Environmental Restoration - Flood Plains vs Potholes

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Introduction

The 1993 midwest floods clearly demonstrated the folly of man's efforts during the past century to harness our rivers, drain our wetlands, and farm every inch of available bottomland and floodplain. These practices have increased flooding problems while destroying millions of acres of valuable riverine, wetland, and aquatic habitat. They are the primary reason that we now face long lists of threatened and endangered aquatic species. Yet one year after the flood, an event that gave us the opportunity to rethink and change floodplain management policy, we find our society working feverishly to put most of the levees and drainage ditches back as they were before the flood -- all at great public economic and environmental cost. According to some critics, we are even putting some of our ag levees back to higher elevations than before the flood, virtually repeating past mistakes.

Despite the Clinton Administration's valiant efforts to address floodplain management issues through the work of the Floodplain Management Review Committee (FMRC 1994) and the Scientific Assessment and Strategy Team (SAST 1994), a serious commitment to changing the way we manage floodplains has not been made. Senator Baucus of Montana, in Senate Bill 2418, made significant recommendations, but his proposed legislation met immediate opposition from some Congressmen in the flood effected States.

The flood and post flood response revealed many opportunities which could provide for both flood control and aquatic habitat restoration -- Senate Bill 2418 addressed many of these issues. They include restoration of wetlands both in the floodplains and in the watersheds, as well changes in levee location and design. Some wetlands created by the flood are being restored through the Agriculture Department's Emergency Wetland Reserve Program, but far more are being filled and restored to farmland, also with Agriculture Department assistance. In fact, some speculate that the flood may have caused a net loss of wetlands, because some previously existing wetlands were filled with sediment by natural riverine hydrologic processes, and these are not being restored to preflood conditions. In this case, a river's self renewal process (i.e. creating and destroying wetlands during high water events) was its own worst enemy. Man's land ownership patterns, land management practices, and land use regulations allow rivers to fill wetlands, but don't allow for those created to remain after flood waters recede.

The Pick Sloan setback levee system described by Rasmussen and Milligan (1993) is an excellent opportunity to provide for both flood control and environmental needs. However, while setback levees make a lot of common sense and could provide many opportunities for aquatic habitat restoration, they would be costly, and will not likely be implemented. Setback levees are also, in and of themselves, not necessary purely from an ecological perspective. What our rivers really need, ecologically, is to restore floodplain connectivity in a few prime habitat areas. In other words, those floodplain areas most subject to erosion and flooding need to identified and set aside to be managed as aquatic habitat restoration focus areas, aimed primarily at preserving native riverine species.

Scientific Consensus on Riverine Habitat Rehabilitation

We are fortunate that the National Biological Survey (NBS) sponsored an international Large Floodplain Rivers Conference and Workshop in La Crosse, Wisconsin this past summer. As part of that conference Dr. Robin Welcomme, of the Food and Agricultural Organization (FAO) of the United Nations led an effort of several key scientists in developing a synthesis statement of views shared on riverine habitat rehabilitation. Dr. Welcomme described measures which managers and decision makers must take immediately to achieve ecological integrity on the world's floodplain river ecosystems. The text of his original draft was published in *River Crossings* (MICRA 1994) this summer, and is currently being finalized for publication by the NBS (EMTC In Press). Some of his points are summarized below:

- River form is a function of the totality of land use patterns in the basin.

- There is an integral relationship between a river's main channel and its floodplain. The flood pulse and morphological diversity arising from it are the major driving factors in floodplain river ecosystems.

- A primary attribute of river integrity is the connectivity of floodplain habitats with the main channel.

- Rivers and their fauna are very resilient and measures to improve or rehabilitate them can produce rapid, positive responses within the system.

- Ecosystem reaction to stress is often expressed catastrophically through critical breakpoints that can only be determined retroactively.

● The biggest stresses on large rivers are produced by high dams and reservoirs as they are so difficult to rectify. Separations from the floodplain by levees are also severe but are more easily remedied technically.

● The Mississippi and its tributaries exist in various states of health. The Upper Mississippi, while in decline, is not yet as degraded as the lower river, due to the habitat diversity created by the lock and dam system and the persistence of an active floodplain. This apparent health is unsustainable, however, due to maintenance of the navigation canal with the resulting sedimentation and loss of habitat in backwater areas, mitigation of which calls for continued human effort. The lower Mississippi with its almost totally levied floodplain, poor water quality and riparian hardening is very unhealthy. The Missouri with the extensive channelization and reservoir cascade is in a high risk condition. The major tributaries such as the Illinois and Ohio rivers have been degraded by severe insult.

● There are many river users each with their own perception, pressure groups and financial interests. As a principle, no one group should be permitted to dominate, nor should it act without reference to other groups. This implies collaboration for management among all interested parties and agencies.

● It is recognized that general rehabilitation of river integrity is constrained by locally competing uses including human occupation through urbanization and agriculture. Nevertheless, general guidelines that can now be advocated include (1) the removal or setting back of levees to allow the river to adjust locally; (2) local floodplain restoration; and (3) when impairing uses, such as a lock and dam system or lateral levees are no longer justified by economic or social benefit, their removal should be considered.

● Application of these actions is clearly limited by local land use and tenure and land acquisition by government may be required to provide the space needed. Therefore the question arises as to how much floodplain is required to make a significant improvement in the integrity of the ecosystem and its biota and in the provision of systemic goods and services. Current theories on floodplain function would predict that the area needed for an improvement to the biota is probably relatively small and could lead toward a development in the form of a string of beads with a series of floodplain patches connected by more restricted river corridors. Alternatively, water regulation procedures at navigation locks and dams could be modified to increase floodplain connectivity during appropriate seasons.

● Restoring integrity involves freeing the river to some extent to maintain, rebuild and rejuvenate itself by the natural processes of scouring and deposition.

● Ultimately, integrated management should be extended into the river catchments to reduce inputs of sediment, nutrients and chemicals which have been shown by a growing body of evidence to impair ecosystem health and integrity.

● Many uncertainties remain and there is a continuing need for support of the elaboration of biological criteria, the formulation of management guidelines and in fine tuning the ongoing process. Management actions should be accompanied by monitoring programs which permit their evaluation and adjustment.

● In any eventuality, the need for further information should not stand in the way of the urgently needed management actions described above.

Application of Scientific Riverine Habitat Restoration Principles

Dr. Welcomme and his colleagues made it clear that riverine habitats and ecosystems can be self renewing and ecosystem integrity can be effectively restored in the form of a series of "beads" or "patches" of prime aquatic and floodplain habitats. These would include those areas most vulnerable to periodic inundation by low frequency flooding, such as the major erosion and scour areas most impacting levee integrity during the 1993 floods, and the low lying areas associated with tributary confluences. Such areas are desirable because they are most amenable to restoration and maintenance by natural riverine hydrologic forces. Scientific principles such as those initiated by SAST using satellite imagery, coupled with ground truthing should be used to map all potentially prime habitat areas along our river corridors. Prime candidate habitats could then be prioritized to focus efforts and funding on those areas or reaches most acceptable politically and socially.

Significant attention must also be given to development of new technologies which could enhance a river's ability to restore and maintain its "dynamic equilibrium" (National Research Council 1992) in the target "beads" or "patches" of habitat. Using the right techniques, it is feasible that riverine habitats could be created that would be constantly changing and self renewing, providing a new mix of restored habitats after each successive flood event. Managing such a dynamic situation would be a special challenge to traditional habitat managers, and would likely require some training as well as a willingness to put aside some long-held habitat management beliefs and policies. But in the long run, using the river's forces to constantly renew and recreate habitats would significantly reduce operation and maintenance costs, while providing important local storage and conveyance areas for high frequency flood events.

To date few non-traditional management measures have been developed and applied to riverine systems. This is, in part, due to lack of funding and lack of creativity and imagination on the part of both engineers and biologists. In the absence of such creative technology, riverine fish and wildlife managers have relied on traditional dikes and water control structures to create small impoundments within the floodplain. The problem with these measures was all too obvious in the aftermath of the 1993 floods, where it now appears that many such recently installed habitat management projects may have been significantly impacted by sedimentation, caused in part, by project design (i.e. working against rather than with natural riverine processes). Appropriately designed projects could actually encourage the scour needed to continually create new and restore old deep water habitats and wetlands. Future projects must therefore be designed to restore and maintain (1) natural (daily, seasonal, annual, and decadal) sediment and water regimes; (2) natural channel morphology; (3) natural riparian communities; and (4) native aquatic plant and animal species (National Research Council 1992).

A hypothetical restored "bead" or "patch" of habitat, as proposed in Dr. Welcomme's "string of habitat beads" concept, is shown in Figure 1 (Page 33). Such a "bead" or "patch" may include several habitat features (e.g. side channels, wetlands, wet meadows, bottomland hardwoods, etc.) and stretch over a 4-5 mile river reach. Most critical to maintaining the habitats shown in Figure 1 would be providing the overland flows and inundations necessary to recreate or simulate natural (daily, seasonal, annual, and decadal) sediment and water pulses. These pulses may, at first, be difficult to achieve because of the preexisting political, economic, and technological needs of other users. A pilot project and educational effort may therefore be needed to reduce fears and change perceptions that such periodic flooding would unnecessarily impact the needs of others. If impacts did occur, compensation may be in order to mitigate economic losses.

Maintenance of adequate flows in the side channel habitats of Areas A and B of Figure 1 would require removal of a portion of any high bank revetment which may be in place at the upstream end of the subject sites, and replacement of this revetment with some form of notched inlet structure. The notched inlet structure would allow normal and high flows to pass through the small side channels, while preventing the river's bedload sediments from entering the channels and filling them up. The notched structures would also ensure that the small channels would not capture too much of the main channel's flow and disrupt navigation or water supply needs. Similar measures would be needed for the wetland habitat in Area D.

High bank revetment could similarly be removed from the channel margin of Area C in an attempt to essentially widen the river's top width and encourage lower elevation flows to flow overland and inundate the area. As new channels or wetlands were created by overbank flows in Area C, measures such as notched inlet structures could be put in place to protect their integrity and that of the main channel.

In all areas four areas (A through D) technologies should be developed such as strategically placed deflectors or hard structure (rocks) which water could flow over or around during high flow events, encouraging erosion and scour and creating renewed deep water areas with each successive flood event. Area E, the tributary mouth habitat, should be self renewing if simply allowed to flood as often as possible.

Aquatic Habitat Restoration Needs

Restoration and maintenance of habitats which simulate natural conditions, such as those displayed in Figure 1, are critical to the restoration and management of native aquatic species, and may be the last best chance to address riverine endangered species needs, and thus avoid catastrophic riverine ecosystem collapse or "train wrecks". However, in order to acquire needed lands and to develop and apply adequate technologies, a federal commitment is required.

Several features proposed by Senator Max Baucus' Floodplain Management Bill, S. 2418 (mentioned earlier) are critical to near-term aquatic ecosystem restoration in the Mississippi River Basin. These include the following:

<u>Comprehensive Upper Mississippi River Evaluation</u> Such a study is needed to (1) assess the environmental sustainability of the Upper Mississippi River system; (2) evaluate on-going programs; (3) recommend additional or alternative actions to enhance and protect the long-term ecological integrity of the Upper Mississippi River Basin; and (4) address both watershed and floodplain actions.

<u>River Basin Management Planning</u> Plans are needed which address the Basin's long-term ecological, economic, and flood control needs; and provide for integration of existing flood-control facilities into an efficiently functioning flood damage reduction system, including structural and nonstructural measures, that are compatible with functioning and restoration of floodplain ecosystems.

<u>Habitat Projects and Resource Monitoring</u> Programs similar to the Upper Mississippi River Environmental Management Program are needed in other areas of the Basin to provide for (1) planning, construction, and evaluation of measures for fish and wildlife habitat restoration and enhancement; and (2) long-term resource monitoring. Such programs must be designed to focus on restoring natural riverine processes and functions.

<u>Congressional Recognition of Environmental and Recreational Resources</u> Congress needs to recognize (1) rivers and reservoirs of the United States as principal sources

of water-based recreation; (2) water resources as habitat for numerous species of animals and plant life; (3) water resources as important ecosystems whose delicate balance is critical to sustaining and preserving the environment and natural resources of the United States; (4) recreation and environmental protection of water resources as proper activities for the Federal Government in cooperation with States, political subdivisions of States, and local governments; and (5) recreational opportunities and protecting the environment as missions of the Army Corps of Engineers of at least equal import to provision of flood control and navigation along inland and shoreline waters and harbors and ports of the United States. Such recognition would bring these important nature resources and natural resource uses in line with the other traditional developmental uses which have so impacted our rivers.

Environmental Improvement Section 1135(b) of the Water Resources Development Act (WRDA) of 1986 (33 U.S.C. 2309a(b)) needs to be amended to improve the non-federal cost share for environmental projects. The Secretary of the Army should also be required to conduct periodic reviews of flood control projects and navigation or other projects in accordance with Section 1135 of the 1986 WRDA; and to determine the need for environmental restoration projects in river systems impacted by construction or operation of such federal projects.

Aquatic Ecosystem Restoration A program is needed whose primary purpose is restoration of aquatic ecosystems or portions thereof. The Federal cost share of aquatic ecosystem projects or components should be 75-100% because of the national interests involved. Environmental evaluations of federal projects are also needed under such a program to define the affects of such projects on the physical structure or hydrology of rivers, lakes, estuaries, wetlands, or any other component of an aquatic system. Restoration projects then need to be developed and implemented, based on the project's impact on all functions of the aquatic system, including the impact on each aquatic and terrestrial organism using the system, on water quality, and on downstream and upstream hydrology. When a water resources project adversely impacts the natural hydrology or physical structure of an aquatic ecosystem, the focus of mitigation should be on efforts to restore the system's natural hydrology or structure, replicating the acreage and functions lost or negatively impacted.

Conclusion

Environmental restoration should be a key element in any flood prevention and control or floodplain management program. The Basin's remaining hydric soils, "footprints" of past beaver ponds and wetlands, provide a useful guide to placement of restoration projects (Hey and Philippi (1994). Proceeding from first order to second and third order streams, palustrine and riverine wetlands should play increasingly important roles in the drainage system, in flood prevention, and in environmental restoration. Greenways, open space and floodplain scour holes all provide temporary and ephemeral habitats that our native aquatic species can and do use to feed, reproduce, and maintain themselves. Where opportunities present themselves throughout the basin, every effort should be made to acquire, enhance, and maintain as many of these areas as possible. In doing so, we can reduce flood damages, future suffering, and public costs; while addressing water quality, wetland, and wildlife species (interjurisdictional, migratory, and endangered) needs. We simply must find the courage to place the greater, long-term public good before the short-term, economic gains of special interests.

References

EMTC. In Press. *Large Floodplain River Ecology in 1994 and its Relationship to Management.* Presented by invited scientists at the conference: "Sustaining the Ecological Integrity of Large Floodplain Rivers", July 12-15, 1994. La Crosse, Wisconsin. Environmental Management Technical Center, National Biological Survey, Onalaska, WI.

FMRC. 1994. *Sharing the Challenge: Floodplain Management into the 21st Century.* Report of the Interagency Floodplain Management Review Committee to the Administration Floodplain Management Task Force. USGPO. ISBN 0-16-045078-0. Washington, D.C. 191 pp. + Apps.

Hey D. L. and N. S. Philippi. 1994. *Reinventing a Flood Control Strategy.* The Wetlands Initiative. 53 West Jackson Boulevard, Suite 1015, Chicago, IL 60604-3703.

MICRA. 1994. *Sustaining Ecological Integrity of Large Floodplain Rivers: Conference Synthesis.* River Crossings, Newsletter of the Mississippi Interstate Cooperative Resource Association, 608 East Cherry, Columbia, MO 65201. Vol. 3, No. 4, July/August 1994.

National Research Council. 1992. *Restoration of Aquatic Ecosystems.* National Academy Press. Washington, D.C. 165-261.

Rasmussen, J. L. and J. Milligan. 1993. *The River Floodway Concept - A Reasonable and common Sense Alternative for Flood Control.* Columbia, MO: Region 3 U.S. Fish and Wildlife Service. 6 pp.

SAST. 1994. *Report of the Scientific Assessment and Strategy Team to the Administration Floodplain Management Task Force.* USGPO. Washington, D.C.

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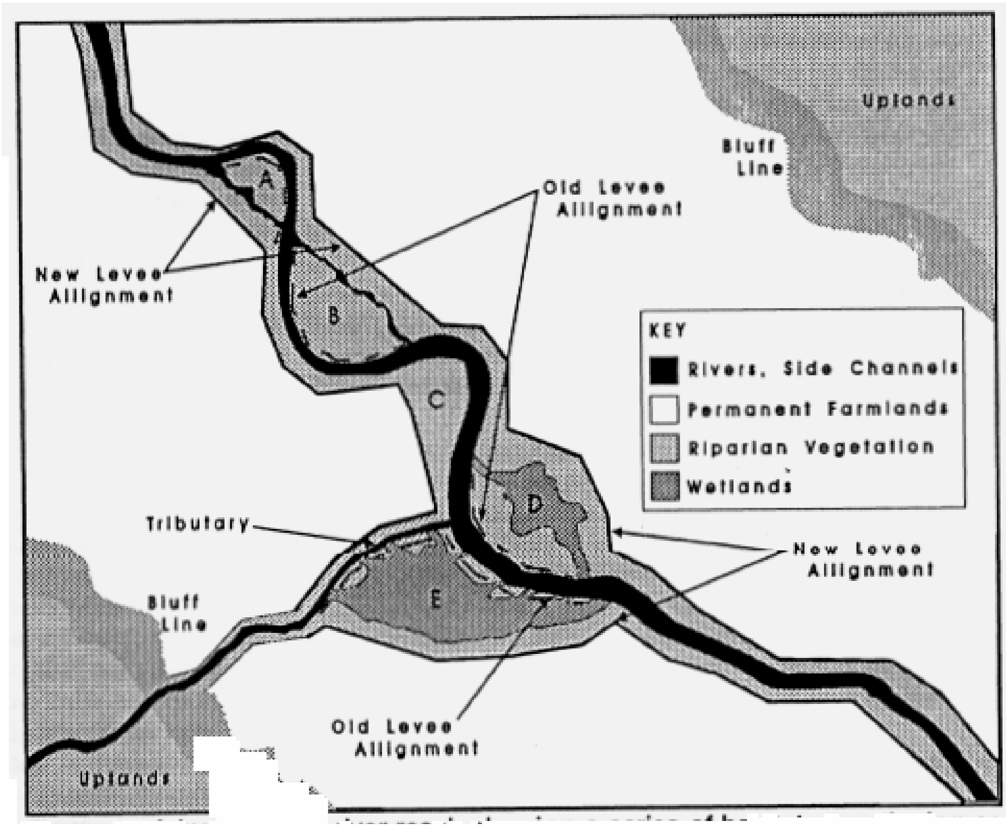

Figure 1. A hypothetical river reach showing a series of habitats functioning as an ecological "bead" or "patch" of habitat necessary to restore and maintain ecological integrity.