



EFFECTS OF FLOATING PHOTOVOLTAICS ON COMPETITION BETWEEN PHYTOPLANKTON AND MACROPHYTES

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Floating photovoltaics (FPV), the deployment of solar panels on water surfaces, has the potential to expand solar energy use and accelerate the transition to renewable energy sources. Environmental impacts of FPV on aquatic ecosystems include reduced light incidence and wind mixing, both of which can directly affect primary producers competing for light and nutrients. These ecological interactions influence lake dynamics and equilibria and can generate shifts between clear and turbid stable states as environmental conditions change. We modified an existing mathematical model to evaluate the effects of FPV on competition for light and nutrients between phytoplankton and macrophytes, and the ensuing consequences for lake dynamics. The model represented a shallow lake in which 30% of the surface was covered by FPV and water exchange could occur freely between the covered and open sectors of the lake. We considered three scenarios involving different macrophyte growth forms: floating, emergent, and submerged. In each scenario, we examined the stable states arising under different combinations of nutrient input and light penetration, at different rates of exchange between the open and covered sectors. We found that FPV favors coexistence of phytoplankton with floating macrophytes under most conditions, and with emergent and submerged macrophytes at low nutrient levels. FPV also reduced macrophyte density at low nutrient levels for all scenarios, and phytoplankton density at low-light, high-nutrient conditions in the emergent and submerged scenarios; changes were stronger at higher rates of exchange between sectors. This work has important implications for lake management, as it shows that FPV can influence ecological interactions between primary producers, with potential cascading effects to higher trophic



levels. Considering FPV's potential for reducing phytoplankton and macrophyte outbreaks, deployment of solar panels can reduce anthropogenic pressure on aquatic ecosystems and support ecosystem services provided by primary producers, contributing to a sustainable energy transition.

Palavras-chave: *competition; floating solar panels; light; nutrients; sustainability*