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MORPHOLOGICAL DIVERSITY OF PLANKTIC ALGAE AND THEIR EVOLUTIONARY RELATEDNESS

A planktonikus algák morfológiai diverzitása és annak evolúciós vonatkozásai

Gábor Borics[1]*, Gábor Várbíró[1], János Falucskai[2], Zsolt Végvári[1,3] Enikő T-Krasznai[1], Judit Görgényi[1] & Verona Lerf[1]

*[1]Centre for Ecological Research, Institute of Aquatic Ecology, Department of Tisza Research, 18/c Bem square, H-4026 Debrecen, Hungary; [2]University of Nyíregyháza, Institute of Mathematics and Informatics, 31/b Sóstói str. H-4400 Nyíregyháza, Hungary; [3]Senckenberg Deutsches Entomologisches Insitut, Eberswalder Str. 90, 15374 Müncheberg, Germany; *E-mail: borics.gabor@ecolres.hu*

Evolution of body shapes has been constrained by geometry in many organisms across the animal and plant kingdoms. Although the relationships among shape complexity and geometry has already been investigated in a number of taxa, a general framework of the interplay between evolution and geometry has not yet been provided for microalgae, which is one of the geometrically most diverse groups on Earth. Numerical characterisation of morphological complexity needs the quantification of morphological attributes of algae.

Surface area and volume are master traits of microalgae, and these variables can be calculated if shape specific surface area and volume constants are known. Using the surface area and volume constants of three-dimensional objects, we created a Euclidean morphospace, in which each species has a numerically well-defined position. Since the covered area in the morphospace represents the morphological diversity of the algal groups, we created the three dimensional models of various morphological representatives of microalgae and cyanobacteria, and after calculating their surface area and volume constants we placed them in the morphospace. We have shown that the algal groups have remarkable differences in the occupied area within the morphospace and these differences are not correlate with evolutionary relatedness. We have also demonstrated that there is a linear relationship between the ratio of surface and volume constants of organisms and their size, suggesting that the development of basic morphologies are constrained by their linear dimensions. We found different morphologies in identical parts of the morphospace, which implies that the different forms can be considered as morphologically different but functionally identical adaptations. Because of the close linkage between phytoplankton morphology and ecology, the proposed morphospace may serve as a proxy of an ecospace, and thus, it can also be used to visualize current ecological processes such as eutrophication of waters or seasonal succession of phytoplankton.