

# Review of the studies of aeroterrestrial algae along the Bulgarian Black Sea coast (1890-2017) with special attention to the newly described and threatened species

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**Abstract** The paper presents a review of the studies of aeroterrestrial algae along the Bulgarian Black Sea coast carried-out during the period 1890-2017 and reflected in 23 available scientific sources. The algal biodiversity was evaluated by taxonomic groups and different inhabited substrates (coastal rocks, coastal stones, shells, wet rocks, brick walls, trees, wet soils, muds and sands,) with special attention to the four new taxa described from the region. The conservation status of the species was indicated according to the Red List of Bulgarian microalgae (four species). A comparison of the taxonomic richness of the coastal region with the inland areas and total biodiversity of algae in Bulgaria was made. The accumulated data were evaluated as promising enough to arise the algological interest to the region and to serve as a good starting point for its future studies.

**Key words:** biodiversity, cyanoprokaryotes, endolithic algae, epilithic algae, Red List

## Introduction

The Bulgarian Black Sea coast with its area of 7 450 km<sup>2</sup> occupies the easternmost parts of the Balkan Peninsula – a well-known European hot spot of biodiversity (GASTON & DAVID 1994, MÉDAIL & QUÉZEL 1999). The peculiar ecological group of aeroterrestrial algae is relatively less investigated and certainly underrepresented in the context of studies of aquatic algae both on the Globe and in Bulgaria in particular, mainly due to taxonomical difficulties and need for time-consuming cultivation of the material (UZUNOV et al. 2007, 2008, GÄRTNER et al. 2010 and references therein). The aim of the present paper is to analyze the algological studies and the knowledge on the diversity of aeroterrestrial algae along the Bulgarian coastal line.

## Material and methods

The study covers the Bulgarian Black Sea coastal region with length of 378 km (starting from the cape Sivriburun on the Romanian border at the North and

finishing on the mouth of Rezovska reka on the border with Republic of Turkey on the South) and width of 10 to 40-50 km, as it is defined by the border of breeze' influence in MICHEV & STOYNEVA (2007). The analysis is based on the available sources on coastal aeroterrestrial algae. The last general assessment of the algal biodiversity of the country for the period 1890-2014 was made by STOYNEVA (2014). She estimated it to comprise of about 5500 species, varieties and forms from 650 genera of 8 divisions, among which the group of aeroterrestrial algae consisted of 589 species, varieties and forms, or about 1% of the total algal biodiversity in the country. The threatened status of the species was evaluated according to the Red List of Bulgarian microalgae (STOYNEVA-GÄRTNER et al. 2016).

## Results

Our search revealed 23 sources on the aeroterrestrial algae from the Black Sea coast region of the

**Table 1.** Aeroterrestrial substrates studied along the Black Sea coast and relevant publications.

Substrates	Sources
Coastal rocks, coastal stones and shells	
Epilithic and algae on barnacle shells	PETKOFF 1905, 1919, KOMAREK 1956, VODENIČAROV 1962, DRAGANOV 1964, STARMACH 1964, VODENIČAROV et al. 1971, DRAGANOV et al. 1984
Endolithic	DRAGANOV et al. 1984
“Wet rocks” in coastal region	PETKOFF 1919, WODENITSCHAROV 1960, VODENIČAROV et al. 1971, 1986
Brick walls	VODENIČAROV et al. 1991
Trees (bark)	VODENIČAROV et al. 1971
“Aerophytic“	VODENIČAROV et al. 1971
Soils (incl. wet and swampy soils)	PETKOFF 1907, VODENIČAROV 1958, VODENIČAROV 1960, DRAGANOV 1975, 1979, DRAGANOV & DIMOVA 1971, VODENIČAROV et al. 1971, DAHN 1986, DRAGANOV et al. 1992
Wet sands and wet muds (some mixed with sands)	PETKOFF 1907, DRAGANOV 1964, VODENIČAROV 1960, 1972

country (PETKOFF 1905, 1907, 1919, KOMAREK, 1956, VODENIČAROV 1958, 1960, 1962, 1972, VODENIČAROV 1960, WODENITSCHAROV 1960, DRAGANOV 1964, STARMACH 1964, VODENIČAROV et al. 1971, 1986, DRAGANOV & DIMOVA 1971, DRAGANOV 1975, 1979, DRAGANOV et al. 1984, DAHN 1986, VODENIČAROV et al. 1991, DRAGANOV et al. 1992, UZUNOV et al. 2007, 2008). They contained data on algae collected from different substrata, or on algae referred with the general term *aerophytic*, all sampled from 69 sites situated almost regularly along the whole coastal line (Table 1).

Totally 164 species, varieties and forms from 56 genera of 4 divisions were found in the coastal region: Cyanoprokaryota (145), Chlorophyta (9), Ochrophyta (7) and Rhodophyta (3). The prevalence of the cyanoprokaryotes is logically better explainable with the scientific profile of the investigators, who conducted studies in the coastal region than with the real poverty of the other taxonomic groups. The diversity of coastal aeroterrestrial algae comprised 31% from the total biodiversity of this group in the country, in which three more divisions were represented (Streptophyta, Euglenophyta and Pyrrhophyta) and only 0,03% of the recent algal biodiversity of Bulgaria.

In the coastal region three new taxa (*Botrydium corniforme* Vodeničarov, *B. milleri* Vodeničarov, *Toxarium undulatum* var. *ponticum* Petkoff) were discovered and a second locality of the species, described from the

soils of Northern-Bulgarian forest-steppe zone (*Cylindrospermum dobrudjense* Draganov) was found. Three of these species (the Critically Endangered *B. corniforme*, the both Endangered *B. milleri* and *C. dobrudjense*), together with the Nearly Threatened *Gloeocapsopsis crepidinum* (Thuret) Geitler ex Komárek) belong to the Red List of Bulgarian microalgae (STOYNEVA-GÄRTNER et al. 2016).

## Discussion

The analysis of the data from the 23 available sources allowed to reveal the main gaps in the knowledge on the aeroterrestrial algal flora of the coastal region, which could serve as guidelines for its future studies. The general and the most obvious conclusion concerned the small number of purposive works and investigated sites (with mainly one substratum studied on the basis of single sampling) and the necessity for studying of the whole coastal territory with broader spectrum of substrata and habitats, and of genetical and molecular studies of the newly described taxa as well. However, taking into account the *time-lag* problems related with the studies of aeroterrestrial algae (GÄRTNER et al. 2010), the accumulated data could be evaluated as promising enough to arise the algological interest to the region and to serve as a good starting point for future studies with strains included in the living algal collection of Sofia University (ACUS), which was created as a collection of aeroterrestrial algae (UZUNOV et al. 2012).

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