

Modeling Diel Trends of Dissolved Oxygen for Estimating the Metabolism in Pristine Streams in the Brazilian Cerrado

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Abstract : The metabolism of the streams is an indicator of ecosystem disturbance due to the influences of the catchment on the structure of the water bodies. The study of the respiration and photosynthesis allows the estimation of energy fluxes through the food webs and the analysis of the autotrophic and heterotrophic processes. We aimed at evaluating the metabolism in streams located in the Brazilian savannah, Cerrado (Sao Carlos, SP), by determining and modeling the daily changes of dissolved oxygen (DO) in the water during one year. Three water bodies with minimal anthropogenic interference in their surroundings were selected, Espiraiado (ES), Broa (BR) and Canchim (CA). Every two months, water temperature, pH and conductivity are measured with a multiparameter probe. Nitrogen and phosphorus forms are determined according to standard methods. Also, canopy cover percentages are estimated in situ with a spherical densitometer. Stream flows are quantified through the conservative tracer (NaCl) method. For the metabolism study, DO (PME-MiniDOT) and light (Odyssey Photosynthetic Active Radiation) sensors log data for at least three consecutive days every ten minutes. The reaeration coefficient (k_2) is estimated through the method of the tracer gas (SF₆). Finally, we model the variations in DO concentrations and calculate the rates of gross and net primary production (GPP and NPP) and respiration based on the one station method described in the literature. Three samplings were carried out in October and December 2015 and February 2016 (the next will be in April, June and August 2016). The results from the first two periods are already available. The mean water temperatures in the streams were 20.0 +/- 0.8C (Oct) and 20.7 +/- 0.5C (Dec). In general, electrical conductivity values were low (ES: 20.5 +/- 3.5uS/cm; BR 5.5 +/- 0.7uS/cm; CA 33 +/- 1.4 uS/cm). The mean pH values were 5.0 (BR), 5.7 (ES) and 6.4 (CA). The mean concentrations of total phosphorus were 8.0ug/L (BR), 66.6ug/L (ES) and 51.5ug/L (CA), whereas soluble reactive phosphorus concentrations were always below 21.0ug/L. The BR stream had the lowest concentration of total nitrogen (0.55mg/L) as compared to CA (0.77mg/L) and ES (1.57mg/L). The average discharges were 8.8 +/- 6L/s (ES), 11.4 +/- 3L/s and CA 2.4 +/- 0.5L/s. The average percentages of canopy cover were 72% (ES), 75% (BR) and 79% (CA). Significant daily changes were observed in the DO concentrations, reflecting predominantly heterotrophic conditions (respiration exceeded the gross primary production, with negative net primary production). The GPP varied from 0-0.4g/m².d (in Oct and Dec) and the R varied from 0.9-22.7g/m².d (Oct) and from 0.9-7g/m².d (Dec). The predominance of heterotrophic conditions suggests increased vulnerability of the ecosystems to artificial inputs of organic matter that would demand oxygen. The investigation of the metabolism in the pristine streams can help defining natural reference conditions of trophic state.

Keywords : low-order streams, metabolism, net primary production, trophic state

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