Phytoplankton defence mechanisms: traits and trade-offs - DTU Orbit (13/12/2018)

Phytoplankton defence mechanisms: traits and trade-offs: Defensive traits and trade-offs

In aquatic ecosystems, unicellular algae form the basis of the food webs. Theoretical and experimental studies have demonstrated that one of the mechanisms that maintain high diversity of phytoplankton is through predation and the consequent evolution of defence mechanisms. Proposed defence mechanisms in phytoplankton are diverse and include physiological (e.g. toxicity, bioluminescence), morphological (e.g. silica shell, colony formation), and behavioural (e.g. escape response) traits. However, the function of many of the proposed defence mechanisms remains elusive, and the costs and benefits (trade-offs) are often unquantified or undocumented. Here, we provide an overview of suggested phytoplankton defensive traits and review their experimental support. Wherever possible we quantify the trade-offs from experimental evidence and theoretical considerations. In many instances, experimental evidence suggests that defences are costless. However, we argue that (i) some costs materialize only under natural conditions, for example, sinking losses, or dependency on the availability of specific nutrients, and (ii) other costs become evident only under resource-deficient conditions where a rivalry for limiting resources between growth and defence occurs. Based on these findings, we suggest two strategies for quantifying the costs of defence mechanisms in phytoplankton: (i) for the evaluation of defence costs that are realized under natural conditions, a mechanistic understanding of the hypothesized component processes is required; and (ii) the magnitude of the costs (i.e. growth reduction) must be assessed under conditions of resource limitation.

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