Warming rate shapes the thermal tolerance of freshwater phytoplankton

Sánchez de Pedro, R*.[1], Melero-Jiménez, I.J.[1], Reul A.[2], Viruel M.[3], Bañares-España, E.[1] Flores-Moya, A. & García-Sánchez, M.J.[1]
*Main speaker
[1]*Universidad de Málaga, Andalucía Tech, Departamento de Botánica y Fisiología Vegetal, Campus de Teatinos, 29010 Málaga, Spain*
[2]*Universidad de Málaga, Andalucía Tech, Departamento de Ecología y Geología, Campus de Teatinos, 29010 Málaga, Spain*
[3]*Instituto de Hortofruticultura Subtropical y Mediterránea La Mayora, UMA-CSIC, 29750, Algarrobo-Costa, Málaga, Spain*
* rsdpc@uma.es

The impact of global warming on phytoplankton species in freshwater ecosystems could vary depending on their capacity for adapting and acclimating to changes in temperature. To make better predictions under different global warming scenarios, it is crucial to perform long-term experiments where the selection of new genetic variants could occur in addition to potential gene expression changes.

Here we aimed to explore the differential evolutionary potential of two freshwater phytoplankton species growing under increasing temperatures, the bloom forming cyanobacterium *Microcystis aeruginosa* (Kützing) Kützing and the green microalga *Chlamydomonas reinhardtii* P. A. Dang. We performed an evolutionary ratchet experiment lasting over 60 generations to detect the limit of resistance to high temperatures of both species. Populations were initially maintained at 25 ºC and then subjected to a slow (+2 ºC) or to a rapid (+4 ºC) temperature increase. To characterize the increase in thermal tolerance of the derived populations, we compared the growth rate and photosynthetic performance of derived and ancestral populations at control (25 ºC), sublethal and lethal temperatures of ancestral populations.

We observed that slow warming facilitates the increase of thermal tolerance of both species. Specifically, the lethal temperature of ancestral populations was only surpassed by derived populations under slow warming conditions. Thermo-tolerant derived strains showed higher photosynthetic capacity than ancestral ones at high temperatures, but at the cost of a limited capacity to dissipate energy via non-photochemical pathways. Our results suggested that the rate of global warming could modulate the thermal tolerance limit and resilience of phytoplanktonic species and alter the primary production and resilience of freshwater ecosystems.