Proposal to for a workshop to assess needs for a large-scale cross-site synthetic effort to characterize the controls on nitrogen transport through streams and rivers

Background

Human sources now rival natural sources of fixed N to the biosphere, changing the biogeochemistry of both terrestrial and aquatic environments by adding biologically available N, primarily from fossil fuel combustion, agricultural fertilizer applications, and legume cultivation. Most of the inorganic N entering and transported by streams and rivers is accounted for as nitrate by many ecosystem scientists. Unlike ammonium, which is considered to be biogeochemically "sticky", nitrate has been thought to flow freely downstream to lakes and coastal ecosystems once it enters streams. Recently, however, this view has been challenged. Mass balance analyses for the Mississippi River drainage have shown that large quantities of total N and nitrate are lost as water travels through its tributary streams and rivers (Alexander et al. 2000). Headwater streams clearly can alter the quantity and forms of N in water passing through them (Peterson et al. 2001). Additionally, larger downstream fluvial networks contain other potential hotspots of N retention, including reservoirs, semi-impounded reaches (i.e., low-head navigation dams), floodplains, estuaries, and deltas. The relative importance of these diverse environments in controlling the transport and fate of excess N is not well understood for any large river system, nor are the impacts of human alterations of these environments.

Prior research on N cycling in lotic systems has been directed at the largest rivers, with particular attention to the role of off-channel aquatic environments associated with navigation dams along the upper Mississippi, and of natural floodplains along unregulated very large rivers such as the Orinoco and Amazon in South America. This research has often entailed a team effort but has not been previously organized into networks performing simultaneous but distinct studies in the same way that the LINX project (a cross site initiative examining N flux in small streams across the LTER network) has been structured, and has had no linkage to the smaller streams in the fluvial system. The N biogeochemistry of estuaries and coastal oceans has also been studied in some detail, and these ecosystems are the focus of several new LTER sites, but traditionally there has been little linkage of this work to the watersheds that contribute N loading. Recent LTER research is making that connection, however, as for example at Plum Island or the Santa Barbara Channel. Concurrently, synthesis efforts have been directed at very large-scale (regional to global) analyses of nitrogen transport from continents into the oceans (e.g., The International Nitrogen Initiative: A Joint Programme of SCOPE and IGBP). Currently, the linkages between small-stream models and watershed-scale transport are not often made. Furthermore, several models of N transport through fluvial systems exist, each with its own strengths and limitations (Alexander et al. 2003), but all suffer from inadequate knowledge of processes and mechanisms across the entire fluvial system, and hence tend to rely on correlative analyses and to focus on one end or the other of the spectrum of stream size. There is a currently a need to bridge ongoing cross-site comparisons of small streams to the large-river efforts and modeling approaches.

Key Issues on N Cycling and Transport

Three workshops at the most recent LTER All-Scientists Meeting focused on issues important to this synthesis: 1) Development of coupled hydrological-biogeochemical models of materials transport at the landscape scale; 2) Methods of determining denitrification rates in lotic ecosystems; and 3) Exploring nitrogen dynamics in streams: Using models to scale up from headwaters reaches to stream networks. Whereas these workshops identified some key issues that needed to be addressed when scaling up to large watershed, constraints of time and large meeting groups made it obvious that a more concentrated session with a smaller working group would provide more focus to efforts. Thus, we propose a working group of 12 individuals to assess issues in integrating small-scale research with large-scale mass balance and modeling approaches in rivers.

The working group would meet at Konza Prairie Biological Station for 2 full days of workshops during early March 2004. The goals would be to identify key issues in linking small-scale mechanistic models to large-scale synthesis of factors influencing N transport. We would identify what could be done with existing data in addition to what data need to be collected to provide predictive models of N transport across natural and human-dominated landscapes. The products would be a publication based on the idea of scaling biogeochemical information from small to large scales (if possible) and at minimum a strategic plan for efforts to obtain funding for future research.

Potential participants include : Bruce Peterson, Woods Hole Marine Biological Laboratory; Jennifer Tank, Notre Dame University; Richard Alexander, USGS; John Melack, University of Santa Barbara; Nancy Grimm, Arizona State University; Patrick Mulholland, Oak Ridge National Laboratory; Sherri Johnson, Oregon State University; Geoff Poole, Eco-Metrics Inc.; William Richardson, USGS; Steve Hamilton, Kellogg Biological Station; and Walter Dodds, Kansas State University. The exact participants will be determined based on availability.

Budget

Travel, 11 investigators $7,260. Food and lodging, $2,004

Participants will fly to Kansas City and rent vehicles to drive to Konza Prairie, $660 is close to normal costs, in my experience as chair of the Biology Seminar Committee, for bringing in outside people to Kansas State University.

Lodging will be inexpensive $264 ($12 per person per night), meeting room will be $300 ($125 per day). Meals will be $1440 ($60 per person per day).

Total costs: $9,264