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Mark M. Brinson and Richard Rheinhardt

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THE ROLE OF REFERENCE WETLANDS IN FUNCTIONAL ASSESSMENT AND MITIGATION^{1,2}

MARK M. BRINSON AND RICHARD RHEINHARDT

Biology Department, East Carolina University, Greenville, North Carolina 27858 USA

Abstract. Compensatory mitigation for damages to wetlands in the United States occurs largely without explicit analysis and replacement of wetland functions. We offer an approach to standardize such analyses and strengthen the connection between ecological principles and policies for wetland resources. By establishing standards from reference wetlands chosen for their high level of sustainable functioning, gains and losses of functions can be quantified for wetlands used in compensatory mitigation. Advantages of a reference wetland approach include (1) making explicit the goals of compensatory mitigation through identification of reference standards from data that typify sustainable conditions in a region, (2) providing templates to which restored and created wetlands can be designed, and (3) establishing a framework whereby a decline in functions resulting from adverse impacts or a recovery of functions following restoration can be estimated both for a single project and over a larger area accumulated over time.

To establish reference standards, conditions inherent to highly functioning sites must be identified for classes of wetlands that share similar geomorphic settings. Ecological functions are then identified, and variables used to model the functions are employed in developing reference standards. Variables range from the highest levels of sustainable functioning to the complete absence of functions when a wetland ecosystem is displaced. An example given for wet pine flats in the North Carolina coastal plain illustrates how to determine the loss of a given function for an impacted wetland, how to calculate recovery (gains) in function through compensatory mitigation, and how to use the relationships between the two (loss vs. gain in function) to set minimum replacement ratios of restored to impacted area. In all cases, data from reference wetlands provide the benchmarks for making these estimates and for directing restoration or creation of wetlands toward the standards established for the wetland class. Programs to implement the use of reference wetlands require regional efforts that build upon the knowledge base of existing wetlands and their functioning.

Key words: assessment; compensatory mitigation; creation; functioning; hydrogeomorphic classification of wetlands; North Carolina wet pine flats; reference standards; reference wetlands; restoration; wetland.

INTRODUCTION

Design and performance standards are used in engineering and manufacturing to ensure that products meet specified levels of quality. With increasing emphasis on ecosystem sustainability, restoration, and

against which impacts to wetlands and restoration efforts are evaluated. Before we describe how reference wetlands can be used, we must first identify goals of mitigation, explain how assessment of wetland ecosystem functioning is conducted, and provide guidance

phasis on ecosystem sustainability, restoration, and adaptive management (Holling 1978, Lubchenco et al. 1991), the development of "performance" standards for ecosystems could provide the basis for judging the quality of restoration efforts and their effectiveness in offsetting unavoidable impacts. Restoration and creation of wetland ecosystems have been the focus of symposia and reviews to address progress and to discuss techniques for replacing lost area and functions (Joselyn 1982, Kusler and Kentula 1990, National Research Council 1992). We argue that reference wetlands should be central to the development of standards

on how reference wetlands are chosen.

Goals of mitigation

Regulatory programs that deal with mitigation of damages to or losses of wetlands operate within a combination of federal, state, and local regulatory programs. The most prevalent of these programs is §404 of the Federal Clean Water Act (CWA)³ which has the goal of maintaining and improving the chemical, physical, and biological integrity of the Nation's waters (40 CFR Part 230.1).⁴ Before a wetland can be filled, drained, or otherwise degraded, the landowner or pro-

¹ Manuscript received 20 March 1994; revised 18 April 1995; accepted 21 April 1995; final version received 30 May 1995.

² For reprints of this group of papers on wetland mitigation, see footnote 2, page 33.

³ United States Code: Title 33.

⁴ CFR = Code of Federal Regulations, the official compilation of all agency regulations that implement U.S. (federal) law.

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