TÜBİTAK

Turkish Journal of Botany

http://journals.tubitak.gov.tr/botany/

Research Article

Turk J Bot
(2015) 39: 173-188

doi:10.3906/bot-1311-52

Marine benthic Cyanobacteria in Northern Cyprus (Eastern Mediterranean Sea)

Sevilay ULCAY*, Ergün TAŞKIN, Oğuz KURT, Mehmet ÖZTÜRK
Department of Biology, Faculty of Life Sciences and Literature, Celal Bayar University, Muradiye, Manisa, Turkey

Received: 26.11.2013 • **Accepted:** 24.07.2014 • **Published Online:** 02.01.2015 • **Printed:** 30.01.2015

Abstract: In this paper, 47 taxa (15 Chroococcales, 20 Oscillatoriales, and 12 Nostocales) of Cyanobacteria that were collected along the coasts of Northern Cyprus (Eastern Mediterranean Sea) are reported. *Aphanocapsa litoralis* (Hansgirg) Komárek & Anagnostidis, *Coelosphaerium minutissimum* Lemmermann, *Chroococcus* cf. *turicensis* (Nägeli) Hansgirg, *Chroococcus varius* A.Braun, *Spirulina tenerrima* Kützing ex Gomont, *Calothrix fuscoviolacea* P.L.Crouan & H.M.Crouan ex Bornet & Flahault, *Rivularia nitida* C.Agardh ex Bornet & Flahault, and *Scytonematopsis pilosa* (Harvey ex Bornet & Flahault) I.Umezaki & M.Watanabe are recorded for the first time from the Mediterranean Sea, and 35 taxa are also recorded for the first time from Northern Cyprus. Data are also provided concerning the geographical, morphological, and ecological distribution of each species. Sampling was based on 4 different localities (Korucam, Girne, Dip Karpaz, and Gazimağusa) in the Northern Cyprus marine ecosystem supralittoral zone at a depth of 30–35 m in the infralittoral zone between 2006 and 2008.

Key words: Cyanobacteria, Northern Cyprus, Mediterranean Sea, taxonomy

1. Introduction

Marine benthic algae of the Mediterranean Sea have been investigated by a number of researchers, but there is a general research gap in the study of cyanobacteria. However, the cyanobacteria of the Mediterranean Sea have been extensively investigated by Coppejans (1974), Haritonidis and Tsekos (1976), Tsekos and Haritonidis (1977), Nizamuddin et al. (1978), Komárek and Anagnostidis (1999, 2005), Pena and Barbara (2008), and Taşkın et al. (2001, 2004, 2008a).

Similarly, marine benthic algae of Northern Cyprus were previously studied by Cirik et al. (2000), Öztürk et al. (2009), and Taşkın et al. (2008b). Cirik et al. (2000) reported a total of 151 marine benthic algae, 11 of which were cyanobacteria. The aim of the present study was to increase our knowledge of the marine cyanobacteria of Northern Cyprus.

2. Materials and methods

2.1. Study area

This study investigated the marine cyanobacteria of Northern Cyprus. The sampling area includes the Northern Cyprus marine ecosystem supralittoral zone at a depth of 30–35 m into the infralittoral zone. Samples were collected from 4 different localities (Korucam, Girne, Dip Karpaz, and Gazimağusa) in Northern Cyprus from 2006 to 2008 during all seasons (Figure 1).

Korucam (35°24′14″N, 32°55′16″E) sampling area includes volcanic rocks and is constantly under the stimulus of waves caused by the strong wind that blows throughout the day, except in the morning. There are various sizes of pools in the area formed by volcanic rocks that are suitable for different kinds of cyanobacteria and algal species due to the climate and the effect of strong wind and waves.

In Girne (35°20′44″N, 33°19′42″E) the shore of the sampling area was formed by artificial stone blocks and volcanic tufa. There are interesting salt formations in the volcanic cavities of the shore. Occasionally, an approximately 1 m length of tide area becomes visible, and in the expanded area rocks of 4 or 5 m covered by a wide range of algae and possessing a rich diversity are visible.

Dip Karpaz (35°36′22″N, 34°26′53″E), another sampling area, is in the shape of a little bay, was formed by volcanic rock blocks, and has a width of 10–15 m and a 150–200 m barrier view. The shore side of the barrier is 20–30 m and has different sandy and stone-cavity habitats. The sea side is abruptly 8–10 m deeper with a steep and flat wall. There are many ponds of different sizes located on this barrier. These little ponds are filled with water, especially from February to March.

Gazimağusa (35°07′03″N, 33°57′29″E), the last sampling area, has big and flat volcanic rocks side by side and is covered with calcareous reef barriers where the seaside

* Correspondence: seviozturk@yahoo.com

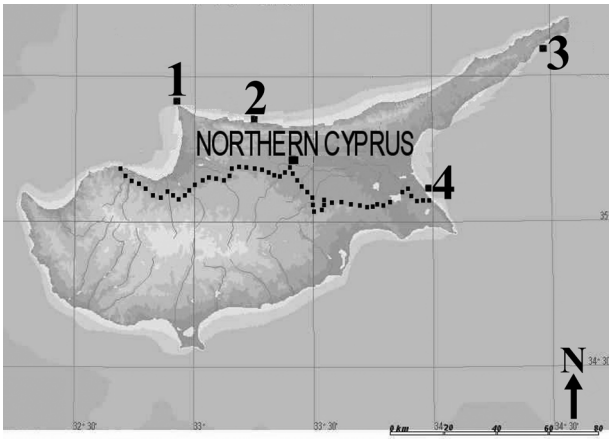


Figure 1. Map of the study area and sampling stations (1. Korucam, 2. Girne, 3. Dipkarpaz, 4. Gazimağusa).

has thin, white sand. There is a rigid, concave natural barrier 5–10 m in width and 400–500 m in length and calcareous, flat rocks in the upper infralittoral zone. The bottom of the shore side of the barrier is sandy, and there are rocks of different sizes on the sea side. Cyanobacteria members were detected in the little caves and holes on the reef barriers.

2.2. Sampling

The specimens were collected by snorkeling and scuba-diving and they were preserved in 4%–5% formaldehyde in sea water. Voucher specimens were deposited in the Department of Biology of Celal Bayar University, Manisa, Turkey.

Location was determined by Magellan SporTrak Color GPS. The pH, turbidity (NTU), temperature (°C), conductivity (mS/cm), dissolved oxygen (mg/L), and salt (‰) were measured by Water Quality Checker (DKK-TOA WQC 24), and the results are given in the Table.

2.3. Identification

The identifications were made according to Geitler (1932), Desikachary (1959), Castenholz (1989), Pankow (1990), Komárek and Anagnostidis (1989, 1999, 2005), Anagnostidis and Komárek (1990), and Komárek and Hauer (2013). Samples were studied using an Olympus BX50 microscope. For each taxon the phytogeographic affinity is given in brackets, according to Furnari et al. (1999), using the following abbreviations: Boreo-Atlantic [BA], Cosmopolite [C], Indo-Atlantic [IA], Subcosmopolitan [SC], Mediterranean Sea [M], Indo-Mediterranean [IM], Atlanto-Pacific [AP], and Circum Boreo-Austral [CBA].

3. Results

Phylum: Cyanobacteria
Class: Cyanophyceae
Order: Chroococcales
Family: Merismopediaceae Elenkin
Genus: *Aphanocapsa* Nägeli

Type species: *Aphanocapsa parietina* Nägeli

***Aphanocapsa litoralis* (Hansgirg) Komárek & Anagnostidis**

Synonyms: *Polycystis litoralis* Hansgirg; *Microcystis litoralis* (Hansgirg) Forti

Colony is 30–40 μm in diameter, oval or round (Figure 2), with colorless mucilage. Cells in the colony in an intensive sheath are clustered very densely; 4.5–5 μm in diameter; spherical; bright blue-green. Located in the coastal area with other algae; collected on sandy, rocky, and calcareous substrates at Gazimağusa and Girne; found from May to June.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988), Denmark (Nielsen, 2005), Canary Islands (Haroun et al., 2002), Baltic Sea, Norway, Portugal, Northern Atlantic coast (Komárek and Anagnostidis, 1999)], W Atlantic Ocean [Brazil (Crispino and Sant'Anna, 2006)], Indian Ocean [Shingle Island (Desikachary, 1959), Mauritius (Silva et al., 1996; Silva and Pienaar, 2000)],

Table. The average physicochemical parameters of the sampling stations.

	Korucam	Girne	Dip Karpaz	Gazimağusa
Salinity (‰)	36.4	35.8	36.7	36.6
Temperature (°C)	22.5	22.8	22.5	22.7
pH	8.4	8.4	8.4	8.4
Conductivity (mS/cm)	5.3	5.4	5.5	5.5
Dissolved oxygen (mg/L)	6.0	5.7	5.6	5.7
Turbidity (NTU)	0.9	0.9	0.5	1.0

South Africa (Silva and Pienaar, 2000), Mediterranean Sea (this study). [IA].

***Aphanocapsa marina* Hansgirg**

Synonyms: *Anacystis marina* (Hansgirg) Drouet & Dailey; *Microcystis marina* (Hansgirg) P.C.Silva; *Microcystis marina* (Hansgirg) Kosinskaja

Small mucilaginous colonies round, transparent, and amorphously structured. Individual sheath found in scattered cells in the colony. Cells very small, round, 0.5 µm in diameter, and bright blue-green. They are located in the sea, in salt water saline lakes, and on moist rocks. Collected on rocky and calcareous substrates at Gazimağusa from May to July.

Note: Silva and Pienaar (2000) reported that this is an amorphous species with homogeneous mucilaginous envelopes and associated with *Phormidium* spp.

Distribution: NE Atlantic Ocean [Spain (Ballesteros and Romero, 1982; Bárbara et al., 2005), Britain (Batters, 1902), Canary Islands (Haroun et al., 2002)], Indian Ocean [Mauritius (Silva and Pienaar, 2000)], Pacific Ocean [New Zealand (Chapman, 1956)], Mediterranean Sea [Italy (Furnari et al., 2003), Greece (Komárek and Anagnostidis, 1999), Romania (Caraus, 2002), Turkey (Taşkın et al., 2008a)]. [IA].

***Aphanocapsa orae* (Kosinskaja) Komárek & Anagnostidis**

Synonyms: *Microcystis orae* Kosinskaja; *Aphanocapsa litoralis* Hansgirg; *Microcystis halophila* Martens & Pankow

Microscopic or macroscopic size colonies covered with amorphous, transparent mucilage. Cells dark green or blue-green, round or oval, and 5 µm in diameter. Collected several times at only 1 locality and as epiphytic on *Padina pavonica* (L.) Thivy. Collected at Gazimağusa from July to August.

Distribution: NE Atlantic Ocean [France and Belgium (Dhont and Coppejans, 1988), Spain (López Rodriguez and Pérez-Cirera, 1996), France, Portugal, Canary Islands (Komárek and Anagnostidis, 1999), Denmark (Nielsen, 2005)], W Atlantic Ocean [Brazil (Crispino and Sant'Anna, 2006)], Indian Ocean [India, Mozambique, South Africa (Silva et al., 1996), Mauritius (Silva and Pienaar, 2000)], Pacific Ocean [South coast (Komárek and Anagnostidis, 1999)], Mediterranean Sea [Romania (Caraus, 2002), Mediterranean coast of Europe (Komárek and Anagnostidis, 1999), Greece (Coppejans, 1974), Mediterranean region of Iberian Peninsula (Pena and Barbara, 2008), Turkey (Aysel et al., 2008)]. [AP].

Genus: *Pannus* B.A.Hickel

Type species: *Pannus spumosus* B.A.Hickel

***Pannus punctiferus* (J.Komárek & J.Komárova-Legnerová)**

Synonyms: *Coelosphaerium punctiferum* J.Komárek & J.Komárova-Legnerová; *Coelosphaerium sensu* F.Hindák & M.T.Moustaka-Gouni

Microscopic colonies, spherical or rarely oval, and 33 µm in diameter. Sheath of colony 5 µm thick, stringent, colorless but distinctly margined. Cells arranged in almost a single layer around the colony edges. Cells spherical, bright blue-green, and 1.5 µm in diameter. Located at the supralittoral zone. Collected on rocky and calcareous substrates at Gazimağusa from July to August.

Note: The genus *Pannus* B.A.Hickel was established by Hickel (1991), and *Pannus spumosus* B.A.Hickel is the type species. Joosten (2006:119) transferred *C. punctiferum* J.Komárek & J.Komárova-Legnerová (1992) to the genus *Pannus* as *P. punctiferus* (J.Komárek & J.Komárova-Legnerová) Joosten. Joosten (2006) indicated that *C. minutissimum* E.J.Lemmerman (1900) is a possible synonym of *Pannus punctiferus*. In addition, Joosten (2006) noted that *C. minutissimum* has priority, but the original diagnosis was without illustration in Lemmerman (1900). This species was described in accounts by Komárek and Anagnostidis (1999) as *C. minutissimum* from Northern Cyprus. Joosten (2006) reported that *C. punctiferum* could be identical to *C. minutissimum*.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988), Denmark (Nielsen, 2005), Baltic Sea (Hallfors, 2004), Poland (Plinski, 2005), France, Belgium (Dhont and Coppejans, 1988)], Mediterranean Sea (this study). [BA].

Genus: *Gomphosphaeria* Kützing

Type species: *Gomphosphaeria aponina* Kützing

***Gomphosphaeria salina* Komárek & Hindák**

Cells in microscopic colonies arranged in radial form with colorless, mucilaginous stalks (Figure 3). Mucilaginous sheath of surrounding cells expanded. Shape of cells obovoid, cordiform during division. Colony size 50–70 µm. Cells 5-µm long and 3-µm wide without sheath. Located in coastal area. Collected from rocky and calcareous substrates at Gazimağusa from June to August.

Distribution: NE Atlantic Ocean [Spain (Barbara et al., 2005), Baltic Sea (Hallfors, 2004), all coasts of Europe (Komárek and Anagnostidis, 1999)], Mediterranean Sea (Komárek and Anagnostidis, 1999). [BA].

Genus: *Merismopedia* Meyen

Holotype species: *Merismopedia punctata* Meyen

***Merismopedia mediterranea* Nägeli**

Synonym: *Merismopedia glauca* f. *mediterranea* (Nägeli) Collins

Flat colonies consist of 32–64 or more cells (Figure 4), epiphyte on the red alga *Polysiphonia* spp. Cells in the colony arranged firmly in parallel rows. Colorless mucilaginous sheath is quite difficult to distinguish. Spherical or oval cells, blue-green, and 3–5 µm in diameter. Collected at Gazimağusa from July to August.

Distribution: NE Atlantic Ocean [Spain (Barbara et al., 2005), England (Parke, 1953), Portugal, France, Belgium

(Dhont and Coppejans, 1988)], Indian Ocean [South Africa (Silva et al., 1996)], Mediterranean Sea [Turkey (Taşkın et al., 2008a), Mediterranean coast (Komárek and Anagnostidis, 1999)]. [IA].

Family: Microcystaceae Elenkin

Genus: *Gloeocapsa* Kützing

Holotype species: *Gloeocapsa atrata* Kützing

***Gloeocapsa atrata* Kützing**

Synonyms: *Gloeocapsa montana* Kützing; *Anacystis montana* (Lightfoot) Drouet & Daily

Cells scattered inside of an irregular colony. Mucilaginous sheath, light blue-green, not layered. Cells spherical, green. Cells 2.5–3 µm in diameter without sheath. Located on wet rocks. Collected from sandy and rocky substrates at Girne from May to July.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988), Indian Ocean [Mauritius (Silva and Pienaar, 2000)], Australia (Phillips, 2002), Mediterranean Sea [Italy (Furnari et al., 2003), Spain (Ballesteros and Romero, 1982)]. [BA]

***Gloeocapsa salina* Hansgirg**

Microscopic, gelatinous colonies consist of small colonies with 2–4–8 cells. Small colonies 20 µm in diameter (Figure 5). Colonies cover the rocky substrate. Mucilaginous sheath around the cell layerless and colorless. Cells 6 µm in diameter and dark green or yellow-green. Located in the coastal area. Collected from rocky and calcareous substrates at Gazimağusa from April to June.

Distribution: Common in the Mediterranean Sea (Komárek and Anagnostidis, 1999). [M].

Family: Chroococcaceae Rabenhorst

Genus: *Chroococcus* Nägeli

Holotype species: *Chroococcus rufescens* (Kützing) Nägeli

***Chroococcus minutus* (Kützing) Nägeli**

Synonyms: *Protococcus minutus* Kützing; *Chroococcus virescens* Hantzsch; *Gloeocapsa minuta* (Kützing) Hollerbach

Cells spherical or oval, solitary or in few-celled colonies with 2–4 cells. Mucilage homogeneous and colorless. Bright blue-green cells, agranular. Cell diameter 5 µm. Collected as epilithic on rocky and calcareous substrates, as epiphytic on macroalgae from Girne and Gazimağusa; found from February to April.

Note: Komárek and Anagnostidis (1999) reported that *Chroococcus minutus* (Kützing) Nägeli is distributed in freshwater habitats and marine populations and belongs very probably to other species. However, this taxon is also known from marine habitats. Silva et al. (1996), Silva and Pienaar (2000), and Caraus (2002) collected this taxon in marine habitats.

Distribution: NE Atlantic Ocean [Baltic Sea (Hallfors, 2004), Poland (Plinski, 2005)], Indian Ocean [India, Mozambique, Madagascar, Bahrain (Silva et al., 1996), Mauritius (Silva and Pienaar, 2000)], Mediterranean Sea [Romania (Caraus, 2002), Turkey (Taşkın et al., 2008a)]. [IA].

***Chroococcus spelaeus* Ercegovic**

Colonies microscopic structure, with 2 cells, and diffluent common sheath. Mucilage colorless, no layers, and greatly extended. Bilateral colony 37 µm, single cell with sheath 15 µm in diameter, without sheath 8 µm. Cells inside granule are bright olive-green. Located on wet rocks. Collected from rocky and calcareous substrates at Gazimağusa from February to March.

Note: According to Komárek and Anagnostidis (1999), this species is aerophytic and lives on wet rocks among other algae. Guiry and Guiry (2013) indicate that this is a marine species. In this study, this species was found on rock in the mid-littoral zone.

Distribution: Mediterranean Sea [Croatia (Komárek and Anagnostidis, 1999)]. [M].

***Chroococcus* cf. *turicensis* (Nägeli) Hansgirg**

Synonym: *Chroococcus rufescens* var. *turicensis* Nägeli

The colony 42 µm in diameter with sheath (Figure 6). Each cell in multicellular colony has its own individual mucilaginous sheath. Mucilaginous sheath broad, transparent, and lamellae-free. Cells 13 µm in length, 20-µm wide, olive-green or yellow-green color, and granulate. Located on wet rocks. Collected from rocky substrate at Girne from January to February.

Note: Komárek and Anagnostidis (1999) indicated *Chroococcus turicensis* (Nägeli) Hansgirg on moist rocks on high mountains. This species was also reported from marine habitats (Silva et al., 1996). In this study it was collected from the supralittoral zone in winter.

Distribution: Indian Ocean [Aldabra Islands (Silva et al., 1996)], Mediterranean Sea (this study). [IM].

***Chroococcus varius* A.Braun**

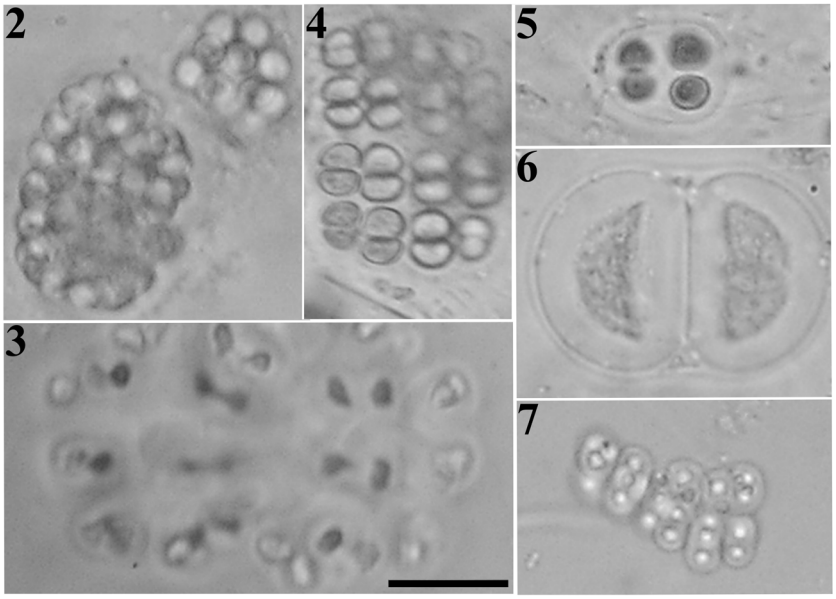
Small colonies formed as 2–3–4 cells, and they come together forming an irregular shape (Figure 7); as a result, they create large colonies that are epilithic. Colonies almost straight when they expand. Bright blue-green cells transparent, and they have a broad mucilaginous sheath. Common sheath inside the cells has single, mucilaginous sheath. Cell 6–8 µm in diameter with sheath, 2.5–3 µm in diameter without sheath. Intracellular granules absent. Collected from supralittoral zone on rocky and calcareous substrates at Girne; found from February to April.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988)], Indian Ocean [Saudi Arabia, Kuwait (Silva et al., 1996)], Mediterranean Sea (this study). [IA].

Family: Entophysalidaceae Geitler

Genus: *Entophysalis* Kützing

Holotype species: *Entophysalis granulosa* Kützing



Figures 2–7. Figure 2. *Aphanocapsa litoralis*; **Figure 3.** *Gomphosphaeria salina*; **Figure 4.** *Merismopedia mediterranea*; **Figure 5.** *Gloeocapsa salina*; **Figure 6.** *Chroococcus* cf. *turicensis*; **Figure 7.** *Chroococcus varius*. All figures at the same scale. Scale bar = 10 μm.

***Entophysalis deusta* (Meneghini) F.E.Drouet & W.A.Daily**

Synonyms: *Coccochloris deusta* Meneghini; *Gloeocapsa deusta* (Meneghini) Kützing

Flat colonies, macroscopic size, dirty yellow-brown or orange. Mature colonies consist of small irregular subcolonies. The cells are more or less spherical or slightly elongated, 3–5 μm in diameter, bright blue-green. Different numbers of colonies (2–3–4) come together to create larger colonies. Colonies of cells were arranged irregularly. Collected from supralittoral zone on wet rocky substrate at Girne; found from February to March.

Note: Guiry and Guiry (2013) indicated that this species was collected from freshwater habitats. However, Komárek and Anagnostidis (1999) reported this species from marine habitats.

Distribution: NE Atlantic Ocean [Portugal (Komárek and Anagnostidis, 1999), Spain (Barbara and Cremades, 1996; Gorostiaga et al., 2004; Barbara et al., 2005), Canary Islands (Haroun et al., 2002), Portugal (Araujo et al., 2009)], SE Atlantic Ocean [Gambia, Ghana (Lawson and John, 1987)], W Atlantic Ocean [Maryland, USA (Wulff et al., 1968); Virginia, USA (Wulff and Webb, 1969); Delaware, USA (Zaneveld, 1972)], Indian Ocean [Maldives, Abu Dhabi, Bahrain, Iran, Indonesia (Silva et al., 1996), Suez Canal (Aleem, 1980)], Pacific Ocean [Eastern Pacific Ocean (Dawson, 1959)], Mediterranean Sea [Spain (Ballesteros and Romero, 1982; Pena and Barbara, 2008), Egypt (Papenfuss, 1968), Italy, Aegean Sea coast, Adriatic coast (Komárek and Anagnostidis, 1999), Italy (Ardissone, 1886)]. [SC].

Family: Xenococcaceae Ercegovic

Genus: *Dermocarpa* P.L.Crouan & H.M.Crouan

***Dermocarpa acervata* (Setchell & Gardner) Pham-Hoàng Hô**

Synonym: *Xenococcus acervatus* Setchell et N.L.Gardner

Cells arranged in a single layer as an epiphyte on other filamentous cyanobacteria, brown and green algae. Cells usually spherical, elliptical, or rarely pear-shaped. Cell diameters range 3–6 μm. Cells have a clearly visible transparent mucilaginous sheath. Cells bright blue-green with a homogeneous content. Collected as epilithic on rocky, calcareous, and volcanic rocky substrates; as epiphytic on macro algae at Girne, Gazimağusa, and Dip Karpaz; found from February to April.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; López Rodriguez and Pérez-Cirera, 1996), Norway (Lein et al., 1999), Canary Islands (Haroun et al., 2002; Komárek and Anagnostidis, 1999)], W Atlantic Ocean [Brazil (Komárek and Anagnostidis, 1999)], Indian Ocean [Sri Lanka, Japan (Komárek and Anagnostidis, 1999); Mozambique, South Africa, Bahrain, India, Pakistan, Sri Lanka (Silva et al., 1996)], Mediterranean Sea [Turkey (Taşkın et al., 2008a), France (Komárek and Anagnostidis, 1999)]. [IA].

Genus: *Xenococcus* Thuret in Bornet & Thuret

Holotype species: *Xenococcus schousboei* Thuret

***Xenococcus schousboei* Thuret**

Synonyms: *Dermocarpa schousboei* (Thuret) Bornet; *Coleonema arenifera* Schousboe

Colonies consist of spherical cells. Colonies flat and attached to the substrate. Blue-green, cell diameters 6–9

µm. Collected as epiphytic on macroalgae at Gazimağusa and found from June to July.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; López Rodriguez and Pérez-Cirera, 1996; Pena and Barbara, 2002; Gorostiaga et al., 2004; Barbara et al., 2005), France, Belgium (Dhont and Coppejans, 1988), Denmark (Nielsen, 2005), Norway (Lein et al., 1999), Portugal (Araujo et al., 2009), Britain (Batters, 1902; Parke, 1953), Baltic Sea (Komárek and Anagnostidis, 1999)], W Atlantic Ocean [Jamaica (Collins, 1901); Caribbean Sea (Taylor and Arndt, 1929)], Indian Ocean [Aldabra Island (Silva et al., 1996)], Pacific Ocean [California, USA (Taylor, 1945); Japan, Southwest Pacific coast (Komárek and Anagnostidis, 1999)], Mediterranean Sea [Mediterranean Sea coasts, Black Sea (Komárek and Anagnostidis, 1999), Italy (Ardissone, 1886)]. [SC].

Order: Oscillatoriales

Family: Pseudanabaenaceae Anagnostidis & Komárek

Genus: *Tapinothrix* Sauvageau

Holotype species: *Tapinothrix bornetii* Sauvageau

***Tapinothrix* sp.**

Grass-like thallus as erect on the substrate. Thallus dirty olive-green or brown-yellow. Filament width up to 2–3 µm. Mucilage very thin and colorless. Cross-walls quite apparent. Cell lengths less than widths. Cells are light yellow-green or light olive-green. Located on littoral rocks. Collected from rocky substrate at Gazimağusa from June to July.

Note: The genus *Tapinothrix* was first described by Sauvageau (1892), and *Tapinothrix bornetii* Sauvageau [=*Homeothrix bornetii* (Sauvageau) Mabille] is the type species. The genus *Tapinothrix* includes some species of *Homoeothrix* (Komárek and Anagnostidis, 2005). Within the Pseudanabenaceae there are 3 genera with tapering trichomes whose species are attached to the substrate at the base: *Tapinothrix* Sauvageau, *Amphithrix* Kützing ex Bornet & Flahault, and *Leptochaete* Hansgirg (Johansen et al., 2011). Another tapering genus is *Homoeothrix*, which differs from *Tapinothrix* by trichomes and cell morphology and probably the arrangement of thylakoids, and so it is considered under Oscillatoriaceae.

Distribution: Mediterranean Sea (this study). [M].

Genus: *Leibleinia* (Gomont) L.Hoffman

Type species: *Leibleinia baculum* (Gomont) Hoffmann

***Leibleinia epiphytica* (Hieronymus) Compère**

Synonym: *Lyngbya epiphytica* Hieronymus

Solitary filaments surrounding other filamentous genus as an epiphyte. Filaments cling tightly in a twisted way. Thin sheath barely visible. Blue-green trichomes 1.5–2-µm wide, not constricted at the cross-walls, cells longer than wide, 2–2.5-µm long. The end of the cells rounded. Collected as epiphytic on algae at Gazimağusa, Dip Karpaz, and Girne; found from July to September.

Note: *Leibleinia epiphytica* (Hieronymus) Compère surrounded by *Lyngbya aestuarii* (Mertens) Liebman ex Gomont and *Lyngbya confervoides* C.Agardh ex Gomont.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; Barbara and Cremades, 1996; López Rodriguez and Pérez-Cirera, 1996; Barbara et al., 2005), France, Belgium (Dhont and Coppejans, 1988), Norway (Lein et al., 1999)], Indian Ocean [Bahrain, Kuwait, Aldabra Islands (Silva et al., 1996)], Pacific Ocean [Galapagos Islands (Taylor, 1945)], Mediterranean Sea [Turkey (Taşkın et al., 2008a), Israel, Egypt (Papenfuss, 1968)]. [IA].

***Leibleinia willei* (Setchell & Gardner) P.C.Silva**

Synonyms: *Lyngbya willei* Setchell & Gardner; *Lyngbya epiphytica* Wille; *Lyngbya nordgaardii* Wille; *Leibleinia nordgaardii* Anagnostidis & Komárek; *Heteroleibleinia epiphytica* Komárek

Filaments cling to 1 or a few points on other algae as epiphytic. Usually the 2 ends of filaments exposed. Sometimes the trichome clings to a single point and stands upright on the substrate. Mucilage sheaths very thin, transparent, and fragile; ends of the sheaths open. Trichomes 1.5–2.5-µm wide, bright blue-green. Cross-walls quite constricted. Cells very short, 1–1.5 µm. Cells at the end rounded and without calyptra. This species was found as an epiphyte on the brown alga *Ralfsia verrucosa* (Areschoug) Areschoug. Collected as epiphytic at Girne, Gazimağusa, and Dip Karpaz; found from April to June.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988), France, Belgium (Dhont and Coppejans, 1988), Norway (Lein et al., 1999; Komárek and Anagnostidis, 2005)], Indian Ocean [Suez Canal (Aleem, 1980), Madagascar, India (Silva et al., 1996)], Pacific Ocean [California, USA; Pacific coasts (Komárek and Anagnostidis, 2005)], Mediterranean Sea [Turkey (Taşkın et al., 2008a), Egypt (Papenfuss, 1968), Black Sea, Mediterranean Sea (Komárek and Anagnostidis, 2005)]. [AP].

Genus: *Leptolyngbya* Anagnostidis & Komárek

Type species: *Leptolyngbya boryana* (Gomont) Anagnostidis & Komárek

***Leptolyngbya fragilis* (Gomont) Anagnostidis & Komárek**

Synonyms: *Phormidium fragile* Gomont; *Lyngbya fragilis* (Gomont) Compère

Thallus in the form of a mat, blue-green or brownish-green. Trichomes 2.5–3-µm wide, blue-green. Trichomes attenuated at the ends. Sheaths colorless and thin. Cross-walls transparent, constricted. Cells 4–5-µm long, bright blue-green. Apical cells acute-conical. Located on coastal rocks in littoral. Collected from rocky substrate at Girne and found from June to August.

Distribution: NE Atlantic Ocean [Britain (Batters, 1902), Spain (Alvarez and Gallardo, 1988; Barbara and Cremades, 1996; López Rodriguez and Pérez-Cirera, 1996), France, Belgium (Dhont and Coppejans, 1988), Denmark (Nielsen, 2005), Poland (Plinski, 2005)], Mediterranean Sea [Egypt (Papenfuss, 1968)]. [BA].

Genus: *Spirulina* Turpin ex Gomont

Type species: *Spirulina major* Kützing [=*Arthrospira major* (Kützing) Crow]

***Spirulina subsalsa* Orsted ex Gomont**

Synonyms: *Spirulina tenuissima* Kützing; *Oscillatoria oceania* Crouan; *Spirulina subsalsa* f. *genuina* Gomont; *Spirulina subsalsa* f. *oceania* (Crouan) Gomont; *Spirulina neumannii* Schmidle; *Spirulina compacta* Perfilev; *Spirulina tenuissima* var. *salina* Wislouch; *Arthrospira subsalsa* Crow; *Spirulina supersalsa* Schiller; *Spirulina condensata* Welsh; *Oscillatoria subsalsa* (Örsted) Bourrelly; *Oscillatoria neumannii* (Schmidle) Iltis

Single trichome bright blue-green, 1–1.5-µm wide, motile, regularly screw-like, and coiled. Spirals very tight and touch each other, without inter coil distances, 3-µm wide. Collected with other algae from rocky and calcareous substrates at Gazimağusa and Girne and found from May to August.

Distribution: NE Atlantic Ocean [Britain (Batters, 1902), Canary Islands (Haroun et al., 2002), Norway (Lein et al., 1999), France, Belgium (Dhont and Coppejans, 1988), Spain (López Rodriguez and Pérez-Cirera, 1996), Denmark (Nielsen, 2005)], W Atlantic Ocean [Virginia, USA (Wulff and Webb, 1969); Delaware, USA (Zaneveld, 1972); Colombia (Diaz-Pulido and Diaz-Ruiz, 2003)], Indian Ocean (Silva et al., 1996), South Africa (Silva and Pienaar, 2000), Pacific Ocean [Eastern Pacific Ocean (Dawson, 1959)], Mediterranean Sea [Turkey (Taşkın et al., 2008a), Italy (Furnari et al., 2003), Spain (Alvarez and Gallardo, 1988; Barbara and Cremades, 1996; Barbara et al., 2005). [C].

***Spirulina tenerrima* Kützing ex Gomont**

Synonym: *Spirulina tenerrima* Kützing

Long trichomes among other cyanobacteria, singly. Trichomes bright blue-green, 0.5-µm wide. Regular spirals not tight and not touching other spirals. Collected with other algae and cyanobacteria from rocky substrate at Gazimağusa; found from June to July.

Distribution: NE Atlantic Ocean [Spain (López Rodriguez and Pérez-Cirera, 1996; Barbara et al., 2005; Canary Islands (Haroun et al., 2002), Poland (Plinski, 2005)], Indian Ocean [Suez Canal (Aleem, 1980), Mauritius (Silva and Pienaar, 2000), Bahrain (Silva et al., 1996)], Pacific Ocean [Galapagos Islands (Taylor, 1945), Marshall Islands (Newhouse, 1954), Eastern Pacific Ocean (Dawson, 1959)], Australia (Phillips, 2002), Mediterranean Sea (this study). [SC].

Family: Schizotrichaceae Elenkin

Genus: *Trichocoleus* Anagnostidis

Type species: *Trichocoleus delicatulus* (W.West & G.S.West) Anagnostidis

***Trichocoleus tenerrimus* (Gomont) Anagnostidis**

Synonyms: *Microcoleus tenerrimus* Gomont; *Schizothrix tenerrima* (Gomont) Drouet

Filaments in large groups or among other algae, 10-µm wide. Single trichome in own sheath or 6–7 trichomes found in a common sheath. Trichome 1.5–2-µm wide. Transparent mucilaginous sheath narrowed towards ends. Usually transparent cross-walls constricted. Bright green colored cells, 2–2.5 µm in length, and rarely granulated. Located on coastal rocks in littoral. Collected from sandy and rocky substrates at Girne and found from February to April.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; Barbara and Cremades, 1996; López Rodriguez and Pérez-Cirera, 1996)], Indian Ocean [Australia, Bahrain, Indonesia, Kenya, Maldives (Silva et al., 1996)], Pacific Ocean [Galapagos Islands (Taylor, 1945)], Australia (Phillips, 2002), Mediterranean Sea [Israel (Papenfuss, 1968)]. [IA].

Family: Phormidiaceae Anagnostidis & Komárek

Genus: *Phormidium* Kützing ex Gomont

Type species: *Phormidium lucidum* (C.Agardh) Kützing ex Gomont

***Phormidium ambiguum* Gomont**

Synonyms: *Amphithrix amoena* Kützing; *Lyngbya bourrellyana* Compère

Thallus bright blue-green or yellow-green. Filaments 6–6.5-µm wide. Mucilaginous sheath thin, loose, transparent, and stratified. Cross-walls not constricted. Cells 2 µm in length, granulated. Apical cells rounded, without calyptra. Located at littoral. Collected from sandy substrate at Girne and found from May to June.

Distribution: NE Atlantic Ocean [Britain (Batters, 1902; Parke, 1953)], Indian Ocean [Madagascar, South Africa, India, Sri Lanka (Silva et al., 1996), Mauritius, South Africa (Silva and Pienaar, 2000), Philippines (Silva et al., 1987)], Mediterranean Sea [Romania (Caraus, 2002), Turkey (Taşkın et al., 2008a)]. [IA].

***Phormidium litorale* Golubic**

Blue-green thallus-like skin and lamellate. Filaments very long, curly, 4–5-µm wide (Figures 8 and 9). Cells 5–6-µm long, bright blue-green or olive-green, and with small granules. Sheath transparent, thin, and firm. Cross-walls constricted very slightly. Apical cells sometimes slightly attenuated. Trichomes end often with an enlarged cone-shaped calyptra. Collected from rocky and calcareous substrates at Gazimağusa and found from April to May.

Distribution: Only in the Mediterranean Sea [Adriatic Sea, Croatia (Komárek and Anagnostidis, 2005)]. [M].

Genus: *Symploca* Kützing ex Gomont

Type species: *Symploca muralis* (Kützing) Gomont

***Symploca hydnoides* Gomont**

Synonyms: *Symploca hydnoides* var. *fasciculata* [Kützing] Gomont; *Symploca catenella* Hauck ex Gomont; *Phormidium rubinatum* Collins; *Symploca microdonta* Setchell & Gardner; *Symploca hydnoides* f. *minor* Iyengar & Desikachary

Filaments grow erect on the substratum. Dark blue-green thallus 3–4-cm high. Empty sheaths brownish-yellow, attached to substrate at the bottom of the thallus. Filaments parallel, arranged at the apex of the thallus. Mucilaginous transparent, not very narrow. Yellow-green, light blue-green, trichome width 6–7.5 µm. Cell length 5–10 µm. Cells have large and small granules. Cross-walls constricted, transparent. Grows as epilithic on rocky substrate by erect filaments. Creates densely mat-like patches, thallus 3–4 cm in length on the rocks. Collected from rocky and calcareous substrates from Gazimağusa; found from June to August.

Distribution: NE Atlantic Ocean [Spain (Barbara and Cremades, 1996; Gorostiaga et al., 2004; Barbara et al., 2005), Britain (Parke, 1953), Canary Islands (Haroun et al., 2002), Denmark (Nielsen, 2005)], Indian Ocean [common in the Indian Ocean (Silva et al., 1996), Western Australia (Huisman, 2004)], Pacific Ocean [Revillagigedo (Taylor, 1945), Marshall Islands (Newhouse, 1954), Philippines (Silva et al., 1987), Thailand (Thongroy et al., 2007)], Australia (Phillips, 2002; Huisman and Borowitzka, 2003), Mediterranean Sea [Northern Cyprus (Cirik et al., 2000), Turkey (Taşkın et al., 2008a)]. [C].

Genus: *Trichodesmium* C.G.Ehrenberg ex Gomont

Type species: *Trichodesmium erythraeum* Ehrenberg

***Trichodesmium* sp**.

Bright blue-green trichomes usually arranged in parallel to form colony or occur singly. Without sheath 6-µm wide (Figure 10). Cross-wall constrictions quite apparent. Cells light blue-green, 5–7.5 µm in diameter. Different size aerotopes arranged irregularly. Slightly attenuated toward the end of trichome and finished with rounded cell. Collected from rocky substrate at Girne and found from February to April.

Distribution: Mediterranean Sea (this study). [M].

Note: The genus *Trichodesmium* is typically planktonic. *Trichodesmium* sp. was collected at the mediolittoral zone on rocky substrate in a small pit. It is very similar to *Trichodesmium erythraeum* Ehrenberg ex Gomont by morphological characters, but it differed from *T. erythraeum* (reddish violet) by the bright blue-green color. Identification of this taxon should be investigated in culture (Jiri Komárek, pers. com.).

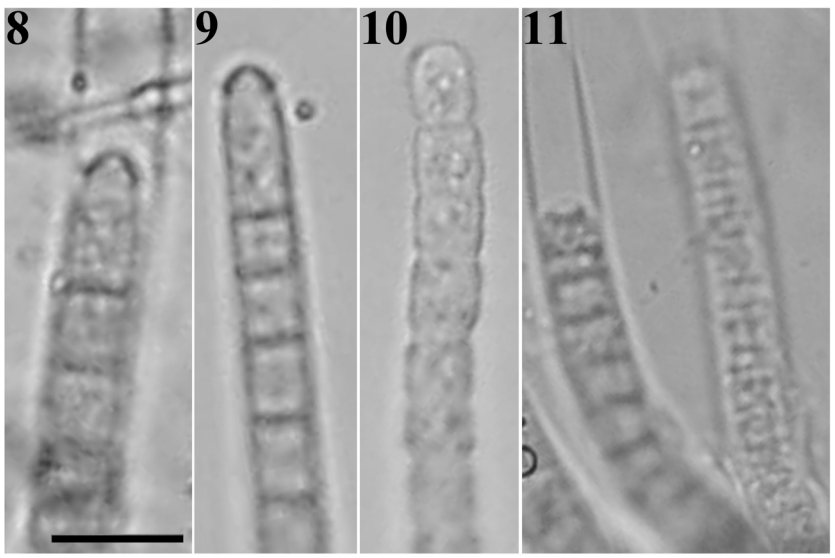
Family: Oscillatoriaceae Engler

Genus: *Lyngbya* C.Agardh ex Gomont

Type species: *Lyngbya confervoides* C.Agardh

***Lyngbya adriae* Ercegovic**

Very short filaments epiphyte on macroalgae. Filaments attached to the substrate by middle part, erect on both ends (Figure 11). Cross-walls without constriction. Trichomes light blue-green, yellow-green. Mucilaginous sheath transparent. Trichomes 7.5-µm wide, cells 3.5-µm long. Cells not attenuated at the end of the trichomes. Apical cells of trichomes rounded. Collected from volcanic



Figures 8–11. Figures 8 and 9. *Phormidium litorale*; **Figure 10.** *Trichodesmium* sp.; **Figure 11.** *Lyngbya adriae*. All figures at the same scale. Scale bar = 10 µm.

rocky substrate as epiphytic on macroalgae at Dip Karpaz; found from February to May.

Distribution: Only in the Mediterranean Sea [Croatia (Ercegovic, 1957), Northern Cyprus (Cirik et al., 2000), Turkey (Taşkın et al., 2008a)]. [M].

***Lyngbya aestuarii* Liebman ex Gomont**

Synonyms: *Conferva aestuarii* Mertens; *Oscillatoria aestuarii* (Mertens) Lyngbye; *Lyngbya aestuarii* (Mertens) Liebman; *Lyngbya aestuarii* (Mertens) Lyngbye; *Oscillatoria aestuarii* (Mertens) Lyngbye ex Gomont; *Oscillatoria aestuarii* var. *atrovirens* Jurgens ex Gomont

Thallus dark blue-green, black-green. Filaments rarely solitary. Sheaths thin and wide, outside uneven and colorless, inside sometimes in yellowish. Filaments blue-green or dark olive-green. Trichomes with sheath 35 µm in diameter, without sheath 22.5 µm in diameter. Cells 4-µm long. Cross-walls not constricted, sometimes with granulation. Apical cells rounded, or often with thickened cell wall. Collected from rocky substrate at Girne and Gazimağusa and found from April to May.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; López Rodriguez and Pérez-Cirera, 1996; Gorostiaga et al., 2004; Barbara et al., 2005), Portugal (Araujo et al., 2009), Britain (Parke, 1953), Canary Islands (Haroun et al., 2002), Denmark (Nielsen, 2005), Poland (Plinski, 2005)], W Atlantic Ocean [Jamaica (Collins, 1901); Colombia (Diaz-Pulido and Diaz-Ruiz, 2003); Delaware, USA (Zaneveld, 1972); Brazil (Crispino and Sant'Anna, 2006)], Indian Ocean [common in Indian Ocean (Silva et al., 1996)], Pacific Ocean [Revillagigedo (Taylor, 1945), Marshall Islands (Newhouse, 1954), Vietnam (Dawson, 1954), Hong Kong (Lee, 1964), Philippines (Silva et al., 1987)], Mediterranean Sea [Turkey (Taşkın et al., 2008a), Romania (Caraus, 2002), Genova (Ardissone, 1886)]. [C].

***Lyngbya confervoides* C.Agardh ex Gomont**

Synonym: *Lyngbya confervoides* C.Agardh

Thallus dark green. Filaments 13-µm wide, straight. Sheaths colorless and homogeneous. Sheath outside smooth at young filaments; later becomes rough. Trichomes olive-green or dark blue-green, 9–10-µm wide. Cross-walls not constricted. Cells 2–2.5-µm long and with granulation. Trichomes not attenuated at the ends. Apical cells rounded and without calyptra. Collected from rocky substrate at supralittoral zone at Girne and Gazimağusa and found from February to May.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; Barbara and Cremades, 1996; López Rodriguez and Pérez-Cirera, 1996; Pena and Barbara, 2008), Norway (Lein et al., 1999), Portugal (Komárek and Anagnostidis, 2005; Araujo et al., 2009), Britain (Parke, 1953), France, Belgium (Dhont and Coppejans, 1988), Denmark (Nielsen, 2005), Canary Islands, Madeira (Haroun et al., 2002)], W Atlantic Ocean [Colombia (Diaz-Pulido and Diaz-Ruiz, 2003); Delaware, USA (Zaneveld, 1972); Caribbean Sea (Taylor and Arndt, 1929); Brazil (Crispino and Sant'Anna, 2006); Jamaica (Komárek and Anagnostidis, 2005)], Indian Ocean [Mauritius, South Africa (Silva and Pienaar, 2000), Suez Canal (Aleem, 1980), Saudi Arabia (Silva et al., 1996), West Australia (Huisman and Borowitzka, 2003; Huisman, 2004)], Pacific Ocean [Philippines (Silva et al., 1987), Japan (Komárek and Anagnostidis, 2005), Hong Kong (Lee, 1964), Phoenix Islands (South et al., 2001)], Australia (Phillips, 2002), Mediterranean Sea [Northern Cyprus (Cirik et al., 2000), Turkey (Taşkın et al., 2008a), Romania (Caraus, 2002), Egypt (Papenfuss, 1968), Mediterranean Sea coasts (Komárek and Anagnostidis, 2005)]. [C].

***Lyngbya majuscula* Harvey ex Gomont**

Synonyms: *Conferva majuscula* Dillwyn; *Oscillatoria majuscula* (Dillwyn) Dillwyn; *Elisa majuscula* (Dillwyn) S.F.Gray; *Lyngbya majuscula* (Dillwyn) Harvey; *Lyngbya major* var. *kerguelenensis* Reinsch; *Lyngbya majuscula* var. *kerguelenensis* Reinsch ex Forti

Thallus dark blue-green, widely expanded. Sheaths outside rough, colorless. Trichomes blue-green, dull-green. Filaments 27.5-µm wide. Cells 2.5–5-µm long. Cross-walls without granulation and constriction. Apical cells rounded and without calyptra. Collected from littoral rocky substrate at Gazimağusa and found from May to July.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; Gorostiaga et al., 2004; Barbara et al., 2005; López Rodriguez and Pérez-Cirera, 1996), Britain (Parke, 1953), Canary Islands (Haroun et al., 2002), Denmark (Nielsen, 2005), Poland (Plinski, 2005)], W Atlantic Ocean [Jamaica (Collins, 1901), Caribbean Sea (Taylor and Arndt, 1929), Colombia (Diaz-Pulido and Diaz-Ruiz, 2003)], Indian Ocean [Sri Lanka (Silva et al., 1996), Yemen (Papenfuss, 1968), Indonesia, Zanzibar (Komárek and Anagnostidis, 2005)], Pacific Ocean [Revillagigedo (Taylor, 1945), Marshall Islands (Newhouse, 1954), Philippines (Silva et al. 1987), Phoenix Islands (South et al. 2001), Thailand (Thongroy et al., 2007), Vietnam (Dawson, 1954)], Australia (Phillips, 2002), Mediterranean Sea [Northern Cyprus (Taşkın et al., 2008b), Egypt (Papenfuss, 1968), Genova, Corsica, Napoli (Ardissone, 1886)]. [C].

***Lyngbya salina* Kützing ex Starmach**

Synonyms: *Lyngbya salina* (Kützing) Kützing; *Lyngbya aestuarii* var. *salina* (Kützing) Hansgirg; *Lyngbya confervoides* f. *salina* (Kützing) Elenkin

Thallus olive-green, layered. Filaments wavy, in clusters. Sheaths colorless, homogeneous, quite large. Trichomes bright or light blue-green. Cross-walls with granulation and without constriction. Filaments with sheaths 15-µm wide, without sheaths 7.5-µm wide. Cells 2.5-µm long. Apical cells rounded without calyptra or

thickened cell walls. Collected from shallow accumulation waters on rocky and calcareous substrates at upper-supralittoral at Gazimağusa; found from July to August.

Distribution: Europe, North America (Komárek and Anagnostidis, 2005), Mediterranean Sea [Romania (Caraus, 2002)].

***Lyngbya semiplena* (C.Agardh) J.Agardh ex Gomont**

Synonyms: *Calothrix semiplena* C.Agardh; *Lyngbya semiplena* (C.Agardh) J.Agardh; *Leibleinia semiplena* (C.Agardh) Kützing

Thallus soft, dark yellow-green. Filaments 8–13-µm wide. Mucilaginous sheath colorless, enlarged. Trichomes constricted at the often granulated cross-walls. Trichomes blue-green or olive-green and attenuated at the ends. Apical cells conical, with calyptra or conical calyptra. Collected on littoral rocky substrate from Girne and Gazimağusa and found from April to September.

Note: This species was reported as *Lyngbya semiplena* J.Agardh ex Gomont by Komárek and Anagnostidis (2005). Taylor (1945) cited this species as *Lyngbya semiplena* Gomont.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; Barbara and Cremades, 1996; Gorostiaga et al., 2004; Barbara et al., 2005), France, Belgium (Dhont and Coppejans, 1988), Portugal (Araujo et al., 2009), Britain (Parke, 1953), Norway (Lein et al., 1999)], W Atlantic Ocean [Brazil (Crispino and Sant'Anna, 2006); Maryland, USA (Wulff et al., 1968); Delaware, USA (Zaneveld, 1972)], Indian Ocean [Madagascar, Mauritius, South Africa, Reunion, Indian Ocean Island, Bangladesh, India, Indonesia (Silva et al., 1996), West Australia (Huisman and Borowitzka, 2003; Huisman, 2004)], Pacific Ocean [California, USA; Costa Rica (Taylor, 1945); Philippines (Silva et al., 1987); Phoenix Islands (South et al., 2001)], Australia (Phillips, 2002), Mediterranean Sea [Turkey (Taşkın et al., 2008a), Egypt (Papenfuss, 1968), Mediterranean Sea coasts (Komárek and Anagnostidis, 2005)]. [C].

***Lyngbya sordida* Gomont**

Synonyms: *Leibleinia capillacea* Kützing; *Leibleinia polychroa* Meneghini; *Lyngbya polychroa* (Meneghini) Rabenhorst; *Calothrix sordida* Zanardini ex Kützing; *Lyngbya bostrychicola* P.L.Crouan et H.M.Crouan; *Lyngbya bostrychicola* P.L.Crouan et H.M.Crouan ex Gomont; *Lyngbya sordida* f. *bostrychicola* (P.L.Crouan et H.M.Crouan) Gomont; *Lyngbya capillacea* Kützing ex Forti; *Lyngbya polychroa* Meneghini ex Forti; *Lyngbya rosea* W.R.Taylor; *Lyngbya sordida* var. *rosea* (W.R.Taylor) Drouet; *Leibleinia sordida* (Gomont) Anagnostidis

Dark yellow-green thallus expanded. Filaments straight. Sheaths thin and colorless (Figure 12). Trichomes yellow-brown, yellow-green, or reddish-purple, becomes reddish-violet when dried. Filaments with sheaths 26-µm wide, without sheaths 20-µm wide. Cells 5-µm long. Trichomes constricted at the cross-walls. Cross-walls without granulation. Trichomes attenuated at the ends. Apical cell rounded. Epiphytic on *Padina pavonica* (L.) Thivy or epilithic on littoral rock. Collected from rocky substrate and on macroalgae as epiphytic from Gazimağusa; found from April to August.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988)], European Atlantic coasts, Indian coasts, Pacific Ocean, Australia (Komárek and Anagnostidis, 2005), Indian Ocean [Madagascar, Mauritius, Aldabra Island, India, Sri Lanka (Silva et al., 1996)], Pacific Ocean [Philippines (Silva et al., 1987)], Marshall Islands (Newhouse, 1954)], Mediterranean Sea [Egypt, Israel (Papenfuss, 1968), Adriatic Sea, Mediterranean Sea (Komárek and Anagnostidis, 2005), Iberian Peninsula (Pena and Barbara, 2008)]. [SC].

Genus: *Oscillatoria* Vaucher ex Gomont

Type species: *Oscillatoria princeps* Vaucher ex Gomont

***Oscillatoria margaritifera* Kützing ex Gomont**

Synonym: *Oscillaria margaritifera* Kützing

Thallus mucilaginous, expanded, blackish-green or dark olive-green. Single trichomes rarely among other algae. Trichomes mostly straight, bright olive-green, 15–20-µm wide. Cells 5–6-µm long. Cross-walls slightly and distinctly constricted. Granules located on both sides of the cross-walls. Apical cells with a very distinct convex calyptra. Collected on benthic algae as epiphytic at Gazimağusa and found from June to July.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; Barbara et al., 2005), France, Belgium (Dhont and Coppejans, 1988), Britain (Batters, 1902; Parke, 1953), Canary Islands (Haroun et al., 2002), Poland (Plinski, 2005)], Indian Ocean [Seychelles, Bangladesh, India, Sri Lanka (Silva et al., 1996)], Pacific Ocean [Philippines (Silva et al., 1987), Vietnam (Dawson, 1954), Hong Kong (Nagarkar, 2002)], Australia (Phillips, 2002), Mediterranean Sea [Turkey (Taşkın et al., 2008a), Egypt (Papenfuss, 1968)]. [IA].

***Oscillatoria* sp.**

Thallus rarely formed and dark blue-green or blackish-green. Solitary trichomes bright blue-green or gray-green, among other algae. Trichomes straight, 12–13-µm wide, rarely with a sheath. Cells 3–4-µm long. Cross-walls not constricted or slightly constricted, ungranulated or granulated with particles. Trichomes slightly attenuated at the ends. Apical cells with a flat, rounded, or semirounded significantly thickened cell wall (Figure 13). Collected from rocky substrate with other algae at littoral of Gazimağusa and found from June to August.

Distribution: Mediterranean Sea (this study). [M].

Order: Nostocales

Family: Microchaetaceae Lemmermann

Genus: *Microchaete* Thuret ex Bornet & Flahault

Holotype species: *Microchaete grisea* Thuret

***Microchaete* sp.**

Filaments come together densely and erectly in thallus. Filaments heteropolar, 20-µm wide (Figure 14). Cells pale blue-green, 5-µm long, barrel-shaped. Mucilaginous sheaths lamellate, colorless or yellowish, and narrow and firm at the ends. Trichomes 10-µm wide. Rarely, false branching occurs after intercalary heterocyst. Caespitous colonies located on rocks at the littoral zone. Collected from rocky substrate at Girne and found from May to July.

Distribution: Mediterranean Sea (this study). [M].

Family: Nostocaceae Eichler

Genus: *Nostoc* Vaucher ex Bornet & Flahault

Type species: *Nostoc commune* Vaucher ex Bornet & Flahault

***Nostoc* sp.**

Short trichomes forming small colonies with a common mucilaginous sheath. Barrel- shaped cells 3-µm long and 5-µm wide (Figure 15). Heterocyst 5-µm long, 6-µm wide, and separated from other cells by their distinct color and size. Collected with other algae from rocky and calcareous substrate from Gazimağusa at littoral; found from March to June.

Distribution: Mediterranean Sea (this study). [M].

Family: Rivulariaceae Frank

Genus: *Calothrix* C.Agardh ex E.Bornet & C.Flahault

Type species: *Calothrix confervicola* (Roth) C.Agardh ex Bornet & Flahault

***Calothrix aeruginea* (Kützing) Thuret**

Synonym: *Leibleinia aeruginea* Kützing

Trichomes cling tightly to the substrate as an epiphyte. They create a light blue–green layer. Filaments 10–15-µm wide, trichomes 7–9-µm wide. Cells shorter than wide, cells 3-µm long. Intercalary and basal heterocyst 15-µm long, 11-µm wide. Trichomes end with hair-shaped trichome. Trichomes without false branching. Thick sheath discolored or yellowish brown. Grow in tiny tufts on small red algae as epiphyte. Collected on other algae as epiphytic at Gazimağusa and found from June to July.

Note: This species was collected on the red algae *Dasya hutchinsiae* Harvey by Collins (1901) and *Posidonia oceanica* (L.) Delile leaves by Jacquemart and Demoulin (2008).

Distribution: NE Atlantic Ocean [Spain (Barbara et al., 2005), Britain (Parke, 1953), Norway (Lein et al., 1999), Canary Islands (Haroun et al., 2002), Denmark (Nielsen, 2005)], W Atlantic Ocean [Jamaica (Collins, 1901), Caribbean Sea (Taylor and Arndt, 1929)], Indian Ocean [Mauritius, South Africa, Tanzania, Seychelles (Silva et al., 1996)], Pacific Ocean [Marshall Islands (Newhouse, 1954), Philippines (Silva et al., 1987)], Mediterranean Sea [Turkey (Taşkın et al., 2008a), Mediterranean Sea coasts (Ardissone, 1886), W Mediterranean Sea (Jacquemart and Demoulin, 2008), Romania (Caraus, 2002)]. [IA].

***Calothrix contarenii* (Zanardini) Bornet & Flahault**

Synonym: *Rivularia contarenii* Zanardini

Barky thallus firm and dull green, about 1 mm in length. Trichomes swollen at the basal, arrangement parallel and dense at the thallus. Filaments 9–15-µm wide. Thick sheath colorless, or most of the time yellowish-brown. Sheath layer or not. Trichome 6–8-µm wide and ends in the form of long hair. Cell length more or less longer or shorter than wide. One or 2 basal heterocysts 10-µm wide and 5-µm long. Collected on other macroalgae as epiphytic at Korucam and found from June to July.

Distribution: NE Atlantic Ocean [Denmark (Nielsen, 2005)], W Atlantic Ocean [Jamaica (Collins, 1901)], Indian Ocean (Silva et al., 1996), Pacific Ocean [Philippines (Silva et al., 1987), Hong Kong (Lee, 1964), Vietnam (Dawson, 1954)], Mediterranean Sea [Turkey (Taşkın et al., 2008a)]. [IA].

***Calothrix fuscoviolacea* P.L.Crouan & H.M.Crouan ex Bornet & Flahault**

Usually occur as single filaments. Trichomes curved and swollen towards the ends (Figure 16). Ends of trichomes 15-µm wide. Sheath generally colorless. Trichome 10–12-µm wide, becomes thinner towards the ends. Cells often disk shaped, shorter than wide, reddish or violet. One basal heterocyst semiglobose, bright green. Small clusters epiphytic or epilithic. Collected on other algae as epiphytic, from rocky substrate as epilithic from Gazimağusa; found from July to August.

Distribution: NE Atlantic Ocean [Canary Islands (Haroun et al., 2002)], Indian Ocean [Mauritius (Silva et al., 1996)], Mediterranean Sea (this study). [IA].

***Calothrix scopulorum* (Weber & Mohr) C.Agardh**

Synonyms: *Conferva scopulorum* Weber & Mohr; *Oscillatoria scopulorum* (Weber & Mohr) C.Agardh; *Lyngbya scopulorum* (Weber & Mohr) Zanardini

Globose colonies forming olive-green, gelatinous thallus. Trichomes arranged perpendicular to the surface of the colony of 1-mm long. Trichomes 13-µm wide, filaments 6-µm wide. Cells isodiametric or shorter than wide, 3-µm long. Mucilaginous sheath thick, yellowish-brown. Trichomes taper towards the end like a hair. One or 2 basal heterocysts, oval. Heterocyst 6–7.5-µm wide, 7.5–8-µm long, inside sheath. Collected from upper littoral rocky substrate at Girne and found from June to July.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; Barbara and Cremades, 1996; López Rodriguez and Pérez-Cirera, 1996; Gorostiaga et al., 2004; Barbara et al., 2005; Pena and Barbara, 2008), Portugal (Araujo et al., 2009), France, Belgium (Dhont and Coppejans, 1988), Britain (Parke, 1953), Norway (Lein et al., 1999), Canary Islands (Haroun et al., 2002),

Poland (Plinski, 2005), Denmark (Nielsen, 2005)], Indian Ocean [(Silva et al., 1996), Suez Canal (Aleem, 1980)], Pacific Ocean [Marshall Islands (Newhouse, 1954), Philippines (Silva et al., 1987), Thailand (Thongroy et al., 2007)], Australia (Phillips, 2002), South Africa (Silva and Pienaar, 2000), Mediterranean Sea [North Cyprus (Cirik et al., 2000), Turkey (Taşkın et al., 2008a), Egypt, Israel (Papenfuss, 1968), Romania (Caraus, 2002), Greece (Coppejans, 1974), France, Italy (Ardissone, 1886)]. [IA].

Genus: *Dichothrix* Zanardini ex Bornet & Flahault

Type species: *Dichothrix penicillata* Zanardini

***Dichothrix* sp. 1**

Thallus 1 mm in length, erected on the substratum. Filaments in clusters densely at thallus (Figure 17). Filaments 9–12-µm wide. Sheaths common, layered, flat, and yellowish brown. Sheaths expanded at the end of the filament. Trichomes 4–5-µm wide, ending in a hair. Cells longer than wide, bright olive-green. Heterocyst semispherical or elongate. Located at littoral zone. Collected from rocky substrate at Girne and found from May to July.

Note: This species similar to *Dichothrix minima* Setchell & N.L.Gardner by shape of thallus and size of filament but differs by the size of trichomes.

Distribution: Mediterranean Sea (this study). [M].

***Dichothrix* sp. 2**

Thallus consists of erect clusters, after becomes flat. Cluster can be 2–8-mm thick, 1 mm in length. Trichomes 7–7.5-µm wide, filaments 11-µm wide (Figure 18). Cells shorter than wide or isodiametric. Cross-walls constricted. Shape of heterocyst may vary from spherical to oval. Trichome has a heterocyst at base. Very long filaments ending in a hair. Collected on volcanic rocky substrate, with masses, at littoral from Dip Karpaz and found from June to July.

Note: This species similar to *Dichothrix rupicola* Collins by shape of thallus and size of trichomes and filaments but differs by numbers of basal or intercalary (rarely) heterocyst.

Distribution: Mediterranean Sea (this study). [M].

Genus: *Isactis* Thuret ex Bornet & Flahault

Type species: *Isactis plana* (Harvey) Thuret ex Bornet & Flahault

***Isactis plana* (Harvey) Thuret ex Bornet & Flahault**

Synonym: *Rivularia plana* Harvey

Thallus covers the substrate. Filaments parallel, arranged at the flat thallus. Single heterocyst cylindrical at the base. Basal part of polarized trichomes more swollen than other part. Filaments 15-µm wide, trichomes 7-µm wide. Trichomes tapering towards the end. Cross-walls distinctly narrowing at the end of trichomes. Cells pale blue-green, some with granule, 2.5–3-µm wide, isodiametric or longer than wide at the base. Collected as epilithic from rocky substrate, epiphytic on other algae at Girne; found from May to June.

Note: *Isactis* like *Rivularia* in many features; however, *Isactis* has common colonial mucilage, within colonies diffluent; trichomes of *Rivularia* with own sheaths within colonies.

Distribution: NE Atlantic Ocean [Spain (Alvarez and Gallardo, 1988; Barbara et al., 2005), Britain (Parke, 1953), Canary Islands (Haroun et al., 2002), Denmark (Nielsen, 2005)], Indian Ocean [Djibouti (Silva et al., 1996)], Pacific Ocean [Costa Rica, Revillagigedo, Panama (Taylor, 1945)], Australia (Phillips, 2002), Mediterranean Sea [Turkey (Taşkın et al., 2008a), Romania (Caraus, 2002), Greece (Coppejans, 1974), Italy (Ardissone, 1886)]. [CBA].

Genus: *Rivularia* C.Agardh ex Bornet & Flahault

Type species: *Rivularia dura* Roth ex Bornet & Flahault

Rivularia polyotis (J.Agardh) Hauck

Synonym: *Diplotrichia polyotis* J.Agardh

Spherical or cylindrical colony hard and dense, olive-green or yellow-green. Filaments radially arranged in the center of the colony. Filaments 20–24-µm wide. Trichomes with individual sheaths, 7–16-µm wide. Very long trichomes thinner towards the end, finishing in a hair. Cell length half of width or 5 times longer than wide. Basal heterocyst spherical or elliptical and 6–8 µm in diameter. Epilithic at littoral zone. Collected from volcanic rocky substrate at Dip Karpaz and found from July to August.

Distribution: Indian Ocean [Diego Garcia Atoll, Maldives (Silva et al., 1996)], Pacific Ocean [New Zealand (Chapman, 1956), Wake Atoll (Tsuda et al., 2010), Queensland (Phillips, 2002)], Mediterranean Sea [Turkey (Taşkın et al., 2008a), Egypt (Papenfuss, 1968)]. [IP].

***Rivularia nitida* C.Agardh ex Bornet & Flahault**

Synonym: *Rivularia nitida* C.Agardh

Young colony spherical or semiglobose. Colony expanded up to 3 cm in diameter with hollow, slightly curved appearance, wavy wrinkled. Trichomes 2–5-µm wide. Trichomes with sheath 12-µm wide and without sheath 5-µm wide at base (Figure 19). Cells 9-µm long. Trichomes ending in a hair. Length of last cell 3–4 times longer than wide. First cell of trichome isodiametric or shorter than wide. Intercalary heterocyst not observed. Collected from rocky and calcareous substrates at Gazimağusa and Girne and found from June to July.

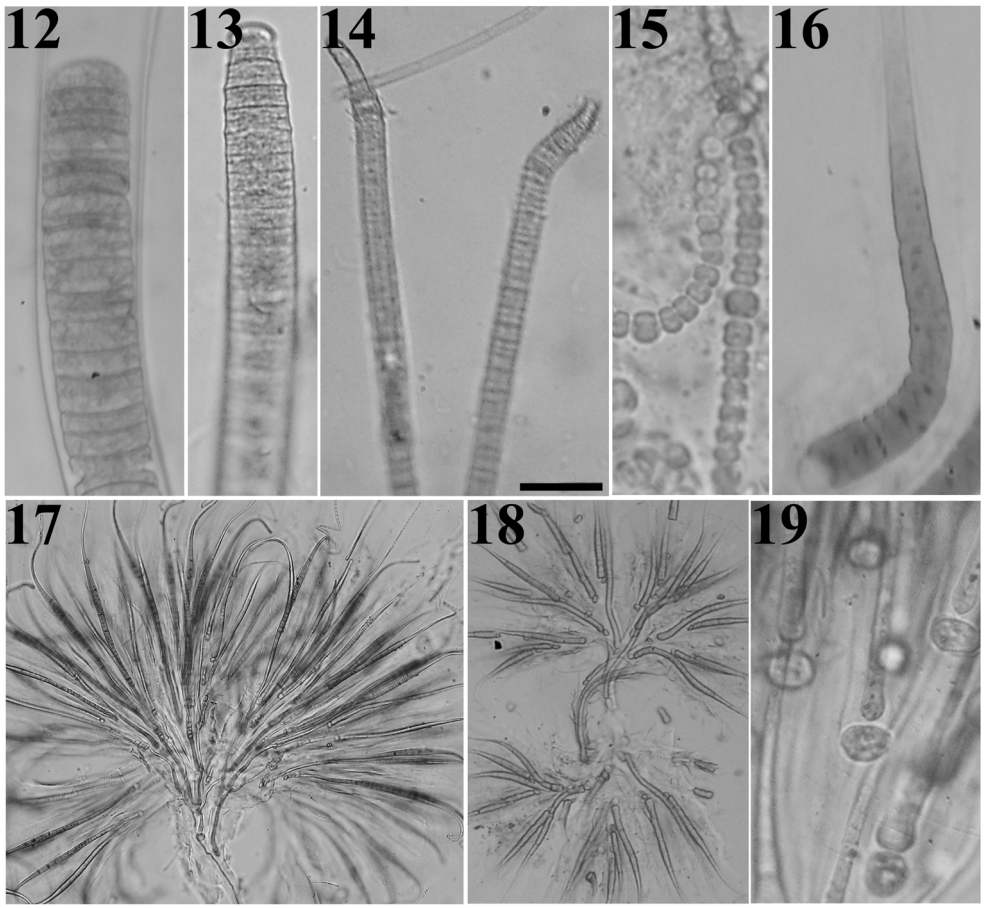
Distribution: NE Atlantic Ocean [Spain (Barbara et al., 2005), Britain (Parke, 1953), Denmark (Nielsen, 2005), Poland (Plinski, 2005)], Pacific Ocean [Philippines (Silva et al., 1987)], Mediterranean Sea (this study). [AP].

Family: Scytonemataceae Frank

Genus: *Scytonematopsis* E.Kiseleva

Type species: *Scytonematopsis woronichinii* Kiseleva

***Scytonematopsis pilosa* (Harvey ex Bornet & Flahault) I.Umezaki & M.Watanabe**



Figures 12–19. Figure 12. *Lyngbya sordida*; **Figure 13.** *Oscillatoria* sp.; **Figure 14.** *Microchaete* sp.; **Figure 15.** *Nostoc* sp.; **Figure 16.** *Calothrix fuscoviolacea*; **Figure 17.** *Dichothrix* sp. 1; **Figure 18.** *Dichothrix* sp. 2; **Figure 19.** *Rivularia nitida*. All figures at the same scale. Scale bar = 20 µm.

Synonyms: *Calothrix pilosa* Harvey; *Tildenia pilosa* (Harvey) Poljansky

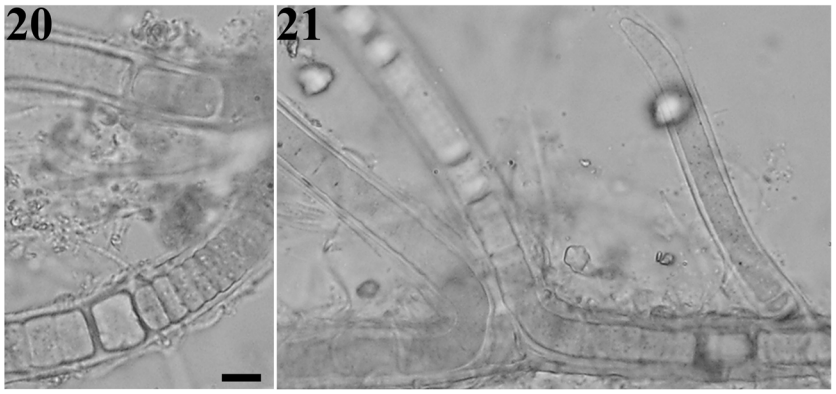
Usually filaments mixed with each other at the base of the flat thallus. Filaments grow upright on the substrate as erect clusters. Filaments 16.5-µm wide, trichomes 9-µm wide. Cells 3-µm long. Heterocyst may be basal or intercalary (Figure 20). Filaments usually attenuated towards to the ends and apical cells spherical. Branching occurs after formation of necridium (Figure 21). Forms velvety mats on upper intertidal rocky substrate. Collected from rocky and calcareous substrates at Gazimağusa and found from June to July.

Note: Family of Scytonemataceae is characterized by isopolar (rarely showing heteropolar) and long trichomes and is always enclosed in a sheath with characteristic false branching. Three genera (*Scytonematopsis*, *Scytonema*, and *Kyrtuthrix*) were classified into the family Scytonemataceae by Komárek and Anagnostidis (1989). *Scytonematopsis* differs from *Scytonema* by morphology of apical parts of trichomes and filaments (Komárek and Anagnostidis, 1989). The genus *Kyrtuthrix* has special morphology and typical scytonematoid branching but differs from the other genus due to lack of connection between heterocyst and false branching (Komárek and Anagnostidis, 1989).

Distribution: W Atlantic Ocean [Jamaica (Collins, 1901)], Indian Ocean [Mauritius, Diego Garcia Atoll, Maldives (Silva et al., 1996)], Pacific Ocean [Galapagos Islands (Taylor, 1945), Marshall Islands (Newhouse, 1954), Vietnam (Dawson, 1954), Philippines (Silva et al., 1987)], Australia (Phillips, 2002), Mediterranean Sea (this study). [IP].

4. Discussion

This study is the first to deal only with the cyanobacteria from Cyprus. There are limited studies related to cyanobacteria of the Mediterranean Sea. Cyanobacteria have been ignored in many studies conducted in the Mediterranean benthic algae. Several studies including only the cyanobacteria of the Mediterranean Sea have been carried out by Coppejans (1974), Haritonidis and Tsekos



Figures 20 and 21. *Scytonematopsis pilosa*. All figures at the same scale. Scale bar = 10 μm.

(1976), Tsekos and Haritonidis (1977), Nizamuddin et al. (1978), Komárek and Anagnostidis (1999, 2005), Pena and Barbara (2008), and Taşkın et al. (2008a).

Marine benthic algae of Northern Cyprus were studied by Cirik et al. (2000), Taşkın et al. (2008b), and Öztürk et al. (2009). Cirik et al. (2000) reported a total of 151 marine benthic algae, 11 of which were cyanobacteria.

In the present study, a total of 47 taxa were found in Northern Cyprus. There was a dominance of members of the orders Oscillatoriales (43%), Chroococcales (32%), and Nostocales (25%). The taxa belong to 3 orders, 13 families, and 26 genera. Distribution of all the taxa according to collection sites is as follows: 25 taxa, Girne; 10 taxa, Gazimağusa; 5 taxa, Dip Karpaz; and 3 taxa, Korucam. Eight taxa are new records for the Mediterranean Sea: *Aphanocapsa litoralis*, *Coelosphaerium minutissimum*, *Chroococcus* cf. *turicensis*, *Chroococcus varius*, *Spirulina tenerrima*, *Calothrix fuscoviolacea*, *Rivularia nitida*, and *Scytonematopsis pilosa*. Seven taxa were only identified at a generic level.

In conclusion, the present study aims to increase our knowledge of marine cyanobacteria of the Mediterranean Sea. Therefore, a detailed algal study of a narrow area was carried out along the coast of Cyprus, and 35 taxa were reported for the first time. A molecular analysis should also be undertaken to describe and identify the Mediterranean species in further studies.

Acknowledgments

This study was supported by TÜBİTAK, Ankara, Turkey (104T484). We also appreciate the contributions of Assoc Prof Salih Gücel (Near East University, Northern Cyprus), Dr Burak Ali Çiçek (Eastern Mediterranean University, Northern Cyprus), and Celal Mert Akçora (Celal Bayar University, Turkey).

References

Aleem AA (1980). Contributions to the study of the marine algae of the Red Sea. IV. The algae and seagrasses inhabiting the Suez Canal (systematic part). Bull Fac Sci. KAU Jeddah 4: 31–89.

Alvarez Cobelas M, Gallardo T (1988). Catalogo de las aguas continentales españolas V. *Cyanophyceae* Schaffner 1909. Acta Botánica Malacitana 13: 53–76 (article in Spanish with English summary).

Anagnostidis K, Komárek J (1990). Modern approach to the classification system of cyanophytes. 5. Stigonematales. Arch Hydrobiol Supplement 86: 1–73.

Araujo R, Bárbara I, Tibaldo M, Berecibar E, Tapia PD, Pereira R, Santos R, Pinto IS (2009). Checklist of benthic marine algae and cyanobacteria of northern Portugal. Bot Mar 52: 24–46.

Ardissone F (1886). Phycologia mediterranea. Parte IIa. Oosporee-Zoosporee-Schizosporee. Memorie della Società Crittogamologica Italiana 2: 1–128.

Aysel V, Dural B, Şenkardeşler A, Erduğan H, Aysel F (2008). Marine algae and seagrasses of Samsun (Black Sea, Turkey). Journal of Black Sea/Mediterranean Environment 14: 53–67.

Ballesteros E, Romero J (1982). Catálogo de las algas bentónicas (con exclusión de las diatomeas) de la Costa Catalana. Collectanea Botanica 13: 723–765 (article in Catalan with English abstract).

Barbara I, Cremades J (1996). Seaweeds of the Ria de A Coruna (NW Iberian Peninsula, Spain). Bot Mar 39: 371–388.

Barbara I, Cremades J, Calvo S, Lopez Rodriguez MC, Dosil J (2005). Checklist of the benthic marine and brackish Galician algae (NW Spain). Anales del Jardin Botanico de Madrid 62: 69–100.

Batters EAL (1902). A catalogue of the British marine algae. J Bot 40: 1–107.

Caraus I (2002). The algae of Romania. Studii si Cercetari, Universitatea Bacau. Biologie 7: 1–694.

Castenholz RW (1989). Order Oscillatoriales. Order Nostocales. Order Stigonematales. In: Staley JT, Bryant MP, Pfennig N, Holt JG, editors. Bergey's Manual of Systematic Bacteriology, Vol. 3. 1st ed. Baltimore, MD, USA: The Williams Wilkins Co., pp. 1771–1780; 1780–1793; 1794–1799.

Chapman VJ (1956). The marine algae of New Zealand. Part I. Myxophyceae and Chlorophyceae. Journal of the Linnean Society of London Botany 55: 333–501.

Cirik Ş, Aysel V, Benli HA, Cihangir B, Ünlüoğlu A (2000). Preliminary studies on the marine vegetation of Northern Cyprus. Turkish Journal of Marine Sciences 6: 31–40.

Collins FS (1901). The algae of Jamaica. Proceedings of the American Academy of Arts and Sciences 37: 229–270.

Coppejans E (1974). A preliminary study of the marine algal communities on the Islands of Milos and Sikinos (Cyclades-Greece). B Soc Roy Bot Belg 107: 387–406.

Crispino LMB, Sant'Anna CL (2006). Cianobacterias marinhas bentonicas de ilhas costeiras do Estado de Sao Paulo, Brasil. Revista Brasil Bot 29: 639–656 (article in Portuguese with abstract in English).

Dawson EY (1954). Marine plants in the vicinity of the Institut Oceanographique de Nha Trag, Viet Nam. Pac Sci VIII: 372–469.

Dawson EY (1959). Some algae from Clipperton Island and the Danger Island. Pacific Naturalist 1: 1–8.

Desikachary TV (1959). Cyanophyta. pp. [i]–x, [1]–686, pls 1–139. New Delhi, India: Indian Council of Agricultural Research.

D'hont D, Coppejans E (1988). Cyanophycées des côtes du nord de la France et de la Belgique. B Soc Roy Bot Belg 121: 35–54 (article in French with summary in English).

Diaz-Pulido G, Diaz-Ruiz M (2003). Diversity of benthic marine algae of the Colombian Atlantic. Biota Colombiana 4: 203–246.

Ercegovic A (1957). La flore sous-marine de l'Ilot de Jabuka. Acta Adriat 8: 1–130 (in French).

Furnari G, Cormaci M, Giaccone G (2003). The benthic macroalgal flora of Italy: floristic and geobotanic considerations. Bocconea 16: 225–243.

Furnari G, Cormaci M, Serio D (1999). Catalogue of the benthic marine macroalgae of the Italian coast of the Adriatic Sea. Bocconea 12: 5–214.

Geitler L (1932). Cyanophyceae. In: Rabenhorst L, editor. Kryptogamenflora von Deutschland, Österreich, und der Schweitz 14. Leipzig, Germany: Akademische Verlagsgesellschaft, pp. 673–1056.

Gorostiaga JM, Santolaria A, Secilla A, Casares C, Diez I (2004). Check-list of the Basque coast benthic algae (north of Spain). Anales del Jardin Botanico de Madrid 61: 155–180.

Guiry, Guiry (2013). AlgaeBase. World-wide electronic publication, National University of Ireland, Galway [online]. Website: http://www.algaebase.org [accessed 18 November 2013].

Hällfors G (2004). Checklist of Baltic Sea phytoplankton species (including some heterotrophic protistan groups). Baltic Sea Environment Proceedings 95: 1–208.

Haritonidis S, Tsekos I (1976). Marine algae of the Greek west coast. Bot Mar 19: 273–286.

Haroun RJ, Gil-Rodriguez MC, Diaz De Castro J, Prud'Homme Van Reine WF (2002). A checklist of the marine plants from the Canary Islands (central Eastern Atlantic Ocean). Bot Mar 45: 139–169.

Hickel B (1991). Two new chroococcal cyanophytes from a brackish environment (Schlei-Fjord), Germany. Algological Studies 64: 97–104.

Huisman JM (2004). Marine benthic flora of the Dampier Archipelago, Western Australia. Records of the Western Australian Museum Supplement 66: 61–68.

Huisman JM, Borowitzka MA (2003). Marine benthic flora of the Dampier Archipelago, Western Australia. In: Wells FE, Walker DI, Jones DS, editors. The Marine Flora and Fauna of Dampier, Western Australia, pp. 291–344.

Jacquemart J, Demoulin V (2008). Comparison of the epiphytic macroflora of the *Posidonia oceanica* leaves in different meadows of the western Mediterranean. Flora Mediterranea 18: 391–420.

Johansen JR, Řeháková K, Acker F (2011). *Tapinothrix ozarkiana* sp. nov., with notes on distribution for the genus in North America. Fottea 11: 141–148.

Joosten AMT (2006). Flora of the blue-green algae of the Netherlands I. The non-filamentous species of inland waters. Utrecht: KNNV Publishing, pp. [1-] 5–237.

Komárek J, Anagnostidis K (1989). Modern approach to the classification system of Cyanophytes 4 Nostocales. Algological Studies 56: 247–345.

Komárek J, Anagnostidis K (1999). Cyanoprokaryota. 1. Chroococcales. In: Ettl H, Gärtner G, Heynig H, Mollenhauer D, editors. Süßwasserflora von Mitteleuropa. Begründet von A. Pascher. Band 19/1. Heidelberg & Berlin, Germany: Spektrum, Akademischer Verlag, pp. 1–548.

Komárek J, Anagnostidis K (2005). Süsswasserflora von Mitteleuropa. Cyanoprokaryota: 2. teil/2nd part: Oscillatoriales. Vol. 19. München, Germany: Elsevier Spektrum Akademischer Verlag, pp. 1–759.

Komárek J, Hauer T (2013). CyanoDB.cz. On-line database of cyanobacterial genera. Word-wide electronic publication, University of South Bohemia and Institute of Botany AS CR [online]. Website: http://www.cyanodb.cz [accessed 18 November 2013].

Lawson GW, John DW (1987). The marine algae and coastal environment of tropical West Africa. 2nd ed. Beihefte zur Nova Hedwigia 93: 1–415.

Lee KY (1964). Some studies on the marine algae of Hong Kong I. Cyanophyta, Chlorophyta and Phaeophyta. New Asia Coll Acad Ann 6: 27–79.

Lein TE, Bruntse G, Gunnarsson K, Nielsen R (1999). New records of benthic marine algae for Norway, with notes on some rare species from the Floro District, Western Norway. Sarsia 84: 39–53.

López Rodriguez MC, Pérez-Cirera JL (1996). Cianófitos en medios alterados por la contaminación industrial en el noroeste de la Península Ibérica. Anales del Jardin Botanico de Madrid 54: 43–49 (article in Spanish with English abstract).

Nagarkar S (2002). Morphology and ecology of new records of cyanobacteria belonging to the genus *Oscillatoria* from Hong Kong rocky shores. Bot Mar 45: 274–283.

Newhouse J (1954). Ecological and floristic notes on the myxophyta of Raroia. Atoll Research Bulletin 33. Washington, DC, USA: Smithsonian Institution Press.

Nielsen R (2005). Danish seaweeds—distributional index. Website: http://www.botaniskmuseum.dk/BOT/seaweeds.htm [accessed 18 November 2013].

Nizamuddin M, West JA, Menez EG (1978). A list of marine algae from Libya. Bot Mar 22: 465–476.

Öztürk M, Taşkın E, Kurt O, Gücel S (2009). Evaluation of algal flora of upper-infralittoral zone from North Cyprus marine ecosystem. In: Gökçekuş H, editor. Proceedings of the International Conference on the Environment: Survival and Sustainability, Nicosia (Lefkoşa), Turkish Republic of Northern Cyprus: Educational Foundation of Near East University 2: 295–303.

Pankow VH (1990). Ostsee—Algenflora. – 648 S. Jena, Germany: Fischer.

Papenfuss GF (1968). A history, catalogue, and bibliography of the Red Sea benthic algae. Israel J Bot 17: 1–118.

Parke MA (1953). Preliminary checklist of British marine algae. J Mar Biol Assoc UK 32: 497–520.

Peña V, Bárbara I (2002). Caracterización florística y zonación de las algas bentónicas marinas del puerto de A Coruña (NO Península Ibérica). Nova Acta Científica Compestelana (Bioloxía) 12: 35–66 (article in Spanish with abstract in English).

Peña V, Bárbara I (2008). Maërl community in the north-western Iberian Peninsula: a review of floristic studies and long-term changes. Aquat Conserv 18: 339–366.

Phillips JA (2002). Algae. In: Henderson RJF, editor. Names and Distribution of Queensland Plants, Algae and Lichens. Brisbane, Australia: Queensland Government Environmental Protection Agency, pp. 228–244.

Pliński M (2005). Blue-green algae (cyanobacteria) from the Gulf of Gdansk. A review. Oceanol Hydrobiol St 34: 19–33.

Sauvageau C (1892). Sur les algues d'eau douce recoltées en Algérie pendant le session de la Societé Botanique en 1892. B Soc Bot Fr 39 (Sess. Extraord. 1892): civ–cxxviii (in French).

Silva PC, Meñez EG, Moe RL (1987). Catalog of the benthic marine algae of the Philippines. Smithsonian Contributions to Marine Science 27: 1–179.

Silva PC, Basson PW, Moe RL (1996). Catalogue of the benthic marine algae of the Indian Ocean. Univ California Publ Bot 79: 1–1259.

Silva SMF, Pienaar RN (2000). Benthic marine Cyanophyceae from Kwa-Zulu Natal, South Africa. Biblioth Phycol 107: 1–456.

South GR, Skelton PA, Yoshinaga A (2001). Subtidal benthic marine algae of the Phoenix Islands, Republic of Kiribati, Central Pacific. Bot Mar 44: 559–570.

Taşkın E, Öztürk M, Kurt O, Öztürk M (2008a). The Check-List of the Marine Algae of Turkey. Manisa, Turkey: Ecem Kırtasiye.

Taşkın E, Öztürk M, Kurt O (2008b). Alien and invasive marine plants of North Cyprus. Proceedings of the 2nd International Symposium on Underwater Research (March 20–22 2008), Eastern Mediterranean University: 20–20, Famagusta, TRN Cyprus.

Taşkın E, Öztürk M, Aysel V, Kurt O (2001). Three new records of the marine algal flora of Turkey. Turk J Bot 25: 245–248.

Taşkın E, Öztürk M, Kurt O, Aysel V (2004). Marine algae of the Bay of Iskenderun (Northeastern Mediterranean): *Cyanophyceae* and *Chlorophyceae*. SDÜ, Eğirdir Su Ürünleri Fakültesi Dergisi 1: 77–83.

Taylor WR (1945). Pacific marine algae of the Allan Hancock Expeditions to the Galapagos Islands. Allan Hancock Pacific Expeditions 12: 1–528.

Taylor WR, Arndt CH (1929). The marine algae of the southwestern Peninsula of Hispaniola. Am J Bot 16: 651–662.

Thongroy P, Liao LM, Prathep A (2007). Diversity, abundance and distribution of macroalgae at Sirinart Marine National Park, Phuket Province, Thailand. Bot Mar 50: 88–96.

Tsekos I, Haritonidis S (1977). A survey of the marine algae of the Ionian Islands, Greece. Bot Mar 20: 47–65.

Tsuda RT, Fisher JR, Vroom PS, Abbott IA (2010). New records of subtidal benthic marine algae from Wake Atoll, Central Pacific. Bot Mar 53: 19–30.

Wulff BL, Webb KL (1969). Intertidal zonation of marine algae at Gloucester Point, Virginia. Chesapeake Science 10: 29–35.

Wulff BL, Wulff EMT, Robinson BH, Lowry JK, Humm HJ (1968). Summer marine algae of the jetty at Ocean City, Maryland. Chesapeake Science 9: 56–60.

Zaneveld JS (1972). The benthic marine algae of Delaware, USA. Chesapeake Science 13: 120–138.