Northwest Science Forum

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Functional Wetland Restoration: An Ecosystem Approach

Introduction

Functional wetland restoration is the culmination of more than a decade of wetland mitigation activity, which has progressed from scattered wetland creation projects to large-scale restoration efforts integrated with and directed at improving ecosystem function. This paper presents a brief history of wetland mitigation and discusses the evolution of functional wetland restoration in the context of a regulatory framework. This paper also provides descriptions of the tools that have been developed specifically to support the move towards functional restoration, including a hydrogeomorphic wetland classification system (HGM) based on geomorphic setting and hydrologic regime, and an associated functional assessment methodology. The hydrogeomorphic functional assessment methodology currently under development is briefly described along with a discussion of the use of reference sites. The paper concludes with a discussion of additional elements to consider to successfully restore ecosystem function, including the need to include areas beyond the boundaries of jurisdictional wetlands, and the rationale for conducting landscape and ecosystem-level evaluations.

Background

Most regulations governing wetlands protection require compensatory mitigation when impacts to wetlands result in lost acreage or function. Local regulations have often focused mitigation efforts on in-kind (i.e., replacing a forested, scrub-shrub or emergent vegetation community with a similar community) and on-site wetland acreage replacement. Mitigation requirements were often fulfilled by wetland creation projects requiring extensive earthwork and hydrologic controls to deliver and maintain water levels. Efforts to address wetland functions in mitigation design were framed in the context of engineered or constructed wetlands. Functions such as flood storage, detention time, and water quality improvement were selected, and mitigation designs often produced systems that looked like naturalized stormwater detention or water quality treatment ponds. Wetland mitigation projects emphasized a few specific functions which could be easily assessed by measuring basin characteristics such as the size of the wetland, depth of storage, and inlet and outlet conditions. Wetland plant community establishment was often a matter of commercial availability, or even sometimes more a horticultural proposition

reflecting what the site could support rather than a natural assemblage of species.

"No net loss of wetlands" has generally been measured on an acreage basis, with different ratios of mitigation area to impact area established for wetlands rated with systems adopted by regulatory agencies. Wetland rating systems, based on a generalized functional assessment, provide a way of assigning a value to different wetlands based on criteria such as size, vegetative complexity, habitat diversity, and water storage or treatment capabilities. Highly rated wetlands require larger mitigation ratios as compensation for wetland losses. The rationale behind the compensation ratios is that complex systems take more time to develop, therefore a greater number of mitigation acres is required to account for the time lag before the mitigation wetlands can provide the functions lost due to impact. In part, compensation ratios also reflect the degree of certainty we have about our ability to replicate the complexity and functions of highly rated wetlands.

Early mitigation efforts resulted in many unsuccessful projects that contributed little to overall wetland and ecosystem function. Created wetlands often suffered from lack of appropriate hydrology, soils, and plantings, and also lacked connections to large, functioning ecosystems. In addition, the isolation of many early mitigation projects resulted in a piecemeal replacement of wetlands that did little to mitigate the cumulative effects of scattered wetland losses.

Restoration has several advantages over wetland creation because some of the elements of a functioning wetland (for example, soils or hydrology) are already in place, and the restoration site is often part of a larger system. The regulatory requirement for on-site mitigation often resulted in poor mitigation planning because the conditions for restoration were either not available or were less than optimal. Where environmentally preferable, off-site mitigation has became more acceptable due to opportunities for connection to larger, functioning systems, and the greater potential for restoration of wetland function through careful site selection.

Wetland Functional Assessment

At the same time attention was focused on improving the quality of mitigation projects, efforts were underway to develop better methods of assessing wetland functions. The first step towards creating a new functional assessment methodology was to develop a wetland classification system based on physical and landscape characteristics. Research sponsored by the U.S. Army Corps of Engineers resulted in the Hydrogeomorphic (HGM) classification for wetlands (Brinson, 1993), which identifies wetland types based on their geomorphic setting and hydrologic regime. Because the HGM classification identifies wetland types by their position in the landscape as opposed to vegetation cover, HGM provides the opportunity to relate specific categories of wetland function to specific types of wetlands.

In a second phase of research, the HGM functional assessment methodology (Brinson et al. 1994, Smith 1993) focuses on the relationship between wetland functions and the hydrologic and geomorphic controls afforded by the surrounding landscape setting. It uses functional indicators both to represent categories of wetland function, and to describe the characteristics and processes of the different wetland types. Because the HGM wetland classification is landscape-based, an HGM functional assessment has to be developed for each geomorphic region. The goal of an HGM functional assessment is to define the specific categories of wetland function associated with a given wetland type (i.e., not all wetlands perform the same functions), as well as the average and range of values expected for the individual functional indicators. The variability and mean values for indicators of specific wetland function(s) are different for similar wetland types in different regions. Efforts are currently underway to regionalize the application of the HGM assessment in Washington State and in other parts of the country.

The application of the HGM classification system and associated functional assessment methodology in the wetland regulatory framework is twofold. First, as a descriptive tool, wetlands can be described and impacts can be assessed relative to a set of commonly agreed upon functional indicators. Second, as a measurement tool, the adequacy of mitigation for functional losses can be evaluated by measuring differences between the pre- and post-project conditions of both the impact and mitigation sites. In assessing an individual site, either impact or mitigation, a functional profile is constructed using site-specific measurements or estimates of functional indicators

for pertinent functions such as hydrology, water quality, biogeochemistry, plant communities, and fish and wildlife habitat. Measurement of the functional losses or gains due to proposed actions (either impact or mitigation), requires assessing the same functional indicators at a series of reference sites. The reference sites should exhibit the same hydrogeomorphic characteristics as the project site and should reflect a range of conditions from degraded (or early seral) to pristine (or late seral) with several sites in between to construct a functional gradient against which the magnitude of impact or mitigation actions can be measured. Once an appropriate suite of wetland functions has been identified and specific functional indicators have been agreed upon, the use of reference sites allows evaluation of individual sites for the potential functional gain achievable from restoration actions. Conditions in the higher functioning reference sites also guide the development of restoration design criteria and can provide measurable performance standards for individual mitigation actions.

Functional Restoration

Restoration is fundamentally an intervention in the projected recovery rate of a given site. Functional restoration undertakes actions at the individual site level that are integrated with ecosystem function at the landscape level. While HGM has the potential to describe individual wetlands in the context of larger ecosystem processes and functions, at this time additional landscape and ecosystem analysis would be required for this level of assessment. Projecting a positive or negative trend in ecosystem function results in a determination of the natural recovery rate of a site and depends to a large extent on conditions in the surrounding watershed and on expected future conditions based on current and proposed land management practices. Therefore, in addition to the HGM assessment of immediate on-site conditions, developing a functional restoration requires broader landscape and ecosystem levels of analysis.

A landscape-level analysis focuses on the conditions in the landscape surrounding the impact, mitigation, and reference sites, and considers the effect of historic, current, and proposed land management practices on the individual functional indicators. For example, a landscape-level analysis would evaluate the effects of grazing or forest practices on sites with similar characteristics, but with different levels of land management activities in the surrounding landscape. Landscape analysis also results in an evaluation of a site's capacity for recovery given the conditions in the surrounding landscape. The Washington Watershed Assessment Protocol (WAP) is an example of a systematic method for conducting a landscape-level analysis focusing primarily on the physical processes in a basin (Washington Forest Practices Board, 1995). WAP evaluates the condition of a basin by assessing hillslope stability, hydrology, riparian condition, and the combined effects of organic and inorganic inputs on fisheries habitat and stream channel condition. Watershed assessment provides a process-driven assessment of the condition of a basin down to the level of an individual stream reach. In addition to identifying constraints on land management practices, it can be useful in identifying critical preservation and restoration opportunities. Understanding the control that human activities exert on the disturbance regimes of an ecosystem allows projections about expected future conditions.

From an ecosystem perspective, the information from a landscape analysis provides a basis for understanding the processes contributing to the pattern and structure in the landscape. Ecosystem analysis addresses the larger issues of biodiversity, connectivity, large-scale wildlife considerations, and patch dynamics. Ecosystem goals that have been formalized into comprehensive land management plans help prioritize specific ecosystem functions and provide guidance for site selection for restoration. The combination of site-level, landscape, and ecosystem assessments comprises a broad ecosystem approach with direct applicability to functional restoration. Functional restoration results from evaluating interactions between the parts of a basin, and identifying prescriptive actions to protect or restore the integrity of the basin as a whole.

Summary

In addition to providing a metric for wetland function for regulatory purposes, the HGM functional assessment evaluates a broad suite of wetland functions such that specific goals for functional restoration can be established. In addition to HGM, an evaluation of broader landscape and ecosys-

tem-level functions helps locate where the most functional gain can be achieved and maintained. Although regulation is concerned with jurisdictional wetlands, most local ordinances require buffers along streams and wetlands in recognition that ecosystem function extends beyond the immediate wetland boundary to include the adjacent uplands. In planning functional restoration projects it is important to consider the interactions between upland and wetland areas, and work within the bounds of functional geomorphic units such as floodplains or riparian zones, rather than restrict our actions only to jurisdictionally-recognized areas.

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