WATERSHED PLANNING IN THE ALBEMARLE-PAMLICO ESTUARINE SYSTEM

Report 6–Use of Information Systems for Developing Subbasin Profiles

by

Randall C. Dodd
Patricia A. Cunningham
Ross J. Curry
Steven J. Stichter

Research Triangle Institute
Research Triangle Park, NC 27709

PREFACE

This report is the sixth in a series of nine reports by Research Triangle Institute (RTI) to support water quality and watershed planning and the Comprehensive Conservation and Management Plan for the Albemarle-Pamlico (A/P) Estuarine Study Area. This work is being done under Cooperative Agreement No. C-14010 between RTI and the U.S. Environmental Protection Agency, with funding also provided by the State of North Carolina.

Current plans call for the report series to include the following, when completed later in 1993:

- Annual Average Nutrient Budgets
- Groundwater Discharge and Groundwater Quality
- Toxics Analysis
- A Subbasin PC Database
- Fishing Practices Mapping
- Subbasin Profiles and Critical Areas
- Geographic Targeting for Nonpoint Source Programs
- Forest Buffers for Water Quality Enhancement in the A/P Study Area
- Nutrient Mass Balances.

The purpose of this report is to bring together results from our efforts for a diverse audience of resource managers, researchers, private interests, public officials, and the general public. More detailed analyses can be found in other reports of this series. Although numerous staff from State and Federal agencies and researchers were consulted during the project, the authors accept full responsibility for the contents of this report.

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EXECUTIVE SUMMARY

The Albemarle-Pamlico (A/P) estuarine system is one of 20 estuaries identified nationwide under the U.S. Environmental Protection Agency (EPA) National Estuary Program. This report presents the results of a project to develop subbasin profiles of resources, indicators of impairment, and stressors (pollutant sources) and to identify areas critical to protecting and restoring the system. This is one of several efforts by the Research Triangle Institute (RTI) to support watershed and water quality planning in the A/P Study Area. The work was performed under contract to the North Carolina Department of Environment, Health, and Natural Resources and EPA Region 4.

This project is intended to: disseminate information about the environmental condition of the A/P Study Area; foster continuing development and integrated use of databases among local, State, and Federal agencies and the private sector; and assist North Carolina in its watershed and water quality planning and management activities. A major concept used throughout this report is the compilation and presentation of data by watershed. Emphasizing watersheds allows those in water quality management to begin to look more holistically at ecological resources and the causes and sources of degradation and provides a focal point for coordinating multijurisdictional efforts.

Most of the data used in this report were obtained from the A/P database or were developed in projects designed to estimate nutrient budgets, assess toxicants, map estuarine fisheries resources, and study nonpoint sources. Geographic information system tools were used to develop a database based on surface water drainage patterns for each of 13 major drainage basins and 68 subbasins in the North Carolina portion of the A/P Study Area. Information was used to characterize the status of indicators of environmental resources, use impairment, and stressors. Indicators discussed include estuarine fisheries resources, aquatic habitats, wetlands, natural areas, surface water intakes, exceedances of toxicant criteria and standards, fish consumption advisories, algal blooms, solid and hazardous waste sites, nutrient and toxicant loading, agricultural and urban land use, and marina locations. Maps are provided for each basin in which these indicators occur as well as for basin and jurisdictional boundaries.

The data summarized in this report support the continuing focus of regional restoration efforts for the Neuse River and Pamlico River estuaries. The watersheds of these estuaries have the most intense level of activity, and these waterbodies appear to be experiencing the most stress. Other waterbodies harbor important resources and exhibit some symptoms of degradation; however, it is suggested that the most pressing conflicts between human activities and ecological resources are occurring in the Neuse and Pamlico basins and projections of future population increases suggest this conflict will continue. This conclusion is based solely on the data obtained and studied for this project. The A/P region is blessed with valuable living resources and a rich, geographically extensive natural heritage. Valuable aquatic, wetland, and terrestrial resources have been identified throughout the region that deserve protection from further degradation.

Perhaps more important, this report demonstrates the database's ability to supply information necessary for assessing the condition of the complex ecosystems. This assessment, therefore, represents the "true" status of the natural system inasmuch as the information system allows.

Efforts to ensure that information systems will adequately serve increasingly complex resource management needs face many challenges. This report concludes with recommendations to further improve information systems to meet those challenges. The recommendations address interagency coordination, user needs assessment, prioritizing data acquisition, database accessibility, information processing standards, and quality assurance.

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1 INTRODUCTION

1.1 Background

The Albemarle-Pamlico (A/P) estuary system is the second largest estuarine complex in the United States and the third largest in North America. The system provides major resources with intrinsic ecological values and serves many human uses as well.

In recognition of the national importance of the system and because of growing concerns about the potential adverse influence of human activities on the system, the A/P estuary was identified in 1986 as one of 20 sites for intensive study under the Environmental Protection Agency (EPA) National Estuary Program.

One of the results of this designation was the initiation of a concerted effort to capture and consolidate a variety of data into a centralized database. A decision was made to use geographic information system (GIS) technology and capabilities of the (then) Land Resources Information Services staff (now the North Carolina Center for Geographic Information and Analysis [CGIA]).

As the study has progressed, a great deal of data have been captured in the database (Tables 1 and 2). Data have been obtained from many different sources, with the assistance of staff members from many agencies. A common feature of all data in this centralized database is the careful attention that has been paid to their geographic location.

Although major hurdles have been cleared and substantial investment made to capture data, a great need exists to determine how the data can be used for resource management and planning purposes. It is also important for those who have invested in data collection and capture to begin to realize the benefits.

In addition to data housed in the A/P database, there is a wealth of information relevant to assessing the condition of the estuary system that is not currently available in a GIS database. A clear need therefore exists to compile, integrate, and analyze diverse data to allow for informed decisions. Examples of important subject areas that are not covered by existing databases (or have not been made available to the public) include shellfish harvesting closures, fish kills and fish disease, confined animal operations, and implementation of nonpoint source incentive and disincentive programs.

1.2 Purpose

This report attempts to improve the use of information in environmental planning efforts in the A/P region. Specifically, the purposes of this report are to

- Present, analyze, and interpret data relevant to ongoing watershed and water quality management planning activities
- Demonstrate the utility of GIS technology for these activities
- Support the ongoing development of the A/P database.

This report presents and summarizes "available" data on important environmental areas and indicators rather than providing a comprehensive characterization of the A/P region. For a comprehensive picture of the region and its ecological systems, see Steel (1991).

2 SUBBASIN PROFILES AND CRITICAL AREAS

The information in this report is organized by subbasins as delineated by the NC Division of Environmental Management (NCDEM). Subbasins initially identified and delineated by RTI and CGIA (Dodd et al., 1992a) are used as the "template" for presenting results. Major drainage areas in the A/P region are shown in Figure 1. Smaller subbasins (for North Carolina) are shown for each drainage area in Figures 2a through 2j. Table 3 identifies each of these subbasins. Table 4 provides an overview of the various indicators for which data are summarized for each subbasin. Table 4 also indicates the magnitude of each indicator (high, medium, low) for each subbasin. Criteria for classification are presented as well;

these criteria were subjectively determined using best professional judgment based on the distribution of the available data.

2.1 Critical Resources

The A/P Estuarine Study published a report (Steel, 1991) that defined "resource critical areas" as . . . . "ecosystems, biotic communities, and habitats which are noteworthy: (1) because of their role in maintaining estuarine productivity, (2) as indicators of the environmental health of the region, or (3) because of their uniqueness, sensitivity to disturbance, or relationship to regional development." In this section, some of the critical resources in the region are discussed. Data were compiled for 10 important indicators of ecological resources (see Table 4).

2.1.1 Estuarine Fisheries

There are three components of estuarine fisheries resources in the A/P Study Area: shellfish, crustacean, and finfish. Harvest areas were delineated by the NC Division of Marine Fisheries (NCDMF) based on harvest regulations promulgated by the State for protection of these resources and on best professional judgment of fisheries biologists as to where harvesting is currently conducted.

Information on each harvesting practice and associated maps of harvest areas are provided in Cunningham et al. (1992b).

2.1.1.1 Shellfish Harvest Areas--

The bivalve shellfishing resource includes oysters, hard clams, and bay scallops. Oysters (*Crassostrea virginica*) are harvested primarily from oyster rocks in western and northern Pamlico Sound, Croatan and Roanoke Sounds, and portions of the Neuse and Pamlico River Estuaries; hard clams (*Mercenaria mercenaria*) are harvested from the sandy or grassed areas of Bogue, Back, and Core Sounds and the southeast portion of Pamlico Sound; and scallops (*Argopecten irradians*) are harvested primarily from the seagrass beds of Bogue, Back, and Core Sounds and in southern portions of Pamlico Sound behind the Outer Banks.

Shellfish harvest areas include all areas where the following fishing practices are conducted:

- Oysters--hand collecting, raking, tonging, and dredging
- Hard clams--clam raking, bull raking, tonging, and mechanical harvesting practices (i.e., clam kicking and hydraulic dredging)
- Bay scallops--scallop raking and dredging.

2.1.1.2 Crustacean Harvest Areas--

Crustaceans harvested include blue crabs (*Callinectes sapidus*) and three species of shrimp--white shrimp (*Penaeus setiferus*), brown shrimp (*P. aztecus*), and pink shrimp (*P. duorarum*). These crustaceans are harvested in Croatan and Roanoke Sounds, southward throughout Pamlico, Core, and Bogue Sounds, and in the Neuse and Pamlico River Estuaries.

The crustacean harvest area includes all areas where shrimp channel netting and trawling and blue crab trawling and dredging are conducted. Note that mapping of crab pot areas was not included even though the majority of crabs are harvested using crab pots. This harvest method was partially mapped, and work on this data layer will be continued by the NC Division of Marine Fisheries.

2.1.1.3 Finfish Harvest Areas--

The A/P estuarine system is not only a major fishing area but also provides essential habitats for the production of fishery resources caught along the entire Atlantic Coast (APES, 1992). The finfishing resources of the A/P estuarine system include anadromous fish that spend the majority of their lives in saltwater but return to freshwater rivers to spawn, resident species that spend their entire lives in the estuaries, and estuarine migratory species, which generally spawn in the open ocean, around inlets, or near shore but which use the estuaries as nursery and feeding grounds (Steel, 1991). The economically important anadromous

species include river herring and shad (*Alosa* sp) and striped bass (*Morone saxatilis*). The resident species include white perch (*Morone americana*) and several species of catfish (*Ictalurus* sp). The most economically important fisheries resource is predominated by estuarine migratory species including spot (*Leiostomus xanthurus*), Atlantic menhaden (*Brevoortia tyrannus*), Atlantic croaker (*Micropogonias undulatus*), weakfish (*Cynoscion regalis*), and the flounders (*Paralichthys lethostigma* and *P. dentatus*) (Steel, 1991). These groups of fishes constitute important commercial as well as recreational fisheries resources.

Finfish harvesting, as delineated in this report, encompasses the following fishing practices: flounder pound netting, river herring pound netting, sciaenid pound netting, bait fish pound netting, catfish pots, eel pots, trotline fishing, and long haul seining.

Flounder pound netting is conducted in various areas of Albemarle Sound and in Roanoke and Croatan Sounds; river herring pound netting is conducted in three distinct areas: (1) along both shores of the Chowan River, in the mouth of the Roanoke River, and in the Perquimans River; (2) in small areas of the Pasquotank River and Currituck Sound; and (3) in small areas of the Scuppernong and Alligator Rivers. Sciaenid pound netting is conducted in one area of Pamlico Sound between Hatteras and Avon. Bait pound netting is conducted in three distinct areas of the A/P Study Area including: (1) small areas of Albemarle and southern Croatan Sounds, (2) areas of the Pungo River and Pamlico River Estuary, and (3) one area in the Neuse River Estuary along West Bay and in Core Sound.

Catfish pot areas include the Chowan and lower Roanoke Rivers, western Albemarle Sound, and the Scuppernong, Alligator, Pasquotank, Perquimans, and Little Rivers. Eel pot harvest areas include the same waters used for catfish pots plus the Yeopim and North Rivers and Currituck Sound. In addition, eel pots are used in limited areas in the Neuse and Pamlico Rivers.

Trotline fishing areas include the Chowan and lower Roanoke Rivers, western Albemarle Sound, and the Little, Perquimans, Yeopim, and Pasquotank Rivers.

Long-haul seining areas encompass: (1) Croatan and Roanoke Sounds and the northern and eastern section of Pamlico Sound inside the Outer Banks, (2) isolated areas in western Pamlico Sound and in the Pamlico River Estuary, and (3) portions of the lower Neuse River Estuary and Core and Back Sounds.

2.1.2 Aquatic Habitat

2.1.2.1 Nursery Areas--

Nursery areas are coastal waters that provide key habitat for postlarval and juvenile marine and estuarine fish and shellfish species. They are defined by regulation and include primary (Type 1), secondary (Type 2), and special secondary (Type 3) nurseries. Primary nurseries, located in shallow, protected upper reaches of estuaries, support initial development of postlarval fish and shellfish species. As these organisms mature, they move seaward into secondary nurseries. In the lower portions of estuaries (special secondary or "transport" nurseries), young-of-the-year continue migratory movement.

Because of their location in the upper reaches of estuaries, both primary and secondary nurseries are extremely sensitive to influences from runoff. The ecological importance of these areas and their sensitivity has resulted in special recognition in surface water classifications and regulatory programs.

Information concerning the location of nursery areas has been gathered primarily by the NCDMF and, to a lesser extent, by the NC Wildlife Resources Commission (NCWRC) and other researchers. NCDMF maintains the database, tracks fish populations, and defines the areal extent of nurseries. Nurseries have been identified in Albemarle, Pamlico, Core, and Bogue Sounds and in the Pamlico River, Neuse River, and White Oak River Estuaries (Figures 3a through 3g).

2.1.2.2 Submerged Aquatic Vegetation--

Submerged aquatic vegetation (SAV) refers to the submerged macroscopic plants that inhabit photic submerged land. The presence of SAV defines valuable

nursery and feeding habitat for protected species (sea turtles) and for a large number of commercially and recreationally harvested species of fish, shellfish, and ducks. The abundance of animals increases dramatically over that for bottoms with even a sparse presence of SAV and continues to increase as the abundance of SAV increases. SAV habitats also stabilize sediments (reducing maintenance dredging of channels), filter particulate matter out of the water column (improving water clarity), and retain and cycle nutrients (buffering nutrient concentrations). In the A/P system, species of SAV include: (1) the seagrasses--eelgrass and shoalgrass; (2) brackish and fresh water species of submerged grasses and forbs--Eurasian water milfoil, bushy pondweed, sago pondweed, redhead grass, and wild celery; (3) the seawater- and fresh-water-tolerant widgeon grass; and (4) several species of marine or brackish water macroalgae (Ferguson et al., 1989b).

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service Beaufort Laboratory has mapped SAV in Back, Core, and eastern Pamlico Sounds from aerial photography (Ferguson et al., 1989a and b, 1990, 1991, 1992, and in press) and is nearing completion of SAV mapping in Albemarle, Bogue, Croatan, Currituck, Roanoke, and Western Pamlico Sounds and the Neuse and Pamlico River Estuaries. The State of North Carolina mapped SAV in Bogue and Core Sounds with 1981 photography (Carraway and Priddy, 1983). (Note: SAV beds indicated in Figures 4a and b do not represent all SAV beds in the A/P Study Area.) Research on the ecology of SAV has focused on seagrasses in Bogue, Back, and southern Core Sounds (e.g., Thayer et al., 1984) and brackish water species in the Neuse and Pamlico River Estuaries and in Albemarle and Currituck Sounds (e.g., Davis and Brinson, 1990). Currituck Sound has the most complete historical record of SAV from surface level surveys and transect studies.

The importance of knowing the location and extent of SAV habitat, however, goes beyond its value for productivity, support of protected and harvested species, nutrient retention and cycling, and sediment stabilization. SAV habitat is an integrator of water quality and an indicator of overall ecosystem health. SAV has great recuperative capacity but will succumb to excessive physical disruption, turbidity, salinity change, nutrient overenrichment, or poisoning with toxic substances. SAV habitat is threatened directly by physical removal or burial due to certain fish and shellfish harvesting practices, prop dredging, and dredge and fill activities. SAV habitat is threatened indirectly by coastal development and water use leading to eutrophication, excessive turbidity, or alteration of current, salinity, and temperature regimes. Restoration of lost SAV habitat requires special and costly techniques and may not be possible where water depths have been altered (too shallow or too deep) or where water quality or salinity has changed.

2.1.2.3 Outstanding Resource Waters–

The Environmental Management Commission (EMC) adopted an Outstanding Resource Waters (ORW) rule in 1986 that defines ORW as waters of exceptional State or national recreational or ecological significance and requires the following conditions:

- Excellent water quality based on physical/chemical/biological sampling
- Unique and special characteristics that may not be protected by water quality standards.

The rule also requires that a candidate waterbody exhibit one or more of the following resource values:

- Outstanding fishery
- Unusually high water-based recreational value
- Special designation (e.g., National Wildlife Refuge) that does not provide for water quality protection
- Important component of State or national park or forest
- Special ecological or scientific significance (e.g., rare or endangered species present, research and education area).

For shellfish waters, ORWs require that the median fecal coliform most probable number (MPN) or geometric mean MPN of water not exceed 14/100 mL, and not more than 10 percent of the samples exceed a fecal coliform MPN of 43/100 mL.

In the A/P region, 201,000 acres of ORWs have been defined (Figures 5a through 5e). All ORWs are large waterways with intensive water-based resource uses. The open-water nature and complex hydrodynamics of designated ORWs present challenges to developing management strategies to protect these areas. For example, the EMC has been attempting to interpret ORW rules and determine necessary requirements for marinas.

2.1.2.4 Freshwater Mussel Habitat--

Freshwater mussel distribution has been mapped by the NCWRC in the Tar-Pamlico River Basin (Figure 6). The NCWRC also tracks species that have been found at each monitoring location. The decline of mussels is seen as an indication of increasing stress from pollution and habitat alteration. Mussels are unique water quality indicators because of their longevity and the amount of water they filter. The NCWRC has been considering rules that would designate streams with mussels as critical habitat. Mussels also occur in the upper Neuse River basin, but a geographic database does not currently exist.

2.1.3 Wetlands

For the purposes of this report, wetlands are lands identified by Khorram et al. (1992) in a classification study of 1987/88 LANDSAT data. This wetlands classification included lands classified as bottomland hardwoods, riverine swamps, white cedar, pocosin, marsh, and evergreen scrub/shrub. Although many studies have attempted to identify wetlands, these data are used here because they provide the most up-to-date areawide digital database.

Total wetlands area by subbasin is presented in Table 5. Most of the wetlands occur in subbasins located in the tidewater region. A breakout of different wetlands classes within subbasins is provided in Dodd et al. (1992a). Data are also available in a PC database (Tippett and Dodd, 1992).

As indicated in Table 5, wetlands in North Carolina are generally more abundant in the northern and eastern part of the study area (in the Roanoke, Chowan, and Albemarle Sound basins) and in the coastal subbasins of the Pamlico Sound drainage area. The inland portion of the Tar-Pamlico and Neuse basins have less wetlands acreage in general, with exceptions being the Swift Creek (Tar-Pamlico subbasin 03-02-01-01-03) drainage.

2.1.4 Natural Heritage Inventory

The Natural Heritage Program (NHP) is the State's most comprehensive source of information on rare and endangered animals and plants and exemplary natural communities, known collectively as "elements of natural diversity." Since 1976, the program has systematically gathered information on the occurrence and status of the State's ecological resources. The inventory consists of information compiled from a broad range of sources, including herbarium and museum collections, published and unpublished literature, and field surveys by volunteers, contracted workers, and staff. Information is kept at the NHP on U.S. Geological Survey (USGS) topographic maps and in a computerized database.

Natural areas have been identified in the northeastern portion of the A/P Study Area (Figures 7a through 7d). Attributes associated with each polygon (e.g., community type, ownership) are also available through the NHP. In addition to polygonal data, the program has identified "element occurrences," which are locations of rare and endangered animals and plants and exemplary natural communities. Although natural communities are element occurrences, most of the element occurrences are animal and plant records. This point coverage is available for the entire A/P Study Area in North Carolina. The program acknowledges that additional areas and elements will likely be added to the database over time as surveys identify new significant and important systems. The NHP database should be an invaluable source of information for development of watershed management plans. See Appendix A for additional information.

2.1.5 Surface Water Intakes

Surface water intakes are the points of withdrawal for municipal water supplies. The NCDEM tracks municipal drinking water intakes (Figures 8a through 8d) and has identified 41 intakes, mostly in the Neuse and Tar-Pamlico basins.

In addition to tracking intake locations, NCDEM and CGIA have developed a database of water supply watersheds that includes information on the location of watershed critical areas and surface water classifications.

2.2 Use Impairment

Data were summarized for several indicators of impairment of beneficial uses: predicted and actual exceedances of ambient water criteria, exceedances of sediment metals screening criteria, exceedances of standards and criteria for biological tissues, regulatory advisories for fish consumption, and algal blooms. These are not the only indicators of use impairment—other examples include dissolved oxygen violations, fish and shellfish disease and mortality, and "poor" biological integrity. (The biennial 305(b) report [NCDEM, 1993] provides a much more comprehensive picture of use support status. NCDEM, CGIA, and RTI are currently working to develop data layers that will allow for 305(b) data to be integrated into the A/P database.)

2.2.1 Point Source Exceedances of Instream Concentrations

Impairment of surface waters may result when point source facilities (both industrial and municipal) discharge pollutants into surface waters and inadequate dilution of these effluents by receiving water results in exceedances of State water quality standards and/or EPA water quality criteria. All facilities that could potentially produce instream water quality standards and/or criteria exceedances modeled under 7Q10 low flow conditions were identified by Cunningham et al. (1992a). The 7Q10 low flow used in this assessment is the minimum average flow over 7 consecutive days that has an average recurrence of once in 10 years. Data used in this analysis included discharger monitoring report (DMR) data from January 1989 through December 1990 provided by the NCDEM.

Using the 7Q10 low flow condition in the dilution model, 15 dischargers were identified in the A/P Study Area of North Carolina as having the potential to cause exceedances of water quality standards and/or EPA water quality criteria for the protection of aquatic life (Figures 9d, 9e, 9g, 9h). Exceedances were detected for a wide variety of metals (e.g., aluminum, cadmium, copper, chromium, lead, mercury, nickel, silver, and zinc) as well as cyanide.

Nine of the 15 dischargers identified are located in the Neuse River Basin primarily in the upper reaches of the Neuse River and in Contentnea Creek, and two dischargers are located in the Neuse River Estuary. Three dischargers are located in the Tar-Pamlico River Basin on the Tar River, and one discharger is located in a tributary river to the Albemarle Sound. Detailed information on each discharger identified as having the potential to produce exceedances of water quality standards in each subbasin is provided in Cunningham et al. (1992a).

2.2.2 Water Quality Exceedances

Actual exceedances of State water quality standards and/or EPA chronic water quality criteria for the protection of aquatic life were identified by screening 3 years of ambient water quality monitoring data (accessed from STORET). Specific procedures used to select the appropriate water quality standard/criterion to screen the ambient monitoring data are described in detail in Cunningham et al. (1992a).

Thirty water quality monitoring sites were identified where more than one violation of a State water quality standard or EPA water quality criterion for an individual pollutant had occurred over the 3-year period of record screened in the analysis. Of the 30 sites identified, 24 were located in fresh waters and 6 were located in estuarine waters (Figures 9a-c and 9e-h). Water quality exceedances were detected for the following metals: aluminum, copper, lead, mercury, nickel, silver, and zinc.

Of the 24 fresh water quality exceedances detected in the A/P Study Area, 18 sites (75 percent) are located in the Neuse River Basin, primarily in the headwater reaches of the Neuse River. Another 3 sites (12.5 percent) are located in the Roanoke River Basin, 2 sites (8 percent) are located in the Chowan River Basin, and 1 site (4 percent) is located in the Tar-Pamlico River Basin.

Of the 6 sites where exceedances of water quality for tidal or estuarine waters were detected, 4 sites (67 percent) are located in tributary creeks lateral to the Pamlico River Estuary and 2 sites (33 percent) are located in tributary creeks lateral to the Neuse River Estuary. No ambient water quality exceedances were detected in the Albemarle Basin.

2.2.3 Sediment Exceedances

Contamination of sediment with heavy metals or organic compounds at elevated concentrations can result in impairment of aquatic life uses. As part of its National Status and Trends Program, NOAA staff reviewed all available biological effects and chemical data on sediment contamination by a wide variety of pollutants. For each individual chemical of interest, NOAA assembled available data, ranked the data in ascending order according to the chemical concentration, examined the distribution of the reported LC_{50} values, and determined the lower 10th and 50th percentile concentrations among the range of values. The low effect range (ER-L) value (representing the lower 10th percentile of data) for each chemical was used as the concentration above which adverse effects begin or are predicted among sensitive life stages or species. The medium effect range (ER-M) value for each pollutant was used as the concentration above which toxic effects were frequently or always observed among most species (Long and Morgan, 1990). The ER-M value for each pollutant was used as a screening value to detect sites where sediment contamination would be most likely to cause toxic effects to aquatic life.

A major estuarine sediment sampling program was conducted in the Pamlico and Neuse River Estuaries and in Albemarle Sound and its tributaries by Riggs et al. (1989, 1991, and 1993) to evaluate heavy metal sediment contamination. Procedures for screening all Riggs et al. data using the NOAA ER-M values are described in detail in Cunningham et al. (1992a). All sites where the concentration of a pollutant exceeded the NOAA ER-M value are identified as sites of sediment contamination that may warrant further study (Figures 9a, 9c, 9f, 9g, 9h).

In the A/P Study Area, 50 sites were identified where the ER-M value for at least one heavy metal was exceeded. In the Pamlico River Estuary, 13 sites located in the lower Tar River in the vicinity of Kennedy Creek and the Washington waterfront have exceedances of the NOAA ER-M values for some metals. In the Neuse River Estuary, 4 distinct areas of contaminated sediment were detected including 2 sites in the lower Neuse River (New Bern/Bridgeton area), 4 sites in the Trent River/Lawson Creek area, 8 sites in Slocum Creek, and 1 site in Oriental harbor.

In Albemarle Sound, 7 distinct areas of contamination were detected, including 1 site in the upper Chowan River, 3 sites in the lower Roanoke River near Welch Creek, 1 site on the Albemarle River, near Edenton, 1 site in the Scuppernong River, and 15 sites on the Pasquotank River near Elizabeth City.

Concentrations of zinc and lead in the Pamlico River Estuary sediments exceeded NOAA ER-M values. In the Neuse River Estuary, exceedances of NOAA ER-M values were detected in sediment for seven metals including zinc, lead, cadmium, copper, chromium, nickel, and mercury, and more than one ER-M value was exceeded at several sites. In the Albemarle Sound and its associated tributaries, lead was the primary metal found in exceedance of the ER-M value; however, sediment concentrations of chromium, zinc, and mercury in some sediment samples also exceeded the ER-M value.

2.2.4 Whole Fish Exceedances

Fish contaminant monitoring is conducted by the NCDEM to determine whether concentrations of toxic pollutants (e.g., heavy metal, pesticides, or dioxins) in whole fish may be injurious to wildlife (piscivorous birds, reptiles, and mammals). In the absence of State standards or Federal criteria, levels of concern for the protection of wildlife were gleaned from the scientific literature. A complete

description of the database that was screened and the procedures used to select the levels of concern for wildlife are presented in Cunningham et al. (1992a).

Samples of whole fish containing pollutant concentrations at levels of concern for wildlife were detected in some subbasins of all major A/P Study Area basins with the exception of Core and Bogue Sounds and the White Oak River (see Figures 10a through 10j). Note: Sites where pollutant residues in whole fish samples exceeded levels of concern for metals and organochlorine pesticides in wildlife are identified as FISH SITES; sites where pollutant residues in whole fish samples exceeded levels of concern for dioxin in wildlife are identified as DIOXWHOLE SITES.

In the Chowan, Roanoke, and Albemarle Sound basin, mercury, copper, lead, and dioxin were the predominant contaminants detected at concentrations exceeding levels of concern for wildlife. In the Tar-Pamlico River and Pamlico River Estuary, copper, mercury, lead, and cadmium were the predominant contaminants detected. In the Neuse River and Neuse River Estuary, mercury, copper, lead, and cadmium were the predominant contaminants detected.

2.2.5 Fish Fillet or Shellfish Exceedances

Fish contaminant monitoring is conducted by the NCDEM to determine whether concentrations of toxic pollutants (e.g., heavy metals, pesticides, or dioxin) in fish fillet tissue or shellfish tissue may pose a risk to human health. The Federal Food and Drug Administration (FDA) has developed levels of concern to protect the general U.S. population from the chronic effects of toxic substances consumed in foodstuffs shipped via interstate commerce (U.S. FDA, 1984).

North Carolina, like many other States, has used the FDA levels of concern to screen fish contaminant monitoring data. Currently EPA does not recommend the use of FDA health protection criteria as screening values or in developing fish/shellfish consumption advisories (U.S. EPA, 1991). A complete description of the database that was screened and the procedures used to calculate screening values using EPA's risk-based approach is given in Cunningham et al. (1992a). It should be noted that all screening values were calculated based on a consumption rate of 30 grams per day, which represented the median (50th percentile) consumption rate of recreational fishermen.

Samples of fish fillets and shellfish containing pollutant concentrations exceeding screening values for human health protection were detected in some subbasins of all major A/P Study Area basins with the exception of Bogue Sound and White Oak River (see Figures 10a through 10j). Note: Sites where chemical pollutant residues in fish fillet samples exceeded human health screening values for metals and organochlorine pesticides are identified as FILET SITES; sites where chemical pollutant residues in fish fillet samples exceeded the human health screening value for dioxin are identified as DIOXFILET SITES; and those sites where chemical pollutant residues in shellfish tissues exceeded human health screening values are identified as SHELL SITES.

In the Chowan, Roanoke, and Albemarle Basins, dioxin, mercury, and arsenic are the predominant contaminants detected at concentrations exceeding screening values for human health concern. In the Tar-Pamlico and Pamlico River Estuary Basins, mercury and arsenic are the predominant contaminants. In the Neuse River and Neuse River Estuary, mercury, dioxin, arsenic, and lead are the predominant contaminants detected at concentrations exceeding screening values for human health concern.

For shellfish samples, a slightly different pattern of contamination was found. Zinc, arsenic, and lead were the three heavy metals found at concentrations exceeding screening values for human health concern.

2.2.6 Fish Consumption Advisories

The State of North Carolina has jurisdiction for issuing fish and shellfish advisories for the protection of its residents when fish contaminant monitoring data indicate that consumption of contaminated fish species may endanger human health. The decision to issue a fish consumption advisory is made by the Division of

Epidemiology in conjunction with the NCDEM. The State of Virginia has sole jurisdiction for issuing fishing advisories in its waters.

Currently, within the A/P Study Area, North Carolina has issued four fish consumption advisories for dioxin contamination in the following waterbodies (Figure 11):

- Western Albemarle Sound—all waters west of a line from Harvey Point to Laurel Point
- Welch Creek—in Beaufort, Martin, and Washington Counties
- Roanoke River—from Williamston to the mouth at Albemarle Sound
- Chowan River—from the Virginia border to the mouth at Albemarle Sound.

The four advisories caution consumers against eating all fish species except herring, shad, and their roe and shellfish.

All four North Carolina advisories recommend that pregnant women, nursing mothers, and children eat no fish from the four waterbodies and recommend restricted consumption (e.g., two meals per person per month) of fish by the general population.

Within the A/P Study Area, Virginia has issued two fish consumption advisories for dioxin contamination in the following waterbodies:

- Blackwater River—from Sandy Landing to confluence with the Nottoway River at the VA/NC State line (5 miles)
- Nottoway River—from the General Vaughan Bridge (U.S. 258) to the VA/NC State line.

Both Virginia advisories recommend that the general public not eat any bottom-feeding species from the two rivers.

2.2.7 Algal Bloom Occurrences

The NCDEM has tracked algal bloom occurrences statewide since 1985; effort has increased steadily since the program's inception. Potential blooms are identified by regional staff, either during routine monitoring or when investigating a complaint. Actual blooms are identified based on chlorophyll *a* concentration and phytoplankton biovolume and density. Blooms are indicative of eutrophic conditions that occur as a result of culturally enhanced nutrient inputs and favorable physical conditions.

Algal bloom data were obtained and an ARC/INFO coverage created for the A/P Study Area. Locations are shown in Figures 12a through 12e. Most blooms have been reported in the Pamlico River Estuary, Neuse River Estuary, and Pamlico Sound near the confluence of the Neuse and Pamlico Rivers.

2.3 Environmental Stressors

2.3.1 Nonpoint Sources

Data sources pertinent to *potential* nonpoint sources were obtained and summarized. It it is extremely expensive and difficult to monitor nonpoint sources; as a result, current information is limited for *actual* nonpoint source inputs. In this section, locational data are compiled on several potential nonpoint sources of pollution. For some of these nonpoint source stressors, surrogate indicators for actual pollutant inputs were used (e.g., land use) as measures of potential pollutant inputs. With the exception of marinas, all data sources represent land-based activities. A discussion of the concept of geographic targeting for nonpoint source control programs is provided in Dodd et al. (1992b).

2.3.1.1 Solid and Hazardous Waste Sites--

Data from the A/P database for several solid and hazardous waste programs identify the location of potential nonpoint sources of pollution to surface and ground water (Figures 13a through 13k) from landfills; hazardous waste treatment, storage, and disposal facilities; and Superfund sites. No data were available in the database to identify the pollutants that could be released from these nonpoint sources. These potential nonpoint sources of chemical contamination are concentrated in the interior portions of the drainage area and are especially prevalent in the Neuse River basin.

2.3.1.2 Nonpoint Source Nutrient Loading--

Dodd et al. (1992a) estimated nonpoint source nutrient loading by subbasin based on LANDSAT-derived land use/land cover data. Because uniform loading factors (export coefficients) were used for different subbasins for each land use category, the total nonpoint source loadings are a direct function of the total amount of land in the various categories in each subbasin. Table 6 presents a ranking of the total nonpoint loading. These estimates represent loading potential to the estuaries, since there is some uncertainty as to the amount of nutrients "lost" during transport from their point of origin.

On a total annual average loading basis, many of the subbasins with the highest loadings are in the Neuse and Pamlico basins. When normalized by total subbasin area, the highest loadings generally occur in the Neuse basin.

2.3.1.3 Marinas--

Marina operations can produce three types of localized stresses to the estuarine environment: dissolved oxygen depletion, bacterial and viral contamination associated with fecal material, and discharges of toxic pollutants associated with boat repair and maintenance activities.

Shellfish such as oysters, mussels, and all varieties of clams are filter-feeders that extract food (plankton) as well as waterborne bacteria and viruses from the water column. These pathogens can accumulate on gills, mantles, and in digestive systems. Contaminated shellfish are a serious public health concern particularly when shellfish are consumed raw. Some of the pathogens associated with sewage discharges can cause such diseases as gastroenteritis, dysentery, cholera, and infectious hepatitis. By State regulation, the development of marinas triggers immediate closure of the surrounding estuarine waters to shellfish harvesting, thereby eliminating use of an important fisheries resource. Similarly, shellfish in proximity to marinas may bioaccumulate a variety of toxic contaminants (e.g., lead, zinc, and copper compounds associated with antifouling paints) in their tissues. Contaminant concentrations may become elevated and can pose a potential health risk to consumers.

The locations of marinas were determined in accordance with the current Department of Environmental Health and Natural Resources (DEHNR) definition of more than 10 boat slips and have been documented by the Shellfish Sanitation Branch, NC Division of Environmental Health (see Figures 14a through 14h). The majority of marinas are located in Bogue Sound (50), Pamlico River Estuary (33), and Core Sound (26).

2.3.1.4 Agricultural and Urban Land--

LANDSAT data were used to calculate area in agricultural and urban land uses by subbasin (see Dodd et al., 1992a) (Table 7). These classes generally represent the most intensive land-disturbing uses and are responsible for much of the nonpoint source pollution entering the A/P system.

Regionally, agricultural lands are much more extensive than urban lands, although the relative areas vary considerably for different subbasins. Pockets of urbanization are apparent not only in the LANDSAT data, but also in other data presented in this report (e.g., population, point sources waste sites).

One of the challenges facing nonpoint source programs is that a limited nonpoint source centralized database exists for targeting watersheds and tracking progress in reducing pollutant loadings (see Dodd et al., 1992b). A major factor is the tracking of information by jurisdictional (county) rather than natural (watershed) units, as discussed in Section 3.

2.3.2 Point Sources

Point sources are defined herein as dischargers with National Pollutant Discharge Elimination System (NPDES) permits. Figures 15a through 15m depict the locations of dischargers, categorized by discharge volume. The highest concentration of dischargers and much of the wasteflow occur in the Neuse basin. Several large facilities also discharge to the Pamlico River and Neuse River Estuaries and the Roanoke River.

Point source impacts can generally be categorized as involving: (1) depletion of ambient oxygen resources through the discharge of carbonaceous and nitrogenous wastes, (2) contributions to accelerated eutrophication, and (3) toxicant effects. During the 1970s and 1980s, great strides were made in reducing oxygen-demanding wastes. With the declaration of Nutrient Sensitive Waters in much of the area and adoption of a ban for phosphate-bearing detergents, nutrient (mostly phosphorus) inputs have been substantially reduced. Effluent limitations for both chemical constituents and whole effluent toxicity have also resulted in progress in minimizing toxicant impacts from point sources.

We have focused on eutrophication and toxicant impacts relative to oxygen-depletion concerns because these impacts generally present more complex problems and because the NCDEM has a well-established program for assessing and regulating oxygen-demanding waste. Results are summarized below.

2.3.2.1 Point Source Toxicant Loading--

Point source loadings of 11 heavy metals, cyanide, and fluoride were calculated for municipal and industrial dischargers in the A/P Study Area based on data provided by the NCDEM. The sources of data and assumptions used to compute loadings are presented in Cunningham et al. (1992a). Loadings could not be calculated for all dischargers because data on one or more parameters were not available for some dischargers. Thus, the average annual loadings presented tend to underestimate actual loadings to the A/P estuarine system for the period January 1989 through December 1990.

Many heavy metals are normal constituents of estuarine ecosystems and play a dual role as trace elements in biological systems at low concentrations and as toxicants at higher concentrations.

Loadings to the three estuarine systems are compared in Table 8. It should be noted that fluoride loadings to the A/P estuarine system are several orders of magnitude higher than individual loadings for all other metals and cyanide and are the result of discharges from the Texasgulf facility to the Pamlico Estuary.

In general, average annual loadings to the Albemarle estuarine system (5,868 lb/yr) are predominated by six metals--zinc, lead, chromium, nickel, copper, and cadmium--and are lower overall than loadings to either the Pamlico or Neuse estuarine systems. Loadings result from one industrial discharger to the Chowan River, one municipal discharger to the Pasquotank River, one industrial discharger to the Alligator River, and two industrial and one municipal discharger to the Roanoke River. The majority of the toxicant loading to the Albemarle estuarine system is added to the Roanoke River Basin.

Average annual loadings to the Pamlico estuarine system (979,518 lb/yr) are the highest of the three systems if fluoride is considered in the total loadings. Loadings to the system result from seven dischargers (four industrial and three municipal facilities) and are predominated by fluoride, zinc, cyanide, nickel, lead, and copper.

Average annual loadings to the Neuse estuarine system (14,349 lb/yr) are predominated by zinc, copper, fluoride, and lead. The system receives the largest metal loading of the three systems. Loadings to the Neuse are predominated by

zinc, copper, fluoride, and lead and result from 21 dischargers, including 6 industrial and 15 municipal facilities.

Overall, zinc (11,071 lb/yr), copper (4,191 lb/yr), and lead (3,828 lb/yr) are the predominant metals; however, fluoride loadings of nearly 1 million lb/yr are by far the largest single source of toxicants entering the A/P estuarine system.

2.3.2.2 Point Source Nutrient Loading--

Dodd et al. (1992a) summarized point source total nitrogen and total phosphorus loading based on DMRs from 1989-1990 (Appendix B). Monitored point sources were estimated to contribute 6 percent of the annual nitrogen loading and 29 percent of the annual phosphorus loading in both Virginia and North Carolina. Large facilities (>10 million gallons per day) are responsible for a large majority of the loading.

Dischargers are, or soon will be, required to meet effluent nutrient limits in three river basins (Chowan, Neuse, and Tar-Pamlico). In the Tar-Pamlico basin an initiative has begun in which dischargers are granted less stringent effluent limits in exchange for providing financial assistance for implementing best management practices (BMPs) on agricultural lands through the North Carolina Agriculture Cost Share Program.

3 JURISDICTIONAL AND WATERSHED BOUNDARIES

The A/P database includes several data layers that are useful for comparing jurisdictional and watershed boundaries. This information can be used to identify important constituencies. It also provides a basis for developing hydrologically oriented databases. Because a wealth of data are maintained based on jurisdictional boundaries, the advent of GIS technology and delineation of these boundaries provide an opportunity to begin to develop information systems based on natural rather than artificial boundaries. One GIS routine allows for the actual "dissolving" of boundaries.

Tippet and Dodd (1992) presented a PC database based on this concept. The Soil Conservation Service (SCS), NCDEM, Division of Coastal Management, and CGIA are currently creating a database of small watershed boundaries that will provide a foundation for integrating watershed planning and management efforts.

Figures 16a through 16m present jurisdictional and watershed boundaries for several Federal, State, and local jurisdictions. Federal lands are located mostly along the coast and are associated primarily with military installations. State parks and coastal reserves are two of many State jurisdictional lands. "Local lands" are those defined by the jurisdictional authority of each municipality or county. County boundaries are shown because they are important for local and regional governance and because of the amount of data currently compiled by county.

4 RECOMMENDATIONS

The database used for this project is a composite of many different databases that are based primarily on programmatic responsibilities. This programmatically fragmented nature of the database provides very important challenges to its long-term utility. One challenge is to ensure that individual data custodians "buy into" the idea that their information is becoming more important for a larger community of users as more comprehensive and complicated resource management issues arise. Another challenge is to ensure that mechanisms are in place to obtain information not covered under existing programs. In addition, information standards and data quality issues are extremely important to the database's success.

The following steps are recommended to improve the database:

- **Establishment of an interagency workgroup to provide leadership for maintaining the A/P database.**

- **Completion of a new user needs assessment.**

- **Establishment of formal priorities for information acquisition.** Information needs identified in this project include:

  – shellfish harvest closures

  – confined animal operations

  – fish kills/fish and shellfish disease

  – extent of draining, ditching, and channelization

  – implementation of nonpoint source control incentive and disincentive programs.

- **Better database accessibility for the non-GIS community.**

- **Development of information processing standards**—For example, the Management Conference could adopt "natural resource management units" (e.g., "waterbodies" as defined through reporting for Section 305(b) of the Clean Water Act; river reaches as defined by EPA's River Reach File Version 3; watershed boundaries as defined by SCS and NCDEM). These units could then serve as standard reporting units for attribute information.

- **Inclusion of a quality assurance plan in the CCMP's Information Management Plan.**

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6 GLOSSARY

algal bloom - rapid growth of algal species to high population density. Requires optimal temperature and light conditions and abundant nutrients.

beneficial uses - designated uses of surface waters identified in water quality standards. Examples are public water supplies and recreation.

biological integrity - the condition of an aquatic community as measured by the structural and functional characteristics of a community of organisms living in unimpaired waters of a specified ecological habitat.

crustacean - a member of the invertebrate phylum Arthropoda, including shrimps, crabs, copepods, barnacles, and other animals having segmented bodies, jointed legs, and hard external shells.

estuary - a body of water in which salt water from the ocean and fresh water from rivers and land drainage meet and mix, producing intermediate salinities.

eutrophication - the process of physical, chemical, and biological changes associated with nutrient, organic matter, and silt enrichment and sedimentation. If the process is accelerated by manmade influences, it is termed cultural euthrophication.

export coefficients - coefficients that represent the total mass of a pollutant (e.g., nutrient) leaving a given area during a given period of time.

geographic targeting - the selection of a geographic area or areas for focused resource management efforts to provide cost-effective solutions.

indicator - a measure reflecting the condition or presence of a fundamental variable.

loading - the amount of a pollutant entering a waterbody, expressed in terms of mass per unit time.

nitrogen - a colorless, tasteless, odorless element that is abundant in the atmosphere and in coastal and marine water. Nitrogen is needed by plants and animals for making proteins. An overabundance of nitrogen can spur algal blooms that can lead to anoxia.

nonpoint source pollution - those sources of pollution that are discharged over a wide area and not at a discrete location. Includes nutrients and chemicals from farms, lawns, city streets, and parking lots and from malfunctioning septic tanks that are washed into rivers and streams with each rain and are carried into the estuary. Unlike pollutants discharged from a pipe by factories and cities, this source is difficult to trace, measure, and control.

nursery areas - areas where young finfish and shellfish spend their early life because of such factors as an abundance of food, availability of protective cover, and favorable conditions of salinity, temperature, and bottom type.

nutrient budget - quantitative assessment of nutrients (e.g., nitrogen or phosphorus) moving into, being retained in, and moving out of an ecosystem.

nutrients - elements essential to the growth and development of living things, such as carbon, oxygen, phosphorus, potassium, nitrogen, and sulfur.

pathogens - a specific causative agent of desease such as a bacterium or virus.

phosphorus - a valuable element and nutrient in coastal and ocean waters used by plants to form the basis of the aquatic food chain. Too much phosphorous and nitrogen in a body of water can lead to a variety of symptoms of imbalance, such as algal blooms and anoxia.

point source pollution - pollution entering waters at a specific location, such as a pipe. It can be measured and is regulated with State-issued permits. Such sources include discharges from wastewater treatment plants and industries.

point sources - those sources of pollution that discharge into the environment via an effluent pipe or channel.

primary nursery areas - areas within the estuarine system where postlarval development of young finfish and shellfish (blue crabs, shrimp) takes place. They are usually located in the uppermost sections of estuarine creeks and bays. Primary nursery areas usually are surrounded by marshes, have low salinity, and have muddy bottoms. These areas are formally designated and regulated by the NC Marine Fisheries Commission.

riparian corridor - the area located immediately adjacent to a natural watercourse such as a river.

river basin - the area of land drained by a river and its tributaries. North Carolina has 17 river basins. Six drain into Albemarle and Pamlico sounds. Each river basin can be divided into smaller units called subbasins.

SAV - submerged aquatic vegetation is composed of submerged macroscopic plants that inhabit photic submerged land.

secondary nursery areas - the lower portions of estuarine creeks and bays into which young fish, shrimp and crabs move as they leave the primary nursery areas of the upper estuaries. These areas are formally designated or regulated by the NC Marine Fisheries Commission.

subbasin - a watershed located within a larger river basin.

tidewater region - low-lying coastal land where water overflows land at flood tide.

water quality criteria - scientifically derived ambient concentrations developed by EPA or States for various pollutants of concern. Criteria developed by EPA are recommended levels that should not be exceeded in a body of water in order to protect aquatic life and human health; all States have both chemical-specific numeric criteria for individual toxic pollutants and narrative "free from toxics in toxic amounts" criteria; criteria are subjected to the regulatory process of regional, State, and public comment.

water quality standards - laws and regulations that consist of the beneficial designated use or uses of a waterbody and water quality criteria that are necessary to protect the use or uses of that particular waterbody.

watershed - a drainage area or basin in which all land and water areas drain or flow toward a central point. Watersheds may range from a few square miles for small streams to thousands of square miles for major rivers.

wetland - an area flooded by water frequently enough to support plants adapted to living in regularly or seasonally wet soil. Wetland types include swamp forests, marshes, bogs, pocosins, and Carolina bays.

Table 1. Albemarle-Pamlico Estuarine Study Database

#	Data layer name	NC status	VA status
1.	State Boundary	Available	Available
	1:100,000 scale		
2.	A/P Study Boundary		
	1:2,000,000 scale	Available	Available
	1:24,000 scale	Available	Available
3.	County Boundaries		
	1:100,000 scale	Available	Available
4.	Subbasins/Subbasins		
	1:1,000,000 scale	Available	Not planned
	1:24,000 scale	Available	Available
5.	Hydrography		
	Geographic base 1:100,000 scale	Available	Available
	Stream classification codes	In progress	Not planned
6.	Land Use/Land Cover		
	Thematic Mapper	Available	Available
7.	Point Source Dischargers (NPDES)		
	1:24,000 scale	Available	Planned
8.	Wetlands (NWI)		
	1:24,000 scale	Partial availability	Partial availability
9.	Ambient Water Quality Monitoring Sites		
	1:24,000 scale	Available	Not planned
10.	Natural Heritage Element Occurrences		
	1:24,000 scale	Available	Planned
11.	1980 Census Boundaries/Population		
	1:126,000 scale	Available	Available
12.	Surface Water Intakes		
	1:24,000 scale	Available	Available
13.	Sub-Aquatic Vegetation (SAV)		
	1:24,000 scale	Available	In progress
	1:100,000 scale		
14.	Superfund Sites		
	1:24,000 scale	Available	Not planned
15.	1990 Census Boundaries		
	1:100,000 scale		
	Boundaries	Available	Available
	Statistics	Available	Available
16.	Coastal Reserves		
	1:24,000 scale	Available	Not planned
17.	Fisheries Biological Monitoring Sites		
	1:24,000 scale	Available	Not planned
18.	Oyster Cultch Plant Sites		
	1:24,000 scale	Available	Not planned
19.	WRC Game Lands		
	1:100,000 scale	Available	Available[a]
20.	Heavy Metals & Organic-Rich		
	Mud Pollutants Sample Sites 1:24,000 scale		
	Pamlico	Available	NA
	Neuse	Available	NA
	Albemarle	Available	NA
21.	Citizen Water Quality Monitoring Sites		
	1:100,000 scale	Available	Available

(continued)

Table 1. (continued)

#	Data layer name	NC status	VA status
22.	Mussel Distribution 1:100,000 scale	Available	Not planned
23.	Bottom Sediment Sample Sites	Available	Not planned
24.	Federal Land Ownership 1:100,000 scale	Available	Available[a]
25.	Fisheries Nursery Areas 1:24,000 scale	Available	Available
26.	Shellfish Proclamation Areas	1988 version available	
27.	Oyster Producing Areas	Complete	
28.	Outstanding Resource Waters 1:24,000 scale	Available	Not planned
29.	1970 Census Boundaries/Population –1:126,000	Available	Not planned
30.	Artificial Marine Reefs	Available	Not planned
31.	CAMA Major Development Permits 1:100,000 scale	Partial availability	Not planned
32.	General Soils, 1:250,000 scale	Available	Available
33.	Transportation 1:100,000 scale		
	Roads & Trails	Available	Available
	Railroads	Available	Available
	Pipelines & Powerlines	Available	Available
	Miscellaneous	Available	Available
34.	State Park Boundaries 1:100,000 scale	Available	Available
35.	Stream Gaging Stations 1:24,000 scale	Available	Not planned
36.	Coastal Marinas 1:24,000 scale	Available	Available
37.	Peat Lands 1:24,000 scale	Available	Not planned
38.	Anadromous Fish Areas 1:24,000 scale	Available	Not planned
39.	Municipal Boundaries 1:100,000 scale	Available	Available
40.	Lease Blocks	Available	Available
41.	Geology 1:250,000 scale	Available	Available
42.	Military Air Space	Available	Available
43.	Fishing Water Jurisdictions	Planned	Not planned
44.	Digital Elevation Models 1:24,000 scale	Partial availability	Partial availability
45.	Bathymetry	Planned	Planned
46.	Protected and Critical Watersheds	Available	Available
47.	Natural Areas	Available	Not planned

Source: North Carolina Center for Geographic Information and Analysis.

Table 2. Additional Databases Developed for RTI Projects (not shown in Table 1)

Database	GIS Coverage Type	Relational Attribute	Geographic Extent	Temporal Extent
Estuarine fishing practices	Polygons	—	NC	1991
Potential point source exceedances of instream water quality standards	Points	NPDES #	NC	1989-1990
Ambient water quality exceedances	Points	Station ID	NC (freshwater)	1988-1991
Sediment exceedances	Points	Station ID	NC (estuarine)	1989, 1991, 1993
Biological tissue exceedances	Points	Station ID	NC	1980-1990
Fish consumption advisories	Polygon	None	NC & VA	1993
Algal bloom occurrences	Points	Station ID	NC	1985-1991
Point source nutrient loading	Points	NPDES #	NC	1989-1990
Point source toxicant loading	Points	NPDES #	NC	1989-1990
Nonpoint source nutrient loading	Polygons	—	NC & VA	1985-1988
Aggregate land use/land cover	Polygons	—	NC & VA	1987-1988
Land use/land cover in hydrologic buffers	Polygons	—	Neuse Basin	1987-1988
Reach File 3	Linear	—	Neuse Basin	1987-1988

Table 3. A/P Subbasins[a]

A/P Subbasin	USGS CU	NCDEM Subbasin	Major drainage	Minor drainage	Area (hectares)
3-01-01-06-01	3010106	3.2.08	Roanoke River	Unnamed	2,468
3-01-01-07-01	3010107	3.2.08	Roanoke River	Unnamed	112,752
3-01-01-07-02	3010107	3.2.09	Roanoke River	Unnamed	140,634
3-01-01-07-03	3010107	3.2.10	Roanoke River	Cashie River	79,597
3-01-02-03-01	3010203	3.1.01	Chowan River	Ahoskie Creek	15,746
3-01-02-03-02	3010203	3.1.01	Chowan River	Unnamed	114,381
3-01-02-03-03	3010203	3.1.03	Chowan River	Unnamed	31,962
3-01-02-03-04	3010203	3.1.05	Chowan River	Unnamed	24,654
3-01-02-04-01	3010204	3.1.02	Meherrin River	Meherrin River	41,329
3-01-02-04-02	3010204	3.1.04	Meherrin River	Potecasi Creek	58,105
3-01-02-05-01	3010205	3.1.04	Albemarle Sound	Unnamed	22,930
3-01-02-05-02	3010205	3.1.50	Albemarle Sound	Pasquotank River	97,842
3-01-02-05-03	3010205	3.1.51	Albemarle Sound	Alligator River	258,232
3-01-02-05-04	3010205	3.1.52	Albemarle Sound	Unnamed	139,822
3-01-02-05-05	3010205	3.1.53	Albemarle Sound	Scuppernong River	119,443
3-01-02-05-06	3010205	3.1.54	Currituck Sound	Unnamed	112,760
3-01-02-05-07	3010205	3.1.56	Albemarle Sound	Roanoke Sound	28,677
3-02-01-01-01	3020101	3.3.01	Tar-Pamlico River	Unnamed	112,269
3-02-01-01-02	3020101	3.3.01	Tar-Pamlico River	Unnamed	59,907
3-02-01-01-03	3020101	3.3.02	Tar-Pamlico River	Swift Creek	42,759
3-02-01-01-04	3020101	3.3.02	Tar-Pamlico River	Unnamed	31,284
3-02-01-01-05	3020101	3.3.02	Tar-Pamlico River	Unnamed	38,047
3-02-01-01-06	3020101	3.3.02	Tar-Pamlico River	Unnamed	53,152
3-02-01-02-01	3020102	3.3.04	Tar-Pamlico River	Little Fishing Creek	46,057
3-02-01-02-02	3020102	3.3.04	Tar-Pamlico River	Fishing Creek	91,008
3-02-01-02-03	3020102	3.3.04	Tar-Pamlico River	Fishing Creek	94,736
3-02-01-03-01	3020103	3.3.03	Tar-Pamlico River	Unnamed	6,134
3-02-01-03-02	3020103	3.3.03	Tar-Pamlico River	Conetoe Creek	18,410
3-02-01-03-03	3020103	3.3.03	Tar-Pamlico River	Unnamed	85,351
3-02-01-03-04	3020103	3.3.05	Tar-Pamlico River	Unnamed	76,712
3-02-01-03-05	3020103	3.3.06	Tar-Pamlico River	Unnamed	63,100
3-02-01-04-01	3020104	3.3.07	Pamlico River Estuary	Van Swamp	3,254
3-02-01-04-02	3020104	3.3.07	Pamlico River Estuary	Unnamed	305,369
3-02-01-05-01	3020105	3.1.57	Pamlico Sound	Unnamed	16,151
3-02-01-05-02	3020105	3.1.55	Pamlico Sound	Unnamed	130,710
3-02-01-05-03	3020105	3.3.08	Pamlico Sound	Unnamed	317,491
3-02-01-05-04	3020105	3.4.13	Pamlico Sound	Unnamed	71,645
3-02-01-06-01	3020106	3.4.14	Core Sound	Unnamed	87,062
3-02-01-06-02	3020106	3.5.01	White Oak River	Unnamed	81,803
3-02-01-06-03	3020106	3.5.04	Core Sound	Unnamed	44,245
3-02-01-06-04	3020106	3.5.05	Core Sound	Unnamed	13,395
3-02-01-06-05	3020106	3.5.03	Bogue Sound	Unnamed	50,437
3-02-01-06-06	3020106	3.5.01	White Oak River	Unnamed	17,630
3-02-02-01-01[b]	3020201	3.4.01	Neuse River	Flat River	38,629
3-02-02-01-02[b]	3020201	3.4.01	Neuse River	Little River	20,682
3-02-02-01-03[b]	3020201	3.4.01	Neuse River	Eno River	36,714
3-02-02-01-04[b]	3020201	3.4.01	Neuse River	Falls Lake	103,841
3-02-02-01-05	3020201	3.4.02	Neuse River	Unnamed	113,314
3-02-02-01-06	3020201	3.4.02	Neuse River	Swift Creek	40,200
3-02-02-01-07	3020201	3.4.03	Neuse River	Middle Creek	21,596
3-02-02-01-08	3020201	3.4.03	Neuse River	Middle Creek	12,433
3-02-02-01-09	3020201	3.4.04	Neuse River	Unnamed	71,861

(continued)

Table 3. (continued)

A/P Subbasin	USGS CU	NCDEM Subbasin	Major drainage	Minor drainage	Area (hectares)
3-02-02-01-10	3020201	3.4.02	Neuse River	Unnamed	34,458
3-02-02-01-11	3020201	3.4.06	Neuse River	Little River	60,079
3-02-02-01-12	3020201	3.4.06	Neuse River	Unnamed	21,980
3-02-02-01-13	3020201	3.4.12	Neuse River	Unnamed	47,458
3-02-02-02-01	3020202	3.4.05	Neuse River	Unnamed	63,601
3-02-02-02-02	3020202	3.4.05	Neuse River	Unnamed	15,213
3-02-02-02-03	3020202	3.4.05	Neuse River	Unnamed	50,302
3-02-02-02-04	3020202	3.4.09	Neuse River	Swift Creek	86,179
3-02-02-02-05	3020202	3.4.08	Neuse River	Unnamed	59,923
3-02-02-03-01	3020203	3.4.07	Neuse River	Contentnea Creek	40,796
3-02-02-03-02	3020203	3.4.07	Neuse River	Contentnea Creek	129,368
3-02-02-03-03	3020203	3.4.07	Neuse River	Nahunta Swamp	20,655
3-02-02-03-04	3020203	3.4.07	Neuse River	Little Contentnea Creek	70,110
3-02-02-04-01	3020204	3.4.11	Neuse River	Trent River	43,067
3-02-02-04-02	3020204	3.4.11	Neuse River	Trent River	71,770
3-02-02-04-03	3020204	3.4.10	Neuse River Estuary	Unnamed	181,831
				TOTAL	4,815,512

[a]Data from Dodd et al. (1992a).
[b]Falls Lake.

Table 4. Subbasin Profiles for the A/P Study Area

	RESOURCES										USE IMPAIRMENT							STRESSORS								
	Estuarine Fisheries			Aquatic Habitat				Wetlands/ Terrestrial Habitat		Drinking Water	Toxicant Contamination						Eutrophic Waters	Nonpoint Sources							Point Sources	
	SHA	CHA	FHA	NA	SAV	ORW	FWM	WL	NHI	SWI	PSE	WQE	SE	WFE	FFE	FCA	AB	SFS	SWS	HWS	MAR	NPS-N	AG	UR	PS-T	PS-N
Meherrin River																										
3-01-02-04-01								◗	○			○		○	○			○	○			◗	◗	○		
3-01-02-04-02							○	◗	○									○	○			◗	◗	○		
Chowan River																										
3-01-02-03-01								◗														○	○	○		
3-01-02-03-02			○					●	○			○	○	◗	◗	●		◗			○	●	●	○		○
3-01-02-03-03			○				○	◗	○					◗	◗	●					○	◗	◗	○	○	○
3-01-02-03-04			○					◗	○					○	○	●		○	○			○	○	○		◗
Roanoke River																										
3-01-01-06-01								○		◗		○			○				○			○	○	○	○	●
3-01-01-07-01								●	◗			○		◗	○			◗	○			●	●	○	◗	●
3-01-01-07-02			○					●	◗				◗	◗	◗	●		◗	◗			●	●	○	○	●
3-01-01-07-03								●	○						○		○	○	○			◗	◗	○	○	○
Albemarle Sound																										
3-01-02-05-01			○					◗	○				○	○	◗	●				○	○	○	○	○		
3-01-02-05-02			◗				○	●	○	○			●	○	○		○	○	○	○	○	●	●	◗	○	◗
3-01-02-05-03		◗	●	○		●		●	◗		○			◗	◗				○		○	●	●	○		○
3-01-02-05-04			◗					●	○					○	○	●	◗	○	◗		○	●	●	○		○
3-01-02-05-05			◗					●	○				○	◗	●	●	○	○	○		○	●	●	○		○
3-01-02-05-07		◗	◗					◗	◗	○											○	○	○	○		○
Currituck Sound																										
3-01-02-05-06			●					●	●						○				○		○	◗	●	○		

(continued)

Table 4. (continued)

	RESOURCES										USE IMPAIRMENT							STRESSORS									
	Estuarine Fisheries			Aquatic Habitat				Wetlands/ Terrestrial Habitat		Drinking Water	Toxicant Contamination						Eutrophic Waters	Nonpoint Sources							Point Sources	
	SHA	CHA	FHA	NA	SAV	ORW	FWM	WL	NHI	SWI	PSE	WQE	SE	WFE	FFE	FCA	AB	SFS	SWS	HWS	MAR	NPS-N	AG	UR	PS-T	PS-N
Tar-Pamlico River																										
3-02-01-01-01							●	●	◗	●	○							○				●	●	●	○	◗
3-02-01-01-02							○	◗	○	○	○						○		○			◗	◗	◗	○	○
3-02-01-01-03							◗	◗	○									○				◗	◗	◗		
3-02-01-01-04							○	◗	○	◗								○				◗	◗	○	◗	○
3-02-01-01-05								◗	○	○								○	○	○		◗	◗	○		
3-02-01-01-06							○	◗	○		○			○				●		○		◗	●	○	○	◗
3-02-01-02-01							◗	◗	○										○			○	○	○		○
3-02-01-02-02								●	○	○								○	◗			◗	◗	◗		
3-02-01-02-03							●	◗	○									○				●	●	○		
3-02-01-03-01								○	○	○												○	○	○		
3-02-01-03-02							○	○	○													○	○	○		○
3-02-01-03-03							○	◗	○					○	○			◗	○			●	●	○	○	◗
3-02-01-03-04							○	●	○	○		○		○	○			●	◗	◗		●	●	○		○
3-02-01-03-05							○	◗	○	◗				○				○				◗	●	○	○	○
Pamlico River Estuary																										
3-02-01-04-01								○	○													○	○	○		
3-02-01-04-02		◗	○	◗			○	●	◗			◗	●	●	●		●	○	◗		●	●	●	◗	●	●

(continued)

Table 4. (continued)

	RESOURCES										USE IMPAIRMENT							STRESSORS								
	Estuarine Fisheries			Aquatic Habitat				Wetlands/ Terrestrial Habitat		Drinking Water	Toxicant Contamination						Eutrophic Waters	Nonpoint Sources							Point Sources	
	SHA	CHA	FHA	NA	SAV	ORW	FWM	WL	NHI	SWI	PSE	WQE	SE	WFE	FFE	FCA	AB	SFS	SWS	HWS	MAR	NPS-N	AG	UR	PS-T	PS-N
Neuse River																										
3-02-02-01-01*								◗	○									○					◗	◗		○
3-02-02-01-02*								◗	○														○	◗		○
3-02-02-01-03*							○	◗	◗	●		○		○			○	○	○				○	◗	○	◗
3-02-02-01-04*							○	◗	●	●	●	●		○				●	◗	○		○	◗	●	◗	●
3-02-02-01-05								◗	◗	●	○	●		○	○			●	●	●		○	●	●	○	●
3-02-02-01-06							○	◗	○	◗							○	○		○		◗	◗	◗		◗
3-02-02-01-07							○	◗	○									◗	○	◗		○	○	◗	◗	●
3-02-02-01-08								○	○										○			○	○	◗		
3-02-02-01-09								◗	○		○			○	○		○					●	●	◗		◗
3-02-02-01-10							○	◗	○								○	○				◗	◗	○	○	◗
3-02-02-01-11								◗	○	○	○						○	○				●	●	◗	○	○
3-02-02-01-12							○	○	○	◗					○				○			○	◗	○		○
3-02-02-01-13							○	◗	○	○								◗	○			◗	◗	○	○	◗
3-02-02-02-01								◗	○									○	◗	○		●	●	○		○
3-02-02-02-02								○														◗	◗	○		
3-02-02-02-03							○	◗	○					○	○		○	○	○	◗		◗	◗	○	○	◗
3-02-02-02-04		○						●	○			○		◗	○		◗	○	○			●	●	○	○	○
3-02-02-02-05		○					○	●	○					○	○			○	○			◗	◗	◗	○	●
3-02-02-03-01								◗	○	○	○	○						○				◗	◗	○		◗
3-02-02-03-02								◗	○	●	○			◗	○			○	○	○		●	●	○	○	●

*Falls Lake

(continued)

Table 4. (continued)

	RESOURCES										USE IMPAIRMENT							STRESSORS								
	Estuarine Fisheries			Aquatic Habitat				Wetlands/ Terrestrial Habitat		Drinking Water	Toxicant Contamination						Eutrophic Waters	Nonpoint Sources							Point Sources	
	SHA	CHA	FHA	NA	SAV	ORW	FWM	WL	NHI	SWI	PSE	WQE	SE	WFE	FFE	FCA	AB	SFS	SWS	HWS	MAR	NPS-N	AG	UR	PS-T	PS-N
3-02-02-03-03								○						○	○			○				◗	◗	○	○	
3-02-02-03-04								◗	○		○			○	○		○	○	○			●	●	○	○	◗
3-02-02-04-01							○	●	○													◗	○	◗		
3-02-02-04-02							○	●	○						○				○			◗	◗	◗		○
Neuse River Estuary																										
3-02-02-04-03		●	○	◗			○	●	●		◗	○	●	●	●		◗	◗		○	◗	◗	◗	◗	○	●
Pamlico Sound																										
3-02-01-05-01		○	○					◗	○					○	○							○	○	○	○	
3-02-01-05-02	●	●	●		●			◗	◗						◗			○			○	○	○	○		○
3-02-01-05-03	◗	●	◗	●	◗	◗	○	●	●					◗	◗		●				◗	●	●	○		
3-02-01-05-04		◗	○	◗				●	○					○	○		●				○	○	○	◗		
Core Sound																										
3-02-01-06-01	●	●	◗	◗	○[a]	●	○	●	○								○				○	○	○	○		
3-02-01-06-03	●	◗	○	◗	○[a]	◗		◗	○												●	○	○	○		
3-02-01-06-04	◗	○	○		○[a]	◗		◗	◗													○	○	○		
Bogue Sound																										
3-02-01-06-05	◗	◗		○		○	○	●	●												●	○	○	◗		
White Oak River																										
3-02-01-06-02	○	○		○		○		●	●									○	○		◗	◗	○	◗		
3-02-01-06-06	○	○		○		○		◗	◗												○	○	○	○		

[a]Note: Based on total number of acres of SAV beds, Core Sound was categorized as low; however, if acres of SAV beds were adjusted for total estuarine areas, than Core Sound SAV beds cover 31% of the water area. Core Sound is the most productive area of the A/P Study Area with respect to SAV habitat.

Table 4. (continued)

Abbreviation	Title of Data Coverage	Criteria for Categorization		
		○ Low	◗ Medium	● High
Resources				
SHA	Shellfish harvest areas (area)	<5,000 acres	5,000-20,000 acres	>20,000 acres
CHA	Crustacean harvest areas (area)	< 25,000 acres	25,000-100,000 acres	>100,000 acres
FHA	Finfish harvest areas (area)	<20,000 acres	20,000-50,000 acres	>50,000 acres
NA	Nursery areas (area)	<2,500 acres	2,500-10,000 acres	>10,000 acres
SAV	Submerged aquatic vegetation (area)	$<5 \times 10^8$ acres	$5 \times 10^8 - 1 \times 10^9$ acres	$>1 \times 10^9$ acres
ORW	Outstanding resource waters (area)	<10,000 acres	10,000-30,000 acres	>30,000 acres
FWM	Freshwater mussel habitat (# of sites/subbasin)	1-2	3-4	>4
WL	Wetlands (area) (identified in LANDSAT study)	≤ 2,500 acres	2,500-25,000 acres	≥25,000 acres
NHI	Natural Heritage Inventory (# of sites/subbasin)	1-49	50-100	>100
SWI	Surface water intakes (# of intakes/subbasin) (municipal drinking water)	1	2-3	4-5
Use Impairment				
PSE	Point source exceedances (# of facilities with the potential of causing water quality exceedances modeled for 7Q10 low flow conditions)	1	2	3
WQE	Water quality exceedances (# of sites where water quality exceedances were detected)	1-2	3-6	>6
SE	Sediment exceedances (# of sites where sediment metal concentrations exceeded NOAA ER-M values)	1-3	4-9	>10
WFE	Whole fish exceedances (# of sites where whole fish pollutant concentrations exceeded levels of concern for wildlife)	1-2	3-4	>5
FFE	Fish fillet/shellfish exceedances (# of sites where fish fillet or shellfish pollutant concentrations exceeded human health screening values)	1-2	3-4	>5

(continued)

Table 4. (continued)

Abbreviation	Title of Data Coverage	Criteria for Categorization		
		○ Low	◗ Medium	● High
FCA	Fish consumpton advisories currently in effect (dioxin advisory issued for waterbody)	—	—	yes
AB	Algal bloom occurrences (# of blooms/subbasin)	0-19	20-39	>40
Stressors				
SFS	Superfund sites (# of sites/subbasin)	1-3	4-7	>7
SWS	Solid waste sites (# of landfills/subbasin)	1	2	>2
HWS	Hazardous waste sites (# of treatment storage, and disposal sites/subbasin)	1	2	>2
MAR	Coastal marinas (# of marinas/subbasin)	1-10	11-25	>25
NPS-N	Nonpoint source nutrient loading (kg/yr)	<150,000	150,000-425,000	>425,000
AG	Agricultural land (area)	≤25,000 acres	25,000-62,000 acres	>62,000 acres
UR	Urban land (area)	≤2,500 acres	2,500-25,000 acres	>25,000 acres
PS-T	Point source metal loading (kg/year)	<900	900-4,500	>4,500
PS-N	Point source nutrient loading (kg/yr)	1,000-9,999	10,000-99,999	>100,000

Table 5. Extent of Wetlands Areas by Subbasin[a]

Subbasin	Major drainage	Minor drainage	Wetlands (hectares)
3-01-01-06-01	Roanoke River	Unnamed	194
3-01-01-07-01	Roanoke River	Unnamed	18,750
3-01-01-07-02	Roanoke River	Unnamed	51,060
3-01-01-07-03	Roanoke River	Cashie River	16,571
3-01-02-03-01	Chowan River	Ahoskie Creek	1,213
3-01-02-03-02	Chowan River	Unnamed	36,827
3-01-02-03-03	Chowan River	Unnamed	6,145
3-01-02-03-04	Chowan River	Unnamed	4,761
3-01-02-03-05	Chowan River	Somerton Creek	7,075
3-01-02-03-06	Chowan River	Buckhorn Creek	78
3-01-02-04-01	Chowan River	Meherrin River	5,650
3-01-02-04-02	Chowan River	Potecasi Creek	6,011
3-01-02-05-01	Albemarle Sound	Unnamed	2,608
3-01-02-05-02	Albemarle Sound	Pasquotank River	20,277
3-01-02-05-03	Albemarle Sound	Alligator River	68,237
3-01-02-05-04	Albemarle Sound	Unnamed	17,735
3-01-02-05-05	Albemarle Sound	Scuppernong River	24,520
3-01-02-05-06	Currituck Sound	Unnamed	24,275
3-01-02-05-07	Albemarle Sound	Roanoke Sound	2,792
3-02-01-01-01	Tar-Pamlico River	Unnamed	10,123
3-02-01-01-02	Tar-Pamlico River	Unnamed	4,117
3-02-01-01-03	Tar-Pamlico River	Swift Creek	3,431
3-02-01-01-04	Tar-Pamlico River	Unnamed	1,282
3-02-01-01-05	Tar-Pamlico River	Unnamed	1,763
3-02-01-01-06	Tar-Pamlico River	Unnamed	3,718
3-02-01-02-01	Tar-Pamlico River	Little Fishing Creek	5,298
3-02-01-02-02	Tar-Pamlico River	Fishing Creek	10,332
3-02-01-02-03	Tar-Pamlico River	Fishing Creek	9,380
3-02-01-03-01	Tar-Pamlico River	Unnamed	335
3-02-01-03-02	Tar-Pamlico River	Conetoe Creek	535
3-02-01-03-03	Tar-Pamlico River	Unnamed	2,536
3-02-01-03-04	Tar-Pamlico River	Unnamed	12,952
3-02-01-03-05	Tar-Pamlico River	Unnamed	8,693
3-02-01-04-01	Pamlico River Estuary	Van Swamp	475
3-02-01-04-02	Pamlico River Estuary	Unnamed	54,532
3-02-01-05-01	Pamlico Sound	Unnamed	2,869
3-02-01-05-02	Pamlico Sound	Unnamed	2,996
3-02-01-05-03	Pamlico Sound	Unnamed	29,006
3-02-01-05-04	Pamlico Sound	Unnamed	17,607
3-02-01-06-01	Core Sound	Unnamed	12,038
3-02-01-06-02	White Oak River	Unnamed	25,526
3-02-01-06-03	Core Sound	Unnamed	8,730
3-02-01-06-04	Core Sound	Unnamed	1,138
3-02-01-06-05	Bogue Sound	Unnamed	11,909

(continued)

Table 5. (continued)

Subbasin	Major drainage	Minor drainage	Wetlands (hectares)
3-02-01-06-06	White Oak River	Unnamed	4,797
3-02-02-01-05	Neuse River	Unnamed	7,616
3-02-02-01-06	Neuse River	Swift Creek	2,477
3-02-02-01-07	Neuse River	Middle Creek	1,362
3-02-02-01-08	Neuse River	Middle Creek	802
3-02-02-01-09	Neuse River	Unnamed	4,937
3-02-02-01-10	Neuse River	Unnamed	3,591
3-02-02-01-11	Neuse River	Little River	2,946
3-02-02-01-12	Neuse River	Unnamed	263
3-02-02-01-13	Neuse River	Unnamed	1,553
3-02-02-02-01	Neuse River	Unnamed	1,836
3-02-02-02-02	Neuse River	Unnamed	222
3-02-02-02-03	Neuse River	Unnamed	3,264
3-02-02-02-04	Neuse River	Swift Creek	10,673
3-02-02-02-05	Neuse River	Unnamed	10,679
3-02-02-03-01	Neuse River	Contentnea Creek	1,349
3-02-02-03-02	Neuse River	Contentnea Creek	3,718
3-02-02-03-03	Neuse River	Nahunta Swamp	229
3-02-02-03-04	Neuse River	Little Contentnea Creek	3,815
3-02-02-04-01	Neuse River	Trent River	12,418
3-02-02-04-02	Neuse River	Trent River	21,250
3-02-02-04-03	Neuse River Estuary	Unnamed	46,248

[a]Raw data from Khorram et al. (1992).

Table 6. Annual Average Nutrient Loading from Nonpoint Sources Ranked by Subbasin[a]

Subbasin	Major drainage	Minor drainage	N loading[a] (kg/yr)	P loading[b] (kg/yr)	Loading rank[c]	N loading (kg/ha/yr)	P loading (kg/ha/yr)	Loading rank[c]
3-02-01-04-02	Pamlico River Estuary	Unnamed	1,284,608	117,907	1	4.21	0.39	43
3-02-02-03-02	Neuse River	Contentnea Creek	872,268	82,995	2	6.74	0.64	8
3-01-02-05-04	Albemarle Sound	Unnamed	643,505	61,383	4	4.60	0.44	37
3-02-02-01-05	Neuse River	Unnamed	643,436	67,037	4	5.68	0.59	20
3-01-01-07-01	Roanoke River	Unnamed	596,502	53,732	6	5.29	0.48	31
3-02-01-01-01	Tar-Pamlico River	Unnamed	596,091	57,575	6	5.31	0.51	28
3-01-01-07-02	Roanoke River	Unnamed	567,186	50,095	8	4.03	0.36	46
3-02-01-02-03	Tar-Pamlico River	Fishing Creek	559,222	51,557	8	5.90	0.54	20
3-02-01-03-03	Tar-Pamlico River	Unnamed	553,163	52,172	8	6.48	0.61	13
3-02-02-01-09	Neuse River	Unnamed	493,880	48,823	10	6.87	0.68	4
3-02-02-03-04	Neuse River	Little Contentnea Creek	454,439	42,945	12	6.48	0.61	12
3-01-02-05-05	Albemarle Sound	Scuppernong River	452,490	42,107	13	3.79	0.35	48
3-01-02-03-02	Chowan River	Unnamed	471,838	41,212	14	4.13	0.36	45
3-01-02-05-03	Albemarle Sound	Alligator River	486,158	38,482	14	1.88	0.15	57
3-02-01-03-04	Tar-Pamlico River	Unnamed	448,591	41,979	14	5.85	0.55	20
3-01-02-05-02	Albemarle Sound	Pasquotank River	443,910	41,926	15	4.54	0.43	39
3-02-02-02-01	Neuse River	Unnamed	421,972	40,103	17	6.63	0.63	9
3-02-02-02-04	Neuse River	Swift Creek	421,239	37,302	18	4.89	0.43	36
3-02-01-05-03	Pamlico Sound	Unnamed	395,962	35,453	20	1.25	0.11	60
3-02-02-01-11	Neuse River	Little River	378,976	36,446	21	6.31	0.61	14
3-02-01-02-02	Tar-Pamlico River	Fishing Creek	391,344	33,467	21	4.30	0.37	43
3-02-01-03-05	Tar-Pamlico River	Unnamed	376,978	35,334	22	5.97	0.56	19
3-02-02-04-03	Neuse River Estuary	Unnamed	388,432	31,884	22	5.41	0.44	31
3-02-01-01-06	Tar-Pamlico River	Unnamed	324,855	30,259	24	6.11	0.57	15
3-02-01-01-02	Tar-Pamlico River	Unnamed	321,001	29,989	26	5.36	0.50	29

(continued)

Table 6. (continued)

Subbasin	Major drainage	Minor drainage	N loading[a] (kg/yr)	P loading[b] (kg/yr)	Loading rank[c]	N loading (kg/ha/yr)	P loading (kg/ha/yr)	Loading rank[c]
3-01-01-07-03	Roanoke River	Cashie River	323,218	27,284	27	4.06	0.34	47
3-01-02-05-06	Currituck Sound	Unnamed	318,479	29,237	27	2.82	0.26	52
3-01-02-04-02	Chowan River	Potecasi Creek	316,312	28,627	28	5.44	0.49	28
3-02-02-02-03	Neuse River	Unnamed	282,774	25,992	30	5.62	0.52	25
3-02-02-02-05	Neuse River	Unnamed	280,810	25,042	31	4.69	0.42	38
3-02-02-04-02	Neuse River	Trent River	288,263	24,930	31	4.02	0.35	48
3-02-02-01-06	Neuse River	Swift Creek	244,110	24,946	32	6.07	0.62	14
3-02-02-01-13	Neuse River	Unnamed	236,805	22,166	33	4.99	0.47	33
3-02-02-03-01	Neuse River	Contentnea Creek	231,913	21,253	34	5.68	0.52	24
3-01-02-04-01	Chowan River	Meherrin River	226,527	20,695	36	5.48	0.50	27
3-02-01-01-03	Tar-Pamlico River	Swift Creek	225,865	20,963	36	5.28	0.49	31
3-02-01-01-05	Tar-Pamlico River	Unnamed	219,324	20,157	37	5.76	0.53	23
3-02-02-01-10	Neuse River	Unnamed	199,954	18,359	39	5.80	0.53	22
3-02-01-06-02	White Oak River	Unnamed	202,950	15,940	39	2.48	0.19	54
3-02-01-01-04	Tar-Pamlico River	Unnamed	188,528	17,561	40	6.03	0.56	18
3-01-02-03-03	Chowan River	Unnamed	154,042	14,627	42	4.82	0.46	35
3-02-02-01-12	Neuse River	Unnamed	151,934	14,497	43	6.91	0.66	6
3-02-01-02-01	Tar-Pamlico River	Little Fishing Creek	163,589	12,770	44	3.55	0.28	51
3-02-02-04-01	Neuse River	Trent River	155,300	13,648	44	3.61	0.32	50
3-02-02-01-07	Neuse River	Middle Creek	141,114	14,459	45	6.53	0.67	8
3-02-02-03-03	Neuse River	Nahunta Swamp	145,165	13,920	45	7.03	0.67	4
3-02-01-03-02	Tar-Pamlico River	Conetoe Creek	112,156	10,430	48	6.09	0.57	16
3-02-02-02-02	Neuse River	Unnamed	112,129	10,851	48	7.37	0.71	1
3-01-02-03-04	Chowan River	Unnamed	110,549	10,150	49	4.48	0.41	41
3-02-01-06-03	Core Sound	Unnamed	106,954	9,667	51	2.42	0.22	54

(continued)

Table 6. (continued)

Subbasin	Major drainage	Minor drainage	N loading[a] (kg/yr)	P loading[b] (kg/yr)	Loading rank[c]	N loading (kg/ha/yr)	P loading (kg/ha/yr)	Loading rank[c]
3-02-01-06-05	Bogue Sound	Unnamed	110,089	9,105	51	2.18	0.18	56
3-02-01-05-04	Pamlico Sound	Unnamed	104,017	9,605	52	1.45	0.13	59
3-01-02-05-01	Albemarle Sound	Unnamed	89,804	8,548	53	3.92	0.37	46
3-02-02-01-08	Neuse River	Middle Creek	84,198	8,378	54	6.77	0.67	6
3-01-02-03-01	Chowan River	Ahoskie Creek	78,225	6,899	55	4.97	0.44	35
3-02-01-03-01	Tar-Pamlico River	Unnamed	43,600	4,190	56	7.11	0.68	2
3-01-02-05-07	Albemarle Sound	Roanoke Sound	42,088	4,027	58	1.47	0.14	58
3-02-01-06-06	White Oak River	Unnamed	42,525	3,591	58	2.41	0.20	55
3-02-01-05-02	Pamlico Sound	Unnamed	30,090	2,800	60	0.23	0.02	64
3-02-01-06-01	Core Sound	Unnamed	30,648	2,585	60	0.35	0.03	63
3-02-01-04-01	Tar-Pamlico River	Van Swamp	21,152	2,026	61	6.50	0.62	10
3-02-01-05-01	Pamlico Sound	Unnamed	18,894	1,127	62	1.17	0.07	61
3-01-01-06-01	Roanoke River	Unnamed	11,094	996	63	4.50	0.40	41
3-02-01-06-04	Core Sound	Unnamed	7,721	731	64	0.58	0.05	62

[a]N loading is the amount of total nitrogen load added to the subbasin.
[b]P loading is the amount of total phosphorus load added to the subbasin.
[c](N Loading Rank + P Loading Rank)/2 as described in Dodd et al. (1992b).

Table 7. Urban and Agricultural Land by Subbasin[a]

Subbasin	Major drainage	Minor drainage	Urban (hectares)	Agricultural (hectares)
3-01-01-06-01	Roanoke River	Unnamed	67	755
3-01-01-07-01	Roanoke River	Unnamed	464	45,469
3-01-01-07-02	Roanoke River	Unnamed	717	40,588
3-01-01-07-03	Roanoke River	Cashie River	130	20,682
3-01-02-03-01	Chowan River	Ahoskie Creek	23	5,684
3-01-02-03-02	Chowan River	Unnamed	327	33,113
3-01-02-03-03	Chowan River	Unnamed	100	13,465
3-01-02-03-04	Chowan River	Unnamed	72	8,880
3-01-02-04-01	Chowan River	Meherrin River	106	18,025
3-01-02-04-02	Chowan River	Potecasi Creek	110	24,611
3-01-02-05-01	Albemarle Sound	Unnamed	217	7,669
3-01-02-05-02	Albemarle Sound	Pasquotank River	1,098	37,124
3-01-02-05-03	Albemarle Sound	Alligator River	160	25,391
3-01-02-05-04	Albemarle Sound	Unnamed	899	56,186
3-01-02-05-05	Albemarle Sound	Scuppernong River	125	37,861
3-01-02-05-06	Currituck Sound	Unnamed	521	25,121
3-01-02-05-07	Albemarle Sound	Roanoke Sound	596	2,924
3-02-01-01-01	Tar-Pamlico River	Unnamed	13,292	35,625
3-02-01-01-02	Tar-Pamlico River	Unnamed	3,460	22,245
3-02-01-01-03	Tar-Pamlico River	Swift Creek	2,337	15,482
3-02-01-01-04	Tar-Pamlico River	Unnamed	140	15,686
3-02-01-01-05	Tar-Pamlico River	Unnamed	257	17,496
3-02-01-01-06	Tar-Pamlico River	Unnamed	273	26,981
3-02-01-02-01	Tar-Pamlico River	Little Fishing Creek	33	8,170
3-02-01-02-02	Tar-Pamlico River	Fishing Creek	1,732	23,739
3-02-01-02-03	Tar-Pamlico River	Fishing Creek	169	45,682
3-02-01-03-01	Tar-Pamlico River	Unnamed	28	3,924
3-02-01-03-02	Tar-Pamlico River	Conetoe Creek	22	9,383
3-02-01-03-03	Tar-Pamlico River	Unnamed	348	47,574
3-02-01-03-04	Tar-Pamlico River	Unnamed	453	37,588
3-02-01-03-05	Tar-Pamlico River	Unnamed	344	31,768
3-02-01-04-01	Pamlico River Estuary	Van Swamp	18	1,882
3-02-01-04-02	Pamlico River Estuary	Unnamed	2,203	101,125
3-02-01-05-01	Pamlico Sound	Unnamed	2	162
3-02-01-05-02	Pamlico Sound	Unnamed	289	2,111
3-02-01-05-03	Pamlico Sound	Unnamed	438	29,511
3-02-01-05-04	Pamlico Sound	Unnamed	1,475	6,442
3-02-01-06-01	Core Sound	Unnamed	279	1,570
3-02-01-06-02	White Oak River	Unnamed	1,017	8,945
3-02-01-06-03	Core Sound	Unnamed	359	7,828
3-02-01-06-04	Core Sound	Unnamed	87	552
3-02-01-06-05	Bogue Sound	Unnamed	1,168	4,994
3-02-01-06-06	White Oak River	Unnamed	343	2,252
3-02-02-01-05	Neuse River	Unnamed	25,454	33,408
3-02-02-01-06	Neuse River	Swift Creek	6,938	15,512
3-02-02-01-07	Neuse River	Middle Creek	3,529	9,751
3-02-02-01-08	Neuse River	Middle Creek	1,187	6,585
3-02-02-01-09	Neuse River	Unnamed	5,378	40,199
3-02-02-01-10	Neuse River	Unnamed	164	16,013
3-02-02-01-11	Neuse River	Little River	3,093	30,047

(continued)

Table 7. (continued)

Subbasin	Major drainage	Minor drainage	Urban (hectares)	Agricultural (hectares)
3-02-02-01-12	Neuse River	Unnamed	86	13,458
3-02-02-01-13	Neuse River	Unnamed	377	19,656
3-02-02-02-01	Neuse River	Unnamed	480	36,669
3-02-02-02-02	Neuse River	Unnamed	41	10,309
3-02-02-02-03	Neuse River	Unnamed	446	22,402
3-02-02-02-04	Neuse River	Swift Creek	176	30,879
3-02-02-02-05	Neuse River	Unnamed	1,030	19,661
3-02-02-03-01	Neuse River	Contentnea Creek	218	18,443
3-02-02-03-02	Neuse River	Contentnea Creek	665	76,489
3-02-02-03-03	Neuse River	Nahunta Swamp	116	12,965
3-02-02-03-04	Neuse River	Little Contentnea Creek	198	39,400
3-02-02-04-01	Neuse River	Trent River	1,126	9,614
3-02-02-04-02	Neuse River	Trent River	1,192	18,234
3-02-02-04-03	Neuse River Estuary	Unnamed	3,140	18,496

[8]Raw data from Khorram et al. (1992).

Table 8. Average Annual Loadings[a] of Toxicants from Point Source Dischargers to the A/P Estuarine System

NPDES	Facility Name	Aluminum	Arsenic	Cadmium	Chromium	Copper	Cyanide	Fluoride	Lead	Mercury	Nickel	Selenium	Silver	Zinc	Total
Pamlico River and Estuary															
N00001503	CSX Transportation					17.0									17.0
N00001627	National Spinning Company				80.7										80.7
N00003255	Texasgulf							970413.3							970413.3
N00020805	Tarboro WWTP				61.3	179.0	192.4							650.9	1083.6
N00025054	Oxford-Renovated WWTP			22.3	78.4	90.1	60.1		253.7	240.6	135.7		112.7	521.9	1515.5
N00030317	Rocky Mount WWTP					858.90	1785.40		929.30		1296.0			1535.8	6405.4
N00086854	Corry Hiebert	2.5													2.5
Total Annual Basin Loadings		2.5		22.3	220.4	1145.0	2037.9	970413.3	1183.0	240.6	1431.7		112.7	2708.6	979518.0
Neuse River and Estuary															
N00001376	Burlington Industries/ Wake Plant				193.9										193.9
N00001881	Phillips Plating Company			2.0	15.4	30.3	1.4		4.6		56.8		0.9	35.4	146.8
N00003417	CP&L/Lee											110.0			110.0
N00003816	Cherry Point WWTP			9.1	91.1	24.0	92.9		16.3		20.3		18.8	213.5	486.0
N00020389	Benson WWTP				43.5	256.7	11.0		33.0					1665.1	2009.3
N00020541	Kinston-Peachtree WWTP				229.3	246.2			288.9					378.9	1143.3
N00020842	Snow Hill WWTP				25.4										25.4
N00023841	Durham-Northside WWTP			6.5	32.6	795.2	133.6		87.9	2.7	57.9			1887.9	3004.3
N00023906	Wilson WWTP			8.9	53.0		58.8		138.9	34.8	150.7				445.1
N00024236	Kinston-Northside WWTP					189.2								177.3	366.5
N00024368	Zebulon WWTP					94.8			13.6		30.4			101.7	240.5
N00025020	Wendell WWTP					13.3	6.6		5.0		3.4			28.7	57.0
N00026336	Durham-Eno River WWTP			2.6	10.3	153.1			29.4		24.3		20.3	464.7	704.7

(continued)

Table 8. (continued)

NPDES	Facility Name	Aluminum	Arsenic	Cadmium	Chromium	Copper	Cyanide	Fluoride	Lead	Mercury	Nickel	Selenium	Silver	Zinc	Total
N00026433	Hillsborough WWTP				36.3										36.3
N00026824	John Umstead Hospital			4.7	40.0	92.2	22.6	1829.4	58.0	0.7	31.9		68.4	250.6	2398.5
N00029572	Farmville WWTP				111.7	201.5	2.6				71.7			238.7	626.2
N00030716	Central Johnston County WWTP			86.50		292.5			384.5					209.7	973.2
N00032077	Contentnea Metropolitan Sewage District								76.30						76.3
N00048879	Cary—North WWTP				104.2	116.7				1.6			243.8	248.6	714.9
N00074667	Worsley Oil Company/ Scotchman Store #76								0.3						0.3
N00075281	Craven Co Wood Energy Limited Partnership					111.3		344.4						134.9	590.6
Total Annual Basin loadings		0.0	0.0	120.3	966.7	2617.0	329.5	2173.8	1136.7	39.8	447.4	110.0	352.2	6035.7	14,349.1
Albemarle															
N00003867	United Piece Dye Works				137.1										137.1
N00025011	Elizabeth City WWTP				134.6									408.0	542.6
N00049140	Dare County Landfill	70.7		0.8	7.7	5.5			8.0	0.1	6.9			13.1	112.8
N00001961	West Point Pepperell/ Hamilton Plant				125.0										125.0
N00023710	Penn Elastic Company				79.2										79.2
N00024201	Roanoke Rapids SD/ Roanoke Rapids WWTP			395.1	219.4	424.0			1500.7		426.8			1905.7	4871.7
Total Annual Basin Loadings		70.7		395.9	703.0	429.5	0.0	0.0	1508.7	0.1	433.7	0.0	0.0	2326.8	5868.4

[a]All loadings are in pounds/year; average loadings calculated from 2 years of DMR data (1989-1990) as described in Cunningham et al. (1992a).

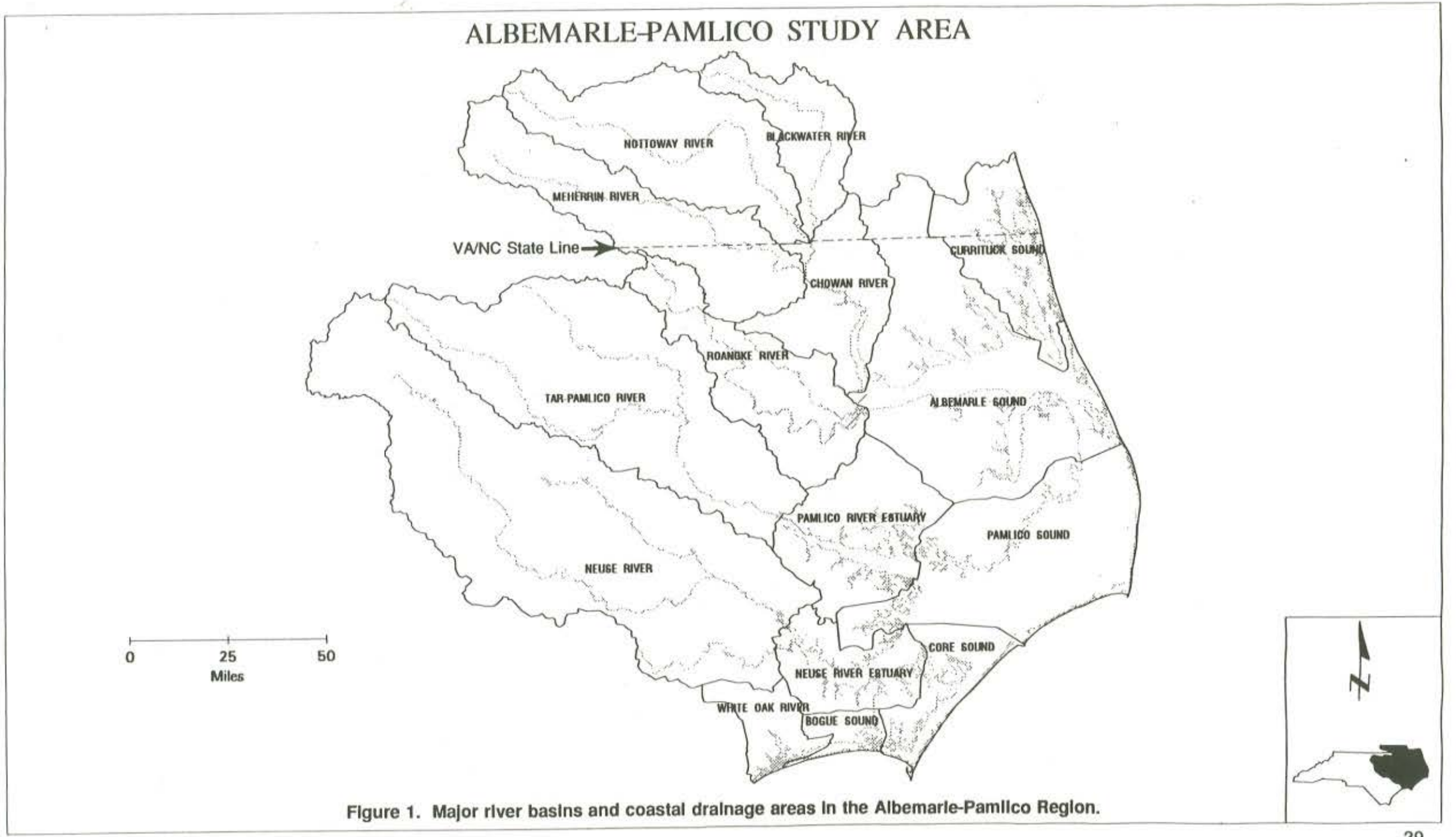


Figure 1. Major river basins and coastal drainage areas in the Albemarle-Pamlico Region.

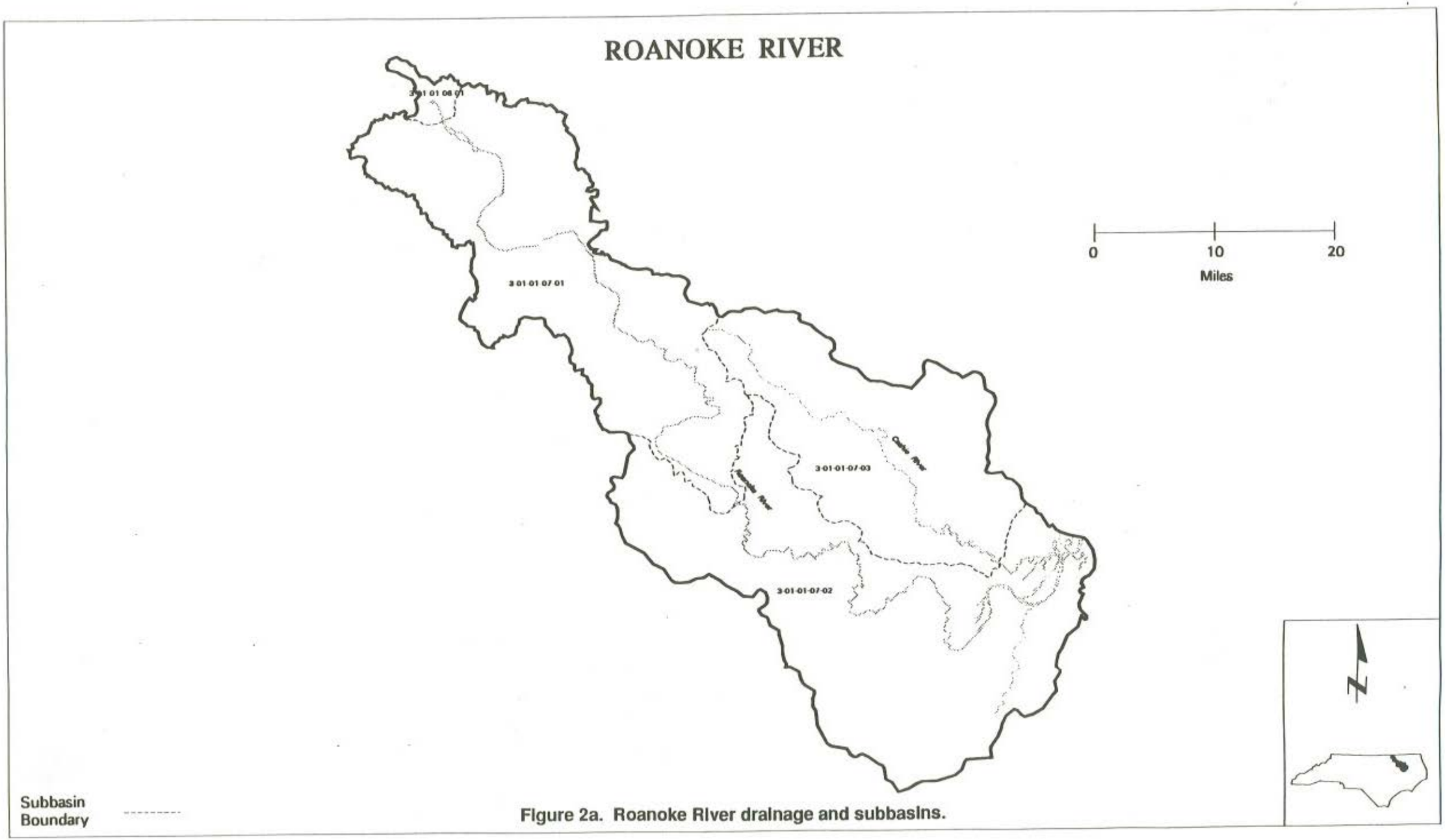


Figure 2a. Roanoke River drainage and subbasins.

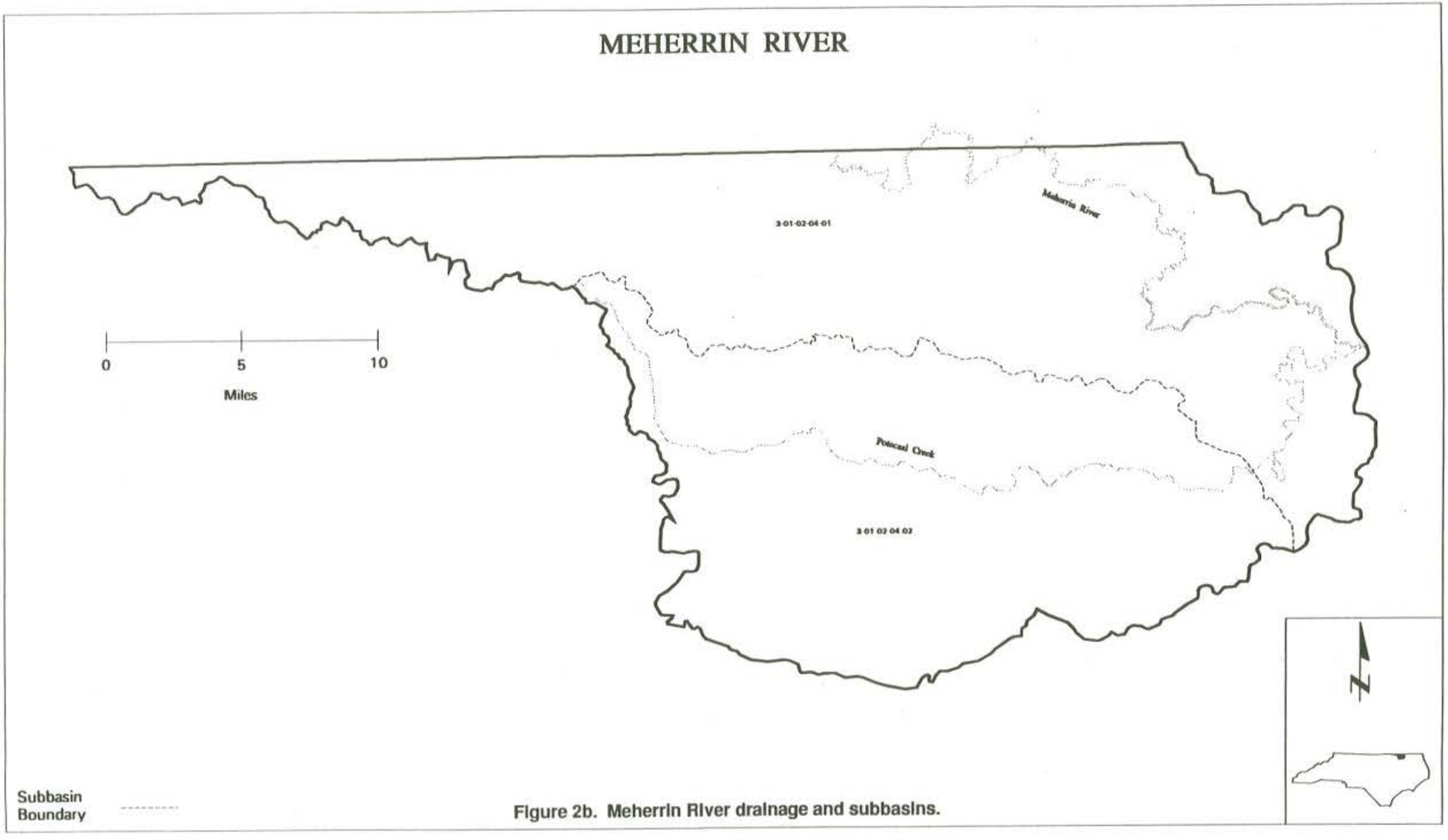


Figure 2b. Meherrin River drainage and subbasins.

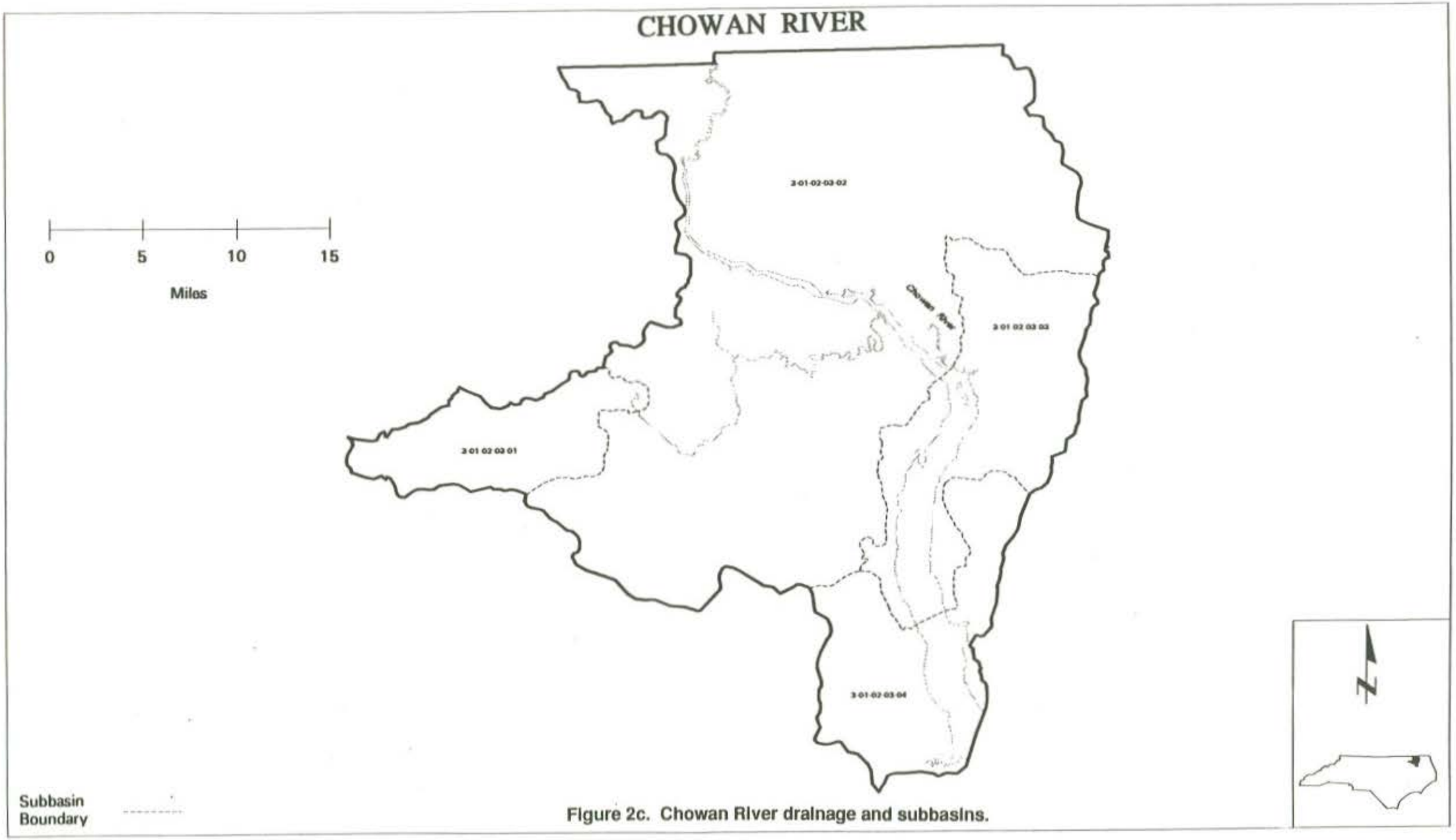


Figure 2c. Chowan River drainage and subbasins.

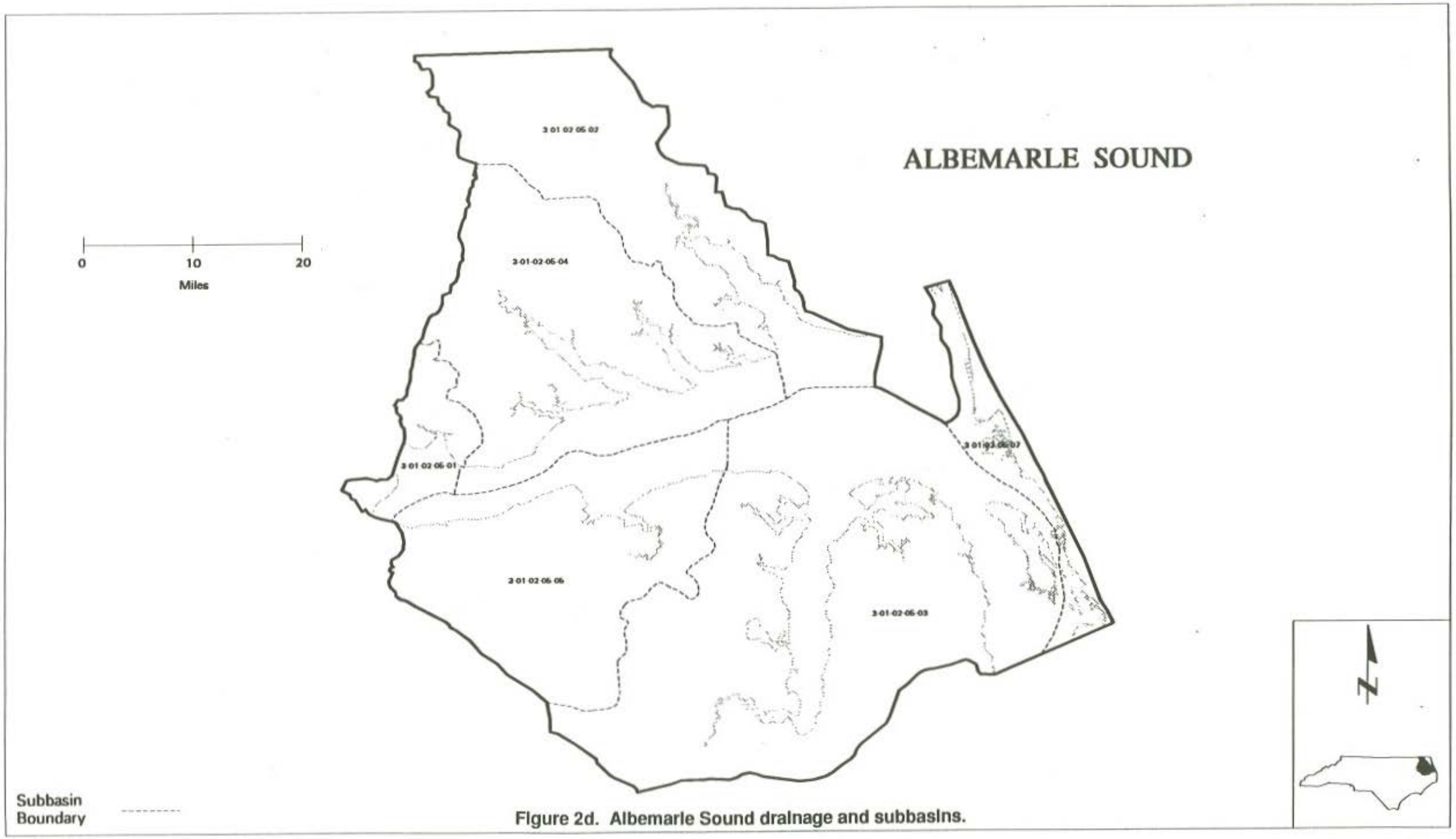


Figure 2d. Albemarle Sound drainage and subbasins.

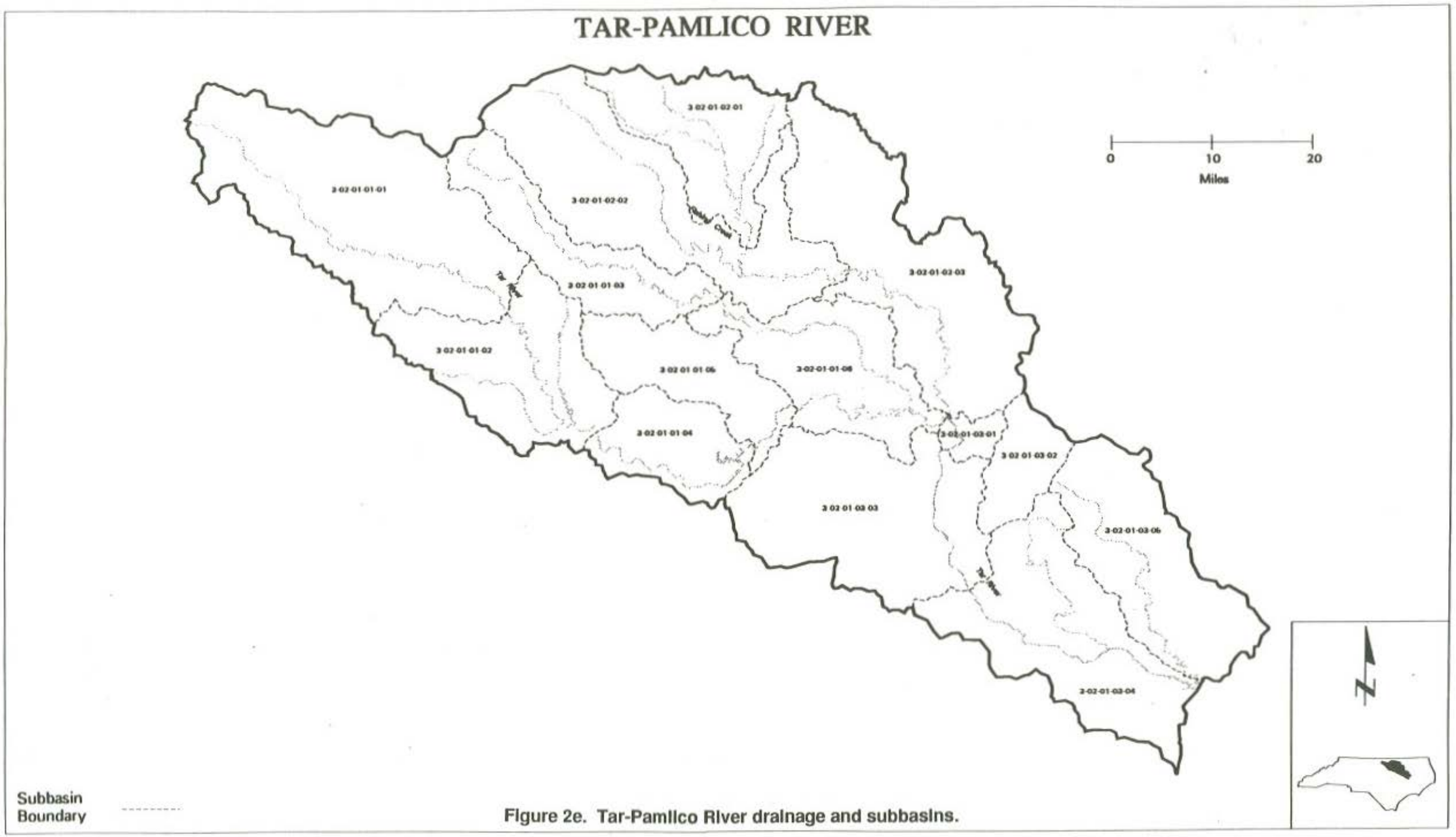


Figure 2e. Tar-Pamlico River drainage and subbasins.

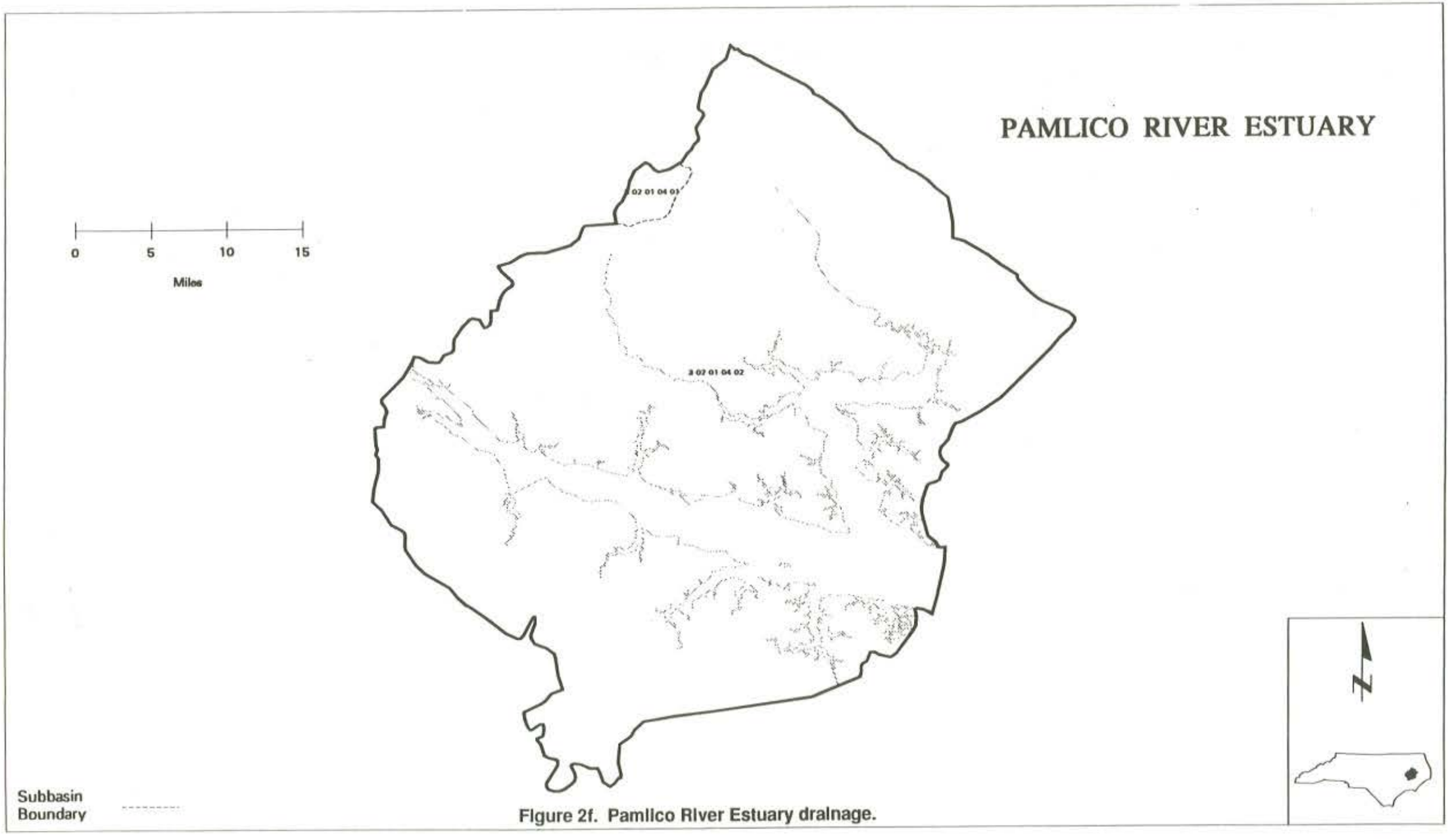
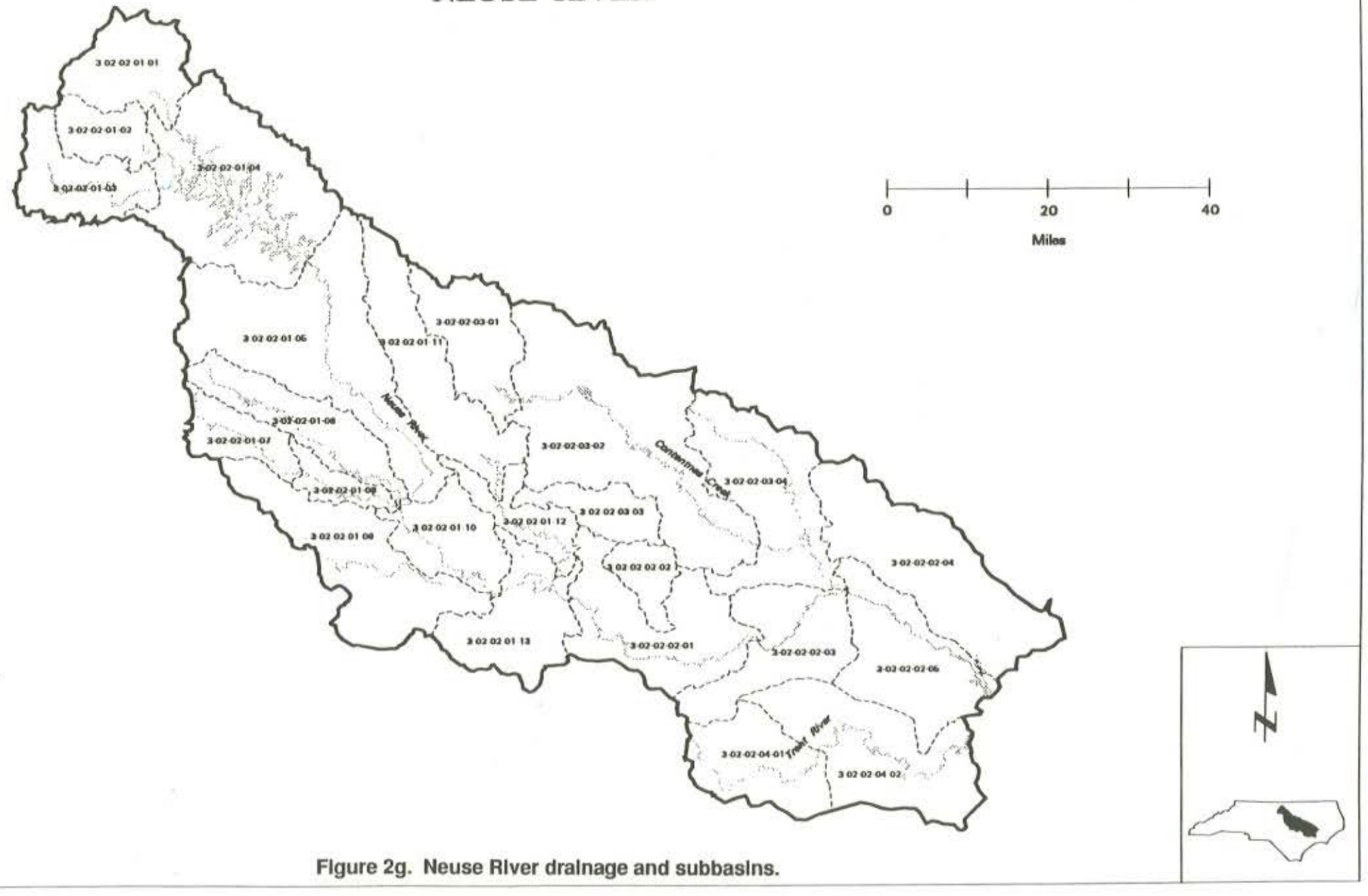


Figure 2f. Pamlico River Estuary drainage.

NEUSE RIVER



Subbasin Boundary ---------

Figure 2g. Neuse River drainage and subbasins.

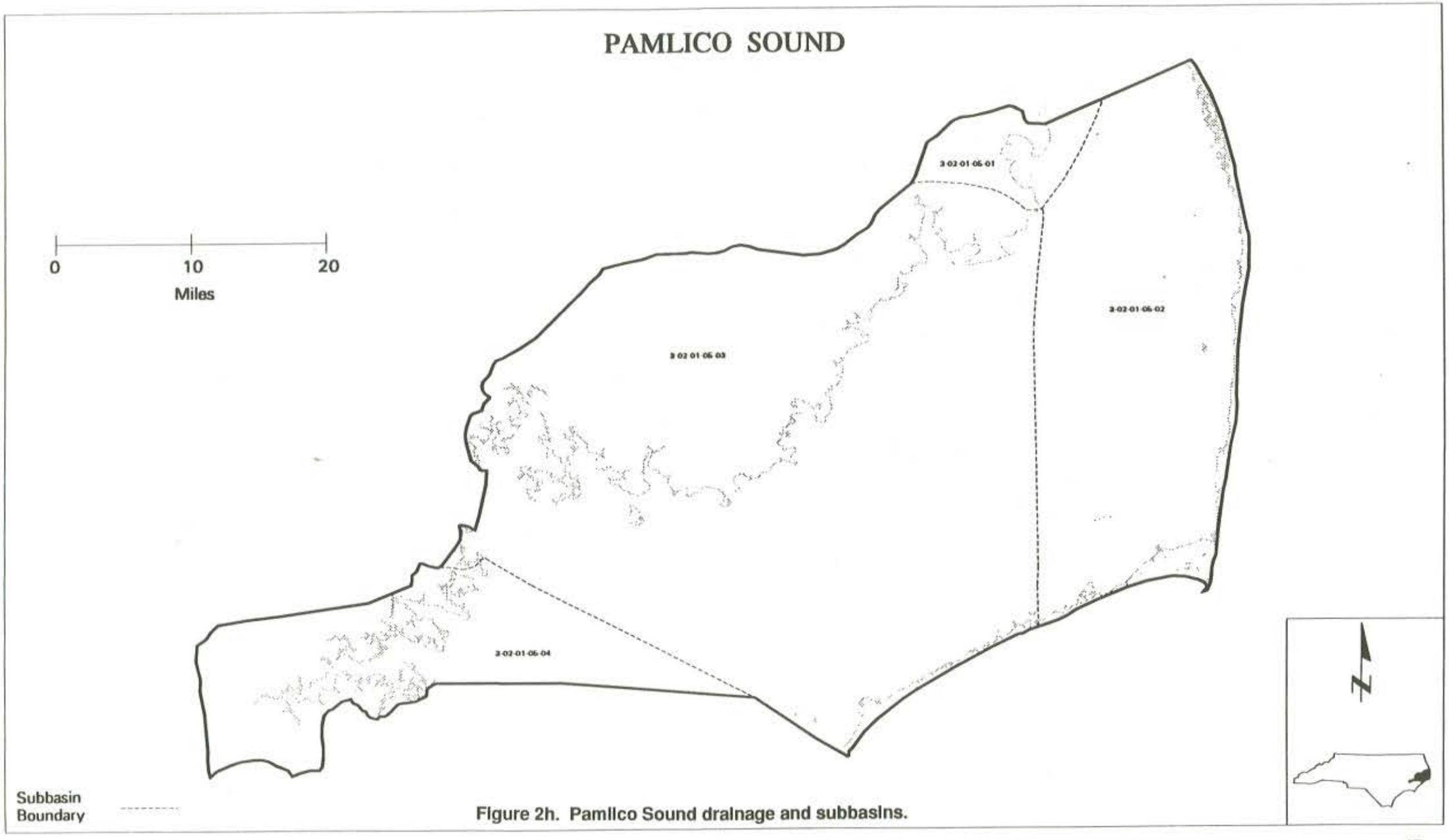


Figure 2h. Pamlico Sound drainage and subbasins.

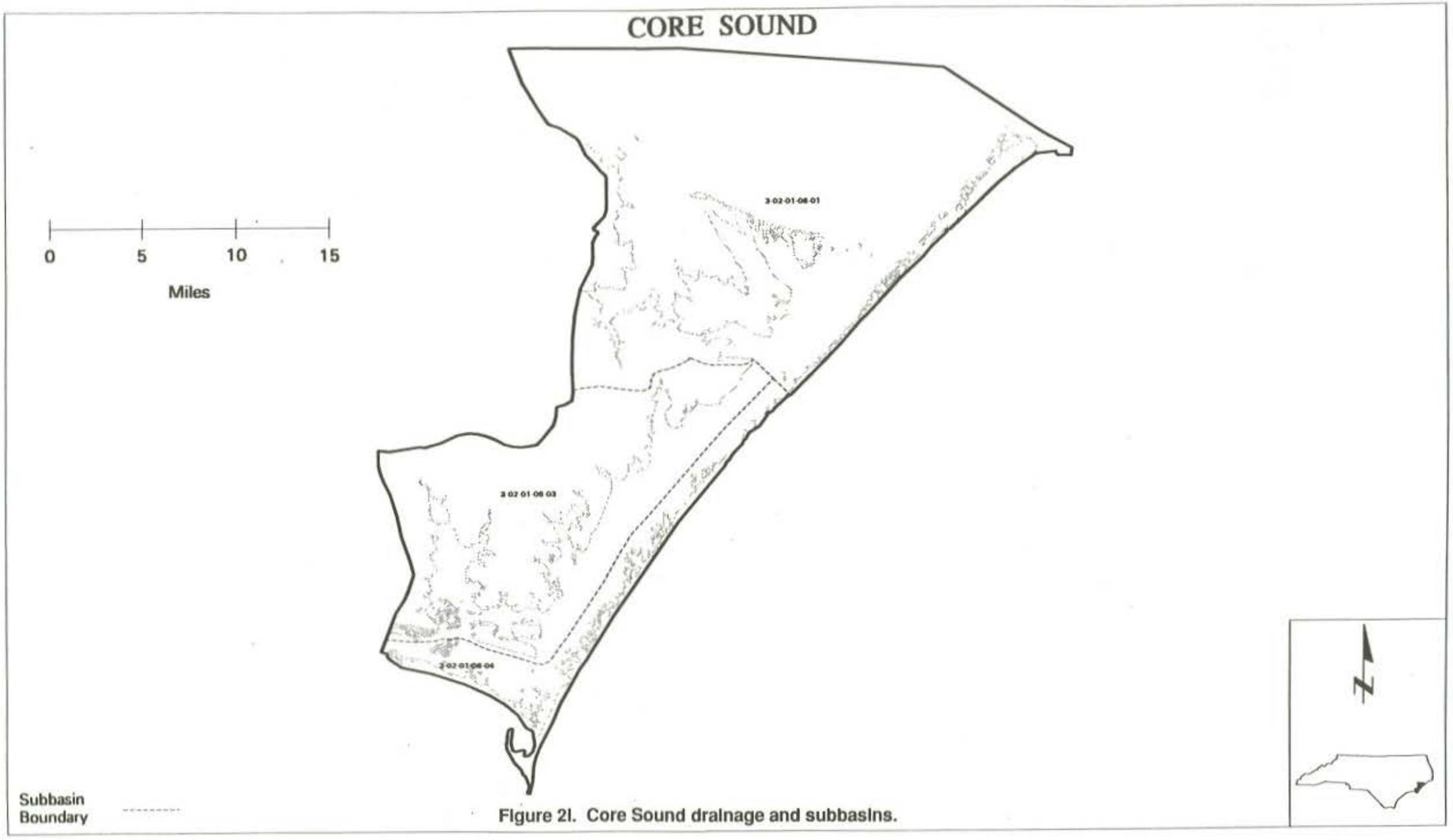


Figure 2l. Core Sound drainage and subbasins.

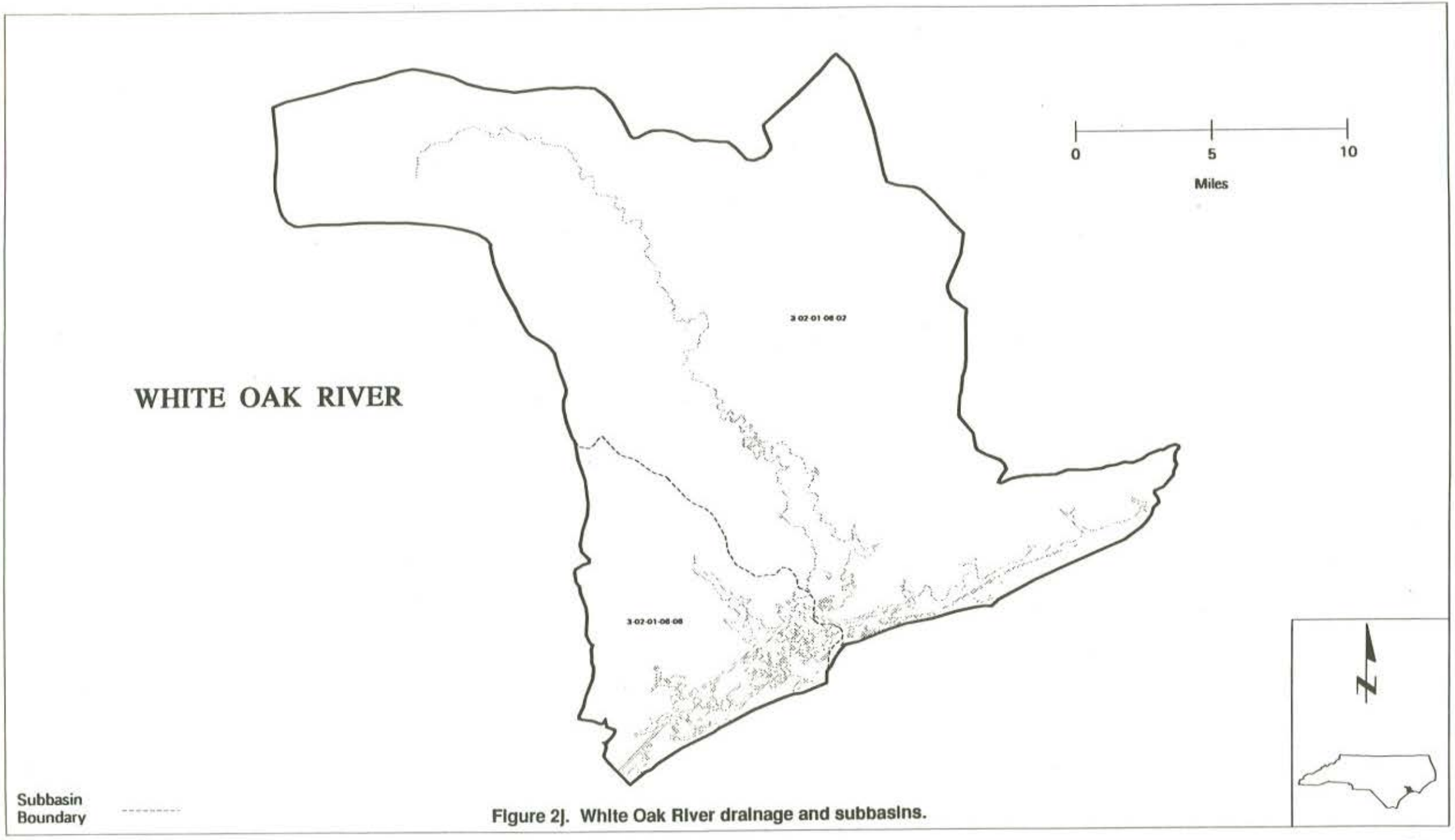


Figure 2J. White Oak River drainage and subbasins.

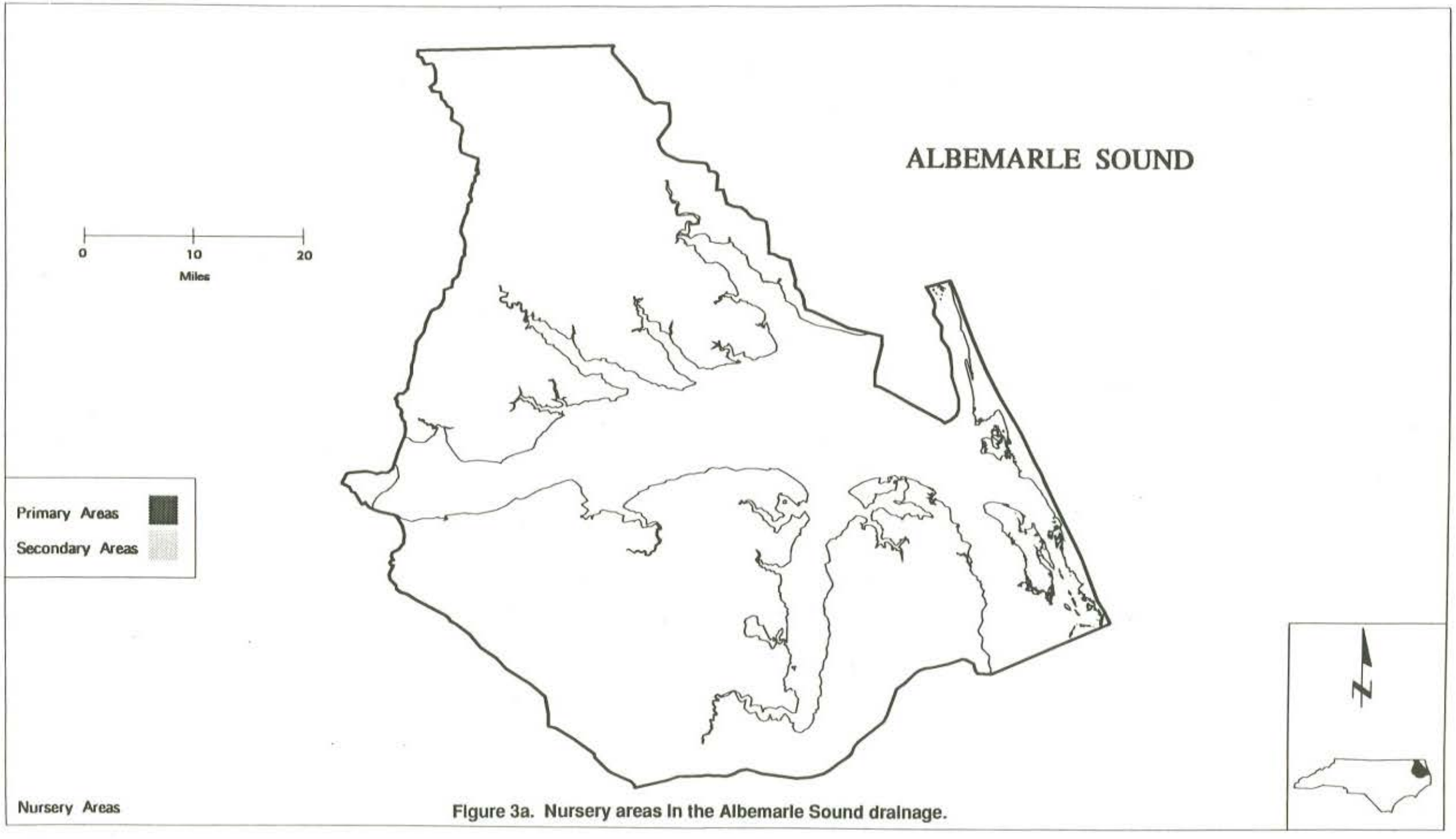
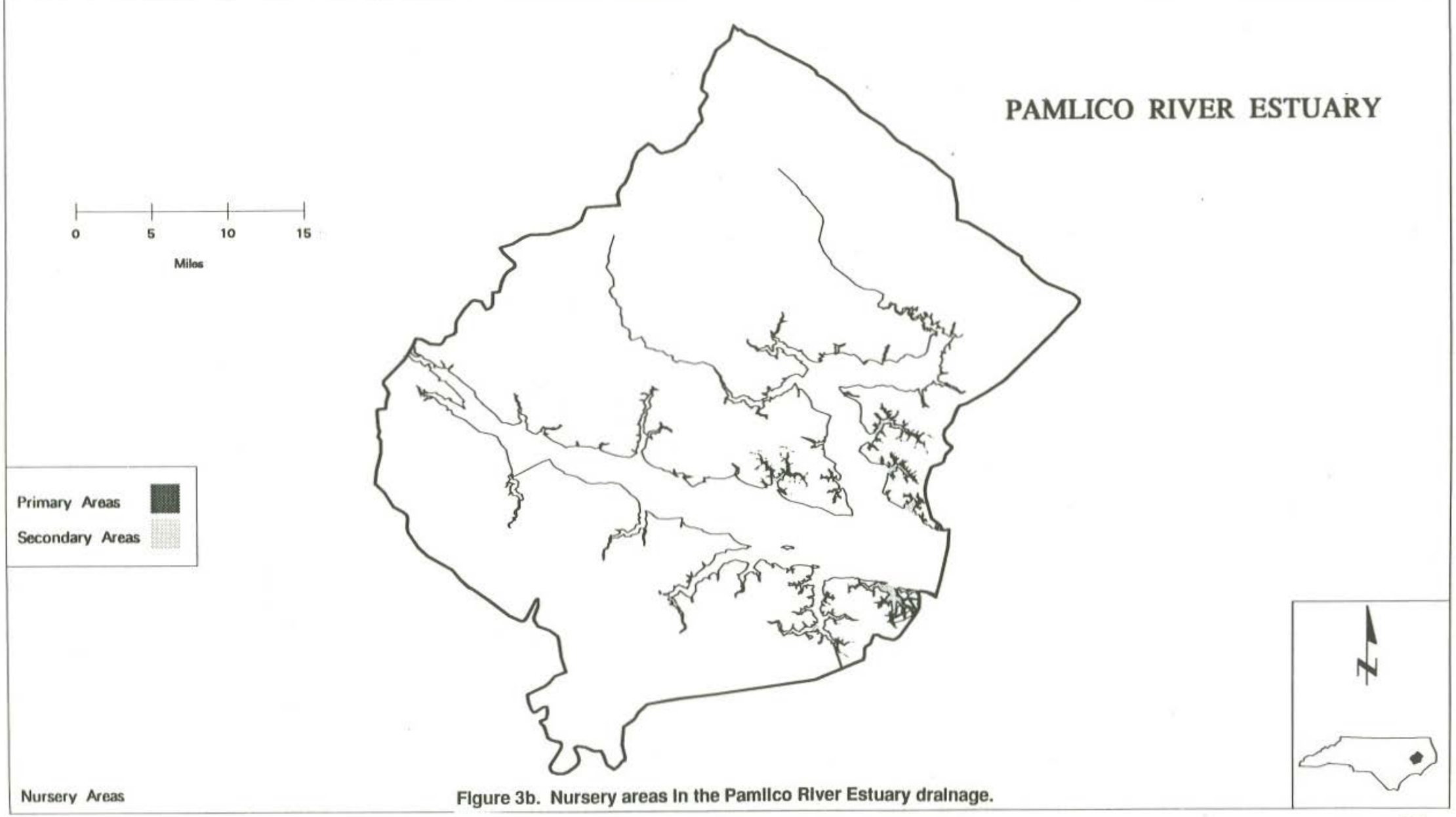


Figure 3a. Nursery areas in the Albemarle Sound drainage.



Nursery Areas

Figure 3b. Nursery areas in the Pamlico River Estuary drainage.

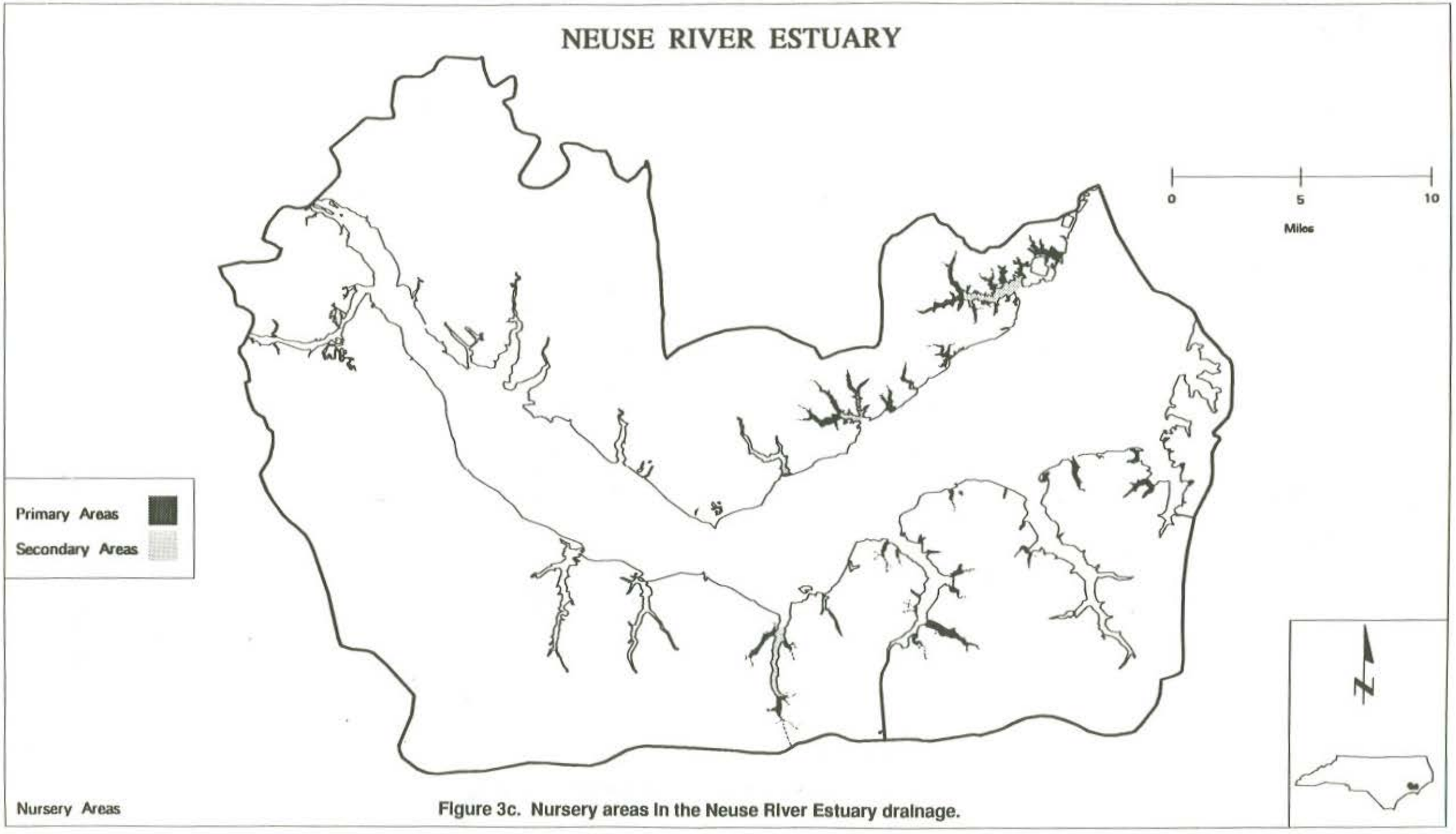


Figure 3c. Nursery areas in the Neuse River Estuary drainage.

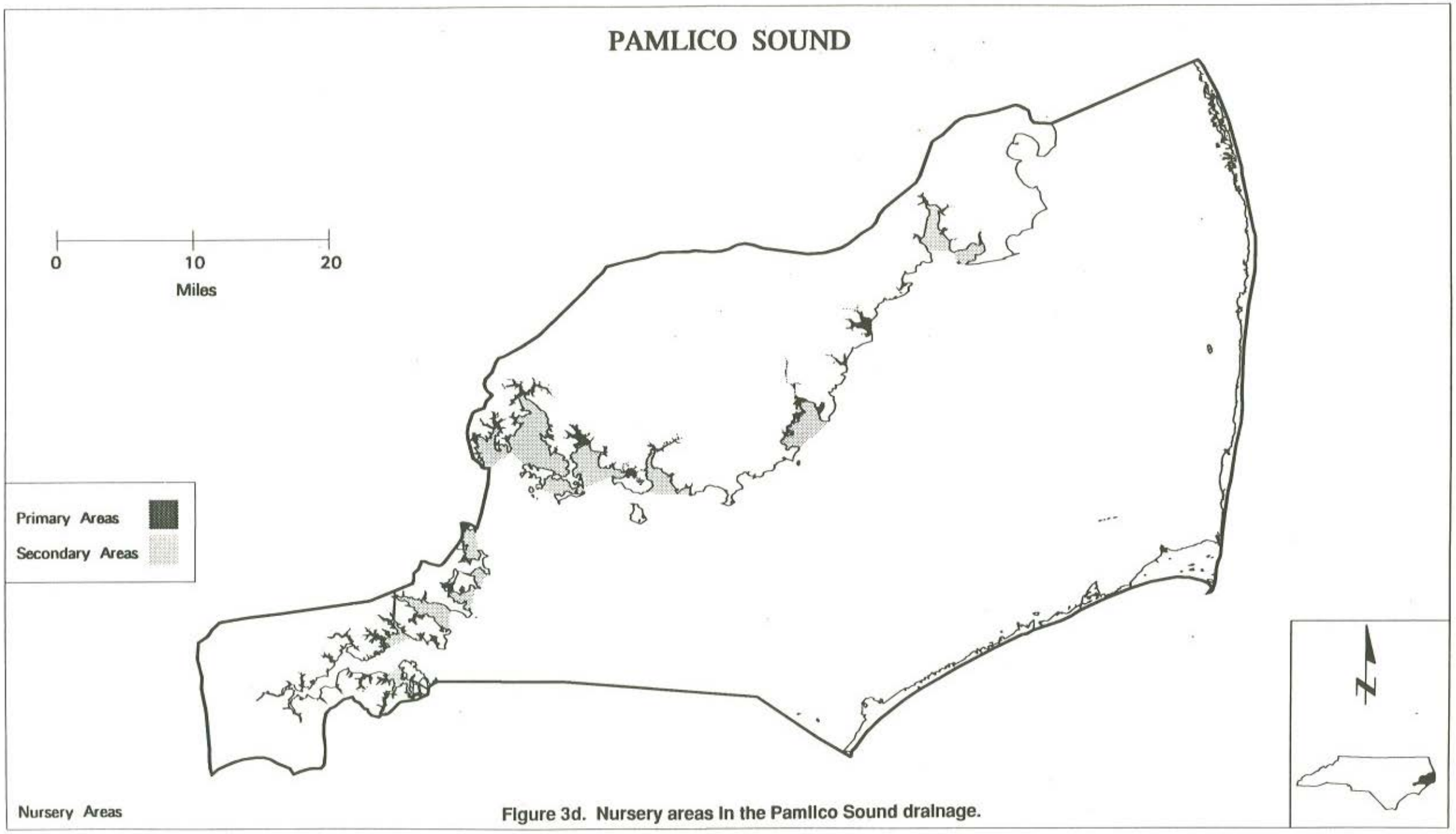


Figure 3d. Nursery areas in the Pamlico Sound drainage.

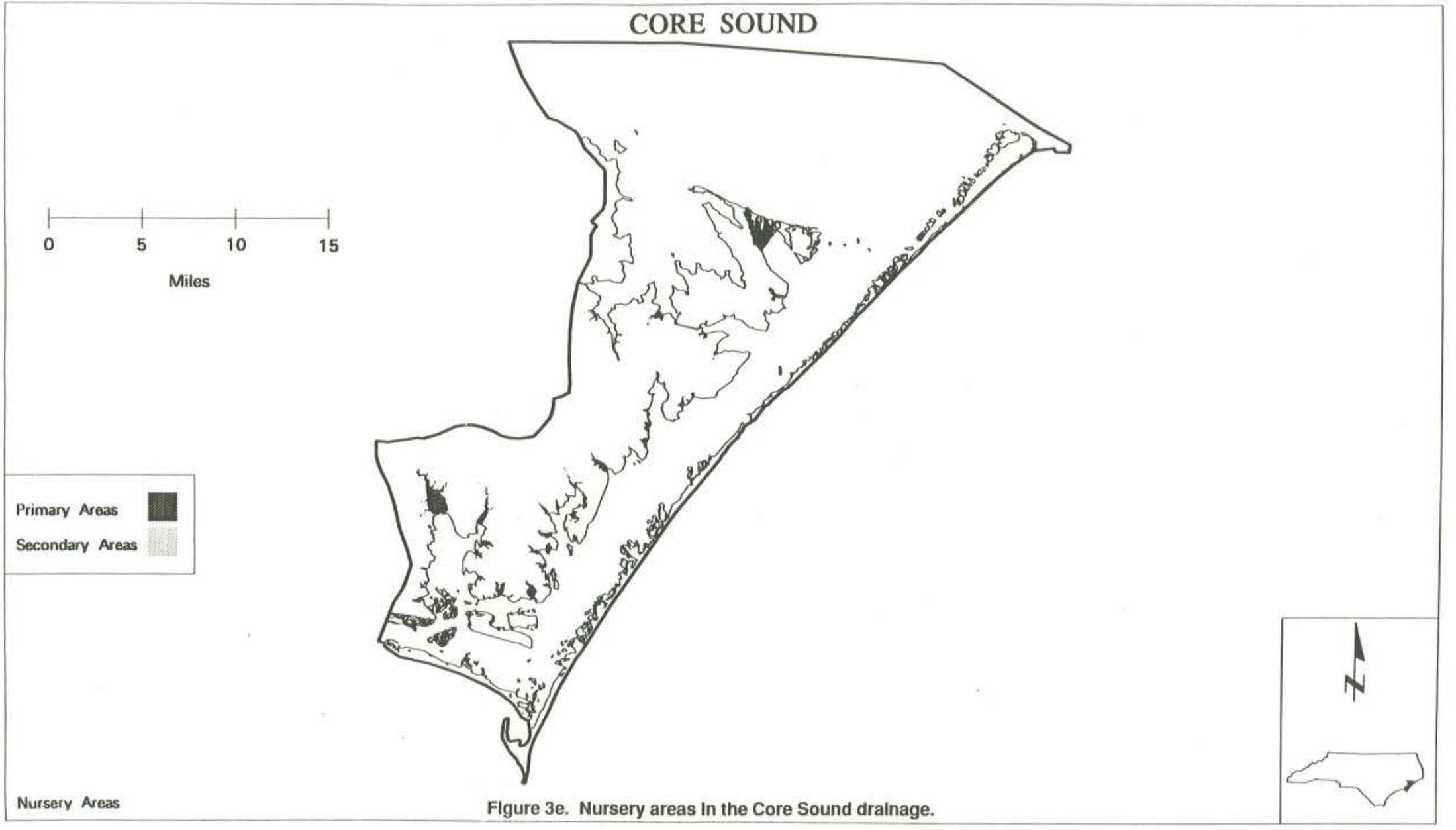


Figure 3e. Nursery areas in the Core Sound drainage.

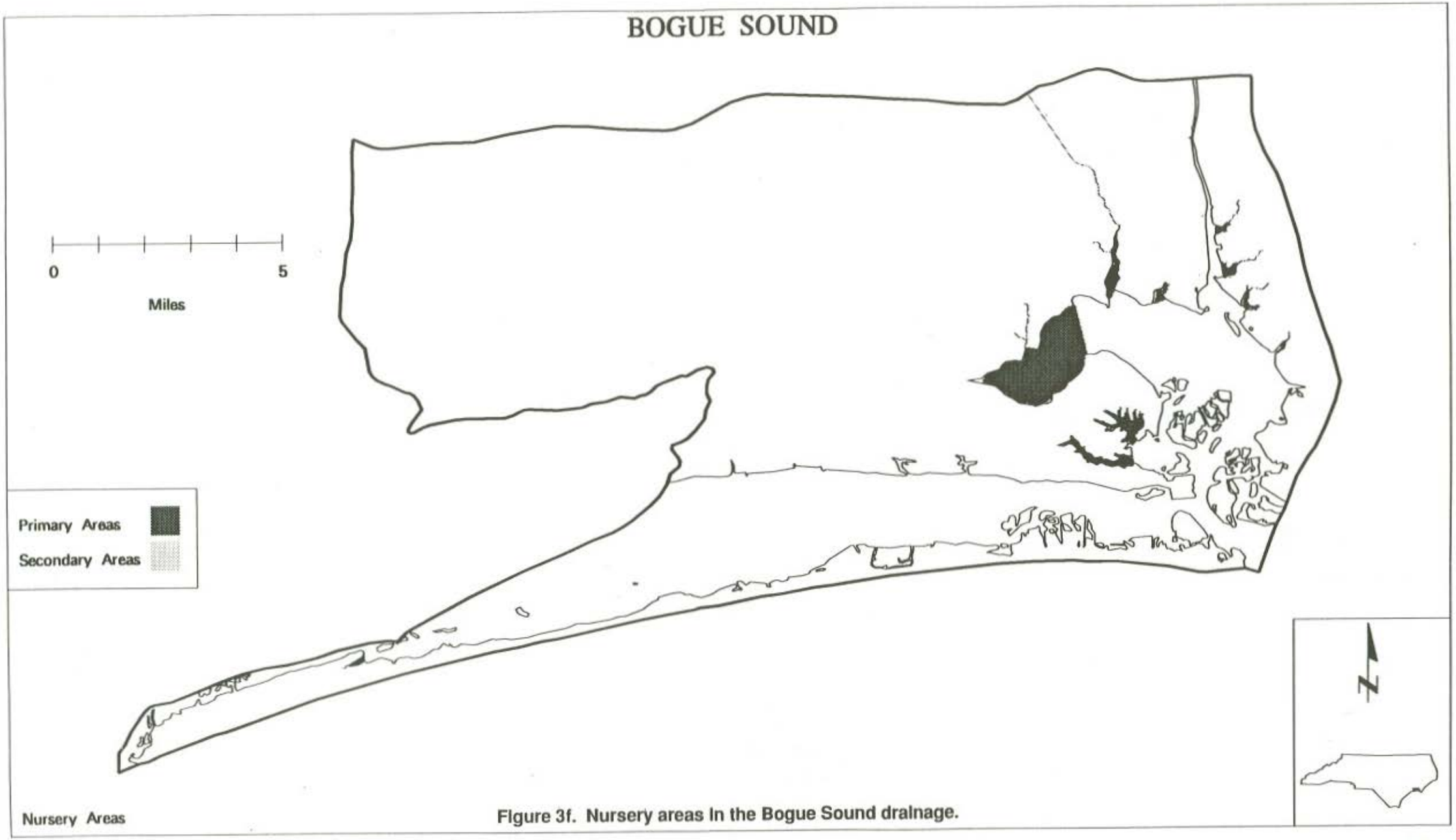


Figure 3f. Nursery areas in the Bogue Sound drainage.

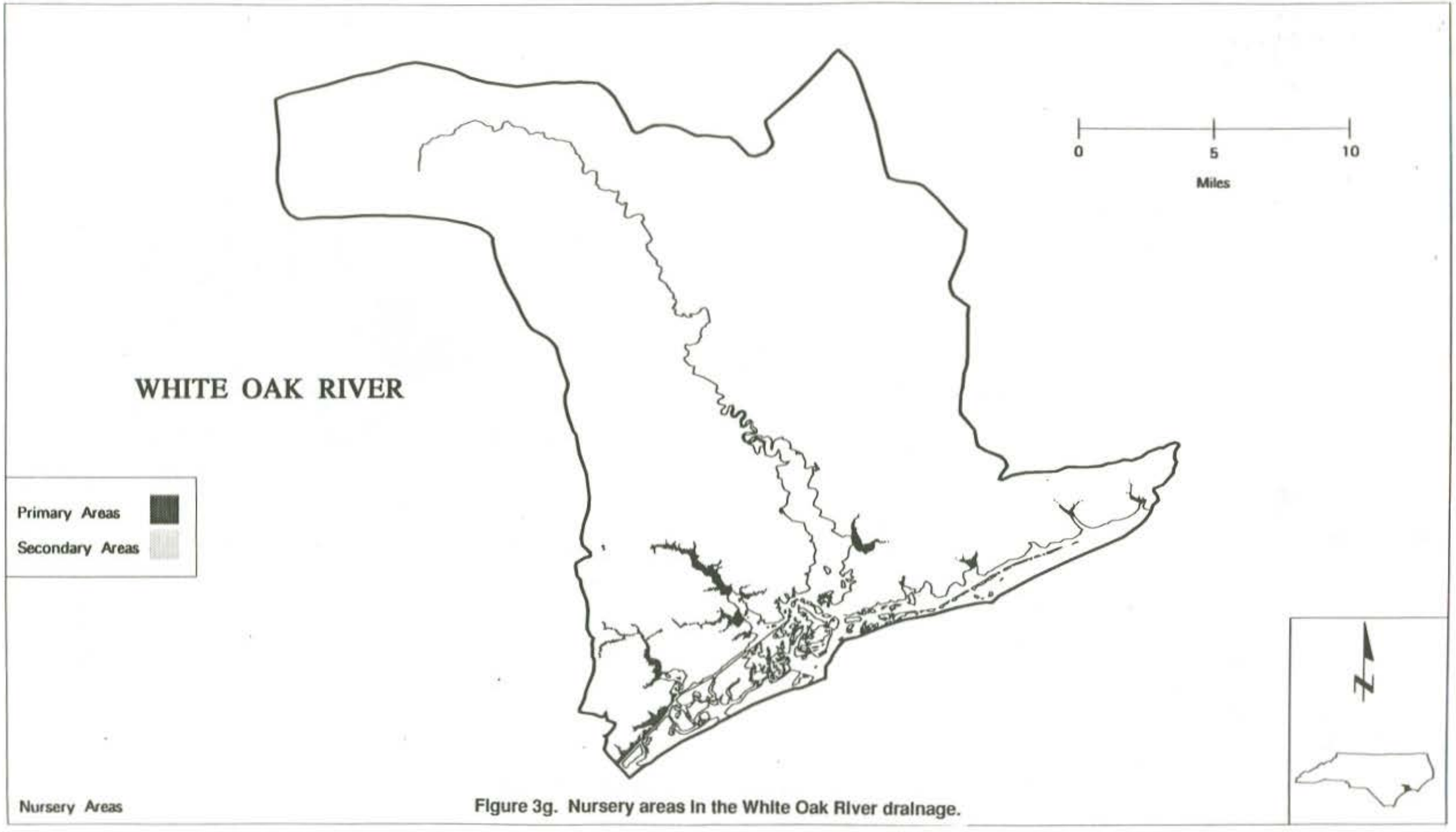
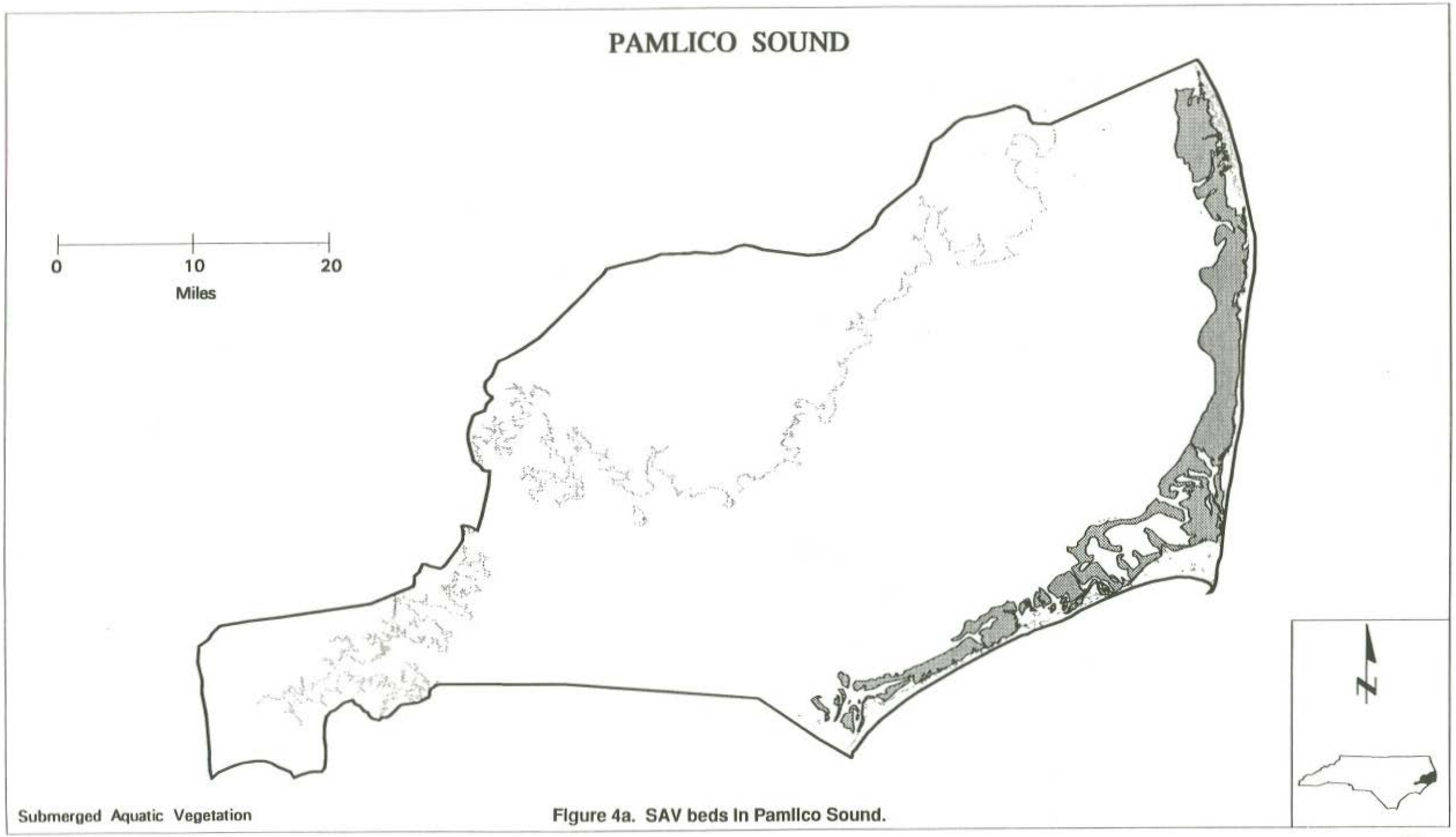


Figure 3g. Nursery areas in the White Oak River drainage.



Submerged Aquatic Vegetation

Figure 4a. SAV beds in Pamlico Sound.

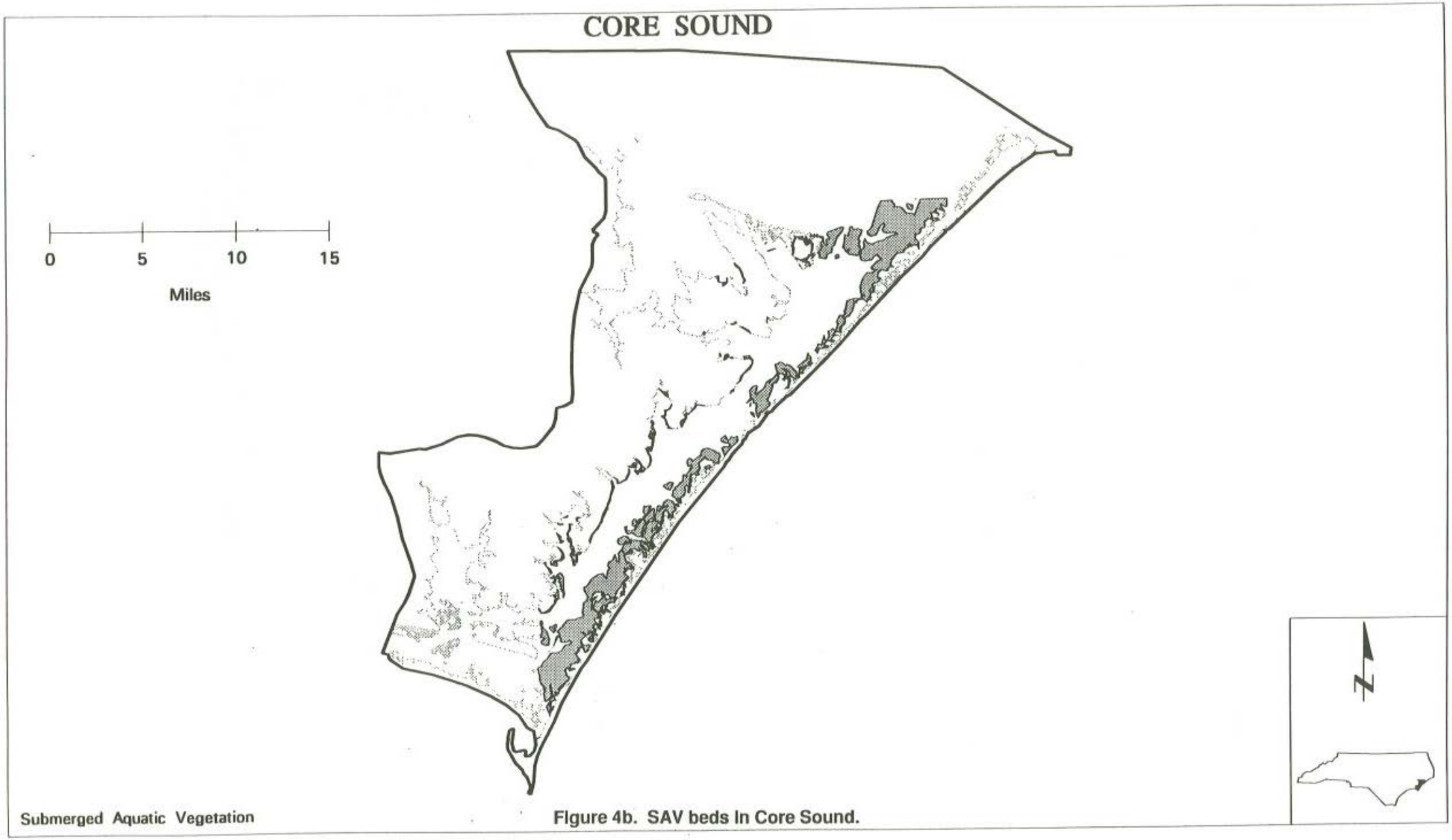


Figure 4b. SAV beds in Core Sound.

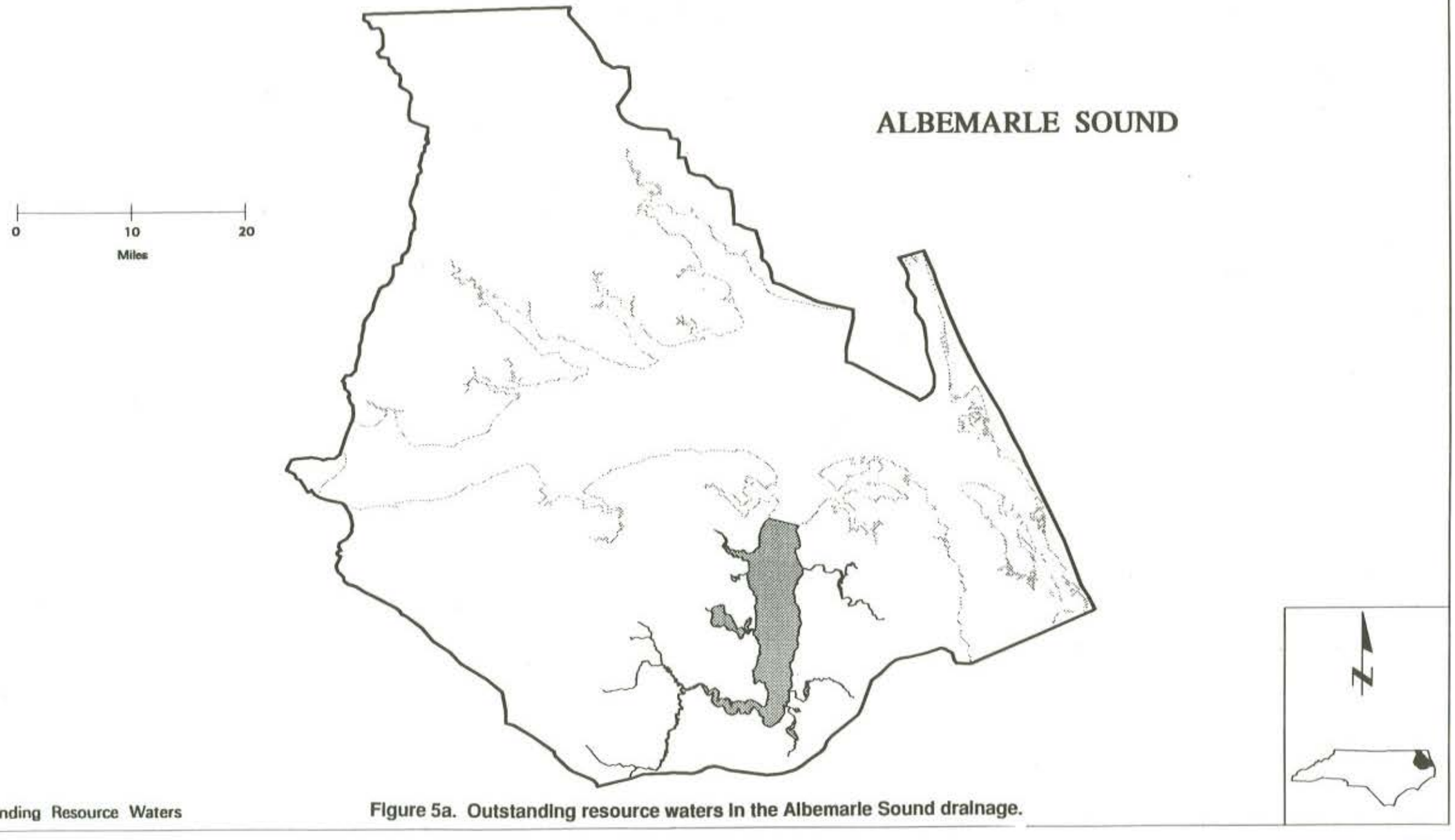


Figure 5a. Outstanding resource waters in the Albemarle Sound drainage.

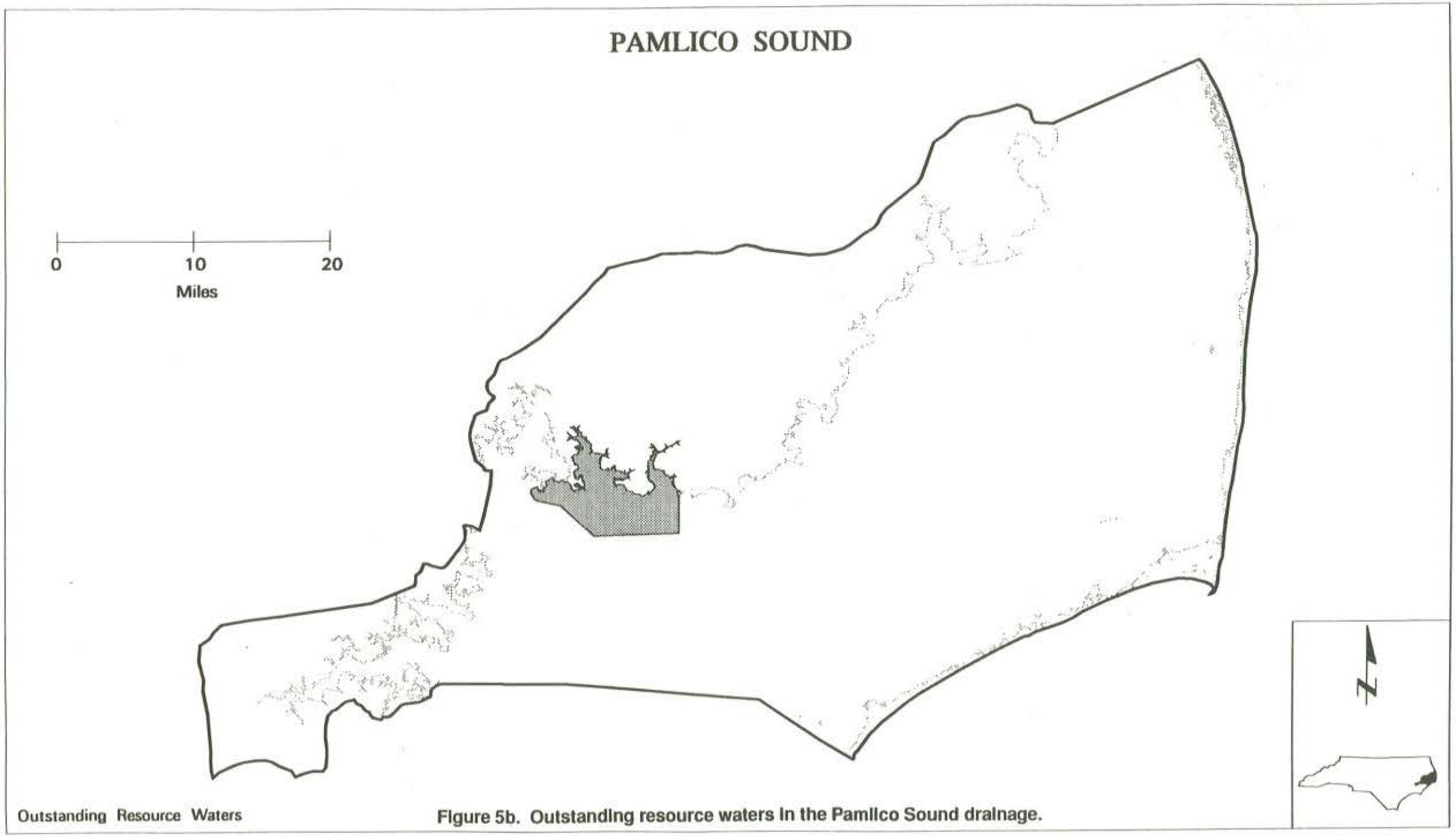


Figure 5b. Outstanding resource waters in the Pamlico Sound drainage.

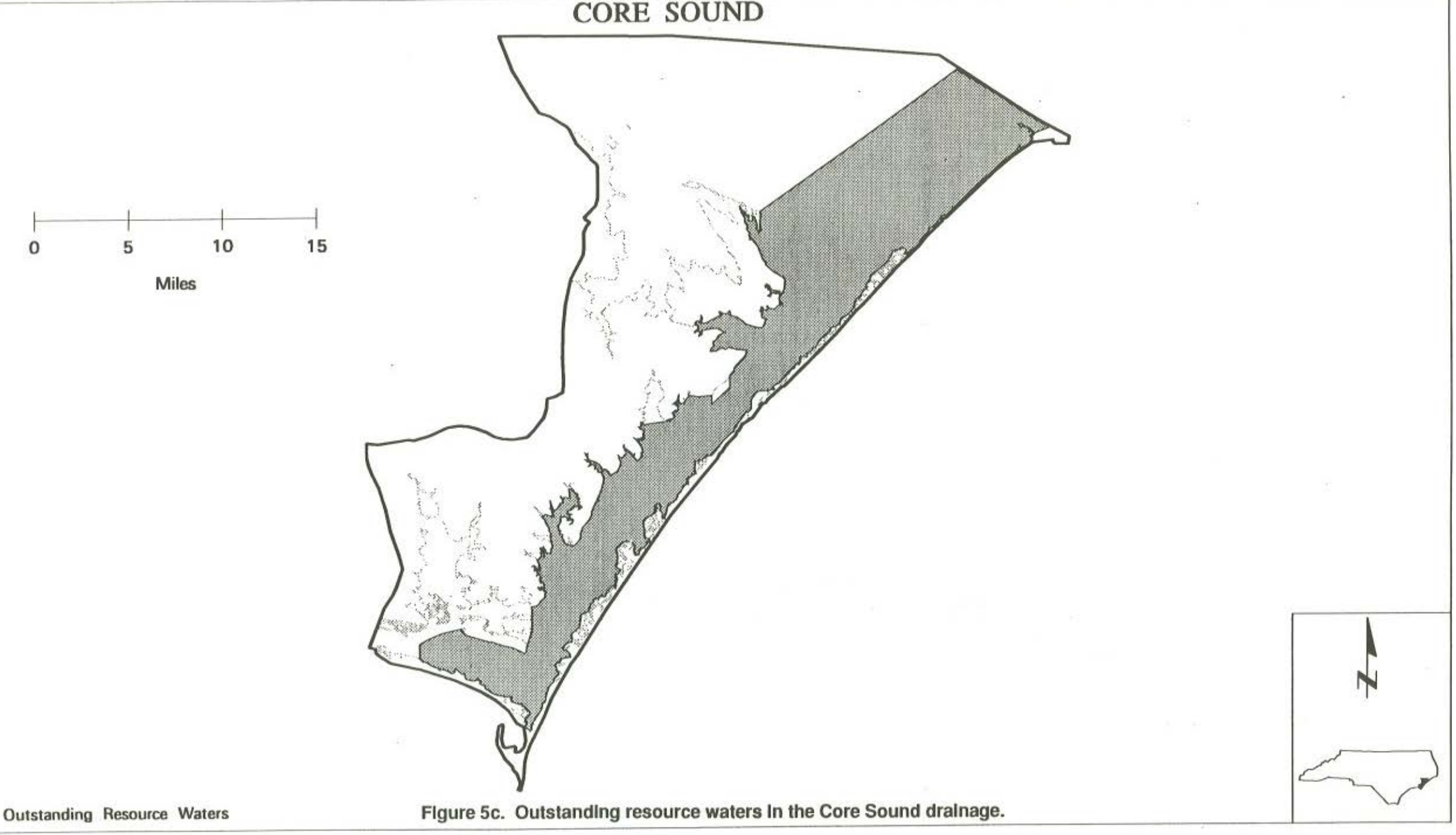


Figure 5c. Outstanding resource waters in the Core Sound drainage.

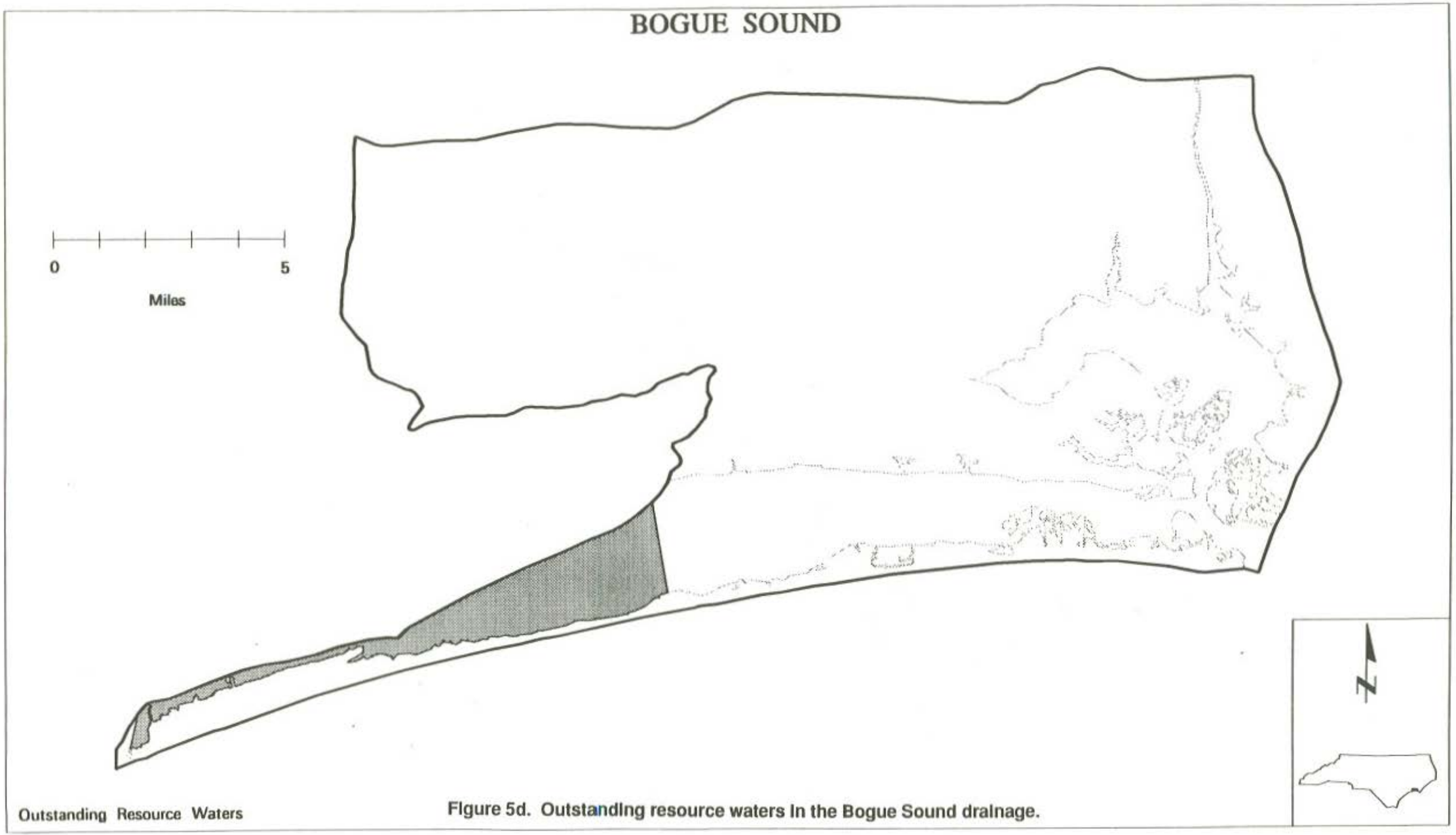
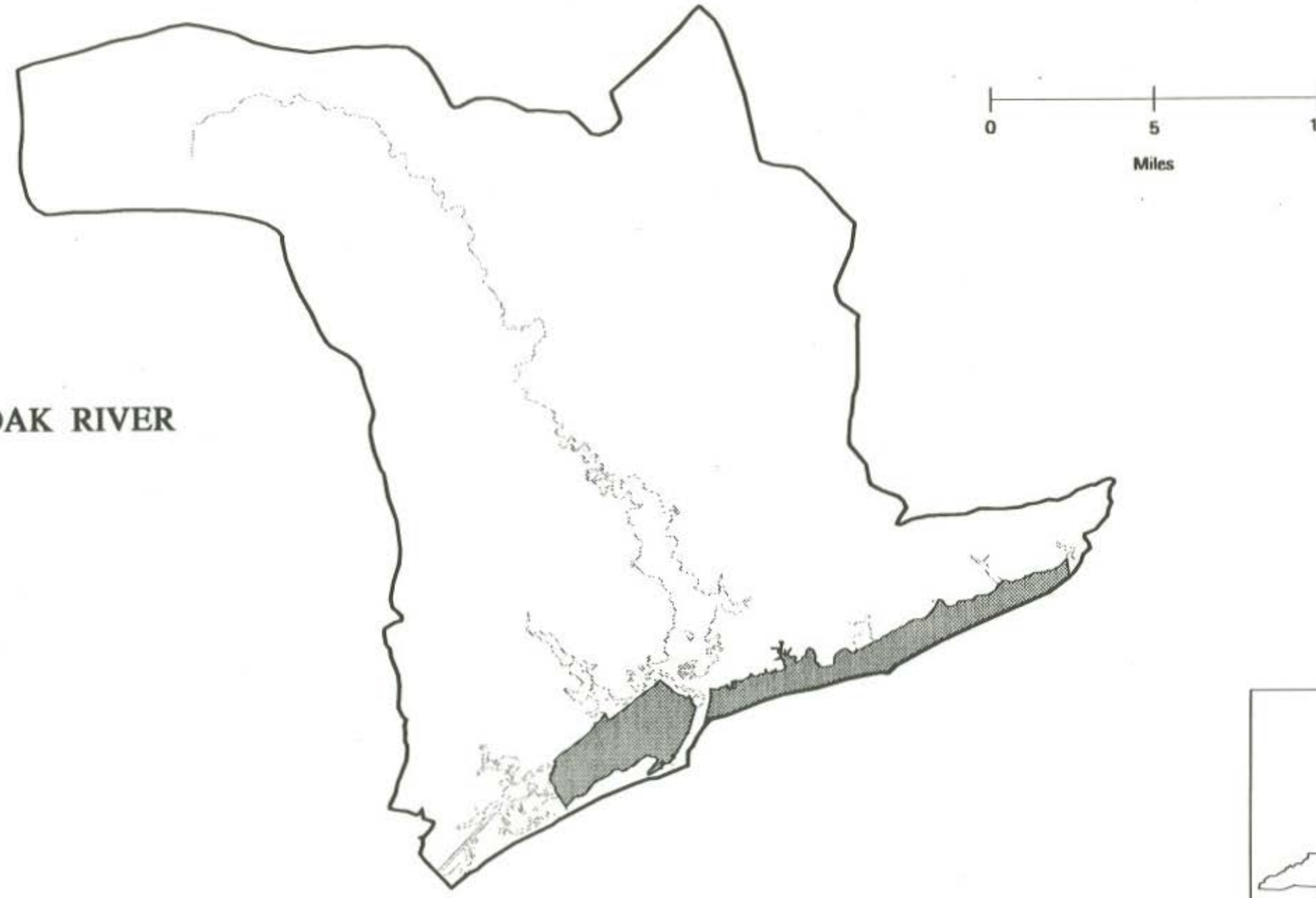
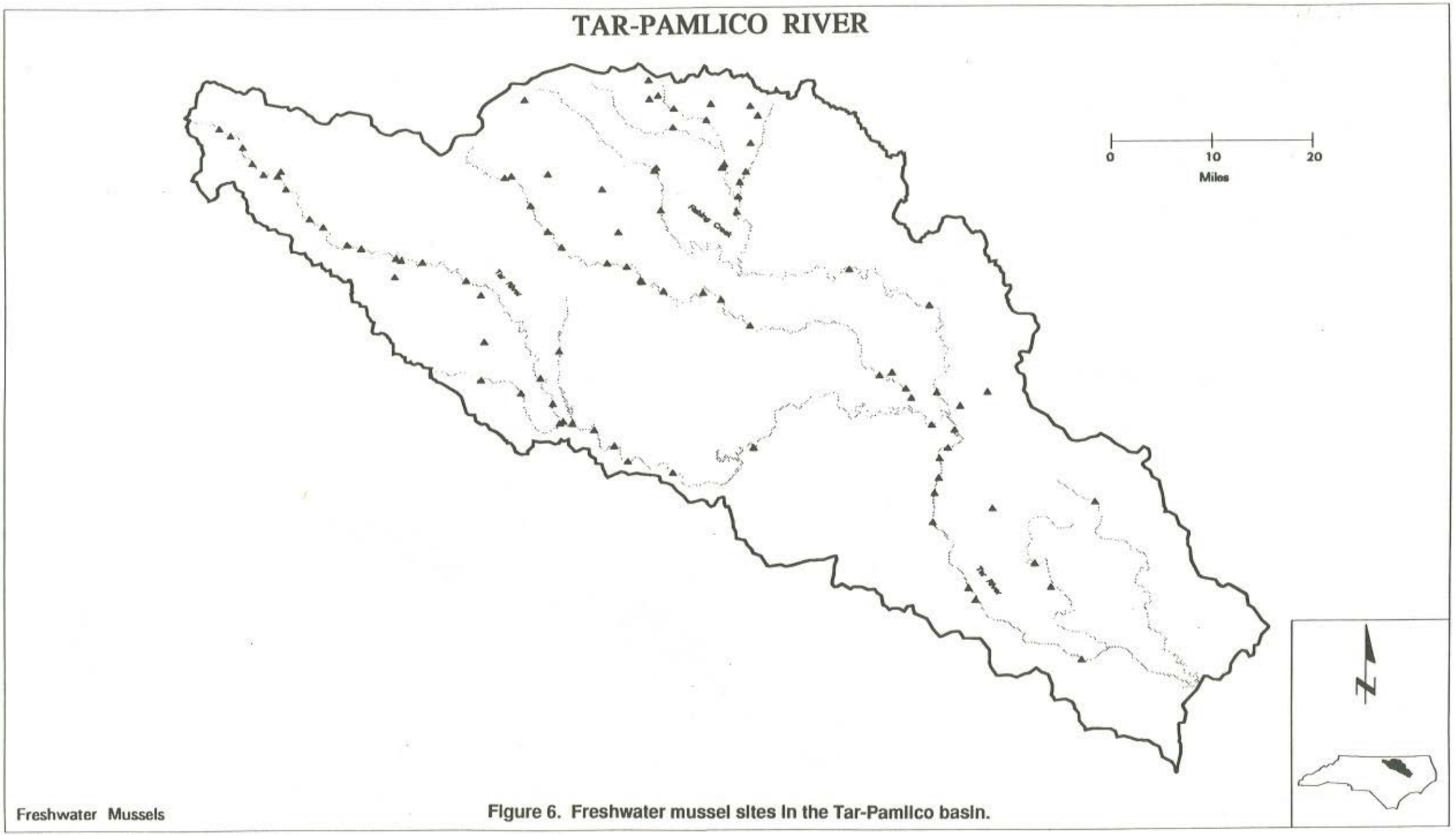


Figure 5d. Outstanding resource waters in the Bogue Sound drainage.



Outstanding Resource Waters

Figure 5e. Outstanding resource waters in the White Oak River drainage.



Freshwater Mussels

Figure 6. Freshwater mussel sites in the Tar-Pamlico basin.

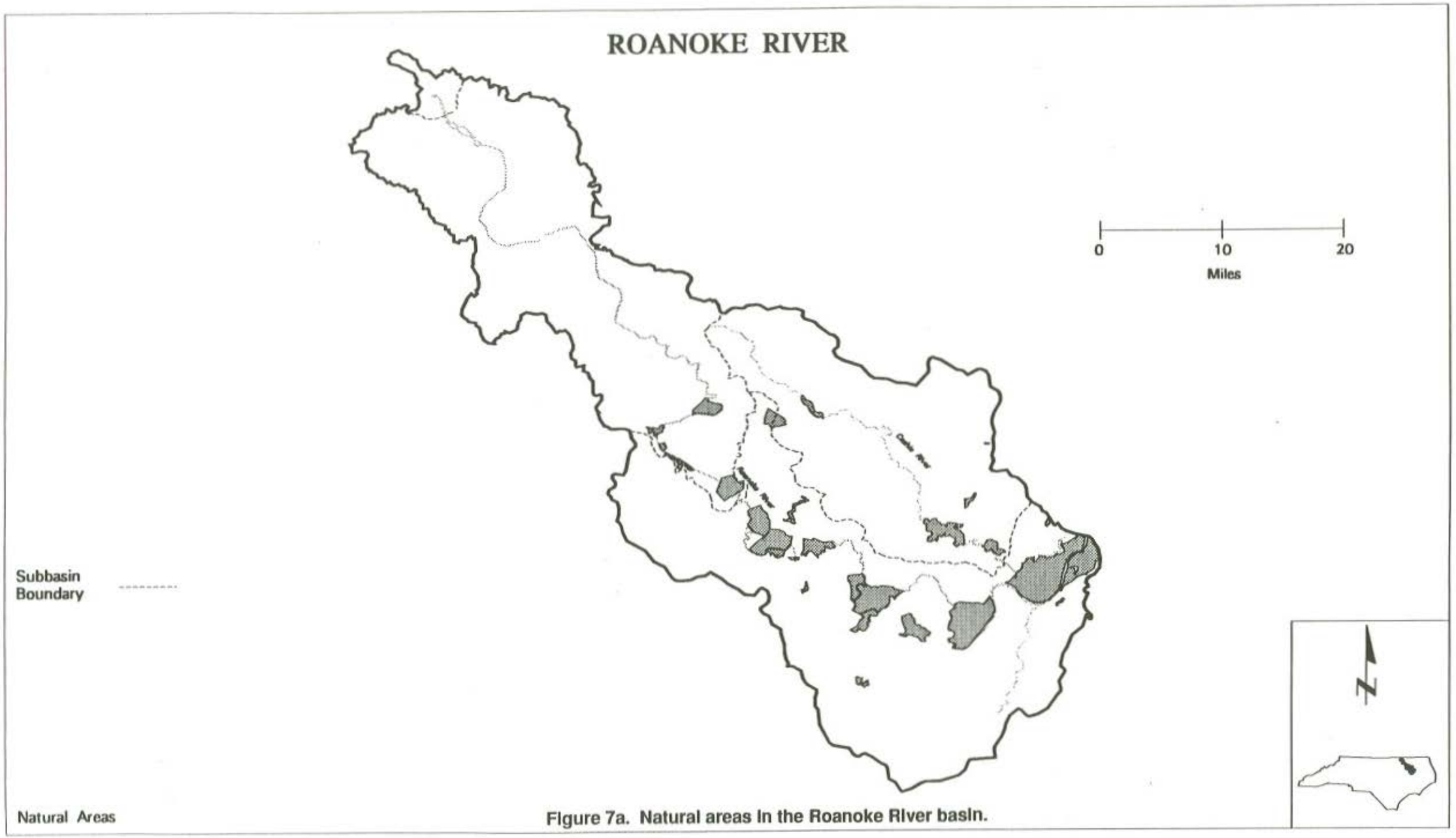


Figure 7a. Natural areas in the Roanoke River basin.

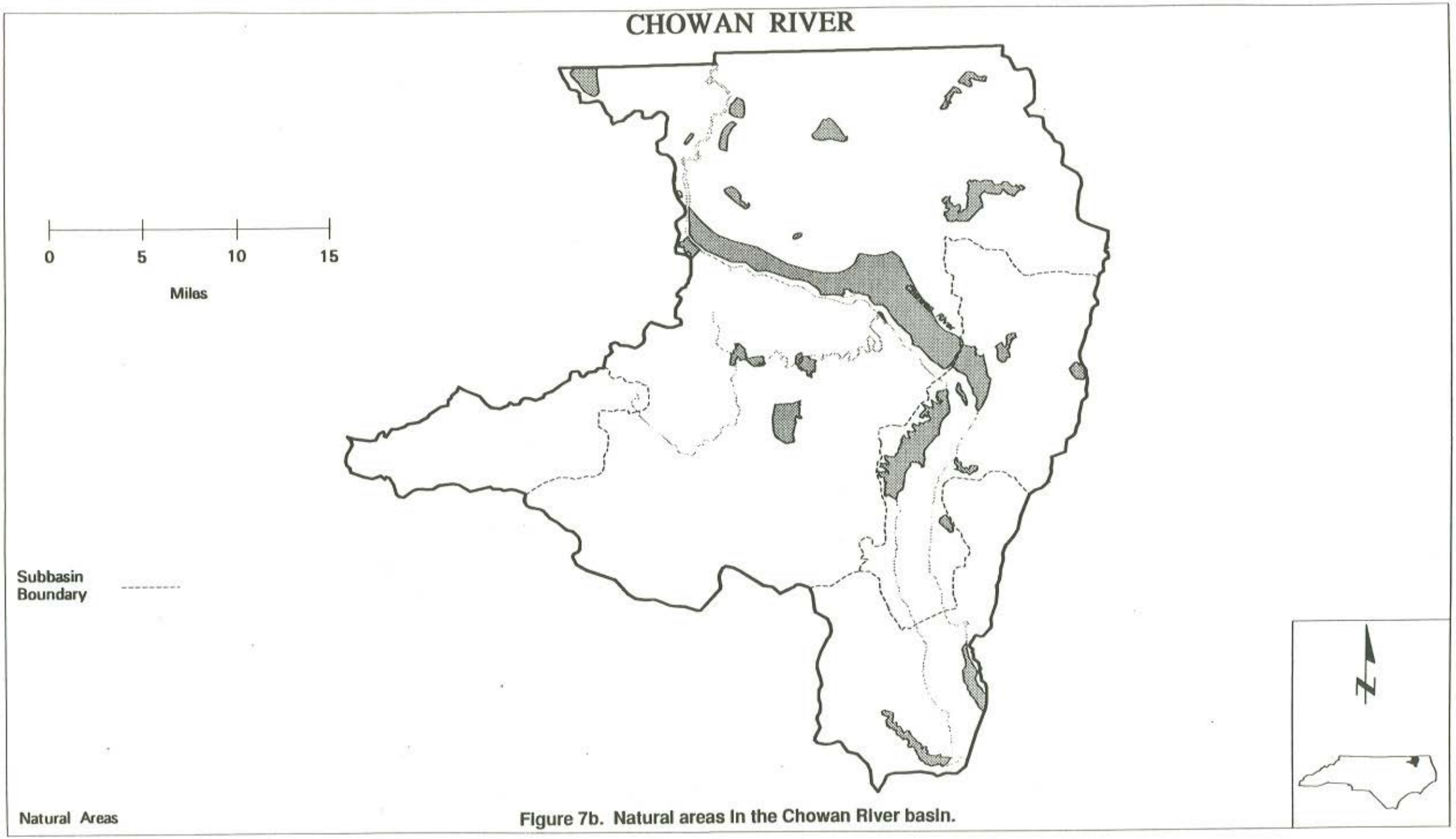


Figure 7b. Natural areas in the Chowan River basin.

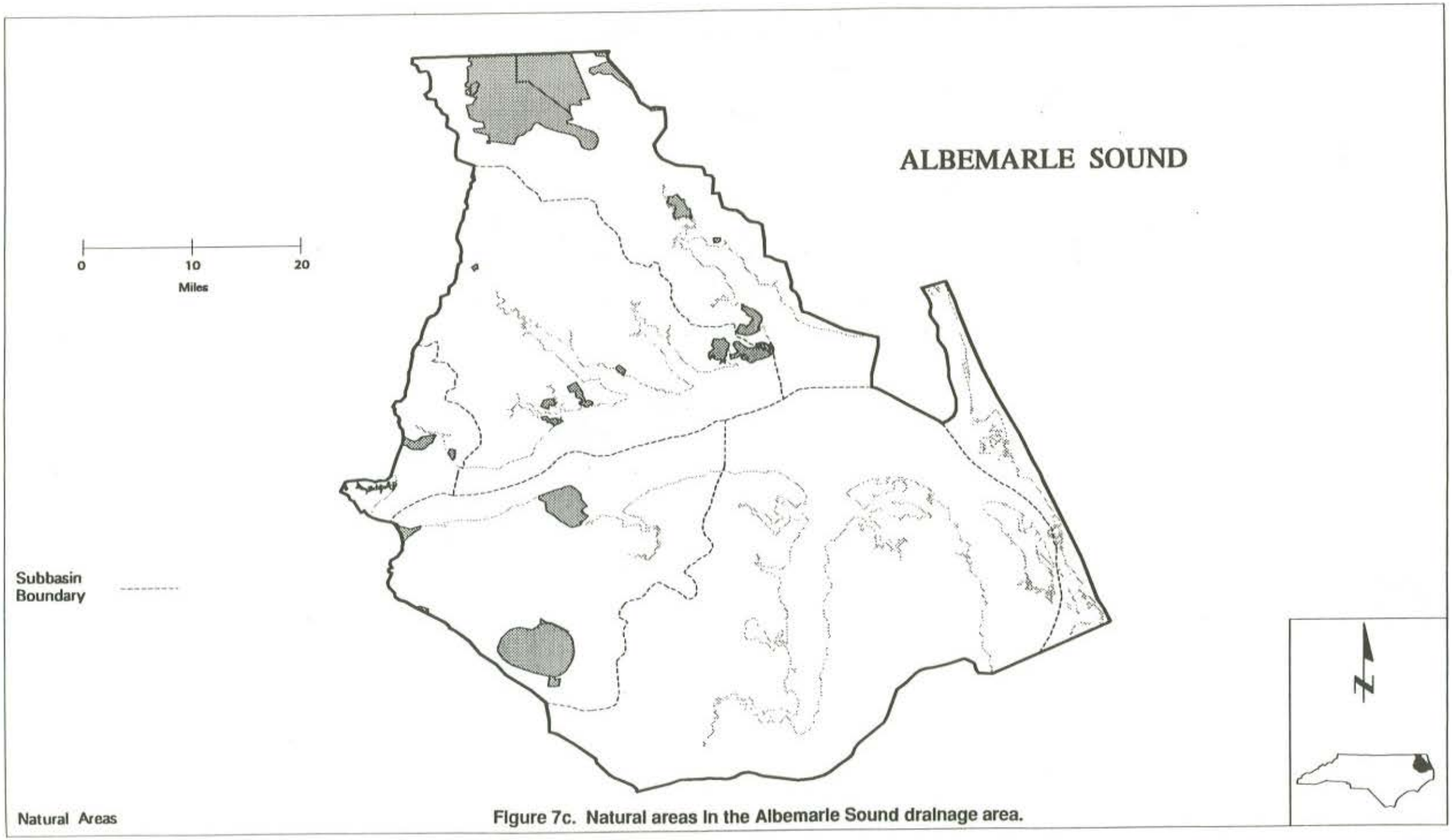


Figure 7c. Natural areas in the Albemarle Sound drainage area.

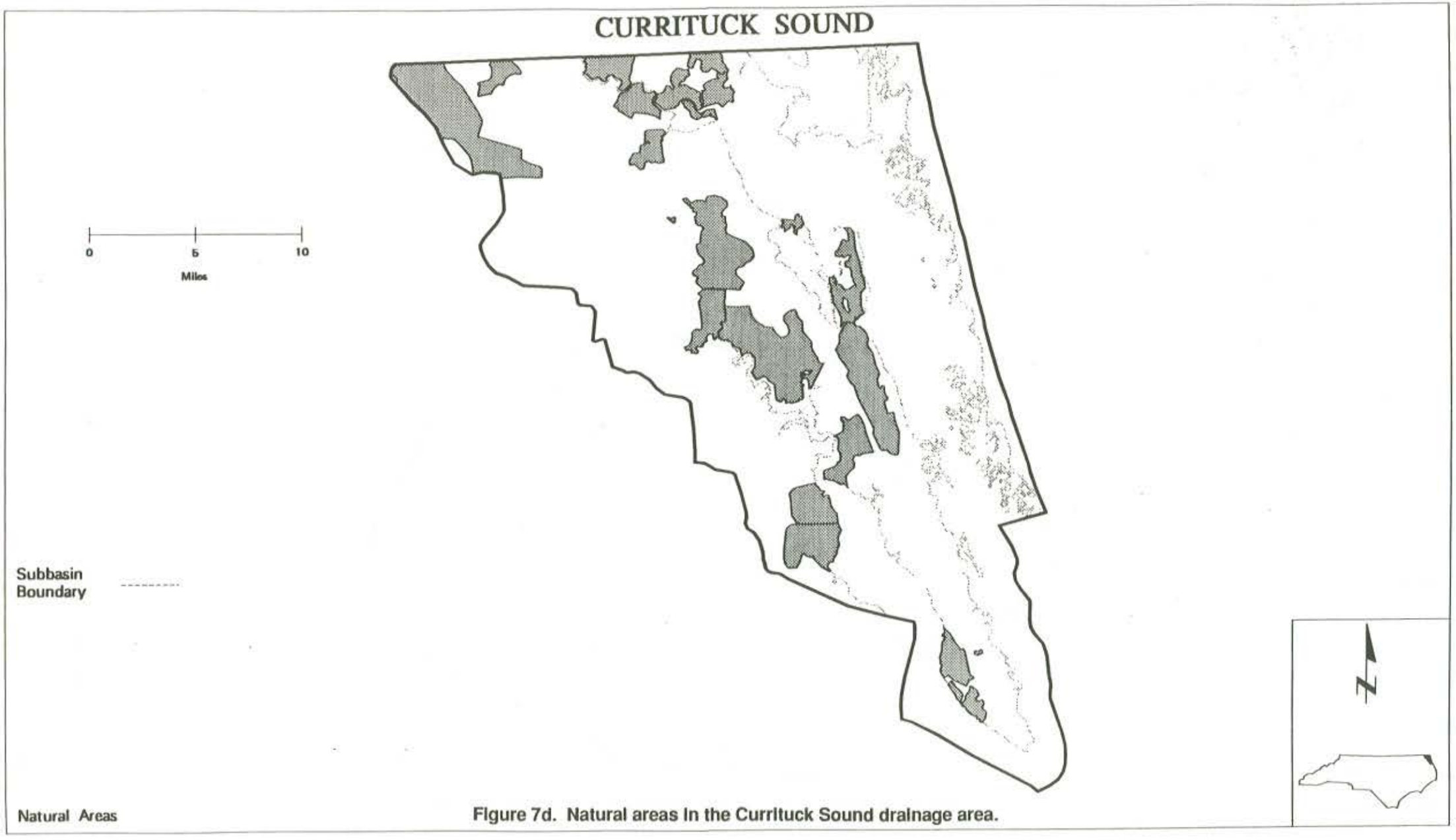
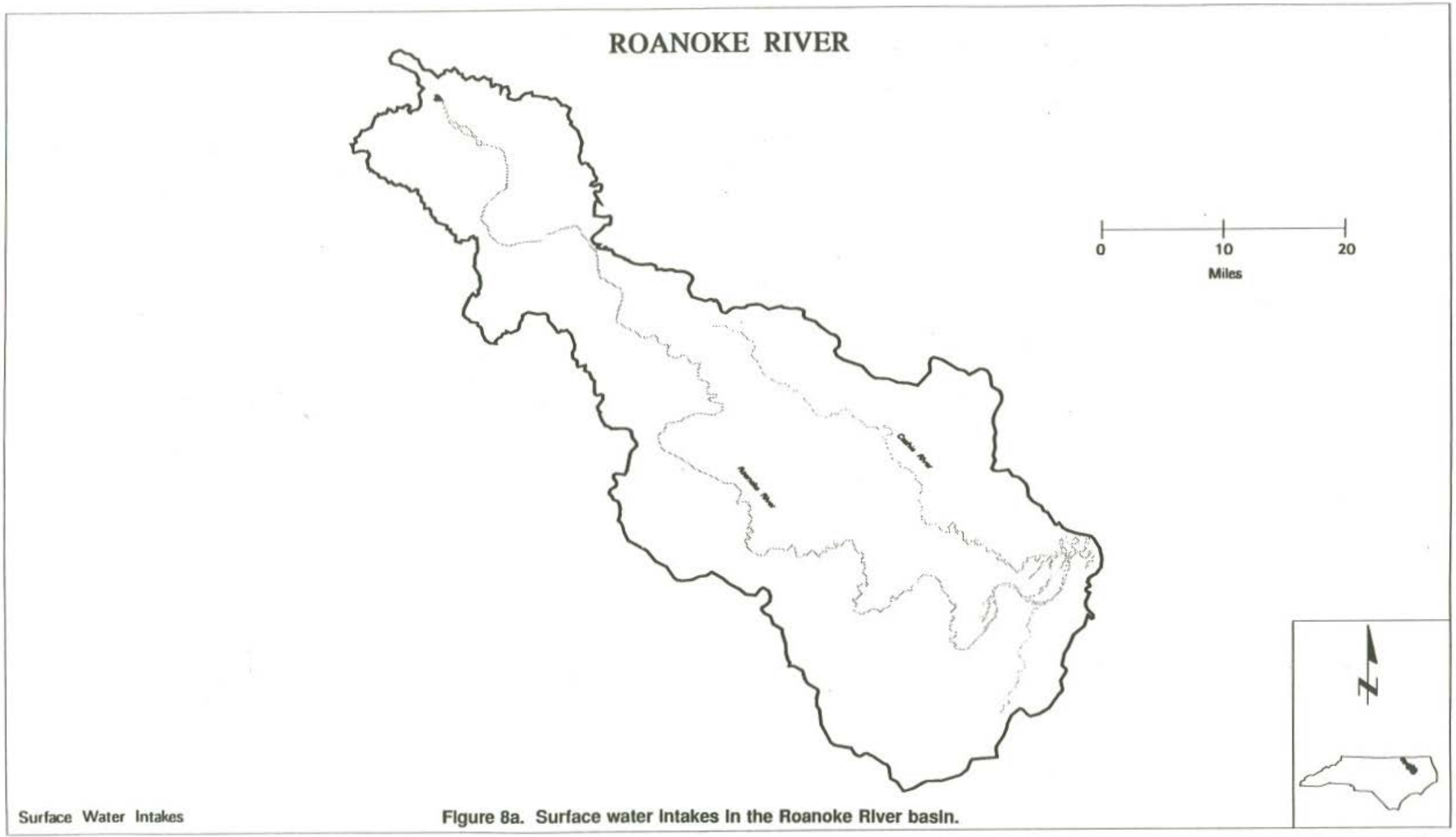


Figure 7d. Natural areas in the Currituck Sound drainage area.



Surface Water Intakes

Figure 8a. Surface water intakes in the Roanoke River basin.

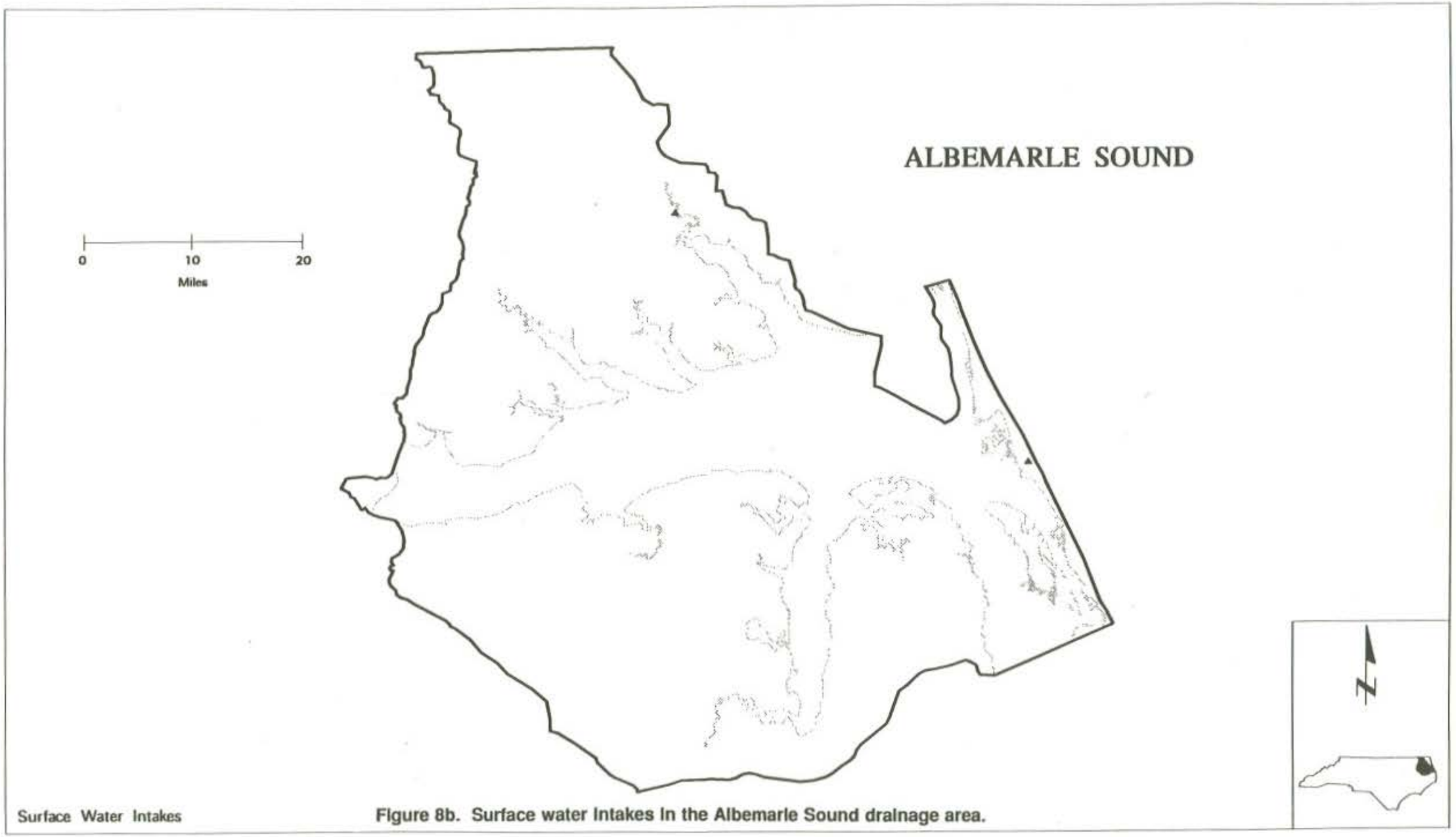


Figure 8b. Surface water intakes in the Albemarle Sound drainage area.

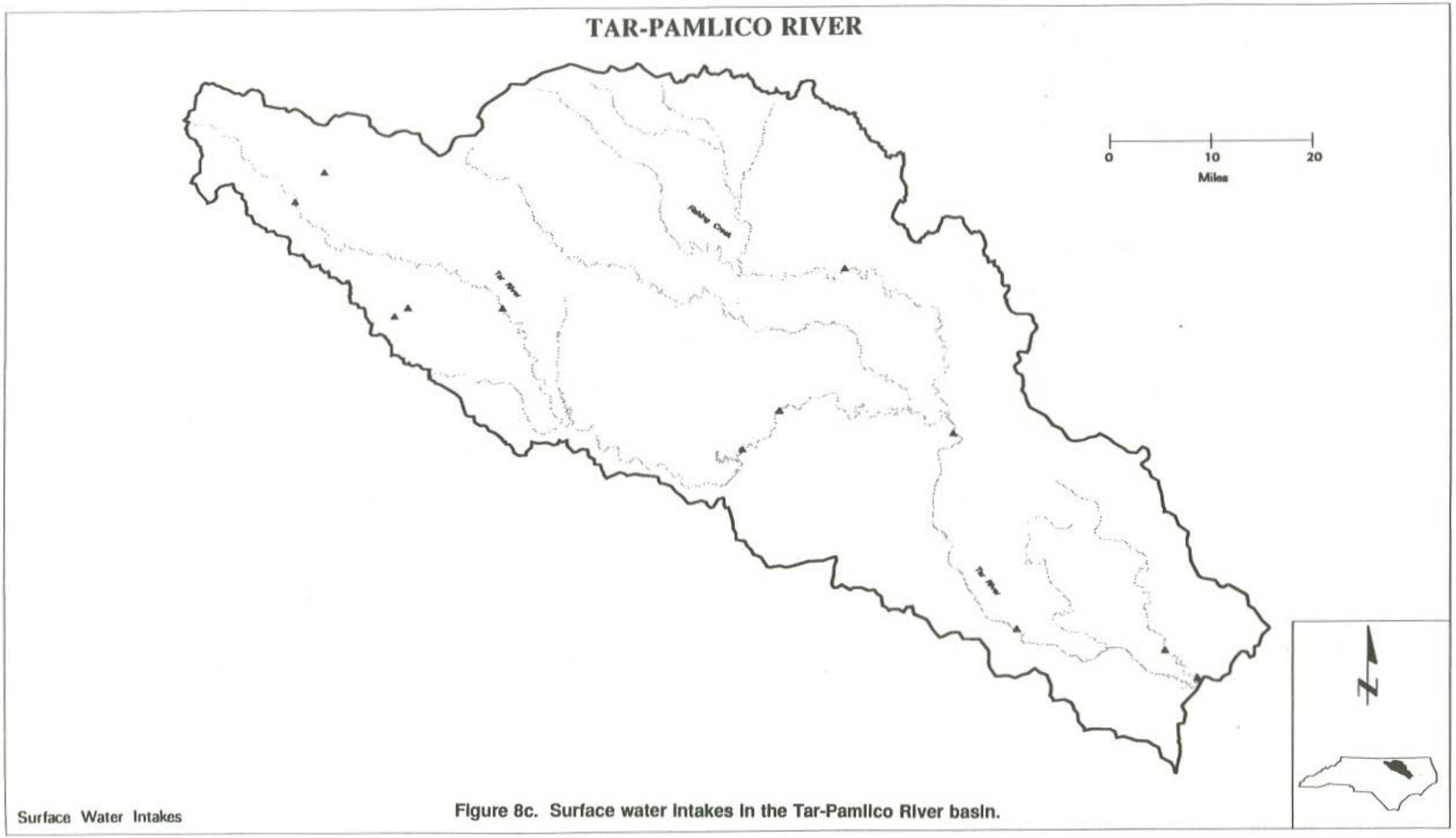
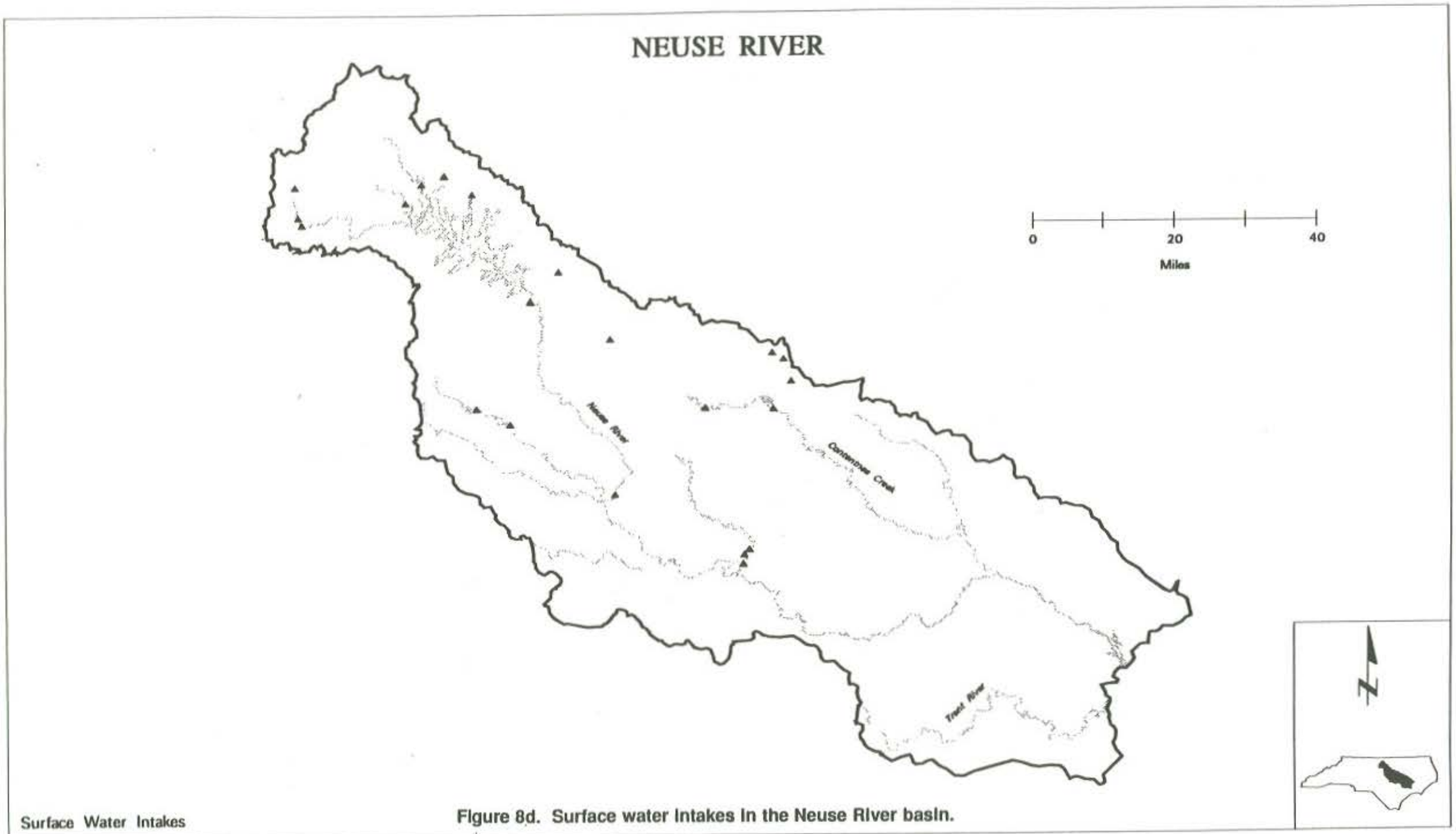


Figure 8c. Surface water intakes in the Tar-Pamlico River basin.



Surface Water Intakes

Figure 8d. Surface water intakes in the Neuse River basin.

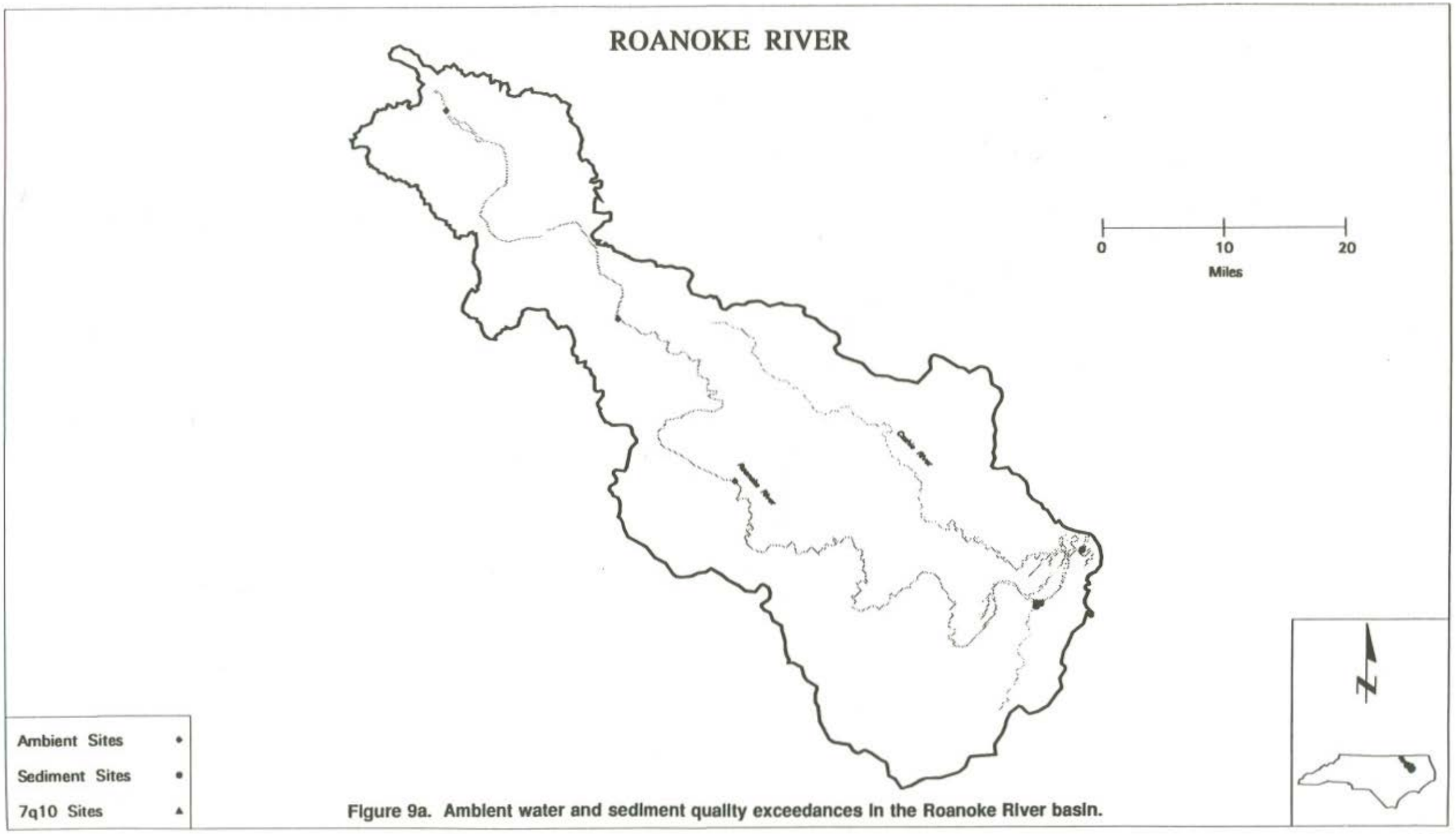


Figure 9a. Ambient water and sediment quality exceedances in the Roanoke River basin.

MEHERRIN RIVER

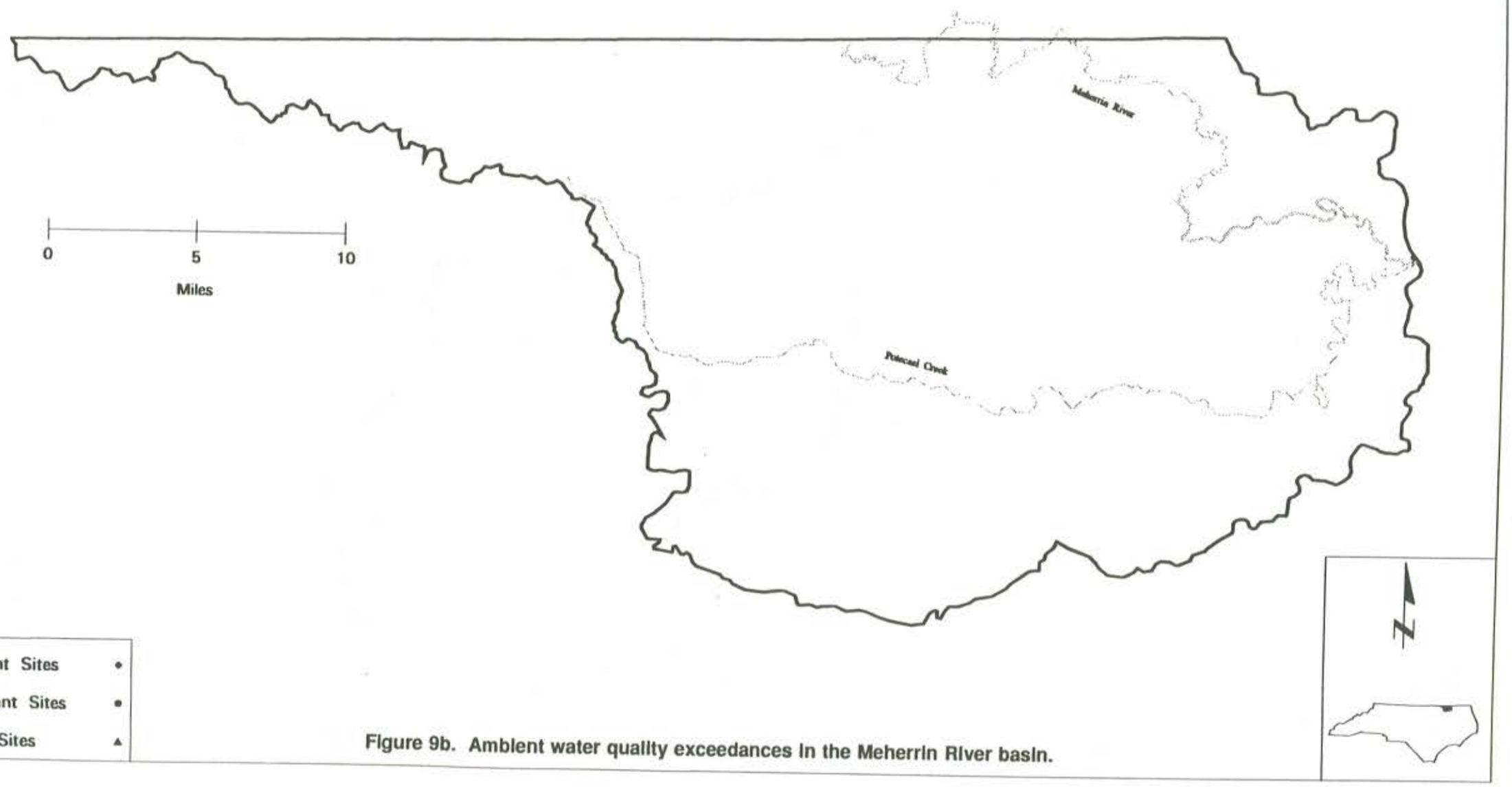


Figure 9b. Ambient water quality exceedances in the Meherrin River basin.

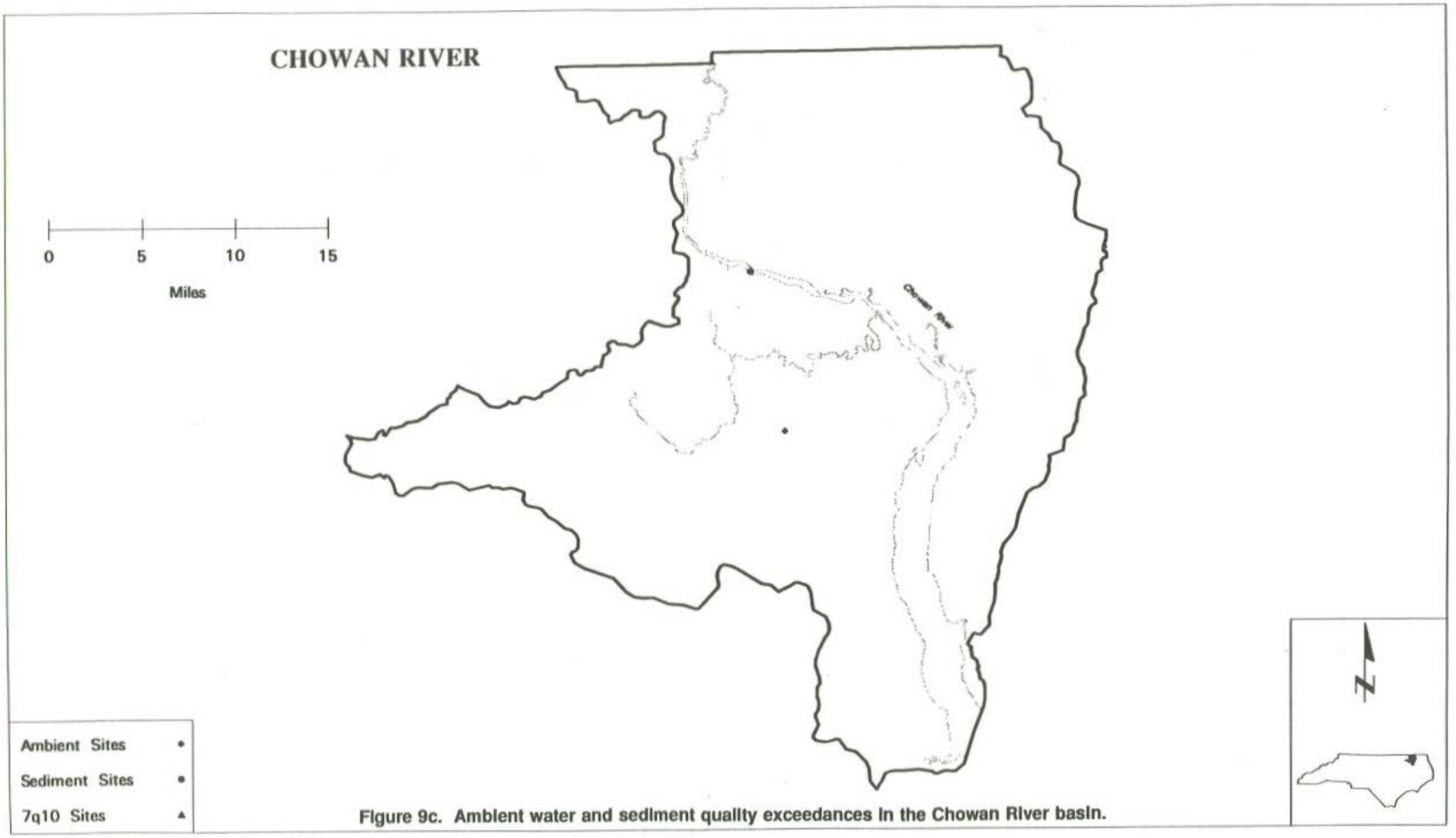


Figure 9c. Ambient water and sediment quality exceedances in the Chowan River basin.

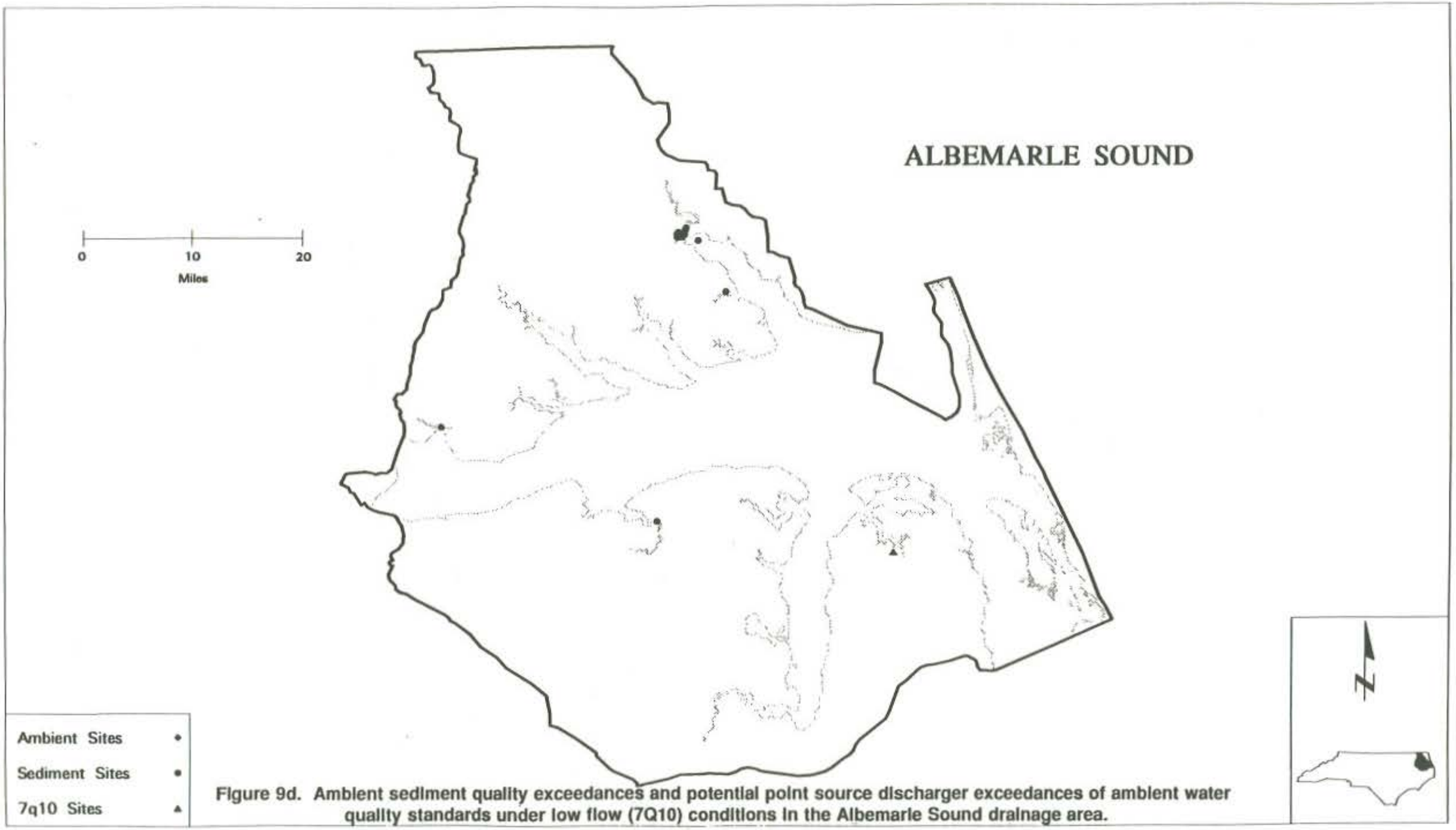


Figure 9d. Ambient sediment quality exceedances and potential point source discharger exceedances of ambient water quality standards under low flow (7Q10) conditions in the Albemarle Sound drainage area.

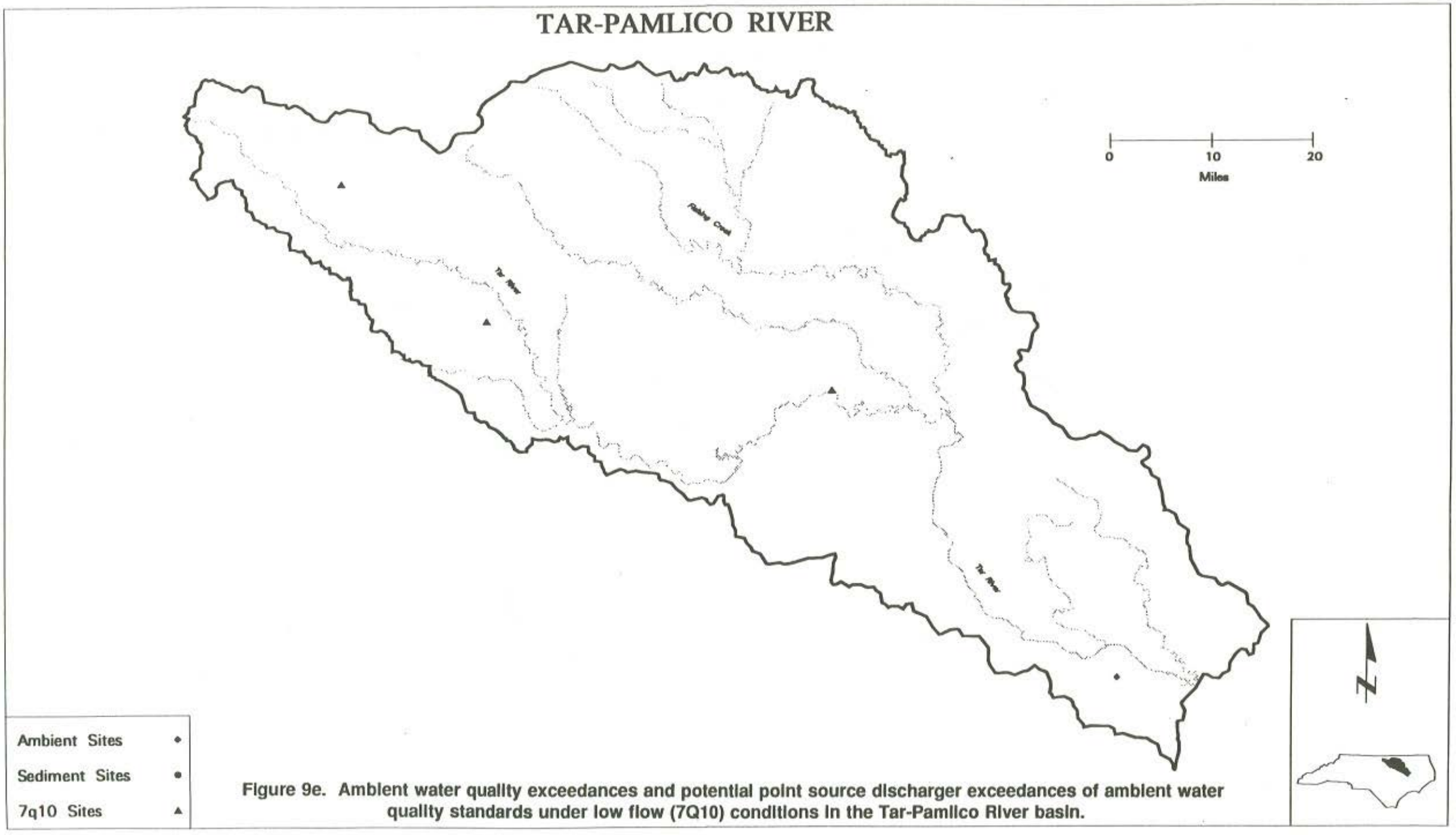


Figure 9e. Ambient water quality exceedances and potential point source discharger exceedances of ambient water quality standards under low flow (7Q10) conditions in the Tar-Pamlico River basin.

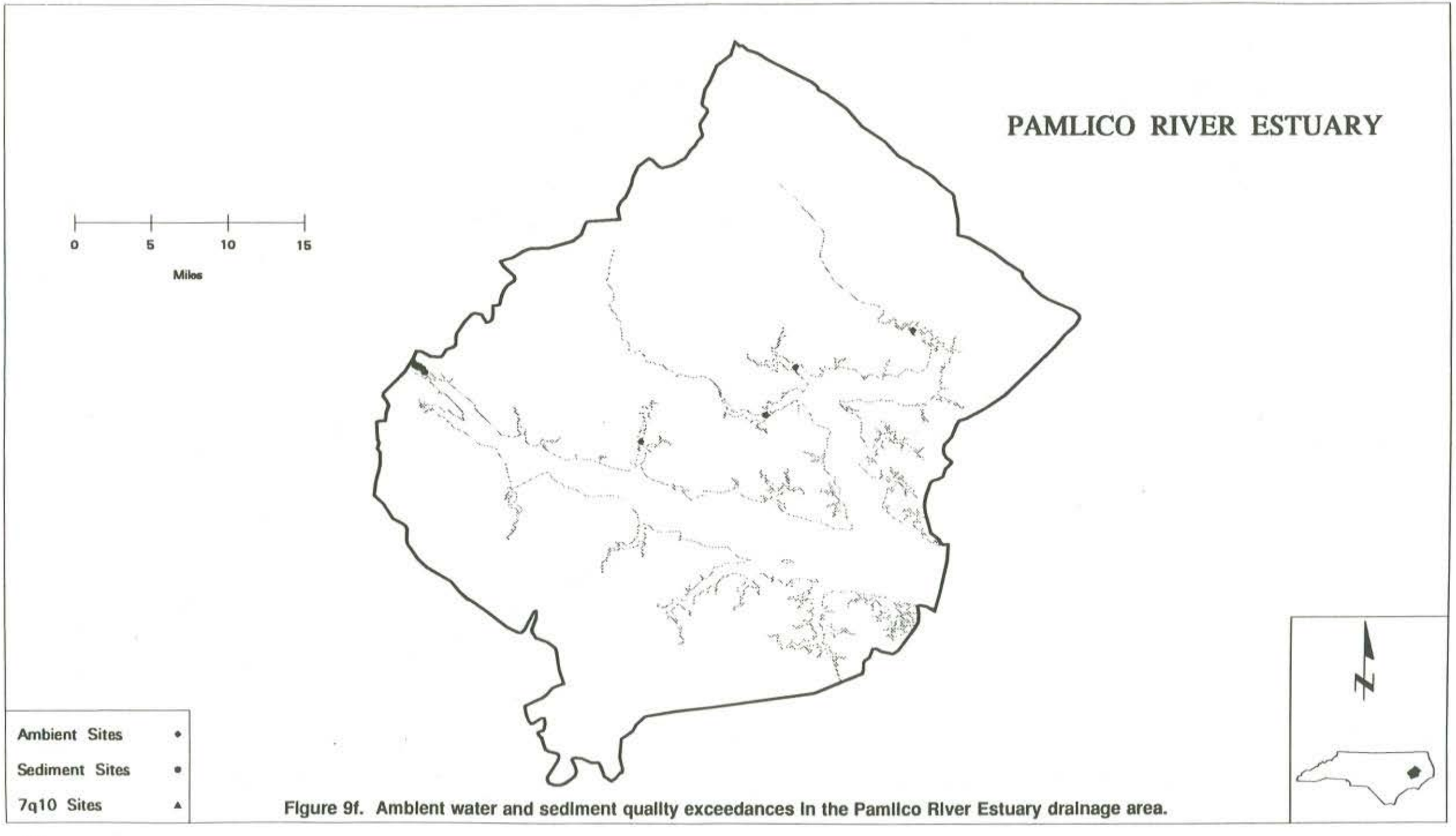


Figure 9f. Ambient water and sediment quality exceedances in the Pamlico River Estuary drainage area.

NEUSE RIVER

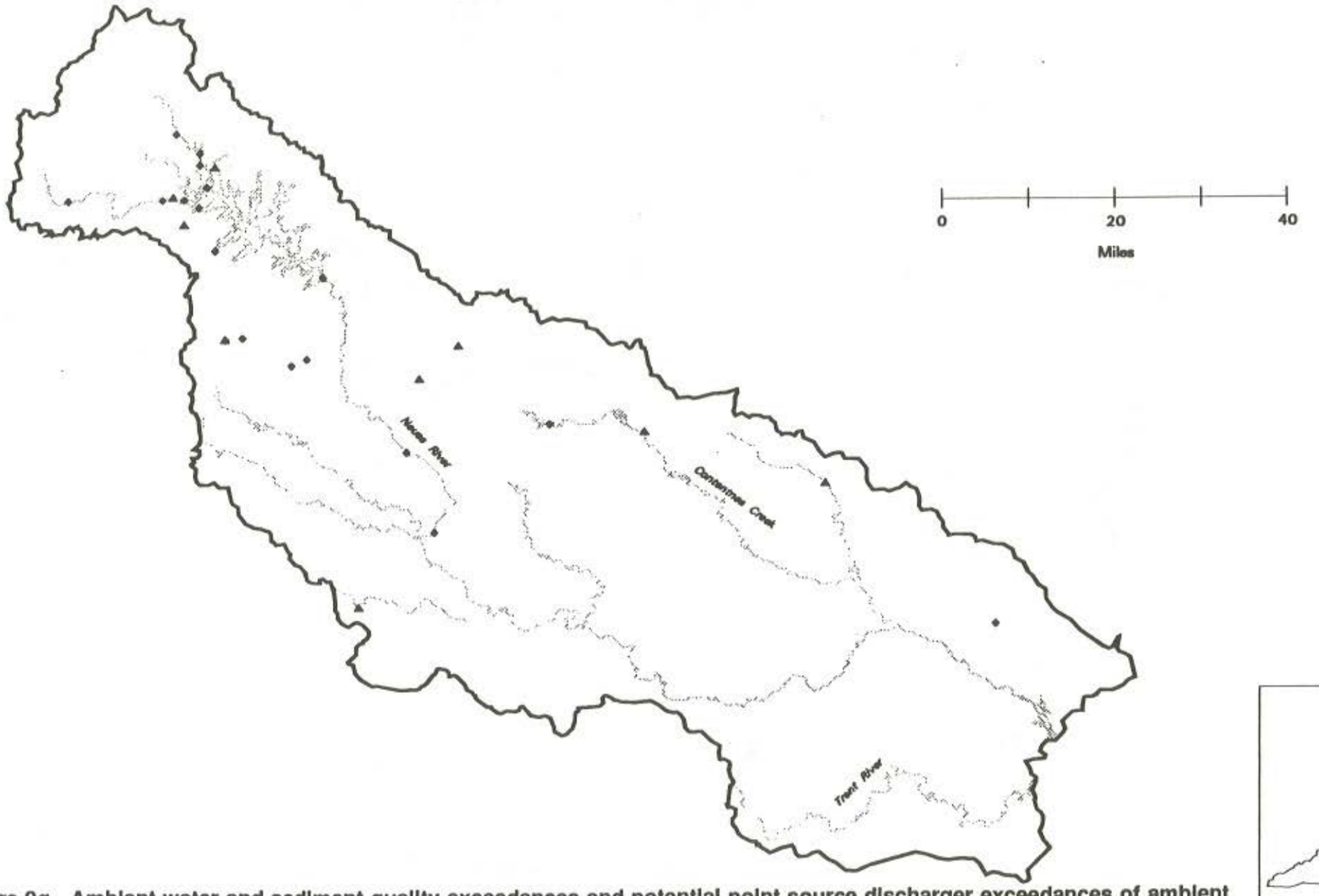


Figure 9g. Ambient water and sediment quality exceedances and potential point source discharger exceedances of ambient water quality standards under low flow (7Q10) conditions in the Neuse River basin.

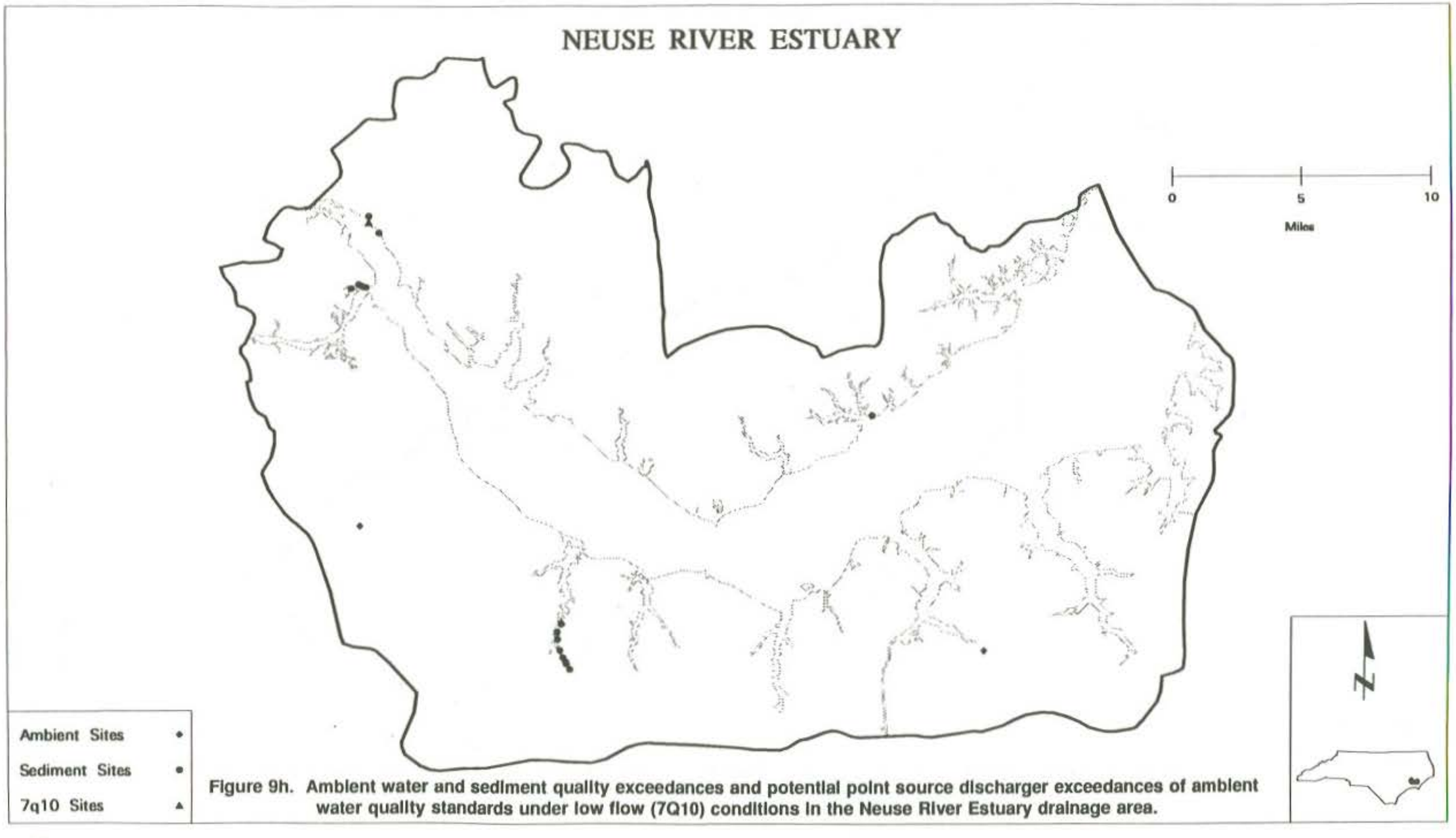


Figure 9h. Ambient water and sediment quality exceedances and potential point source discharger exceedances of ambient water quality standards under low flow (7Q10) conditions in the Neuse River Estuary drainage area.

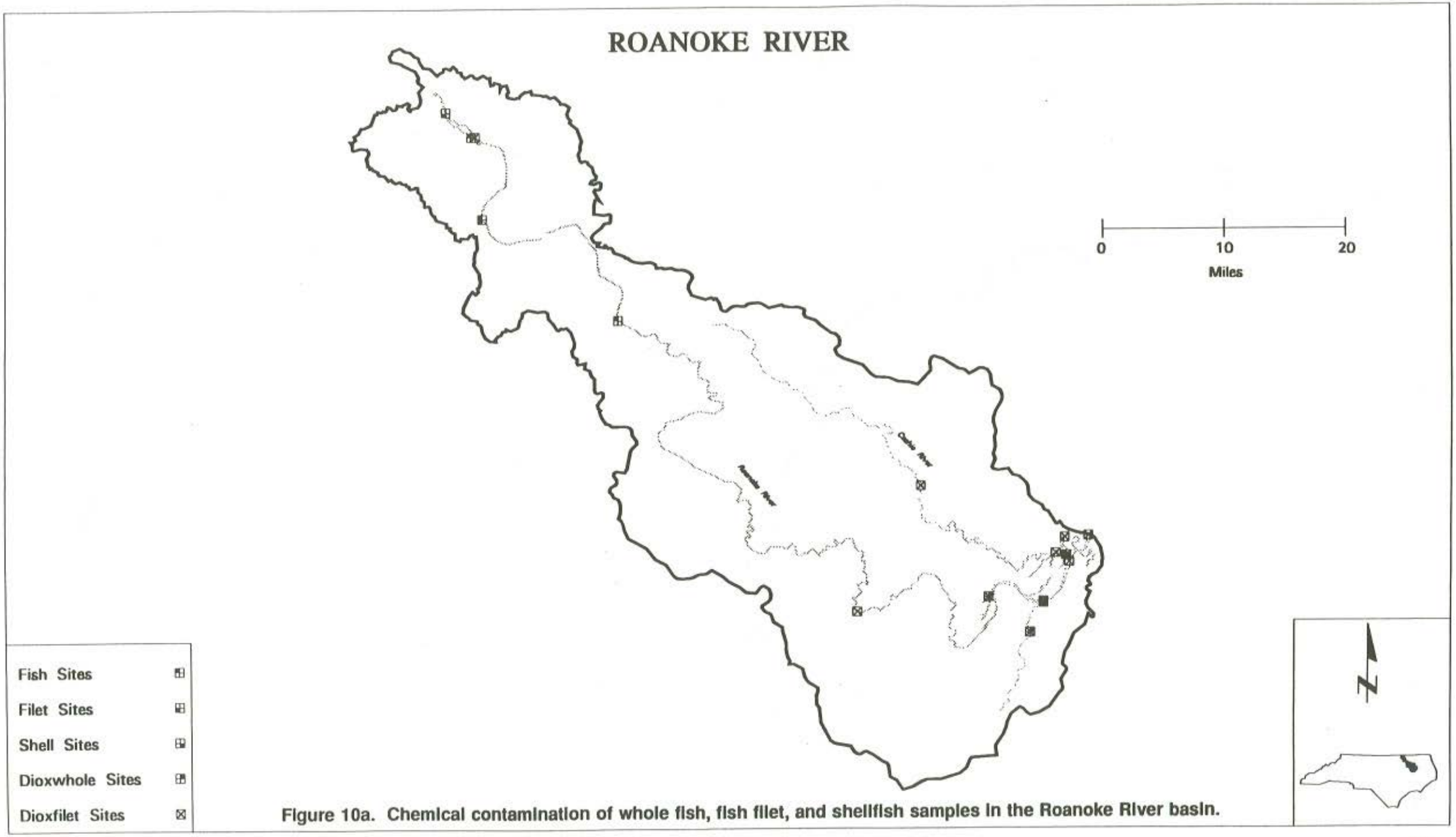


Figure 10a. Chemical contamination of whole fish, fish filet, and shellfish samples in the Roanoke River basin.

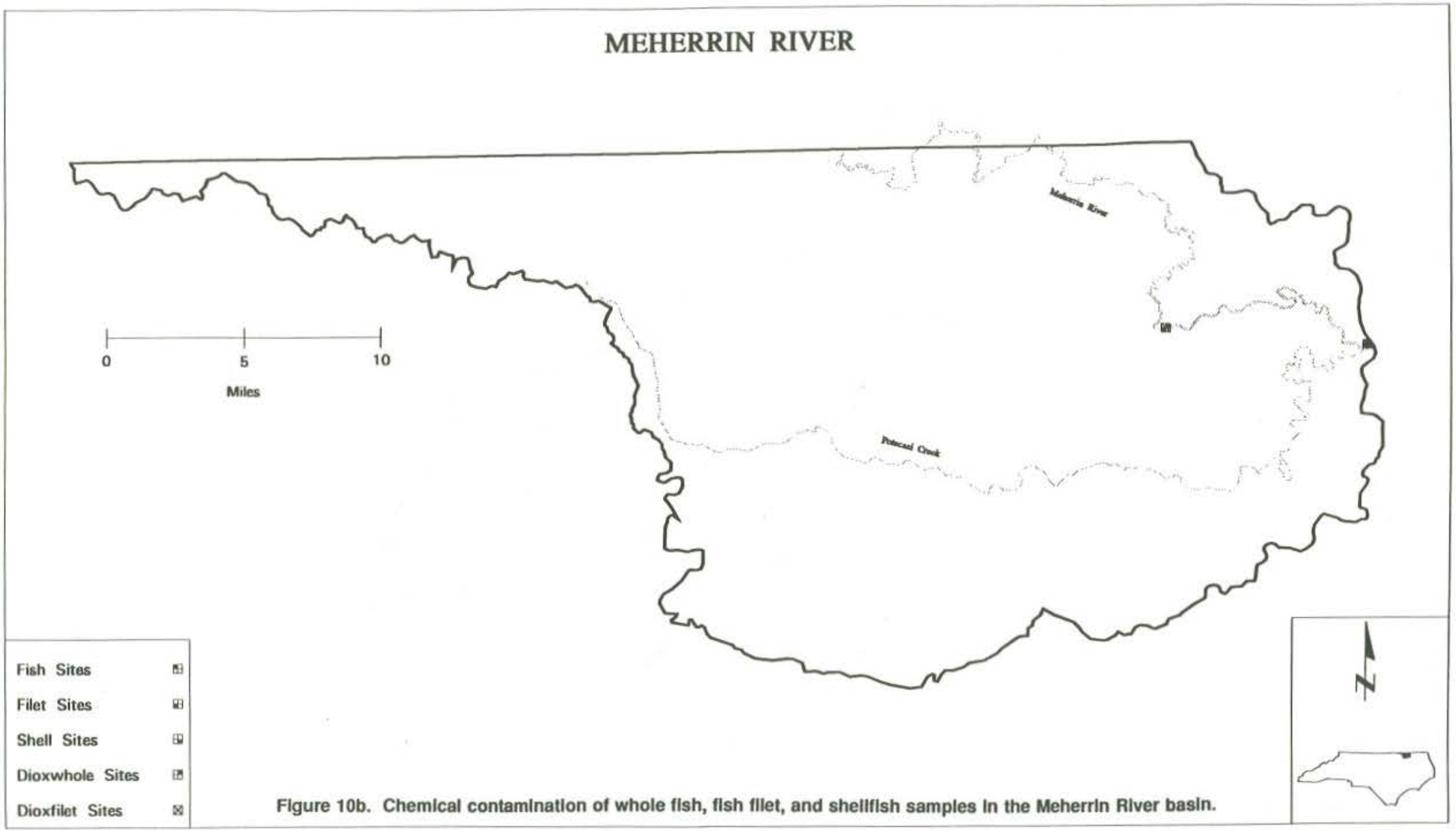


Figure 10b. Chemical contamination of whole fish, fish filet, and shellfish samples in the Meherrin River basin.

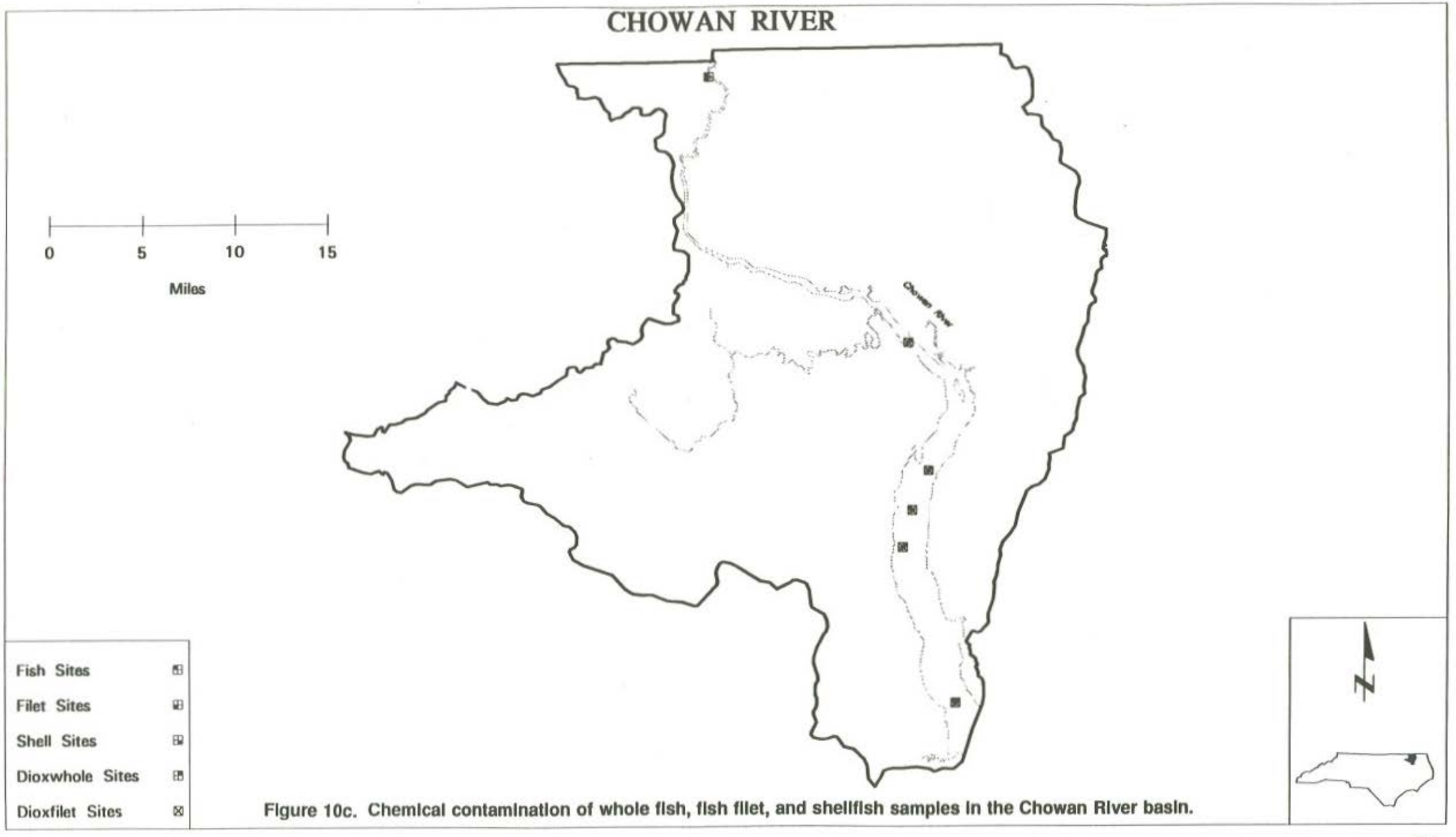


Figure 10c. Chemical contamination of whole fish, fish filet, and shellfish samples in the Chowan River basin.

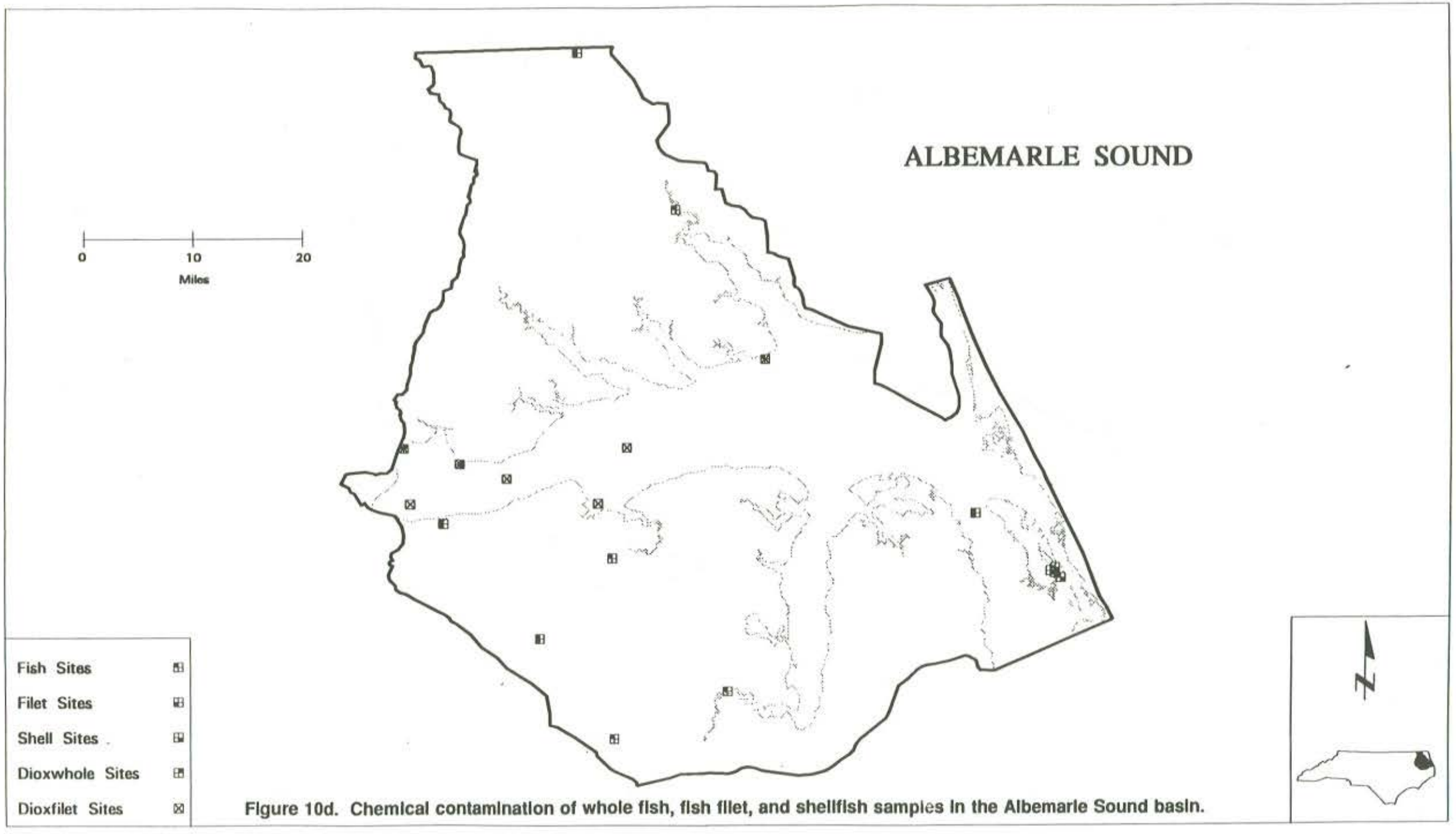


Figure 10d. Chemical contamination of whole fish, fish filet, and shellfish samples in the Albemarle Sound basin.

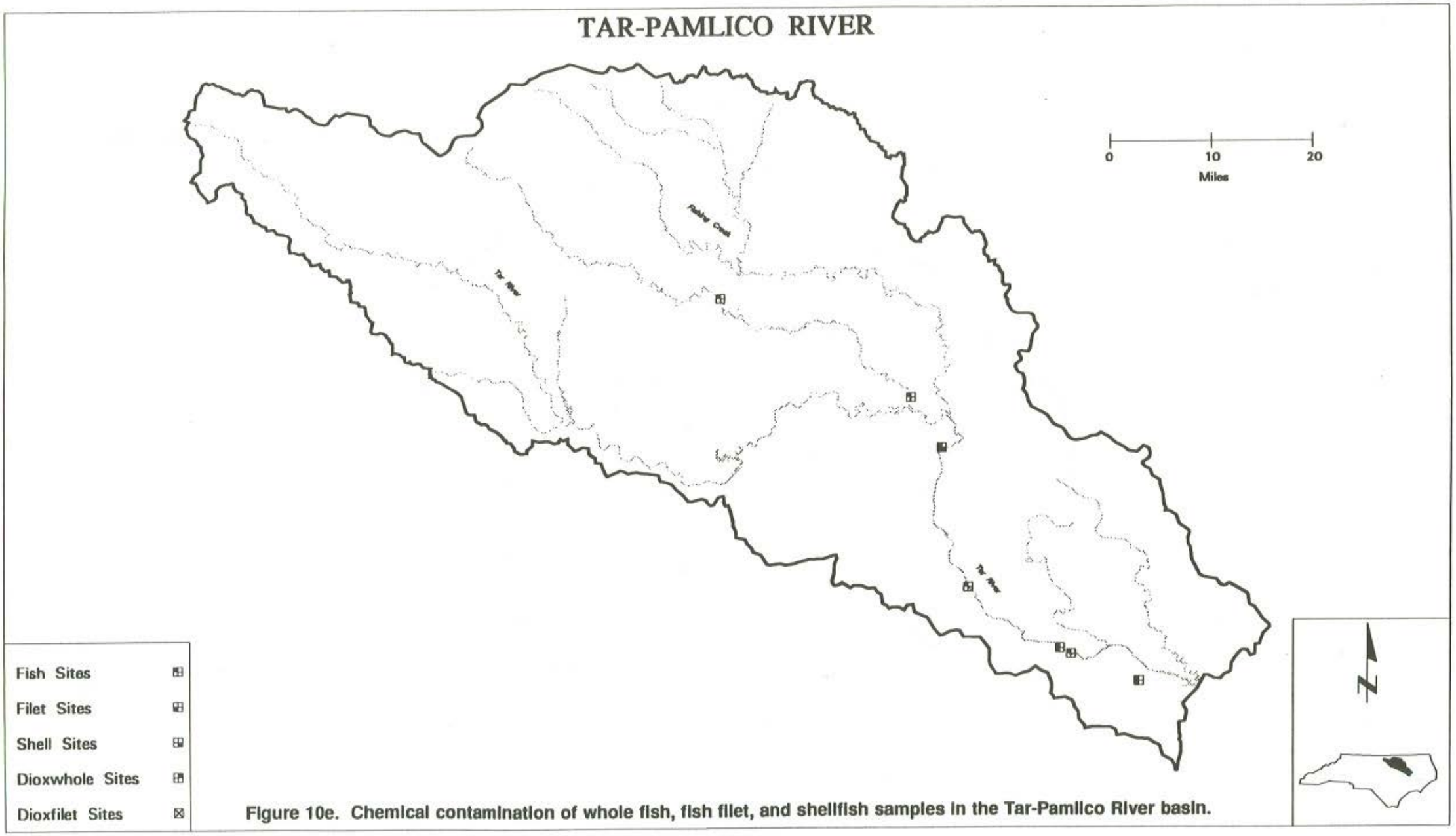


Figure 10e. Chemical contamination of whole fish, fish filet, and shellfish samples in the Tar-Pamlico River basin.

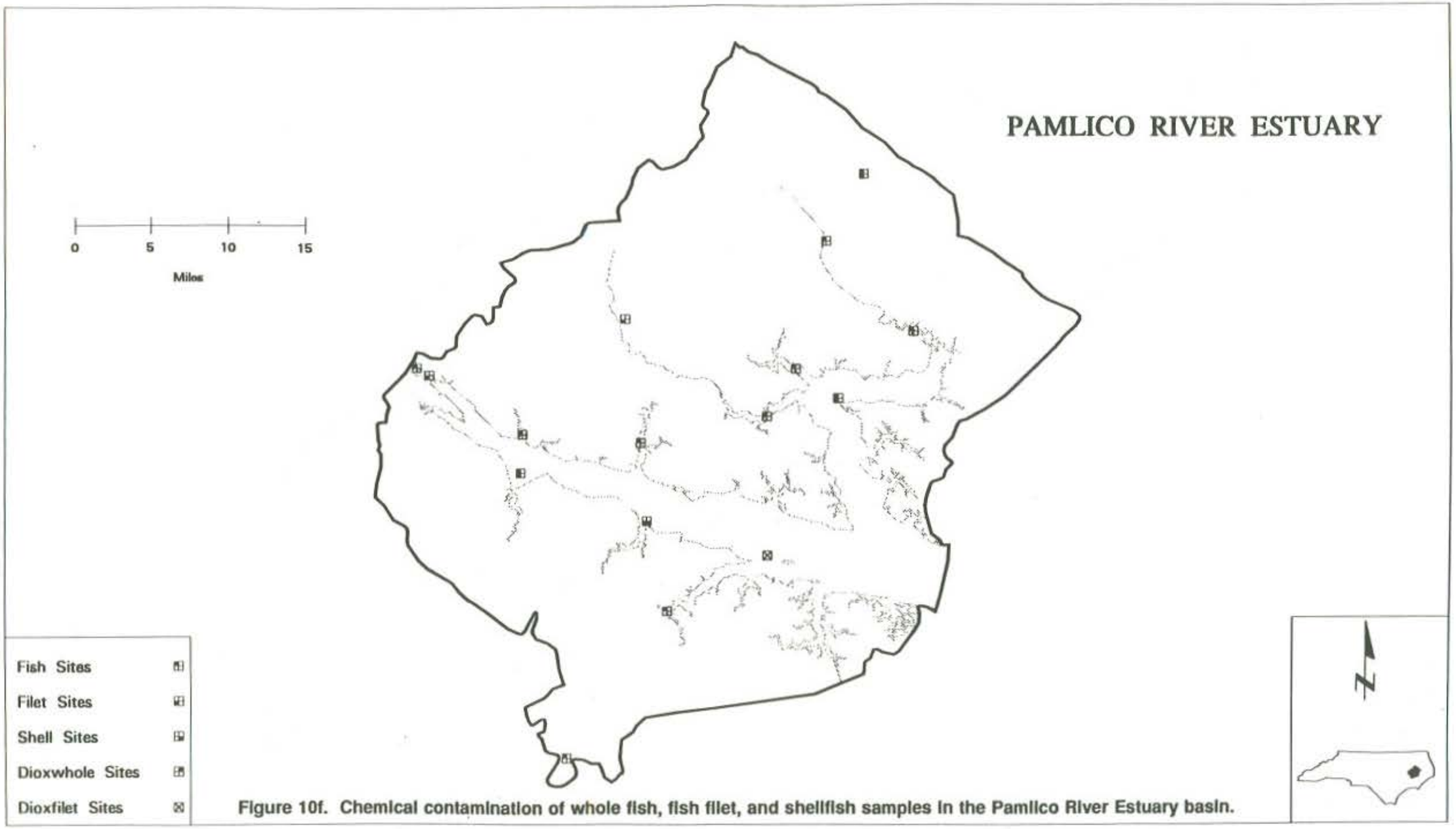


Figure 10f. Chemical contamination of whole fish, fish filet, and shellfish samples in the Pamlico River Estuary basin.

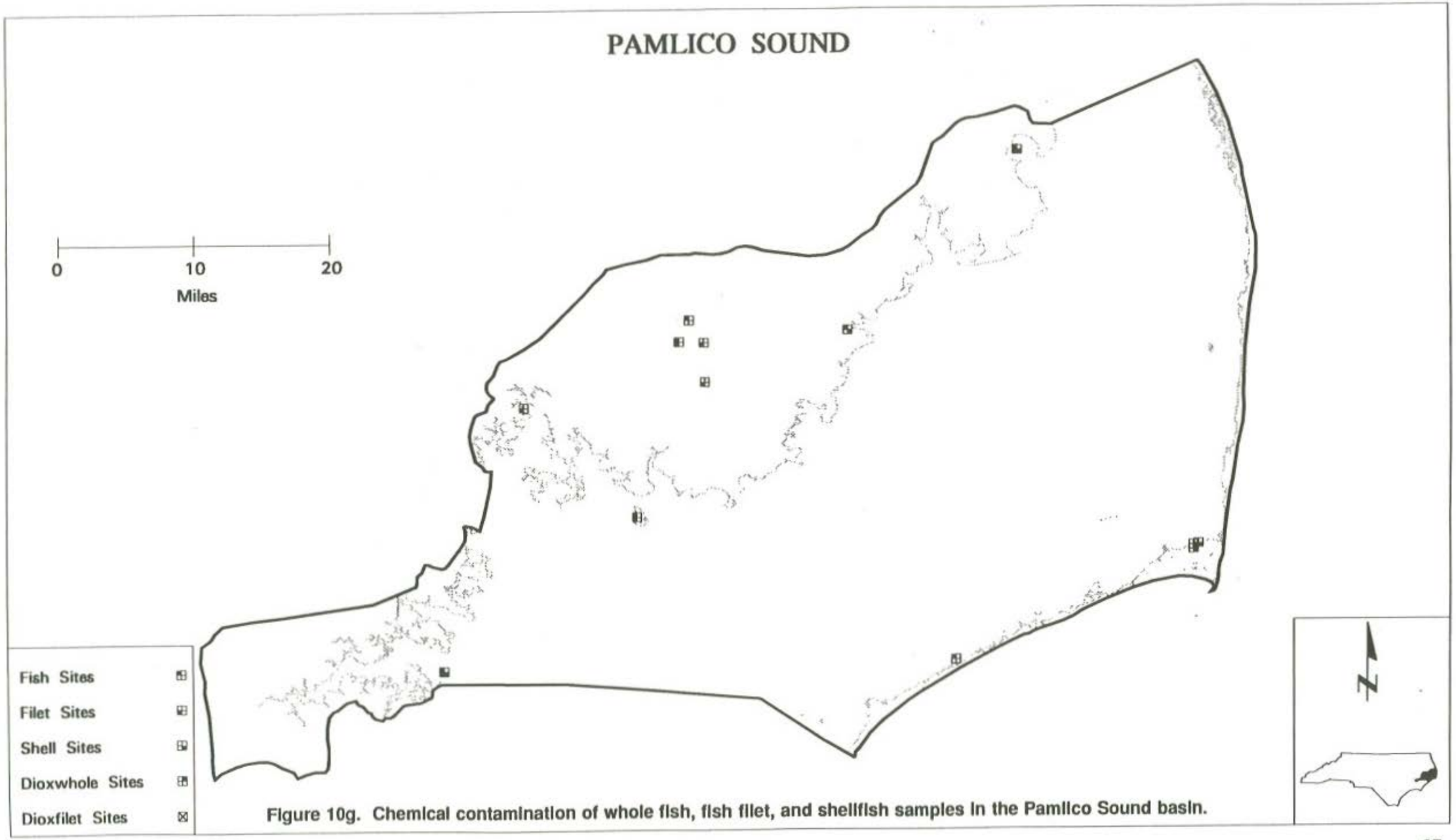


Figure 10g. Chemical contamination of whole fish, fish filet, and shellfish samples in the Pamlico Sound basin.

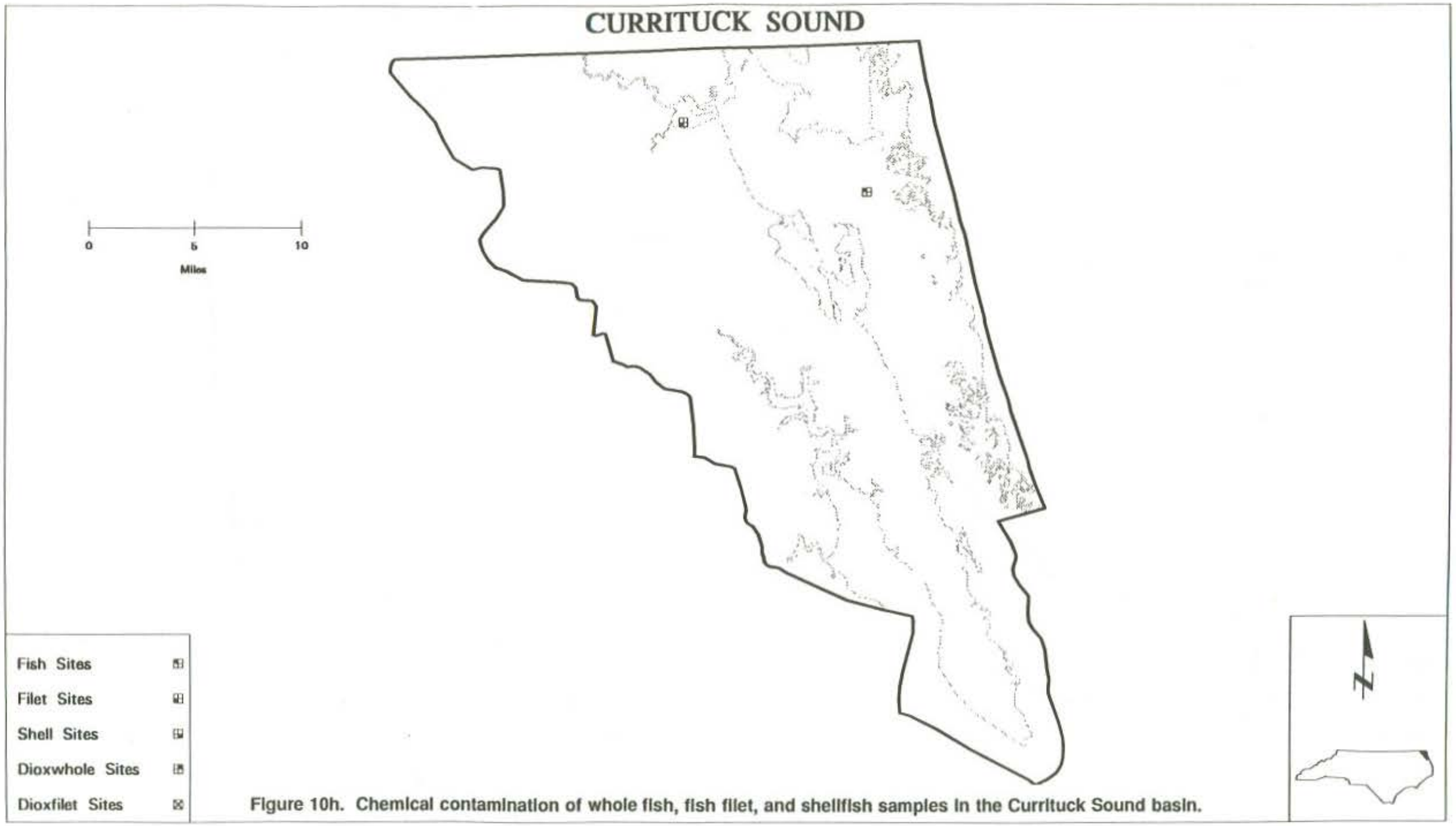


Figure 10h. Chemical contamination of whole fish, fish filet, and shellfish samples in the Currituck Sound basin.

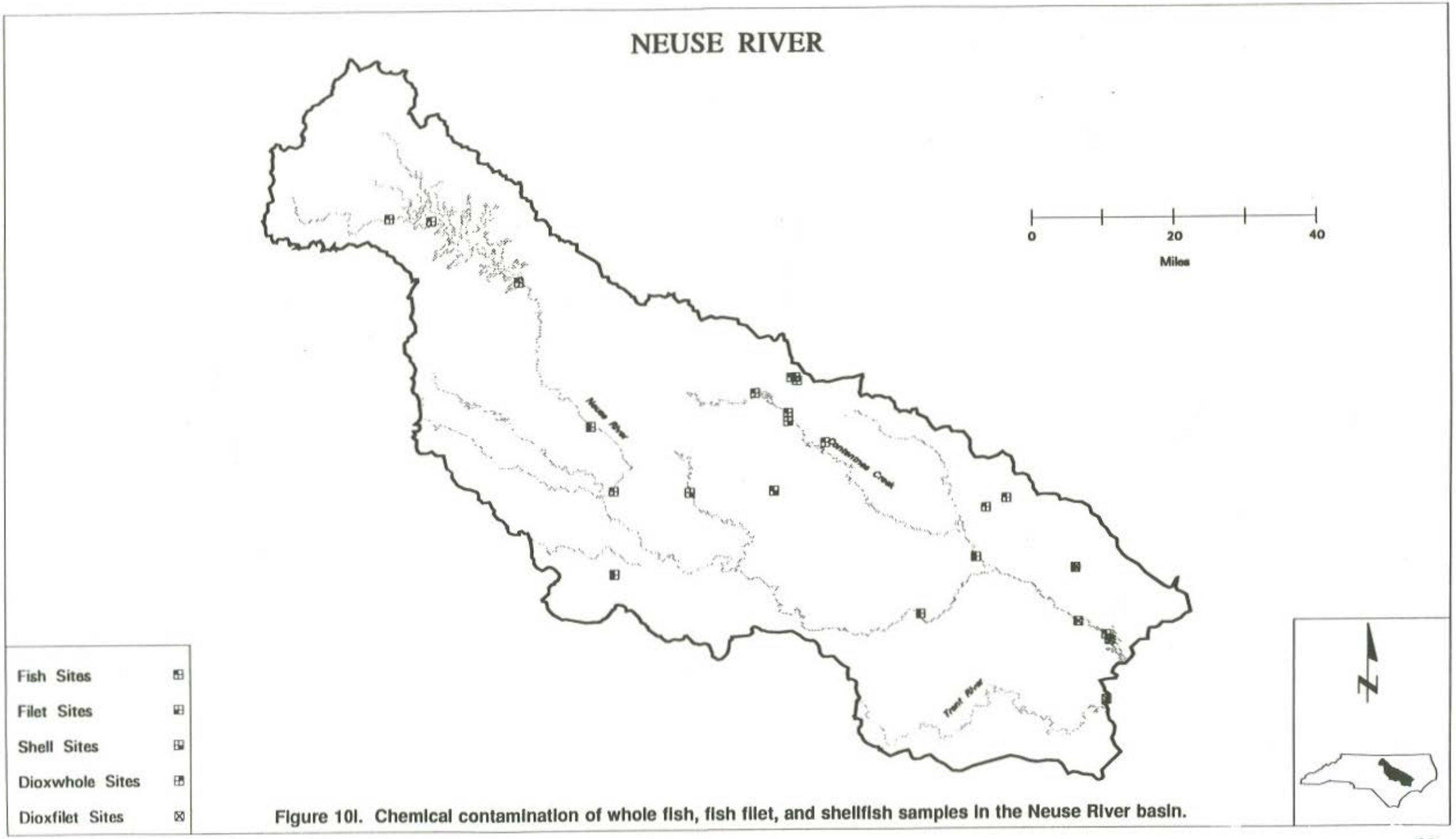


Figure 10l. Chemical contamination of whole fish, fish filet, and shellfish samples in the Neuse River basin.

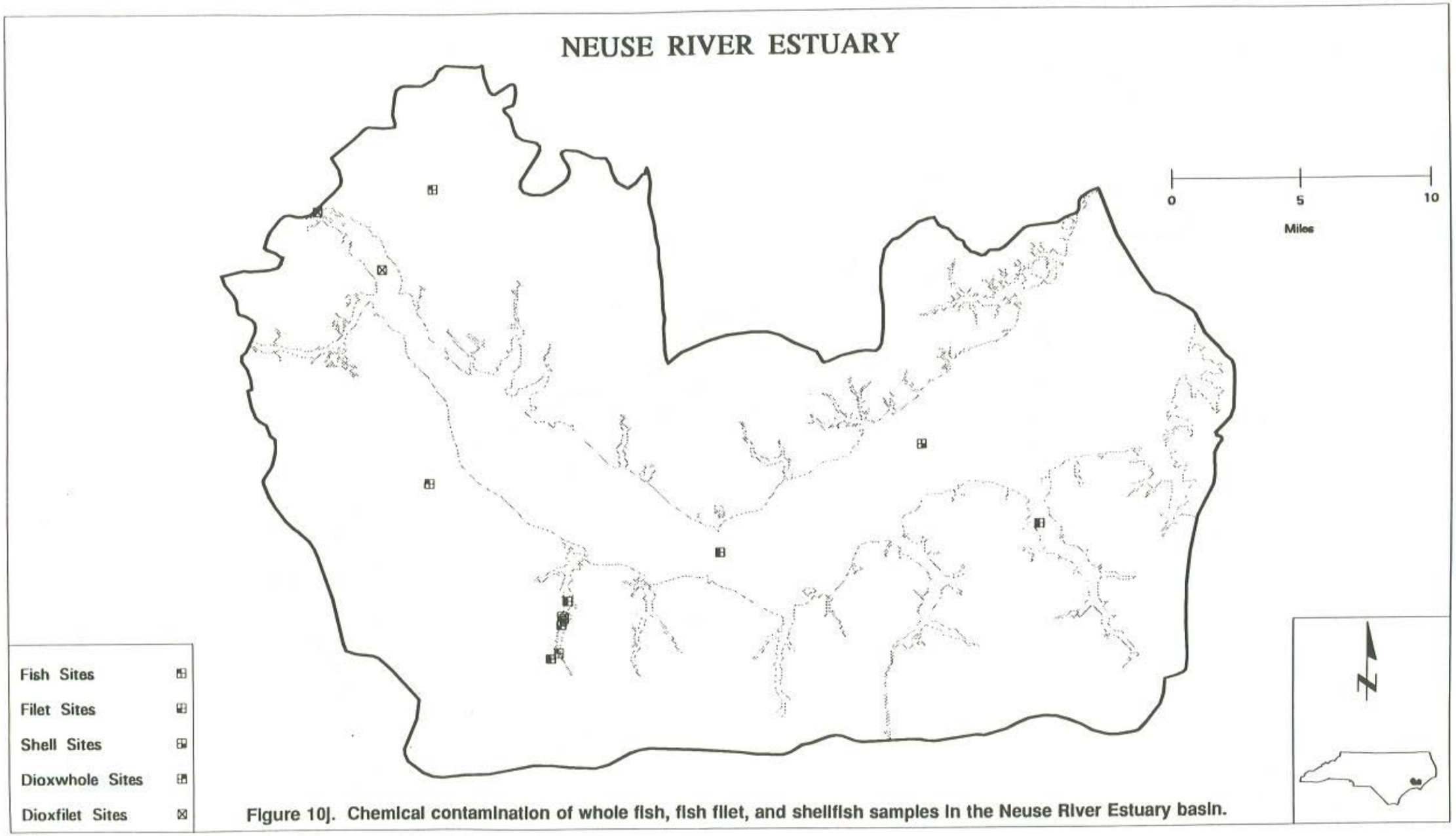


Figure 10j. Chemical contamination of whole fish, fish filet, and shellfish samples in the Neuse River Estuary basin.

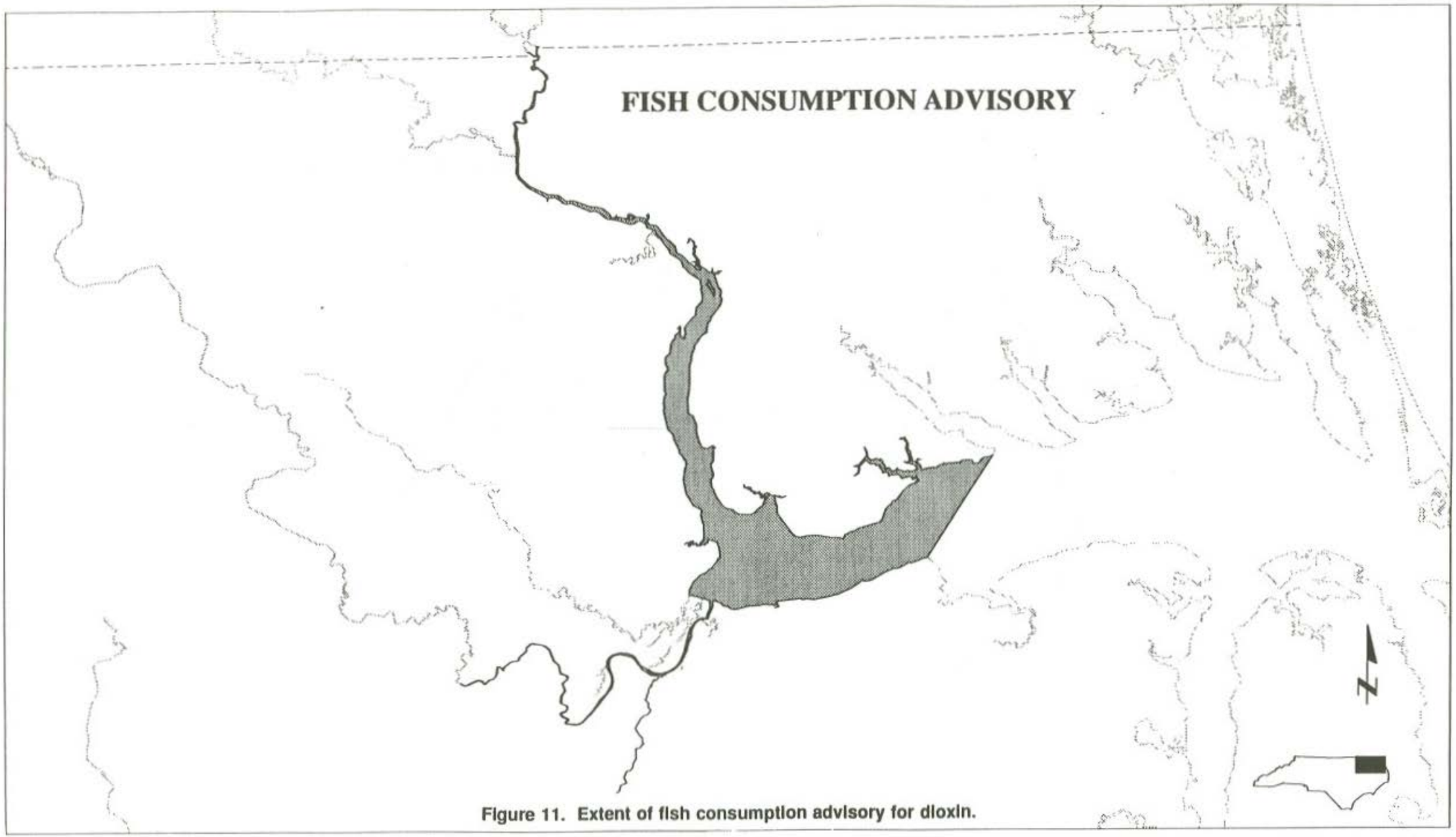


Figure 11. Extent of fish consumption advisory for dioxin.

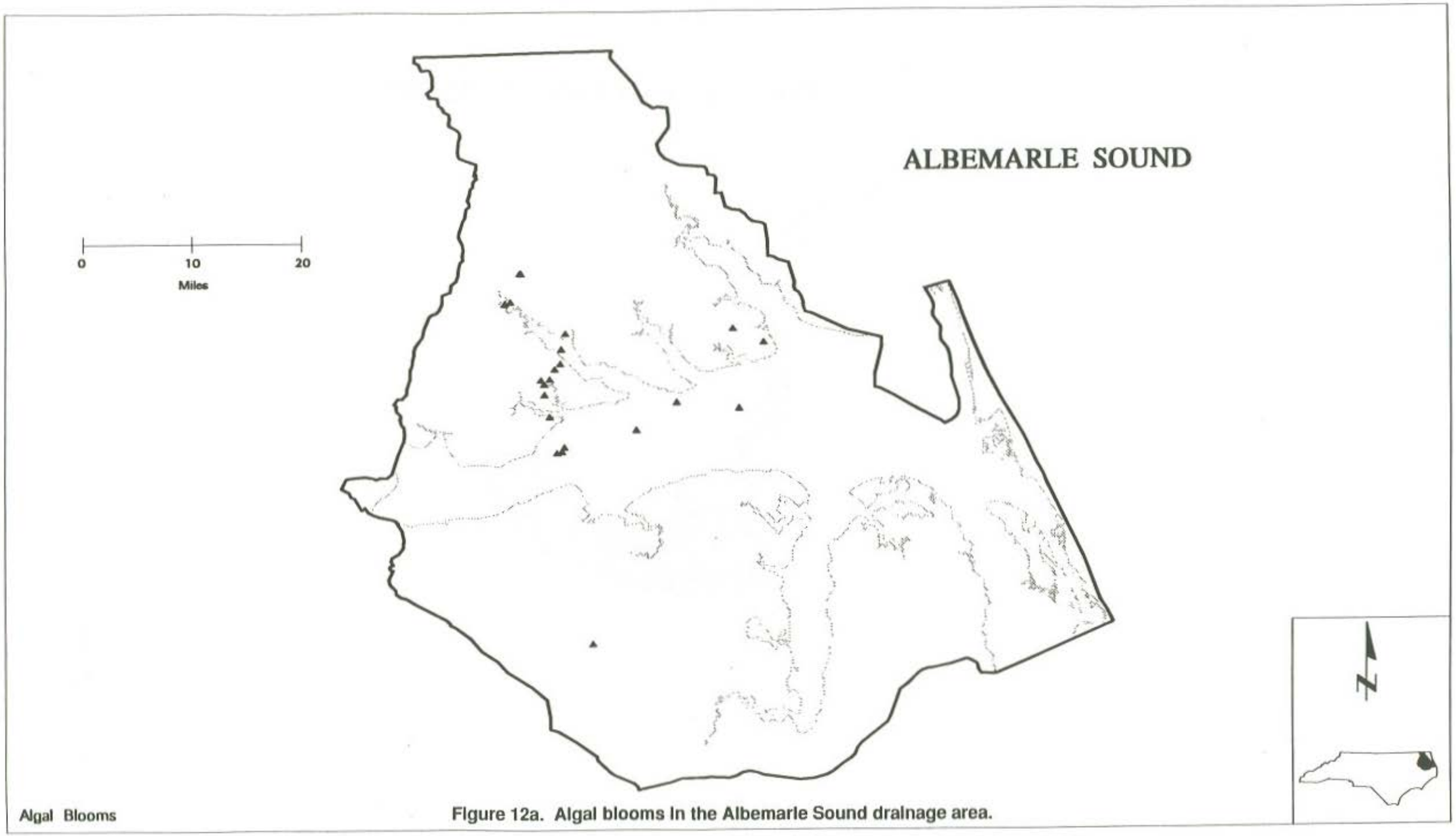


Figure 12a. Algal blooms in the Albemarle Sound drainage area.

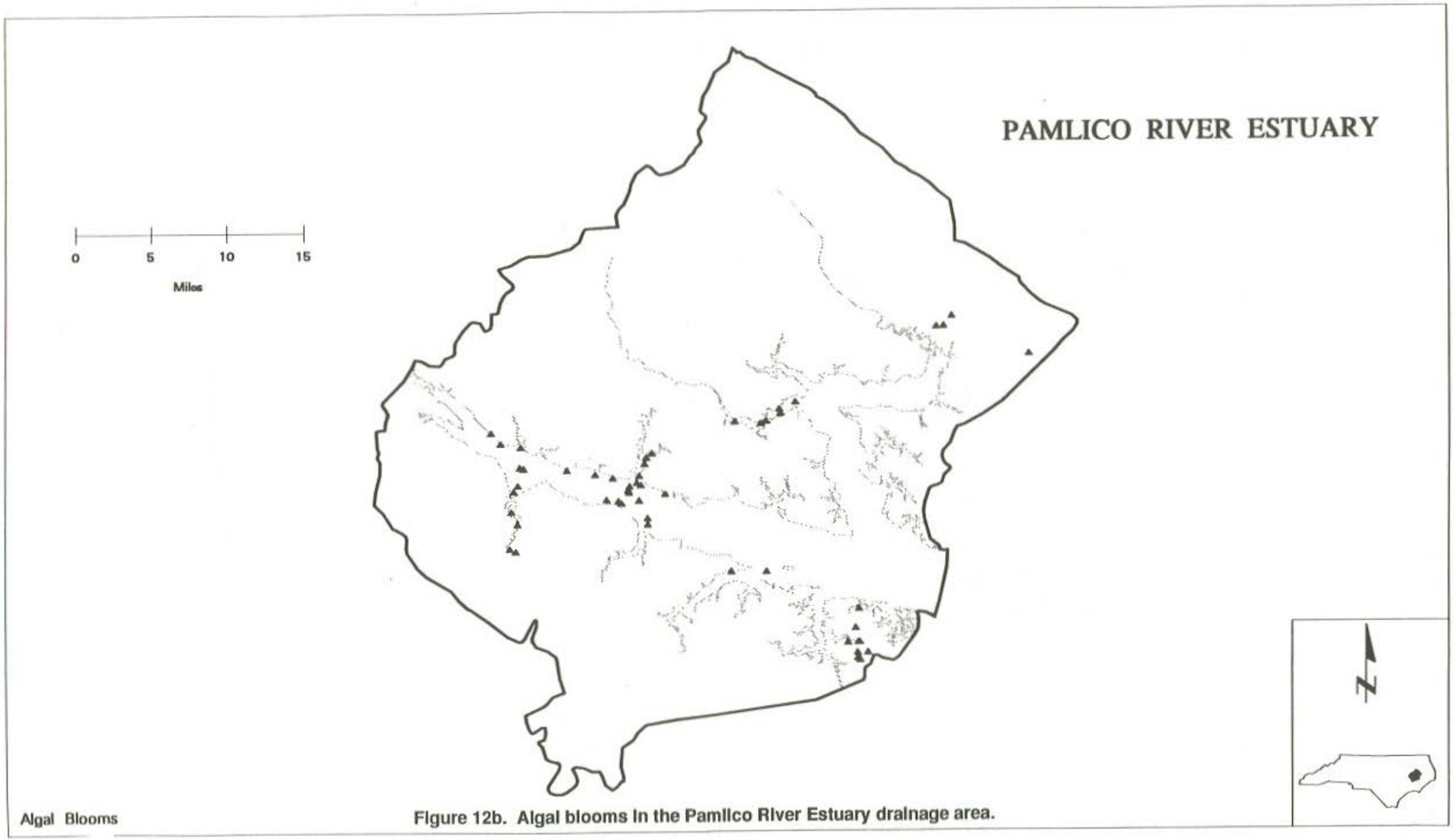


Figure 12b. Algal blooms in the Pamlico River Estuary drainage area.

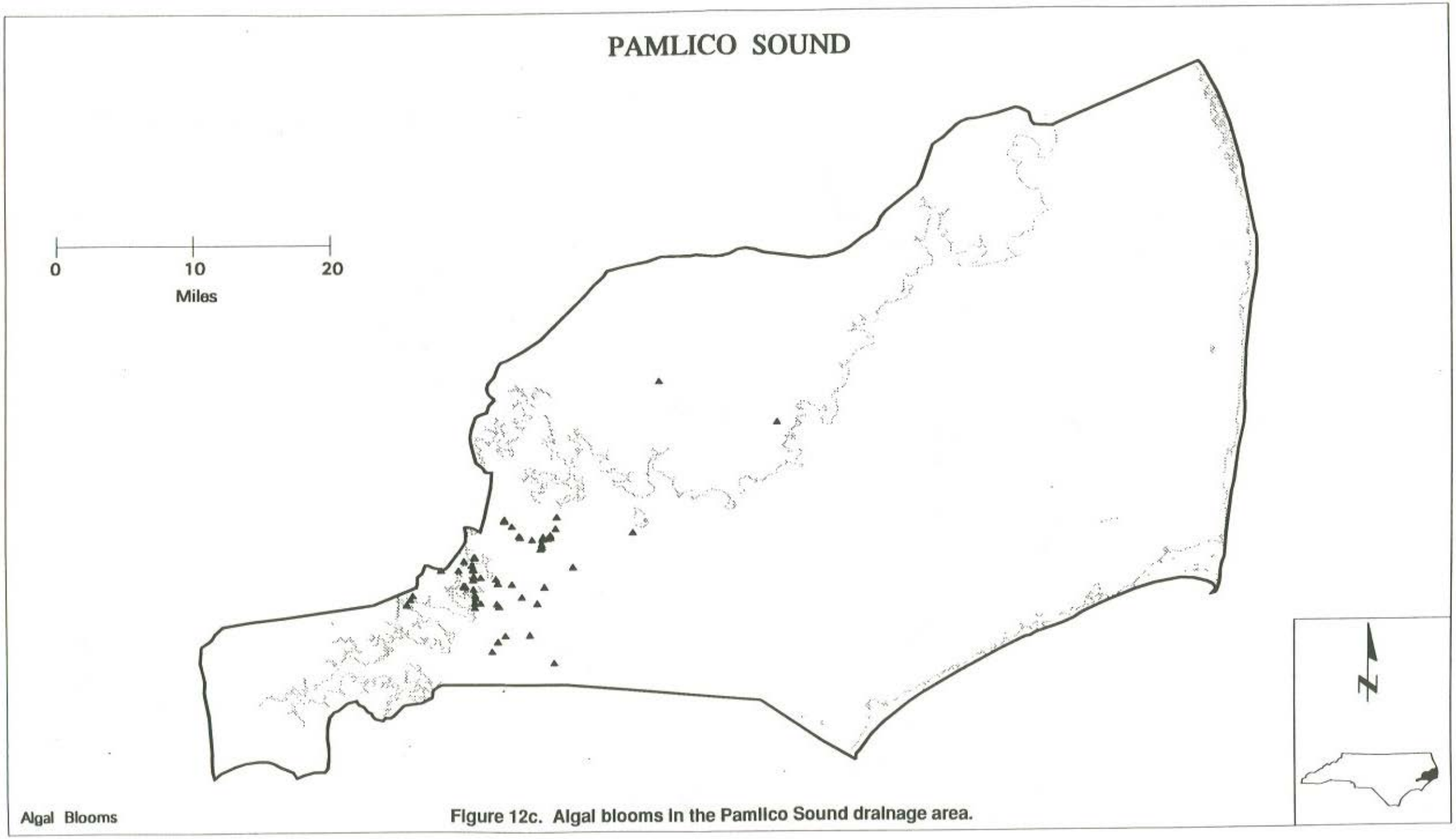
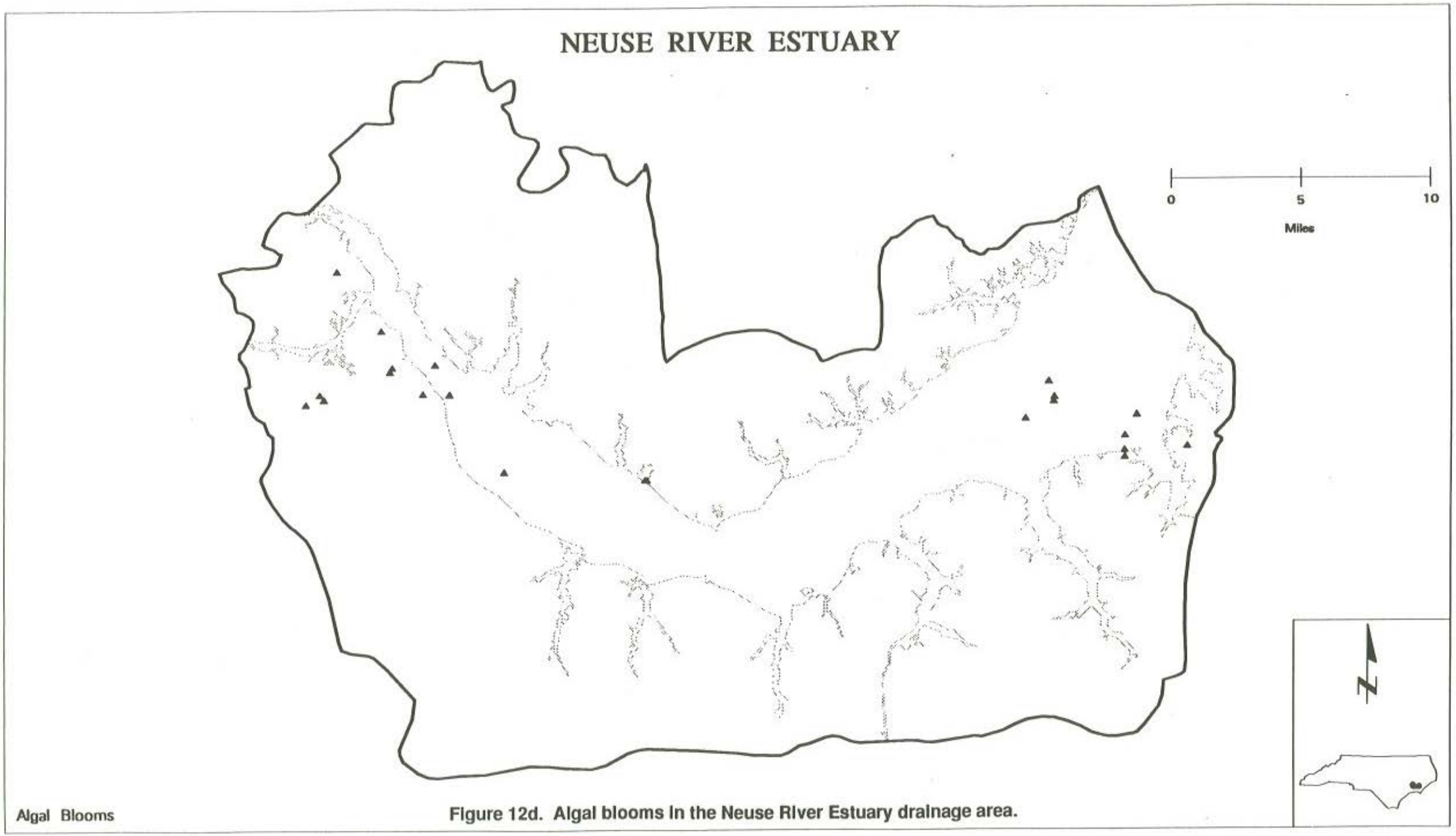
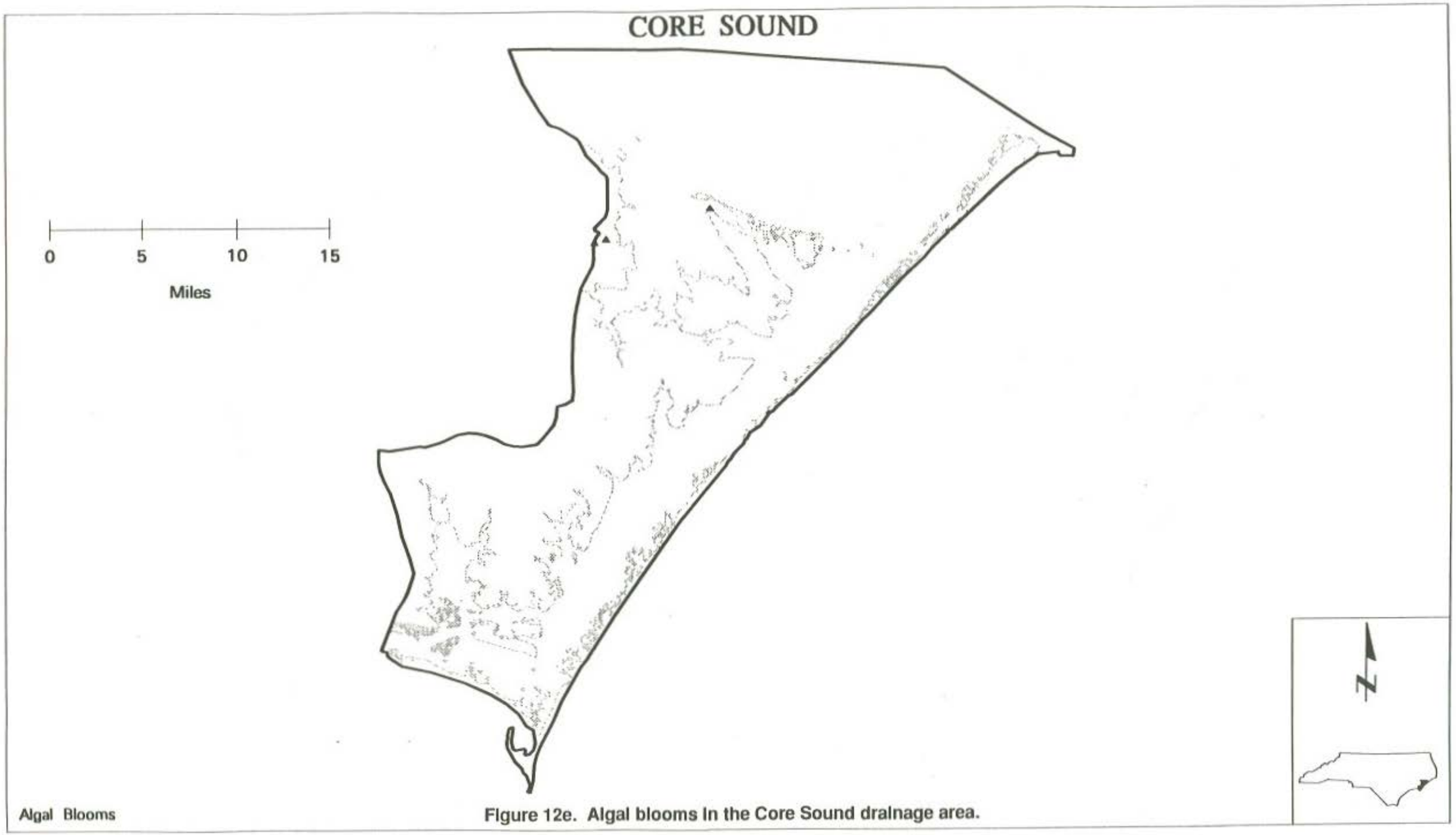


Figure 12c. Algal blooms in the Pamlico Sound dralnage area.



Algal Blooms

Figure 12d. Algal blooms in the Neuse River Estuary drainage area.



Algal Blooms

Figure 12e. Algal blooms in the Core Sound drainage area.

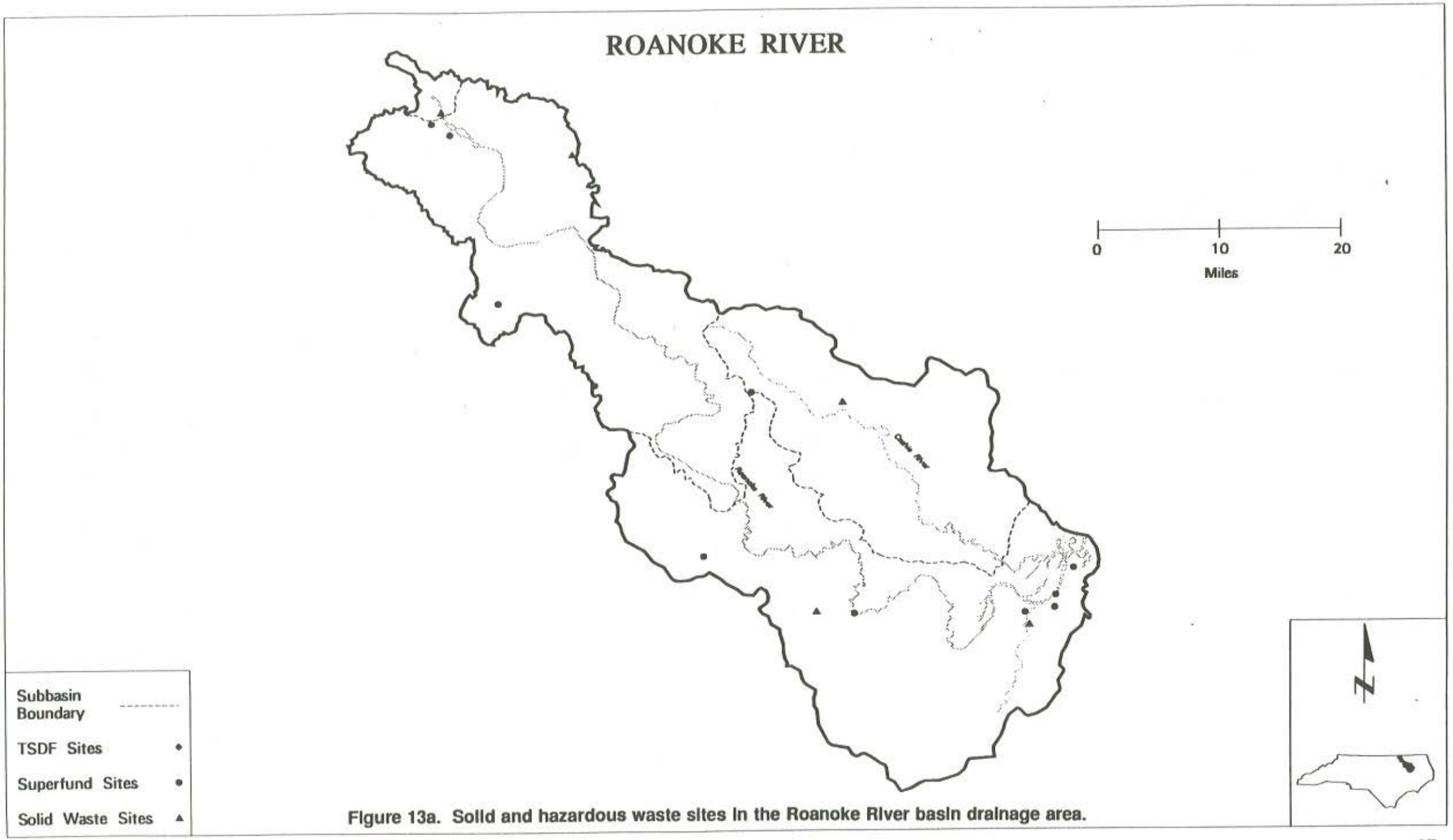


Figure 13a. Solid and hazardous waste sites in the Roanoke River basin drainage area.

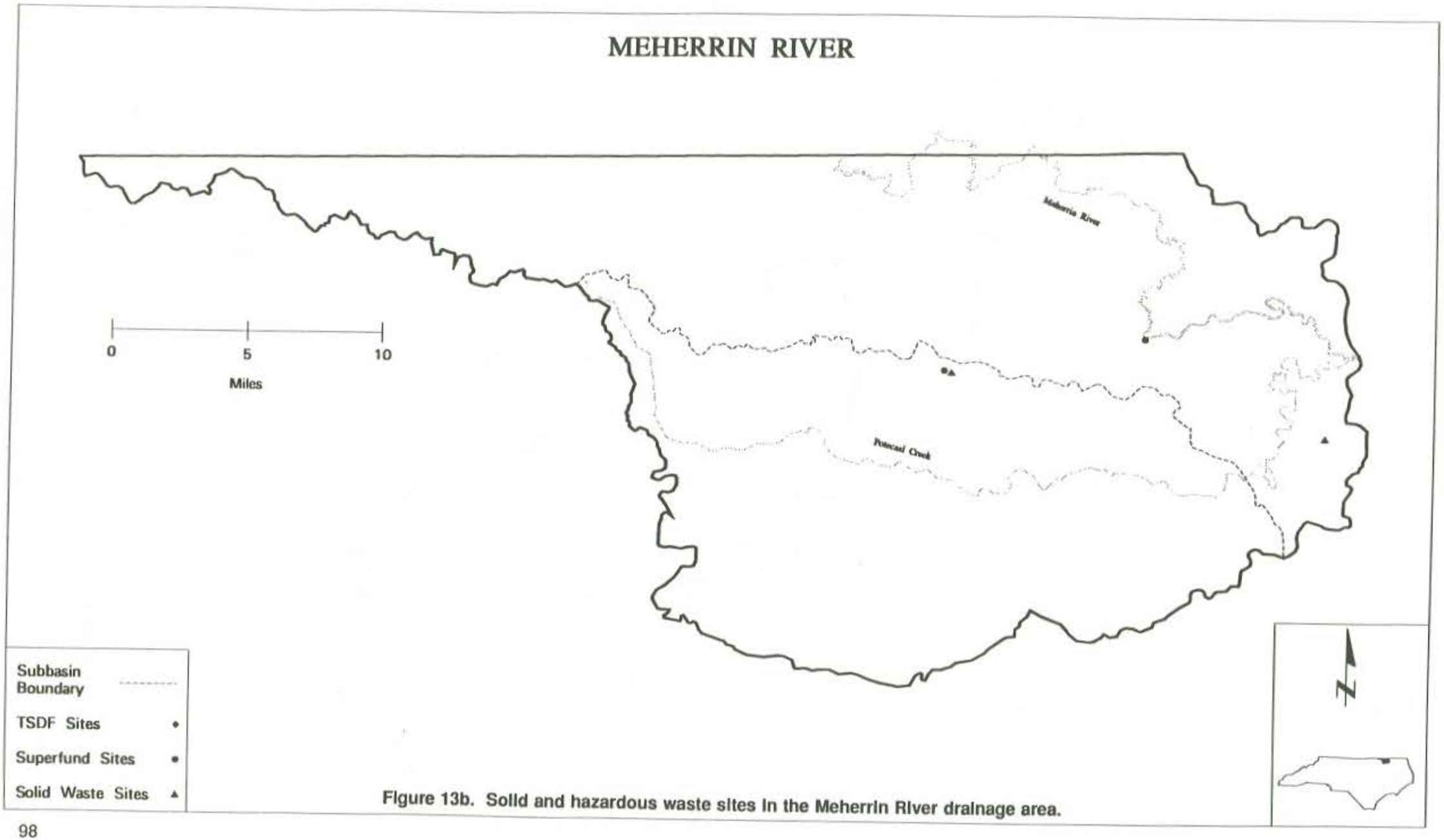


Figure 13b. Solid and hazardous waste sites in the Meherrin River drainage area.

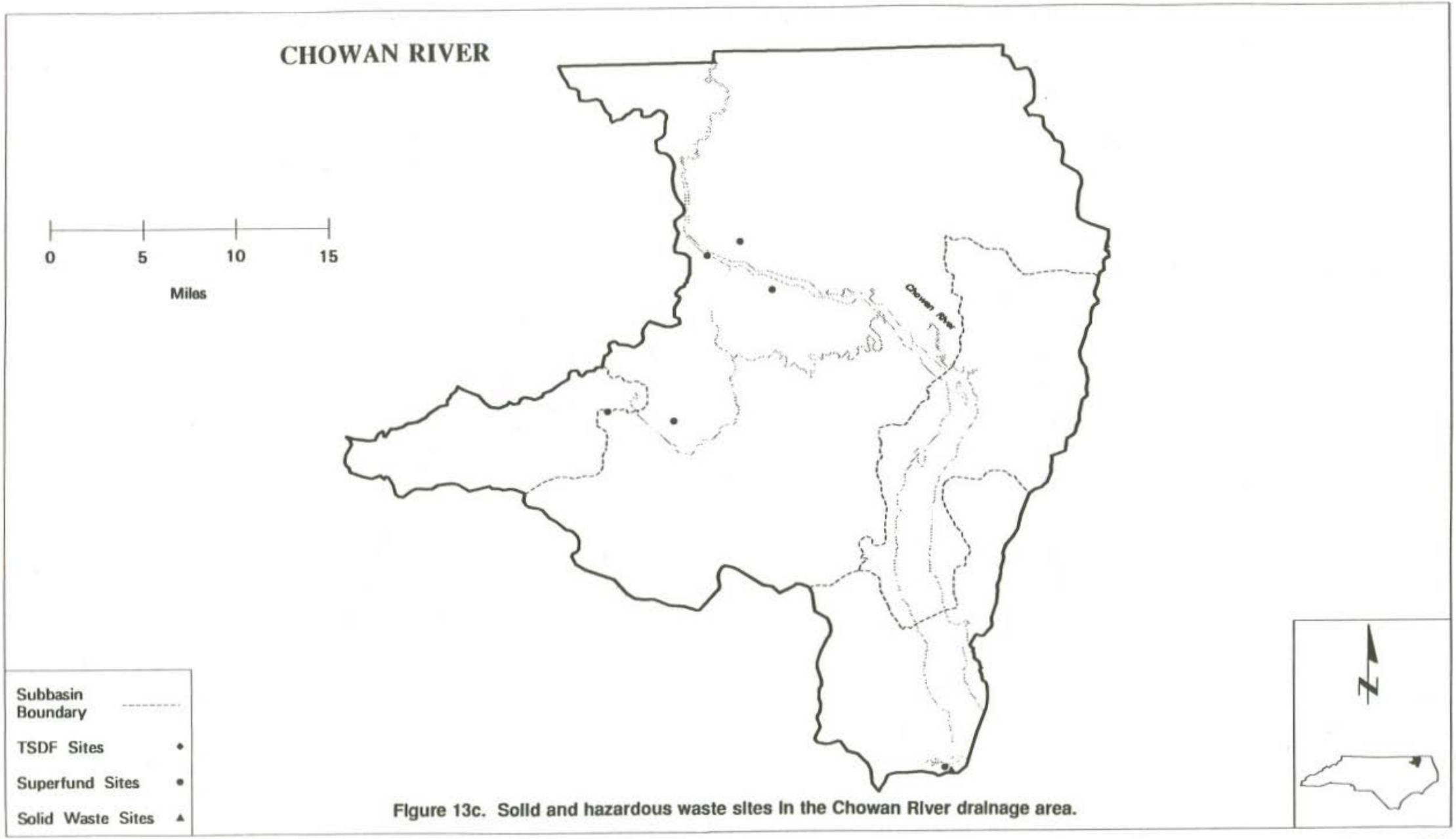


Figure 13c. Solid and hazardous waste sites in the Chowan River drainage area.

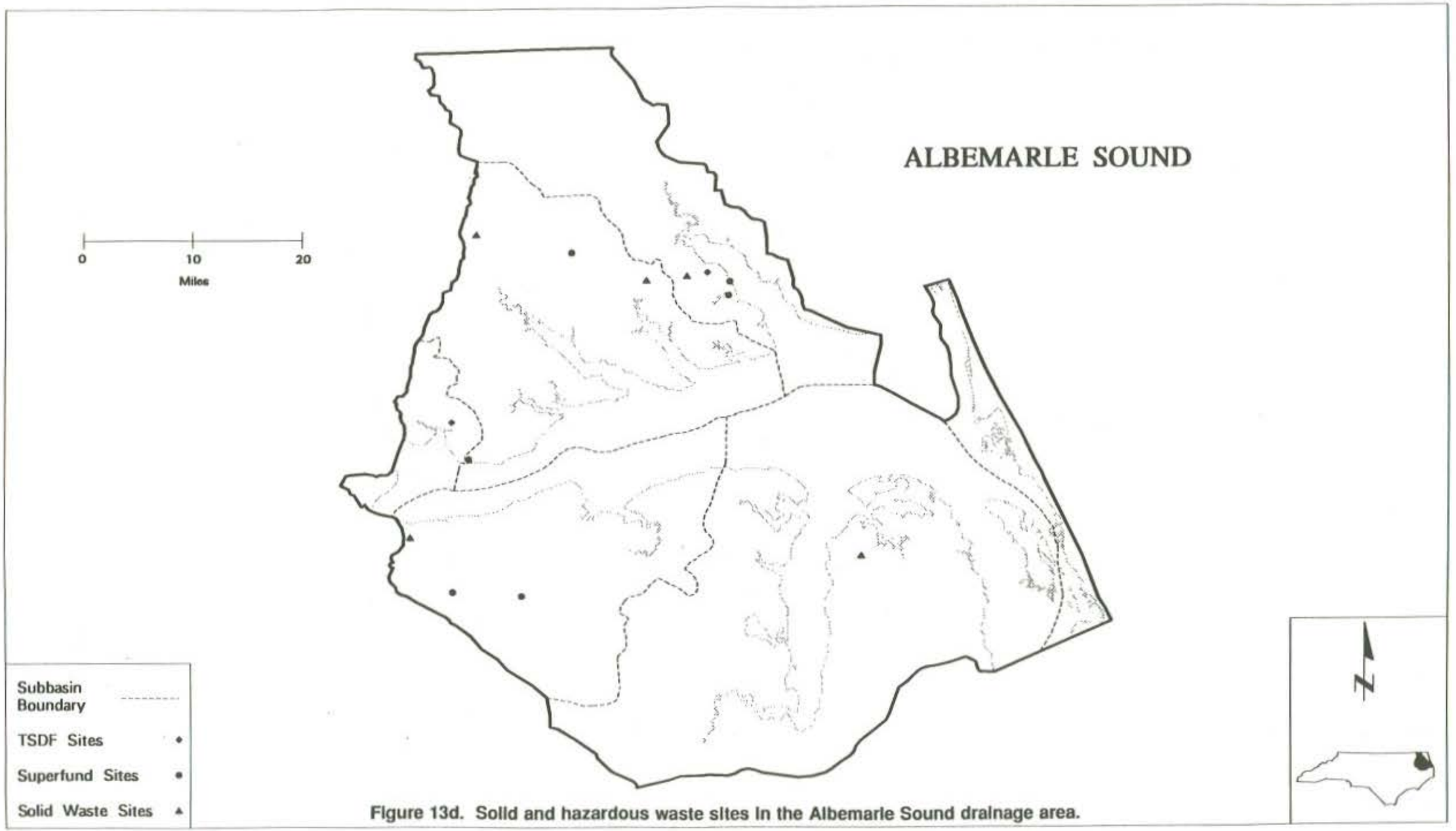


Figure 13d. Solid and hazardous waste sites in the Albemarle Sound drainage area.

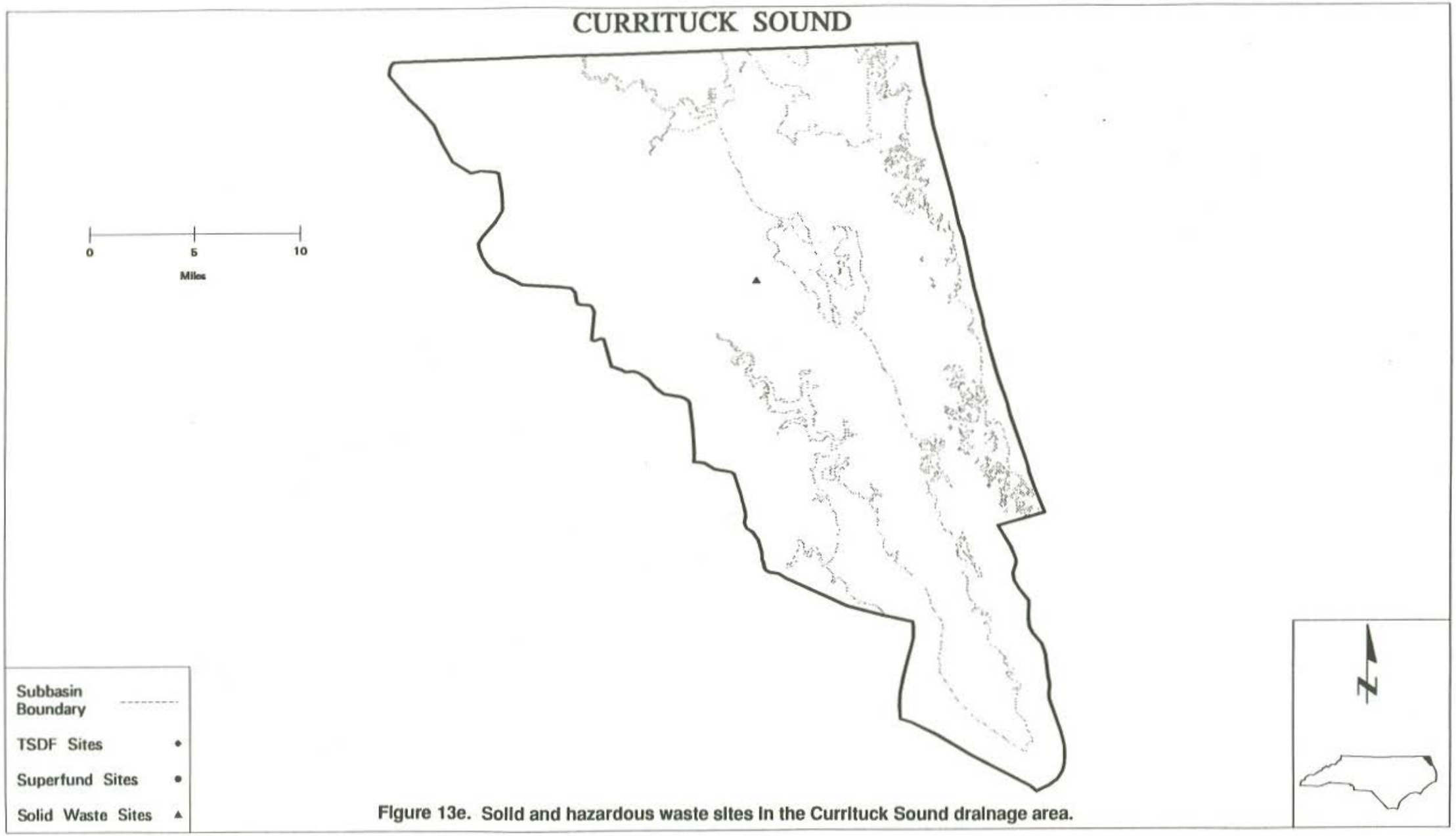


Figure 13e. Solid and hazardous waste sites in the Currituck Sound drainage area.

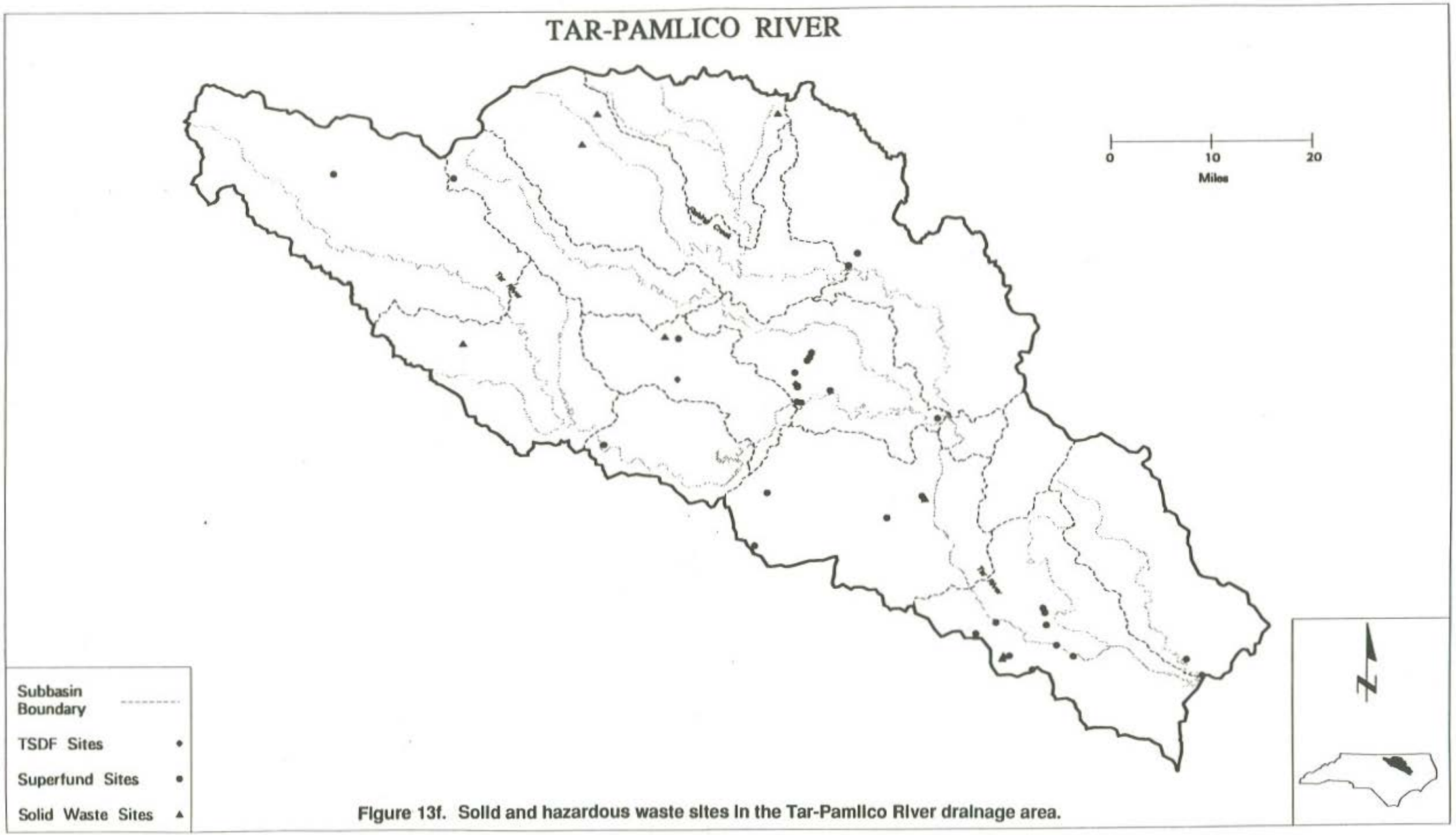


Figure 13f. Solid and hazardous waste sites in the Tar-Pamlico River drainage area.

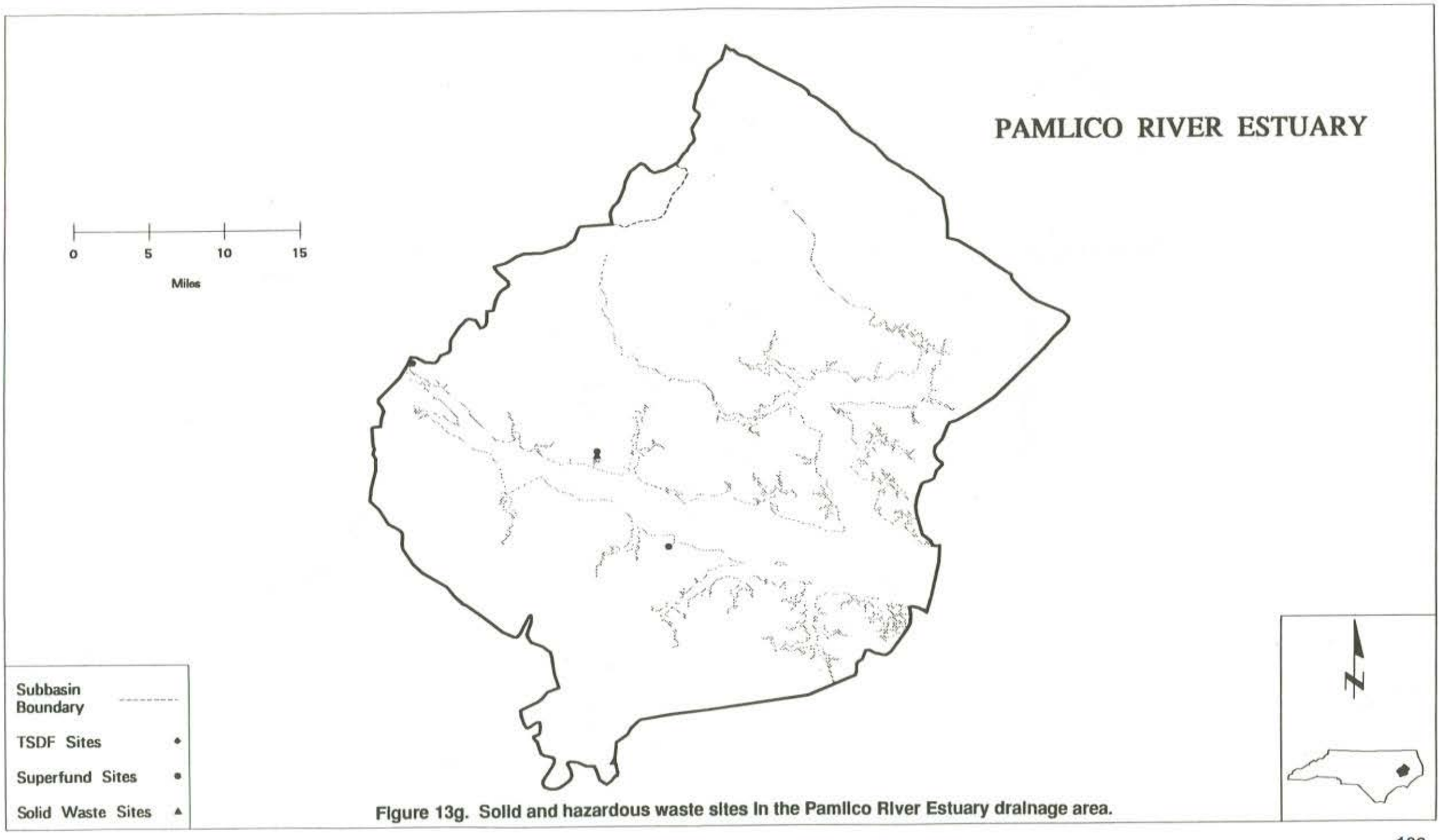


Figure 13g. Solid and hazardous waste sites in the Pamlico River Estuary drainage area.

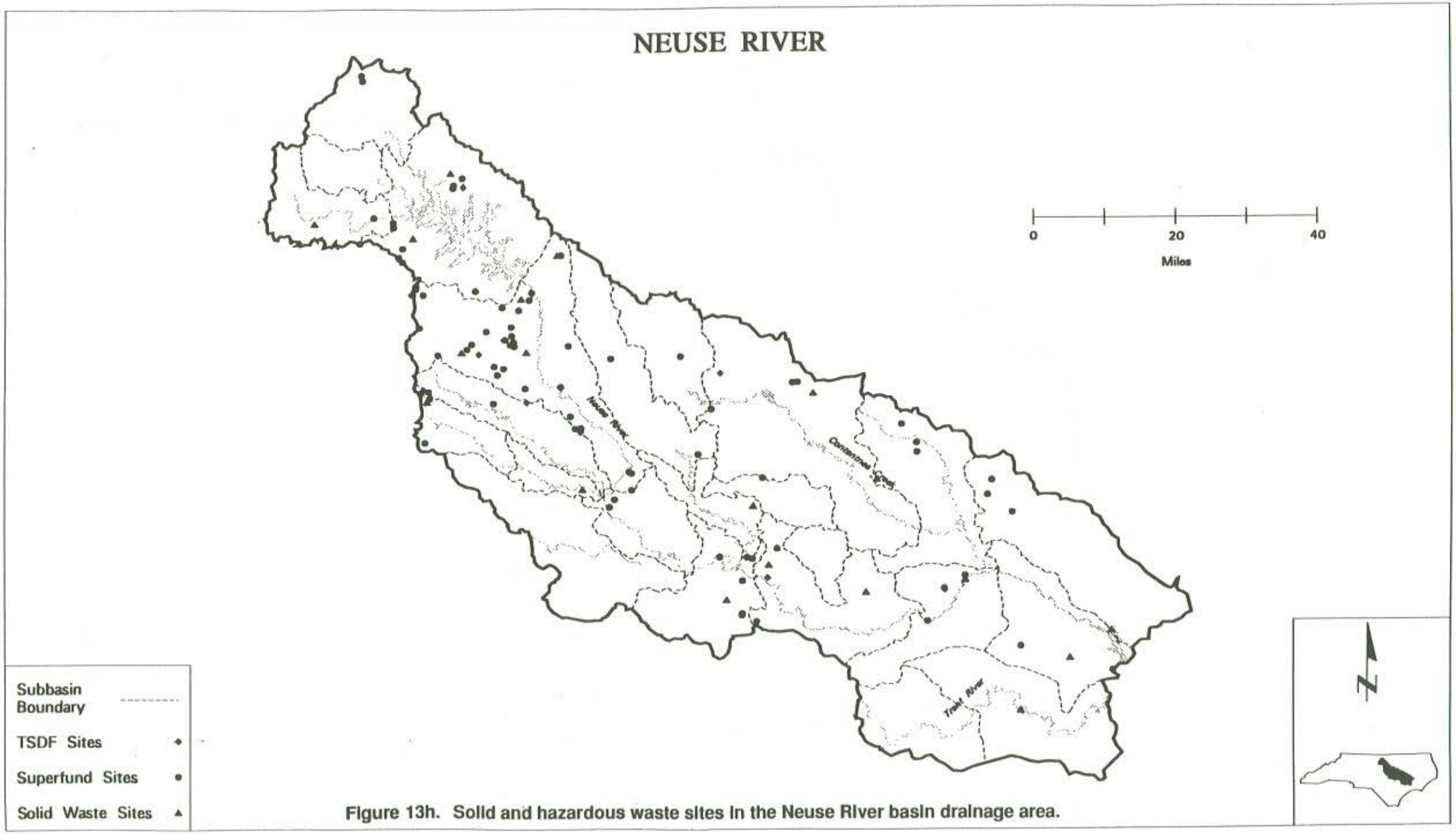


Figure 13h. Solid and hazardous waste sites in the Neuse River basin drainage area.

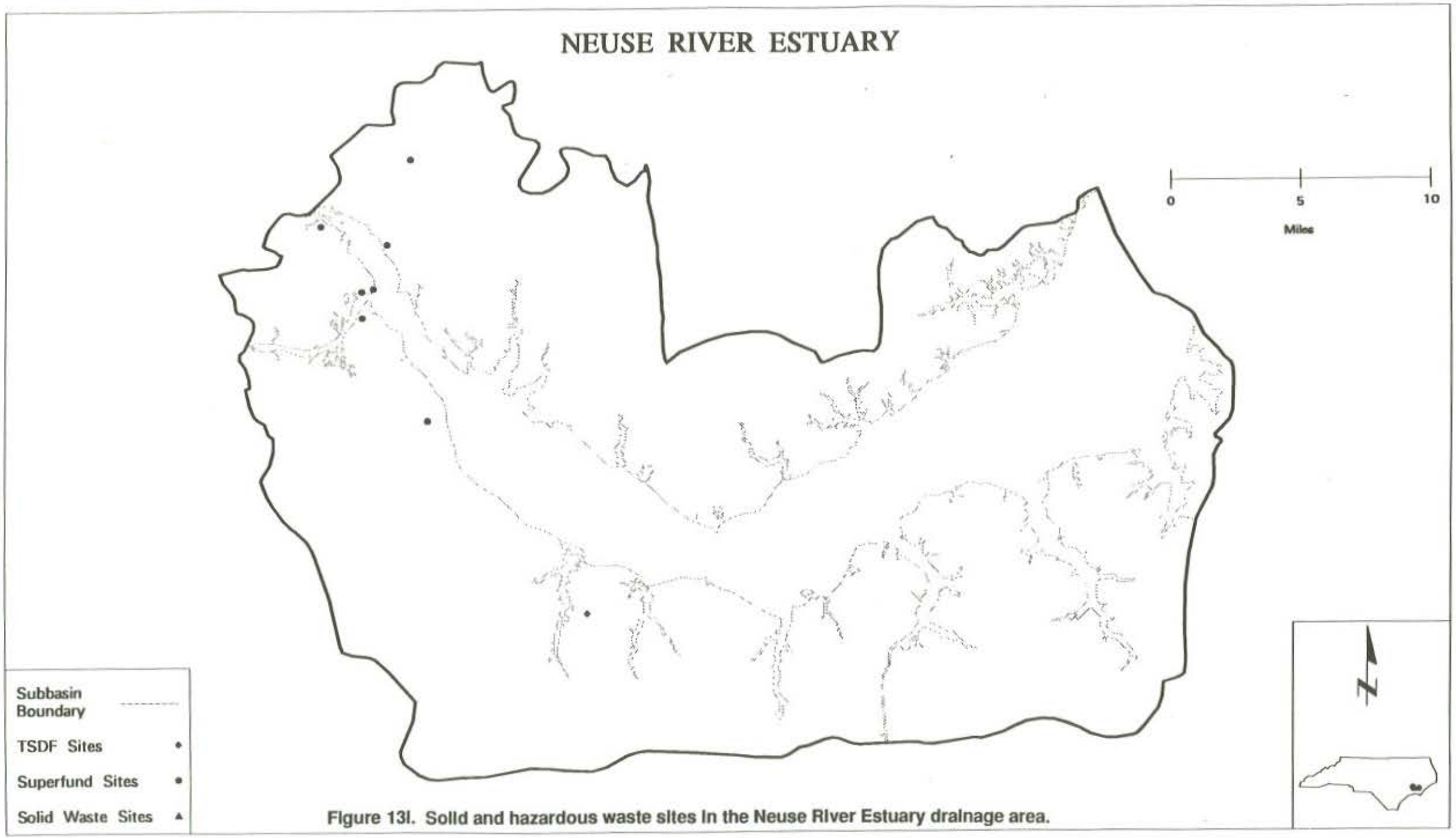


Figure 13l. Solid and hazardous waste sites in the Neuse River Estuary drainage area.

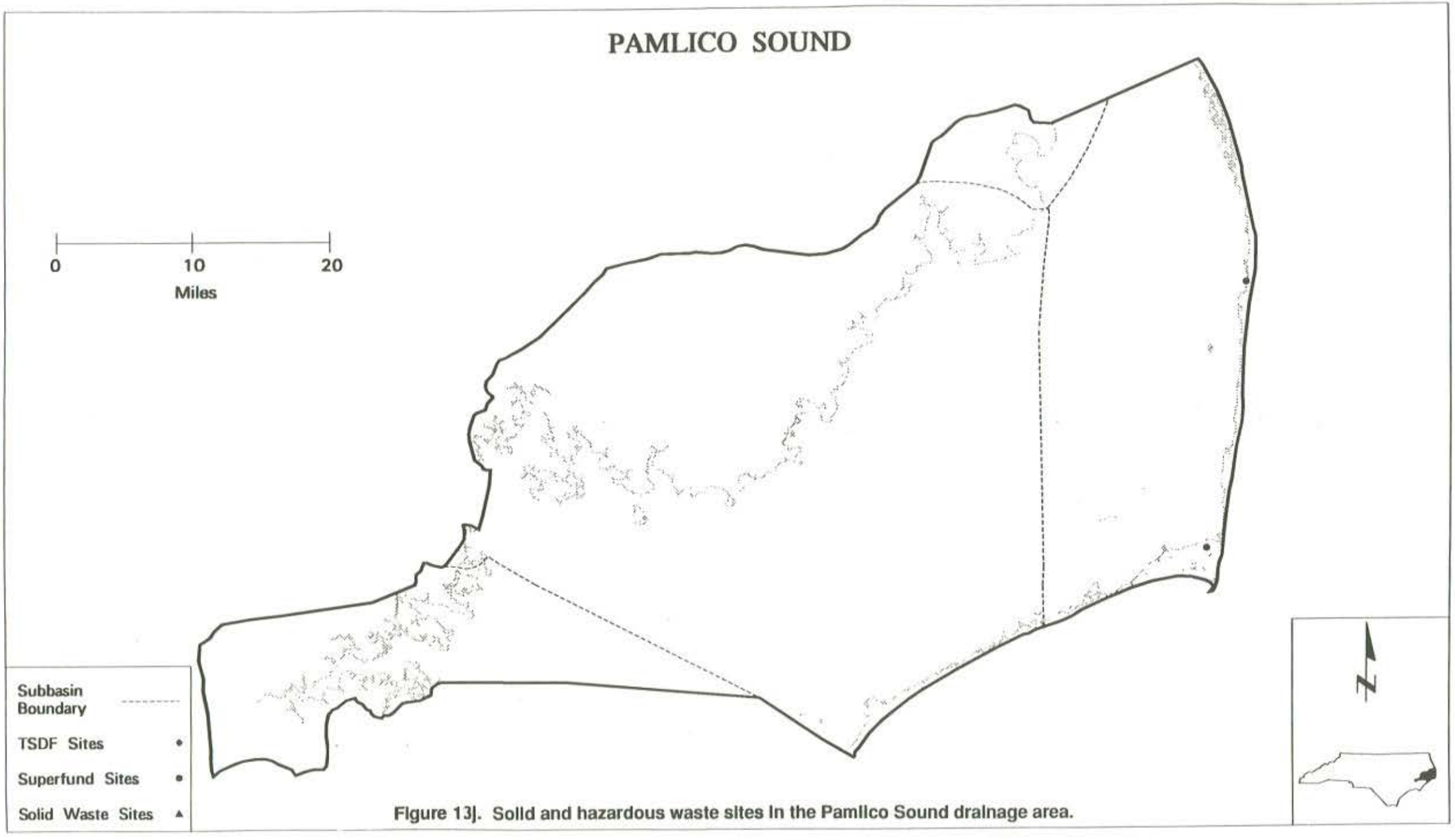


Figure 13j. Solid and hazardous waste sites in the Pamlico Sound drainage area.

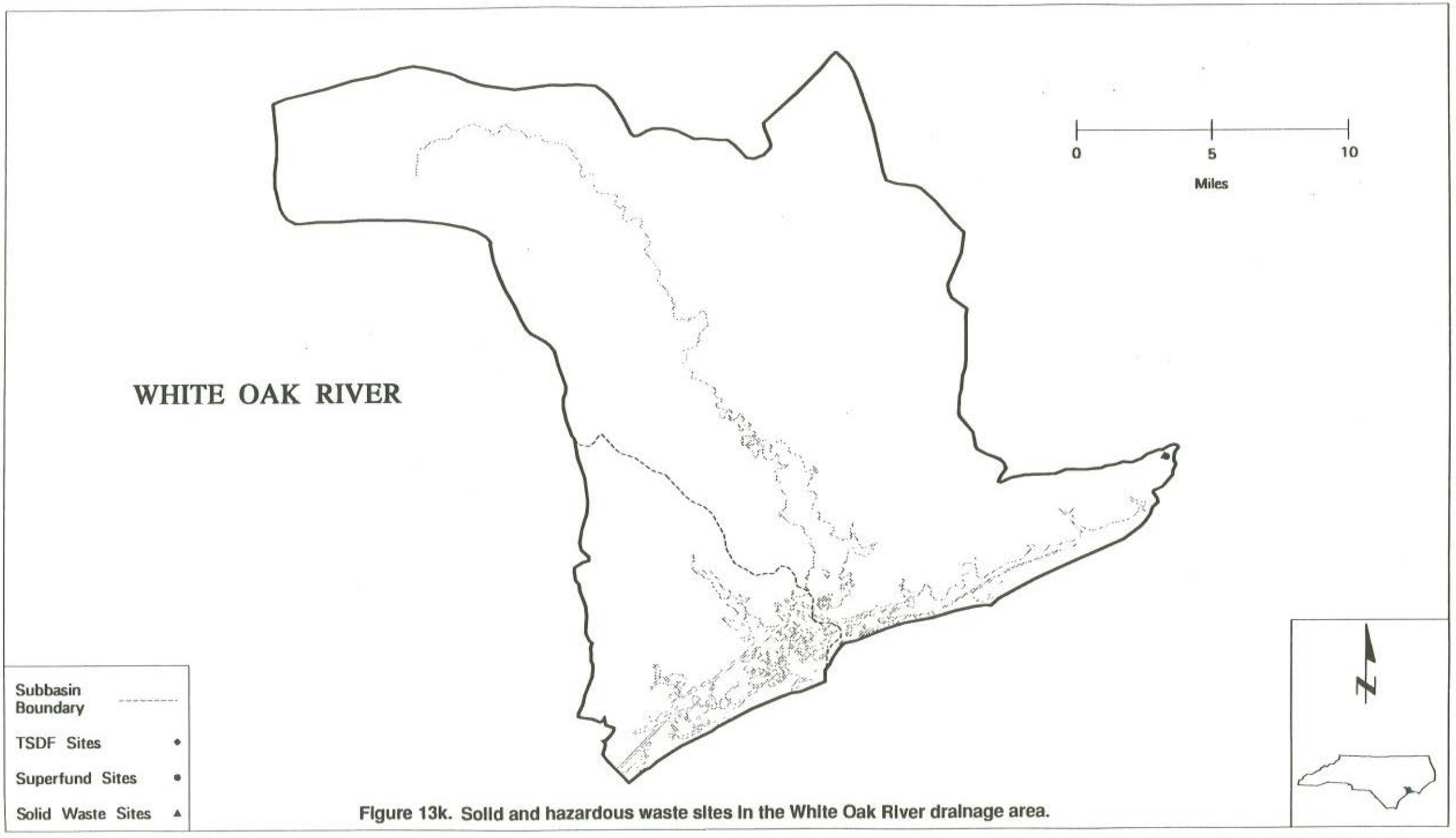


Figure 13k. Solid and hazardous waste sites in the White Oak River drainage area.

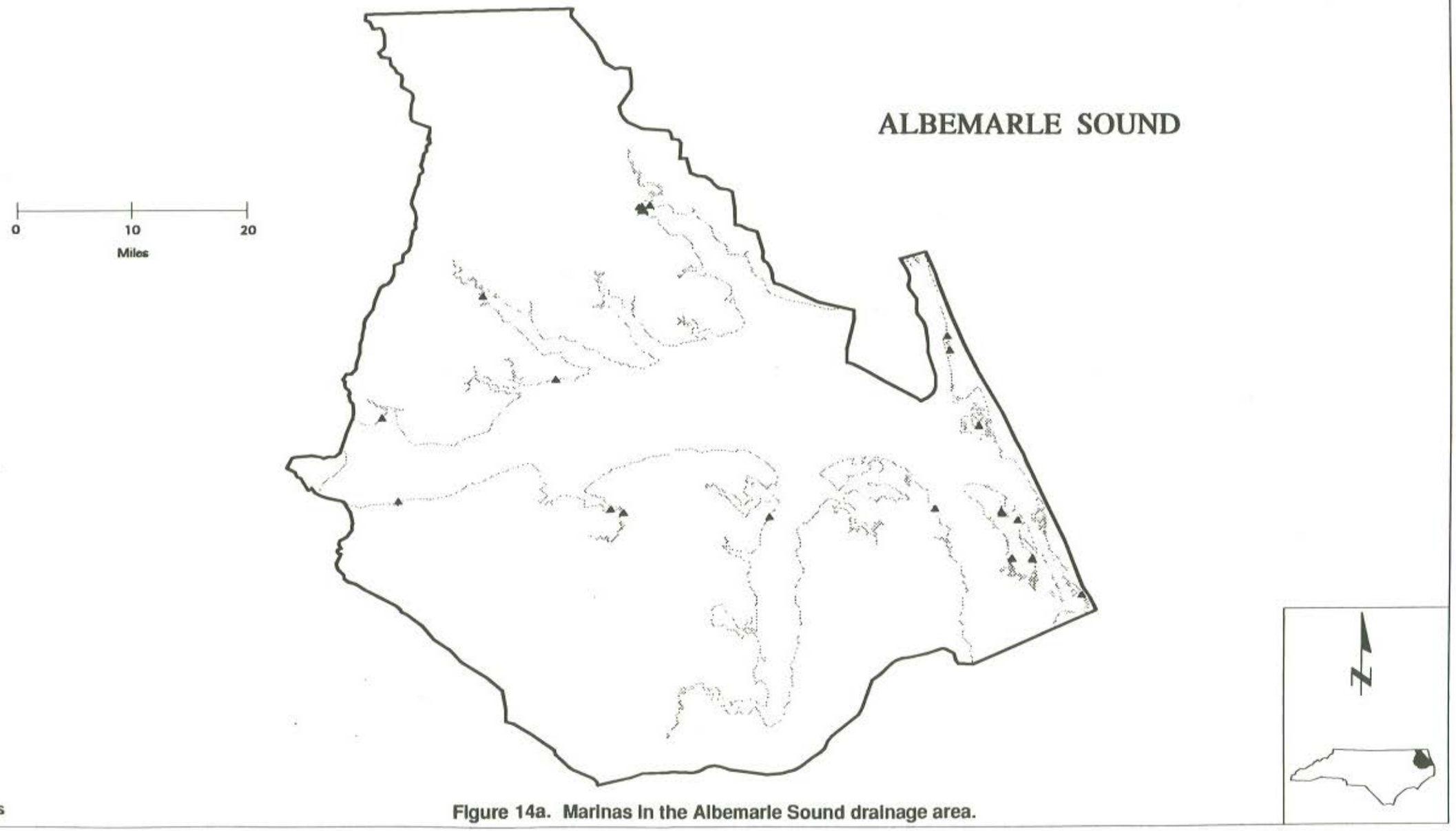
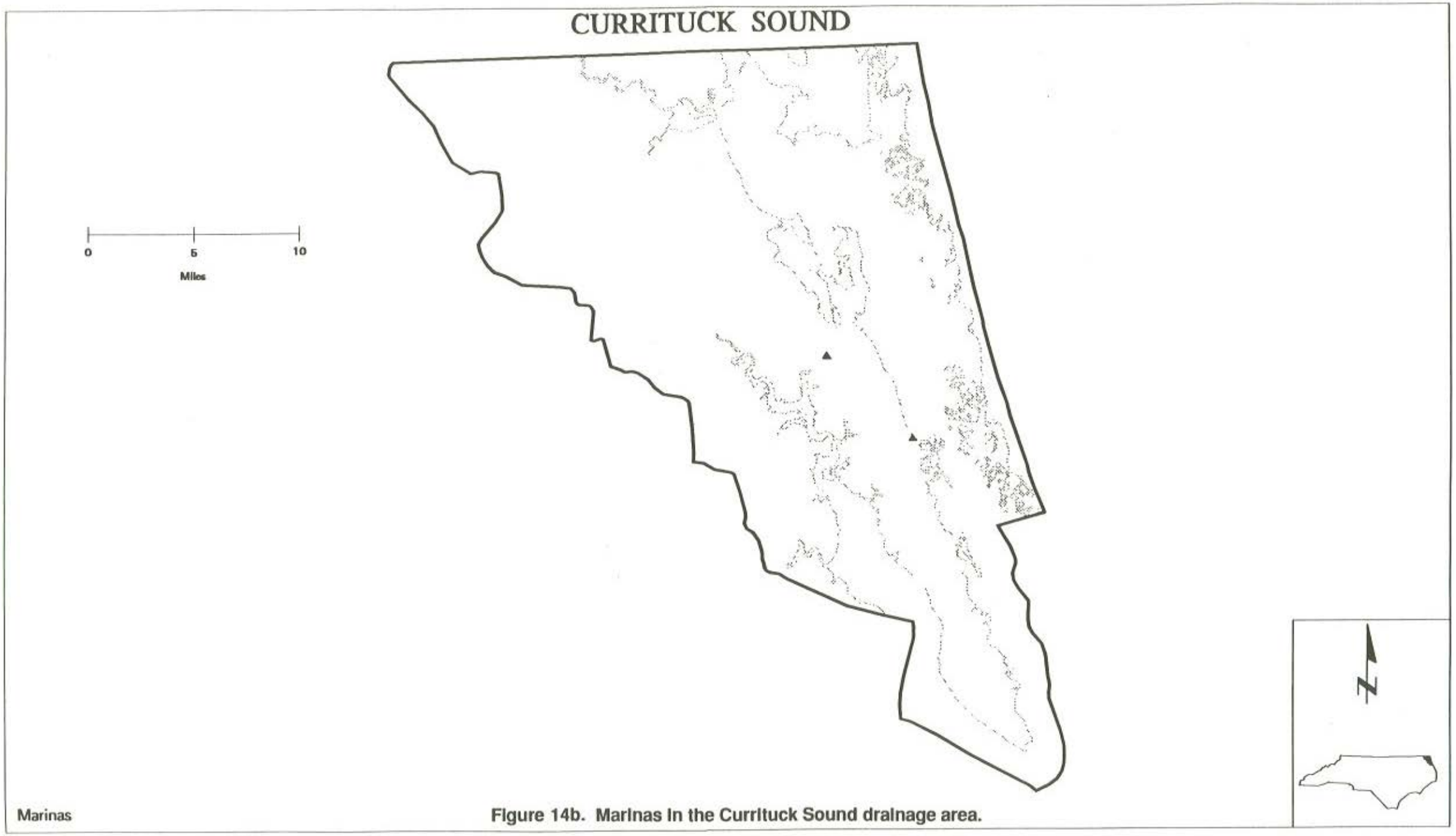


Figure 14a. Marinas in the Albemarle Sound drainage area.



Marinas

Figure 14b. Marinas in the Currituck Sound drainage area.

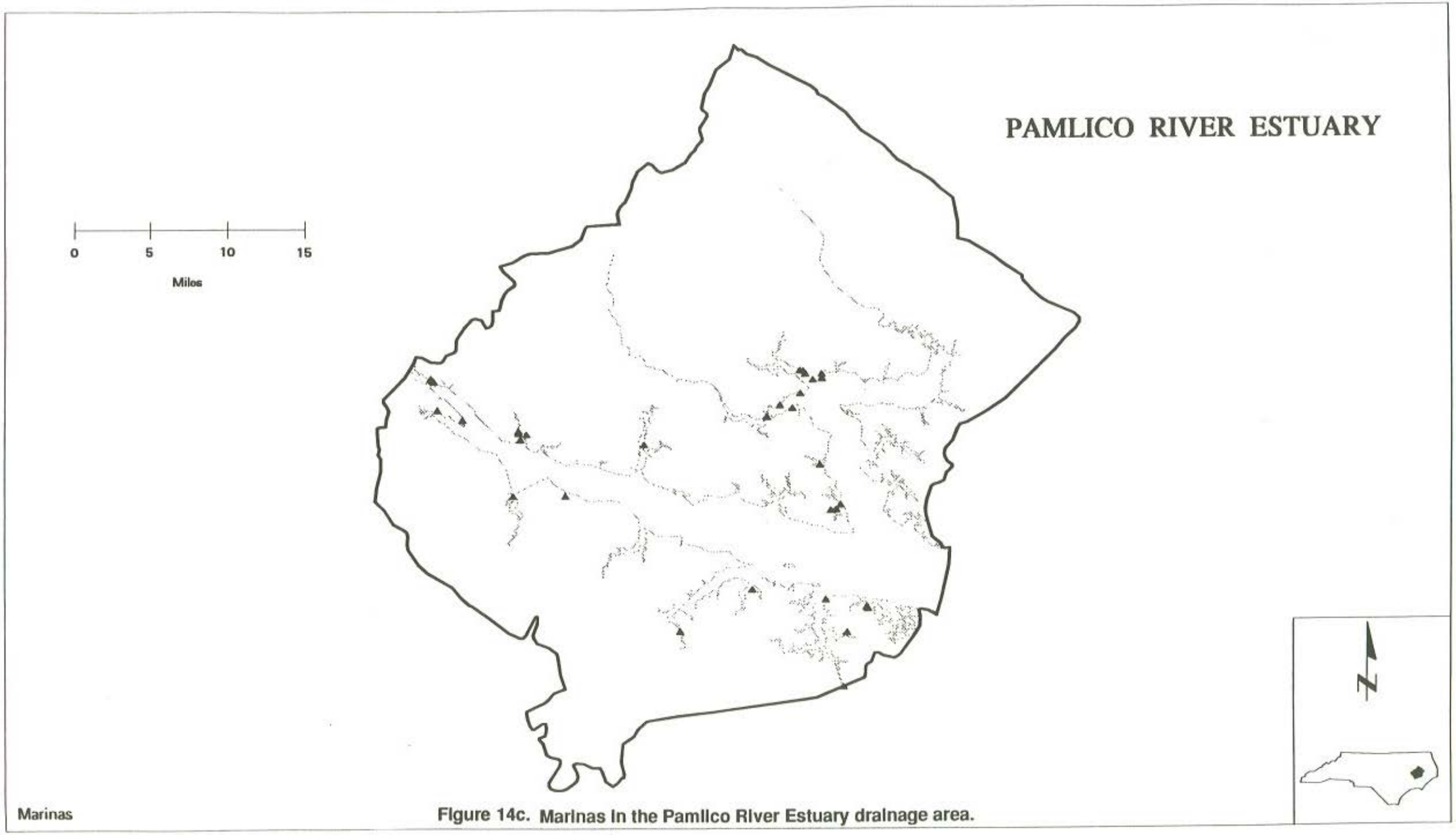


Figure 14c. Marinas in the Pamlico River Estuary drainage area.

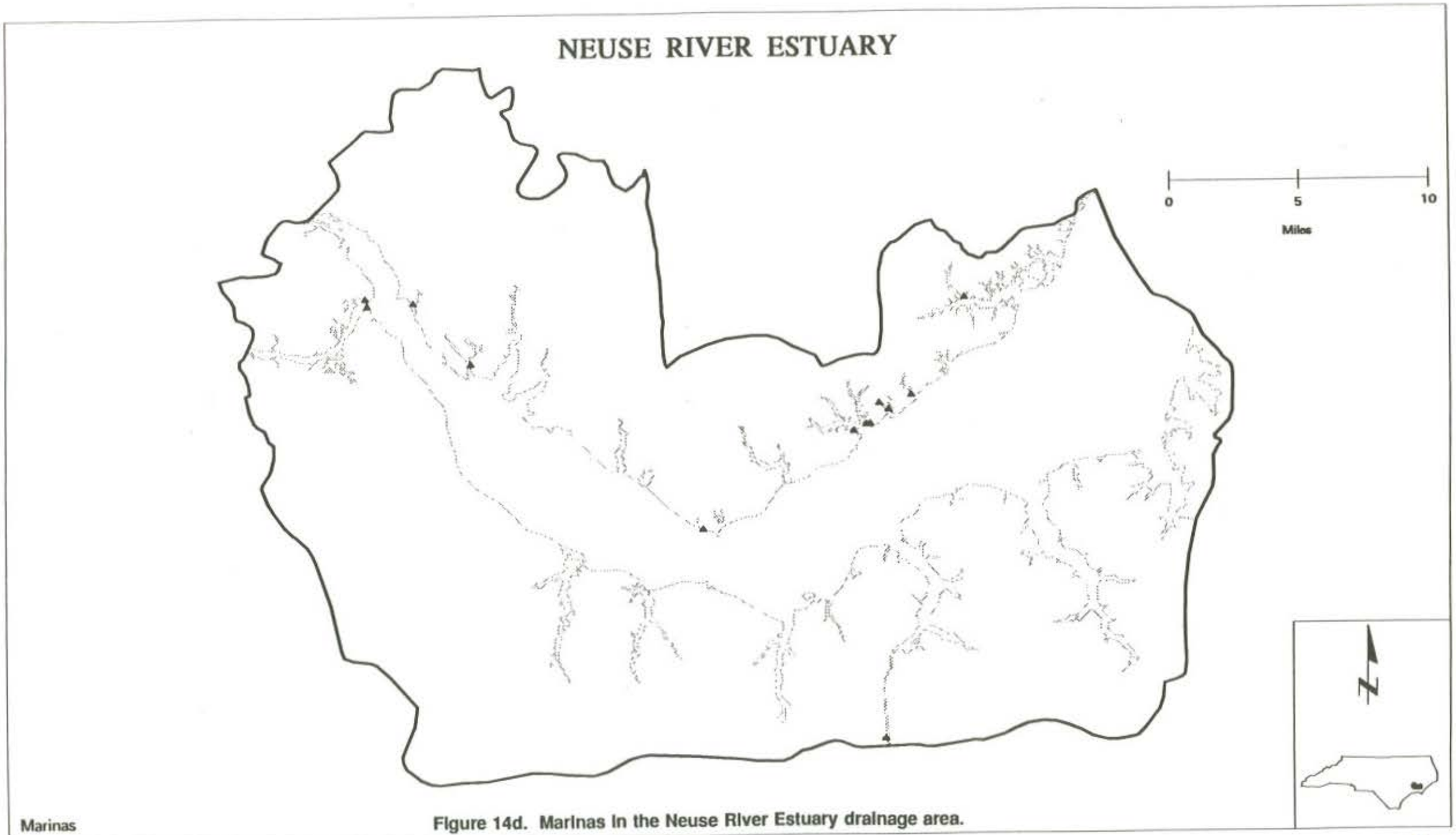


Figure 14d. Marinas in the Neuse River Estuary drainage area.

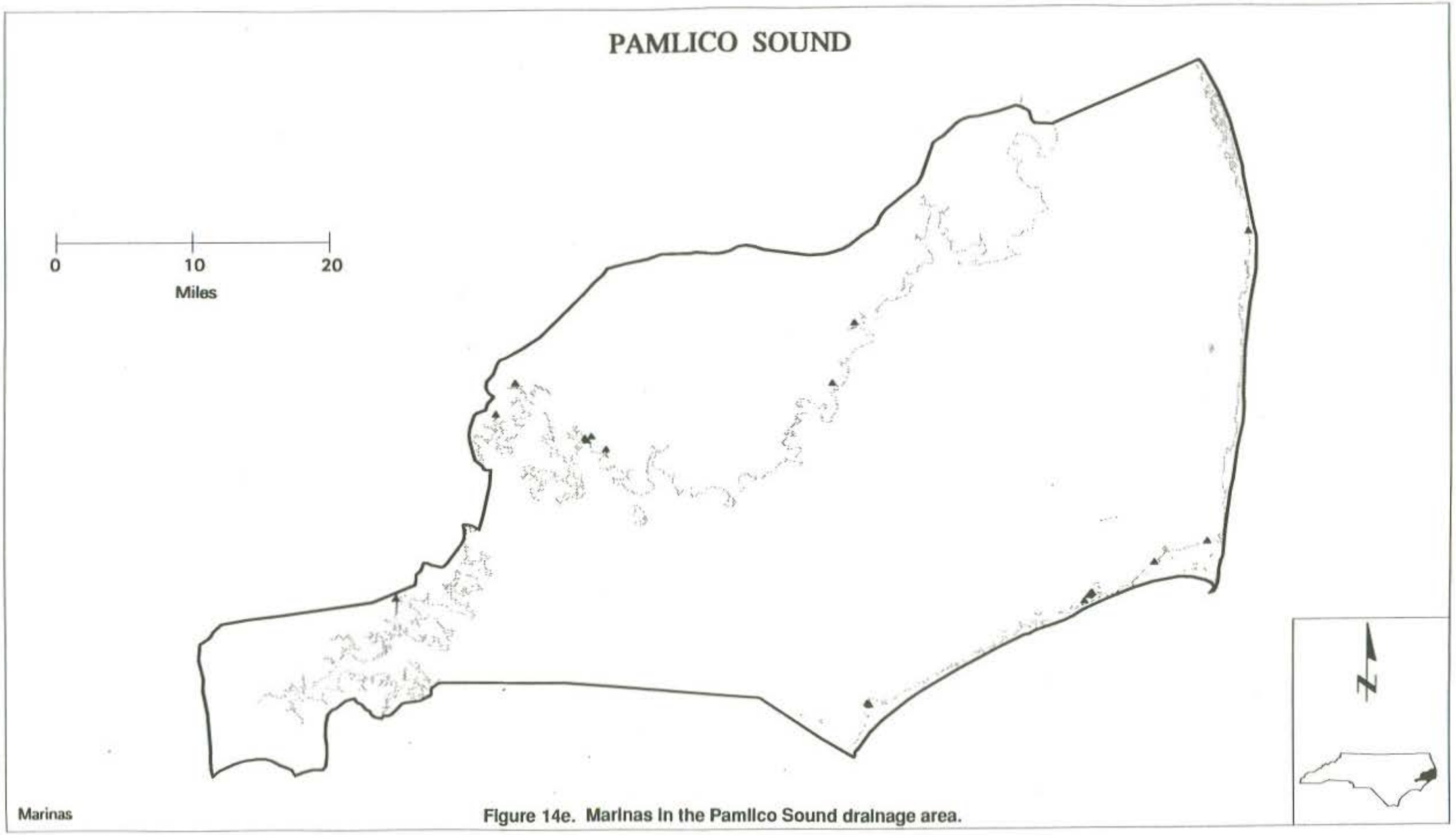


Figure 14e. Marinas in the Pamlico Sound drainage area.

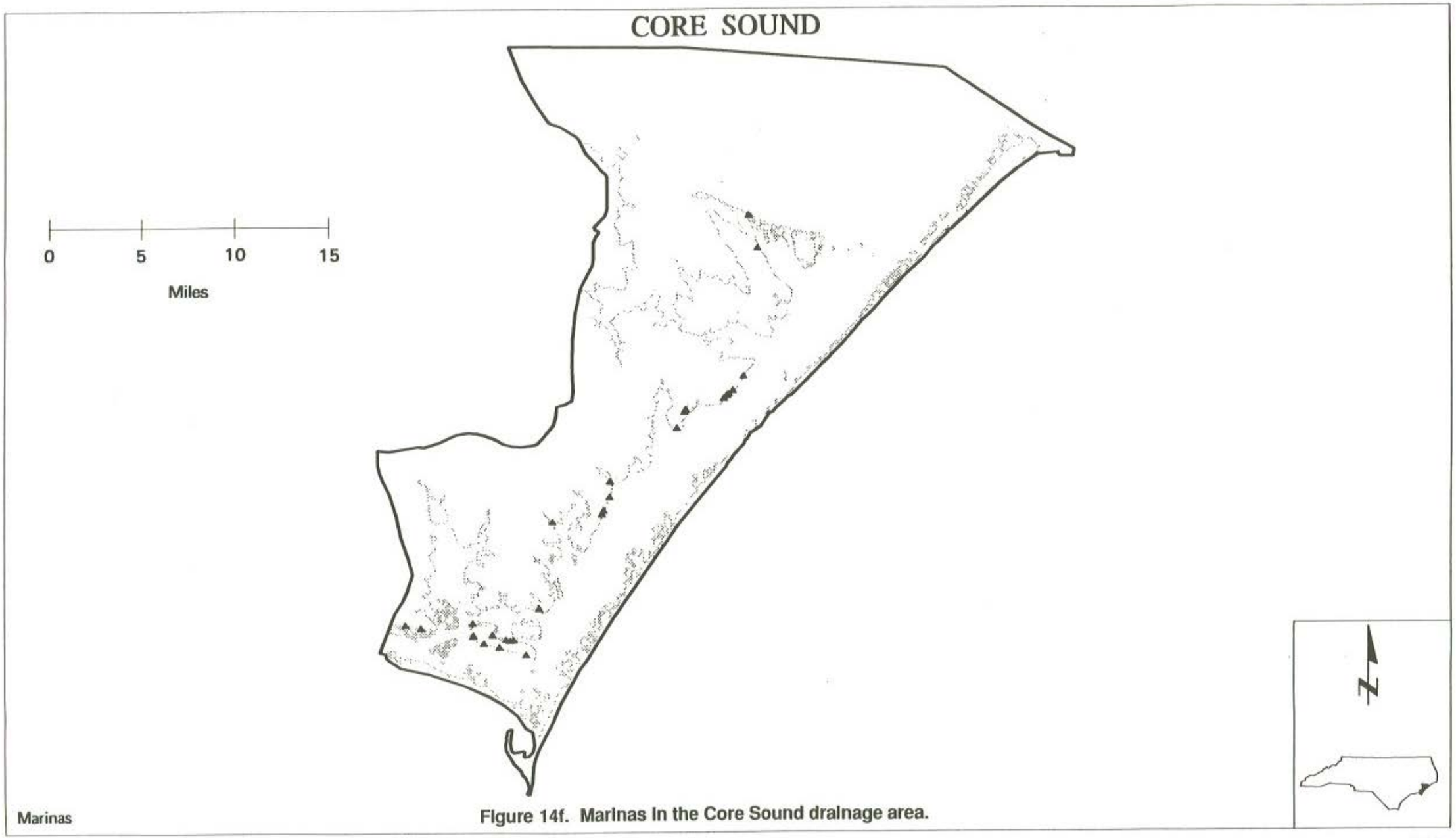


Figure 14f. Marinas in the Core Sound drainage area.

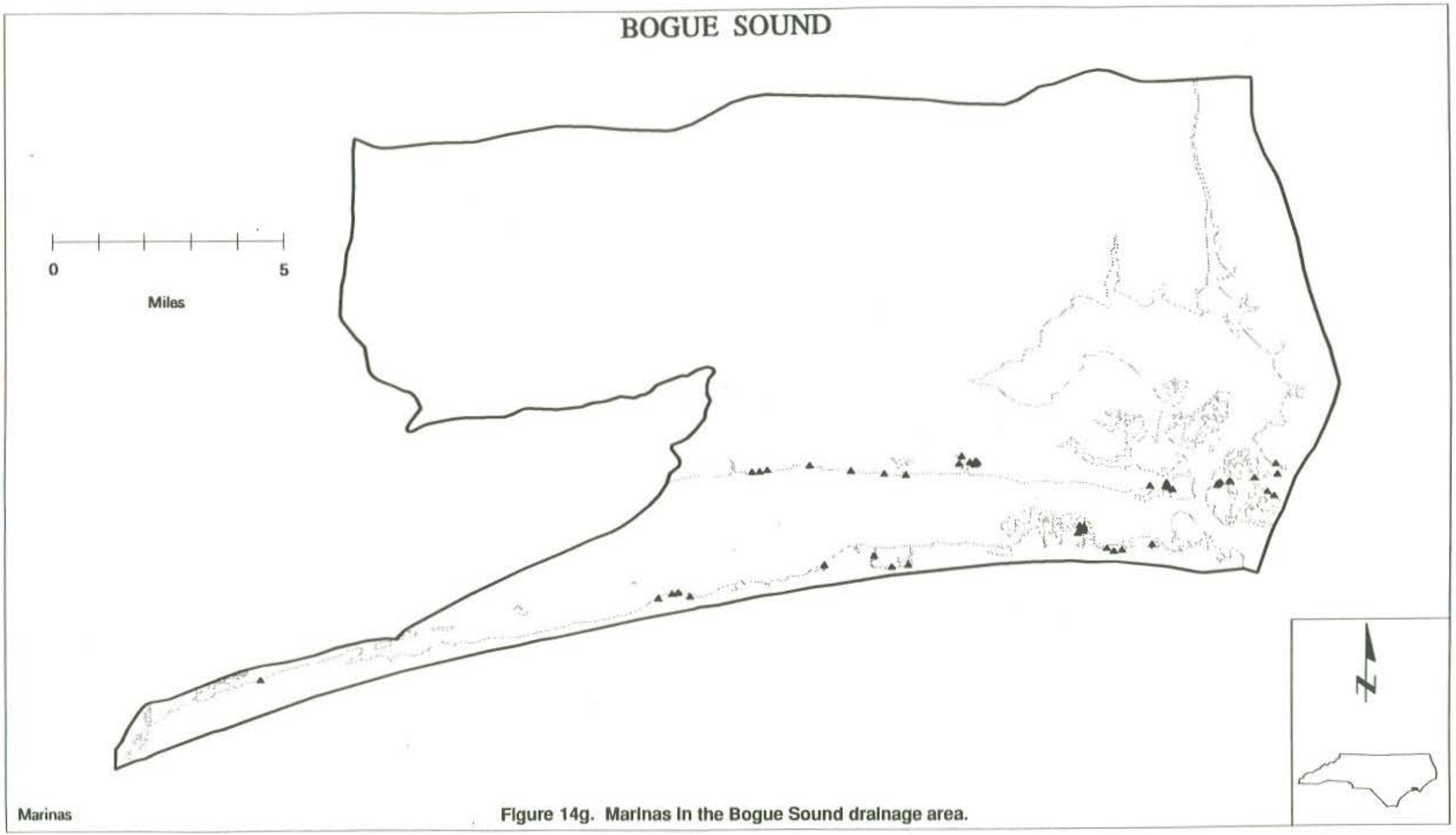
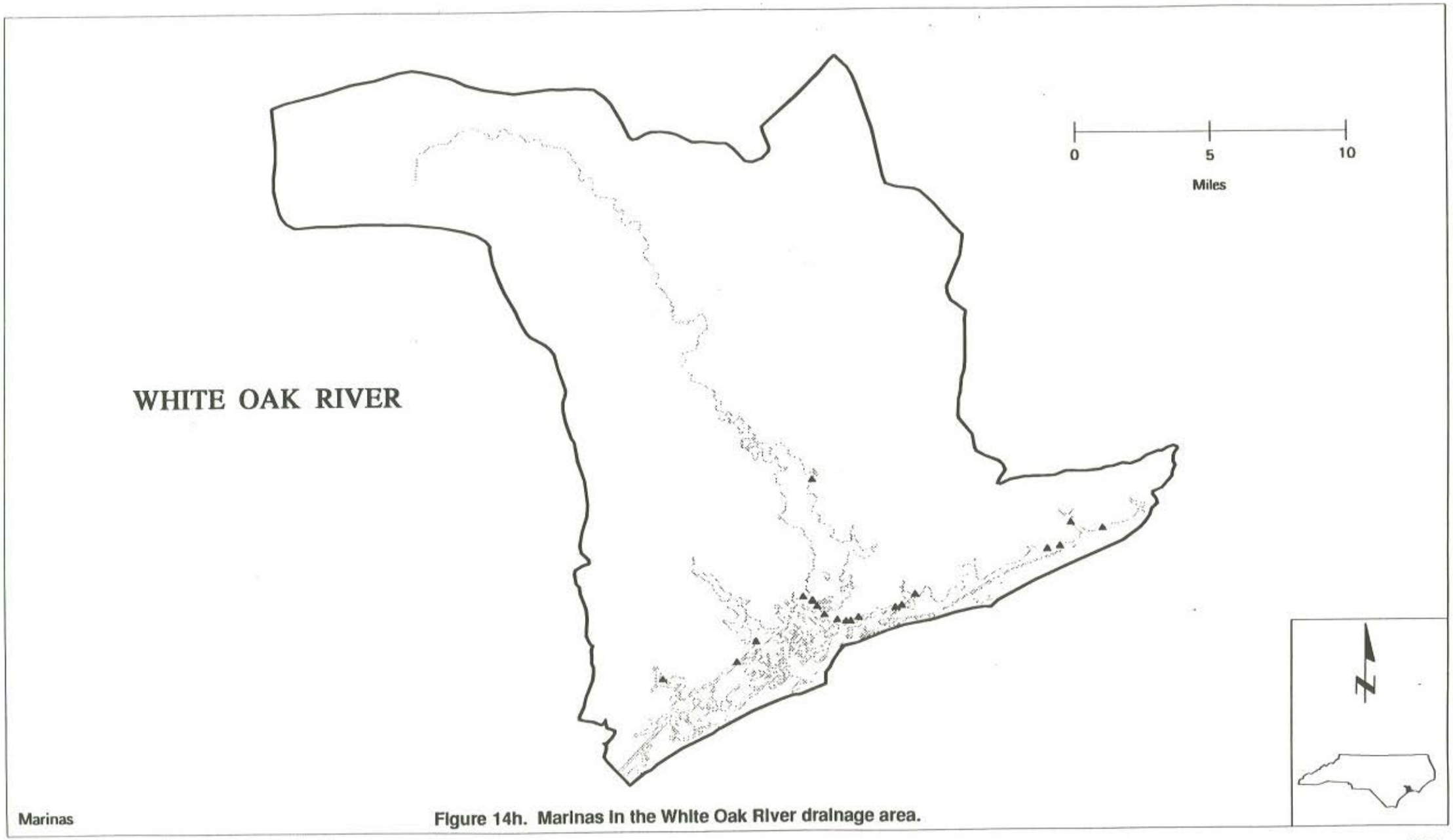
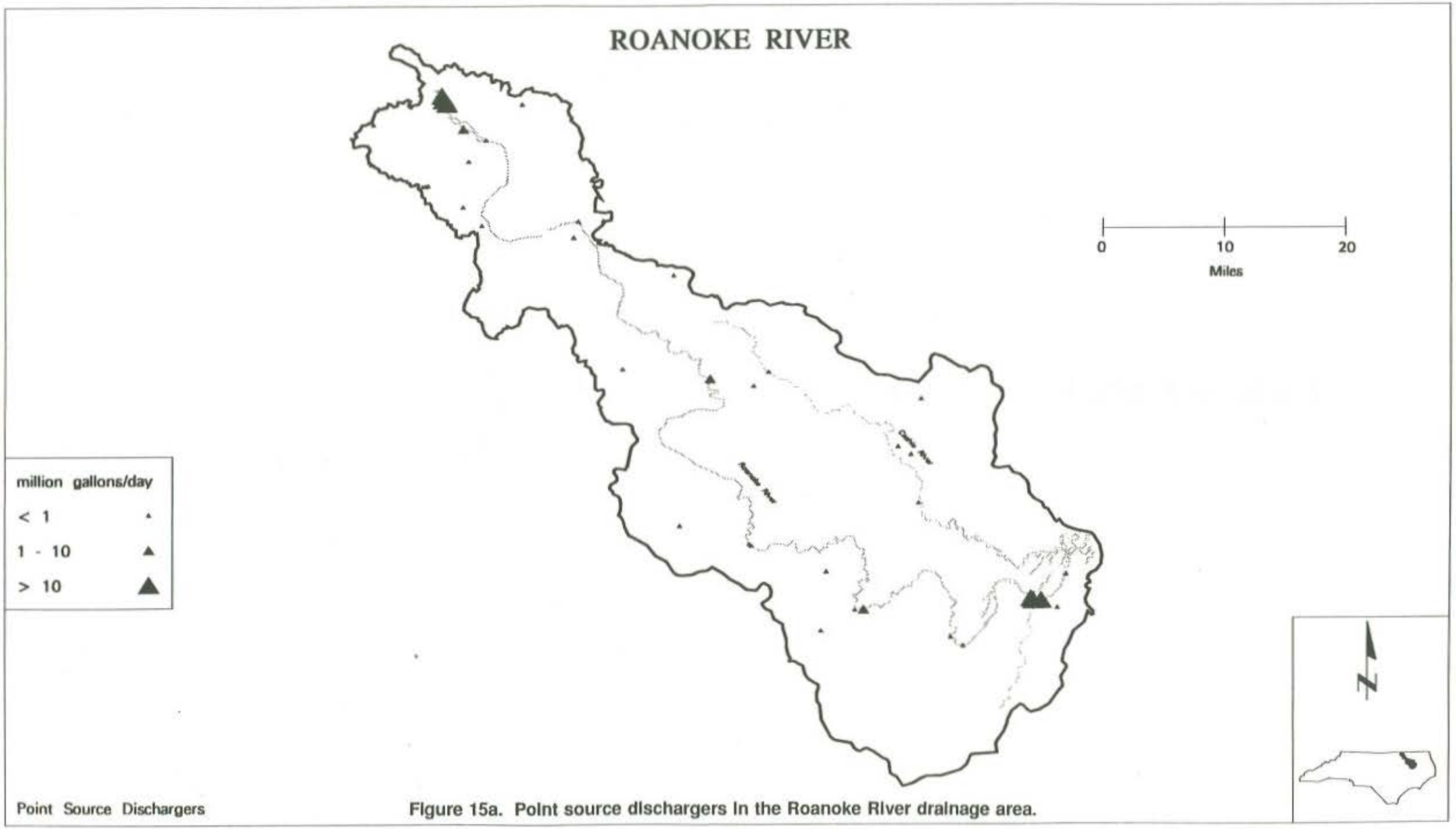


Figure 14g. Marinas in the Bogue Sound drainage area.



Marinas

Figure 14h. Marinas in the White Oak River drainage area.



Point Source Dischargers

Figure 15a. Point source dischargers in the Roanoke River drainage area.

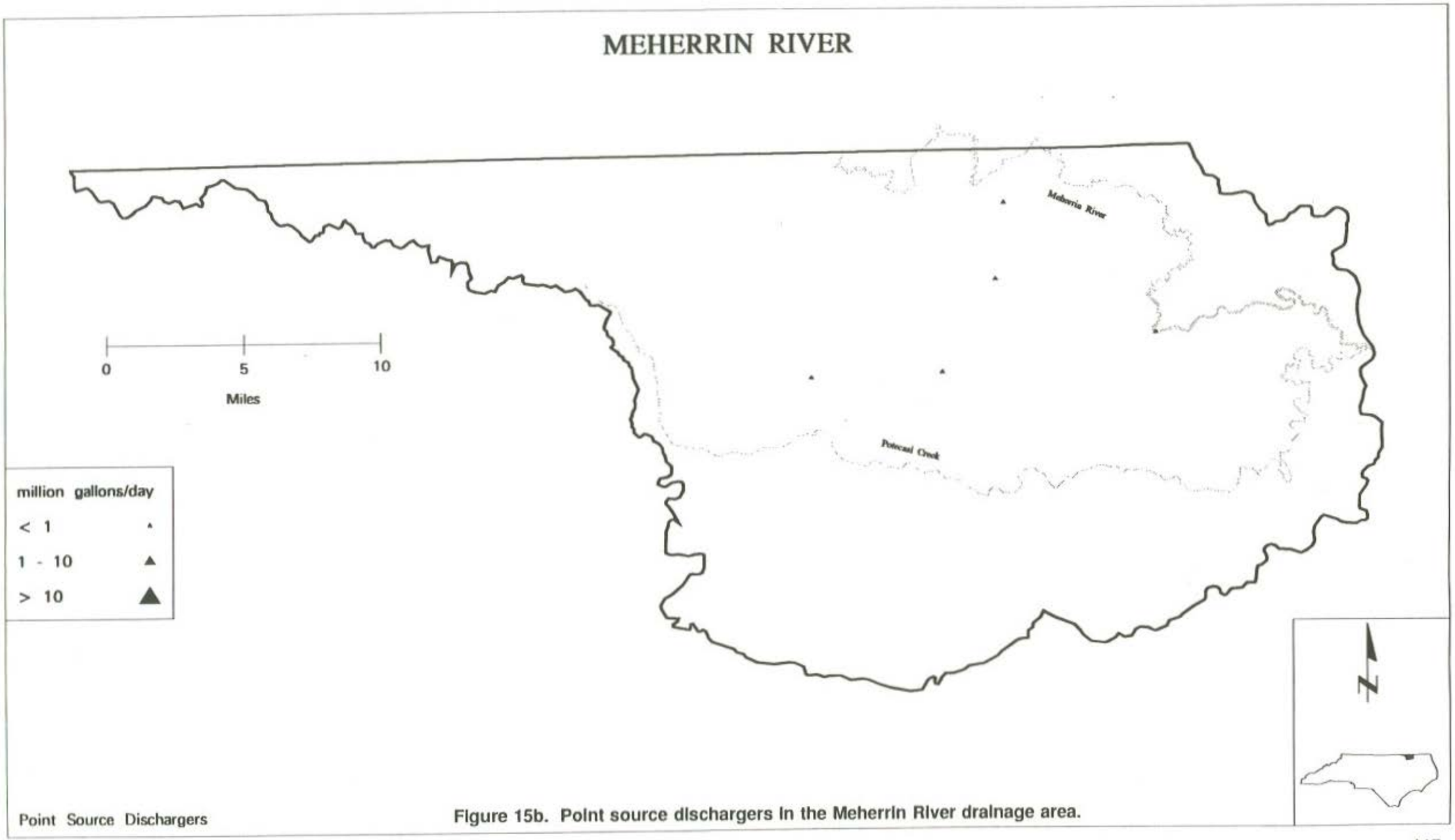


Figure 15b. Point source dischargers in the Meherrin River drainage area.

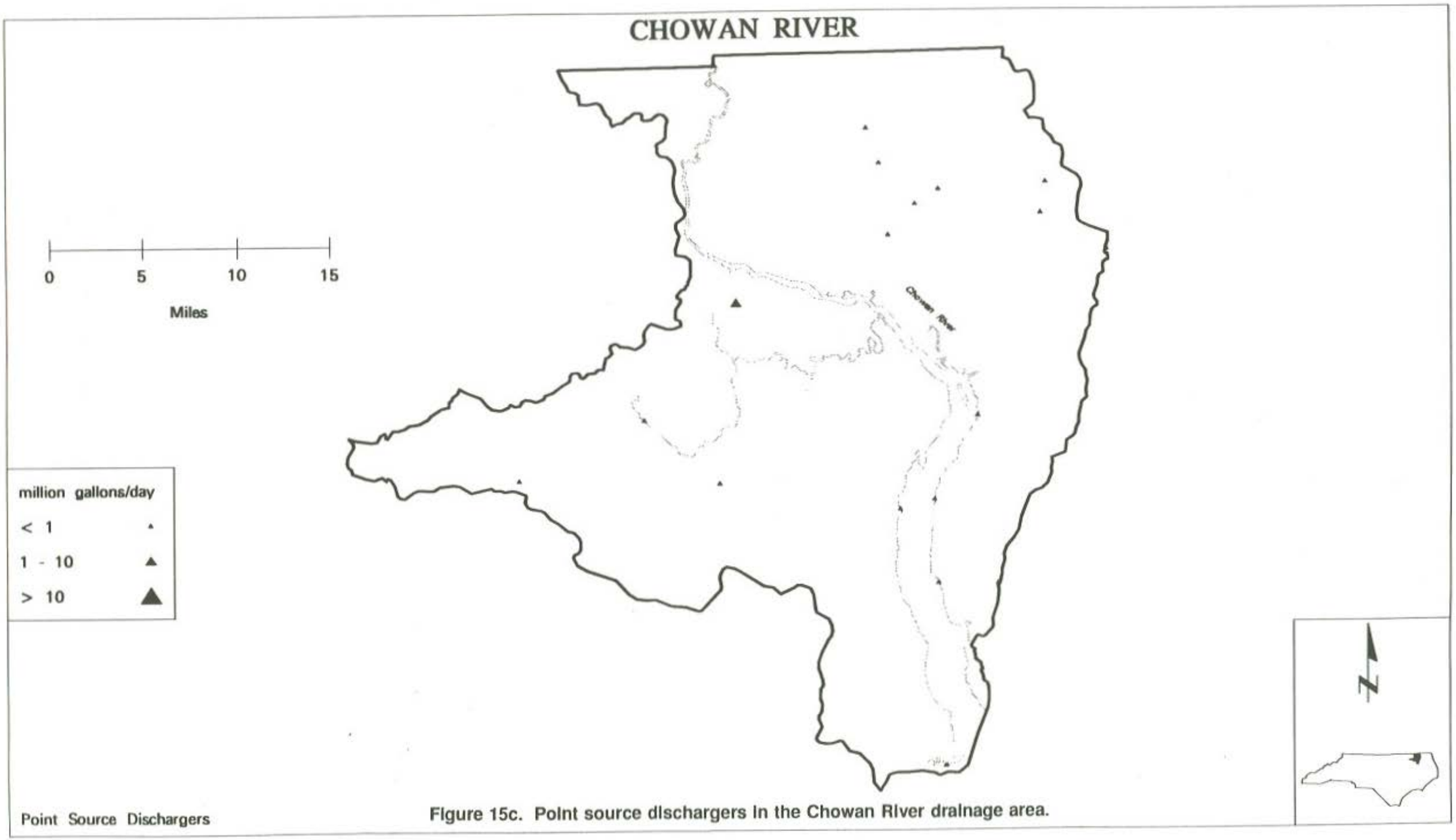
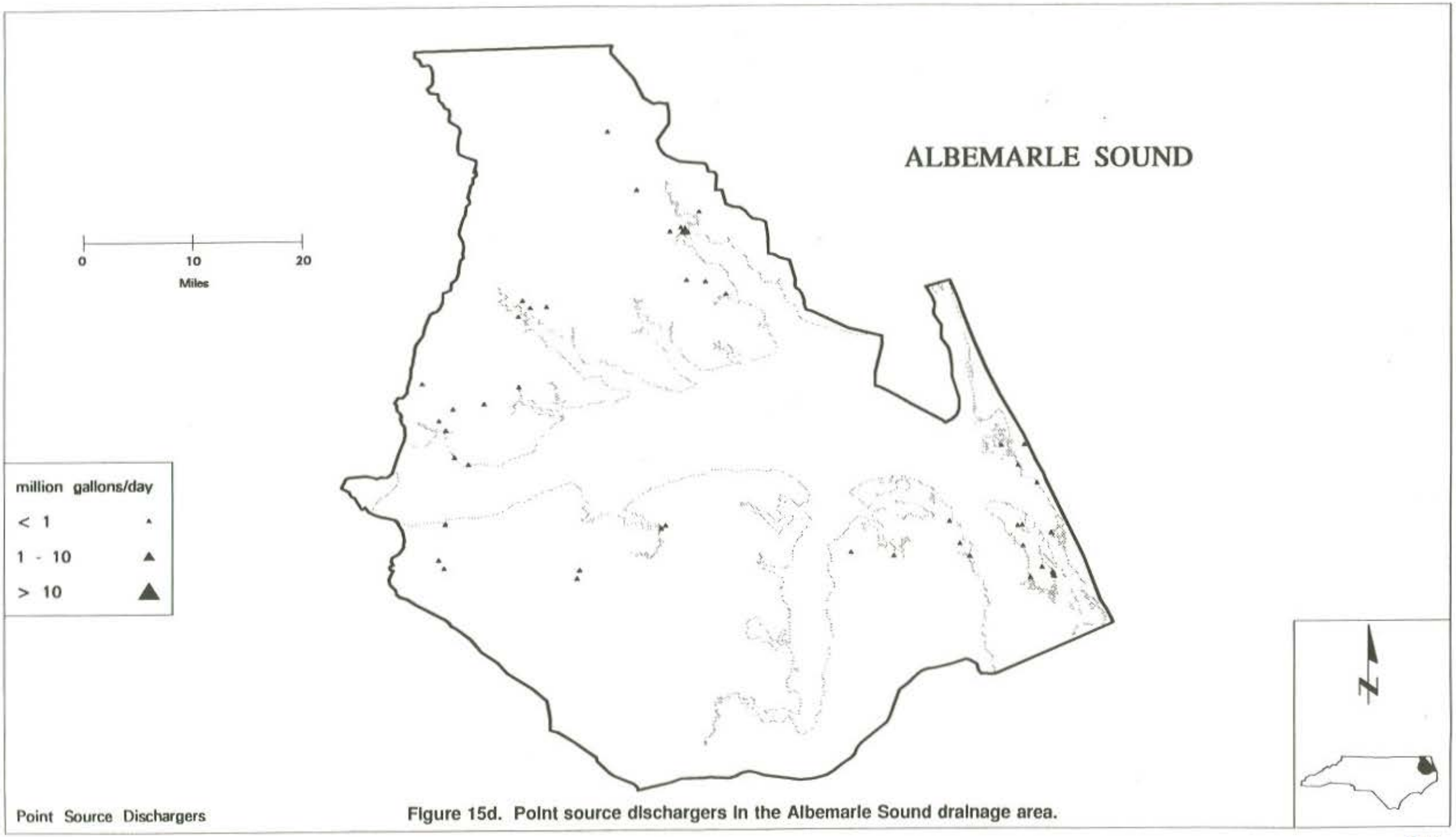


Figure 15c. Point source dischargers in the Chowan River drainage area.



Point Source Dischargers

Figure 15d. Point source dischargers in the Albemarle Sound drainage area.

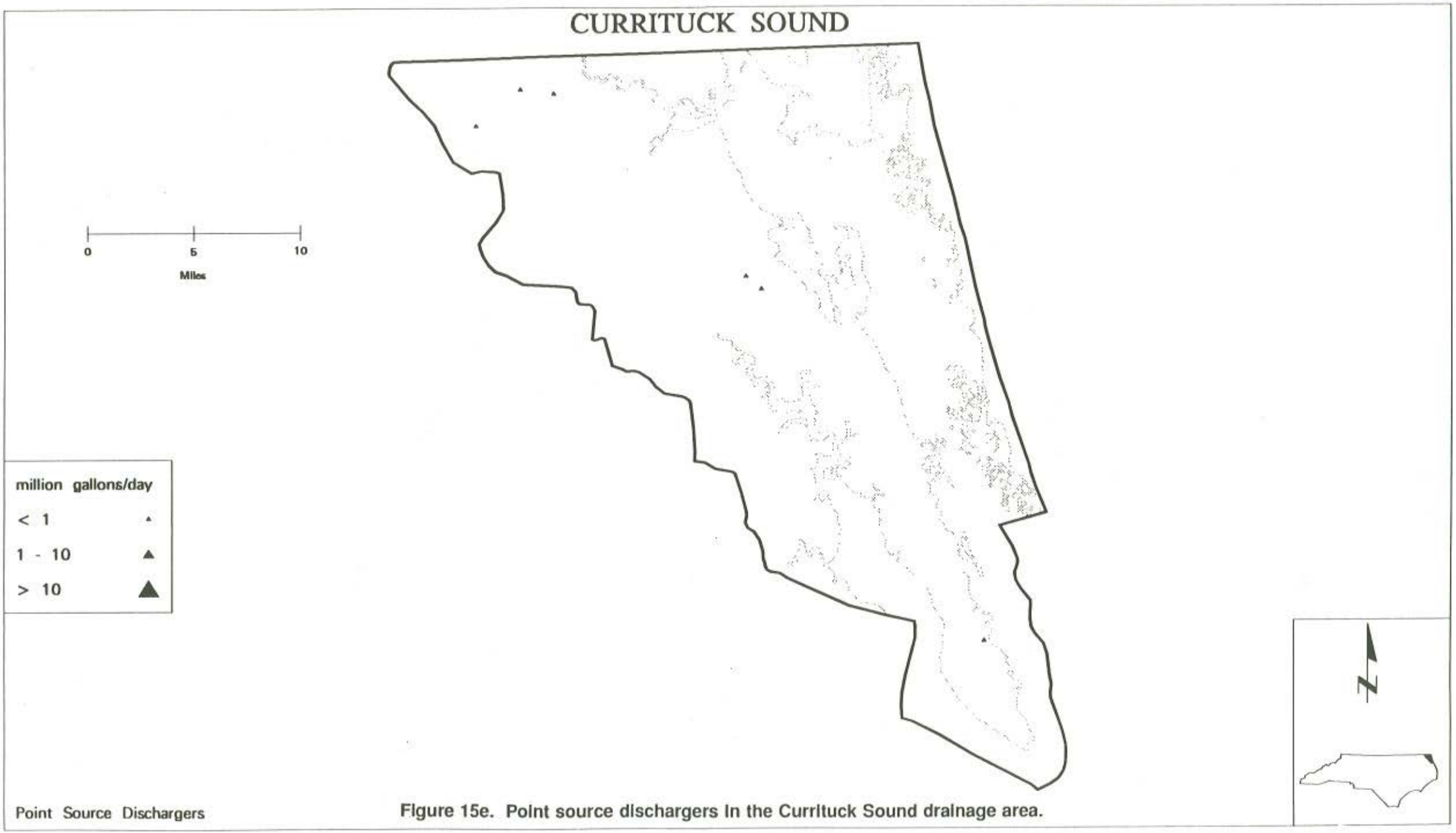


Figure 15e. Point source dischargers in the Currituck Sound drainage area.

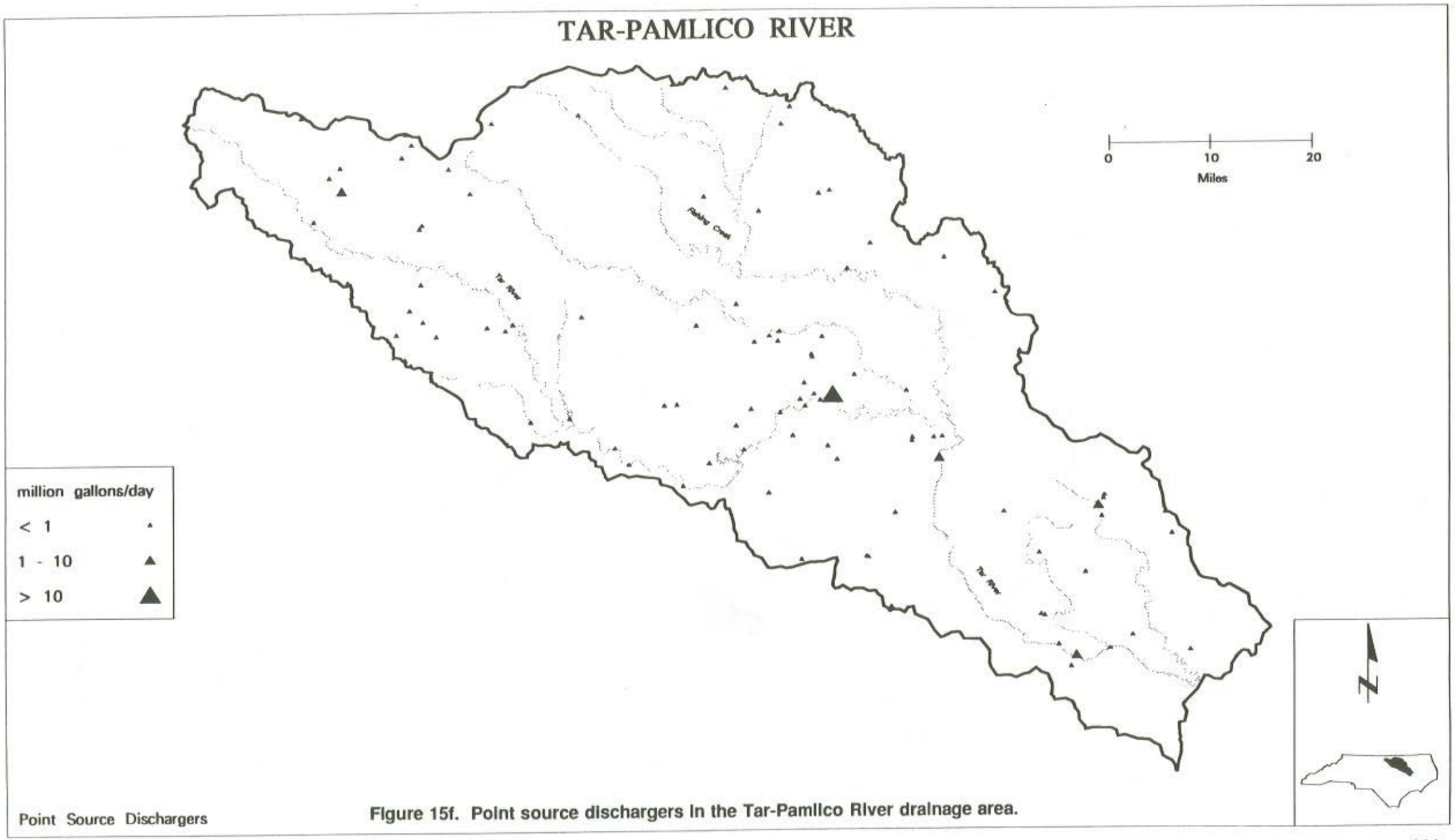


Figure 15f. Point source dischargers in the Tar-Pamlico River drainage area.

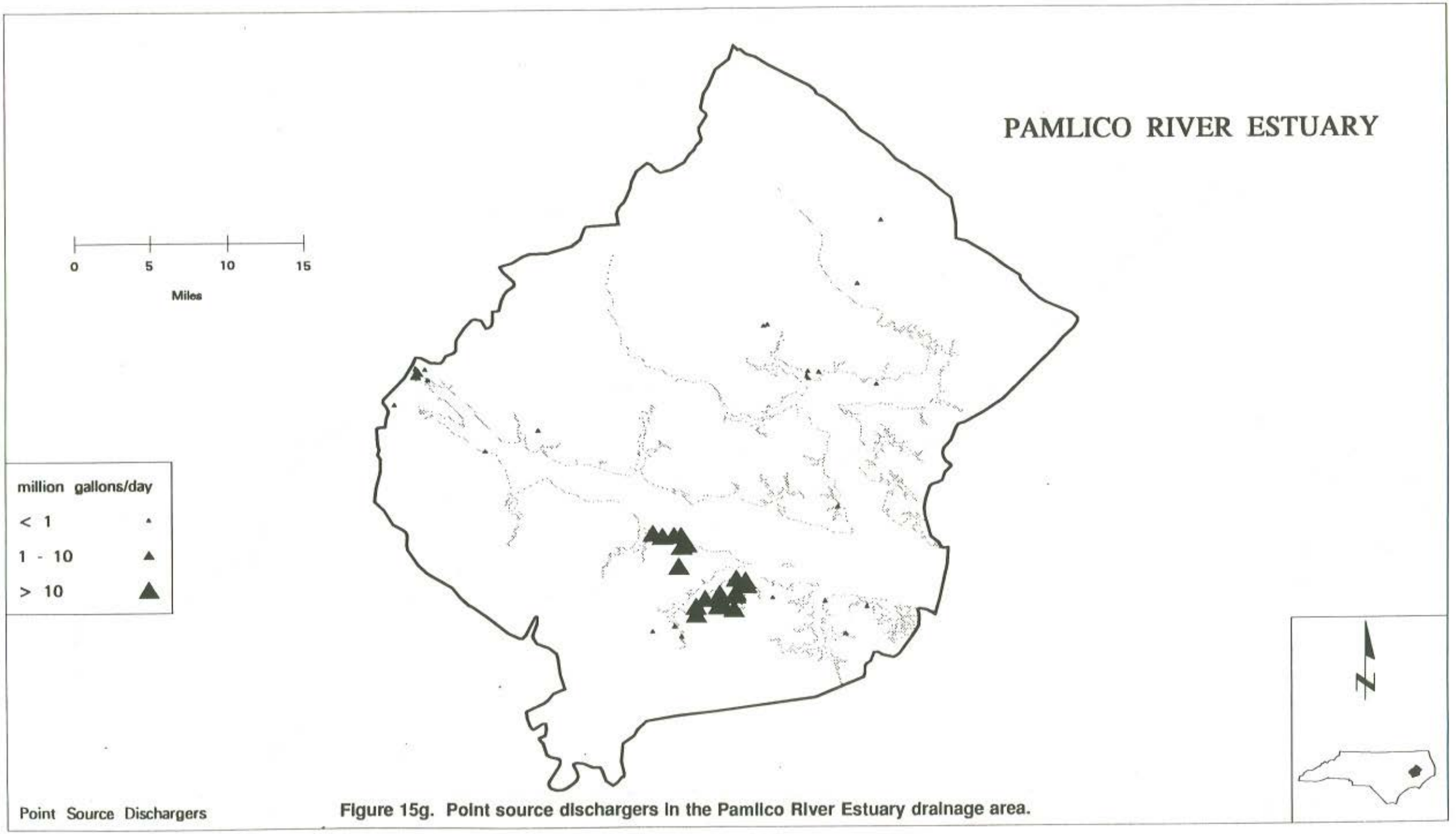
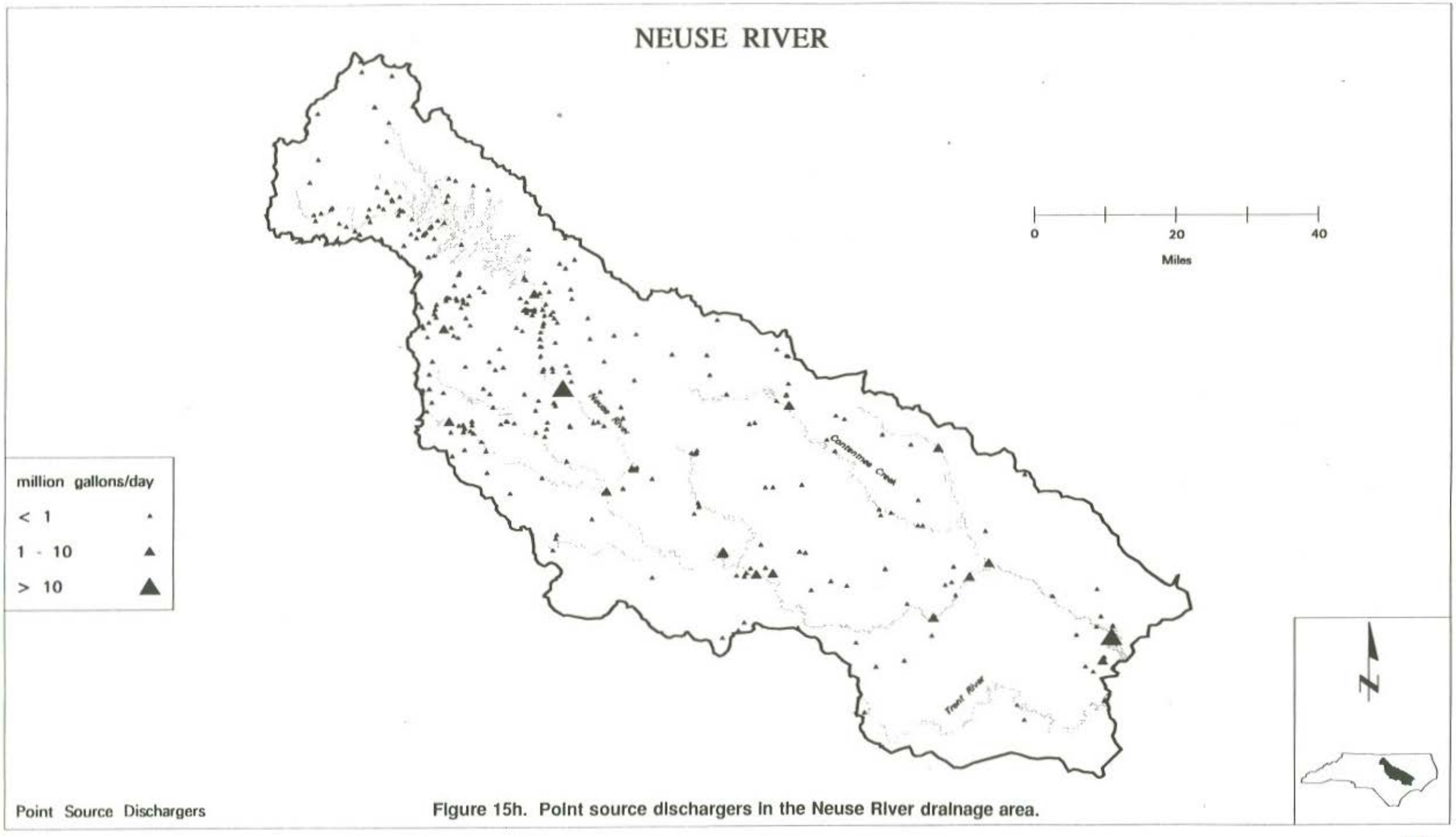


Figure 15g. Point source dischargers in the Pamlico River Estuary drainage area.



Point Source Dischargers

Figure 15h. Point source dischargers in the Neuse River drainage area.

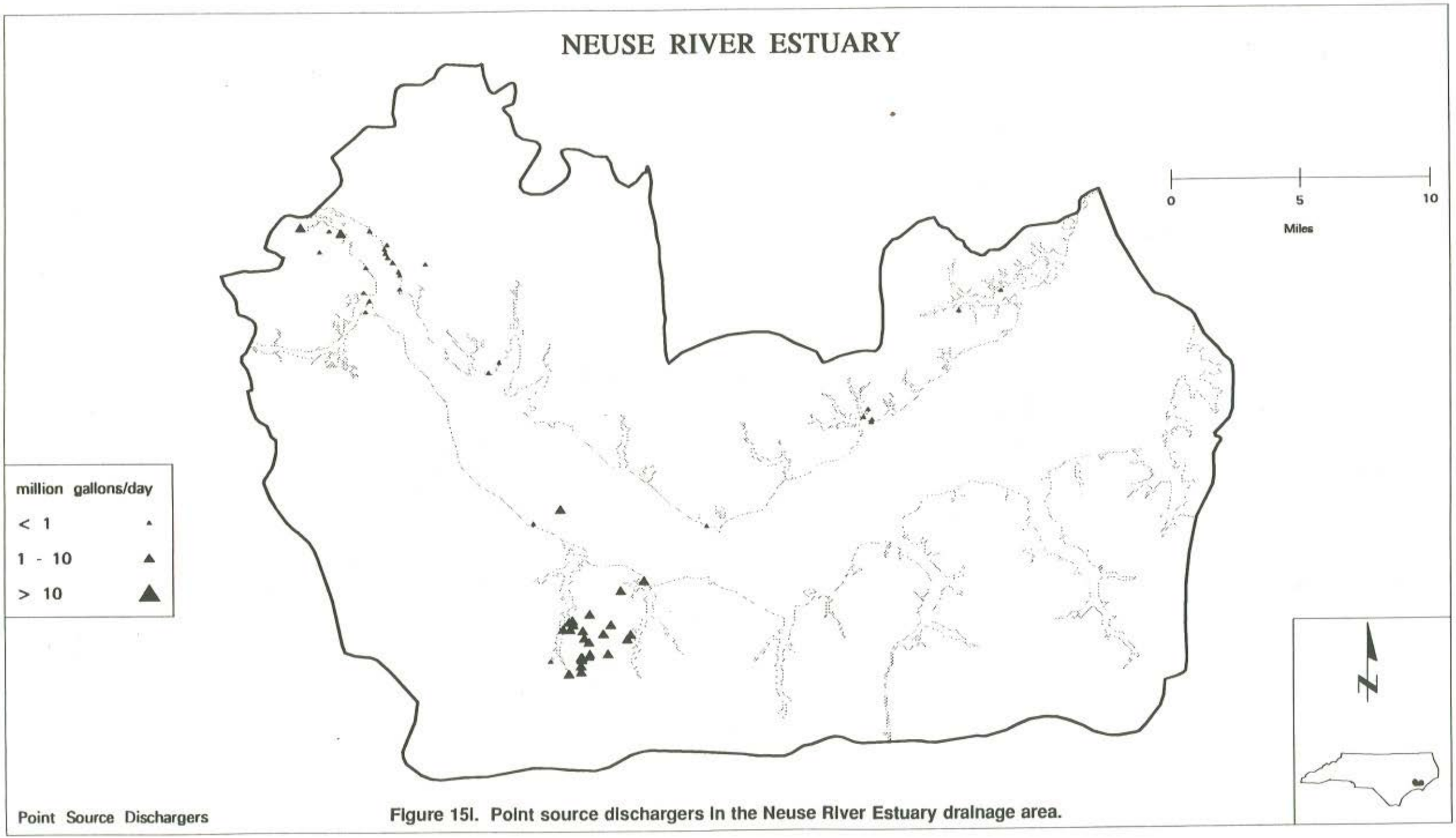


Figure 15l. Point source dischargers in the Neuse River Estuary drainage area.

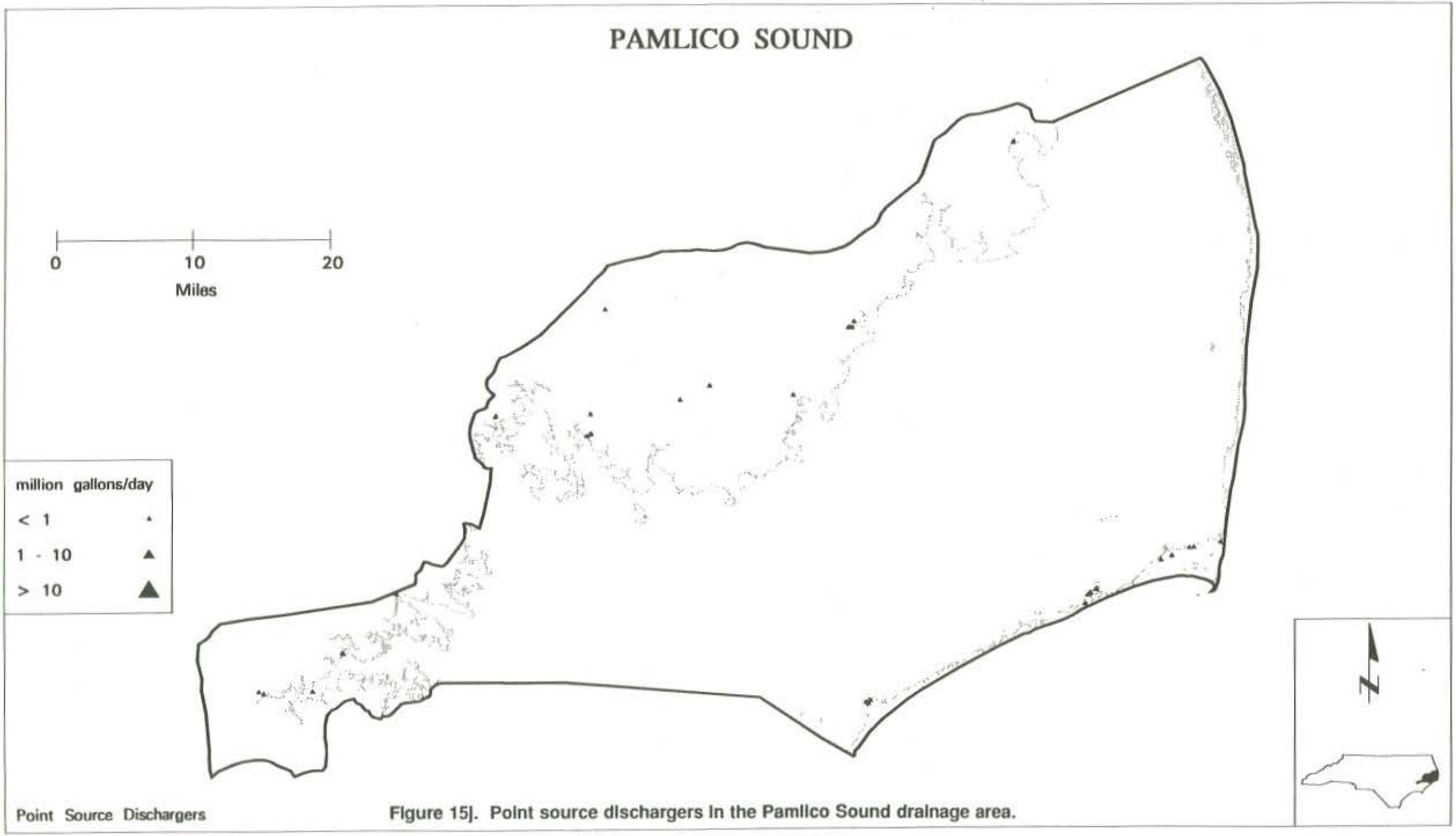


Figure 15J. Point source dischargers in the Pamlico Sound drainage area.

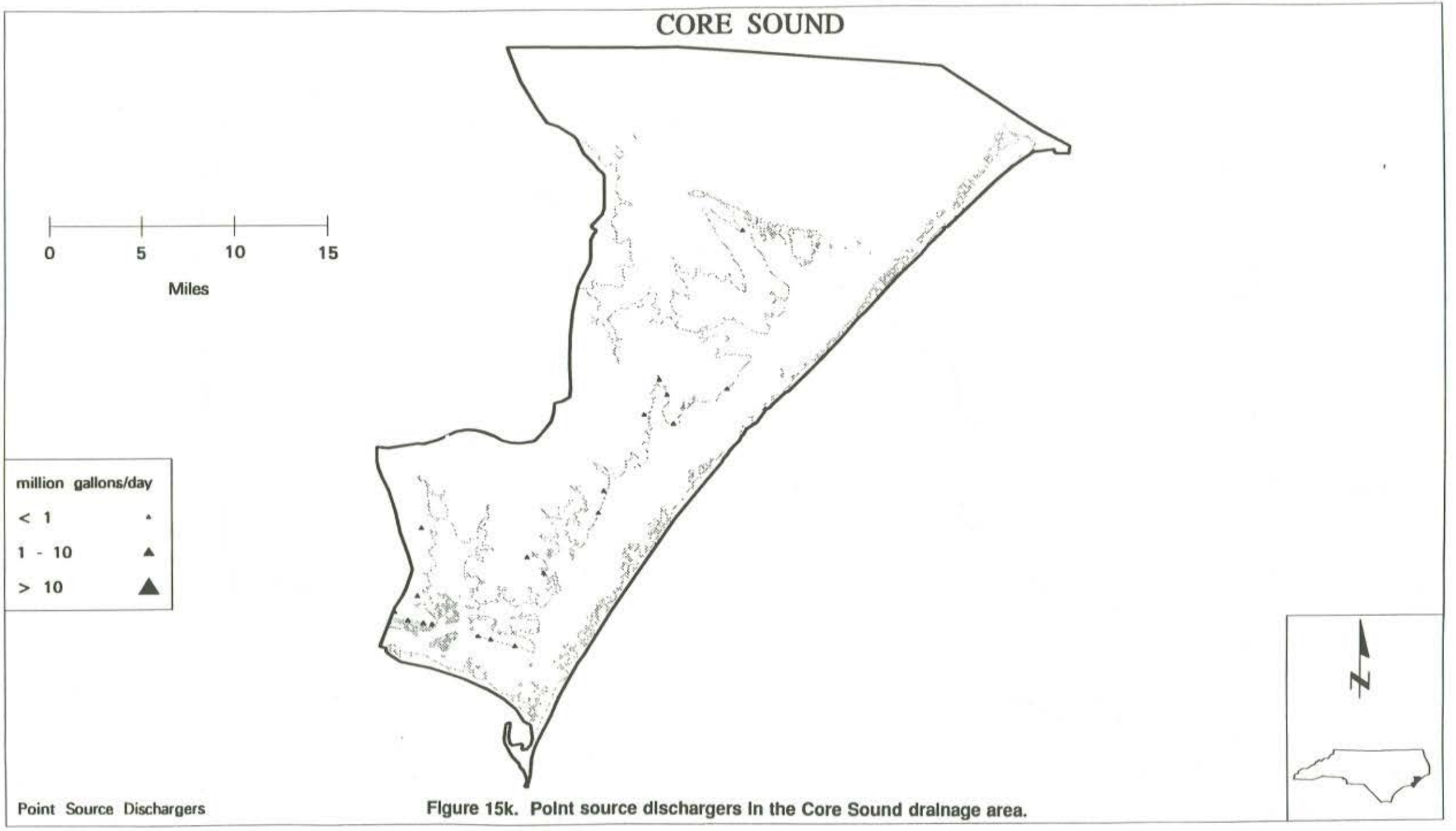


Figure 15k. Point source dischargers in the Core Sound drainage area.

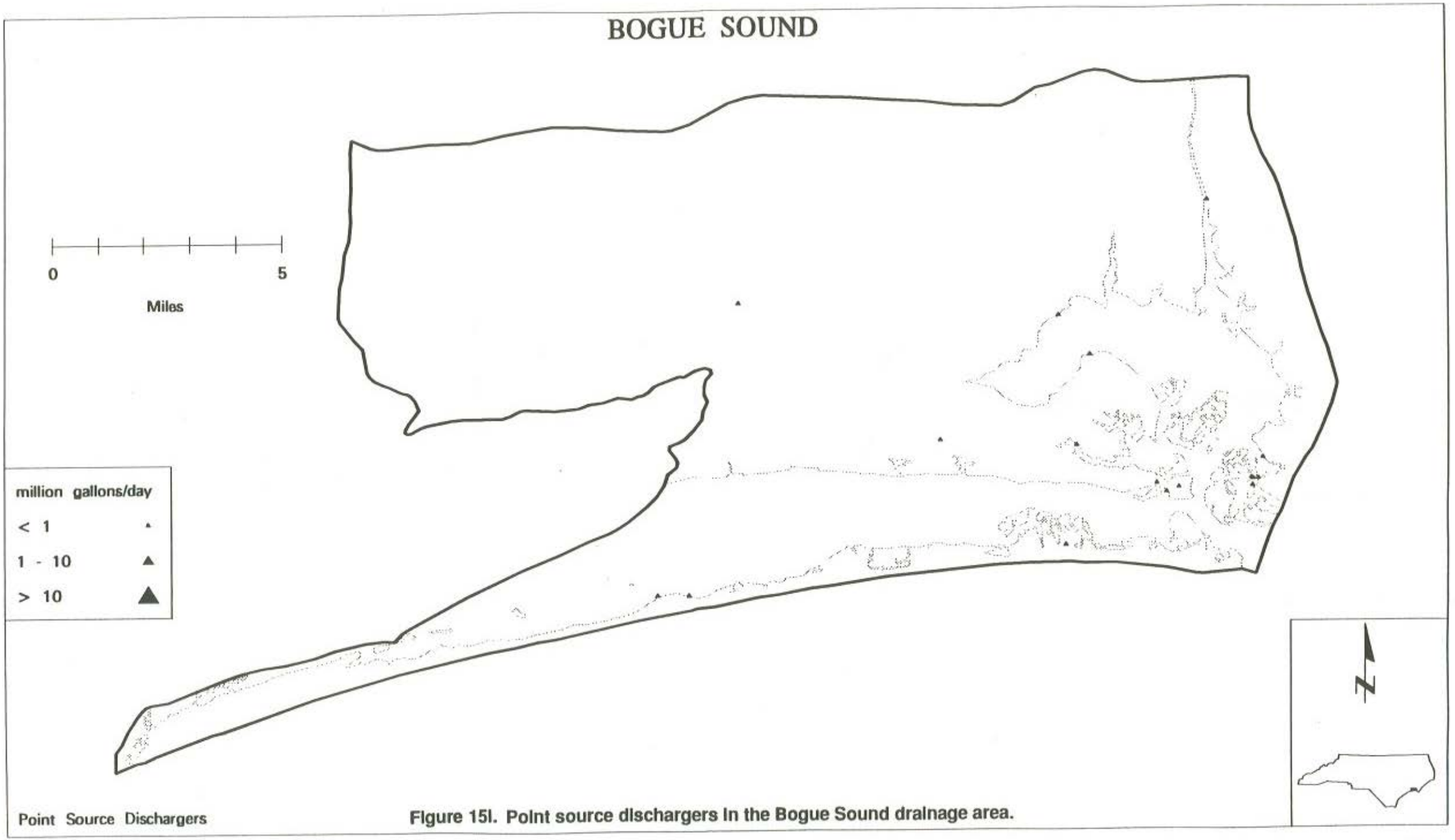


Figure 15l. Point source dischargers in the Bogue Sound drainage area.

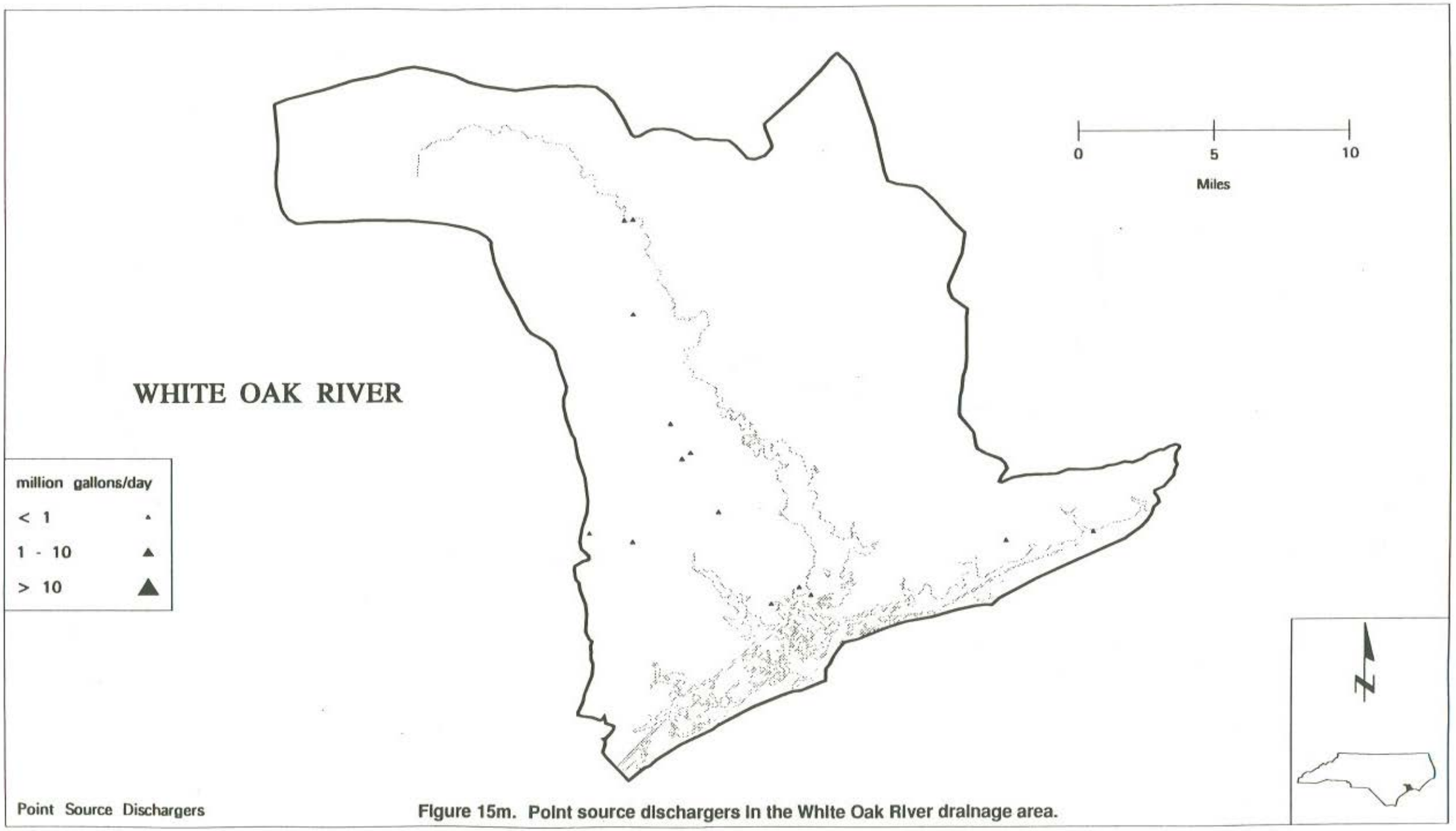


Figure 15m. Point source dischargers in the White Oak River drainage area.

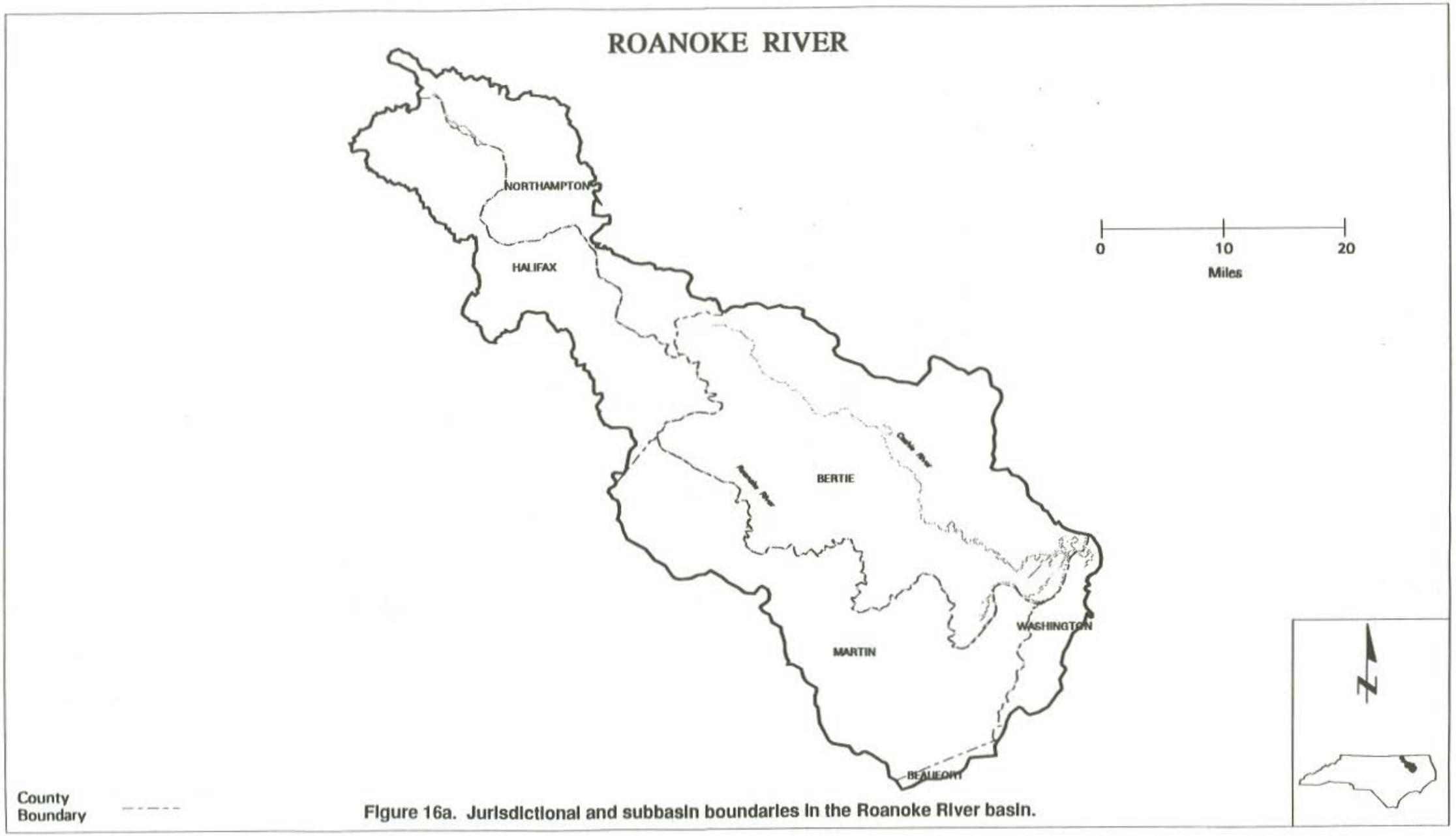


Figure 16a. Jurisdictional and subbasin boundaries in the Roanoke River basin.

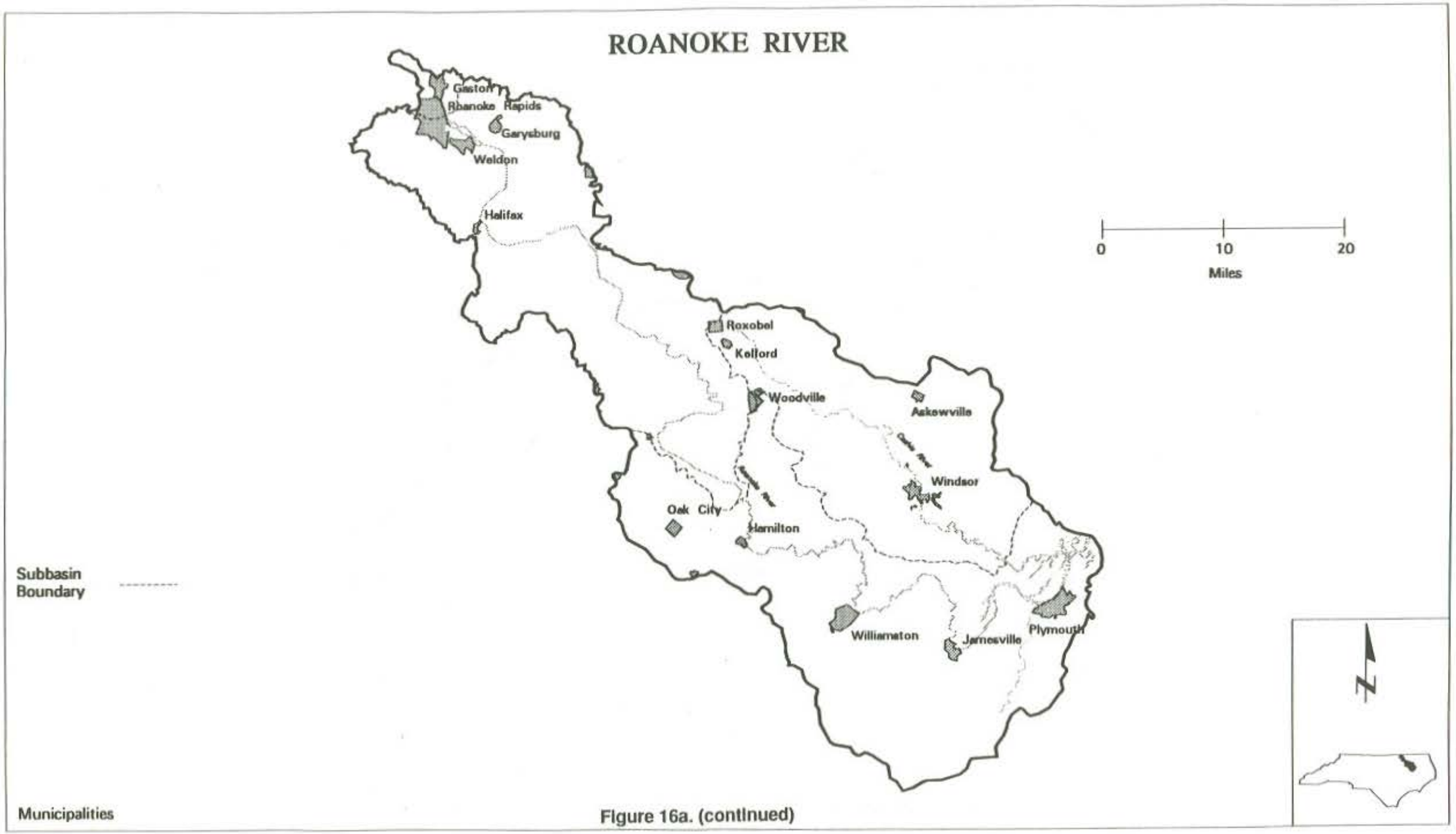


Figure 16a. (continued)

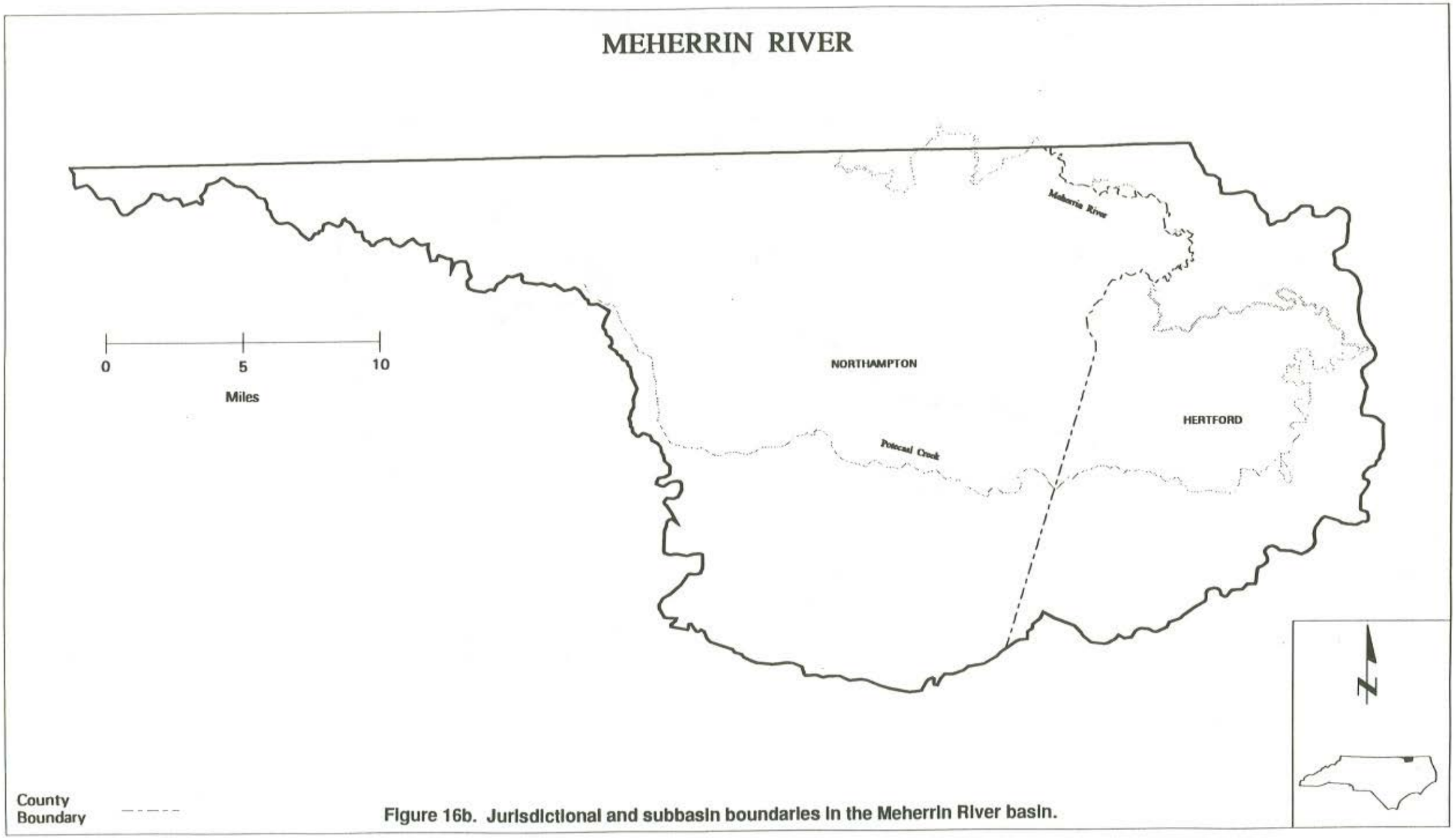


Figure 16b. Jurisdictional and subbasin boundaries in the Meherrin River basin.

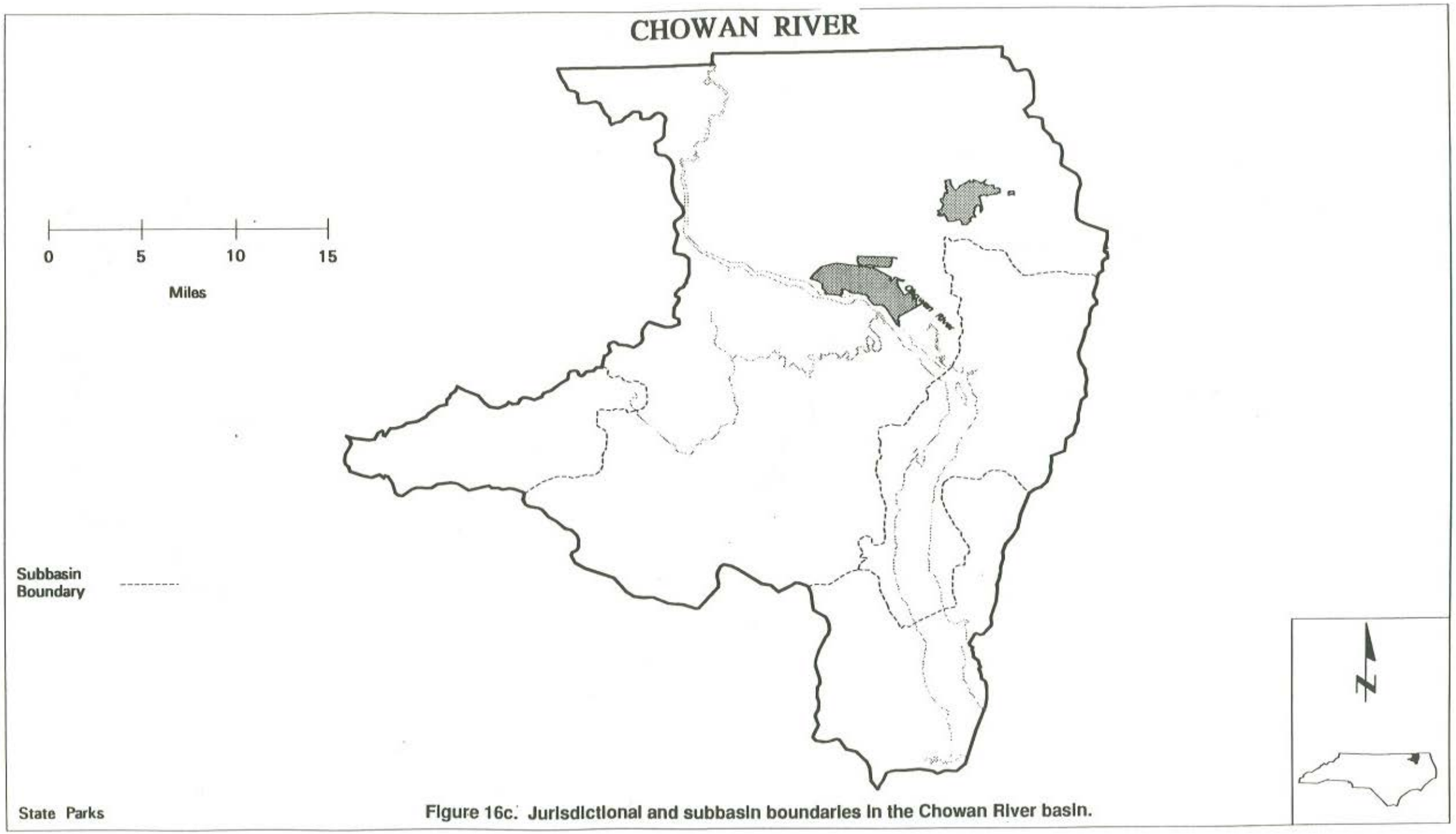


Figure 16c. Jurisdictional and subbasin boundaries in the Chowan River basin.

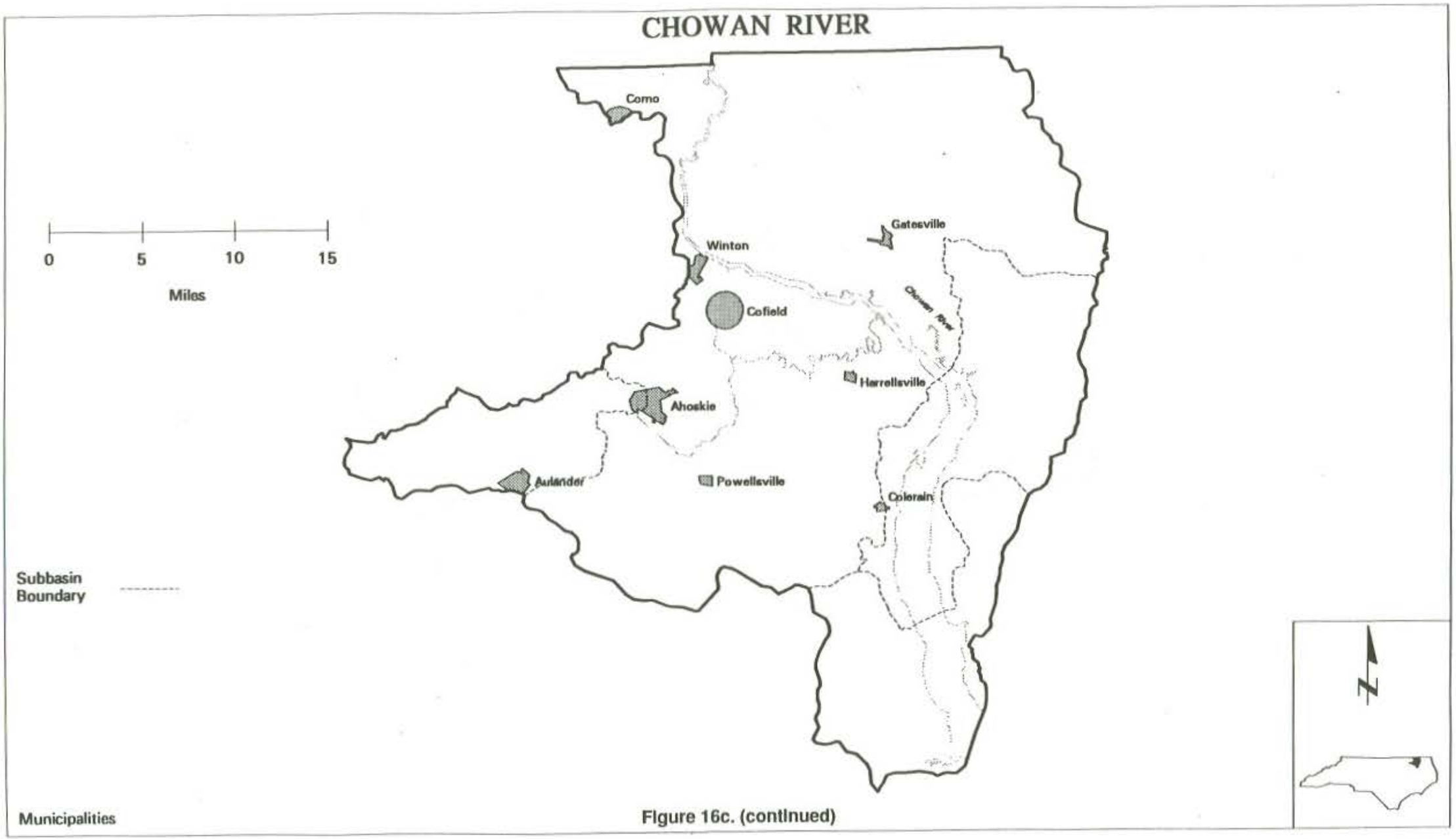


Figure 16c. (continued)

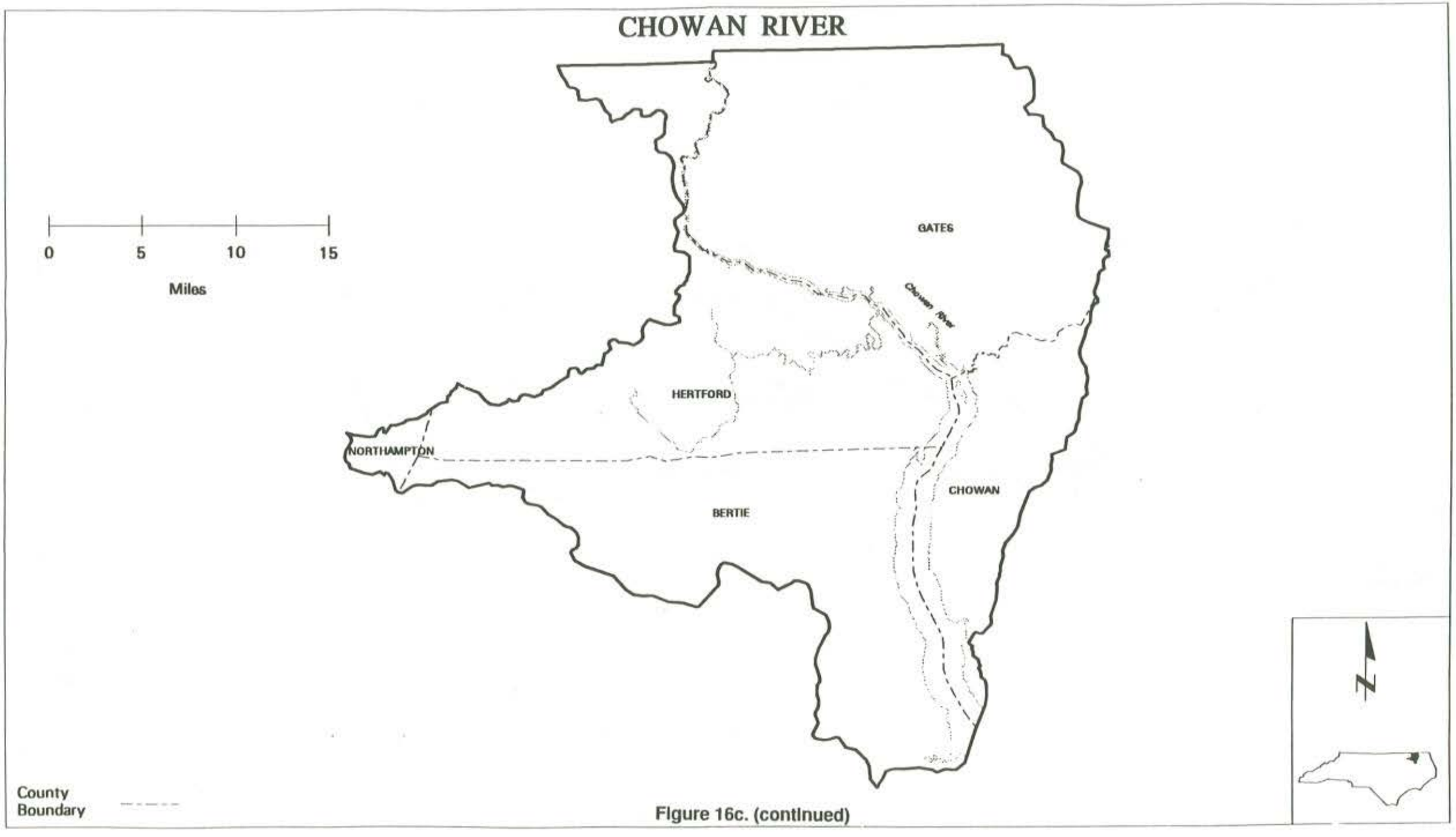


Figure 16c. (continued)

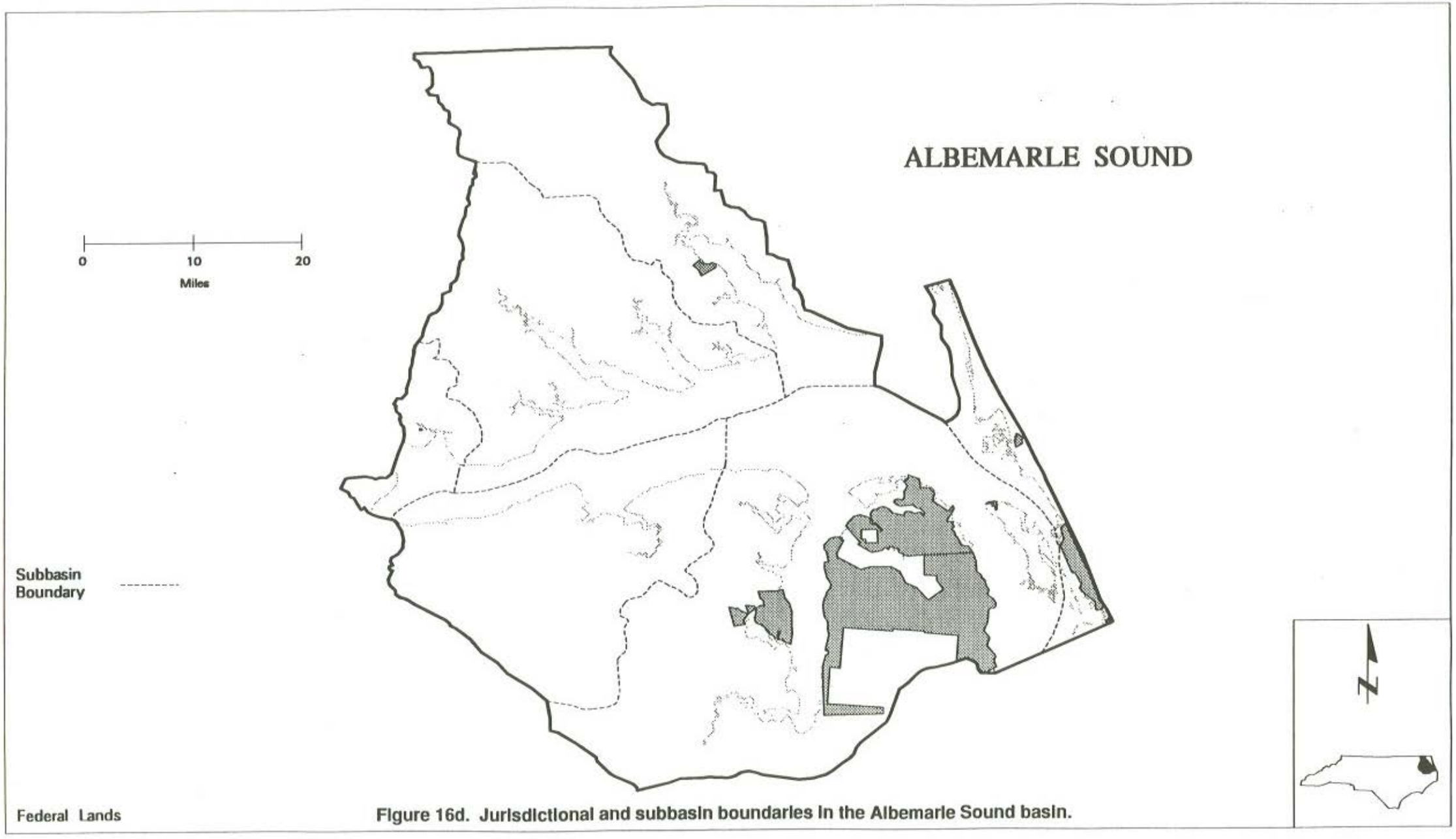


Figure 16d. Jurisdictional and subbasin boundaries in the Albemarle Sound basin.

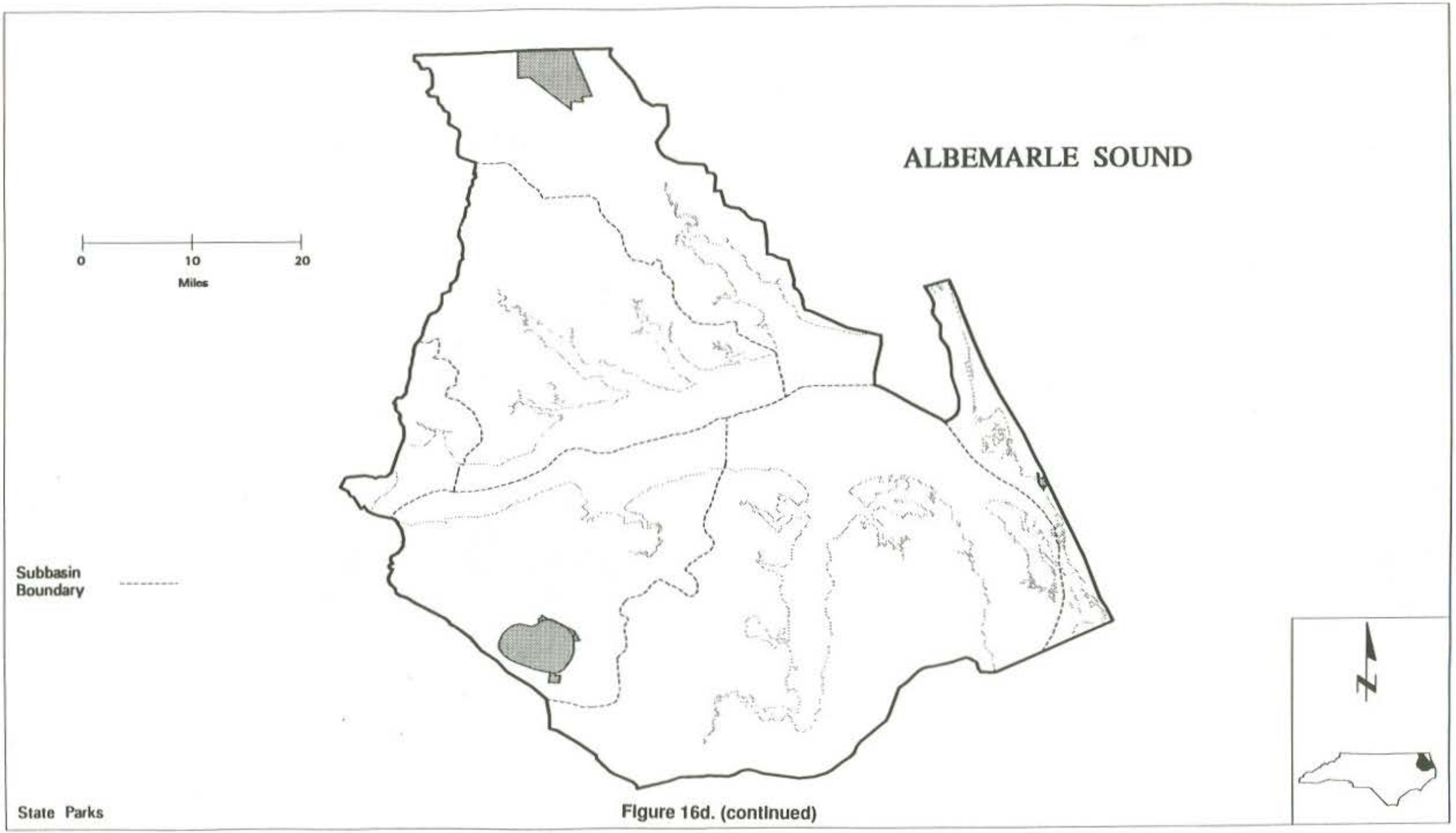


Figure 16d. (continued)

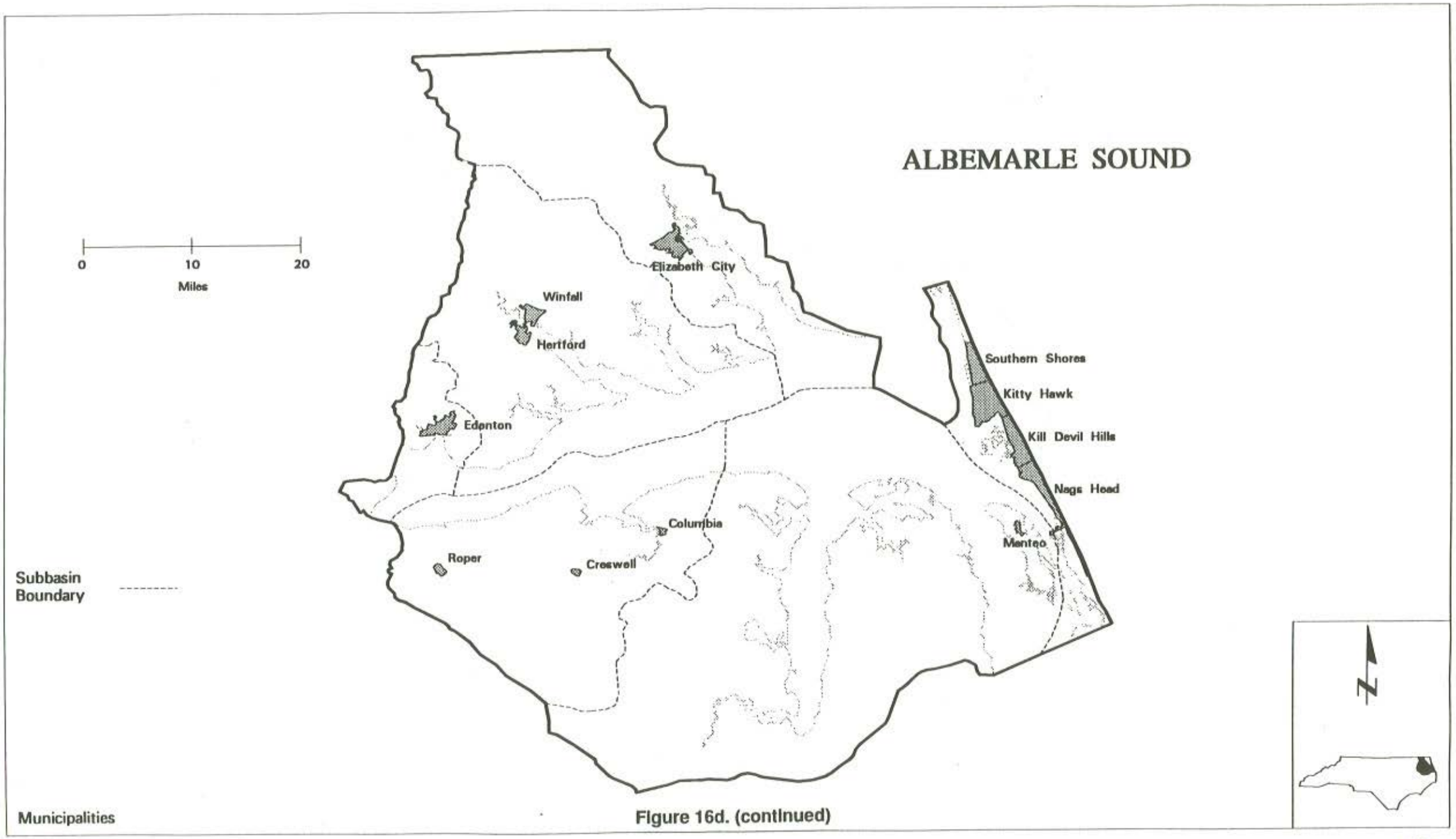


Figure 16d. (continued)

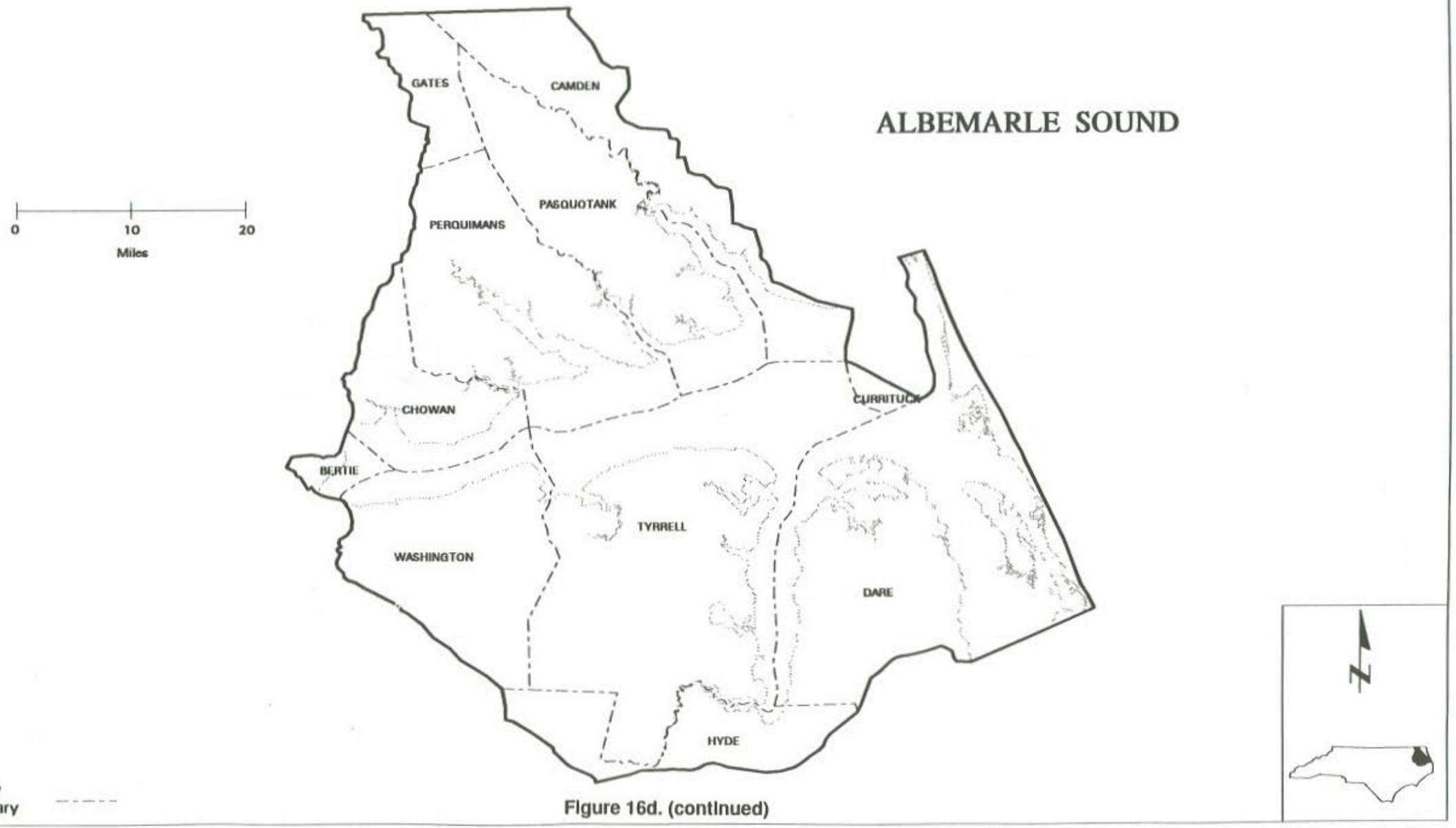


Figure 16d. (continued)

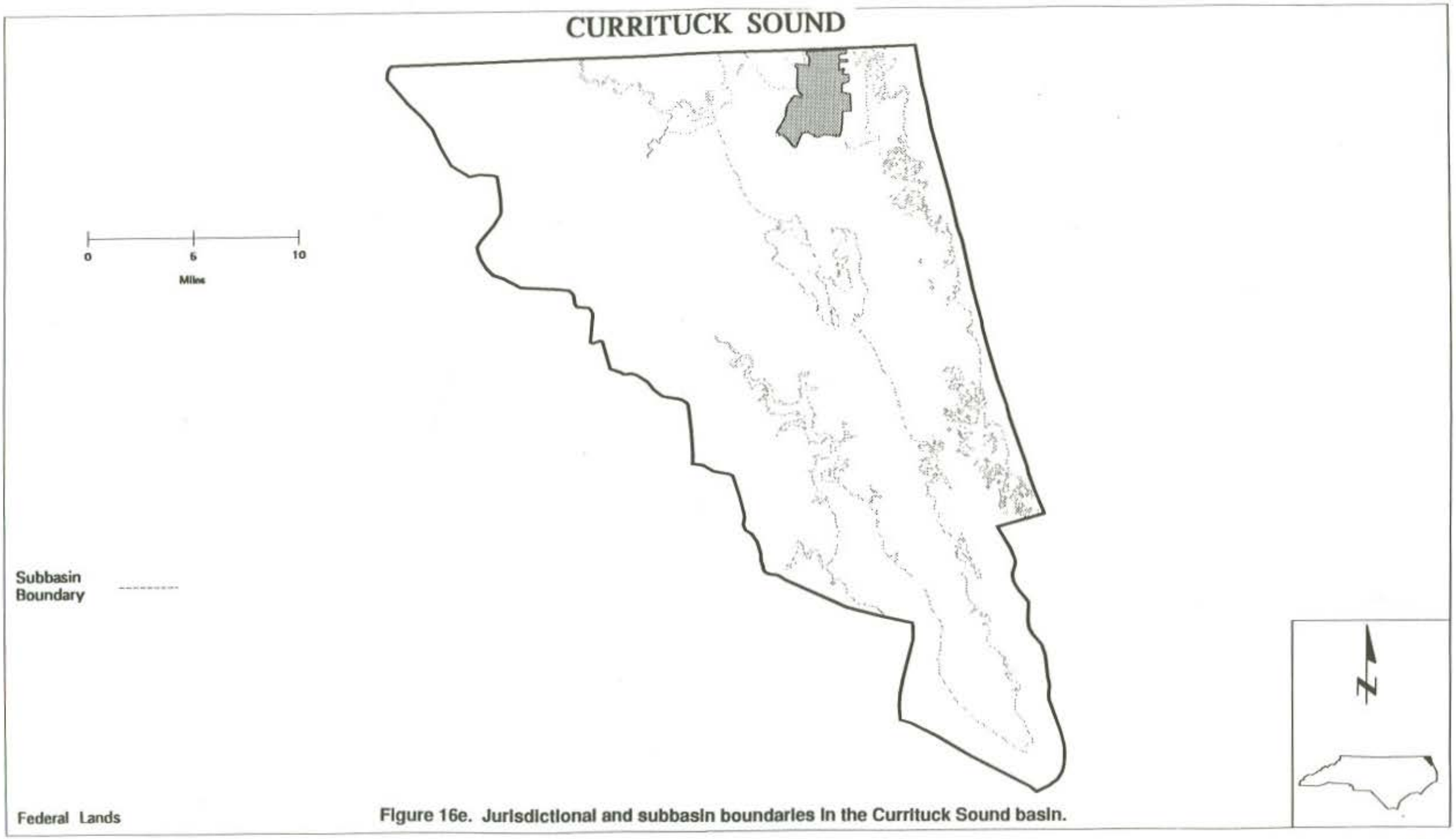


Figure 16e. Jurisdictional and subbasin boundaries in the Currituck Sound basin.

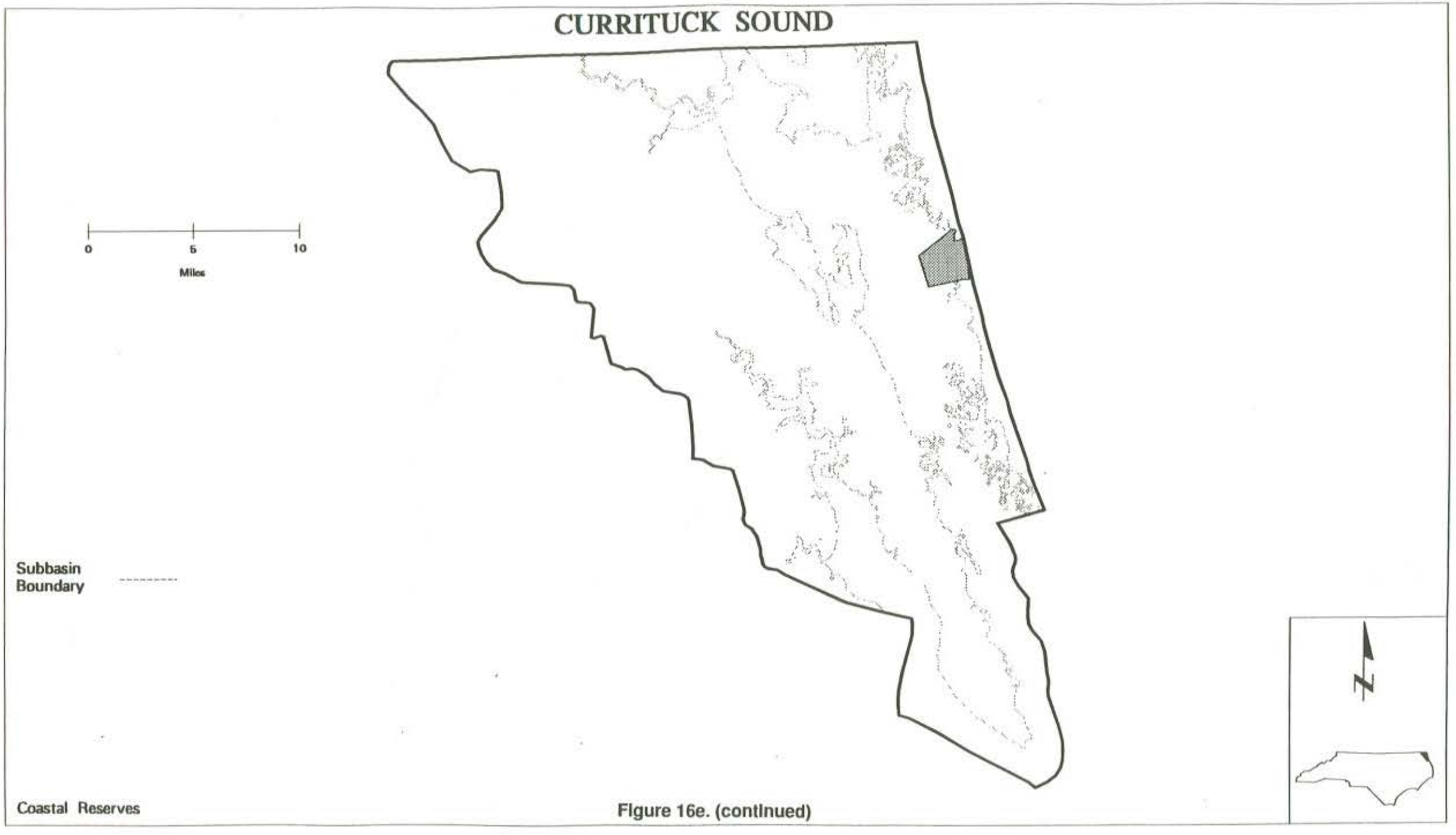


Figure 16e. (continued)

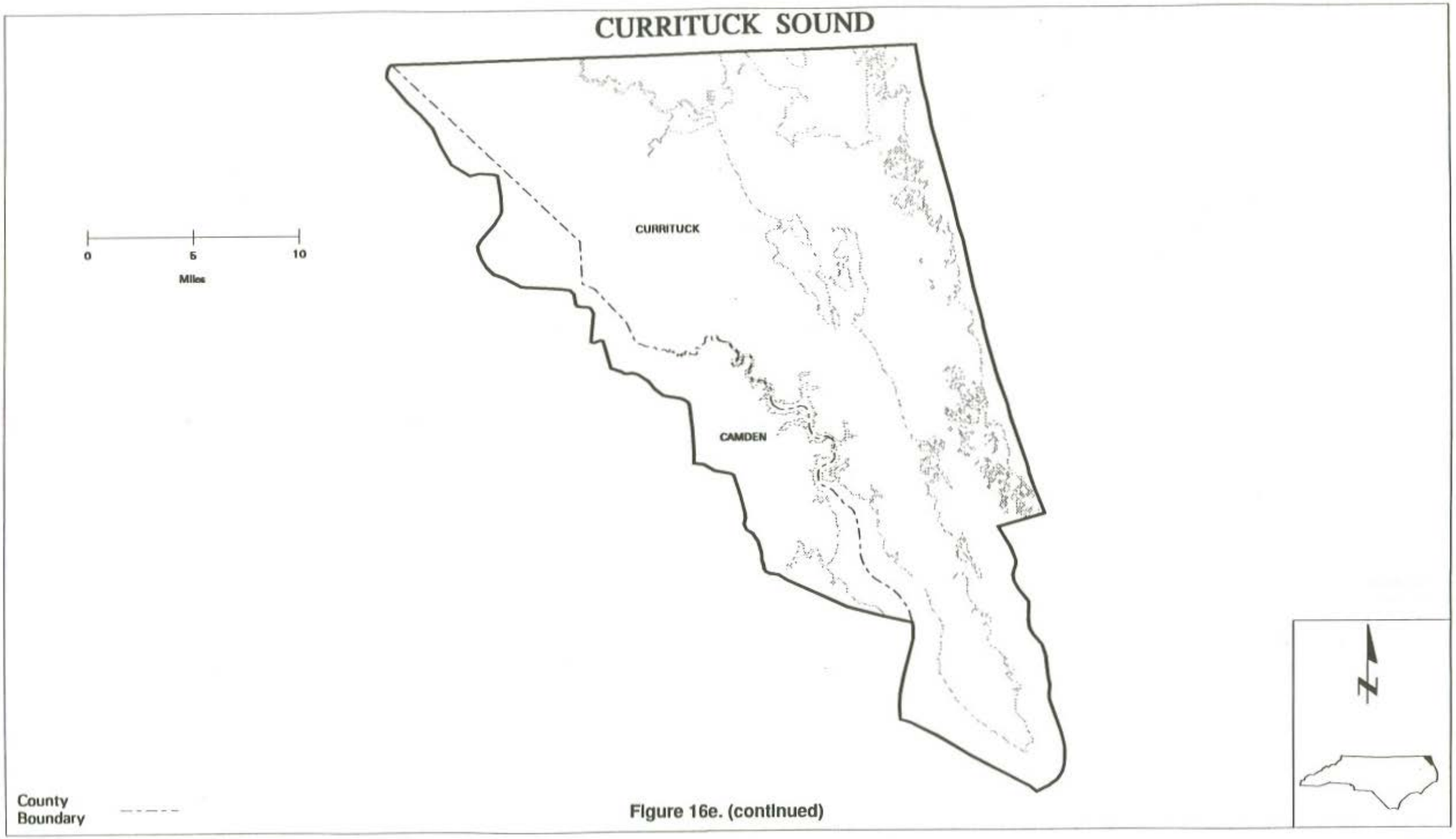


Figure 16e. (continued)

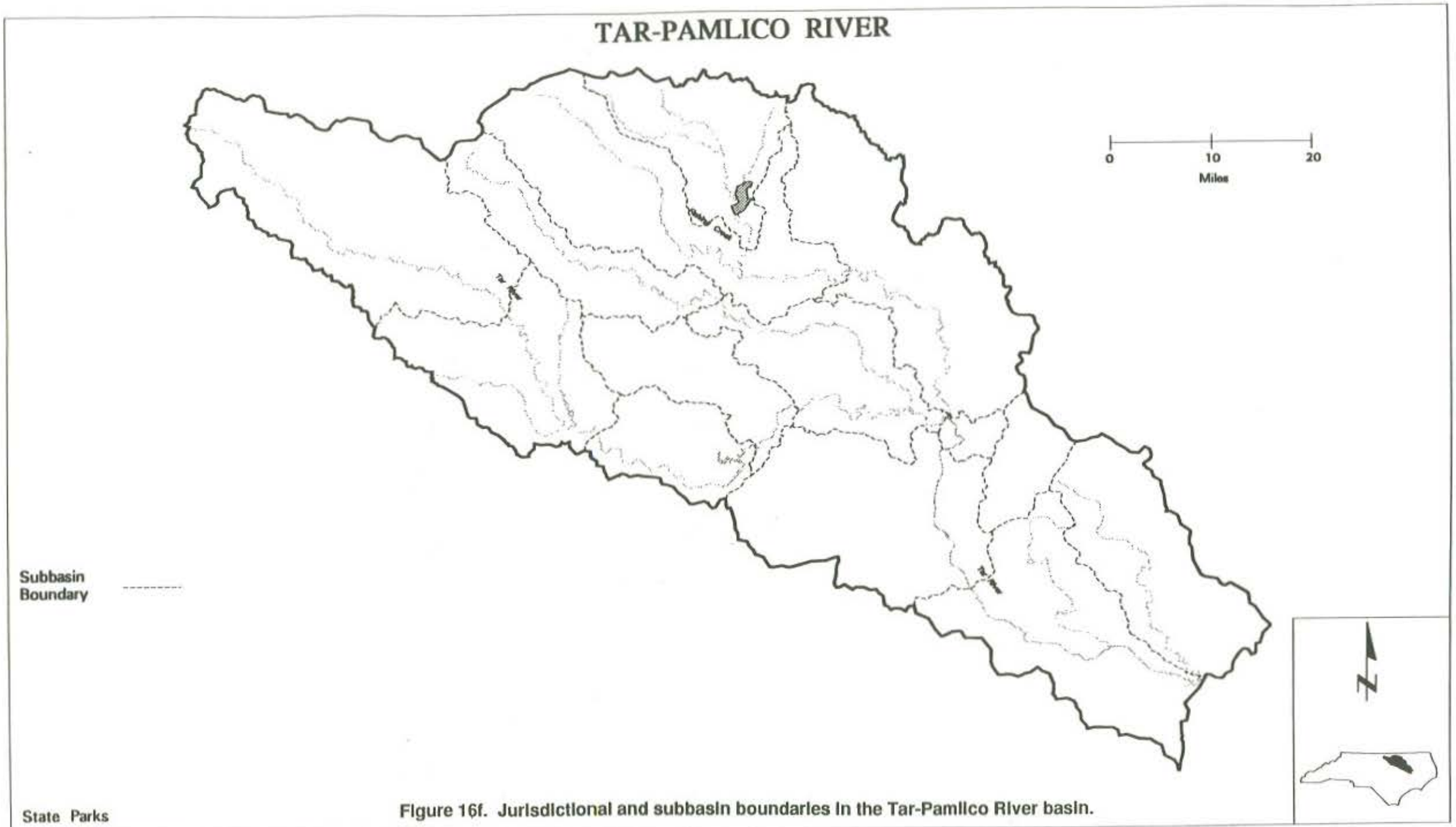


Figure 16f. Jurisdictional and subbasin boundaries in the Tar-Pamlico River basin.

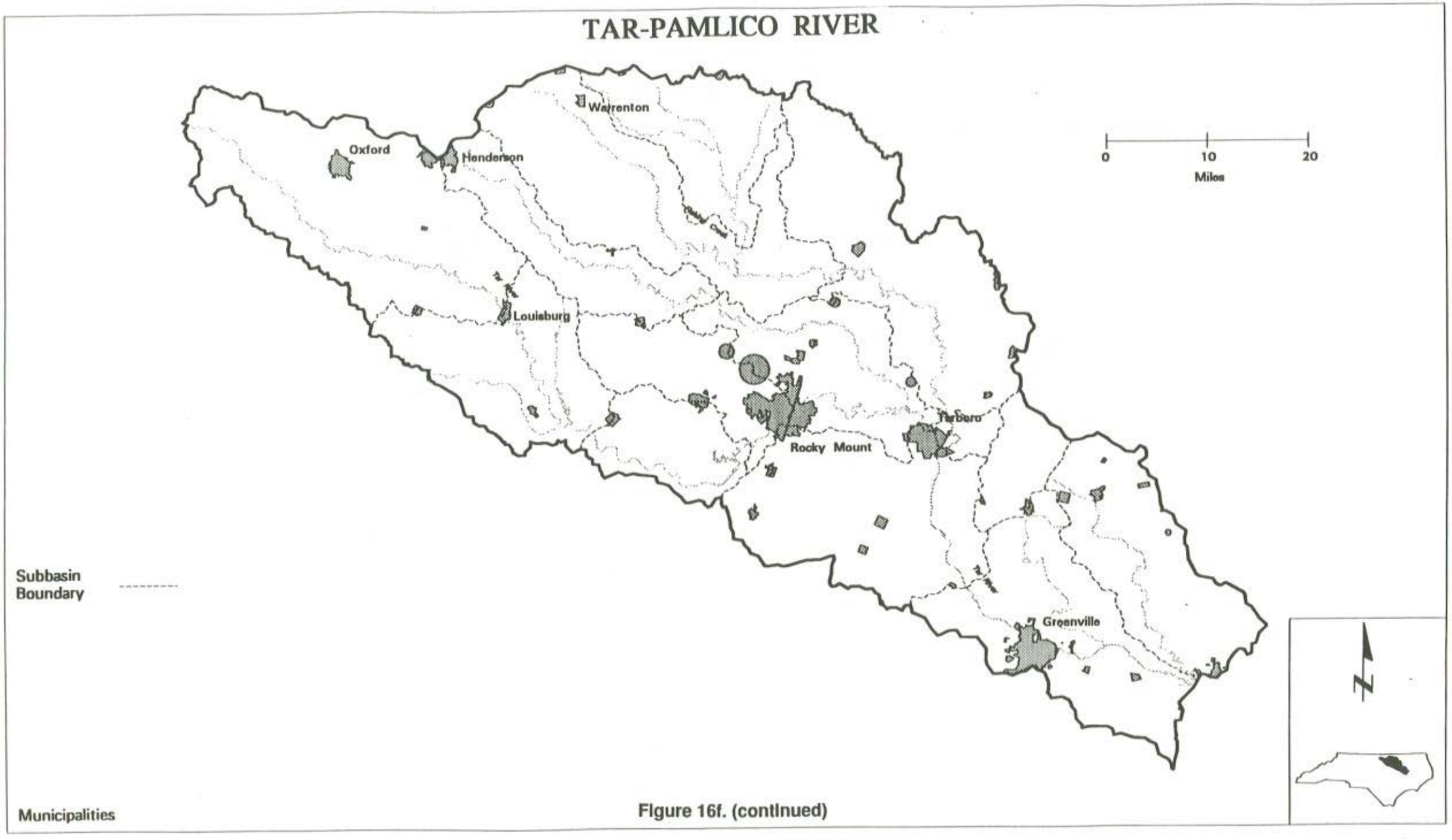
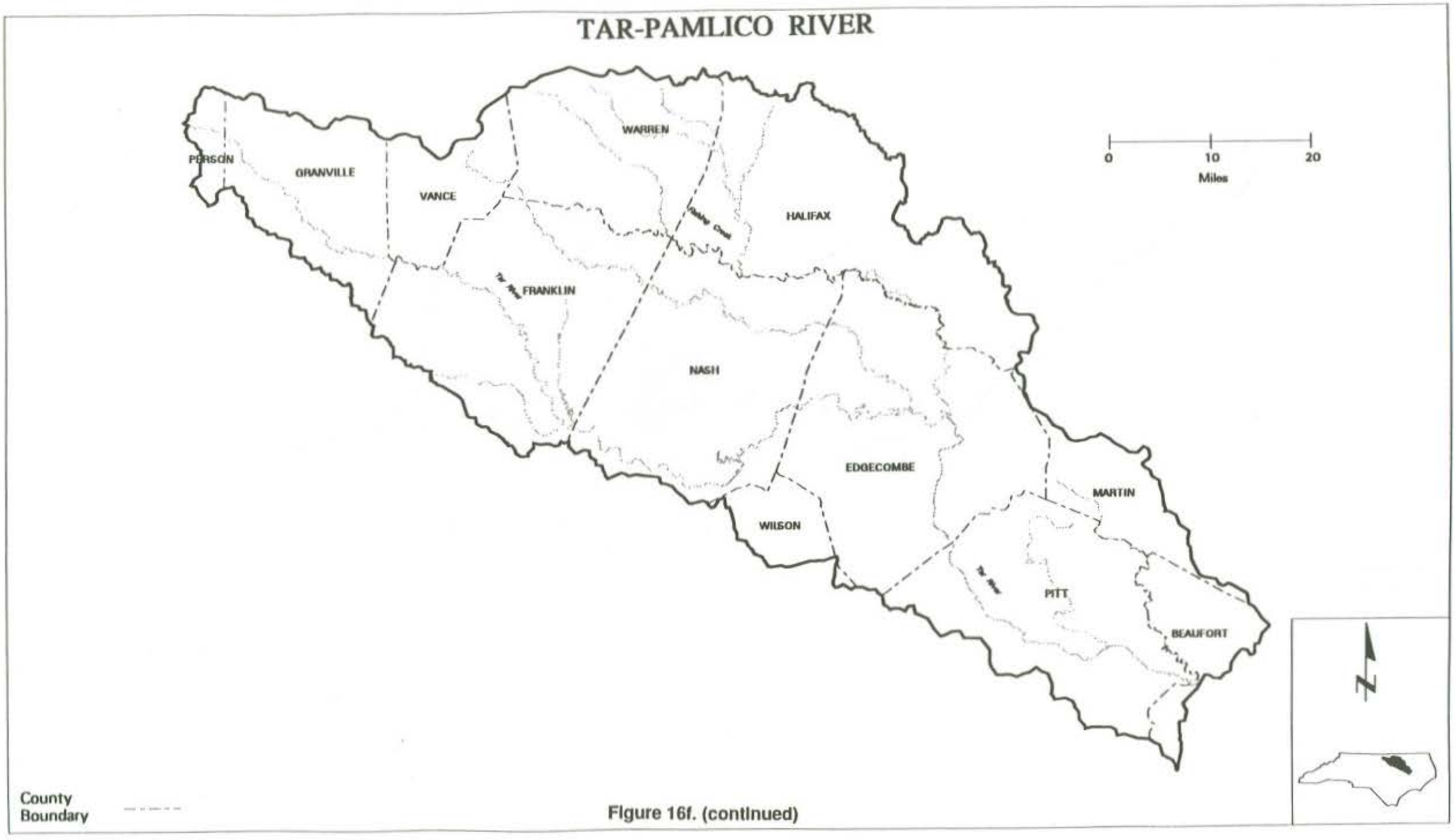


Figure 16f. (continued)



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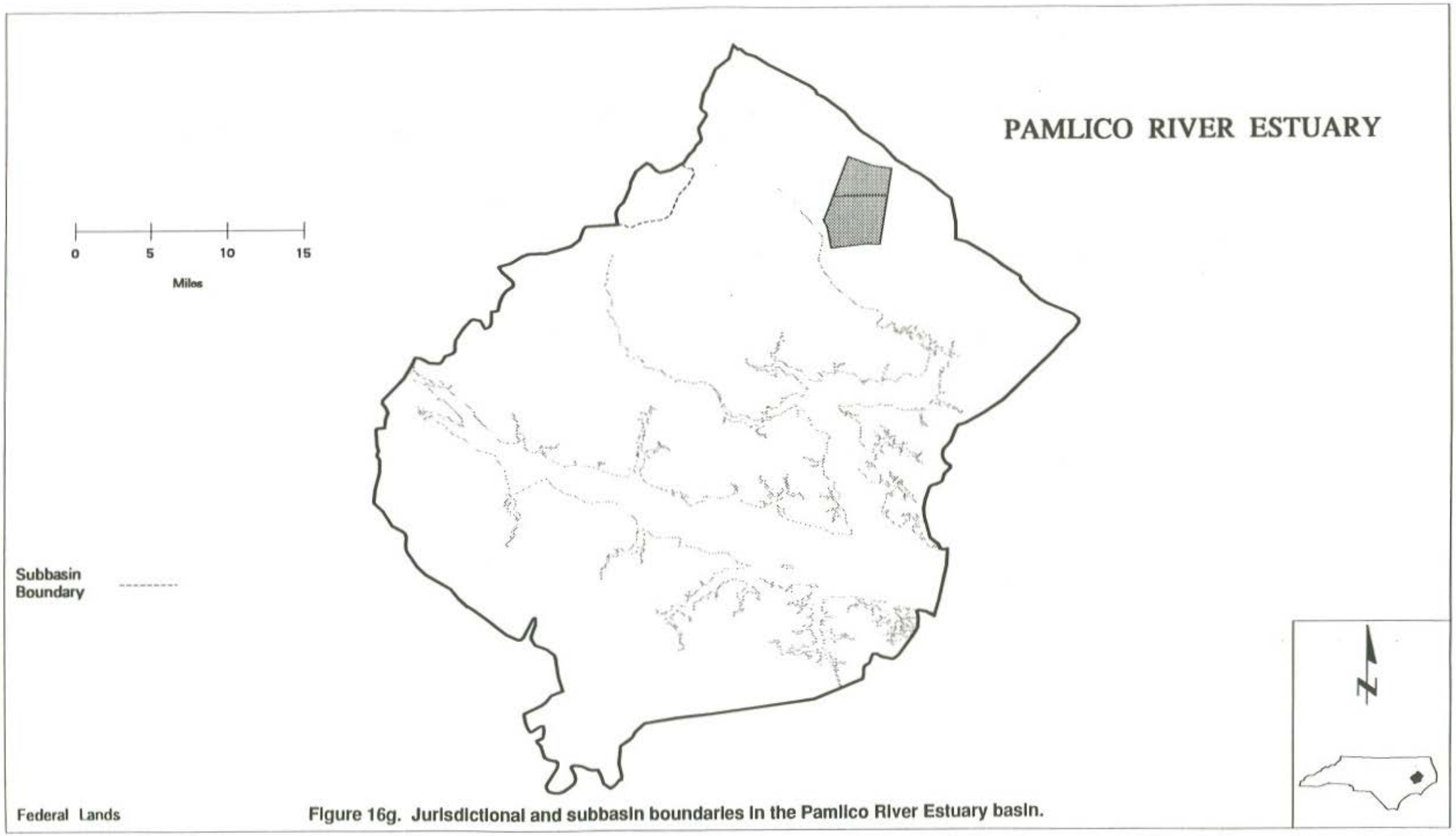


Figure 16g. Jurisdictional and subbasin boundaries in the Pamlico River Estuary basin.

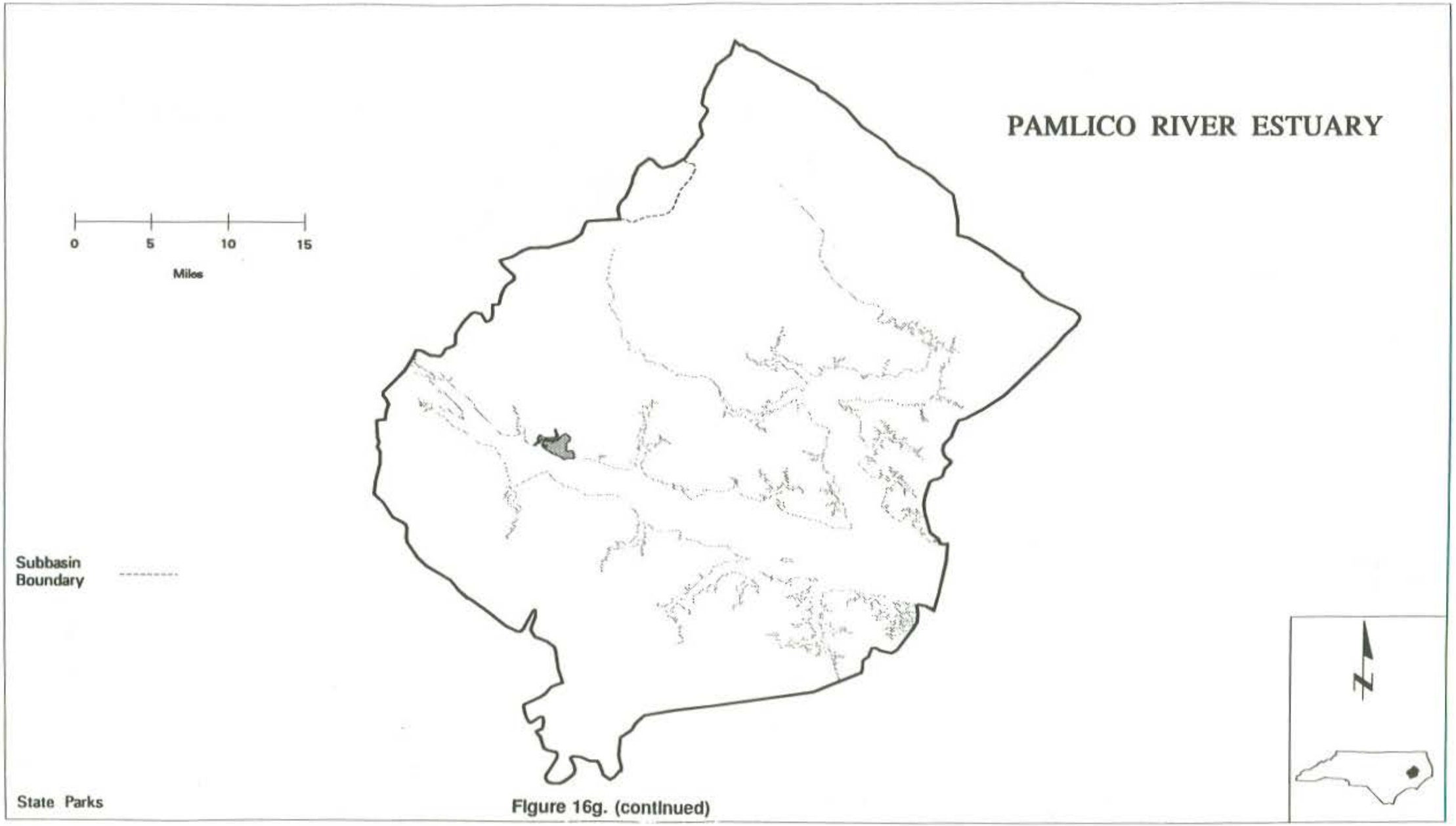


Figure 16g. (continued)

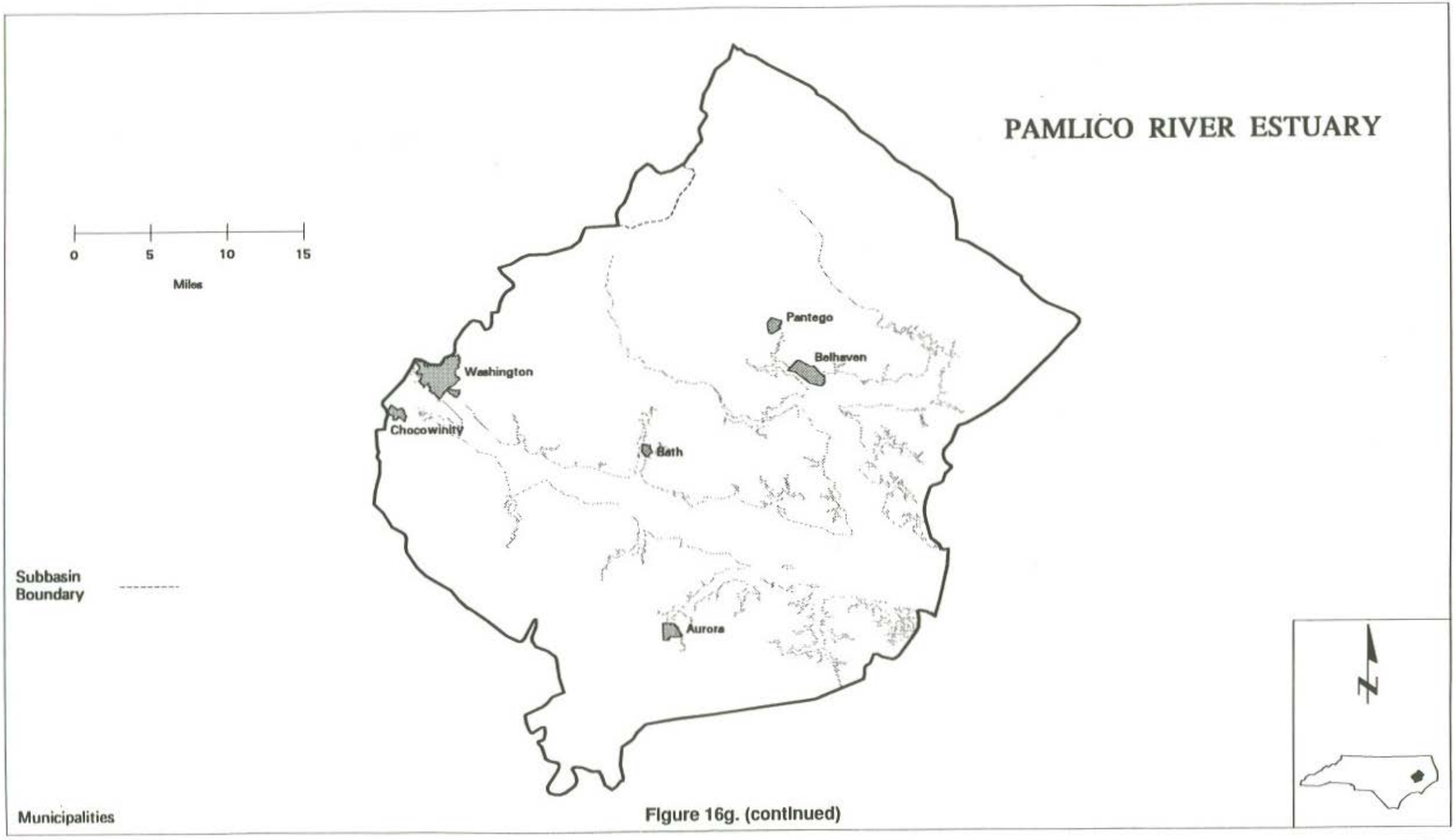


Figure 16g. (continued)

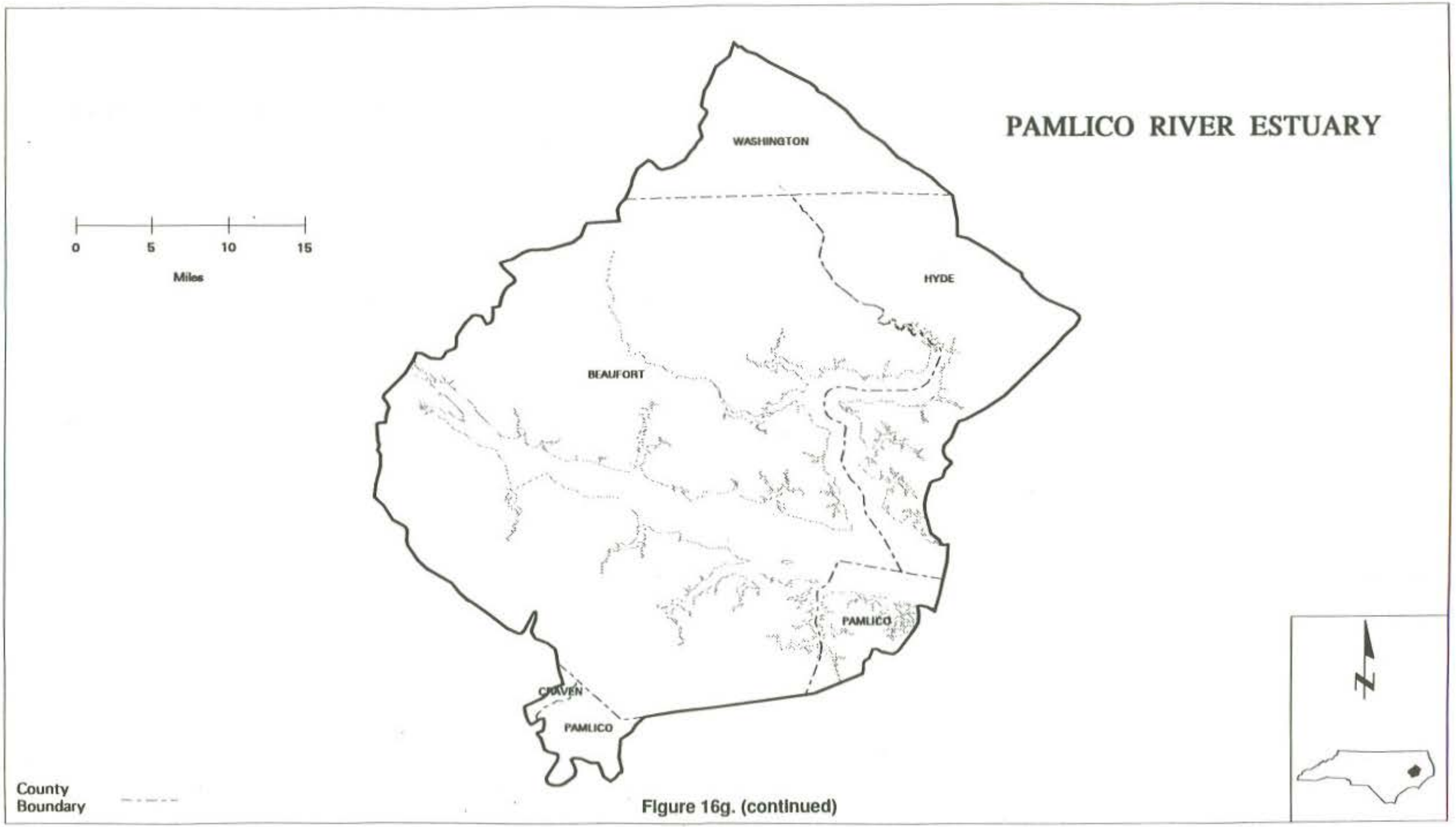


Figure 16g. (continued)

NEUSE RIVER

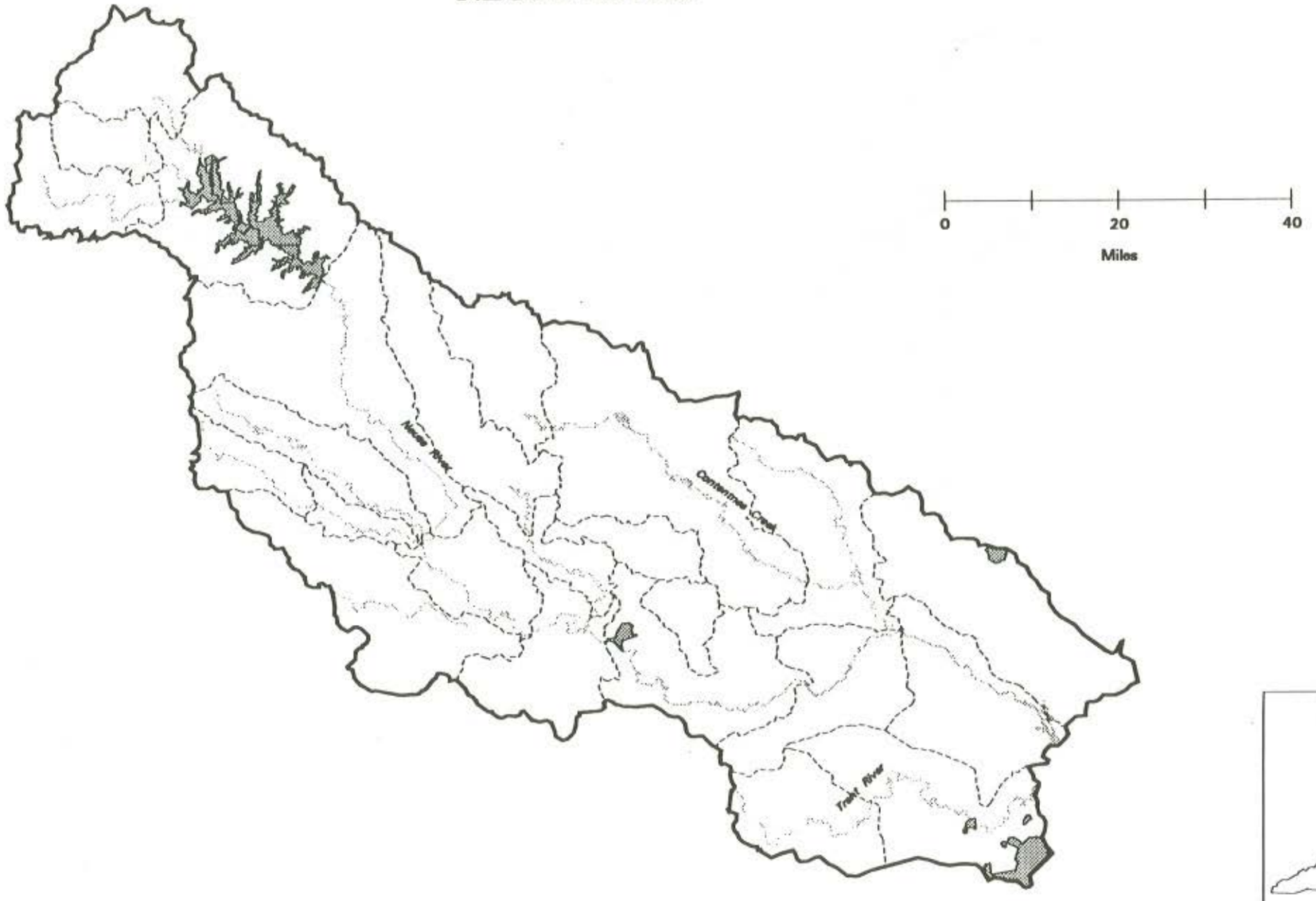


Figure 16h. Jurisdictional and subbasin boundaries in the Neuse River basin.

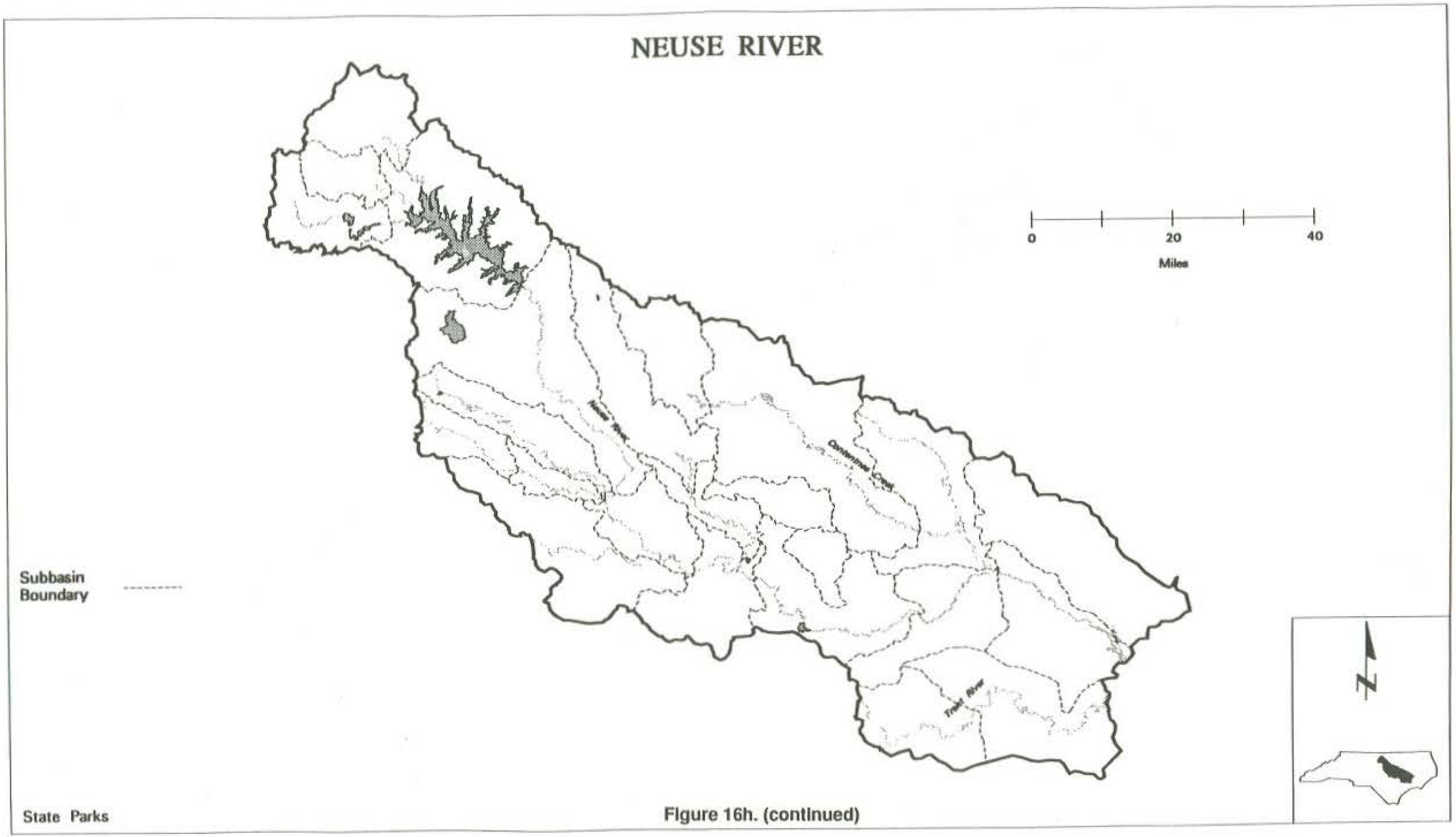


Figure 16h. (continued)

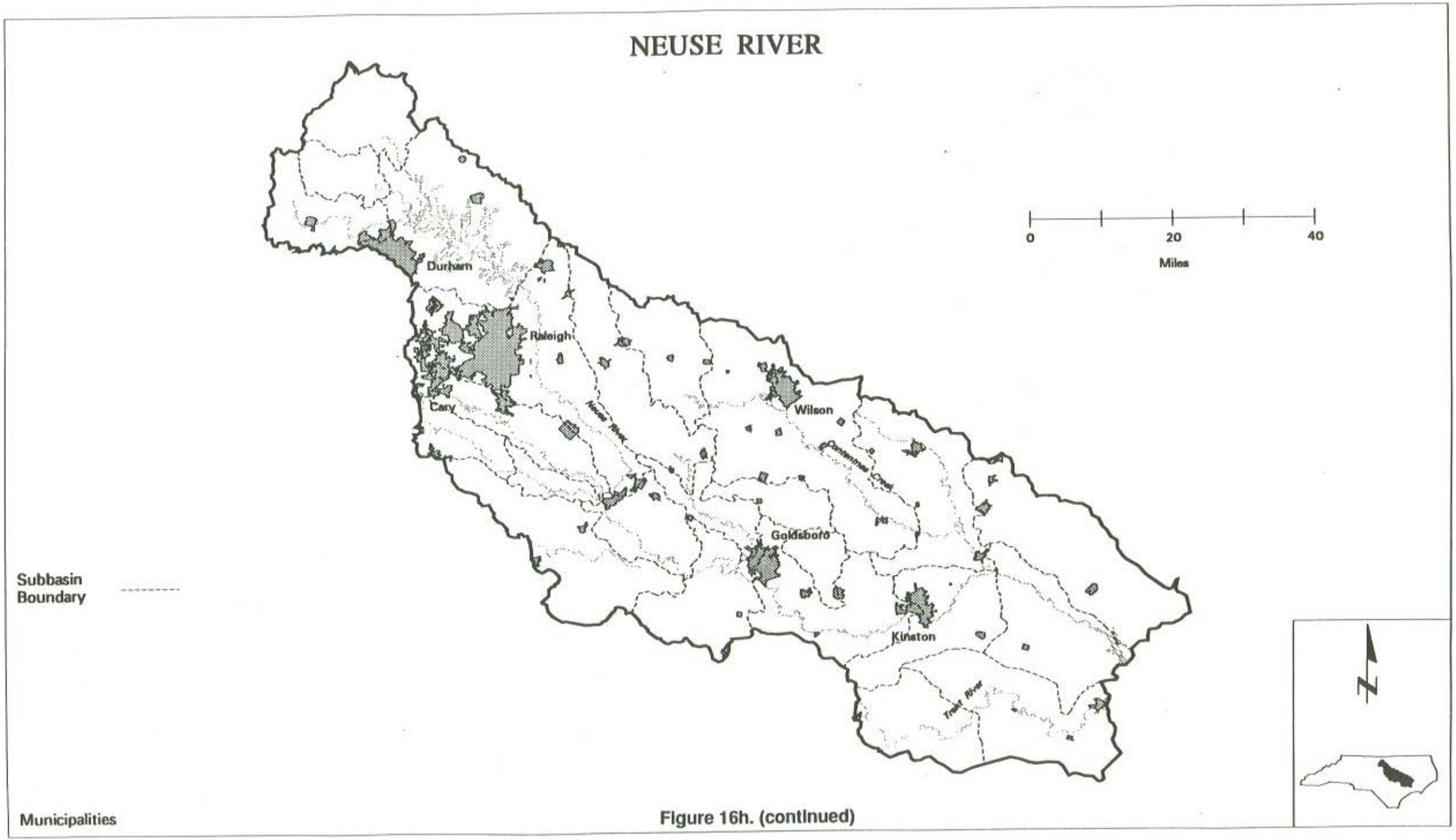


Figure 16h. (continued)

NEUSE RIVER

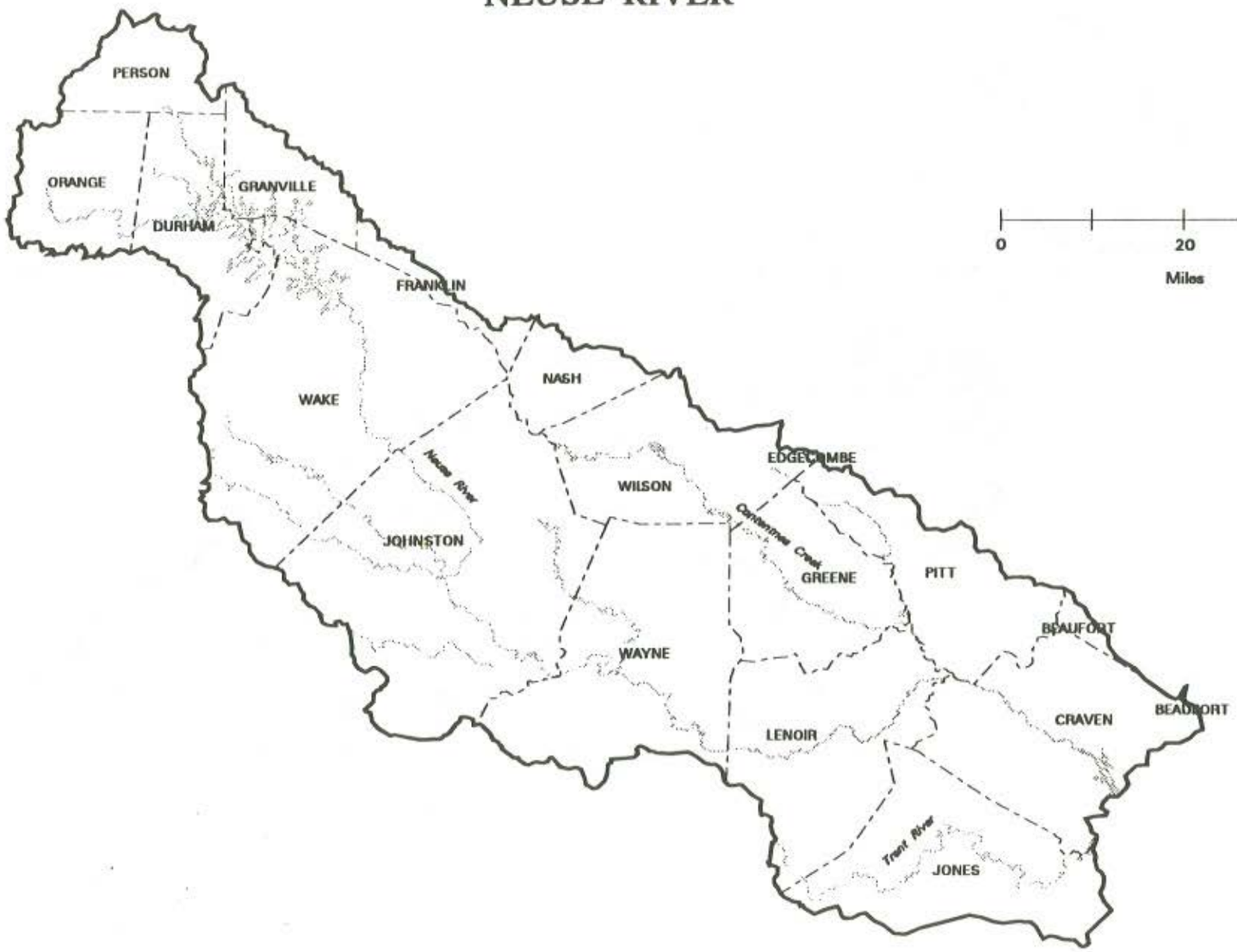


Figure 16h. (continued)

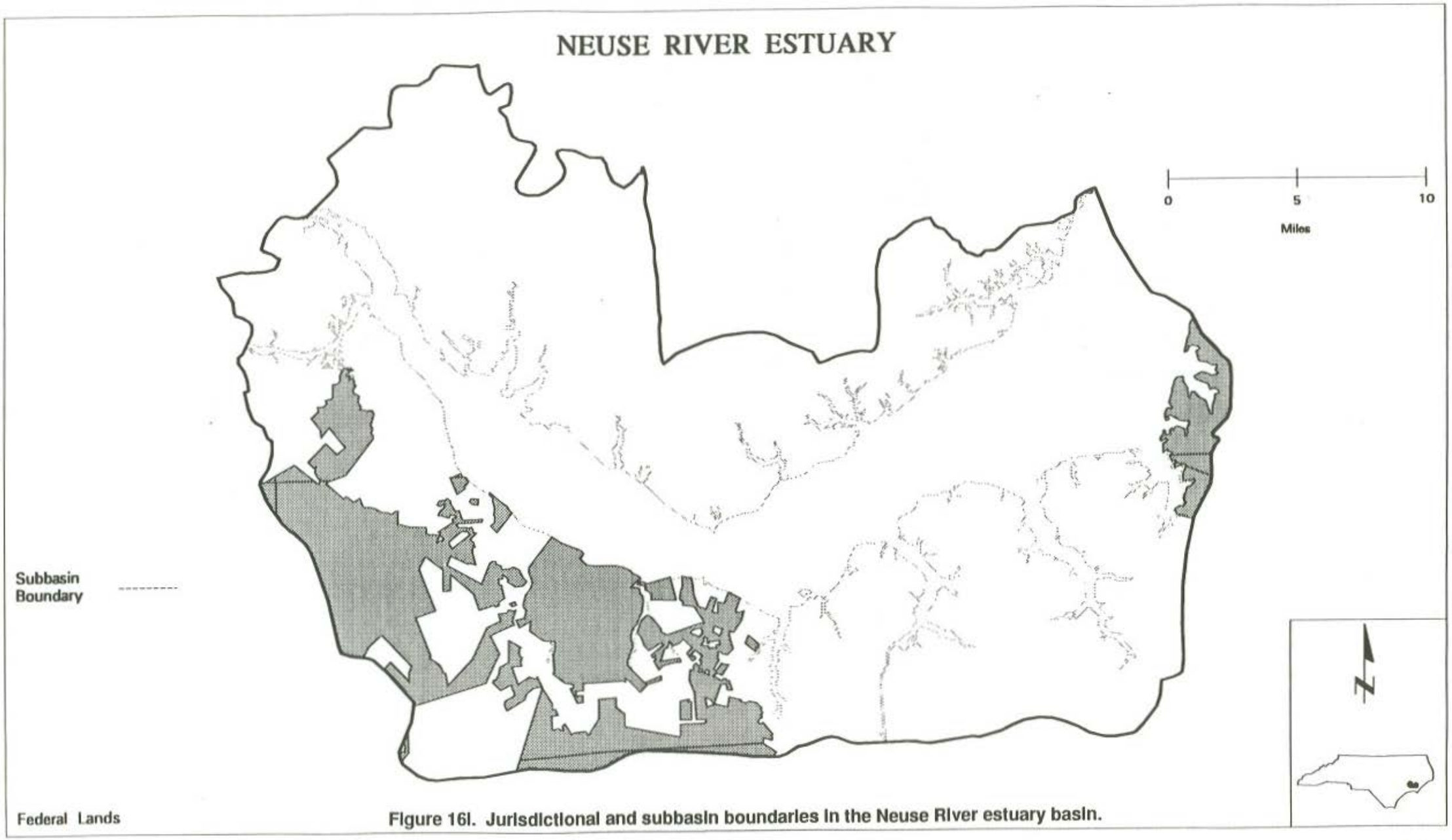


Figure 16l. Jurisdictional and subbasin boundaries in the Neuse River estuary basin.

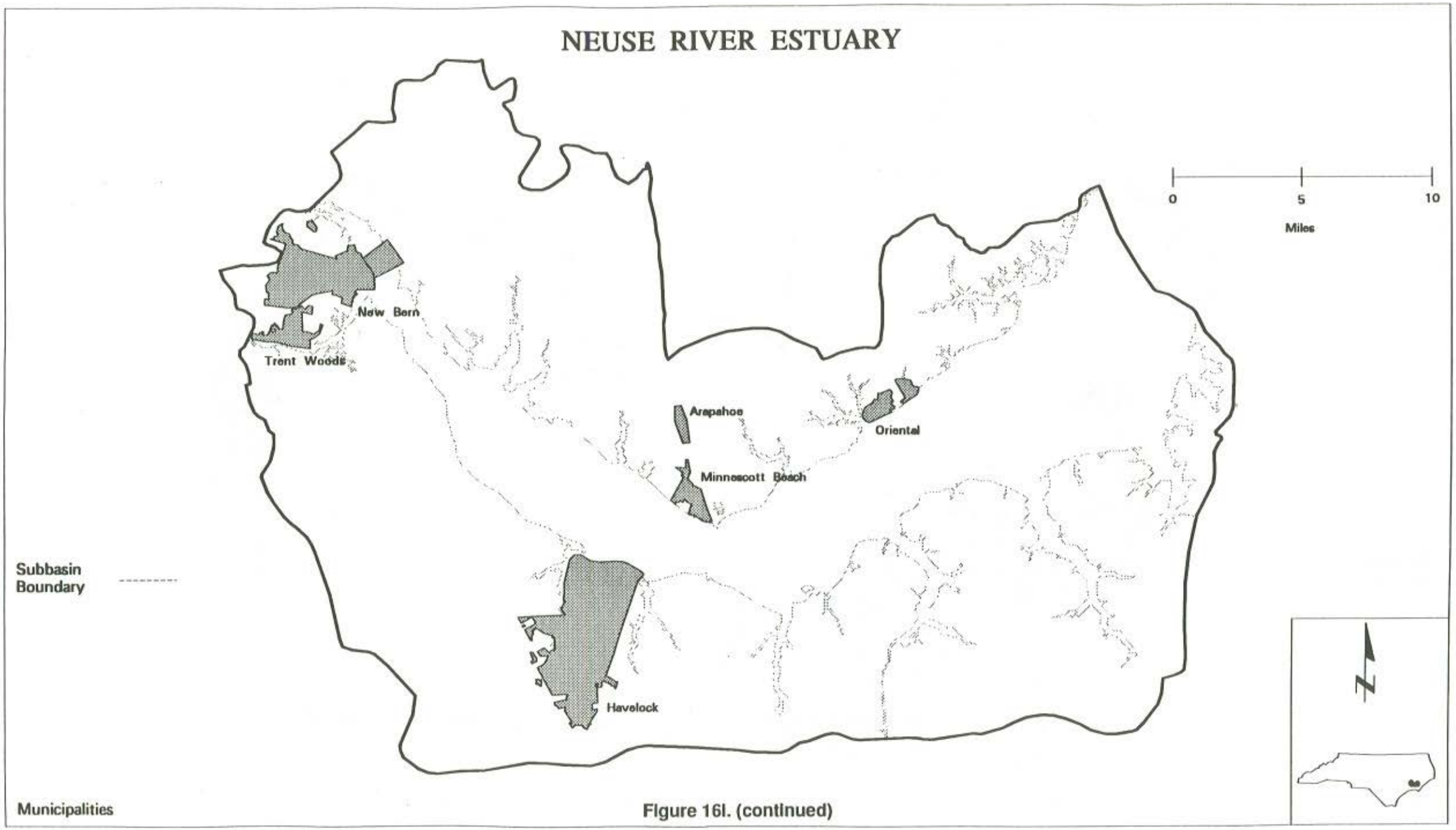


Figure 16l. (continued)

NEUSE RIVER ESTUARY

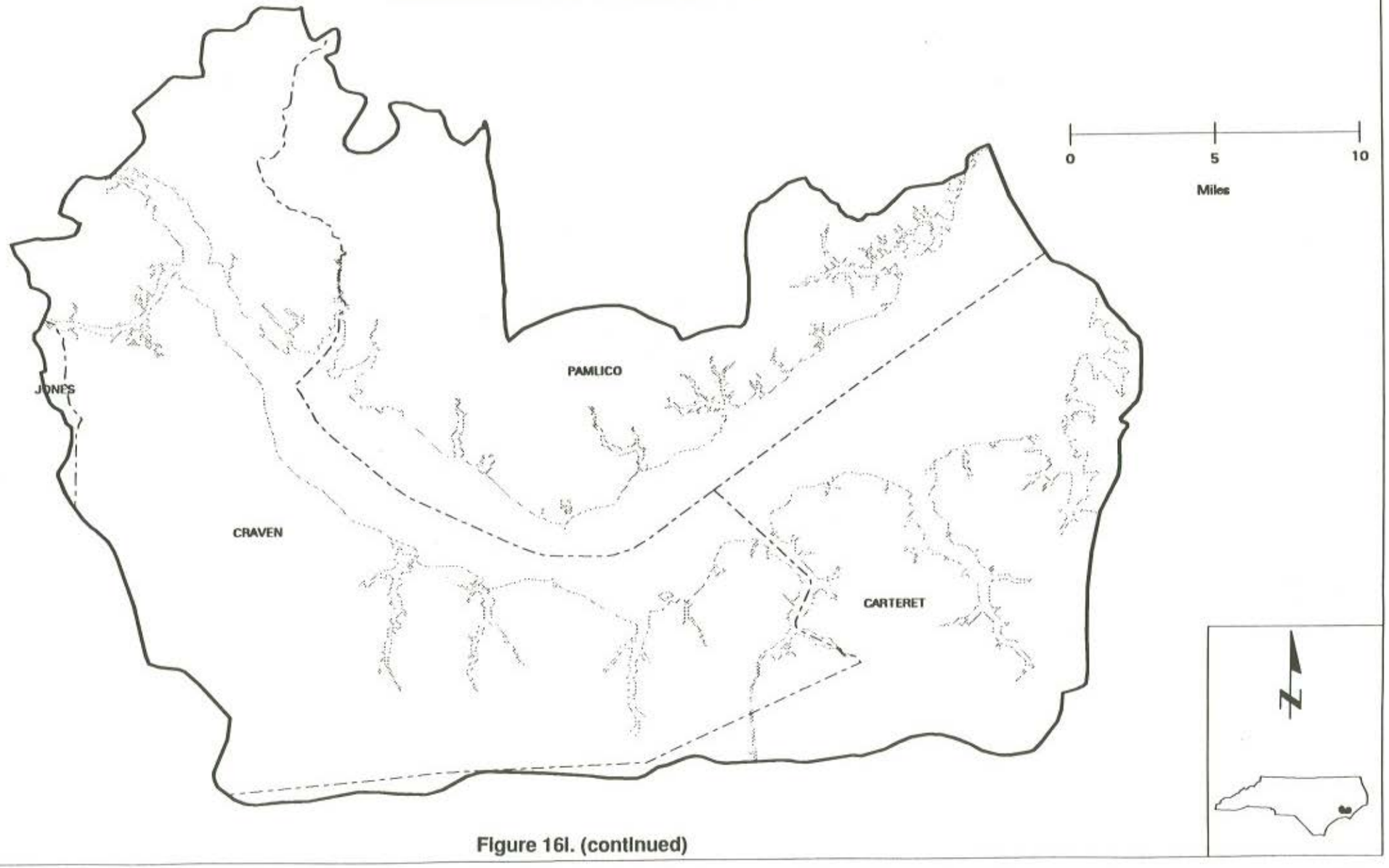


Figure 16l. (continued)

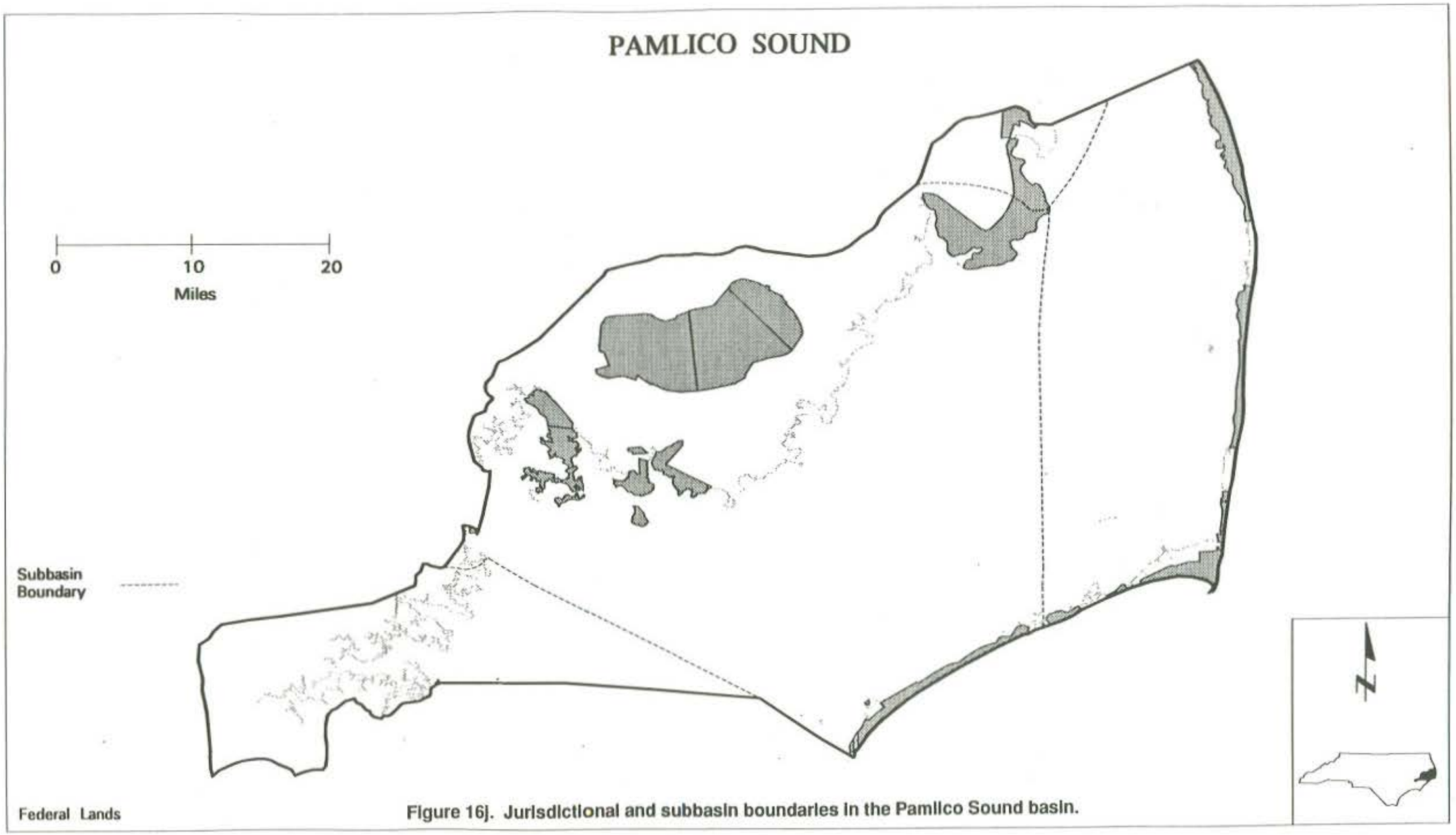


Figure 16j. Jurisdictional and subbasin boundaries in the Pamlico Sound basin.

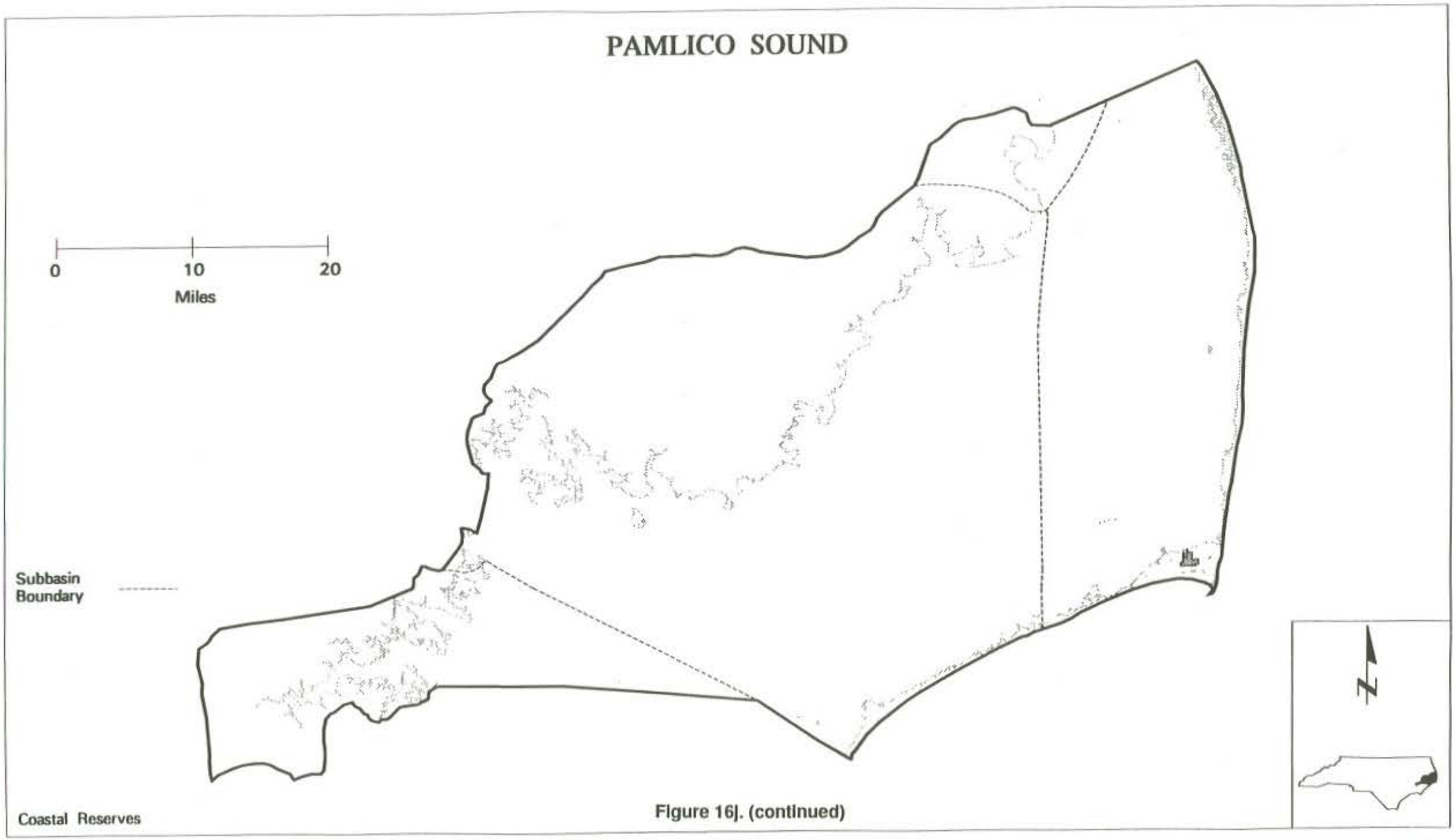


Figure 16j. (continued)

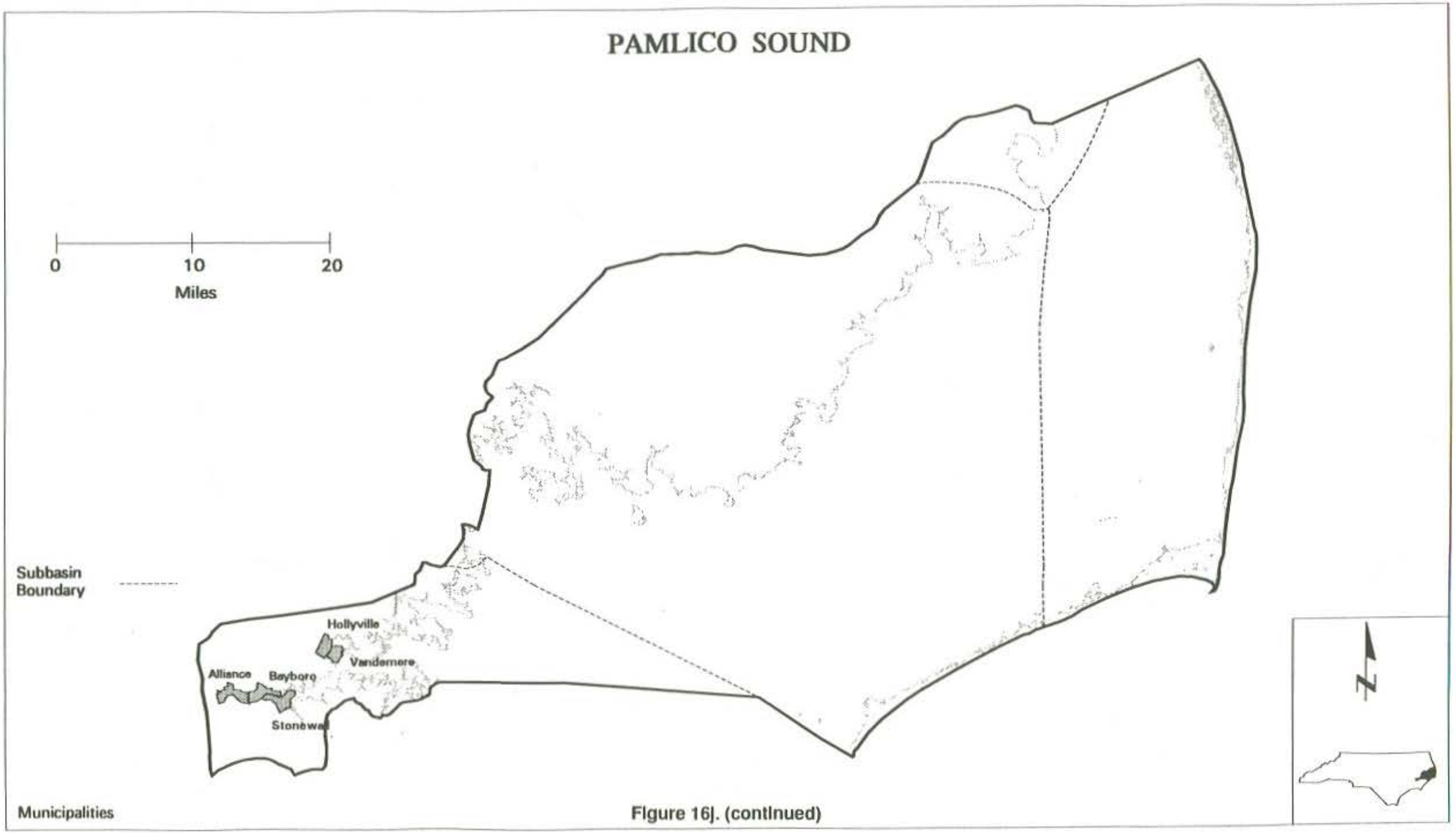


Figure 16J. (continued)

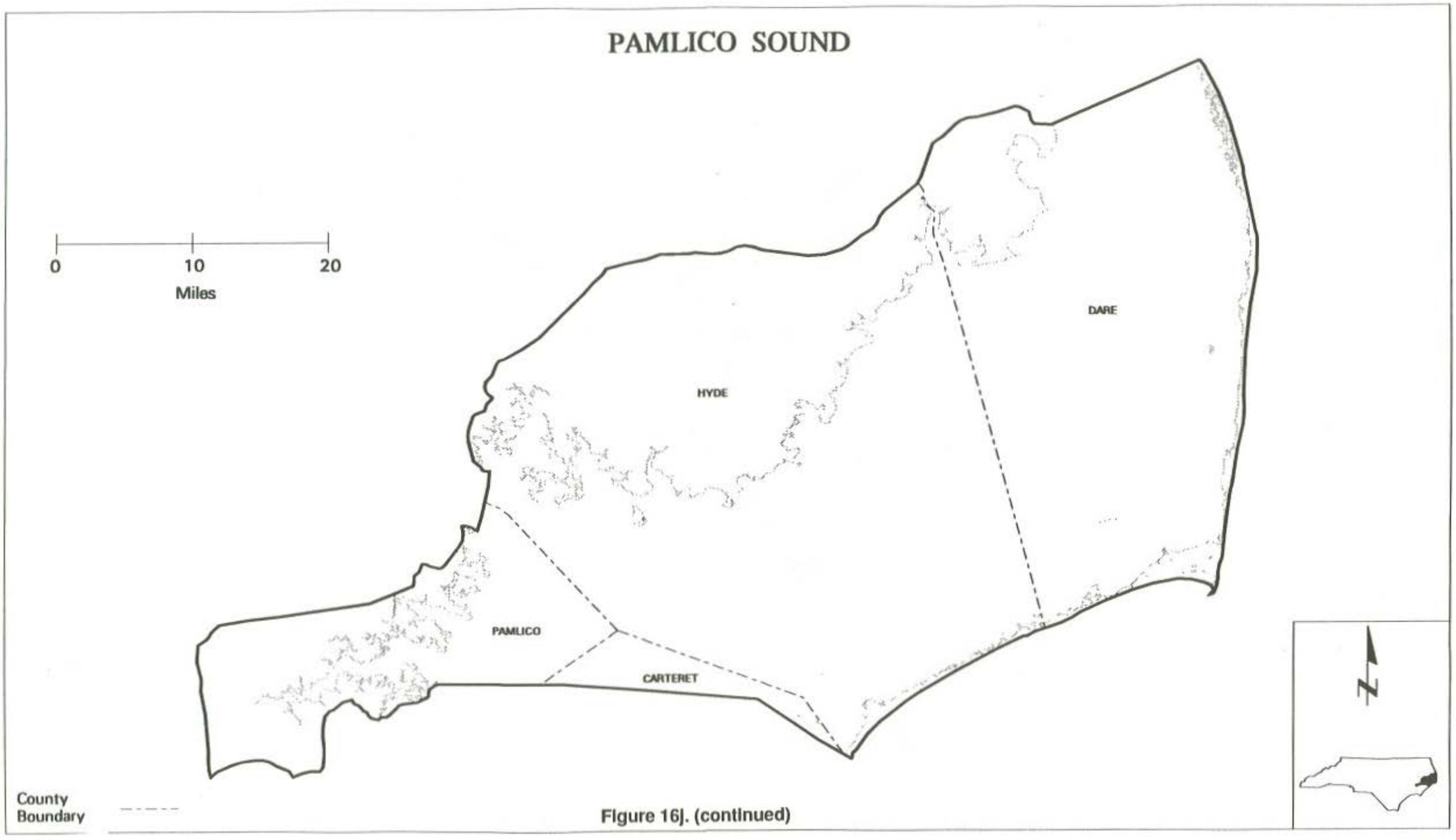


Figure 16j. (continued)

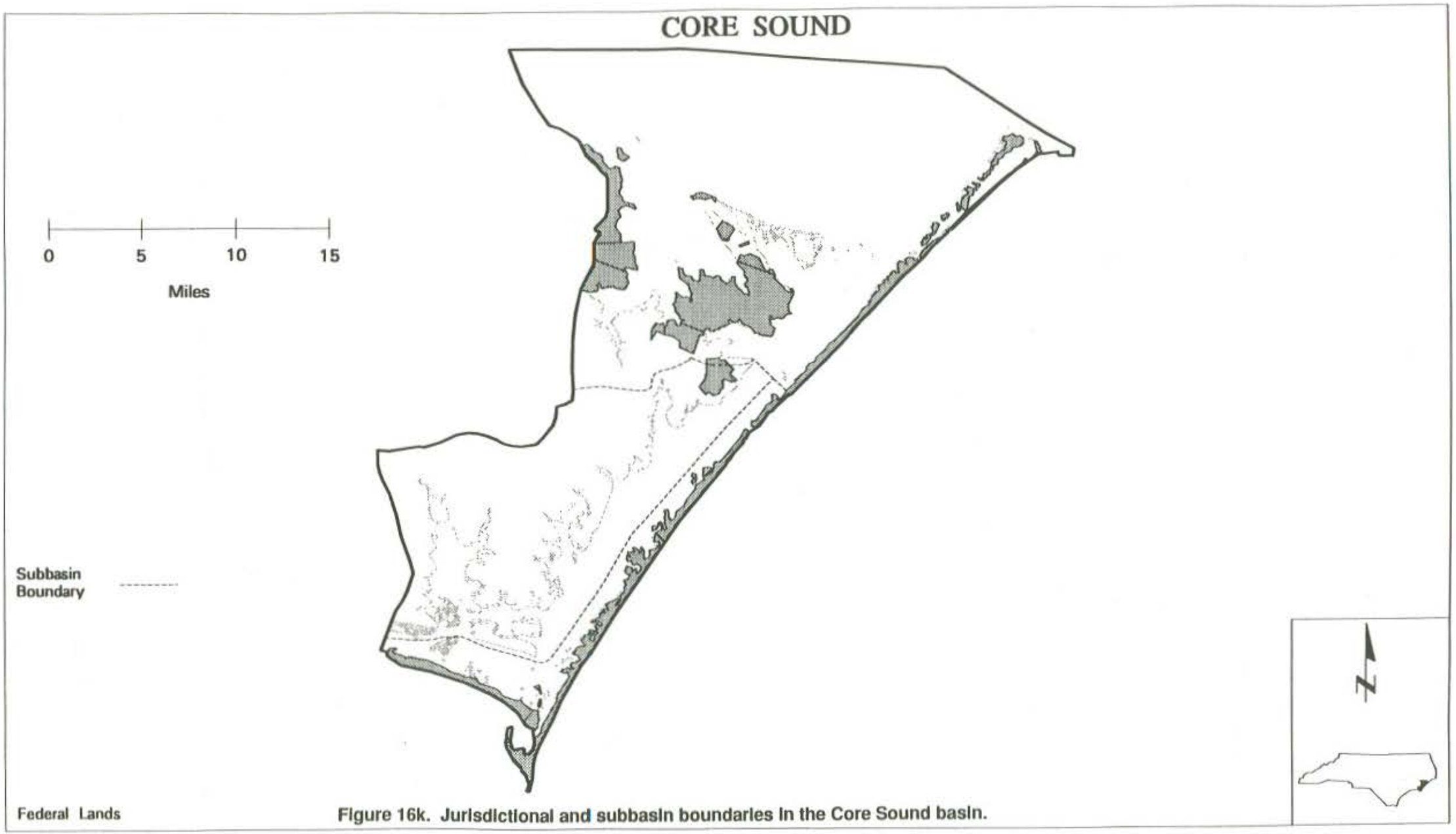
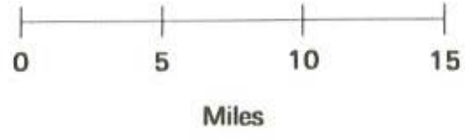
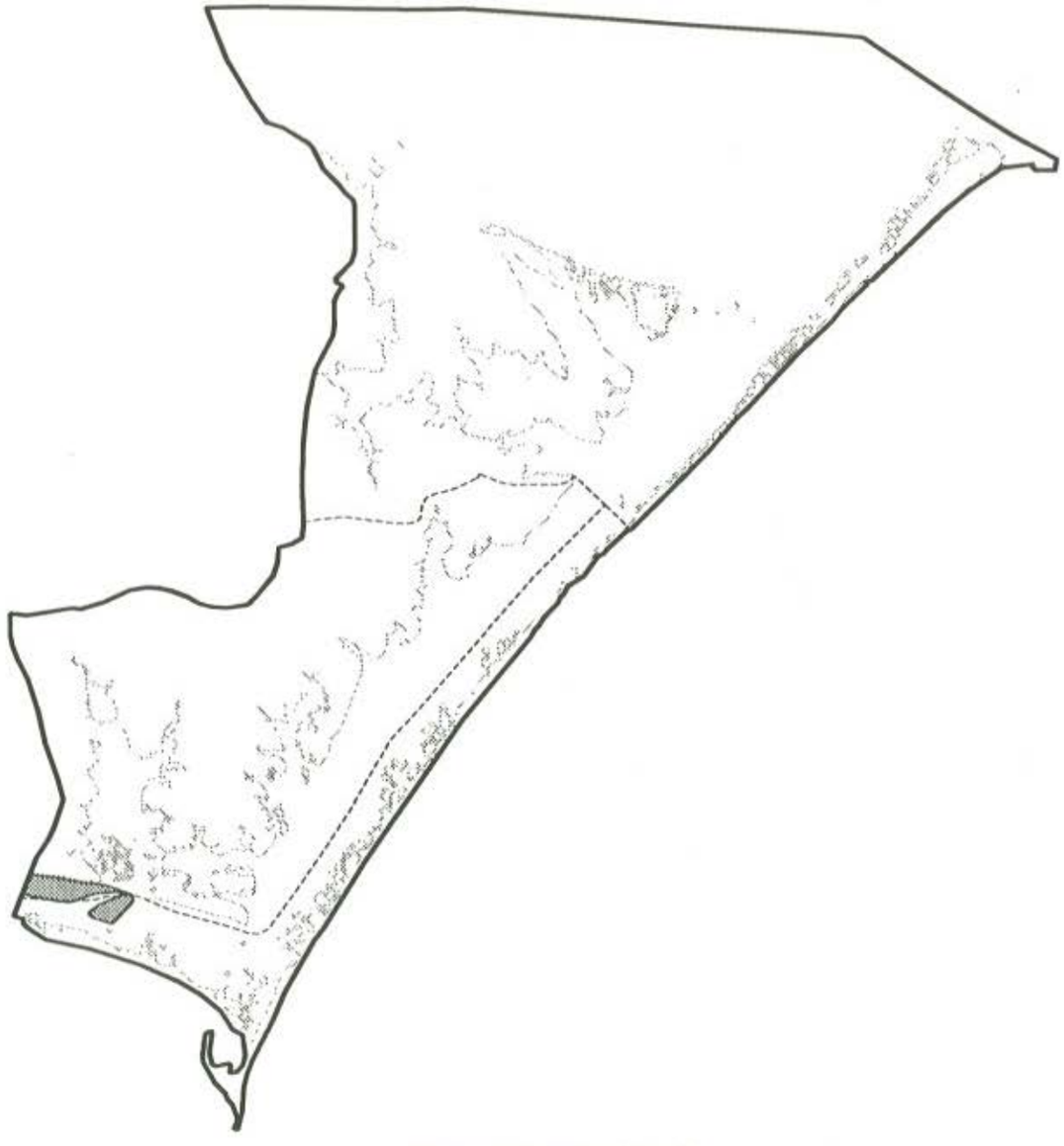


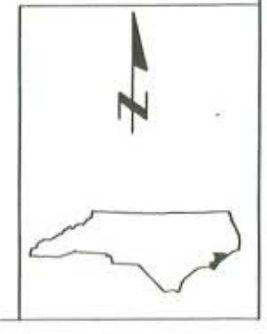
Figure 16k. Jurisdictional and subbasin boundaries in the Core Sound basin.

CORE SOUND





Subbasin Boundary ---------



Coastal Reserves

Figure 16k. (continued)

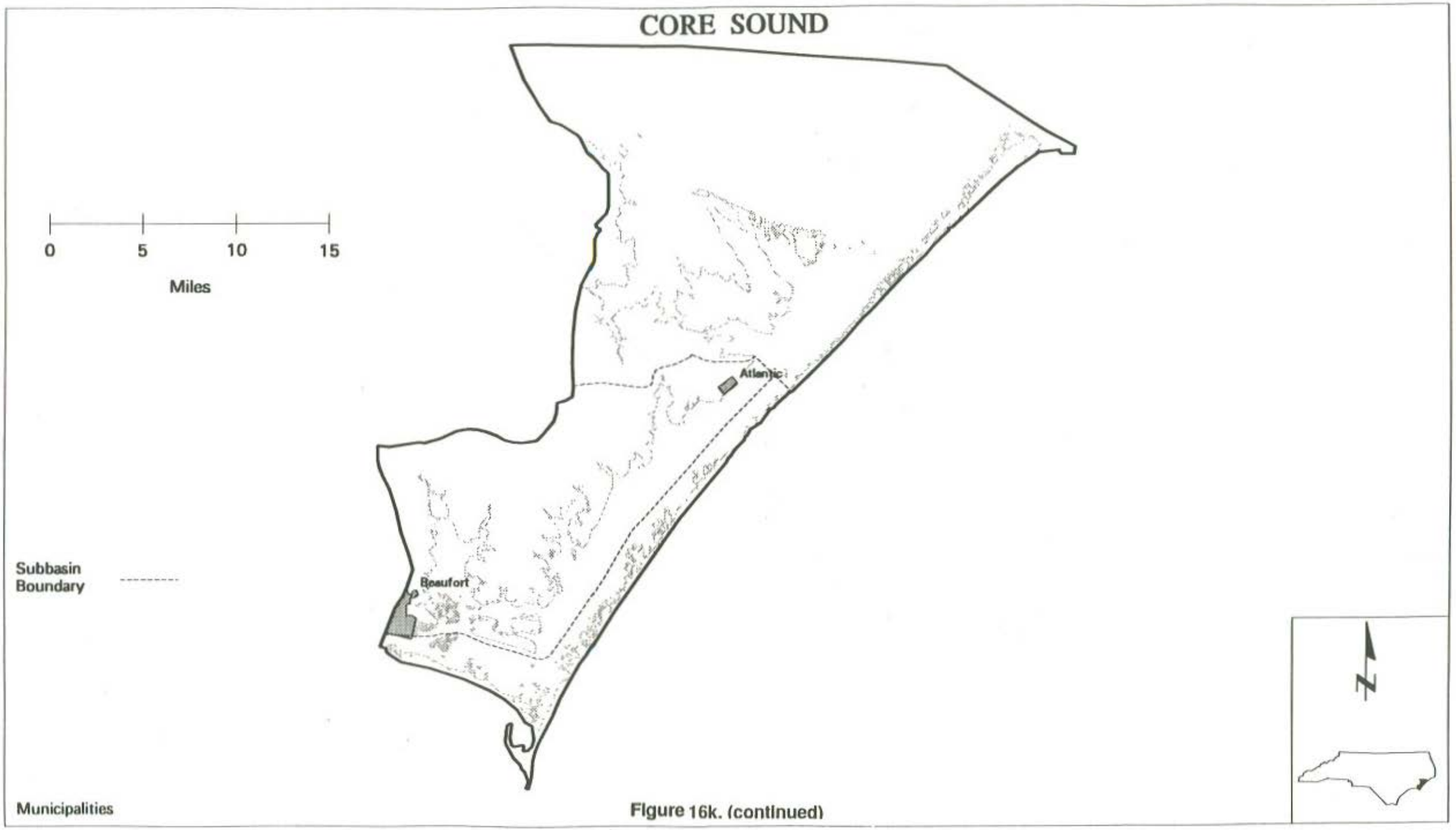


Figure 16k. (continued)

CORE SOUND

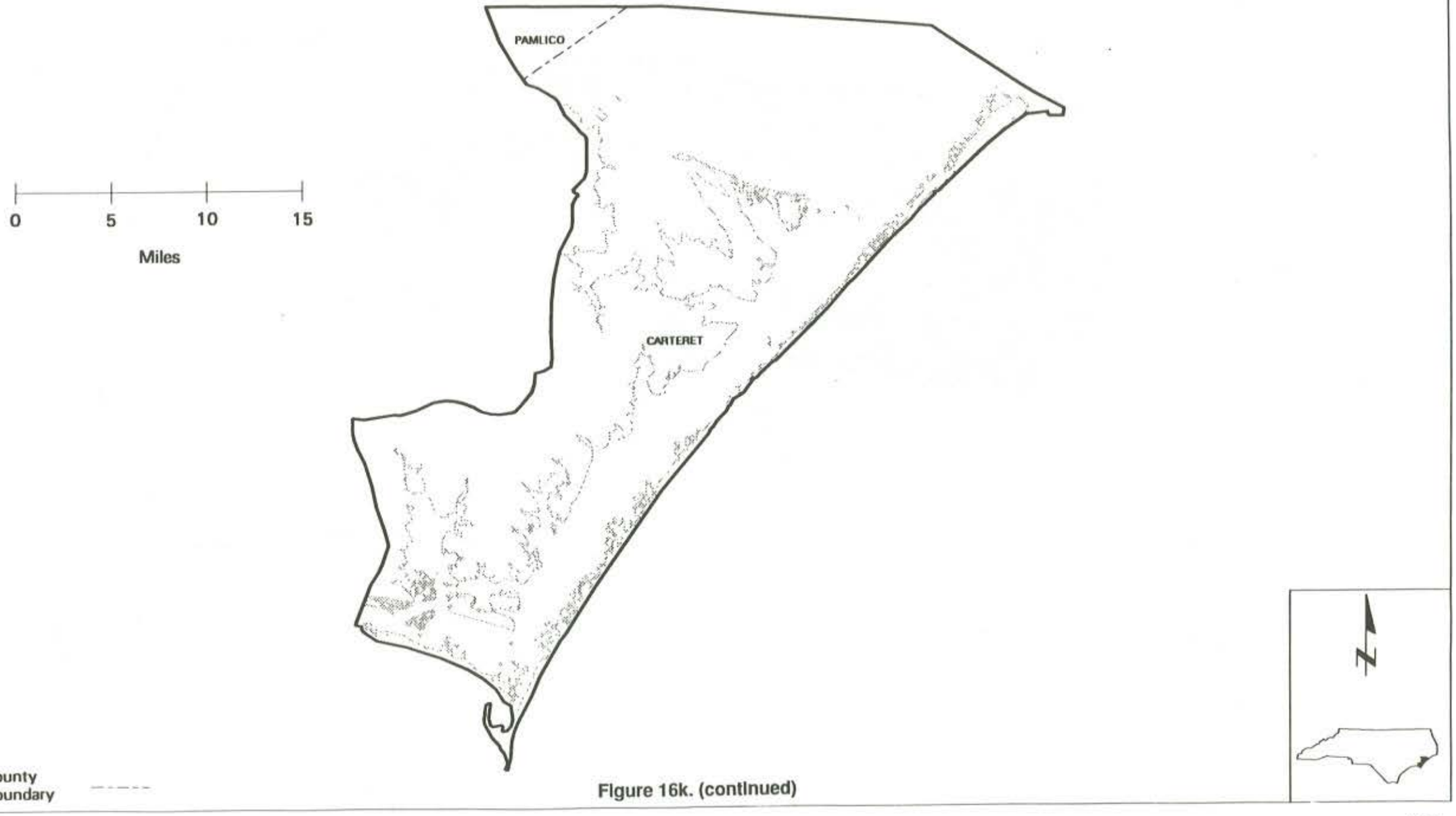


Figure 16k. (continued)

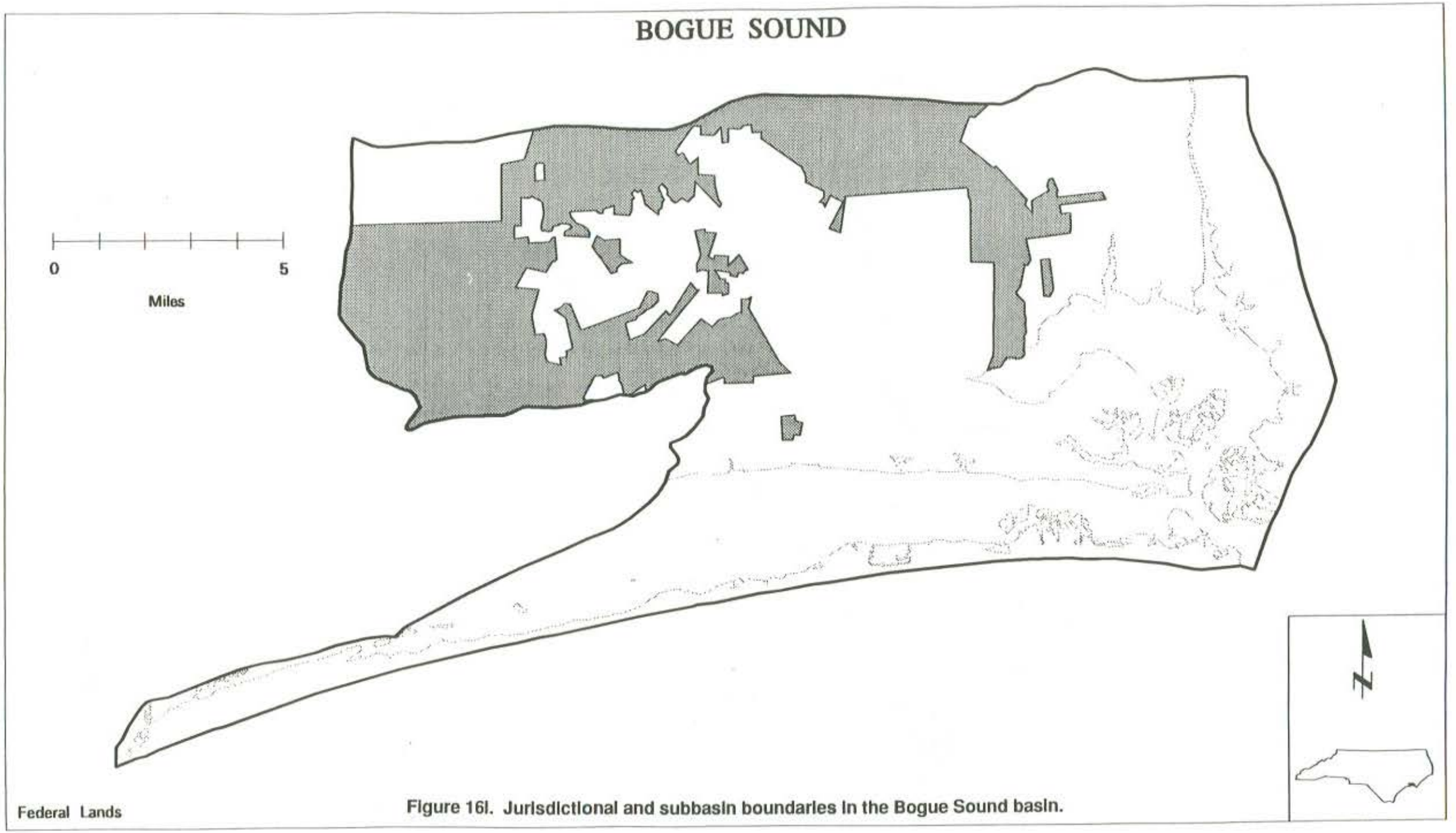


Figure 16l. Jurisdictional and subbasin boundaries in the Bogue Sound basin.

BOGUE SOUND

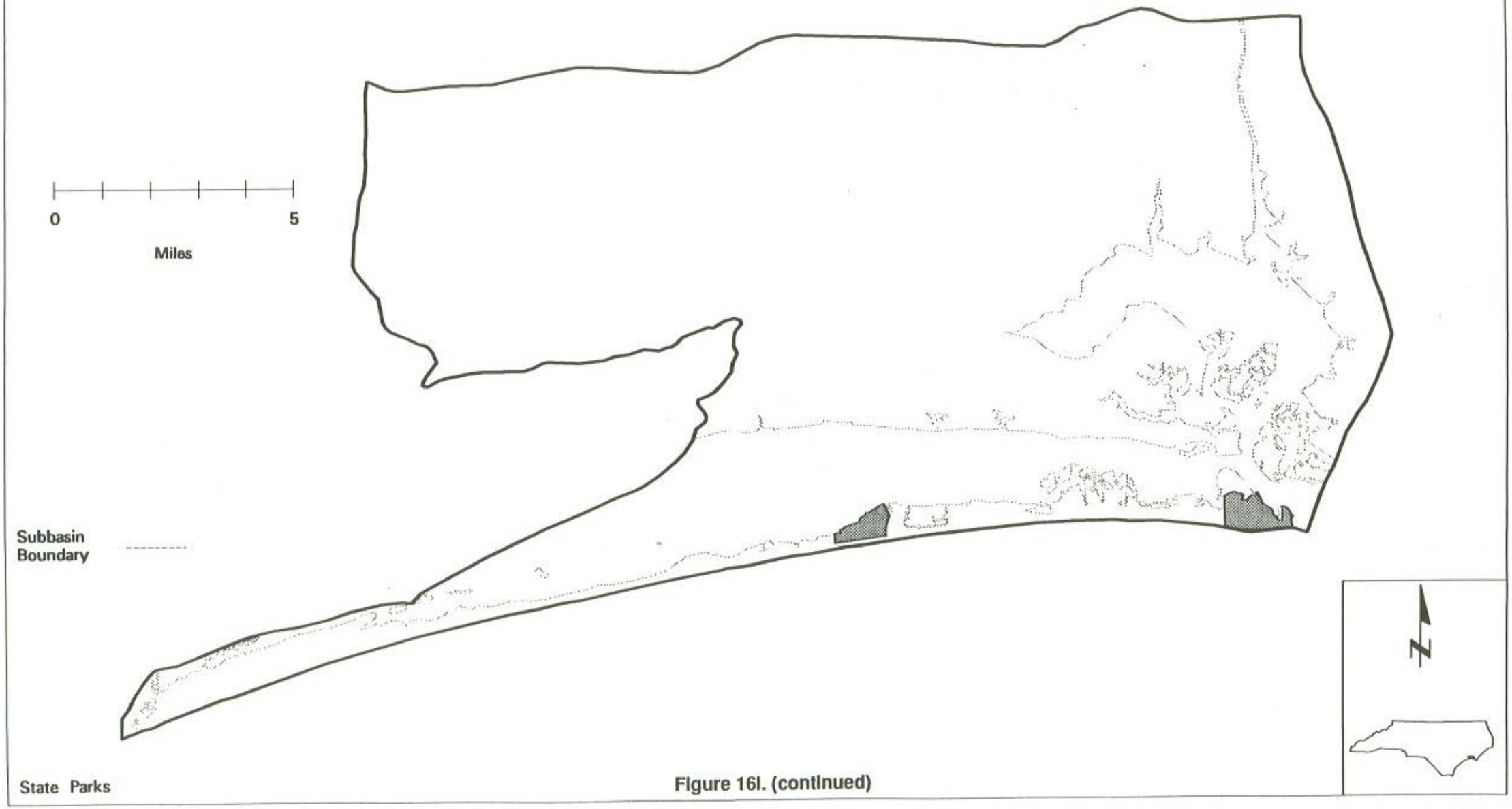


Figure 16l. (continued)

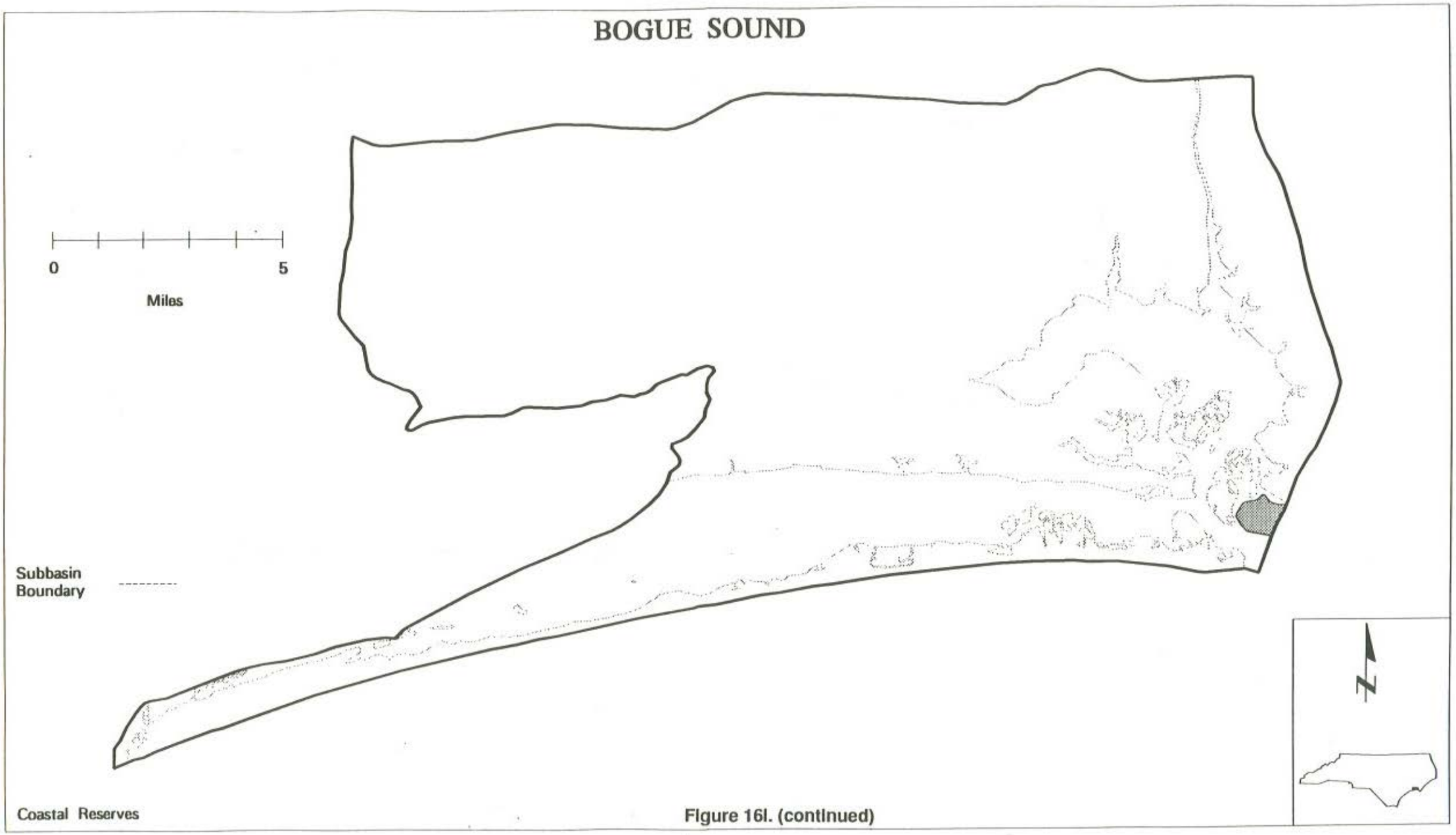


Figure 16l. (continued)

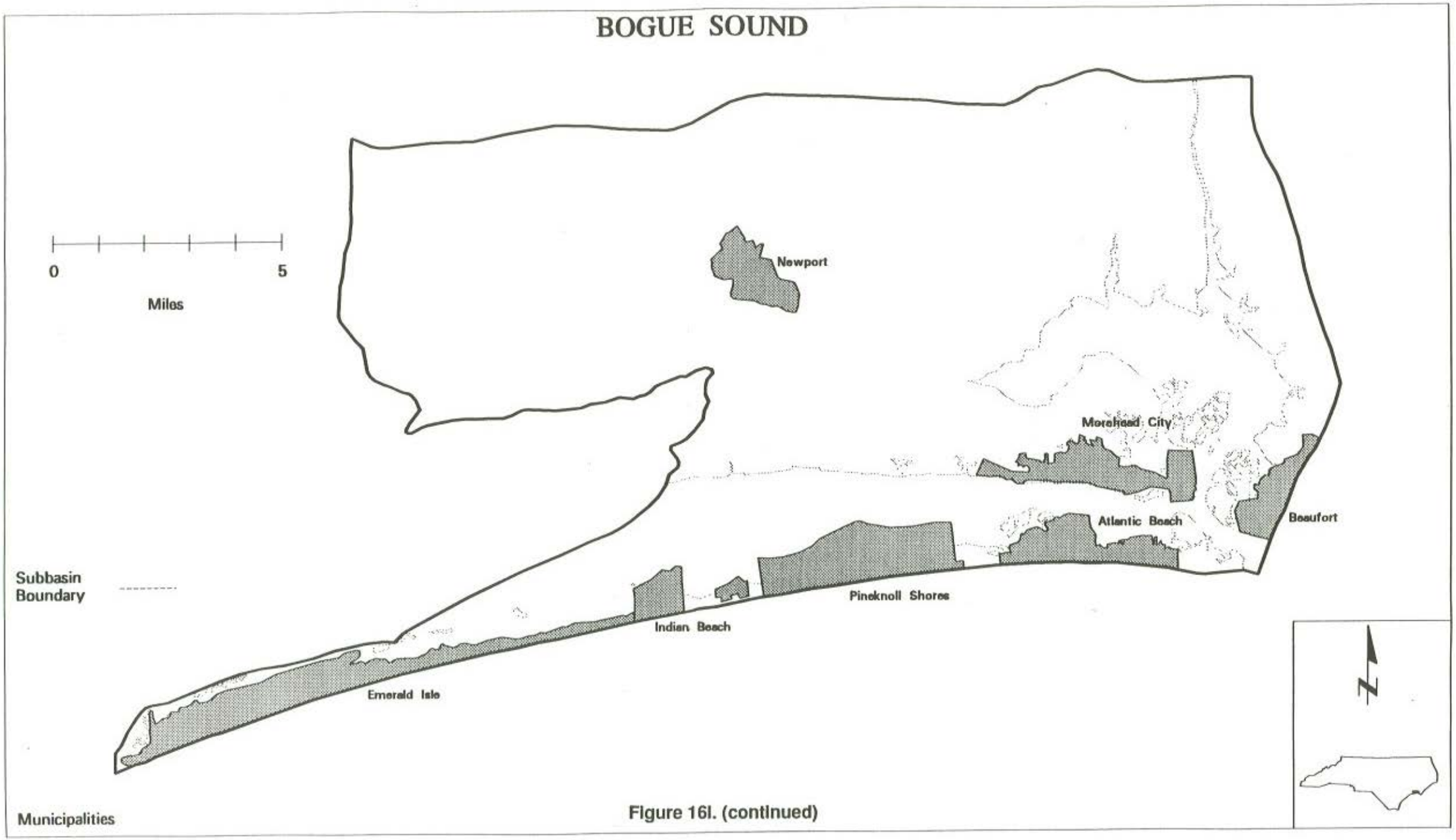


Figure 16l. (continued)

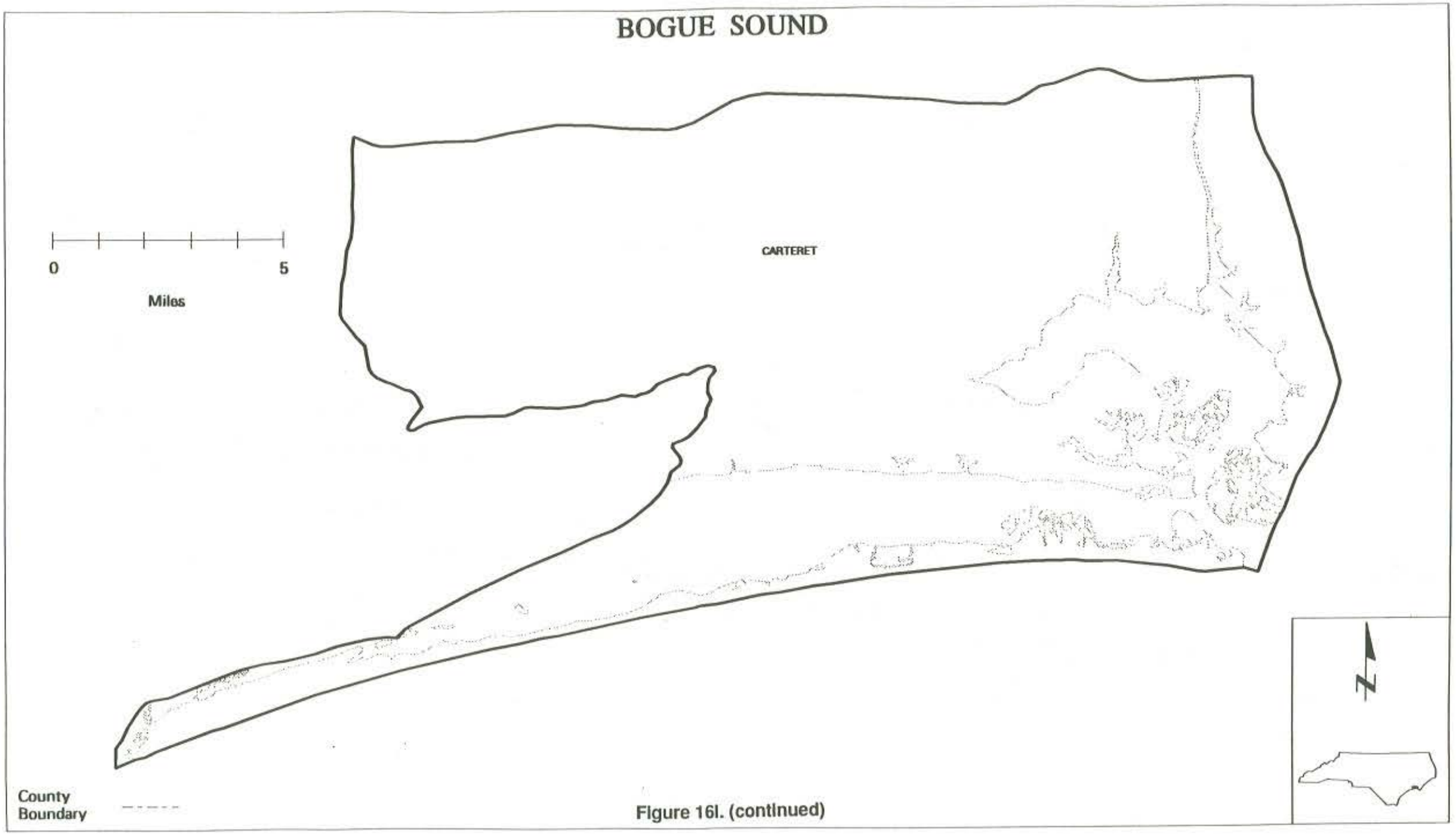


Figure 16l. (continued)

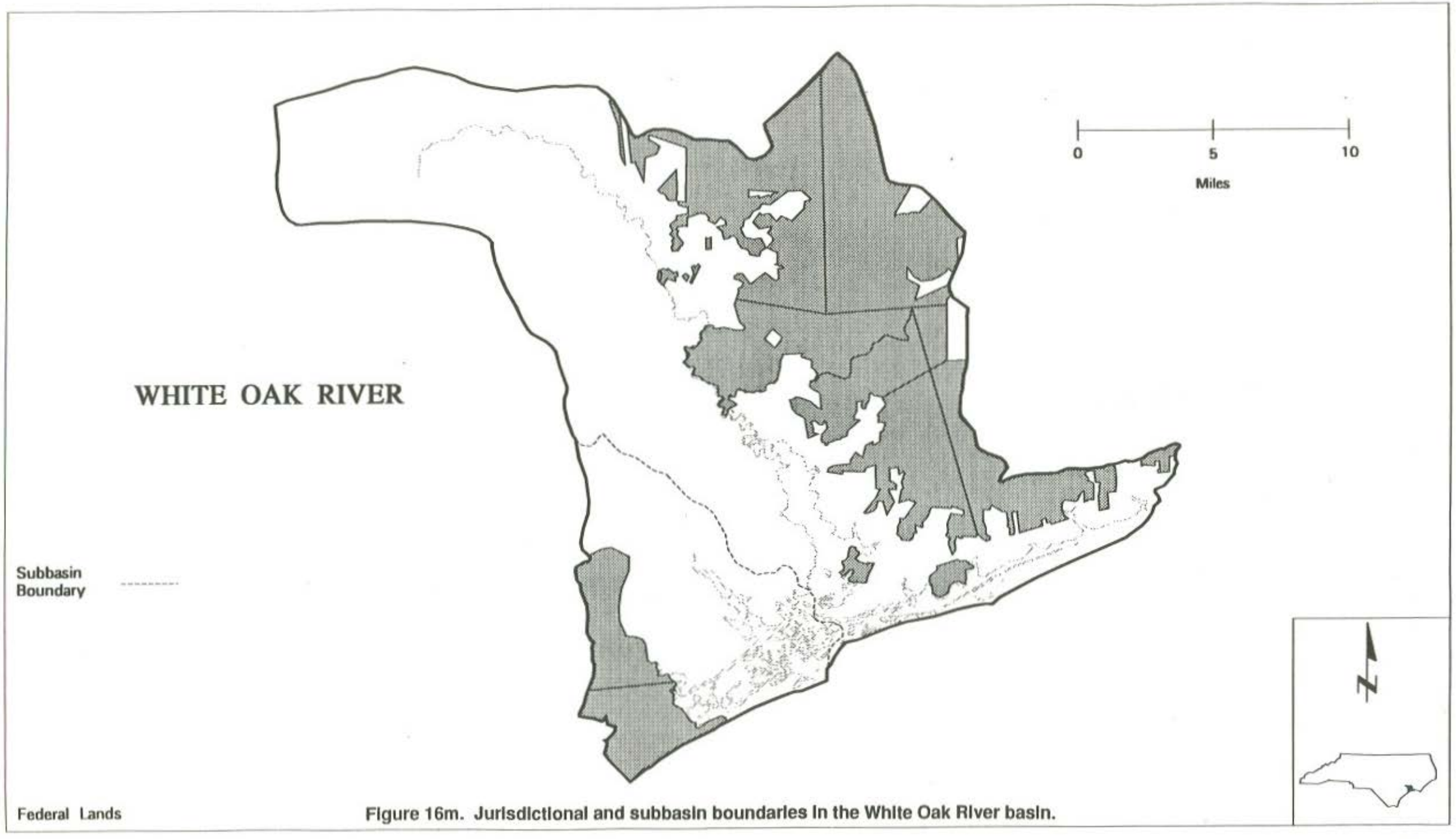


Figure 16m. Jurisdictional and subbasin boundaries in the White Oak River basin.

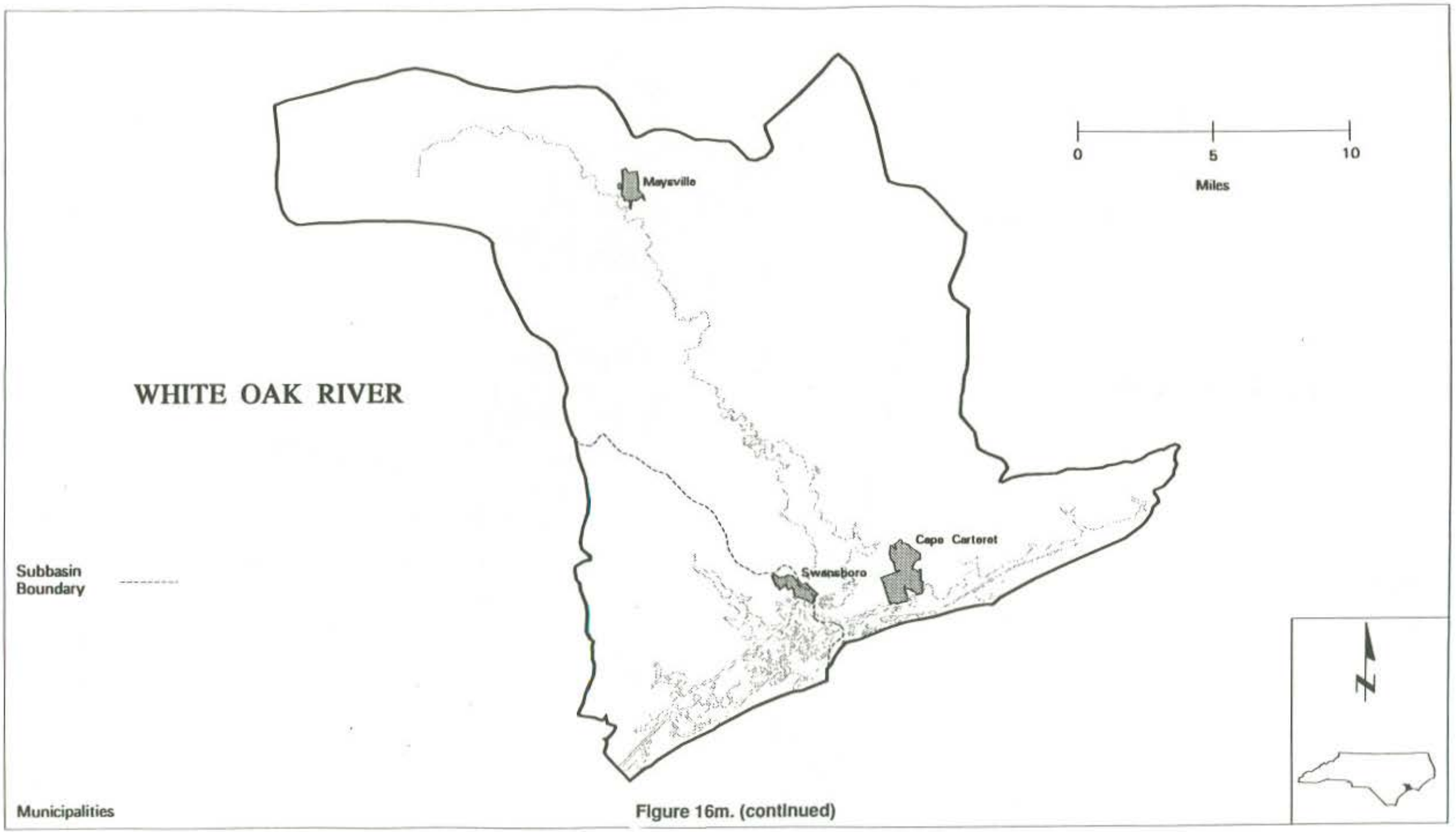


Figure 16m. (continued)

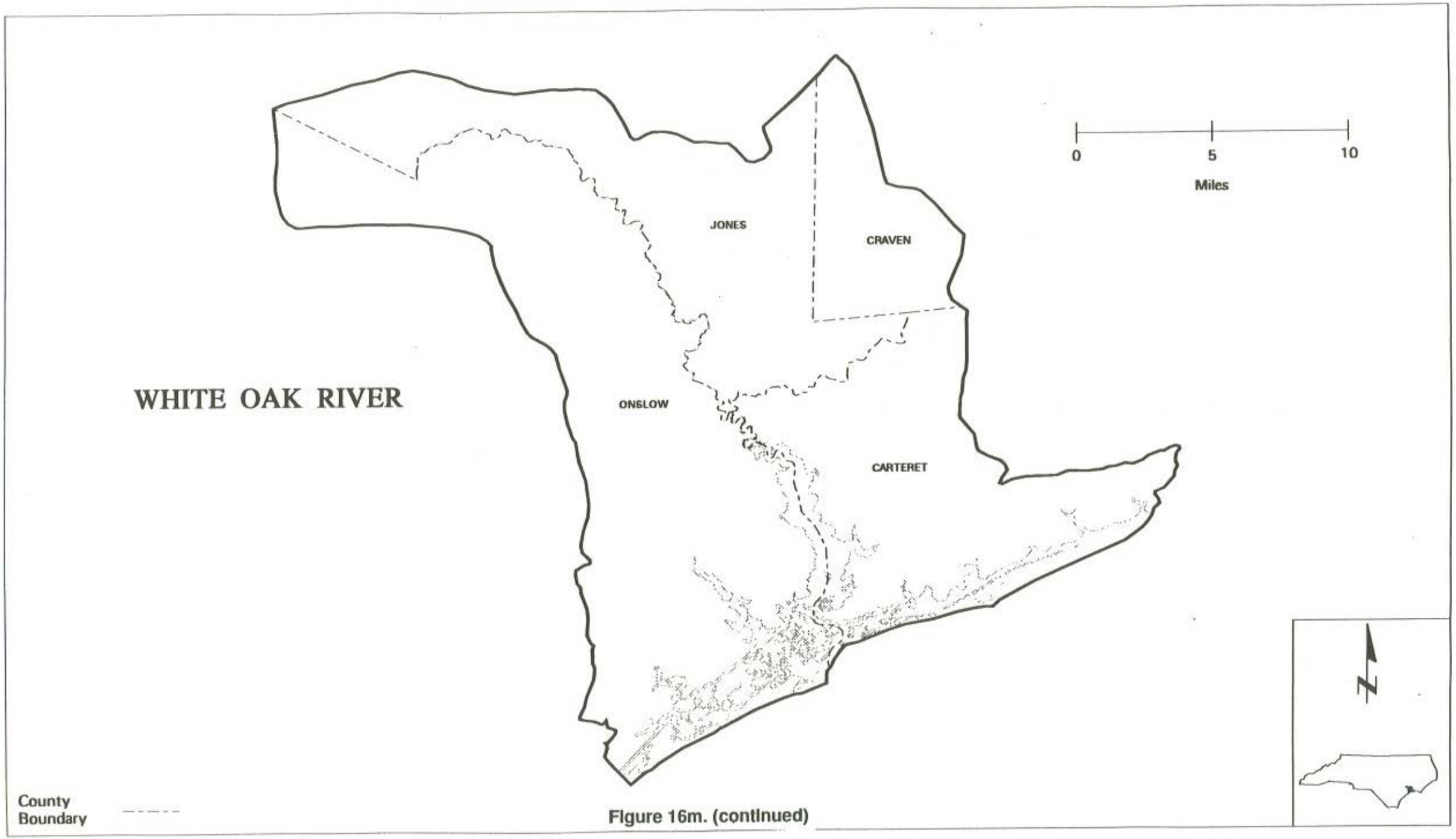


Figure 16m. (continued)

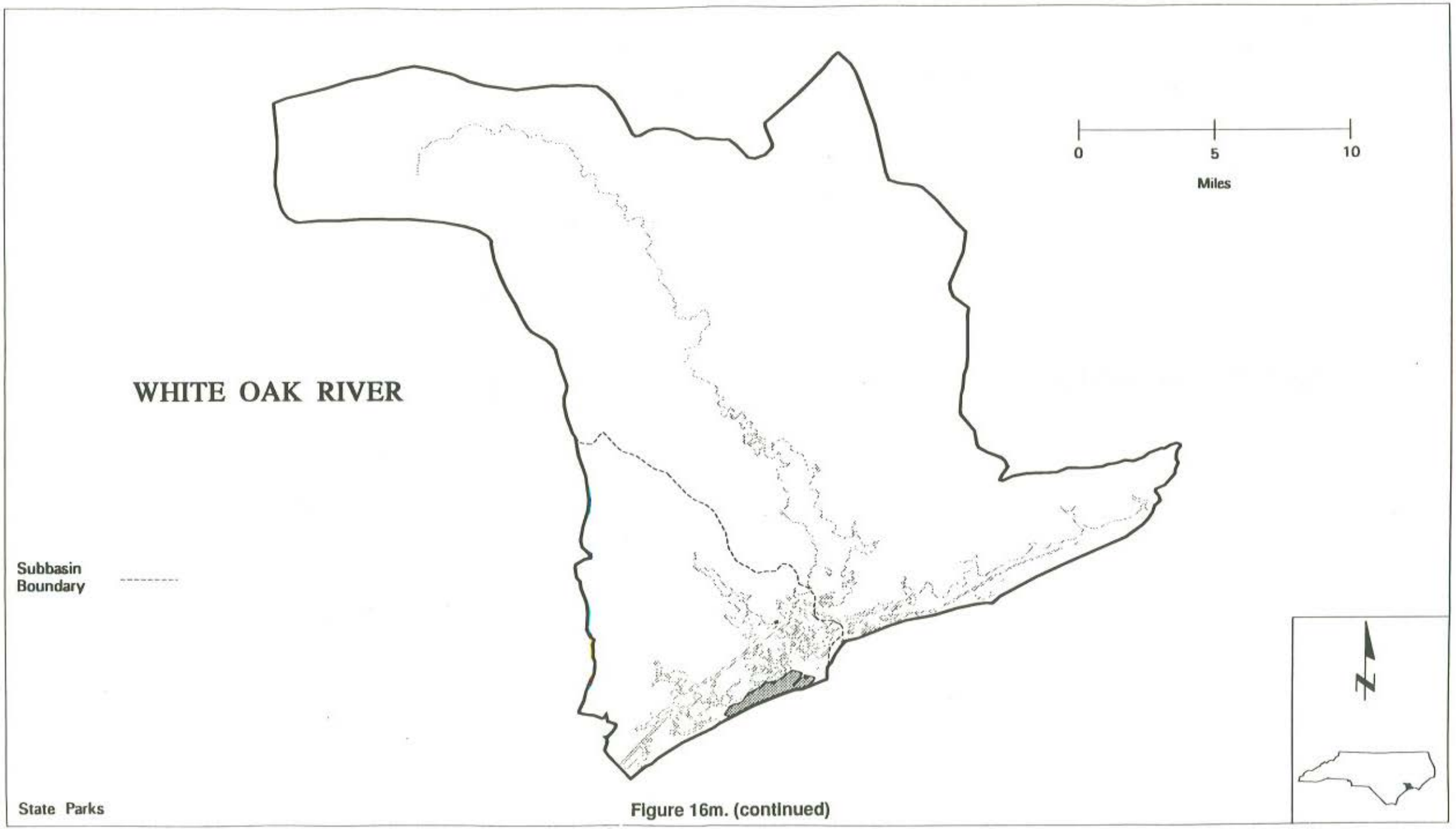


Figure 16m. (continued)

APPENDIX A

DATA SOURCES

Appendix A. Data Sources

Several considerations and criteria influenced the review and inclusion of data presented in this report:

- Availability as part of the Albemarle-Pamlico database
- Availability as electronic databases
- Geographic extent of the data coverage
- Data developed in earlier phases of RTI's Albemarle-Pamlico Estuarine studies (see Preface for list of reports).

More specifically, the Albemarle-Pamlico database was the primary source of information used to prepare this report. Data capture of nondigital data sources (beyond that completed in earlier phases of RTI's Albemarle-Pamlico Estuarine studies) was generally not pursued. Acquisition and inclusion of data for which spatial coverage was incomplete was also not pursued. These decisions were made in view of the objective of the report, which was to characterize *areawide* patterns.

Because complementary data for many data layers were not available for Virginia, data presented are only for the North Carolina portion of the A/P study area. A listing of the A/P database is provided in Table 1 of the main text.

Agricultural Output Statistics

Description:

County-wide annual statistical summaries of agricultural production. RTI converted NC data to hydrological basis (see Tippett and Dodd, 1992)

Geographic Extent: A/P Study Area

Key Contacts:

Jim Olson
NC Department of Agriculture
Agricultural Statistics Division
P.O. Box 27767
Raleigh, NC 27611
(919) 733-7293

VA Department of Agriculture and Consumer Services
Agricultural Statistics Service
1100 Bank Street
P.O. Box 1659
Richmond, VA 23213
(804) 786-3500

Data Updates: Annual. No current plan exists for converting county data to hydrological basis. Database currently housed in FOXPRO format, but can easily be transferred to INFO database.

Attributes: Numerous agronomic and economic indicators.

Considerations for Data Interpretation:

Hydrological data were converted assuming uniformity across a county.

Algal Blooms

Description:

Point data identify locations where algal blooms have been documented by NCDEM.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

Karen Lynch
NC DEHNR
Division of Environmental Management
Ecological Services Branch
4401 Reedy Creek Road
Raleigh, NC 27607
(919) 733-6946

Data Updates: Ongoing network.

Attributes:

Station code
County
Biovolume
Chlorophyll *a*
Species
Date of bloom
Occurrence of fish kill

Note: Not all attributes are available for all occurrences.

Considerations for Data Interpretation:

Development of this database has been driven by observations during routine monitoring by DEM regional staff and complaint investigations.

Ambient Water Quality Exceedances

Description:

Point data of ambient water quality sampling sites identify sites with more than one exceedance of State water quality standards or EPA criteria for any one pollutant over a 3-year period (July 1988-July 1991). All ambient water chemical analyses data were retrieved from STORET and were screened using the North Carolina State water quality standards for the protection of aquatic life or, if no State standard existed, the EPA chronic water quality criterion.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

Patricia Cunningham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC
(919) 541-6944

Data Updates: August 1992

Attributes:

Station
ID number
Basin name
USGS cataloging unit
Freshwater or saltwater site (F or S)
Type of exceedances detected

Considerations for Data Interpretation:

Users should review Cunningham et al., 1992a, for detailed discussion of procedures used to retrieve State ambient water quality monitoring station data and procedures for selecting State water quality standards or EPA chronic criteria for screening data. Exceedances identified are only for the 3-year period (1988-1991) when data were analyzed.

Census of Agriculture

Description:

Federal census of agricultural activities for 1987. RTI has converted NC data to hydrological basis (see Tipptee and Dodd, 1992).

Geographic Extent: A/P Study Area

Key Contacts:

U.S. Bureau of the Census
Data Users Services Division
Customer Services
Washington, DC
(301) 763-4100

Data Updates: Every 5 years

Attributes: Numerous agronomic, economic, and land use indicators.

Considerations for Data Interpretation:

Hydrologic data were converted assuming uniformity across a county.

Chemically Contaminated Fish—Human Health Concerns

Description:

Point data of fish and shellfish contaminant monitoring stations identify sites where the concentration of one or more chemical contaminants in fish fillet samples exceeds the EPA risk-assessment screening value based on a dietary consumption rate for the 50th percentile of recreational fishermen. All fish tissue residue data were obtained from NCDEM and were derived from three sources: NC DEM fish contaminant monitoring program, US EPA dioxin monitoring program, and discharger-conducted dioxin monitoring program.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:
Patricia Cunningham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6944

Data Updates: August 1992

Attributes:
Station ID number
Basin name
USGS cataloging unit
Type of exceedance detected
Number of exceedances (for dioxin only)
Sample type (F = fillet for dioxin only)

Considerations for Data Interpretation:

Users should review Cunningham et al., 1992a, for detailed discussion of procedures used to calculate screening values and other assumptions made in data interpretation. Exceedances of screening values are determined only for data collected from January 1980 through January 1990.

Chemically Contaminated Fish—Wildlife Concerns

Description:

Point data of fish contaminant monitoring stations identify sites where the concentration of one or more chemical contaminants in whole fish samples may be of concern to piscivorous wildlife. All fish residue data were obtained from NCDEM and were derived from three sources: DEM fish contaminant monitoring program, U.S. EPA dioxin monitoring program, and discharger-conducted dioxin monitoring program.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:
Patricia Cunningham
Research Triangle Institute
Research Triangle Park, NC 27709
(919) 541-6944

Data Updates: August 1992

Attributes:
Station ID number
Basin name
USGS cataloging unit
Type of exceedance
Number of exceedances (for dioxin only)
Sample type (W = whole fish for dioxin only)

Considerations for Data Interpretation:

Users should review Cunningham et al., 1992a, for detailed discussion of procedures used for selecting levels of concern to wildlife, sources of the levels of concern, and assumptions made in data interpretation. Exceedances of levels of concern are determined only for data collected from January 1980 through January 1990.

Coastal Reserves

Description:

Polygon data identify State-owned research areas (established under the provisions of the Coastal Zone Management Act) that are completely protected to provide scientists and students with the opportunity to examine the ecological relationships within the area over time. The four current reserves are Currituck Banks, Rachel Carson, Masonboro Island, and Zeke's Island.

Geographic Extent: Coastal North Carolina

Key Contacts:
Rich Shaw
NCDEHNR
Division of Coastal Management
225 N. McDowell St.
Raleigh, NC 27602
(919) 733-2293

Data Updates: April 1990; September 1990

Attributes:
Abbreviated sanctuary name
Sanctuary type

Considerations for Data Interpretation:

Users are advised to contact NCDEHNR-DCM for background on how this data layer was created and whether the information is current. The number of coastal reserves may expand in the future.

County Boundaries

Description:

Polygon data identify the perimeters of each county.

Geographic Extent: A/P Study Area

Key Contacts:
Tim Johnson
NC Center for Geographic Information and Analysis
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-2090

Data Updates: Unknown

Attributes: None

Considerations for Data Interpretation:

Data were captured from 1:100,00 scale maps.

Crustacean Harvesting Areas—Blue Crabs and Penaeid Shrimp

Description:

Polygon data identify areas where harvesting practices are conducted for blue crabs and three penaeid shrimp species. This data layer encompasses areas where the following shellfish harvesting techniques are used:

Blue crabs: crab pots, crab trawling, crab dredging

Shrimp: channel nets, shrimp trawling.

All harvesting practices for these shellfish species are described in detail in Cunningham et al., 1992.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

Patricia Cunningham
Research Triangle Institute
Research Triangle Park, NC 27709
(919) 541-6944

Paul Phalen
North Carolina Division of Marine Fisheries
P. O. Box 769
Morehead City, NC 28557
(919) 726-7021

Data Updates: September 1992

Attributes: None

Considerations for Data Interpretation:

Users should review Cunningham et al., 1992b, for detailed descriptions of individual crustacean fishing practices, gear used, equipment and harvesting restrictions associated with each practice, and a map of the harvest area for each crustacean harvesting practice.

Users should also be aware that the shellfish harvest areas represent areas where harvesting has typically been conducted (1980 through 1992). Users should check with NCDMF staff to determine whether the DMF Fisheries Director has issued any proclamations regarding shellfish harvesting practices in these areas to ensure that the most recent information on harvest areas has been entered.

Federal Land Ownership

Description:

Polygon data identify federally owned land.

Geographic Extent: A/P Study Area

Key Contacts:

Tim Johnson
NC Center for Geographic Information and Analysis
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-2090

Data Updates: Unknown

Attributes:

Agency number
Agency
Co number
Type

Considerations for Data Interpretation:

Data were captured from 1:100,000 scale maps.

Finfish Harvesting Areas

Description:

Polygon data identify estuarine areas where major finfish harvesting practices are principally conducted. This data layer encompasses areas where the following finfish harvesting techniques are used

Pound netting: Flounder, sciaenid, river herring, bait fish
Catfish pots
Eel pots
Trotline fishing
Long haul seining (and swipe netting).

All harvesting practices for these finfishing techniques are described in detail in Cunningham et al., 1992b.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

Patricia Cunningham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6944

Paul Phalen
North Carolina Division of Marine Fisheries
P.O. Box 769
Morehead City, NC 28557
(919) 726-7021

Data Updates: September 1992

Attributes: None

Considerations for Data Interpretation:

Users should review Cunningham et al., 1992b, for detailed descriptions of individual finfishing practices, gear used, equipment and harvesting restrictions associated with each practice and a map of the harvest area for each finfish harvesting practice.

Users should also be aware that the finfish harvest areas represent areas where harvesting has typically been conducted (1980 through 1992). Users should check with NCDMF staff to determine whether the DMF Fisheries Director has issued any proclamations regarding finfish harvesting practices in these areas to ensure that the most recent information on harvest areas has been entered.

Fish Consumption Advisories

Description:

Polygon data identify areas where the States of North Carolina and Virginia have issued fish consumption advisories for dioxin.

Geographic Extent: A/P Study Area

Key Contacts: Patricia Cunningham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6944

Data Updates: September 1992

Attributes: None

Considerations for Data Interpretation:

Users should check with the following State staff to ensure that fish advisory information is current: Dr. Kenneth Rudo, NC Department of Environment, Health, and Natural Resources, 225 North McDowell Street, Raleigh, NC 27611, and Dr. Peter Sherertz, Virginia Department of Health, P.O. Box 2448, Richmond, VA 23218. Data were captured from 1:100,000 scale maps.

Hydrologic Unit Boundaries

Description:

NC watershed boundaries delineated by RTI and digitized by NCCGIA. Boundaries represent NCDEM subbasins with several boundaries also representing USGS gaged watersheds. Virginia watershed boundaries were delineated by the State of Virginia.

Geographic Extent: A/P Study Area

Key Contacts: Mike Flagg
Virginia Division of Soil and Water Conservation
203 Governor Street, Suite 206
Richmond, VA 23219
(804) 786-3959

Zsolt Nagy
NC Center for Geographic Information and Analysis
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-2090

Randy Dodd
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6491

Data Updates: Unknown

Attributes: Subbasin ID; USGS cataloging unit #.

Considerations for Data Interpretation:

Users should review Dodd et al., 1991, for more detailed information on NC subbasin delineation procedures and contact Mike Flagg for information on VA delineations. SCS and NCCGIA are pursuing a project to delineate small watersheds in North Carolina.

Land Use and Cover

Description:

Polygon data identify land use classifications and land cover. Data were captured from 1987-88 LANDSAT images.

Geographic Extent: A/P Study Area, with several small data gaps as a result of satellite image coverage and cloud cover.

Key Contacts:

Tim Johnson
NC Center for Geographic Information and Analysis
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-2090

Data Updates: Unknown

Attributes: Each classified pixel includes a number identifying the area with one of 20 land use/land cover categories.

Considerations for Data Interpretation:

Users should consult Khorram et al., 1992.

Marinas

Description:

Point data identify locations providing secure moorings for sailboats, motorboats, and yachts.

Geographic Extent: Estuarine portion of A/P Study Area (North Carolina only)

Key Contacts:

Patricia Fowler
NCDEHNR—Division of Environmental Health
Shellfish Sanitation Branch
P.O. Box 769
Morehead City, NC 28557
(919) 726-6827

Data Updates: July 1992

Attributes: Marina name

Considerations for Data Interpretation:

Users are advised that this inventory includes marinas with more than 10 boat slips. Information about each marina is kept current by the Shellfish Sanitation Branch (SSB). Users should contact SSB staff to ensure that coverage is current.

Metal Contaminated Sediments

Description:

Point data of sediment sampling sites identify where the concentration of one or more heavy metals exceeds NOAA Biological Effects Range-Low (ER-L) and Effects Range-Medium (ER-M) values for estuarine sediment. All chemical analysis data were obtained from the following Riggs et al., in preparation; Riggs et al., 1991; and Riggs et al., 1989.

All data were screened using the NOAA ER-M value to identify those sites that were most likely to pose adverse biological effects.

Geographic Extent: Estuarine portion of A/P Study Area (North Carolina only)

Key Contacts:
Patricia Cunningham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6944

Data Updates: July 1992

Attributes: Sediment core ID number (derived from Riggs [1989, 1991, in preparation] sampling site codes)

Considerations for Data Interpretation:

Users should review Riggs et al. reports (1989, 1991, and in preparation) for detailed discussion of selection of sediment sampling sites, sampling and chemical analysis procedures used. Users should also review Cunningham et al., 1992a, for procedures used to screen estuarine sediment data using NOAA ER-L and ER-M values to identify the most contaminated sites. The criterion for mapping a contaminated site was that the NOAA ER-M value for at least one metal was exceeded at the site.

Municipal Boundaries

Description:

Polygon data identify perimeter boundaries for cities, towns, and municipalities.

Geographic Extent: A/P Study Area

Key Contacts:
Tim Johnson
NC Center for Geographic Information and Analyses
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-2090

Data Updates: 1984, 1986, and 1988

Attributes: Name of municipality

Considerations for Data Interpretation:

Data were captured from 1:100,000 scale maps.

Mussel Distribution

Description:

Point data identify the distribution of 13 different species of fresh water mussels that are good water quality indicators because their life spans range up to 75 years.

Geographic Extent: Tar-Pamlico River basin in North Carolina

Key Contacts:
John Alderman
Wildlife Resources Commission
512 North Salisbury Street
Raleigh, NC 27611
(919) 542-5331

Data Updates: 1989?

Attributes: Site ID number

Considerations for Data Interpretation:

Users should note that mussel distribution data are mapped at a scale of 1:100,000 and that locational aspects of the species distribution is based on individual streams at a sampling interval of 0.1 miles.

Natural Heritage Inventory

Description:

Point data identify locations of rare and endangered species and natural communities. Polygon data identify the boundaries of unique natural ecosystems (terrestrial and palustrine) and special wildlife habitats.

Geographic Extent: A/P Study Area (North Carolina only). Database developers indicate that identification is an ongoing process.

Key Contacts:
Linda Pearsall
Harry LeGrand
NCDEHNR
Division of Parks and Recreation
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-7701

Data Updates: January 1992

Attributes:
Class
Precision

Considerations for Data Interpretation:

This is a **Restricted Use** database. Users who want to obtain Natural Heritage Program data that are archived in the CGIA database should contact CGIA, which then contacts the Natural Heritage Program to obtain approval of the data request made by the user. An information guide is provided to any user of the NGIA data layer and a $50 access fee is required to use the CGIA data layer. Users who want a printout of rare and endangered species present in a given county or on

a given quad map or a printout of species-specific information on population size, location, or other data may contact the Natural Heritage Program directly.

Limitations of Absence of Data

Although the Natural Heritage Program has conducted numerous biological inventories and has assembled as much of the secondary source data as possible, the large majority of the State has never been systematically surveyed for rare species or natural communities. In addition, negative surveys are seldom reported to the Natural Heritage Program and are not recorded. The database reflects only locations where an element was once known to occur. It does not distinguish between areas known to have no elements and those that have not been checked. The absence of element locations cannot be taken as an indication of absence of elements or of ecological concerns. Natural Heritage Program biologists are often able to give indications of the potential for concern in unsurveyed areas, and the CGIA map database is not a substitute for this kind of interpretation.

Data Currency

The Natural Heritage Program databases are continually updated as new information is acquired. The locational database at CGIA is updated as needed for applications. Users should determine from CGIA the date of the last update, and, if necessary, see that an update is done prior to their application being run. All printed maps from the GIS should be dated. Depending on activity in a given area, a map may quickly become outdated, or may remain current for several years. It is not possible to set a specific expiration date on maps; however, data more than 6 months old should not be depended on without checking with the Natural Heritage Program.

Only a small portion of the rare species and community locations are monitored on a regular basis. Information in the Natural Heritage Program database represents the occurrence at the last time it was observed. The date of last observation is given in the Natural Heritage Program database, but is not included in the CGIA database. Records are kept in the database until the destruction of an occurrence is confirmed. Thus, some of the records are likely to represent locations where an element has not been seen in many years and may no longer be present.

Nursery Areas

Description:

Polygon data identify location and extent of primary and secondary nursery areas used as habitat by juveniles of a wide variety of estuarine and marine fish and invertebrate species.

Geographic Extent: A/P Study Area (North Carolina only).

Key Contacts:

Paul Phalen
NCDEHNR
Division of Marine Fisheries
P.O. Box 769
Morehead City, NC 28557
(919) 726-7021

Data Updates: August 1992

Attributes:

SEQ number
5 relate codes
Type of nursery area
DMF district

Considerations for Data Interpretation:

Users should check with DMF staff to determine whether the information on designated nursery areas is current.

Outstanding Resource Waters

Description:

Polygon and line data describe areas that are designated as sensitive waters requiring special environmental protection.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

Steve Zoufaly
NCDEHNR
Division of Environmental Management
Water Quality Section
Raleigh, NC
(919) 733-5083

Data Updates: 1989

Attributes: ORW name

Considerations for Data Interpretation:

This is the most protective use classification assigned by the Environmental Management Commission.

Point Source Dischargers

Description:

Point data identify locations of permits issued for industrial facilities or municipal sewer systems, sewage treatment plants, or disposal systems that result in a discharge into surface waters.

Geographic Extent: Statewide (North Carolina only). Most, but not all, Virginia dischargers have been georeferenced.

Key Contacts:

Dennis Ramsey
NCDEHNR
Division of Environmental Management
Water Quality Section
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-5083

Data Updates:

Attributes:

Name of discharger
NC permit number
Active discharger designation
Pipe number
Permit date
Receiving stream
Map number
County
Basin

Considerations for Data Interpretation:

New digital coverage under development at CGIA will be registered to the 1:100,000-scale shoreline. Data on discharge quality are housed by DEM and are not available as an INFO database.

Point Source Exceedances of Water Quality Standards

Description:

Point data of dischargers identify those facilities with a potential to cause instream water quality standard exceedances under 7Q10 low flow conditions. All information on loadings, discharge flows, receiving stream flows, and stream classifications was obtained from the Compliance Monitoring System specifically from DEM's Discharge Monitoring Report (DMR) database. The period of record encompassed 2 years from January 1989 through December 1990. All calculated instream contaminant concentrations were screened against North Carolina State water quality standards for the protection of aquatic life or EPA chronic water quality criteria.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:
Patricia Cunningham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6944

Data Updates: August 1992

Attributes:
Discharger NPDES number
Subbasin number
Basin name
Flow type (7Q10)
Type of exceedances potentially occurring

Considerations for Data Interpretation:

Users should review Cunningham et al., 1992a, for a detailed discussion of procedures and assumptions used for calculating potential exceedances.

Population Estimates/Projections

Description:

Data from the U.S. Census Bureau and projections from the State demographer. RTI has used county-wide data to calculate hydrologic unit populations in NC (see Tippett and Dodd, 1992).

Geographic Extent: Statewide (NC only)

Key Contacts:
Francine Stephenson
North Carolina State Data Center
116 West Jones Street
Raleigh, NC 27603
(919) 733-7061

Data Updates: Major data updates occur as a function of the national census.

Attributes: None

Considerations for Data Interpretation:

Data included in the PC data base reflect permanent residents.

Reach File 3 (RF3) Hydrology

Description:

RF3 is a national hydrologic network of surface water features. Development has been sponsored by EPA and is based on USGS digital line graph (DLG) data; RF3 is linked to numerous national databases (e.g., Geographic Names Information System, STORET).

Geographic Extent: Areawide. RF3 indexing has been completed for inland waters but not for coastal waters.

Key Contacts:

Randy Dodd, Tim Bondelid
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6491

Data Updates: September 1991. Improvements in spatial resolution will be completed in Fall 1992.

Attributes: The key RF3 attribute is the reach number which identifies where in the local, regional, and national network the stream reach occurs.

Considerations for Data Interpretation:

Inclusion of RF3 in the A/P database allows for both more sophisticated hydrologic and water quality modeling as well as more efficient hydrographic mapping.

Shellfish Harvesting Areas—Oysters, Hard Clams, and Bay Scallops

Description:

Polygon data identify estuarine areas where shellfish harvesting practices are principally conducted. This data layer encompasses areas where the following shellfish harvesting techniques are used.

Oysters: hand-collecting, tonging, raking, dredging

Hard clams: raking, bull raking, tonging, clam kicking, hydraulic dredging

Bay scallops: raking and dredging.

All fishing practices for these shellfish species are described in detail in Cunningham et al., 1992b.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

Patricia Cunningham
Research Triangle Institute
P.O. Box 12194
Research Triangle Park, NC 27709
(919) 541-6944

Paul Phalen
North Carolina Division of Marine Fisheries
P.O. Box 769
Morehead City, NC 28557
(919) 726-7021

Data Updates: September 1992

Attributes: None

Considerations for Data Interpretation:

Users should review Cunningham et al., 1992, for detailed descriptions of individual fishing practices, gear used, equipment and harvesting restrictions associated with each practice and a map of the harvest area for each shellfishing practice.

Users should be aware that the shellfish harvest areas represent areas where harvesting has typically been conducted (1980 through 1992). Users should check with NCDMF staff to determine whether the DMF Fisheries Director has issued any proclamations regarding shellfish harvesting areas to ensure that the most recent information on harvest areas has been entered.

Solid Waste Facilities

Description:

Point data identify locations of landfills and permit information pertaining to each site.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

J. Gordon Layton
NCDEHNR
Division of Solid Waste Management
401 Oberlin Road
Raleigh, NC 27605
(919) 733-0692

Data Updates:

Attributes:

Facility name
Permit number
Town-county
Road location
Quad sheet name (based on 1:24,000 scale maps)

Considerations for Data Interpretation:

State Boundary

Description:

Line data identify the State borders.

Geographic Extent: Statewide

Key Contacts:

Tim Johnson
NC Center for Geographic Information and Analysis
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-2090

Data Updates: 1977

Attributes: None

Considerations for Data Interpretation:

Data were captured from 1:100,000 scale maps.

State Park Boundaries

Description:

Polygon data identify all State parks, recreation areas, natural and scenic rivers, trails, State natural areas, State lakes, and nature preserves.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

Susan Regier
NCDEHNR
Division of Parks and Recreation
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-7795

Data Updates: 1989

Attributes:

Park ID number
Park type
Park name
Acres

Considerations for Data Interpretation:

Users should note that overlap areas exist in current data where multiple agencies claim the same area. Users should contact Division of Parks and Recreation Staff for further information.

Submerged Aquatic Vegetation

Description:

Polygon data identify location and areal extent of seagrass beds and other submerged aquatic vegetation species.

Geographic Extent: Core and Bogue Sounds and Albemarle, Currituck, and Pamlico Sounds

Key Contacts:

Randolph Ferguson
NOAA/National Marine Fisheries Service
Southeast Fisheries Center
101 Pivers Island Road
Beaufort, NC 28516
(919) 728-8747

Data Updates: 1981, 1985, 1988, 1990, 1991, 1992
(partial coverage of study area in each year, total coverage achieved by combining 1988-1992 data).

Attributes:

Box number
Polygon number
Acres

Considerations for Data Interpretation:

Users should be aware that some subbasin areas were geographically referenced to 1:24,000 or 1:100,000 scale topographic base maps. Users are advised to contact NOAA/NMFS for background information and ancillary data on how these coverages were defined and created.

Superfund Sites

Description:

Point data identify the locations of uncontrolled, unregulated, and unevaluated hazardous waste sites designated as National Priority sites.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

Lee Crosby
NCDEHNR
Division of Solid Waste Management
401 Oberlin Road
Raleigh, NC 27605
(919) 733-2801

Data Updates:

Attributes:

U.S. EPA ID number
Category

Considerations for Data Interpretation:

Users should contact DSWM staff to determine whether information in this data layer is current.

Surface Water Intakes

Description:

Point data identify locations where communities draw raw water from a lake, river, or stream.

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

Steve Zoufaly
NCDEHNR
Division of Environmental Management
Water Quality Section
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-5083

Data Updates:

Attributes:

DEHNR-DEM identification number
Public Water Supply System-ID number
DEM Public Water Supply-Classification
County
River or lake
Improvement (yes or no)

Considerations for Data Interpretation:

Users should contact DEM staff to determine whether information in this data layer is current.

Treatment, Storage, and Disposal Facilities (TSDFs)

Description:

Point data identify locations of treatment, storage, and disposal facilities (TSDFs)

Geographic Extent: A/P Study Area (North Carolina only)

Key Contacts:

NCDEHNR
Office of Solid Waste Management
401 Oberlin Road
Raleigh, NC 27605
(919) 733-0692

Data Updates: Unknown

Attributes: TSDF permit number

Considerations for Data Interpretation:

Users should contact SWM staff to determine whether information in this data layer is current.

References

Frost, C.C., H.E. LeGrand, and R.E. Schneider. 1990. *Regional Inventory for Critical Natural Areas, Wetlands Ecosystems, and Endangered Species Habitats of the Albemarle-Pamlico Estuarine Region: Phase 1.* A/P Study Project No. 90-01.

LeGrand, H.E. Jr. 1990. *Natural Heritage Program List of the Rare Animal Species of North Carolina.*

Schafale, M.P., and A.S. Weakley. 1990. *Classification of the Natural Communities of North Carolina, Third Approximation.*

Weakley, A.S. 1990. *Natural Heritage Program List of the Rare Plant Species of North Carolina.*

APPENDIX B

NORTH CAROLINA PERMITTED POINT SOURCE LOADING FOR DISCHARGERS WITH SELF-MONITORING DATA

North Carolina Permitted Point Source Loading for Dischargers With Self-Monitoring Data

FACILITY	NPDES	FLOW MGD	TN MG/L	TN KG/Y	TP MG/L	TP KG/Y	Hydro Unit
ALBEMARLE & PAMLICO SOUNDS							
ELIZABETH CITY WWTP, CITY OF	NC0025011	1.654	19.00	43,399	2.50	5,710	3-01-02-05-02
HERTFORD WWTP, TOWN OF	NC0021849	0.269	11.17	4,150	0.46	171	3-01-02-05-04
MANTEO WWTP, TOWN OF	NC0025488	0.166	10.29	2,359	1.00	229	3-01-02-05-03
COLUMBIA WWTP, TOWN OF	NC0020443	0.090	8.12	1,009	0.36	45	3-01-02-05-05
ROPER WWTP, TOWN OF	NC0036315	0.063	4.13	359	2.76	240	3-01-02-05-05
KILL DEVIL HILLS WWTP, TOWN OF	NC0025313	0.040	26.04	1,438	4.62	255	3-01-02-05-07
EDENTON WTP (TOWN OF)	NC0007552	0.010	1.45	20	0.10	1	3-01-02-05-01
EDENTON WTP (TOWN OF)	NC0007552	0.010	1.34	19	0.08	1	3-01-02-05-01
HATTERAS WASH BASKET INC	NC0001724	0.004	NO DATA	NO DATA	0.98	5	3-02-01-05-02
TOTAL		**2.282**		**52,753**		**6,659**	
CHOWAN RIVER							
PERDUE INC. COFIELD PLANT	NC0049191	1.180	1.15	1,874	0.58	945	3-01-02-03-02
UNITED PIECE DYE WORKS LTD.PA	NC0003867	0.816	12.40	13,974	0.50	563	3-01-02-03-04
COLERAIN WWTP, TOWN OF	NC0020630	0.091	9.23	1,160	0.44	55	3-01-02-03-03
DOC - GATES CO. SUBSIDIARY	NC0029700	0.015	21.30	441	5.55	115	3-01-02-03-02
NORTHAMPTON CO SCH-NCHS EAST	NC0031330	0.007	10.18	98	1.96	19	3-01-02-04-02
GATES CO SCH - GATES CO H.S.	NC0033821	0.005	48.40	334	5.01	35	3-01-02-03-02
GATES CO SCH - SUNBURY PRIMAR	NC0033791	0.004	40.22	222	5.92	33	3-01-02-03-02
GATES CO SCH - GATESVILLE ELE	NC0033782	0.003	26.40	109	8.40	35	3-01-02-03-02
GATES CO SCH - BUCKLAND ELEM	NC0043974	0.003	32.16	133	4.98	21	3-01-02-03-02
CHOWAN CO SCH - CHOWAN JR. HS	NC0039462	0.003	21.45	89	2.18	9	3-01-02-03-03
BERTIE CO SCH-C G WHITE ELEM	NC0032441	0.002	13.77	38	1.10	3	3-01-02-03-02
GATES CO SCH - CENTRAL JR HIG	NC0033812	0.002	47.09	130	5.20	14	3-01-02-03-02
CHOWAN CO SCH - WHITE OAK SCH	NC0039454	0.002	38.75	107	6.90	19	3-01-02-03-04
GATES CO SCH - T S COOPER ELE	NC0033804	0.001	58.24	80	5.78	8	3-01-02-03-02
TOTAL		**2.134**		**18,791**		**1,874**	

North Carolina Permitted Point Source Loading for Dischargers With Self-Monitoring Data

FACILITY	NPDES	FLOW MGD	TN MG/L	TN KG/Y	TP MG/L	TP KG/Y	Hydro Unit
NEUSE RIVER							
RALEIGH NEUSE RIVER WWTP	NC0029033	29.067	9.52	382,147	2.03	81,487	3-02-02-01-05
WEYERHAEUSER-NEW BERN *	NC0003191	26.350	6.40	232,892	0.60	21,834	3-02-02-02-05
WILSON WWTP, TOWN OF	NC0023906	8.440	11.33	132,058	1.10	12,821	3-02-02-03-02
GOLDSBORO WWTP, CITY OF	NC0023949	5.892	NO DATA	NO DATA	1.91	15,541	3-02-02-01-13
KINSTON, CITY-PEACHTREE PLANT	NC0020541	3.971	7.00	38,388	1.50	8,226	3-02-02-02-03
CARY-SOUTH WWTP, TOWN OF	NC0065102	3.724	17.20	88,457	1.20	6,171	3-02-02-01-07
CENTRAL JOHNSTON COUNTY WWTP	NC0030716	2.846	13.09	51,448	1.09	4,284	3-02-02-01-10
E. I. DUPONT, KINSTON	NC0003760	2.479	3.50	11,982	1.24	4,245	3-02-02-02-03
BURLINGTON IND., WAKE PLANT	NC0001376	2.460	7.85	26,668	3.22	10,939	3-02-02-01-05
CARY-NORTH WWTP, TOWN OF	NC0048879	2.159	8.00	23,853	3.33	9,929	3-02-02-01-05
FARMVILLE WWTP, TOWN OF	NC0029572	2.027	5.45	15,256	2.80	7,838	3-02-02-03-04
CP&L LEE S.E. (PWR PLT)	NC0003417	1.614	16.47	36,711	0.02	45	3-02-02-01-13
CONTENTNEA SEWAGE DIST. WWTP	NC0032077	1.449	11.70	23,413	0.76	1,521	3-02-02-03-04
CLAYTON WWTP, TOWN OF	NC0025453	0.957	6.60	8,723	1.10	1,454	3-02-02-01-06
BENSON WWTP, TOWN OF	NC0020389	0.818	11.71	13,228	3.01	3,400	3-02-02-01-09
APEX, TOWN OF (MIDDLE CRK.)	NC0064050	0.815	21.01	23,647	1.99	2,240	3-02-02-01-07
KINSTON-NORTHSIDE WWTP	NC0024236	0.715	8.54	8,433	1.09	1,076	3-02-02-02-03
WAKE FOREST-SMITH CREEK WWTP	NC0030759	0.548	8.31	6,289	1.80	1,362	3-02-02-01-05
STANTONSBURG WWTP, TOWN OF	NC0057606	0.449	6.02	3,733	0.89	552	3-02-02-03-02
ZEBULON WWTP, TOWN OF	NC0024368	0.448	15.80	9,775	2.10	1,299	3-02-02-03-01
LA GRANGE WWTP, TOWN OF	NC0021644	0.440	NO DATA	NO DATA	1.72	1,045	3-02-02-02-01
KENLY NEW WWTP, TOWN OF	NC0064891	0.378	6.70	3,498	1.65	861	3-02-02-01-11
WENDELL WWTP, TOWN OF	NC0025020	0.225	10.22	3,176	3.23	1,004	3-02-02-01-11
PRINCETON, TOWN OF WWTP	NC0026662	0.194	7.26	1,945	0.95	255	3-02-02-01-12
CRA. CO. WOOD ENERGY LIM. PAR	NC0075281	0.189	0.63	164	0.57	149	3-02-02-02-05
SNOW HILL WWTP, TOWN OF	NC0020842	0.185	8.98	2,294	1.16	296	3-02-02-03-02
VANCEBORO WWTP, TOWN OF	NC0031828	0.120	16.98	2,814	2.18	361	3-02-02-02-04
WAYNE COUNTY (GENOA IND. WWTP	NC0030392	0.100	9.75	1,346	1.34	185	3-02-02-01-13

North Carolina Permitted Point Source Loading for Dischargers With Self-Monitoring Data

FACILITY	NPDES	FLOW MGD	TN MG/L	TN KG/Y	TP MG/L	TP KG/Y	Hydro Unit
DOC - EAST'N CORR. CTR.-GREEN	NC0029718	0.082	5.40	612	0.55	62	3-02-02-03-04
CAROLINA WATER SER-RIVER BEND	NC0030406	0.070	10.00	967	1.95	189	3-02-02-04-02
PINK HILL WWTP, TOWN OF	NC0020001	0.070	3.50	338	1.28	124	3-02-02-04-01
MIDDLESEX WWTP, TOWN OF	NC0021563	0.066	13.60	1,240	0.90	82	3-02-02-03-01
MORRISVILLE WWTP, TOWN OF	NC0050041	0.063	2.11	184	1.21	105	3-02-02-01-05
MORRISVILLE(PERIMETER PK),TOW	NC0050938	0.050	3.71	256	0.72	50	3-02-02-01-05
UNIPROP, INC./RIVER WALK MHP	NC0039292	0.042	18.49	1,072	2.48	144	3-02-02-01-05
WALNUT CREEK, VILLAGE OF	NC0039233	0.024	8.87	294	2.74	91	3-02-02-02-01
CROSS CREEK MOBILE ESTATES	NC0056391	0.021	11.65	338	3.35	97	3-02-02-01-05
CAROLINA WATER SERVICE, INC.	NC0051322	0.020	12.77	353	1.98	55	3-02-02-01-05
HOOKERTON WWTP, TOWN OF	NC0025712	0.020	7.03	194	1.88	52	3-02-02-03-02
WALSTONBURG WWTP, TOWN OF	NC0020362	0.017	20.48	481	2.10	49	3-02-02-03-04
TRENTON WWTP, TOWN OF	NC0021342	0.017	8.00	188	1.39	33	3-02-02-04-02
CAROLINA WATER SERVICE,INC.	NC0060330	0.016	12.55	277	3.20	71	3-02-02-01-06
COMPASS DEVELOPMENT CORP.	NC0063541	0.014	4.82	93	1.12	22	3-02-02-01-05
IRA D LEE ASSOC., INC. DEERCH	NC0063746	0.013	17.30	311	4.02	72	3-02-02-01-05
PITT CO SCH-D H CONLEY HS	NC0034169	0.013	23.10	415	3.00	54	3-02-02-02-04
STRAWNS CROSSING	NC0062367	0.012	10.30	171	1.74	29	3-02-02-01-05
LENOIR CO SCH-N. LENOIR HIGH	NC0032565	0.012	7.66	127	2.50	41	3-02-02-03-04
WAKE HIGH MEADOWS HOMEOWNERS	NC0058246	0.011	15.32	233	4.80	73	3-02-02-01-05
LENOIR CO SCH-S. LENOIR HIGH	NC0032557	0.010	12.38	171	4.66	64	3-02-02-02-03
INDIAN CREEK OVERLOOK DEV.	NC0060771	0.009	22.23	276	5.60	70	3-02-02-01-06
LENOIR CO SCH - CONTENTNEA EL	NC0032581	0.009	18.89	235	5.25	65	3-02-02-02-03
LENOIR CO SCH - WOODINGTON MI	NC0032549	0.009	15.65	195	4.82	60	3-02-02-04-02
COMPASS DEVELOPMENT CORP.	NC0063533	0.008	5.53	61	1.96	22	3-02-02-01-05
LENOIR CO SCH - SAVANNAH MIDD	NC0032522	0.008	7.53	83	0.82	9	3-02-02-02-03
JOHNSTON CO SCH-S. JOHNSTON H	NC0038954	0.007	16.00	155	3.68	36	3-02-02-01-09
HEATER UTILITIES-BEACHWOOD	NC0060577	0.006	29.83	247	4.02	33	3-02-02-01-05
JOHNSTON CO SCH-CORINTH HOLDE	NC0038938	0.006	12.14	101	6.55	54	3-02-02-01-11
CRAVEN CO SCH - W. CRAVEN HIG	NC0033081	0.006	5.10	42	0.67	6	3-02-02-02-04
HEATER UTILITIES-MALLARD XING	NC0058505	0.005	22.82	158	4.40	30	3-02-02-01-05

North Carolina Permitted Point Source Loading for Dischargers With Self-Monitoring Data

FACILITY	NPDES	FLOW MGD	TN MG/L	TN KG/Y	TP MG/L	TP KG/Y	Hydro Unit
CWS-PINE HOLLOW (WILLOW BROOK	NC0064378	0.005	14.65	101	2.25	16	3-02-02-01-05
MILL RUN ASSC./UNIPROP	NC0056499	0.005	15.30	106	2.08	14	3-02-02-01-06
LENOIR CO SCH - SOUTHWOOD ELE	NC0032531	0.005	15.15	105	3.80	26	3-02-02-02-03
LENOIR CO SCH-MOSS HILL ELEM.	NC0032573	0.004	26.35	146	6.60	36	3-02-02-02-01
THE DURANT GROUP	NC0060801	0.003	8.06	33	1.74	7	3-02-02-01-05
TRADEWINDS HOMEOWNERS ASSO.IN	NC0065714	0.003	22.99	95	4.80	20	3-02-02-01-05
RIVER MILL HOMEOWN. ASSOC.,IN	NC0056278	0.002	9.21	25	2.12	6	3-02-02-01-05
NERO UTILITY, INC.	NC0061638	0.002	6.10	17	1.10	3	3-02-02-01-07
CRAVEN EVAL/TRAIN CTR	NC0042765	0.002	10.30	28	0.80	2	3-02-02-02-05
S. E. DOUGLASS WAREHOUSE	NC0058980	0.001	22.20	31	5.35	7	3-02-02-01-05
		99.827		1,162,889		202,501	
NEUSE RIVER ESTUARY							
NEW BERN WWTP, CITY OF	NC0025348	2.957	18.82	76,854	4.00	16,334	3-02-02-04-03
USMC-CHERRY POINT MCAS	NC0003816	2.133	12.70	37,410	1.22	3,594	3-02-02-04-03
HAVELOCK WWTP, CITY OF	NC0021253	1.059	4.95	7,239	2.55	3,729	3-02-02-04-03
NORTHEAST CRAVEN UTILITY CO #2	NC0033111	0.215	7.95	2,360	2.25	668	3-02-02-04-03
NORTHEAST CRAVEN UTILITY CO #1	NC0033111	0.055	8.80	668	3.37	256	3-02-02-04-03
ORIENTAL WWTP	NC0057011	0.054	4.83	360	1.92	143	3-02-02-04-03
PHILLIPS PLATING COMPANY	NC0001881	0.025	3.62	125	0.17	6	3-02-02-04-03
SHIPYARD PROPERTY	NC0056545	0.013	14.45	259	1.90	34	3-02-02-04-03
CAROLINA PINES UTILITY CO.	NC0056618	0.010	2.49	34	0.53	7	3-02-02-04-03
TOTAL		6.521		125,311		24,772	
PAMLICO RIVER ESTUARY							
TEXASGULF CHEMICALS (PIPE 1)	NC0003255	55.450	NO DATA	NO DATA	10.48	802,521	3-02-01-04-02
TEXASGULF CHEMICALS (PIPE 2)	NC0003255	1.162	NO DATA	NO DATA	1.16	1,865	3-02-01-04-02
TEXASGULF CHEMICALS (PIPE 5)	NC0003255	0.890	NO DATA	NO DATA	0.11	135	3-02-01-04-02
TEXASGULF CHEMICALS (PIPE 9)	NC0003255	0.667	NO DATA	NO DATA	0.18	166	3-02-01-04-02
TEXASGULF CHEMICALS (PIPE 11)	NC0003255	0.290	NO DATA	NO DATA	0.05	20	3-02-01-04-02

FACILITY	NPDES	FLOW MGD	TN MG/L	TN KG/Y	TP MG/L	TP KG/Y	Hydro Unit
TEXASGULF CHEMICALS (PIPE 3)	NC0003255	0.271	NO DATA	NO DATA	0.17	64	3-02-01-04-02
TEXASGULF CHEMICALS (PIPE 10)	NC0003255	0.216	NO DATA	NO DATA	0.10	30	3-02-01-04-02
TEXASGULF CHEMICALS (PIPE 4)	NC0003255	0.135	NO DATA	NO DATA	0.12	22	3-02-01-04-02
TEXASGULF CHEMICALS (PIPE 8)	NC0003255	0.041	NO DATA	NO DATA	0.16	9	3-02-01-04-02
TEXASGULF CHEMICALS (PIPE 6)	NC0003255	0.037	NO DATA	NO DATA	0.90	46	3-02-01-04-02
TEXASGULF CHEMICALS (PIPE 7)	NC0003255	0.021	NO DATA	NO DATA	0.07	2	3-02-01-04-02
TOTAL		59.180		NO DATA		804,880	
ROANOKE RIVER							
WEYERHAEUSER, PLYMOUTH	NC0000680	47.005	6.73	436,871	1.07	69,458	3-01-01-07-02
CHAMPION INTERNATIONAL-R RAPI	NC0000752	17.691	5.93	144,877	0.54	13,193	3-01-01-06-01
ROANOKE RAPIDS SANITARY DIST.	NC0024201	6.133	9.20	77,921	1.35	11,434	3-01-01-07-01
PERDUE INC.-LEWISTON PLT	NC0028835	2.410	23.20	77,214	10.80	35,945	3-01-01-07-01
WILLIAMSTON WWTP, TOWN OF	NC0020044	1.597	10.44	23,025	1.60	3,529	3-01-01-07-02
WEST POINT PEPPERELL,HAMILTON	NC0001961	0.922	10.83	13,790	4.47	5,692	3-01-01-07-02
PLYMOUTH WWTP, TOWN OF	NC0020028	0.459	10.26	6,504	1.62	1,027	3-01-01-07-02
WELDON WWTP, TOWN OF	NC0025721	0.438	39.85	24,104	2.30	1,391	3-01-01-07-01
DOC - CALENDONIA CORRECTIONAL	NC0027626	0.378	11.20	5,847	1.99	1,039	3-01-01-07-01
WINDSOR WWTP, TOWN OF	NC0026751	0.292	4.93	1,988	0.92	371	3-01-01-07-03
LIBERTY FABRICS,INC	NC0023710	0.150	19.95	4,133	5.30	1,098	3-01-01-07-02
JAMESVILLE WWTP, TOWN OF	NC0035858	0.083	10.49	1,202	2.44	280	3-01-01-07-02
DOC - ODOM CORRECTIONAL INST.	NC0027642	0.070	21.60	2,088	3.93	380	3-01-01-07-01
LEWISTON-WOODVILLE UTILITIES	NC0023116	0.059	NO DATA	NO DATA	1.62	132	3-01-01-07-03
RICH SQUARE WWTP, TOWN OF	NC0025437	0.044	13.50	820	1.75	106	3-01-01-07-01
HALIFAX NEW WWTP	NC0066192	0.029	15.91	637	3.80	152	3-01-01-07-01
TOTAL		77.760		821,021		145,226	

North Carolina Permitted Point Source Loading for Dischargers With Self-Monitoring Data

FACILITY	NPDES	FLOW MGD	TN MG/L	TN KG/Y	TP MG/L	TP KG/Y	Hydro Unit
TAR-PAMLICO RIVER							
ROCKY MOUNT (TAR RIVER WWTP)	NC0030317	10.756	13.31	197,707	2.03	30,154	3-02-01-01-06
GREENVILLE UTILITIES	NC0023931	8.202	11.39	129,014	1.90	21,521	3-02-01-03-04
TARBORO WWTP, TOWN OF	NC0020605	2.086	13.75	39,611	1.18	3,399	3-02-01-03-03
OXFORD (RENOVATED WWTP)	NC0025054	1.779	11.90	29,236	1.05	2,580	3-02-01-01-01
WASHINGTON WWTP, TOWN OF	NC0020648	1.588	8.68	19,035	1.24	2,719	3-02-01-04-02
NATIONAL SPINNING CO. WASH'TO	NC0001627	1.035	9.64	13,779	0.78	1,115	3-02-01-04-02
ROBERSONVILLE WWTP, TOWN OF	NC0026042	1.029	11.65	16,555	2.15	3,055	3-02-01-03-05
BETHEL, TOWN OF (WWTP)	NC0061514	0.674	6.62	6,162	0.76	707	3-02-01-03-02
LOUISBURG WWTP, TOWN OF	NC0020231	0.637	12.55	11,040	0.95	836	3-02-01-01-02
BELHAVEN WWTP, TOWN OF	NC0026492	0.399	2.13	1,174	0.72	397	3-02-01-04-02
WARREN CO WWTP	NC0020834	0.395	9.20	5,019	7.50	4,091	3-02-01-02-02
PINETOPS WWTP, TOWN OF	NC0020435	0.343	8.11	3,842	0.78	369	3-02-01-03-03
FRANKLIN WATER & SEWER AUTHOR	NC0069311	0.188	9.90	2,570	1.50	389	3-02-01-01-02
SPRING HOPE WWTP, TOWN OF	NC0020061	0.162	17.12	3,830	1.84	412	3-02-01-01-04
LITTLETON WWTP, TOWN OF	NC0025691	0.154	12.79	2,720	0.95	202	3-02-01-02-01
CSX TRANSPORTATION-SEABOARD R #	NC0001503	0.149	9.85	2,027	0.13	27	3-02-01-03-03
EAGLE SNACKS, INC. (PIPE 2)	NC0051195	0.141	10.31	2,008	0.08	16	3-02-01-03-05
BUNN WWTP, TOWN OF	NC0042269	0.031	6.45	276	1.10	47	3-02-01-01-02
MACCLESFIELD WWTP, TOWN OF	NC0050661	0.022	12.54	381	1.46	44	3-02-01-03-03
CSX TRANSPORTATION-SEABOARD R #	NC0001503	0.017	9.45	222	0.15	4	3-02-01-03-03
PITT CO SCH-STOKES ELEM.	NC0034142	0.010	38.90	537	2.32	32	3-02-01-03-04
PITT CO SCH-N. PITT HIGH SCH.	NC0034134	0.006	26.93	223	2.32	19	3-02-01-03-04
WILSON CO. SCH.-GARDNERS	NC0057321	0.001	23.40	32	6.17	9	3-02-01-03-03
TOTAL		29.804		487,000		72,144	
AREAWIDE TOTAL		277.5		2,667,765		1,258,056	

* From NCDEM, 1987