Synopsis of discussions at two stream workshops

Discussions at the stream workshops diverged along schizophrenic pursuits of a) What are fundamental measures of system properties that we should be measuring; b) Intersite comparisons based on logistically feasible methodologies; and c) Major ecological questions, hypotheses or paradigms. We agreed that intersite research organized around a compelling ecological hypothesis was the most profitable way to proceed. We recommend continued encouragement of intersite proposal development by groups of LTER scientists and facilitating efforts to identify major ecological questions requiring intersite collaboration for their answer.

1. Planned intersite activities: The following ideas for comparative studies were proposed by workshop participants.

a) Short-term releases of a conservative tracer (e.g. chloride) offer a fairly simple and transportable technique to compare hydraulic properties of streams across the network. These could be done at summer low flow in a number of sites to increase our understanding of physical drivers in streams across the network. Donna D'Angelo will take the lead in developing these ideas further. A number of people indicated their interest in this activity.

b) Tim Kratz and George Kling discussed their upcoming workshop on carbon dynamics in aquatic systems and several stream sites were interested in participating.

c) A previous comparative study of leaf decomposition in streams revealed a latitudinal trend in the relative importance of microbes vs. invertebrates. Tannin and nitrogen content of leaves were useful predictors of decay rate. Jock Irons will take the lead on developing a proposal to do the stream equivalent of LIDET = SLIDET. He suggested using 6 leaf species, coarse vs. fine mesh, in 2 - 3 order streams at 10 sites. We have a list of individuals interested in working on such a project.

d) Comparison of quality of fine benthic organic matter in streams across the network. We hypothesize a direct relationship between organic matter quality and relative importance of autochthonous carbon in the stream. We will test this using a chironomid bioassay of organic matter quality. The FPOM will be sampled from depositional areas of streams at summer low flow or immediately before annual leaf input and sent frozen to a central lab. Judy Meyer will work with Steve Golladay and Carolyn Hax on this project. Eight sites were willing to send the FPOM samples when the necessary sampling and shipping containers are sent.

e) Fred Benfield proposed a study of microbial exoenzymes and stick decay using red maple twigs. The study will focus on a range of sites in the Appalachians, but could be extended to interested sites in the network. A number of individuals expressed interest in participating in this research.

f) We recognized a need to develop a better understanding of the biodiversity and biotic structure in streams in the network. As a beginning, we propose that each site compile and share a list of taxa identified to the extent possible for a stream at the site. With this

information and basic knowledge of feeding groups, one can make a prelimary attempt at constructing a food web for the site. Judy Meyer offered to compile the species lists, and Todd Crowl and Fred Benfield will work with those data. This effort will be done in concert with the comparisons being discussed during the food web workshop.

g) There are several new quick and dirty measures of water quality in water and sediment pore water (e.g. Microtox). There is potential for wide use of these in monitoring water quality by water users and water treatment plants. LTER sites could provide data on the normal range of variation for these measures in undisturbed stream sites. Mark Oswood will work on this, and several others expressed an interest in participating.

h) We also discussed possible future comparative projects including a comparison of stream organic matter models, studying food limitation in higher trophic levels by supplemental feeding with freeze-dried krill, and comparing food webs using 15N tracer additions.

2. Data comparability in streams. Our discussion focussed around 3 themes:

a) There are many major societal issues for which stream ecological information is needed; for example, water allocation (how much in-stream flow is necessary to support an intact stream ecosystem), impacts of acid deposition on streams, impacts of forest and agricultural practices on stream resources. Current LTER research can address some of those issues, but we are hampered by the limited number of stream sites in the network --specifically by the lack of a large river site.

b) One critical issue that our network should be but is not addressing, is loss of biodiversity. Recent studies have documented a much greater fraction of the freshwater fauna threatened or endangered than is true for the terrestrial fauna. We debated what we should be doing to better document populations in our systems.

Macroinvertebrates are an important and diverse component of streams. They are being sampled at most sites in the network, at least intermittently. However, to commit to a regular sampling program runs up against a technological wall -- picking bugs from samples. We discussed several possible solutions including once/year sampling of bugs with kick nets or choosing a trophically significant species (a top consumer) and monitoring its population variability. We did not reach consensus on this issue.

We should encourage large-scale monitoring programs like EMAP to use LTER sites as as references.

c) Comparative research on aquatic systems in the LTER network is hampered by the lack of fundamental information on basic driving variables: a continuous record of water temperature, a continuous record of stream discharge, and solar radiation reaching the stream channel (using fish-eye lens photos or spherical densiometer). This is like trying to do terrestrial ecology without a climate station.

We began discussing the idea of a minimum standard installation for aquatic research at LTER sites. Components of this would include the above variables, conductivity, pH, nutrients (minimally seasonal grab samples for organic and inorganic N and P), and a suite of geomorphic measures. We discussed using standard tiles for periphyton and some measure of

the consumer community. Even for this limited set of information, it is highly unlikely that any of the LTER sites are measuring the factors in the same manner. Newer sites are faced with greater challenges to establishing these than sites with longer research histories. Most sites lack the financial resources or personnel to install these fundamental long-term monitoring systems, but lack of consistent information severly weakens interpretation of stream ecosystems at an individual site and jeopardizes future intersite exploration of hypotheses.

The group felt that the idea of a Minimum Standard Installation was too important to attempt to discuss it in such a short time. We decided to begin an email conference on the subject and developed a list of people who wanted to be involved in that discussion. We encourage NSF to establish Minimum Standard Installations based on the recommendations that will be developed collectively by the LTER sites. Future opportunities for supplemental funds for establishing Minimum Standard Installation for long-term aquatic research should be pursued actively.

3. Follow-up on stream organic matter workshop: Jack Webster will work toward producing a paper (author will be the Stream Organic Matter Workshop) based on the work presented in the plenary session. The first step will be to send the massaged data back to the sites where it was collected. Good topics for future workshops include one analysing key hydrologic and geomorphic drivers in streams and one comparing models of organic matter dynamics in streams.