ISSN:1306-3111
e-Journal of New World Sciences Academy
2010, Volume: 5, Number: 2, Article Number: 5A0035

Yaşar Özvarol[1]
Ö.Osman Ertan[2]
İ.İsmail Turna[2]
Akdeniz University[1]
Suleyman Demirel University[2]
ozvarol@akdeniz.edu.tr
Antalya-Turkey

ECOLOGICAL LIFE SCIENCES
Received: December 2009
Accepted: March 2010
Series : 5A
ISSN : 1308-7258

DETERMINATION MACROBENTIC FLORA OF NORTHEASTERN MEDITERRANEAN (GAZİPAŞA-ISKENDERUN)

ABSTRACT

The purpose of this study is to determine the macrobentic marine flora of Northeastern Mediterranean (Gazipasa-Iskenderun) shores. Seasonal samples of the shore macroflora were taken from the eight stations selected along the coast. The samples were collected a depth of 12 m from five; 25 m from two and 40 m from one of the stations. The effect of flora distributies was studied in four of the stations. A total of 42 species were determined, 20 species belonging to *Rhodophyta*, 13 species belonging to *Phaeophyta*, 8 species belonging to *Chlorophyta,* and 1 species belonging to *Spermatophyta.* Maximum species diversity was found at stations seven. *P. oceanica* (L.) Delile populations, which is an endemic species of Turkish Mediterranean coasts, found to be changed under the stres beacuse lessepsian species and pollution.

Keywords: Northeastern Mediterranean, Macrobentic Flora, Gazipaşa, Iskenderun, Turkey

KUZEYDOĞU AKDENİZ KIYILARI (GAZİPAŞA–İSKENDERUN)'NIN MAKROBENTİK DENİZ FLORASI

ÖZET

Bu çalışmada, Kuzeydoğu Akdeniz kıyıları (Gazipaşa–İskenderun) makrobentik deniz florasının belirlenmesi amaçlanmıştır. Çalışma, sekiz istasyonda mevsimsel örneklemelerle yürütülmüştür. İstasyonların beşinde 12, ikisinde 25 ve birinde 40 m derinlikler temel alınarak derinliğin makrobentik flora dağılımına olan etkileri de araştırılmıştır.

Çalışma sonunda Rhodophyta'dan 20, Phaeophyta'dan 13, Chlorophyta'dan 8 ve Spermatophyta dan 1 olmak üzere toplam 42 türün bölgede dağılım gösterdiği tespit edilmiştir. Maksimum tür çeşitliliği 7. istasyonda bulunmuştur. Akdeniz'in endemik türü olan *P. Oceanica* (L.) Delile populasyonlarının bazı lesepsiyen türler ve kirlilik gibi nedenlerle giderek bozulduğu tespit edilmiştir.

Anahtar Kelimeler: Makrobentik Flora, Kuzeydoğu Akdeniz, Gazipaşa, İskenderun, Türkiye

1. INTRODUCTION (GİRİŞ)

Algae and other plants are the main determinants of the efficiency of aquatic ecosystems. Algae are of great ecological importance, since they maintain oxygen and carbon dioxide balance in the aquatic environment; constitute the first link of the food chain, and; some algae species serve as pollution indicators. On the other hand, macroalgae, in particular, provide places for aquatic organisms to feed, breed, shelter and seek protection. Locations with abundant algae populations are important, since they enable many vertebrates and invertebrates to lay their eggs, to hide their larvae and to protect themselves from predators [1-2].

2. RESEARCH SIGNIFICANCE (ÇALIŞMANIN ÖNEMİ)

The aim of the present study was to determine the macrobentic marine flora of Northeast Mediterranean (Gazipaşa - Iskenderun) shores. It is very important to know, to descibe and to determine changes of macrolagae species by the year the species of marine macrolagae of Turkish Mediterranean Shores. By this study it is found the last stiuation of *P. oceanica* which is called as mediterranean endemic species and the economical algae species between Gazipaşa-Iskenderun.

3. MATERIAL AND METHOD (MATERYAL VE METOD)

The infralittoral area of the northeastern Mediterranean coast of Turkey (Gazipasa-Iskenderun) was selected as the study area (32° 12′ 10.82′′ – 35° 48′ 53.23′′)(Figure 1). This area covers approximately 1300 km of coastline. 8 stations were selected in the study area for seasonal sampling of coastal algae. A depth of 12 meters was taken as basis in 5 stations, 25 m depth in 2 stations and 40 m depth in the remaining station, and the effects of depth on algae distribution was analyzed in 4 stations.

Attention was paid to ensuring equal distribution of the sampling stations along the study area and selection of sampling areas appropriate for the study. The geographical locations of the sampling areas were determined via GPS (Global Positioning System).

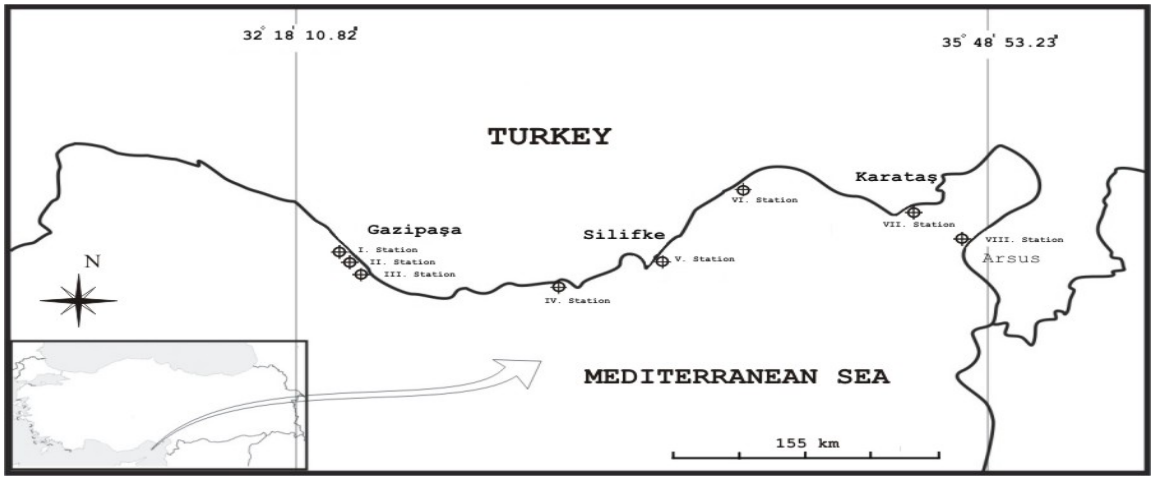

Figure 1. Map of northeastern mediterranean coastline
(Şekil 1. Kuzeydoğu Akdeniz kıyıları haritası)

3.1. Collection ff Samples (Örneklerin Toplanmasi)

Samples were collected of *Rhodophyta*, *Phaeophyta*, *Chlorophyta* and *Spermatophyta* macrobenthic species living in the infralittoral area of the northeastern Mediterranean coasts. Sampling took place in spring, summer, fall and winter months (depending on the sea conditions at the study stations) during 2007-2008.

Most of the sampling stations were close to the direct effects of sea waves. Samples were collected mainly from the upper infralittoral area. In order to analyze the depth-induced changes in the population distributions, a depth study was conducted at 3 stations in Gazipasa and 1 station in Mersin. The first depth study in Gazipasa was conducted at 0-40 m depth (Fener), the second depth study at 0–25 m (Güney Kalesi), the third depth study at 0–12 m (Halil Port) and the fourth depth study at 0-12 m (Başparmak island). Samples were collected via SCUBA diving at all sampling stations except for 7^{th} station. In 7^{th} station, free diving was used to collect samples, as the station had a shallow and rocky sea bottom.

Epilithic algae growing on rocks were collected with a scraper and species in sandy and muddy areas were collected by hand Collected samples were kept in sea water with 4% neutral formaldehyde content. Specimens belonging to *Rhodomelaceae, Corallinaceae* and *Halimeda tuna* is identificated with 10% HCl in identification procedures for specific cell wall properties. The samples were then transferred to the laboratory of the Faculty of Fisheries, Suleyman Demirel University.

3.2. Imaging of Samples (Örneklerin Görüntülenmesi)

Underwater and surface photographs of all stations included in the study area were taken using digital cameras and video cameras. Video cameras were used to record the underwater view of the stations, in order to detect seasonal and depth-induced changes in the vegetation.

3.3. Identification of Samples (Örneklerin Tanımlanması)

Initially, all the samples were classified into two groups, as either algae or flowery plants. Macroalgae were then classified into green, red and brown algae on a seasonal basis. Some algae species were examined under a microscope to assist identification. Macro photographs were taken of samples. Samples were then stored in glass jars containing of formaldehyde-including sea water, and were labeled with the collection date and sampling station.

3.4. Cover and Abundance (Baskınlık ve Örtü)

While collecting the algae samples at the stations, a video camera was used in order to identify dominant species and their levels of abundance. Algae samples identified in the laboratory were then evaluated using the cover-abundance scale developed by Braun-Blanquet et Pavillard and Boudouresque [3]. Each number in the tables refers to the cover and abundance value of that species.

Accordingly;

+: Rare, very low possibility of repeated sampling
1: Scarce, low possibility of repeated sampling (less than 5% of the surface)
2: In patches, mid-level possibility of repeated sampling (5–25% of the surface)
3: Sufficient number in the environment (25-50% of the surface)

4: Abundant in the environment (50-75% of the surface)
5: Highly abundant in the environment (More than 75% of the surface)

4. RESULTS AND DISCUSSION (TARTIŞMA VE SONUÇ)

The present study of the northeastern Mediterranean coasts of Turkey (Gazipasa – Iskenderun) identified a total of 42 species: 20 Rhodophyta, 13 Phaeophyta, 8 Chlorophyta and 1 Spermatophyta species.

Taxa distributed in study area are listed in Table 1. In this table were arranged for classes, all upper and lower categories were arranged according to Riedl [4], Dural et al [5], Pankow [6], Oztürk [7 and 8], Turna [9], Oztürk & Taşkın [10] Delephine et al [11], Denizot [12], Feldmann [13], Feldmann & Hamel [14, 15, 16, and 17], Feldmann & Feldmann [18, 19, and 20], Fritsch [21], Ballesteros [22 and 23], Cormaci & Furnari [24], Diapoulis & Haritonidis [25], Diapolis [26], Ercegovic [27], Furnari et al [28], Nizamuddin & Lehnberg [29], Nizamuddin et al. [30], Perret et al. [31], Rechinger [32], Rizzi [33 and 34], Tsekos & Haritonidis [35].

SPERMATOPHYTA
Liliopsida
Posidoniaceae
Posidonia oceanica (L.) Delile

CHLOROPHYTA
Ulvales
Chlorophyceae
Ulvaceae
Ulva lactuca Linnaeus

Bryopsidales
Udoteaceae
Flabellia petiolata (Turra) Nizamuddin

Cladophorales
Anadyomenaceae
Anadyomene stellata (Wulfen) C. Agardh

Siphonocladales
Valoniaceae
Valonia macrophysa Kützing

Dasycladales
Dasycladaceae
Acetabularia acetabulum (Linnaeus) Silva
Dasycladus clavaeformis (Roth) Agardh

Bryopsidophyceae
Bryopsidales
Scarabaeoidae
Codium bursa (Linnaeus) C. Agardh

Cryptonemiales
Halimedaceae

Halimeda tuna (J.Ellis & Solander) J.V.Lamouroux

PHAEOPHYTA
Phaeophyceae
Dictyotales
Dictyotaceae
Padina pavonica (Linnaeus) Thivy
Dictyopteris membranacea (Stackhouse) Batters
Dictyota dichotoma (Hudson) Lamouroux
Dictyota linearis (C. Agardh) Greville
Taonia atomaria (Woodward) J. Agardh

Sphacelariales
Stypocaulaceae
Halopteris filicina (Grateloup) Kützing
Halopteris scoparia (Linnaeus) Sauvageau

Fucales
Sargassaceae
Sargassum horunschuchii C. Agardh
Cystoseira crinita Duby
Cystoseira amantacea (C. Agardh) Bory de Saint-Vincent
Cystoseira adriatica Sauvageau (*Spinosa*)
Cystoseira barbata (Stackhouse) C. Agardh
Cystoseira compressa (Esper) Gerloff & Nizamuddin

RHODOPHYTA
Florideophyceae
Nemaliales
Liagoraceae
Ganonema farinosum (J.V. Lamouroux) K.C. Fan & Yung C. Wang

Nemaliales
Galaxauraceae
Galaxaura oblongata (Ellis and Solander) Lamouroux

Helminthocladiaceae
Liagora distenta (Mertens ex Roth) J.V. Lamouroux
Liagora viscida (Forsskal) C. Agardh

Ceramiales
Rhodomelaceae
Chondria dasyphylla (Woodward) C. Agardh
Laurencia papillosa (C. Agardh) Greville
Laurencia obtusa (Hudson) J.V. Lamouroux
Laurencia succisa A.B. Cribb
Halopithys incurva (Hudson) Batters

Spyridiaceae
Spyridia filamentosa (Wulfen) Harvey

Corallinales
Corallinaceae
Corallina elongata Ellis & Solander

Lithophyllum stictaeforme (J.E. Areschoug) Hauck
Jania rubens (Linnaeus) Lamouroux
Jania corniculata (Linnaeus) J.V. Lamouroux
Phymatolithon lenormandii (J.E. Areschoug) W.H. Adey
Melobesia membranacea (Esper) Lamouroux
Amphiroa rigida J.V. Lamouroux

Gigartinales
Peyssonneliaceae
Peyssonnelia squamaria (S. G. Gmelin) Decaisne

Cystocloniaceae
Hypnea musciformis (Wulfen) Lamouroux

Gelidiales
Gelidiaceae
Gelidium latifolium (Greville) Bornet and Thuret

The low number of species identified in station 8th (Table 1) may have resulted from the sandy environment of the station and openness of the station to the effects of the waves. Compared to the other stations, a higher number of species was identified in the 7th station, which was shallow and had a rocky shoreline, which sheltered the station from wave action. Such rocky areas provide anchoring points for algae and areas which are protected from predators.

Table 1. Taxonomic groups according to stations
(Tablo 1. İstasyonlara göre taksonomik gruplar)

Stations	Systematc Groups			
	Chlorophyta	Phaeophyta	Rhodophyta	Spermatophyta
I	1	3	13	1
II	1	3	10	1
III	1	1	8	1
IV	2	2	3	-
V	2	4	11	1
VI	-	1	6	1
VII	4	8	10	1
VII	-	8	7	-

Analysis showed that the 7th station (Karataş-Fener) had the greatest abundance of macroalgae species and the highest species diversity, with 23 species. Examination of the cover-abundance scale of the species showed that algae at the 7th station were more abundant and covered a larger area compared to the stations (Table 2, 3, 4 ve 5).

Table 2. Cover-abundance scale of Chlorophyta species in stations
(Tablo 2. İstasyonlara göre Baskınlık ve örtü değerleri)

	Stations							
	I	II	III	IV	V	VI	VII	VIII
U.lactuca				+1				
F.petiolata							2	
A.stellata				+1				
V.macrophysa							2	
A.acetabulum							1	
D.clavaeformis							1	
C.bursa	2	3	3		1			
H.tuna							2	

Table 3. Cover-abundance scale of Rhodophyta species in stations
(Tablo 3. Rhodophyta türlerinin istasyonlardaki baskınlık ve örtü değerleri)

	Stations							
	I	II	III	IV	V	VI	VII	VII
G.farimosum	1	+1						
G.oblongata	3	4	5		3	4		
L.distenta	3	2	+1					1
L.viscida	3	3	3	2	+1	+1	2	2
C.dasyphylla	1				+1			
S.flamentosa							3	
L.papillosa	4							
L.obtusa					3			2
L.succisa					2			
H.incurva							+1	+1
C.elongata	3	3	5	4	4		2	2
L.stictaeforme					+1			
J.rubens	3	4	5	1	3	2	4	2
J.corniculata								+1
P.lenormandii	+	+					+	
M.membranacea	3	3	3		3	3	3	
A.riigida	2	2	2		2	3	1	
P.squamaria	2	5	5		2	1	+1	
H.musciformis					1		1	
G.latifolium	1							

Table 4. Cover-abundance scale of Phaeophyta species in stations
(Tablo 4. Phaeophyta türlerinin istasyonlardaki baskınlık ve örtü değerleri)

	Stations							
	I	I	I	I	I	I	I	I
P.pavonia	4	4	4	3	2	1	4	4
D.membranacea							2	
D.dichotoma					4		4	
D.linearis	3	3					4	2
T.atomaria							3	
S.horunschuchii				+1				
H.filicina								2
H.scoparia								2
C.crinita							3	
C.amantacea					3			
C.adriatica							3	
C.barbata							3	
C.compresa	3	3			3			

Table 5. Cover-abundance scale of Spermatophyta species in stations
(Tablo 5. Spermatophyta türlerinin istasyonlardaki baskınlık ve örtü değerleri)

	Stations							
	I	I	I	I	I	I	I	I
P.oceanica	5	5	3		2	4	2	

Red and brown algae (particularly brown algae species) are indicators of water cleanliness. In addition, low occurrence of green algae is also an indicator of a clean environment [9 and 36].

Species found in the stations were analyzed in terms of dominance. Red algae were found to be the most dominant species, followed by brown algae and green algae respectively. In the light of the data, it can be concluded that most of the study stations have clean water, as do most of the other areas of the Mediterranean coasts of Turkey [9]. An abundance of green algae in the 7th Station, may be attributed to the effects of the fishing port close to the station and pollution.

Turna [9] reported 9 brown algae species of the order *Fucales* in a study he carried out. Presents the distribution of species sampled during the present study. This indicates that the majority of species belonging to the genus *Cystoseira* occurred in 5th, 6th, 7th stations.

In the present study, 5 *Fucales* species of the genus *Cystoseira* were found in the area between 1st and 8th stations. This suggests that Mediterranean shores provide appropriate habitats for members of the order *Cystoseira*.

Among the algae species found in the present study, *H. musciformis* and *S. flamentosa* (red algae) are used to produce "Hypnean" and "agar", respectively; *C. bursa* and *U. lactuca* (green algae), *L. distenta* and *L. viscida* are used to produce edible food; and brown algae, particularly, *Cystoseira* and *S. horunschuchii*, are used in the production of alginic acid and in the medical and pharmaceutical sectors [37]. It is thought that these species identified in the study area can be also be utilized in Turkey for economic purposes.

Fritsch [21] stated that red algae are abundant in tropical waters. High populations of red algae found at the study stations reflect the subtropical climate of the study area.

The division *Spermatophyta* was represented by a single species, *P. Oceania*, which is endemic to the Mediterranean. The Mediterranean population of this plant, which is an indicator of clean areas, is known to have decreased due to environmental pressure. The notable dominance of *P. oceanica* over other species in the study area may be because these areas are remote from environmental pressures and have appropriate substrates. The fact that *Phaeophyta* is also dominant in regions rich in *P. oceanica* species supports this suggestion.

P. oceanica was not observed in flower in any season during the study. This supports Cirik's [38] suggestion that it is very rare for *P. oceanica* to reproduce sexually.

ACKNOWLEDGMENT (TEŞEKKÜR)

This study was taken from a section of PhD thesis of the first author and supported by Suleyman Demirel University Scientific Research Found, Project no: 1248-D-06

REFERENCES (KAYNAKLAR)

1. Sze, P., (1998). A Biology of the Algae. Third Edition, Georgetown University, 278p.
2. Sze, P., (1998). A Biology of the Algae. Third Edition, Georgetown University, 278p.
3. Öztürk, M., (1984). Türkiye'nin Ege ve Akdeniz Kıyılarındaki Phaeophyta (Kahverengi Algler) Üyelerinin Yayılımı ve Taksonomisi.109- 118s.
4. Sukatar, A., (1992). Güney Ege (Çeşme-Marmaris arası) Kıyılarındaki Ekonomik Değeri Olan Alglerin Ekolojisi. Ege Üniversitesi Fen Bilimleri Enstitüsü. 142 sayfa.
5. Riedl, R., (1963). Fauna und Flora der Adria, Verlag Paul Paray, 640 p. Hamburg und Berlin.
6. Dural, B., Guner, H., and Aysel, V., (1992), The comparison of Marine Flora of Çeşme-Eskifoça with Türkiye and Mediterranean. E.Ü.Journ.Fac.Sci. E.Ü.Ser.B.14 (2): 65 - 77.
7. Pankow, H., (1990). Ostsee-Algenflora. Gustav Fischer Verlag, Jena. 648p.
8. Oztürk, M., (1983). Taxonomy of Some Dictyotaceae (Phaeophyta) from the Bay of İzmir. Doğa Bilimleri Dergisi 7, 85 – 92.
9. Öztürk, M., (1996). Taxonomy and Distribution of Fucales (Phaeophyta) Members on Aegean and Mediterranean Coasts of Turkey. Tr. Journal of Botany 20, 109–118.
10. Turna, II., (1997). Antalya A Study on the Macroscobic Marine Flora of Antalya Gulf (Doctora Thesis), Süleyman Demirel Univ. Fen Bil. Enst., Eğirdir-Isparta, 101 s.
11. Özturk, M. and Taskin, E., (1999). Taxonomy and Distribution of Phaeophyta (Brown Algae) of Iskenderun Gulf (Hatay Shores/Turkey). Çukurova Univ. X. National Symposium of Fisheries, 22-24th Sept. 1999, , Adana, Vol. II: 856-864.
12. Delephine, R., Boudouresque, C.F., Orestano, C.F., Noailles, M.C., and Asensi, A., (1978). Algues et Autres Vegetaux Marins In Fischer, W., Schneider, M., Bauchot, M. L., (ed.) Mediterranee et

Mer Noire, Zone de Peche 37, Vegetaux et Invertebres. FAO- CEE, pp. 2-136. Rome.
13. Denizot, M., (1968). Les Algues floridees Encroutantes (a 1'exclusions. Des Corallinacees) These, Paris, 310p.
14. Feldmann, J., (1931). Contribution a la Flora Algoligigue marine de l'Algerie les Algues de Cherchell. Bull. Soc. Hist. Nat. Afr. Nord, 22,179-254.
15. Feldmann, J. and Hamel, G., (1934). Observation Sur Quelques Gelidiacees. Rev. Gen. Bot. 46,528-550.
16. Feldmann J. and Hamel G., (1936). Floridees de France Gelidiales. Rev. Alg. IX (1),209-264.
17. Feldmann, J. and Hamel, G., (1937a). Les Algues Marines de la cote des Alberes. Rev. I-III Rev. Algol IX, 141-331.
18. Feldmann, J. and Hamel, G., (1937b). Rechherches Sur la Vegetation Marine de la Mediterranee. La Cote des Alberes. Rev. Algol., 339p.
19. Feldmann J. and Feldmann G., (1954). Inventaire de la Flore marine de Roscoff. Algues, Champignos, Lichens et Spermatophytes, Suppl. 6 aux Trav. Station Biologigue de Roscoff, 152 pages.
20. Feldmann, J. and Feldmann, G., (1958). Recheiches Sur Quelques Floridées Parasites. Rev. Gen. Bot. 65,1-49.
21. Feldmann, J. and Feldmann, G., (1966). Aur le Gymnothamnion elegans (Schousboe) J. Agardh. et la Situation des Organes Femelles Chez les Ceramiacees Rev. Gen. Botany, 73, 6-18.
22. Fritsch, F.E., (1965). The Structure and Reproduction of the Algae, Chlorophyceae Xanthophyceae, Chrysophyceae, Bacillariophyceae, Cryptophyceae, Dinaphyceae, Chloromonadineae, Euglenineae , At the Universty Pres. Vol I. 791 p. Cambridge.
23. Ballesteros, E., (1984a). Contribucio al Coneixement Algologia de la Mediterrania Espanyola, IV. Fol. Bot. Misc. 4:29-33.
24. Ballesteros, E., (1984b). Contribucio al Coneixement Algologia de la Mediterrania Espanyola, V. Coll. Bot. Vol. 15: 59-68.
25. Cormaci, K., Furnari, G., (1979). Flora Algale Della Penisola Della Maddalena (Siracusa). Thalassia salentina, 9:1-18.
26. Diapoulis. A. and Haritonidis. S., (1977). Marine algae of the Lesvos Island, Greece I. Systematic Identification and Geographical Distribution, Thalas, 7:95-107.
27. Diapolis, A.C., (1984). The Photophil Algal Flora of Saronics Gulf Inst. Ocean and Fish Res, 1-171.
28. Ercegovic, A., (1957). La Flora Sous Marine de Litol de Jakuba Acta Adriatica, 8:1-127.
29. Furnari, G., Scammacca. B., Cormaci M., and Battiato A., (1972). Zonazione Della Vegetationa Sommersa Dell'isola Lachea (Catania) IX. Cong. Soc. Ital. Biol. Marine, 245-257.
30. Nizamuddin. M. and Lehnberg. W., (1970). Studies on the Marine Algae of Paros and Sikinos Islands, Greece. Botanica Marina, 13, 116-130.
31. Nizamuddin. M., West J.A., and Menez, E.G., (1979). A List of Marine Algae from Libya. Botanica Marina, 22, 465-476.
32. Perret, M., Boudouresque GF., and Seridi H., (1989). Inventaire des Algus Marines Benthiques d'algarie. GIS Posidonie Publ. Marseille France, 117p.
33. Rechinger, K.H., (1943). Flora Aegaea. Acad. Wiss. Wien Math.-Naturwiss. Kl. Denkschr. 105. (1).

34. Rizzi, L., (1972a). La Flora Sottomarina dele Isole Tremiti Istituto veneto. Scie. Ann. Acc. 80, 329-376.
35. Rizzi, L., (1972b). Compionamenti di Alghe Benthoniche nel Quarnero. Mus. Civ. St. Nat. Trieste, 28(1), 147-166.
36. Tsekos, I., Haritonidis, S., (1974). The Marine Algae of the Rhodos Island, Greece, br. Phycologia Journal 9, 399-406.
37. Rudar, B., (1996). Ege Denizi Ildır Körfez'i (Çeşme İlçesi -İzmir) Alg Florası. Ege Üniversitesi Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, 175s.
38. Levring, T., Hoppe, H.A., and Schmid, O.J., (1969). Marine Algae, A Survey of Research and Utilization Cram, de Gruyter and CO., 421 p. Hamburg.
39. Cirik, Ş. ve Cirik, S., (1999). Su Bitkileri (Deniz Bitkilerinin Biyolojisi Ekolojisi Yetiştirme Teknikleri), Ege Üniversitesi Su Ürünleri Fakültesi Yayınları No:58. Ders Kitabı, 188s.