APPENDIX 7A

Planning for Riparian and Terrestrial Wildlife Habitat*

Gary S. Casper[1] and Marsha B. Burzynski[2]

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1 - Corresponding author, UW-Milwaukee Field Station, mailing address PO Box 375, Slinger, WI 53086, 262-689-4095, gc@greatlakeseco.com
2 - Wisconsin Dept. Natural Resources, 2300 N Dr Martin Luther King Jr Dr Milwaukee, WI 53212-3128. 414-263-8708, marsha.burzynski@wisconsin.gov

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Introduction

Members of the Watershed Action Teams have indicated a desire to determine the extent to which populations of birds, amphibians, reptiles and other species are fairing within the focus watersheds. The stakeholders would like to see improvements to habitat (the living environment) that go beyond meeting water quality criteria (the physical environment). This objective aligns with Wilson's Law: *If you save the living environment, you will automatically save the physical environment. But if you only try to save the physical environment, you will lose them both* (New Scientist, No. 2722, Aug., 2009). E. O. Wilson, the influential scholar and two-time Pulitzer Prize winner, is well known for his contributions to the science of sociobiology, and recently launched the Encyclopedia of Life (http://www.eol.org/). He argues that the public clearly understands the need for addressing physical environmental problems, such as air and water quality, but that we are not making the headway we should be in preventing the destruction of ecosystems and species, the living environment, where a major mass extinction event is well underway. This despite mounting evidence that preservation of ecosystems, and interaction with nature, is essential for human health and well being, as so eloquently articulated in Richard Louv's book *Last Child in the Woods: Saving Our Children From Nature-Deficit Disorder* (2008. Algonquin Books; Updated and Expanded edition).

An analysis of the latest IUCN Red List of Threatened Species, *Wildlife in a Changing World - An analysis of the 2008 IUCN Red List of Threatened Species* (Vié, J.-C., Hilton-Taylor, C. and Stuart, S.N. (eds.). 2009. Gland, Switzerland: IUCN. 180 pp.), suggests that the wildlife crisis is worse than our economic crisis (in fact they are interconnected). The global species extinction numbers are bleak, with 16,928 species threatened with extinction (3,246 are Critically Endangered, 4,770 are Endangered and 8,912 are Vulnerable). The number of threatened species (as a percent of species evaluated) includes 21% of mammals, 12% of birds, 31% of reptiles, 30% of amphibians, and 37% of fishes - and that's just vertebrates. Preservation of ecosystems is essential for maintaining the life support systems and natural resources we depend upon for survival.

Locally, in the SWWT region, things are no better, and perhaps worse. The Wisconsin extinction crisis was addressed in the recent publication *The Vanishing Present: Wisconsin's Changing Lands, Waters, and Wildlife* (Waller, D. M. and T. P. Rooney (editors). 2008. University of Chicago Press). Chapters on the status of Milwaukee County amphibians, reptiles, breeding birds and flora detail species losses of 44%, 47%, 37%, and 37%, respectively, due largely to habitat loss and degradation, including the transformation of habitats by invasive species (Figures 1, 2). These stark losses of species richness are reversible to some extent, through habitat restorations, and subsequent repatriation of species to establish functional communities. The "If you build it they will come" paradigm, however, has proven to be unreliable for many wildlife groups. Highly mobile species such as birds do successfully colonize new habitats rather quickly, as do some insects, mammals, reptiles and amphibians. However, the ability to colonize new habitats is directly related to the isolation of the habitat (distance to existing habitats and physical or other barriers between habitats), and the mobility of the species. Groups such as salamanders, for example, are particularly problematic in fragmented landscapes, due to their poor mobility and inability to cross many barriers (Greenwald et al. 2009. Landcover predicts isolation in *Ambystoma* salamanders across region and species. Biological Conservation 142(11): 2493-2500).

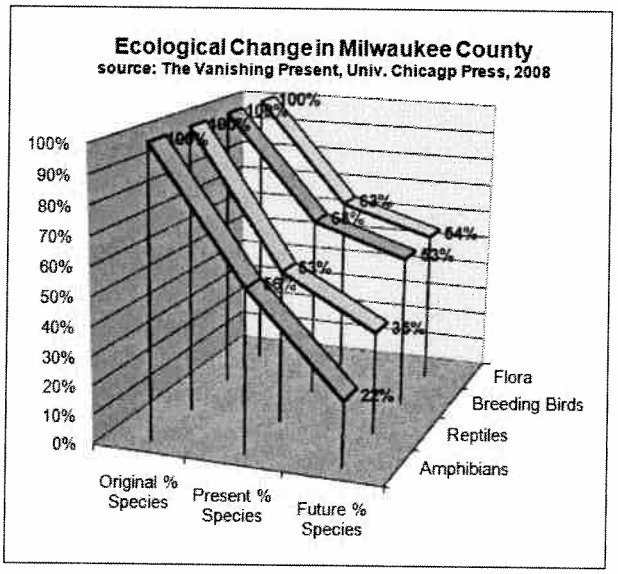

Figure 1: Changes in species richness in Milwaukee County

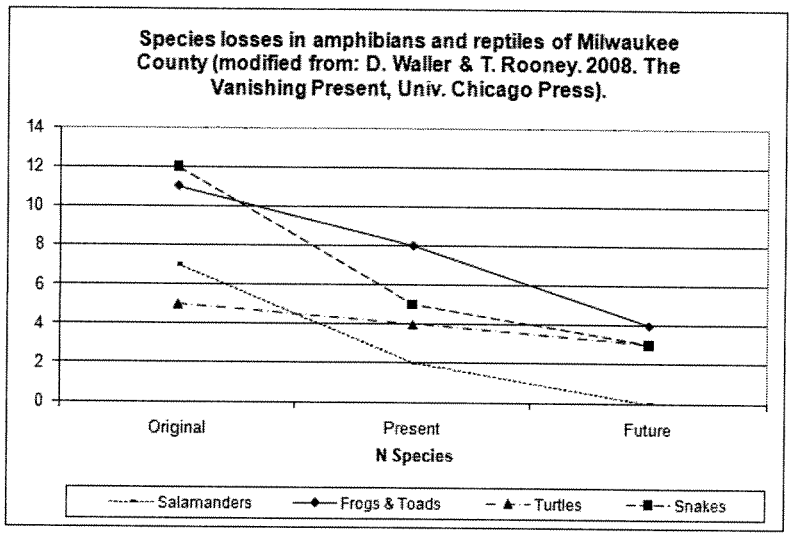

Figure 2: Losses of herp species richness in Milwaukee County

In the heavily urbanized SWWT region, addressing the wildlife crisis represents a significant challenge, as the existing fragmentation of living environments will make restoring functional communities with higher species richness difficult. It will require explicit focus on species community needs in the context of landscape ecology, where the interdependence of habitats are recognized, and planning addresses physical connections of habitat areas and the critical habitat needs of individual species. In many cases, where opportunities for habitat restoration are constrained by permanent development, the small size of restored habitat patches will limit the number and types of species supported. However, establishing connections between these constrained areas and larger habitat areas via wildlife corridors, which allow for immigration and emigration, will enhance the ability of these areas to support a richer fauna. Projects to improve water quality are needed, but this alone cannot restore habitats or reverse the extinction crisis. Preservation, restoration, and re-connection of terrestrial habitats, especially those adjacent to and interacting with aquatic habitats, is necessary to achieve functional wildlife habitat restoration.

Fairly comprehensive data collected for water quality, fisheries and in-stream habitat are readily available through various sources and have been compiled into the MMSD Corridor Database. This invaluable tool allows for geographic assessment of water quality and fisheries in order to guide decision making for improving water resources with these areas in mind. The information needed to complete similar assessments for the terrestrial living environment is not as readily accessible or complete. The data must be gathered, compiled and quality checked. Additional data may be needed through targeted surveys. To holistically address wildlife habitat needs, spatial studies of terrestrial habitats and habitat connectivity needs, and restoration design potentials, are required. Following is an outline of the steps necessary to achieve this.

Create a Biodiversity Vision

We recommend developing a *Biodiversity Vision* in order to clearly articulate the objectives for habitat restoration in the context of Watershed Restoration Plans. Stakeholders have a general idea that they want better habitat, but the specific goals and objectives must be developed, with quantifiable metrics for measuring progress, just as metrics such as dissolved oxygen concentrations and a fish index of biotic integrity have been used for meeting water quality goals. For example, goals for the extent of riparian habitat areas can be based on known required activity areas, minimum critical habitat areas, and discrete habitat type requirements, for representative species. Target species can be identified and goals set for habitat criteria, population size, and reproductive success to establish viability metrics. Degrees of connectivity of habitat patches can be defined and goals set for watersheds based on wildlife movement capabilities and seed dispersal limits. Development of a *Biodiversity Vision* should include the following steps:

1. Create Inventory and Analyze Trends

   An initial step is to document existing and historic conditions (inventory), and determine what has changed between these two end points. This information is necessary to evaluate what can and should be reasonably targeted for restoration, and to define a vision based on science. While an example of this process is available for Milwaukee County (Waller and Rooney, *op. cit.*), watershed specific data must be developed. This process should be documentary, performing the research necessary to reconstruct pre-settlement flora and fauna to the extent possible, and document existing flora and fauna, based on evidence for species occurrence. Collection and listing of voucher specimens, and clear methodology for interpretation of data gaps, should be included to allow for peer review. This step will likely require that surveys be conducted for some faunal groups lacking readily available data. These surveys should adhere to modern standards, including the use of detection probabilities to account for false negatives in survey results (MacKenzie et al. 2005. Occupancy Estimation and Modeling: Inferring Patterns and Dynamics of Species Occurrence. Academic Press, New York, New York. 344 p.). Currently, comprehensive modern data for these watersheds are limited to fishes, aquatic invertebrates, and flora, which, while extensive, also have data gaps.

2. Conduct Landscape Ecology Assessment

   The watersheds should be characterized from a landscape ecology perspective based on the results of Step 1 and analysis of physical parameters. In these highly fragmented landscapes, this assessment should address island biogeography theory (which applies to fragmented corridors), principles of metapopulation dynamics, habitat fragmentation issues, and conceptual theories and design issues of wildlife corridors, in a manner understandable to lay persons. The assessment should document the existing state of the watershed, and identify clear problem areas which could be addressed, with supporting documentation on biodiversity

and physical parameters, including exhibits to illustrate important concepts such as the state of habitat connectivity, spatial patterns of remaining species richness, and minimum viable habitat area. Finally, the assessment should provide social context, explaining the potential benefits of biodiversity preservation, including effects on natural resources, quality of life, and health and well being.

3. Identify Focal Species

Based on the above research, recommendations should be made for focal species. These should include *keystone species*, *umbrella species*, and *flagship species*. *Keystone species* have a strong and unique role in an ecosystem. Removal of these species can disrupt ecosystem process and possibly trigger extinctions of other species in the community. Nitrogen fixing bacteria, for example, are keystone species whose loss would result in the extinction of most life on earth. A less catastrophic example, the American alligator, provides critical drought refuges in southern swamps by digging depressions which remain ponded. Similar roles may be played by burrowing crayfishes in Milwaukee County ecosystems, and beavers in much of Wisconsin.
Umbrella species require habitat and resources which also support a variety of other species, communities, and/or ecosystems. As a result, conservation efforts aimed at umbrella species are likely to generate broad conservation benefits for many species. Umbrella species typically have large area requirements, specific well defined habitat requirements, well understood life histories (ideally subject to ongoing monitoring studies), and good chances for population stability or reintroduction to areas prioritized for conservation efforts. For example, grizzly bears have been used as an umbrella species for the design of landscape connectivity in the Rocky Mountains. In the SWWT area, umbrella species might include species requiring aquatic, semi-aquatic, and terrestrial habitat continuity, or specific habitat types which other species depend upon. Examples might include northern leopard frogs and Blanding's turtles for multi-habitat connectivity; wood ducks and wood frogs for ephemeral wetlands; red-shouldered hawks and great-crested flycatchers for forest interior habitat.

Flagship species are charismatic species that help attract public support for conservation (i.e. giant pandas). Several flagship species should be selected for the watersheds which are representative of prioritized habitat restoration goals (i.e. scarlet tanager for deciduous forest, wood duck for woodland ponds, pike for backwater sloughs, etc.).

4. Develop Broad Objectives

This step should articulate broad objectives and conceptual foundations for wildlife corridors, habitat restoration, and biodiversity, in lay person language. This should be broad brush, identifying the contexts, objectives, and elements for designing wildlife corridors and restoring biodiversity. Theoretical examples may be used, including exhibits to illustrate elements of successful design through

case studies, but this exercise should remain theoretical and not specifically address actual SWWT watershed areas. Agreement on and understanding of the science and concepts of wildlife corridors, habitat restoration, and biodiversity, and consensus on needs, goals, and objectives among stakeholders, is necessary before implementation specific to SWWT watersheds can move forward.

5. Develop Watershed Specific Recommendations and move toward Implementation

The final challenge is implementation of watershed specific recommendations. An implementation phase should develop watershed specific habitat/species recommendations; identify stakeholders and stakeholder consensus on achievable goals; provide clear goals and objectives for a watershed with metrics and specifics of design and restoration work steps; develop post-restoration monitoring, management, and preservation plans; identify sources of support and funding; outline a strategy for funding and achieving projects.

Conclusion

The concepts discussed above are being widely implemented throughout the world, where communities are realizing the need to live with and within nature, in a practical manner. Wildlife corridors, highway ecopassages, and biodiversity planning are being implemented in regions as diverse as Australia, Brazil, British Columbia, California, Chicago, Costa Rica, England, Florida, Idaho, India, Malaysia, Nepal, Netherlands, and Oregon (Anderson, A. B. and C. N. Jenkins. 2006. Applying Nature's Design: Corridors as a Strategy for Biodiversity Conservation. Columbia University Press, New York.). The process outlined above is greatly needed for the entire SWWT area. Until we have the resources needed to understand the past and present, we will not be able to make solid recommendations to improve conditions for the future. We are in the process of identifying potential partners and funding sources to move forward.