



Abstract

# Historical Geographical Distribution of Potentially HCBs (Harmful Cyanobacterial Blooms) across the Portuguese Territory under a European Context <sup>†</sup>

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**Abstract:** Climate change enhances the occurrence of HCBs (Harmful Cyanobacterial Blooms) worldwide, particularly in freshwater ecosystems, posing increased risks for local populations. The present work intends to conduct a spatiotemporal historical overview on the occurrence of potentially toxic cyanobacterial blooms in Europe and Portugal, particularly over the past four decades. *Microcystis* blooms are widely reported across the globe, and microcystins (MCs) are the most detected cyanotoxins. Nevertheless, this can be greatly attributed to the fact that MC-LR is the main cyanotoxin targeted in most studies over the past 40 years due to the health risk guidelines from World Health Organization (WHO). In Europe, this trend is also observed, with microcystins as the most reported cyanotoxins, followed by anatoxins, saxitoxins, cylindrospermopsin, and nodularin. In Portugal, MCs have been reported since the 1980s in freshwater bodies such as shallow lakes (e.g., Mira and Vela lakes) and reservoirs (e.g., Torrão, Carrapetelo, Agueira, Alvito, Odivelas, Monte Novo, Enxoé, and Roxo reservoirs), and their occurrence has not only been mainly related with the blooms of *Microcystis* spp. (particularly *M. aeruginosa*) but also with *Aphanizomenon* and *Planktothrix* spp. High levels of anatoxin-a have been detected in strains of *Anabaena* and *Aphanizomenon* spp. isolated from Maranhão reservoir and near Waste Water Treatment Plants. Saxitoxins have been reported from reservoirs such as Montargil and Crestuma, and related to *Aphanizomenon flos-aquae*. Toxic *Raphidiopsis raciborskii* (formerly *Cylindrospermopsis raciborskii*) strains have been reported for the first time in Portugal in 2003. Although cylindrospermopsin was not detected then, it has been later reported to occur at Vela Lake and São Brás Lake (Azores). This also suggests the importance of referring and monitoring species recognized as having toxic strains with a wide variety of toxic compounds rather than only the most known target cyanotoxins. The present compilation of data aims to contribute to a preliminary Portuguese/Iberian database platform on HCBs and future modelling by integrating the available historical data. The persistent incidence of potentially toxic cyanobacteria through the years in target water bodies may help better understand their dynamics and design deeper ecological research approaches as well as more effective management and control strategies.

**Keywords:** cyanobacterial blooms; cyanotoxins; freshwater bodies; Portugal; spatiotemporal database



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