

The importance of vegetated ponds to water quality and phytoplankton carbon production in Liberty Island, California



Liberty Island

Question : Do the small vegetated ponds in the upper portion of Liberty Island contribute significantly to the overall water quality and phytoplankton production of the wetland?

Abstract

Liberty Island is a freshwater tidal wetland that is thought to provide habitat and food resources for the endangered delta smelt. However, little is known about the mechanisms that control environmental conditions and carbon production in the wetland. This study was designed to address the question: Do the small vegetated ponds in the upper portion of Liberty Island contribute significantly to the overall water quality and phytoplankton production of the wetland? To address this question, a suite of physical, chemical and biological variables were measured at four locations in three wetland ponds between 2010 and 2011. Continuous measurements of water temperature, pH, specific conductance, dissolved oxygen, turbidity and chlorophyll *a* fluorescence with YSI 6600 water quality sondes provided information on water quality conditions. Continuous phytoplankton carbon production was predicted from continuous Turner Phytoflash photometers, Li-COR underwater light measurements and chlorophyll *a* fluorescence. Continuous and discrete monthly measurements provided baseline information on nutrient availability. Calibration data were collected semi-monthly to monthly throughout the study. Chlorophyll *a* concentration, water temperature, specific conductance and turbidity were greater in the vegetated ponds. On average, phytoplankton cells were growing at 45% to 48% of their maximum potential yield (Fv/Fm) throughout the ponds. Average daily yield was similar among the three ponds at 0.38 ± 0.10 to 0.41 ± 0.11 Fv/Fm and ranged from 70% to 10% of the maximum potential yield. In situ 24 hr light and dark bottle dissolved oxygen incubation studies indicated both the net primary productivity and maximum photosynthetic potential were greater in the vegetated ponds. Phytoplankton production was supported by elevated nitrate, ammonium, soluble reactive phosphorus and silica concentrations that were often greater in the vegetated ponds. Initial findings suggest vegetated ponds are a potential source of suspended solids, salt and phytoplankton carbon to the wetland.

Methods

Water quality conditions were measured at four stations located in three connected ponds within the wetland. At each station, a YSI water quality sonde, Turner Phytoflash rapid rate fluorometer and LiCOR light meter were positioned within 0.3 m of the surface and sampled continuously at 15 min intervals. The Turner Phytoflash fluorometer measured photosynthetic yield. Discrete surface water samples were also collected with a diaphragm pump at semi-monthly to monthly intervals for measurement of the concentration of nitrate, ammonium, soluble reactive phosphorus and silica and to calibrate sonde values. Primary productivity was measured at semi-monthly to monthly intervals using a 24 hr in situ dissolved oxygen light and dark bottle incubation technique.

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Water Quality

Continuous data



Average daily chlorophyll *a* concentration, specific conductance, water temperature, turbidity, and pH were consistently greater in the vegetated ponds, upper beaver pond UBP and/or lower beaver pond LBP than the Main Pond stations MPNW and MPSE.



Discrete measurements confirmed the greater chlorophyll *a* concentration, specific conductance and turbidity in the vegetated ponds UBP and/or LBP.



Secchi disk depth measurements also confirmed the greater turbidity (lower Secchi disk depth) in the vegetated ponds, upper and lower beaver pond, compared with the Main Pond stations Main-NW or Main-SE.



Primary Productivity

Phytoplankton Yield



Continuous phytoflash measurements indicated the photosynthetic yield ranged between 0.38 + 0.10 to 0.41 + 0.11 Fv/Fm and averaged 45% to 48% (range 10% to 70%) of the maximum potential yield.





Both the a) in situ net primary productivity and b) the maximum photosynthetic potential (P_{max}) were greater at the vegetated pond upper beaver pond UBP followed by lower beaver pond LBP and then the open water main pond MP.

Conclusions

- Vegetated ponds had grater chlorophyll *a* concentration, turbidity, pH and specific conductance than the open water pond
- Average daily phytoplankton yield based on fv/fm averaged 45 to 48% of the maximum daily yield and was similar among ponds
- Primary productivity and the maximum photosynthetic potential were greater in the vegetated ponds







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