

# Analyzing Institutional Arrangements for Ecosystem-Based Management: Lessons from the Rhode Island Salt Ponds SAM Plan

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*Scholars, practitioners, and environmentalists are increasingly supportive of collaborative, ecosystem-based approaches to coastal resource management. However, few researchers have focused their attention on the institutional challenges confronting practitioners. The objective of this study is to explore these challenges using a case study of the implementation of a special area management (SAM) plan for the Salt Ponds watershed in Rhode Island. Specifically, the article utilizes the institutional analysis and development (IAD) framework to examine the structure and performance of the institutional arrangement used to implement the Salt Ponds SAM plan. The analysis reveals important lessons for practitioners involved in ecosystem-based management. In particular, the case study demonstrates that polycentric institutional arrangements can often be just as effective as centralized, hierarchical approaches to coordinating and implementing integrated coastal resource management programs.*

**Keywords** coastal resource management, ecosystems, ecosystem management, environmental planning, environmental policy, estuaries, evaluation, implementation, institutions, institutional analysis, integrated coastal resource management, natural resource management, watershed management, water quality management

## Introduction

The ecosystem-based approach to natural resource management, while relatively new and still evolving, is receiving growing support from practitioners (Ecological Society of America, 1995), government officials (Congressional Research Service (CRS), 1994; General Accounting Office (GAO), 1994; Executive Office of the President, 1993), and researchers (e.g., Hauber, 1996; Cortner & Moote, 1994). This integrated systems-based approach has been used to manage a growing number of environmental problems. It has been used to manage fisheries on Georges Bank (e.g., Burroughs & Clark, 1995; Backus & Bourne, 1987) and other large marine ecosystems (e.g., Alexander, 1993; Sherman, 1991).

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It has been used to address resource management problems in terrestrial habitat systems (e.g., Kohn & Franklin, 1997; Yaffee et al., 1996; Baskerville, 1995; Agee & Johnson, 1988) such as the Greater Yellowstone Ecosystem (e.g., Burroughs & Clark, 1995; Clark & Minta, 1994; Lichtman & Clark, 1994) and the Florida Everglades (e.g., Harwell et al., 1996; Light, Gunderson, & Holling, 1995). Programs have also examined various fisheries, land use, and water quality problems in various estuaries (e.g., Imperial & Hennessey, 1996; Colt, 1994; Imperial, Hennessey, & Robadue, 1993; Imperial, Robadue, & Hennessey, 1992; Tuohy, 1993, 1994) and riverbasins (e.g., Foster, 1984) such as the Chesapeake Bay (e.g., Costanza & Greer, 1995; Hennessey, 1994), the Great Lakes (e.g., Mackenzie, 1996; Gurtner-Zimmerman, 1996; Francis & Regier, 1995; Francis, 1993; Caldwell, 1988), the Columbia River (e.g., Lee, 1993, 1995), and Puget Sound (e.g., Healey & Hennessey, 1994; Fletcher, 1990; Leschine, 1990; Bish, 1982).

This research suggests that ecosystem-based management has a strong administrative and institutional orientation that emphasizes redefining management units and building on the best ecosystem science to improve resource management (Slocombe, 1993b, p. 612). The research also reveals that the goal of many programs is to improve institutional performance by improving coordination between federal, state, and local governments. Unfortunately, while an integrated ecosystem-based approach to coastal resource management is appealing, a wide range of institutional and administrative challenges exist, many of which have largely been ignored by researchers who tend to focus on the development of management plans and not their implementation. For example, many researchers underestimate the problems associated with changing organizational arrangements and incorporating human values into decision making (Grumbine, 1994; Slocombe, 1993a). The literature also demonstrates a normative preference for centralized hierarchical approaches to improving coordination and integrating coastal resource management programs.

The objectives of this article are to examine the institutional challenges associated with implementing an ecosystem-based management program and to draw lessons useful to practitioners working in similar integrated coastal resource management programs in the United States and abroad (Rose, 1993). The analysis focuses the implementation of a special area management (SAM) plan for the Salt Ponds watershed in Rhode Island. The case was selected for several reasons. First, the program represents a typical multiparty, multiissue situation that confronts practitioners working at the watershed level. Second, the Salt Ponds SAM plan has a rich history with nearly 14 years of implementation experience. Third, the literature often advocates centralized, hierarchical approaches to policy integration. However, this study demonstrates that polycentric institutional arrangements can often be just as effective.

### Preparation of the Case Study

The case study was developed using a variety of data sources including research publications, government reports, newsletters, and memoranda. Interviews were conducted with key actors involved in the SAM plan's development and implementation. The author was also involved as a participant-observer, having worked for two organizations discussed in the case. The data were analyzed using systematic qualitative techniques (Miles & Huberman, 1994; Patton, 1990). The analysis was guided by the institutional analysis and development (IAD) framework developed by Ostrom (1986, 1990) and her colleagues (e.g., Blomquist, 1992; Kiser & Ostrom, 1982; see Figure 1). The IAD framework has been used to examine institutional arrangements managing groundwater, common pool resources (CPRs; e.g., irrigation systems, forests, fisheries, etc.), metropolitan organiza-

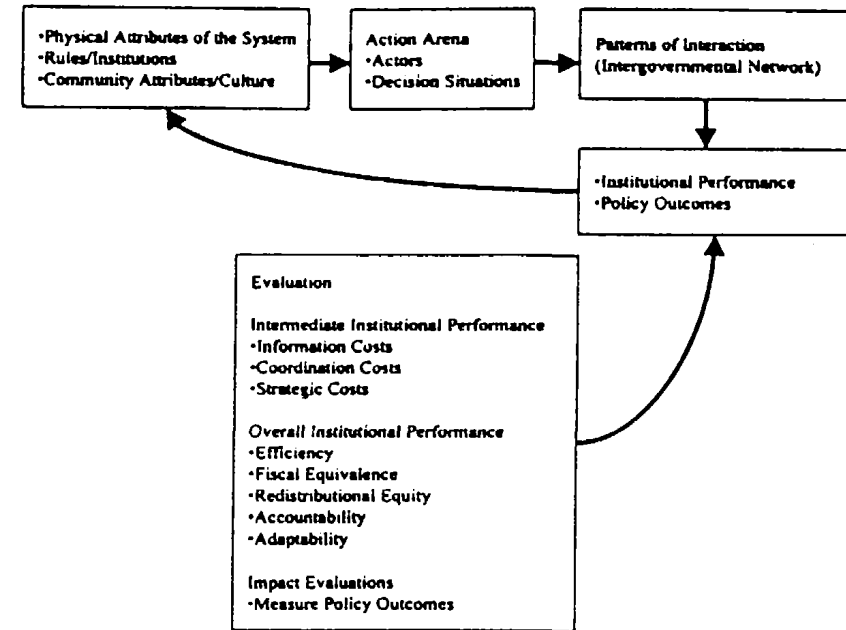


Figure 1. The institutional analysis and development framework. Modified from Ostrom, E., R. Gardner, and J. Walker. 1994. *Rules, Games, & Common-Pool Resources*. Ann Arbor, MI: The University of Michigan Press.

tions, and rural infrastructure development. It has also been used to examine institutional arrangements for coastal resources management (Sproule-Jones, 1993).

The IAD framework is a theoretical framework that is used to guide the analysis of an institutional arrangement's structure and performance. Institutions are defined as "enduring regularities of human action in situations structured by rules, norms, and shared strategies, as well as by the physical world. The rules, norms, and shared strategies are constituted and reconstituted by human interaction in frequently occurring or repetitive situations" (Crawford & Ostrom, 1995, p. 582). Institutions include families, churches, local governments, government agencies, and most organizations since they are defined by rules, norms, and shared strategies (Ostrom, Schroeder, & Wynne, 1993, p. 6). Institutions promote socially beneficial outcomes by helping actors resolve "social dilemmas" resulting when individually rational actions aggregate to produce socially irrational outcomes. Therefore, institutional arrangements provide the means to resolve collective action problems (Firmin-Sellers, 1995, p. 203).

What differentiates institutional analysis from most forms of organizational analysis is the focus on rules. Rules are an implicit or explicit attempt to achieve order and predictability among humans (Ostrom, 1986). Rules are prescriptions that forbid, permit, or require some action or outcome and the sanctions authorized if the rules are not allowed (Crawford & Ostrom, 1995). Rules can be formal (e.g., laws, policies, regulations, etc.) or informal (e.g., social norms). Since "rules are not self-formulating, self-determining, or self-enforcing" (Ostrom, 1980, p. 312), they are formulated in human language and

subject to problems of lack of clarity, misunderstanding, and varied interpretations. The stability of rule-ordered interactions therefore depends upon the development of shared understanding of rules (Ostrom, Gardner, & Walker, 1994, p. 40). This often requires building trust by monitoring and enforcing rules. Enforcement can take the form of formal (e.g., cease and desist order, civil penalties, criminal penalties, etc.) or informal (e.g., verbal comments or facial expressions demonstrating displeasure) sanctions.

Institutional analysis is therefore an attempt to examine a problem that a group of individuals (or organizations) face and how the rules they adopt address a problem. The IAD framework does not advocate a particular type of institutional arrangement (e.g., markets or hierarchies), nor does it rely on a single measure of institutional effectiveness. Rather, the IAD framework draws attention to the various factors that influence institutional design: the physical characteristics of the ecological system and the nature of problems, the culture of the individuals (organizations) trying to solve the problem, and the institutional setting that the individuals (organizations) are embedded within (Ostrom, 1990, p. 55).

### The Salt Ponds Ecosystem

The Salt Ponds, as they are known locally, are a string of nine brackish coastal lagoons separated from the ocean by a low narrow strip of barrier beach islands. Their watershed encompasses approximately 82.4 km<sup>2</sup> and is contained within the municipalities of Narragansett, South Kingstown, Charlestown, and Westerly (Figure 2). The ponds are

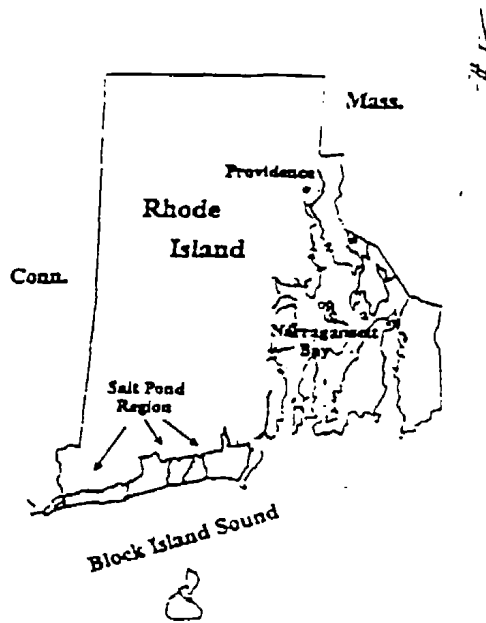


Figure 2. Rhode Island's Salt Ponds region. Ernst, L. 1995. Integrating state government for improved coastal water quality: Analysis of the Rhode Island Salt Pond region. *Coastal Management* 23:316.

shallow and poorly flushed, and the freshwater input is primarily from groundwater and surface runoff. This makes them valuable as fish and shellfish nurseries but also susceptible to eutrophication and bacterial loading. Historically, the ecology of the ponds has also been influenced by the stabilization of inlets, dredging of channels, the installation of on-site sewage disposal systems (OSDSs), and alterations of the quality and quantity of freshwater inflow resulting from development activities. The low, narrow barrier beaches also make the region particularly susceptible to coastal erosion and storm damage from winter storms (i.e., Nor'easters) and summer hurricanes. There is a strong regional identity among the area's residents. The watershed boundary closely follows coastal highway U.S. 1. This helps make the watershed somewhat distinct and recognizable. The Salt Ponds have long supported commercial and recreational fisheries, and one of the major fishing ports in New England, the Port of Galilee, is located in the watershed. As a result, many residents have a connection to the commercial fishing industry. A large portion of the population is also directly or indirectly involved in the area's growing tourist industry. During peak summer weekends, an additional 165,000 people enjoy the region's recreational amenities. Accordingly, a large proportion of the population has an interest in maintaining the area's environmental quality. Residents are also politically active and the New England tradition of home rule is very much part of the region's political culture. One community still holds well-attended financial town meetings. Residents have also demonstrated a strong desire to maintain the region's rural and historic character (see Olsen & Lee, 1991, 1993; Coastal Resources Management Council (CRMC), 1985; Lee, 1980 for more discussion of the region).

Until a four-lane highway provided easy access to the area in the 1950s, the region remained relatively undeveloped. However, between 1950 and 1980 residential development increased threefold. By the late 1970s, the Salt Ponds region began to experience a number of the environmental problems affecting coastal areas in the United States:

- loss of habitat and impacts due to development in and adjacent to critical habitat;
- declining fish and shellfish stocks;
- increased shellfish closures due to bacterial contamination;
- excessive nitrogen loadings and pathogens from OSDs;
- stormwater runoff increased sedimentation and nutrient loading to the ponds;
- stabilized breachways changed salinity regimes and caused sedimentation problems;
- storm damage from hurricanes and winter storms; and
- conflicts among resource users.

There was also a general belief among the public that government was not responsive and that agency decision making was cumbersome, contradictory, and time-consuming (see Ernst, 1995; Olsen & Lee, 1991, 1993; CRMC, 1985; Lee, 1980 for more discussion).

### The Institutional Arrangement Governing the Salt Ponds Ecosystem

To understand how the Salt Ponds ecosystem is "managed," one must first understand how the rules (e.g., statutes, regulations, policies, zoning ordinances, permit decisions, etc.) of various government programs interact with one another. To simplify the discussion, the analysis focuses on the actions of the key actors: University of Rhode Island (URI) Coastal Resources Center (CRC), Rhode Island Coastal Resources Management Council (CRMC), Rhode Island Department of Environmental Management (RIDEM),

Statewide Planning Program (SPP), and the municipalities of Narragansett, South Kingstown, Charlestown, and Westerly. The nonprofit organizations Save The Bay, Pond Watchers, and the Salt Ponds Coalition also played roles. Other actors played minor roles, including the National Oceanic and Atmospheric Administration (NOAA), the Environmental Protection Agency (EPA), the U.S. Fish and Wildlife Service, the U.S. Army Corps of Engineers, various developers, individual residents, and the newspapers.

One of the most important actors was the CRC. It was created, in part, to assist the CRMC with the development of its federal coastal zone management (CZM) program. Over the years, the CRC has emphasized the importance of stakeholder involvement and constituency building in its technical assistance programs, both domestically and abroad. Historically, the CRC also played an important role in helping to develop new policies and programs for the CRMC. The CRMC was created in 1971 with the charge to:

Preserve, protect, develop and where possible restore coastal resources for this and succeeding generations . . . through comprehensive, long-range planning and management designed to produce the maximum benefit for society and that the *preservation and restoration of ecological systems* shall be the primary guiding principle by which alteration of coastal resources will be measured, judged, and regulated. (Rhode Island General Laws §46-23-1, emphasis added)

The CRMC's mandate focuses specifically on balancing resource conservation with the needs for development and human use of coastal resources. The CRMC has approached fulfilling this mandate by maintaining a constant balance between planning, management, and regulation. The Salt Ponds SAM plan is an important attempt to try to achieve this balance.

The CRMC is a legislative agency delegated broad authority to develop whatever policies and programs the agency deems necessary to fulfill its mandate. The initial focus was not to create a new bureaucracy. Instead, the Council relied on staff of the Department of Natural Resources (soon to become the Department of Environmental Management) and other state agencies to review and comment on development proposals. In fact, the CRMC did not have its own technical staff until 1986. Major permit decisions are decided by a 16-member Council composed of politicians and citizens appointed by the governor, lieutenant governor, and the Speaker of the House. The formula determining representation on the Council is quite complicated and ensures that all regions of the state and communities of different sizes are represented. The membership includes both citizens and elected officials. While the structure of the Council has opened up the agency to charges of being political, during several high profile and controversial projects the agency demonstrated a surprising capacity to resist overt pressure brought by the governor and major interest groups. The CRMC also focused on building a constituency to support its policies and programs and has been effective in maintaining strong relations with the state legislature.

With assistance from the CRC, the CRMC developed the Rhode Island Coastal Resources Management Program (RICRMP), which received federal approval in 1978. The program has been substantially revised several times since its inception. The RICRMP contains rules that regulate all development along Rhode Island's 401 miles of shoreline. It also regulates certain activities (e.g., power generation facilities, chemical and petroleum processing facilities, and mineral extraction activities) on a statewide basis and other activities located in the watersheds of poorly flushed estuaries like the Salt

Ponds. All federal, state, and local development projects are also subject to the CRMC's review and approval. The permit review process is open, with opportunities for both written comment and public testimony at hearings for all major development projects. The process is similar to the one used by local governments when reviewing development projects.

The RIDEM is the state agency responsible for implementing the regulatory programs administered by the EPA. The agency is saddled with multiple and sometimes conflicting mandates and pressure from the EPA and the regulated community. Of particular interest to this study are the RIDEM's programs regulating water quality, freshwater wetlands, and the installation of OSDs. Unlike the CRMC's programs that try to balance conservation and development in coastal areas, the RIDEM's programs focus on protecting human health and the environment on a statewide basis. This leads to some conflict between the RIDEM and the CRMC in areas where there is overlapping authority and responsibility. The RIDEM's programs also tend to be more "bureaucratic." Opportunities for public involvement in permit decisions are more limited. Responsibility for the review of projects is divided among different divisions and it is not uncommon for a single development project to be reviewed by several divisions who may disagree on the merits of a project. Moreover, RIDEM's enabling legislation is more restrictive, which limits their ability to adopt new policies and programs. It should also be noted that since the CRMC's inception, the RIDEM has mounted several unsuccessful attempts in the legislature to gain control of the Council and its programs. As a result, there has been a good deal of political conflict between the two agencies, even though RIDEM staff conducted the technical review for projects before the Council until 1986 (Robadue, Hennessey, & Kaiser, 1986).

The Department of Administration's Division of Planning and the Statewide Planning Council administer the SPP. The SPP provides technical assistance to local governments and state agencies. The SPP reviews comprehensive land use plans to ensure that they are consistent with state requirements and the policies contained in the *State Guide Plan*. It is important to note that the RICRMP and the Salt Ponds SAM plan are elements of the *State Guide Plan*, and all three documents are part of the CRMC's federally approved coastal program. There have been fewer instances of political conflict surrounding the relationship between the CRMC and the SPP. The only major conflict in recent years concerned whether the CRMC's regulations had to be consistent with the policies contained in the *State Guide Plan*. When the conflict arose, at the prompting of the CRMC, the state legislature adopted legislation clarifying that the CRMC's authority superseded all other state agencies.

The final set of key actors is the municipalities of Narragansett, South Kingstown, Charlestown, and Westerly. Prior to the SAM plan's development, local officials lacked the technical expertise and information necessary to adequately review the impacts of development projects resulting from OSDs, erosion, stormwater runoff, and habitat alteration. Local officials typically relied on the staff working for state agencies and the information provided by permit applicants. Some communities lacked comprehensive land use plans, while others were outdated. The communities had relatively unsophisticated zoning ordinances that didn't consider how land use activities impacted water quality and habitat. Moreover, there was little integration of local policies concerning the extension of sewer lines, the protection of habitat, and the acquisition of open space. Other problems included the poor management of recreational boating activities and the lack of public access to the shoreline. Accordingly, local communities played a relatively minor role in managing the impacts resulting from coastal development.

### *Demands for Institutional Change*

The growing environmental problems and the possible siting of a nuclear power plant along the shores of Ninigret Pond helped generate a growing awareness that additional management measures were needed to protect the Salt Ponds ecosystem (Olsen & Lee, 1991, 1993). These concerns were expressed during the public hearings on the development of the CRMC's RICRMP. The public's general concern was that the RICRMP would not adequately address the problems facing Salt Ponds region. They argued that a more comprehensive approach was needed to manage the region's ecological resources. The CRMC agreed and, as it had in the past, turned to the CRC for technical assistance in developing a comprehensive management plan for the Salt Ponds.

### *Developing the Salt Ponds SAM Plan*

From 1979 to 1984, federal funds received by the CRMC and the CRC were combined to support a research program that led to the formal adoption of the Salt Ponds SAM plan in 1984 (Table 1). While a detailed discussion of the planning process is beyond the scope of this article, it is useful to briefly discuss four aspects of the CRC's approach that seemed important to their success (see Olsen & Lee, 1991, 1993 for more discussion of the planning process). First, the process began with a review of the region's ecological and cultural history. This proved to be a good way to involve and educate residents in the region at the onset of the planning process. It also provided staff with an opportunity to learn more about the culture of those who would be affected by the plan. Second, the CRC was effective in coordinating scientific research on a number of water quality, sedimentation, and overfishing problems. The CRC was also able to keep the research focused on issues important to state and local decision makers. Third, the CRC identified one integrating problem around which the SAM plan was developed. The research suggested that the density of OSDSs needed to be controlled in order to limit

**Table 1**

Major events in the development of the RICRMP and the Salt Ponds SAM plan

Events in the development of the RICRMP	Events in the development of the SAM plan
<ul style="list-style-type: none"> <li>• 1971 CRMC State Enabling Legislation</li> <li>• 1972 Federal Coastal Zone Management Act</li> <li>• 1975 RICRMP adopted</li> <li>• 1978 Federal CZM program approved</li> <li>• 1983 RICRMP substantially revised</li> <li>• 1988 Harbor Management Program adopted</li> <li>• 1990 RICRMP revised again</li> <li>• 1993 New RICRMP regulations for stormwater, erosion, and sediment control, and wetlands mitigation</li> <li>• 1994 New buffer zone requirements</li> </ul>	<ul style="list-style-type: none"> <li>• 1975 Public hearing on the RICRMP</li> <li>• 1979 Ecological history conducted</li> <li>• 1979–1984 Multidisciplinary research study</li> <li>• 1983–1984 Salt Ponds Advisory Committee</li> <li>• 1984 SAM plan adopted by the CRMC</li> <li>• 1986 Westerly added to the SAM plan</li> <li>• 1994 Denitrification requirements for a subwatershed added to the SAM plan</li> </ul>

the nitrogen loadings to groundwater. In some areas, the well water had already become nonpotable. The concern was that continued development and the installation of accompanying OSDSs would lead to eutrophic conditions and increase shellfish closures due to bacterial contamination. To be effective, the SAM plan would have to manage the density of OSDSs associated with future development in order to limit nitrogen loadings.

Finally, the CRC was effective in building a constituency to support the SAM plan's development and implementation. The CRMC created an advisory committee composed of various stakeholders including local and state officials and members of various interest groups. The group worked intensively between 1983 and 1984. The group first developed a detailed synthesis of the research findings that would be included in the management plan. The advisory committee then formulated a set of management measures. The major challenge proved to be convincing municipal officials that they had the authority and capability to manage the impacts of development in the watershed. To build local support, CRC staff organized a series of dinner seminars attended by members of local town councils, planning boards, and zoning boards. Bringing the officials together provided an opportunity for them to build a shared understanding of the problems they faced. It also helped build trust between the CRC's staff and local officials (Olsen & Lee, 1991, 1993).

The effectiveness of the CRC's constituency-building approach is evidenced by the fact that it met with limited opposition at the final public hearing. Most of the public comments were supportive in nature. The Salt Ponds SAM plan was formally adopted by the CRMC in November 1984 (CRMC, 1985). It is important to note that approximately one year earlier the new statewide RICRMP was adopted (CRMC, 1990). This version of the RICRMP benefited from the research in the Salt Ponds region and adopted some of the policies recommended in the SAM plan on a statewide basis. Accordingly, it is important to look at both sets of rules when examining the governance of the Salt Ponds region.

Concurrent with the process of adopting the SAM plan, the CRC worked with local officials to enact zoning changes that would implement the plan's policies. A series of reports were prepared for communities detailing proposed zoning changes (Olsen, Lee, & Collins, 1982a, 1982b). As a result, Narragansett, South Kingston, and Charlestown amended their zoning ordinances to make them consistent with the SAM plan's requirements. Westerly was reluctant to amend its zoning ordinances and had minimal involvement in the plan's development. However, based on the experience of the other three municipalities and pressure from nongovernmental organizations, Westerly decided to join the management plan. The CRC prepared recommended zoning changes and these changes were made to the plan in 1986 (Collins, 1985). Westerly then adopted almost all of the recommended zoning changes. The only changes rejected by Westerly were in a tourist area that serves as an important local revenue source.

### *Implementing the Salt Ponds SAM Plan*

The SAM plan recommended state and local officials, university researchers, and homeowners to take a variety of actions (Table 2). The CRC envisioned the SAM plan as a sort of "constitution" that would bind the actors to a set of prescribed actions and guide future efforts to manage the region's ecological resources. This is exactly the effect that the plan had on the CRMC and local governments and, to some extent, on the RIDEM.

Local governments revised zoning ordinances to be consistent with the SAM plan's

**Table 2**  
Problems and recommended actions contained in the Salt Ponds SAM plan

Problem	Actions recommended/adopted
Decision making	—Recommends coordinated permitted review process for state and local permits <sup>a</sup>
Nonregulatory initiatives are uncoordinated and ad hoc	—Recommends an action committee chaired by the CRMC to identify annual priorities and coordinate nonregulatory initiatives <sup>a</sup>
Water quality problems from residential & commercial development	—SAM plan establishes density overlays <sup>a</sup> —Municipalities changed zoning <sup>a</sup> —Established priorities for sewerage <sup>a</sup> —Improved stormwater and erosion controls <sup>a</sup>
Water quality problems from excessive OSDS loadings	—SAM plan establishes density overlays <sup>a</sup> —Construction setbacks and buffer zone requirements <sup>a</sup> —Recommends establishment of wastewater management districts <sup>a</sup> —Recommends use of denitrification systems in some areas <sup>a</sup>
Loss of habitat	—Limits extension of public water and sewer lines that encourage further high density development <sup>a</sup> —Identifies wetland and other habitat restoration sites <sup>a</sup> —Identifies critical habitat areas <sup>a</sup> —Buffer zone requirements <sup>a</sup>
Stabilization of inlets	—Limits further dredging <sup>a</sup> —Maintains catchment basins at each inlet —Promotes use of tide gates where practicable
Overfishing and habitat degradation	—Proposed modifications in catch limits —Proposed creation of fishing stewards to monitor stocks —Habitat protection and water quality measures <sup>a</sup>
Hurricane and severe storm damage	—Construction setbacks on barrier beaches <sup>a</sup> —Prohibits construction on undeveloped and moderately developed barrier beaches <sup>a</sup> —Prohibits expansion of public infrastructure in many barrier beach areas <sup>a</sup>
User conflicts and loss of open space	—Water use zoning to protect critical areas and priority uses <sup>a</sup> —Proposes improving public access <sup>a</sup> —Identifies priority sites for preservation and restoration <sup>a</sup>

<sup>a</sup>Implemented.

<sup>b</sup>Different review process adopted.

<sup>c</sup>Operated initially but then gradually faded out when most of the recommendations were implemented or it was determined that they either couldn't be implemented or were not a good idea.

<sup>d</sup>Only implemented by Narragansett.

<sup>e</sup>Limited by unavailable technology. Denitrification requirements are now starting to be added to the SAM plan.

<sup>f</sup>Implemented by the Harbor Management Planning initiative and changes in how public access sites are reviewed by the Council.

<sup>g</sup>Used permit stipulations to preserve and restore sites (e.g., Coastal America project near the Port of Galilee).

OSDS density overlays. Local officials prioritized sewer extensions and other infrastructure investment in a manner consistent with the plan's policies. There have been no large-scale proposals to invest in public infrastructure that would substantially increase the density of development in the watershed. Moreover, a review of municipal comprehensive land use plans indicates that, for the most part, local policies are consistent with the SAM plan's density requirements. In some instances, the comprehensive plans actually recommend policies more restrictive than those contained in the SAM plan.

A number of changes also occurred at the state level. The CRMC enforced many of the plan's requirements through its permit review process. New rules included increased buffer zone and setback requirements, density requirements for large projects, and more stringent stormwater and erosion control requirements. The SAM plan became a component of the *State Guide Plan* that required future decisions by federal, state, and local agencies to be consistent with the plan's policies and recommendations. The RIDEM also adopted new requirements for the siting and design of OSDSs statewide, as well as more stringent requirements in the Salt Ponds region.

The resulting institutional arrangement is complex. Municipalities review development projects in their towns and they control most decisions regarding infrastructure development. The CRMC reviews all projects within 200 feet of the most inland coastal feature (e.g., beach, bluff, coastal wetland, shoreline, etc.). The CRMC also reviews all subdivisions of six units or more, large commercial projects, and any development activity generating more than two acres of impervious surface in the watershed. The RIDEM reviews any project that discharges pollutants to coastal or inland waters, alters or impacts freshwater wetlands, or requires an OSDS. Accordingly, the municipality, the CRMC, and one or more divisions within the RIDEM review most large development projects in the watershed.

Given the complexity of the institutional arrangement, it should not be surprising that one of the plan's major recommendations was for the enactment of a "coordinated" (i.e., centralized) state and local permit review process. As originally envisioned, the CRMC would have served as a permit coordinator sending applicants to appropriate agencies and coordinating the flow of information between agencies. At the time, the CRMC had limited staff capabilities and it would have coordinated a number of development activities that had little impact on coastal resources. There were also problems concerning a lack of information about the requirements of other regulatory programs. Accordingly, the review process did not develop as envisioned.

What emerged instead was an informal, decentralized review process. The CRMC entered into agreements with each municipality regarding the coordinated review of major development projects. A town requests review of a project at the early stages of a proposal, often before detailed site plans have been developed. The CRMC's technical staff then arrange a meeting with local officials and developers to discuss the project. The meetings take place informally and are designed to provide a forum for communication and negotiation so that all involved gain a better understanding of each other's interests. It is also limited to projects that parties believe require coordination and where the interests of all agencies are likely to be affected (e.g., large subdivisions and commercial development). This minimizes coordination costs. Conducting the reviews during the early stages of the development process saves developers time and money by allowing them to incorporate state and local concerns during the design phase. It also facilitates the review of projects during the later stages of the development process because officials are familiar with the project and many of their concerns have been addressed. More importantly, the review process improves communication between the CRMC,

local officials, and developers. This helps build trust and keeps the parties informed about changing policies. It helps maintain a shared understanding of the plan's requirements over time. In fact, the coordinated process proved to be so successful that the CRMC entered into cooperative agreements with other communities outside the watershed. Moreover, the coordinated review process became the basis for new statewide requirements for the review of subdivisions (R.I.G.L. §45-23).

It should be noted that although the RIDEM's staff are invited to participate, historically their attendance has been sporadic. There are two possible causes for their reluctance to participate. First, the costs in terms of staff time (i.e., meeting time and travel time from Providence) were perceived to be greater than the benefits. Second, the RIDEM has been reluctant to informally comment on development proposals until an official agency position has been determined. As a result, the informal review process has been less effective in building trust between the aforementioned parties and the RIDEM. It is also unlikely that the review process proposed in the SAM plan would have met with the same RIDEM resistance.

#### *Evolution of the Institutional Arrangement*

While many institutional changes occurred shortly after the plan's adoption, others, like the coordinated review process, evolved over time. It is worth mentioning a few examples because they illustrate Ostrom's (1990, p. 137) observation that the development of institutional arrangements often occurs in an "incremental, sequential, and self-transforming" manner.

Lessons learned during the SAM plan's implementation led to another major revision in the RICRMP in 1990 and subsequent revisions over the last eight years. For example, the CRMC substantially revised its stormwater and erosion control requirements, adopted formal wetland mitigation requirements, and substantially revised their buffer zone policies (Desbonnet et al., 1995). The plan also stimulated the development of a SAM plan for the Narrow River watershed that is located adjacent to the Salt Ponds in 1986. The SAM plan also served as a catalyst for the development of the Harbor Management Program (HMP) that is implemented in conjunction with local municipalities. The HMP helps communities improve the management of recreational boating activities, identifies public access sites for the CRMC's designation, and integrates local land use planning with the CRMC's regulatory policies. The CRMC also underwent major organizational changes in the years following the adoption of the Salt Ponds SAM plan. It hired its first executive director and acquired its own technical staff in 1986. Today, the agency has its own permit review staff and has taken over much of the policy development work previously done by the CRC.

The SAM plan also served as a catalyst for institutional changes at the local level. Municipalities stepped up their efforts to make sewer extensions. Several towns adopted conservation ordinances to protect habitat areas (e.g., wetlands) and address erosion and stormwater problems. Conservation commissions were created to apply these ordinances and they routinely use the information contained in the SAM plan to justify their decisions. For example, South Kingston routinely requires the installation of denitrification OSDs to protect wetlands or when applicants apply for variances, even though the CRMC or the RIDEM may not require the systems. The plan helped stimulate the adoption of state enabling legislation that authorized wastewater management districts. As a result, Narragansett became the first municipality in the state to adopt a wastewater management district. Finally, all municipalities were required by statute to

prepare comprehensive land use plans. All four communities prepared comprehensive land use plans that embraced and built upon the SAM plan's policies and recommendations. Accordingly, these communities now play an active role in managing the region's ecological resources.

#### *Evaluating Institutional Performance*

The question that arises at this point in the analysis is whether the Salt Ponds SAM plan's implementation has been successful. One of the strengths of the IAD framework is that it contains no normative bias with respect to the institutional arrangement used to implement policy. It also relies on a variety of evaluative criteria to identify the strengths and weaknesses of the different institutional arrangements (e.g., markets, centralized hierarchies, decentralized hierarchies, and polycentric arrangements).

#### *Transaction Costs Associated with the SAM Plan's Implementation*

One important set of evaluative criteria draws attention to three interrelated categories of transaction costs: (a) coordination costs; (b) information costs; and (c) strategic costs. Coordination costs include those invested in negotiating, monitoring, and enforcing agreements. Information costs are those associated with searching for and organizing information and the errors resulting from poor or incomplete information. Strategic costs result from asymmetries in information, power, or other resources such that some obtain benefits at the expense of others. Common strategic costs include free-riding, rent-seeking, shirking, and corruption (Ostrom, Schroeder, & Wynne, 1993). Transaction costs are likely to increase as the number of bargaining partners and routine interactions increase (Levi, 1990, p. 403). They can also increase when asymmetries of information and power exist. Thus, as jurisdictional complexity increases and the actors' interests become increasingly heterogeneous, transaction costs are likely to increase.

During the planning process, coordination costs were consistent with those expected in an ecosystem-based planning effort involving a variety of stakeholders. It is unlikely that any other approach would have substantially reduced coordination costs. The CRC was also effective in coordinating the efforts of scientists and building a constituency that supported the SAM plan. These efforts certainly helped facilitate the plan's initial implementation. Moreover, the informal permit review process has proven to be a low-cost means of coordinating the review of development projects.

Information costs were also kept relatively low. The planning process was effective at coordinating scientific research and keeping it focused on issues important to decision makers. The efforts to synthesize the information paid dividends during the implementation phase when the information contained in the SAM plan began to be used by state and local officials when making land and water use decisions. The CRC's constituency-building approach also reduced information asymmetries by focusing on the development of a common understanding of the causes and effects of problems between the key actors. The RIDEM, CRMC, and local officials have also benefited from other efforts to obtain information related to the management of the Salt Ponds. The Salt Pond Watchers, a volunteer water quality monitoring organization, has been very active and is acknowledged to be the best source of surface water quality data for the watershed. The RIDEM, CRMC, and local governments also benefit from the scientific and social science research conducted by graduate students and faculty at the University of Rhode Island, which is located a short distance from the watershed.

The strategic costs also appear relatively low. In part, this can be attributed to the fact that the Salt Ponds watershed is composed of nine subwatersheds that are often contained within a single town. This helps limit potential free-riding problems because it is not possible for one town not to act and then benefit from the actions of the other three. Moreover, each town gets a return on their investments in infrastructure (i.e., sewer lines, stormwater ponds, etc.) because the water quality in the adjacent ponds often improves. The major strategic costs can be attributed to the RIDEM's failure to actively embrace many of the SAM plan's recommendations. The RIDEM is probably best characterized as a reluctant partner that resisted implementing many recommendations and often only did so after being criticized by Save the Bay, CRC, the CRMC, and local officials.

There are several explanations for the RIDEM's reluctance to embrace the SAM plan's implementation. First, while protecting the Salt Ponds is a major priority for the CRMC and the local governments, this is just one of many watersheds that the RIDEM has to worry about. Second, the periodic policy conflicts between the RIDEM and the CRMC have probably had an adverse impact on the SAM plan's implementation. Finally, traditionally, the RIDEM's internal organization has been segmented by media (e.g., air, water, etc.) and program, with priority given to regulatory programs. This has made it difficult to orient the RIDEM's efforts toward protecting individual watersheds and their unique problems. This has changed over the last several years. The RIDEM has improved its planning capacity and has begun to adopt the watershed approach advocated by the EPA. As a result, coordination between the RIDEM and the CRMC in issues related to the Salt Ponds has improved. Coordination has also improved between RIDEM and communities in other watersheds around the state.

#### *Overall Institutional Performance*

While focusing on transaction costs provides a useful way to examine the performance of the institutional arrangement at different points in time, it is also useful to examine institutional performance over a sustained period. The IAD framework suggests that overall institutional performance should be evaluated from several different perspectives and points out that there are often trade-offs among the criteria (Ostrom, Schroeder, & Wynne, 1993; Blomquist, 1992). One way to view institutional performance is in terms of efficiency. Efficiency is defined here in administrative terms and includes the costs associated with administering a management program. In general, the institutional arrangement appears to demonstrate a moderate level of efficiency. The transaction costs are relatively low and the informal review process appears to be effective. There is also a relatively high degree of compliance by local governments and permit applicants with the SAM plan's requirements. The main losses of administrative efficiency are those related to RIDEM's sporadic participation in the review process.

Institutional performance can also be judged in terms of equity. There are two important aspects of the "equity" concept. First, the principal of fiscal equivalence holds that those who benefit from a service should bear the burden of financing it. Thus, those who derive greater benefits are expected to pay more. Second, redistributive equity is concerned with structuring program activities around differential abilities to pay. Important considerations here are the equality of the process as well as results. It is important to remember that an efficient program is not necessarily a fair program. While efficiency would dictate that resources be utilized where they produce the greatest benefit, equity concerns can lead to different resource allocations.

The Salt Ponds institutional arrangement appears to satisfy both criteria reasonably well. An important feature of the informal review process is that the parties are not required to participate. This may distribute costs in a more equitable fashion because the parties participate when they receive some benefit. Arguably, the main problem with the recommended review process was that it imposed disproportionate costs on the CRMC. The proposed policy changes also did not create redistributive concerns among the towns. Each town saw the benefit of its investments in infrastructure (e.g., sewer extensions) and the plan's policies didn't channel development and tax revenue into one town at the expense of the others.

Institutional performance can also be evaluated in terms of accountability. Government officials should be held accountable for their actions. It is also important for institutional arrangements to provide opportunities for the participants to monitor each other's behavior. The CRMC and local government permit review processes are open and provide opportunities for individuals and nongovernmental organizations (e.g., Salt Ponds Coalition, Save the Bay, etc.) to play an active role in monitoring decisions related to the SAM plan's implementation. The informal permit review process is another example where participants can monitor others' actions. The main area where accountability could be improved would be to open up the RIDEM's permit review processes to more public scrutiny.

The IAD framework also suggests viewing institutional performance in terms of its adaptability. Unless institutional arrangements respond to changing political, economic, cultural, and environmental conditions, institutional performance is likely to suffer (Ostrom, Schroeder, & Wynne, 1993, pp. 112-116). Reflected here are concerns similar to those who argue for adaptive approaches to ecosystem-based management (e.g., Imperial & Hennessey, 1996; Imperial, Hennessey, & Robadue, 1993; Lee, 1993). The institutional arrangement in the Salt Ponds region has been quite adaptive. Some of the changes occurred in response to experiences with the plan's implementation (e.g., new stormwater, erosion control, and wetland mitigation requirements) while others occurred in response to changes outside the watershed (e.g., statewide harbor management program and land use planning requirements). Other changes occurred as a result of new information and changes in technology. For example, when the SAM plan was adopted, the technology for denitrification OSDs was quite limited. As technology developed and surface water quality data suggested a continued decline in surface water quality in several small embayments due to nitrogen loadings and bacterial contamination, the CRMC and RIDEM adopted new denitrification requirements that were incorporated into the SAM plan.

The overall performance of the institutional arrangement appears to be quite effective when viewed from these different perspectives. But perhaps the most important measure of success is the fact that federal, state, and local officials; nongovernmental organizations; and the public appear satisfied with the institutional arrangement's performance over the last 14 years. Attention of local and state officials remains focused on protecting the Salt Ponds region. Local officials like the coordinated permit process that has evolved, so much so that the new statewide subdivision review requirements are modeled on the process. Environmental groups such as Save the Bay, Pond Watchers, and the Salt Ponds Coalition continue to be supportive. The SAM plan has been touted as a success by the EPA, the NOAA, and the RIDEM's Narragansett Bay Project. Thus, there appears to be a high degree of satisfaction with the performance of the institutional arrangement for managing the Salt Ponds ecosystem.

### *Institutional Performance from the Perspective of Individual Actors*

Up until this point, the analysis has examined the aggregate performance of the institutional arrangement. While not the focus of this analysis, it is important to note that judgments about institutional performance might change when you examine the institutional arrangement from the perspective of only one actor, because one actor's costs are often another's benefits. This is an important factor that influences interorganizational relationships. Several examples illustrate this point. The RIDEM and the CRMC receive information benefits at the expense of costs incurred by the URI researchers and the Salt Ponds Watchers. The coordination costs incurred by the CRMC and RIDEM during the informal permit review process translate into information benefits for local governments making land use decisions. Since the CRMC issues permits after developers receive permits from the RIDEM and the local government, they incur strategic costs when either the RIDEM or the local government shirk their responsibilities and issue variances or special exceptions for projects that should be denied. In these situations, the RIDEM and local governments enjoy strategic benefits while the CRMC incurs costs.

There are also differences in terms of the overall performance criteria. The CRMC and local government decision-making processes are more accountable than the RIDEM's. Both processes are open and all large projects have public hearings. However, the RIDEM's permit approvals are all done administratively and the appeals process is more cumbersome. There are also major differences between the RIDEM, the CRMC, and local governments in terms of their adaptability. The CRMC has proven to be the most adaptable. It changes its regulations frequently, often in as little as a few months. The RIDEM lies at the other end of the spectrum. The RIDEM changes its regulations infrequently and it often takes several years to do so. The local governments cover the full range of this spectrum. It is important to consider these dynamics and the asymmetric relationships that result because they can cause conflicts. For example, while the CRMC is often frustrated by the time it takes RIDEM to change regulations, the RIDEM becomes frustrated and distrustful of the CRMC because it has trouble maintaining a clear understanding of their current regulations.

### *Examining Policy Outcomes*

Thus far, the discussion of institutional performance has not addressed the question of whether the institutional changes improved the health of the Salt Ponds ecosystem. It is interesting to note that while touted as a success, until recently there were no good groundwater monitoring data that could be used to evaluate the success of the density overlay policies. Clearly, the determination of the plan's "success" was related more to institutional performance than it was to the knowledge that the policies actually "worked." Moreover, most of the policy changes that occurred after 1984 had little connection to changes in environmental conditions, the major exception being the OSDS denitrification requirements.

Because the Salt Ponds is fed primarily by groundwater, surface water quality data do not completely tell one whether the SAM plan's density policies were effective in controlling nitrogen loading to groundwater. Surface water quality as defined by nitrogen levels and pathogens appeared to improve or stay the same in some areas, while in others it declined. These conditions fluctuated from year to year, making it difficult to discern clear trends. There was also no groundwater monitoring due to the lack of funding.

In 1994, the CRMC obtained funding to examine the SAM plan's implementation. As part of this effort, the CRC monitored groundwater quality at the same wells monitored during the SAM plan's development. While there is only one year's monitoring data to compare with the early 1980s, the study conducted by the CRC indicates that the policies appear to be working. Groundwater quality has improved or stayed the same in many areas and the projected impacts at current buildout levels are mostly within an acceptable range (Ernst, 1996; Ernst, Lee, & Desbonnet, 1996). For the most part, the density requirements appear to be managing nitrogen loadings in a relatively effective manner (Ernst, 1996; Ernst, Lee, & Desbonnet, 1996).

### **Discussion**

It should be clear from the analysis that "institutions matter." The development of rules to manage coastal ecosystems is a complex human endeavor constrained by limits on human abilities, imperfect information, and uncertainty about present and future states of the world. In this respect, all attempts at coastal resource management involve policy experiments. Coastal resource management requires developing a set of rules (i.e., policies) that take into account the physical characteristics of the ecosystem, the interaction of human activities, and the problems they create. Government officials and citizens then determine whether the policies are operating as intended and whether they are satisfied with the outcomes of implementation efforts. Based on these determinations, management actions may be modified.

It is important to remember that while innovation, adaptation, learning, and entrepreneurial skill often mark the process of institutional design, important constraints exist. Existing policies can limit the ability to solve problems in the desired fashion (Blomquist, 1992). Political, cultural, and economic conditions can influence which policies are preferred and whether they operate as intended. The physical characteristics of the ecosystem and the nature of the problem can also impose constraints on the policy choices available to decision makers. The following sections review some of the specific lessons that emerge from the case study.

### *Polycentric Institutional Arrangements Can Be Effective*

A great deal of environmental policy research contains a clear preference for either market-based or centralized institutional arrangements. Often, the preferences are supported by a truncated analysis that fails to consider the full range of transaction costs associated with developing and implementing coastal resource management programs. In fact, the polycentric institutional arrangement governing the Salt Ponds watershed has been criticized for not having a centralized coordination mechanism and for having too much duplication and overlap of government authority (Ernst, 1995; Olsen & Lee, 1991, 1993).

This case study suggests that researchers should guard against jumping to the conclusion that fragmentation and duplication of authority are always "bad" things. Clearly, excessive fragmentation or duplication of authority can be important problems. However, too many researchers neglect the positive aspects associated with polycentric institutional arrangements and the fact that they can be just as effective as centralized hierarchical or market-based arrangements. The criticism that the duplication and fragmentation of authorities or the lack of a centralized coordination mechanism decreases effectiveness is simply not supported by the analysis. In fact, it can be argued that an

effort to centralize decision making could increase transaction costs. Centralized governance arrangements and large bureaucracies often:

1. become increasingly indiscriminating in their response to diverse demands;
2. impose increasingly high costs on presumed beneficiaries;
3. fail to proportion supply to demand;
4. allow public goods to erode by failing to prevent one use from impacting others;
5. become increasingly error-prone and uncontrollable to the point where actions deviate from public purposes and objectives; and
6. compound these problems to the point that remedial actions actually exacerbate rather than ameliorate problems (Ostrom, 1989, p. 56).

Holling (1978, 1995) also noted that rigid, centralized attempts to manage ecosystems often lead to their collapse. Thus, there is reason to question the assumption that a centralized arrangement will result in more effective natural resource management. Moreover, given the local home rule tradition and the turf battles between the RIDEM and the CRMC, an effort to centralize decision making could have reduced the likelihood of the SAM plan's implementation.

It is also important to recognize that our federal system of government is polycentric in structure in that it has multiple overlapping centers of authority (Ostrom, 1994; Wright, 1988; Elazar, 1987). This type of institutional arrangement can offer distinct advantages over centralized systems of government (Ostrom, 1989, 1994). Polycentric arrangements allow for specialization and take advantage of economies of scale (Blomquist, 1992, p. 340). For example, RIDEM has a technical staff with a high degree of specialization in evaluating the siting and design of OSDSs; the CRMC has technical staff specialized in evaluating impacts to water quality and coastal resources; and local officials have expertise with respect to zoning and building code requirements. The fact that each agency reviews the same project could be viewed as "wasteful duplication and overlap." However, it can also reflect the type of functional specialization that minimizes costs through economies of scale (Blomquist, 1992). If one agency were to review all aspects of a project, it would still have to develop each area of expertise.

Since ecosystem-based management is an information-intensive endeavor, the advantages of functional specialization should not be discounted. It is important for practitioners to recognize that functional specialization can improve the quality of the information used to make resource management decisions. In the previous example, the RIDEM maintains detailed information regarding OSDS siting and design; the CRMC has access to information on coastal resources; and local governments have access to information concerning the local impacts of a development project. A centralized institutional arrangement could be used to obtain this information. However, large centralized (i.e., hierarchical or bureaucratic) systems often have difficulty collecting, acting upon, and communicating information. They are also vulnerable to information distortions. Therefore, centralized arrangements often have higher information costs than those with a polycentric structure.

The fact that the CRMC, RIDEM, and local officials may disagree on the merits of a project could be viewed as a "costly fragmentation of authority." Instead, it simply guarantees that the interests represented by different institutions like RIDEM, CRMC, and local governments will be deliberated. This deliberative process is arguably more "democratic" than simply giving one agency the authority to impose its will on others. Moreover, organizing governance arrangements on different scales makes it possible to

include only those decision makers affected by decisions. Important information about preferences is included, while extraneous information is excluded. This reduces information and coordination costs. Polycentric arrangements can therefore be the opposite of what analysts might predict as being "wasteful," "uncoordinated," and "inefficient." Instead, organizations contract with one another to perform specialized services (Blomquist, 1992). This can lower coordination costs once the interactions become standardized. The symbiotic nature of interactions can also lower the probability that actors will engage in strategic behavior.

The conflicts and turf fights that took place between CRMC and RIDEM could be viewed as "wasteful." However, they could also be described as a constructive debate over different ideas and policies for addressing complex problems. This competition of ideas can be valuable, and previous research suggests that an "institutionally rich environment" improves the prospects of solving complex problems (Blomquist, 1992, p. 360; Ostrom, 1994, p. 258). It can stimulate the diffusion of ideas, information, administrative processes, and policies which then enables others to solve similar problems in different programs and other geographic areas (Rogers, 1995). For example, the analysis demonstrates how the informal review process diffused to towns outside the watershed and was ultimately adopted statewide.

#### *Configurational Nature of Policies and Problems*

Another important observation is that in order to understand how an ecosystem is managed, one must understand how the policies of different federal, state, and local programs interact with one another. It is also important to understand the configurational relationships between different problems and their various causes. The interconnectedness between policies, problems, and the causes of problems has important implications for practitioners. An example from the case illustrates the point.

Some areas zoned for low density in the Salt Ponds watershed have prohibitions on sewer extensions. If sewers were installed, both surface and groundwater quality would likely improve. However, this action could lead to a variety of unintended consequences. It would become difficult to justify the low-density requirements. This could lead to attempts to rezone at higher densities. Increased development at higher densities would likely lead to greater stormwater runoff and increased habitat degradation and loss. Installing sewer lines would also open up new land to development because projects that failed to satisfy the RIDEM's OSDS requirements would now be allowed. Thus, failure to recognize the interconnected nature of policies and problems could lead to proposals with unintended consequences. This brief example also demonstrates that ecosystem management involves making trade-offs. If the exclusive focus were to reduce nitrogen loading to groundwater, then the SAM plan would recommend sewerage the entire watershed. However, this would increase the problems associated with stormwater and habitat loss. Therefore, some nitrogen loading to groundwater is necessary to avoid other problems. Many times, single issue management programs fail to recognize these important trade-offs, and their implementation efforts have unintended consequences.

#### *Changing Institutional Arrangements*

The analysis reveals a number of important observations about changing institutional arrangements. The case demonstrates the importance of constituency building, particularly the importance of trust and credible commitments. If individuals and organizations

do not believe that others will follow through on their commitments, they will be less likely to make institutional changes (Ostrom, 1990). For example, it is unlikely that the CRMC would have adopted the SAM plan unless they believed that local governments would change their zoning. The case also demonstrates that effective constituency building requires developing a shared understanding of problems, the meaning of policies, and how they should operate. This appears to be an important reason why the CRC was able to convince local governments to make the zoning changes necessary to implement the SAM plan. The case study also demonstrates the challenge of building trust and maintaining credible commitments when the participants are engaged in larger institutional conflicts, as was the case between the RIDEM and the CRMC.

The case study also illustrates the frequent observation that institutional change tends to be incremental. This can make it easier to get political support. It also allows participants to gradually develop and enhance their capacity to manage complex problems. For example, an incremental change such as requiring denitrification OSDs in a small subwatershed in the Salt Ponds region allowed the participants to experiment with new policies before requiring them on a broader scale. The study also demonstrates the self-organizing and self-transforming nature of institutional arrangements in that it is not uncommon for policies to develop and operate in ways unintended by their designers (Ostrom, 1990). For example, the informal review process, while effective, is different than the one proposed in the original plan.

The case study also reveals the important observation that institutional change tends to be path dependent (Ostrom, 1990). As a result, institutions both constrain and enhance what you do in the future. For example, the density overlays resulting from the plan's implementation allowed other policies such as denitrification requirements to be linked to the density requirements. At the same time, the density overlays constrain future choices. It would be difficult to radically change the current density requirements because legal rights to develop at these levels exist. Municipalities have also made long-range planning and infrastructure investment decisions based on current densities. It is important for practitioners to recognize that a policy choice can reduce the possibility of achieving an optimal solution when the solution exists in the policy space cut off early in the process of developing policies (Ostrom, Gardner, & Walker, 1994, p. 325). Therefore, practitioners should give careful consideration to how a proposed policy change might constrain future policy choices.

### *Evaluating Institutional Performance*

One of the interesting observations emerging from the analysis was the disconnect between institutional performance and environmental outcomes. Institutional performance appears to be more important in this case than environmental outcomes with respect to whether the program was judged to be a success. An interesting question is whether this is a widespread phenomenon. There is at least some evidence that this might be occurring in other watersheds. For example, the EPA and others have touted the nutrient-trading program in the Tar-Pamlico Basin in North Carolina as a major institutional innovation. Yet, no one knows whether the nutrient trading program will work as intended.

The potential disconnect identified in this case does have serious implications for practitioners and it should be an important area for future research. The case study suggests that developing effective institutional arrangements is at least as important as developing policies that ensure desired outcomes. It is also important for academics and practitioners to understand that there is not necessarily a direct causal linkage between

institutional performance and environmental outcomes. You can have an inefficient institutional arrangement (i.e., high transaction costs) which produces desired outcomes or have an efficient institutional arrangement (i.e., low transaction costs) which doesn't produce the outcomes. Moreover, it is possible that participants may prefer an institutional arrangement with low transaction costs even though it results in degraded environmental quality. Thus, academics and practitioners are cautioned not to assume that a collaborative ecosystem-based management program is necessarily more protective of the environment. Once human values are incorporated into decision making, the opposite situation can occur.

### *Adaptive Management and Policy-Oriented Learning*

Previous research on ecosystem-based management argues that adaptive management is a way to encourage the policy-oriented learning necessary to manage complex ecosystems (e.g., Lee, 1993). This study reveals several observations about the limitations of adaptive management. There are still major limitations in terms of what we know about how ecological systems function. For example, the Salt Ponds ecosystem may be one of the best-researched shallow lagoon systems in the world. However, it is still unclear how the groundwater system functions and what the optimum nitrogen loading levels should be. The groundwater monitoring data needed to monitor policy implementation were unavailable. When the CRMC did obtain funding to conduct the groundwater studies, the data provided nothing more than an educated guess as to how effective the policies were. The natural variations in the Salt Ponds ecosystem and the long residence time for groundwater make it difficult to determine what effect management policies are having and when the effect should be observed. Moreover, even if it were possible to determine that the policies were not working, it is not clear what policies should be changed. For example, if the CRC's data indicated that nitrogen loadings increased, it isn't clear whether the density overlays or the RIDEM's OSDs regulations should be modified.

The case study suggests that adaptive management is best thought of as a management philosophy—one that encourages policy-oriented learning and is not resistant to organizational change. The study also demonstrates some of the different types of policy-oriented learning that are important in an ecosystem-based management program (Sabatier & Jenkins-Smith, 1993). The staff of the CRC and other scientists at URI are engaged in ongoing research designed to improve the understanding of how the ecological system functions. This increased knowledge helps government practitioners gain a better understanding of the problems and whether the policies are likely to function as designed. Practitioners are also engaged in learning about how their policies work and interact with related programs. Practitioners and advocacy groups are learning about changes in environmental conditions and the causes of problems. Moreover, as political, economic, and cultural conditions change, the policy preferences of constituency groups can change with them. These learning processes are important because they can lead to changes in current policies.

### *Summary and Conclusion*

The argument advanced here is not that polycentric institutional arrangements are the "solution" to ecosystem-based management. "No single form of organization is presumed to be 'good' for all circumstances" (Ostrom, 1989, p. 48). Instead, the argument is that effective ecosystem-based management is really a question of proper institutional

design: finding the right balance between federal, state, and local control in order to achieve the collective and sometimes conflicting goals of the different programs (Elmore, 1985). Every organizational arrangement will have different strengths and weaknesses, and researchers are cautioned against jumping to the conclusion that some types of institutional arrangements are superior to others.

It is also important for practitioners to recognize that given the polycentric structure of our federal system, it is likely that many ecosystem-based management programs will utilize polycentric arrangements. In our federal system, the capacity (e.g., knowledge, power, and resources) to solve complex problems is often widely dispersed across a set of actors located at different levels of government.

Indeed, it is often difficult for any one actor, or group of actors, to manage, or manipulate, the flow of problems and solutions onto the political agenda in the first place. Thus, there are complex multi-actor processes for both the identification, definition and resolution of policy problems, and for the implementation of policy. (Bressers, O'Toole, & Richardson, 1995, p. 4)

In some cases, centralized (i.e., top-down) or decentralized (i.e., bottom-up) institutional arrangements may be effective. In other cases, polycentric institutional arrangements or market-based solutions may offer distinct advantages (Ostrom, Schroeder, & Wynne, 1993).

Researchers also need to recognize that the "integration" of policies is not synonymous with the "centralization" of authority. The two concepts are conceptually distinct. The case study demonstrates that policies can be well integrated but also be implemented through a polycentric arrangement. In addition, researchers should avoid thinking that improved coordination requires action by a central coordinator. A great deal of coordination occurs in an invisible fashion by standardizing information requirements, review procedures, and permit stipulations, and through the skills of those involved in the process. It can also occur through informal communication between key actors.

It is also important for practitioners to recognize that developing effective institutional arrangements can be a complicated and time-consuming task and that designing "satisfactory" policies is often a significant achievement regardless of whether an optimal solution is achieved (Ostrom, Gardner, & Walker, 1994, p. 325). Even when the population is relatively homogeneous and its members are well informed about problems, it is likely that strong incentives exist that cause key actors to act opportunistically and resist the changes that are necessary to more effectively manage coastal resources (Ostrom, 1990, p. 210). Accordingly, the institutional challenges confronting the implementation of an ecosystem-based management plan should not be left as an afterthought to the end of a planning process. The challenges are often too daunting.

For a coastal resource management paradigm based on the principles of ecosystem-based management to flourish, researchers and practitioners must pay closer attention to the important institutional challenges that have largely been ignored. This study is one small step in that direction. It is important for practitioners and researchers to recognize that ecosystem-based management is as much a problem of "governance" involving multiple organizations located at different levels of government as it is a question of science and designing effective coastal resource management policies. Accordingly, the failure to appreciate the complexity and difficulty of the institutional challenges surrounding ecosystem-based management can result in faulty policy recommendations that decrease the effectiveness of these programs.

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