Report 91-02

EXECUTIVE SUMMARY

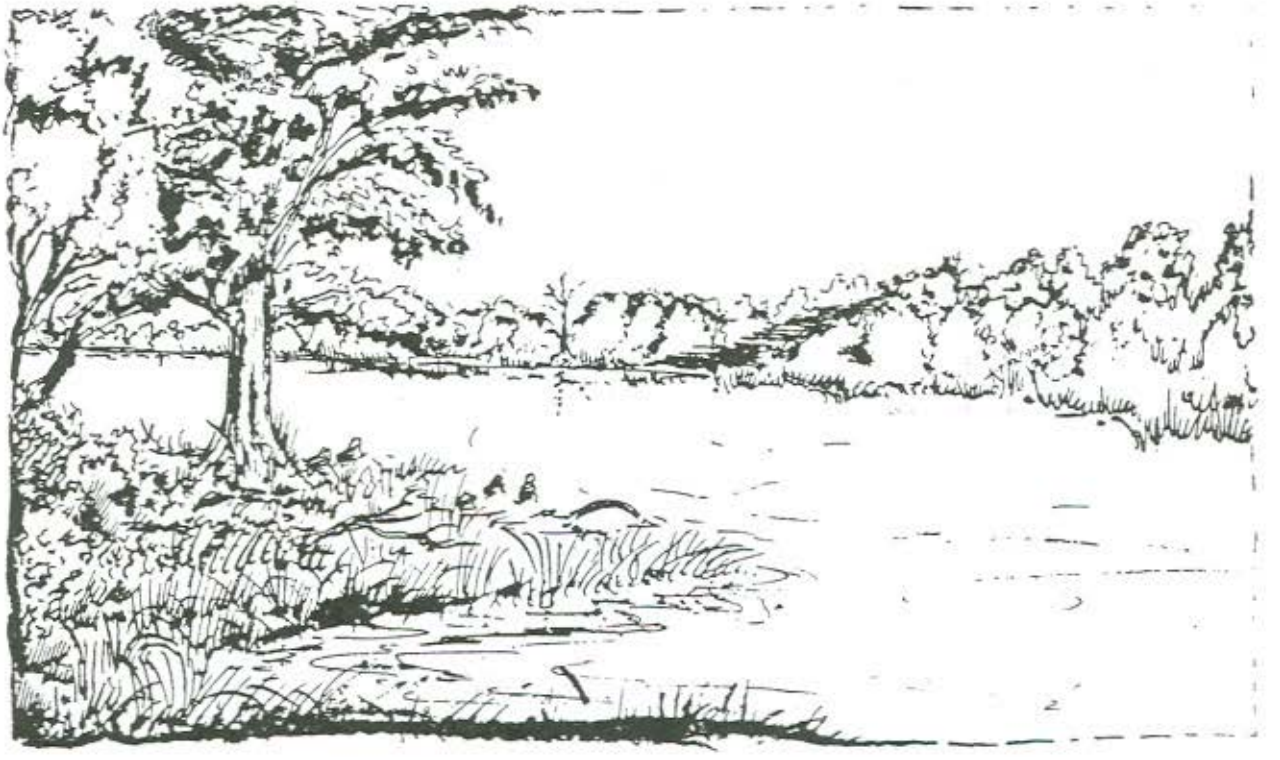
OF THE

STATUS AND TRENDS REPORT

OF THE

ALBEMARLE-PAMLICO ESTUARINE STUDY

April 1991



EXECUTIVE SUMMARY

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ALBEMARLE-PAMLICO ESTUARINE STUDY

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FINDINGS OF THE

ALBEMARLE-PAMLICO ESTUARINE STUDY

MANAGEMENT CONFERENCE

April 1991

This synopsis provides the judgements of the Albemarle-Pamlico Estuarine Study on the health of the Albemarle-Pamlico estuarine system, which has been under study since 1987. It is based on the best information and observations available.

INTRODUCTION

In spite of a suite of laws enacted during the 1970s, many of the nation's critical coastal ecosystems are in serious decline. Public attention has turned once again to threatened estuarine systems -- Chesapeake Bay, Narragansett Bay, Buzzards Bay, Long Island Sound, Puget Sound, and San Francisco Bay -- areas in which decades of population concentration and industrial development have resulted in the contamination of sediments, and the dramatic declines of living resources.

The Albemarle-Pamlico (A/P) estuarine system in North Carolina had become another one of these threatened systems. It is the second largest estuarine complex in North America and a key nursery area for east coast fisheries. In 1987, the A/P system was designated as an estuary of national significance and was selected to be studied, along with those mentioned above, as part of the Environmental Protection Agency's (EPA) National Estuary Program. Thus, the Albemarle-Pamlico Estuarine Study was initiated, a cooperative research and management program between EPA and the State of North Carolina's Department of Environment, Health, and Natural Resources.

The purpose of the A/P Study is to find out how serious environmental problems are in North Carolina's estuaries and how the estuaries can be preserved and managed to maintain their environmental integrity and maximize the use and pleasure people derive from them. The A/P Study's efforts are focused and guided by four committees composed of concerned citizens and people with knowledge of environmental science, management, and law. For more than three years, scientists funded by the A/P Study and other state and federal agencies have focused their research efforts on the characterization of and changes in the A/P system. This report is a compilation of the results of those studies and many previous years of estuarine research.

Any attempt to understand and rectify the problems of the A/P system must be based on an understanding of the dynamics of the system. The A/P system is made up of Albemarle Sound (including Currituck and Croatan Sounds), Pamlico Sound (including Core, Roanoke, and Bogue Sounds), with their many tributaries, marshes, swamps, and wetlands. On the western side of the system, numerous rivers discharge fresh water into the sounds. On the eastern side, a chain of barrier islands with only a few inlets in the southern portion of Pamlico Sound, hold back the Atlantic Ocean. River flow, winds, and tides are the most important forces at work in this system. These dynamic forces act to push, pull, mix, stratify, and remix the water and affect numerous physical, biological, and chemical processes such as fish recruitment, stratification of the waters, and sedimentation.

People who live near the rivers and estuaries have seen striking changes in the environment. In places along the riverbanks, submerged grasses once grew in beds so thick that it was necessary to cut paths to pass between the open river and the shore. Today, in many places, the grasses are gone and with them the young fish and shellfish that grew and were nurtured among them. Often, the river waters are turbid and dirty looking. Vast swamp area once inhabited by snakes, bears, and other wildlife, have been cleared, drained, and planted as extensive fields of soybeans, wheat, and corn. Shopping centers and condominium complexes have sprung up near fragile marshlands, once nursery areas for fish and shellfish. Shellfishing areas have disappeared or have been closed to harvests because of contamination by human waste. Fishing catches have declined. many fish and crabs suffer skin and shell diseases and so cannot be sold for human consumption. Large algae blooms occur periodically in many of the estuaries, rendering some areas unfit for swimming or fishing. Anoxic events have decimated local populations of fish and shellfish.

How people view changes in the A/P system depends on how they want to use its resources. Increasingly, conflicts are arising among the uses and the users of the estuarine resources. Boaters may think that a quiet accessible harbor is a perfect place for a marina, but people who harvest shellfish from the area may be concerned about contamination from human waste, marine fuels, and other toxicants. A recreational fisherman may be happy to pull a shrimp trawl and take home a few dozen pounds of

shrimp, but a commercial shrimper may be upset when thousands of recreational fishermen do the same thing and compete for the available resource. A farmer may want to use a small stream as a drainway to help lower the water table under one of his fields to keep his crops from drowning, but fishermen may regret the changes that the fresh water brings to a once productive primary nursery area. Commercial clammers may think that using a propeller wash to dislodge clams from the bottom is simply a more effective method of harvest, but those who understand the ecological value of submerged grasses and the harm that "clam kicking" can do, may think otherwise.

Use conflicts extend far upstream, too. Residents of inland cities and towns see "their" streams as water supplies and waste disposal resources. Coastal residents, however, expect those same streams to be clean when they reach the coast and to support wetland production, fish propagation, and other vital ecological functions.

This document summarizes the conditions and the trends that have been found in the A/P system and what is known about their causes.

CRITICAL AREAS

Submerged Aquatic Vegetation (SAV):

Status: SAV occurs in shallow low-salinity waters, in narrow bands along the eastern shores of Albemarle and Pamlico Sounds and in broad swaths across much of Core, Back, and Bogue Sounds. SAV habitat supports populations of bay scallops and numerous other species of shellfish, fish, and birds.

Trends: Scant historical observational records indicate an almost complete disappearance of SAV in the Pamlico River and Back Bay. In Currituck Sound major shifts in density and species assemblages have occurred; currently, SAV beds are greatly reduced in density and extent. In the western portion of Albemarle Sound significant (though unquantified) declines have also been documented. In the eastern portions of Albemarle and Pamlico Sounds, SAV appears to be quite stable.

Causes: On the western shores of the A/P system, the primary cause of the decline of SAV is believed to be related to increasing freshwater runoff, increased turbidity (from sediment-laden runoff, bottom-disturbing practices, and algal blooms), and encrustation by algae. Turbidity and encrustation effectively reduce the amount of light available to the plants for photosynthesis. On the eastern shores, decline is caused primarily by physical destruction or disturbance by dredges, boat propellers, and illegal fishing practices. If these conditions and practices continue, SAV will likely continue to decline.

Wetlands:

Status: There were an estimated 12,100 acres of tidal salt marsh (regularly flooded marsh) and 138,000 acres of non-tidal brackish marsh (irregularly flooded salt marsh) within the study area, according to a 1962 report (Wilson, 1962). The same report estimated that approximately 38,700 acres of nontidal freshwater marsh existed in the area. Significant tracts of riparian/alluvial forested wetlands ("wooded swamps and bottomlands") also exist; as of 1954 it was estimated that there were roughly 804,000 acres of these wetlands within the study area. Inland wetlands (pocosin and related wetlands and nonriverine swamps) also exist in significant numbers. Richardson (1981) estimated that as of 1979, 695,000 acres of

pocosin wetlands remained in their natural state within the North Carolina portion of the study area; an additional 808,000 acres were either partially developed or, at the time, scheduled for development.

Trends: While mapping is incomplete and historical records are inadequate, there is evidence of extensive localized reduction of ecologically important emergent wetlands and inland wetlands. Tidal salt marshes and fringe swamps are now protected by regulations and quite stable in areal extent, but it is estimated that 25-50% of wetlands that line tributaries or lie well inland have been lost to development or altered so significantly that their functioning has been severely impaired. By 1979, 33% of the state's original pocosin acreage had been drained and the native vegetation permanently removed or altered; an additional 36% were either partially altered or scheduled for development.

Causes: Regulatory changes have helped to reduce losses of coastal wetlands to residential and commercial development, and losses of all wetlands to agricultural conversion and mosquito ditching. Major losses of freshwater wetlands still occur as a result of draining or filling for silviculture and commercial or residential development.

Nursery Areas and Fisheries Habitats:

Status: The suitability of protected nursery areas for fish, seagrass beds for scallops, sands or muds for hard clams, or hard substrate for american oysters may be influenced by freshwater runoff, bottom disturbing practices, or hypoxic and anoxic conditions. A program is in place to designate and protect fisheries nursery areas from harmful fishing practices. Analysis of juvenile abundances, indicates that most of these designated areas are currently functioning satisfactorily.

Trends: Scallop habitat (SAV) has declined in areas where turbidity has increased. Clam beds appear to be generally stable, fluctuating primarily in response to climatic and hydrologic variations. Oyster beds appear to be in decline in the Pamlico and Neuse River Estuaries due in part to disease, anoxia, fresh water inflows, and harvest pressures. Access to historical anadromous spawning habitats (rivers and tributaries to the Sounds) have been blocked by dams and reservoirs and limited by roads and culverts. No long-term records exist that allow trends in the areal extent of nursery areas to be determined, but records of juvenile abundance indicate continued health of existing nursery areas--no significant population trends of any major species have been found. Records of water quality (e.g., dissolved oxygen, turbidity, and salinity), however, indicate deteriorating conditions within some nursery areas.

Causes: Nursery areas and fisheries habitats, often located in shallow creeks, embayments, and tributaries, are particularly sensitive to effects of land and water uses. Continued increases in sediment, nutrient, or pollutant laden runoff from developed land and could further reduce these areas or impair their functioning.

Barrier Island Habitat:

Status: Over the past 300 years, human impact has reduced the original extensive coverage of maritime forest, shrub, herbaceous dune growth, and soundside high marsh, to remnant quantities. However, about two-thirds of the Outer Banks is now in public ownership.

Trends: Losses of habitat, other than intertidal salt marsh, continue at a substantial rate on private lands. Acreage in public trust ownership or jurisdiction is increasing the protection of some of these habitats.

Causes: Most losses result from urbanization and related development, which includes drainage removal of vegetation, installation of hard surfaces, off-road vehicle traffic, and altering dune slopes and configuration.

WATER QUALITY

Nutrients and eutrophication:

Status: The waters of the A/P system are phosphorous-rich and relatively nitrogen-limited. Blooms of algae require concurrent inputs of nitrogen and adequate sunlight, salinity, and temperature conditions -- a fairly common occurrence during the summer-fall warm, low-flow months.

Trends: Total annual phosphorous loading into the Neuse River is estimated to have increased 60% over the past century to 1.7 million kg/yr (1985). Most of that increase has occurred within the past 40 years due primarily to the increase in sewage discharge. Total annual nitrogen loading into the Neuse River is estimated to have increased 70% over the past century to 7.8 million kg/yr (1985). After declining in the 1950s and 1960s, loading increased rapidly as population growth overtook old gains in efficiency of wastewater treatment plants. Despite the increased loadings, concentrations of nitrogen and phosphorous in the water column have, in general, declined in the recent past. However, increased concentrations of chlorophyll a (an indicator of algal abundance) may account for the declining concentration of nutrients. Throughout the Neuse River, increased concentrations of chlorophyll a and changes in the species composition have been noted; specifically, nuisance blue-green algae have increased significantly. In the Pamlico River, concentrations of chlorophyll a have increased up-river (50% in 16 years) and in middle-river segments. Trends of the frequency of algal blooms have not been able to be documented, but species composition does not appear to have changed significantly. In the Tar-Pamlico, algal blooms have been associated with fish kills. Increases in the concentration of chlorophyll a have also been noted in upper Albemarle Sound and lower Chowan and Alligator Rivers.

Causes: Point sources (such as municipal wastewater treatment plants), nonpoint sources (diffuse sources of pollutants, sediment, and nutrients such as agricultural, silvicultural, and urban runoff, and direct atmospheric deposition), and internal nutrient cycling play major roles in determining nutrient availability. Depending on the system, point sources can contribute as much as 75% of the annual nutrient inputs, while in other systems, nonpoint sources have been known to contribute up over 60% of the nutrients. Particulate deposition of atmospheric nitrogen is thought to play a large role in estuarine eutrophication; in Chesapeake Bay, a very similar system, it is estimated to contribute 10 to 20% of the annual nitrogen inputs in the upper portions of the estuaries and 30 to 50% of the annual nitrogen inputs in the lower estuaries, open sounds, and coastal waters. Along with the right climatic conditions, these nutrients can cause blooms of algae, associated hypoxic or anoxic events, changes in the food chain, and even toxic conditions.

Metals and Toxicants:

Status: Studies of the concentrations of toxic pollutants within the water column describe generally safe and reasonable levels, but studies of the estuarine sediments indicate that areas of localized but severe enrichment exist, most often associated with known point source dischargers. There is some indication that, from parts of the A/P system, concentrations of dioxin (a probable human carcinogen) found in

finfish tissues, have declined since last year, however, half of Albemarle Sound, portions of the Roanoke River, and the Chowan River still have health advisories posted for dioxin.

Trends: No long-term data base of sediment quality exists, but there is some indication of recent localized degradation due to anthropogenic loadings and disturbances. With such limited data, trends in the concentration of dioxin in sediment, water, and fish tissue are not reliable at this time. Long-term declines in concentrations of dioxin are expected, however, due to process changes in paper mills.

Causes: Municipal and industrial point source dischargers are considered to be responsible for the majority of localized degradation of the sediments. Long-term accumulation and biological and physical processes act to concentrate toxicants within the sediments, but biological effects of these toxicants are not yet known. Elevated levels of dioxin in fish tissues are primarily associated with pulp and paper mill effluents.

Freshwater Discharge and Flow Regimes:

Status: Alteration of the natural flow regimes of the tributaries to Albemarle and Pamlico Sounds can have significant effects upon the water quality and the health and distribution of flora and fauna in the receiving waters. In places, drainage ditches have reduced the salinity of receiving waters and have acted as conduits for the landward flow of brackish water. Overdraught of coastal aquifers has caused localized intrusion of brackish water. Dams have altered patterns of salinity and sedimentation, critical for the survival of many species of plants and animals. Construction and development have led to an increase of impervious surfaces, and so to an increase in stormwater runoff. The now inactive saltwater pumping station in Back Bay, Virginia caused major changes in salinity in the efforts to control the bay's habitat.

Trends: Mosquito ditching is no longer condoned and federal regulations have eliminated incentives to drain land for crop production. However, ditching associated with silvicultural practices is still exempt from 404 regions. Due to the complex hydrology of the estuarine system, precise trends of changing salinity remain unknown, but the pace of that change appears to be decreasing.

Causes: Artificial drainage of the wet interior of the study area, the pumping of groundwater, and the construction of dikes and dams may amplify natural hydrologic fluctuations.

Anoxia and hypoxia:

Status: Anoxia or hypoxia can stress or kill affected benthic and pelagic biota, however, such events are usually not wide-spread and are usually short-lived. These conditions are most common in the down-river sections of the tributaries and upper estuaries during periods of high runoff and in the up-river sections during periods of lower flow. Anoxic and hypoxic conditions can become established, broken-up, and reversed very quickly. These sporadic events seem to have little long-term impact on the health of the ecosystem as a whole.

Trends: There are no apparent trends of decreasing dissolved oxygen in the past 19 years of water quality data.

Causes: Data do not show a direct causal link between the size of the winter-spring algal blooms and the occurrence of anoxia or hypoxia. Anoxic and hypoxic conditions are usually caused by natural climatic and hydrologic conditions that result in concurrent warm temperatures (above 20 degrees

Celsius) and stratification of the estuarine waters. These events may, however, be exacerbated by algal blooms caused by cultural eutrophication.

FISHERIES

Shellfish bed closures:

Status: The Division of Environmental Health, Shellfish Sanitation Branch conducts detailed Sanitary Surveys on a continuing basis. These bacteriological, hydrological, and shoreline surveys serve as the basis on which recommendations for closures are made to the Division of Marine Fisheries. Currently, roughly 36,000 acres within the study area are closed to the harvest of shellfish. Additional areas may be closed for a few days or weeks following a heavy rainfall. Within the A/P Study area, temporary closures are usually confined to tributaries in Carteret County. An area is closed to harvest until tests indicate a return to acceptable conditions. Bogue and Core Sounds, and select areas within Pamlico Sound are significantly affected.

Trends: Closures due to point source dischargers (primarily wastewater treatment facilities) have declined with improved technology and regulations, but the area subject to temporary closures due to nonpoint source and urban stormwater runoff has increased along with increasing development, keeping the total area closed to harvest relatively constant. Within the A/P Study area, roughly 15,000 acres are now subject to temporary closures due to contaminated stormwater runoff, indicating continued localized water quality degradation.

Causes: Freshwater discharge from drainage ditches can disrupt local salinity regimes and cause the degradation of shellfish beds. Bacterial contamination from point sources, improperly sited or maintained septic systems, urban and agricultural runoff, and marinas can cause the closure of shellfish beds.

Diseases:

Status: Several new or epidemic diseases have been documented recently among the fish and shellfish of the Albemarle-Pamlico region. Outbreaks of ulcerative mycosis (UM), a fungal infection primarily affecting menhaden in the Pamlico River, have occurred biannually in epidemic proportions since its first occurrence in 1984. "Red sore" disease first occurred among a wide variety of finfish in epidemic proportions in 1975; periodic outbreaks are still reported. The occurrence of "MSX" and dermocystidium ("dermo"), diseases fatal to oysters, was first reported as a widespread problem in 1988. Shell disease in blue crabs (found primarily in the Pamlico River) causes severe and aggressive lesions, it is infectious, and is often fatal. Even when not fatal, all of these diseases can make the affected organisms unmarketable.

Trends: Prevalence of fish diseases (especially UM) in the Pamlico River has increased dramatically since 1984, yet in other areas, such as Core Sound, disease is not considered to be a real problem, and in Albemarle Sound the prevalence of disease is considerably less than in the 1970s.

Causes: Causes of fish and shellfish diseases seem to be multiple and complexly interrelated, but general degradation of water quality has been associated with outbreaks of disease. Areas with elevated levels of toxicants such as metals in the water column or sediments have been associated with outbreaks of shell

disease and UM, but no individual contaminants have been proven to be causal agents. Phytoplankton-produced toxins have been linked with increased mortality and susceptibility to diseases. Increased salinity occurring during periods of drought is believed to facilitate the spread of oyster disease. Decreased salinity has been associated with severe outbreaks of UM.

Commercial Fisheries:

Status: Dockside commercial landings data, compiled by the Division of Marine Fisheries, reflect not only stock sizes, but regulatory and market influences. In 1989 within the Albemarle-Pamlico Study area commercial fishermen landed a total (excluding menhaden) of 59.1 million pounds of fish and North Carolina fishermen as a whole landed 85.4 million pounds of estuarine-dependent fish.

Trends: In general, the total catch-per-unit-effort is decreasing despite improvements in fishing gear and methods. North Carolina's total commercial estuarine-dependent landings (including menhaden) have fluctuated 35 million pounds over the past five years from a low of 140.7 million pounds in 1987 to a high of 175.3 million pounds in 1988. Since 1988, landings have declined 14% to 151.5 million pounds.

Landings of catfish and striped bass have continued to decline since the 1970s. Landings of four other species have been in general decline since the early 1980s: river herring, American shad, croaker, and bluefish. Landings of flounder, weakfish, white perch, bay scallops, and oysters have shown a dramatic and sudden decline in the past one to three years. Coastal landings of flounder, for example, declined 60% in the past year. These declines may indicate declining stocks.

Commercial landings of hard clams, spot, and shrimp have remained fairly stable over time. Landings of blue crabs and Atlantic menhaden have continued to increase.

Causes: Specific causes of the declining landings are unknown, but several factors have been associated with the declines. Increased "effective effort" (the ability to inflict mortality) has significantly depleted some stocks. Fishermen have a greater impact on standing stocks because of the increased size and power of fishing vessels and improved electronics, fishing gear, and techniques. Alteration of riverine flow regimes has significantly reduced the habitat and reproductive success of anadromous fish. Declining water quality has been implicated in the reduced productivity of some primary nursery areas. Although trawling bycatch may negatively affect fish stocks, such an impact had not been demonstrated in the South Atlantic Region.

Recreational Fisheries:

Status: Recreational anglers compete for many of the same species as commercial fishermen and account for a significant proportion of the total catch. For some species of fish, such as bluefish, red drum, and spanish mackerel, recreational harvest probably exceeds commercial harvest. 53% of all commercial vessel licenses are issued for recreational use.

Trends: Unfortunately, no long-term recreational landings data exist, so no trends can be inferred. In general, however, the total catch-per-unit-effort is decreasing, despite increasing effective fishing effort.

Causes: North Carolina is unique in the freedom it offers recreational fishermen to use commercial gear and in the scale of the recreational fishing industry. While the total number of angler trips has remained relatively stable (or even declined slightly) over the past ten years, effective fishing effort continues to increase with improvements in gear and techniques.

THE HUMAN ENVIRONMENT

Population:

Status: According to the 1990 Census, North Carolina A/P study area counties have roughly 1,898,000 permanent residents, an increase of 16.3% since 1980. Two of North Carolina's three fastest growing counties of the 1980s are within the study area: Dare County grew 70% and Wake County grew 40.5%. Census information indicates that Virginia's A/P counties also exceeded the Virginia state-wide growth rate in the 1970s and 1980s. This relatively rapid growth of the permanent population and a concomitant growth of the recreational or seasonal population places ever-increasing demands on and creates ever-increasing conflicts over the limited and fragile resource base.

Trends: The population of the entire A/P study area is expected to reach nearly 3 million by the year 2000. The rate of growth of NC counties within the study area, while locally varied, has continued to increase. During the 1970s these counties grew at a rate below that of the statewide average, but during the 1980s, they grew 16.3%, 28% faster than the statewide average of 12.7%. This trend of growth will be reflected in increasing demands on the resources and increasing costs of maintaining the quality of the coastal environment.

Causes: The diverse resource base, healthy economy, and pleasant climate have attracted large numbers of people to the A/P area. There is a direct correlation between the growth and development of this region and the stress that is placed on the coastal environment.

Resource Utilization:

Status: The A/P study area offers opportunities for a wide variety of uses including: agriculture, tourism, residence, fishing, forestry, construction, mining, defense, retail, wholesale, and service. Each of these comprises a significant sector of the North Carolina economy. Although the A/P watershed covers about 1/3 of North Carolina, agriculture, the largest industry in the A/P area, accounts for 50% of NC's hogs, 45% of NC's cropland, and 40% of NC's chickens. Tourism is one of the state's largest industries; the A/P region accounts for 32% of the state's total tourism revenues. One-third of the state's woodlands are located within A/P counties. Degradation of drinking water supplies is not a widespread phenomenon in the A/P study area, but localized problems do exist. Livestock production, agriculture, and residential and commercial development are major industries within the Virginia portion of the A/P watershed. As in North Carolina, these practices add to the stress placed on the estuarine system.

Trends: Land in crop production has been declining since 1980, reflecting world-wide agricultural trends. Woodland acreage has also been decreasing, but pine plantation acreage increased substantially from 1973 to 1984. Swine and poultry production have been increasing as a percentage of the state total, but have not been expanding rapidly. Tourism-related industries are expanding rapidly within the A/P study area. Commercial fishing pressures, as measured by vessel licenses, have increased only slightly in the recent past. Marina development, an indicator of recreational estuarine use, has continued to increase (184% from 1970-1989). Travel and tourism are increasing within the study area (though their revenues remain a constant proportion of the statewide travel and tourism revenues). Forested land within the study area has been decreasing. Specific locations within certain aquifers suffer from salt water intrusion induced by overdraught. Surface water supplies are protected by existing water quality regulations.

Causes: Permanent and seasonal populations continue to grow throughout the A/P study area, bringing with them ever-increasing demands on the limited resource base. Continued land development, increased

domestic and municipal freshwater demands and wastewater discharges, the increasing application of fertilizer (despite the decreasing acreage of cropland), the growth of the poultry industry, the large scale hog industry, phosphate mining, forestry practices, the growth of commercial and recreational fisheries, and continued marina development have given rise to the concerns about the preservation and conservation of habitat and living resources.