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Impacts of Eutrophication and Global Warming on the Emergence of Toxic Cyanobacteria blooms

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Abstract: *Cyanobacteria, the oldest phytoplankton on the planet, cause toxic algal blooms in freshwater, estuarine, marine and fresh water habitats. According to recent study, eutrophication and climate change may contribute to the spread of dangerous cyanobacterial algae blooms. This study examines the correlation between eutrophication, climate change, and cyanobacterial taxa in freshwater (Microcystis, Anabaena, Cylindrospermopsis). Cyanobacterial genera have the capacity to compete for low inorganic phosphate concentrations and acquire organic phosphate molecules. Cyanobacteria, both diazotrophic (nitrogen (N2) fixers) and non-diazotrophic, may create blooms using a wide range of nitrogen sources. Some cyanobacterial blooms are linked to eutrophication, although others occur at low inorganic N and P concentrations. Cyanobacteria dominate phytoplankton assemblages at higher temperatures due to physiological (e.g., faster growth) and physical reasons (e.g., greater stratification), with distinct species exhibiting various temperature peaks. The impact of rising carbon dioxide (CO2) concentrations on cyanobacteria is unclear. However, some research shows that some genera of cyanobacteria thrive in low CO2 environments. Future eutrophication and climate change are expected to increase the frequency and size of dangerous cyanobacterial blooms, despite their complicated interactions*.

Keywords: Oldest Phytoplankton, Cyanobacteria, Eutrophication, Cyanobacterial blooms

REFERENCES

[1]. Agawin, N.S.R., Duarte, C.M., Agusti, S., (2000). Nutrient and temperature control of thecontribution of picoplankton to phytoplankton biomass and production. Limnol. Oceanogr. 45, 591–600.

[2]. Bosch, K., Visser, P.M., Huisman, J., (2007). Salt tolerance of the harmful cyanobacterium Microcystis aeruginosa. Aquat. Microb. Ecol. 46, 117–123.

[3]. Cao, L., Caldeira, K., (2008). Atmospheric CO2 stabilization and ocean acidification. Geophys. Res. Lett. 35, L19609.

[4]. Carmichael, W.W., (2001). Health effects of toxin-producing cyanobacteria: ‘‘The CyanoHABs’’. Hum. Ecol. Risk Assess. 7 (5), 1393–1407

[5]. Carmichael, W.W., (2008). A world view—One-hundred twenty-seven years of research on toxic cyanobacteria—Where do we go from here? In: Hudnell, K.H. (Ed.), Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs. Advances in Experimental Medicine and Biology, vol. 619, vol. XXIV. pp.105–120.

[6]. Carmichael, W.W., (2008). A world view—One-hundred twenty-seven years of research on toxic cyanobacteria—Where do we go from here? In: Hudnell, K.H. (Ed.), Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs. Advances in Experimental Medicine and Biology, vol. 619, vol. XXIV. pp. 105–120.

[7]. Chan, F., Pace, M.L., Howarth, R.W., Marino, R.M., (2004). Bloom formation in heterocystic nitrogen-fixing cyanobacteria: the dependence on colony size and zooplankton grazing. Limnol. Oceanogr. 49, 2171–2178

[8]. Chonudomkul, D., Yongmanitchai, W., Theeragool, G., Kawachi, M., Kasai, F., Kaya, K., Watanabe, M.M., (2004). Morphology, genetic diversity, temperature tolerance and toxicity of Cylindrospermopsis raciborskii (Nostocales, Cyanobacteria) strains from Thailand and Japan. FEMS Microbiol. Ecol. 48, 345–355.

[9]. Chorus, I., Bartram, J., (1999). Toxic Cyanobacteria in Water: A Guide to their Public Health Consequences, Monitoring and Management. World Health Organization, E&FN Spon, Routledge, London, UK.

[10]. Codd, G.A., Morrison, L.F., Metcalf, J.S., (2005). Cyanobacterial toxins: risk management for health protection. Toxicol. Appl. Pharmacol. 203, 264–272.

[11]. Downing, J.A., Watson, S.B., McCauley, E., (2001). Predicting cyanobacteria dominance in lakes. Can. J. Fish. Aquat. Sci. 58, 1905–1908.

[12]. Francis, G., (1878). Poisonous Australian Lake. Nature 18, 11–12.

[13]. Frangeul, L., Quillardet, P., Castets, A.-M., Humbert, F., Matthijs, H.C.P., Cortez, D., et al., (2008). Highly plastic genome of Microcystis aeruginosa PCC 7806, a ubiquitous toxic freshwater cyanobacterium. BMC Genomics 9, 274–294

[14]. Fristachi, A., Sinclair, J.L., (2008). Occurrence of cyanobacterial harmful algal blooms workgroup report. In: Hudnell, K.H. (Ed.), Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs. Springer, New York, pp. 45–103.

[15]. GEOHAB (Global Ecology and Oceanography of Harmful Algal Blooms Programme), (2001). In: Glibert, P., Pitcher, G. (Eds.), Science Plan. SCOR and IOC, Baltimore, MD/Paris, France.

[16]. Goldman, J.C., Carpenter, E.J., (1974). A kinetic approach to the effect of temperature on algal growth. Limnol. Oceanogr. 19, 756–766.

[17]. Hawkins, P.R., Runnegar, M.T.C., Jackson, A.R.B., Falconer, I.R., (1985). Severe hepatotoxicity

[18]. Hudnell, K.H., 2008. Cyanobacterial harmful algal blooms: state of the science and research needs. In: Hudnell, K.H. (Ed.), Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs. Advances in Experimental Medicine and Biology, vol. 619, vol. XXIV. pp. 950.

[19]. Huisman, J., Hulot, F.D., (2005). Population dynamics of harmful cyanobacteira. In: Huisman, J., Matthijs, H.C.P., Visser, P.M. (Eds.), Harmful Cyanobacteria, Aquatic Ecology Series. Springer, Dordrecht, The Netherlands, pp. 143–176.

[20]. IPCC, (2007). A report of working group I of the Intergovernmental Panel on Climate Change. Summary for Policymakers and Technical Summary.

[21]. Koma´rkova´ , J., (1998). The tropical planktonic genus Cylindrospermopsis (Cyanophytes, cyanobacteria). In: Azevedo, T., de Paiva, T. (Eds.), Anais do IV Congresso Latino AmericanadeFicologia, vol. I. Secretaria do MeioAmbiente do Estado de Sa˜o Paulo, Brazil, pp. 327–340.

[22]. Mitrovc, S.M., Chessman, B.C., Bowling, L.C., Cooke, R.H., (2006). Modelling suppression of cyanobacterial blooms by flow management in lowland river. River Res. Appl. 22, 109–114.

[23]. Paerl, H.W., Huisman, J., (2009). Climate change: a catalyst for global expansion of harmful cyanobacterial blooms. Eviron. Microb. Rep. 1, 27–37

[24]. Paerl, H.W., Huisman, J., (2009). Climate change: a catalyst for global expansion of harmful cyanobacterial blooms. Eviron. Microb. Rep. 1, 27–37.

[25]. Paerl, H.W., Millie, D.F., (1996). Physiological ecology of toxic cyanobacteria. Phycologia 35, 160–167

[26]. Paul, V.J., (2008). Global warming and cyanobacterial harmful algal booms. In: Hudnell, K.H. (Ed.), Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs. Advances in Experimental Medicine and Biology, vol. 619, vol. XXIV. pp. 239–257.

[27]. Paul, V.J., (2008). Global warming and cyanobacterial harmful algal booms. In: Hudnell, K.H. (Ed.), Cyanobacterial Harmful Algal Blooms: State of the Science and Research Needs. Advances in Experimental Medicine and Biology, vol. 619, vol. XXIV. pp. 239–257

[28]. Qui, B., Gao, K., (2002). Effects of CO2 enrichment on the bloom-forming cyanobacteriumMicrocystis aeruginosa (Cyanophyceae): pyhsiological responses and relationshipswith the availability of dissolved inorganic carbon. J. Phycol. 38, 721–729.

[29]. Rouhiainen, L., Vakkilainen, T., Siemer, B.L., Buikema, W., Haselkorn, R., Sivonen, K., (2004). Genes coding for hepatotoxic heptapeptides (microcystins) in the cyanobacterium Anabaena strain 90. Appl. Environ. Microbiol. 70, 686–692.

[30]. Seifert, M., McGregor, G., Eaglesham, G., Wickramasinghe, W., Shaw, G., (2007). First evidence for the production of cylindrospermopsin and deoxy-cylindrospermopsin by the freshwater benthic cyanobacterium, Lyngbyawollei (Farlow ex Gomont) Speziale and Dyck. Harmful Algae 6, 73–80.

[31]. Spro˝ ber, P., Shafik, H.M., Pre´ sing, M., Kova´ cs, A.W., Herodek, S., (2003). Nitrogen uptake and fixation in the cyanobacterium Cylindrospermopsis raciborskii under different nitrogen conditions. Hydrobiologia 506–509, 169–174.

[32]. Tonk, L., (2007). Impact of Environmental Factors on Toxic and Bioactive Peptide Production by Harmful Cyanobacteria. Department of Aquatic Microbiology, Institute for Biodiversity and Ecosystem Dynamics, Universiteit van Amsterdam NieuweAchtergracht, Amsterdam, 136 pp.

[33]. Wagner, C., Adrian, R., (2009). Cyanobacteria dominance: quantifying the effects of climate change. Limnol. Oceanogr. 54, 2460–2468.

[34]. Wood, S.A., Prentice, M.J., Smith, J., Hamilton, D.P., (2010). Low dissolved inorganic nitrogen and increased heterocyte frequency: precursors to Anabaena planktonica blooms in a temperate, eutrophic reservoir. J. Plankton Res. 32, 1315–1325.