Evaluating Mitigation Performance: Functional and Condition-Based Assessment Methods

Noted ecologist A.D. Bradshaw described restoration ecology as the "acid test" of our understanding of how ecosystems work. If the goal of mitigation is to recreate a more natural, self-regulating, and self-sustaining ecosystem, research has shown that wetland mitigation projects often do not meet this goal. In fact, mitigation wetlands are often found to be distinct from natural sites in terms of their structure and function. Patterns in the major differences that have been reported between natural and mitigation sites include:

- deeper surface water at the mitigation sites;
- lower overall species diversity in many taxonomic groups;
- substantially reduced soil nutrient pools at mitigation sites;
- significantly different patterns of nutrient movement, both in terms of rates and quantities cycling between ecosystem components; and
- low soil nutrient availability that propagates through mitigation sites (limiting productivity for example) and appears, in some cases, to set a limit on ecosystem development.

Where they have been adopted, the use of assessment tools and performance standards (based on hydrology, biota, and soils) have proved effective in evaluating program success and, by providing feedback on the performance of mitigation projects, helped to improve their overall success.

When developing or adopting an assessment approach to evaluate mitigation performance, a central question is, what should be measured? Two broad assessment approaches have emerged over the past few decades, functional assessment methods, designed to evaluate a set of functions at a given site, and measures of ecological condition, such as Indexes of Biotic Integrity (IBIs), which assess the ecological condition of a site. Both approaches are fundamentally data-driven, depending on data collected at reference standard sites to determine the characteristics of the "least impacted" reference wetland for each class. Functional assessment methods result in a score for each function, typically 8-12 per wetland, while condition assessments report a single score.

The use of assessment methods evolved from the need to implement provisions of the federal Clean Water Act. In particular, the goal of the Act is to maintain and restore the chemical, physical, and biological integrity (sometimes referred to as condition) of the nation's waters. State, tribal, and national mitigation policies, and more recently the federal Compensatory Mitigation Rule, have been adopted to help attain the goal. Much of this regulation has been distilled by wetland regulatory programs into the policy goal of "no net loss" of wetland acres, function, and condition. That is to say that unavoidable losses associated with a permit action generally need to be replaced through mitigation activity. Until more recent times, the analysis needed to balance wetland loss and mitigation benefits focused on functional assessment. However, program experience has revealed that functions are notoriously difficult to measure directly, because they typically require repeated measures of different ecosystem processes. For example, it is laborious and time-consuming to quantify ecosystem processes, such as primary productivity, decomposition, or carbon sequestration.

From an ecological standpoint, wetlands perform a wide variety of functions at a hierarchy of scales ranging from the specific, e.g., carbon sequestration, to the broad, e.g., biogeochemical cycling, as a result of their physical, chemical, and biological characteristics. At the highest level of this hierarchy is the maintenance of ecological integrity, the function that encompasses all ecosystem structure and processes (as described in one of the first hydrogeomorphic (HGM) documents by R. Daniel Smith et al., U.S. Army Corps of Engineers, Technical Report WRP-DE-9, An Approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices (1995)). In this view, the link between function and condition lies in the assumption that ecological integrity is an integrating "super" function of wetlands. If condition is excellent, i.e., equal to reference standard condition, then the ecological integrity of the wetland is intact, and the functions typical of that wetland type are assumed to occur at reference standard levels. As condition declines, and the departure from reference standard sites increases, the functions characteristic of that wetland class are also altered.

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Functional assessments use structural measures of the biological, physical, and chemical characteristics of a site, and combine them using simple mathematical formulas to indicate a set of functions, thus functional capacity is inferred from a set of structural and stressor measures. Similarly, wetland IBIs use structural attributes of the biological community, e.g., plants, macroinvertebrates, or amphibians, and assume that as those attributes deviate from those at reference standard sites, ecological condition declines. If the overall condition is deemed to be good (or

poor), then the functions that support, or are supported by, that structure are also deemed to be good (or poor) for that wetland class, relative to reference sites. Condition-based assessment tools, such as an IBI, offer an alternative to functional measures in assessing whether a wetland of equivalent condition and function to the one lost has been replaced through the mitigation process.

As an example, the Ohio Environmental Protection Agency (OEPA) has been using measures of condition to ensure ecological parity and functional replacement in both their regulatory program, and as a tool for the ambient assessment of wetlands in the state. This is a model of how to operationalize this approach including determination of mitigation ratios (see reports by the OEPA; *see* http://www.epa.state.oh.us/dsw/wetlands/WetlandEcologySection.aspx). Ultimately, if the mitigation wetland that results is of the same HGM class and vegetation type, which by definition perform the same functions as the impacted site, and if there is a no net loss of acres, and if its condition is equivalent to or higher than the impacted wetland, there is a high likelihood that functional replacement has occurred, and that the overall status of the wetland resources has been protected.

The choice of which approach to use depends, of course, on the goals of the assessment program. If the goal is to track replacement of a specific rate of ecosystem function, a functional assessment might be used. If the program goal is to evaluate the overall performance of wetland mitigation projects or programs in a state or region, condition-based approaches may be employed. For example, condition assessment can be combined with probabilistic sampling of a population of natural wetlands (both reference standard and reference wetlands) and compared with a sample of mitigation wetlands. This will help with the establishment of mitigation performance standards that best reflect reference condition in a region and that can inform decisions about the ecological suitability of proposed mitigation sites. ■

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INTERAGENCY REVIEW TEAMS

Post-Mitigation Rule IRTs in New England: Overseeing Transitions From Pre-Rule to Rule-Compliant In-Lieu Fee Programs

The New England District of the U.S. Army Corps of Engineers (the Corps) covers six states, which offers both opportunities for learning and challenges for overseeing six different approaches to aquatic resources. The advantage is that we can learn from the experiences with mitigation in one state when dealing with the other states, but the disadvantage is that all six states have different laws related to aquatic resources and mitigation. Also, we have just one region of the U.S. Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service (FWS), and the National Marine Fisheries Service (NMFS) with whom to coordinate, so there is much overlap between the federal members of the Interagency Review Teams (IRTs).

The region differs from much of the rest of the country in that we have no approved mitigation banks, and only one department of transportation (DOT) umbrella bank in process. However, we have fairly new (early 2008), but active, in-lieu fee (ILF) programs in three states, one just approved in January 2011, and discussions on ILF program establishment in two others.

Maine, Massachusetts, and New Hampshire established ILF programs that pre-date the 2008 Mitigation Rule. As a result, all are in the process of developing Mitigation Rule-compliant programs with varying challenges to address. The Association of State Wetland Managers has set up a monthly conference call for states across the country developing compliant programs; this has proven to be a good forum in which to share frustrations, confusion, and potential solutions. For these three New England states, there are several important components of becoming compliant: establish formal IRTs; develop comprehensive planning frameworks (CPFs); determine advance credits; and incorporate the best of the existing programs while following the Mitigation Rule.

Revise the ILF instrument to establish formal IRTs (33 C.F.R. §§332.2 and 332.8(b)(2,4,5): The Mitigation Rule requires the District Engineer to approve all ILF and mitigation banking decisions, meaning that compliant instruments must afford the Corps veto power over proposed ILF mitigation sites. In New Hampshire, the Corps and EPA have been the only federal agencies actively involved in the ILF program, and the Corps already must approve all projects selected for funding, as must the state's Wetland Council. While the formal IRT to review the proposed new instrument will include the FWS and the NMFS, these agencies have limited staff resources and would generally have to limit involvement to reading e-mails. The state will also need to decide if it would like participation of state resources agencies on the IRT, since some are already on the site selection committee, which selects projects to recommend for funding.

In Maine, the existing program does not specifically reference an IRT naming the federal and state agencies involved and their roles, but there is an IRT for the pending DOT umbrella bank comprised of the Corps, EPA, the FWS, the NMFS, the Maine Department of Environmental Protection (MEDEP), the Maine Department of Inland Fisheries and Wildlife, and the Maine Land Use Regulatory Commission. The Corps plans to use this IRT with the ILF program, except for the MEDEP, which is the sponsor of the ILF program.

The Massachusetts program, sponsored by the Massachusetts Department of Marine Fisheries (MADMF), is specifically for