Seasonal and scale-dependent variability in nutrient- and allelopathy-mediated macrophyte–phytoplankton interactions

macrophyte–phytoplankton interactions were investigated using a dual laboratory and field approach during a growing season, with responses quantified as changes in biomass. Short-term, close-range interactions in laboratory microcosms always led to mutual exclusion of macrophytes (Elodea canadensis or Ceratophyllum demersum) and algae (Raphidocelis subcapitata, Fistulifera pelliculosa) or cyanobacteria (Synechococcus leopoliensis), suggesting regulation by positive feedback mechanisms, progressively establishing and reinforcing a “stable state”. Laboratory results suggest that close-range regulation of R. subcapitata and F. pelliculosa by macrophytes was primarily via nutrient (N, P) mediation. Sprig-produced allelochemicals may have contributed to inhibition of S. leopoliensis in C. demersum presence, while S. leopoliensis was apparently enhanced by nutrients leaked by subhealthy (discolored leaves; biomass loss) E. canadensis. Seasonal changes in algal growth suppression were correlated with sprig growth. Marginal differences in in situ phytoplankton patterns inside and outside monospecific macrophyte stands suggest that the nutrient- and/or allelopathy-mediated close-range mechanisms observed in the laboratory did not propagate at the macrophyte-stand scale. Factors operating at a larger scale (e.g., lake trophic state, extent of submerged vegetation coverage) appear to override in situ macrophyte–phytoplankton close-range interactions.

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Obtenir le document : EDP Sciences
Mots clés : Ceratophyllum demersum, Elodea canadensis, nutrients, allelopathy, alternate stable states in shallow lakes, Ceratophyllum demersum, Elodea canadensis, nutriments, allélopathie, états stables alternatifs en lacs peu profonds
Thème (issu du Text Mining) : FLORE, MILIEU NATUREL
Date : 2013-08-15
Format : text/xml
Source : https://doi.org/10.1051/kmae/2013055
Langue : Anglais
Télécharger les documents : https://www.kmae-journal.org/10.1051/kmae/2013055/pdf