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WERF Explores Research Needs for Large Rivers: Focus on Reference Conditions

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WERF is …

- A Non Profit Research Foundation providing sound science for the water quality community
- Our funding comes from subscribers (municipal utilities, states, industry and corporate) and cooperative agreements and grants (U.S. EPA and others)
- We have Six Research Program Areas:
  - **Watershed Management & Water Quality**
  - **Stormwater**
  - **Infrastructure Management**
  - **Conveyance Systems**
  - **Wastewater Treatment and Reuse**
  - **Solids Treatment, Residuals and Reuse**

WERF's Interest in Large Rivers

- Significant number of WERF subscribers located on Large River Systems
- Utility subscribers are responsible for a host of water quality management functions, and asked WERF to define research needs
- Large River Systems, particularly the human-altered Great Rivers, do not behave the same as wadeable streams and other water bodies.

Large Rivers, reference conditions..

and flying pigs….

WERF's Workshop on Large Rivers

- WERF's research team, led by Bruce Lippincott at LMS, developed an annotated bibliography and convened a group of academics, utility and government representatives (USGS, U.S. EPA, NSF, state government)
- Participants developed a list of eleven higher priority research needs and a larger list of needs

Photo: USEPA

Criteria Used in Considering Research Needs

- Focus: large rivers and floodplains
- Relevance to WERF subscribers and others
- Connection to regulatory policy
- Contribution to understanding large river system function
- Potential for demonstrable products within 10 years
- Contributes to areas of research not currently adequately funded
- Enables changing perspectives (understanding how humans and rivers interact)
- Multiple scale research—temporally and spatially, linking geomorphology, hydrology and ecology.

Topics For Discussion

- Six broad categories discussed:
  - Biodiversity
  - Restoration
  - Flow, Hydrology and Ecology
  - Scale
  - Drivers of altered states
  - Contaminants

Photo: USCOE

Framing the Priorities: Research Drivers and Common Themes

- Given that most large rivers have been altered by man, need to define an adequate reference condition
- Large rivers and small rivers are perceived and used differently
- Interest in both history and prehistory to help determine former conditions

Framing the Priorities: Research Drivers and Common Themes

- Need for large, long term databases—to understand historic condition, and connectivity between habitats, land and water, hyporheos and channels
- Need to identify and measure thresholds of change
- Need for a good mechanistic understanding of population and community characteristics

Large Rivers "Top Eleven" list…

The top three:

- Large Rivers Status and Inventory
- Historical Records
- Effects of Compression on Ecological Function

All of these strongly tie to the need for reference conditions in large river systems…..

Large Rivers "Top Eleven" list… (cont.)

And those that remain (not in a ranked order)

- Flow Regime Effects on Ecological Processes
- Biological Function and Bio-Information
- Normative—Restoration—Tools
- Assessment Technology Development
- New Technologies for Large Rivers
- Social Values and Relations
- Landscape forecasting Tools
- Trophic Level and Spatial Transfer of Contaminants

Priority #1: Large Rivers Status and Inventory…

- Develop an inventory of large rivers or natural segments of large rivers
- Identify least impacted reaches
- Will help establish/define reference conditions (least impacted by humans)
- Which human activities most impact large river systems?
- Data exist, but are not synthesized
- Go beyond the Nationwide Rivers Inventory
- Useful for other research endeavors as well

Priority #2: Historical Records…

- Search historical records—mine and synthesize information regarding former conditions of large river systems
- Could prove useful in help define reference conditions
- Could provide useful insight into restoration end points

Priority #3: Effects of Compression on Ecological Function…

- What are the effects of spatially compressing (and fragmenting?) ecological function?
- Altering large rivers for navigation and other reasons has spatially compressed ecological function into reduced areas
- Therefore the array of functions and processes must be simulated in these small spaces
- Intensive management activities necessary
- Better understanding would be very useful for planning and designing restoration efforts

Other Top Priorities: Flow Regime Effects on Ecological Processes…

- Quantify the relationship between flow regime and ecosystem processes: frequency magnitude, duration, relates to sediment transport, etc.
- Determination of ecological services provided by suite of flow regimes
- Eliminating the "seams" between socioeconomic and hydrogeologic models; hydrogeologic and hydrologic models; and hydrologic and ecological models. Presence of "seams" is complicated by issues of scale in large river systems.
- Better understand extreme high and low flow events.
- Identify and mechanistically understand thresholds of change

Other Top Priorities: Normative—Restoration—Tools

- Normative condition is the goal or endpoint of the effort: what is possible and realistic, given competing human needs?
- What normative is NOT:
  - Pristine, the best, historical, normal
- This topic speaks to "how do we define the normative condition" and then develop the tools needed for restoration
- Link retrospective analysis and ecological theory to describe system potential

Other Top: Biological Function and Bio-Information…

- Gain an understanding of the basic ecological roles of organisms in large rivers (e.g., trophic dynamics, life histories, influence of exotic species)
- Emphasis on species specific to large rivers
- Critical to understanding baseline conditions and for working on restoration efforts

Other WERF research…

- Suite of Research examining "multiple stressors" that have application to large river systems
  - Literature Review and Database and Experimental Design to move from identification of impairment and single stressors to working toward the understanding of predicting effects of combinations of stressors.
  - Workshop in September 2004 to work on next steps
    - Much to be done to better predict effects
    - Many tools available that can help, if used with a framework.

Other WERF research…What if we can't define reference conditions on large rivers?

- WERF Project focused on urban waters, 01-WSM-3 *Bioassessment: A Tool for Managing Urban Aquatic Life* Uses
- Same kind of challenge with reference conditions in a different context
- Exploring the use of bioassessment for characterizing urban impacts and developing an urban biological indicator
- Developing methods for defining not reference conditions, but BIOLOGICAL POTENTIAL across urban gradients
- Would similar approach work for large rivers?

Outcomes, Next Steps

- WERF didn't get further specific Large Rivers research off the ground
  - The most pressing needs (inventories and databases) didn't fit well in WERF's usual research approach
- Clearly, it's time to share the results of the workshop with the broader public and see if there are others for whom this type of research is better suited
- Large Rivers are also increasing in interest again, and therefore may be a part of WERF research in the future

For More Information, please contact me at….

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