# Cyanobacteria (blue-green algae) from the Gulf of Gdańsk and surrounding waters (the Southern Baltic Sea)

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## A key to the identification of the species

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# Introduction

Cyanobacteria (blue-green algae, formerly – Cyanoprokaryota) play an important role in the ecological processes, especially in the last several decades when changes in the structure and functioning of the water ecosystems have been observed. This also applies to coastal waters of the Baltic Sea. Therefore, knowledge of cyanobacterial taxonomy is very important. Significant advances have been recently made in the studies of cyanobacterial taxonomy. In those studies, genetic techniques are used increasingly, which allow us to look from a different perspective on the essence of taxonomy, thus the relationships between taxa and their affiliation with higher systematic ranges.

The taxonomical system adopted in this book, based on the "polyphasic approach" methodology contains substantial changes and sometimes is far deviating from the systems used in the hitherto existing textbooks. In addition to genetic differentiation, the following features were used in the applied system as differentiating factors: the locations of thylakoides in the cell, the type of branching and of course the presence or absence of heterocytes and akinetes. Three main groups of taxa can be distinguished with respect to these characteristics. The first one includes simple forms without thylakoids or with parietal thylakoides, thus single cells or cells gathered in spatial colonies and filamentous forms, but always without heterocytes and not distinctly branched. The second group includes non-filamentous as well as filamentous forms, always without heterocytes but with thylakoids arranged radially or irregularly. In this group, a special process of irregular cell division often occurs, during which baeocytes, exocytes and endocytes are produced. The third group includes filamentous, branched or non-branched forms, which are usually multicellular and morphologically varied, and are characterized by the presence of heterocytes and akinetes, as well as irregular arrangement of thylakoids. However, these three groups do not yet have a clearly defined systematic position. In the taxonomic system adopted in this book, it is proposed to place them in the rank of subclasses, as Pseudanabaenophycideae, Oscillatoriophycideae and Nostocophycideae.

It is obvious that when creating new taxonomic systems in cyanobacteria, the latest genetic criteria should be used. However, it should be, and is even necessary, to classify and characterize new, revised taxonomic groups also based

on morphological criteria. This will allow for the comparison of newly created taxonomic ranks with the characteristics assigned to them in old systems. This method is referred to as "polyphasic approach", in which data from genetic analyses as well as morphological descriptions, anatomical or ecological data are used to determine the rank responses. Using these methodological assumptions, a new proposal for cyanobacterial taxonomic classification is presented (Strunecký et al. 2023). According to this system, the highest taxonomic unit in cyanobacteria is the order. Therefore, species found in the Gulf of Gdańsk and the Southern Baltic are now classified into the following orders: Synechococcales, Nodosilineales, Pseudanabaenales, Leptolyngbyales, Spirulinales, Chroococcales, Oscillatoriales, Coleofasciculales, Nostocales.

This handbook includes a list of cyanobacteria species recorded in the Southern Baltic, especially in the Gulf of Gdańsk (Aurivillius 1896; Fraude 1907; Lakowitz 1907, 1929; Namysłowski 1924; Marchewianka 1925; Rumek 1948, 1950; Biernacka 1967, 1968, 1970; Pankow 1971, 1976; Pliński 1975; Pliński et al. 1985; Witkowski 1993; Witek & Pliński 1998; Komárek & Anagnostidis 1999, 2005; Dobroń 2004) and in costal, brackish water bodies such as the Vistula and Szczecin Lagoons (Szarejko-Łukaszewicz 1957; Zembrzuska 1962; Pliński & Simm 1978; Pliński 1979; Rybicka 2005). The list also includes species occurring in other parts of the Baltic Sea (Hällfors 2004) which have been considered as potentially available for the cyanobacterial flora of the Gulf of Gdańsk.

This book has a specific editorial layout. It consists of an introduction, comprising the purpose of publication, then several specific parts. At first, there are some general remarks concerning the anatomy and morphology also reproduction of cyanobacteria which are important for the identification of taxa. Then a brief review of the most important taxonomic views on cyanobacteria in historical aspect, concluding with a taxonomic scheme for the genera described in this book. The main part consists of keys to species, which include a general description of higher-ranking units and detailed keys within families for genera and species. The identification keys for species provides also data on size measurements for a given species. The most important part of this handbook are plates with drawings and images of selected species. This work is provided with original photographs of chosen taxa from the samples collected in the Gulf of Gdańsk and adjacent regions of the Baltic Sea. Thus, we present an updated key useful for the identification of these cyanobacteria.