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LINKING ACTIONS TO OUTCOMES IN WETLAND MANAGEMENT: AN OVERVIEW OF U.S. STATE WETLAND MANAGEMENT

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Abstract: Despite a national focus on saving wetland systems in the U.S., evaluations of wetland resources and management outcomes have been limited. A fifty-state survey of wetland managers was conducted in order to collect information on (1) wetland resources, (2) management actions taken, and (3) management impact on the resources (wetlands). An overview of the general status of state knowledge of the quantity and quality of their wetland resources is presented. Results indicate that most states have a rough estimate of the resources and most have wetland conservation plans and intend to develop better databases of wetland resources. However, few states track management actions relevant to wetlands and fewer have any idea of the success or impact of past management actions. The ability to assess program effectiveness is key to implementing adaptive management frameworks. A number of lessons learned suggest a basic framework for future wetland management that includes state planning, better quantification (mapping) of wetlands, development of methods to measure wetland quality, and tracking of wetland management actions and outcomes. This framework could also be used as an outline for the development of a more adaptive approach to wetland management.

Key Words: wetland management, wetlands, state wetland programs, evaluation, adaptive management

INTRODUCTION

Feedback loops linking changes in the natural system to management decisions are a ubiquitous feature of emerging environmental management concepts. This growing area of focus emphasizes the need for “adaptive” management programs that (1) monitor the state of the resources, (2) evaluate the impacts of management actions, and (3) adapt the management program based on the findings of (1) and (2) (Holling 1978, Walters 1986, Lee 1993, Cortner et al. 1996). Environmental policy evaluations involving both ecological indicators and policy outcomes are critical to designing environmental management models that are dynamic and responsive to changing conditions (Figure 1).

Environmental policy evaluation seeks to identify and, if possible, quantify the effects of specific man-

agement programs or actions on the natural system. While evaluation theory is not new (i.e., Rossi and Freeman 1993), evaluation of environmental management actions has been limited (but see Good 1994, Hershman et al. 1999). This is largely due to a lack of consistent, reliable information concerning the ecological state of the environment (Stevens 1994). Aside from this lack of information, several other explanations for minimal environmental evaluations exist. 1) Management responsibilities are often split between various agencies and levels of government requiring increased coordination and information sharing. 2) Selecting comparable control sites to compare the changes in the natural system with and without management action (i.e., reference sites) is often difficult. 3) Lack of personnel, funding, and long-term commitment prevents long-term ecological monitoring from occurring, making policy evaluation difficult (Good et al. 1999).

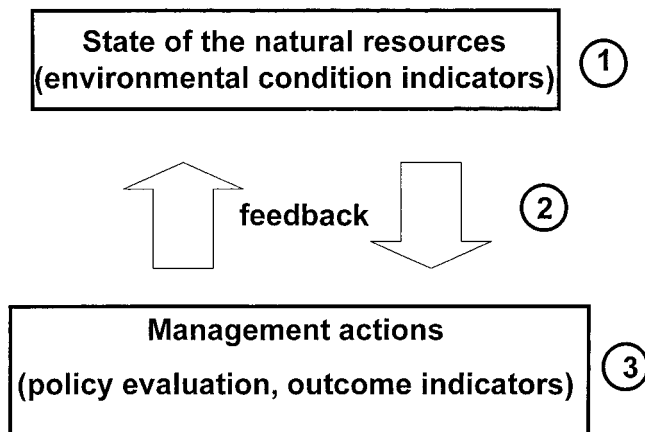


Figure 1. Emerging environmental management concepts emphasize the need for feedback loops that incorporate ecological and policy indicators. Environmental “report cards” or performance reviews require (1) ecological indicators, (2) management tracking and outcome indicators, and (3) a mechanism to incorporate the use of (1) and (2) into a responsive management approach.

Despite the emphasis of many environmental programs on the need for evaluation, there is a paucity of studies identifying potential indicators for evaluation of specific resources or for specific management programs. Moreover, few studies have documented the availability or type of data that are available for the evaluation of specific natural resources.

In recent years, discussions at both the national and international levels have focused on the need for environmental indicators and performance reviews in order to assess the success of environmental management (e.g., Cairns *et al.* 1991, OECD 1997, Rodenburg 1997, WRI 1998, Harwell *et al.* 1999). Several organizations have begun publishing various indicators of environmental, economic, and health conditions by nation in order to meet the need for accessible, accurate information on the environment and development (i.e., WRI 1998). Within the United States, State of the State Reports, as well as regional reports such as the State of the Bay (www.chesapeakebay.net/bayprogram) and State of the Great Lakes (EPA/EC 1995), have become more common. Moreover, a joint U.S. Environmental Protection Agency and Florida Center for Public Management project strives to assist states in the development and integration of environmental goals and indicators into their environmental management systems (SEGIP; mailer.fsu.edu/~cpm/segip.html). As more information regarding the environment is made available, environmental reviews incorporating these data into management frameworks are more in demand.

Comprehensive environmental reviews that use both ecological and policy indicators are currently being developed and tested in a number of places. At the in-

ternational level, the Organization for Economic Cooperation and Development (OECD) established a Group on Environmental Performance that began conducting environmental performance reviews of member countries in 1992 (OECD 1993, 1993b, 1997). Similarly, the World Bank has been involved in producing documents to aid in designing a framework of environmentally relevant indicators (World Bank 1995). In the United States, the federal Environmental Monitoring and Assessment Program (EMAP) was designed specifically to evaluate the success of current policies and programs placing high priority on research related to ecological indicators, monitoring, and the synthesis of environmental data (e.g., Turner *et al.* 1995). These projects aim to link the state of the environment with current and past management programs designed to influence the natural system. While theoretically relevant, these projects have yet to be incorporated into daily environmental management decision-making.

Recently, a group of scientists and policy makers in the United States suggested a framework for use as an environmental “report card” (Harwell *et al.* 1999). This report card combines policy and ecology by using goals set by society (policies) to select relevant ecological and stressor measures. This provides a mechanism to report on the magnitude and quality of change in ecosystems in response to management decisions and policies. The key to this approach and similar ones at the international level is in making environmental data useful to policymakers.

Wetland systems are one of the most discussed and high-profile natural ecosystems managed worldwide. The focus of the first international convention to protect a single ecosystem (Ramsar Convention), wetland systems have also taken center stage in the United States, with a national goal of no-net loss of wetland resources. Despite this attention, assessment of wetland management and changes in wetland resources have been limited. Primary to assessing wetland management and changes in wetland resources are methods and technical resources to quantify wetlands and to measure the ‘quality’ of wetlands. Measuring the quantity of wetlands follows well-established methodologies; however, methods to measure the ‘quality’ of wetlands are still being explored. Various methodologies have been advocated (i.e., Kusler and Niering 1998, Stein and Ambrose 1998, Bartoldus 1999). Probably the most well-known is the hydrogeomorphic assessment method (HGM) that has been developed and tested in a number of environments (Brinson 1995, Brinson *et al.* 1998, Whigham *et al.* 1999). Most promising in these approaches is the idea of establishing reference wetlands to use as baselines to measure wetland quality.

After establishing the baseline of wetland resources,

the next step is to identify the impact wetland management decisions are having on wetlands (quantity and quality) within a state. Wetland systems are managed in a piecemeal and often uncoordinated fashion through a wide range of laws, regulations, and conservation programs at local, state, and federal levels (Scodari 1997, Strand 1997). With the diversity of regulations, policies, and actions designed to achieve wetland protection, tracking the overall and individual effects of management programs on wetland resources is a challenging task. Further complicating this task is the fact that there are many non-wetland-related actions (such as hydrologic changes) and illegal actions that result in potentially significant (but as yet unmeasured) wetland impacts. While numerous local and regional studies document specific aspects of wetland resources and the effects of specific programs on wetlands (i.e., Mager and Ruebsamen 1988, Holland and Kentula 1992, Race and Fonseca 1996, Stein and Ambrose 1998, Brown and Lant 1999), there has been no systematic study of wetland management of state or federal management programs using consistent program measures or indicators of wetland quantity or quality.

In an evaluation of the effectiveness of the Coastal Zone Management Act (CZMA 1972) on protecting coastal wetlands, Good et al. (1998) suggested a set of potential indicators for evaluation of wetland programs under the CZMA involving areas of wetlands restored, protected, acquired, and lost through formal management processes (i.e., regulatory permitting and non-regulatory programs). These suggestions provide a basis for the development of evaluation indicators for all wetland systems. Beginning with these suggestions for wetlands affected by the CZMA, this research expanded the scope of the indicators and explored the state of our knowledge for coastal and inland wetlands concerning (1) the resources being managed (wetland systems), (2) the management actions taken, and (3) the management impact on the resources. While this study ideally would evaluate the effectiveness of wetland programs, a lack of available data prohibited a full evaluation. This study reports on what information was available and identifies management needs in order to build a more adaptive management program.

METHODS

In order to elucidate the state of wetland resources and identify management focus, programs, and their potential impacts, data were collected from the literature, technical and legal documents, unpublished reports, and through a 50-state survey of state wetland managers and regulators. This information was compiled to present a snapshot of the information available

to wetland managers concerning the quantity and quality of wetlands in their state, as well as information on actual management tools used and actions taken, unique programs or tools used to manage wetlands, and where possible, the outcome of management actions and management impact on the wetland resources.

These data were then used to provide an overview of state wetland management, including identification of a potential framework to guide development of wetland management programs. Specifically, this information was used to evaluate (1) the focus/importance of wetland management in the state, (2) the extent to which managers had information available concerning the extent and quality of the wetland resources in the state, (3) the extent to which data were available concerning the actual management actions taken and their effects on wetland resources, and (4) a potential framework for monitoring and evaluation of coastal and inland wetlands. It should be noted that this information reflects only the effects of management actions directed at wetland resources and does not account for indirect effects of management or human actions directed at other resources. The following sections will describe the survey methods and the survey instrument.

Survey Methods

Data concerning the status of state wetland management programs and program resources were collected through a 50-state survey of state wetland managers and regulators in 1998 and 1999. Specifically, data regarding state wetland planning and goal setting, wetland resources, permit and management action tracking were collected for each state.

The survey was mailed to the appropriate people in the different states after initial contact by telephone (often more than one person was required to provide all of the information requested). Surveys were completed and returned by mail. Follow-up interviews and e-mails were used to clarify responses and obtain more information where needed. Responses were compiled and tabulated for coastal and inland programs in each state. Coastal programs were those relating to wetlands in the coastal zone area, as defined by the coastal zone management programs of all coastal states. Inland programs refer to programs related to all remaining wetlands.

Survey Instrument

The survey instrument consisted of three main sections, the first set of questions related to the status of state wetland protection programs, including the existence of a state wetland conservation plan, establish-

Table 1. List of indicators collected through survey of wetland managers for evaluating wetland resources and management actions (adapted from suggestions in Good *et al.* 1999).

1. Program Focus/Importance	Status of state wetland conservation plan State wetland protection goal Wetland staff (# person years) Annual wetland budget
2. Wetland Area Knowledge	Current estimated rate of wetland area change Wetland area in state Area (percent) of state wetlands in GIS database
3. Tracking of Wetland Management	Total number of permits issued Area of permitted loss Area of non-permitted violation loss Permit tracking/monitoring Area of required compensatory mitigation # enforcement actions Area of wetlands in public ownership Area of wetlands acquired Area of wetlands created in mitigation bank Area of wetlands debited from mitigation bank Area given protection by local plans Area given protection by other plans/designations Area restored/enhanced with non-regulatory means

ment of state goals, and the state resources allocated to wetland management. The second section consisted of gathering information on the use of specific wetland policy tools divided into four types of programs: information, regulatory, planning, and non-regulatory programs. The information from this section is not reported specifically in this paper but can be found in La Peyre *et al.* (2000). The third section dealt specifically with questions related to outcome indicators of wetland management. These outcome indicators were adapted from the suggestions made by Good *et al.* (1999) for the Coastal Zone Management Program and modified to reflect the entire suite of coastal and inland wetland management programs (Table 1). For example, we asked if the state had a permit tracking/monitoring system in place, the total number of permits issued for a given year, and area of permitted loss. Other questions related to different programs, such as area of wetlands restored through non-regulatory means, and enforcement actions for wetland protection in the state. Respondents were required to answer with a yes/no or with a number (area or number of actions taken).

Combined, this information was used in an attempt to address two basic questions. The first question we pursued was what is happening to the overall wetland resource within a state. We were interested in trying to document, if not the actual status and trends of wetlands in each state, then the general availability or lack of data to answer this question. The second question revolves around the impact of current state wetland management programs on wetland resources. We were

interested in using indicators of management actions and linking the actions to the outcomes (resources). Again, if we couldn't get a complete data set of management actions and outcomes, then we were just as interested in the availability, or general lack of, this information. This type of information is critical to developing more accountable and adaptive management programs.

RESULTS AND DISCUSSION

Surveys were received from 27 coastal and 48 inland programs, although few were able to provide answers to all the questions. Thus, analyses are based on a maximum of 27 coastal and 48 inland programs and, in most cases, on some subset of these programs. Percentages given below are based on the responding states.

Focus/Importance of Wetland Issue

The first set of questions on the survey sent to state managers dealt with the establishment of state wetland goals, the development of state wetland management plans (coastal and/or inland) and the amount of resources allocated for wetland management activities. Over 75% of responding states (N=69) have established state wetland goals of no net loss or of a net gain for coastal and inland wetland resources. A significant percentage of states (>60%) have state wetland conservation plans under development or currently being implemented (Figure 2). The remainder

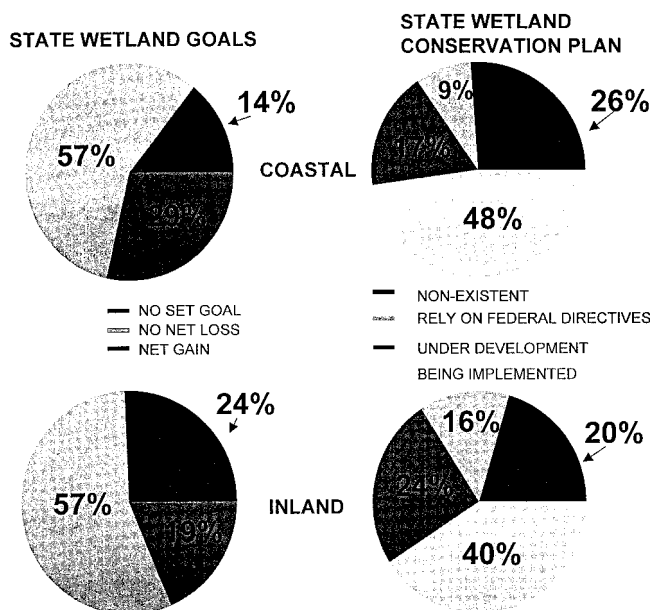


Figure 2. Status of state wetland goals and wetland conservation plans, divided by coastal and inland wetland programs. States are listed by abbreviation within each category.

of states either rely on federal directives or have no state wetland conservation plan at the present time.

An attempt to collect data on the amount of resources allocated specifically to wetland protection programs found that most states were only able to give rough estimates of wetland program spending and staff. This likely reflects the fact that much wetland management occurs under federal statutes addressing other issues such as water pollution and agricultural programs.

In general, the data indicate that most states are committed to wetland management at the state level. Many states have made the effort to develop wetland plans and to identify specific goals for their programs. For example, in Louisiana, as part of a larger government accounting effort (LA Performance Accountability System; www.doa.state.la.us/opb/lapas/lapas.html), the Department of Natural Resources, Coastal Management Division has identified key program goals and measurable, supporting indicators. In this case, the Coastal Management Division has a key goal "... to develop and construct projects to create, restore, enhance or conserve..." a specified area of vegetated and coastal wetlands during the fiscal year. The specific indicator that they have identified to measure success is the area of wetlands created.

Similarly, Tennessee, as one of the first states to develop a wetland conservation plan (Galbreath 1998), identified a number of priorities to guide funding and action on wetland issues. This state has a number of

specific objectives identified as part of its action plan (TDEC 1998). The first objective is a basic characterization of the state's wetland resource base, suggesting that basic information is still lacking. In general, the states with conservation plans and set goals were able to provide more information related to wetland planning and resources allocated to wetland management. Developing a set of goals and indicators to measure achievement of these goals is an obvious first step in creating a feedback loop for the management of wetland systems. The "report card" approach advocated by Harwell et al. (1999) suggests that general goals be established in order to later guide the development and analysis of specific ecological and stressor measures. The use of conservation planning is a straightforward first step to developing the framework and data necessary for evaluation of environmental management programs.

Quantity and Quality of State Wetlands

The second set of questions was intended to capture the available information (or lack thereof) concerning the quantity and quality of wetlands in the states. Measuring wetland quantity is straightforward; we have both the methods and the technology. At the national level, we have a reasonable idea of quantity and trends over time (Heimlich and Melanson 1995). At the state level, general estimates of total wetland area were available, although in most cases, the data were not available for both coastal and inland wetlands. Many of the estimates reported were taken from federal documents created by programs such as the National Wetlands Inventory, Natural Resources Inventory, status and trends, and regional analyses of wetland resources (i.e., Tiner 1984, Dahl 1990, Dahl and Johnson 1991, Field et al. 1991, Hefner et al. 1994). Most coastal programs had relatively current data on wetland quantity. Inland programs in largely agricultural states (i.e., Illinois, Indiana, Iowa, Oklahoma) provided data of wetland quantity; however, many states with a strong coastal focus (i.e., Louisiana) were unable to provide any information on inland wetlands. Not surprisingly, Louisiana has the greatest current loss of coastal wetlands, reporting an annual average loss of 7,767 ha, while Florida reported the greatest current loss of inland wetlands (9,400 ha/year).

In order to assess the impacts of management programs, trends in wetland resources are needed. Few states had adequate historic data to report current trends in wetland quantity. Some states did, however, have adequate data to report attaining no net loss (i.e., Kentucky, South Dakota, Tennessee) and even small net gains (i.e., Iowa, Oklahoma) in recent years (Figure 3).

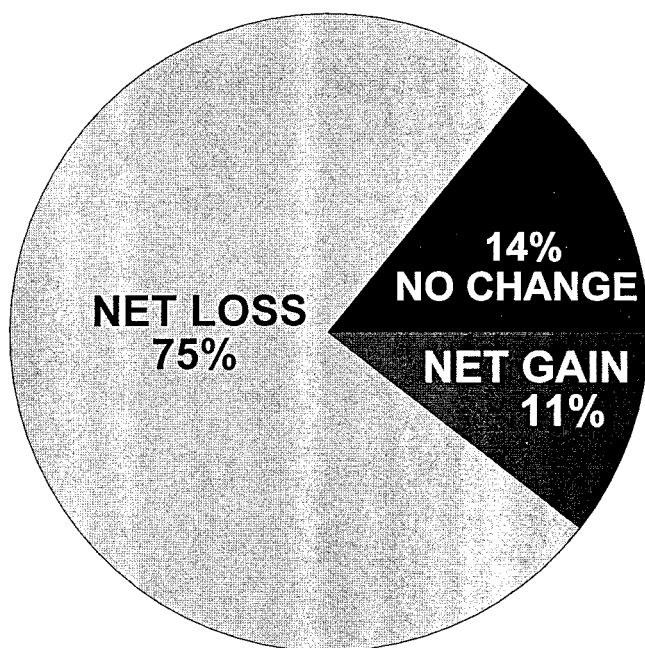


Figure 3. Recent trends in wetland resources for all states.

The issue of wetland quality presents a different question. Little data were collected on wetland quality, mostly due to the fact that methods for defining and measuring wetland “quality” are still being developed. This issue is extremely important, as wetland degradation can essentially result in the loss of wetland functioning without having a loss in wetland quantity. Furthermore, if we continue to allow compensatory mitigation to be used, the issue of replacing natural wetlands with created or restored wetlands begs the question of comparability of wetland “quality.” The establishment of representative wetlands to provide a baseline for evaluation of wetland quality within different states is discussed in a number of the state conservation plans (i.e., Oklahoma Conservation Commission 1996, TDEC 1996). It has also been reported that almost half of the states are working on some sort of wetland assessment approach (Kusler and Niering 1998). This line of research, however, is still in the development stage (but see Brinson *et al.* 1994, 1995, Brinson and Rheinhardt 1996, Whigham *et al.* 1999).

Overall, it seems that most states have a very general idea of the quantity of their wetland resources and little idea of the quality. This lack of basic data concerning the extent of wetland resources suggests that a basic goal for wetland protection should involve, as Tennessee has set as a goal (TDEC 1996), characterizing the wetland resource base. At the federal level, the National Wetlands Inventory (FWS) and Natural Resource Inventory (NRCS) are both key programs generating this type of data, although they have limits, including lack of complete state coverage, small sta-

tistical size at the state level, and an aging database. Establishing an estimated baseline of state wetland resources would allow monitoring in terms of changes in wetland quantity and, equally important, wetland quality over the years. Furthermore, it would allow the adoption of an adaptive management approach where ineffective management programs are dropped and effective programs used.

Tracking Management Actions and Their Effects

In an era of greater government accountability, this set of questions seemed very straightforward in trying to answer the general questions: what wetland management actions have occurred over the last year, and how did they effect the wetland resources? The survey attempted to collect information on the number of permits, permitted areas, violations, compensatory action, mitigation banking, wetland acquisitions, and area of wetlands protected, acquired, and restored. While permitting is largely done at the federal level, most states review and comment on the Clean Water Act, Section 404 permitting decisions (primary regulatory control of wetlands) to ensure that they also meet applicable state standards (i.e., State 401 Water Quality Certifications).

While approximately 50% of state programs (N=38) claimed to have a permit-tracking system in place, only about half of them (25%) were able to provide the number of permits issued or the area of wetlands the permits affected. The available data indicate that while numerous permits are often approved, most are for small areas as reflected by the area of wetlands permitted. Even fewer states were able to identify non-permitted wetland loss. This may be due to the fact that non-permitted wetland loss isn't occurring or, more likely, due to the fact that it is hard to track non-permitted loss (especially when basic information on where wetlands currently exist is lacking). Similarly, a number of states reported enforcement actions for non-compliance with permit conditions. Minnesota, New Jersey, and New Mexico reported the greatest number of enforcement actions. This either reflects greater vigilance on their part, a better tracking system, or more wetland violations. Regardless of the reason, these three states clearly are actively tracking and monitoring wetland actions.

A number of studies have examined the effects of wetland management in limited regional areas (i.e., Holland and Kentula 1992, Allen and Feddema 1996, LA CWPPRA Task Force 1997, Stein and Ambrose 1998). In most cases, permit data from the U.S. Corps of Engineers files were used to evaluate the cumulative impacts of wetland permitting and mitigation actions. In general, mitigation was often found to not compen-

sate fully, in terms of area, for wetland areas impacted. In the future, this type of basic data on permitted wetland impacts and required mitigation should be easily accessible to provide an overview of regulatory wetland programs. Furthermore, as Stein and Ambrose (1998) have suggested, these permit data need to be combined with information on the actual functioning of the wetlands to draw accurate conclusions about the effect of management on wetland resources.

Data on the use of planning, non-regulatory, and wetland acquisition tools that can be used for setting aside wetland areas for protection, preventing development of significant wetland areas, and restoring wetland areas were scarce. Most states, although noting that these types of tools are important components of their programs, were unable to provide a complete account of wetlands restored or protected through these types of programs. This is due, in part, to non-governmental efforts to protect wetlands (i.e., environmental groups), private wetland creation efforts (i.e., private mitigation banks), and federal programs (i.e., Wetland Reserve Program) resulting in a diversity of databases from which information must be constantly updated. Differences in definitions of wetland restoration (restoring badly degraded wetlands versus restoring historic wetlands that have been filled) and problems with double-counting of multi-organization restoration projects also contribute to the difficulty of accurately tracking wetland acquisition and restoration activities (Smith 1997).

Developing a Framework for Wetland Monitoring and Evaluation

Several lessons emerge from this attempt to identify useful information and potential indicators for wetland management. These lessons suggest a basic framework, incorporating the four following components, that should be adopted for future wetland management.

1) The development of state wetland plans is critical in developing a framework for managing wetlands and collecting information related to wetland quantity, quality, and management actions. States that had developed state wetland conservation plans tended to have, overall, a better idea of their resources and relevant management actions. Attainment of information that they possessed was explicitly spelled out as a goal in their management plans.

2) The development of comprehensive databases, including better and more current wetland mapping and status and trend information on both the state and federal level, is necessary to develop more accountable and adaptive management programs. This type of information supports planning and regulatory programs and was highlighted as a basic problem with the ex-

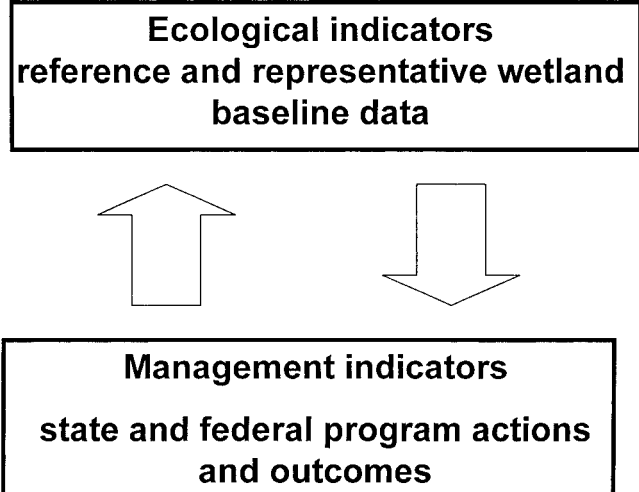


Figure 4. Basic framework suggestion for wetland management. This framework would incorporate ecological and policy indicators. Providing both ecological and policy indicators enables the analysis of wetland trends and the effects of management actions. Wetland management actions may then be continually evaluated and adapted to provide the most effective means of wetland protection.

isting wetlands management framework (Gilman 1999). Furthermore, this basic information on wetland resource status and trends is critical for evaluating the effectiveness of wetland management activities.

3) The use of reference and representative wetlands within each state would enable monitoring of wetland "health." The concept of reference wetlands is currently being explored by a number of researchers (i.e., Brinson 1995, Brinson and Rheinhardt 1996, Whigham et al. 1999). Reference wetlands are "pristine" wetlands whose natural functioning is characterized and monitored over time. These baseline data can then be used to evaluate the success of wetland creation or restoration projects, as well as to monitor changes in natural wetlands in similar settings. Representative wetlands would be used to establish baseline monitoring programs for different and/or important types of wetlands within the state. This would provide some basis for evaluation of wetland quality and changes in quality within the state.

4) Indicators should be established for tracking wetland management actions for coastal and inland wetlands at the state and federal level, including federal and state regulatory actions (permitting losses, mitigation, violations), planning, and non-regulatory (restoration, protection) actions (Figure 4). Harmonization of indicators at the national level would enable systematic measurements and comparison of regional and state coastal and inland wetland management. Furthermore, states could develop specific and relevant indicators for their programs, as some states have adopted

unique programs. For example, Oregon ties wetland inventories and planning into land-use-planning GIS systems. Thus, urban areas have fairly detailed wetland information that can be used in land-use planning. The development of explicit goals and indicators within each state program, combined with the monitoring of federal indicators, would enable evaluation of the effectiveness of management in the state and the nation.

CONCLUSION

The “adaptive” feedback loop of emerging environmental management concepts for wetland management in the United States has room for much improvement. Basic information on wetland quantity and quality still needs to be collected and compiled in accessible computer databases. At the same time, better tracking and sharing of information on management actions by state and federal government agencies is necessary. As we strive to make government more accountable, the effectiveness of many environmental management programs needs to be determined.

Discussions with state wetland managers suggested that there is a strong push in wetland management for increased focus on non-regulatory wetland management actions through restoration projects, education, and economic-incentive measures that would encourage individuals, organizations, and landowners to protect wetland resources. As we move into this more “voluntary” era, we need to ensure that managers have the necessary information to effectively and efficiently protect wetland resources. Knowing what types of tools work in protecting wetland resources, as well as in what circumstances different approaches are more effective, is the key to building more efficient, effective, and adaptive management programs. Not only will this help in better management of our wetland resources, but in the long run, a more efficient and effective program is likely to be more successful. Continual evaluation and flexibility in adapting wetland resources and management programs, based on the evaluations, is the only way to ensure effective programs.

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