

## **Final Working Group Report - Urban aquatic ecosystems: a synthesis**

### **Submitted by**

Nancy Grimm (nbgrimm@asu.edu), CAP LTER  
School of Life Sciences & Global Institute of Sustainability  
Arizona State University  
Box 874501  
Tempe, AZ 85287-4501  
Ph. 480-965-4735

Co-PIs: Neil Bettez (BES; nbettez@gmail.com), Jen Morse (BES; jlmorse@gmail.com), and Monica Palta (CAP; monica.palta@asu.edu)

Graduate student leaders: Kristina Hopkins (University of Pittsburgh), Nathaniel Morse (PIE)

Other members of the working group: Sujay Kaushal (BES), Bill McDowell (LUQ), John Melack (SBC), Emily Stanley (NTL), and Wil Wollheim (PIE)

Other graduate-student participants: Anika Bratt (CDR), Leila Desotell (KBS), Seth Gustafson (CWT), Fox Peterson (AND), Rose Smith (BES), Amanda Suchy (CAP), Carolyn Voter (NTL)

### **Goals**

The goals of this synthesis working group were to 1) coordinate organization of data on spatial distribution, numbers, and kinds of aquatic ecosystems in urban areas associated with participating LTER sites (high-resolution data available for many sites); 2) build a database of explanatory variables for urban aquatic ecosystem design, including such factors as development age, primary use of system (e.g., stormwater conveyance vs. aesthetic considerations, data available from infrastructure maps), climatic and hydrologic conditions (data from ClimDB and HydroDB), and socio-economic information (using census dataset assembled for EcoTrends); 3) build community of collaborators and enhance interaction among LTER graduate students working in urban ecosystems; 4) develop a comparative pilot project that will lead to a manuscript and provide a foundation for development of further cross-site research; and 5) develop a framework for ecosystem services in urban infrastructure.

### **Activities**

Activities were carried out during a web meeting, two in-person working-group meetings, and in the intervening times. The first meeting was held in January 2013 at ASU (CAP), and focused on designing and compiling/organizing data for a graduate student-led pilot project. Prior to this workshop (in early December, 2012), we held a Web conference with students from multiple sites who were interested in participating in the working group. Although we selected three students to receive stipends and lead the pilot project, other students were funded to attend the workshop or participated remotely. The workshop was attended by graduate-student leader Kristina Hopkins (University of Pittsburgh) and the other two leaders, Rose Smith (BES) and Nat Morse (PIE) participated via videoconference. It was decided at the meeting to focus on how urbanization has altered certain hydrologic metrics and nutrient exports, and to relate these changes to metrics of land-cover change derived from available GIS data. Later, R Smith withdrew from project leadership due to other demands on her time.

The second, four-day working group meeting was held in early July at SESYNC, and included the PIs, graduate-student project leaders, and three additional LTER scientists (Sujay Kaushal,

BES; Emily Stanley, NTL; and Wil Wollheim, PIE). At this workshop, the graduate students reported on the pilot project, and led the outlining and initial writing of a manuscript. We also developed ideas for continued collaborations, including outlining components of a database, developing a research plan for exploring ecosystem services associated with stormwater, developing a framework for integrated models of emergent function in urban watershed and river networks, and beginning work on a typology of urban water chemistry.

### **Progress and outcomes**

A manuscript led by K. Hopkins is in final stages of preparation. This reports the results of comparisons of hydrologic metrics (such things as high-pulse frequency, reversals, minimum flows) along urban-rural gradients (i.e., space-for-time substitution) and in longer time series. A major finding is that locations exhibiting faster urbanization (measured as rate of change in housing development) showed greater change in high-pulse frequency.

A second manuscript, linking the changes in hydrology with changes in nutrient export, is also under development, with N. Morse as the lead. We found that urbanization did not have as direct an effect on nutrient export as on hydrology; however, the data sources were not as long-term nor as complete as for hydrology.

Components of an urban aquatic database were discussed, and a structure for such a database was developed. This part of the working group activities will require more time and resources to develop.

We developed a general approach and rationale for understanding how the ecosystem services provided by water features in urbanizing landscapes change over the course of urban growth. This project would rely on data sources such as the National Wetlands Inventory, the US Inventory of Dams, the US Census, and local historical archives in addition to USGS gauge records. This project is shovel-ready but lacking funding.

We also discussed the need for integrative projects on how natural processes and infrastructure processes interact to yield ecosystem services. We compared conceptual frameworks and models that have previously been applied to these systems, and articulated the need for interdisciplinary integration between environmental engineers, terrestrial and aquatic ecologists, urban planners, modelers, and hydrologists. Further effort on this topic, of interest to all in the working group, would be led by Wil Wollheim.

A classic study in geochemistry by Gibbs (1970) outlines the key processes controlling world water chemistry. In our workshop, we began work on a typology of urban water chemistry that will be based on available literature, an existing NAWQA study of nine cities, and LTER data. We did some preliminary data organization that suggested the importance of regional groupings, particularly for the major ions. This work is ongoing, being led by Sujay Kaushal and Emily Stanley.

Finally, we proposed a special session for the Joint Aquatic Societies (JAS) meeting to be held in Portland in May, 2014. The session, entitled "Crossing the highway: comparative analyses in urban aquatic ecosystems," will be organized by Jennifer Morse and Nat Morse, and will provide an excellent follow-on from the third Symposium on Urban Stream Ecology (SUSE) scheduled to be held immediately before the JAS meeting.