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New Records of Marine Algal Species Collected From Some Localities of Al-Jabel Al-Akhdar Coastline, Libya

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ABSTRACT

Field surveys were planned to screen and document the new macroalgal species of Al-Jabel Al- Akhdar coastline. Seven different sites (S1-S7) of the target area were randomly and independently visited during remittent times between October 2012 and April 2013 for collecting samples. Of 12 new record algal species, 6 were recorded for the first time for the Libyan algal flora; 3 for Al-Jabel Al-Akhdar coastline and 3 for the investigated area. These 6 newly record algal species for the Libyan environment were *Vaucheria piloboloides* Thuret (Heterokontophyta), *Penicillus dumetosus* (Lamouroux) Blainville, *Cladophora laetevirens* (Dillwyn) Kützing (Chlorophyta), *Corallina pilulifera* Postels & Ruprecht, *Champia parvula* (Agardh) Harvey and *Thuretella schousboei* (Thuret) F. Schmitz (Rhodophyta). The physico-chemical analysis indicated that, *Ch. parvula*, *C. pilulifera*, *Bangia atropurpurea* (Maertens ex Roth) C. Agardh, *Lithophyllum incrustans* Philippi, *Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman et Boudouresque and *Chaetomorpha linum* (O.F. Müller) Kützing were found to be restricted to polluted seawater while *Cl. laetevirens* inhabited both sites (as a pelt in the clean site and patches in polluted site).Water quality of the target area was classified as clean (oligotrophic), ranging between mostly very clean (ultraoligotrophic) in S4 and S7 and moderate polluted (mesoeutrophic) in S3 and S6. Most exotic species were found to belong to Rhodophyta. The present study recommended further surveys to explore the newly Libyan algal species.

INTRODUCTION

Libya has a coastline of ≅1970 km on the Mediterranean Sea. Al-Jabel Al-Akhdar is one of the districts that lies in the north east of Libya and extends from the city of Benghazi towards the east, reaching Gulf of Bomba with a length of about 350 km. It is characterized by a relative abundance of rainfall, unique terrestrial and aquatic plants, especially seaweeds in the coastal strip. Marine algal species were considered to be approximately a half of the total global biodiversity (Kolanjinathan *et al*., 2014).

Marine algal communities suffered from various anthropogenic activities, such as the impacts of uncontrolled exploitation of bodies, introduction of exotic species and global climate change, which can modify the natural distribution patterns of seaweeds along the coasts of the Mediterranean Sea (USEPA, 2003). Aquaria trade and routine ship operations are considered as possible vectors for the invasion of algal species to new habitats. In particular, marine pollution affecting the Libyan ecosystem health enhances and flourishes the exotic algal species (Bazairi *et al*., 2013).

The libyan marine algal studies began in 1878 by Piccone, who started the first scientific expedition along the Libyan coast and recorded 5 algal species (Nizamuddin, *et al.* 1978). After that, extensive studies had been done until 1978 where, Nizamuddin, *et al*. (1978) recorded 178 marine algal species as well as Godeh *et al*. (1992) who recorded 169 marine algal species at eastern coast of Libya (Cyrenaica). In spite of the richness in marine algal species inhabiting Al-Jabel Al-Akhdar coastline, there are no mentionable studies on such species at the target area. So, the prelude study was planned to screen and document the new macroalgal species that likely appeared on some sites of the coastline of Al-Jabel Al- Akhdar.

MATERIALS AND METHODS

Study area:

The study area lies on the Mediterranean coast in north eastern Libya. Remittent and random surveys were carried out in 7 sites (S1-S7) during the period October 2012 to April 2013 (Fig. 1). Some of these sites receiving anthropogenic wastes, like sewage discharges and rubbish whereas, some others are clean (Table 1).

Fig. 1: Map showing the localities of the study sites (from Ras Hailal to Al- Hanyaa), Libya.

Table 1: General characteristics of the seven studied sites at Al-Jabel Al- Akhdar coastline.

Sites	Locations	Latitude	Longitudes	Distance from S1	Date of collection	Remarks
S1	Ras Hailal	32°53'2"N	22°11'8"E	--	Nov. 2012	No anthropogenic activities
S2	Port Susa	32°54'11"N	21°57'50"E	≅ 20.7 Km	Apr. 2013	Fishing wastes
S3	Susa sewage outlet	32°54'7"N	21°57'41E	≅ 21 Km	Apr. 2013	Sewer pipes
S4	Susa desalination plant	32°53'47"N	21°54'31E	≅ 26 Km	Apr. 2013	Salt discharges
S5	Al-Hamama	32°53'47"N	21°54'3"E	≅ 59 Km	Oct. 2012	No anthropogenic activities
S6	Al-Hanyaa (polluted)	32°50'30"N	21°31'11"E	≅ 71Km	Feb. 2013	Sewer pipes
S7	Al-Hanyaa (unpolluted)	32°49'50"N	21°30'20E	≅74 Km	Feb. 2013	No anthropogenic activities

Sample collection

Macroalgal specimens were hand-picked from studied sites during low tide, rinsed thoroughly with seawater on-site, placed in plastic bags and transferred to the laboratory as soon as possible. The collected samples were specifically identified to the species level, while still alive in most cases. The nomenclature of algal species followed mainly the different taxonomical keys of the World Register of Marine Species (WoRMS Editorial Board, 2013), contributing databases (Algae Base) and Abbott (1999).

Calculation of Frequency

Frequency of macroalgae was calculated by the quadrate technique associated to the point interception according to Krebs (1989).

Water quality and Trophic status

Physico-chemical properties of water samples (temperature, pH, TDS and DO) in each site were measured by portable meters. Marine water quality and trophic status of the present sites were evaluated from the main parameter (DO) based on the Applied Algal Research Laboratory Physical and Chemical score (AARL PC score) Table (2) according to Lorraine and Vollenweider (1981).

Table 2: Applied Algal Research Laboratory Physical and Chemical Score (AARL PC score) for DO.

DO		Trophic status		
Value (mg l^{-1})	Score	Score	Status	Water quality
>8	0.1	<0.1	ultraoligotrophic	very clean
7-8	0.2	0.2 - 0.29	oligotrophic	clean
6-7	0.3	0.3- 0.39	oligotrophic mesotrophic	clean-moderate
5-6	0.4	0.4- 0.49	mesotrophic	moderate
4-5	0.5	0.5 - 0.59	mesotrophiceutrophic	moderate-polluted
3-4	0.6	0.6-0.69	eutrophic	polluted
2-3	0.7	> 0.7	hypereutrophic	very polluted

RESULTS AND DISCUSSION

Physico- chemical characteristics

In Table 3, surface water temperature ranged from 24.2^{o}C at S1in November 2012 to15.2^{o}C at S6 in February 2013. This variation seems to coincide with the changes in air temperature. In this context, Sridhar (2013) indicated that the surface water temperature is largely influenced by the air temperature. On the other hand, the water pH slightly varied from 7.6 at S6 in February 2013 to 7.0 at S2 in April 2013.

Table 3.Physico-chemical parameters in 7sites at Al-Jabel Al- Akhdar coastline, Libya.

Location	Collection date	Temp.^{o} C	pH	TDS (gl^{-1})	DO (mgl^{-1})
S1	Nov. 2012	24.2 ±2.1	7.2 ± 0.28	34.8 ± 1. 6	7.3 ± 0.24
S2	Apr. 2013	19.2 ± 1.9	7.0 ± 0.22	34.1 ± 1. 3	5.8 ± 0.18
S3	Apr. 2013	19.5± 2.1	7.1 ± 0.43	34.2 ± 2. 5	4.8 ± 0.32
S4	Apr. 2013	19.7 ± 2.3	7.2 ± 0.41	35.6 ± 1. 4	8.3 ± 0.31
S5	Oct. 2012	23.8 ± 2.1	7.5 ± 0.20	35.4 ± 2.3	7.4 ± 0.23
S6	Feb. 2013	15.2 ± 2.1	7.6 ± 0.44	34.3 ± 2. 6	4.8 ±0.27
S7	Feb. 2013	15.9 ± 2.4	7. 4 ± 0.29	35.0 ± 2. 3	8.7 ± 0.29

Meanwhile, the values of TDS seemed mostly similar in all sites under investigation throughout the experimental period (ranged between 34.1and 35.6 gl^{-1}, the little elevation in S4 may be attributed to the salt discharge of the desalination plant into the surrounding seawater. Finally, DO concentrations varied between the greatest value (8.7 mgl^{-1}) at S7

in February 2013 and smallest value (4.8 mgl^{-1}) at S6 and S3 during February and April 2013, respectively. The drop of DO in S6 may be attributed to sewage impacts. In agreement with these results, Gallup *et al*. (1970) reported that DO of water with the range of 4.6 - 4.8 mgl^{-1} is considered polluted. The present results reveal that there were clear spatial and temporal variations in pH, TDS and DO. These variations may be resulted in a great variation in macroalgal species. In this accordance, Dhargalkar and Kavlekar (2004) concluded that light exposure, salinity, nutrients, depth, temperature, tides and the shore nature determine the distribution and variety of seaweeds.

Totally, the overall trophic status of the studied localities seemed to be clean (oligotrophic) (Table 4). However, water quality and trophic status were really very clean (ultraoligotrophic) in S4 and S7, clean (oligotrophic) in S1 and S5, moderate (oligotrophic) in S2 and moderate polluted (mesoeutrophic) in S3 and S6.

Table 4: Water quality and trophic status based on AARL PC score in 7 sites at Al-Jabel Al-Akhdar coastline, Libya.

Location	Score of DO	Trophic status	Water quality
S1	0.2	oligotrophic	clean
S2	0.4	mesoeutrophic	moderate
S3	0.5	mesoeutrophic	moderate polluted
S4	0.1	ultraoligotrophic	very clean
S5	0.2	oligotrophic	clean
S6	0.5	mesoeutrophic	moderate polluted
S7	0.1	ultraoligotrophic	very clean

Morphological and biological notes on macroalgal taxa

The alien /new record macroalgae were detected, during the evaluation of pollution status using biomonitors at Al-Jabel Al-Akhdar coastline. Reviewing the previous lists of marine algal species, it is confirmed that the target algal species were not recorded before for the Libyan coastline algal flora including that of Al-Jabel Al-Akhdar. Alien species that recorded in the present study for the first time are *Champia parvula* (Agardh) Harvey, *Penicillus dumetosus* (Lamouroux) Blainville, *Thuretella schousboei* (Thuret) F. Schmitz, *Vaucheria piloboloides* Thuret, *Cladophora laetevirens* (Dillwyn) Kützing, *Lithophyllum incrustans* Philippi and *Corallina pilulifera* Postels & Ruprecht. These species were identified (Plates 1-6) and brief morphological and biological notes were given as follows:

Champia parvula (Agardh) Harvey

Ch. parvula is a small red alga (3 to 8 cm long), with rather short, alternate tapered branches (Plate 1). It grows on hard bottoms in the shallow sublittoral zone, and appears as a bushy, branching, dull red-brown plant, with axis and branches coarsely segmented. Segments are as broad or broader than long.

Penicillus dumetosus (Lamouroux) Blainville

P. dumetosus, named Neptune's Shaving Brush, has a thick stalk crowned with a tuft of green non-calcified filaments (Plate 2). It is short-lived (only few weeks). Yet new growths will occur within a short distance of the main stalk. Its stalk is shorter and the head larger and looser than *P. capitatus*. It inhabits sandy bottom and shallow warm water, exposing to sunlight most of day, in sheltered cavity where *Dasycladus* grows in Al-Hanyaa rocky shore.

Thuretella schousboei (Thuret) F. Schmitz

Th. Schousboei is a genus composing one species. It is cylindrical, mucilaginous, richly branched; annulated and uniaxial (Plate 3). Each axial cell bearing four cortical fascicles of subdi-,-trichotomously

branched filaments of progressively smaller, sub-cylindrical cells. Rhizoids cloaking axial filament. Secondary pit connections and cuticle are absent.

***Vaucheria piloboloides* Thuret**

V. piloboloides, marine taxa, was found as clumps attached to rocks, forming considerable mats. It is bright green coenocytic with irregularly branches (Plate 4) i.e. a siphon consists of multinucleate, branched tubes without cross walls, but these occasionally occur. A large vacuole and chloroplasts occupied the central part of the filament, tending to be parietal and aligned parallel to the axis.

***Cladophora laetevirens* (Dillwyn) Kützing**

Cl. laetevirens consists of light green stalk and dark delicate filaments, fixes to the substrate with rhizoids. It forms dense tufts 2–10 cm high with pseudo-dichotomous axes (Plate 5). It is generally sparse in the middle portion of the stalk, becoming dense at apex. Filament tapered slightly, branched from every cell in the apical portions, with falcate and unilateral branchlets. The intercalary divisions in the mid and lower thallus cells, separating the laterals by 2–6 cells. New laterals,1–3(–4) for each parent cell, often arise at about 45°; below intercalated cross walls, later becoming almost horizontal.

Calcareous structures:

***Lithophyllum incrustans* Philippi and *Corallina pilulifera* Postels & Ruprecht**

C. pilulifera is a red alga with hard, abrasive calcareous skeletons. It is stiff, branched plant with articulations (Plate 6A & B). It grows in isolated patches associated with *L. incrustans*, on the rocky substrate of Al-Hanyaa intertidal zone nearby the outlet pipe, where strong waves occur. Whenever *corallina* alga is growing, the rock surfaces appear pink. *C .pilulifera* was not detected in any clean site. It was collected from only one polluted site of Al-Hanyaa rocky shore, adjacent to sewer pipe. Plate (6 B) showed the assemblages of the calcareous structures of *L. incrustans* and its allied *C. pilulifera*. *L. incrustans* is an encrusting coralline algae that grows forming a tapestry on hard substrates in the littoral zone. It is thick, dull chalky, pink or lavender calcareous crusts forming irregular concretions, up to 40 mm thick, margins ridged where crusts meet (Plate 6 C). It grows on rocky shore, in lower intertidal semi-exposed region, of Al-Hanyaa (S6) that is partially exposed to the swinging of the waves. Its petals, striking violet color, can reach a diameter of 10 cm. When young, they are set fully to the surface, while as they age edge-lifting, undulate and become thicker. It can live among other algae, molluscs, etc. As for *L. incrustans,* it was not detected in any clean site. The algae are embraced by *Lithophyllum* and looming as whitish- pink patches.

Taxonomy and distribution of alien macroalgal species

The previous results reveal that six macroalgal species were determined for the first time as new records for the Libyan algal flora. As presented in Table 5, these species are grouped under three divisions namely, Chlorophyta (2 species: *Cl. laetevirens* and *P. dumetosus*), Rhodophyta (3 species: *Ch. parvula, C. pilulifera* and *Th. schousboei*) and Heterokontophyta (Xanthophyta, 1 species: *V. piloboloides*). These exotic species were distributed among the studied localities as follow: *C. pilulifera* and *Ch. parvula* were determined at S6 and *Th. Schousboei*, *Cl. laetevirens* and *P. dumetosus* were detected at S7. While, *V. piloboloides* was collected from S5 (Table 6). This increment in number of Rhodophyta agrees with the findings of Nizamuddin, *et al*. (1978) and Godeh *et al.* (1992), who recorded excess number of Rhodophyta than Chlorophyta at north eastern Libyan coastline.

It is worthily mentioned as indicated in Table 6 that the species *Chaetomorpha linum* (S2), *Bangia atropurpurea* (S3) and *L. incrustans* (S6) were new records for Al-Jabel Al-Akhdar coastline algal flora, however, they were previously recorded in Tripoli, Benghazi and Ain Ghazala by Nizamuddin *et al*. (1978) and Godeh *et al.* (1992).

Table 5: Taxonomy of Chlorophyta, Rhodophyta and Heterokontophyta collected from Al-Jabel Al-Akhdar coastline, Libya.

Taxonomy	Synonyms
Rhodophyta / Rhodophyceae / Rhodymeniales / Champiaceae/ *Champia/ / Ch. parvula*	*Champia intricata*, Cremades 1990 - *Chondria parvula* C. Agardh 1824 - *Chylocladia parvula* (C. Agardh) W. Hooker - *Conferva intricata* Clemente 1807, nom. illeg. *Lomentaria parvula* (C. Agardh) Zanardini- *Lomentaria parvula* var. *vaga* Kützing.
Chlorophyta/Bryopsidophyceae/ Bryopsidales / Udoteaceae / *Penicillus*/ *P. dumetosus.*	**Basionym:** *Nesaea dumentosa* J. V. Lamouroux **Homotypic Synonym(s)**- *Nesaea dumentosa* J.V.Lamouroux 1816. **Heterotypic Synonym**(s): *Penicillus longiarticulatus* (Shaving brush alga).
Rhodophyta / Florideophyceae Gigartinales/ Gloiosiphoniacea/ *Thuretella* /*Th. schousboei*	The only taxonomically valid species is *Thuretella schousboei* **Parent**: *Thuretella* F. Schmiz, 1889- *Crouanias chousboei* Thuret, 1876.
Heterokontophyta/ Xanthophyceae/ Heterosiphonales/ Vaucheriaceae/ *Vaucheria / V. piloboloides*	*Vaucheria disperma* A.P. de Candolle, 1801 *Vaucheria fuscescens* Kützing, 1856.
Chlorophyta / Ulvophyceae/ Cladophorales Cladophoraceae/ *Cladophora* / *Cl. laetevirens*	**Parent**: *Conferva* Linnaeus, 1973 **Basionym**: *Conferva laetevirens* Dillwyn **Homotypic Synonym(s)**: *Conferva laetevirens* Dillwyn 1805. *Cladophora utriculosa* var. *laetevirens* (Dillwyn) Hauck 1885 **Heterotypic Synonym(s)**: *Cladophora meneghiniana* (Kützing) Kützing- *Conferva heteronema* C. Agardh 1824- *Cladophora heteronema* (C. Agardh) Kützing 1843 – *Cladophora incurva* Meneghini 1844.
Rhodophayta/ Florideophyceae/Corallinales Corallinaceae/ *Corallina*/ *C. pilulifera* Postels & Ruprecht 1840	**Homotypic Synonym**(s): *Corallina officinalis* f. *pilulifera* (Postels & Ruprecht) Setchell&N.L.Gardner1903. **Heterotypic Synonym**(s) :*Corallina sessilis* Yendo 1902 - *Corallina kaifuensis* Yendo 1902.

Table 6: Algal species in 7 sites at Al-Jabel Al- Akhdar coastline, Libya.

Sites	Species	Substratum
S1	*Dasycladus vermicularis*	Sandy gravel
S2	*Chaetomorpha linum*	Rock
S3	*Bangia atropurpurea*	epiphytic (on *Sargassum*) Sandy clay
S4	*Boergeseniella fruticulosa*	Rock
S5	*Vaucheria piloboloides*	Rock
S6	*Caulerpa racemosa* var. *cylindracea*	Sand
	Champia parvula	Rock
	Cladophora laetevirens	Rock
	Corallina pilulifera	Rock
	Lithophyllum incrustans	Rock
S7	*Cl. laetevirens*	Sand
	Boerg. fruticulosa	Rock
	Penicillus dumetosus	sandy gravel
	Thuretella schousboei	Rock

On the other hand, *Boergeseniella fruticulosa* (Wulfen) Kylin was recorded for the first time at S4 & S7 whereas *Caulerpa racemosa* var. *cylindracea* and *Dasycladus vermicularis* were recorded for the first time at S6 and S1, respectively. Where, *Boerg. fruticulosa* was detected earlier by Nizamuddin, *et al*. (1978) at Tripoli & Cyrenacia. Likewise, *C. racemosa* var. *cylindracea* was recorded by Bazairi *et al*. (2013) at El-Kouf National Park. Nonetheless, *D. vermicularis* was recorded in the present study at Ras Hailal and Al-Hamama but it was recorded previously at Susa by Godeh *et al.* (1992).

Frequency of alien macroalgal species

As shown in Table 7, the frequency percentages fluctuated between 0.05% to 50%. *Cl. laetevirens* was the predominant species either in the clean site (S7) with a percentage of 50% or in the polluted site (S6) with a percentage of 10%, followed by

L. incrustans (5%), *C. pilulifera* (2%) and *C. racemosa* var. *cylindracea (*1%). The remaining macroalgal species were scarcely recorded, sharing a frequency percentage of 0.05%. This may be attributed to that the exotic species may take some time to establish, spread and / or overgrow on the native macrophyte species in the invaded area. The exotic *C. racemosa* var. *cylindracea* replaced the dominant seagrass community, *Posidonia oceanica*, in much of the Mediterranean coastline within six years (Bazairi *et al*., 2013). The same author cited that, after 23 years of *C. racemosa* var. *cylindracea* discovery in Libya, it is present all around the Mediterranean Basin and in the close Atlantic Ocean.

Acclimatization status of alien macroalgal species

The sites S1, S2, S3, S5 and S7 are characterized by sandy beaches with sandy bottoms and rocky patches as well as sandy gravel (S1 and S7), whereas S4 and S6 are more rugged with little sandy beaches and a dominance of cliffs and rocky shores (Table 6). The nature of locality studied, the differences in nature of rocky shore composition, the sewage pollutants discharged into some of these sites and suitable environmental conditions enable exotic algal species introduced by shipping, aquaria trade and migrant fish or other animals, to grow, acclimate and spread on Al-Jabel Al- Akhdar coast, forming a variant composition. The acclimatization status of alien macroalgal species may be established, casual, questionable, cryptogenic or invasive in the Mediterranean (Bazairi *et al*., 2013).

Although the range of *P. dumetosus* is South Florida, Bahamas and Caribbean, it was detected in Al-Hanyaa site (S7) in sheltered cavity which exposed to sunlight most of day time. This may attribute to aquaria trade, shipping (ballast water) and animal migration which enable it to introduce into Mediterranean Sea reaching the Libyan coastline.

C. racemosa var. *cylindracea*, the most invaders to the Mediterranean, was first observed in Libya (Tajora, Tripoli) in 1990 on sandy rocky platforms (Nizamuddin, 1991). Secondly, it was recorded by Bazairi *et al*. (2013) at El-Kouf National Park, Libya. In the present study, *C. racemosa* var. *cylindracea* was found to be associated with *Dictyota dichotoma* and *Corallina* sp. in small patches less than one meter, on sandy sediment adjacent to sewage discharges at S6 during winter 2013. It is expected that, the exotic *C. racemosa* var. *cylindracea* will spread by time to affect the native macroalgal species.

Calcareous structures of *L. incrustans* and its allied *C. pilulifera*, create a highly heterogeneous substratum, independently of the kind of bottom on which they develop. This heterogeneity increases the variability of assemblages by creating microhabitats with different environmental conditions and influencing the recruitment and the spread of benthic species.

It must be noted that a few *Vaucheria* species are completely restricted to marine environments (Schneider *et al*., 1999). It was registered for the first time on a rocky substratum at Al-Hamama region on the north-eastern coast of Libya. It is worthily mentioned that, *B. atropurpurea* was found as epiphytic on *Sargassum* sp. in polluted site (S3). Also, *Ch. parvula*, was found to be attached to a rocky substrate adjacent to sewage discharge at S6, consequently, they may be used as water quality bioindicators, as they were not recorded at clean sites. On the other hand, *Cl. laetevirens* was found to inhabit both sites at Al-Hanyaa "as a pelt in the clean site (S7) and patches in the polluted site (S6). In addition, *Chaeto. linum* formed a patch attached to a rocky substrate that submerged under water at Susa port (S2).

Pollution status of the study area

The studied region has unique weather, sandy beaches and rocky shore coasts at majority of its sites, which attract several recreation activities such as fishing hobby. Some sites (S1, S2, S4, S5 and S7) are formed from open beaches, and others (S3 and S6) are semi- isolated and difficult to

eliminate the different pollutants, such as sewage, industrial, anthropogenic, agronomic wastes. As mentioned above, water quality classified as very clean (S4 and S7), clean (S1 and S5), moderate clean (S2) and moderate polluted (S3 and S6), while, the corresponded trophic status varied between ultraoligotrophic and mesoeutrophic (Table 4).

Table 7: Distribution and frequency of new record macroalgae collected form the eastern Libyan coastline during the period of October 2012 and April 2013.

Species boulder	Distribution		References	Frequency	Status*
	Previous	Present			
1- *Ch. parvula*	--	Al-Hanyaa	Present study	0.05%	**N.R**
2- *P. dumetosus*	--	Al-Hanyaa	Present study	0.05%	**N. R**
3- *Th. schousboei*	--	Al-Hanyaa	Present study	0.05%	**N.R**
4- *V. piloboloides*	--	Al-Hamama	Present study	0.05%	**N.R**
5- *Cl. Laetevirens*	--	Al-Hanyaa (S6&S7)	Present study	S6 (10%) - S7 (50%)	**N.R**
6 – *C. pilulifera*	--	Al-Hanyaa	Present study	2%	**N.R**
7- *L. incrustans*	Tripoli	Al-Hanyaa	Nizamuddin *et al*. (1978)	5%	**S.R**
8- *B. atropurpurea*	Tripoli	Susa sewage discharge	Nizamuddin *et al*. (1978)	0.05%	**S.R**
9- *Chaeto. linum*	Ain Ghazala-Benghazi	Susa sewage discharge	Nizamuddin *et al*. (1978) - Godeh *et al*. (1992)	0.05%	**S.R**
10- *Boerg. fruticulosa*	Tripoli - Cyrenaica	Susa desalination plant & Al-Hanyaa	Nizamuddin *et al*. (1978)	0.05%	**S.R**
11- *C. racemosa* var. *cylindracea*	El-Kouf	Al-Hanyaa	Bazairi*et al*. (2013)	1%	**S.R**
12- *D. vermicularis*	Susa	Ras Hailal& Al-Hamama	Godeh *et al*. (1992)	1%	**S.R**

*N.R: New Record; S.R: Second Record.

B. atropurpurea, *Ch. parvula*, *C. pilulifera, L. incrustans*, *C. racemosa* var. *cylindracea* and *Chaeto. linum* were found to be restricted to polluted sites, where, they attached to a sandy, sandy clay or rocky substrate adjacent to sewage discharge. Moreover, *Cl. laetevirens* was found to inhabit a wide range of polluted (S6) to unpolluted site (S7). This disagrees with the results attained by Mc Lean (1974), who proved that *Cl. Laetevirens* tolerated a narrower range of nutrient concentrations. Based on Arévalo *et al*. (2007) findings, *Corallina*-dominated intermediate levels of nutrient enrichment habitats, consequently, the obtained *C. racemosa* var. *cylindracea* which associated with *Corallina* sp., may be classified as intermediate levels of nutrient enrichment habitant.

CONCLUSION

Twelve macroalgal species belong to Chlorophyta, Rhodophyta and Heterokontophyta were determined as new record species for Al-Jabel Al- Akhdar coastline. Of these species, Chlorophyta was represented by five species, Rhodophyta by six species and Heterokontophyta by only one species. Six species (*C .pilulifera, Ch. parvula, Th. schousboei, P. dumetosus*, *Cl. laetevirens* and *V. piloboloides*) were identified as new records for the Libyan algal flora for the first time. Three species, *Chaeto. linum*, *B. atropurpurea* and *Lithophyllum incrustans* were recorded as new records for Al-Jabel Al- Akhdar coastline for the first time whereas, *Boerg. fruticulosa, C. racemosa* var. *cylindracea* and *D. vermicularis* were recorded as new record, for the study area and for the second time outside. *B. atropurpurea*, *Ch. parvula*, *C. pilulifera, L. incrustans*, *C. racemosa* var. *cylindracea* and *Chaeto. linum* were restricted to polluted seawater. Most exotic species were found to belong to Rhodophyta. Water quality classified as very clean (S4 and S7), clean (S1 and S5), moderate clean (S2) and moderate polluted (S3and S6), while, the corresponded trophic status varied

between ultraoligotrophic and meso-eutrophic. The attained results pave the way to the establishment of a complete precise monitoring program for macroalgal community of Al-Jabel- Al-Akhdar coastline**.**

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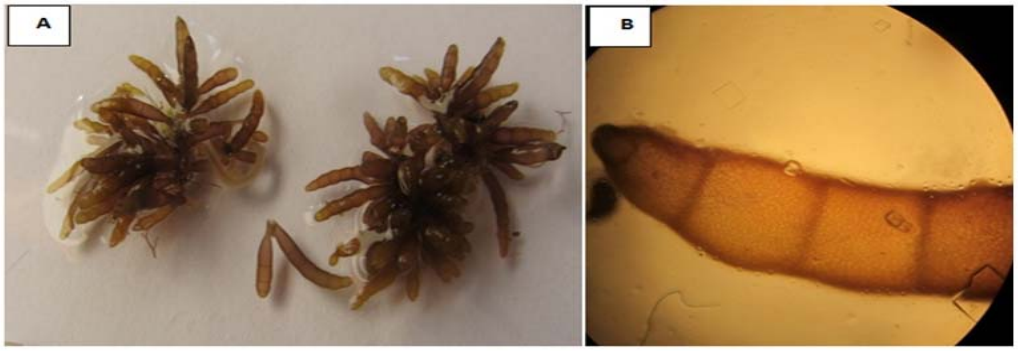

Plate 1. *Champia parvula*. A. Apart obtained from unialgal clumps attached to a rocky substrate. B. A cylindrical branch tapering towards apices.

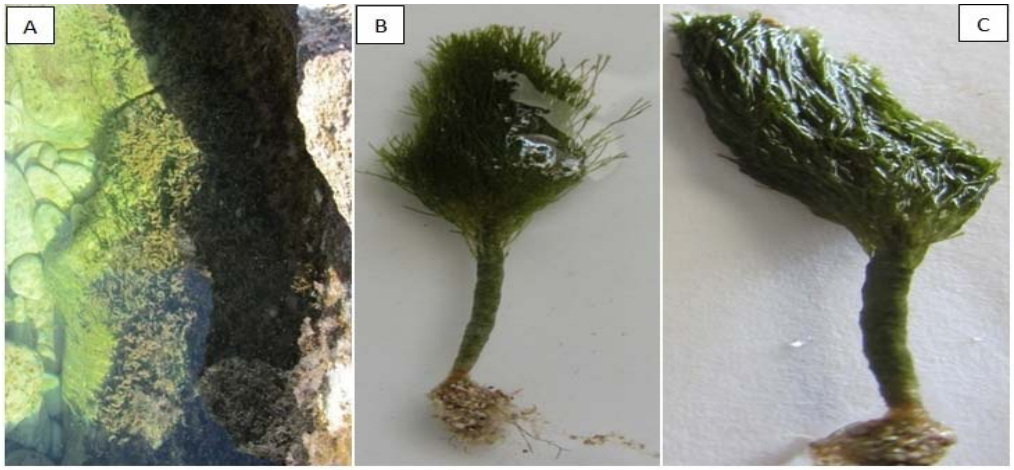

Plate 2. *Penicillus dumetosus* A. Some individuals, associated with *Dasycladus vermiculari.* growing on rocks in nature habitat. B and C. Magnified view.

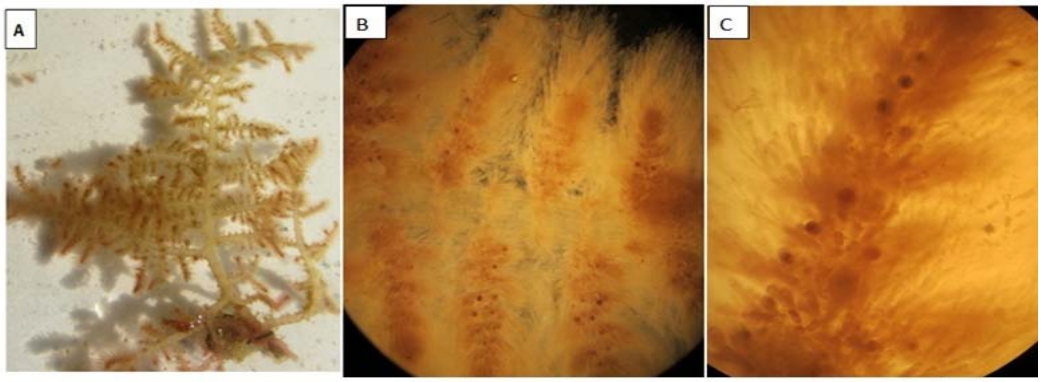

Plate 3. *Thuretella schousboei*. A. Apart taken from patch growing on rocks. B and C. Microscopic view of richly branched filaments (40X and 100X, respectively).

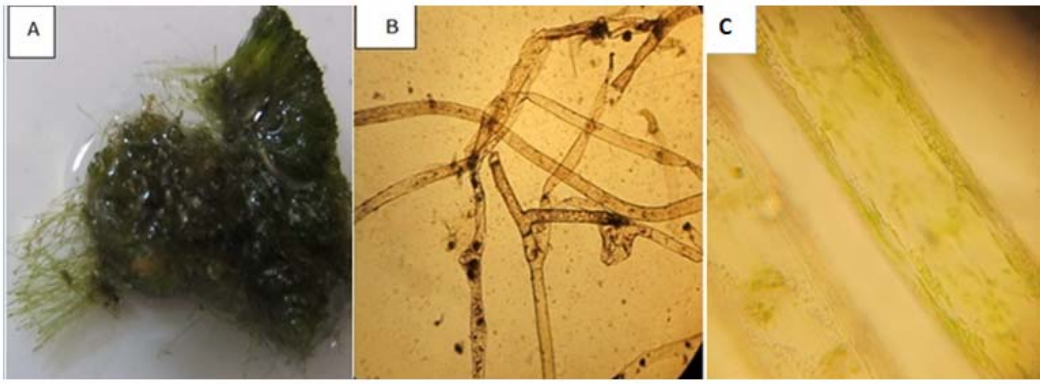

Plate 4. *Vaucheria piloboloides*. A. A clump isolated from a specimen attached to rocks. B and C. Magnified thallus showing its coenocytic nature.

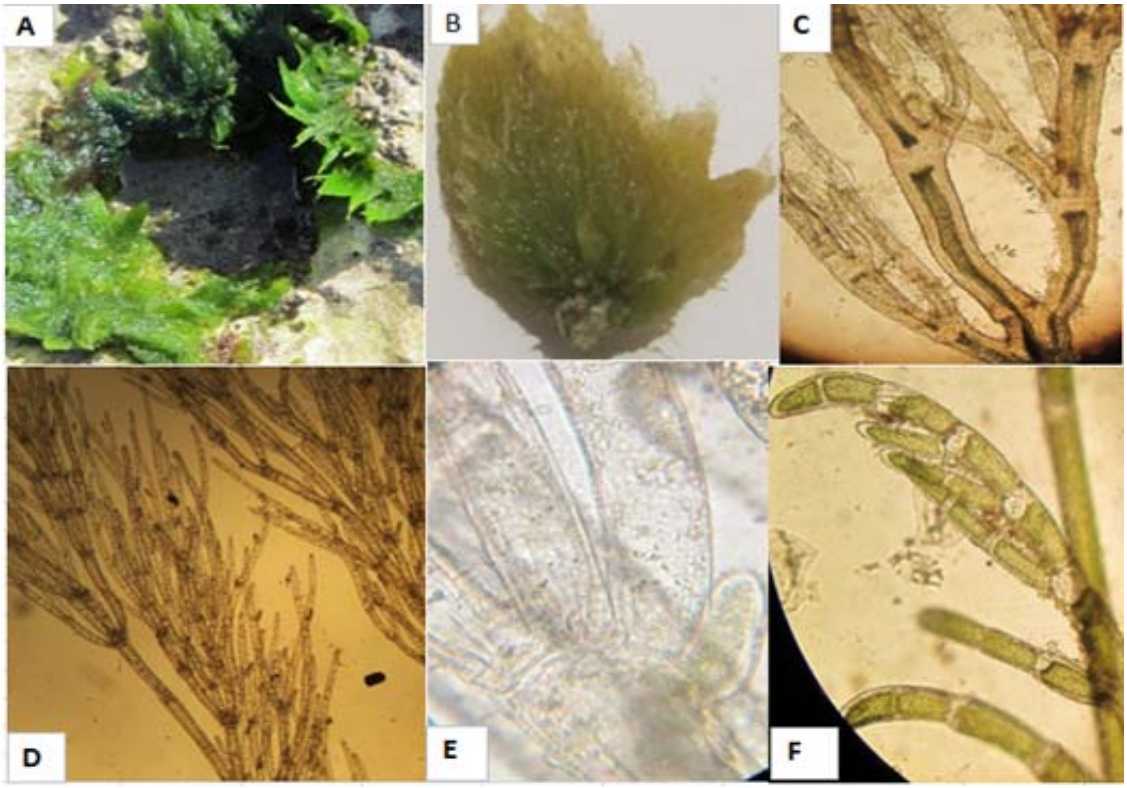

Plate 5. *Cladophora laetevirens* A. Assemblages growing on polluted rocky shore in natural habitat. B. general view of thallus that likes cushion with Rhizoids. C. Thickness of basal and lower portion cells (100X). D. Tuft apical growth showing three or four branches in the case of increasing growth (40X). E. Magnification showing four branches (400X). F. Growth in one side in young species (100X).

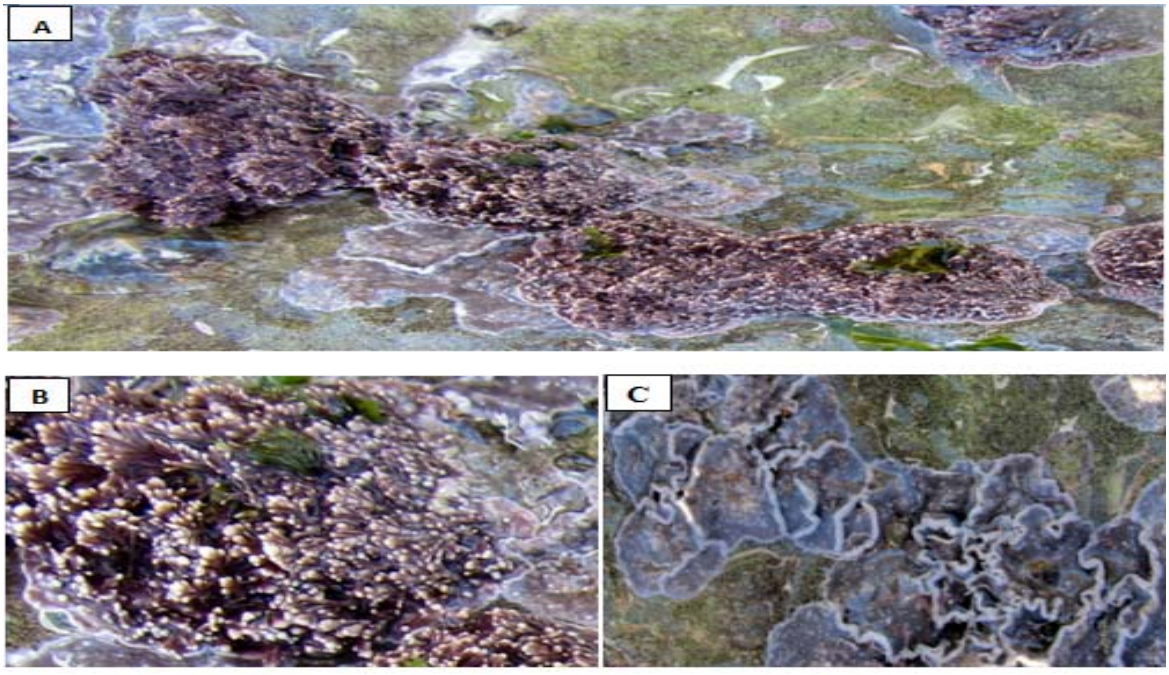

Plate 6. A. general view of heterogeneous substratum of calcareous structures for *Corallina pilulifera* and *Lithophyllum incrustans*. B. Enlarged view of *Corallina pilulifera*. C. Magnified view of *Lithophyllum incrustans*.

ARABIC SUMMARY

تسجيل جديد لأنواع من الطحالب البحرية المجمعة من بعض المناطق بساحل الجبل الأخضر، ليبيا

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تم المسح الميداني لاستكشاف وتوثيق أية أنواع جديدة من الطحالب البحرية موجودة على ساحل الجبل الأخضر-ليبيا وذلك بزيارة سبعة مواقع مختلفة (S1-S7) من المنطقة المستهدفة عشوائيا وبشكل مستقل خلال أكتوبر 2012 و أبريل 2013 لجمع العينات. من بين 12 نوعا من الطحالب المسجلة، تم اكتشاف 6 أنواع تسجل للمرة الأولى علي الشواطئ الليبية، ثلاثة منها سجلت كأنواع جديدة لساحل الجبل الأخضر وثلاثة أخرى لمنطقة الدراسة.وكانت الأنواع المسجلة كأنواع جديدة على البيئة النباتية الليبية هي: *Vaucheria piloboloides* Thuret (Heterokontophyta), *Penicillus dumetosus* (Lamouroux) Blainville, *Cladophora laetevirens* (Dillwyn) Kützing (Chlorophyta), *Corallina pilulifera* Postels & Ruprecht, *Champia parvula* (Agardh) Harvey and *Thuretella schousboei* (Thuret) F. Schmitz (Rhodophyta).
وأشارت التحاليل الفيزيائية والكيميائية إلي أن أنواع *C. pilulifera, Bangia atropurpurea* (Maertens ex Roth) C.Agardh, *Ch. parvula*, *Lithophyllum incrustans* Philippi, *Caulerpa racemosa* var. *cylindracea* (Sonder) Verlaque, Huisman et Boudouresque and *Chaetomorpha linum* (O. F. Müller) Kützing. يقتصر وجودها على مياه البحر الملوثة في حين أن *Cl. laetevirens* تسكن كلا من الموقعين النقي والملوث في الحنية، حيث لوحظ وجودها على هيئة شريط أو حزام في الموقع النظيف : بينما وجدت على هيئة بقع مبعثرة في الموقع الملوث. وقد صنفت نوعية المياه في منطقة الدراسة على أنها نظيفة (قليل التغذية)، والتي تتراوح ما بين نظيفة جدا (ultraoligotrophic) في S4، S7 ونظيفة في S1، S5 ومتوسطة النظافة في S2 ومتوسطة التلوث (mesoeutrophic) في S3، S6. وأوصت الدراسة بالمزيد من المسوحات لاستكشاف المزيد من الانواع الجديدة من الطحالب الموجوده في البيئة الليبية.