CHAPTER 2

GENERAL BASIN DESCRIPTION

2.1 CHOWAN BASIN OVERVIEW

The Chowan River basin is located in the northeastern coastal plain of North Carolina and southeastern Virginia. The North Carolina portion includes all or parts of Northampton, Hertford, Gates, Bertie and Chowan Counties. The Chowan River is formed at the border of Virginia and North Carolina by the confluence of the Nottoway and Blackwater Rivers, and its streams flow southeastward towards the Albemarle Sound. The Chowan basin includes 1,315 square miles in North Carolina, but the largest part of the drainage basin (3,575 square miles-approximately 76%) lies in Virginia (Figure 2.1). Major tributaries to the Chowan River include the Meherrin River and its largest tributary, Potecasi Creek, as well as the Wiccacon River and its largest tributary, Ahoskie Creek. The Meherrin River flows into North Carolina from Greensville County, Virginia.

Based on data from the US Department of Agriculture, Natural Resources Conservation Service (NRCS), land cover in the basin is dominated by forest and agriculture which together make up 87% of the total area. In looking at land cover changes between 1982 and 1992, the most significant change was seen in the urban/built-up category with a 59% increase. During that same time period, there were reductions seen in the amount of forested land (-1%) and cultivated cropland (-2%), and pastureland (-23%), and there was a slight increase in the amount of uncultivated cropland.

Population in the North Carolina portion of the basin declined by 1% from 1970 - 1990. Murfreesboro, Ahoskie, and Edenton are the largest urban areas in the basin. Population growth in the basin is low to moderate, with most growth occurring around the larger municipalities and in the vicinity of the lower Chowan River. Rural areas are seeing declines in population. Based on projections from 1990 into the year 2020, Chowan County is expected to see a 17% increase and Gates County may see a 19% increase. Other areas within the basin are expected to see decreases in numbers of residents.

Important natural resources in the basin include wetlands, anadromous fish spawning areas and Merchant's Millpond State Park. River herring and shad migrate into the river from the ocean to reproduce. There are seven species that are listed by North Carolina as either Threatened, Special Concern, or Significantly Rare. No species in this basin have been listed as Endangered.

Most of the water used in the basin comes from ground water sources. Projected use estimates indicate that there will be modest increases in water use over the next couple of decades.

The Chowan River basin is part of the Albemarle-Pamlico Estuarine system, the second largest estuarine system in the United States. In 1987 this estuarine system became part of the Environmental Protection Agency National Estuary Program and was the subject of a major study known as the Albemarle-Pamlico Estuarine Study (APES). The results of research conducted as part of APES culminated in the Comprehensive Conservation and Management Plan (CCMP) which is currently being implemented, and is discussed further in Chapters 5 and 6. Basinwide management is part of this implementation.

Figure 2.1. Map Showing Chowan River Basin Boundary in North Carolina and Virginia (Source: APES Comprehensive Conservation and Management Plan, 1994)

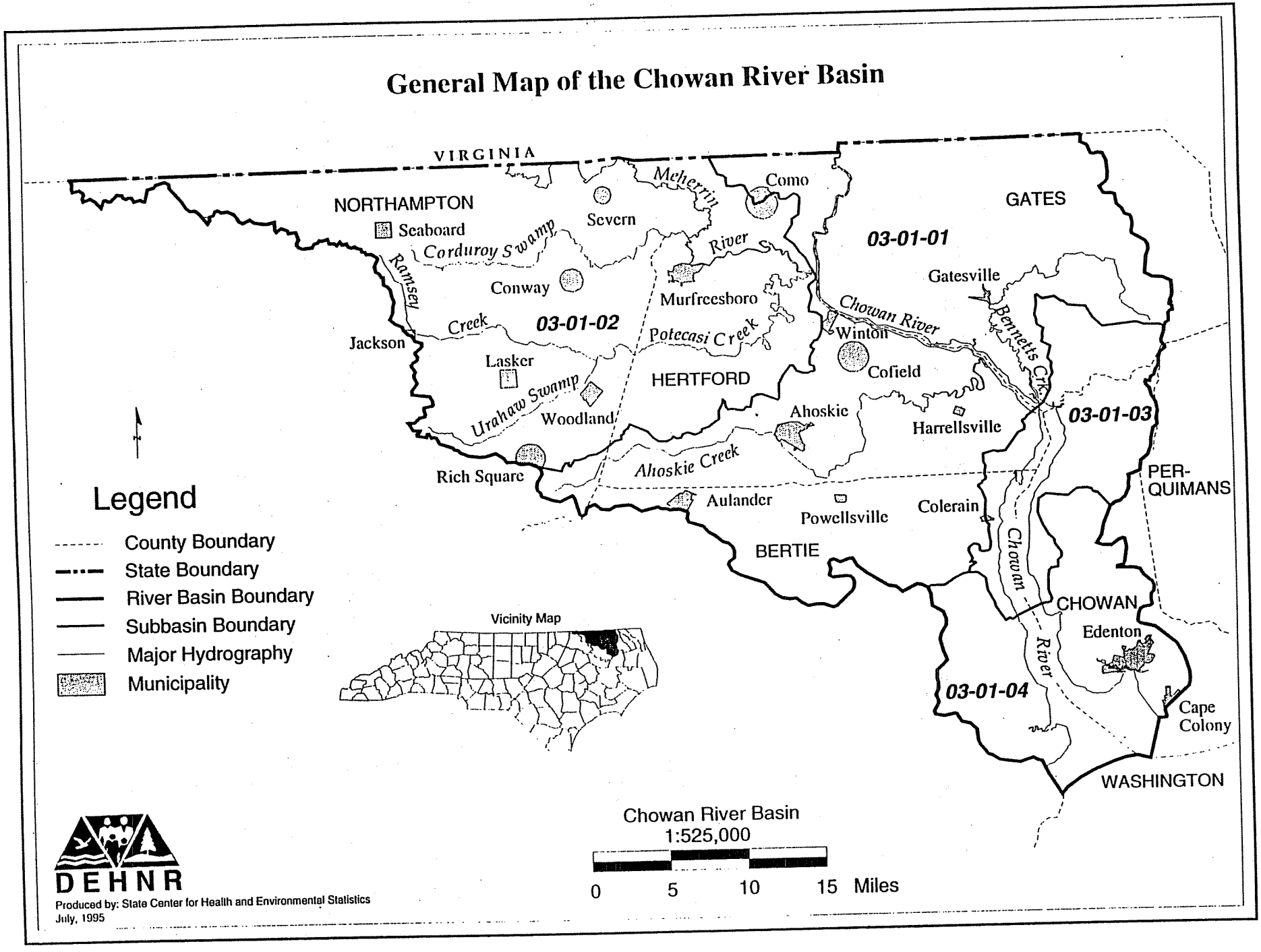

Figure 2.2. General Map of the Chowan River Basin

2.2 COMPARISON OF STATE AND FEDERAL HYDROLOGIC AREAS IN THE CHOWAN BASIN

Most federal government agencies, including the US Geological Survey and the US Natural Resources Conservation Service (NRCS) use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. DWQ has a two-tiered system in which the state is subdivided into 17 river basins, and each basin is subdivided into subbasins. The Chowan River basin is subdivided by DWQ into 4 subbasins. By contrast, a nationally uniform hydrologic unit system was developed in 1974 by the US Geological Survey's Office of Water Data Coordination (USDA, NRCS, Nov 1995). This system divides the country into 21 regions, 222 sub-regions, 352 accounting units and 2,149 cataloging units based on surface hydrologic features. Under the federal system, the North Carolina portion of the Chowan basin is divided into two hydrologic areas referred to as cataloging units. Each cataloging unit is defined by an 8-digit number. One of these units includes the Meherrin River and all of its tributaries, and is assigned the number 03010204. This area corresponds exactly to DWQ subbasin 030102. The other cataloging unit includes the remaining three DWQ subbasins in the Chowan and is assigned the number 03010203. These subbasins basically split the Chowan River into three sections (upper, middle and lower) and include tributaries to those sections. Table 2.1, below, compares the two systems. Maps of each subbasin are included in Chapter 4.

Table 2.1. Hydrologic Divisions in the Chowan River Basin

Watershed Name and Major Tributaries	Federal Cataloging Unit. 8-digit Hydrologic Units	DWQ Subbasin 6-digit codes Figure 2.3
Meherrin River and Tributaries	03010204	030102
Upper Chowan River and Ahoskie Cr.	03010203	030101
Middle Chowan River and Tribs.	"	030103
Lower Chowan River and Tribs.	"	030104

These comparisons are presented to aid in the interpretation of land cover data summaries in Section 2.4. That section presents land cover information developed by the US NRCS which is summarized for each of the two cataloging units in the basin.

2.3 LOCAL GOVERNMENT AND PLANNING JURISDICTIONS

The basin encompasses parts of Bertie, Chowan, Gates, Hertford and Northampton counties and 18 municipalities as presented in Table 2.2. Also included in the table are abbreviations for the Lead Regional Organizations (Council of Governments) and Districts of the North Carolina League of Municipalities.

Table 2.2. Local Governments and Local Planning Units within the Chowan River Basin

County	% of county in basin*	Lead Regional Organization	NC League of Munic. Dist.	Municipality
Bertie	25%	Region Q	I	Aulander Colerain Powellsville
Chowan	90%	Region R	I	Edenton#
Gates	60%	Region R	I	Gatesville#
Hertford	100%	Region Q	I	Ahoskie Cofield Como Harrellsville Murfreesboro Winton#
Northampton	85%	Region L	V	Conway Jackson# Lasker Rich Square Seaboard Severn Woodland

*percentages are approximate # - denotes county seat
Region L = Region L Council of Governments
Region Q = Mid-East Commission
Region R = Albemarle Regional Planning and Development Commission

2.4 LAND COVER, POPULATION AND GROWTH TRENDS

2.4.1 General Land Cover

Land cover information in this section is derived from two sources. The first is the US Department of Agriculture (USDA), Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) of 1992 and 1982 (USDA, 1994). The NRI is a multi-resource national inventory based on soils and other resource data collected at scientifically selected random sample sites. According to the NRCS 1992 NRI Instructions booklet, the 1982 NRI was the most comprehensive study of our nation's natural resources ever conducted. The inventory is considered accurate to the 8-digit cataloging unit scale established by the US Geological Survey (NRCS, 1993). A 1992 update of these data was recently released.

Table 2.3 summarizes acreages and percentage of land cover from the 1992 and 1982 NRI for the basin as a whole and for the two major watershed areas within the basin. Land cover types identified in Table 2.4 by the NRI as occurring in the Chowan River basin include cultivated cropland, uncultivated cropland, pastureland, forest land, urban and built-up lands, rural transportation, open water (small water areas and census waters), federal lands and other.

Land cover in the basin, as presented in Table 2.3, is dominated by forest and agriculture which make up 87% of the total area. Between 1982 and 1992, the most significant change was seen in the urban/built-up category with a 59% increase. During that same time period, there were slight changes seen in the amount of forested land (-1%) and cultivated crop (-2%), and there was a

Table 2.3. Estimated Acreage by Broad Land Use for the Chowan River Basin in 1992 and 1982. (Source: USDA, NRCS, 1994)

1992 NRI

LAND COVER	Meherrin Riv. 03010204		Chowan R. + tribs 03010203		TOTAL ACRES (1000s)	% of TOTAL
	Acres (1000s)	%	Acres (1000s)	%		
Cult. Crop	121.3	37	140.9	30	262.2	33
Uncult. Crop	0.0	0	1.4	<1	1.4	<1
Pasture	4.9	1	4.3	1	9.2	1
Forest	164.9	50	273.0	57	437.9	54
Urban/Built-up	10.7	3	8.7	2	19.4	2
Other	28.1	9	47.8	10	75.9	9
Totals	329.9	100.0	476.1	100.0	806.0	100.0
% of Basin	41		59			100.0
DWQ Subbasins	03-01-02		03-01-01, 03, & 04			

1982 NRI

LAND COVER	Meherrin Riv. 03010204		Chowan R. + tribs 03010203		TOTAL ACRES (1000s)	% of TOTAL
	Acres (1000s)	%	Acres (1000s)	%		
Cult. Crop	125.6	38	141.4	30	267.0	33
Uncult. Crop	0.0	0	0.0	0	0.0	0
Pasture	4.9	1	7.0	1	11.9	1
Forest	165.8	50	274.9	58	440.7	55
Urban/Built-up	6.6	2	5.6	1	12.2	2
Other	27.0	8	47.2	10	74.2	9
Totals	329.9	100.0	476.1	100.0	806.0	100.0
% of Basin	41		59			100.0
DWQ Subbasins	03-01-02		03-01-01, 03 & 04			

Table 2.4 Description of Land Cover Types (1992 NRI - USDA NRCS)

Land Cover Type (No.)	Land Cover Description
1) Cultivated Cropland	Land used for the production of adapted crops for harvest, including row crops, small-grain crops, hay crops, nursery crops, orchard crops, and other specialty crops. The land may be used continuously for these crops or they may be grown in rotation with grasses and legumes.
2) Uncultivated Cropland	Summer fallow, aquaculture in crop rotation, or other cropland not planted (may include cropland in USDA set-aside or similar short-term program).
3) Pastureland	Land used primarily for production of introduced or native forage plants for livestock grazing. This category includes land that has a vegetative cover of grasses, legumes, and /or forbs, regardless of whether or not it is being grazed by livestock.
4) Forest Land	Land at least 10 percent stocked by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover and not currently developed for non-forest use. Ten percent stocked, when viewed from a vertical direction, is a canopy cover of leaves and branches of 25 percent or greater. The minimum area for classification of forest land is 1 acre, and the area must be at least 1,000 feet wide.
5) Urban and Built-up Land	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Highways, railroads, and other transportation facilities are considered part of this category if surrounded by other urban and built-up areas. Tracts of less than 10 acres that do not meet this category's definitions (e.g., small parks or water bodies) but are completely surrounded by urban and built-up lands are placed in this category.
6) Other:	This category includes rural transportation, water areas and federal lands. Rural Transportation consists of all highways, roads, railroads, and associated rights-of-way outside Urban and Built-up areas; private roads to farmsteads, logging roads; and other private roads (but not field lanes). Water consists of small water bodies (water bodies less than 40 acres in size and streams less than one-half mile wide) and census water (large water bodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width). There are no lands owned by the Federal Government in the Chowan Basin.

1,400 acre increase in the amount of uncultivated crop and a 2,700 acre decrease in the amount of pasture land.

The second land cover source is derived from interpretation of LANDSAT satellite data. This information is based on interpretation of 1987 Landsat satellite data that was made available through the North Carolina Center for Geographic Information and Analysis (CGIA) and Research Triangle Institute. The eight land cover types presented in this section are a composite of 20 land cover categories available through CGIA. Table 2.5 defines the categories into which this data is divided.

Table 2.5. Landsat Land Cover Categories and Descriptions.

Land Cover Type	Land Cover Description
1) Agriculture	Agriculture, Bare Soil, Grass and Disturbed Land
2) Urban	Greater than 25% paved surfaces
3) Forest	Pine, Hardwood and Mixed Upland Forest
4) Wetlands	Bottomland Hardwoods, Riverine Swamp, Evergreen Hardwood/Conifer, Atlantic White Cedar Low Pocosin, High Marsh, Low Marsh
5) Scrub	Low Density Vegetation
6) Water	Lakes, Reservoirs, Ponds, Estuaries, Sounds
7) Barren	Sand
8) Shadow	Areas in shadows or appearing to be in shadows and where actual cover types are indiscernible.

Table 2.6 presents the figures for Landsat data in the Chowan River basin in North Carolina, divided by DWQ subbasin. Unlike the NRI data, this information provides an estimate of the amount of wetlands in the basin. Approximately 20% of the land cover in the Chowan basin is wetland area as defined in the table above. Consistent with the NRI data, the Landsat data indicates that the majority of the basin is covered by forest and agriculture (33% and 37% respectively).

2.4.2 Population and Growth Trends in the Basin

The Chowan River basin has an estimated population of 62,474 people based on 1990 census data. Table 2.7 presents census data for 1970, 1980, and 1990 for each of the subbasins. It also includes land and water areas and population densities (persons/square mile of land area) by subbasin. Figure 2.3 shows the percent population growth by subbasin. The subbasins that encompass the lower and larger portion of the Chowan River have experienced all of the growth in the North Carolina portion of the basin. The two upper subbasins (030101 and 030102) have actually experienced a slight loss of population (-2% and -8% respectively). Growth in the lower Chowan has been most pronounced in subbasin 03 which experienced a 29% increase in population between 1970 and 1990.

Two of the five counties that are in the Chowan Basin are expected to see an increase in population by the year 2020 (NC Department of Administration). Based on projections from 1990 to the year 2020, Chowan County will see a 17% increase and Gates County will see a 19% increase. Other areas within the basin are expected to see 6% to 20% a decrease in numbers of residents. Therefore, overall population growth in the basin is anticipated to be minimal.

Table 2.6. Land Cover in the Chowan Basin and Subbasins by Acreage and Percent Cover

SUBBASIN	Agriculture (acres)	Forest (acres)	Urban (acres)	Wetland (acres)	Water (acres)	Scrub (acres)	Barren (acres)	Shadow (acres)	TOTAL ACRES	TOTAL PERCENT
03 01 01	95,869	108,142	165	93,553	5,630	17,041	1	444	*320,845*	*42.6%*
03 01 02	105,354	105,522	534	28,289	904	4,571	0	527	*245,701*	*32.6%*
03 01 03	33,272	9,699	247	14,897	15,070	1,455	91	52	*74,783*	*9.9%*
03 01 04	40,891	22,647	714	18,087	23,767	4,802	968	122	*111,998*	*14.9%*
TOTAL ACRES	*275,386*	*246,010*	*1,660*	*154,826*	*45,371*	*27,869*	*1,060*	*1,145*	*753,327*	
PERCENTAGES	*36.6%*	*32.7%*	*0.2%*	*20.6%*	*6.0%*	*3.7%*	*0.1%*	*0.2%*		*100.0%*

Table 2.7 Chowan River Basin Subbasin Population (1970, 1980 and 1990) and Land Area Summaries

SUBBASIN	POPULATION (Number of Persons)			POPULATION CHANGE (%)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
										Total Land and Water Area		Water Area	Land Area
	1970	1980	1990	1970-80	1980-90	1970-90	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-01-01	25,469	26,191	24,884	2	-4	-2	44	46	43	371,289	580	12	568
03-01-02	24,723	23,168	22,719	-6	-1	-8	50	47	46	317,137	496	3	493
03-01-03	3,659	4,028	4,731	10	17	29	34	37	44	79,124	124	17	107
03-01-04	9,428	10,249	10,146	8	-1	7	68	74	73	114,221	178	41	137
Totals	63,279	63,636	62,474	1	-2	-1	48	49	48	881,771	1,378	73	1,305

Note: Population, land area and water area were derived from 1970, 1980 and 1990 census data.

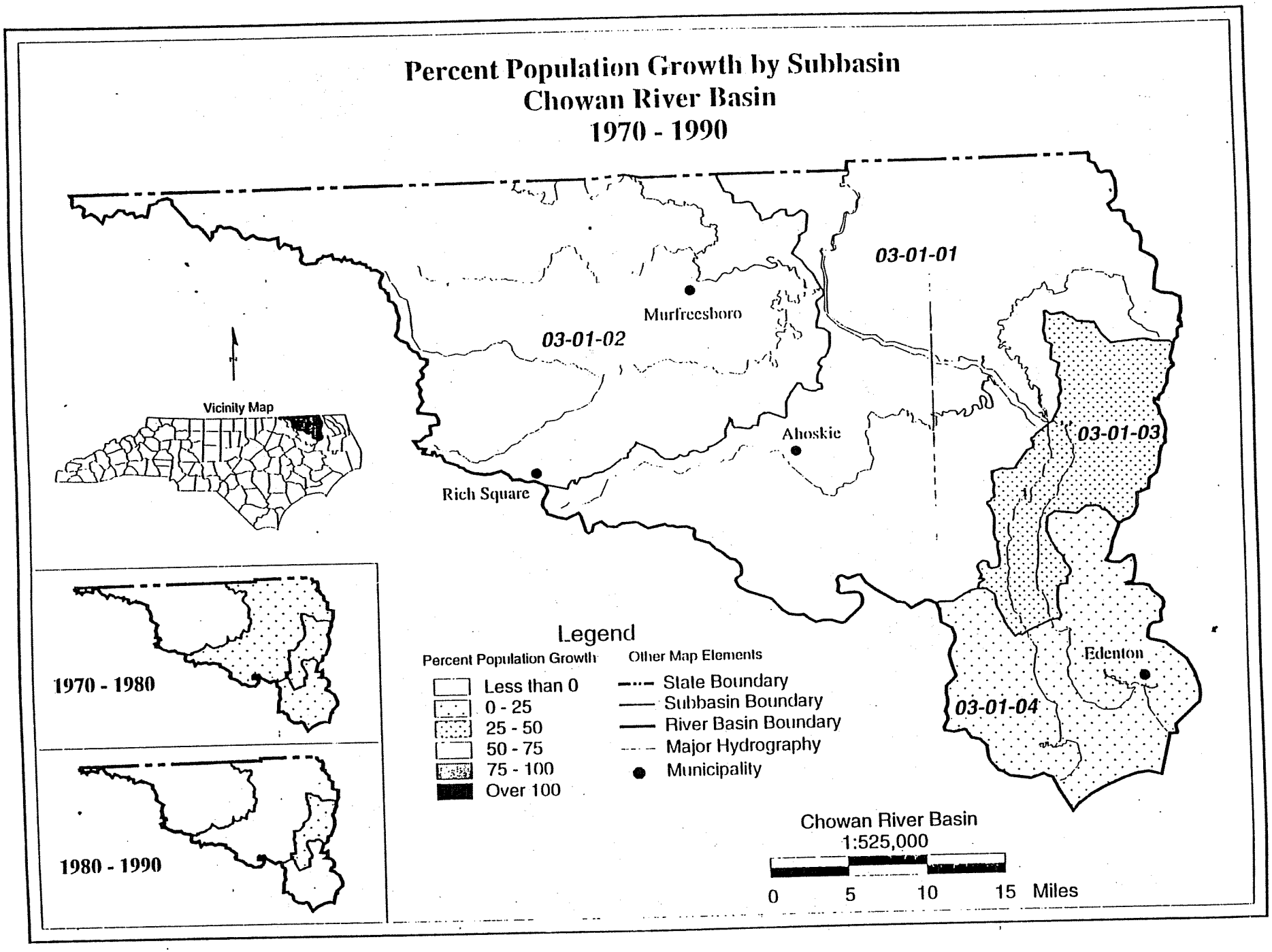

Figure 2.3. Percent Population Growth by Subbasin

The municipalities in the Chowan basin are relatively small in size, ranging in size from 104 people in Como to 5,407 people in Edenton (1994 figures from the NC Office of State Planning, 1995). Growth in municipal areas have generally been modest. The largest municipalities, Edenton and Ahoskie, grew by 2.6% an 0.6% respectively between 1990 and 1994. The most growth was in Gatesville which added 65 people between 1990 and 1994, which translates to a 21.1% increase.

Figure 2.4 demonstrates population density by census block group for the Chowan basin. The majority of the basin is rural, but there are pockets of more densely populated areas. These pockets are centered around Edenton, Ahoskie, Colerain and Murfreesboro. It is also interesting to note that these areas are located near major waterways in the basin including portions of the Chowan River, the Meherrin River and Ahoskie Creek.

In using these data, it should be noted that the population figures are estimates because the census block group boundaries do not generally coincide with subbasin boundaries. The census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, an estimate has to be made on the percentage of the population that is located in the subbasin. This is done by simply determining the percentage of the census block group area located in the subbasin and then taking that same percentage of the total census block group population and assigning it the subbasin. Use of this method necessitates assuming that population density is evenly distributed throughout a census block group, which is not always the case. However, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups may change for each census so comparisons between years must be considered approximate.

2.5 AGRICULTURAL ACTIVITIES IN THE CHOWAN RIVER BASIN

Agriculture is an extremely important industry in the Chowan River basin. Based on a 1995 report from the North Carolina Department of Agriculture, there are a total of 1,726 farms in counties that overlap the Chowan River Basin (see Table 2.8). These farms comprise a total of 495,934 acres with the overall average farm size for all of the counties being 301 acres. In 1993, cash receipts for agricultural products in these counties, including both livestock and crop production, totaled $293,980,000. The following sections focus more specifically on livestock operations and crop production in the Chowan basin.

Table 2.8. Summary of 1992 Agricultural Statistics for Counties in the Chowan River Basin (Source:NC Department of Agriculture, 1995)

County (approx. % of Co.in basin)	Number of Farms	Acres of Land in Farms	Average Size of Farm (Acres)	Total Cash Receipts (1993)
~~Bertie (25%)~~	~~456~~	~~170,006~~	~~373~~	~~$89,278,000~~
Chowan (90%)	179	53,902	301	$29,378,000
Gates (60%)	199	64,532	324	$37,111,000
Hertford (100%)	511	52,281	102	$69,034,000
Northampton (85%)	381	155,213	407	$69,179,000
TOTALS	1,726	495,934	301	$293,980,000

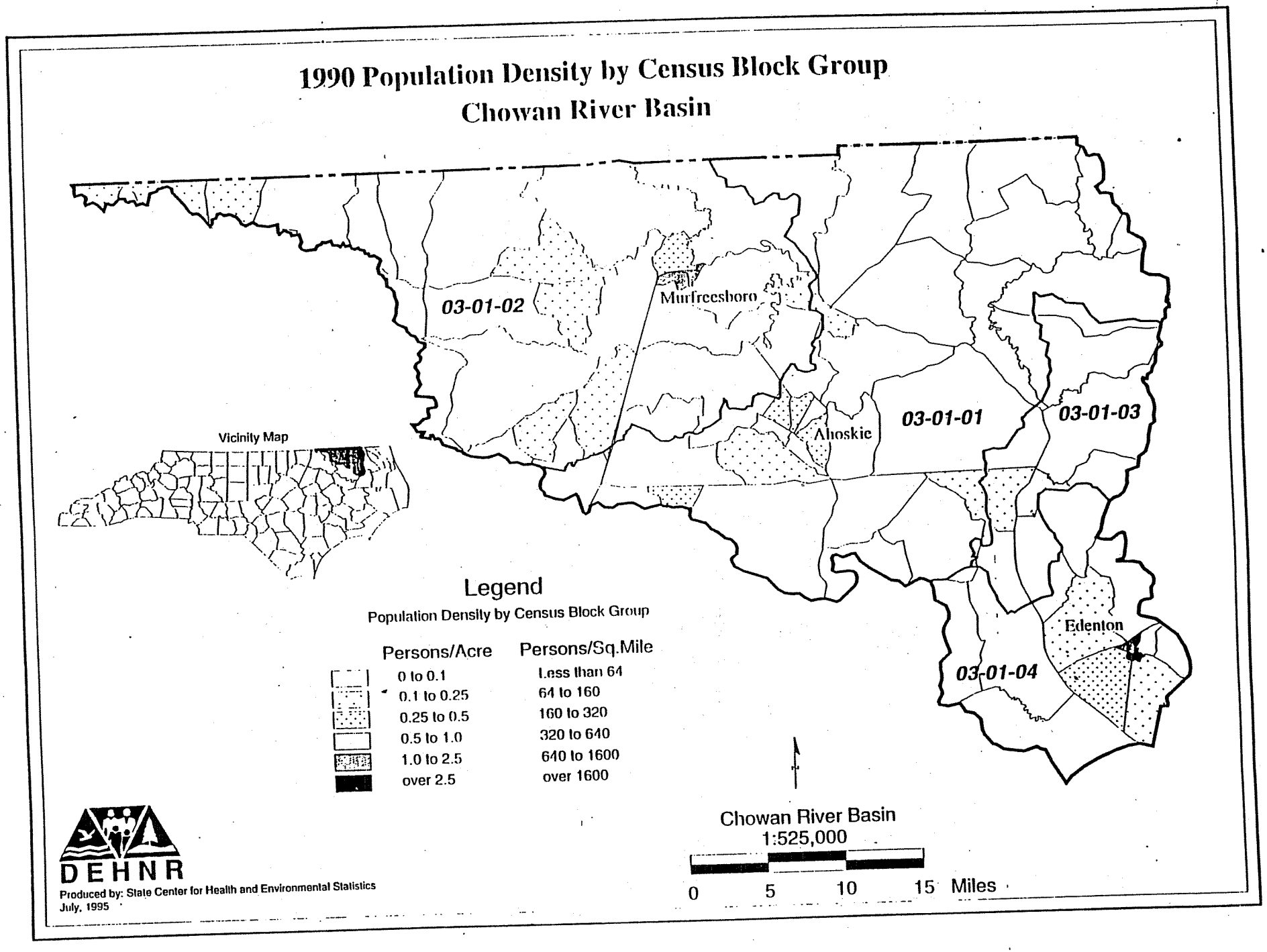

Figure 2.4. 1990 Population Density by Census Block Group for the Chowan River Basin

2.5.1 Livestock Operations

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for managing and reusing animal wastes from intensive livestock operations (See section 5.3.1 for additional information on rule requirements). The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. The deadline for submittal of registrations to DWQ for existing facilities was December 31, 1993.

In the counties that overlap the Chowan River basin, there are a total of 191 registered livestock operations. Thirty-eight (38) of these (or 20%) are certified, meaning they have approved waste management plans (the remainder must have approved plans in place before the end of 1997). The majority of the operations (68%) are raising swine, but there are some cattle and poultry operation in these counties also. Locations of registered animal operations in the Chowan basin are illustrated in Figure 2.5. This map is intended to provide a general idea of locations of registered operations in the basin.

The increase in swine numbers from 1990 to 1994 has been dramatic in subbasins 01 and 02 (NCDA Veterinary Division, 1995). In subbasin 01, which includes the upper portion of the Chowan River in North Carolina, there was a 327% increase in the number of swine during this four year time period. And in the adjoining subbasin (02) which encompasses the Meherrin River and tributaries, there was a 446% increase. The other two subbasins of the Chowan saw 30% and 40% decreases in the number of swine, but the large growth in 01 and 02 far outweighs these relatively modest declines. The basin as a whole experienced a 196% increase in the number of swine between 1990 and 1994.

2.5.2 Crop Production

According to the NC Department of Agriculture (1995), there are a variety of crops grown in the Chowan River basin (based on data from counties that overlap that basin). The biggest crop in this region is peanuts. In fact, all five counties in the Chowan basin are within the top ten producers of peanuts in the state, with Northampton County being the highest. Northampton County is also ranked statewide as the second highest producer of sorghum and the third highest producer of cotton. Other crops grown in the area include corn, tobacco and potatoes.

2.6 NATURAL RESOURCES IN THE CHOWAN RIVER BASIN

2.6.1 Fisheries

North Carolina's commercial and recreational fishery resources are both nationally and regionally significant. Commercial harvest of fish and shellfish in North Carolina produces an average of 180.6 million pounds of marketable resource each year (based on figures from 1987 - 1991) (Division of Marine Fisheries, 1993). The annual economic value of this resource is $1 billion and is a critical component of North Carolina's coastal economy. Management of these fisheries resources has recently become a critical issue in the state as fisheries are threatened by overfishing, habitat loss, and water quality decline.

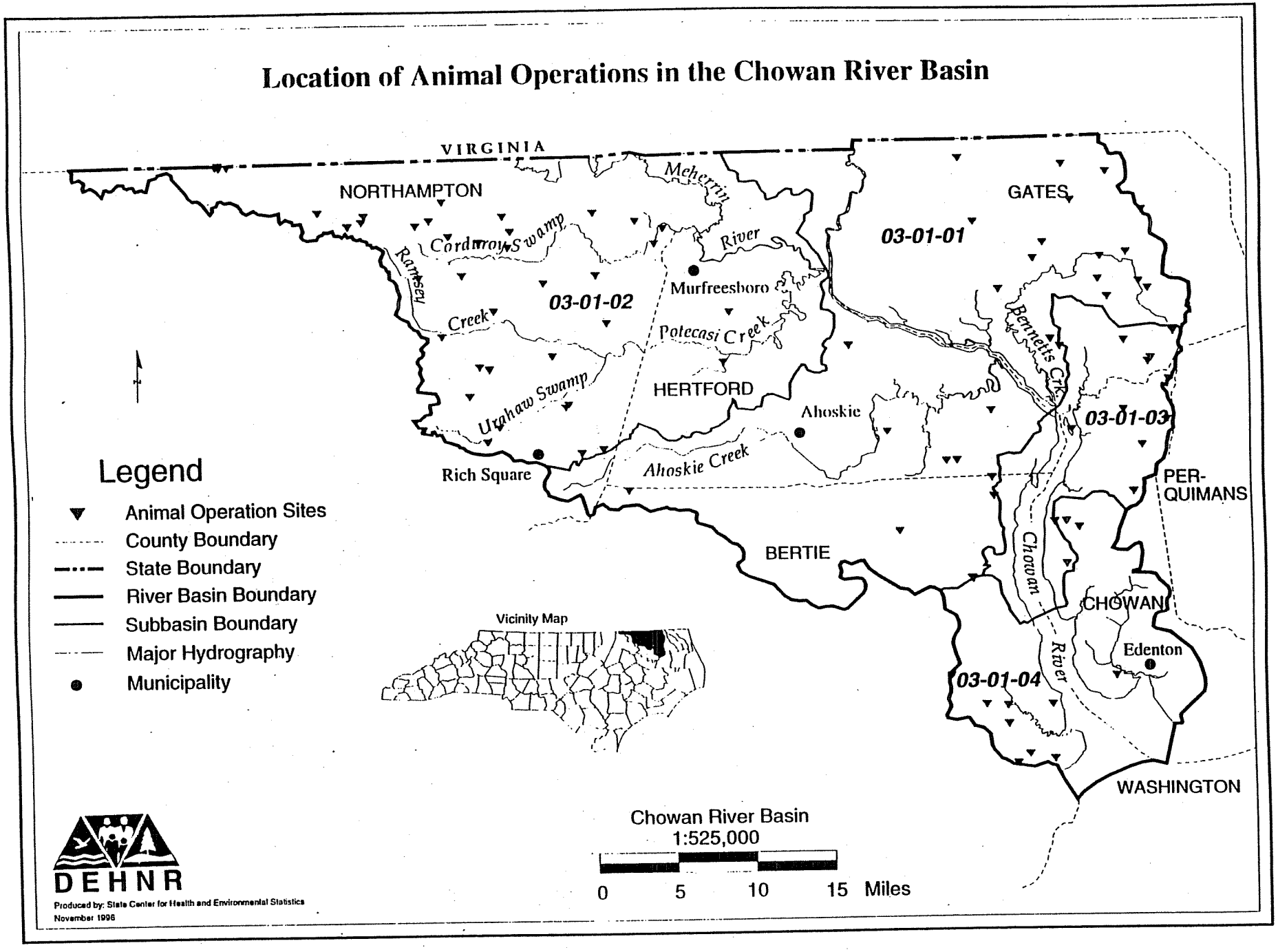

Figure 2.5. Location of Registered Livestock Operations in the Chowan River Basin

Estuarine fishery resources can be described by how fish live their lives. There are three major types (DMF, 1993): anadromous fish, resident fish and migratory fish. Anadromous fish spend most of their lives in saltwater but spawn in freshwater streams. Examples of these include river herrings and striped bass. Resident fish stay in the same area for their whole life because they need a certain kind of habitat in which to live. Examples of these include catfish and clams. Migratory species spawn in the ocean and around inlets and some migrate seasonally along the Atlantic coast. These fish are the most prominent in the estuaries and include menhaden, croaker, spot, flounder and blue crab.

Recreationally important gamefish species that are resident within the Chowan River include largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*) and numerous sunfish species. Total sport fishing effort on Chowan River averaged approximately 201,600 angler hours per year from 1977-1980 (Mullis and Guier, 1982). Although current angler effort figures are unavailable, the Chowan River largemouth bass population continues to be subjected to intense fishing pressure. North Carolina Wildlife Resources Commission fisheries and law enforcement personnel estimate that at least 4 - 6 organized largemouth bass tournaments occur on the river each weekend from March through October in addition to non-tournament fishing (Kornegay, 1991). Although specific economic data is not available for recreational fishing on the Chowan River, anecdotal evidence suggests local and regional economies within the basin are often strengthened by fuel, lodging, food, bait and tackle purchases made by recreational fishermen.

The Chowan River is an important habitat for several anadromous fish species. These species include blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), hickory shad (*Alosa mediocris*), American shad (*Alosa sapidissima*), Atlantic sturgeon *(Acipenser oxyrhynchus)* and striped bass *(Morone saxatilis).* The first two species (blueback herring and alewife) are often generally referred to as 'river herring'. All of these fish have a very large range extending along the Atlantic from Canada to northern Florida. Blueback herring that were tagged during the summer in Canada have been recaptured in the Roanoke River in North Carolina, and fish tagged in North and South Carolina waters have been recaptured in Georges Bank, Canada (DMF, 1993). Figure 2.6 provides a map illustrating the location of anadromous fish spawning areas in the Chowan River basin.

There are two types of fisheries data that have been examined to determine the status of the populations in the Chowan River and Albemarle Sound into which the river flows. One is commercial landings which is a measure of the number of pounds of fish caught by commercial fishermen. The other is 'catch per unit effort', or CPUE, which is derived from the amount of commercial landings and how much gear, such as pound nets, was used to catch those fish.

Commercial landings and CPUE data indicate that populations of anadromous fish species in the Chowan River are stressed or depressed. A publication of the NC State Museum of natural history lists the migratory Atlantic sturgeon, herrings and shads as "depleted" (Cooper et. al., 1977). More recent stock information from NC DMF lists American shad as "stressed declining", hickory shad as "stressed recovering", and Atlantic sturgeon and river herring in the Albemarle/Chowan Basin as "depressed". Looking at landings of river herring in the Chowan River, which accounts for approximately 85% of the state's total landings for these fish (DMF, 1993), there is a clear downward trend in landings (Figure 2.7). A similar trend is being seen in the Albemarle sound for American shad (Winslow, 1994). Although landings data is influenced by a variety of factors including, but not limited to, market demand, fishing effort and the weather, they can provide a general indicator of fishery trends.

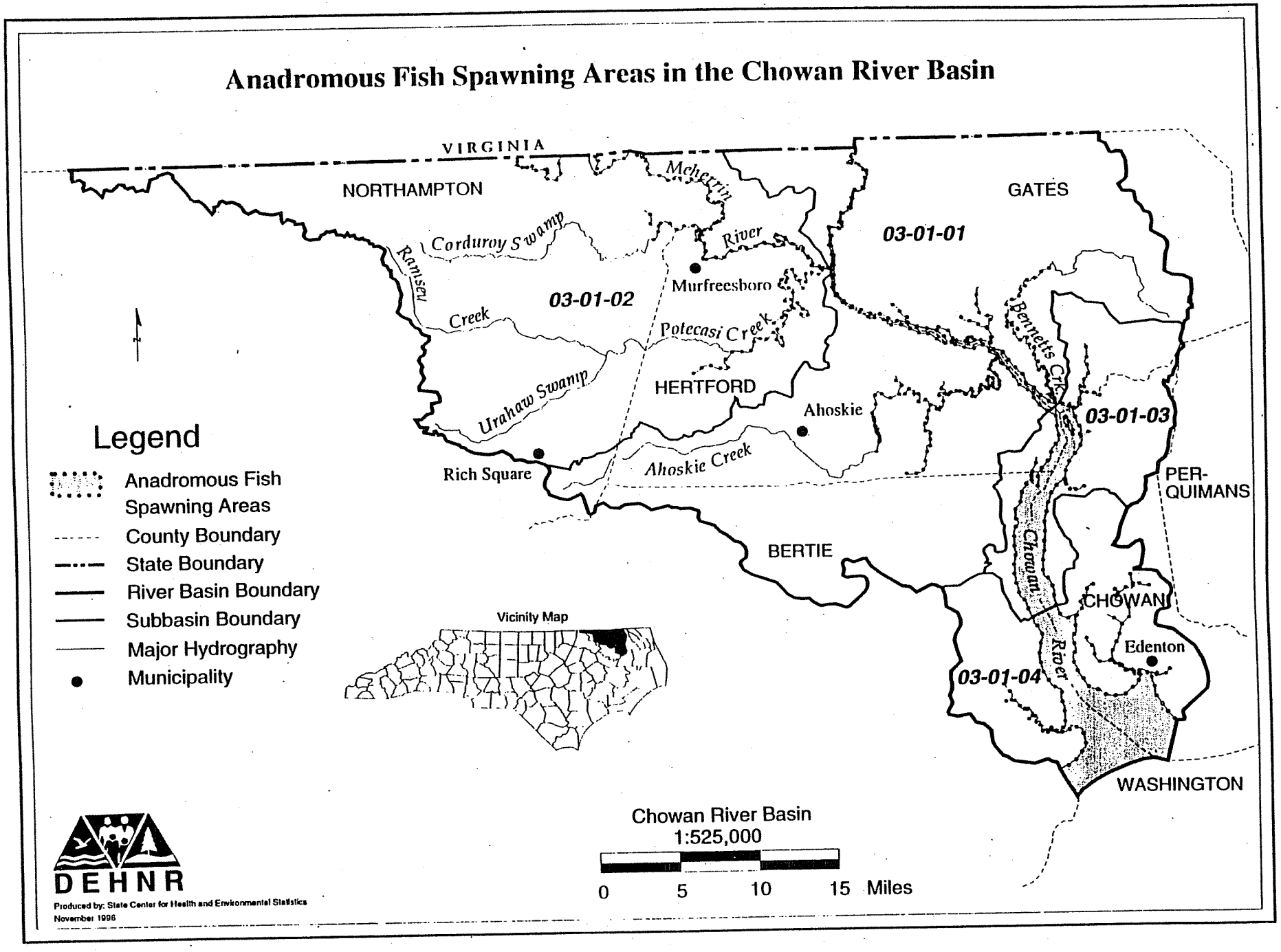

Figure 2.6. Anadromous fish spawning areas in the Chowan River Basin.

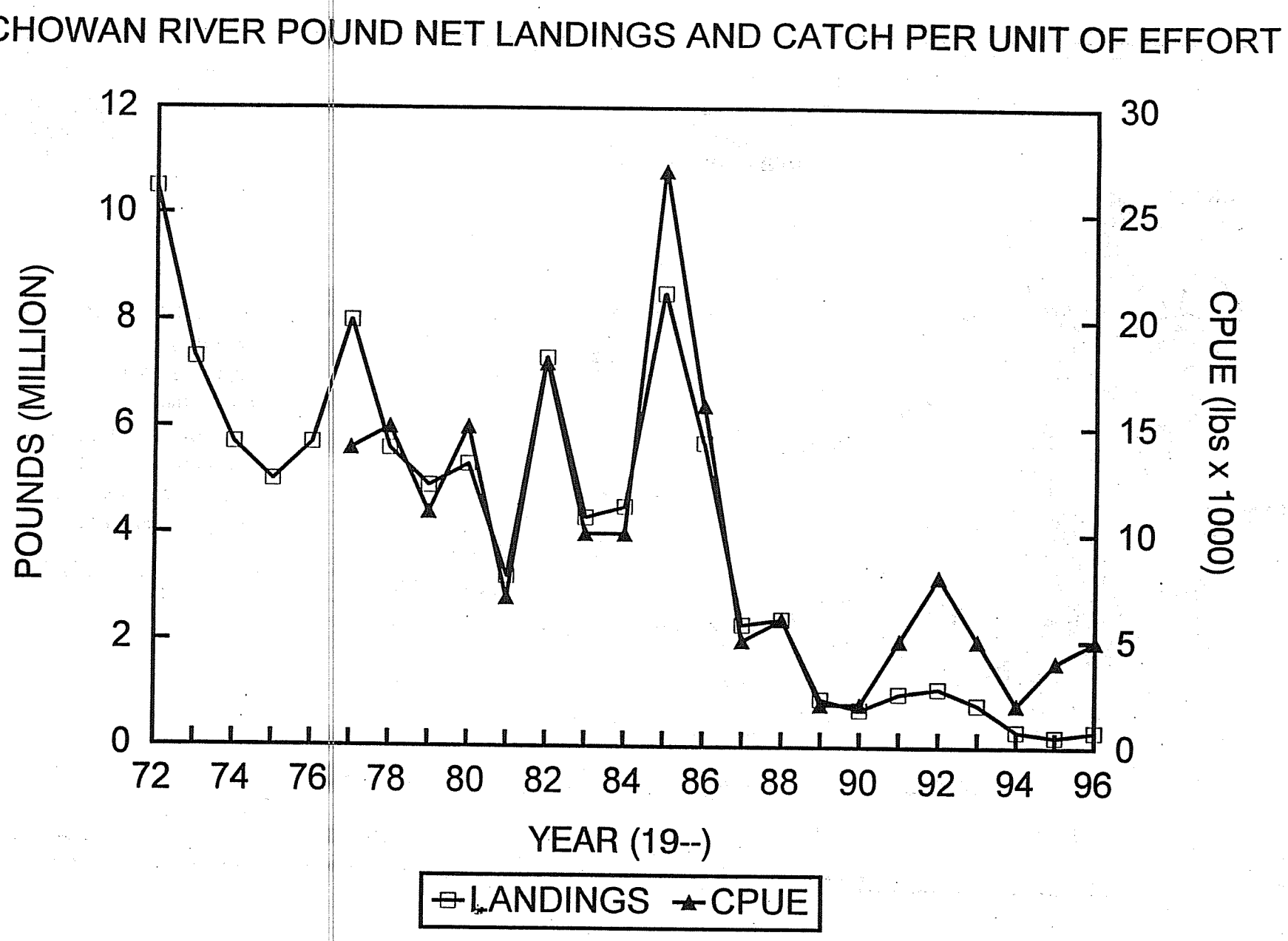

Figure 2.7. Commercial landings of river herring pound nets (all species) in Chowan River, 1972 -1996, and CPUE for river herring in Chowan River pound nets, 1977 - 1996. (Source: DMF).

Factors influencing the decline in abundance of these species include loss of spawning habitat and nursery areas, overfishing and water quality. Specifically with regard to water quality, several conditions including algae blooms and low dissolved oxygen levels have been identified as possible contributors to declines in these fisheries (Winslow, 1994; DMF, 1993).

The extensive Chowan River watersheds that contain intermittent and tidally flooded wetlands, swamp, hardwood forests, shallow open waters and areas of emergent and submerged aquatic vegetation are considered very important as spawning, nursery, and feeding areas for anadromous and resident species. Maintenance of the water quality benefits provided by these habitats is critical to fishery resources. Channelization and drainage projects have severely impacted many of these areas and downstream water quality.

2.6.2 Merchants Millpond State Park and Chowan Swamp Natural Area

Merchants Millpond State Park

The North Carolina state parks system exists for the enjoyment, education, health and inspiration of all citizens and visitors. The mission of the state parks system is to conserve and protect representative examples of the natural beauty, ecological features, and recreational resources of statewide significance; to provide outdoor recreational opportunities in a safe and healthy environment; and to provide environmental education opportunities that promote stewardship of the state's natural heritage.

The Chowan River basin contains a popular state park. Merchants Millpond State Park is located in the Coastal Plain province of the state in central Gates County. It was established in 1973 and covers 2,922 acres of land and water (NC DPR, 1994). The park provides opportunities for canoeing, nature study, picnicking, camping, fishing and hiking. The millpond, (originally known as Norfleets Millpond), was formed when Bennetts Creek was impounded to serve a grist and saw mill in 1811. The park contains many important biological resources representative of a coastal millpond and southern swamp. Examples include old-growth stands of cypress-gum forests and a Mesic Mixed Hardwood Forest dominated by beech. An unusual feature of the millpond is the thick scattering of massive stumps within the millpond which provide habitats for complex ecosystems. Many plant species are at or near the limits of their range, with mountain species and northern species coexisting with the typical southern varieties.

Merchants Millpond is currently experiencing a problem with an overabundance of aquatic weeds. The water quality of the pond and the status of the weeds is discussed further in section 4.5.1 of Chapter 4.

Chowan Swamp Natural Area

Downstream of Merchants Millpond State Park and located adjacent to the Chowan River is Chowan Swamp Natural Area. A tributary to the Chowan River, called Sarem Creek, runs through the middle of it. The area is considered valuable for recreation, although recreational activities are limited to water areas because there is no high ground to support campgrounds or shoreline activities. The area supports a wide variety of vegetation and fish and wildlife.

2.6.3 Wetlands

There are a number of wetland natural communities found in the Chowan Basin. Perhaps the most important wetland community in this basin is the Tidal Cypress--Gum Swamp, which is found along much of the shoreline of the Chowan River, extending as far upriver as the Chowan Swamp area of southern Gates County. This community blends with the Cypress--Gum Swamp (Blackwater subtype) farther away from the river, but still within the Chowan River floodplain. The Meherrin River extends into the Piedmont in Virginia and has areas of brownwater communities, whereas the forests along the Chowan are generally of the blackwater subtype (of

cypress--gum swamp). The most common wetland community in the Chowan Basin is the Coastal Plain Small Stream Swamp, which is found along most of the tributary streams and creeks; such sites generally have narrow floodplains with no natural levees, backswamps, and other fluvial features found on the larger rivers.

A somewhat rare community is the Tidal Freshwater Marsh, which is found at a few sites along the Chowan River and adjacent lower portions of tributary streams. There is a scattering of millponds in the basin, and the Coastal Plain Semipermanent Impoundment is the community present at such sites. Though not truly a "natural" community, these plant associations -- commonly bald-cypress in standing water over a wide variety of aquatic herbs -- are repeated at many sites, highlighted by Merchants Millpond State Park. There are a few small stands of Atlantic white cedar, and a few areas of pocosin vegetation. All in all, however, most of the pocosins in the basin have been cleared or converted to other types of forests.

Wetlands can be very important in watershed planning because they perform a variety of services beneficial to society. These systems are able to process sediments, nutrients, and other pollutants, provide wildlife habitat, store organic matter and provide other means to protect habitat as well as downstream and on-site water quality. In some instances, wetlands serve as spawning and nursery areas for anadromous fish. Each of the actions that a wetland performs, regardless of human recognition of that action, is called a function. When these actions are declared important to society as a whole, they are called values. The following discussion primarily concerns wetland values. Some wetland values are ubiquitous to most wetland types, such as wildlife habitat. However, wetland values are ultimately tied to specific wetlands because they depend on site specific factors such as landscape position, size, soil type, and land use. Table 2.9 lists those wetland types that are most common in the Chowan basin and provides acreages for those types. These figures were generated by the NC Division of Coastal Management (DCM). DCM is currently working to identify and digitize into GIS wetland areas (by type) in the NC coast. Only the Northhampton County portion of the Chowan basin has not been completed. Table 2.10 provides a brief description of typical values associated with the different wetland types.

Table 2.9. Number of acres of wetlands in the Chowan River Basin (not including Northhampton County).

Wetland Type	Not Drained or Cleared	Drained	Cleared	Total	Percent of Total
Freshwater Marsh	579	18	85	682	1
Bottomland Hardwood	20,560	737	1,244	22,541	16
Swamp Forest	55,418	1,364	2,465	59,247	43
Hardwood Flat	3,183	1,419	576	5,177	4
Pine Flat	1,455	290	47	1,792	1
Managed Pineland	46,094	n/a	n/a	46,094	34
Headwater Swamp	1,449	0	220	1,670	1
TOTAL	128,738	3,828	4,637	137,203	100
PERCENT	94	3	3	100	

Table 2.10. Wetland types common in the Chowan Basin.

Wetland Type	Values
Headwater Forests	overland pollutant removal, wildlife habitat, timber production
Bottomland Hardwood Forests	water storage, shoreline stabilization, pollutant removal, wildlife habitat, aquatic habitat, outdoor recreation/ education, timber production, hunting leases
Swamp Forests	water storage, overland and overbank pollutant removal, wildlife habitat, aquatic habitat, outdoor recreation/ education, timber production, hunting leases
Wet Flats	special ecological attributes, wildlife habitat, outdoor recreation/education, timber production, hunting leases

Bottomland hardwood and headwater wetlands perform valuable water quality functions including flood water storage, nutrient and sediment retention and nutrient transformation. However, their effectiveness is diminished if the stream waters can no longer inundate adjacent floodplains or if nutrient loads exceed the assimilative capacity of the wetland. As these wetlands are lost upstream, the potential for erosion, flooding, sedimentation, algal blooms, and fish kills increase downstream. Those wetlands adjacent to intermittent streams are especially important in filtering nonpoint pollution from agricultural and urban runoff.

Wet flats and pocosins in the coastal plain also may have a considerable influence on the water quality of the region. In general, wet flats and pocosins do not store as much water or retain as many pollutants as wetlands directly associated with streams, such as bottomland hardwood forests. However, wet flats and pocosins occupy extensive areas of interstream divides, and, based on sheer magnitude of coverage in the coastal plain, the cumulative effects of these wetlands may be vital to water quality of coastal plain streams. Consequently, the conversion of these wetlands may significantly affect the hydrology or water quality of the region. Between 1994 and 1996, the 'other' category (which in the Chowan basin includes primarily headwater forest and swamp forest) received the greatest impacts from permitted wetland fill activities in the basin (Table 2.11). The majority of the conversions were related to DOT projects and the creation of ponds. The Division of Water Quality is currently assessing the cumulative impacts on water quality of incremental fill of wet flats and pocosins.

Table 2.11. Fill activities in the Chowan Basin by wetland type (1994-1996).

Wetland Type	Acres Wetland Fill Permitted
Bottomland Hardwood Forest	5.54
Salt Marsh	0
Wet Flat	11.91
Pocosin	0
Other	30.74
TOTAL	48.19

Note: Numbers have not yet been completely QA'd. However, it is not anticipated that they will change significantly upon completion of that process.

2.6.4 Threatened and Endangered Aquatic Faunal Species

In the Chowan River basin, there are seven species that are listed by North Carolina as either Threatened, Special Concern, or Significantly Rare. In the Chowan basin, only the bald eagle is

Federally listed. Threatened species are considered likely to become endangered within the foreseeable future. Endangered species are those species that are in danger of becoming extinct. Species of Special Concern have limited numbers and vulnerable populations and are in need of monitoring. Significantly Rare species are those whose numbers are small and whose populations need monitoring. The American Alligator has received the classification of 'Threatened Due to Similarity of Appearance' due to the similarity between the alligator and the endangered crocodile. Locations of rare species are shown in Figure 2.8. Table 2.12 lists the species in the Chowan River basin that have received a State or Federal listing because of limited or vulnerable populations.

Table 2.12. Threatened and Endangered Species in the Chowan River Basin (Source: NC Natural Heritage Program)

Common Name	Scientific Name	Subbasins where found	Listing Status: State	Federal
RARE AQUATIC ANIMALS				
Alewife Floater	*Anodonta implicata*	All	SC	
Eastern Lampmussel	*Lamsilis radiata*	01, 03, 04	SC	
Tidewater Mucket	*Leptodea ochracea*	All	SC	
Eastern Pondmussel	*Ligumia nasuta*	All	SC	
American Alligator	*Alligator mississippiensis*	01	T	T(S/A)
Triangle Floater	*Alasmidonta undulata*	01, 03, 04	T	
Chowanoke Crayfish	*Orconectes virginiensis*	02	SR	SC
RARE AQUATIC-DEPENDENT ANIMALS				
Bald Eagle	*Haliaeetus leucocephalus*		E	T
Black Bear	*Ursus americanus*		SR	

Abbreviations: E = Endangered, T = Threatened, SR = Significantly Rare, SC = Species of Concern, T(S/A) = Threatened Due to Similarity of Appearance.

2.6.5 Natural Heritage Priority Areas

The North Carolina Natural Heritage Program (NHP) compiles the N.C. Department of Environment, Health and Natural Resources' (DEHNR) priority list of Natural Heritage Areas as required by the Nature Preserve Act (NCGS Chapter 113-A-164 of Article 9A). The list is based on the program's inventory of natural diversity in the state (DEHNR 1995). Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high-quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determines a site's priority rating. The sites included on this list are the best representatives of the natural diversity of the state, and therefore have priority for protection. Inclusion on the list does not imply that any protection or public access exists.

Figure 2.8 shows the Natural Heritage Priority Areas in the Chowan Basin. The numbers on the map correspond to the numbered areas described in this section. Certain priority areas that contribute to the maintenance of water quality in the Chowan Basin are highlighted below. More complete information on the natural areas may be obtained from the NHP.

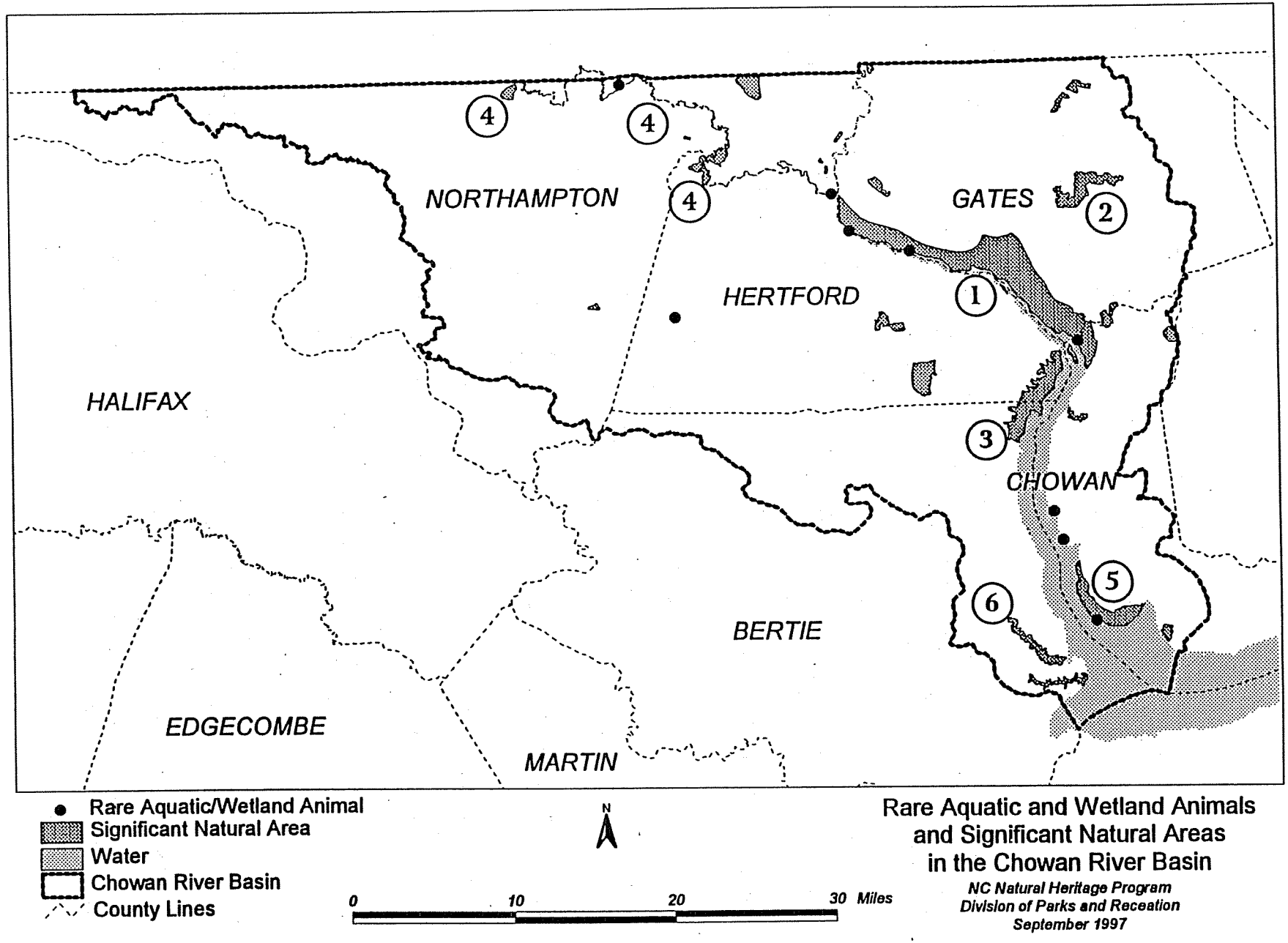

Figure 2.8. Rare species within 500 feet of water and Priority Natural Areas in the Chowan River Basin.

Natural Heritage Priority Areas in the Chowan Basin that are Important to Water Quality

1.Chowan Swamp/Bennetts Creek/Catherine Creek Swamps. This natural area consists of approximately 16,000 acres along the northern floodplain of the Chowan River, in southern Gates and adjacent Chowan counties. The Chowan Swamp State Natural Area, administered by the N.C. Division of Parks and Recreation, covers more than 6000 acres of this larger site. Additional lands in this swamp are administered by the Wildlife Resources Commission as the Chowan Swamp Game Land. The remainder of the site is privately owned and is not protected. The entire natural area contains some of the most extensive acreage in the state of Tidal Cypress--Gum Swamp.

2. Merchants Millpond State Park. This park contains perhaps the best example of the Coastal Plain Semipermanent Impoundment natural community in the state. There is an impressive array of floating aquatic plants at the park. The swamp along Bennetts Creek, at the head of the millpond, contains a stand of old-growth cypress--gum forest. The park also contains good stands of upland forests, including several beech-dominated slopes.

3. Colerain/Cow Island Swamp and Slopes. This 3500-acre site is similar to the Chowan Swamp, in that it lies in the floodplain of the Chowan River and features Tidal Cypress--Gum Swamp along the shoreline and Cypress--Gum Swamp, Blackwater subtype farther from the river. It is located downstream from the Chowan Swamp, on the western shore of the river in Hertford and Bertie counties. A small portion of the site is protected by a registry agreement with a timber company, but fuller protection of the site is needed.

4. Meherrin River natural areas. There are six Natural Heritage Priority sites located along the Meherrin River. Those important to water quality include the Meherrin River Swamp in Hertford County (505 acres) and the Meherrin River Slopes and Swamp (360 acres) in Northampton County. These sites contain good to excellent examples of Cypress--Gum Swamp, Brownwater subtype communities. All sites need protection.

5. Reedy Point Swamp. This 1850-acre site lies along the northern shore of the Chowan River, just west of Edenton. In addition to Tidal Cypress--Gum Swamp, there is some Pond Pine Woodland natural community present in this site. Protection of this site is needed.

6. Salmon Creek Swamp. This site consists of approximately 2000 acres in the lower floodplain of Salmon Creek, in eastern Bertie County. Most or all of this site consists of Coastal Plain Small Stream Swamp natural community. Protection of this site is needed.

2.7 SURFACE WATER CLASSIFICATIONS AND STANDARDS

2.7.1 Program Overview

North Carolina has established a water quality classification and standards program pursuant to G.S. 143-214.1. Classifications and standards are developed pursuant to 15A NCAC 2B.0100 - Procedures for Assignment of Water Quality Standards. Waters were classified for their "best usage" in North Carolina beginning in the early 1950's, with classification and water quality standards for all the state's river basins adopted by 1963. The effort to accomplish this included identification of water bodies (which included all named water bodies on USGS 7.5 minute topographic maps), studies of river basins to document sources of pollution and appropriate best uses, and formal adoption of standards/classifications following public hearings.

The Water Quality Standards program in North Carolina has evolved over time and has been modified to be consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters and the protection of unique and special pristine waters with outstanding resource values. Classifications and standards have been broadly interpreted to provide protection of uses from both point and nonpoint source pollution.

2.7.2 Statewide Classifications and Water Quality Standards

All surface waters in the state are assigned a primary water classification, and they may also be assigned one or more supplemental classifications (Table 2.13).

Table 2.13. Primary and Supplemental Classifications Applicable to the Chowan River Basin

PRIMARY CLASSIFICATIONS

Class	Best Uses
C	Aquatic life propagation/protection and secondary recreation
B	Primary recreation and class C uses

SUPPLEMENTAL CLASSIFICATIONS

Class	Best Uses
Sw	Swamp Waters: recognizes waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen
NSW	Nutrient Sensitive Waters: Waters that are subject to growths of microscopic or macroscopic vegetation that require the control of nutrient inputs.

As noted above, classifications are assigned to protect uses of the waters such as swimming, aquatic life propagation or water supplies. For each classification, there is a set of water quality standards that must be met in order to protect the uses. Appendix I provides a more detailed summary of the state's primary and supplemental classifications including, for each classification, the best usage, water quality standards, stormwater controls and other protection requirements as appropriate. This information is derived from 15A NCAC 2B .0200 - Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina.

2.7.3 Surface Water Classifications in the Chowan River Basin

The waters of the Chowan River basin have a few surface water quality classifications applied to them. The whole basin (approximately 1,564 stream miles) has been designated as Nutrient Sensitive Waters since 1979. This area was the first in North Carolina to receive this designation because the Chowan River was experiencing problems with algae blooms. More information on the history of nutrient enrichment in the Chowan is contained in the nutrient section of Chapter 3. The majority of the basin (approximately 92% or 1,439 stream miles) has a primary classification of C to protect for aquatic life. There are some waters in the basin, including the Chowan River, that have been classified as Class B to protect primary recreational uses. These waters represent about 8% (125 stream miles) of all waters in the basin.

Although no waters in this basin are supplementally classified as swamp (Sw) waters, there are many that exhibit characteristics associated with that classification (such as low dissolved oxygen levels and low pH). Due to limited resources, this is an issue that DWQ has not addressed through intensive studies and regulatory revision (reclassification). However, it is recognized that there are areas in the basin that may need to be reclassified to reflect their naturally having swamp

characteristics. As priorities and resources allow, potential reclassification of appropriate waters will be investigated.

A complete listing of classifications for all surface waters in the basin can be found in a DWQ publication entitled "Classifications and Water Quality Standards Assigned to the Waters of the Chowan River Basin". This is available from the Division of Water Quality's Water Quality Section (919/733-5083, ext. 564). Pending reclassifications are discussed in Chapter 6.

2.8 WATER USE IN THE CHOWAN RIVER BASIN

2.8.1 State Water Supply Plan Database

The Division of Water Resources is compiling a State Water Supply Plan (SWSP) Database that contains information from Local Water Supply Plans pursuant to GS 143-355 (l) and (m). As of July 30, 1996, 15 of an expected 27 systems that are wholly (or partly) in the Chowan River basin are represented in the Sate Water Supply Plan Database. The following summary of current and future population and water use is based on these 15 water systems.

Table 2.14 presents the 1992 and projected serviced population for these systems through to the year 2020. Based on this table it may be expected that the population serviced by these systems will increase by 42% percent over the next few decades.

Table 2.14. 1992 and Projected Service Populations for Water Suppliers in the Chowan River Basin that have Provided Information to the NC Division of Water Resources.

SYSTEM NAME YEAR	1992	2000	2010	2020
AULANDER	1,366	1,450	1,500	1,550
COLERAIN	238	250	250	250
POWELLSVILLE	672	656	634	611
BERTIE CO WATER DIST IV	0	2,307	2,934	2,815
BERTIE CO WATER DIST I	0	3,093	2,990	2,881
BERTIE CO WATER DIST II	0	2,866	3,514	3,374
EDENTON	5,600	5,768	5,941	6,119
CHOWAN CO	8,253	8,665	9,098	9,553
GATES CO	8,394	8,871	9,379	9,938
AHOSKIE	4,583	5,533	5,588	5,643
WINTON	796	797	781	762
SEVERN	310	350	400	425
CONWAY	758	588	545	501
SEABOARD	805	885	973	1,070
WOODLAND	1,000	1,000	1,000	1,000
TOTALS	32,775	43,079	45,527	46,492

SOURCE: SWSP Database, Division of Water Resources, DEHNR, Not Published

Based on the information submitted by the water suppliers, total average daily use is 260,000 gallons per day. Approximately 65% of the total amount of water supplied goes to residences, while the remaining 35% is used for industrial and commercial purposes.

As Figure 2.9 illustrates, overall projected water use in million gallons per day is expected to increase modestly in the next two decades approaching a high of 5 MGD. The forecast between 1992 and 2020 is for a 27% increase in water use.

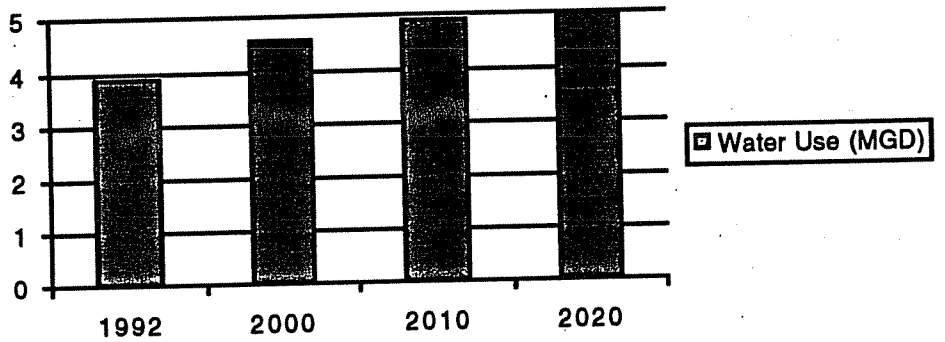

Figure 2.9. Total Projected Water Use in MGD for Water Suppliers in the Chowan River Basin. (Source: SWSP Database, Division of Water Resources, Not Published.)

2.8.2 US Geological Survey Water Use Information

The US Geological Survey (USGS) maintains a water use database that characterizes whether the source of the water is surface or ground water, as well as what the purpose for which the water is used. Table 2.15 summarizes the USGS data for the Chowan River Basin.

Table 2.15. 1990 Water Withdrawals in the Chowan River Basin in MGD. (Source: USGS Water Use Database, Not Published, file retrieved from ftp site at... 130.11.144.77 in /var/ftp/pub)

Withdrawal Category	Ground Water	Surface Water	Ground + Surface	Percent of Total
Public Water Supply	29.7	0.0	29.7	83%
Commercial	0.01	0.0	0.01	<1%
Domestic	1.31	0.0	1.31	4%
Industrial	1.65	0.0	1.65	5%
Livestock	0.58	0.1	0.68	2%
Irrigation	0.07	2.2	2.27	6%
Totals	**33.32**	**2.3**	**35.62**	**100**
Percent	**94%**	**6%**	**100**	

Note: All withdrawal categories other than Public Water Supply are self-supplied. For example, the domestic category represents residents that supply their own water.

The information contained in table 2.15 indicates that the vast majority (94%) of water used in the basin is coming from groundwater sources. Surface water is only used for agricultural purposes such as the maintenance of livestock and irrigation. Most of the water used in the basin is directed toward supplying people with water in their homes.

2.8.3 Other Water Resource Issues in the Chowan River Basin

One area of concern is the City of Norfolk's withdrawals from the Blackwater and Nottoway Rivers. Norfolk has historically pumped up to 24 mgd from the Blackwater and up to 22 mgd from the Nottoway to augment its municipal water supply. The Blackwater pumping station is located 2 miles west of Burdette, Virginia. The Nottoway facility is located near Courtland, Virginia. Both pump transmission systems discharge into the upstream end of Lake Prince.

Under current operating procedures, Norfolk maintains a minimum instream flow of 25 cfs (16 MGD) at its pumping stations on both the Blackwater and Nottoway. In addition, peak pumping usually occurs during periods of low flow. Previous reports have assumed different flowby requirements in calculating the potential pumping rates. Flowby requirements were 25 cfs (16 mgd) for the Blackwater, and 25 to 50 cfs (16 to 32 mgd) for the Nottoway. Minimum pumping rates vary from 0 to 10 mgd.

A recent report by Norfolk's consultant suggests that with minor improvements to the pumping stations, up to 26.0 and 23.5 mgd could be pumped from the Blackwater and Nottoway, respectively (Gannett Fleming, Safe Yield Study, April 1996). The consultant assumed no minimum flowby requirement.

The Division of Water Resources is concerned that current and proposed operating policies pose a threat to instream aquatic habitat and water quality. The Chowan River and its tributaries act as a spawning and nursery area for species of herring and shad. River flows are related to the upstream migration of these fish. In addition, the Blackwater and Nottoway are classified as nutrient enriched waters. Maintaining minimum flows will decrease the detention time in the Chowan River, reduce the chance of algal blooms, and improve river water quality at low flows. The effects of the Norfolk pumping have never been adequately studied. An investigation of downstream flow requirements is needed to determine reasonable pumping rates for the Blackwater and Nottoway.

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