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MINI-REVIEW

Nutrient Cycling in Lakes and Streams: Insights from a Comparative Analysis

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ABSTRACT

Understanding of general ecosystem principles may be improved by comparing disparate ecosystems. We compared nutrient cycling in lakes and streams to evaluate whether contrasts in hydrologic properties lead to different controls and different rates of internal nutrient cycling. Our primary focus was nutrient cycling that results in increased productivity, so we quantified nutrient cycling by defining the recycling ratio (ρ) as the number of times a nutrient molecule is sequestered by producers before export. An analytic model of nutrient cycling predicted that in lakes ρ is governed by the processes that promote the mineralization and retard the sedimentation of particulate-bound nutrients, whereas in streams, ρ is governed by processes that promote the uptake and retard the export of dissolved nutrients. These differences were the consequence of contrast between lakes and streams in the mass-specific export rates (mass exported · standing stock^{-1} · time^{-1}) of dissolved and particulate nutrients. Although ρ is calculated from readily measured ecosystem variables, we found very few published data sets that provided the necessary data for a given ecosystem. We calculated and compared ρ in two well-studied P-limited ecosystems, Peter Lake and West Fork Walker Branch (WFWB). When ecosystems were scaled so that water residence time was equal between these two ecosystems, ρ was three orders of magnitude greater in WFWB. However, when we scaled by P residence time, ρ was nearly equal between these two ecosystems. This suggests broad similarities in ρ across ecosystem types when ecosystem boundaries are defined so that turnover times of limiting nutrients are the same.

Key words: ecosystem; lakes; streams; nutrient cycling; lotic; lentic; comparative analysis; ecosystem models.