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The Currituck Sound Drainage Basin: Perceived Issues and Prospective Management Alternatives

Rebecca R. Rideout
Department of Forestry

David A. Adams
Center for Environmental Studies

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Rebecca R. Rideout

Department of Forestry
North Carolina State University

David A. Adams

Director, Center for Environmental Studies
North Carolina State University

Introduction

The Water Quality Act of 1987 (Public Law 100-4) created a National Estuarine Program with a fourfold purpose:

1. identification of nationally significant estuaries that are threatened by pollution, development, or overuse;
2. promotion of comprehensive planning for, and conservation and management of, nationally significant estuaries;
3. preparation of management plans; and
4. coordination of estuarine research (101 Stat 61).

The law gave "priority consideration" to Albemarle Sound, North Carolina. A joint project of the United States Environmental Protection Agency (EPA) and the State of North Carolina, the Albemarle-Pamlico Estuarine Study (A/P Study) was the first program designated under the 1987 amendments to the Clean Water Act. Developing a comprehensive resource management plan for the Albemarle-Pamlico drainage basin emerged as a major goal of the A/P Study.

This paper will summarize the results of a project designed to gather and analyze background information necessary for development of a comprehensive management plan for the Currituck Sound drainage basin, a small portion of the greater Albemarle-Pamlico watershed. In addition to the waters of Currituck Sound, the study area included 26,000 acres of open water in Back Bay, Virginia and the land draining into Currituck Sound, Back Bay, Northwest River, North Landing River, and other tributaries to Currituck Sound (Figure 1). Based on North Carolina Center for Geographic Information and Analysis calculations, the Currituck Sound watershed covers approximately 733 square miles.

Land in the Currituck Sound watershed is devoted to many different uses including agricultural production, urban development, and preservation. A sprawling city, farms, hamlets, forests, marshes, and sand dunes jointly occupy the study area. The City of Virginia Beach, located in the northernmost portion of the drainage basin, threatens to expand urban development southward. Rapid population growth and development are challenging the Currituck Sound drainage basin's current rural character. Thus, the study area is in a period of change. The natural system is being surrounded by people and manmade environments.

Future management of this rapidly changing watershed and its many resources depends on the answers to two questions:

1. What are the the perceived issues surrounding management of the Currituck Sound drainage basin?
2. What types of responsive management alternatives are available?

Methods

Government officials, natural resource managers, and researchers performing investigations in the study area were consulted for their views concerning management issues in the Currituck Sound drainage basin. Fifteen formal interviews and numerous informal interviews were conducted over an 8 month period from December 1989 through July 1990. Interview questions were tailored for the respective represented agencies or research programs.

In addition, a short survey was used to determine general issue perception of the Currituck Sound Watershed Advisory Committee, the 15-member advisory panel for the project. Members of the advisory committee included representa-

tives of three federal resource management agencies, state officials from North Carolina and Virginia, a regional representative from southeastern Virginia, and a member of the Albemarle Citizens' Advisory Committee.

Perceived Management Issues

During the course of the project, natural resource managers and scientists were asked to define management issues for Currituck Sound. There are no correct or incorrect opinions. Each interviewee had an individual perception of the issues in the watershed based on personal experiences, observations, and scientific evidence. Perceptions differed widely between interviewees.

Although no clear consensus exists on the nature and extent of problems in the Currituck Sound watershed, the interviews/surveys yielded two broad issue categories:

1. Currituck Sound is perceived to be a declining resource with respect to water quality, the fishery, and waterfowl wintering grounds.
2. Responsibility for management of this ecosystem is split among multiple federal, state, and local jurisdictions.

Interviewees also discerned the potential for future problems stemming from the continued growth and development predicted for the region, especially in regards to the limited water supply. Controversy surrounding the City of Virginia Beach's plans to pipe drinking water from Lake Gaston to the city has already eroded the relationship between the State of North Carolina and Commonwealth of Virginia. Resource managers recognized the need for immediate unified action in order to halt the decline of this shared estuarine system and address the water supply issue.

Issue 1: Declining Resource Values

Water Quality

At the present time, no one has examined Currituck Sound and its tributaries in terms of defining the highest uses for the Sound and conditions necessary to optimize those uses. In the absence of such standards, it is difficult to assess the status of water quality in the study area. Moreover, there is currently little water quality data for the Sound system, especially the portion located in North Carolina. Several interviewees and members of the Currituck Sound Watershed Advisory Committee pointed to the lack of scientific evidence to document declining water quality in Currituck Sound. Regardless, almost everyone agreed that water quality problems exist in the Sound and its tributaries. Eight of nine respondents to the issues survey ranked water quality problems as the "issue of greatest concern in terms of detrimental effects on the Currituck Sound drainage basin". What evidence is there to support this perception?

In a 1986-87 study conducted in Back Bay, Virginia, suspended solids and total Kjeldahl nitrogen (TKN) surpassed or violated Environmental Protection Agency (EPA) reference levels (Southwick and Norman, 1987). A later study found very poor water clarity and high turbidity values in Back Bay. The turbidity appears to be "correlated with the continuing decline in aquatic vegetation" (Southwick, 1989). Between 1972-78, submerged aquatic vegetation (SAV) suffered severe, rapid population declines in Back Bay.

In the North Carolina portion of the drainage basin, the North Carolina Division of Environmental Management operates one water quality monitoring station. Located at Point Harbor, the station monitors monthly for chlorophyll a, dissolved oxygen, coliform bacteria, pH, turbidity, and certain metal concentrations. In 1989, chlorophyll a concentrations violated the North Carolina standard on one occasion. Although it was not a gross violation of the 40 microgram per liter standard, the 42 microgram per liter reading was indicative of high nutrient levels in the water. As a result, the mouth of Currituck Sound will be classified as "support threatened" for its class "C" water uses which include propagation of aquatic life and secondary recreation (John Dorney, personal communication).

Ideas abound concerning the causes and symptoms of the perceived Currituck Sound water quality problems. The interviews focused attention on three issues affecting water quality in the Currituck Sound drainage basin: agricultural runoff, development, and salinity changes.

In the Back Bay-North Landing River watershed, there are approximately 350 farm units with an average size of 100 acres (Mann, 1984). For the Currituck Sound drainage basin as a whole, the exact number of farms is unknown. No one can deny that cropland management impacts water quality in the Currituck Sound drainage basin. One might question the extent of agricultural runoff's contribution to perceived water quality problems. Overall, farm acreage has declined while the water quality situation has worsened. This observation on reduced farm acreage is based on scrutiny of Agricultural Stabilization and Conservation Service (ASCS) aerial photographs dating from the 1930's to the present (Ron Southwick, personal communication).

Much of the farmland no longer in production has been developed and is now part of the Virginia Beach urban complex. The Currituck Sound watershed lies within the Norfolk-Virginia Beach Mean Metropolitan Statistical Area. A region experiencing rapid growth, the drainage basin has expanded in terms of urban area and popu-

lation. Currituck County, a bedroom community for the mushrooming cities to the north, underwent a greater than 20 percent increase in permanent population between 1980-86 (Albemarle-Pamlico Estuarine Study, undated). Development, like agriculture, contributes to the perceived water quality issue.

The population increase for Virginia Beach during the 1970's exceeded 50 percent (Mann, 1984). Tidewater Virginia grew more slowly in the 1980's, but the overall population continued to climb. Most of the urbanization occurred in the northern sector of Virginia Beach and to the northwest of the city. This helped preserve the water quality of Back Bay and the rural quality of the southern portion of the coastal city. Furthermore, the City of Virginia Beach has expressed the desire to continue efforts to protect the rural character of the Back Bay watershed. Adopted by the City Council, the Comprehensive Plan established a "green line" south of which development is limited. However, as developable land becomes more scarce north of the "green line", there will be increasing pressure to expand southward. This is a matter of great concern to those involved in management of the Currituck Sound watershed and its resources.

The final perceived problem affecting water quality in the Sound is changes in salinity. The saltwater versus freshwater controversy has existed for many years in North Carolina. The argument climaxed in the early 1980's when citizens proposed introduction of seawater into Currituck Sound to restore water quality. This idea was based on the principle that positively-charged particles in saline water will bind with negatively-charged soil particles and precipitate out of solution. This, in turn, results in improved water clarity and, thereby, allows sunlight to penetrate the water column. One desired outcome is increased plant production which is beneficial for fish and waterfowl (Norman, 1988).

Salinities in excess of ten percent sea strength, however, interfere with largemouth bass (*Micropterus salmoides*) reproduction (Currituck Sound Task Committee, 1980). For this reason, sports fishermen opposed introduction of saltwater into Currituck Sound, a nationally famous largemouth bass fishery. North Carolina never attempted to change this freshwater estuary's salt content due to the prohibitive cost and uncertainty about possible effects (Currituck Sound Task Committee, 1980). The City of Virginia Beach did pump seawater into Back Bay intermittently between 1965 and the mid-1980's. During this time, water quality in the Bay did not improve. In fact, water clarity and vegetation reached "record lows" during the pumping period (Norman and Southwick, 1987). The Virginia Fish and Game Department forced Virginia Beach to discontinue pumping seawater into Back Bay in 1985. Presently, there is general agreement that the Currituck Sound-Back Bay complex should be managed as a freshwater estuary.

Resource managers and researchers also perceived declining water quality to be a significant management issue for the Currituck Sound drainage basin. Although the available data indicate that Currituck Sound possesses the highest level of water quality in the coastal area of northeastern North Carolina (Currituck Sound Task Committee, 1980; John Dorney, personal communication), there is still concern among resource professionals. Agricultural production and rapid urban development in the watershed are viewed as the primary causes of declining water quality in the Currituck Sound-Back Bay complex.

The Fishery and Waterfowl Habitat

Along with water quality, there is a general perception that the fishery and waterfowl habitat is declining. Below normal rainfall during the 1980's has resulted in reduced freshwater input into Currituck Sound. The salinity level has increased "beyond tolerable limits for most freshwater species" (Kornegay, 1989). Although fish populations are not statistically lower than in the 1970's (Kornegay, 1989), many fishermen feel they just are not catching the numbers of fish they did in past years (Mike Corcoran, personal communication). Sportsmen in the Back Bay area would agree (Norman, 1988). Norman, a biologist with the Virginia Department of Game and Inland Fisheries, summarized the sport fishing situation as follows:

> "This gold mine of a freshwater fishery began a rapid decline in the early 1980's and has continued its decline up to the present day. As a result, there is virtually no freshwater fishery in Back Bay today" (Norman, 1988).

Norman and his coworker Ron Southwick believe that high salinity levels and loss of the formerly abundant submerged aquatic vegetation (SAV) contributed to the decline in the freshwater fishery and waterfowl habitat.

Rapid development in the Currituck Sound drainage basin has also had a negative impact on wildlife, especially waterfowl. Prior to the 1980's, Currituck Sound was one of the premier waterfowl wintering areas along the Atlantic flyway. During the last decade, however, there has been a significant decline in populations of ducks, geese, and swans utilizing Currituck Sound. Based on aerial, midwinter surveys, waterfowl populations in the Currituck Sound area have decreased at a "much greater rate than elsewhere in eastern North Carolina" (Dennis Luszcz, personal communication). Luszcz, Waterfowl Project Leader for the North Carolina Wildlife Resources Commission, attributes the decline to increased human disturbance, loss of submerged

aquatic vegetation, and rising salinity levels. "There have been noticeable changes in a short period of time" (Dennis Luszcz, personal communication).

Issue 2: Lack of a Coordinated Management Approach

The State of North Carolina and Commonwealth of Virginia share responsibility for any decline in the waters or resource values of the Currituck Sound-Back Bay complex. Ecosystems do not recognize state borders. This leads us to the second broad issue category uncovered during the interviews: lack of cooperation between/among the governing bodies responsible for the management of the Currituck Sound drainage basin.

Several agencies representing four different levels of government manage land and water in the study area (Table 1). No one agency, however, possesses all the functions required for effective natural resource management. In addition, there is no comprehensive environmental management plan for the Currituck Sound watershed. Presently, the many managing agencies operate independently. Federal, state, and local officials agree that North Carolina and Virginia must cooperate in order to best manage the Currituck Sound- Back Bay complex.

Analysis of Prospective Management Alternatives

This section of the report will focus on three classes of management options in order of increasing departure from existing conditions:

1. Alternatives requiring no new institutions
   — Maintenance of the status quo
   — Increased local government action
2. Alternatives requiring formation of new, non-statutory institutions
   — Administrative agreement
   — Interstate planning agency
3. Alternatives requiring formation of new, statutory institutions
   — Interstate compact
   — Federal-interstate compact.

Alternatives Requiring No New Institutions

Maintenance of the Status Quo

Maintaining current management strategies in the Currituck Sound- Back Bay complex would allow time for scientists to gather and analyze data on the status of the resource. This new information, in turn, would more definitively answer the questions of whether and why Currituck Sound is in a state of decline. In this scenario, the basis for future action would be fact rather than perception. No difficult or binding decisions would have to be made at this time. Thus, maintaining the status quo is politically attractive.

However, under the current management system, the responsible agencies have failed to manage and monitor Currituck Sound/Back Bay. This is evident from the shortage of published material dealing with the study area. In addition, local governments such as Currituck County have not received sufficient expert help in managing the Sound resources (Yates Barber, personal communication). In some cases, however, local governments in the watershed have acted without drawing on the available expertise. The result has been a perceived decline in the quality of the Currituck Sound/Back Bay ecosystem and its many resources.

Finally, the current management strategies do not address the perceived need for cooperative management of the bi-state resource, especially in the critical areas of growth management, water quality control, and water supply. Currently, North Carolina and Virginia work independently on problems related to management of the Currituck Sound drainage basin. There is no concerted effort to manage the watershed as a system.

Increased Local Government Action

Local governments in the Currituck Sound watershed constantly face two seemingly opposed forces: development pressure and demands for environmental protection. In addition, local governments must provide public services and facilities to serve existing populations. Preserving the natural character of the Currituck Sound-Back Bay complex and promoting development in the drainage basin is impossible without active local government participation. Federal and state agencies have only limited authority in this arena while "local governments have the jurisdiction—through zoning and police powers—to thoroughly address the wide variety of water quality problems and their sources" (Division of Coastal Management, 1986). Land use planning and growth management systems are methods whereby local governments such as Currituck County and the cities of Chesapeake and Virginia Beach can balance preservation and development. Among the many alternatives available to local governments for growth management are: transfer of development rights, preferential assessment, performance zoning, population caps, annual permit limits, conservation easements, and local environmental impact ordinances.

Increased local government action in management of the Currituck Sound drainage basin has inherent advantages. Involving local people who live in the watershed and depend upon the estuarine ecosystem for their livelihood is the primary advantage of this option. Traditionally, North Carolina has given local governments authority in the land use regulation arena due

to the belief that "citizens should have maximum direct control over the specific areas within which they live and work" (Green and Heath, 1984). Local governments are already involved in management of the Currituck Sound watershed. They possess planning, permitting, and enforcement powers granted to them by the respective states. Under this alternative, no time would be wasted in negotiating an agreement between the multiple agencies involved in management of the resource. Local governments could act immediately to enact growth management measures.

However, no single local government has complete geographic jurisdiction over the Currituck Sound drainage basin and, for that reason, cannot single-handedly resolve the watershed's problems. In addition, the local governments lack resources such as money and manpower which are essential for education, research, and policy enforcement. Finally, the local governments have a vested economic interest in promoting development: "They [local governments] have a legislative charge and public mandate to pursue economic development to some degree" (John Carlock, personal communication). Environmental problems resulting from rapid or unplanned growth may be ignored until the situation reaches crisis proportions.

Alternatives Requiring New, Non-Statutory Institutions

Administrative Agreement

According to Zimmerman and Wendell (1951), the administrative agreement is "...an informal or a formal arrangement between administrative departments or officers of two or more states..." which does not require the approval of Congress. This third alternative offers opportunity for action at the state level outside the confines of a legally-binding interstate compact. The primary powers and functions of an agency formed by administrative agreement include development of institutional arrangements for cooperation on water resource matters of mutual interest and formation of joint positions on major issues in the broad arenas of water resources management and water quality control (North Carolina-Virginia Water Resources Management Committee et al., 1982).

An agency formed by administrative agreement has certain advantages over the preceding alternatives and alternative interstate institutions. First, this less formal mechansim can avoid the delays and political repercussions involved with legislative ratification. In addition, committees formed by administrative agreement generally operate within pre-existing agencies, thereby, they place a low financial burden on the participating states. Finally, there is a precedent for cooperation between the State of North Carolina and the Commonwealth of Virginia via this mechanism. In 1974, Governors Godwin and Holshouser created the now defunct North Carolina-Virginia Water Resources Management Committee by written agreement. The Committee concentrated on water resource problems in the North Carolina-Virginia Tidewater area, of which the Currituck Sound drainage basin is a significant portion.

The voluntary administrative agreement mechanism suffers several disadvantages including organizational and structural problems. Typically, agencies formed by administrative agreement lack planning, regulatory, and enforcement powers. Other inherent problems in this type of agency include inability to influence water resources decisions made by local and regional governing bodies; lack of accountability; inadequate financial resources; and poor continuity in time (North Carolina-Virginia Water Resources Management Committee et al., 1982). A final disadvantage of the administrative agreement is its somewhat uncertain legal status. Article I, Section 10 of the Constitution of the United States prohibits agreements and compacts among states without the consent of Congress. A literal interpretation of this directive would construe the term "agreement" as to include every agreement, written or verbal, formal or informal. In 1893, however, the Supreme Court ruled that the constitutional prohibition as to compacts or agreements among the states without the consent of Congress was "directed to the formation of any combination tending to increase the political power in the States, which may encroach upon or interfere with the just supremacy of the United States" (148 U.S. 503, 519 (1893)). Clearly, an administrative agreement between North Carolina and Virginia designed to deal with water resources issues in the Currituck Sound drainage basin would not interfere with the power relationship between the two states and the nation.

Interstate Planning Agency

The interstate planning agency functions to develop and encourage planning processes between the states (Advisory Commission on Intergovernmental Relations, 1972). Normally, interstate planning commissions have the power to:

> "collect, analyze, and distribute data; conduct studies and prepare reports on existing or potential problems; serve as an advisory board; and identify and recommend actions to local, state, or Federal jurisdictions for more coordinated management" (North Carolina-Virginia Water Resources Management Committee et al., 1982).

In the case of the Currituck Sound drainage basin, an interstate planning agency would prepare plans to direct management of the Sound

complex and its many resources. These plans, however, should be consistent with the two basin states' existing coastal area management programs. The North Carolina Coastal Area Management Act directs all State agencies to keep informed of federal and interstate agency plans, activities, and procedures within their areas of expertise that affect the coastal area:

> "Where federal or interstate agency plans, activities, or procedures conflict with State policies, all reasonable steps shall be taken by the State to preserve the integrity of its policies" (G.S. 113A-127).

North Carolina and Virginia would be free to voluntarily implement the recommendations of such an interstate planning agency.

An interstate planning commission can be in operation much more quickly than a more formal coordinative mechanism such as an interstate compact commission (Chesapeake Bay Legislative Advisory Commission, 1979). Thus, an interstate planning agency could easily be designed as a precursor to a formal cooperative management program. Serving as a foundation for cooperation, the agency's first priority would be exchange of information and identification of basinwide problems. The interstate planning agency "can serve as a visible regional focus for water problems and can help develop a regional perspective toward water resources management" (North Carolina- Virginia Water Resources Management Committee et al., 1982).

As with any option, the interstate planning agency mechanism does have drawbacks. First, this form of agency lacks the regulatory and enforcement powers needed to implement its plans. Member states participate on a voluntary basis and are not obliged by law to put the interstate agency's plans into effect, reducing the interstate planning agency to an advocacy role (Advisory Commission on Intergovernmental Relations, 1972). In addition, this type of agency usually must rely on federal, state, and local agencies for information, aid in preparing plans, and execution of plans. Jurisdictional fragmentation in the drainage basin would slow the work of an interstate planning agency just as it currently prevents effective management of the Currituck Sound-Back Bay system. These disadvantages have hindered many interstate planning commissions to the point that they had only "marginal impact on improving basinwide water resources management" (North Carolina-Virginia Water Resources Management Committee et al., 1982).

Alternatives Requiring New, Statutory Institutions

Interstate Compact Commission

Since the inception of America, states have entered legally- binding compacts in order to address bi- or multi-state issues in a cooperative fashion. These compacts are contractual in nature and take precedence over other state statutes (21 U.S. 1, 91-92 (1823)). If necessary, an interstate compact can be enforced by suit in the Supreme Court.

Creation of a compact between the State of North Carolina and Commonwealth of Virginia would require that the states' respective legislatures pass identical laws authorizing the compact. Then, Congress would have to give consent through resolution or ratifying legislation. Congressional approval, however, is not a large obstacle as Congress generally grants consent to compacts drawn and agreed to by the party states (Leach and Sugg, 1959). Moreover, the Federal Coastal Zone Management Act (90 Stat 1019) granted consent of Congress to any two or more coastal states to negotiate and enter into agreements or compacts which do not conflict with any law or treaty of the United States, for

1. "developing and administering coordinated coastal zone planning, policies, and programs...and
2. establishing executive instrumentalities or agencies which such States deem desirable for the implementation of such agreements or compacts" (16 U.S.C. 1456b(b)).

Similar in content, wording, and form to an international treaty (Zimmerman and Wendell, 1951), interstate compacts are, essentially, treaties between two or more states. "It is generally accepted that the compact device affords the most appropriate legal base for administration of a single facility that stretches across state lines" (Barton, 1967). This reasoning may also be applied to natural systems such as the Currituck Sound-Back Bay complex which straddles the North Carolina-Virginia border. The interstate compact insures intergovernmental cooperation on activities affecting interjurisdictional resources. This form of agreement has been successfully utilized to abate and control pollution in shared watersheds as well as to facilitate development of water and related land resources.

Interstate compacts have some advantages over other coordinative mechanisms in addressing interstate problems. First, the compact is a

formal, legally-binding agreement indicative of the participating states' commitment to resolving the issue at hand. After the agreement is finalized, execution of compact terms is mandatory rather than voluntary. This mechanism is more powerful and stable than the administrative agreement or interstate planning agency. Generally, compact representatives meet on a regular basis, thereby maintaining a continuous interactive relationship among the member states. An interstate compact commission, with aid from existing management institutions, could manage the Currituck Sound-Back Bay complex from an ecosystem perspective.

Although this alternative has great potential, it has been utilized, primarily, when all else failed. States are reluctant to enter an interstate compact until they are convinced that independent federal, state, and local efforts cannot resolve the problem. Public and political acceptablitity of the compact mechanism is generally low because this formal coordinative device if often viewed as an infringement on traditional state and local jurisdictions. Acceptability of the compact mechanism as a coordinative tool for management of the Currituck Sound drainage basin may be further hampered by North Carolina's recent controversial involvement in the Low Level Radioactive Waste Compact and the Southeastern Compact. As a result of the compact affiliations, North Carolina has been selected as the site for a low level radioactive waste repository and a hazardous waste incinerator. Exhibiting the Not In My Backyard (NIMBY) Syndrome, many North Carolinians have revolted against the respective compacts' waste disposal decisions. The State of North Carolina, however, is legally obligated to fulfill compact duties.

The amount of time required to negotiate and ratify an interstate compact is also a major negative aspect of this alternative. The average time needed for compact formation is greater than 8 years (Muys, 1971). During the negotiation and ratification periods, the party states usually engage in few or limited cooperative efforts. As a result, immediate problems receive little attention and may worsen. There is no reliable way to estimate how long it would take North Carolina and Virginia to agree on terms for a compact. Perhaps, the two states would never reach a mutually satisfactory agreement.

Other predominant drawbacks of the interstate compact mechanism stem from member states' jealousy and distrust of compact commissions (Leach and Sugg, 1959). Often, state and local government officials fear that a compact commission will become a "regional supergovernment" that will ride roughshod over their interests (North Carolina-Virginia Water Resources Management Committee et al., 1982). This distrust and fear prompts states to limit the powers of compact commissions to the point that they become ineffective in resolving issues (North Carolina-Virginia Water Resources Management Committee et al., 1982). Another result of distrust on part of the member states is that the compact commission is purposefully alienated from the respective states' administrations and legislatures: the commission stands alone as a regional agency (Leach and Sugg, 1959). Lack of integration into the administrative fabric, in turn, leads to inadequate liaison and coordination (Chesapeake Bay Legislative Advisory Commission, 1979).

An interstate compact commission could effectively manage the Currituck Sound drainage basin if granted sufficient acceptance and power. The State of North Carolina and Commonwealth of Virginia should not consider this alternative, however, unless they are convinced that the identified problems need a regional solution. In order to succeed, this option would require enormous commitment, cooperation, and effort.

Federal-Interstate Compact Commission

A compact in which the federal government is a full and formal participant, the federal-interstate compact acts as a "mechanism to unite the constitutional powers of state and federal government while creating a regulatory agency of all party jurisdictions" (Council of State Governments, 1979). Enactment of a federal-interstate compact requires ratification by the signatory states' legislatures and, also, Congressional approval. Congress must give consent to the compact itself and to federal participation on the resulting compact agency. Typically, federal-interstate compact commissions are composed of the governors of the respective member states and one representative appointed by the President of the United States (North Carolina-Virginia Water Resources Management Committee et al., 1982).

The federal-interstate compact mechanism is very similar to the interstate compact commission discussed in the previous section. The federal government serves as a full member of a federal-interstate compact commission. In contrast, ordinary interstate compact commissions exclude the federal government from membership.

Federal-interstate compact agencies have one distinct advantage over other mechanisms for interstate cooperation: they require cooperation between the states and the federal government. In the Currituck Sound drainage basin, the United States Fish and Wildlife Service alone is responsible for management of more than 125,000 acres of land. In addition, the Environmental Protection Agency, Army Corps of Engineers, and Soil Conservation Service play a significant role in land and water resources management. The federal-interstate compact mechanism provides the opportunity for the

highest attainable level of cooperation between the multiple agencies responsible for management of the study area. Additionally, a federal-interstate compact would have sufficient power and authority to address the water supply and land space issues in the Currituck Sound drainage basin.

There are, of course, distinct disadvantages to this cooperative mechanism. First, a federal-interstate compact commission would suffer all the drawbacks common to the interstate compact commission. Furthermore, formation of a federal-interstate compact commission to deal with the perceived issues in the Currituck Sound drainage basin would present a significant departure from the water laws and institutions of North Carolina and Virginia. It would be very difficult to build the broad public and political support necessary to create such an agency (North Carolina-Virginia Water Resources Management Committee et al., 1982).

Comparison of the Alternative Management Strategies

Each prospective coordinative mechanism possesses distinct advantages and disadvantages. Ultimately, selection and implementation of a management alternative will depend upon the priorities of the many managing agencies in the study area and of the citizens in the two states. Comparing the prospective management alternatives in terms of critical attributes and capabilities will provide the information necessary for final decision making (Tables 2 and 3).

No single alternative possesses all the desirable characteristics and capabilities of the ideal natural resource management agency. For example, maintenance of the status quo ranks high for public and political acceptability; however, this alternative does not vest complete geographic jurisdiction in a single managing agency. In contrast, a federal-interstate compact commission would have jurisdiction over the entire study area, but would probably fail to gain widespread political and public support. The compact mechanism would represent a significant departure from current management strategies.

The prospective management alternatives fall along continuums for flexibility and power. Flexibility allows a natural resource management agency to take more innovative approaches to solving problems. A flexible agency is not restrained by controls and standard operating procedures. Ranking the management alternatives in order from most to least flexible produces the following list:

1. Maintenance of the status quo
2. Increased local government action
3. Adoption of an administrative agreement
4. Creation of an interstate planning agency
5. Formation of an interstate compact commission
6. Formation of a federal-interstate compact commission.

Compact commissions are inflexible because their duties are explicitly stated in their ratifying legislation. The formality and contractual nature of compacts limit flexibility (Leach and Sugg, 1959). Ironically, the exact attributes of the compact mechanism which curb flexibility serve to empower compact agencies. Typically, compact commissions have planning, regulatory, and enforcement powers (North Carolina-Virginia Water Resources Management Committee et al., 1982) as well as complete geographic jurisdiction. Flexibility and power are inversely related. Thus, arranging the prospective management alternatives from most to least powerful results in a list that is the inverse of the one above:

1. Formation of a federal-interstate compact commission
2. Formation of an interstate compact commission
3. Creation of an interstate planning agency
4. Adoption of an administrative agreement
5. Increased local government action
6. Maintenance of the status quo.

Conclusions

There are two broad categories of perceived issues surrounding management of the Currituck Sound drainage basin. First, Currituck Sound is perceived to be a declining resource with respect to water quality, the fishery, and waterfowl wintering grounds. Insufficient data exist to confirm the opinion that Currituck Sound is a declining resource, however. No comprehensive study has been conducted for the Currituck Sound-Back Bay complex since the early 1960's when the Bureau of Sport Fisheries and Wildlife, North Carolina Wildlife Resources Commission, and Virginia Commission of Game and Inland Fisheries carried out a cooperative study popularly referred to as the "Sincock Study".

Second, no single resource management agency has complete geographic jurisdiction over the watershed. Since the time of the "Sincock Study", the Currituck Sound watershed has experienced rapid population growth and development. Much change has occurred in the study area. Throughout this period of growth and change, North Carolina and Virginia have failed to cooperate in the management of their shared ecosystem. Responsibility for management of the Currituck Sound-Back Bay system was, and still is, split among multiple federal, state, and local jurisdictions.

Many resource managers perceive a crisis situation for Currituck Sound. Government officials, resource managers, and the public must

reach a consensus on the best course of action. Selection of a responsive management strategy stands as the first step toward resolving the issues of the Currituck Sound drainage basin as well as the entire Albemarle-Pamlico Estuarine study area.

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Table 1. Resource Managing Agencies in the Currituck Sound Watershed

Government Level	Agency
Federal	Army Corps of Engineers (COE)
	Environmental Protection Agency (EPA)
	Fish & Wildlife Service (USFWS)
	⅞ Back Bay National Wildlife Refuge
	⅞ Currituck National Wildlife Refuge
	⅞ Dismal Swamp National Wildlife Refuge
	⅞ Mackey Island National Wildlife Refuge
	Soil Conservation Service (SCS)
State	
North Carolina	Division of Coastal Management (DCM)
	⅞ Currituck Banks Estuarine Research Reserve
	Division of Environmental Management (DEM)
	Division of Land Resources (DLR)
	Division of Marine Fisheries (DMF)
	Division of Water Resources (DWR)
	Wildlife Resources Commission (WRC)
	⅞ Northwest River Game Lands
Virginia	Council on the Environment (VCOE)
	Chesapeake Local Assistance Department (CLAD)
	Department of Game and Inland Fisheries (DGIF)
	⅞ Pocahontas Waterfowl Management Area
	⅞ Trojan Waterfowl Management Area
	Division of Soil and Water Conservation (DSWC)
	Division of State Parks (DSP)
	⅞ False Cape State Park
	Marine Resources Commission (MRC)
	State Water Control Board (SWCB)
County	
North Carolina	Camden County
	Currituck County
	Dare County
City	
Virginia	Chesapeake
	Virginia Beach
Regional	
North Carolina	Albemarle Regional Development Commission (ARDC)
Virginia	Hampton Roads Planning District Commission (HRPDC) (HRPDC was formerly referred to as the Southeastern Virginia Planning District Commission)

Table 2. Comparison of the Prospective Management Alternatives.

Attributes of a Successful Natural Resource Management Agency	Management Alternatives* 1	2	3	4	5	6
Complete geographic jurisdiction	No	No	No	Yes	Yes	Yes
Continuity in time	No	No	No	Yes	Yes	Yes
Flexibility	Yes	Yes	Yes	Yes	No	No
Political/Public acceptability	Yes	Yes	Yes	Yes	No	No
Power to enforce plans at ecosystem level	No	No	No	No	Yes	Yes
Wide special interest appeal (Represent varied interests)	Yes	Yes	Yes	Yes	Yes	Yes

* **No new institutions**
1=Maintenance of status quo
2=Increased local government action

New, Non-statutory Institutions
3=Agency formed by administrative agreement
4=Interstate planning agency

New, Statutory Institutions
5=Interstate compact commission
6=Federal-interstate compact commission

Table 3. Comparison of the Prospective Management Alternatives (b).

Duties of a Natural Resource Management Agency (after Matthews, 1976)	Management Alternatives*					
	1	2	3	4	5	6
Planning	Yes	Yes	No	Yes	Yes	Yes
Public education	Yes	Yes	Yes	Yes	Yes	Yes
Regulatory/enforcement functions	Yes	Yes	No	No	Yes	Yes
Receiving and administering funds	Yes	Yes	No	Yes	Yes	Yes
Research	Yes	No	No	Yes	Yes	Yes
Fostering intergovernmental relations	No	No	Yes	Yes	Yes	Yes

* **No new institutions**
1=Maintenance of status quo
2=Increased local government action

New, Non-statutory Institutions
3=Agency formed by administrative agreement
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New, Statutory Institutions
5=Interstate compact commission
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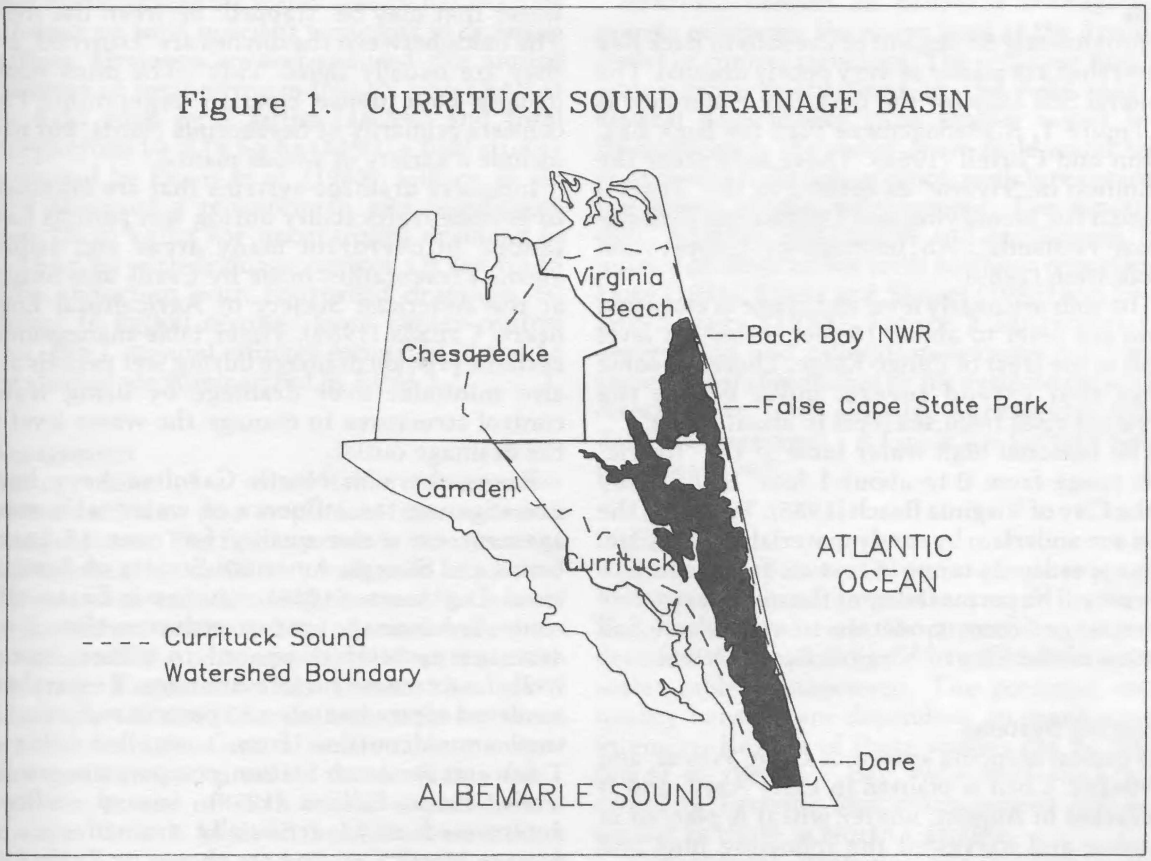

Figure 1. Currituck Sound Drainage Basin