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Plowing Through the Muck: A Review Of Wetland Assessment / Evaluation Methods

Melissa Chaun

Introduction

Since the early 1970's, numerous wetlands evaluation methods have been developed in attempts to balance conflicts between conservation goals and development pressures. Methods have been designed by federal/state agencies, private consulting firms, and the academic community. Some methods attempt to ascertain all known wetland functions and values, while others focus on a selected few. Assessment techniques have been created to produce a verifiable and reproducible outcome which can be applied in a number of ways: comparison of two or more wetlands; prioritization of wetlands for acquisition, research or advanced identification; identification of possible permit conditions; prediction of project impacts on wetland functions and values; and, comparison of created or restored wetlands with reference or pre-impact wetlands for mitigation purposes (Adamus et al., 1987).

Wetland evaluation can be considered as two operations: the scientific process of functional assessment in which the biological, chemical and physical characteristics of a wetland are determined; and, the socio-economic process of assigning values to the wetland by defining those characteristics that are beneficial to society (Larson and Mazzarese, 1992). Some methods focus on functional assessment; others take a more comprehensive approach and incorporate both the functional assessment and valuation of a wetland.

Functional assessment typically focuses on the probability a wetland is important for hydrological processes such as flood control, shoreline stability and water quality maintenance. To determine its ability to purify water, the assessment may therefore examine the wetland's capability of trapping sediments and/or retaining nutrients. However, many assessment methods also consider the wetland's importance as a wildlife habitat for aquatic and terrestrial species.

The socio-economic evaluation of wetlands considers the habitat significance of a wetland, but it examines that feature as it pertains to human values. For example, a particular wetland may be highly valued by society if it is utilized by an endangered species. Socio-economic evaluation may also consider the passive and active recreational value of a wetland. Bird watching and general aesthetic enjoyment constitute passive recreational activities, while game hunting and fishing are considered active ones. The potential of a wetland to serve as an educational/research site is also often weighed in this type of evaluation.

Recently, developers of assessment/evaluation methods have focused on producing relatively simple techniques enabling a preliminary assessment/evaluation to be conducted within a minimal time period. Such techniques are intended to precede, not substitute, lengthier scientific inventories (Abate, 1992). They are a means of quickly assessing those wetlands which may require further examination as they appear to be particularly important for one or several functions and/or values. The methods may be used, therefore, for "red-flagging" a wetland, as well as comparing several wetlands within a watershed or region.

In addition to being a component of many wetlands assessment techniques, the socio-economic evaluation of wetlands also has its own field in the domain of economics. Methods include both market and non-market strategies. To date, a handful of economic evaluation methods exist, but none have proved entirely acceptable in their application to wetlands.

This paper is a review of several non-economic functional assessment methods. Although the literature is extensive, a majority of the methods simply represent slight modifications. Moreover, this paper will focus on assessment methods which may be employed in the assessment of non-tidal wetlands.

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Commonwealth's Declared Policy:
"to preserve the wetlands and to prevent their despoliation and destruction . . ."

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Assessment/evaluation Methods

Habitat Assessment Technique (HAT)

The wetland Habitat Assessment Technique (HAT), developed by Cable et al. (1989), is the first known attempt to directly incorporate ecological concerns (faunal and species indices) with the concept of economic efficiency (optimum habitat area). The HAT procedure is based on the premise that species diversity and the uniqueness of species found in a wetland can be used to assess the quality of a wetland habitat. The presence of more species and uncommon species makes an area more valuable. Economics and ecology are integrated in an effort to determine the optimum habitat tract size. However, determination of the optimum tract size is the least precise component of HAT. Additional studies in ecological and environmental sciences will help to provide the missing data on species habitat requirements.

HAT quantifies habitat quality using birds as indicators. This allows comparisons to be made among sampled areas. It is not only rapid, (a field visit is not necessary if site-specific bird records can be obtained), simple and inexpensive, but it can provide input to more comprehensive evaluation techniques, such as the United States Fish and Wildlife Services' Habitat Evaluations Procedure (Fish and Wildlife Service, 1976 and 1980), or the Army Corps of Engineers' WET II (Adamus et al., 1987), which assess other wetland values.

Wetland Evaluation Technique (WET)

WET II, a revision of the method initially developed for the Federal Highway Administration, qualitatively evaluates a total of eleven wetlands functions and values:

- ground water recharge,
- groundwater discharge,
- flood flow alteration,
- sediment stabilization,
- sediment/toxicant retention,
- nutrient removal/transformation,

- production export,
- wildlife diversity and abundance,
- aquatic diversity and abundance,
- uniqueness/heritage, and
- recreation (Adamus et al., 1987).

WET evaluates these characteristics at three levels: social significance, effectiveness and opportunity. Social significance assesses the value of a wetland to society based on its strategic location, official status or designations, and natural features. Effectiveness assesses the capability of a wetland to perform a function due to its biological, chemical or physical attributes. The last level, opportunity, assesses the opportunity of a wetland to perform a function to its level of capability. To illustrate, a wetland with a constricted outlet may be an effective sediment trap. The opportunity of the wetland to function as a sediment trap determined by the presence, or absence, of a sediment source.

WET is primarily designed for conducting an initial, rapid assessment of wetland functions and values. The procedure involves answering a series of questions in the field and using a key to interpret the answers. A ranking of low, moderate or high is generated for each function.

WET does not assess the suitability of wetland habitats for many important wildlife resources (furbearers, game animals). Other methods such as HEP must be used for these species (Adamus et al., 1987). Furthermore, it is not intended as a substitute for quantitative data or evaluation methods. Since the procedure yields only high, moderate or low values, comparisons among wetlands are difficult but nonetheless possible.

Wetland Evaluation Technique for Bottomland Hardwoods (WET-BLH)

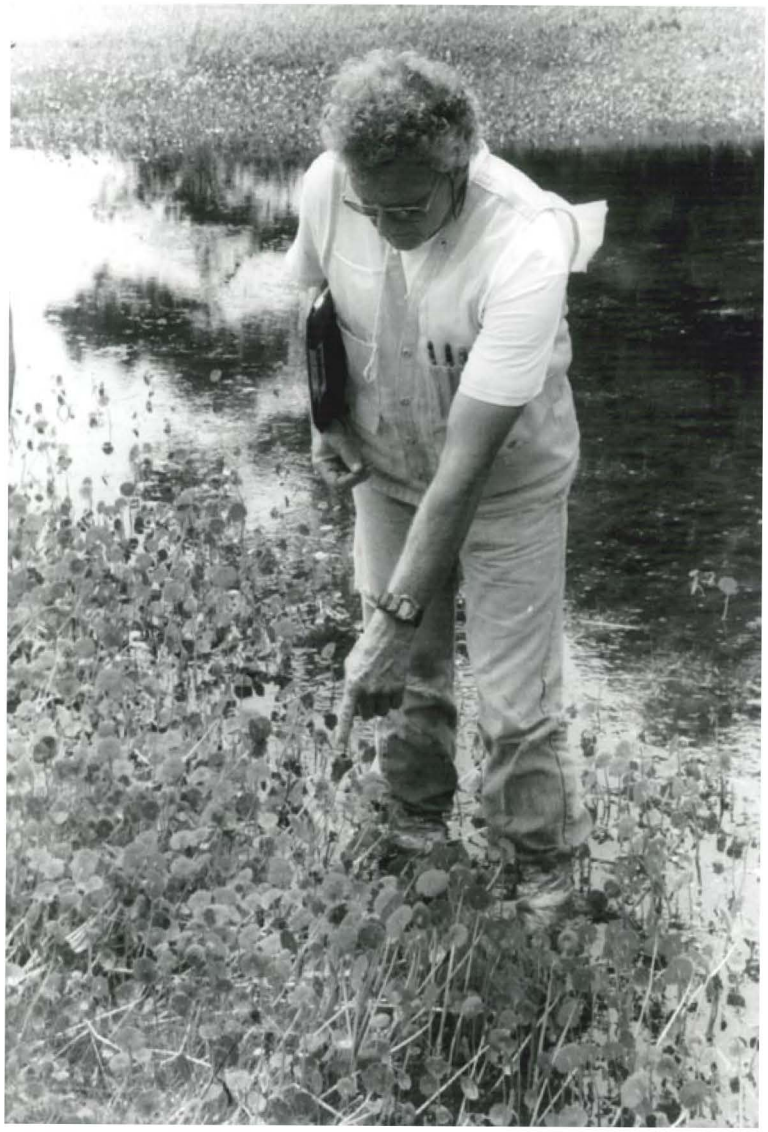
An effort to create a regional version of WET resulted in the Manual for Assessment of Bottomland Hardwood Functions (Adamus et al., 1990). This technique applies to bottomland hardwoods (BLH) in the southeastern United States. As in WET, WET-BLH evaluates functions in terms of effectiveness and opportunity, and values in terms of social significance. It evaluates the majority of wetlands functions described in WET II. In addition, WET-BLH evaluates ecological significance, economic sig-



The Willet, a common breeder on salt-water marshes in Virginia, is protected by the Migratory Bird Treaty Act.

nificance, cultural and recreational significance.

WET-BLH evaluates functions and values by characterizing the BLH in terms of simple or integrated variables that correlate with the physical, chemical and biological characteristics of the BLH and its surroundings. Responses are analyzed in a series of interpretation keys. Interpretation keys assign qualitative probability rating of high, moderate or low to each of the functions and values assessed. As a modification to the WET technique, WET-BLH assesses each function individually allowing for evaluations for subsets of functions.



Assessment evaluation methods may be used for "red-flagging" a wetland for further investigation.

Method for the Evaluation of Inland Wetlands in Connecticut:

A Watershed Approach

The "Connecticut Model" provides a quantitative method of wetland evaluation for use by public officials and others involved in wetland management who are not necessarily wetland specialists or engineers (Ammann et al., 1991). The method is simplified, rapid and easier to use than WET. It is designed to be scientifically defensible, although the technical rationales for many of the rating criteria are not included in the manual (Bradshaw, 1991). The method covers as many of the known functional values of wetlands as possible, including wildlife and aquatic habitat, groundwater use potential, ecological integrity, flood control and water-based recreation. In addition, it introduces archaeological site potential and urban wetland quality functional values.

The method advises that all wetlands in a watershed be evaluated. The wetlands can then be ranked for each of the 14 functional values. Comparisons among wetlands for each function can be easily made since the method utilizes a functional value index (FVI). The FVI is obtained from scaled and weighted values. Since the numbers are only arbitrary and comparative, the index is most useful in comparing different wetlands, or the same wetland under different management plans (Mitsch and Gosselink, 1986).

A Technique for the Functional Assessment of Nontidal Wetlands in the Coastal Plain of Virginia

This very rapid, relatively inexpensive assessment technique designed by Bradshaw (1991), relies on data easily obtained from existing sources or brief site visits. The

method allows the ranking of each wetland as having a high, moderate, or low probability of opportunity and effectiveness at performing the following functions: flood storage and flood flow modification; nutrient retention and transformation; sediment retention; toxicant retention; sediment stabilization; wildlife and aquatic habitat and public use. It omits the evaluation of groundwater discharge/recharge due to time constraints and does not address the social values of a wetland.

For each function, the method specifies the factors which determine a wetland's ability to perform that function. Quantitative and qualitative assessment of the wetland results in a qualitative rating for each factor. The relative importance of each factor is reflected in the combination of the factor ratings to produce an overall ranking of the wetland (again, high, moderate or low) for each function.

The method has had limited field testing but is promising. Revisions of the technique are currently underway in order to better evaluate functions according to effectiveness and opportunity. Additionally, consideration is being given to the incorporation of modifications to create several different versions of the technique. It is intended to allow evaluation of different wetland types according to landscape location (ie. lakeside, riverine, and estuarine).

Canada's Wetland Evaluation Guide

The scope of functions in the Canadian method is similar to that of WET II, but it does not clearly differentiate between wetland functions, processes, products and values. Nevertheless, it advances wetland assessment to a new dimension (Larson and Mazzarese, 1992). An assessment of both the wetland to be impacted and the proposed project are conducted using this technique. The guide consists of



Wetland ecosystems are among the most threatened of all natural resources.

three stages which allows for three levels of evaluation.

Stage One, called the "General Analysis," is a preliminary assessment of the wetland, based on bio-physical, hydrological, biogeochemical and socio-cultural data, and the proposed project, based on economic significance. All considerations are at an international, national, or provincial/state level of significance. Comparing the significance of the wetland and the project provides the evaluator with knowledge about the desirability of: 1) protecting the wetland due to its exceptional value; 2) approving the project because it has outstanding value and the wetland has little or no value; and 3) deferring to Stage Two because no conclusion is obvious.

Stage Two, the "Detailed Analysis," is a procedure for the detailed assessment of functions and benefits of both the wetland and the proposed project using a multiple value evaluation matrix. The matrix requires biological, hydrological and biogeochemical, social/cultural and market and non-market economic production values of the wetland. It also uses project production values. This stage is divided into six steps: steps one to five complete the multiple value wetland evaluation matrix and summary of wetland and project status, and step six recommends a course of action: project approval, rejection, approval with conditions, or referral to Stage Three, "Specialized Analysis."

Stage Three requires expertise in resource economics, biology and financial assessment. It emphasizes the calculation of precise market and non-market economic production costs and benefits occurring from wetlands and from proposed development with potential impact. The focus is on the detailed impact assessment and estimation of the social and economic benefits and costs to society associated with those impacts. Stage Three is designed for use in the evaluation of large federal or provincial projects.

Conclusions

Wetland ecosystems are among the most threatened of all natural resources. As the first wave of public awareness and resulting protective strategies begins to subside, a second more clearly defined set of policies and regulations may be required to reflect the values of wetland ecological systems in landscape mosaics that are dominated by humanity (Brown, 1986).

Most assessment/evaluation methods are currently based on the premise that not all wetlands perform all functions at all times or perform functions equally well (Albrecht, 1991). The economic valuation of the multifunctional wetland resource is required; yet, there is still considerable uncertainty about the total social value of wetlands ecosystems. Mitsch and Gosselink (1986) recognize four generic problems: 1) wetlands are multiple-value systems: they may be valuable for many different reasons and therefore the difficulty lies in comparing and weighing different commodities; 2) the most valuable products of wetlands are public amenities that have no commercial value for the private wetland owner; 3) as wetland area decreases, its marginal value increases, following conventional economic theory; and, 4) commercial values are finite, whereas wetlands provide values in perpetuity; wetland development is often irreversible. More research is obviously needed to increase the accuracy of wetland valuation estimates.

At the same time, due to the extent and urgency of the threats to wetlands, particularly nontidal wetlands, a simple, rapid assessment procedure is essential. The present challenge is not only to assess the ecological role of wetlands, but to design an economic evaluation procedure that can feasibly be incorporated into a rapid assessment technique.

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