Effects of Aquatic Macrophytes on Ecosystem Metabolism and Oxygen Dynamics in a Shallow Wetland.

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Wetlands are the most abundant freshwater ecosystem on Earth. They are also one of the most susceptible to increased atmospheric warming, especially oxygen cycles. Our objective was to determine the effects of metaphyton, Chara, Potamogeton foliosus, and Lemna on daily dissolved oxygen dynamics during the spring, summer and fall using clear, cylindrical mesocosms with one end embedded in the mud of a small (323 m2), shallow (0.3 m to 0.6 m) riparian pond. We predicted that the severity of hypoxia (≤ 4.0 mg O2 L-1) would depend on which macrophyte patch was most productive during the warm summer months: Lemna > Chara and metaphyton > P. foliosus. Net aquatic production (NAP = GPP - ER) in each patch clustered near 0.0 g O2 m-2 d-1 as gross primary production (GPP) was roughly balanced by ecosystem respiration (ER). In the spring, all four macrophyte patches were autotrophic and only metaphyton showed brief periods (< 2.5 hrs) of nighttime hypoxia. In the summer, temperatures reached as high as 37º C, all patches were heterotrophic and produced extensive periods of severe hypoxia (≤ 1.0 mg O2 L-1) consistent with our predictions: Lemna (daily mean = 16.8 h d-1), Chara (daily mean = 8.3 h d-1), and metaphyton (daily mean = 6.3 h d-1). Potamogeton foliosus died-back in the summer. In the fall, temperatures dropped and the duration of hypoxia depended on the density of Lemna, which was the dominant macrophyte. Hypoxia was rare where Lemna was sparse (AFDM = 38.6 g) and extensive (72 hrs at < 1 mg O2 L-1) where it was abundant (AFDM = 67.5 g). This study showed the importance of both warming and macrophyte type in determining hypoxia. We discuss macrophyte traits that might reduce the harmful effects of hypoxia as temperatures increase in shallow wetlands.