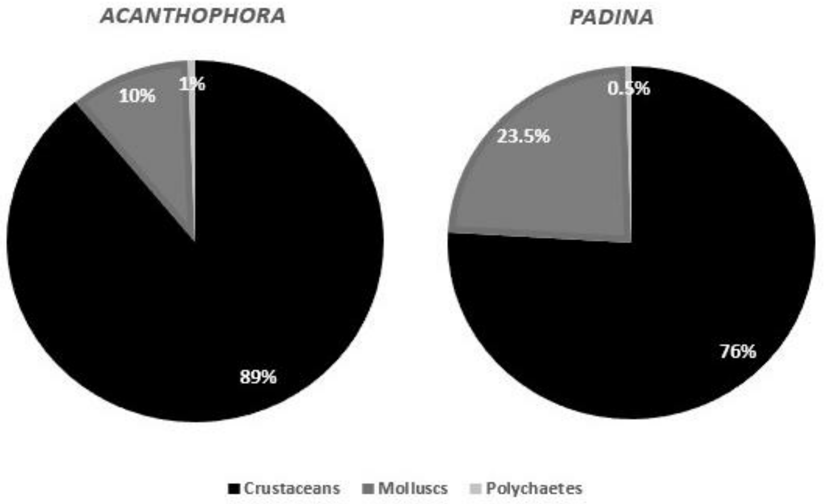

Fig. 5. Total abundance percentage of invertebrates associated with *Acanthophora* and *Padina* seaweeds after the epifaunal density in summer and winter seasons were pooled.

Table 2. Two-way ANOVA (analysis of variance) of isopods and decapods abundance on seaweeds. Season (summer and winter) and seaweed (*Acanthophora* and *Padina*) were considered as factors.

Source of variation	df	*F*	*P*
Isopods			
Season	1	6.4967	0.034234*
Seaweed	1	0.01473	0.906387
Error	8		
Total	11		
Decapods			
Season	1	5.80992	0.04248*
Seaweed	1	0.09078	0.77087
Error	8		
Total	11		

* $P < 0.05$.

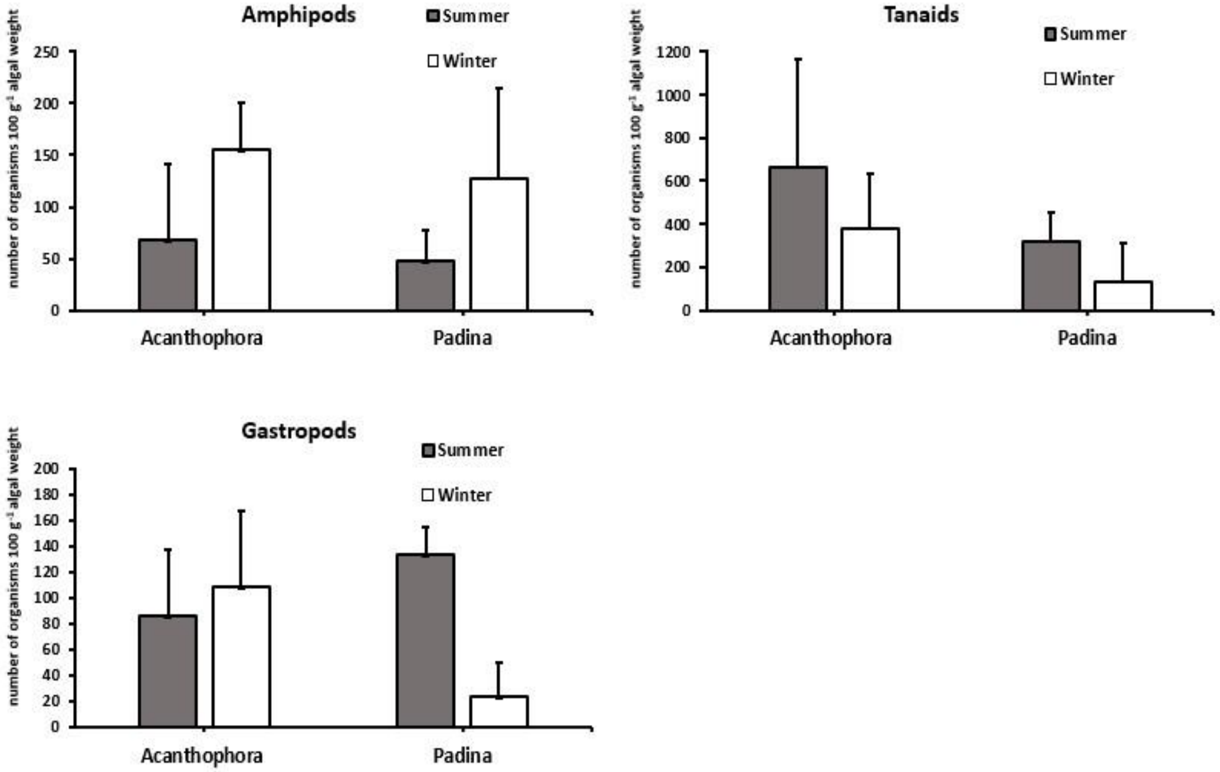

Fig. 6. The mean total number of major invertebrate taxa such as amphipods, tanaids, and gastropods associated with *Acanthophora* and *Padina* seaweeds during summer and winter. Error bars indicate standard deviation (n = 3).

4. Discussion

This study recorded several invertebrate groups such as amphipods, isopods, tanaids, cumaceans, gastropods and polychaetes associated with two macroalgal species. Previously Ba-akdah *et al*. (2016) reported that polychaetes, amphipods, bivalves, gastropods, and echinoderms were the common epifaunal groups associated with five macroalgae species including *Acanthophora* and *Padina* on the central Red Sea coast. In our study, the epifauna was more abundant in *Acanthophora* than on *Padina*. This observation contradicts the previous study which reported a higher abundance of epifauna on *Padina* among other algae (Ba-Akdah *et al*., 2016). The higher number of invertebrates associated with the algal species on the Jeddah coast indicates their functional role in structuring algal communities and overall coastal ecology. For instance, the amphipods associated with the macroalgae may eat the host plant or the epiphytes associated with algae (Duffy, 1990; Viejo, 1999). Also, other herbivores observed in this study such as gastropods, tanaids and isopods may play a key role in structuring algal communities in the coastal ecosystems (Sala & Dayton, 2011). The presence of a large number of gastropods may be due to the availability of rich amounts of food sources (epiphytes) on macroalgae (Jephson *et al*., 2008).

Studies on the diversity and ecology of the organisms associated with macroalgae are important to assess their role in coastal ecosystems. As macroalgal and other benthic habitats are under the stress of climate change and pollution-related stress throughout the world, the monitoring of these important habitats is necessary. A previous study from the central Red Sea coast showed that the diversity and distribution of marine invertebrates associated with the macroalgae varied temporally and between different algal species (Ba-Akdah *et al.*, 2016). In this study, the abundance of isopods and decapods showed significant temporal variation. None of the invertebrate groups varied between the algal species or the algal morphology. This indicated that epifauna structure on algal surface was not affected by seasonal or algal morphology traits. A previous study by (Stoner & Lewis III, 1985) reported the influence of algal morphology on the abundance of epifauna. In this study, though both algal species are morphologically distinct, they are providing space for many invertebrates.

The significant variation in the abundance of isopods and crabs may be due to the environmental factors or chemical defesne characters of the algae. Generally, variability in the abundance of marine organisms on soft and hard surfaces is caused mainly by multiple factors such as hydrodynamics, larval availability, habitat structure and species preference for habitats (Ba-Akdah *et al*., 2016; Bologna & Heck Jr, 1999; Chen *et al*., 2021). Isopods use macroalgae as food or as shelter (Orav-Kotta and Kotta, 2004). The genus *Cymodoce* collected from the macroalgae in this study is also reported as herbivores eating algae (Arrontes, 1990). Some isopod species are having feed preference as they eat one macroalgal species and use the other for shelter (Arrontes, 1990; Orav-Kotta & Kotta, 2004). The other important group that showed seasonal variation was crabs belonging to the families Majidae and Paguridae. Crabs also selectively ingest macroalgae that was confirmed by previous studies that reported the presence of good percentage of algal diet in stomach contents (Barros *et al.*, 2008; Woods, 1993). Hence, the role of algal chemical defense traits also needs to be studied to understand whether production of some compounds varied between the seasons. Macroalgae in general, possess many defense mechanisms against herbivores and predators (Hay, 1997; Hay & Fenical, 1988; Pereira *et al*., 2023). The chemical compounds produced by the macroalgal species are rich and diverse which include polyphenols, acetogenins, terpenes and halogenated compounds (da Gama *et al*., 2014).

The epifauna associated with the macroalgal communities may form potential trophic links with other organisms including fishes. In addition, by acting as a habitat, the macroalgae appear to increase the biodiversity of the coastal regions (Marzinelli *et al*., 2016). The diversity of epifauna recorded in this study is an indication of the possible functional role they could perform in the coastal ecosystems. Besides, the presence of large number of organisms on macroalgal communities as recorded in this study indicated the need to preserve these algal beds for maintaining the health of the ecosystems. Coastal ecosystems including fragile systems like seagrasses, seaweeds and coral reefs are under immense anthropogenic pressures throughout the world (Marzinelli *et al*., 2016). Hence, understanding the distribution of organisms in these ecosystems over spatial and temporal scales is of paramount importance for assessing the natural and anthropogenic causes responsible for the benthic community fluctuations (Levin, 1992; Underwood & Peterson, 1988).

In conclusion, the results of this study indicated the association of the large number of invertebrates on the macroalgal beds. Though the dominance of the invertebrate group varied between the algal species, both studied algal species support rich fauna. The significant variation observed in the abundance of isopods and crabs between the sampling seasons revealed that environmental factors and algal defense factors may play key role in structuring the epifaunal communities on the Jeddah coast of the Red Sea. Hence further studies on the factors regulating the epifaunal community structure may provide more insights to understand the ecology of these organisms.

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References

Arrontes, J. (1990). Diet, food preference and digestive efficiency in intertidal isopods inhabiting macroalgae. *Journal of experimental marine biology and ecology*, **139**(3), 231-249 .

Ba-Akdah, M., Satheesh, S. & Al-Sofyani, A. (2016). Habitat preference and seasonal variability of epifaunal assemblages associated with macroalgal beds on the Central Red Sea coast, Saudi Arabia. *Journal of the marine biological association of the United Kingdom*, **96**(7), 1457-1467 .

Barros, S. d. P., Cobo, V. J. & Fransozo ،A. (2008). Feeding habits of the spider crab *libinia spinosa H*. Milne Edwards, 1834 (Decapoda, Brachyura) in ubatuba Bay, São Paulo, Brazil. *Brazilian archives of biology and technology*, **51**, 413-417 .

Bell, S. S. (1991). Amphipods as insect equivalents ؟An alternative view. *Ecology*, **72**(1), 350-354 .

Bologna, P. A. & Heck Jr, K. L. (1999). Macrofaunal associations with seagrass epiphytes: relative importance of trophic and structural characteristics. *Journal of experimental marine biology and ecology*, **24**(1), 21-39.

Cacabelos, E., Olabarria, C., Incera, M. & Troncoso, J. S. (2010). Effects of habitat structure and tidal height on epifaunal assemblages associated with macroalgae. *Estuarine, Coastal and Shelf Science*, **89**(1), 43-52 .

Chen, Y. Y., Cooper، P. & Fulton, C. J. (2020). Sargassum epifaunal communities vary with canopy size, predator biomass and seascape setting within a fringing coral reef ecosystem. *Marine ecology progress series*, **640**, 17-30 .

Chen, Y.-Y., Edgar, G. J. & Fox, R. J. (2021). The nature and ecological significance of epifaunal communities within marine ecosystems. *Oceanography and Marine Biology* .

Cowles, A., Hewitt, J. E. & Taylor, R. B. (2009). Density, biomass and productivity of small mobile invertebrates in a wide range of coastal habitats. *Marine Ecology Progress Series*, **384**, 175-185 .

da Gama, B. A., Plouguerné, E. & Pereira, R. C. (2014). The antifouling defence mechanisms of marine macroalgae. In *Advances in Botanical Research* (Vol. **71**, pp. 413-440). Elsevier .

DiBattista, J. D., Roberts, M. B., Bouwmeester, J., Bowen, B. W., Coker, D. J., Lozano-Cortés, D. F., Howard Choat, J., Gaither, M. R., Hobbs, J. P. A. & Khalil, M. T. (2016). A review of contemporary patterns of endemism for shallow water reef fauna in the Red Sea. *Journal of Biogeography*, **43**(3), 423-439 .

Duffy, J. E. (1990). Amphipods on seaweeds: partners or pests? *Oecologia*, 267-276 .

Edgar, G. (1994). Observations on the size-structure of macrofaunal assemblages. *Journal of experimental marine biology and ecology*, **176**(2), 227-243 .

Edgar, G. J. (1990). The use of the size structure of benthic macrofaunal communities to estimate faunal biomass and secondary production. *Journal of experimental marine biology and ecology*, **137**(3), 195-214 .

Edgar, G. J. & Klumpp, D. W. (2003). Consistencies over regional scales in assemblages of mobile epifauna associated with natural and artificial plants of different shape. *Aquatic botany*, **75**(4), 275-291 .

Fraser, K., Stuart-Smith, R., Ling, S., Heather, F. & Edgar, G. (2020). Taxonomic composition of mobile epifaunal invertebrate assemblages on diverse benthic microhabitats from temperate to tropical reefs. *Marine ecology progress series*, **640**, 31-43 .

Gan, S. X., Tay, Y. C. & Huang, D. (2019). Effects of macroalgal morphology on marine epifaunal diversity. *Journal of the marine biological association of the United Kingdom*, **99**(8), 1697-1707 .

Gunnill, F. (1983). Seasonal variations in the invertebrate faunas of *Pelvetia fastigiata* (Fucaceae): effects of plant size and distribution. *Marine Biology*, ***73***, 115-130 .

Hagerman, L. (1966). The macro-and microfauna associated with *Fucus serratus L*., with some ecological remarks. *Ophelia*, **3**(1), 1-43 .

Hay, M. (1997). The ecology and evolution of seaweed-herbivore interactions on coral reefs. *Coral Reefs*, **16**, S67-S76 .

Hay, M. E. & Fenical, W. (1988). Marine plant-herbivore interactions: the ecology of chemical defense. *Annual review of ecology and systematics*, **19**(1), 111-145 .

Jephson, T., Nyström, P., Moksnes, P. O. & Baden ،S. P. (2008). Trophic interactions in *Zostera marina* beds along the Swedish coast. *Marine ecology progress series*, **369**, 63-76 .

Kramer, M., Bellwood, D. & Bellwood, O. (2012). Cryptofauna of the epilithic algal matrix on an inshore coral reef, Great Barrier Reef. *Coral Reefs*, **31**, 1007-1015 .

Levin, S. A. (1992). The problem of pattern and scale in ecology: the Robert H. MacArthur award lecture. *Ecology*, **73**(6), 1943-1967 .

Marzinelli, E. M., Leong, M. R., Campbell, A. H., Steinberg, P. D. & Vergés, A. (2016) .Does restoration of a habitat-forming seaweed restore associated faunal diversity? *Restoration Ecology*, **24**(1), 81-90 .

Orav-Kotta, H. & Kotta, J. (2004). Food and habitat choice of the isopod Idotea baltica in the northeastern Baltic Sea. *Hydrobiologia*, **514**, 79-85 .

Pereira, R. C., Paradas, W. C., de Carvalho, R. T., de Lima Moreira, D., Kelecom, A., Passos, R. M. F., Atella, G. C. & Salgado, L. T. (2023). Chemical Defense against Herbivory in the Brown Marine Macroalga *Padina gymnospora* Could Be Attributed to a New Hydrocarbon Compound. *Plants*, **12**(5), 1073 .

Sala, E. & Dayton, P. K. (2011). Predicting strong community impacts using experimental estimates of per capita interaction strength: benthic herbivores and giant kelp recruitment. *Marine Ecology*, **32**(3), 300-312 .

Sonnewald, M. & El-Sherbiny, M. (2017). Editorial: Red Sea. Biodiversity, **47**, 991-993. In.

Stoner, A. W. & Lewis III, F. G. (1985). The influence of quantitative and qualitative aspects of habitat complexity in tropical sea-grass meadows. *Journal of experimental marine biology and ecology*, **94**(1-3), 19-40 .

Tano, S., Eggertsen, M., Wikström, S. A., Berkström, C., Buriyo, A. & Halling, C. (2016). Tropical seaweed beds are important habitats for mobile invertebrate epifauna. *Estuarine, Coastal and Shelf Science*, **183**, 1-12 .

Taylor, R. B. (1998). Density, biomass and productivity of animals in four subtidal rocky reef habitats: the importance of small mobile invertebrates. *Marine ecology progress series*, **172**, 37-51 .

Underwood, A. & Peterson, C. (1988). Towards an ecological framework for investigating pollution. *Marine ecology progress series*, 227-234 .

van Lier, J. R., Wilson, S. K., Depczynski, M., Wenger, L. N. & Fulton, C. J. (2018). Habitat connectivity and complexity underpin fish community structure across a seascape of tropical macroalgae meadows. *Landscape Ecology*, **33**, 1287-1300 .

Viejo, R. M. (1999). Mobile epifauna inhabiting the invasive *Sargassum muticum* and two local seaweeds in northern Spain. *Aquatic botany*, **64**(2), 131-149.

Vine, P. (1986). *Red sea invertebrates*. Immel .

Wahl, M. E. (2010). In Biofouling; Dürr, S., Thomason, JC, Eds. In: Wiley Blackwell: Oxford, UK.

Wilson, S., Fulton, C., Depczynski, M., Holmes, T., Noble, M., Radford, B. & Tinkler, P. (2014). Seasonal changes in habitat structure underpin shifts in macroalgae-associated tropical fish communities. *Marine Biology*, **161**, 2597-2607 .

Woods, C. M. (1993). Natural diet of the crab *Notomithrax ursus* (Brachyura: Majidae) at Oaro, South Island, New Zealand. *New Zealand Journal of Marine and Freshwater Research*, **27**(3), 309-315 .

WoRMS Editorial Board (2023). *World Register of Marine Species*. Available from https://www.marinespecies.org at VLIZ. Accessed 02-01-2023. Doi:10.14284/170.

تنوع ووفرة اللافقاريات الموجودة على سطح نوعين من الطحالب الكبيرة في وسط ساحل البحر الأحمر بالمملكة العربية السعودية

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المستخلص. تمت دراسة تنوع ووفرة اللافقاريات الموجودة على سطح نوعين مختلفين من الطحالب الكبيرة نوع الأكانثوفورا (*Acanthophora*) (من الطحالب الحمراء) ونوع البدينا (*Padina*) (من الطحالب البنية) والموجدين بوفرة في المياه الساحلية شمال مدينة جدة وسط البحر الأحمر خلال فصلي الصيف والشتاء. من حيث التنوع، فقد تم خلال هذه الدراسة ملاحظة ما مجموعه سبع مجموعات رئيسة من اللافقاريات، والتي تنتمي إلى ١٨ عائلة. أما من حيث العدد، فقد أظهرت الدراسة أن أكثر أنواع اللافقاريات تواجدًا هي القشريات (crustaceans)، تليها الرخويات (molluscs)، تليها الديدان البحرية عديدة الأشواك (polychaetes). كانت كثافة المجتمعات الموجودة على طحلب الأكانثوفورا وطحلب البدينا أعلى خلال فصل الصيف منها في فصل الشتاء. كما كان متوسط العدد الإجمالي للافقاريات الموجودة على سطح طحلب الأكانثوفورا أعلى من طحلب البدينا خلال فصلي الصيف والشتاء. ولقد أظهرت نتائج تحليل التباين ANOVA وجود فرق معنوي في الاختلافات الموسمية على الوفرة العددية لمجموعتين من اللافقاريات، هما: متساوية الأرجل (isopods) وعشرية الأرجل (decapods).

الكلمات المفتاحية: الكائنات السطحية، الطحالب الكبيرة، اللافقاريات البحرية، ساحل جدة، البحر الأحمر.