



Measuring groundwater–surface water interaction and its effect on wetland stream benthic productivity, Trout Lake watershed, northern Wisconsin, USA[☆]

Randall J. Hunt^{a,*}, Mac Strand^b, John F. Walker^a

^aUS Geological Survey, 8505 Research Way, Middleton, WI 53562, USA

^bDepartment of Biology, Northern Michigan University, 1401 Presque Isle Avenue, Marquette, MI 49855, USA

Received 10 May 2005; revised 23 May 2005

Abstract

Measurements of groundwater–surface water exchange at three wetland stream sites were related to patterns in benthic productivity as part of the US Geological Survey's Northern Temperate Lakes–Water, Energy and Biogeochemical Budgets (NTL–WEBB) project. The three sites included one high groundwater discharge (HGD) site, one weak groundwater discharge (WGD) site, and one groundwater recharge (GR) site. Large upward vertical gradients at the HGD site were associated with smallest variation in head below the stream and fewest gradient reversals between the stream and the groundwater beneath the stream, and the stream and the adjacent streambank. The WGD site had the highest number of gradient reversals reflecting the average condition being closest to zero vertical gradient. The duration of groundwater discharge events was related to the amount of discharge, where the HGD site had the longest strong-gradient durations for both horizontal and vertical groundwater flow. Strong groundwater discharge also controlled transient temperature and chemical hyporheic conditions by limiting the infiltration of surface water. Groundwater–surface water interactions were related to highly significant patterns in benthic invertebrate abundance, taxonomic richness, and periphyton respiration. The HGD site abundance was 35% greater than in the WGD site and 53% greater than the GR site; richness and periphyton respiration were also significantly greater ($p \leq 0.001$, 31 and 44%, respectively) in the HGD site than in the GR site. The WGD site had greater abundance (27%), richness (19%) and periphyton respiration (39%) than the GR site. This work suggests groundwater–surface water interactions can strongly influence benthic productivity, thus emphasizing the importance of quantitative hydrology for management of wetland-stream ecosystems in the northern temperate regions.

© 2005 Elsevier B.V. All rights reserved.

Keywords: Groundwater–surface water interaction; Wetland; Upwelling; Benthic invertebrates; Periphyton respiration

[☆] Authors' note: Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the US Government. This article is a US Government work and is in the public domain in the USA.

* Corresponding author. Fax: +1 608 821 3817.

E-mail addresses: rjhunt@usgs.gov (R.J. Hunt), rostrand@nmu.edu (M. Strand), jfwalker@usgs.gov (J.F. Walker).