V. HUMAN ENVIRONMENT

Written by

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CHAPTER V: HUMAN ENVIRONMENT

CHAPTER V: FIGURES and TABLES

A. INTRODUCTION

Estuaries are important natural resources. In addition to supporting a wide range of wildlife, fish species, and complementary resources, they contribute in important ways to the economy of the coastal region. The Albemarle-Pamlico estuarine system is one of North Carolina's most dynamic regions. Many of the counties within the study area are undergoing tremendous changes in population, economic structure and land use. Some of these changes are positive. For example, historically "depressed" regions have experienced an increase of economic activity (e.g., tourism, or resort development). However, many of these alterations have caused serious environmental degradation to the resource base of the Albemarle-Pamlico ecosystems. The majority of these environmental problems arise from human activities in and around these systems. Human activities affect specific resources within the A/P region, (e.g., water quality and recreational aesthetics). These activities, and the subsequent alterations within the system, are most realized when the changes in environmental factors affect other human activities, (i.e., conflicts among competing human uses). Finding realistic, workable methods to mediate conflicts between human uses of the estuaries is one of the challenges now facing North Carolina's citizens (NC NRCD 1987).

The successful management of the A/P estuarine system depends upon the understanding of how human activities affect the natural resource system. Indeed, one of the stated purposes of the A/P Study is to expand relevant knowledge about the impact of human uses upon the physical, biological and social systems of the Albemarle-Pamlico ecosystems (NC NRCD 1987).

Since human activities have been shown to have a profound effect on the A/P system, natural resource managers must consider how human activities have changed and will continue to change within the estuarine system. These activities can be as straightforward as land conversion, population increases, or an increase in livestock production. Some changes are both economic and social in nature. These include modifications in legislation, economic structure, and educational programs. An analysis of these trends, both past and future, is an important step in the formulation of a management plan for the A/P Estuarine System. The purpose of this chapter is to examine the "status and trends" of human activities that directly, and in some cases indirectly, affect the environmental quality of the A/P system.

The activities associated with the Albemarle-Pamlico estuarine system are classified into two broad components. The first is the direct use of estuarine resources. Direct use can involve extractive and non-extractive resource activities supported by the A/P system. An example of an extractive activity is the recreational and commercial fishing industry. The fishing industry is dependent upon the continued health and productivity of the fisheries supported by the estuaries; therefore, harvesting fish stocks can affect the future yield available from those fish populations. Non-extractive activities include other forms of recreation and tourism which are supported by the estuarine systems. The quality of these activities often depends upon the quality of the estuary, but they are described as non-extractive because they do not directly affect the quality of the resource.

Both extractive and non-extractive activities depend on the estuaries and the associated resources they support. Recreational swimming and boating certainly could take place in other areas -- freshwater or other coastal locations -- but they would very likely be different experiences. Consequently, both are dependent upon the character of the Albemarle-Pamlico estuarine system.

Other activities such as agriculture or timber production, while not necessarily dependent upon the A/P estuarine system, certainly have the potential to effect both the extractive and non-extractive activities discussed above. These activities can be classified as indirect uses of the estuary. Indirect uses correspond to economic and social activities that occur within the coastal counties bordering the sounds as well as the inland counties which comprise the estuarine drainage area. In many cases these activities could take place anywhere. An important research task that cannot be addressed with existing

information would be to model the reasons these activities occur in specific locations. In some cases, the answers involve combinations of locational advantages, the use of unique resources such as phosphate ore, or simply the servicing of local populations. These factors often explain, in a retrospective fashion, why certain activities have taken place at particular geographic locations; however, this is certainly not the case for all the sectors involved.

Developing a trends analysis of the direct and indirect uses of the Albemarle-Pamlico estuarine system is important for two reasons. Trend analysis provides resource managers and policy-makers information for appraising what is likely to happen to estuarine activities in the absence of policy intervention. Of course, this first use should be recognized as an indicator of future patterns rather than a prediction. Any examination of past patterns of activity is simply a history of events. It reflects what happened during the conditions of the past period. Prediction requires that we understand why those conditions fostered the observed pattern; nonetheless, in most cases, trends analysis can be used as indicators of future patterns for short time horizons. Dramatic changes in human activities and subsequent changes in socio-economic activities take time. Therefore, one can expect a certain amount of persistence in a well-established trend. If the historical record does not display a clear pattern of change, projections of anything but status quo conditions is much more difficult.

The second potential use of a trends analysis is anticipating how current or future policies may affect the direct and indirect activities using (or affecting) the A/P system. Here the insight provided by past trends is more problematic, precisely because the policy actions imply changes and the analysis is intended to evaluate how they will modify the evolution of these economic and social activities. At best, such information is suggestive. Here we clearly have a need for analyses that focus on the factors that motivated the patterns of activities. This point will be addressed in the final section.

A third component of the discussion of trends will be some consideration of the interconnections between direct and indirect uses of the estuarine resource. Policy-makers at virtually every level of government recognize that certain economic activities have a propagation or developmental effect. That is, the location of a large manufacturing complex or the introduction of an important tourism-based activity has a spill-over effect generating a wide range of other complementary economic activities. This arises because of the interconnections required to maintain the level of activity in each sector. Clearly, the interconnections will vary depending upon the sectors involved. In these cases, increases in the direct uses, extractive and non-extractive, will give rise to increased activity in other sectors; and they in turn will require a more modest increase in yet new sectors. This "multiplier effect" explains why using simple trends to anticipate the nature and composition of future economic or social activities can be difficult.

Thus, this trends analysis is intended to provide information which may increase understanding of likely patterns of use in the future. Indeed, an important message flows from the analysis of the data: that patterns of activities can be highly variable and change from one time interval to the next. This reinforces the need for a clear understanding of the interconnections between economic and social activities and the motivations for changes in their levels and geographic locations.

Equally important, government policy at both the local and state level influences the patterns and types of economic activities taking place in any region. These policies can range from local taxes and zoning ordinances to state mandated land use controls such as those in the North Carolina Coastal Area Management Act of 1974 (CAMA) which requires comprehensive regional resource management for the state's 20 coastal counties. Other factors affecting social and economic activities include the availability of roads, low-cost electric power, skilled labor, and other geographically specific resources that can be influenced by policy decisions. Developing a predictive evaluation of what is likely to take place in coastal counties requires substantive research on these activities. No program of research of this type has taken place in North Carolina. The Albemarle-Pamlico Estuarine Study did not initiate or have access to such a program of research. Consequently, what has been developed here is a short-term appraisal based on existing information only.

The analysis that follows is divided into three broad sections. Following this introduction, we discuss the trends in direct activities (including demographic, economic and social activities) influencing the A/P study area. Next we discuss the indirect activities and the interconnections between direct and indirect uses that are likely to influence the economic and social activities currently taking place in the area. Finally, the last section discusses the need for evaluation in developing a more comprehensive analysis of future patterns of economic and social activities in the Albemarle-Pamlico region.

A. 1. Background

The 36 counties which comprise the North Carolina A/P study area represent a diverse mix of land uses, growth patterns and economic development. There are also 16 counties in Virginia that are included in the complete A/P geographic delineation.

Tschetter (1989) classified the North Carolina study area as non-metropolitan. He notes that the only exceptions are Wake County, in the western part of the study area, and Currituck County, which is part of the Norfolk-Virginia Metropolitan Service Area (MSA) (Tschetter 1989). (Note: Tschetter did not include Durham, Orange or Person counties in his study; however, based on his classification, Orange and Durham would also be considered metropolitan). All of the Virginia counties would be classified non-metropolitan except the Norfolk-Virginia Beach area.

Although the geographic area covered by the A/P Study has been defined in previous chapters, our data analysis and discussion will be based on Paul Tschetter's study area characterization. Tschetter divides the North Carolina counties into three groups: coastline, sound, and drainage basin counties. He separates the 14 counties that directly border on the Albemarle and/or Pamlico sounds into two categories. The 4 counties which border the Atlantic Ocean and A/P sounds (Carteret, Currituck, Dare and Hyde) are referred to as "coastline" counties. The 10 counties bordering the sounds (Beaufort, Bertie, Camden, Chowan, Craven, Pamlico, Pasquotank, Perquimans, Tyrrell and Washington) are referred to as "sound" counties. Since the remaining counties are included in the drainage basins for the sounds, Tschetter refers to these 22 counties as "drainage basin" counties. These include Durham, Edgecombe, Franklin, Gates, Granville, Greene, Halifax, Hertford, Johnston, Jones, Lenoir, Martin, Nash, Northampton, Orange, Person, Pitt, Vance, Wake, Warren, Wayne, and Wilson. The distinction between coastline, sound, and drainage basin counties has some important value when specific data are presented.

A. 2. Data Analysis

Although there are hundreds of human activities that can have an affect on the A/P system, several specific activities were analyzed in this study because it was believed that they have the potential to cause the greatest environmental impacts on the estuarine systems. Some activities, such as agriculture or mining, have both direct and indirect effects that can be measured or determined sufficiently through historical and/or current data. Others such as public sector activity or social structure are less easily determined, although these activities certainly affect the study area in numerous ways.

Data indicative of current status and historical trends were obtained for the majority of the activities; however, data availability varied depending upon the activity. Projections are included for a few activities such as population growth.

For the majority of the activities, data are presented for the entire North Carolina study area (36 counties). In some instances data are presented for individual counties or for a specific group of

counties, (e.g., coastline counties). State-wide averages are used as a control or for comparison in select analyses.

Although 16 Virginia counties are included in the study area, the majority of the data is presented only for the North Carolina counties. Population data are analyzed for all 52 counties in the A/P estuarine system.

B. POPULATION

Analyzing population data is a simple method for determining an area's growth and for comparing different counties or regions of the state. Growth can translate into both economic and social benefits and has a direct connection to the economic well-being of a locality. Generally, population growth benefits businesses, creates jobs and expands the local tax base (Center for Public Service 1988).

Growth can also have detrimental effects. Population growth can strain natural resources and public facilities. Growth can lead to severe environmental consequences such as degraded water quality from overloaded or improperly operated wastewater treatment systems. Localities undergoing rapid development are likely to face challenges that include not only the expansion of government services such as roads or school systems but also planning for growth so that its effect may be favorable to the community and to the surrounding environment.

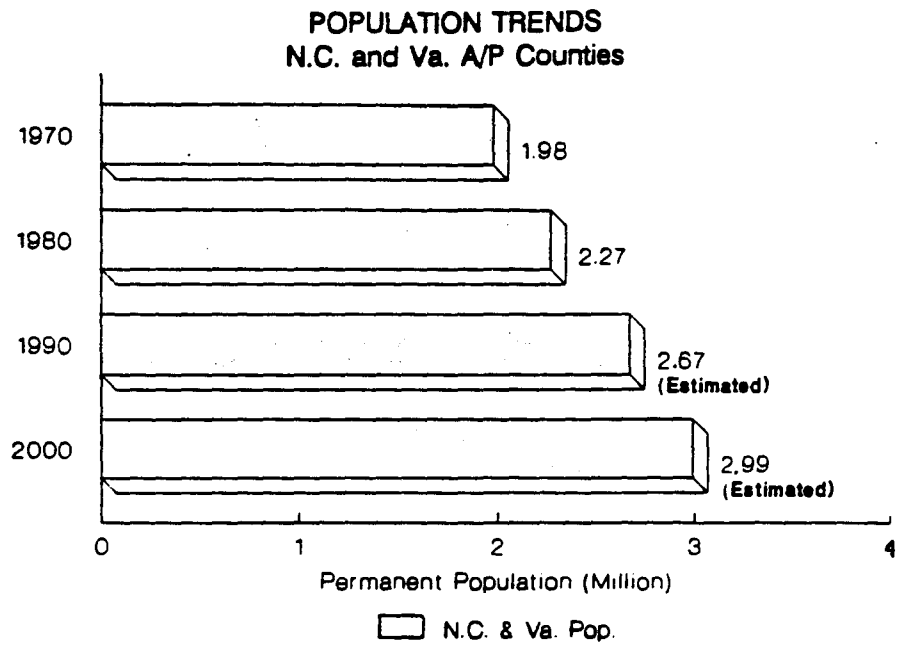
Since increasing population is the basis for many of the changes in the individual socio-economic divisions, population data could arguably be assigned to either the direct or indirect categories of activities affecting the estuarine system. To provide the reader with an overview of growth within the A/P study area, a discussion of population follows.

B. 1. Permanent Population

The initial population analysis addresses permanent population fluctuations within the A/P study area. Population data will be presented for the entire study area, both North Carolina and Virginia. To further address population changes, specific counties classified according to Tschetter's categories are analyzed. Permanent population data were obtained from "North Carolina Population Projections: 1988-2010", "Virginia Population Projections 2000", and US Census Bureau, Department of Commerce 1991.

Permanent population for the entire A/P Study area has continued to increase since 1970 and is expected to reach almost 3 million by the year 2000 (Figure V-1). When the population data is shown as a growth rate,or percentage change, further trends are evident. During the 1970s, North Carolina counties within the study area grew at a rate below the state-wide average, but in the 1980s those counties exceeded the state-wide average growth rate of 12.7% by 3.6%. The growth rate for A/P counties in Virginia, indicates that the counties within the study area are growing at a rate much greater than the state-wide growth rate. Growth during the 1970s and 80s exceeded state-wide rates. Population growth is projected to slow but still exceed the state-wide rate during the 1990s (Figure V-1).

From 1970 to 1980, 7 of the North Carolina A/P counties and 2 of the Virginia A/P counties exceeded the state-wide growth rates. The rates of growth varied from slightly above 1 to almost 6 times (in Dare County) the state-wide averages. During the same period, six counties lost population. From 1980 to 1990, 11 of the North Carolina A/P counties exceeded state-wide growth rates and 10 lost population. Of the three fastest growing counties in North Carolina, two are in the A/P study area. From 1990 to 2000, 14 counties are expected to experience growth exceeding that of their respective



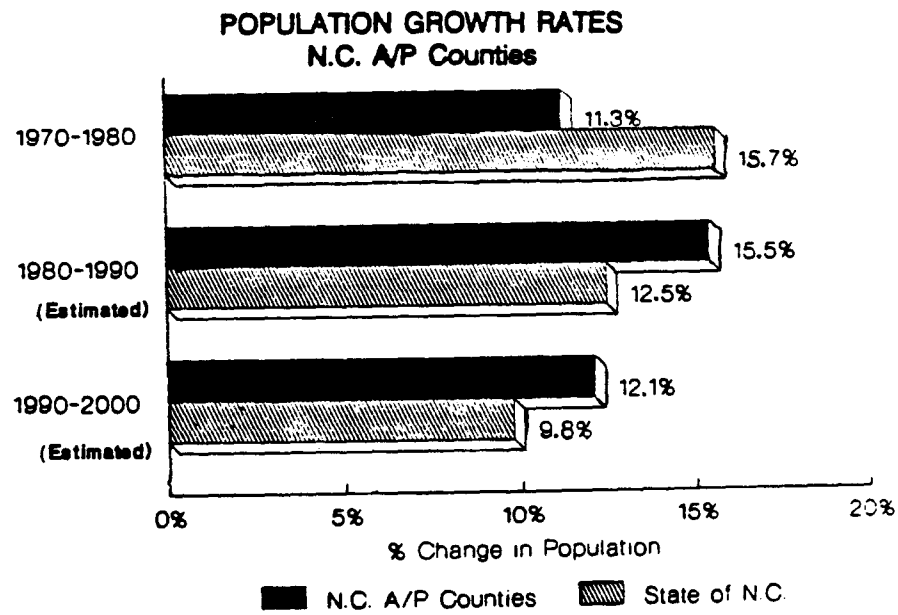


Figure V-1. **Population Trends and Growth Rates: NC and VA A/P Counties. From NC OSBM 1988; VA. DPM 1986.**

states, and 8 counties are expected to lose population. Twelve of the 14 growth counties are located in North Carolina.

These data indicate that population growth rates vary from county to county as well as regionally. To further illustrate this point, select counties from Tschetter's classification were analyzed. The "coastline" counties of North Carolina are experiencing tremendous growth in permanent populations. Currituck, Dare, and Carteret Counties are among the fastest growing counties in North Carolina. During the 1970s, the growth rate in Dare County exceeded the state-wide rate by almost 6 times, Currituck's exceeded that of the state by almost 4 times, and Carteret's exceeded that of the state by almost 2 times. During the 1980s Dare County was the fastest growing county in the state (70%), growing 5.5 times faster than the state-wide average; Currituck County grew 1.9 times faster than the state average; and Carteret County grew 2.2 times faster than the state average. While these general trends are projected to continue throughout the next decade, growth rates are expected to slow. Hyde County is a coastline county, but it has been losing population during the past decade and is expected to continue to do so throughout the next.

Of the "sound" counties, Beaufort County grew at a rate slightly below that of the state in the 1970s, and significantly below the state in the 1980s and the 1990s. The growth rate of Craven County was below that of the state during the 1970s, but the county surpassed the state's growth rate by 2% in the 1980s. Rapid growth is expected to continue.

There are mixed growth rates for the "drainage basin" counties. Durham and Johnston Counties grew at a rate slightly below that of the state during the 1970s; however, both exceeded the state's growth rate during the 1980s. Wake County grew at twice the state's growth rate during the 1970s, and is now the third fastest growing county in the state (40.5% since 1980). Nash County grew at a rate below the state average in the 1970s, but exceeded the state average in the 1980s. Pitt County grew at double the state's growth rate during the 1970s; its growth rate slowed in the 1980s but continued to exceed the state average. Population growth in Wayne County equalled the state's growth during the 1970s, but it is projected to grow at a rate well below that of the state during the 1980s and lose population during the 1990s.

Finally, two counties in Virginia, selected for analysis, also present a picture of contrasting growth rates. Currently, the City of Virginia Beach is the second fastest growing area in the state. During the 1960s Virginia Beach grew in population 102%; during the 1970s it grew 52% (3.5 times greater than the state-wide growth); during the 1980s it grew 49.9%, more than triple Virginia's growth rate. Southampton County lost population during the 1970s and 1980s and is projected to experience little or no growth during the remainder of this century. Overall, the Virginia portion of the A/P Study area grew 29.4% in the 1980s, with the vast majority of that growth occurring in the eastern and coastal regions.

In summary, the A/P study area is projected to have a population of approximately 3 million by 2000. The growth rate of the North Carolina portion of the A/P study area is expected to slightly exceed state-wide levels until the year 2000. Growth rates tended to be highest in the coastline counties. Craven County was the fastest growing sound county. Among the drainage basin counties, Wake, Durham, Orange and Pitt had the highest growth rates over the 30 year study period. In Virginia, a similar pattern is projected. Virginia Beach, on the coast, is experiencing the greatest increases in population.

A/P counties in North Carolina and Virginia, are experiencing varying levels of population growth. Some of these counties are among the fastest growing counties in their respective states. Dare County and Virginia Beach are experiencing growth rates that are exceeding state-wide levels by 5.5 and 3.0 times, respectively. Numerous counties in the study area, however, are experiencing growth rates well below state levels and many counties are losing permanent residents. The counties which lost population

or are projected to lose population, are predominantly rural, isolated, and heavily dependent upon agriculture (Tschetter, 1989).

B. 2. Recreational Population

Determination of population data for the Albemarle-Pamlico estuarine system area would seem rather straightforward using census data. US Census population data, however, refer only to permanent residents, i.e., people for whom a particular community is their usual place of residence (Tschetter 1989). One of the unique features of the study area is that many locations attract significant temporary populations of tourists. "This temporary population often has a tremendous impact on the demand for housing, food services, health care, water, electricity, waste disposal, police and fire protection, and many other public and private goods and services" (Tschetter 1989). Recreational or seasonal populations, therefore, present serious problems to city and regional managers and must certainly be considered in the development and implementation of management plans for the Albemarle-Pamlico estuarine system area.

In 1989, Paul D. Tschetter completed a study that analyzed the effects of recreational activities on the populations of the North Carolina A/P counties. In that study, Tschetter calculated the total number of persons who were in residence due to recreational activities. Recreational residence was based on occupancy in seasonal units, such as hotels and motels, campgrounds, and marinas. He combined these estimates with published permanent population to obtain the "peak seasonal population"; i.e, the total population if all of the units in the housing infrastructure were occupied. "Such peak populations are approached for specific times during the summer season; e.g., Memorial Day weekend, Fourth of July weekend, and Labor Day weekend" (Tschetter 1989). The data presented in that study are the basis for the following graphical presentations. The 1987 seasonal data are presented for the "coastline" counties as well as for select "sound" counties. The graphs illustrate the total population, (i.e, seasonal population plus permanent population) versus the permanent population (Figure V-2).

The coastal counties in Virginia and North Carolina experience tremendous population fluctuations due to the influx of recreational residents. The population of Dare County is over 4 times that of the permanent population during the peak seasonal day in 1987. The other coastline counties experienced similar increases. The population of Carteret County increased 2.3 times while the populations of Hyde and Currituck counties increased 2.15 and 1.4 times, respectively. These estimates do not include day visitors, those who visit the area but do not stay overnight. According to a 1985 NC Department of Transportation study conducted in Nags Head, a Dare County beach community, the municipality's population increased over 18 times that of the permanent population during the peak seasonal day (Dare County 1988).

The effects of recreational visitation varies from county to county in the "sound" counties. In Craven County, the fastest growing sound county, the peak seasonal population increase was more than equal to that of the permanent population. Pamlico County experienced an increase of greater than 1.5 times, and Beaufort County's seasonal population was slightly greater than 1.2 times the resident population. Pasquotank County, however, experienced only a slight increase in population during the same period.

Seasonal visitors have only a slight effect on the "drainage basin" counties. Warren County, a county experiencing little permanent population growth, experienced the largest seasonal increase, slightly over 1.3 times that of the resident population. Northampton also experienced a slight increase, but Pitt and Edgecombe Counties realized little, if any, population increase from recreational visitors.

In summary, peak seasonal visitors have a great effect on populations in some A/P counties; however, the effect varies from region to region. As one would expect, the counties that border the ocean and

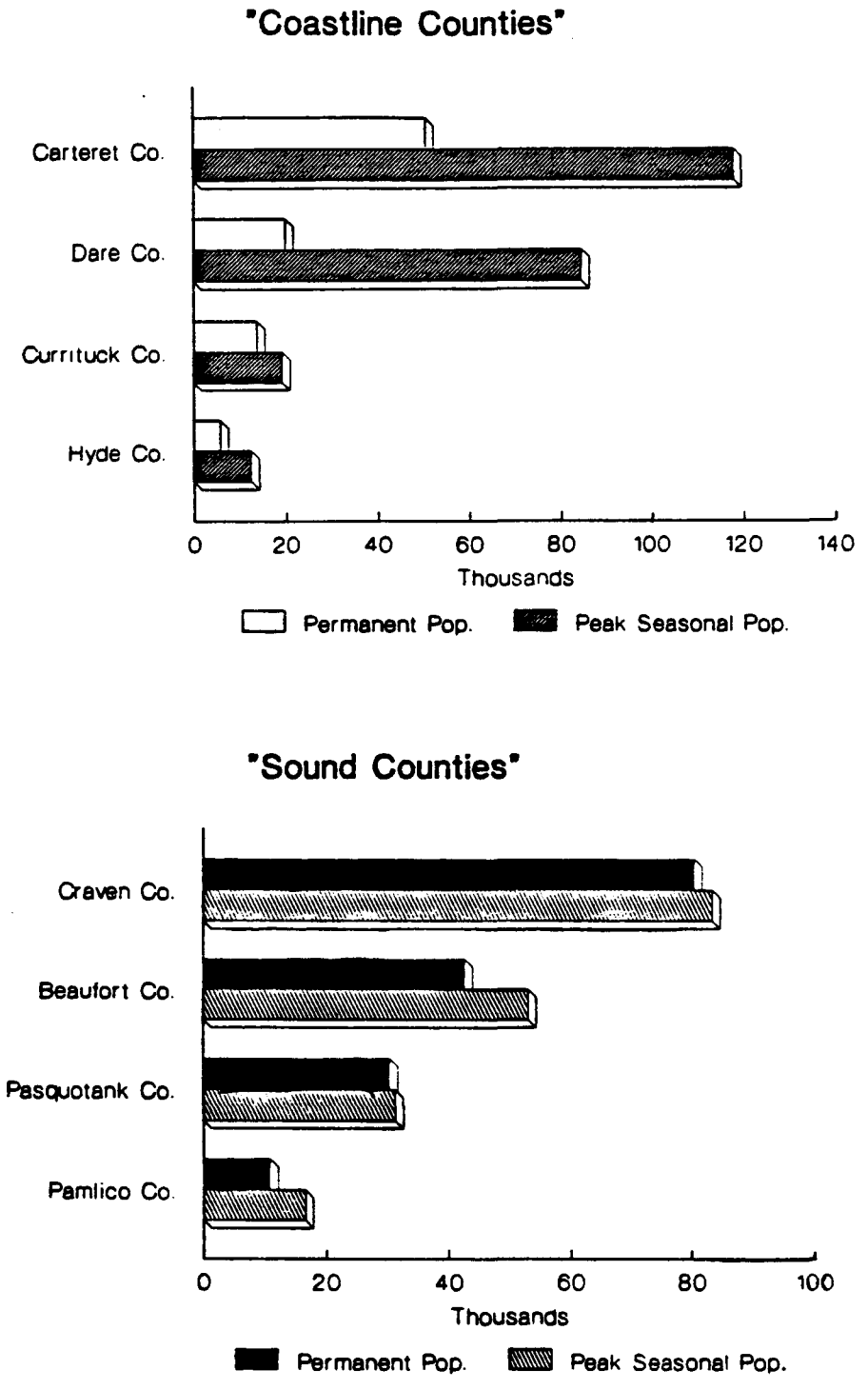


Figure V-2. Peak Seasonal vs. Permanent Population in A/P Counties. From Tschetter 1989.

sounds are experiencing the greatest population fluctuations due to tourism. In many of these counties, public facilities such as wastewater treatment, roads, and water supply systems are being taxed to the limit. The "drainage basin" counties experience little or no effect from seasonal visitors.

C. DIRECT USES OF THE ESTUARINE RESOURCES

It is important to realize that little in the way of actual research has been conducted in terms of analyzing and describing this component from any social science perspective. The few studies that do exist have primarily depended on secondary source material, such as landings and value statistics. This section will depend on these secondary sources of data and provide brief discussions based on a few primary studies done in the area, as well as similar studies in other areas.

C. 1. Commercial Fishing

The commercial fishing sector is marked by a high degree of seasonal variation by species (see Chapter IV). The species important to most fishermen in this study area include blue crab, bay scallops, shrimp, oysters, clams, herring, flounder and other finfish. Because analyses of landings and associated values are discussed in other sections they will be examined only briefly here.

Due to the seasonal nature of species availability, commercial fishermen must often be involved in the harvesting of more than one species. This can involve multiple gears, multiple vessels, or geographical movement. Johnson and Orbach 1989, for example, provide a case study of North Carolina commercial fishermen's adaptation to this seasonality that involves interstate migrations.

Total dockside value of commercial landings for the state, excluding industrial landings (e.g., menhaden), increased from approximately $24 million to around $65 million over the 10 year period from 1977 to 1987 (Figure V-3). Although there appears to be an almost three-fold increase in the nominal value of landings over this period, one must be cautious in interpreting this trend. The late 1970s and early 1980s were periods of considerable inflation. Adjusting for this inflation and displaying the value of landings in constant 1967 dollars shows that the value of landings has remained relatively constant or has declined slightly over this period. Most of the increases observed are accounted for by only a few of the counties (i.e., Pamlico, Dare, and Carteret).

Another important aspect of the trends in commercial fishing activities is the number and character of participants. Figure V-4 shows trends in the number of vessel licenses by type between 1977 and 1987. These designations are based on the applicants' own evaluations. Full-time commercial fishermen are defined as those individuals who earn over 50% of their income from commercial fishing, while the part-time designation refers to earnings less than 50%. Pleasure designation is defined as the use of commercial gear without the sale of harvested species. The graph indicates a very slight increase in the number of full-time vessels; though, it is unlikely that this pattern would be judged to be a statistically significant trend. Over the same period, the number of part-time vessels has declined steadily. Pleasure vessel licenses increased dramatically from 1977 to 1982 and dropped sharply in 1983. This is due to a change in the state license fee structure for this designation instituted in 1983. Many pleasure vessel licenses were probably bought by the increasing number of tourists or summer residents frequenting the area. The increase in fees seems to have limited the growth in "recreational" fishing of this type. It should be noted, however, that the self-defining character of these distinctions limits our ability to evaluate these trends.

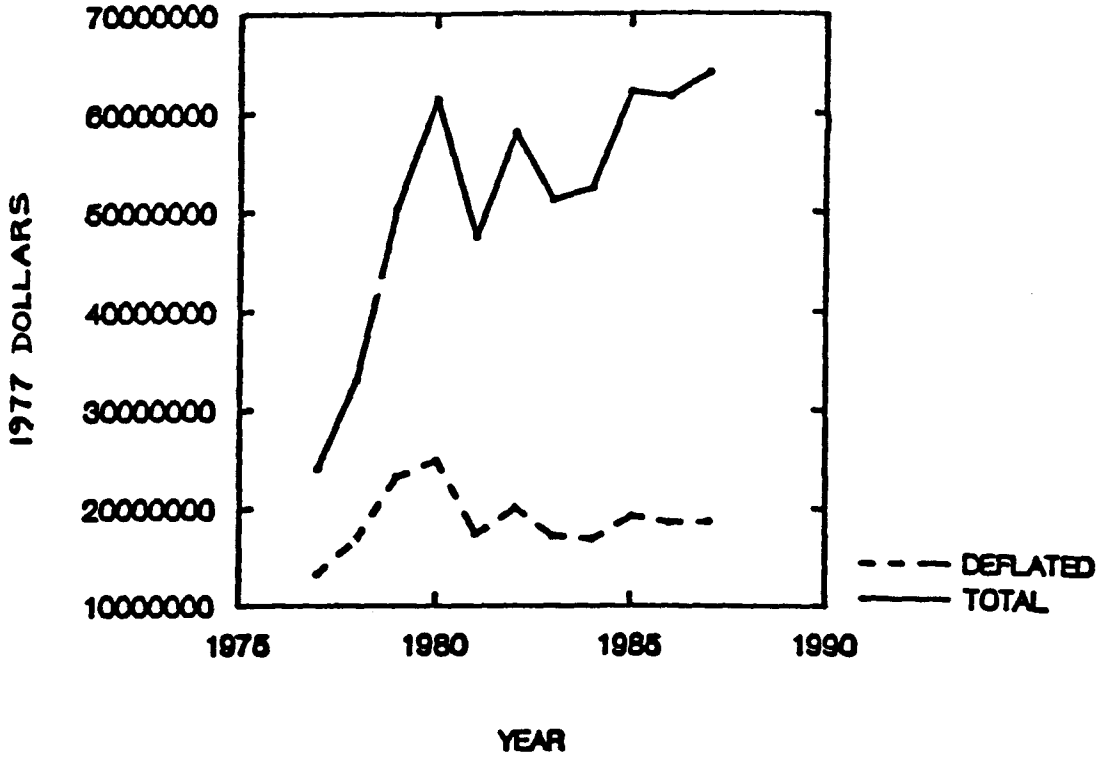


Figure V-3. Total and Deflated (to 1967 Dollars) Annual Dockside Values for NC Commercial Fisheries. From Division of Marine Fisheries Data.

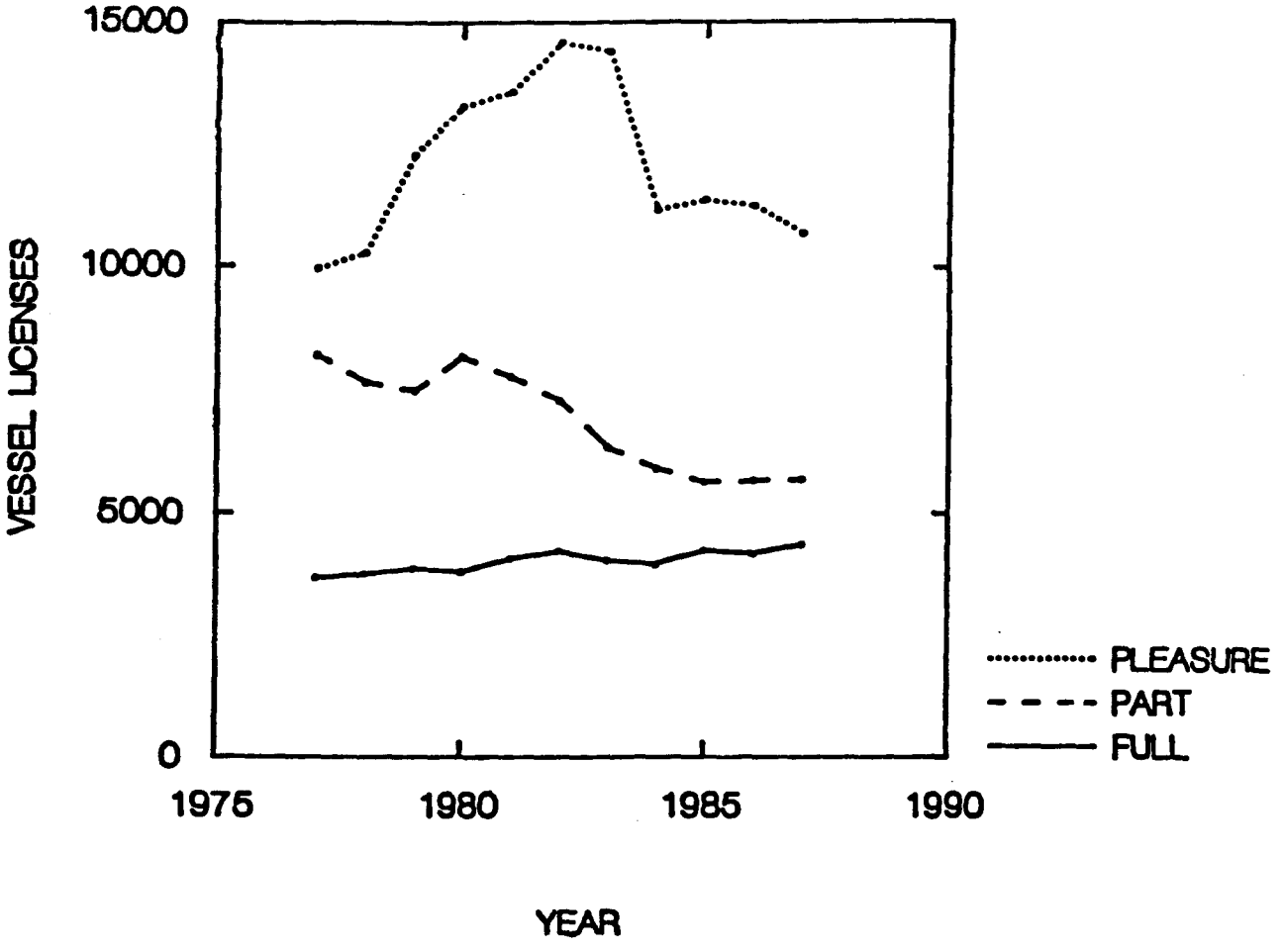


Figure V-4. Total Annual Vessel Licenses in the A/P Counties. From NC Division of Marine Fisheries.

Carteret County has the largest number of fishermen who consider themselves full-time commercial. Similar to the overall trend in commercial licenses, each of three major counties indicates relatively constant participation over the 11-year time period.

In order to develop a crude estimate of the size of the operations, dockside values per full-time vessel for each of the three counties were calculated. Carteret has many small-scale operators, while Pamlico County has fewer large operators. As the next section outlines, this pattern corresponds to the size of processing operations in each of the counties.

C. 2. Seafood Processing

Fishermen are not the only direct users of the estuarine resources who must deal with the seasonal nature of fishing. Processors and processing labor must also contend with such variations. According to 1982 National Marine Fisheries Service statistics, North Carolina had 112 processing plants employing 2,918 seasonal and 1,886 year-round workers. Thus, 60% of the seafood processing labor force was seasonal.

Most of the seafood processing industry in this area consists of small, independently owned and operated fish houses. Griffith (1988) contends that the official employment figures of this labor intensive industry would be higher if one considered the nature of recruitment based on kinship and the lack of good record-keeping. The number of processing firms in each of the counties in the study area for which data is available is shown in Table V-1. Approximately 75% of the 112 processing firms found in North Carolina are found within the study area. By far, the most active counties for processing, outside of the Core Sound/Carteret County area, are Pamlico and Beaufort. The most important species for these firms is blue crab, followed by finfish, oysters, scallops and shrimp. In general, the processing of seafood is labor intensive. According to Griffith (1988), rural counties such as Pamlico are, therefore, important sources of low-wage labor.

TABLE V-1: Number of Processing Firms by Coastal County. From Griffith (1988).

	Oysters	Scallops	Crab	Shrimp	Fish	Total
Carteret	2	10	5	6	8	31
Pamlico	5	4	11	1	9	29
Beaufort			8		3	11
Hyde	4		3			7
Bertie			1		1	2
Chowan					2	2
Pasquotank			1		1	2
Craven			1			1
Totals	11	14	30	7	24	85

Based on an analysis of the North Carolina seafood processing industry, Griffith (1988) provides a three-fold classification of seafood processing, each having different characteristics and implications for policy and management. Based on this classification, firms and workers in the study area outside of Core Sound have predominantly: (1) stability throughout the year, (2) low-dependence on local sources of seafood, (3) typical employer/employee relations, (4) no direct ties between the processing and harvesting sectors, (5) little control over processing, (6) pay based on wages or piece work, (7) low reliability of labor, and (8) a primarily black work force. Such characteristics demonstrate that the bulk of the seafood processing workers in the area outside of Core Sound are heavily reliant on processors and have few employment alternatives. Households to which seafood workers belong must often supplement low wages with transfer payments (Griffith 1988).

The second "category", which incorporates the Carteret County/Core Sound area, is different from the other areas in terms of processing activities for two reasons: (1) this area has the largest number of processors, particularly processors dealing in shrimp and scallops and (2) there tends to be more variance in the form and types of processing labor found here.

Although some of this labor can be characterized in a manner similar to that of Pamlico and Beaufort Counties, particularly in western Carteret County, there are two distinct forms. The dealers in this area can be characterized as having: (1) high-seasonality and dependence on local sources of seafood, (2) familial or community-based worker/employer relations, (3) strong relations between harvesting and processing sectors, (4) more worker control over the processed product, (5) much self-employment or unpaid family participation, and (6) a highly reliable, primarily white, labor force.

Griffith (1988) describes a third category of seafood processors, also found in the Carteret County/Core Sound area that is exemplified by the menhaden processing industry. This form of processing can be characterized as having (1) moderate seasonal dependence, (2) some degree of local dependence on the source of seafood, (3) conventional employer/employee relations, (4) strong ties between harvesting and processing labor, (5) no worker control over the processed products, (6) remuneration based on wages or piece work, and (7) a highly reliable, primarily black labor force. The processors themselves can be characterized as primarily family-owned and operated businesses in which kinship networks play an important role in management, marketing, and labor recruitment. Most of the processing plants are involved in more than one species, with much of the final product being shipped outside the state to such places as Baltimore and New York.

In summary, it is important to note that the seafood processing industry is an important part of the local economies for these coastal counties, particularly as a source of employment for poorer, rural coastal residents. The nature of the economic relations between workers, state and county agencies, and owners are critical determinants of future expansion of the industry under current economic conditions. Whereas workers may welcome alternative forms of employment in the area (i.e., they may have little occupational commitment to seafood processing), the unskilled nature of the labor force seems to imply they will have a dependence on the seafood processing sector for their employment, at least in the near future.

It is also important to anticipate how changes in the quality of the estuary or management policies might affect the levels of harvesting permitted by commercial operators (e.g., plans allocating access to particular fisheries between commercial and recreational fishermen, or limiting seasons, etc.) and impact the seafood processing industry. Firms having less dependency on local sources of seafood for processing naturally will experience more limited impacts. More seasonal operations depending on local sources of seafood can be expected to be dramatically affected. These impacts may be exacerbated for processing operations that are linked directly to harvesting operations through kinship and community ties. Thus, family businesses that involve both harvesting and processing could be more substantially affected by any reductions in harvest levels.

C. 3. Recreational Fishing

Although some recent attempts have been made to estimate and model the demand for recreational fishing in the sounds of North Carolina (Smith and Palmquist 1989), no comprehensive attempt has been made to describe the aggregate value of recreational fishing trips and their associated economic impacts in North Carolina. Moreover, because the Smith-Palmquist analysis is the first such study of demands in this region, there is little basis for evaluating the trends in demands for marine fishing.

The Smith-Palmquist (1989) research primarily focused on estimating the value recreationists would place on improving the quality of marine fishing. Their research focused on boat fishermen and measured quality in terms of an average catch rate (i.e., fish caught per unit of fishing effort) as a proxy measure of fish stocks. They applied a modified version of the travel cost recreational demand model for areas within the Albemarle-Pamlico estuarine system based on the fishermen's launch sites. These sites were treated as distinct recreation sites, and the demands for them were estimated using a 1981-82 survey of sport fishermen sponsored by the NC Sea Grant Program (see Johnson et al. 1986 for a description of these data and the survey procedures). Consumer surplus is the difference between what an individual would be willing to pay for a good or service and what he or she actually pays (directly or indirectly). It is the conventional economic measure of the value or benefit consumers derive in excess of what they actually pay, explicitly or implicitly, for a good or service. Smith and Palmquist (1989) developed estimates for the consumer surplus per fishing trip and for the increase in value per trip that would be generated by a 25% improvement in the catch rate (Table V-2).

TABLE V-2: Benefit Estimates for Sport-Fishing Trips in the Albemarle-Pamlico Sounds. From Smith and Palmquist (1989).

	Consumer Surplus Per Trip		Increment to Consumer Surplus Per Trip 25% Increase in Catch Rate	
Demand Model	(1982 $)	(1967 $)	(1982 $)	(1967 $)
Outer Banks Site	$163	$56	$24	$8
Pamlico Site	$103	$36	$9	$3

Estimates are rounded to the nearest dollar.

Smith and Palmquist (1989) use the estimates of the value of quality improvements to construct a benefit-quality elasticity estimate, i.e., the percentage increase in the benefits derived from a fishing trip to the Albemarle-Pamlico region in response to a percentage increase in quality. Their estimates imply a range of .40 to .60 for this elasticity, depending on the model and assumptions used. This would imply that a 10% increase in quality would yield a 4 to 6% increase in the benefits per trip.

While this work offers one component of the information necessary to gauge the economic effects of non-extractive uses of the sounds, it is incomplete. It focuses on one type of fishermen, neglects, other types of recreation supported by the estuary, and considers only a single time period. These findings offer no insight into trends, fail to consider the gains or losses non-users experience from knowledge of improvements or deteriorations in the quality or character of the estuary, and provide no insight into the indirect impacts of these activities on other sectors.

Some of these shortcomings can be partially remedied with information recently available in the "1985 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation" from the US Fish and Wildlife Service. This survey indicates that annual participation in saltwater fishing has been growing at a statistically significant rate of over 3% nationally since 1965 (the first year their survey results are reported). Saltwater fishing is clearly an important recreational activity in North Carolina. Table V-3 highlights some of the results of the 1985 North Carolina saltwater fishing survey. Nearly 800,000 people are estimated to have participated in the activity in 1985; over 60% of those were state residents.

TABLE V-3. Saltwater Fishing in North Carolina in 1985. From US Fish and Wildlife Service.

Fishing Trips, Days of Fishing, Fishermen, Mode of Fishing	Residents	Nonresidents
Total		
Fishermen	503.9	294.2
Trips	3973.2	738.6
Days of Fishing	5401.8	1568.0
Average One Way Distance Per Trip (Miles)	82.5	163.0
Type of Water Used (Fishermen)		
Deep Sea (more than 3 miles off shore)	86.3	42.0
Off Shore (.2 to 3 miles off shore)	52.8	41.7
Surf and Shore (less than .2 miles off shore)	344.7	207.3
Sounds and Bays	151.7	68.6
Tidal Rivers and Streams	39.3	---
Mode of Fishing (Fishermen)		
Party or Charter Boat	33.2	46.2
Private or Rental Boat	147.1	65.4
Surf or Shore	293.5	174.0
Bridge, Pier, or Jetty	287.1	95.7

Except where indicated, these statistics are in thousands of individuals.

Another indirect source of information is boat ownership. Based on an analysis of boat registration in North Carolina, Johnson and Perdue (1986) found 196,269 boats registered in 1984. 45,926 were registered in the coastal counties and a large number (e.g., 12,249 in Wake County) are registered in inland counties near the study area, indicating that great numbers of boats have access to the sounds and their tributaries. It is difficult to determine any trends in registration over the last two decades due to changing registration requirements in that same period. Nevertheless, in the 14-year period from 1970 to 1984, boat registration in the state grew 167%; boat registration within the 22 coastal counties grew 155%. The bulk of this growth occurred inland or in southeastern counties. It is difficult to know how many of these boats are used in recreational fishing, particularly in the area of Carteret County. Based on the estimates of marina operators, Johnson and Perdue (1986) found that an average of 59.1% of the boats in coastal North Carolina marinas were used in recreational fishing. In addition, 22% of the marina operators estimated that all the boats in their marinas were used almost exclusively for recreational fishing.

Using the same data that Smith and Palmquist (1989) employed in their analysis of the demand for sport-fishing, Johnson et al. (1986) reported that most of the recreational boat fishermen interviewed between 1981 and 1982 were not residents of the site county. 28.4% of the boat fishermen interviewed were from the "sound" counties and 52.1% were residents of counties within a three-county radius of the sound, (e.g, "drainage basin" counties). Thus, less than 20% of the fishermen would be estimated to have come from outside this area. By contrast, 45.2% of all bank or fixed structure fishermen came from "sound" counties and 68.7% came from "drainage basin" counties.

In summary, saltwater fishing is an important recreational activity in the study area. An economic model by Smith and Palmquist (1989) indicated that as the quality of fishing increases (improved catches) fishermen are willing to pay more for recreational activities. Boat registration has increased substantially during the 1970s and 1980s. While most of this growth has occurred in the inland counties, many of these boats have access to the study area. The majority of the boats owned in the state are used in some way for recreational fishing. A large percentage of the recreational fishermen are residents of the "drainage basin" counties.

C. 4. Marinas

As the number of boats increase in an area there is a corresponding increase in the number of marinas (any facility which can service and accommodate one or more boats) that support boating activities (gas pumping, repair work, sewage removal, etc.). There have been two recent studies involving marinas, one by Tschetter (1989) and one by the NC Division of Coastal Management (DCM) (1991). Taken together, these reports present a comprehensive overview of marina activities and they are the basis of the following analysis.

There was a significant increase in marina activity during the period 1970 to 1987. "Marinas existed in 9 of the 36 A/P counties in 1970 and in 11 counties by 1980. There were 32 marinas in 1970, 62 marinas in 1980, and 91 marinas in 1987" (Tschetter 1989). The number of marinas has increased by 184% since 1970 however, the development of marinas has been limited to counties which directly border the Albemarle or Pamlico Sounds (Tschetter 1989).

Between 1980 and 1987 DCM granted permits for the construction of 50 new marinas within the A/P study region. Forty-seven of the 50 permits were in five counties: Carteret (23), Craven (7), Pamlico (7), Beaufort (6), and Dare (4) (DCM 1991). Between 1980 and 1987 there was a 36.6% increase in the actual number of boat slips within the A/P region. An examination of the 1987 marina data indicate that over 51% of the marinas were located in just two counties, Carteret and Beaufort (Figure V-5). These two counties plus Dare, Pamlico and Craven Counties account for over 80% of the marinas in the A/P study area. According to Tschetter, this is because all of these counties border Albemarle or

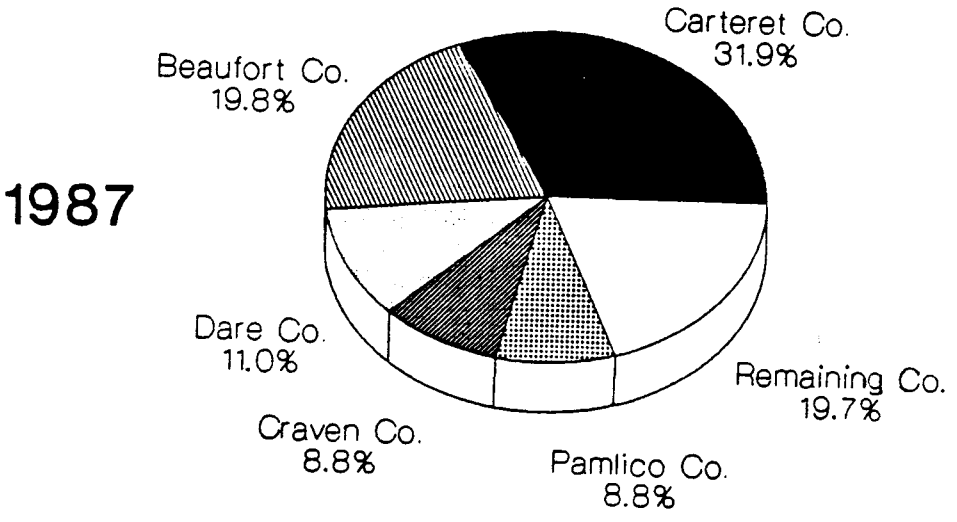


Figure V-5. Distribution by County (1987) of Marinas in the A/P Study Area. From Tschetter (1989).

Pamlico Sound and are on the Atlantic Intracoastal Waterway (Tschetter 1989). Marinas are an important source of jobs and revenues for the counties bordering the sounds. A study by Johnson and Perdue (1986) indicated that in 1985 total revenues from marinas were estimated to be $23,427,000, of which $3,950,000 was the result of tourist or non-resident activities. The same study noted that among marina operators interviewed in 1985, 42.8% had added employees in the years from 1982 to 1985, accounting for a growth of between 10 and 30% of the full-time equivalents as of 1985 (Johnson and Perdue 1986).

There is a strong link between marinas and the recreational fishing industry. In 1985, $13,750,000 of the total marina revenues were attributed to recreational fishing activities. On average, boats engaged in recreational fishing accounted for 59.1% of the boats found in marinas. Commercial boats (e.g., commercial fishing and charter/headboats) accounted for 7.9% of the boats found in the surveyed marinas. Over half the marinas surveyed estimated that over 60% of their business was attributable to recreational fishing (Johnson and Perdue 1986).

In summary, the number of marinas found in the A/P study area is increasing; however, the majority of the marinas are found in 5 counties. As the recreational boat industry continues to grow in popularity, marina construction will likely increase to meet increased demand. Marinas provide substantial revenues for many of the counties that border the sounds. Recreational fishing activities are an important component of the marina industry.

A study of marinas conducted by the NC Division of Environmental Management (DEM) (1990) entitled "North Carolina Coastal Marinas: Water Quality Assessment" did not suggest any widespread water quality degradation due to marina operation. In 1988 DEM estimated that 1.089 acres of estuarine waters in the A/P region were impaired by marinas (NC DEM 1989), an area that represents

only roughly 1% of the impaired estuarine waters. Marina activities can, however, have substantial impacts on local water and sediment quality, particularly in small rivers or embayments (Nichols et al. 1990). Riggs (In Press), in a study of the organic-rich muds of the Neuse River Estuary, found significant enrichment of many trace elements and heavy metals in the sediments around coastal marinas. The nearly automatic closure of shellfish beds in the immediate vicinity of marinas indicates that problems of fecal coliform contamination from marinas are common. Marinas can also spark controversy over issues of access to and ownership of public trust bottomland area.

C. 5. Travel and Tourism

Already one of the larger industries in North Carolina, tourism is likely to grow within the next few years to become the largest, surpassing textiles, furniture, and tobacco. In this analysis, tourism is considered a direct use of the estuarine system, although it is a non-extractive activity. As noted previously in the population section, travel-related activities can cause an area's population to increase many times that of the permanent population. Seasonal populations can create economic havoc with businesses, and pose significant problems for the small local governments found throughout the A/P Study area. The tremendous influx of seasonal residents represents a severe strain on the carrying capacity of the sound and coastal areas. The seasonal populations, however, represent a much needed boost for the economies of this region. This point is addressed in the following discussion.

More than 227,000 North Carolinians, or 10% of privately employed workers in North Carolina are employed in businesses that serve tourists. Other areas of the economy, retail trade for example, also owe a portion of their earnings to travel-related expenditures. Estimates indicate that each travel dollar yields another 79 cents of spending as it moves through the economy of the state. If one includes secondary economic impacts, travel related jobs support another 112,000 jobs state-wide (Armingeon 1989). Much of the growth in the tourism industry is occurring in the A/P study area. Dare County, the state's leader in the tourism industry, generated $18,607 in travel revenues for each permanent resident in 1986. When that figure is compared to the state's average, $805 per resident, it is easy to realize the economic impact that tourism is having on the coastal area (Armingeon 1989).

The first analysis of this section will focus on the A/P counties' share of the total travel and tourism expenditures from 1971 to 1987. The next analysis will examine the impact of travel and tourism on the economies of select A/P counties. The Division of Travel and Tourism, in the North Carolina Department of Commerce, compiles and publishes an annual travel study. Those reports provided the data for this discussion. In order to adjust for inflation, revenues were adjusted to 1984 dollars (1984=100) using the Consumer Price Index (CPI).

Tourism provides substantial revenues to the A/P counties. In 1982, revenues exceeded $1.1 billion (32.4% of the state total) in the 36 A/P counties (Figure V-6) and in 1987 revenues exceeded $1.8 billion (32.3% of the state total) (Figure V-6). The financial impacts from tourism, however, vary from county to county. Dare and Currituck Counties, both "coastline" counties, present a contrasting picture. The revenues of Dare County have increased steadily since 1971, reaching $347 million in 1987. Travel revenues in Currituck County have fluctuated and are well below those of neighboring Dare County.

Tourism revenues in the "sound" counties are well below those of Dare County. Beaufort County experienced decreasing revenues during the study period, although the county's 1987 total was double that of Currituck County. Revenues in Pamlico County were well below those of other counties, although they appear to be increasing. If the recreational boating industry continues to increase, tourism revenues in the "sound" counties should also increase.

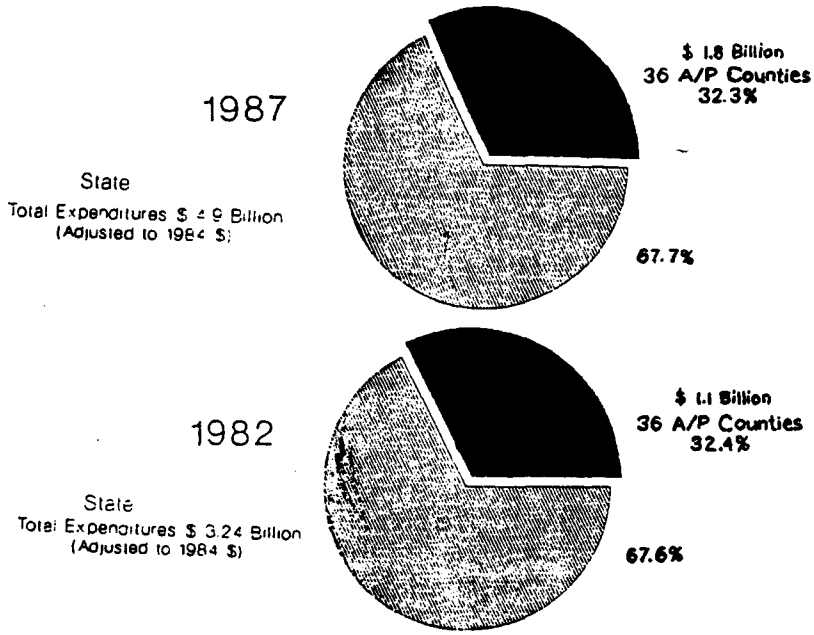


Figure V-6. Travel and Tourism Expenditures in NC A/P counties, 1982 vs. 1987. From NC Travel and Tourism (1983, 1988).

One would expect the tourism revenues in "drainage basin" counties to be well below those of the traditional recreational areas such as Dare and Currituck Counties. This analysis, however, does not support that assumption. Annual travel revenues in Wake County have risen steadily to $450 million in 1987. Although these revenues do not represent the substantial per capita share as some of the smaller counties, these revenues are important to the local economy. Lenoir County, located midway between the central region of the state and the coast, has also experienced rising travel revenues.

In summary, the travel and tourism industry is an important industry in the A/P study area. In 1987, the share of these revenues in the A/P counties was over 30% of the state's total, representing a $1.8 billion economic boost to the area. The share of the tourism expenditures vary from county to county, however, it appears that this industry will continue to increase and provide much needed revenues for some of the smaller, rural counties.

D. INDIRECT USES OF THE ESTUARINE RESOURCES

The term "indirect use" does not imply that these human activities cannot seriously affect the environmental quality of the region. To the contrary, many of the indirect uses, while not dependent upon the sounds, have a greater potential for effecting the A/P system than the aforementioned direct uses. One reason is that the magnitude of indirect activities around the sounds is far greater than that of the direct uses.

Measuring the trends in indirect economic and social activities taking place in the study area is a difficult task. As noted at the outset, no systematic programs of research have been in place or are underway to assemble, maintain and analyze these data. Consequently, these efforts have been limited to what could be prepared using readily available data from published sources. An analysis of the trends will consist of two components.

The first component regards the measurement of the real level of economic activities in each of the sectors selected for discussion. For this analysis two types of measures were developed. The first of these is based on annual payroll expenditures reported by standard industrial classification codes by county. The most aggregative one-digit codes were deflated and used to develop a measure of real labor input for many of the indirect activities. Because these sectors are highly aggregated, they will include within them the commercial fishing, seafood processing, marinas, and expenditures on recreation-related equipment, supplies, and services that were discussed as part of the separate consideration of activities directly dependent on the estuary.

In principle, it would be impossible to disaggregate and treat each activity separately by refining the sectoral definitions from one level of one-digit standard industrial classification to the more detailed definitions associated with a higher digit (and therefore finer) classification of industries. This task was beyond the scope of the present exercise. Moreover, the overlap does not markedly detract from our objectives.

The second component regards physical measures of trends in certain activities because many of the indirect uses of the estuarine system, such as agriculture and forestry, are especially difficult to interpret based solely on real payroll trend analysis. These measures are based on historical trends of the indirect activities that surround and/or involve the study area. This analysis is more generalized and deals with factors other than dollar-based economic trends. For example, within the agricultural sector factors such as harvested cropland acreage, livestock production, and fertilizer tonnages are examined. In the forestry sector, woodland acreage and pine plantation acreage are discussed. These general trends, when combined with the economic analysis, presents an accurate picture of human activities that affect the A/P system. These analyses are not all inclusive, nor are they intended to infer a "cause and effect" relationship. Rather they are simply tools to be used by managers in implementing future management schemes for the area.

One final note regarding these data. One of the most important factors influencing any activity within the A/P region is rapid population growth. The trends presented here are sensitive to the population base from which the growth takes place. In other words, as population increases many of these trends would mirror this expansion.

D. 1. Real Payroll Trends of Indirect Uses

The most readily available and comparable measure of economic activity at the county level is the level of payroll expenditures by sector for each county. These data are available in current dollar terms and reflect (on an annual basis) the expenditures for employment of personnel in each sector. Because inflation will affect the level of wage rates and in turn the dollar expenditures for labor inputs, it is important to adjust these figures for the movement in wage rates over time. This provides an estimate of the level of real activity as reflected by the payroll expenditures in each sector in constant dollar terms.

We developed a specific index of wage movements in North Carolina using the average weekly earnings in the fourth quarter of each year and evaluated payroll expenditures from 1975 to 1986 by sector and county. The statistics reported in Figures V-7 and V-8 are deflated to 1967 dollars based on this index. The definition of the sectors is given in Table V-4. The sources for the information used in

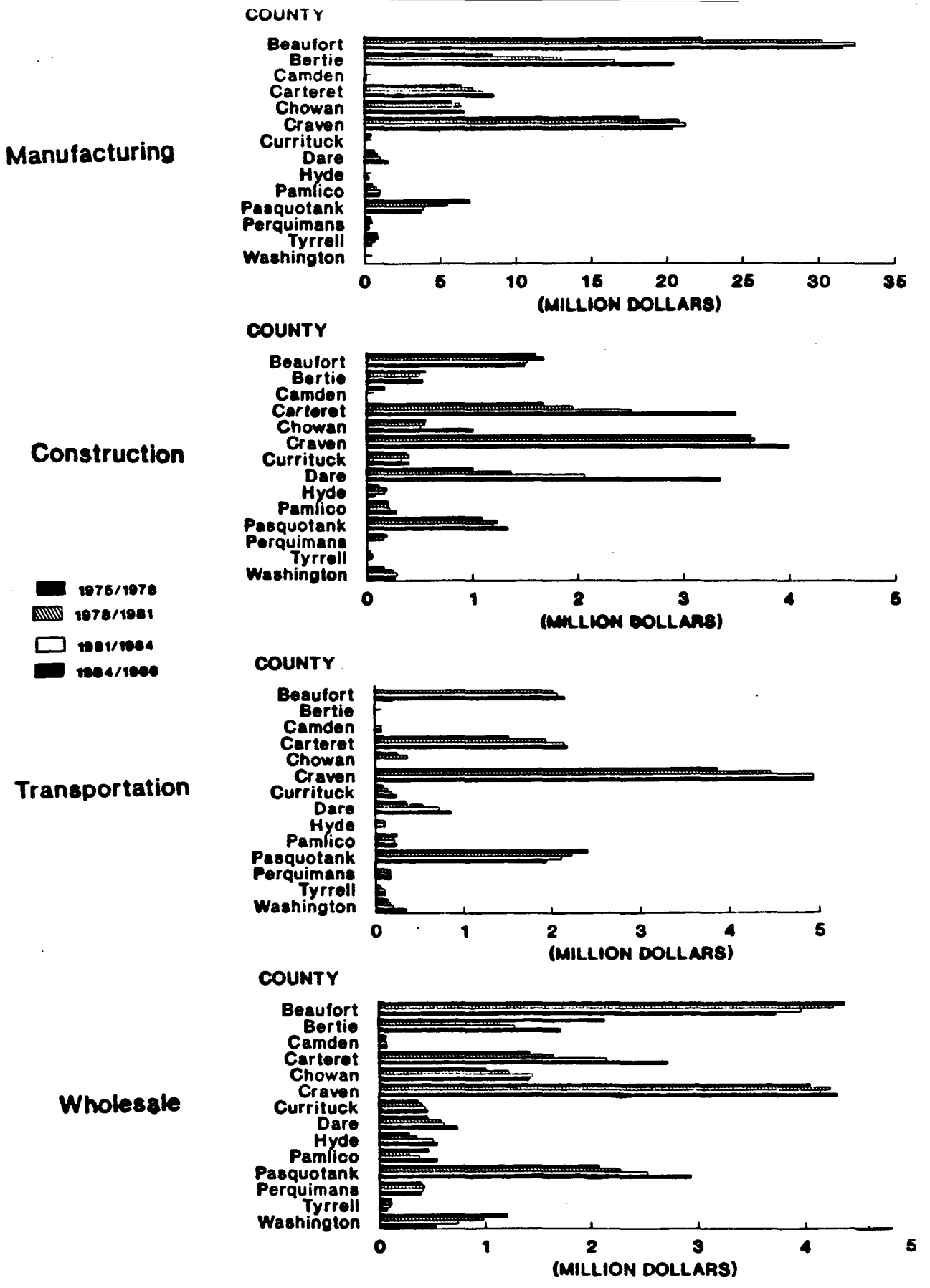


Figure V-7. Average Value of Real Payroll for Manufacturing, Construction, Transportation, and Wholesale Sectors of the Economy in A/P Counties.

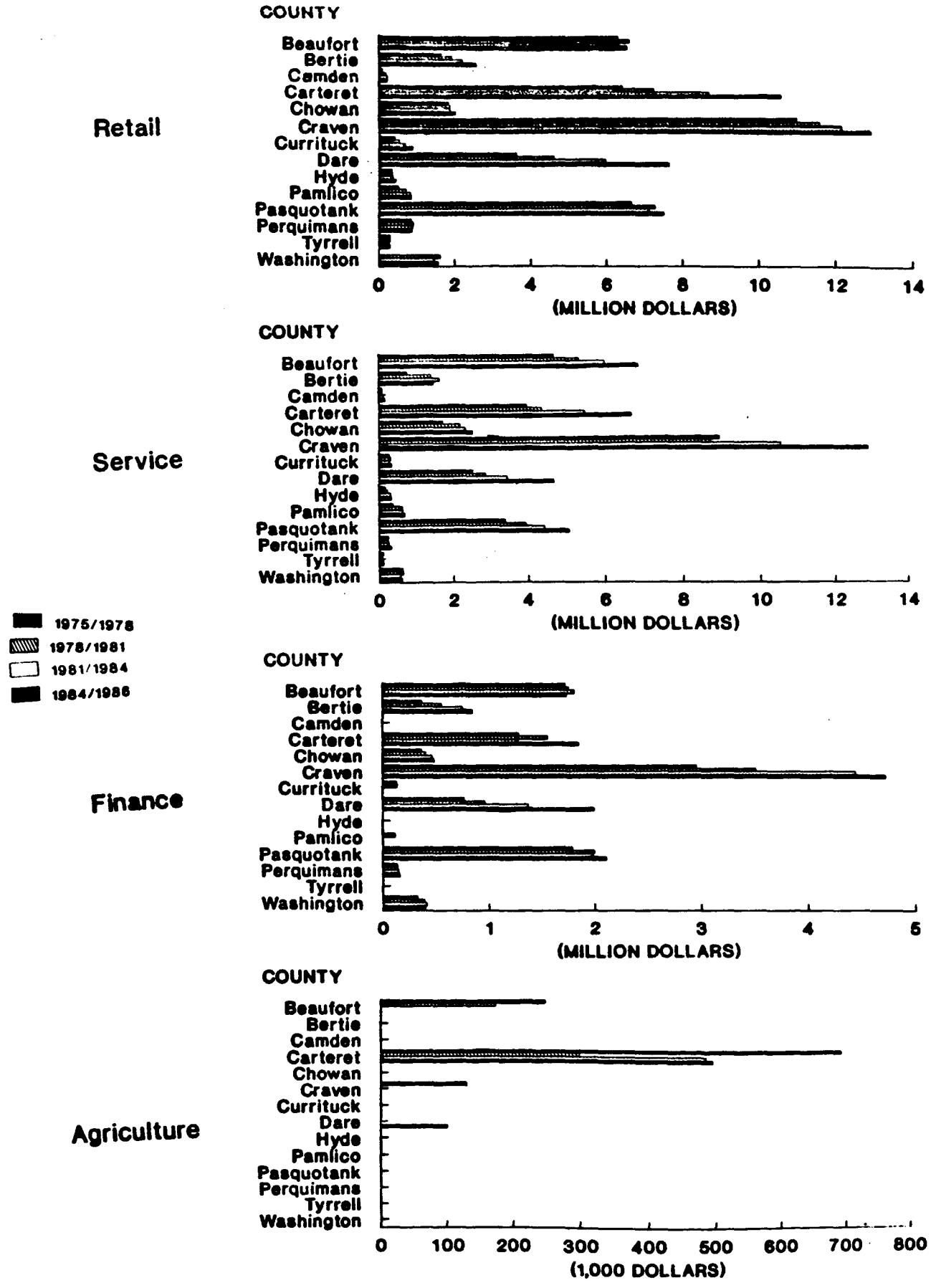


Figure V-8. Average Value of Real Payroll for Retail, Service, Finance and Agriculture Sectors of the Economy in A/P Counties.

TABLE V-4. Definition of Sectors. Office of Management and Budget (1972)

Sector	Description
Agriculture	This division includes establishments primarily engaged in agricultural production, forestry, commercial fishing, hunting and trapping, and related services.
Construction	This division includes establishments (or kind-of-activity units) primarily engaged in construction. The term "construction" includes new work, additions, alternations, and repairs. Construction activities are generally administered or managed from a relatively fixed place of business, but the actual construction work is performed at one or more different sites which may be dispersed geographically. If a company has more than one relatively fixed place of business from which it undertakes or manages construction activities and for which separate data on the number of employees, payroll, receipts, and other establishment-type records re maintained, each such place of business is considered a separate construction establishment. Each legal entity is considered a separate establishment, even where two or more legal entities carry out construction activities from the same place of business.
Manufacturing	This division includes establishments engaged in the mechanical or chemical transformation of materials or substances into new products. These establishments are usually described as plants, factories, or mills, and characteristically use power driven machines and materials handling equipment. Establishments engaged in assembling component parts of manufactured products are also considered manufacturing if the new product is neither a structure nor other fixed improvement. Also included is the blending of materials such as lubricating oils, plastics, resins, or liquors.
Transport	This division includes establishments providing to the general public or to other business enterprises passenger and freight transportation, communication services, electricity, gas, steam, water or sanitary services, and the US Postal Service.
Wholesale	This division includes establishments or places of business primarily engaged in selling merchandise to retailers; to industrial, commercial, institutional, farm, or professional business users; or to other wholesalers; or acting as agents or brokers in buying merchandise for or selling merchandise to such persons or companies.
Retail	This division includes establishments engaged in selling merchandise for personal or household consumption, and rendering services incidental to the sale of the goods. In general, retail establishments are classified by kind of business according to the principal lines of commodities sold (grocers, hardware, etc.), or the usual trade designation (drug store, cigar store, etc.). Some of the important characteristics of retail trade establishments are that: they are usually a places of business and are engaged in activities to attract the general public to buy; they buy or receive and sell merchandise; they may process their products, but such processing is incidental or subordinate to selling; they are considered as retailers; and they sell to customers for personal or household use. Not all of these characteristics need be present, and some are modified by trade practice.

TABLE V-4. Definition of Sectors (continued)

Finance	This division includes establishments operating primarily in the fields of finance, insurance, and real estate. Finance includes banks and trust companies, credit agencies other than banks, holding (but not predominantly operating) companies, other investment companies, brokers and dealers in securities and commodity contracts, and security and commodity exchanges. Insurance covers carriers of all types of insurance, and insurance agents and brokers. Real estate includes owners, lessors, lessees, buyers, sellers, agents, and developers of real estate.
Service	This division includes establishments primarily engaged in providing a wide variety of services for individuals, business and government establishments, and other organizations. Hotels and other lodging places; establishments providing personal, business, repair, and amusement services; health, legal, engineering, and other professional services, educational institutions, membership organizations, and other miscellaneous services are included. Establishments which provide specialized services closely allied to agriculture, mining, transportation, etc., are classified in their respective divisions.

developing these comparisons is given in the Data Source Bibliography. The values for the wage index to adjust for wage inflation are given in Table V-5. In examining Figures V-7 and V-8, it is important to note the scale on the horizontal axis describing the real level of activity. It switches depending upon the magnitude of the activity between millions of dollars and thousands of dollars.

The most important sector in terms of level of activity in the coastal areas is the manufacturing sector, with the results given in Figure V-7. The most important counties with manufacturing sector activities are Beaufort, Craven, and Bertie. Beaufort County has experienced uneven but progressive growth in the size of real payroll expenditures to over $30 million (in 1967 dollars) by 1984-86. This represented a slight decline over the 1981-84 period, but was still substantially above levels realized in earlier periods. Craven County demonstrated initial growth between 1975-78 and 1978-81 and relatively stable activity thereafter. Bertie County experienced a more consistent growth rate rising from about $8 million (in constant dollars terms) to just over $20 million by the end of this period, making it comparable to the level realized in Craven by 1978-81. The levels of manufacturing activity in the other counties are substantially below those for Beaufort, Craven and Bertie. Carteret, Chowan and Pasquotank Counties experienced much more modest levels of activity, with Carteret and Chowan between $5 and $10 million and Pasquotank declining from over $5 million to about $3 million (in constant dollar terms) at the end of this period.

Table V-5. Values of Wage Deflator for North Carolina (Base - 1967)

Year	Wage Deflator (1967 - 1.000)
1975	1.701
1978	2.074
1981	2.704
1984	3.124
1986	3.438

Source of Wage Index: Table C (Average Weekly Earnings per Insured Worker by Quarter and Industry Division) in "Employment and Wages in North Carolina," Fourth Quarter, Labor Market Information Division, Employment Security Commission of North Carolina

The second sector to be considered is the construction sector, which is presented in Figure V-7. Here we find the most dramatic growth rates in the counties experiencing substantial population growth. Carteret and Dare Counties each have over $3 million in real payroll expenditures by the close of the time period for our analysis. Both represent consistent patterns of growth from 1975 to 1976, with somewhat faster initial growth in Dare County. Of course, Craven County has had the highest level of construction activity, but has experienced little growth in real terms. At the close of the period, there was an increase of $4 million in real terms. Beaufort County has a fairly steady level of activity around $1.5 million in real terms, with a slight decline from peak experience in the 1978-81 period. Pasquotank County experienced some slight growth, but the level of real payroll in this sector never exceeded $1.5 million over the full period of our evaluation. Some growth was experienced toward the end of the

period in Chowan County. In the remaining counties, the value of real payrolls in construction activity is much more limited.

Growth of the payroll in the transportation sector (Figure V-7) is also concentrated. Craven County experienced considerable growth in the transport sector until 1981-84, realizing nearly $5 million in real payroll, but remaining at that level until the close of the period. Beaufort County has had a relatively steady level of activity as measured by real payroll. Pasquotank County experienced substantial decline from nearly $2.4 million (in real dollar terms) to under $2 million by the close of the study period. The data indicate modest increases in the level of real payroll in Dare County following the population growth in that county.

The wholesale sector tracks the level of manufacturing activity which was found to be concentrated in Beaufort and Craven Counties (Figure V-7). However, the level of this activity is steadily declining in Beaufort County from a high exceeding $4 million (in real dollar terms) in 1975 to below $2.8 million by the close of our study period. Craven County experienced some growth over the full period, with a slight downturn in 1981-84 and a subsequent recovery to a record level of nearly $4.5 million at the end of the study period. Carteret, Chowan, and Pasquotank Counties experienced some growth over the period, with Carteret and Pasquotank rising to nearly $3 million (in real dollar terms) in a steady pattern beginning in 1975. Chowan County increased at a slower pace, with nearly $1.5 million of real payroll activity in the wholesale sector.

The retail sector (Figure V-8) also tracks population growth and the level of manufacturing activity. This correspondence with population growth is an example of the interdependency mentioned earlier. Of the four counties experiencing the greatest levels of activity by the close of the period, three had either the largest growth in population or high levels of manufacturing activity. Craven County is once again the county with the highest level of activity and displays a consistent growth rate over the period. Carteret County experienced a fast rate of growth from just over $6 million in real terms in 1975, to nearly $11 million in 1986. While the levels of activity are not as high in Dare County, the rate of growth appears to correspond to the growth in population, with the closing level of real activity approaching $8 million. In contrast, while the activity of the manufacturing sector has been largely stable since 1981 in Beaufort County, the retail sector is equally stable. Similarly in Pasquotank County, while construction activity and the transport sector have remained stable or slightly declining, the retail sector has also approximately stable. Other counties have experienced much lower levels of activity. Only Bertie County experienced modest growth over the study period, growth that appears to correspond to the growth of the manufacturing sector.

The service and finance sectors are other cases where we would expect to find activities in support of either population growth or growing levels in the other sectors, and that is exactly what we find on a county-by-county basis. Those experiencing the most dramatic growth in the other sectors, in population, or both, have correspondingly large growth in the service and finance sectors (Figure V-8). The leader for the service sector is Craven County with Beaufort and Carteret Counties distant seconds, and Dare and Pasquotank experiencing steady growth from lower levels. The record is more uneven in the other counties, with Chowan and Bertie experiencing more modest levels of activity in the service sector. For Craven County the level of real activity was nearly double that of Carteret and Beaufort Counties by the end of the study period.

Craven is once again the leader for the finance sector (Figure V-8) with over $4 million in real payroll by the end of the period. Pasquotank has the second highest level of activity, with nearly comparable levels in Beaufort, Dare and Carteret Counties by the end of the period. Indeed, the record is approximately steady in Beaufort County and somewhat uneven in Carteret County.

The last sector to be considered is agriculture (Figure V-8). Note that only corn, wheat, and soybeans are considered in this analysis and that only those counties exhibiting statistically significant patterns of

growth are recorded. Here the real payroll data suggest a rather small level of economic activity in agriculture for the "coastline" and "sound" counties. Only Carteret County has a high level of activity, and this appears to be declining over time from nearly $700,000 in real payroll activity at the beginning of the period to under $500,000 by the end of the period. This is only about 1.5% of the activity measured in these terms attributable to the manufacturing sector in Beaufort County. A pattern of decline is also apparent in the case of Beaufort County, with activity recorded for 1975-78 and 1978-81. Following that, there was nothing large enough to be recorded.

In summary, in the "sound" and "coastline" counties that were analyzed, there are highly concentrated patterns of activity in manufacturing. It also appears that the nature of activities taking place in the coastal zone is moving away from agriculture and forestry activities. Retail, service and finance and supporting activities appear to be more diversified. Construction is concentrated in those counties where population growth or the largest growth in a composite of sectors has occurred.

What do these economic patterns imply for the future? Because the pattern is in many cases mixed, it is difficult to formulate clear-cut expectations. Nonetheless, a few judgments do seem possible with these data. The bulk of the growth in economic activity, to the extent that it is taking place, is concentrated in less than five coastal counties. Craven County appears to be the most consistently high in terms of level of activity and usually in the pattern of growth. Population increases and economic activities do go hand-in-hand. Thus to the extent we have better demographic records than economic records, it is reasonable to assume that the counties experiencing rapid population growth will experience increased economic activities.

This economic analysis has singled out coastal zone counties and broad sectors experiencing growth. All of the counties with high levels of activity (in relative terms) and consistent growth patterns are potentially important contributors to the overall estuarine quality. These impacts have the potential to improve the economic growth of the region, however, as is the case of many human activities, these activities can cause environmental degradation of the sounds.

D. 2. Physical Measures of Indirect Uses

D. 2. a. Agriculture. Agriculture is the largest industry in the 28 counties of the central and northern coastal plain of North Carolina. It accounts for over 40% of North Carolina's gross farm receipts, contains 45% of the state's cropland, 50% of the state's hogs, and 40% of the state's chickens (NC NRCD 1987). Although the environmental impacts of agriculture on the sounds are not well understood, concerns about water quality problems associated with cropland runoff and animal waste do exist. Row cropping is a principal source of sediment as well as nutrients and pesticides in the A/P study area. Studies have shown that there is a statistically significant relationship between the amount of manure generated in a watershed and the mean concentration of nutrients in nearby streams (Humenik and Foreman 1984, Nichols et al. 1990)

There is an important qualification to the use of real payroll as a measure of trends taking place in the agricultural sector. The nature of production activities in this sector, as well as its evolution over time, indicates that measures of labor inputs used may be declining as outputs are increasing. Ideally, one would like to evaluate the trends in output measures for all sectors -- but detailed time series information was not available at the county level. For many sectors, such as agriculture, supplementary information is available to aid in further trend analysis. The North Carolina Department of Agriculture publishes annual reports for most of the agricultural activities within the state, and these reports provided the data for the following discussion.

Harvested cropland for the 36 North Carolina A/P counties rose steadily through the 1970s and peaked in 1980 (Figure V-9). Since that time, acreage in production has fallen. This decline is probably

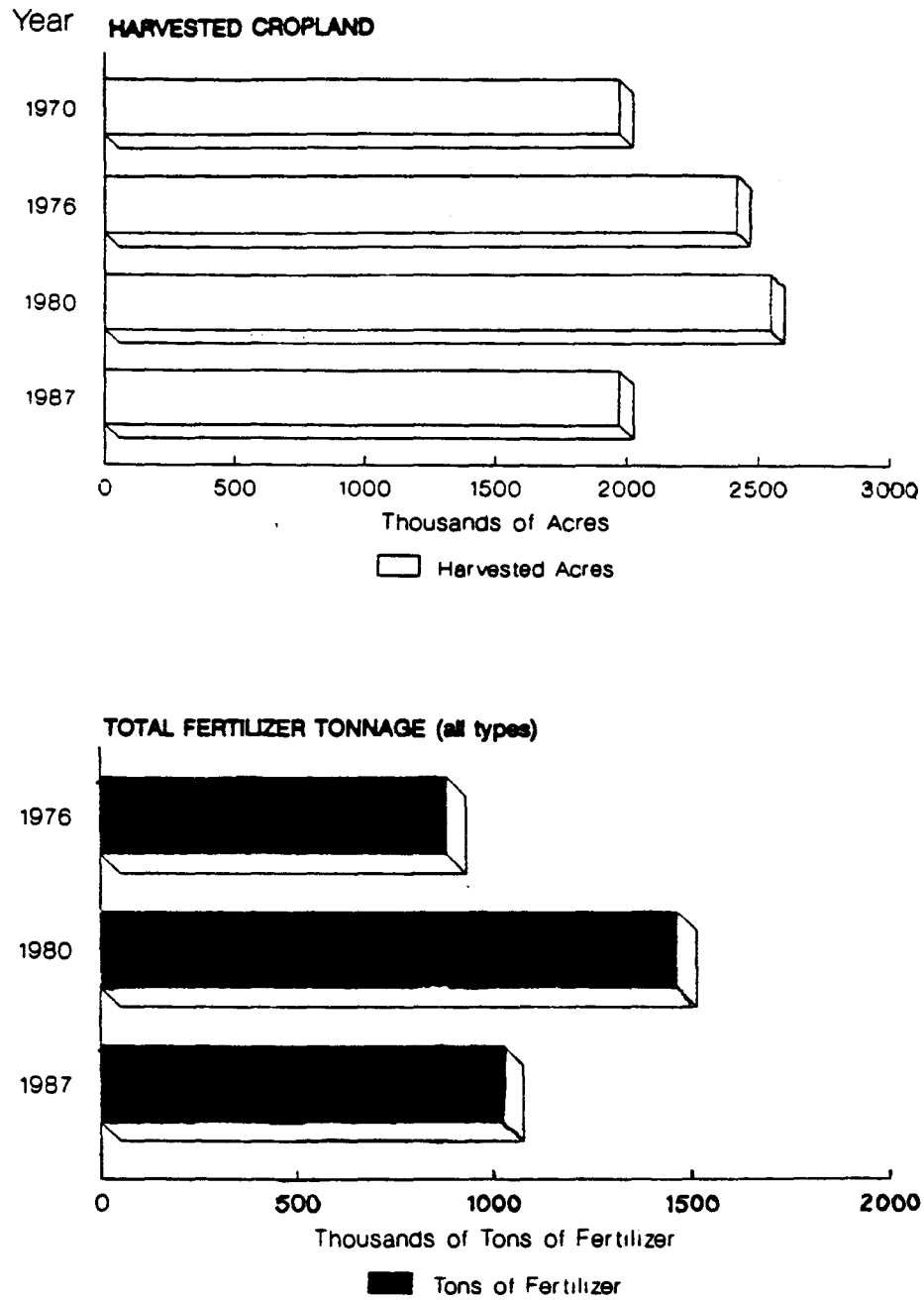


Figure V-9. Acres of Harvested Cropland and Total Fertilizer Tonnage Shipped to the 36 A/P Counties. From NC Department of Agriculture.

an indication of world-wide agricultural trends rather than state-wide trends. A more detailed analysis seems to support this conclusion. From 1970 to 1987, the A/P counties' share was about 50% of the total NC acreage in production. Despite declining acreage, the region's share of the state-wide total of harvested cropland has remained steady for the past 17 years. To further define agricultural acreage trends, three major crops--corn, wheat, and soybeans--were considered.

Wheat appears to be the only crop with consistent growth in acreage between 1975 and 1986 in the coastal counties. Corn and soybeans, in general, exhibited no growth or modest levels of growth in the amount of acreage dedicated to their production (NC DOA, Nichols et al. 1990)

Of course, in interpreting these data it is important to recognize that acres planted will be responsive to economic policy and market conditions. A recent federal policy initiative, the Conservation Reserve Program, might have an important influence on these planting decisions. The program involves targeting land designated as highly erodible for reserve contracts under the program. The contracts involve removing the land from production for ten years. If a farmer accepts the contract, trees or groundcover must be planted at a 50% cost-sharing rate. Land eligible for the program is categorized into pools; each pool has associated with it varying qualifications for the program. Periodically the US Soil Conservation Service reports the number of farms and acres offered and accepted into the program. The number of acres reserved under this program from July 1986 through March 1989 was investigated. A review of the records indicates that the program has had minimal impact on the counties adjoining the Albemarle-Pamlico estuaries. Less than one tenth of one percent of the total acreage accepted into the program in each of eight reporting periods can be associated with the coastal counties. Consequently, the level of the amount of acreage planted by crop does not appear to have been impacted by the Conservation Reserve Program.

One of the major concerns about agricultural nonpoint source pollution of the sounds involves the loading of freshwater with nutrients, particularly nitrogen and phosphorus (NC NRCD 1987). Much of this nitrogen and phosphorus originates from agricultural fertilizer. In 1976 the A/P counties' share of North Carolina's fertilizer consumption was approximately 48%. By 1987, that figure had risen to almost 60% even though harvested cropland decreased by nearly 20%. Beaufort County, directly bordering on Pamlico Sound received the largest share of fertilizer even though it ranked 74th in acres of total cropland (NC DOA). An analysis of fertilizer tonnage shipped to the study area is presented (Figure V-9).

The amount of fertilizer shipped does not necessarily represent the actual amount of fertilizer used during the year, however, according to the NC Department of Agriculture little fertilizer is carried over from one season to the next. As one would suspect, the tonnage pattern closely resembles the harvested cropland acreage graph. The fertilizer tonnage peaked in 1980, at over 1.5 million tons shipped to the region. This amount declined to slightly over 1 million tons in 1987.

Livestock production is another important industry throughout the A/P study area. A recent report by the North Carolina Division of Environmental Management noted that raising of farm animals near the coast is in direct conflict with maintaining habitat for the estuarine biota (NC Division of Environmental Management 1989). This analysis addresses the trends in hog, cattle, and chicken production. These data were obtained from the annual agricultural reports published by the NC Department of Agriculture.

Swine production accounts for the largest proportion of animal feeding operations in the A/P region; these operations often have the most serious water quality impacts (Nichols et al. 1990). Historical hog production trends for the A/P study area indicate that the pattern is similar to that shown in harvested cropland (Figure V-10). Hog production peaked in 1980 and declined in 1987. When these data are analyzed as a share of the state's total hog production, however, a different trend is evident. In 1974, the A/P counties' share of the state's hog production was 22%. In 1980, that share almost doubled to 43%. By 1987, hog production rose to over a 50% share of the state's total figure. By 1990, NC Department

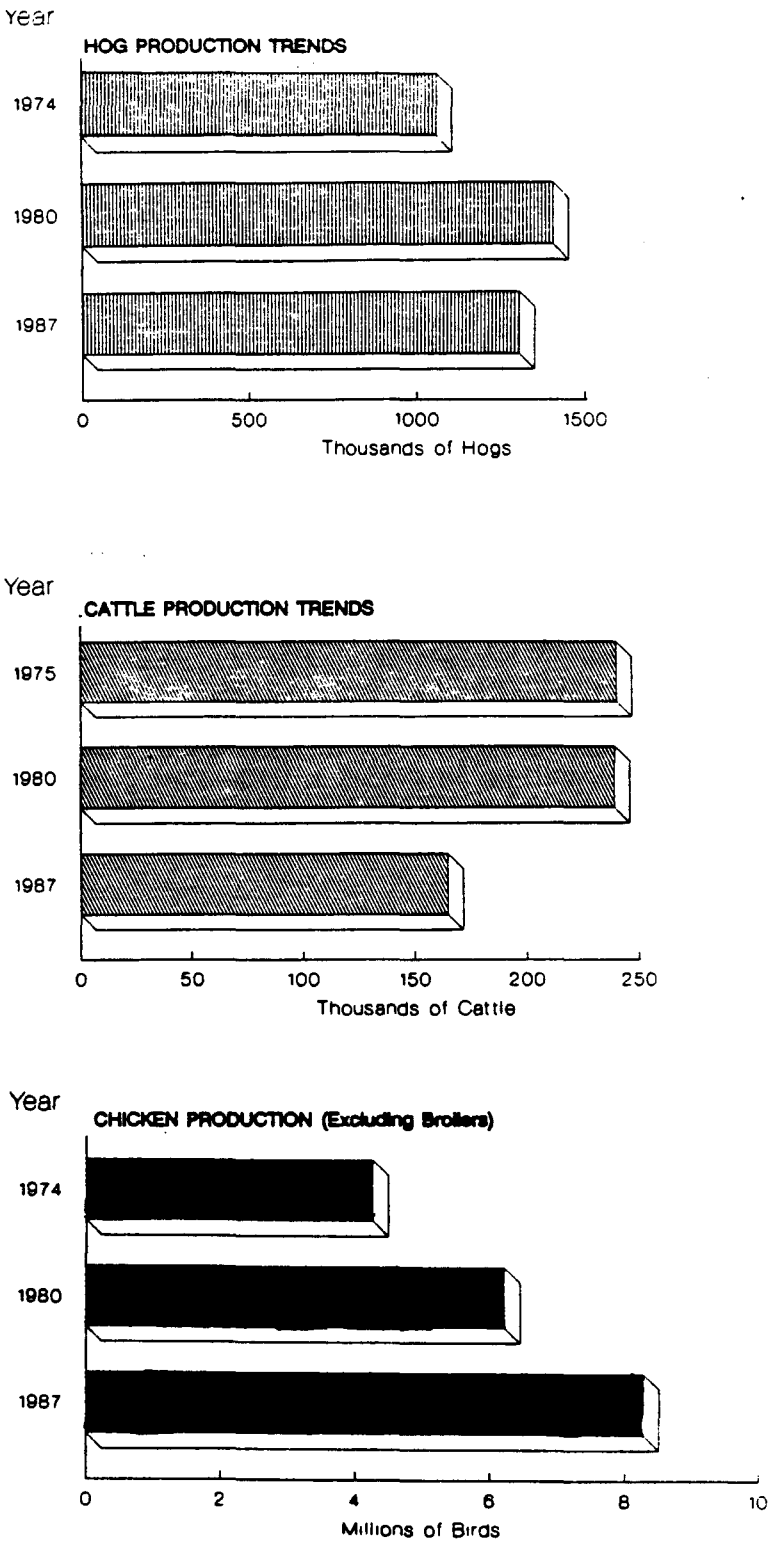


Figure V-10. Production Trends of Hogs, Cattle, and Chickens (Excluding Broilers) in the 36 A/P Counties. From NC Department of Agriculture.

of Agriculture suggested that there were 2000 producers in NC DEM Region 5 (two-thirds of the North Carolina portion of the A/P study area).

Cattle production remained constant from 1975 to 1980, but declined 45% from 1980 to 1987 (Figure V-10). As in the case of harvested cropland, this decline mirrors a nation-wide decline in cattle production. Cattle production is also shown as a percentage of the state-wide total. During 1975, the A/Pcounties' cattle production was 21.4% of the state's total. That share remained constant through 1980 (22.1%), but had declined to 17.3% by 1987.

Chicken production is an important industry in this region of the state. Chicken production (excluding broilers) has risen steadily in the study area since 1974. In 1974 the A/P counties produced 23% of the state's chickens. In 1980 they were producing 32% of the state's chickens. There was a 33% increase in production from 1980 to 1987 (Figure V-10), and by 1987, the A/P counties were producing nearly 40% of the state's chickens.

In summary, the amount of harvested cropland within the study area has declined since 1980. Fertilizer use within the 36 A/P counties is increasing despite the decrease in cropland acreage. In Beaufort County, 1987 fertilizer tonnage rates exceed all other counties in the study area. Hog production is declining slightly; 1987 production represented over half of the state's total. During the study period, cattle production fluctuated. Chicken production has increased steadily throughout the 1970s and 1980s, and in 1987, almost 40% of the chickens produced in North Carolina were produced in the A/P study area.

D. 2. b. Forestry. The current use of the forestland in the A/P Study area is as a base for the production of raw material for the diverse forest products industry. These forests also serve as extensive wildlife habitat. The Southeastern Forest Experiment Station of the US Forest Service maintains an extensive inventory of the woodlands in North Carolina. These data were used for the majority of this trends analysis. Additional data were obtained from the book, "Who Owns North Carolina?" (Institute for Southern Studies 1986).

In 1984, 31.6% of the woodlands in the state were located in the A/P Study area. In general, however, the amount of forested land in the study area is decreasing. This decrease was also evident in the payroll analyses of the forest industry. Correlative output levels could not be obtained, and the pattern implied by data from the period 1973-1984 is unclear. Most of the calculated rates of change in the outputs of softwood and hardwood, however, indicated declining outputs in coastal counties.

Pine plantation acreage was also analyzed. To date, pine plantations in North Carolina have contributed only minor amounts to the supply of timber in the state. That trend, however, is changing. The US Forest Service expects plantations to provide an increasing share of softwood timber supplies in the coming years (USFS 1986). From 1973 to 1984, there was almost a 79% increase in the amount of pine plantation acreage. According to the "Source Document" for the A/P Study, the establishment of pine plantations has the potential for causing degraded water quality. It is a common practice for the forest industry to apply phosphorus during the establishment of a plantation on poorly drained sites. Post establishment application of nitrogen is less widely practiced and the degree of disturbance involving plantation establishment has decreased, but the use of pesticides in pine plantations is still wide-spread (NC NRCD 1987). In summary, in the mid-1980s one third of the state's woodland acreage was located in the A/P counties; however, woodland acreage is decreasing. On the other hand, the amount of pine plantation acreage increased substantially from 1973 to 1984.

D. 2. c. Mining. As of April 1989, there were 252 permitted mines in the A/P Study area (NC DEHNR Division of Land Resources, Land Quality Section). The type of mine operation varies; however, the majority are sand and gravel mines or crushed stone mines. Because of the nature of the permitting process, a mine may be permitted but may not be in operation at this time. Because of the

limitations of this study, no attempt was made to determine how many of these mines are operating nor how many of them might be discharging into a water body. There are, however, some mining operations that are permitted to discharge into the sounds, and they are briefly discussed below.

Mining of phosphate rock and production of phosphate chemicals is presently limited to Texasgulf Inc.'s operations in Beaufort County. The rate of mining is approximately 150 to 200 acres per year. During the course of the mining process, 50 to 60 million gallons/day of freshwater are pumped into the Pamlico Sound. The 1988 nutrient budget for the Tar-Pamlico River system indicated that over 50% of the total phosphorus budget came from the Texasgulf operation (DEM 1989). A new permit issued by the NC Division of Environmental Management should reduce Texasgulf's loading by 90% by 1992 through a recycling process.

There are three peat mines permitted for operation in the A/P region. In 1987, the total acreage permitted was over 3,700 acres, all of which drains into the Pamlico River (N.C. NRCD 1987). There is the potential for tens of thousands of acres of peat mining, however, because the current peat demand is low, there is only limited active mining at this time.

Mining for sand and gravel (construction materials) consists mainly of sand pits scattered throughout the area. Construction materials mines account for over 90% of the mines in the study area. This type of mine is typically shallow (10 to 20 feet deep). The area devoted to construction materials mining varies according to the market and transportation costs. There are no specific data showing trends in this activity.

D. 2. d. Department of Defense. Department of Defense (DOD) activities have a profound affect upon the Albemarle-Pamlico estuarine system (NC NRCD 1987). Defense activities are diverse and include the construction, use and maintenance of the Atlantic Intracoastal Waterway, Cherry Point Marine Air Station, and numerous and dispersed bombing ranges and target areas. A systematic assessment of DOD activities is, as with some of the other sectors, beyond the capacity of this analysis. There are, however, some data available from North Carolina Department of Environment, Health, and Natural Resources (NC DEHNR) that will be used to indicate the amount of defense activity that occurs within the A/P Study area.

Because of national security restrictions, it is difficult to determine the precise acreage covered by DOD activities. In 1987, the Department of Natural Resources and Community Development (NRCD) estimated that DOD facilities encompassed over 96,000 acres within the study area. On much of this land, civilian use is severely restricted or prohibited (Figure V-11). Currently, extensive areas of the sounds are restricted to military aircraft and boat traffic; only narrow corridors remain for public use. With the Marine Corps' proposed expansion in the Croatan National Forest, this restricted-use acreage could increase.

In terms of persons employed and revenues, the DOD is the one of the largest industries in the A/P area, and if the proposed expansions are realized those figures will surely increase. The number of federal military employees in the A/P Study area declined slightly from 30,000 in 1970 to almost 28,000 in 1987. According to the published military economic impacts in North Carolina, Craven and Wayne Counties received more DOD economic benefits than any other A/P county. In fiscal year 1986, the DOD estimated that Wayne County received $210,077,221 in revenues from DOD activities. During the same period, Craven County's share of the DOD expenditures was $476,835,136.

DOD is a major contributor of point source contamination to the A/P estuarine waters. Cherry Point Marine Base, for example, has contributed large quantities of heavy metals to the waters and sediments of Slocum Creek and the Neuse River from its industrial plating, metal cleaning, engine stripping, and sewage discharge practices. Non-compliance with NC water quality standards was found to be common (Riggs In Press).

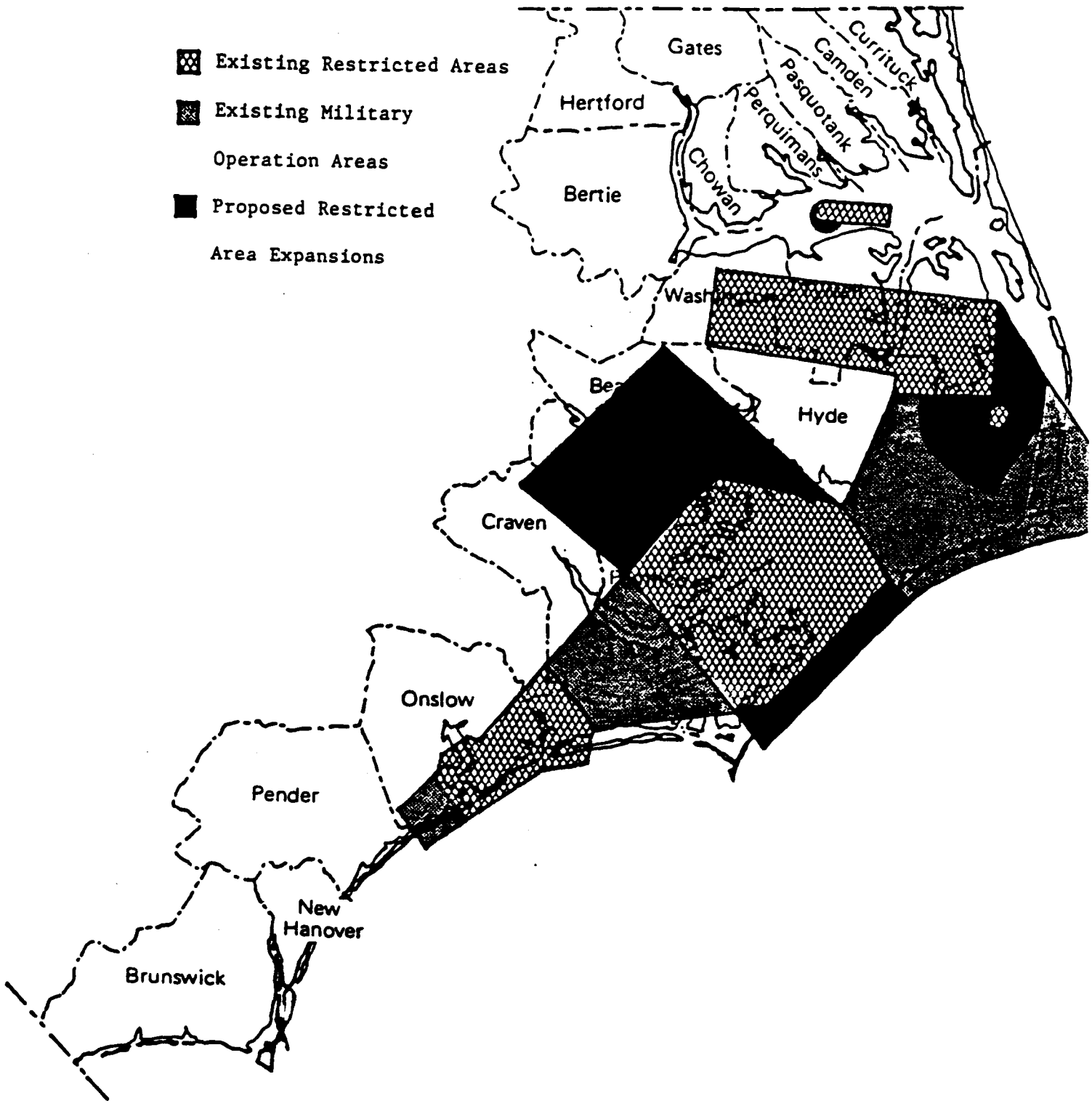


Figure V-11. Existing and Proposed Military Restricted Operation Areas in Eastern North Carolina.

In summary, the DOD is one of the largest single landowners in the A/P region. Although the exact acreage is unknown, it is estimated that DOD activities utilize close to 100,000 acres. The DOD has employed well over 25,000 persons in the A/P area since the 1970s. The DOD has a substantial economic impact in the 36 county study area; however, while localized effects are known, the indirect effects of the DOD's activities on the estuarine systems are not fully understood.

D. 2. e. Waste Disposal. A major use of the Albemarle-Pamlico estuarine system and its tributaries is for the disposal of waste generated by domestic facilities, industrial facilities, and other human activities on the surrounding land. For the purposes of this discussion, "waste" will refer to any material which enters waters of the State of North Carolina through human actions (NC NRCD 1987). Waste disposal within the A/P Study area is a complex topic and cannot be adequately addressed in this limited analysis. The reader is reminded that waste can enter the system through point sources such as pipes or through nonpoint sources such as roadways, agricultural areas, or construction sites. There is little data documenting sources or amounts of nonpoint source runoff, however, there are some data that can be presented to show trends in waste disposal.

The discharge of waste by domestic and industrial facilities is regulated in North Carolina by the Division of Environmental Management (DEM) under the National Pollution Discharge Elimination System (NPDES) permit program. The reconstruction of temporal trends in waste disposal in the A/P region is difficult because NPDES permit information contains both active and inactive permits. ("Inactive" refers to permitted facilities that are not actually discharging waste). Nearly half of all permits represent small domestic dischargers such as schools, prisons, and private residences. The vast majority of the waste volume, however, is discharged by municipal wastewater treatment plants and industries. Figure V-12 shows the approximate location of the NPDES permits in the North Carolina portion of the study area.

NPDES temporal data for the 36 North Carolina counties were obtained from the NC DEM data files. Based on these data, it is evident that NPDES permitting has increased steadily since 1973. Much of this activity has taken place since 1980. From 1980 to 1987 the number of NPDES permits increased nearly 2.5 times to 600 dischargers permitted to release up to 368 million gallons per day. It should be noted that approximately one-half of the permits issued during the 1980s are now "inactive". Actual discharges were roughly 65% of the permitted total. Wastewater discharges from permitted activities can have a substantial impact on the receiving water bodies. In the Tar-Pamlico River in 1988, 14.9% of the nitrogen budget and 25.2% of the phosphorus budget originated from wastewater treatment plants.

Due to the changing character of land uses, it is difficult to determine trends for nonpoint source waste disposal. A 1982 DEM study indicated that over 75% of the nitrogen and phosphorus loads in the Chowan River originated with nonpoint source discharges. The levels of nutrients contained in nonpoint sources can be estimated from information such as cropland acreage, crop type, and management practices, however, this type of estimate is well beyond the scope of this analysis.

In summary, whereas waste disposal throughout the A/P area is extensive, the true impacts of these practices is unknown. The number of NPDES permits issued in the region has increased dramatically since the early 1970s, but approximately 50% of the permits are presently inactive. Because nonpoint pollution is dependent to a large extent on land uses, it is difficult to determine trends for this type of waste disposal.

D. 2. f. Automobile/Transportation. Since World War II, the number of cars in this country has grown dramatically. Today, many households have two or three cars. Fueled by relatively cheap gasoline and a subsidized road network, human activity has spread out in the low density pattern that is often labeled "sprawl" (Chesapeake Executive Council 1989). Due to shifting development patterns and economic need, owning and operating a car has changed from a luxury to a necessity. In a largely rural area such as the A/P region, employment opportunities are limited. In 1984, over 56% of the persons

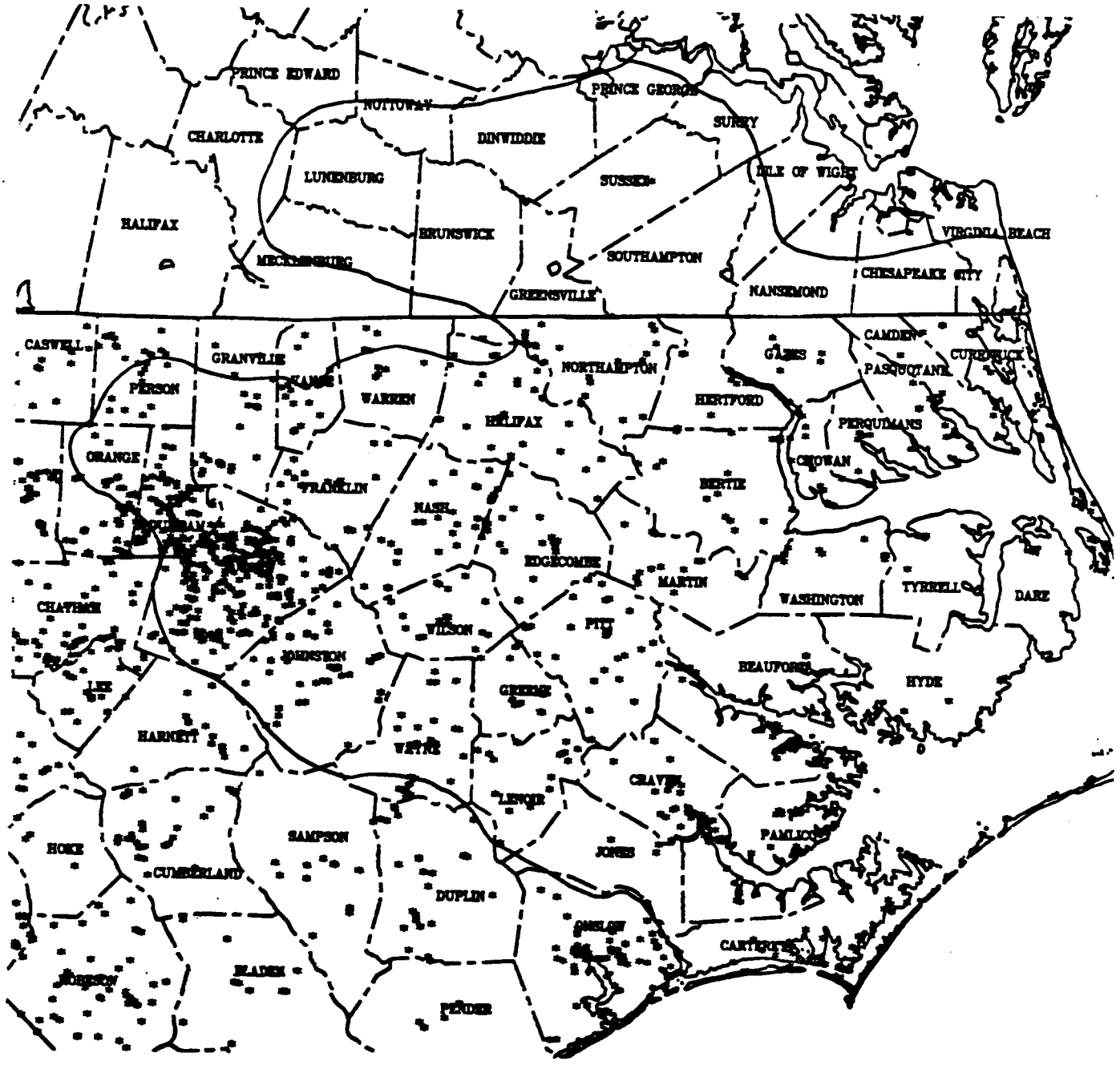


Figure V-12. NPDES Discharge Locations in the North Carolina portion of the A/P Study Area, 1989. From NC Land Resources Information Service.

residing in the Albemarle area found employment outside of the region (Albemarle Regional Planning Commission 1987). Much of the commuting to jobs outside the local area is dependent upon automobile travel. As with many of the human activities previously described, there are environmental impacts associated with this dependence on automobiles.

In communities of low density, such as those found throughout the A/P region, a single automobile can produce 147 pounds of carbon monoxide, 18 pounds of hydrocarbons, and over 17 pounds of nitrous oxides (Chesapeake Executive Council 1989). In a 1989 report, the DEM estimated that 18.6% of the nitrogen budget in the Tar-Pamlico River originated from atmospheric deposition. The same study estimated that 5.5% of the phosphorus in the basin also came from atmospheric deposition. Some of these atmospheric contaminants originate from automobile emissions. The environmental impacts of automobiles are not only due to airborne pollutants; runoff from paved surfaces such as highways and parking lots contain heavy metals, hydrocarbons, and sediments. These too, have the potential to degrade the water quality of the sounds.

In 1984, there were 22,430 miles of primary and secondary roads in the A/P study area. This figure was approximately 30% of the state's total. To determine automobile ownership patterns in the region, the change in the number of vehicles registered was compared to the change in population growth. The results of this comparison are shown in Figure V-13. In the decade from 1970 to 1980, the population in the region increased by slightly more than 11% while vehicle registration (cars and trucks) increased 56.8 percent. From 1980 to 1988 the population increase was estimated at 10.3 percent, however, the increase in vehicle registration was over 6 times that figure, or 65 percent. It seems that multi-vehicle ownership is quite common throughout the A/P study area. In many families both parents work at jobs great distances from the home, necessitating more than one vehicle.

As noted earlier, the coastal zone is experiencing growth that exceeds much of the remainder of the state. The increasing populations are taxing many public facilities including water supplies and wastewater treatment facilities. This growth is also affecting the road system in the region. In order to determine how growth is affecting the highway network, the North Carolina Department of Transportation (NC DOT) selected 11 sites along major highways leading from the central portion of the state to the coast. Most of the sites were located near a municipality and ranged from the northern to the southern boundary of the study area. Traffic counts (average 24 hour day-all vehicles) are maintained by the NC DOT. During the period from 1975 to 1983, average traffic counts increased at the majority of the study sites. These increases ranged from 117% at the bridge over Currituck Sound to only 8% at US 13/64 near Williamston. Only two sites experienced decreases in traffic counts. For the period from 1983 to 1985, all 11 sites experienced an increase in traffic, ranging from 3% near New Bern to 87% at the Roanoke Sound Bridge. The greatest increases were observed at sights on or near the coast.

As noted in the permanent versus seasonal population discussion, seasonal population may far exceed permanent populations. This fact is supported by comparing seasonal traffic counts to the 24 hour average day counts. At the Bonner Bridge on the Outer Banks, the 1988 July Fourth traffic count exceeded the daily average by 2.5 times (9,760 vs. 4,000). Anyone who has visited Nags Head or Atlantic Beach during the summer months can attest to the effects of recreational travel on the coastal road system.

In summary, in much of the rural A/P study area, employment opportunities are dispersed. For many people in these areas automobile travel is a necessity. The rate of vehicle registration far exceeds population increases implying that multi-car households are likely to be increasing. Automobiles and roadways have the potential to impact the sounds' water quality. Many of the major highways leading to the coast are experiencing increased traffic counts; however, it is difficult to separate the effects of increasing permanent population from that of the travel and tourism industry.

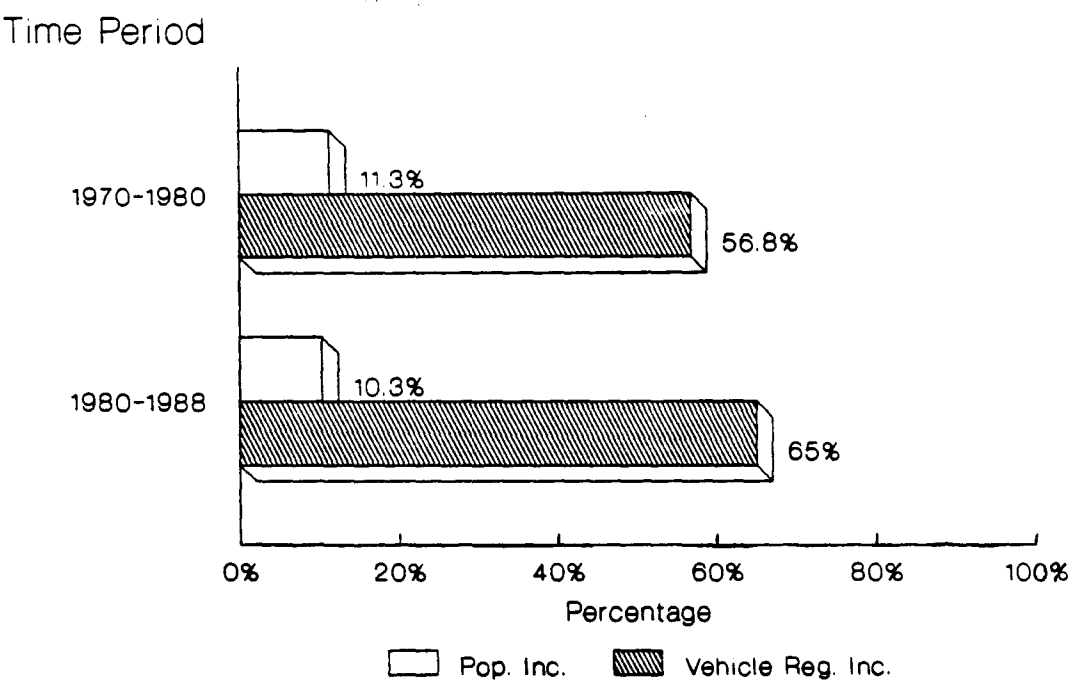


Figure V-13. **Population Change vs. Vehicle Registration in the 36 North Carolina A/P counties. From NC Department of Transportation.**

E. PUBLIC SECTOR ACTIVITY

Previous discussion addressed both direct and indirect uses of the Albemarle-Pamlico estuarine system. There are, however, sectors of activity that affect the study area that are not classified in either of these two categories. For the purpose of this discussion, these interactions will be addressed as public sector activities. Public sector activities include legislation and the educational system. In the case of legislation, or "governmental intervention", the potential for affecting change within the A/P region is great; so, too, within the education system. The values and beliefs taught in the school framework have the potential to affect a large proportion of the population now and in the future. A more informed public can take an active role in the maintenance and management of the A/P estuarine system.

As mentioned throughout this analysis, very little research has taken place regarding the socio-economic forces that affect the study area and only a small portion of that research has dealt with public sector activities. Unlike woodland acreage, vehicle registrations, or fish landings, there is little historical data regarding the effects of legislative or educational programs. Rather than addressing trends based on insufficient data, this section will deal with legislation and educational processes currently in place throughout the region.

E. 1. Legislative Programs

There are three levels of government that affect the Albemarle-Pamlico region: 1) federal government, 2) state government and 3) local government. Each level represents a separate jurisdiction, yet each interacts with the others regularly (Appendix V-1). It is beyond the scope of this study to discuss each of these levels of government in detail, however, a brief discussion of each follows.

As of December 1986, there were at least 81 federal programs affecting activities within the A/P region. Federal laws cover a variety of activities from water quality to soil conservation, and from endangered species to hazardous waste storage. Although some laws are more inclusive than others, each has the potential to alter many of the previously discussed land and water uses. Finch and Brower (1987) used a simple classification system to divide them according to their potential impact on the various activities taking place. Forty-eight federal laws and regulations are described as having a "major" impact on human activities, 8 are classified as having a "minor" impact on the region, and 25 legislative programs are classified as having a "marginal" or "extremely minor" impact on the area (Appendix V-1).

As in the case of the federal laws, state laws govern a variety of activities ranging from wastewater treatment plants to bicycle paths. Some of the state laws, such as the Coastal Area Management Act (CAMA), are very selective and only apply to the counties that border the ocean or sounds. As of December 1986, there were at least 109 North Carolina regulatory programs affecting human activities in the study region. Forty-two are classified as having a major impact on the sounds, 6 are considered to have a minor impact on the A/P study area, and 61 are judged to have only a marginal impact on the direct or indirect uses of the area's resources.

Local government ordinances, like federal and state regulations, cover a wide range of human activities. Land-based development controls are one method whereby local governments can affect water quality. There is some limited data available on this type of program. In 1987 the Division of Community Assistance, within NC Department of Environment, Health and Natural Resources, conducted an inventory of local land development controls within the Albemarle-Pamlico study area. The study collected data for 33 counties; these data are the basis for this brief description. In 1987, only slightly more than one-half of the counties had zoning ordinances in place. Seventy-nine percent of the 33 counties had subdivision ordinances in effect and 79% of the A/P counties had land use plans in effect.

In summary, there are over 200 state and federal laws that regulate human activities within the A/P study region. These laws govern countless activities involved with both land and water use. There is little data that addresses how these regulations effect the use of the sound. The majority of the local governments within the study area have adopted the necessary planning and management tools to control land use activities (i.e., zoning ordinances, subdivision regulations, and land use plans), the first step in effectively managing their resource base.

E. 2. Education and Public Awareness

North Carolina citizens have many opportunities to learn about the status and health of coastal waters and estuaries. Increased recreational use, development around the estuaries and on the barrier islands, and greater impact on the estuaries from their watersheds are major forces of change. Education agents include mass media, public schools, universities, state agencies, and private initiatives.

Many statewide and regional newspaper and television stations devote sections to pressing environmental issues. Reports on fish kills, declining fisheries, algal blooms, and poor water quality are frequently in the media. These features increase public awareness and help to educate citizens about estuarine issues. Mass media are an increasingly important educational resource.

Within the past ten years, new programs have been developed that focus specifically on coastal water resources. Educational funding from the Albemarle-Pamlico estuarine study has provided additional projects targeted at youth and adult audiences.

E. 2. a. Education Curriculum Materials. "North Carolina Coastal Plain: A Geologic and Environmental Perspective" -- An eight-part video accompanied by scripts and a student activity guide was developed by the NC Department of Public Instruction, East Carolina University, and Texasgulf, Inc. It is correlated to the eighth grade Standard Course of Study in social studies and science and is applicable in grades 4-12. A 1987 one-day summer workshop introduced this material to teachers in the northeast education region. The original materials were in a filmstrip/cassette format and were distributed to 543 northeast schools and to the eight statewide regional education centers. The new video format is now available through UNC Sea Grant at a cost of $30.

"Project Estuary" -- A multidisciplinary curriculum guide appropriate for grades 5-10 that includes a variety of activities and information materials designed to fit into the existing science curriculum, this project was developed by the NC National Estuarine Research Reserve System, written by Gail Jones and published by the NC Division of Coastal Management.

"Project MOST Environmental Curriculum, Pitt County Schools" -- Project Model Outdoor Science Teaching (MOST) is an outdoor education program designed to complement on-going K-6 science instruction. The project encourages the use of local natural resources as alternatives to distant, often expensive, field trips. Using swamps as off-campus visitation sites, Project MOST promotes the philosophy of making outdoor education "a part of" rather than "apart from" the overall learning experience. More than 5,000 students are served by the project each year. Project MOST was developed by the Pitt County Schools and funded, as part of a nation-wide effort to improve science education, by the Association of Science-Technology Centers in Washington, D.C. Actual funding was made available through the Science Teacher Education at Museums (STEAM) program sponsored by the General Electric Foundation. Pitt County Schools and the East Carolina University Science/Math Education Center provided matching funds to be used in teacher training under Project MOST.

"Project Wild/Aquatic WILD" -- Another educational packet and more training for teachers occurs under Project Wild/Aquatic Wild. In this program, education activity guides have been developed for

teachers of kindergarten through high school age students. The most recent instructional material titled "Project WILD Aquatic Education Activity Guide" provides opportunities to explore and understand the aquatic habitats. The aquatic environment includes freshwater rivers, lakes, ponds, and streams and saltwater marshes, estuaries, and oceans. The material in Aquatic WILD is designed to assist learners of any age in developing awareness, knowledge, skills, and commitment to result in informed decisions, responsible behavior , and constructive actions concerning wildlife and the aquatic environment upon which all life depends. Project WILD was initiated under the sponsorship of the Western Association of Fish and Wildlife Agencies and the Western Regional Environmental Education Council. In North Carolina its sponsor is the NC Wildlife Resources Commission. Educational guides are provided to those teachers who participate in training workshops on the material. Representatives of the NC Wildlife Commission, the NC Department of Public Instruction and others have conducted workshops to train teachers in the use of these and other estuarine and wetland materials.

"Project Learning Tree" -- Project Learning Tree (PLT) is an award-winning environmental education program designed for teachers and other educators working with students in kindergarten through grade 12. PLT is a source of interdisciplinary instructional activities and provides workshops and in-service programs for teachers and youth group leaders. PLT was developed through a joint effort of the American Forest Foundation (AFF) and the Western Regional Environmental Education Council (WREEC). The materials are written by classroom teachers and other educators, resource agency personnel, representatives of private conservation groups and forest company representatives. WREEC also developed Project WILD, an environmental education program emphasizing wildlife. PLT, which has a significant water resources component, is growing in popularity among teachers in North Carolina. For example, in 1988 there were 33 teacher workshops in which 876 teachers were trained to use the PLT guides and resource materials for classrooms. In this state, PLT is sponsored and coordinated by the North Carolina Agricultural Extension Service and the North Carolina Forestry Association.

E. 2. b. Examples of Sponsored Teacher Workshops. "Elizabeth City State University Teacher Training Workshops" -- With the support of A/P Study, Elizabeth City State University conducted a series of three teacher workshops in 1989 on aquatic environmental management. These workshops stressed the integration of aquatic management into classroom environment, the development of class projects, and the development of lesson plans.

"Water Quality Training Institute for Teachers" -- In 1989, a two-week workshop was conducted at the University of North Carolina at Chapel Hill to give middle, junior high, and high school public school teachers an opportunity to learn about the state's major water quality issues. Topics included the impact of wastewater treatment plants, agricultural runoff, industrial discharges, and development on the state's rivers and estuaries. The institute was conducted by the Environmental Resource Project of UNC-CH's Institute for Environmental Studies and the UNC-CH Department of Environmental Sciences and Engineering with support from the NC Center for Math-Science Education. Teachers were paid a $35-per-day stipend and received two graduate credits from UNC-CH.

E. 2. c. Environmental Group Initiatives. Educational materials from the Department of Public Instruction have been shared with representatives of the Pamlico-Tar River Association, who in turn conduct lessons in the schools. Teachers have been recruited to have their classes involved in Citizens Monitoring. Teachers are informed that environmental groups are an educational resource.

E. 2. d. State Agency Support. Representatives of appropriate state agencies have been invited to teacher workshops in order to apprise teachers of the educational services available and of the involvement of state agencies in conservation. Some examples are the Soil Conservation Service, the Agricultural Extension Service, the Division of Coastal Management, the NC Department of Environment, Health, and Natural Resources, and the NC Wildlife Resources Commission.

E. 2. e. NC Agricultural Extension Service. The North Carolina Agricultural Extension Service (NCAES) has an educational program committed to improving water quality. Extension is already helping protect water quality by teaching farmers and other land users to deal properly with pesticides, animal wastes, sediment, commercial fertilizers and freshwater drainage. Extension promotes BMPs to keep these contaminants out of water bodies, including the Albemarle-Pamlico estuarine system. The NCAES has an established network of offices and agents in every county in the project area. County Extension agents have connections with local communities that can serve to further the goals of the A/P Study.

The Albemarle-Pamlico Estuarine Study is supporting a project in which NCAES will conduct a series of four leadership development workshops and develop a handbook on water quality impacts of nonpoint source pollution. This project will promote public understanding of and support for the Albemarle-Pamlico Estuarine Study through increased awareness and involvement of local leaders, professional agricultural workers, and concerned citizens. These workshops are expected to improve two-way communication between the citizen advisory committees and local leaders.

The Agricultural Extension Service 4-H and Youth Development Program has educational curricula for youths which address coastal environmental problems. These curricula include:

* "Aquatic Wild" -- a K-12 curriculum designed in lesson-plan format and delivered in all modes

* "Marine Science Camp" -- a week-long curriculum designed for teenagers

* "River's Edge" -- a curriculum developed for fifth grade and delivered in the school enrichment or special interest mode

* "Soil and Water in North Carolina" -- a curriculum designed for 10-year-olds, teaches the basics of soil and water quality

* "Plastics" -- lessons designed for 9 to 12-year-olds, focus on the perils of plastic in an aquatic environment

* "4-H Seafood Project" -- designed for the 4-H members in a community or project club. 4-H delivers its program in a variety of ways including community/project clubs, special interest groups, school enrichment and camping.

E. 2. f. UNC Water Resources Research Institute. The Water Resources Research Institute (WRRI) is a unit of the University of North Carolina with offices located at North Carolina State University in Raleigh. The mission of the Institute is to identify the state's water-related research needs, support research by qualified scientists, train graduate students, and provide for technology transfer. WRRI has supported 35 research projects on estuarine and coastal water problems of North Carolina and has published and made available to the public reports on these projects. Some of WRRI's published reports are on problems associated with fish diseases, aquatic plants, sediments and nutrients, nutrient and algae relationships for both the Pamlico Estuary and the Chowan River, water management and water quality associated with intensive agricultural operations, wetland buffers to improve water quality, and detention basins for stormwater management. WRRI also conducts workshops on coastal water issues and publishes a newsletter as part of its technology transfer and education efforts.

E. 2. g. UNC Sea Grant College. The UNC Sea Grant College, administered by the University of North Carolina system, operates in three capacities: research, education, and communications. Results of research funded by Sea Grant are published in reports and scientific journals. The main points are often included in Coastwatch, a free newsletter sent to 18,000 readers. Education workshops initiated or

supported by Sea Grant agents and specialists provide techniques and information on applying the results of the research in industry, agriculture, and fisheries. These include concepts such as models for predicting movement of nutrients from soils to estuarine waters and the role of sediments in removing nutrients.

Sea Grant assisted the NC Coastal Federation in producing The Citizen's Guide to Coastal Water Resource Management (out of print). This guide provided information for public involvement in management policies.

A Sea Grant education specialist has assisted in teacher in-service programs providing techniques and information concerning watersheds, plastics in the marine environment, and ecological activities. A set of marine education curriculum materials is available for teachers and 4-H staff. It includes the following publications: Coastal Geology, Seawater, Coastal Ecology, and Coastal Beginnings and Connections. A primary curriculum guide, Coastal Capers, is available for grades K-3. Other publications on seashells and marsh and dune plants support field trip activities.

"The Big Sweep" is a multi-agency, public and private program which is in its third year. Begun as "Beach Sweep" initiated by UNC Sea Grant, the Division of Coastal Management and the Division of Parks and Recreation, it focuses on litter as a visible symbol of habitat degradation and public responsibility, and on citizens' ability to take corrective action. This program won state and national awards in "Keep America Beautiful" for 1987 and 1988. In 1989, the project expanded to include estuarine shores, reservoirs, rivers and state parks. The NC Wildlife Resources Commission, 4-H, WRAL-TV, and private companies are part of the expansion strategy for a statewide aquatic program. The goal is to increase public awareness and institute a sustained, multi-age education program.

E. 2. h. North Carolina Aquariums. The North Carolina Aquariums provide educational opportunities for the public in an effort to create a better understanding and appreciation for the diverse natural resources of coastal North Carolina. The aquariums are located on Roanoke Island, at Pine Knoll Shores and at Fort Fisher. They are administered by the Office of Marine Affairs in the North Carolina Department of Administration. The facilities are open seven days a week, all year, and are staffed by professional educators, exhibitors, and aquarists.

The Aquariums offer a wide variety of educational activities highlighted by living displays of North Carolina's marine life. Exhibits on coastal ecology, outdoor field experiences, seafood workshops, films and other events are all designed to increase public awareness of and appreciation for the fragile coastal environment. Each year, over 50,000 students from around the state and region participate in educational programs, such as offshore trawling excursions, beach and salt marsh studies, workshops, films and other "hands-on" activities. In 1988, the Aquariums were visited by nearly 1.5 million people, making them the most visited state facilities.

The North Carolina Aquarium on Roanoke Island was a 1988 winner of the Today's Aquarist Conservation Award for its exhibit "Secrets of the Salt Marsh." The 1,500-square-foot exhibit is designed to educate the public about the value of North Carolina's marshes and estuaries. The exhibit features an estuarine touch tank, video system, interpretative graphics, an interactive computer center, a 1,100-gallon aquarium and a discovery room equipped with projection microscopes and computers. This aquarium, made possible with a grant from the A/P Study and private support, provides an ideal setting for conducting educational programs aimed at increasing the public awareness of one of the nation's largest estuarine systems.

E. 2. i. National Estuarine Research Reserves. The four estuarine reserves in North Carolina--Currituck Banks, Rachel Carson, Masonboro Island and Zeke's Island--serve as natural, outdoor laboratories where scientists, students, and the public learn about coastal ecosystems. Established by the state of North Carolina in 1982 with matching funds from the National Oceanic and Atmospheric

maritime forests, and estuarine waters at the four sites. The Reserve is part of the National Estuarine Reserve Research Systems created by Congress to ensure the preservation of vital coastal systems for research and study. In North Carolina the program is administered by the Division of Coastal Management. Education and research are the primary objectives of the National Estuarine Reserve Research System. Educational programs, guided tours, and workshops are offered at most reserves.

A useful educational publication available to the public is "A Field Guide to Exploring the North Carolina National Estuarine Research Reserve", published by the Division of Coastal Management. A fifteen-minute video entitled "It's a Beautiful Day: A Visit to the North Carolina National Estuarine Research Reserve" is also available. This video, designed for middle school students, will be available through the Regional Education Centers of the Department of Public Instruction.

E. 2. j. A/P Education Projects. The Albemarle-Pamlico Estuarine Study has supported a number of projects which are designed to increase public awareness and aid in disseminating relevant knowledge about the estuaries to the general public. These initiatives play an important role in helping to inform and/or educate the public.

Public involvement projects which have a significant educational component include the following:

* Development of a citizen estuarine monitoring network;

* A state-of-the-estuaries booklet;

* Public service announcements (PSAs) on the radio and television;

* A media tour;

* Workshops on management issues and a management guidebook;

* A video-tape and slide show;

* A program newsletter;

* Public meetings;

* A Guide to the Estuaries booklet;

* "Journey of the Striped Bass" aquarium exhibit;

* Community education outreach;

* A 1990 educational calendar; and

* Teacher environmental education programs.

E. 2. k. Department of Community Colleges. The North Carolina System of Community Colleges is made up of 58 community and technical colleges, 25 of which are in the A/P Study area. Colleges in the system offer a host of programs to meet the needs of individuals, businesses, and industries. These programs range from one quarter to two years in length. Single courses are also offered to update job skills and for personal enrichment. The primary emphasis of every college is on-job training, and most programs are in vocational and technical areas.

A few community colleges and technical institutes, mostly outside the A/P Study area, have programs in commercial fishing, environmental science technology, fish and wildlife management technology, marine maintenance, marine technology and soil and water conservation technology. Some colleges have individual courses in which the marine environment and biology are explored. For example, the College of the Albemarle offers relevant specialized credit courses such as "Introduction to the Marine Environment" and "Current Issues in Biology and Principles of Ecology". These courses include topics on pollution, marine resources, productivity, nutrient cycles, and other environmental factors.

There has been no systematic review of the community colleges outreach and extension activities relating to coastal water quality and estuarine protection. In such programs a variety of topics could be addressed depending on the expressed needs of adults in the community.

E. 2. l. The North Carolina Coastal Federation. The North Carolina Coastal Federation is a non-profit, tax exempt organization dedicated to involving citizens in decisions about managing coastal resources. Its aim is to share technical information and resources to better represent present and long-term economic, social and environmental interests of coastal North Carolina. The Federation has been involved in the following educational activities:

* Organization of the kick-off meeting for the Albemarle-Pamlico Estuarine Study which was attended by nearly 600 people;

* Planning and implementation of a three-day press tour for the Albemarle-Pamlico Estuarine Study;

* Writing and distributing 2,000 copies of A Citizens Guide to Coastal Water Resource Management;

* Organizing and conducting four two-day workshops in the Albemarle-Pamlico study area to discuss citizen participation in coastal water resource management;

* Publishing a quarterly newspaper (Coastal Review) about coastal management issues;

* Alerting citizens about up-coming public hearings concerning coastal management issues and activities;

* Organizing the annual meeting for the Albemarle-Pamlico Estuarine Study; and;

* Developing a series of workshops to examine alternatives for managing estuaries.

E. 2. m. Pamlico-Tar River Foundation, Inc. The Pamlico-Tar River Foundation (PTRF) is a non-profit research and public education foundation concerned with the environmental quality of the Pamlico-Tar River, its tributaries, and surrounding land. The Foundation seeks to protect the water resources through education, advocacy, monitoring, research, and recreation.

The PTRF has a number of educational programs directed toward informing the public about the need to protect the natural resource. Among its programs are the following:

* A citizens water quality monitoring program involving adults in monitoring at 65 sampling stations. Trained citizens test for pH, temperature, salinity, turbidity, dissolved oxygen, nitrogen and phosphorus;

* A community education outreach project consisting of an inventory of existing educational materials (booklets, maps, posters, etc.) to assist with educating the public regarding estuaries and their

management. Presentations on these materials are made to school children, youth groups and citizens' organizations;

* Development of "A Guide to the Estuaries." The educational publication is designed to be an avenue for dissemination of information about the estuarine system and the work of the A/P Study; and

* Development of an educational calendar to convey information about estuaries, the ecology and the A/P Study.

E. 2. n. Albemarle Environmental Association. The Albemarle Environmental Association (AEA) is an organization concerned with a number of environmental topics including water quality. Its membership includes individuals and groups such as civic associations and Extension Homemakers clubs. The Association publishes newsletters for its members and local libraries. It also holds public meetings on environmental issues and sponsors outings to sites of environmental interest.

AEA has assisted in organizing volunteers for monitoring of local bodies of water. This group is currently monitoring water quality at eight sites in Albemarle Sound. AEA has also undertaken, with support from the Albemarle-Pamlico Study, a program of public education. In this effort three groups have been targeted: public officials, high school students and teachers, and members of local civic associations. A half-time educator has been hired to prepare and present programs about water quality and the Albemarle-Pamlico Study.

E. 2. o. WRAL-TV, Channel 5. One of North Carolina's largest television stations has given the sounds and coastal environment top priority with a significant public education program. The station's stated mission was to educate and alert the viewer to the extent of the problem, to sensitize the whole community, and to move the issue to the top of the public agenda, thereby stimulating the preservation of North Carolina's coastal environment.

With "Troubled Waters," a half-hour documentary examining the sources of water pollution in the rivers and sounds of the state, WRAL-TV launched a year-long campaign in the fall of 1988 called "Save Our Sounds," which included the following elements:

* "Sound Advice" resource book, sent to schools statewide and offered to the public;

* Poster produced and distributed to elementary schools;

* "Save Our Sounds", year-long weekly news report;

* Public Service Announcements and "info-mercials" (educational spots);

* "Reflections on Our Coastal Environment" symposium, a free lecture, with keynote speaker Walter Cronkite. WRAL-TV hosted two receptions around Mr. Cronkite's speech to raise funds to sponsor the Carolina Coastal Celebration; and

* "Carolina Coastal Celebration", a two-day education fair/festival with exhibitors, craftspeople, environmental groups, music, and seafood. The event was attended by 10,000 people.

* "Troubled Waters", a half-hour television documentary which won the National Edward R. Murrow Award in the news series/documentary category.

E. 2. p. Conclusions. In the past 2-3 years there has been increased educational activity for youth and adults on coastal and estuarine issues. Much of this increase can be attributed to the initiatives of individuals in the public school system, state agencies, the media, and environmental groups. The A/P

Study has stimulated part of the education and awareness efforts and has supported a number of projects especially for teacher training and public awareness. The A/P Study has also developed a very active public awareness and public participation program.

While there has been a noticeable increase in educational programs, much of the work is sporadic, heavily dependent upon one-time funding, and much of it is left to voluntary efforts of a few leaders. While many young people and adults are being reached, a majority of citizens need educational information if they are to be active participants in protecting and enhancing the coastal environment.

F. RECOMMENDATIONS

The preceding discussion addresses many of the activities that affect the quality of life within the Albemarle-Pamlico estuarine system. This discussion has been rather anthropocentric, but one should remember that the A/P Sounds are home to many thousands of organisms who coexist within its borders. There are numerous environmental factors that contribute to the health of this unique natural system and maintaining water quality is of the utmost importance. The difficult question for residents and natural resource managers is, what is the best way to accomplish this mandate?

This chapter presents a large amount of data; however, despite this volume, little is known about the many subtle interactions that maintain the estuaries. Rather than an all encompassing view, the reader has been shown a "snapshot" of the activities that have taken place over the past 15 to 20 years. This chapter presents a picture of increasing populations, automobile use, wastewater discharge, and use of fertilizers, etc. In fact, little in the region has decreased except for fish stocks and wetland acreage.

While much discussion has dealt with indicators of growth, there has been little discussion regarding the far reaching effects of this ever increasing human activity. It is hoped that this analysis will lay the foundation for this type of dialogue. Based on the insight gained through the collection and analysis of these data, the following recommendations are presented to those interested in the future of the Albemarle-Pamlico ecosystem:

* A central database, such as that created by NC Center for Geographic Information and Analysis (CGIA), should be maintained to catalog and analyze all data involving the A/P area. A system such as this would assist many divisions within NC DEHNR, simplify future projects such as this, and prevent duplication of data collection.

* The Department of Defense activities must be better documented. Furthermore, there is a need for research projects to identify the environmental impacts of DOD activities within the study area. The DOD is one of the major actors in this region, yet little or no useful data is available for much of its land use practices. This completed document should be used to identify future data needs and research projects. Little research appears to involve the socio-economic activities that greatly affect the estuaries.

* The environmental cost of the ever-increasing travel and tourism industry should be determined. Tourism is one of the major industries in the area; however, little is known about its affects upon these environmentally sensitive coastal and sound systems.

* Comprehensive and consistent land use plans, similar to those required by CAMA, should be developed and implemented throughout the entire A/P region. Financial aid should be supplied to the smaller, rural counties who are unable to undertake such projects.

* Waste disposal should be addressed from a regional viewpoint rather than from a county by county level. Waste disposal, both solid and liquid, is potentially one of the most serious environmental problems within the A/P Study area.

* A clearer direction should be established for the A/P Study and increased efforts at public education should be undertaken. Many people in the region (citizens and environmental managers) are unaware of the Albemarle-Pamlico project or do not fully understand its goals. This was very evident in many of the state agencies interviewed for data requests.

F.1. Research Needs to Adequately Deal with Economic and Social Trends

Following the same structure we used to assemble the information available on economic trends, we have outlined some research needs that should be addressed if we are to adequately evaluate the potential effects of a comprehensive conservation management plan. We must be able to identify the factors influencing direct and indirect uses of the estuary and how those factors and uses might respond to alternative management options.

Develop a model of recreational fishing in the A/P estuarine system. Ideally, we would like to be able to model the demand for recreational fishing in the Albemarle-Pamlico area. Many qualities of the estuary affected by management influence recreational choices. These dimensions are more subtle than simply fish availability. They involve the aesthetic dimensions of the resource and the likelihood of disruption to environmental quality by specific episodes, such as the "red tide" and other forms of coastal pollution not easily predicted in advance. In order for a model to adequately reflect the influence of management policies, it would need to incorporate measures of: (1) how the quality of the estuary affects recreational fishing in the area, (2) local vs. non-local use, and (3) how the decisions to use the estuary are made.

Develop a model of commercial fishing in the A/P estuarine system.
Commercial activities are also dependent upon the character of the estuarine resource, and the nature of the response to change can be equally as complex as that of recreational fishing. Clearly they are related to the availability of fish, but they are also affected by regulations, cultural patterns, and market economics. Anticipating future trends in the fisheries and their responses to management policies is critical to successful management of this precious resource.

Develop an economic model of the different productivity sectors. Such an analysis would allow some predictions to be made regarding the scale and location of growth and development and their relation to coastal policy. Development of such a model would involve the determination of the change in output or the change of location as functions of the characteristics of the location in question. Carlton (1979, 1983) and Bartik (1985, 1988) have conducted research on the location of firms or plants according to regional and local characteristics including: (1) access to markets, (2) the price, character, and quality of local labor, (3) the quality and accessibility of the overall infrastructure (e.g., highways and support industries), and (4) policies regulating operations and finances. The Bureau of the Census Longitudinal Establishment Database provides information that could be used to develop these types of models for coastal areas in North Carolina and other regions.

Determine the real costs associated with each production sector and the costs associated with extant and proposed management policies. Calculations of the revenues generated by one activity or another provide only a part of the picture. Environmental, social, cultural, and hidden economic costs are real and, at times, great. Realistic estimates must be developed so that balanced and far-sighted policies can be developed. In this we can begin to balance the implications of alternative uses of the estuary and develop management plans that reflect both the benefits and costs of alternative uses.

F. 2. Recommendations for Public Education

Expand educational programs on coastal water and estuarine issues. Policy makers, educators, mass media representatives, adult citizens, youths, planners, engineers, legislators, and leaders of business and industry must be reached. This will require creative leadership, financial support, and a planned and diverse program. The NC Department of Environment, Health, and Natural Resources should be responsible for sponsoring such a program. Following are some specific recommendations.

1. The program should coordinate closely with the A/P Study.

2. The program should define major categories of information to be presented.

3. The program should identify specific target audiences and strategies for reaching those audiences.

4. The program should identify and work in support of those organizations best suited to assist in the task of public education.

5. The program should provide teacher training workshops.

Other recommendations for education and public awareness include the following:

* Conduct a study identifying and describing the presentation of estuarine and local environmental science in the A/P region's public schools and determine, if possible, the long-term effects of such education. Such a study could help identify successful strategies for classroom presentation and teacher education.

* Assess current youth and adult understanding of environmental issues and concepts, so that public education programs can be tailored to their needs.

* Encourage local school systems and funding agencies to support teachers attending training workshops and to provide study and presentation materials for estuarine-related topics. There is a need for strong leadership within the public school system to create new and expand current programs. Such programs are often heavily dependent upon a few enthusiastic individuals and one-time funding efforts from sources such as the A/P Study.

* Conduct follow-up studies to determine the effectiveness of teacher workshops, educational materials, and different modes of presentation.

* Develop cooperatively with professional educators additional information and materials on estuarine related topics

* Encourage community college officials in the region to become more actively involved with adult education outreach and extension programs dealing with coastal and estuarine issues. The Community Colleges should also be encouraged to provide more standard course offerings related to these issues, such as Marine Operations, Fishing, and Wastewater Disposal.

* Work with the NC Department of Public Education to develop curricula regarding estuarine systems and aquatic resources for the public school system. Ideally, such programs would be initially introduced in primary schools and expanded upon in the secondary schools as special units or as elective science courses.

G. SUMMARY

The A/P Study region, like other coastal regions, is experiencing rapid growth of permanent and seasonal (recreational) populations. This growth generates employment opportunities and revenues, but also has associated with it real costs. The growth is placing ever-increasing demands on the limited resource base: direct demands for the extraction and utilization of coastal and estuarine resources and indirect demands for continued existence of those resources. Direct uses of the estuarine system include commercial and recreational fishing, marina development and operation, travel, and tourism. Indirect uses of the estuarine system may be supportive of or completely independent of the direct uses. They include the agricultural, construction, manufacturing, transportation, wholesale, retail, finance, and service sectors.

Growth of each of the direct use sectors can be measured in real dollar terms. Measurements of specific industries give indications of the growth of the indirect use sectors. In this report, trends in agriculture, mining, national defense, point source waste disposal, and automobile registration and traffic are described.

State and federal legislative/regulatory programs as well as numerous educational programs supported by state, local, and federal governments and private organizations aim to combat the negative effects of coastal development and foster good stewardship in the citizens of the North Carolina.

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APPENDIX V-I
PROGRAMS THAT AFFECT DEVELOPMENT IN THE A/P REGION
(December 1986)

Federal Legislation

Major Impact

Anadromous Fish Conservation Act
Clean Air Act Amendments (1967, 1970, 1977, and 1990)
Clean Water Act (1977)
Coastal Barrier Resources Act (1982)
Coastal Zone Management Act (1972)
Comprehensive Environmental Response, Compensation, and Liability Act (1980)
Consolidated Farm and Rural Development Act (1965)
Department of Transportation Act (1966)
Disaster Relief Act (1974)
Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
Federal Environmental Pesticide Control Act (1972)
Federal Land Policy and Management Act (1976)
Federal Water Pollution Control Act Amendments (CWA) (1972)
Fish and Wildlife Act (1956)
Fish and Wildlife Conservation Act (1980)
Fish and Wildlife Coordination Act (1934)
Fishery Conservation and Management Act (1976)
Forest and Rangeland Renewable Resource Planning Act (RPA)
Highway Beautification Act (1965)
Housing and Community Development Act
Land and Water Conservation Fund Act
Marine Mammal Protection Act (1972)
Marine Protection, Research, and Sanctuaries Act (1972)
Migratory Bird Conservation Act
Migratory Bird Treaty Act (1918)
Mineral Leasing Act (1920)
National Environmental Policy Act (NEPA) (1969)
National Flood Insurance Act (1968)
National Forest Service Organic Act (1897)
Ports and Waterways Safety Act (1972)
Resource Conservation and Recovery Act (RCRA) (1976)
Rivers and Harbors Acts (1899, 1917, and 1968)
Rural Development Act (1972)
Safe Drinking Water Act (1974)
Small Business Act
Soil Conservation Act (1935)
Solid Waste Disposal Act
Surface Mining Control And Reclamation Act
Toxic Substances Control Act (TOSCA) (1976)
Water Quality Improvement Act (1970)
Water Resources Planning Act (1965)
Watershed Protection and Flood Prevention Act (WPFPA)

Minor Impact

Airport and Airway Development Act (1970)
Airport and Airway Improvement Act (1982)
Atomic Energy Act (1954)
Commercial Fisheries Research and Development Act (1964)
Energy Reorganization Act (1974)
Energy Supply and Environmental Coordination Act (1974)
Fish Restoration and Management Projects Act (1950)
Wild and Scenic Rivers System

Marginal Impact

Agriculture and Consumer Protection Act
Deep Seabed Hard Mineral Resource Act (1980)
Deepwater Port Act (1974)
Federal Water Power Act (1920)
Food and Agriculture Act (1962)
Hazardous Material Transportation Act
Interstate Land Sales Full Disclosure Act (1969)
National Ocean Pollution Research and Development and Planning Monitoring Act (1978)
National Wilderness Act (1964)
Natural Gas Act (1938)
Natural Gas Pipeline Safety Act (1968)
Natural Gas Policy Act (1978)
Noise Control Act (1972)
Occupational Safety and Health Act (OSHA) (1970)
Oil Pollution Act (1961)
Outer Continental Shelf Lands Act (1953)
Port and Tanker Act (1978)
Public Health Services Act
Shipping Act (1916)
Submerged Lands Act (1953)
Urban Mass Transportation Act (1964)
Water Bank Act (1970)

State Legislation

Major Impact

Agricultural Development Act
Air and Water Resources Act
Boating Safety Act
Coastal Area Management Act (1974)
Conservation and Historic Preservation Agreements Act
County Service Districts Act
Dredge and Fill Act
Drinking Water Act
Emergency Management Act
Environmental Policy Act (1971)
Fisherman's Economic Development Program
Forest Development Act
Industrial and Pollution Control Facilities Federal Program Financing Act

State Legislation (cont.)

Major Impact (cont.)

Industrial and Pollution Control Facilities Financing Act
Metropolitan Sewerage Districts Act
Metropolitan Water Districts Act
Mining Act (1971)
Mosquito Control Districts
Municipal Services Districts Act
Municipal Subdivision Control Act
Municipal Zoning Act
Natural and Scenic River System Act
Nature and Historic Preserve Dedication Act
Oil Pollution and Hazardous Substances Control Act
Pesticide Law (1971)
Regional Sewage Disposal Planning Act (1971)
Regional Water Supply Planning Act (1971)
Sedimentation and Pollution Control Act (1973)
Small Watershed Projects Act
Soil Additives Act
Soil and Water Conservation Districts Act
Solid Waste Management Act (1978)
Special Assessments Act
Stream Sanitation Act
Structural Pest Control Act
Toxic Substances Act (1979)
Water Use Act (1967)
Watershed Improvement Districts Act
Watershed Improvement Programs Act
Well Construction Act (1967)
Wildlife Resources Law

Minor Impact

Condominium Act
Outdoor Advertising Control Act
Tax Increment Financing Act
Trails System Act
Water Safety Act

Marginal Impact

Advertising Control Act
Air and Water Quality Reporting Act
Airport Development Act
Alien Property Act
Annexation Act
Archives and History Act
Atlantic States Marine Fisheries Compact Act
Balanced Growth Policy Act
Bicycle and Bikeway Act (1974)
Building Contract Act
Carrier Act
Cemetery Act
City-County Consolidation Act

Marginal Impact (cont.)
Condemnation Act
Connor Act (registration of conveyances)
Corporations Act
Dam Safety Law (1967)
Energy Policy Act
Engineering and Land Surveying Law
Fiscal Information Act for Local Government
Fraudulent Conveyance Act
Gas Conservation Act
Highway Safety Act
Horizontal Property Act
Housing Authorities Law
Housing Corporation Act
Housing Finance Agency Act
Inheritance Tax Act
Land Contracts Registration Act
Land Policy Act
Local Government Budget and Fiscal Control Act
Local Government Fiscal Information Act
Local Government Bond Act
Mine Safety and Health Act
Mining Compact
Municipal Corporations Act
Municipal Finance Act
Municipal Fiscal Control Act
Occupational Safety and Health Act of North Carolina
Oil and Gas Conservation Act
Public Building Contracts Act
Public Transportation Authorities Act
Public Utilities Act
Public Utilities Commission Act
Public Works Act
Quarries and Mines Act
Real Property Acquisitions Policies Act
Right of Way Act
Rural Electrification Act
Sales and Use Tax Act
Sinking Fund Act
S.E. Interstate Forest Fire Protection Compact
S.E. Interstate Low-level Radioactive Waste Management Compact
Southern Growth Policies Agreement Act
Southern State Energy Compact
Supplemental Local Government Sales and Use Tax Act
Transportation Authorities Act
Unmarked Human Burial and Human Skeletal Remains Protection Act
Use Tax Act