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Marine algae and seagrasses of Samsun (Black Sea, Turkey) *

Samsun (Karadeniz, Türkiye) kıyıları deniz algleri ve deniz çayırları

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Abstract

In this investigation, the presence and the distribution of the blue-green algae; Cyanophyeae, 20 taxa, red algae; Rhodophyceae, 106 taxa, one of them is new record for the Blacksea shore of Turkey, *Gelidium pusillum* (Stackhouse) Le Jolis var. *pusillum* brown algae; Fucophyceae, 27 taxa, green algae; Chlorophyceae, 21 taxa, and seagrasses, 2 taxa were identified in the upper infralittoral zone of Samsun (Black Sea) shore of Turkey. A total 176 taxon was determined.

Key Words: Turkey, Samsun, blue-green, red, brown, green algae and seagrasses

Introduction

According to Zinova (1964) the first investigations of the Turkish Black Sea algae were carried out by Buxbaum (1740) on Trabzon coasts. Followed by the contribution from Dumont D'Urvile (1822), Agardh (1851-1876), Tchichatcheff (1860) and Sperk (1869) and Voronichin (1908). According to Zinova (1967) the first russian researcher in Türkish Black Sea Coast was Zernov (1913).

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All countries along Black Sea coast except Turkey have made systematic studies of marine algae complate. Importans of this studies; Voronichin (1908), Zinova (1964, 1967) and Vinogradova (1974) from Russia, Celan (1948), Celan and Bavaru (1967) and Bavaru *et al.* (1991) from Romania, Zinova *et al.* (1974), Zinova and Dimitrova (1975, 1976, 1981), Dimitrova *et al.* (1992) from Bulgaria. In Turkish coast, the first algae collection was made by Diratzoyan (1894-1995), and publication by Fritsch (1895), Handel-Mazetti and Stockmayer (1909). Öztığ (1957, 1962), Zeybek (1969), Güven (1970), Güner (1970), Güven and Öztığ, (1971) Bilecik (1973), Cirik (1978), Cihangir (1987), Aysel *et al.* (1990), Özer and Köksal (1994), Aysel and Erduğan (1995), Erduğan *et al.*, (1996, 2003), and Aysel *et al.* (1996, 1997, 1998, 2000, 2004), Sea of Marmara and Bosphorus, 1986-1994 Aydın et al., 2006 (revised by V. Aysel).

Material and Methods

In this study, marine algae (*Cyanophyta*, *Rhodophyta*, *Ochrophyta* and *Chlorophyta*) and seagrasses (Magnoliophyta) in the upper infralittoral zone of the Black Sea coast of Samsun were investigated. Samsun is located between 35° 28' 17″ and 37° 13' 26" eastern longitudes (Figure 1).

Collected specimens were fixed using 4% formaldehyde. Specimens belonging to *Rhodomelaceae*, *Corallinaceae* and *Halimeda tuna* were exceptionally treated with 10% HCl in identification procedures for specific cell wall properties.

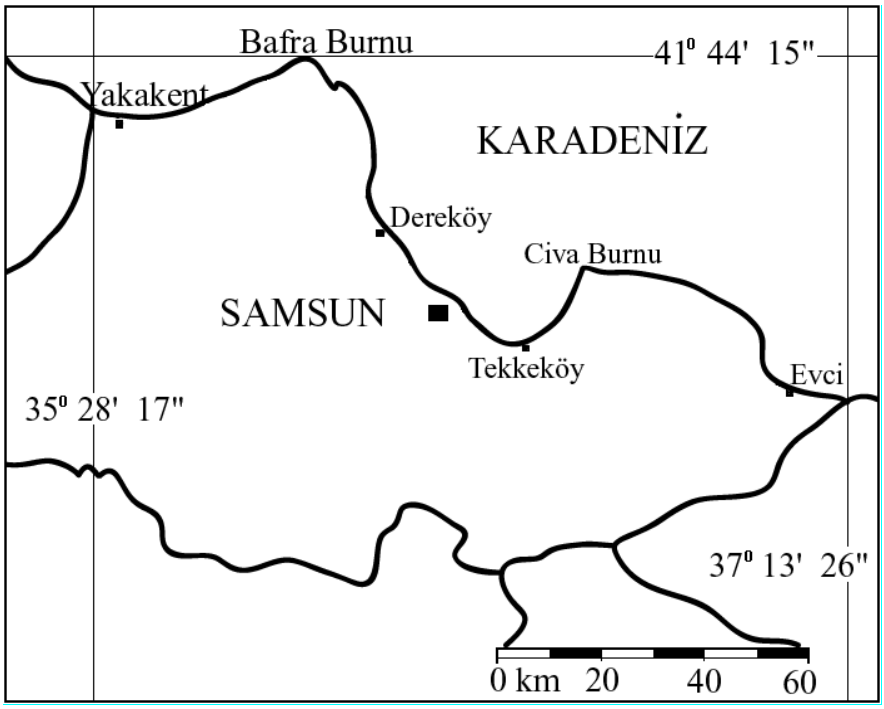

Figure 1: Map of Samsun coastline

Results

Taxa distributed in study area are listed in Table 1. In this list, classes and upper categories were arranged according to Van den Hoek *et al*. (1997) and Guiry and Dhonncha (2005). Arrangement of lower categories, presented in the list were followed by specialists [(Silva *et al*. (1996) for *Cyanophyta* and *Rhodophyta*, Stegenga (1985) for *Acrochaetiales*, Frederic and Hommersand (1989) for *Gracilariales*, Bressan and Babbini-Benussi (1995, 1996) for *Corallinales*, Gomez Garreta *et al*. (2001), Benhissoune *et al*. 2003 for *Ceramiales*, Ribera *et al*. (1992), Benhissoune *et al*. (2002) for *Fucophyceae*, Gallardo *et al*. (1993), Benhissoune *et al*. (2001) for *Chlorophyceae*]. On the other hand, the studies of Barbara and Cremades (1996), Ballantine and Aponte (1997) and Hardy and Guiry (2003) were used to create an evolutionary list of taxa above genus level. Taxa in species or below species level are listed alphabetically. New record for the Turkish coasts of Black Sea (*) is indicated with asteriks.

Table 1: Taxa distributed on Samsun, Turkish coasts of the Black Sea (*).

CYANOPHYTA
CYANOPHYCEAE
CHROOCOCCALES
CHROOCOCCACEAE
Chroococcus dimidiatus (Kützing) Nägeli
DERMOCARPACEAE
Dermocarpa acervata (Setchell & Gardner) Pham Hoàng Hô
MICROCYSTACEAE
Gloeocapsa compacta Kützing
Microcystis halophila Martens & Pankow
M. marina (Hansgrig *in* Foslie) Silva
M. sescianensis (Frémy) *nov. comb.* [Basionym:Aphanocapsa sescianensis Frémy]
MERISMOPEDIACEAE
GOMPHOSPHAERIOIDEAE
Gomphosphaeria aponina Kützing

OSCILLATORIALES
OSCILLATORIACEAE
Lyngbya adriae Ercégovic
L. aestuarii (Mertens) Liebmann
L. confervoides C. Agardh
PHORMIDIACEAE
PHORMIDIOIDEAE
Phormidium ambiguum Gomont
P. breve (Kützing) Anagnostidis & Komàrek
P. corallinae (Gomont ex Gomont) Anagnostidis &Komárek
PSEUDOANABAENACEAE
LEPTOLYNGBYOIDEAE
Planktolyngbya subtilis (W. West) Anagnostidis & Komarek
Spirocoleus tenuis (Meneghini) Silva

NOSTOCALES
RIVULARIACEAE
Calothrix aeruginea (Kützing) Thuret
C. confervicola (Roth) C. Agardh
C. crustacea Thuret
C. scopulorum (Webervan Bosse & Mohr) C. Agardh
Rivularia polyotis (J. Agardh) Hauck

RHODOPHYTA
RHODELLOPHYCEAE
STYLONEMATALES
STYLONEMATACEAE
Stylonema alsidii (Zanardini) Drew
S. cornucervi Reinsch

COMPSOPOGONOPHYCEAE
ERYTHROPELTIDALES
ERYTHROTRICHIACEAE
Erythrotrichia carnea (Dillwyn) J. Agardh
Sahlingia subintegra (Rosenvinge) Kornmann

BANGIOPHYCEAE
BANGIOPHYCIDAE
GONIOTRICHALES
GONIOTRICHACEAE
Chroodactylon ornatum (C. Agardh) Basson

BANGIALES
BANGIACEAE
Bangia atropurpurea (Roth) C. Agardh
Porphyra leucosticta Thuret in Le Jolis
f. ***leucosticta***
P. minor Zanardini
P. umbilicalis (Linnaeus) Kützing

FLORIDEOPHYCEAE
NEMALIOPHYCIDAE
ACROCHAETIALES
ACROCHAETIACEAE
Acrochaetium hallandicum (Kylin) Hamel
A. humile (Rosenvinge) Børgesen
A. leptonema (Rosenvinge) Børgesen

A. mahumetanum Hamel
A. microscopicum (Nägeli *ex* Kützing) Nägeli
A. parvulum (Kylin) Hoyt
A. rosulatum (Rosenvinge) Papenfuss

COLACONEMATALES
COLACONEMATACEAE
Colaconema daviesii (Dillwyn) Stegenga
C. membranaceum (Magnus) Woelkerling

NEMALIALES
LIAGORACEAE
Liagora viscida (Forsskål) C. Agardh
NEMALIACEAE
Nemalion helminthoides (Velley) Batters

RHODYMENIOPHYCIDAE
GELIDIALES
GELIDIACEAE
****Gelidium pusillum*** (Stackhouse) Le Jolis
var. ***pusillum***
G. spinosum (Gmelin) Silva
var. *hystrix* (J. Agardh) Furnari
Pterocladiella capillacea (Gmelin) Santelices & Hommersand
f. ***crinita*** (Hauck) V. Aysel, H. Erduğan, B. Dural-Tarakçı, E.Ş. Okudan, A. Şenkardeşler, F. Aysel
P. melanoidea (Schousboe *ex* Bornet) Santelices & Hommersand
var. ***filamentosa*** (Schousboe *ex* Bornet) Wynne
GELIDIELLACEAE
Gelidiella ramellosa (Kützing) Feldmann & Hamel
Parviphycus antipai (Celan) B. Santelices

GRACILARIALES
GRACILARIACEAE
Gracilaria armata (C. Agardh) Greville
G. dura (C. Agardh) J. Agardh
G. gracilis (Stackhouse) Steentoft, Irvine & Farnham
var. ***gracilis***

CORALLINALES
CORALLINACEAE
AMPHIROIDEAE
Amphiroa rigida Lamouroux
CORALLINOIDEAE
CORALLINEAE
Corallina elongata Ellis & Solander
C. panizzoi Schnetter&U. Richter
JANIEAE
Haliptilon virgatum (Zanardini) Garbary & Johansen
Jania longifurca Zanardini
J. rubens (Linne) Lamouroux
var. ***rubens***
var. ***corniculata*** (Linnaeus) Yendo
MASTOPHOROIDEAE
Hydrolithon farinosum (Lamouroux) D. Penrose & Chamberlain
var. ***farinosum***
LITHOPHYLLOIDEAE
Lithophyllum cystoseirae (Hauck) Heydrich

GIGARTINALES
HYPNEACEAE
Hypnea musciformis (Wulfen *in* Jaquin) Lamouroux
PEYSSONNELICEAE
Peyssonnelia rosa-marina Boudouresque & Denizot
P. rubra (Greville) J. Agardh
P. squamaria (Gmelin) Decaisne
PHYLLOPHORACEAE
Ahnfeltiopsis furcellata (C. Agardh) Silva & De Cew

Coccotylus truncatus (Pallas) Wynne & J.N. Heine
f. ***truncatus***
f. ***concatenatus*** (Lyngbye) H. Erduğan, V. Aysel, B. Dural-Tarakçı, E.Ş. Okudan, F. Aysel
Gymnogongrus griffithsiae (Turner) Martius
Phyllophora crispa (Hudson) P.S. Dixon
f. ***crispa***
P. pseudoceranoïdes (Gmelin) Newroth & A.R.A. Taylor

RHODYMENIALES
LOMENTARIACEAE
Lomentaria articulata (Hudson) Lyngbye
var. ***articulata***
var. ***linearis*** Zanardini
L. clavellosa (Turner) Gaillon

HALYMENIALES
GRATELOUPIACEAE
Grateloupia dichotoma J. Agardh

CERAMIALES
CERAMIACEAE
CALLITHAMNIOIDEAE
CALLITHAMNIEAE
Aglaothamnion tenuissimum (Bonnemaison) G. Feldmann Mazoyer
var. ***tenuissimum***
Callithamnion corymbosum (Smith) Lyngbye
C. granulatum (Ducluzeau) C.Agardh
CERAMOIDEAE
ANTITHAMNIEAE
Antithamnion cruciatum (C.Agardh) Nägeli
var. ***cruciatum***
A. tenuissimum (Hauck) Schiffner
CERAMIEAE
Ceramium arborescens J. Agardh
C. ciliatum (Ellis) Ducluzeau
var. ***ciliatum***
var. ***robustrum*** (J. Agardh) Mazoyer
C. circinatum (Kützing) J. Agardh
C. deslongchampsii Chauvin *ex* Duby
C. gaditanum (Clemente) Cremades
var. ***gaditanum***
C. rubrum *auctorum*
var. ***rubrum***
var. ***implexoconcortum*** (Solier) G. Feldmann Mazoyer
C. siliquosum (Kützing) Maggs & Hommersend
var. ***siliquosum***
var. ***elegans*** (Roth) Furnari
var. ***tenuissimum*** (Lyngbye) V. Aysel, Erduğan, Dural-Tarakçı, Okudan.
var. ***zostericola*** (Feldmann Mazoyer) Furnari
f. ***zostericola***
C. tenerrimum (Martens) Okamura
var. ***tenerrimum***
var. ***brevizonatum*** (Peterson) G. Feldmann Mazoyer
PTEROTHAMNIEAE
Pterothamnion plumula (Ellis) Nägeli
COMPSOTHAMNIOIDEAE
COMPSOTHAMNIEAE
Compsothamnion thuyoides (Smith) Schmitz
SPERMOTHAMNIEAE
Spermothamnion flabellatum Bornet
DASYACEAE
Dasya baillouviana (Gmelin) Montagne
var. ***baillouviana***
D. hutchinsiae Harvey *in* Hooker
D. ocellata (Grateloup) Harvey

Eupogodon planus (C. Agardh) Kützing

DELESSERIACEAE
DELESSERIOIDEAE
APOGLOSSEAE
Apoglossum ruscifolium (Turner) J. Agardh
HYPOGLOSSEAE
Hypoglossum hypoglossoides (Stackhouse) Collins & Harvey
NITOPHYLLOIDEAE
NITOPHYLLEAE
Nitophyllum punctatum (Stackhouse) Greville
var. ***punctatum***
var. ***ocellatum*** (Lamouroux) J. Agardh
RHODOMELACEAE
CHONDRIEAE
Chondria capillaris (Hudson) Wynne
var. ***capillaris***
C. dasyphylla (Woodward) C. Agardh
LAURENCIEAE
Chondrophycus paniculatus (C. Agardh) Furnari
C. papillosus (C. Agardh) Garbary & J. Harper
Laurencia obtusa (Hudson) Lamouroux
var. ***obtusa***
var. ***gracilis*** (Kützing) Hauck
var. ***laxa*** (Kützing) Ardissone
Osmundea pinnatifida (Hudson) Stackhouse
POLYSIPHONIEAE
Alsidium corallinum C.Agardh
Herposiphonia secunda (C. Agardh) Ambronn
f. ***secunda***
f. ***tenella*** (C. Agardh) Wynne
Lophosiphonia obscura (C. Agardh) Falkenberg
L. subadunca (Kützing) Falkenberg
Polysiphonia brodiae (Dilliwyn) Sprengel
P. elongata (Hudson) Harvey *in* Hooker
P. fibrillosa (Dillwyn) Sprengel
P. fucoides (Hudson) Greville
P. opaca (C. Agardh) Moris & De Notaris
P. sertularioides (Grateloup) J. Agardh
P. tenerrima Kützing
P. urceolata (Lightfoot *ex* Dillwyn) Greville
P. variegata (C. Agardh) Zanardini
P. violacea (Roth) Spregel
POLYZONIEAE
Dipterosiphonia rigens (Shousboei) Falkenberg

OCHROPHYTA
(=HETEROKONTOPHYTA)
FUCOPHYCEAE
(= PHAEOPHYCEAE)
ECTOCARPALES
ACINETOSPORACEAE
Acinetospora crinita (Carmichael *ex* Harvey) Kornmann
Feldmannia caespitula (J. Agardh) KnoepfflerPéguy
var. ***lebelii*** (Areschoug *ex* P.L. Crouan) KnoepfflerPéguy
F. irregularis (Kützing) Hamel
Hincksia sandriana (Zanardini) Silva
CHORDARIACEAE
Ascocyclus orbicularis (J. Agardh) Kjellman
Corynophlaea umbellata (C. Agardh) Kützing
Eudesme virescens (Carmichael *ex* Berkeley) J. Agardh

Halothrix lumbricalis (Kützing) Reinke
Kuetzingiella battersii (Bornet *ex* Sauvageau) Kornmann
var. ***battersii***
Litosiphon laminariae (Lyngbye) Harvey
Mikrosyphar polysiphoniae Kuckuck
Myriactula arabica (Kützing) Feldmann
M. rivulariae (Shur) Feldmann
Myrionema strangulans Greville
Stilophora nodulosa (C. Agardh) Silva
S. tenella (Esper) Silva
Streblonema sphaericum (Derbès & Solier) Thuret

ECTOCARPACEAE
Ectocarpus siliculosus (Dillwyn) Lyngbye
var. ***siliculosus***
var. ***arctus*** (Kützing) Kuckuck
var. ***dasycarpus*** (Kuckuck) Gallardo
var. ***hiemalis*** (P.L. Crouan *ex* Kjellman) Gallardo
var. ***penicillatus*** C. Agardh

FUCALES
CYSTOSEIRACEAE
Cystoseira corniculata (Turner) Zanardini
var. ***corniculata***
C. crinita (Desfontaines) Bory
f. ***crinita***
C. foeniculacea (Linnaeus) Greville

SARGASSACEAE
Sargassum acinarum (Linnaeus) Setchell
S. vulgare C. Agardh
var. ***vulgare***

CHLOROPHYTA
CHLOROPHYCEAE
CHAETOPHORALES
CHAETOPHORACEAE
Entocladia cladophorae (Hornby) G.S. West & F.E. Fritsch
E. leptochaete (Huber) Burrows

ULVOPHYCEAE
ULOTRICHALES
ULOTHRICHACEAE
Ulothrix flacca (Dillwyn) Thuret *in* Le Jolis

ULVALES
ULVACEAE Lamour *ex* Dumort.
Blidingia minima (Nägeli *ex* Kützing) Kylin
Enteromorpha ahleriana Bliding
E. clathrata (Roth) Greville
E. compressa (Linnaeus) Nees
var. ***compressa***
E. flexuosa (Wulfen) J. Agardh
subsp. ***flexuosa***
E. linza (Linnaeus) J. Agardh
var. ***linza***
E. muscoides (Clemente) Cremades
E. prolifera (O.F. Müller) J. Agardh
subsp. ***gullmariensis*** Bliding
Ulva fenestrata Postels & Ruprecht
U. rigida C. Agardh
f. ***rigida***

CLADOPHOROPHYCEAE
CLADOPHORALES
CLADOPHORACEAE
Cladophora dalmatica Kützing
C. hutchinsiae (Dillwyn) Kützing
C. pellucida (Hudson) Kützing
f. ***pellucida***
C. prolifera (Roth) Kützing
C. vagabunda (Linnaeus) Van Den Hoek
Rhizoclonium riparium (Roth) Harvey
R. implexum (Dillwyn) Kützing

BRYOPSIDOPHYCEAE
BRYOPSIDALES
BRYOPSIDACEAE
Bryopsis plumosa (Hudson) C. Agardh var. ***plumosa***

TRACHEOPHYTA
ANGIOSPERMAE
LILIOPSIDA
ZOSTERALES
ZOSTERACEAE
Zostera marina Linnaeus
Z. noltii Homermann

Discussion

176 taxa (174 algae and 2 seagrasses) have been found in the present study. One of them, *Gelidium pusillum* (Stackhouse) Le Jolis var. *pusillum* is new record for the Turkish Black Sea. *Lyngbya confervoides*, *Spirocoleus tenue* (*Cyanophyceae*), *Acrochaetium parvulum*, *Callithamnion corymbosum*, *Ceramium ciliatum* var. *ciliatum*, *C. siliquosum* var. s*iliquosum C. tenerrimum* var. *tenerrimum*, *Dasya ocellata*, *Herposiphonia secunda* f. *secunda*, *Laurencia obtusa* var. *obtusa*, *Polysiphonia elongata*, *P. sertularioides*, *P. tenerrima* (*Rhodophyceae*), *Ectocarpus siliculosus* var. *siliculosus, Feldmannia irregularis*, *Stilophora nodulosa*, *S. tenella*, *Sargassum vulgare* var. *vulgare* (*Fucophyceae*), *Blidingia minima*, *Enteromorpha clathrata*, *E. linza* var. *linza*, *Cladophora hutchinsiae* ve *C. dalmatica* (*Chlorophyceae*) are common algae of this area.

The number of algae species of Samsun and the other the Black Sea coastal cities are shown in Table 2.

The provinces (Trabzon, Rize and Artvin) that need revision will be determined and these areas will be studied in detail. At the end of this work, all of the coast of Black Sea will be completed.

Table 2: The number of algae species of Samsun and the other the Black Sea coastal cities (SM: Samsun, KR: Kırklareli, KSD: Kocaeli, Sakarya, Düzce, ZN: Zonguldak, BR: Bartın, KS: Kastamonu, SN: Sinop, OR: Ordu, TR: Trabzon, RA: Rize-Artvin).

Division	SM	KR	KSD	ZN	BR	KS	SN	OR	TR	RA
Cyanophyta (Cy)	20	23	30	20	12	22	22	14	1	3
Rhodophyta (R)	106	71	126	100	116	133	136	93	23	43
Ochrophyta (O)	27	24	50	42	43	56	52	27	8	15
Chlorophyta (C)	21	30	46	43	39	48	55	26	23	27
Tracheophyta	2	3	3	3	3	3	3	4	3	3
Toplam	176	151	255	208	213	262	268	164	58	91

The percentage ratio of marine algae of the cities on the Black Sea coast are shown in Table 3.

Table 3: The percentage ratio of marine algae of the cities on the Black Sea coast.

Division	SM	KR	KSD	ZN	BR	KS	SN	OR	TR	RA
Cyanophyta	11,5	15,5	12,0	9,8	5,8	8,4	8,3	8,8	1,8	3,4
Rhodophyta	61,0	48,0	50,0	48,8	55,2	51,3	51,3	58,1	41,9	48,9
Ochrophyta	15,5	16,2	19,8	20,4	20,4	21,7	19,6	16,9	14,5	17,0
Chlorophyta	12,0	20,3	18,2	21,0	18,6	18,6	20,8	16,2	41,8	30,7
Toplam	100	100	100	100	100	100	100	100	100	100

The dominancy in division is shown in Table 4.

Table 4: Dominancy in division level among Northern provinces of Turkey (R: Rhodophyta, O: Ochrophyta, C: Chlorophyta and CY: Cyanophyta).

Division	SM	KR	KSD	ZN	BR	KS	SN	OR	TR	RA
R/O	3,92	3	2,52	2,4	2,7	2,37	2,60	3,44	2,9	2,9
R/C	5,05	3,7	2,73	2,3	3	2,77	2,50	3,58	1	1,6
R/CY	5,3	3,1	4,2	5	9,7	6,04	6,50	6,64	23	14,3
O/C	1,28	0,8	1,08	1	1,1	1,16	0,96	1,04	0,3	0,6
O/CY	1,35	1	1,66	2,1	3,6	2,54	2,50	1,93	8	5
C/CY	1,05	1,3	1,53	2,2	3,3	2,18	2,59	1,86	23	9

Özet

Bu araştırmada, Türkiye'nin Samsun (Karadeniz) kıyılarının üst infralittoral bölgesinde yayılış gösteren mavi - yeşil algleri (Cyanophyceae, 20 takson), Kırmızı algler, Rhodophyceae, 106 takson, biri Türkiye Karadeniz kıyıları için yeni kayıt; *Gelidium pusillum* (Stackhouse) Le Jolis var. *pusillum*, Kahverengi algler (Fucophyceae, 27 takson), yeşil algler, Chlorophyceae, 21 takson ve deniz çayırları, Liliopsida, 2 takson üzerinde çalışılmıştır. Toplam 176 takson tayin edilmiştir.

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