

A proposal for developing an urban stream research framework and an international meeting on urbanization and stream ecology

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June 28, 2007

In December 2003, the first Symposium on Urbanization and Stream Ecology was held in Melbourne, Australia. During that meeting, over 100 scientists and urban water managers from around the world gathered to present talks and have discussions on the current knowledge of urban effects on streams, and knowledge gaps to direct future urban stream research. The symposium resulted in two products: (1) a technical report summarizing the meeting and workshops published by the CRC for Freshwater Ecology (attached), and (2) a special issue of the Journal of the North American Benthological Society (JNABS) containing invited papers from the meeting (JNABS Vol 24 No 3), including a synthesis document about “the urban stream syndrome.”

These publications did a great job of summarizing the state of our understanding of the effects of urbanization on streams. However, as pointed out in those papers, many mechanisms remain poorly understood. It is especially unclear which stressors are most significant in driving ecological changes to urban streams, and under which circumstances, which can confound management. Here are a handful of questions:

- How significant a problem are contaminants in runoff? Can these alone explain ecological changes in some locations? If we had really good contaminant-removal standards but allowed some changes to the hydrograph, could we protect highly urban streams?
- How significant is channel erosion from increased storm flows? Why does this matter—is it habitat instability? Increased suspended sediment? If instability is an issue, can it be mitigated by in-stream structures? Engineers will want to know.
- Are reduced base flows an issue, where they occur? Is there a way to maintain natural baseflows in highly urban streams where opportunities for infiltration and natural subsurface flow are severely limited?
- How important is alteration of the trophic basis of production—the rapid loss of leaves in some urban streams? Can this be mitigated by creation of retention structures?
- How does locality (climate, geology, etc) affect the strength of relationships? Under what conditions are mechanisms more or less important?
- Are relationships established in the US and Australia applicable to urban streams in less developed countries? What about in Europe, where some urban streams have a much longer history of impacts?
- To what extent do socioeconomic factors influence local urban stream conditions?

In short, we know that urban streams are degraded and can describe the degradation, but we don't yet have a good understanding of the mechanisms—particularly which mechanisms are most important and under what conditions. It's like we've drawn the linkages of the food web but have only begun to document the flows. And understanding

the nature of these mechanisms is key to effective management for protecting and restoring streams in urban and suburban landscapes. Part of our role as ecologists is to inform management decisions by identifying the combinations of solutions that provide the greatest benefit to urban streams, and this cannot be done without a good understanding of mechanisms. This leads to an additional series of questions:

- Can watersheds be urbanized without significant impacts to stream ecosystems?
- To what extent can stormflow/hydrologic mitigation restore stream ecosystems?
- How do we prioritize what streams to restore or protect? For places with >50% impervious, what is a practical standard to manage flows?
- What are the costs associated with various standards for stream ecosystem protection? Decision-makers will need to balance the costs against the benefits associated with various policy options.

Why get together to plan a research agenda?

There is a lot of good urban stream research going on in the world, but the number of unanswered questions is fairly daunting and the complexity of the system can make it hard to know the next step. We're suggesting that perhaps progress could be faster if we work as a group to clearly articulate the major unanswered questions and prioritize them. Some advantages of doing this as a group are that (a) we get multiple perspectives, helping us to see evaluate the generality of relationships and prioritize the research questions, (b) we can potentially divide up the resulting research work (to an extent), (c) we can potentially elevate the visibility of the collective research effort in the eyes of funding agencies.

How to go about this?

We propose a two-step process:

- a) Work in groups by email to construct generalized conceptual models of the effects of urbanization on streams and stream biota. An example of this is in the Urban Stream Syndrome paper, but other versions abound. Some examples of sub-models appear on the EPA's CADDIS web site (<http://cfpub.epa.gov/caddis/examples.cfm?Section=26>); these submodels amount to specific hypotheses on the effect of urbanization on stream biota (the CADDIS project is actually much broader, and worth checking out). By examining conceptual models we can identify linkages that are unproven or whose magnitudes are unknown; these are research areas.
- b) **Hold a meeting** to present this conceptual model and the identified research needs. This could include discussions to prioritize the research needs, maybe how the key research could/should be conducted, discuss funding opportunities, and hopefully form collaborative programs to pursue funding and conduct the needed work. The meeting could also include contributed talks. We see two options for holding this meeting:
 - a. Hold it immediately prior to NABS 2008. This was requested by some non-US participants to ease the travel burden.
 - b. Hold a larger, longer stand-alone meeting-- a Symposium on Urbanization and Stream Ecology II.

How Interdisciplinary Should We Be?

Obviously, this research requires an interdisciplinary approach-- engineers, hydrologists, geomorphologists and others are essential. Holding a meeting in conjunction with NABS may seem insufficiently inclusive. However, many of the ecologists who work on urban streams already conduct research as part of interdisciplinary teams, and will bring that perspective to the discussions. Second, there is efficiency to first working in a group that speaks a common language to develop a straw man, which can then be tweaked by broader review by an interdisciplinary group. If we have the meeting adjacent to NABS we may wish to follow it up with a meeting in conjunction with the American Water Resources Association conference. In any case, however, we should do our best to encourage those engineers, hydrologists, etc. who work on these issues to be part of creating the straw man conceptual models and to be a part of either meeting.

We will also work to encourage participation from researchers beyond the US and Australia.

Proposed Next Steps

- (1) Review this proposed approach, suggest changes, etc. To manage the input, we have established a website at <http://blackbear.ecology.uga.edu/survey/urban.htm> where you can sign up for a listserv, vote on the preferred format for a meeting, and provide other input.
- (2) Form into committees. We suggest the following:
 - a. an executive committee of those who want to be most active (i.e., receive lots of emails). This group will propose the initial overall, simple conceptual model and post it for comment. Then the group may propose breaking this up into submodels for further development by subcommittees and suggest initial research questions.
 - b. a meeting organization committee, who will put together the logistics for the meeting.
 - c. Possible subcommittees to work on conceptual sub-models and propose research needs within a sub-field. An example of a sub-field might be hydrologic alteration. Ideally, each should be interdisciplinary and geographically diverse. Alternatively, the larger group can suggest changes to the conceptual model and propose and rank research questions, which are maintained on a website for review.

Please forward this on to other potentially interested researchers.

Thanks!