EDICIONES COMPLUTENSE

Mediterranean Botany
ISSN-e: 2603-9109

BOTANICAL CHECKLISTS

Checklist updating of the Mediterranean Western Algeria algae, fifteen first records case of *Phaeophyceae, Chlorophyceae* and *Rhodophyceae*

Fatima Zohra Abdeldjebbar
Laboratory of Eco-development of Spaces, University of Djilali Liabes Sidi Bel Abbes, 22000, Algeria
Meryem Belabbas
Laboratory of Eco-development of Spaces, University of Djilali Liabes Sidi Bel Abbes, 22000, Algeria
Faiza Bennabi
Laboratory of Eco-development of Spaces, University of Djilali Liabes Sidi Bel Abbes, 22000, Algeria
Nacéra Bouriah
Laboratory of Agro-Biotechnology and Nutrition in Semi-Arid Zones, University of Ibn Khaldoun Tiaret, 14000, Algeria
Ilyes El Hocine Nouar
Laboratory of Agro-Biotechnology and Nutrition in Semi-Arid Zones, University of Ibn Khaldoun Tiaret, 14000, Algeria
Abdelwahab Chedad
Laboratory of Saharan Bio-Resources: Preservation and Valorisation, University Kasdi Merbah Ouargla, 30000, Algeria
Directorate of Forest Conservation of Ghardaïa (General Directorate of Forestry), 47000, Algeria
Mohamed Ali Bouzidi
Laboratory of Eco-development of Spaces, University of Djilali Liabes Sidi Bel Abbes, 22000, Algeria

https://doi.org/10.5209/mbot.87758 Received: 26 March 2023 / Accepted: 8 May 2024 / Published online: 24 March 2025

Abstract. The study of algal flora is an important component in determining the overall state of the marine ecosystem. It is still not well known, particularly in some parts of Mediterranean Western Algeria. This work seeks to update the checklist of Western Algeria algae to establish and enrich the floristic inventory of algae. Macroalgae were sampled at 13 stations along Algeria's west coast in the mediolittoral and upper infralittoral zones between 2019 and 2021 using a simple random method. The species description, accompanied by original photos taken from a representative living specimen, was used to make the determination, which was then interpreted in light of the most recent literature records. The results revealed that 80 marine macroalgae were discovered and identified. They are classified into three taxa: *Phaeophyceae, Chlorophyceae*, and *Rhodophyceae*. Almost half of the algae counted in this inventory belonged to the dominant Rhodophyte class. Furthermore, 15 new species have been discovered along the West Algerian coast. These findings could serve as a basis for future phycological and biogeographic studies of taxa in Algeria.
Keywords: macroalgae, checklist, *Phaeophyceae*, *Chlorophyceae*, *Rhodophyceae*, marine environment, Mediterranean algae, Western Algeria.

How to cite: Abdeldjebbar, F.Z., Belabbas, M., Bennabi, F., Bouriah, N., Nouar, I. El H., Chedad, A. & Bouzidi, M.A. 2025. Checklist updating of the Mediterranean Western Algeria algae, fifteen first records case of *Phaeophyceae*, *Chlorophyceae* and *Rhodophyceae*. Mediterr. Bot. 46(1), e87758. https://doi.org/10.5209/mbot.87758

Introduction

The Mediterranean Sea has a diverse range of animal and plant biocenoses, including macroalgae. An algal stand creates a multidimensional space that adds complexity to the habitat and promotes biodiversity. Macroalgae are a prominent feature of marine communities. They provide a number of critical services to coastal zone ecosystems. Their most visible impact is their contribution to local primary production, which puts them at the bottom of the food chain (Tamigneaux & Johnson, 2016).

There are over 40,000 seaweed species worldwide, divided into three categories: green (*Chlorophyceae*), brown (*Phaeophyceae*), and red algae (*Rhodophyceae*) (Jean-Pierre & Yan-Chim, 2018). These colors indicate the presence of different photosynthetic pigments. Green is the color of chlorophyll, a pigment found in all plants that transform solar energy into photosynthesis. Supernumerary pigments capture the sun's energy and direct it toward the chlorophyll, resulting in brown and red colors (Chabot & Rossignol, 2002).

Algae are much less well-known than terrestrial plants and much more difficult to understand. They

primarily live in aquatic environments, particularly marine and underwater, and represent an extremely diverse group of organisms that is difficult to present in a univocal manner (Person *et al.*, 2011). The diversity of macroalgae in aquatic environments can help assess ecosystem health and provide information about new species invasions (Ramdani *et al.*, 2020).

Aquatic macroalgae are relatively unknown along Algeria's west coast (Bachir Bouiadjra, 2012; Traiche *et al.*, 2018; Hellal *et al.*, 2021; Mansouri *et al.*, 2021). The majority of inventories conducted have not been updated. Several researchers have studied Algerian marine algae (Perret-Boudouresque & Seridi, 1989; Seridi, 2007; Ould-Ahmed *et al.*, 2013; Ould-Ahmed *et al.*, 2019). The current study aims to update the inventory of coastal macroalgal flora in some western Algerian sites to determine the diversity and richness of marine macrophytes along Algeria's coastline.

Materials and Methods

Study area

This study was conducted on Algeria's western coast, which stretches approximately 202 kilometers from Stidia to Port Honaine (Figure 1). The study area was divided into four regions: Mostaganem, Oran, Ain Témouchent, and Tlemcen.

The annual average seawater surface temperature in the study area ranges between 11°C and 28°C. Anthropogenic activities along the western coast include summer tourism, massive urbanization, and year-round overexploitation of natural resources, industries, and fishing ports.

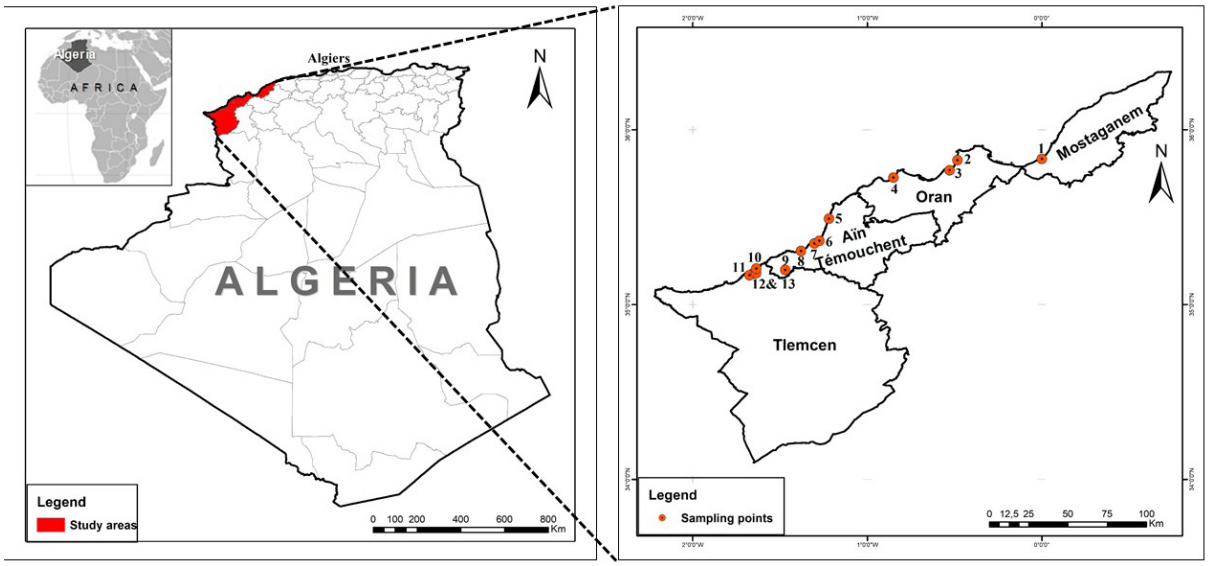

Figure 1. Study area with the sampling localities marked with codes: S1, Stidia (35°50'01''N, 0°00'00''W); S2, Kristel (35°49'34''N, 0°29'00''W); S3, Ain Franine (35°46'05''N, 0°31'43''W); S4, Bousfer (35°43'36''N, 0°51'00''W); S5, Sassel (35°29'29''N, 1°13'11''W); S6, El Hillal (35°21'54''N, 1°16'28''W); S7, Sidi Djelloul (35°21'20''N, 1°17'14''W); S8, Sidi Boucif (35°18'26''N, 1°22'46''W); S9, Rechgoun (35°17'55''N, 1°28'12''W); S10, Agla 1 (35°12'24''N, 1°38'08''W); S11, Agla 2 (35°12'22''N, 1°38'11''W); S12, Tafsout (35°10'35''N, 1°39'18''W); S13, Port Honaine (35°10'46''N, 1°39'31''W).

Sampling methods

From March 2019 to October 2021, 13 localities in the study area were sampled 9 times in each region, with seaweeds (green, brown, and red) collected throughout the year except for winter, which was due to unfavorable conditions and the difficulty of observing some species. Marine macrophytes were collected from both the mediolittoral and upper infralittoral zones. Because algal systematics in a marine environment is difficult and many species are miniaturized, sampling was done at random. It is necessary to collect the entire vegetative apparatus, reproductive organs, and elements that appear different (Laplace-Treyture *et al.*, 2014).

Collected samples were thoroughly cleaned to remove debris and small crustaceans before being separated and stored at 4°C in vials containing 5% formalin seawater in darkness. To allow for precise identification, observe the collected specimens with a binocular magnifying glass, which will aid in the determination. Algae identification is based on the morphology of each species as well as several criteria such as color, thallus length and shape, extremities, mode of fixation for each species, and zone of presence.

Species were identified using various guides, identification keys, the FAO determination key, and research works (Chabot & Rossignol, 2003; Daw *et al.*, 2003; Bachir Bouiadjra, 2012; Cabloc'h *et al.*, 2014; Doré *et al.*, 2014; Lugilde *et al.*, 2017). Taxonomy and nomenclature are followed (Guiry, 2014), utilizing AlgaeBase, the global algal database of taxonomic, nomenclatural, and distributional data (https://www.algaebase.org/). The families, genera, and species are arranged alphabetically. Several similar research studies provided biogeographic analyses (Furnari *et al.*, 2003; Ould Ahmed, 2015; Bahbah, 2021).

The checklist of marine macroalgae in western Algeria is based on data from this study and literature references (Perret-Boudouresque & Seridi, 1989; Ribera *et al.*, 1992; Gallardo *et al.*, 1993; Gomez *et al.*, 2001; Seridi, 2007; Bachir Bouiadjra,

Table 1. List of species inventoried in the study area (see Figure 1). Abbreviations are: +, presence; –, absence; FR, first record; Ref.*, Reference already report the species in Algeria: 1, Perret-Boudouresque & Seridi, 1989; 2, Bachir Bouiadjra, 2012; 3, Ould-Ahmed *et al*., 2013; 4, Hussein, 2015; 5, Ouerghi *et al*., 2016; 6, Ribera *et al*., 1992; 7, Hellal *et al*., 2021; 8, Mansouri *et al*., 2021; 9, Ghellai *et al*., 2021; 10, Traiche *et al*., 2018; 11, Benali *et al*., 2019; 12, Ould-Ahmed *et al*., 2019; 13, Gallardo *et al*., 1993; 14, Bentaallah & Kerfouf, 2013; 15, Seridi, 2007; 16, Gomez *et a*l., 2001; 17, Bahbah, 2021.

Taxa (Div., Fam.)	Species	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	Ref.*
Phaeophyta															
Chordariaceae	*Asperococcus bullosus* J.V. Lamouroux	-	-	-	-	+	-	-	-	-	-	-	-	-	[1–3]
	Asperococcus fistulosus (Hudson) W.J. Hooker	-	-	-	-	-	-	-	-	-	-	+	+	-	FR
	Elachista fucicola (Velley) Areschoug	-	-	+	-	-	-	-	-	-	-	-	-	-	FR
	Elachista scutulata (Smith) Areschoug	-	-	+	-	-	-	-	-	-	-	-	-	-	FR
	Leathesia difformis Areschoug	-	-	-	-	-	-	-	-	-	-	+	+	-	[4]
Cladostephaceae	*Cladostephus spongiosus* (Hudson) C. Agardh	-	+	-	-	-	-	-	-	-	-	+	-	-	[2–5]
Dictyotaceae	*Dictyopteris polypodioides* J.V. Lamouroux	+	-	-	-	-	-	-	-	-	-	-	-	-	[1–6]
	Dictyota dichotoma (Hudson) J.V. Lamouroux	+	-	-	-	-	-	-	-	-	+	+	-	-	[1–5,7–9]
	Dictyota fasciola (Roth)J.V. Lamouroux	+	-	+	-	-	-	-	-	-	-	-	-	-	[1–5]
	Padina pavonica (Linnaeus) Thivy	+	-	+	-	-	+	-	+	-	-	+	+	-	[1,3,5,7–10]
Fucaceae	*Ascophyllum nodosum* (Linnaeus) Le Jolis	+	-	-	-	-	-	-	-	-	-	-	-	-	FR
Sargassaceae	*Bifurcaria bifurcata* R. Ross	-	-	-	-	-	-	-	-	-	+	-	-	-	FR
	Cystoseira compressa (Esper) (Gerloff & Nizamuddin)	+	-	-	-	-	-	-	-	-	-	-	+	-	[1–5,9]
	Cystoseira foeniculacea (Linnaeus) Greville	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,3]
	Cystoseira sp.	-	-	-	+	-	-	-	-	-	+	-	-	-	
	Cystoseira stricta (Montagne) Sauvageau	+	+	-	+	-	-	-	-	-	-	+	-	-	[1,2,4,9]
	Cystoseira tamariscifolia (Hudson) Papenfus	-	-	-	+	-	-	-	-	-	-	+	-	-	[2,3,6,10]
	Sargassum muticum (Yendo) Fensholt	+	-	-	-	-	-	-	-	-	-	-	-	-	[7,8,11]
	Sargassum vulgare C. Agardh	+	-	-	-	-	-	-	-	-	-	+	-	-	[1–6,9]
Stypocaulaceae	*Halopteris filicina* (Grateloup) Kützing)	-	+	-	-	-	-	-	-	-	-	+	-	-	[1,3,4–7]
	Halopteris scoparia (Linnaeus) Sauvageau)	+	+	-	-	+	-	+	-	+	+	+	+	+	[1,3,5,7]
Chlorophyta															
Anadyomenaceae	*Anadyomene stellata* (Wulfen) C. Agardh	-	-	-	+	+	-	-	-	-	-	-	-	-	[1,4,5,12,13]
Bryopsidaceae	*Bryopsis muscosa* J.V. Lamouroux	-	-	+	-	-	-	-	-	-	-	-	-	-	[1,2,12,13]
Caulerpaceae	*Caulerpa prolifera* (Forsskål) J.V. Lamouroux	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,2,9,12,13]
	Caulerpa racemosa (Forsskål) J. Agardh	+	-	-	-	-	-	-	-	-	-	-	-	-	[2,4,7,8,12,14,15]
Cladophoraceae	*Chaetomorpha aerea* (Dillwyn) Kützing	+	-	-	+	-	-	-	-	-	-	-	-	-	[1,2,4,12,13]
Codiaceae	*Codium bursa* C. Agardh	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,2,4,5,12,13]
	Codium fragile (Suringar) Hariot)	+	-	-	-	-	-	-	-	-	-	-	-	-	[2,4,5,9,12,15]
	Codium tomentosum (Stackhouse)	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,2,12]
Monostromaceae	*Monostroma grevillei* (Thuret) Wittrock)	+	-	-	+	-	+	-	-	-	+	+	+	-	[12]
Prasiolaceae	*Prasiola calophylla* (Carmichael ex Greville)	+	-	-	-	-	-	-	-	-	-	-	-	-	FR

Taxa (Div., Fam.)	Species	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	Ref.*
Ulvaceae	*Enteromorpha compressa* (Linnaeus) Nees)	+	-	+	-	-	+	+	+	-	+	+	+	-	[1,4,5,8,9,12]
	Enteromorpha intestinalis (Linnaeus) Nees)	+	+	-	-	-	+	+	+	-	-	-	+	-	[1,4,7,8,9,12]
	Ulva lactuca (Linnaeus)	+	+	-	+	+	+	+	+	+	+	+	+	+	[1,2,4,5,7–10,13]
	Ulva linza (Linnaeus)	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,2,5,12]
	Ulva olivascens **(**P.J.L. Dangeard**)**	+	-	-	-	-	-	-	-	-	-	-	-	-	FR
	Ulva rigida (C. Agardh)	+	-	-	-	+	-	-	+	-	-	+	+	+	[1,2,4,5,7–9,12]
	Ulvaria obscura (Kützing)	-	-	-	-	-	-	-	-	-	-	+	+	+	[7]
Rhodophyta															
Bangiaceae	*Porphyra leucosticata* (Thuret)	-	-	-	-	-	+	+	+	+	-	+	-	+	[1,2,5]
	Porphyra linearis (Greville)	-	-	-	-	-	-	-	-	+	-	+	-	-	FR
	Porphyra suborbiculata (Kjellman)	-	-	-	-	-	-	-	-	+	-	-	-	-	FR
	Porphyra umbilicalis (Kützing)	-	-	-	-	-	-	-	-	-	+	-	-	-	[1,15]
Bonnemaisoniaceae	*Asparagopsis armata* (Harvey)	+	-	-	-	+	-	+	-	+	-	-	-	-	[1,2,4,5,7,8]
	Bonnemaisonia hamifera (Hariot)	-	-	-	-	-	-	-	-	-	+	-	-	-	[1]
Ceramiaceae	*Centroceras clavulatum* (C. Agardh) Montagne)	-	-	-	-	-	-	-	-	-	+	-	-	-	[1,2]
	Ceramium ciliatum (J. Ellis) Ducluzeau	-	-	+	-	-	-	-	-	-	-	+	-	-	[1,4,5,16]
	Ceramium rubrum (C. Agardh)	+	+	+	-	-	-	-	-	-	+	+	+	-	[1,16]
	Microcladia glandulosa (Solander ex Turner) Greville	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,16]
Corallinaceae	*Corallina elongata* (J. Ellis&Solander)	+	-	+	-	-	-	-	-	-	+	+	-	+	[1,2,4,7,8]
	Jania corniculata (J.V. Lamouroux)	-	-	-	-	-	-	-	-	-	+	-	-	-	[1,4]
	Jania longifurca (Zanardini)	-	-	+	-	-	-	-	-	-	-	-	-	-	[1,2]
	Jania rubens (Linnaeus) J.V. Lamouroux)	+	-	+	-	-	-	-	-	-	-	-	-	-	[1,2,4,7–9]
	Jania squamata (Linnaeus)	-	-	-	+	+	+	+	-	+	-	-	-	-	FR
	Jania virgata (Zanardini) Montagne)	-	-	-	-	-	-	-	-	-	+	-	-	-	[17]
Cystocloniaceae	*Cystoclonium purpureum* (Hudson) Batters)	-	-	+	-	-	-	-	-	-	-	-	-	-	FR
	Hypnea musciformis (Wulfen) J.V. Lamouroux)	-	-	-	+	-	-	-	-	+	-	-	-	-	[1,2,4,7,8,9]
	Hypnea spinella (C. Agardh)	+	-	-	-	-	-	-	-	-	-	-	-	-	[17]
Delesseriaceae	*Delesseria sanguinea* (Hudson) J.V. Lamouroux)	-	-	-	-	-	-	-	-	-	-	+	-	-	FR
Furcellariaceae	*Furcellaria lumbricalis* (Hudson) J.V. Lamouroux)	-	-	-	+	-	-	-	-	-	-	-	-	-	FR
Gelidiaceae	*Gelidium pulchellum* ((Turner) Kützing)	-	-	-	-	-	-	-	-	-	+	-	-	-	[1]
	Gelidium pusillum (Stackhouse) Le Jolis)	-	-	-	-	-	-	-	-	-	+	-	-	-	[1,5]
	Gelidium sp (J.V. Lamouroux)	-	-	+	-	-	-	-	-	+	+	-	-	-	
Gigartinaceae	*Gigartina acicularis* (Roth) J.V. Lamouroux)	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,2,7]
	Gigartina pistillata (S.G. Gmelin) Stackhouse)	-	-	-	-	-	-	-	-	-	-	-	+	-	[1]
Gracilariaceae	*Gracilaria bursa-pastoris* (S.G. Gmelin) P.C. Silva)	-	-	+	-	-	-	-	-	-	-	-	-	-	[1,2]
Peyssonneliaceae	*Peyssonnelia squamaria* (S.G.Gmelin) Decaisne ex J. Agardh	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,2,4,5,7,8]
Phyllophoraceae	*Ahnfeltiopsis flabelliformis* (Harvey) Masuda	-	-	-	-	-	-	-	-	+	-	-	-	-	FR
Pterocladiaceae	*Pterocladia capillacea* (S.G. Gmelin) Bornet	-	-	-	-	-	-	-	-	-	+	-	-	+	[1,2,7]

Taxa (Div., Fam.)	Species	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12	S13	Ref.*
Rhodomelaceae	*Chondria capillaris* (Hudson) M.J. Wynne	-	-	+	-	-	-	-	-	-	-	-	-	-	[1,16]
	Halopithys incurva (Hudson) Batters	-	-	+	-	-	-	-	-	-	-	+	-	-	[1,16]
	Halopithys sp.	-	-	-	-	-	-	-	-	-	+	-	-	-	
	Laurencia hybrida (A.P.De Candolle) T. Lestiboudois	-	-	-	-	-	+	+	-	-	-	-	-	-	[1]
	Laurencia obtusa (Hudson) J.V. Lamouroux	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,2,5,10,16]
	Laurencia papillosa (C. Agardh) Greville	+	-	-	-	-	-	-	-	-	-	-	-	-	[1,2,4,8]
	Osmundea pinnatifida (Hudson) Stackhouse	-	-	-	-	+	+	+	-	-	-	+	+	-	[1,7,8]
	Polysiphonia opaca (C. Agardh) Moris & De Notaris	+	-	-	-	-	-	-	-	-	+	+	-	-	[1,16]
Rissoellaceae	*Rissoella verruculosa* (A. Bertoloni) J. Agardh	-	-	-	-	-	-	-	-	-	+	-	-	-	[1,2,5]
Solieriaceae	*Solieria chordalis* (C. Agardh) J. Agardh	-	-	+	-	-	-	-	-	-	-	-	-	-	FR
Sphaerococcaceae	*Sphaerococcus coronopifolius* Stackhouse	+	-	-	-	-	-	-	-	-	-	+	-	-	[1,2,4,5]
Wrangeliaceae	*Bornetia secundiflora* (J. Agardh) Thuret	-	-	+	-	-	-	-	-	-	-	-	-	-	[1,16]

2012; Bentaallah & Kerfouf, 2013; Ould-Ahmed *et al*., 2013; Hussein, 2015; Ouerghi *et al*., 2016; Traiche *et al*., 2018; Benali *et al*., 2019; Ould-Ahmed *et al*., 2019; Bahbah, 2021; Ghellai *et al*., 2021; Hellal *et al*., 2021; Mansouri *et al*., 2021).

Results

Species inventoried, specific richness of algae and number of species per station

The checklist presented in this work contains 80 species classified into three taxa: *Phaeophyceae, Chlorophyceae*, and *Rhodophyceae*. There are 15 new records for the western Algerian coastline. *Phaeophyceae* (4 orders/6 families) contains 21 species, with the order Fucales accounting for 43%. *Chlorophyceae* includes seventeen species (5 orders and eight families). Ulvales represent the majority of this group (41%). *Rhodophyceae* includes 42 species from 8 orders and 18 families, with Ceramiales accounting for 34% of the group (Table 1). Respect to specific richness *Rhodophyceae* have a fairly representative coverage, accounting for 52.5%, followed by *Phaeophyceae* (26.25%) and *Chlorophyceae* (21.25%) (Figure 2A). Specific diversity (total number of species) varies by site (Figure 2B); S_1 has the most diversity with 37 species, followed by S_{11} and S_{10}, which have 25 and 21 species, respectively, in contrast to site S_8, which has the least diversity with only six species. Notably, stations S_2, S_5–S_8 and S_{12} record fewer than ten species each (Figure 2B).

New species recorded

Phaeophyta

Five *Phaeophyceae* species are newly introduced on the Algerian coastline, and they belong to the orders Fucales (2 species) and Ectocarpales (3 species).

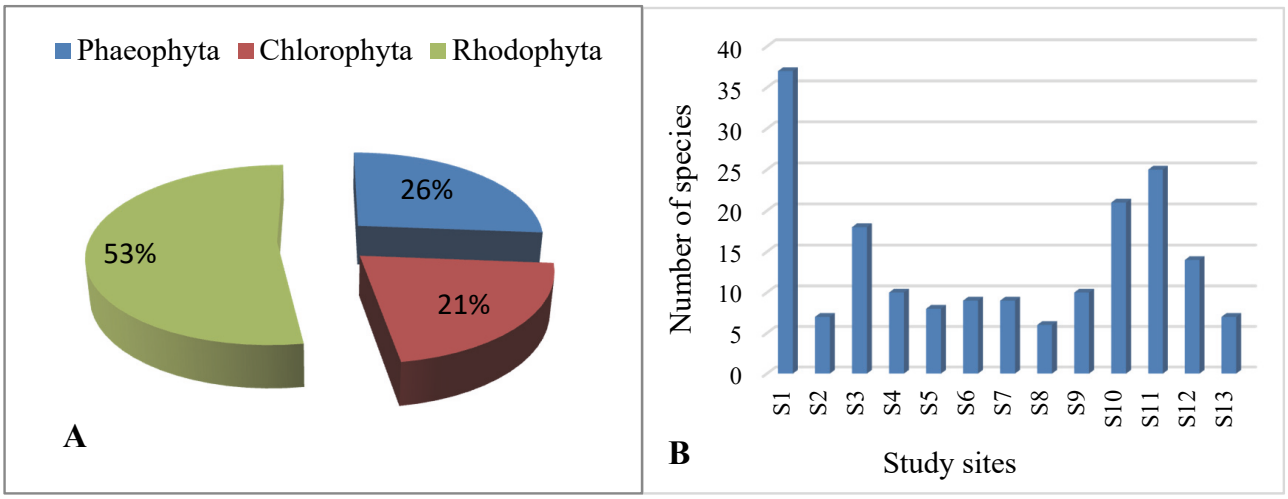

Figure 2. Some features of collected algae. A, specific richness of macroalgae in the study area; B, variability of the total specific richness according to the sites.

Fucales

Fucaceae

Ascophyllum nodosum (Linnaeus) Le Jolis (Figure 3)

Brown alga collected along the coast of Stidia in the mediolittoral stage, of greenish-brown color. The linear thallus is regular with vesicles, no median vein and brown spots. The apical cell initiates a dichotomous primary ramification, which leads to bilateral secondary ramification from the initial cell in the marginal slits.

Geographical distribution: *Ascophyllum nodosum* is found in the Atlantic Ocean (Neto *et al.*, 2020), the White Sea (Smirnova & Mikhailova, 2013), and the Mediterranean (Gallardo *et al.*, 2016; Petrocelli & Cecere, 2019). Previous research on Algerian coasts has found no record of this species. *Ascophyllum nodosum* is a new taxon recorded on the coast of western Algeria, more precisely on the Stidia coast, during sampling carried out in March 2020.

Sargassaceae

Bifurcaria bifurcata R. Ross (Figure 3)

Brown alga in the form of dichotomous, smooth, light brown cylindrical strands collected from Agla 1 beach. The spikes are composed of persistent, intertwined rhizoids. Cylindrical receptacles elongated at the apices, and numerous conceptacles are visible as lighter-colored spots.

Geographical distribution: this species is present in the Northeast Atlantic (from the British Isles to southern Morocco) (Cabioc'h *et al*., 2014; Bunker *et al*., 2017; Belattmania *et al*., 2018), and Moroccan Mediterranean (Sabri *et al*., 2021). However, its presence on the Algerian coastline was not previously reported. The first record of the species *Bifurcaria bifurcata* in Algeria was discovered on Agla 1 beach during a March 2021 sampling.

Ectocarpales

Chordariaceae

Asperococcus fistulosus (Hudson) W.J. Hooker (Figure 3)
= *Asperococcus echinatus* (Mertens) Greville

Brown algae in the form of tubes, with a small basal disc and a kind of stipe. It is a seaweed of 12,5 cm in length and 4 mm in width. The thallus is light brown with brown spots. *Asperococcus fistulosus* is collected on the two beaches, Agla 2 and Tafsout, in the rocky area.

Geographical distribution: it is present in the Atlantic (John *et al*., 2004; Ferreira *et al*., 2018), the Mediterranean (Ribera *et al*., 1992; Bárbara *et al*., 2005; Gallardo *et al*., 2016) and Moroccan Mediterranean (Sabri *et al*., 2021). Its presence on the Algerian coast had never been reported before. *Asperococcus fistulosus* was the first introduced species found on the two beaches, Agla 2 and Tafsout, during the spring season in March 2019.

Elachista fucicola (Velley) Areschoug (Figure 3)
Light brown alga collected along the Ain Franine coast, Oran region. *Elachista fucicola* is an epiphytic taxon of *Zostera*. It is found floating, and the thallus is found in the form of a loose and globular cushion, which is present as a tuft and constitutes free, unbranched filaments.

Geographical distribution: *Elachista fucicola* is present in the Atlantic (Pedersen, 2011), Pacific and Black Sea (Ribera *et al*., 1992; Cabioćh *et al*., 2014), the Mediterranean (Silberfeld *et al*., 2011; Gallardo *et al*., 2016) and Moroccan Mediterranean (Sabri *et al*., 2021). *Elachista fucicola* is a new species introduced in Algeria, and it has not previously been recorded on the Algerian coast; it was collected in February 2020.

Elachista scutulata (Smith) Areschoug (Figure 3)

Dark brown alga collected along the Ain Franine coast. *Elachista scutulata* is an epiphytic *Zostera* species with a loose and globular thallus that appears as a tuft of free, unbranched assimilating filaments.

Geographical distribution: *Elachista scutulata* is present in the Black Sea (Ribera *et al*., 1992), the Northeast Atlantic (from Norway to Portugal) (Cabloc'h *et al*., 2014) and the Mediterranean (Bárbara *et al*., 2005; Gallardo *et al*., 2016). Its presence on Algeria's coast had not previously been mentioned. *Elachista scutulata* was the first species reported on the Ain Franine coast in February 2020.

Chlorophyta

Two new *Chlorophyceae* species have been introduced along the Algerian coast, one from the Prasiolales order and one from the Ulvales order.

Prasiolales

Prasiolaceae

Prasiola calophylla (Carmichael ex Greville) Kützing (Figure 4)

Light green species, 2 cm long. It appeared only once on the substratum during the supralittoral stage. This species was spotted along the Stidia coast. It takes the form of irregular ribbons with basal fragments attached to the substrate by a disk.

Geographical distribution: it is a common species along the Atlantic coasts (Burel *et al*., 2019) and in the colder waters of the Atlantic south to northern Spain (Rindi *et al*., 2004). It has also been reported from Antarctica (Broady, 1989) and the White Sea (Garbary & Tarakhovskaya, 2013). It had not previously been reported on the Algerian coast. *Prasiola calophylla* was the first species reported to be introduced to the Stidia coast in March 2020.

Ulvales

Ulvaceae

Ulva olivascens P.J.L. Dangeard (Figure 4)
= *Umbraulva dangeardii* (Dangeard) Bae & I.K. Lee

Large, olive-green, irregular leaf-shaped species, 27 cm long, with holes of various diameters. *Ulva olivascens* has been reported for the first time on the Stidia coast during the mediolittoral stage on the rocks.

Geographical distribution: it is widespread in western and southern Ireland (De Valéra *et al.*, 1979; Burrows, 1991), the Canary Islands (Moro *et al.*, 2011), the western and eastern Mediterranean (Gallardo *et al*., 1993), Morocco, and Tunisia (Gallardo *et al.*, 1993; Benhissoune *et al*., 2001). It had not previously been reported on the Algerian coast. *Ulva olivascens* is the first species recorded on the Stidia coast in March 2020.

Rhodophyta

Eight *Rhodophyceae* species have recently been introduced along Algeria's coastline, including four from Gigartinales, one from Ceramiales, one from Corallinales, and two from Bangiales.

Gigartinales

Phyllophoraceae

Ahnfeltiopsis flabelliformis (Harvey) Masuda (Figure 5)

Dark red, 4 cm in diameter, with cylindrical branches and a flattened stipe giving numerous upright axes ending in irregular dichotomous branches. It has a more rigid, cartilaginous texture. We identified *Ahnfeltiopsis flabelliformis* at Rechgoun station. It was most observed on substrates in the mediolittoral zone.

Geographical distribution: *Ahnfeltiopsis flabelliformis* is widespread in Asia and the Pacific (Titlyanov *et al.*, 2016; Kozhenkova, 2020; Huisman *et al.*, 2007), as well as in the Mediterranean (France) (Verlaque, 2001). It had not previously been reported on the Algerian coast. *Ahnfeltiopsis flabelliformis* was first reported on the Rechgoun coast in March 2019.

Cystocloniaceae

Cystoclonium purpureum (Hudson) Batters (Figure 5)

Red-brown species color, 13.2 cm high and in the form of voluminous cylindrical fronds that are soft to the touch. *Cystoclonium purpureum* was observed at the Ain Franine station, where it grows in the infralittoral stage on the rocks. The medulla is a cord of narrow, loosely intertwined filaments surrounded by large, rounded cells. The fronds are located in this medulla, which is followed by several axes; each frond consists of many branches with tapered ramifications.

Geographic distribution: It inhabits the northeast and northwest Atlantic (Conde *et al*., 1996; Nielsen & Gunnarsson, 2001; Zubia *et al.*, 2009) as well as the White Sea (Mikhaylova, 2017). Its presence on Algeria's coast had not previously been mentioned. *Cystoclonium purpureum* is the first recorded species to be introduced to the Ain Francine coast in February 2020.

Furcellariaceae

Furcellaria lumbricalis (Hudson) J.V.Lamouroux (Figure 5)
= *Furcellaria fastigiata* (Linnaeus) J.V. Lamouroux

Reddish-brown species. It takes the form of a tuft with many cylindrical axes; each axis has several ramifications and ends in a dichotomous form. A basal disc that lacks a true spike fixes this taxon to the substrate. This species was discovered on the Bousfer station during the infralittoral stage of the rocks.

Geographical distribution: *Furcellaria lumbricalis* has been observed in the Atlantic (Burel *et al.*, 2019), White Sea (Mikhaylova, 2017), Black Sea (Cabioćh *et al.*, 2014), and Mediterranean (Furnari *et al.*, 2003; Cabioćh *et al*., 2014). Its presence along Algeria's coastline had not previously been mentioned. *Furcellaria lumbricalis* is the first species reported on the Bousfer coast in August 2019.

Solieriaceae

Solieria chordalis (C. Agardh) J. Agardh (Figure 5)

Reddish-brown species, 5 cm long. This species is shaped like a tuft and has regular cylindrical branches with ramifications. These branches grew along one side of very short spiny ramules. It was discovered at the Ain Franine station during the infralittoral stage of the rocks.

Geographical distribution: Gallardo *et al*. (2016) and Burel *et al*. (2019) reported its presence on the Atlantic. It had not previously been mentioned or confirmed along the Algerian coast or in the Mediterranean. *Solieria chordalis* was the first species to be reported on the Ain Francine coast in February 2020.

Ceramiales

Delesseriaceae

Delesseria sanguinea (Hudson) J.V. Lamouroux (Figure 5)

Bright red species, 5–10 cm high. This species is branch-shaped with lanceolate and wavy oval blades (leaves), each blade having a main median rib. This branching comes from a thickened discoid crempon. The taxon *Ceramium* has been found epiphytic on *Delesseria sanguinea*. It was inventoried at the Agla 2 station in the infralittoral stage on the rocks.

Geographical distribution: it is present in the Northeast Atlantic (Araújo *et al*., 2009; Gallardo *et al*., 2016; Burel *et al*., 2019) and the Mediterranean (Cabioćh *et al*., 2014). It had not previously been mentioned on the Algerian coast. *Delesseria sanguinea* is the first recorded species to be introduced to the Agla 2 coast in March 2021.

Corallinales

Corallinaceae

Jania squamata Linnaeus (Figure 5)
= *Corallina squamata* Linnaeus

Species with variable pinkish-brown or purplish-pink color, 4.7–7 cm high. This species takes the form of spires and fronds with white, calcified articulated ends. It has repeated branches in the shape of a dichotomously branched main axis and a second regularly pinned branch. It was inventoried at Rechgoun, Sidi Djelloul, El Hillal, Sassel, and

Bousfer stations, where it was discovered fixed in the infralittoral stage.

Geographical distribution: it is present in the Atlantic (Cabioc'h *et al*., 2014), the Canary Islands (Afonso-Carrillo, 2014), and the Mediterranean (Moussa *et al*., 2018). It had not previously been mentioned on the Algerian coast. *Jania squamata* was first reported on the coasts of Rechgoun, Sidi Djelloul, El Hillal, Sassel, and Bousfer in March 2019.

Bangiales

Bangiaceae

Porphyra linearis Greville (Figure 5)

Violet-brown or brownish species, in the form of very thin fronds, linear without median vein, undulated in the extremities. This species is fixed to the rocks using a small crampon. It was inventoried at two stations in the upper zone, Agla 2 and Rechgoun, which were fixed to the rocks.

Geographical distribution: *Porphyra linearis* is present in the Atlantic (Mols-Mortensen *et al*., 2012; Gallardo *et al*., 2016) and the Mediterranean (Cabioćh *et al*., 2014). Its presence along Algeria's coastline had not previously been mentioned. *Porphyra linearis* is the first recorded species to be introduced to the Agla 2 and Rechgoun coasts in March 2019.

Porphyra suborbiculata (Kjellman) J.E.Sutherland, H.G.Choi, M.S.Hwang & W.A.Nelson (Figure 5)

Brownish species, in very fine lanceolate or oval linear form with regular spinules processes and forming folded rosettes attached to the center. It was inventoried at the Rechgoun station in the upper zone, which is fixed to the rocks.

Geographical distribution: it is present in the Northwest Atlantic (New England, USA) (Neefus *et al*., 2008) and Asia (Daw *et al*., 2014; Phang *et al*., 2016). Its presence along Algeria's coastline had not previously been mentioned. *Porphyra suborbiculata* was first reported on the Rechgoun coast in March 2019.

Discussion

The compiled checklist advances our understanding of the algal flora of the West Algerian coastline. Adding several new records for this region and increasing understanding of species presence and distribution. Except for the introduced species in this study, the majority of the taxa inventoried were cited in Algeria by multiple authors in various locations. The 15 newly reported species have diverse origins and may have appeared recently or gone unnoticed unless a large-scale, spatially detailed sampling program is implemented.

We observed that the variation in the average recovery rate of species over four seasons does not follow any strict rules because different biotic and abiotic factors always influence it. The number of species varies by site due to various factors such as harvesting season, beach nature, and anthropic impact. *Porphyra leucosticata* and *Ceramium rubrum* stand out as *Rhodophyceae* in this study. *Ulva lactuca* represents the *Chlorophyceae*, while *Halopteris scoparia* represents the *Phaeophyceae*.

Several studies have confirmed the dominance of the Rhodophytes class in Western Algeria, with percentages ranging from 47.80% to 50.36% (Bachir Bouiadjra, 2012; Hellal *et al*., 2021; Mansouri *et al*., 2021). The Mediterranean Sea is home to two endemic species, *Cystoseira stricta* and *Rissoella verruculosa*, among 80 recorded taxa (Ben Maiz *et al*., 1987; Cabioćh *et al*., 2014).

Furthermore, four taxa are considered invasive introduced species (*Asparagopsis armata, Caulerpa racemosa, Codium fragile* and *Sargassum muticum*, see Figure 6), and their origins differ depending on whether they were introduced from one site to another directly or indirectly; these taxa are mentioned in several works in Algeria (Ould Ahmed & Meinesz, 2007; Bachir Bouiadjra, 2012; Bentaallah & Kerfouf, 2013; Benali *et al*., 2019; Bahbah, 2021).

The study also highlighted 15 new species. Medium-sized or larger species, such as *Ascophyllum nodosum*, first appeared in a less developed stage. These grow in response to the short days of autumn, mature in winter, and are most abundant in spring during the second year (Baardseth, 1970). *Ascophyllum nodosum* development influences the size and shape of the vesicles, serration, average number of branches, and bifurcation position relative to the vesicles. Floats on each axis form at a consistent rate each year, except for the first year (Cabioćh *et al*., 2014). Furthermore, *Prasiola calophylla*, a small species, is one of the few macroalgal species that can withstand extreme temperatures (Häder & Gao, 2018).

The results are in agreement with previous studies on aquatic algae which show that the most cited taxa in Algeria belong to the Fucales (Ould-Ahmed *et al*., 2013), such as *Ascophyllum nodosum, Bifurcaria bifurcata*, *Cystoseira compressa*, *Cystoseira foeniculacea*, *Cystoseira* sp., *Cystoseira stricta*, *Cystoseira tamariscifolia*, *Sargassum muticum* (see Figure 6) and *Sargassum vulgare* have been found on the Algerian west coast. Biogeographically, the algal flora inventoried in our study was dominated by the Atlantic element, with 33 species (43%), followed by the cosmopolitan element, with 21 species (27%), and the Mediterranean element, with 8%.

These findings on the biogeographical affinity of the Algerian algal flora are consistent with previous research (Ould Ahmed, 2015; Bahbah, 2021), which demonstrated that the Atlantic, Cosmopolitan, and Mediterranean elements always occupy the first three positions with relatively moderate percentages. Furnari *et al*. (2003) found that Mediterranean species ranked third on the Italian coast, which supports our findings.

The maximum presence of these Atlantic species in the Mediterranean is thought to be the result of Atlantic waters entering through the Strait of Gibraltar, allowing them to settle in the region. As a result, Atlantic boreal species can be found at the Mediterranean's southern and northern limits, with the Atlantic element dominating the algal flora (Ribera *et al*., 1983). Furthermore, increased maritime traffic and trade promote the spread of algae beyond their natural habitats (Molnar *et al*., 2008).

The findings are most likely explained by the improved phycological knowledge of this region, which has enriched previous research on species presence and distribution. Our findings emphasize the importance of conducting long-term seaweed surveys and inventories along the Algerian coast, particularly in less-studied areas, to improve phycological knowledge of the southern Mediterranean.

Conclusions

The inventory of marine algae aims to establish a census of species of patrimonial interest. This study discovered 80 species on some Algerian West coasts, which were classified into three taxa: *Phaeophyceae*, *Chlorophyceae*, and *Rhodophyceae*. Rhodophytes were the dominant class which occupies almost half of the total number of algae. 15 species first records were identified (*Ascophyllum nodosum*, *Bifurcaria bifurcata*, *Asperococcus fistulosus*, *Elachista scutulata*, *Elachista fucicola*, *Ulva olivascens*, *Prasiola calophylla, Ahnfeltiopsis flabelliformis*, *Furcellaria lumbricalis*, *Solieria chordalis*, *Cystoclonium purpureum*, *Delesseria sanguinea*, *Jania squamata*, *Porphyra linearis*, *Porphyra suborbiculata).* It is well understood that recent climatic changes are influencing species distribution and abundance.

However, the number of algae recorded along Algerian coasts remains low when compared to the total number recorded in the Mediterranean Sea. This necessitates long-term monitoring of all littoral zones to better understand the existing algal flora. We think our research should be extended over several annual cycles to understand macroalgae evolutionary dynamics better.

Authorship

FZA and FB designed the research and conducted the analyses. FZA wrote the manuscript with the supervision of FB and MAB. All authors discussed the results, commented on the manuscript and approved the last version.

Conflict of interest

None

References

Afonso-Carrillo, J. 2014. Lista actualizada de las algas marinas de las islas Canarias, 2014. Sociedad Española de Ficología (SEF), Las Palmas. 64p.

Araújo, R., Bárbara, I., Tibaldo, M., Berecibar, E., Díaz-Tapia, P., Pereira, R., Santos, R. & Sousa-Pinto, I. 2009. Checklist of benthic marine algae and cyanobacteria of northern Portugal. Bot. Mar. 52(1): 24–46. doi: 10.1515/BOT.2009.026

Baardseth, E. 1970. Synopsis of biological data on knobbed wrack Ascophyllum nodosum (Linnaeus) Le Jolis. FAO fisheries Synopsis, 50p.

Bachir Bouidjra, B. 2012. Étude de la flore algale benthique et les impacts de ses espèces invasives devant la côte Mostaganemoise. PhD Thesis. Université Abdelhamid Ibn Badis, Mostaganem. 143p.

Bahbah, L. 2021. Cartographie par différentes techniques du peuplement algal photophile de substrat dur de l'infralittoral de la région Algéroise: Impacts des rejets d'effluents. PhD Thesis. Université des sciences de la technologie Houari Boumedienee, Argel. 252 p.

Bárbara, I., Cremades, J., Calvo, S., López-Rodríguez, M.C. & Dosil, J. 2005. Checklist of the benthic marine and brackish Galician algae (NW Spain). An. Jard. Bot. Madrid 62: 69–100. doi: 10.3989/ajbm.2005.v62.i1.32

Belattmania, Z., Chaouti, A., Reani, A., Machado, M., Engelen, A.H., Serrão, E.A. & Sabour, B. 2018. Similar epiphytic macrofauna inhabiting the introduced Sargassum muticum and native fucoids on the Atlantic coast of Morocco. Cryptogam. Algol. 39(3): 269–292. doi: 10.7872/crya/v39.iss3.2018.269

Ben Maiz, N., Boudouresque, C.-F. & Quahchi, F. 1987. Inventaire des algues et phanérogames marines benthiques de la Tunise. Giorn. Bot. Ital. 121: 259–304. doi:10.1080/11263508709429380

Benali, M., Djebri, I., Bellouis, D., Sellam, L.N. & Rebzani-Zahaf, C. 2019. First record of drifting Sargassum muticum (Yendo) Fensholt thalli on the Algerian coasts of Cherchell and Sidi Fredj. BioInvasions Records 8(3): 575–581. doi: 10.3391/bir.2019.8.3.13

Benhissoune, S., Boudouresque, C.-F. & Verlaque, M. 2001. A checklist of marine seaweeds of the Mediterranean and Atlantic coasts of Morocco I. Chlorophyceae Wille s.l. Bot. Mar. 44: 171–182. doi: 10.1515/BOT.2001.023

Bentaallah, M.E. & Kerfouf, A. 2013. Prolifération de l'algue *Caulerpa racemosa* dans les écosystèmes littoraux de l'Algérie : état des lieux et des connaissances. *Physio-Géo* 7(1): 157–164. doi: 10.4000/physio-geo.3238

Broady, P.A. 1989. The distribution of Prasiola calophylla (Carmich.) Menegh. (Chlorophyta) in Antarctic freshwater and terrestrial habitats. Antarct. Sci. 1: 109–118. doi: 10.1017/S0954102089000179

Bunker, F., Brodie, J.A., Maggs, C.A. & Bunker, A.R. 2017. Seaweeds of Britain and Ireland. 2nd ed. Wild Nature Press, Plymouth. 312p.

Burel, T., Le Duff, M. & Ar Gall, E. 2019. Updated checklist of the seaweeds of the French coasts, Channel and Atlantic Ocean. An aod. Les Cahiers Naturalistes de l'Observatoire Marin 7(1): 1–38.

Burrows, E.M. 1991. Seaweeds of the British Isles, vol. 2. Chlorophyta. Natural History Museum Publications, London. 238p.

Cabioc'h, J., Floc'h, J.-Y., Le Toquin, A., Boudouresque, C.-F., Meinesz, A. & Verlaque, M. 2006. Guide des Algues des Mers d'Europe. Delachaux et Niestlé. 272 p.

Chabot, R. & Rossignol, A. 2003. Algues et faune du littoral du Saint-Laurent maritime: Guide d'identification. Institut des sciences de la mer de Rimouski, Rimouski; Pêches et Océans Canada (Institut Maurice-Lamontagne), Mont-Joli. 113p.

Conde, F., Flores-Moya, A., Soto, J., Altamirano, M. & Sánchez, A. 1996. Checklist of Andalusia

(S. Spain) seaweeds. III. Rhodophyceae. Acta Botanica Malacitana 21: 7–33.

Daw Aye-Mon-Sein, San-Tha-Htun, U., Soe-Htun, U. & Ohno, M. 2003. Studies on Porphyra suborbiculata Kjellman (Bangiales, Rhodophyta) from Myanmar. I. The morphology and life history in culture. *Bulletin of Marine Science and Fisheries, Kochi University 22:* 65.

De Valéra, M., Pybus, C., Casley, B. & Webster, A. 1979. Littoral and benthic investigations on the west coast of Ireland X. Marine algae of the northern shores of the Burren, Co. Clare. P. Roy. Irish Acad. 79(B): 259–269.

Doré, A., Noël, P. & Séret, B. 2014. Fiches descriptives des espèces marines de France métropolitaine dont la protection est envisagée. Rapport SPN 2014–28, Museum National d'Histoire Naturelle, Paris, 275p.

Ferreira, S.J., Gonçalves Silva, J.J. & Araujo, R. 2018. Marine algae collection in the Herbarium of the Funchal Natural History Museum (MADM) with new records from the archipelago of Madeira. Boletim do Museu Municipal do Funchal 68: 31–52.

Fischer, W., Bauchot, M.L. & Schneider, M. 2007. Fiches FAO d'identification des espèces pour les besoins de la pêche. (Révision 1). Méditerranée et mer Noire. Zone de pêche, 37, I. Végétaux et Invertébrés.

Furnari, G., Giaccone, G., Cormaci, M., Alongi, G. & Serio, D. 2003. Biodiversità marina delle coste italiane: catalogo del macrofitobenthos. Biologia Marina Mediterranea 10(1): 1–482.

Gallardo, T., Bárbara, I., Afonso-Carrillo, J., Bermejo, R., Altamirano, M., Gómez Garreta, A., Barceló Martí, M.C., Rull Lluch, J., Ballesteros, E. & De la Rosa, J. 2016. Nueva lista crítica de las algas bentónicas marinas de España. A new checklist of benthic marine algae of Spain. Algas. Boletin Informativo de la Sociedad Española de Ficologia 51: 7–52.

Gallardo, T., Gómez Garreta, A., Ribera, M.A., Cormaci, M., Furnari, G., Giaccone G. & Boudouresque C.F. 1993. Checklist of Mediterranean Seaweeds, II. Chlorophyceae Wille s.l. Bot. Mar. 36: 399–421. doi: 10.1515/botm.1993.36.5.399_

Garbary, D.J. & Tarakhovskaya, E.R. 2013. Marine macroalgae and associated flowering plants from the Keret Archipelago, White Sea, Russia. Algae 28(3): 267–280. doi: 10.4490/algae.2013.28.3.267

Ghellai, M., Bachir-Bouiadjra, M.E.A., Dahloum L., Megharbi, A. & Bachir-Bouiadjra, B. 2021. Distribution of phytobenthosis in the presence of an invasive alga Caulerpa cylindracea on the Algerian west coast. Biodiversitas 22: 5644–5653. doi: 10.13057/biodiv/d221250

Gómez-Garreta, A., Gallardo, T., Ribera, M.A., Cormaci, M., Furnari, G., Giaccone, G. & Boudouresque, C.F. 2001. Checklist of Mediterranean seaweeds. III. Rhodophyceae Rabenh. 1. Ceramiales Oltm. Bot. Mar. 44: 425–460. https://doi.org/10.1515/BOT.2001.051

Guiry, M.D. & Guiry, G.M. 2014. AlgaeBase. World-wide electronic publication, National University of Ireland, Galway. http://www.algaebase.org

Häder, D.P. & Gao, K. 2018. Aquatic Ecosystems in a Changing Climate. *CRC Press, 324p.*

Hellal, S., Bennabi, F., Baaloudj, A. & Kerfouf, A. 2021. Checklist of the Marine Macroalgae of Algerian West Coast (Ain Témouchent site). Ukrainian Journal of Ecology 11(3): 22–25. doi: 10.15421/2021_137

Huisman, J.M., Abbott, I.A. & Smith, C.M. 2007. Hawaiian reef plants. University of Hawai'i Sea Grant College Program, Honolulu. 264p.

Hussein, K.B. 2015. Suivi et évaluation de la structure écologique et biodiversitaire infralittorale de la zone côtière Oranaise. PhD Thesis. Université d'Oran Ahmed Ben Bella, Algérie, 252 p.

Jean-Pierre, J. & Yan-Chim, J.T. 2018. Les Plantes hyperaccumulatrices de métaux lourds une solution à la pollution des sols et de l'eau? Connaissances et Savoirs. 168p.

John, D.M., Prud'homme van Reine, W.F., Lawson, G.W., Kostermans, T.B. & Price, J.H. 2004. A taxonomic and geographical catalogue of the seaweeds of the western coast of Africa and adjacent islands. Nova Hedwigia 127: 1–339.

Kozhenkova, S.I. 2020. Checklist of marine benthic algae from the Russian continental coast of the Sea of Japan. Phytotaxa 437(4): 177–205. doi: 10.11646/phytotaxa.437.4.1

Laplace-Treyture, C., Peltre, M.C., Lambert, E., Rodriguez, S., Vergon, J.P. & Chauvin, C. 2014. Guide pratique de détermination des algues macroscopiques d'eau douce et de quelques organismes hétérotrophes. Irstea Bordeaux, Cestas. 204 p.

Lugilde, J., Peña, V. & Bárbara, I. 2017. Morphology and distribution of Jania virgata (Corallinales, Rhodophyta) and revision of Jania s.l. in Galicia. Nova Acta Cientifica Compostelana Biologia 24: 105–116.

Mansouri, A., Baaloudj, A., Toumi, F., Bouzidi, M.A. & Kerfouf, A. 2021. Checklist of Benthic Marine Macroalgae in Western Algeria. Ukrainian Journal of Ecology 11(3): 40–45. doi: 10.15421/2021_140

Mikhaylova, T.A. 2017. Checklist of Rhodophyta of the White Sea (the Arctic Ocean). Bot. Mar. 60(1): 55–65. doi: 10.1515/bot-2016-0060

Molnar, J.L., Gamboa, R.L., Revenga, C. & Spalding, M.D. 2008. Assessing the global threat of invasive species to marine biodiversity. Front. Ecol. Environ. 6(9): 485–492. doi:10.1890/070064

Mols-Mortensen, A., Neefus, C.D., Nielsen, R., Gunnarsson, K., Egilsdottir, S., Pedersen, P.M. & Brodie, J. 2012. New insights into the biodiversity and generic relationships of foliose Bangiales (Rhodophyta) in Iceland and the Faroe Islands. Eur. J. Phycol. 47(2): 146–159. doi: 10.1080/09670262.2012.666678

Moro, L., Martín, J.L., Garrido, M.J. & Izquierdo, I. 2011. Listado preliminar de especies marinas de Canarias. Observatorio Ambiental Granadilla, Tenerife. 174p.

Moussa, H., Hassoun, M., Salhi, G., Zbakh, H. & Riadi, H. 2018. Checklist of seaweeds of Al-Hoceima National Park of Morocco (Mediterranean Marine Protected Area). Acta Botanica Malacitana 43: 91–109. doi: 10.24310/abm.v43i0.4966

Neefus, C.D., Mathieson, A.C., Bray, T.L. & Yarish, C. 2008. The distribution, morphology and ecology of three introduced asiatic species of Porphyra (Bangiales, Rhodophyta) in the northwestern

Atlantic. J. Phycol. 44(6): 1399–1414. doi: 10.1111/j.1529817.2008.00607.x
Neto, A.I.A., Parente, M.I., Botelho, A.Z., Prestes, A.C.L., Resendes, R., Afonso, P., Álvaro, N.V., Milla-Figueras, D., Neto, R.M.A., Tittley, I. & Moreu, I. 2020. Marine algal flora of Graciosa Island, Azores. Biodiversity Data Journal 8: e57201. doi: 10.3897/BDJ.8.e57201
Nielsen, R. & Gunnarsson, K. 2001. Seaweeds of the Faroe Islands. An annotated checklist. Fródskaparrit 49: 45–108.
Ouerghi, A., Sghaier, Y.R. & Hadj Aissa, R., 2016. Algérie : Île de Rachgoun Cartographie des habitats marins clés de Méditerranée et initiation de réseaux de surveillance. Ministère des ressources en eau et de l'environnement. MAVA, Fondation pour la Nature, Alger.139p.
Ould Ahmed, N. & Meinesz, A. 2007. First record of the invasive alga Caulerpa racemosa on the coast of Algeria. Cryptogamie Algol. 28(3): 303–305.
Ould-Ahmed, N. 2015. Etude de la flore algale des côtes algériennes: connaissance, caractérisation, conservation et utilisation. PhD Thesis. Ecole Nationale Supérieure d'Agronomie de Alger, Alger. 203p.
Ould-Ahmed, N., Gómez Garreta, A., Ribera Siguan, M.A. & Bouguedoura, N. 2013. Checklist of the benthic marine macroalgae from Algeria. Phaeophyceae. An. Jard. Bot. Madrid 70(2): 136–143. doi: 10.3989/ajbm.2349
Ould-Ahmed, N., Gomez Garreta, A. & Ribera Siguan, M.A. 2019. Checklist of the benthic marine macroalgae from Algeria, part II: Ulvophyceae. An. Jard. Bot. Madrid 76(2): e087. https://doi.org/10.3989/ajbm.2471
Pedersen, P.M. 2011. Grønlands havalger. Forlaget Epsilon, Copenhagen. 208p.
Perret-Boudouresque, M. & Seridi, H. 1989. Inventaire des algues marines benthiques d'Algerie. GIS Posidonie Publication, Marseille. 166p.
Person, J. 2011. Livre turquoise. Algues, filières du futur. Colloque Algues; filières du futur. Romainville, France. Adebiotech, Romainville. 182p.
Petrocelli, A. & Cecere, E. 2019. A 20-year update on the state of seaweed resources in Italy. Bot. Mar. 62(3): 249–264. https://doi.org/10.1515/bot-2018-0072
Phang, S.-M., Yeong, H.-Y., Ganzon-Fortes, E.T., Lewmanomont, K., Prathep, A., Hau, L.N., Gerung, G.S. & Tan, K.S. 2016. Marine algae of the South China Sea bordered by Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam. Raffles B. Zool. Suppl. 40: 13–59.
Ribera, M.A., Gómez Garreta, A., Gallardo, T., Cormaci, M., Furnari, G. & Giaccone, G. 1992. Checklist of Mediterranean seaweeds. I. Fucophyceae (Warming, 1884). Bot. Mar. 35: 109–130. https://doi.org/10.1515/botm.1992.35.2.109
Rindi, F., McIvor, L. & Guiry, M.D. 2004. The Prasiolales (Chlorophyta) of Atlantic Europe: an assessment based on morphological, molecular, and ecological data, including the characterization of Rosenvingiella radicans (Kützing) comb. nov. J. Phycol. 40: 977–997. https://doi.org/10.1111/j.1529-8817.2004.04012.x
Sabri, H., Cherifi, O., Maarouf, A., Bahammou, N. & Boundir, Y. 2021. The checklist and the ecological index of the brown seaweeds from Essaouira coastline (Morocco). Journal of Applied Science and Environmental Studies 4(2): 406–417. https://doi.org/10.48393/IMIST.PRSM/jases-v4i2.26536
Seridi, H. 2007. Étude de la flore algale de l'Algérie. Etude phytosociologique des peuplements algaux photophiles de l'infralittoral supérieur de substrat dur. Ph.D. dissertation. USTHB, Alger, 174p.
Silberfeld, T., Racault, M.-F.L.P., Fletcher, R.L., Couloux, A., Rousseau, F. & De Reviers, B. 2011. Systematics and evolutionary history of pyrenoid-bearing taxa in brown algae (Phaeophyceae). Eur. J. Phycol. 46(4): 361–377. https://doi.org/10.1080/09670262.2011.628698
Smirnova, N.P. & Mikhailova, T.A. 2013. Seaweeds in the vicinity of Marine Biological Station of St-Petersburg State University. Vestnik St. Petersburg University Mathematics 3(2): 12–22.
Tamigneaux, É. & Johnson, L.E. 2016. Les macroalgues du Saint-Laurent : une composante essentielle d'un écosystème marin unique et une ressource naturelle précieuse dans un contexte de changement global. Le Naturaliste Canadien 140(2): 62–73. https://doi.org/10.7202/1036505ar
Titlyanov, E.A., Titlyanov, T.A., Xia, B.M. & Bartsch, I. 2016. Retrospective analysis of diversity and species composition of marine macroalgae of Hainan Island (China). Ocean Sci. J. 51(3): 1–22. https://doi.org/10.1007/s12601-016-0044-6
Traiche, A., Belhaouari, B. & Rouen-Hacen, O. 2018. Study of Macroalgae Biodiversity In The Western Algerian Coast, Ténès. Current Botany 9: 28–32. https://doi.org/10.25081/cb.2018.v9.3559
Tsiamis, K., Peters, A.F., Shewring, D.M., Asensi, A.O., Van West, P. & Küpper, F.C. 2017. Marine benthic algal flora of Ascension Island, South Atlantic. Journal of the Marine Biological Association U.K. 97(4): 681–688. https://doi.org/10.1017/S0025315414000952
Verlaque, M. 2001. Checklist of the macroalgae of Thau Lagoon (Hérault, France), a hot spot of marine species introduction in Europe. Oceanol. Acta 24: 29–49. https://doi.org/10.1016/S0399-1784(00)01127-0
Zubia, M., Fabre, M.-S., Kerjean, V. & Deslandes, E. 2009. Antioxidant and cytotoxic activities of some red algae (Rhodophyta) from Brittany coasts (France). Bot. Mar. 52(3): 268–277. https://doi.org/10.1515/BOT.2009.037

Websites

AlgaeBase the global algal database of taxonomic, nomenclatural and distributional information, National University of Ireland. Available from https://www.algaebase.org/

Figure 3. First records of *Phaeophyceae* species. a, *Ascophyllum nodosum*; b, *Bifurcaria bifurcata*; c, *Asperococcus fistulosus*; d, *Elachista fucicola*; e, *Elachista scutulata*.

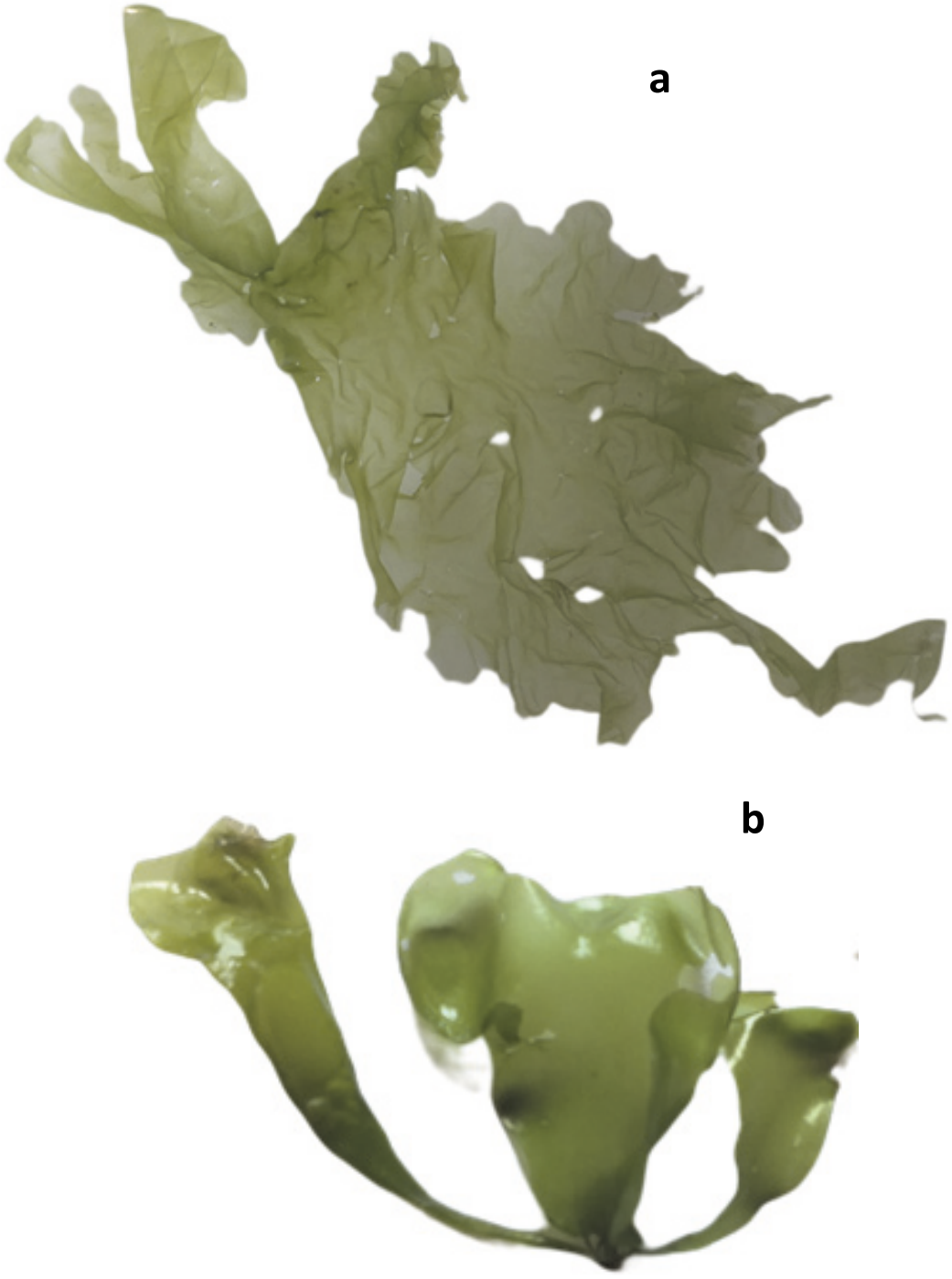

Figure 4. First records of a *Chlorophyceae* species; a, *Ulva olivascens*; b, *Prasiola calophylla*.

Figure 5. First records of a *Rhodophyceae* species. a, *Ahnfeltiopsis flabelliformis*; b, *Furcellaria lumbricalis*; c, *Solieria chordalis*; d, *Cystoclonium purpureum*; e, *Delesseria sanguinea*; f, *Jania squamata*; g, *Porphyra linearis*; h, i, *Porphyra suborbiculata*

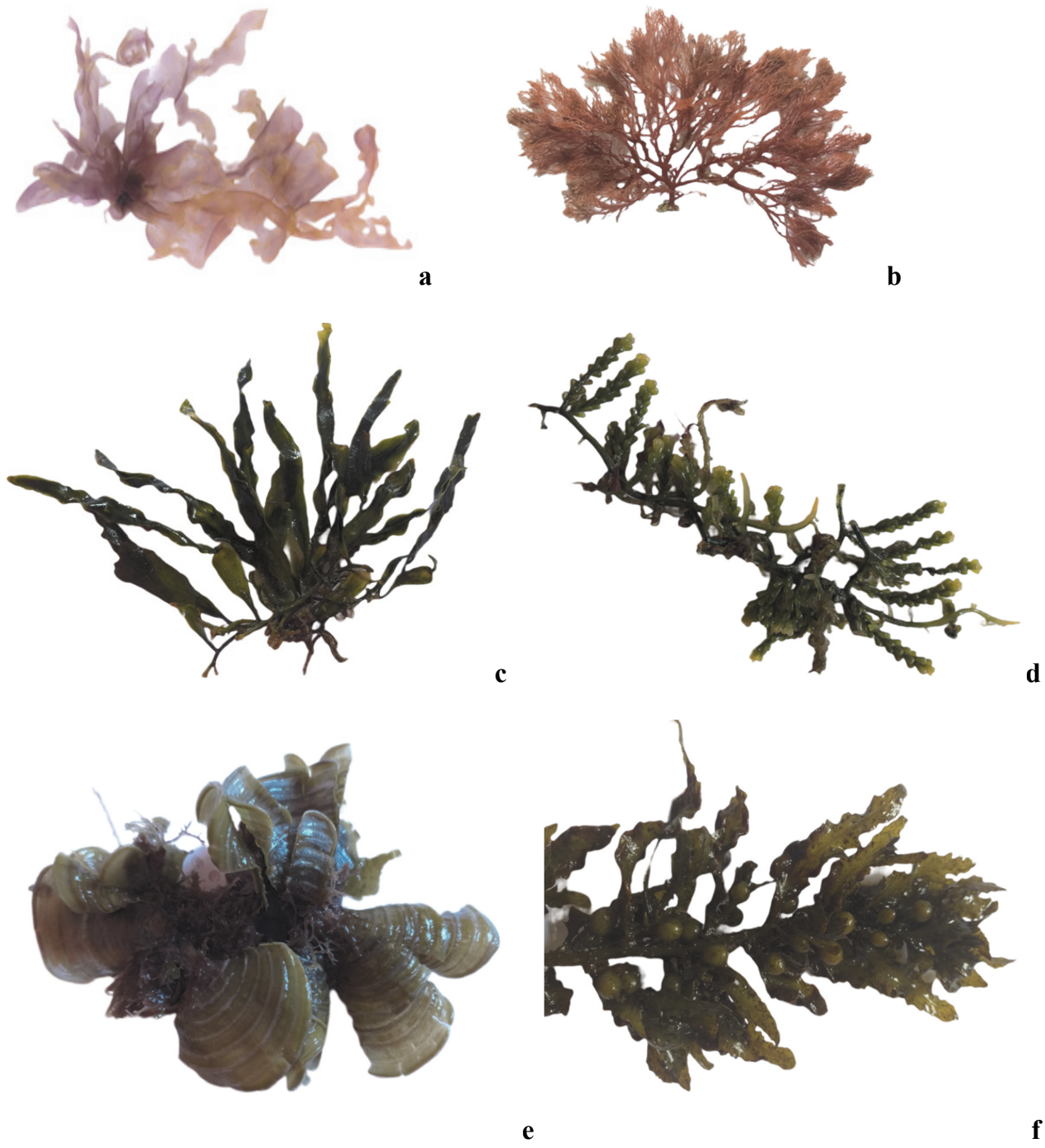

Figure 6. Macroalgae species. a, *Porphyra umbilicalis*; b, *Sphaerococcus coronopifolius*; c, *Caulerpa prolifera*; d, *Caulerpa racemosa*; e, *Padina pavonica*; f, *Sargassum muticum*.