Optimum temperature for carbon assimilation in Kentucky Lake follows seasonal change in ambient temperature

William E. Spencer, Stacey R. Delaney, Gary T. Rice, Karla L. Johnston, Russell Seither and David S. White

Department of Biological Sciences and Hancock Biological Station, Murray State University

With 4 figures and 2 tables in the text

Abstract: Long-term (six years) field-descriptive data from Ledbetter Bay, Kentucky Lake, Kentucky showed that phytoplankton carbon assimilation (mg C l⁻¹ h⁻¹) was dependent upon chlorophyll concentration ($r^2 = 0.66$, $p = 0.0001$) and temperature ($r^2 = 0.11$, $p = 0.02$), while assimilation number (mg C h⁻¹ mg chlorophyll⁻¹) was not dependent upon temperature. When assimilation number by natural phytoplankton assemblages collected eight times throughout 1995 was measured in the laboratory using an experimental-manipulative approach at 5, 10, 15, 20, 25, and 30 °C, the optimum temperature for assimilation number showed a significant positive relationship with ambient temperature. The optimum temperature shifted from a low of 11 °C for the winter community to 30 °C for the summer community. The following second order equation ($r^2 = 0.91$) adequately described the relationship between optimum temperature for assimilation number (OptT) and ambient temperature (AmbT); OptT = 13.75 + [(5.067 x 10⁻³) (AmbT)] + [(1.55 x 10⁻²) (AmbT)²]. The assimilation number of the winter phytoplankton measured at 5 °C was almost 165 % greater than carbon assimilation of the summer phytoplankton measured at 5 °C, while the assimilation number of the winter phytoplankton measured at 30 °C was about 75 % less than the summer phytoplankton measured at 30 °C. These data suggest that adaptations which allow for greater carbon assimilation during one seasonal extreme preclude equivalent or greater carbon assimilation at the opposite seasonal extreme. It appears that the same phytoplankton community cannot maintain optimal carbon assimilation rates at both cold and warm temperatures, and that phytoplankton communities adapt to seasonal change in temperature. These data demonstrate that the optimum temperature of carbon assimilation for freshwater phytoplankton can vary with seasonal change in ambient temperature.

Authors’ address: Department of Biological Sciences and Hancock Biological Station, Murray State University, Murray, KY 42071-0009, USA.

DOI:10.1127/archiv-hydrobiol/141/1998/389
(c) 2015 www.schweizerbart.com