

## COMPARISON OF THE BROWN ALGAL DIVERSITY BETWEEN FOUR SEA COASTS OF TURKEY

Ergün TAŞKIN

Celal Bayar University, Faculty of Arts and Sciences, Department of Biology, Manisa, Turkey

Received: 10 October 2014

Accepted: 08 December 2014

Corresponding Author: Tel.:+902362013262; E-mail: ergun.taskin@cbu.edu.tr

### ABSTRACT

In this paper, marine brown algal diversity between coasts of four seas in Turkey is studied. Sampling was made from four different localities [Iskenderun Bay (Mediterranean coast), Ayvalık (Aegean coast), Dardanelles (Sea of Marmara), and Sinop (Black Sea coast)] of Turkey in the years from 2009 to 2014. In total, 127 brown algal taxa at specific and infraspecific levels were reported, and Ayvalık had the highest number of taxa (106 taxa), followed by Dardanelles (82 taxa), Iskenderun Bay (58 taxa) and Sinop (42 taxa), respectively. *Choristocarpus tenellus* Zanardini and *Cladosiphon lubricus* (Sauvageau) Kylin are reported for the first time from Turkey. Ten brown algae are classified as alien species in Turkey.

**Key words:** Algal diversity, brown algae, marine algae, Phaeophyceae, Turkey

## TÜRKİYE DENİZLERİ ARASINDA KAHVERENGİ ALGAL ÇEŞİTLİLİĞİNİN KARŞILAŞTIRILMASI

### ÖZET

Bu çalışmada, Türkiye'nin dört denizel kıyısı arasında kahverengi algal çeşitliliği çalışılmıştır. Örneklemeler 2009 ve 2014 yılları arasında Türkiye kıyıların dört farklı istasyonundan [İskenderun Körfezi (Akdeniz kıyıları), Ayvalık (Ege kıyıları), Çanakkale Boğazı (Marmara Denizi) ve Sinop (Karadeniz kıyıları)] gerçekleştirilmiştir. Tür ve türaltı seviyede toplam 127 taksa rapor edilmiş olup Ayvalık en fazla çeşitliliğe sahip (106 taksa) istasyon tespit edilirken bunu Çanakkale Boğazı (82 taksa), İskenderun Körfezi (58 taksa) ve Sinop (42 taksa) sırasıyla takip etmiştir. *Choristocarpus tenellus* Zanardini ve *Cladosiphon lubricus* (Sauvageau) Kylin Türkiye denizel alg florası için ilk kez kayıt edilmektedir. Türkiye'de 10 kahverengi alg yabancı olarak tespit edilmiştir.

**Anahtar kelimeler:** Algal çeşitlilik, kahverengi algler, deniz algleri, Phaeophyceae, Türkiye

### INTRODUCTION

Turkey is surrounded by four seas (Mediterranean Sea, Aegean Sea, Sea of Marmara, and Black Sea) and its coasts have different structures (physicochemical parameters of water, coastline shape, etc.). In total, 586 marine benthic macroalgae (32 of which are alien species) were reported from Turkey (Taşkın et al. 2008,

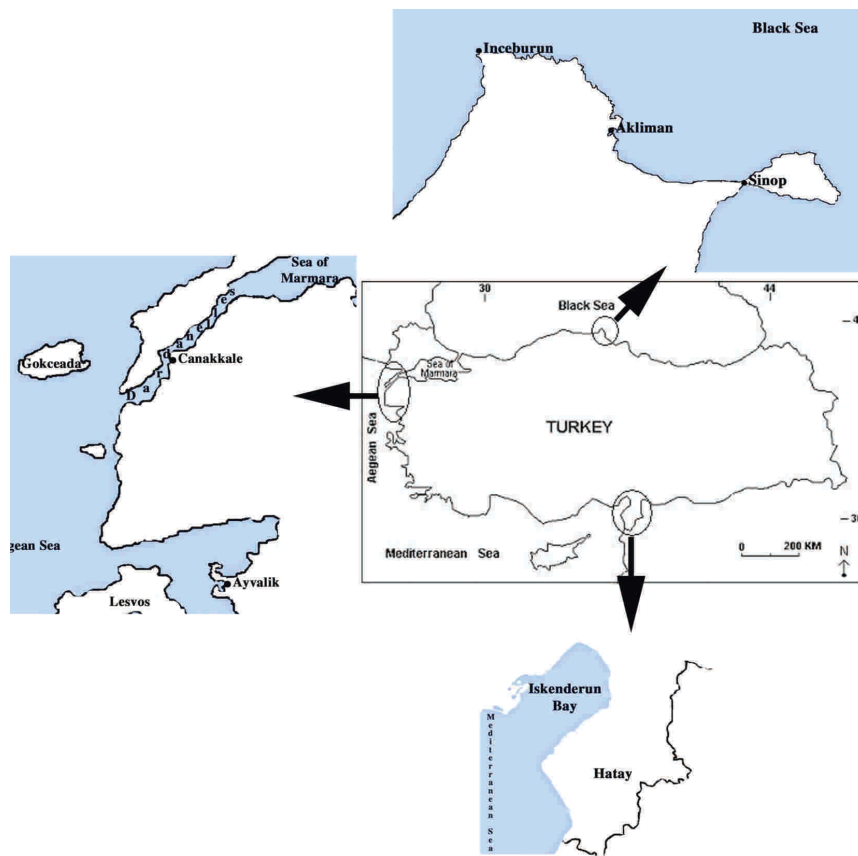
2011). They represent less than 50% of the total number of seaweeds reported from the Mediterranean Sea [1117 taxa at specific and infraspecific levels, according to Coll et al. (2010)]. They include 141 Phaeophyceae, 327 Rhodophyta and 118 Chlorophyta (270 Phaeophyceae, 657 Rhodophyta, and 190 Chlorophyta in the Mediterranean Sea, respectively). Coll et al.

(2010) and Cormaci et al. (2014) have reported 277 green algae from the Mediterranean Sea. Furnari et al. (2010) have reported 210 brown algal taxa from Italy, which has higher number of marine brown algae than other Mediterranean countries [e.g. 180 Croatia (Antolic et al. 2010), 130 Morocco, 129 France, 124 Spain (Ribera et al. 1992), 107 Greece (Tsiamis et al. 2013), 90 Cyprus (Tsiamis et al. 2014)]. According to Taşkın et al. (2008), the highest floristic richness occurs in the Aegean coasts of Turkey (430 taxa at specific and infraspecific level), followed by the Sea of Marmara (400 taxa), the Mediterranean coasts (382 taxa) and the Black Sea coasts (244 taxa). Several studies were made on Turkish marine brown algae by different authors (Güner 1974, Aysel et al. 1977, Öztürk and Güner 1986, Öztürk 1988, 1993, 1996a, b, Taşkın 2006, 2008, 2013a, b, Taşkın and Öztürk 2007, Taşkın et al. 2010). Recently, 150 brown algal taxa (at specific and infraspecific level) have been reported from Turkey, with 111 from the Aegean coast, 105 from the Sea of Marmara, 80 from the Mediterranean coast, and 50 from the Black Sea (Taşkın and Öztürk 2013). In the present paper, results of a study of the marine brown

algal flora of four different Turkish localities were reported. A total of 127 brown algal taxa at specific and infraspecific level was found, with the highest specific diversity occurring in Ayvalık (106 taxa), followed by Dardanelles (82 taxa), Iskenderun Bay (58 taxa), and Sinop (42 taxa).

## MATERIALS AND METHODS

Sampling was made from the above mentioned four different Turkish localities [Iskenderun Bay (Mediterranean coast), Ayvalık (Aegean coast), Dardanelles (Sea of Marmara), and Sinop (Black Sea coast)] between 2009 and 2014 (Figure 1). The material was collected by snorkelling and SCUBA diving, and specimens were preserved in 2-4% formaldehyde in seawater. Samples were studied using a light microscope (Nikon SE). Voucher specimens were deposited in a personal herbaria of Ergün Taşkın (ET) the Department of Biology of the Celal Bayar University of Manisa, Turkey. Taxonomy and nomenclature were checked from Guiry and Guiry (2014).

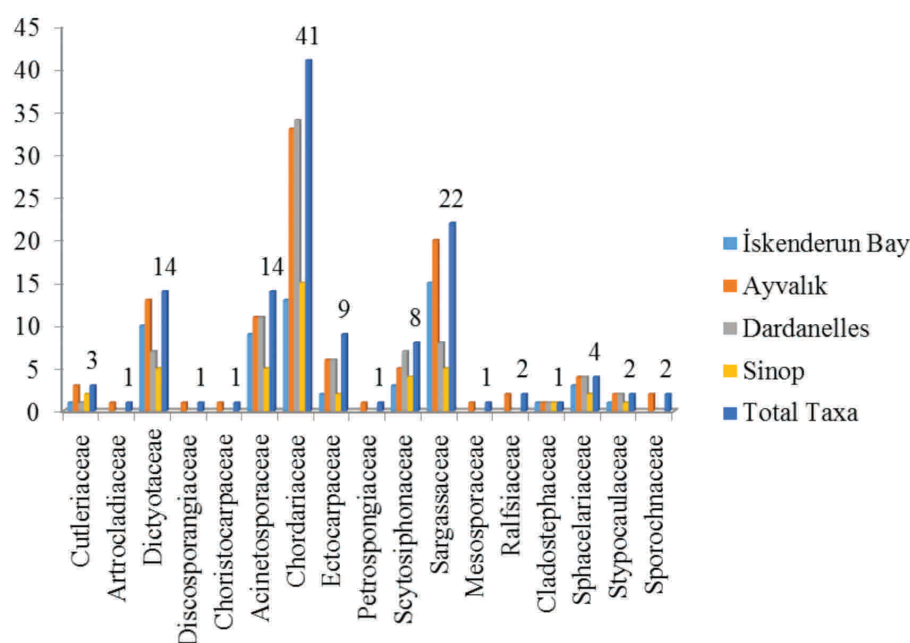


**Figure 1.** The study stations in Turkish coasts.

## RESULTS AND DISCUSSION

A total of 127 brown algal taxa at specific and infraspecific levels was found from the four stations (Table 1). The highest number of species (106) was found in the Aegean coast (Ayvalık), while the lowest (42) was found in the Black Sea station (Sinop). The most represented order was Ectocarpales, with 73 taxa (58%), while the family Chordariaceae showed the highest number of taxa (41), followed by Sargassaceae (22) (Figure 2). The hot spot stations for the Chordariaceae diversity were Ayvalık and Dardanelles, while for the Sargassaceae were Ayvalık and İskenderun Bay. Two species [*Choristocarpus tenellus* Zanardini and *Cladosiphon lubricus* (Sauvageau) Kylin] are reported for the first time for Turkey. Ten brown algae are classified as alien species in Turkey (Table 1). The invasive dictyotalean species *Styopodium schimperi* was common in the Aegean and Mediterranean coasts of Turkey. The other invasive species *Botrytella parva*, *Microspongium globosum* and *Scytosiphon dotyi* were rare in Dardanelles, while *Colpomenia peregrina* was common in Dardanelles. Several previous papers including or dealing only with the brown algae occurring at Iskenderun Bay, Ayvalık, Dardanelles and Sinop, were consulted. Öztürk and Taşkın (1999) and Aysel et al. (2006) reported 29 and 73 taxa from Iskenderun Bay, respectively. 51 taxa were reported from Ayvalık by Taşkın and Öztürk (2005), 73 taxa

from Dardanelles by Taşkın et al. (2003), Taşkın and Öztürk (2007), Taşkın (2008), and 46 taxa from Sinop by Dural et al. (2011). Taşkın et al. (2008) stated that the diversity and abundance of marine brown algae were greater in the Aegean coast and the Sea of Marmara compared with the Mediterranean and Black Sea coasts of Turkey. Recently, some minute or rare marine brown algal taxa [*Compsonema minutum* (C. Agardh) Kuckuck, *Corynophlaea crispa* (Harv.) Kuckuck, *Dictyopteris lucida* M.A.Ribera Siguán, A.Gómez Garreta, Pérez Ruzafa, Barceló Martí and Rull Lluch, *Dictyota cyanoloma* Tronholm, De Clerck, Gomez Garreta and Rull Lluch, *Myrionema conchicola* (J. Feldmann) Boudour., *Microspongium gelatinosum* stadium Reinke, *Padina pavonicoides* Ni-Ni-Win and H. Kawai, *Padina ditristromatica* Ni-Ni-Win and H.Kawai, *Ulonema rhizophorum* Foslie] have been reported from different localities of Turkey (Ni-Ni-Win et al. 2011, Taşkın 2006, 2013a, b, c). *Petrospongium kuckuckii* (E. Taşkın, M. J. Wynne & M. Öztürk) Cormaci & Furnari was known only from Ayvalık and identified by Taşkın et al. (2010) as *Cylidrocarpus kuckuckii* E. Taşkın, M.J. Wynne and M. Öztürk. In conclusion, further detailed floristic investigations from small locations along the coasts of Turkey should be carried out in order to get a better knowledge of the benthic algal biodiversity of Turkey that probably is higher than that presently known.



**Figure 2.** The number of taxa at specific and infraspecific levels per brown algal family from four stations of Turkish coasts.

**Table 1.** List of brown algae occurring in four station of Turkish seas

Taxa	Station			
	İskenderun Bay	Ayvalık	Dardanelles	Sinop
<b>Ordo: Cutleriales</b>				
<b>Familia: Cutleriaceae J.W.Griffith &amp; A.Henfrey</b>				
<i>Cutleria chilosa</i> (Falkenb.) P.C.Silva		+		
<i>Cutleria multifida</i> (Turner) Grev.	+	+	+	+
<i>Zanardinia typus</i> (Nardo) P.C.Silva		+		+
<b>Ordo: Desmarestiales</b>				
<b>Familia: Artrocladiaceae Chauvin</b>				
<i>Arthrocladia villosa</i> (Huds.) Duby		+		
<b>Ordo: Dictyotales</b>				
<b>Familia: Dictyotaceae Lamouroux ex Dumortier</b>				
<i>Dictyopteris polypodioides</i> (A.P.De Candolle) J.V.Lamour.	+	+	+	+
<i>Dictyota dichotoma</i> (Huds.) J.V.Lamour. var. <i>dichotoma</i>	+	+	+	+
<i>Dictyota dichotoma</i> var. <i>intricata</i> (C.Agardh) Grev.	+	+	+	
<i>Dictyota fasciola</i> (Roth) J.V.Lamour. var. <i>fasciola</i>	+	+	+	+
<i>Dictyota fasciola</i> var. <i>repens</i> (J.Agardh) Ardissona		+		
<i>Dictyota linearis</i> (C.Agardh) Grev.	+	+	+	
<i>Dictyota mediterranea</i> (Schiffner) G.Furnari		+		
<i>Dictyota spiralis</i> Mont.	+	+	+	+
<i>Lobophora variegata</i> (J.V.Lamour.) Womersley ex E.C.Oliveira		+		
<i>Padina ditristomatica</i> Ni-Ni-Win & H.Kawai <sup>a</sup>		+		
<i>Padina pavonica</i> (L.) Thivy	+	+	+	+
<i>Styopodium schimperi</i> (Buchinger ex Kütz.) Verlaque & Boudour. <sup>b</sup>	+	+		
<i>Taonia atomaria</i> (Woodw.) J.Agardh	+	+		
<i>Taonia pseudociliata</i> (J.V.Lamour.) Nizam. & Godeh	+			
<b>Ordo: Discosporangiales</b>				
<b>Familia: Choristocarpaceae Kjellman</b>				
<i>Choristocarpus tenellus</i> Zanardini <sup>c</sup>		+		
<b>Familia: Discosporangiaceae Schmidt</b>				
<i>Discosporangium mesarthrocarpum</i> (Menegh.) Hauck		+		
<b>Ordo: Ectocarpales</b>				
<b>Familia: Acinetosporaceae G.Hamel ex J.Feldmann</b>				
<i>Acinetospora crinita</i> (Carmich.) Sauv.	+	+	+	+
<i>Feldmannia irregularis</i> (Kütz.) G.Hamel	+	+	+	+
<i>Feldmannia lebelii</i> (P.L. Crouan & H.M.Crouan) G.Hamel	+	+	+	+
<i>Feldmannia padinae</i> (Buffham) G.Hamel	+	+		
<i>Feldmannia paradoxa</i> (Mont.) G.Hamel var. <i>caespitula</i> (J.Agardh) Cormaci & G.Furnari	+	+	+	
<i>Feldmannia paradoxa</i> (Mont.) G.Hamel var. <i>globifera</i> E.Taşkın & M.Öztürk	+	+	+	+
<i>Feldmannia paradoxa</i> (Mont.) G.Hamel var. <i>paradoxa</i>	+	+	+	
<i>Hincksia fuscata</i> (Zanard.) P.C.Silva			+	
<i>Hincksia granulosa</i> (J.E.Smith) P.C.Silva		+		
<i>Hincksia mitchelliae</i> (Harv.) P.C.Silva	+	+	+	+

Table 1. (Continued)

Taxa	Station			
	İskenderun Bay	Ayvalık	Dardanelles	Sinop
<i>Hincksia ovata</i> (Kjellman) P.C.Silva			+	
<i>Hincksia sandriana</i> (Zanard.) P.C.Silva			+	
<i>Kutzingiella battersii</i> (Bornet) Kornmann	+	+	+	
<i>Pylaiella littoralis</i> (L.) Kjellman <sup>b</sup>		+		
<b>Familia: Chordariaceae Grev.</b>				
<i>Asperococcus bullosus</i> J.V.Lamour.		+	+	
<i>Asperococcus ensiformis</i> (Della Chiaje) M.J.Wynne			+	
<i>Asperococcus fistulosus</i> (Huds.) W.J.Hooker	+	+	+	+
<i>Botrytella micromora</i> Bory <sup>a</sup>			+	
<i>Botrytella parva</i> (Takamatsu) H.-S.Kim <sup>a,b</sup>			+	
<i>Cladosiphon contortus</i> (Thur.) Kylin		+	+	
<i>Cladosiphon irregularis</i> (Sauv.) Kylin <sup>a</sup>		+		
<i>Cladosiphon lubricus</i> (Sauvageau) Kylin <sup>c</sup>			+	
<i>Cladosiphon mediterraneus</i> Kütz.		+	+	
<i>Cladosiphon zosterae</i> (J.Agardh) Kylin <sup>b</sup>		+	+	
<i>Corynophlaea umbellata</i> (C.Agardh) Kütz.	+	+	+	+
<i>Elachista fucicola</i> (Vellely) Aresch. <sup>a</sup>		+		
<i>Elachista stellaris</i> Aresch.				+
<i>Eudesme virescens</i> (Carmich. ex Berkeley) J.Agardh	+	+	+	+
<i>Giraudia sphaclarioides</i> Derbès & Sol.		+	+	
<i>Halothrix lumbricalis</i> (Kütz.) Reinke <sup>b</sup>		+	+	
<i>Hecatonema terminale</i> (Kütz.) Kylin <sup>a,e</sup>		+	+	
<i>Mesogloia lanosa</i> P.L. Crouan & H.M.Crouan		+		
<i>Mesogloia leveillei</i> (J.Agardh) Menegh.		+	+	
<i>Mesogloia vermiculata</i> (J.E.Smith) S.F.Gray		+	+	
<i>Microcoryne ocellata</i> Strömf. <sup>a</sup>		+	+	
<i>Microspongium globosum</i> Reinke <sup>a,b,d</sup>			+	
<i>Mikrosyphar polysiphoniae</i> Kuckuck	+	+	+	+
<i>Myriactula arabica</i> (Kütz.) Feldmann	+	+	+	+
<i>Myriactula rivulariae</i> (Suhr) Feldmann	+	+	+	+
<i>Myrionema orbiculare</i> J.Agardh	+	+	+	+
<i>Myrionema strangulans</i> Grev.	+	+	+	+
<i>Myriotrichia claviformis</i> Harv.	+	+	+	+
<i>Nemacystus flexuosus</i> (C.Agardh) Kylin var. <i>giraudyi</i> (J.Agardh) de Jong		+	+	
<i>Phaeostroma bertholdii</i> Kuckuck <sup>a</sup>		+		
<i>Protectocarpus speciosus</i> (Børgesen) Kornmann	+	+	+	+
<i>Punctaria latifolia</i> Grev. <sup>f</sup>	+	+	+	+
<i>Punctaria plantaginea</i> (Roth) Grev.			+	
<i>Punctaria tenuissima</i> (C.Agardh) Grev. <sup>b</sup>			+	+
<i>Sauvageaugloia divaricata</i> (Clem.) Cremades		+	+	
<i>Spermatochnus paradoxus</i> (Roth) Kütz.		+	+	
<i>Stictyosiphon adriaticus</i> Kütz.		+	+	
<i>Stictyosiphon soriferus</i> (Reinke) Rosenv.			+	
<i>Stilophora nodulosa</i> (C.Agardh) P. C. Silva		+		
<i>Stilophora tenella</i> (Esper) P.C.Silva	+	+	+	+
<i>Striaria attenuata</i> (Grev.) Grev.	+	+	+	+

Table 1. (Continued)

Taxa	Station			
	İskenderun Bay	Ayvalık	Dardanelles	Sinop
<i>Cystoseira spinosa</i> var. <i>tenuior</i> (Erceg.) Cormaci et al.		+		
<i>Cystoseira squarrosa</i> De Not.	+			
<i>Sargassum acinarium</i> (L.) Setchell	+	+		
<i>Sargassum hornschurchii</i> C.Agardh	+			
<i>Sargassum vulgare</i> C.Agardh	+	+	+	+
<b>Ordo: Ralfsiales</b>				
<b>Familia: Mesosporaceae Tanaka &amp; Chihara</b>				
<i>Hapalospongidion macrocarpum</i> (Feldmann) León Álvarez & González-González		+		
<b>Familia: Ralfsiaceae Farlow</b>				
<i>Pseudolithoderma adriaticum</i> (Hauck) Verlaque <sup>a</sup>		+		
<i>Ralfsia verrucosa</i> (Aresch.) Aresch.		+		
<b>Ordo: Sphacelariales</b>				
<b>Familia: Cladostephaceae Oltmanns</b>				
<i>Cladostephus spongiosum</i> (Huds.) C.Agardh <sup>h</sup>	+	+	+	+
<b>Familia: Sphacelariaceae Decaisne</b>				
<i>Sphacelaria cirrosa</i> (Roth) C.Agardh	+	+	+	+
<i>Sphacelaria cirrosa</i> f. <i>mediterranea</i> Sauv.		+	+	
<i>Sphacelaria rigidula</i> Kütz.	+	+	+	+
<i>Sphacelaria tribuloides</i> Menegh.	+	+	+	
<b>Familia: Stypocaulaceae Oltmanns</b>				
<i>Halopteris filicina</i> (Grateloup) Kütz.		+	+	
<i>Halopteris scoparia</i> (L.) Sauv.	+	+	+	+
<b>Ordo: Sporochneales</b>				
<b>Familia: Sporochneaceae Grev.</b>				
<i>Nereia filiformis</i> (J.Agardh) Zanard.		+		
<i>Sporochnus pedunculatus</i> (Huds.) C.Agardh		+		

[<sup>a</sup>; rare and small marine brown algae in Turkey and the Mediterranean. <sup>b</sup>; alien species in Turkey. <sup>c</sup>; new record for Turkey <sup>d</sup>; it is only known from Turkey in the Mediterranean Sea. <sup>e</sup>; it is considered to be a microthallus in the life histories of *Punctaria tenuissima* (Parente et al. 2010). <sup>f</sup>; Recent studies by Parente et al. (2010), based on rbcL sequence, showed that *P. latifolia* is conspecific with *P. tenuissima*, and it is considered to be a taxonomic synonym of *Punctaria tenuissima* (Cormaci et al. 2012), however it is accepted as a current name in the present study. <sup>g</sup>; the erect thalli were poorly developed in culture but were recognisable as like *Petalonina* or *Scytosiphon* (Fletcher 1987). <sup>h</sup>; including *Cladostephus spongiosum* f. *verticillatum*].

Table 1. (Continued)

Taxa	Station			
	İskenderun Bay	Ayvahk	Dardanelles	Sinop
<b>Familia: Ectocarpaceae C.Agardh</b>				
<i>Ectocarpus crouaniorum</i> Thur.		+		
<i>Ectocarpus fasciculatus</i> Harv.	+	+	+	+
<i>Ectocarpus siliculosus</i> (Dillwyn) Lyngb. var. <i>siliculosus</i>	+	+	+	+
<i>Ectocarpus siliculosus</i> var. <i>dasycarpus</i> (Kuckuck) Gallardo			+	
<i>Ectocarpus siliculosus</i> var. <i>hiemalis</i> (P.L.Crouan & H.M.Crouan ex Kjellman) Gallardo <sup>b</sup>			+	
<i>Ectocarpus siliculosus</i> var. <i>penicillatus</i> C.Agardh		+	+	
<i>Kuckuckia spinosa</i> (Kütz.) Kornmann		+		
<i>Spongonema tomentosum</i> (Huds.) Kütz. <sup>a</sup>			+	
<i>Streblonema parasiticum</i> (Sauv.) De Toni <sup>a</sup>		+		
<b>Familia: Petrosongiaceae Racault, Fletcher, Reviere, G.Y. Cho, S.M. Boo, Parente &amp; Rousseau</b>				
<i>Petrospongium kuckuckii</i> (E.Taskin, M.J.Wynne & M.Öztürk) Cormaci & Furnari <sup>b,c</sup>		+		
<b>Familia: Scytosiphonaceae Farlow</b>				
<i>Colpomenia peregrina</i> Sauv. <sup>a</sup>			+	
<i>Colpomenia sinuosa</i> (Mertens ex Roth) Derbès & Sol.	+	+	+	+
<i>Compsomena saxicola</i> - stadium (Kuckuck) Kuckuck <sup>a,g</sup>		+		
<i>Hydroclathrus clathratus</i> (C.Agardh) Howe		+	+	
<i>Petalonia fascia</i> (O.F.Müll.) Kuntze	+	+	+	+
<i>Petalonia zosterifolia</i> (Reinke) Kuntze			+	+
<i>Scytosiphon dotyi</i> M.J.Wynne <sup>b</sup>			+	
<i>Scytosiphon lomentaria</i> (Lyngb.) Link	+	+	+	+
<b>Ordo: Fucales</b>				
<b>Familia: Sargassaceae Kützing emend. De Toni</b>				
<i>Cystoseira amentacea</i> (C.Agardh) Bory var. <i>amentacea</i>		+		
<i>Cystoseira amentacea</i> var. <i>stricta</i> Mont.	+	+		
<i>Cystoseira barbata</i> (Stackh.) C.Agardh	+	+	+	+
<i>Cystoseira barbatula</i> Kütz. emend. Cormaci, G. Furnari & Giaccone		+		
<i>Cystoseira brachycarpa</i> J.Agardh emend. Giaccone		+		
<i>Cystoseira compressa</i> (Esper) Gerloff & Nizam. f. <i>compressa</i>	+	+	+	+
<i>Cystoseira compressa</i> f. <i>plana</i> (Erceg.) Cormaci & al.	+	+		
<i>Cystoseira corniculata</i> (Turn.) Zanard.	+	+		
<i>Cystoseira crinita</i> Duby	+	+	+	+
<i>Cystoseira elegans</i> Sauv.	+	+		
<i>Cystoseira foeniculacea</i> (L.) Grev. f. <i>foeniculacea</i>	+	+	+	+
<i>Cystoseira foeniculacea</i> f. <i>latiramosa</i> (Erceg.) A.Gómez Garreta, M.C.Barceló, M.A.Ribera & J.R.Lluch		+		
<i>Cystoseira foeniculacea</i> f. <i>tenuiramosa</i> (Erceg.) A.Gómez Garreta, B.Martí, R.Siguan & R.Lluch	+	+	+	
<i>Cystoseira humilis</i> Kütz.	+	+		
<i>Cystoseira mediterranea</i> Sauv.		+	+	
<i>Cystoseira spinosa</i> var. <i>compressa</i> (Erceg.) Cormaci et al.		+		
<i>Cystoseira spinosa</i> Sauv. var. <i>spinosa</i>	+	+	+	

## ACKNOWLEDGMENTS

A part of this study was supported by TOTAL Foundation research grant for the project “Brown algal biodiversity and ecology in the Eastern Mediterranean Sea” led by Prof. Christos Katsaros (Greece).

## REFERENCES

- Antolic A, Span A, Nikolic V, Grubelic I, Despatalovic M, Cvitkovic I, 2010, A checklist of the benthic marine macroalgae from the eastern Adriatic coast: II. Heterokontophyta: Phaeophyceae, Acta Adriatica 51, 9-33.
- Aysel V, Zeybek N, Güner H, 1977, New algal species for Turkish coasts. 1. *Liebmannia leveillei* J. Agardh, Ege University, Faculty of Science Journal 1, 275-280.
- Aysel V, Erdurağan H, Okudan ŞE, 2006, Marine algae and seagrasses of Hatay (Mediterranean, Turkey), Journal Black Sea/Mediterranean Environment 12, 159-179.
- Coll M, Piroddi C, Steenbeek J, Kaschner K, Ben Rais Lasram F, et al., 2010, The Biodiversity of the Mediterranean Sea: Estimates, Patterns, and Threats, PLoS ONE 5(8):e11842.doi:10.1371/journal.pone.0011842.
- Cormaci M, Furnari G, Alongi G, 2014, Flora marina bentonica del Mediterraneo: Chlorophyta, Bollettino dell'Accademia Gioenia di Scienze Naturali di Catania 47, 11-436.
- Cormaci M, Furnari G, Catra M, Alongi G, Giaccone G, 2012, Flora marina bentonica del Mediterraneo: Phaeophyceae, Bollettino dell'Accademia Gioenia di Scienze Naturali di Catania 45, 1-508.
- Dural B, Aysel V, Demir N, Erdurağan H, Okudan, EŞ, Karaçuha A, Yazıcı I, Atalay G, 2011, Seagrasses and associated algae of Sinop Port (Black Sea, Turkey), Samsun Symposium (13-16 October 2011, Samsun, Turkey), 1, 1-23.
- Furnari G, Giaccone G, Cormaci M, Alongi G, Catra M, Nisi A, Serio D, 2010, Macrophytobenthos, Biologia Marine Mediterranea 17, 801-828.
- Guiry MD, Guiry GM, 2014, *AlgaeBase*. World-wide electronic publication, National University of Ireland, Galway. Available: <http://www.algaebase.org>. Accessed 28 November 2014.
- Güner H, 1974, *Cystoseira* species from Gulf of Izmir and their is situations with qualitative-quantitative assessment of troops, Assoc. Prof. Thesis, Ege University, Faculty of Science, Izmir, Turkey, 102.
- Ni-Ni-Win Hanyuda T, Draisma SGA, Furnari G, Meinesz A, Kawai H, 2011, *Padina ditristomatica* sp. nov. and *Padina pavonicoides* sp. nov. (Dictyotales, Phaeophyceae), two new species from the Mediterranean Sea based on morphological and molecular markers, European Journal of Phycology 46, 327-341.
- Öztürk M, 1988, Taxonomy and distribution of Cutleriales, Sphacelariales, Scytosiphonales and Dictyotales (Phaeophyta) members on Aegean and Mediterranean coasts of Turkey, Turkish Journal of Botany 12, 154-163.
- Öztürk M, 1993, Taxonomy and distribution of Chordariales and Sporochnales (Phaeophyta) members on Aegean and Mediterranean coasts of Turkey, Turkish Journal of Botany 17, 237-247.
- Öztürk M, 1996a, Taxonomy and distribution of Fucales (Phaeophyta) members on Aegean and Mediterranean coasts of Turkey, Turkish Journal of Botany 20, 109-118.
- Öztürk M, 1996b, Taxonomy and distribution of Punctariales (Phaeophyta) members on Aegean and Mediterranean coasts of Turkey, Turkish Journal of Botany 20, 127-132.
- Öztürk M, Güner H, 1986, Taxonomy and distribution of Ectocarpales (Phaeophyta) members on Aegean and Mediterranean coasts of Turkey, Turkish Journal of Botany 10, 459-472.
- Öztürk M, Taşkın E, 1999, Taxonomy and distribution of Phaeophyta (Brown algae) in Iskenderun Bay (Hatay), X. Ulusal Su Ürünleri Sempozyumu (22-24 Eylül 1999, Adana, Türkiye), 2, 856-864.
- Parente MI, Fletcher RL, Neto AI, Tittley I, Sousa AF, Draisma S, Gabriel D, 2010, Life history and morphological studies of *Punctaria tenuissima* (Chordariaceae, Phaeophyceae), a new record for the Azores, Botanica Marina 53, 223-231.
- Ribera MA, Gómez-Garreta A, Gallardo T, Cormaci M, Furnari G, Giaccone G, 1992, Check-list of Mediterranean Seaweeds. I. Fucophyceae (Warming 1884), Botanica Marina 35, 109-130.
- Taşkın E, 2006, First report of *Corynophlaea crispa* (Harvey) Kuckuck (Phaeophyceae, Corynophlaeaceae) in the Mediterranean Sea, Nova Hedwigia 82, 217-225.
- Taşkın E, 2008, The Marine Brown Algae of the east Aegean Sea and Dardanelles. II. Ectocarpaceae, Chordariaceae and Scytosiphonaceae, Cryptogamie,



- Algologie 29, 173-186.
- Taşkın E, 2013a, New records of three dictyotalean brown algae for Turkey, *Botanica Marina* 56, 299-302.
- Taşkın E, 2013b, First reports of five marine algae from Turkey, *Nova Hedwigia* 97, 515-528.
- Taşkın E, 2013c, First report of the North Atlantic myrionematoid brown alga *Ulonema rhizophorum* Foslíe (Phaeophyceae, Chordariaceae) in the Mediterranean Sea, *Mediterranean Marine Science* 14, 125-128.
- Taşkın E, Öztürk, M, 2005, The Marine Algae of Ayvalık “Aegean Sea, Turkey”. Proceedings of the Seventh International Conference on the Mediterranean Coastal Environment 1, 567-580.
- Taşkın E, Öztürk M, 2007, The Marine Brown Algae of East Aegean Sea and Dardanelles. I. Ectocarpaceae, Pylaiellaceae, Chordariaceae, Elachistaceae and Giraudiaceae, *Cryptogamie, Algologie* 28, 169-190.
- Taşkın E, Öztürk M, 2013, Marine algae of Turkey. I. Phaeophyceae. Manisa, Celal Bayar University Press. 1-229.
- Taşkın E, Öztürk M, Kurt O, Öztürk M, 2003, Marine Algae of Kilitbahir Shore (Gelibolu, Çanakkale, Turkey), *Pakistan Journal of Botany* 35, 53-59.
- Taşkın E, Aydoğan Ö, Çınar E, Öztürk M, 2011, Alien marine macrophytes in Turkey, *European Journal of Phycology* 46, 188-188.
- Taşkın E, Öztürk M, Kurt O, Öztürk M, 2008, The check-list of the marine flora of Turkey. Manisa, Ecem Kırtasiye. 87.
- Taşkın E, Wynne MJ, Öztürk M, 2010, *Cylindrocarpus kuckuckii* sp. nov. (Chordariaceae, Phaeophyceae), a newly recognized species from the Aegean Sea coast of Turkey, *Nova Hedwigia* 90, 263-270.
- Tsiamis K, Panayotidis P, Economou-Amilli A, Katsaros C, 2013, Seaweeds of the Greek coasts. I. Phaeophyceae, *Mediterranean Marine Science* 14, 141-157.
- Tsiamis K, Taşkın E, Orfanidis S, Stavrou P, Argyrou M, Panayotidis P, Tsioli T, Cicek BA, Marcou M, Küpper FC, 2014, Checklist of seaweeds of Cyprus (Mediterranean Sea), *Botanica Marina* 57, 153-166.