Watershed Monitoring Program of the Illinois River Basin

Ann Marie Holtrop
Illinois Natural History Survey

Rivers and streams are a valuable and integral part of every major ecotype and alteration of these systems has a long and varied history throughout the world. Many of these changes are a direct result of various management practices designed to meet human needs including flood control, power generation, navigation, irrigation, and recreation. Dominant management practices used to meet these needs have typically involved altering flow and habitat availability through impoundment, channelization, levee constructioning, and water diversion. All of these practices have far ranging temporal and spatial impacts on the physical and biological processes that define a given ecosystem. However, new initiatives to repair aspects of ecosystem structure and function are beginning to emerge. The Illinois River Ecosystem Restoration (IRER) project is one such initiative that is focusing on restoring not only mainstem areas of the Illinois River, but also much of the contributing watershed.

The IRER is a multi-disciplinary, collaborative initiative between several federal agencies (U.S. Army Corps of Engineers, U.S. Environmental Protections Agency, U.S. Fish and Wildlife Service, U.S. Geological Survey, Natural Resources Conservation Service), the state of Illinois (Department of Natural Resources, Environmental Protection Agency, Department of Agriculture), local and/or regional government agencies, and several non-government organization (e.g., The Nature Conservancy). The overall goals of the IRER are to: 1. Restore and maintain ecological integrity, including habitats, communities, and populations of native species, and the processes that sustain them, 2. Reduce sediment delivery to the Illinois River from upland areas and tributary channels with the aim of eliminating excessive sediment load, 3. Restore aquatic habitat diversity of side channels and backwaters, including Peoria Lakes, to provide adequate volume and depth for sustaining native fish and wildlife communities, 4. Improve floodplain, riparian, and aquatic habitats and functions, 5. Restore and maintain longitudinal connectivity on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species, 6. Restore Illinois River and tributary hydrologic regimes to reduce the incidence of water level conditions that degrade aquatic and riparian habitat, and 7. Improve water and sediment quality in the Illinois River and its watershed.

To achieve these objectives, most of the restoration practices implemented through the IRER will focus on projects that establish physical reductions in sediment loads; restoring or protecting side channel, backwater, and floodplain habitats; and naturalizing water level fluctuations throughout the basin.

One very important aspect of the IRER effort is documenting the physical and biological responses to restoration practices. These responses can be measured primarily through long term monitoring at several spatial scales. Because river restoration is a newly emerging field, there are likely considerable knowledge gaps that may need to be investigated to provide a better understanding of ecosystem responses to restoration practices. In this situation, short term (i.e., 3-5 year) studies may be appropriate to identify the underlying processes that will aid in understanding the ecosystem. Accordingly, a summary of potential focused research topics were presented in the monitoring plan. The information learned through monitoring and focused research initiatives allows us to evaluate the monitoring plan, thereby fine-tuning target indicators and ultimately adjusting restoration practices.

Our objectives were to develop a conceptual and structural framework for long term monitoring of the IRER program. The proposed monitoring framework is defined at three distinct, hierarchical spatial scales to facilitate ecosystem response to the restoration goals and will also provide information that 1) characterizes the current status of the ecosystem (status), 2) tracks changes in the ecosystem through time at multiple spatial scales (trends), and 3) rigorously evaluates project specific management practices (evaluation).

There are several ongoing data collection efforts and programs (e.g., long term fish population study, hydrology monitoring, water quality monitoring, Long Term Resource Monitoring Program, etc.) within the Illinois River Basin that will likely be beneficial and complimentary to the monitoring program proposed. These data are beneficial because they provide the only existing information about the current condition of the ecosystem. However, there are several considerations that limit the applicability of these data from a restoration assessment perspective. First, many of these efforts are focused on localized responses or are limited in spatiotemporal extent and were not intended to measure changes within the entire Illinois River ecosystem. Second, because most of these plans have evolved independently, many of the existing data have not been collected in a standardized manner that can raise issues of comparability. Common examples of this issue include sampling designs that have changed over time or approaches and philosophies that differ among agencies collecting the information. Finally, these projects were not designed to specifically address the goals outlined within the IRER. The result has been a suite of datasets that are not well suited nor adequate to measure IRER responses. Fortunately, most of these issues can be resolved relatively easily with a well designed and integrated monitoring plan that can take into account multiple spatial and temporal scales such as we propose here.

Designing a framework that provides the ability to test hypotheses in a rigorous, statistical fashion is crucial to the success of not only the monitoring plan, but also the restoration activities being evaluated. Further, the value of such a program without this characteristic is severely reduced. There are several options that can be used to perform these analyses including trend analysis, regional references, and Before-After Control-Impact (BACI) pair design. Each approach is useful, but exhibits desirable characteristics within certain disciplines that facilitate restoration evaluations. Therefore, we recommend a monitoring design that provides an opportunity to quantitatively measure ecosystem change in the following ways.

Trend Analysis - Many larger ecosystems pose unique problems that prevent experimental assessment using traditional approaches. The main problem is that in most cases, un-impacted systems of similar size, structure, and function are not available, thereby making either paired or replicated analyses impossible. In this instance, monitoring aspects of the system over long periods can provide the most robust approach in measuring system changes.

Regional References for Sub-Basin Comparison - Regional reference sites are least disturbed areas within the same region as the treated sub-basin. Abiotic and biotic indicators at the regional reference sites are used as benchmarks to assess changes in treated sub-basins once restoration practices are implemented. There are two basic approaches to establishing the regional reference condition. The simplest is to use sites that have not been impacted or have a relatively low level of anthropogenic impacts for comparison among the impacted sites. Alternatively, when clearly identifiable reference sites are not available, regional normalization for the variables or metrics being measured can be used.

Before-After Control-Impact (BACI) Design - The basic BACI design involves the use of paired watersheds, in which only one of the two watersheds receives restoration practices. The paired watersheds should be as similar as possible in characteristics such as climate, geology, drainage area, aquatic thermal regimes, land use, and stream gradient. In this design, paired samples are taken simultaneously (as nearly as possible) at the Impact site (i.e., where a restoration practice has been applied) and a nearby "Control" site. Each observed difference (e.g., in smallmouth bass density, sediment load) between the Impact and Control sites in the Before period is considered to be an estimate of the mean difference that would have existed in the After period had the restoration practice not been implemented. A time series of observed differences between the Impacted and Control sites is developed, and a change in the mean difference between the Before and After periods indicate that the system at the Impacted site has undergone a change relative to the Control site.

This monitoring protocol highlights an inter-disciplinary effort attempting to monitor major characteristics of the river (e.g., water quality, geomorphology, biota) at several spatial scales. Examples of response variables were discussed at two levels: 1) those that are critical and must be measured and 2) those additional variables that are desirable and would provide a significant amount of information, but may not be as immediately critical as those listed above. We recognize that several ongoing data collection efforts and programs within the basin are beneficial and complimentary to the proposed monitoring program presented here. Therefore, the intent of the proposed monitoring framework is to complement the already existing programs to create a more comprehensive monitoring effort.

The monitoring plan submitted to the Army Corps of Engineers in June 2004 highlights an inter-disciplinary effort attempting to monitor all major characteristics of the river (e.g., water quality, geomorphology, biota). Although the ACOE has been authorized to begin critical restoration projects, including pre- and post-construction monitoring. However, systemic monitoring has yet to be authorized. The ACOE anticipates authorization in 2007, which means systemic monitoring may not begin until 2008. When systemic monitoring is implemented, identifying appropriate biotic and abiotic response variables that can be used to identify ecosystem change as a result of restoration practices is crucial. Within the Illinois River Basin, there are many potential measures that may be useful in assessing goal-specific accomplishments. The response measures identified throughout the monitoring plan will provide information that is ecologically meaningful, relevant to the spatial and temporal scales being measured, responsive to implemented restoration practices, provide benchmarks of progress in accomplishing the stated goals, and be easily understood.

Acknowledgments:

The monitoring plan presented here was the result of an inter-disciplinary team comprised of members the State Surveys. Mark Pegg, was a co-editor of the report to the ACOE. Other collaborators include: Illinois State Geological Survey - Andrew Phillips, Michael Miller, Geoff Pociask, Lisa Smith, Richard Cahill, James Miner; Illinois Natural History Survey - Mark Pegg, Hope Dodd, Patrick Hubert, Ann Holtrop, Dave Wahl, Patrick Brown; and Illinois State Water Survey - Misganaw Demissie, Vernon Knapp, David Crowder, and James Slowikowski.