$\delta^{13}C$ is a signature of light availability and photosynthesis in seagrass

Xinping Hu, David J. Burdige and Richard C. Zimmerman

Limnol. Oceanogr., 57(2), 2012, 441-448 | DOI: 10.4319/lo.2012.57.2.0441

ABSTRACT: We explored the role of light-saturated (carbon-limited) photosynthesis on $\delta^{13}C$ of turtlegrass (*Thalassia testudinum* Banks ex König) populations from the clear, blue waters of the Great Bahama Bank and the turbid, green waters of Florida Bay using field observations and radiative transfer models. Consistent with numerous previous observations, leaf $\delta^{13}C$ decreased significantly with water depth in both regions. However the $\delta^{13}C$ for Bahamas turtlegrass was 3‰ heavier than that for Florida Bay turtlegrass at equivalent depths, and broadband irradiance explained even less of the $\delta^{13}C$ variations than depth. Instead, leaf $\delta^{13}C$ showed a stronger relationship to the fraction of the day that photosynthesis of the intact plant canopy was carbon-limited. When the Bahamas and Florida Bay $\delta^{13}C$ values were related to the fraction of the day that photosynthesis was carbon-limited, the variations in leaf $\delta^{13}C$ observed for Florida and Bahamas populations collapsed into a single relationship that explained 65% of the variation in leaf $\delta^{13}C$. Consequently, turtlegrass from the Bahamas was isotopically heavier than Florida Bay populations growing at equivalent depths because they were more carbon-limited (= light-saturated) for a larger fraction of the day. The ability to predict turtlegrass $\delta^{13}C$ from the daily period of carbon-limited photosynthesis provides a mechanistic link to fundamental relationships between light and photosynthesis that can transcend geographic differences in depth and water-column optical properties, and may permit leaf $\delta^{13}C$ to provide a robust indicator of recent photosynthetic performance and plant survival in response to changing environmental conditions.