



Taxonomy and Description of the Three Marine Cyanophycean Algae from the Mediterranean Sea

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Abstract

In the present study, three marine Cyanophycean species from the Mediterranean are reported and described. These species were: *Phormidium boryanum* (Bory ex Gomont) Anagnostidis and Komárek (1988), *Oscillatoria sancta* f. *caldariorum* (Hauck) Lagerheim and Elenkin (1949) and *Lyngbya anomala* (C.B.Rao) Umezaki and Watanabe (1994), all members of the Oscillatoriales. The samples were collected from mid-littoral zones of Dikili Gulf (Aegean Sea, Turkey). The samples were kept in jars, fixed in 4% formaldehyde-sea water. The algae were identified under the microscope, mounted directly between lam and lamel. Current literature sources were used for the determinations. The photographs were taken using normal microphotography techniques. Data concerning distribution, morphology and ecology of each species are also given.

Keywords: Cyanobacteria, *Phormidium boryanum*, *Oscillatoria sancta* f. *caldariorum*, *Lyngbya anomala*, Turkey.

Türkiye'nin Akdeniz Kıyılarında Yayılış Gösteren Üç Mavi-Yeşil Alg Türünün Tanımlanması ve Taksonomisi

Özet

Bu çalışmada Türkiye'nin Akdeniz kıyılarından üç Cyanophyceae türü tanımlanmıştır. Bu türler: *Phormidium boryanum* (Bory ex Gomont) Anagnostidis et Komárek (1988), *Oscillatoria sancta* f. *caldariorum* (Hauck) Lagerheim et Elenkin (1949) ve *Lyngbya anomala* (C.B.Rao) Umezaki ve Watanabe (1994), olup hepsi Oscillatoriales ordosu üyesidir. Örnekler Dikili Körfezi'nin (Ege Denizi, Türkiye) mid-littoral zonundan toplanmıştır. Toplanan örnekler içinde yaklaşık % 4'lük formaldehit-deniz suyu karışımı bulunan cam kavanozlarda fikse edilmiştir. Alglerin tayini ışık mikroskobu altında incelenerek yapılmış ve tanımlanmasında bu alanda yayınlanmış eserlerden yararlanılmıştır. Fotoğraflar mikrofotografi tekniklerine uygun olarak çekilmiştir. Bununla birlikte tanımlanan türlerin her birinin yayılış alanları, morfolojileri ve ekolojileri ile ilgili ayrıntılı bilgi verilmiştir.

Anahtar Kelimeler: Cyanobacteria, *Phormidium boryanum*, *Oscillatoria sancta* f. *caldariorum*, *Lyngbya anomala*, Türkiye.

Introduction

Blue-green algae, called *Cyanobacteria*, which are included in Monera, are widely distributed in seas, fresh water, wet soil and hot water springs. It was reported by Hoek *et al.* (1995) that there were approximately 150 genera and 2000 species belonging to the class *Cyanophyceae*. As a result of the studies which were carried out at Turkey's seashores, Taşkın *et al.* (2008) reported 107 *Cyanophyceae* species in the check-list of the marine flora of Turkey. The distributions of the species are as follows: 38 Black

Sea, 15 Sea of Marmara, 77 Aegean Sea and 57 Mediterranean Sea.

Reported *Cyanophyceae* taxa from Turkey; 67 taxa, 9 of which were new records from the Aegean Sea (Dural, 1995); 11 taxa, 5 of which were new records from the Sea of Marmara (Aysel *et al.*, 1991); 26 taxa, 8 of which were in the Sea of Marmara, 10 specimens in the Aegean Sea and 17 specimens in the Mediterranean Sea (Zeybek *et al.*, 1993); 12 specimens in Bartın (Aysel *et al.*, 1996); 13 blue-green algae for the Black Sea (Aysel and Erduğan, 1995); 50 taxa in the check-list of Mediterranean Sea

flora of Turkey (Aysel and Gezerler, 1996); 3 new records for the marine algal flora of Turkey (Kurt et al., 2001).

Materials and Method

The specimens were sampled with the use of SCUBA and snorkelling by Oğuz Kurt from the coast of Dikili Gulf located at the Aegean Sea coasts of Turkey. The location of the study area is shown in Figure 1. The coast includes sandy and rocky in the littoral regions. Specimens were preserved in 4-5% formalin-seawater. The phycological material was identified using Chlor-Zinc-Iodide solution and the techniques used by the studies of Geitler (1925), Desikachary (1959), Pankow (1971) and Komárek and Anagnostidis (2005). The classification principally follows the criteria of Silva et al. (1996), Komárek and Anagnostidis (2005) and *AlgaeBase*; World-wide electronic publication. Photographs of sections were adequately taken and printed. The three marine Cyanophycean algae, which were presented as

a poster at the 7th International Phycological Congress, were discussed with Prof. Dr. J. Komárek and his opinions were obtained.

Results

Cyanophyceae Sachs, 1874

Oscillatoriales Anagnostidis et Komárek, 1988

Phormidiaceae Anagnostidis et Komárek, 1998

Phormidium Kützing ex Gomont 1892: 156.

Phormidium boryanum (Bory ex Gomont)

Anagnostidis et Komárek 1988: 405 (Figure 2)

Basionym: *Oscillatoria boryana* Bory ex Gomont 1892: 234

Synonyms: *Oscillatoria nigra* var. *boryana* C.A. Agardh 1824, *Oscillaria boryana* (C. Agardh) Bory 1827: 465, *Oscillatoria boryana* (C. Agardh) Bory ex Gomont 1892: 234, *Oscillatoria nigra* var. *boryana* A.Forti 1907.

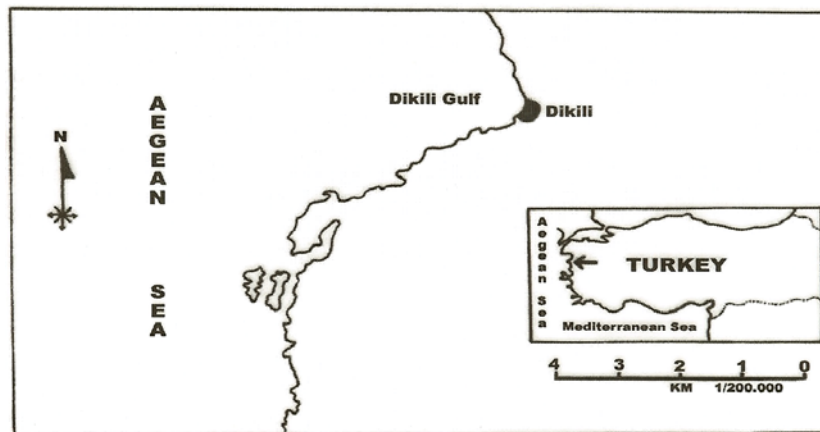


Figure 1. The collection area of the specimens (Dikili Gulf, Aegean Sea, Turkey).

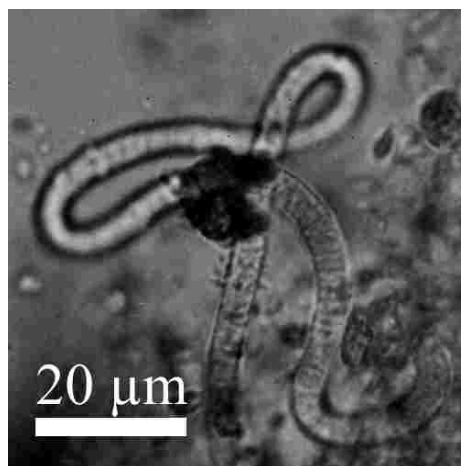


Figure 2. Photograph of *Phormidium boryanum*.

Description: Trichomes solitary, free-living, dark steel-grey, olive-green, rarely grayish violet to violet. Only the apical section or whole of the thallus is spiral twisted. Sometimes straight, constricted and lightly granulated at the cross-walls. It is not stained by Chlor-Zinc-Iodide. Width of the cells varies between 7,5-11 μm , while the length varies between 3,7-4 μm . End-cells are rounded or more or less pointed, not capitate and calyptra absent.

Ecology and Distribution: Common in thermal springs and saline waters, also found abundantly in sulphurous, sulphur-salty and salty thermal springs in Greece, reported also from saline in Germany (Anagnostidis and Komárek, 1988). We found it from Kaplica Station, which has characteristic for sulphurous, sulphur-salty and salty thermal waters.

Oscillatoriaceae (S.F. Gray) Harvey ex Kirchner, 1898

Oscillatoria Vaucher ex Gomont, 1892

Oscillatoria sancta f. *caldariorum* (Hauck) Lagerheim ex Elenkin 1949: 1262 (Figure3)

Basionym: *Oscillaria caldariorum* Hauck 1876: 151

Synonyms: *Lyngbya caldariorum* (Hauck) Hansgirg 1885: 267, *Oscillaria sancta* var. *caldariorum* (Hauck) Hansgirg 1887: 68, *Oscillatoria caldariorum* Hauck ex Gomont 1892: 209, *Lyngbya sancta* var. *caldariorum* (Hauck) Hansgirg ex Forti 1907: 154

Description: Mucilaginous block is rectangular. Trichomes straight or bent distinctly constricted at the cross-walls. Its length is 1/6 of its width and its olive-

green, bright blue-green, greyish. The width of trichome is about 10–11 μm , while their length is about 2–3 μm . Apical cells flattened and surrounded by a hemispherical membrane, slightly capitate to wart-like and with a calyptra.

Ecology and Distribution: Very common, distributed world-wide, probably cosmopolitan, occurs in freshwater, thermal springs, brackish and salt waters in benthic zones of medio to upper-infralittoral.

Lyngbya C. Agardh ex Gomont, 1892

Lyngbya anomala (C.B.Rao) Umezaki & Watanabe 1994: 192–193 (Figure 4)

Basionym: *Phormidium anomalum* C.B. Rao 1937: 371

Synonyms: *Phormidium anomalum* C.B. Rao 1937: 371, *Lyngbya anomala* (C.B. Rao) Anagnostidis 2001: 372

Description: Thallus is about 3-6 mm thick, soft, mucilaginous, thick expanded and yellow or yellow-brown, sometimes colourless or deep blue-green. Cells are in the shape of disc, with flat and constricted at the cross-walls. Its width is about 8 μm , length is about 2 μm . Its sheath is thin, colourless and not stained by Chlor-Zinc-Iodide. Apical cells are bluntly-rounded and flattened without calyptra.

Ecology and Distribution: Subaerophytic, on bricks, described from India. Recorded from thermal to salty waters in various concepts and in different habitats. According to Komárek and Anagnostidis (2005), this species outside the Europe, but we found

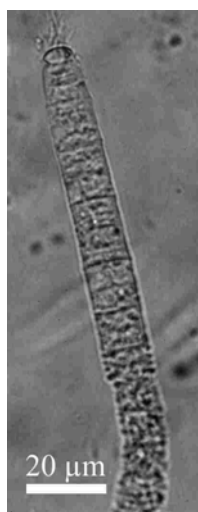
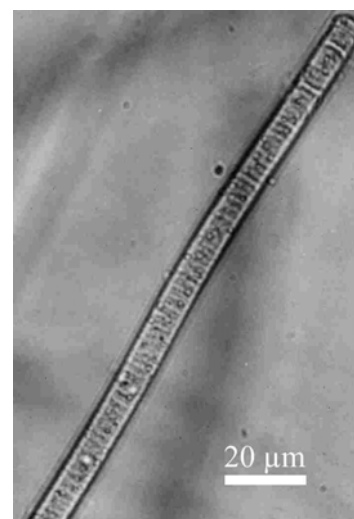


Figure 3. Photograph of *O. sancta* f. *caldariorum*.



Figure 4. Photographs of *Lyngbya anomala*.



it at the mediolittoral zone in Kaplica (Ilica) and Killik Stations.

Discussion

The first description of *P. boryanum* and *L. anomala* for algae flora of the Mediterranean Sea were made in this study. These two algae were described by Komárek and Anagnostidis (2005) and Desikachary (1959) in detail and were obtained from the coasts of the Indian Ocean. They are also common in Atlantic and Pacific Oceans. One reason for their existing on the shores of our country is that their spores which stuck to the carina of transatlantic, play an important role in international trade and adapt themselves to the atmosphere of our waters. Another possible reason is the sections where Gulfstream hot water stream passes through the Atlantic Ocean. This stream passes through Gibraltar, goes around the northern shores of Africa, mixing with the stream of California extraction coming from the Red Sea and thus reaches the shores of Turkey. As a result, the algae have been determined in our country by this study. In the sampling process, the physico-chemical properties of sampling stations were identified using TOA WQC-24 water quality measurement device. These values were measured, the station structure and properties of the substratum is associated with. Kaplica (Ilica) station, there is a continuous hot and sulphurous water leak. As a result, the highest and lowest temperature values were measured here for do (Table 1).

Of these algae, *L. anomala*, was especially taken into consideration for the facts that its thallus was 3-6 mm thick, spreadable, soft and its surface was yellow or yellow-brown; that drawings of Kützing (1849) and Desikachary (1959) and the measurements in trichome were coherent, and that it was not dyed with Chlor-Zinc-Iodide solution. In Desikachary (1959), its thallus was said to be yellow. Furthermore, he pointed out that it can be with or without calyptra. In this study it, was sampled as without calyptra.

P. boryanum, is characteristic for that only the apical section or whole of its thallus is spiral twisted. In this study it has been found that the whole thallus was spiral-twisted. In the determination of this taxon, the fact that the drawings of Kützing (1849), Desikachary (1959), Pankow (1971) and Komárek

and Anagnostidis (2005) are coherent with trichome measurements, characteristics of which were diagnostic.

O. sancta f. *caldariorum*, the third new described marine Cyanophycean algae for the algae flora of the Mediterranean Sea, according to the literature, is depicted as common in fresh water, on the weeds in wet and watery places. Finding of the species in seas shows that the members of *Cyanophyceae* can choose anywhere as habitat. In the description, the data of Desikachary (1959), Kützing (1849) and Komárek and Anagnostidis (2005) were evaluated and it was found that the findings were similar.

In conclusion, the three marine Cyanophycean algae which were presented as a poster at the 7th International Phycological Congress (Kurt *et al.*, 2001) and listed in the check-list of the marine flora of Turkey (Taşkın *et al.*, 2008) are described and detailed taxonomy, distribution, morphology and ecology of each species are also given with this study.

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Table 1. The annual average values of the physicochemical parameters in Dikili Gulf

Parameter	Station		
	Kaplica (Ilica)	Killik	Dikili Gulf
Temperature (°C)	21.92	20.67	19.78
pH	8.45	8.28	8.20
dO ₂ (mg/L)	9.45	10.77	10.64
Turbidity (NTU-mg/L)	291.69	296.08	293.46
NaCl (‰)	38.85	38.77	37.42

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