Tiz Mogollón December 3, 2012

Key Principles of Stream Habitat Management

**BAS= Best Available Science** **BPP= Best Practicing Principle**

1. The functional pyramid (Hydrology – Hydraulics – Geomorphology – Physiochemical – Biology) provide a framework for any restoration project to work from the bottom up, starting with hydrology. (BAS, extensively tested)

   Rich Starr. Stream Functions Pyramid - A Tool for Assessing Success of Stream Restoration Projects, http://www.fws.gov/chesapeakebay/Newsletter/Fall11/Pyramid/Pyramid.html

2. **Aquatic organisms have adapted to variations in flow that suit their life history traits (natural Flow Paradigm). (BAS, extensively tested)**

   Bunn, S. E., & Arthington, A. H. (2002). Basic Principles and Ecological Consequences of Altered Flow Regimes for Aquatic Biodiversity. Environmental Management, 30(4), 492–507.

   If practitioners do not adhere to this principle, the rest of the efforts to safeguard aquatic biodiversity or stream properties (controlling erosion, water quality, hyporheic exchange zones, etc) are in vain. Without the changes in hydrology – from low flows to above bankfull events – spawning and recruitment might be impacted.

3. Intact watersheds allow water to infiltrate into subsurface flows allowing for a longer residence time. (BAS, extensively tested)

   Schulze, R. (2000). Transcending scales of space and time in impact studies of climate and climate change on agrohydrological responses. Agriculture, Ecosystems and Environment, 82, 185–212.

4. Classifying streams into classes according to their hydrology can assist management in places where streams have been understudied or inform restoration plans in highly altered streams. (BAS, lacks evidence)

   McManamay, R.A., Orth, D.J. and Dolloff, C.A. (2012) Revisiting the homogenization of dammed rivers in the southeastern US. Journal of Hydrology.

5. Rosgen's Natural Channel Design is one way to restore the profile, pattern and dimension of streams to maintain a stable channel. (BPP)

   Rosgen, D.L. (2011) Natural channel design: Fundamental concepts, assumptions, and methods. Stream Restoration in Dynamic Fluvial Systems: Scientific Approaches, Analyses, and Tools, Simon A, Bennett SJ, Castro JM (eds). American Geophysical Union: Washington, DC.

6. Lane Diagram shows the balance between sediment size and load, and stream slope and discharge to determine the degradation or aggradation of a stream that by nature is dynamic, changing all the time, through time and space. (BAS, extensively tested)

   Fryirs, K. A. and Brierley, G. J. (2012) Sediment Movement and Deposition in River Systems, in Geomorphic Analysis of River Systems: An Approach to Reading the Landscape, John Wiley & Sons, Ltd, Chichester, UK.

7. Appropriately placed in stream structures can provide desirable geomorphic features to decrease erosion, stabilize banks and provide aquatic organisms with additional habitat. (BPP)

   Schmetterling, D.A. and Pierce, R.W. (1999) Success of Instream Habitat Structures After a 50-Year Flood in Gold Creek, Montana. Restoration Ecology 7(4), 369-375.

8. Log dams, deflectors, and in-stream cover structures increase the visual isolation, provide a hiding place from predators and shade can increase the abundance of young trout under certain conditions (types of structures, condition of stream, limiting factor of ecological integrity, time). (BPP)

   Schmetterling, D.A., Pierce, R.W., 1999. Success of Instream Habitat Structures After a 50-Year Flood in Gold Creek, Montana. Restoration Ecology 7, 369-375.

   White, S.L., Gowan, C., Fausch, K.D., Harris, J.G., Saunders, W.C., Rosenfeld, J., 2011. Response of trout populations in five Colorado streams two decades after habitat manipulation. Canadian Journal of Fisheries and Aquatic Sciences 68, 2057-2063.

   Whiteway, S.L., Biron, P.M., Zimmermann, A., Venter, O., Grant, J.W.A., 2010. Do in-stream restoration structures enhance salmonid abundance? A meta-analysis. Canadian Journal of Fisheries and Aquatic Sciences 67, 831-841.

9. Putting in LWD (large woody debris) in streams that do not have a source can last a long time (slow decay) and provides many benefits to streams, including habitat for aquatic organisms and appropriate pool-riffle sequences. (BAS, extensively tested)

   Wohl, E., 2011. Seeing the Forest and the Trees: Wood in Stream Restoration in the Colorado Front Range, United States, Stream Restoration in Dynamic Fluvial Systems: Scientific Approaches, Analyses, and Tools. AGU, Washington, DC, pp. 399-418.

10. In-stream habitat improvement efforts have a low effectiveness and the least evidence, compared to protecting high quality habitat that has a high effectiveness and ample evidence of success. (BAS, extensively tested)

    Roni, P., Hanson, K., Beechie, T., 2008. Global review of the physical and biological effectiveness of stream habitat rehabilitation techniques. North American Journal of Fisheries Management 28, 856-890.

11. **The lack of evidence to link an increase in habitat heterogeneity and complexity to greater macroinvertebrate richness might be because habitat heterogeneity might not be the limiting factor (e.g. water quality), and thus there is no ecological response to changes in habitat. (BAS, difficult to test but extensively tested)**

    Palmer et al. 2009 River restoration, habitat heterogeneity and biodiversity: a failure of theory or practice? Freshwater Biology, 55:1-18.

The implications for stream habitat managers is that funding gets allocated to stream restoration projects that do not end up working. If practitioners continue to carry out projects at a small scale stream-reach restoration projects, without taking into account the bigger watershed processes (including hydrology, hydraulics and water quality/quantity), they are not going to be successful if the end goal is to increase biodiversity and ecological integrity. There is a need to look at the wider scale and integral management approach to stream restoration and stream habitat management, while also acknowledging the limiting factors.

12. The amount of impervious area in a watershed, as low as 2% change, can be detrimental to sensitive aquatic organisms. (BAS, extensively tested)
    Wenger, S.J.W.S.J., Peterson, J.T.P.J.T., Freeman, M.C.F.M.C., Freeman, B.J.F.B.J. and Homans, D.D.H.D.D. (2008) Stream fish occurrence in response to impervious cover, historic land use, and hydrogeomorphic factors. Canadian Journal of Fisheries and Aquatic Sciences 65(7), 1250-1264.
13. Findings from research studies that were done at a small spatial and temporal scale, do not scale-up to basin level management. (BAS, extensively tested)
    Fausch, K.D., Torgersen, C.E., Baxter, C.V. and Li, H.W. (2002) Landscapes to riverscapes: bridging the gap between research and conservation of stream fishes. BioScience 52(6), 483-498.
14. At greater spatial scales, climate is what is going to drive floods – not land use change or physiographic characteristics. (BAS, extensively tested)
    Chang, H., & Franczyk, J. (2008). Climate Change, Land use change, and floods: Towards an Integrated Assessment. *Geography Compass*, *2*(5), 1549–1579.
15. River management should be redundant and invite competition (many agencies in charge of stream management), the system of agencies should be malleable and flexible to change so that the resulting experiment is the work of many minds. (BAS, extensively tested within the US framework)
    Doyle, M.W., 2012. America's Rivers and the American Experiment1. JAWRA Journal of the American Water Resources Association 48, 820-837.