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HGM and wetland functional assessment: Six degrees of separation from the data?

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Abstract

Ecologists routinely use rapid assessment protocols to try and determine level of function for wetlands. In the United States, one of the more intensively used approaches is the hydrogeomorphic (HGM) approach. Using this system, wetlands are classified by their location, the source of water, and their hydrodynamics. Models are built to attempt to determine levels of function, but models rely almost exclusively upon structural indicators that may, or may not, relate in any meaningful way to function. In this paper I examine several models from Pennsylvania where a considerable amount of data exists for the sites from which the models were developed. I show that, even with a large data set, models still rely upon structure with a tenuous connection to real function. I then examine several other models from around the United States related to hydrology, and assess the relationship of the models to actual function. Suggestions for change include slowing the permit process down, continuing to develop large sets of reference wetlands, reducing the use of indices within indices, and developing a research agenda that addresses the relationships between structure and function.

Keywords: Functional assessment; HGM; Hydrogeomorphic; Rapid assessment; Wetlands

1. Introduction

1.1. Clean water act

In the United States, the enactment of the Federal Water Pollution Control Act (hereinafter referred to as the Clean Water Act) of 1972 began the process of regulating the disposal of dredged or fill materials in ''waters of the United States''. The introduction to the Act reads as follows:

''The objective of this Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters.''

The Federal Water Pollution Control Act (as amended through P.L. 107-303, November 27, 2002) [33 U.S.C. 1251 et seq.].

All decisions of a regulatory nature with respect to wetlands stem from that very simple statement. From

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that broadly stated objective a very complex regulatory program has arisen for the waters of the United States, only some of which are wetlands. Section 404 of the Clean Water Act (CWA) is the section that has been used to develop a program designed to regulate the disposal of dredged materials or fill into waters of the U.S. As many wetlands are considered to be waters of the U.S., a complex permitting program has been designed under Section 404 to deal with issues pertaining to impacts to wetlands from dredge and fill activities. Early permits under that program typically looked for the replacement of acreage on a 1:1 basis for any wetlands lost during a development activity. However, the CWA refers to "...biological integrity...". As such, the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers (the two federal agencies with Section 404 responsibilities) agreed in 1990 that wetland functions, not merely acreage, would be the units of wetland mitigation (USEPA and USACE, 1990). With that agreement came the need for some rapid method that would assess wetland function.

1.2. Rapid assessments

Ainsley (1994) described the role of rapid wetland functional assessment within the context of the Section 404 regulatory program. He felt that the use of functional assessment was integral to implementation of the Section 404 program and that regulators needed to understand wetland function if they were to properly implement the program. He observed that there were deficiencies in the program without some formal level of functional assessment.

"The determination of whether a project will result in significant degradation is based upon best professional judgement of the project manager and other resource agencies and tends to place much emphasis on loss of wildlife habitat" (Ainsley, 1994; p. 436).

In the decade since Ainsley's (1994) statement, there have been numerous attempts to measure function, albeit indirectly, through the use of indicators. However, function itself is not so readily defined, even though the National Research Council (1995; p. 34) defined function as "...all processes and manifestations of processes that occur in wetlands." If a function equates to a process or a rate, then truly calculating a function requires multiple measurements throughout the year (e.g., for production, Dilustro and Day, 1997). Kentula et al. (1992; p. 7) suggested using indicators, or those variables seen as closely related to a particular function, noting that "Measures of wetland structure, e.g., site morphology or species present, are readily available and more often meet the requirements of expediency and economy than do measures of function." Measurement of function is complex and expensive and the NRC (1995) itself has listed several measurements that might be considered as indirect indicators of wetland function.

The Corps of Engineers began to develop a comprehensive classification and functional assessment protocol in the early 1990's based upon hydrogeomorphic (HGM) principles. Brinson (1993a) showed that classifying wetlands by position within the landscape, the source of water, and hydrodynamics was very useful in explaining wetland function. Functional aspects of seemingly disparate wetland types could be seen to be similar when classified in this manner. Landscape position, water source and hydrodynamics together constitute the HGM class (Smith et al., 1995). Direct water sources include surface water, groundwater, and precipitation and geomorphic setting includes riverine, fringe, depression, slope, and flat (Brinson, 1993b). The classification of a wetland into an HGM class allowed for the development of draft functional assessment models for each class. (For an in-depth review of the HGM process, see the reports at http://www.el.erdc.usace.army.mil/index.cfm.) Regionalization of these models was expected by the Corps such that wetland managers could apply specifically calibrated functional assessment models that were appropriate to any location in the country. The models as developed, however, typically do not measure function, but instead rely heavily upon indicators that themselves are structural in nature. Structure is not a particularly good correlate with function (Cole, 2002) and, as a result, leaves the functional assessment models open to considerable ambiguity and criticism. In fact, a great many of the models developed to date appear to rely on the use of indicators of function rather than trying to measure function itself. This is understandable as functional measurement is an elusive (and expensive) pursuit. Nevertheless, we need to cast a critical eye to the use of indicators if we are to decide