The North Carolina Geographer

Volume 13, 2005

FROM THE EDITORS

Dear Geographers,

This volume of *The North Carolina Geographer* represents the second installment of the new journal format. This new format includes the traditional research articles and the new Carolina Landscapes section. In this volume, this new section includes a report on the role of corporations in the transformation of North Carolina's urban landscape by GlaxoKleinSmith Faculty Fellow Bill Graves (UNC Charlotte) and a lesson plan on North Carolina's American Indians by Thom Ross (UNC Pembroke), the 2004 North Carolina Geographical Society Educator of the Year. We encourage submissions of both research articles and Carolina Landscapes entries to the journal. Only through submission of manuscripts will our journal remain vital and sustainable. Remember, the goal of the journal is to highlight research on the geography of North Carolina, and topics of interest to geographers in North Carolina. Submit a manuscript yourself or encourage your colleagues and students to submit. We are currently accepting submission for the 2006 issue.

Thanks for your continued support of *The North Carolina Geographer!*

Sincereley,

Mike Benedetti (editor for physical geography)
Doug Gamble (editor for Carolina Landscapes)
Joanne Halls (editor for applied geography)
Liz Hines (editor for human geography)
Amanda Williams (editorial assistant)

About the Cover
Bill Graves (UNC Charlotte) took this picture of the former Alpha Cotton Mill undergoing transformation into condominiums in downtown Charlotte, 2006.

Authors alone are responsible for opinions voiced in this journal. Please direct inquiries concerning subscriptions and availabiilty of past issues to the Editors. Back issues of the *North Carolina Geographer* are available for $6 per copy.

DEPARTMENT of GEOGRAPHY

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The University of North Carolina at Chapel Hill is the oldest state university in the country and is one of the nation's premiere public institutions, with extensive and state-of-the-art resources and a range of nationally and internationally recognized academic programs. Set within this environment is Geography, a collegial, dynamic, and highly productive department of 17 faculty, including national and international leaders in areas of human geography, earth systems science and geographic information science. Geography offers the B.A., M.A., and Ph.D. degrees, with most graduate students pursuing the doctorate. The department enjoys excellent collaboration with a set of leading interdisciplinary programs on campus, including the Carolina Population Center, Carolina Environment Program, Shep Center for Health Services Research, Center for Urban and Regional Science, International Studies and Latin American Studies.

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The Journal of Frances Anne Kemble and the Stagecoach Line of Wilmington and Raleigh Rail Road - Enfield to Stantonsburg

James C. Burke
University of North Carolina at Greensboro

The purpose of this study was to determine the route used by the stagecoach line of the Wilmington & Raleigh Rail Road, to locate modern roads that closely approximate the stage route, and compare the present landscape along the route with descriptions of that provided in historic documents. Although its service was brief, this stagecoach line is significant because the use of stagecoaches by the railroad illustrates how transportation was organized during railroad construction. Frances Anne Kemble's *Journal of a Residence on a Georgian Plantation in 1838 – 1839* is explored because it describes travel on this particular stagecoach line, and places the line in a geographic context.

A combined program of archival research, map analysis, and field study were used in this inquiry. This study concluded that in late 1838 the stage route commenced (going in southward direction) from the area of Fishing Creek below the town of Enfield, passed within the neighborhood of Tarborough, with a stop at Stantonsburg before continuing to Waynesborough. The section of the route south of Stantonsburg was not examined. The modern landscapes fronting the approximate stagecoach route remain rural. Additionally, Mrs. Kemble was not able to observe the established towns of Halifax, Enfield, Tarborough, and Stantonsburg. Her observations of the landscape and people of North Carolina, thus, are hobbled by the limitations for her immediate experience and assumptions.

Introduction

Some problems in historical geography demand a combination of techniques to arrive at a solution. It is particularly true of those problems where portions of the solution may be found in different classes of sources, or in a changing physical landscape. Discerning the nature of specific routes, such as that of a stagecoach, within the context of historic road networks and determining their approximate path on the modern landscape provides an opportunity to employ different research techniques. The example presented in this article involves determining which roads in modern Edgecombe and Wilson Counties (North Carolina) closely approximate the route taken by the stagecoach line of the Wilmington & Raleigh Rail Road during its brief existence in the late 1830s.

Historical sources used in this study include the *Journal of a Residence on a Georgian Plantation in 1838-1839* by Frances Anne Kemble, period newspaper articles concerning the building of the railroad, and two historical maps from *North Carolina in Maps* by W.P. Cumming. The *capability constraints* and *coupling constraints* of Hagerstrand's *Time Geography* provide a framework for analyzing the period texts.[1] The probable route that was identified within the road network of the historic maps was reconciled with GIS data sets by establishing control points where the geometry of all sources matched, and where the probable route crossed a local stream. The final element of the research involved a qualitative examination of the landscape aimed at ascertaining whether physical elements (architecture, for example) along the probable route can be associated with information derived from historic texts and maps.

Geographic Details in the Historic Texts and Their Time Geography Aspects

The stagecoach line of the Wilmington & Raleigh Rail Road (later renamed the Wilmington & Weldon Railroad) existed briefly between 1837 and 1840 as the railroad was being constructed. As the railroad advanced from the north and south, the stage route's length decreased. The southern route from Wilmington to Waynesborough (later Goldsboro) followed roads that paralleled the projected railroad. The northern route, however, traversed areas of Edgecombe County, Wilson County (formed later), and Wayne County that were bypassed by the railroad – particularly, the towns of Tarboro and Stantonsburg.

The history of the stage route is documented in several period North Carolina newspapers.[1] At least three of these pieces of information found in newspaper articles are necessary for this study because they help establish locations along the route that can be associated with the narrative of traveling on the stagecoach line provided by Frances Anne Kemble. A notice from the office of the Petersburg Rail Road dated 27 October 1838 announced to planters and farmers that produce to be sent north could be consigned to their agent (Major B.F. Halsey) or the agent for the Wilmington & Raleigh Rail Road at Enfield (*Tarborough Press*, 17 November 1838). The southern termination of stagecoach line is established in an article published in a Wilmington newspaper two days before Mrs. Kemble's stagecoach ride.

> The section of the Wilmington and Raleigh Rail Road between Faison's and Martin's, 12 miles long, was traveled over yesterday for the first time by the passenger's train. The remaining section – nine miles – between Wilmington and Waynesboro' is finished, except the iron, which will be nailed down as speedily as possible. (*Wilmington Advertiser*, 21 December 1838)

Mrs. Kemble substantiates what the newspaper reports on the southern extent of the railroad by noting that the stagecoach had traveled about ten miles after a stop in Waynesborough, and that a group of locals had gathered at the place where the stage stop to meet the train from Wilmington to see the locomotive "come up for only the third time into the midst of their savage solitude" (Kemble [1865] 1984, 27-28). An article reporting an example of fish being purchased in Wilmington and arriving in Tarboro the next day by way of the stagecoaches of the WRRR illustrates that the stagecoach line was still servicing Tarboro in late 1838 (*Tarborough Press*, 22 December 1838). The two sections of the railroad that are in operation and towns located on the stagecoach route can be mapped out using the information provided in these articles for Mrs. Kemble's trip on 23 December 1838 (Figure 1).

Mrs. Kemble, after departing Weldon by train between eight and nine o'clock in evening, arrives four hours later at the end of the northern section of the railroad.

> Between twelve and one o'clock [in the early morning of Sunday, December 23, 1838], the engine stopped, and it was announced to us that we had traveled as far upon the railroad as it was yet completed, and that we must transfer ourselves to the stagecoaches; so in the dead middle of the night we crept out of the train, and taking our children in our arms, walked a few yards into an open space in the woods, where three four-horse coaches stood waiting to receive us. (Kemble [1865] 1984, 22)

Mrs. Kemble's description of a group of men warming themselves by a fire at the end of the railroad most likely was a work crew, and the opening in the woods suggests that railroad construction had advanced a short distance south of Enfield. The log road that her stagecoach traveled that night was through swampland. The stage arrived at Stantonsburg shortly after sunrise. Though Kemble writes a single paragraph about the night's journey, it would be safe to assume that it was miserable. The cold coupled with the hours of being jostled

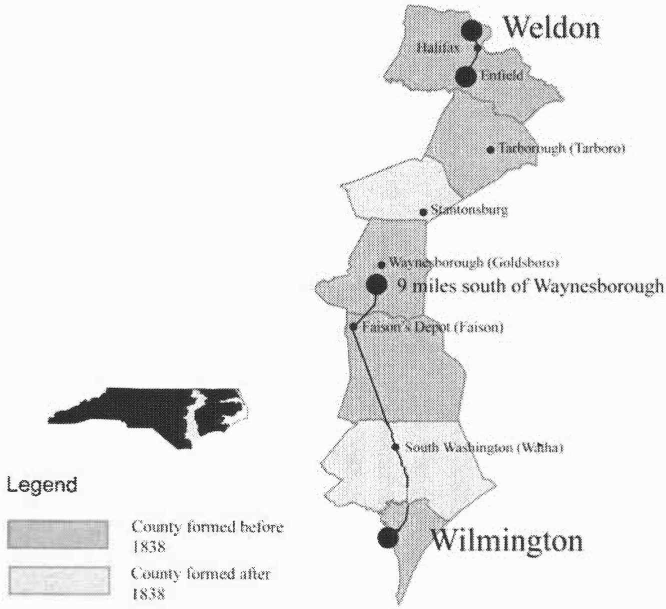


Figure 1. Map of the progress of construction on the Wilmington and Raleigh Rail Road during 1838, as reported in the area newspapers. The Wilmington & Raleigh Rail Road was finished in March 1840. The total length of the railroad from Wilmington to Weldon was 161.5 miles. The stagecoach line of the railroad operated during construction. By May 1838, the stage line ran from Halifax to South Washington. A section from Halifax to Enfield was completed in October 1838, and the southern section was completed to Faison's Depot. By the last week of December, the railroad was within nine miles of Waynesborough. Source: Census 2000 TIGER/Line Files. Map by James C. Burke

about in the stagecoach on a rough road must have been excruciating. There had only been a four hour respite at Weldon from the time she had left Portsmouth, Virginia the previous morning. In addition, she was nursing a baby along the way (*ibid.*, 19-23). It is evident from her account that both the Portsmouth & Roanoke Rail Road and the Wilmington & Raleigh Rail Road had subjected their passengers to an unimaginable ordeal to meet the scheduled connections. When Mrs. Kemble and her family arrived at Wilmington at 5 AM on 24 December 1838, they had been deprived of sleep and adequate nourishment for nearly two days.

Other sources can be employed to determine the duration of the stage ride from Enfield to Stantonsburg and the approximate speed of the stage. The US Naval Observatory in Washington, DC calculates that sunrise at Stantonsburg (W 077° 49', N 35° 36') on December 23, 1838 occurred at 7:18 AM (Astronomical Applications Department of the US Naval Observatory, 2004). Given Mrs. Kemble's observation that her stage trip began around 12:30 AM, the stage ride lasted approximately seven hours. Frederick Law Olmsted, recounted a similar journey by stagecoach through southeastern North Carolina while traveling on the yet to be completed Wilmington & Manchester Rail Road in *A Journey in the Seaboard Slave States with Remarks on their Economy*. His stagecoach also traveled during the winter over log roads through swampland. The driver and teams were changed out about ever ten miles (Olmsted, 1861, 380).

Applications of the *Time Geography* proposed by Torsten Hagerstrand are most closely associated with transportation planning in the urban context and the concepts of space-time autonomy in describing the mobility of individuals and classes of individuals. Susan Hanson's *The Context of Urban*

Travel, Concepts and Recent Trends list three categories of constraints that limit mobility that are associated with *Time Geography*: 1) *capability constraints* are limitations on what tasks can be accomplished in an interval of time with a specific transportation technology; 2) *coupling constraints* are transportation problems that arise from the need to have coordinate schedules and tasks with others using different transportation during the course of completing a single trip (For example, the tasks of a trip might include having lunch with a friend, picking up a child from school, going to the post office, and buying groceries before returning home – some of these tasks involve being in specific place in space and time with certain individual or classes of individuals; 3) and authority constrains are "the social, political, and legal restrictions on access" (Hanson, 2004, 3-8). *Time Geography* is a valuable tool for the modern transportation planner. However, some aspects of Hagerstrand's theory lend themselves to the study of historic transportation systems.

The aspects of *Time Geography* that are applicable to the problem addressed in this study involve determining what route through the road network of 1830s Edgecombe County would allow a trip by stagecoach that would begin in the neighborhood of Enfield, pass near Tarboro, and terminate at Stantonsburg within the span of approximately seven hours. The *capability constraints* to be considered are related to stagecoach travel in general, and the road conditions particular to the route. The *coupling constraints* are whatever purposes the railroad had to route their stage line near Tarboro (deliver or receive mail, freight, or passengers). The *authority constraints* are those limitations that impact the stage route that originate from the necessity of the railroad as a corporation to fulfill its obligations to other railroads and steamship companies to maintain scheduled connections. The distance "as the crow flies" between Enfield (N 36° 10.858', W 77° 40.000') to Stantonsburg (N 35° 36.408', W 77° 49.401') is 40.64 miles; the distance between Enfield and Tarboro (N 35° 53.808', W 77° 32.150') is 20.96 miles; and, the direct distance between Tarboro and Stantonsburg is 25.72 miles. Thus, the ideal road network for a route between Enfield and Stantonsburg via Tarboro would be 46.68 miles long (Figure 2). If a stagecoach traveling at an average speed of 7 mph were to take this ideal route, it would take 6.668 hours. At an average speed of 8 mph the trip would last 5.838 hours. If it can be assumed that the historic route between Enfield and Stantonsburg took seven hours (by Mrs. Kemble's account), the distance traveled for 7 mph would be 49 miles, and for 8 mph would be 56 miles. An examination of historic maps can determine whether the road network of the 1830s in Edgecombe County contained roads that would allow a route that satisfies these time/distance conditions.

Historic Maps and GIS Datasets

Two historic maps from William P. Cumming's *North Carolina in Maps* were helpful sources for reconstructing the historic stage route. These were the MacRae-Brazier map of 1833 and the United States Coast Survey of 1865 (Cumming, 1966, Plate X, Plate XIII). I selected nine locations common to the MacRae-Brazier Map of 1833 and the United States Coast Survey of 1865 for the purpose of finding the same using recent GIS datasets of the region's road network (Figures 3a and 3b). When the sections of the maps containing Edgecombe County (later Edgecombe and Wilson) are examined, common elements of the shortest route from Enfield to Stantonsburg via Tarboro appear, even though more than thirty years separate the two. The road on the south side of Enfield passes over Fishing Creek by Wyatt's Bridge (Location 1), crosses Swift Creek at Dorches' Bridge (Location 2), and crosses the Tar River at Teat's Bridge (Location 3). The road intersects the road between Rocky Mount and Tarboro.[1] The most direct route from Tarboro to Stantonsburg is by crossing Town Creek (Location 4) and continuing to the crossroads at Pitt's Crossroads (Location 5) and Saratoga. The MacRae-Brazier Map of 1833 names Town Creek, but not Pitt's Crossroads or Saratoga (Figure 3a). However, Pitt's Crossroads is mentioned in a newspaper article concerning subscriptions to the stock of the Wilmington & Raleigh Rail Road prior to the es-

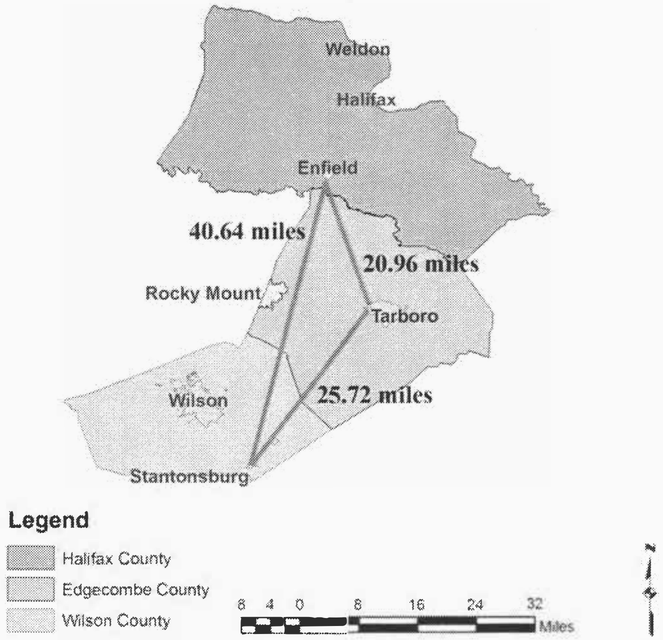


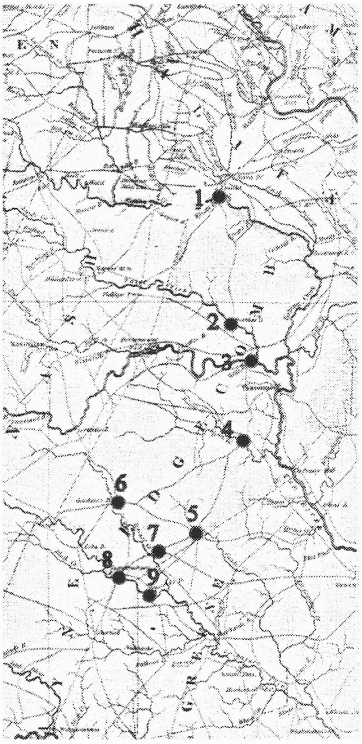
Figure 2. Map of modern Halifax, Edgecombe, and Wilson Counties. The direct distance between Enfield and Tarboro is 20.96 miles, and the direct distance between Tarboro and Stantonsburg is 25.72 miles. The direct distance between Enfield and Stantonsburg is 40.64 miles. The total direct distance between Enfield and Stantonsburg via Tarboro is 46.68. Mrs. Kemble's stagecoach trip between Enfield and Stantonsburg took app. 7 hours. At an average speed of 7 mph, the trip would cover 49 miles during this amount of time. Source: Census 2000 TIGER/Line Files. Map by James C. Burke

tablishment of the stage route (*The Wilmington Advertiser*, 25 April 1836). Pitt's Crossroad was the intersection of the Tarboro-Stantonsburg Road and the Tarboro-Smithfield Road. The Tarboro-Smithfield Road and the Stantonsburg-Nashville (NC) Road intersect at a location that would become Wilson (Location 6). From Pitt's Crossroads the route would have to continue to that crossroads that would become Saratoga (Location 7). At Stantonsburg (Location 8), Contentnea Creek could be crosses by passing through town, or bypassing town by way of Peacock's Bridge (Location 9).

Mrs. Kemble's journal entries become problematic because she is unaware that there were established towns along the completed section of railroad and the stage route through Halifax and Edgecombe Counties.

> From Suffolk to Wilmington we did not pass a single town – scarcely anything deserving the name village. The few detached houses on the road were mean and beggarly in their appearance ... (Kemble [1865] 1984, 25)

Can this be entirely attributed to the fact that most of the journey was undertaken in the dead of night? Mrs. Kemble, by her own admission, "endeavored in vain to guess at the nature of the country through which we were traveling" (*ibid.*, [1865] 1984, 22). However, the likely explanation for the



MacRae-Brazier, 1833

1. Wyatt's Bridge (Daniel's Bridge at Fishing Creek

2. Dorches' Bridge at Swift Creek

3. Teat's Bridge over the Tar River

4. Town Creek

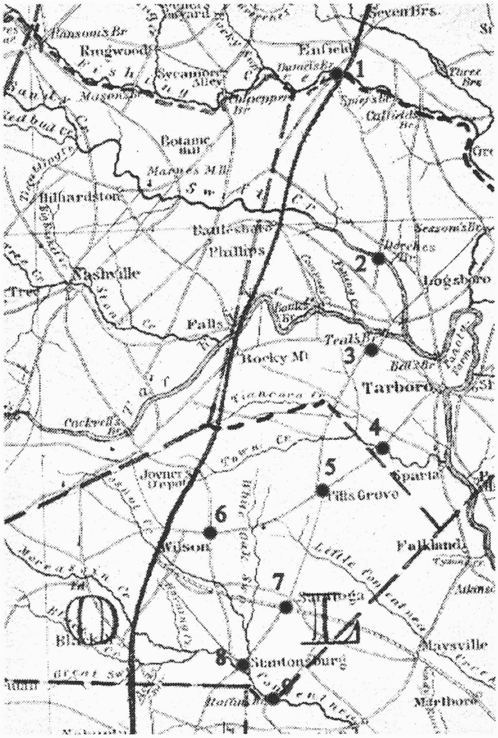
5. Pitt's Crossroads (Pitts Grove)

6. Intersection of the road from Pitt's Crossroads and the road from Stantonsburg to Nashville

7. Crossroads (later Saratoga) between Pitt's Crossroads and Stantonsburg

8. Stantonsburg

9. Peacock's Bridge



United States Coast Survey, 1865

Figures 3a and 3b. The likely stage route through Edgecombe County (later Edgecombe and Wilson counties). Location points placed on the 1833 MacRae-Brazier map and the 1865 United States Coast Survey map. 3a. MacRae-Brazier, 1833. 3b. United States Coast Survey, 1865. Source: Cumming, W.P. (1966). North Carolina in Maps. Raleigh: North Carolina Office of Archives and History, Department of Cultural Resources, Plate X, Plate XIII.

reason that she did not notice towns when the stage made its stops was that the stables for the horse were located on the outskirts of town. Assuming that this was true, the stagecoach route stopped short of entering Tarboro proper and started its southward leg to Stantonsburg. Stantonsburg could be bypassed by way of Peacock's Bridge.

After establishing a general length and duration of the stage route from Enfield to Stantonsburg, examining the historical maps for a probable route, and identifying locations along this route, the author set out to discover the route's approximate path in the modern road network of Edgecombe and Wilson Counties using very modern technology, ArcGIS 9 and US Census TIGER/Line datasets (SHP files). Because the historic maps identify named streams that are crossed by roads of the likely route in Edgecombe County, the same named streams are selected from the attribute table of the hydrography lines and saved as a new data layer. When the data layer of the road network of modern Edgecombe County is added to the edited hydrography layer, a modern set of roads emerges as an approximation of the historic route. Speights Chapel Road forks from US 301 less that a mile below Fishing Creek and continues over Swift Creek. New Hope Church Road/Dunbar Road is the closest road to Speights Chapel Road that crosses the Tar River. Dunbar Road intersects US 64A between Rocky Mount and Tarboro. McNair

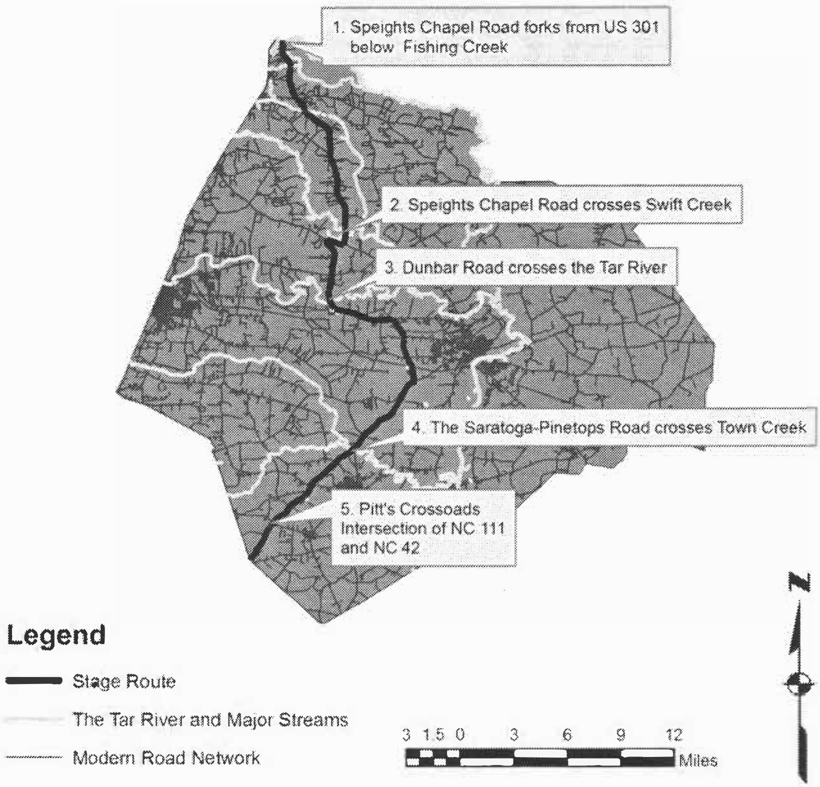


Figure 4. Direct distances between Enfield, Tarboro, and Stantonsburg. The roads in black include US 301, Speights Chapel Road, Battleboro-Leggett Road, New Hope Church Road/Dunbar Road, US 64A, McNair Road, McKendree Church Road, and the Saratoga/Pinetops-Tarboro Road (NC 111). This set of modern roads cross the stream system of the county at the approximate locations of the roads found on historic maps. Pitt's Crossroad is a location mentioned in the 25 April 1836 issue of the Wilmington Advertiser. Source: Census 2000 TIGER/Line Files. Map by James C. Burke

Road, on the outskirts of Tarboro, was selected for it resemblance a road in the MacRae-Brazier map originating near Teat's Bridge and terminating at the Saratoga-Pinetops-(Tarboro) Road[1] (NC 111). This road crosses Town Creek and passes through Pitt's Crossroads (Figure 4).

The hydrographic layer is not as useful for examining roads in modern Wilson County for evidence of the relic stage route. NC 111/NC 222 (call the Good News Church Road, Saratoga Road and Pinetops-Tarboro Road at various points between Tarboro and Stantonsburg) is the most direct route. However, it is still necessary to prove that the modern roads are built on the path of the nineteen century roads. The MacRae-Brazier map shows the intersection of two important roads near Toisnot Swamp. One of the roads connected Tarboro to Smithfield. The other road connected Stantonsburg to Nashville (NC). These roads remain in the United States Coast Survey map three decades later. In this map, the intersection now has the name of Wilson. In the modern city of Wilson, the intersection of Tarboro and Nash Streets preserved the place where the two earlier roads crossed. If Tarboro Street is traced east from Wilson, it becomes NC 42. After this highway enters Edgecombe County, NC 42 divides into NC 124 and NC 42. NC 124 intersects NC 111 at Pitt's Crossroads. If Nash Street is traced east from Wilson, it becomes NC 58/US 264 and passes through Stantonsburg on NC 58. The town of Saratoga, appearing on the United States Coast Survey map, also connects to Wilson. The modern NC 91 retains the curves of the road depicted on historic map. The relationships between the modern roads and their earlier manifestations suggest that NC-111/NC-222 retains much the same path as it followed in the 1830s. At Stantonsburg, the stagecoach could have passed through the town, but it is more likely to have bypassed the town using Peacock's Bridge (Figure 5).

The total distance of the route between Enfield and Stantonsburg using the modern road network is 49.9 miles. This route is remarkably close to the 46.69 miles of direct distance between Enfield to Stantonsburg via Tarboro.

The Physical and Cultural Landscape

Hitherto, this article has been concerned with determining the approximate route of the stagecoaches of the Wilmington & Raleigh Rail Road through Edgecombe County (and Wilson County). Roads of the modern road network of the study area appear to allow the reconstruction of the historic route. However, the significance of this route cannot be determined solely from this information. Mrs. Kemble described the North Carolina of 1838 as a vast wilderness populated by an indolent and savage people:

> North Carolina is, I believe, the poorest state in the Union: the part of it through which we traveled should seem to indicate as much. From Suffolk to Wilmington we did not pass a single town – scarcely anything deserving the name of a village. The few detached houses on the road were mean and beggarly in their appearance; and the people whom we saw when the coach stopped had a squalid, and at the same time fierce air, which at once bore witness to the unfortunate influence of their existence. Not the least of these is the circumstance that their subsistence is derived in great measure from the spontaneous produce of the land, which yielding without cultivation the timber and turpentine, by the sale of which they are mainly supported, denies to them all the blessing which flow from labor. (Kemble [1865] 1984, 25-26)

This eloquently worded statement, and others like it in her narrative, should be subjected to scrutiny.

North Carolina may have been the poorest state, but not for the lack of having an industrious people. Anti-Federalist politics and sectional divisions had inhibited economic growth in North Carolina since the founding of the Republic (Jeffery, 1978, 114-121). The remedy to this problem was improved transportation, not improved morals. Inland farmers gain little from producing large yields without having access to an affordable means of getting their crops to market. Additionally, the variety of manufactured goods available to coastal dwellers would be costly or unavailable to the same farmer for the same reasons. Mrs. Kemble assumes that timber and turpentine production was preferable to agriculture because they were easy to produce. However, Olmsted described the collection and processing of turpentine as a labor intensive enterprise that required considerable skill (Olmsted, 1861, 338-351). Robert B. Outland III provides an overview of the rise of its production:

> A marginally profitable business since the early eighteenth century, beginning in the 1830s, the North Carolina naval stores industry flourished because of a rise in spirits of turpentine prices encouraged intensified production and transportation improvements permitted access to large sections of the state's pine stands. (Outland, 2001, 309)

According to Outland, it was the railroads that made it possible to transport this heavy product to market and the Wilmington & Raleigh Rail Road cut through the northeastern longleaf pine forest. He also stated that the Panic of 1837 had depressed the cotton market while turpentine remained a profitable commodity; and turpentine production increased when wealthy investors encouraged the expansion of this industry. However, by the 1850s,

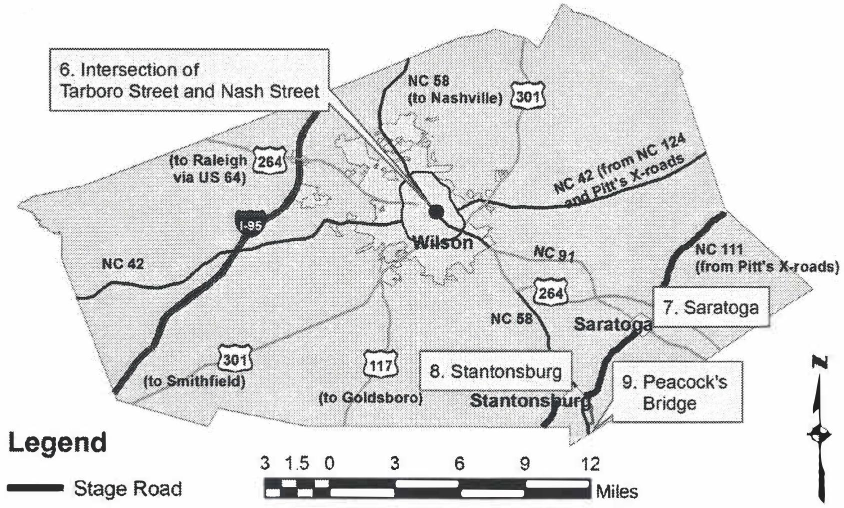


Figure 5. Map of modern Wilson County. NC 124 and NC 111 intersect at Pitt's Crossroads. NC 124 and NC 42 merge before the Wilson County line. NC 42 becomes Tarboro Street in Wilson. NC 111 (the Good News Church Rd./Saratoga Rd./Pinetops-Tarboro Rd.) continues to Stantonsburg. NC 58 connects Stantonsburg to Wilson. NC 58 becomes Nash Street in Wilson and intersects with Tarboro Street. NC 58 continues to Nashville. NC 91 connects Saratoga to Wilson. These set of roads approximate the road network represented in the MacRae-Brazier map of 1833 and the United States Coast. Survey map of 1865. NC 111/NC 222 appears to be the best modern road that approximates the stagecoach route of the Wilmington & Raleigh Rail Road to Stantonsburg. Source: Census 2000 TIGER/Line Files. Map by James C. Burke.

the introduction of fertilizers made the growing of cotton possible in the sandy soils of the coastal plain. Edgecombe County was one of the first counties to replace turpentine production with cotton (*ibid.*, 2001, 315-317, 330,335-336).

It is apparent from the reconstruction of the route that Mrs. Kemble traveled by train in the dark from Weldon to Enfield without noticing Halifax or Enfield. She traveled by, but not through, Tarboro and Stantonsburg. She believed that she "did not pass a single town – scarcely anything deserving the name of a village." However, the National Register of Historic Places contains listings for dwellings in these towns that pre-date Mrs. Kemble's journey. For these, many are substantial homes built in the Georgian and Federal Styles (http://www.nationalregisterofhistoricplaces.com/NC/state.html (30 December 2005)).

The construction of dwelling in a "style' is a good indicator that a town had transcended the "mean and beggarly" of bare necessity to have skilled craftsmen to build it, and a prosperous class to pay for it. In *Folk Housing in Middle Virginia*, Henry Glassie addresses the implication of these style choices. With the Georgian form, the owner established his identity; and the two-story arrangement, particularly, demonstrated that he was aspiring to prosperity:

> Simultaneously, it stated his separation from people unable to build two-story houses – the poorest of the freeholder, living still in single-

> story dwellings, and especially, those human beings thrust into rows of one-story squares off from the plantation's big house. (Glassie, 1975, 145)

The cultural landscape that Kemble describes along the road of the stage route appears to be that of the "poorest of the freeholder."

Though 168 years have passed since Mrs. Kemble passed through northeastern North Carolina, some aspects of the rural landscape might reflect the material culture of earlier times. A windshield survey presents the opportunity to investigate the landscape in ways that indirect methods cannot. The modern motorist traveling the approximate stage route and the stagecoach passenger traveling the actual route could share the common experience of travel through a landscape that contains similar fields, farms, lowlands, and woods. The modern motorist might be hard pressed to find food, lodging, or gas along most of highways that approximates the stage route in much the same way the nineteenth century traveler found little or no accommodations. At best, the researcher can explore the landscape with text in hand and connect its physical qualities to the written word.

Mrs. Kemble has left clues in her text concerning architecture and physical geography. Likewise, the material and physical landscape provide clues to the text. At Weldon, she notices a "large millpond that could have been part of the Jabez Smith's nill at the basin fo the Roanoke Canal" that best describes the appearance of the Roanoke Canal (Figure 6a). The "old wooden house" where her party rests and has dinner has a "flight of wooden stairs" leading to a large room with a fireplace. Men and women were divided in this room by "large rattling folding doors drawn across the room" (Kemble [1865] 1984, 19-21). An old house in 1838 would have been an eighteenth century house – a two story Georgian floor plan. In the Town of Weldon's application to the National Register of Historic Places, Tom Butchko, states that Major William Weldon purchased 1,273 acres of land on the river in 1752 and built a house. The property passed to his granddaughter, and by 1819 parts of the Weldon plantation were divided for sale as lots (*Roanoke Rapids Herald*, 28 January 1996). Mrs. Kemble may have lodged for a few hours in this house. When she left Weldon, the late hour prevented her from seeing anything from her car. The motorist notices that Halifax is orientated towards the Roanoke River and the railroad passes to the west of town. Certain stylistic elements are common to the architecture of the area. One house exhibits the Queen Anne style, yet its element are classically symmetrical, with the right wing of the house balanced by the *porte-cochere*. The insets of the eaves further suggest the classical temple pediment. The core of the dwelling is the Georgian four-over-four with a central stairway (Figure 6b).

At Enfield, the railroad passes through the center of town (Figure 6c). The railroad and roads that pass through town diverge near Jarrdott Swamp Road near Fishing Creek. The stagecoach route must have commenced near this point. After passing over Fishing Creek on US 301, the motorist notices the site of the Brick School near the intersection of the highway and Speights Chapel Road. This school for African Americans was found by Mrs. Joseph K. Brick in 1895. The building in the photograph, although built at the end of the nineteenth century, retains the Georgian four-over-four plan and inset chimney. The hip roof is also common with many other houses in the region (Figure 7a).

The McKendree Methodist Church near the intersection of McKendree Church Road and McNair Road (8 miles southeast of Tarboro) was built in 1871. This church embodies a form that can be traced back to North Carolina's earliest surviving church – the 1734 St. Thomas Episcopal Church in Bath. The McKendree Methodist Church differs from its Colonial predecessor in its wooden construction and the addition of a classical portico. The inset eaves are a featured on its single gable. This simple design is common to many rural churches in the eastern part of the state (Figure 7b). The most interesting example of rural domestic architecture near the stage route is a farm house located at the intersection of NC 124 and NC 42, a short distance from Pitt's Crossroads (Figure 7c).

Figure 6a. Mrs. Kemble observed "a large millpond" at Weldon. It was likely part of the Roanoke Canal. This figure shows the remains of the canal where it joined the Roanoke below Weldon.

Figure 6b. A house near the railroad at Halifax. While this house appears to post-date Mrs. Kemble's journey, the town had existed since Colonial Era.

Figure 6c. The tracks leading out of Enfield to the south. Mrs. Kemble began her stagecoach journey in a clearing outside Enfield. Photographs 6a, 6b and 6c by James C. Burke and Cyn Johnson

One section of the farmhouse is built in the hall and parlor form with additions built onto this core structure. This type of house was common in colonial Virginia and North Carolina. Its design is remarkably similar to the Slayden house in Virginia (Glassie, 1975, 68-69) and the eighteenth century McNairy house in Guilford County. Typically, these houses began as log structures and were later covered with lapboard. George Savage, a resident of Tarboro in his eighties, described rural construction techniques in a 2004 interview (Burke, 2004). His father, L. B. Savage (born in 1893), had been a builder who had constructed many houses and barns in the area around Pinetops. Mr. Savage stated that dressed lumber was hard to come by in rural Edgecombe County during the early half the 20th century. Because carpenters milled much of their own wood, it was used sparingly. The house that he had grown up in had been built in the antebellum period and rooms had been added subsequently. The original section of the house used traditional joinery – mortise and tenon held together by pegs. The ceiling was high to allow for cooling in the summer and it was heated by a large fireplace in winter. A farmer would begin with a modest dwelling and add on to it as his family and fortune grew. Subsequent generations would continue to add to the house rather than pull down the original and start anew. Mr. Savage's description of the nucleus for these dwellings closely matches those of historian Alan D. Watson in analyses of colonial construction techniques in Edgecombe County.

> Many were one or one-and-a-half room structures supplemented by lofts, sheds, or porches. Clapboard siding and shingle roofs completed the houses. Some of the humbler may have lived in log cabins; the wealthier occasionally erected brick homes ... The arrangement of the main (and often the only) room of the house was dominated by the fireplace. (Watson, 1979, 14)

Mrs. Kemble describes the interior of a similar hall and parlor dwelling south of Waynesborough as "a rough brick-and-plank chamber, of considerable dimensions, not even whitewashed, with the great beams and rafters by which it was supported displaying the skeleton of the building"(Kemble, 1861, 30). The hall and parlor house was most likely the typical house fronting the roads of the stage route.

Mrs. Kemble's description of the stage route through Wayne County is sparse although it includes two physical features that contribute to understanding the landscape. The first is a description of the step banks of the rapidly moving Neuse River below Waynesborough. As she walked across a rotten bridge crossing the river, she noted its unusual color through the planking (*ibid.*, 1861, 27). The brown waters of the Neuse River still flow rapidly through step banks under the bridge on Grantham Road at Goldsboro (Figure 8a). She also provided a clue to the spot where the stagecoach route ended.

Toward nightfall, the train from Wilmington had not arrived. The men traveling in the stagecoaches took it upon themselves to seek lodging at the home of a gentleman of the community. The men then impressed the assistance of the railroad work gang to push a flat car loaded with the women, children, and their trunks a distance up the tracks to his plantation. Mrs. Kemble noted that she had to shield her child from the north wind. This suggests that they were facing south and being pushed north. She also noted that the track, supported by pilings, passed over two deep ravines (*ibid.*, 1861, 29). The ravines appear to be two banks cut by Brooks Swamp located on the Old Mt. Olive Road one mile south of Dudley. The piling has now been replaced by an embankment and culverts. The distance between the track and the stream has not changed (Figure 8b).

Conclusion

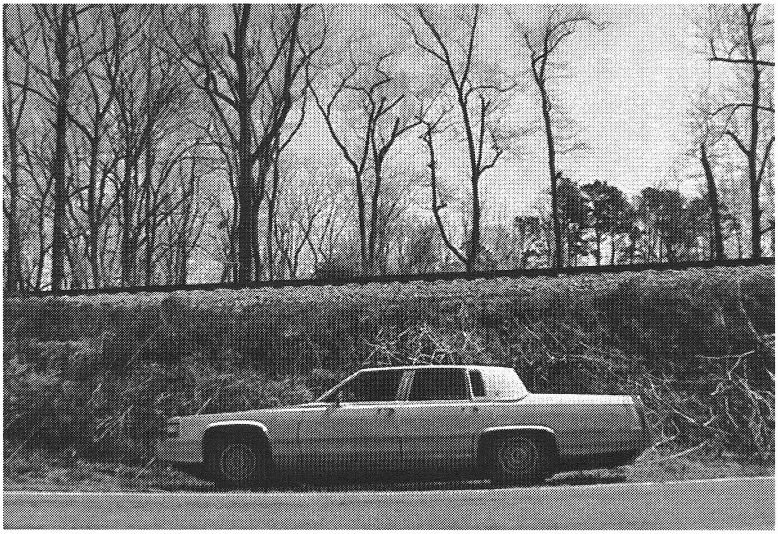
The purpose of this study was to determine the route used by the stagecoach line of the Wilmington & Raleigh Rail Road, to locate modern roads that closely approximate the stage route, and compare the present landscape along the route with descriptions of the same landscape provided in historical documents. The significance of the this short-lived stagecoach line is twofold: 1) the use of stagecoaches by the railroad illustrated how transportation was organized during the period of con-

Figure 7a. Many building along the stage route retain elements of earlier styles. Figure 7a shows a building at the 1895 Brick School near the intersection of US 301 and Speight Chapel Road. The hip roof, internal chimney, and two story-double pile arrangement are elements of the earlier Georgian Style.

Figure 7b. The 1871 McKendree Methodist Church near the intersection of McNair Road and McKendree Church Road. It is built is the simple form of the "meeting house" with a Classical portico.

Figure 7c. Part of a farmhouse located near Pitt's Crossroads at the intersection of NC 124 and NC 42. This early vernacular form was common in Colonial Virginia and North Carolina. Photographs 7a, 7b and 7c by James C. Burke and Victor Galloway.

a)



b)

Figure 8: Mrs. Kemble observed the current and color of the Neuse River as she crossed a rotten bridge south of Waynesborough. Figure 7a shows a view of the Neuse River from the Grantham Road bridge south of Goldsboro. Figure 7b illustrates the height of difference between the railroad track and Old Mt. Olive Road at the Brooks Swamp near Dudley in Wayne County. Originally, this Wilmington & Raleigh Rail Road crossed the ravine with trestle work and later filled (WRRR Stockholders Report - Report of the Engineer & Superintendent, 1856, 6-7). A railroad construction gang and the men from the stages pushed the Mrs. Kemble, other women, children, and trunks on a flat car for a mile to seek lodging after the train from Wilmington failed to arrive. She notes crossing one or two deep ravines. Photographs by James C. Burke and Cyn Johnson.

struction; and, 2) it provides missing elements of the geographic context of the narrative of traveling this stagecoach line provided by Frances Anne Kemble in her *Journal of a Residence on a Georgian Plantation in 1838-1839*. A direct examination of the landscape fronting the modern road fronts that approximates the likely route demonstrates that the area has remained rural and its domestic architecture possesses elements of earlier styles, and that the earlier structures were augmented and improved over time. Additionally, determining the approximate route also impacts the interpretation of the Kemble text. Her impressions of the ubiquitous poverty of North Carolina were shaped by what she experienced on the rural landscapes of the Coastal Plain. Ironically, the route took her past established towns, but never into them.

An extension of the study is dependent on uncovering specific period documentation - particularly, those documents that identify the individuals contracted by the railroad to stable the teams of horses along the route and those lodging the passengers; and a more detailed history of road building in the may lead to refinements or alteration in the route.

Footnotes

[1] Torsten Hagerstrand identified three categories of limitations that impact space-time autonomy. These limitations are *capability constraints*, *coupling constraints*, and *authority constraints*. *Capability constraints* are those limitations that can be associated with the mode of transportation used to accomplish a task. For example, a bicycle might be the appropriate technology for accomplishing certain tasks but it is not capable of covering the same highway distances in a day as an automobile. *Coupling constraints* involve the need to accomplish tasks in certain place with others. If, for example, a flight from Atlanta to Toronto involves changing airplanes in New York, both airplanes need to be in New York at the same time. *Authority constraints* are social, political, and legal limits that prevent free access to places. For example, the winter hours for visiting the Petrified Forest National Park are 8 AM to 5 PM.

[2] The *Wilmington Advertiser* reported in its 5 May 1837 issue that the topic of acquisition of stagecoaches and horses was mentioned at a meeting of the stockholders of the WRRR held in Wilmington on 1 May 1837. In the 9 June 1837 issue of the *Wilmington Advertiser*, an article notes that double teams of horses had been stationed along the stagecoach route in advance of the arrival of the coaches. The *Wilmington Advertiser* reported the success of the stagecoach line in its 18 August 1837 issue. An announcement in the 3 January 1838 issue of the *North Carolina Standard* (Raleigh) stated that the winter route for the southbound stages of the WRRR started at Halifax and included a stopover at South Washington (later moved and renamed Watha). The 18 May 1838 issue of the *Wilmington Advertiser* and the 9 June 1838 issue of the *Tarborough Press* reported the proceeding of the Second Annual Meeting of the stockholders of the WRRR that was held earlier that month. At this meeting, the director considered and rejected a plan to change the stagecoach route from "Enfield, by Tarborough, to Stantonsburg, to the route by Rockymount." An article in the 27 October 1838 issue of the *Tarborough Press*, reprinted from the *Wilmington Advertiser*, announced the opening of section of the railroad from Halifax to Enfield in the north and a section to Faison's Depot in the south. After the last spike of the railroad was driven on 7 March 1840, the stagecoach line was phased out. The *Wilmington Weekly Chronicle* reports in its 28 July 1841 issue that the stagecoaches were sold to C.W. Hause of Leechville in Beaufort County, NC.

[3] Wyatt's Bridge, Dorches' Bridge, and Teat's Bridge also appear on the 1808 Price-Strother map of North Carolina (Cumming, 1966, Plate IX).

[4] The Price-Strother map identifies an inn at this intersection.

Acknowledgements

Historic maps from W.P. Cumming's North Carolina in Maps were used by permission of the North Carolina Office of Archives and History, Department of Cultural Resources. The book and maps are available through the Historical Publications Section online at www.ncpublications.com.

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Political Fragmentation, Municipal Incorporation and Annexation in a High Growth Urban Area: The Case of Charlotte, North Carolina

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The population of the Charlotte, North Carolina metropolitan region has grown rapidly in recent decades. Charlotte was the second most rapidly growing city of over 100,000 in the nation in the 1990's. Typically, metropolitan population growth is accompanied by significant increases in the number of municipal governments and a corresponding increase in political fragmentation. However, compared to rapidly growing areas in other parts of the nation in this century and the last, relatively few new municipal governments have been created in the Charlotte region. This paper explores the impact of state annexation and incorporation policy and historical, economic and cultural legacy on the development of the municipal landscape in the Charlotte Urban Region.

Results suggest that because municipal incorporation is difficult and annexation is relatively easy in North Carolina, annexation has been a major tool for municipalities to use in expanding and controlling political fragmentation. The authors also note that the economic and cultural history of the region, most critically, the late 19th and early 20th century expansion of the textile industry in the region, may have also been important factors in reducing fragmentation in the latter part of the 20th century.

Introduction

During the 1990s Charlotte, North Carolina grew more rapidly than any other city (more than 100,000 people) in the nation except for Phoenix, Arizona. This high rate of population growth was, of course, not limited to within Charlotte's city limits, or to the last decade of the century. The entire Metropolitan Statistical Area witnessed sustained population increase over the last thirty years, almost doubling in size to an estimated 1,652,000 in 2004. Growth in the Charlotte-Gastonia-Rock Hill, MSA accelerated in the 1980s and 1990s and into the current century, with sustained annual population growth rates estimated at 2 percent or more per year (Office of State Budget and Management 2001). While such population growth often produces municipal fragmentation (i.e. many new municipalities are created in a single or multi-county area) sustained population growth in the Charlotte urban region appears to have taken place without the creation of substantial numbers of new municipalities.

In this paper we employ Charlotte as a case study for exploring how explosive population growth and suburban sprawl impact the municipal structure of a metropolitan region. In the face of high levels of economic development, rapid and sustained population growth and the accompanying sprawl, how has the Charlotte Metropolitan Area avoided the expected proliferation of new municipalities? We explore the impact of North Carolina annexation and incorporation policy, which is among the most liberal in the United States, on levels of fragmentation in the Charlotte urban region. Finally, we suggest that cultural and economic history matter and that pre-existing municipal pattern, in particular the spatial pattern of development associated with the growth of the textile industry in the region during the late 19th early 20th centuries, influenced the character of urban growth and fragmentation during the explosive urban development in the latter part of 20th century.

Local Government Expansion and Fragmentation, Incorporation and Annexation

There is a substantial body of literature devoted to political and/or urban fragmentation. In this study we draw on this rich literature to inform our research in three major dimensions. First, how is fragmentation measured? Second, does fragmentation matter? Third, how do annexation and incorporation policies impact fragmentation?

Measuring Fragmentation

Political fragmentation has traditionally been defined as the proliferation of local government units in one geographic area. Fragmentation is usually measured in two ways – absolute and relative (Dye and Hawkins 1971; Baker 1998). Absolute fragmentation is the total number of government units in the area and is the most common measure. Relative fragmentation is the number of government units per 1000 persons, or alternatively, the number of people per government unit. Other types of measures look at differences in finances across units or the number of taxing districts in a geographic area (Baker 1998). Dye and Hawkins (1971), using an absolute measure, found that fragmentation in metropolitan areas was a function of population—the more populous the area, the more fragmented the government structure. They also discovered that fragmentation was related to the age of the settlement and to income levels; the older the settlement and the more affluent, the more fragmented it was. Fragmentation, in their study, did not appear to increase or decrease spending for municipal services.

Oakerson (1987) and Foster (1991) criticized these traditional measures of fragmentation. According to Oakerson (1987), although the number of units of local government is used to describe fragmentation, this number is not related to the ability of a metropolitan community to act on metropolitan-wide concerns. Foster developed measures of five dimensions underlying them: central city domination, suburban unincorporation, suburban municipal fragmentation, school district decentralization, and functional overlap. The author ranked 129 large metropolitan areas according to each of these dimensions and concluded that the separate measures captured different aspects of fragmentation.

Barlow (1981) concluded that the problems of fragmentation vary among areas and are related to the number and size of municipal governments and the extent to which local governments are dependent upon property taxes for fiscal support; where there is more dependence, there are more problems. The author also suggested that the legal relationship between local and state governments affected the degree of fragmentation. Zeigler and Brunn (1980) claimed that fragmentation varied between political and cultural regions. They compared fragmentation across regions in the United States using an Index of Geopolitical Fragmentation and found the most fragmentation in the Northeast and the least in the Sunbelt.

In this paper we employ an absolute measure of fragmentation. We compare the increase in the number of municipal governments in the study area from 1970 to 2000.

Does Fragmentation Matter?

From the 1960s to the present there has been a sustained debate in the urban literature on the impact of fragmentation. Scholars debated whether political and governmental fragmentation is a burden or a blessing (Baker 1998; Barlow 1981). The decline of central cities and the growth of suburban centers in the 1960s and early 1970s raised concerns about the negative impacts of fragmentation (Barlow 1981; Bollens and Schmandt 1965). In the late 1980s and 1990s scholars revisited the traditional concerns about fragmentation's impact on government including cost, quality of urban service, diversity, and political representation (Hamilton and Wells 1990; Oates 1990). Literature during this period also addressed fragmentation's relationship to economic development and metropolitan growth (Morrill 1990; Olin 1991).

Some social scientists and economists claim that fragmentation is a way to restrain the growth of local government budgets (Morrill 1990; Oates 1990; Foster 1997). Other proponents herald fragmentation as a magnet for new firms and residents attracted to the greater choice among public service and tax packages, increased socio-economic diversity, and more responsive government which they claim fragmentation produces (Oakerson 1987; Lyons and Lowery 1989; Ostrom et al. 1989; Foster 1991). Foster (1991) noted that the positive and negative effects of growth in the number of governments may operate simultaneously and that little empirical evidence existed to show when, where, how and to whom fragmentation might matter.

Scholars critical of multiple units of government argue that the problems resulting from fragmentation hinder metropolitan growth and economic development (Barlow, 1981; Foster, 1991). Fragmentation is said to reduce coordination among services, to decrease efficiency in service provision, to increase social and fiscal inequities, to contribute to the failure of government cooperation to solve metropolitan wide problems, and to impact government structure and effectiveness (Bollens and Schmandt 1965; Morrill 1990; Foster 1991).

Barlow (1981) also grouped problems of fragmentation into three categories: inefficiency, coordination, and equity. However, he further elaborated three sources of inefficiency: duplication of services, scale economies, and spill over effects. Inefficiencies resulted from failure to realize economies of scale—many municipalities are so small that unit costs for services are high. Spillover effects were the benefits of public services that go beyond the boundaries of the municipality to benefit those who do not live in the providing jurisdiction and do not pay for those services. These spillovers are inefficient because some taxpayers pay more than they should and some consumers do not pay for services they receive.

Curran (1963) regarded the failure of the many governments in a fragmented urban region to cooperate to solve area wide problems such as traffic congestion and air pollution as the primary metropolitan problem. Eliminating municipal boundaries would facilitate solving urban problems at the metropolitan scale. Barlow (1981) suggested that lack of coordination occurred with regard to services, planning, and city problems and many opponents of fragmentation claim that equity problems occur in connection with financing public services in a highly fragmented area. At its worst, metropolitan fragmentation can produce a situation where individuals are treated differently depending on where they live in the metropolitan area (Barlow, 1981; Baker, 1998). Barlow argued that the existence of numerous municipal boundaries fragmented the property tax base, the source of revenue for most local services, leaving tax rich and tax poor communities whose tax rates and levels of service might vary substantially.

The Impact of Incorporation and Annexation On Fragmentation

Incorporation and annexation policies of state and local governments can greatly affect the number of municipal governments in an area (Barlow 1981). Incorporation is the process by which an area becomes a legal municipality granting it the right to form a government as well as certain powers and responsibilities, most of which are related to providing public services. Annexation is the legal process by which a municipality acquires surrounding territory thereby increasing its size and extending its jurisdiction. Although these processes are ways to allow a city to adapt to growth, according to Barlow (1981) they have spawned politically fragmented cities. The procedures could work in opposing directions, however, incorporation increasing fragmentation, annexation constraining it.

A few case studies trace the history of incorporations in specific areas. Reynolds (1976) studied the creation of municipalities in three metropolitan areas: Los Angeles County, California, Saint Louis County, Missouri, and the three counties around Detroit, Michigan. In Los Angeles County 32 new cities incorporated between 1954 and 1970. In the Detroit area, 23 new cities and villages were incorporated between 1950 and 1970. Olin (1991) found in Orange County, California that 12 of 28 municipalities had been incorporated during rapid growth in the 1950s and 1960s.

State laws governing incorporation in the United States have generally been liberal, making it relatively easy for small areas to become municipal governments. In large urbanized areas there is usually a potential for new incorporations to accommodate growth as well as pressure to incorporate to avoid annexation by another municipality (Barlow 1981).

Extending boundaries through annexation has been a favored and effective tool for cities to deal with urbanization and growth. Several studies investigated the effect of state laws on city annexation activity (Dusenbury 1980; Galloway and Landis 1986; Liner 1990; Liner and McGregor 1996; Carr and Feiock 2001;). Sengstock (1960) categorized the various state annexation laws into the following five groupings according to the primary body or method entrusted with making the final decision: (1) state legislature; (2) popular election; (3) judicial body; (4) quasi-legislative or administrative body; and (5) municipal officials. Most researchers investigating annexation laws use this classification. Galloway and Landis (1986) report that cities where final annexation decisions are made by the municipal government and judicial and quasi-legislative bodies are more likely to annex than cities where a majority vote from residents is required. Dusenbury (1980, 46) concluded "...state law largely determines how often and how much cities annex."

Liner (1990) found that cities in states allowing municipally determined annexations had the highest rates of annexation and those with judicially determined had the lowest. Liner and McGregor (1996) found that both municipal government structure and annexation statutes were significantly related to annexation activity. In a study of annexations in the 50 states between 1990 and 1999, Carr and Feiock (2001) found that state laws designed to constrain annexations actually increased their number. Two explanations for these results were, first, that smaller annexations encountered less resistance than larger ones and, second, that municipal officials annexed smaller parcels to avoid restrictions that would be invoked if some threshold size of population or land area were surpassed. In other words, there were more but smaller annexations.

Incorporation and Annexation in North Carolina

In North Carolina, the legal relationship between incorporation and annexation favors annexation. Incorporation is more restricted; annexation is much easier.

Incorporation

In North Carolina the state constitution specifies that a city can be incorporated in only one way – by an act of the General Assembly (Lawrence 1996). Such an act establishes the initial borders of the city and enacts its charter. The single constitutional restriction on the General Assembly's power of incorporation is on its ability to incorporate new cities in close proximity to existing ones. If a community seeking incorporation lies within a certain distance of another city and that city is of a minimum size, then a three-fifths vote of both houses is necessary for incorporation. Otherwise a simple majority vote is sufficient. This provision reflects a state policy favoring annexation by existing cities of urban areas near their borders over incorporation of new cities. When the General Assembly incorporates an area, it may first require the approval of the area's residents. The decision of whether or not to require residents' approval, however, rests with the General Assembly; local voters have no constitutional right to vote on incorporation (Lawrence 1996). Only the General Assembly may abolish a legally established city. It does so by repealing the city's charter.

Annexation

North Carolina's annexation laws are a central part of the state's policies for providing government services in urban areas, policies that favor the expansion of existing cities over other ways of providing those services, such as incorporating new municipalities or creating special districts. Only cities are authorized to provide the full range of basic urban services (Lawrence 1996). While the state constitution restricts the General Assembly's ability to incorporate new cities close to existing ones, the state's annexation statutes help implement a public policy strongly favoring annexation by existing cities. North Carolina was the leading state in the United States in reported annexed population during the years 1990-1995 (Hemmings Information Services 1997).

State statutes provide four methods by which cities may annex: (1) by legislative act; (2) voluntary annexation of areas contiguous to the city; (3) voluntary annexation of areas not contiguous to the city but nearby; and (4) annexation at the city's initiative of contiguous areas that are developed for urban purposes (Lawrence 1996). With few exceptions, all of the state's 527 cities may use these methods. In general, a city may annex any territory qualifying under the various procedures as long as that territory is not part of another, active city. County boundaries do not bar annexation; approximately thirty cities lie within two or more counties, having grown across county lines through annexation.

Most annexations in North Carolina are voluntary. Most of these, however, are relatively small, often involving only one or a few property owners. The city initiated procedure, involuntary as far as annexed citizens are concerned, accounts for the largest number of persons and the largest amount of property annexed. Cities can annex using this procedure by using development standards and service requirements.

The statute allowing annexation of areas developed for urban purposes was enacted in North Carolina in 1959. Cities are permitted to annex an area if the area is developed in an urban manner and if the city plans to provide services to the area on the same basis as it provides services within the existing city. The North Carolina procedure was recommended by the Advisory Commission on Intergovernmental Relations (ACIR) as a model for all states (Wicker 1980). This law granted local governments the authority to annex areas, which qualified under these standards through municipal ordinance and without the consent of area residents. Statutory standards were intended to ensure that annexations occurred only when areas were sufficiently urban and contiguous to the municipality.

To be subject to annexation, an area must meet general standards and be developed for urban purposes as defined in the statute. The annexing city must be able to provide major services to the annexed area on the same basis as it provides them to the existing city. When a city annexes an area, in the absence of a statute providing for private service providers, the city becomes entitled to be the primary provider of municipal services in the annexation area.

Since 1959, North Carolina has also granted municipalities the power to exercise zoning and subdivision regulation authority outside their boundaries. Municipalities of 10,000 or more in population have this extra-territorial jurisdiction up to two miles beyond their boundaries; municipalities of 25,000 or more have this authority up to three miles beyond the municipal boundaries. These powers may only be exercised, however, where the county government is not doing so (Ducker 1996). Extraterritorial jurisdiction enables cities to plan and manage growth on their fringes before areas qualify for annexation.

Data and Methods

Data used in this analysis were drawn primarily from the website of the North Carolina Office of State Budget, Planning, and Management. The data depicting incorporations and annexations were provided by the State Demographer, Bill Tillman and the Office of State Budget, Planning and Management. Incorporation dates were taken directly from the various web sites of the municipalities in the study area.

The Study Area

The study area is composed of Mecklenburg County, in which the central city of Charlotte is located, and its five adjacent North Carolina counties (Figure 1). With the exception of Iredell, all of these counties were (together with York County, South Carolina) in the Charlotte-Gastonia-Rock Hill, NC-SC, Metropolitan Statistical Area according to the 1999 OMB definition. The total population of the study area in 2000 was 1,326,999 (Office of State Budget and Management 2001)[1].

As shown in Table 1, five of these six counties experienced substantial population growth during the last 30 years of the 20th century. Only Gaston County had a growth rate that averaged less than one percent per year during this period. Much of the growth in this metropolitan area from 1970-2000 was related to the rapid expansion of the central city economy. The population of Charlotte, the major growth engine of the region, expanded by more than 124 percent during this time. Population growth in the counties adjacent to Mecklenburg ranged from a low of 28 percent to a high of 126 percent. Of course, some of this growth occurred in relatively rural areas such as the counties of Lincoln, Iredell and Union; hence their percentage increase, while impressive (Union grew by 126 percent) was of a relatively small population base in 1970.

Like most late automobile-era North American cities, Charlotte's growth sprawled outward from the original core. From 1960 through the 1980s, this growth was initially absorbed by development in open spaces immediately surrounding the city. More recently growth pushed outward into the surrounding counties, especially those in the path of the two primary growth sectors (Figure 2). Until the 1990s, Charlotte's primary growth sector was southward into Union County. During the last decade, a secondary sector pushed northward towards the small towns in northern Mecklenburg and on into the counties of Iredell and Cabarrus. This northern expansion was facilitated by major public sector, financial stimuli including a university, hospital, library, major highway construction, and creation of water and sewer treatment facilities. While this stimulated the initial northward expansion, the natural amenities of artificial lakes on Mecklenburg County's western boundary has played a significant role in the more recent growth. By the 1990s the small towns directly in the path of both growth axes began to absorb much of the entire urban region's growth. However, even as the new century dawned, the City of Charlotte still made up almost 41 percent of the region's total population and accounted for over half of its total population growth during the last three decades of the 20th century.

Several factors make this region an intriguing case to study. First, there is the rapid and extensive population growth. As Charlotte's growth spilled outward into the surrounding countryside, it threatened what was, until the 1980s, a small town and rural setting. Many of the small towns were mill towns in an earlier economic era. They were the centers of the textile industry that dominated the region's economy until the 1970s. Second, as the United States' textile industry continued its inextricable march offshore, the small textile towns surrounding Charlotte lost most of their previous industrial base and became bedroom communities to the economic expansion and dominance of Charlotte. A transportation network focused on Charlotte, but built to service the dispersed textile industry, permitted these towns to develop as suburban centers to Charlotte's economic core. Finally, and important for this research, is the role that incorporation and annexation have played in this rapid growth and expansion. As demonstrated in the following sections, incorporation seems to play a limited role. Annexation, however, is a major element of the growth picture.

In the 1990s Charlotte's total population grew by more than 144,000, from approximately 396,000 to 541,000. Over 53 percent of that growth came through annexation. The growth has continued since then in similar fashion. In a July 2001 annexation, the city added more than 22,300 residents and grew to more than 260 square miles. Following an annexation in 2002, the city had jurisdiction over development decisions in a 382 square mile area[2]. That made Charlotte geographically larger than New York

Table 1. Population Growth in the Study Area, 1970-2000

LOCATION	NUMBER MUNICPAL	POP Apr-70	POP Apr-80	POP Apr-90	POP Apr-00	Chng 70-00	Chng 90-00
North Carolina		5,084,411	5,880,095	6,632,448	8,049,313	58.3%	21.4%
MSA	44	737,293	848,079	1,012,649	1,326,999	80.0%	31.0%
Cabarrus Cnty	4	74,629	85,895	98,935	131,063	75.6%	32.5%
Gaston Cnty	14	148,415	162,568	174,769	190,365	28.3%	8.9%
Iredell Cnty	5	72,197	82,538	93,205	122,660	69.9%	31.6%
Lincoln Cnty	1	32,682	42,372	50,319	63,780	95.2%	26.8%
Mecklenburg Cnty	7	354,656	404,270	511,211	695,454	96.1%	36.0%
Union Cnty	13	54,714	70,436	84,210	123,677	126.0%	46.9%
City of Charlotte		241,420	326,330	395,934	540,829	124.0%	36.6%

Source: Adapted from Office of State Budget and Management, 2001.
NUMBER MUNICIPAL = Number of Municipalities in county or area.
POP = Population
Chng = Percent change in population over time period.

City and all but eight of North Carolina's 100 counties (Dodd 2001).

Results—The Pattern of Incorporations In the Study Area

In terms of the number of formally constituted governments, the Charlotte urban region is markedly different from many of its counterparts across the United States. With only 50 local governments (6 counties and 44 municipalities) in 2000, Charlotte is at the opposite end of the fragmentation scale from Chicago (260 municipalities in Illinois alone), New York (153 in New York) or St. Louis (170 in Missouri) (US Bureau of the Census 2002).

In the midst of the rapid growth and expansion of the built up area of Charlotte and its surrounding urban centers, relatively few new governments have been created within the urban region. Of the 44 municipalities in Mecklenburg and the five adjacent North Carolina counties in 2000, all but 15 were incorporated before 1930. In fact, 22 were incorporated during the height of North Carolina's industrial expansion between 1870 and 1930. Like its northern industrial counterparts, Charlotte was also bordered by municipalities incorporating around it during the peak of the industrial expansion in the region and most of the municipal pattern of the Charlotte urban region was in place before its recent rapid population growth began. One way to see this is to compare Figures 1 and 3. Figure 3 provides a visual image of municipalities in 1970 at the very beginning of our study period. Virtually all of the places listed in Figure 1 existed in 1970. These places simply exploded outward from their 1970 cores to municipal limits outlined in Figure 1. Most of the energy for that explosion came in the form of annexation. The major exception to this generalization was Charlotte's southern growth sector expanding outward into Union County. Here new municipalities were created.

What happened in the study area during the explosive growth of the last three decades of the 20th century? Evidence suggests that incorporation has been employed as a defense against the expansion of the Charlotte central city and a tier of older (19th century) municipalities to the south of the central city (See the municipalities of Matthews, Mint Hill and Indian Trail in Figure 2). Of the 12 municipalities created since 1970 all were in the path of Charlotte's high growth sectors; in fact 10 were in the direct path of the southern high growth sector moving outward from Charlotte into western and northern Union County (See Figure 2 and Table 2). All 6 of the incorporations in the study area during the 1990s were in the high growth southern sector. As a comparison there were 35 incorpora-

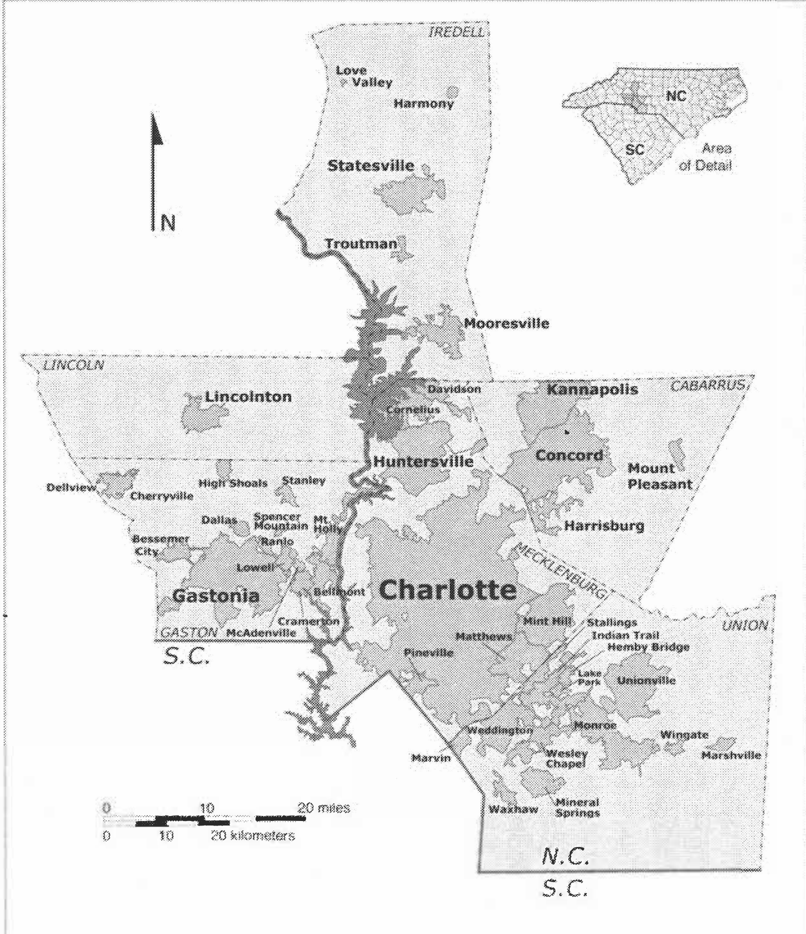

Figure 1. The Study Area, 2000. The study area includes the City of Charlotte, Mecklenburg County and all surrounding adjacent counties (Iredell, Lincoln, Gaston, Union and Cabarrus) with the exception of counties in South Carolina. This figure includes the locations of all incorporated places and their legal boundaries as of December 2000.

Cartography Lab, Department of Geography & Earth Sciences, UNC Charlotte, September 2003

tions in the entire state during the 1990s (Morgan and Tillman, 1999).

How does the study area compare to the national pattern of incorporation? Nationally, the number of incorporations remained at about the same annual rate between 1980 and 1995. Table 2 shows the trend in the number of incorporated places nationwide and in the study area during the period of this study. Nationally, the number of municipalities increased from 18,048 in 1967 to 19,429 in 2002, the date of the most recent Census of Governments. This was a 7.7 percent increase (US Census Bureau 1967, 2002). During the same period, the number of municipalities in the study area increased from 32 to 46, a 44 percent increase. Clearly the number of new incorporations in the study area exceeded the pace of incorporations in the nation as a whole. Ten new municipalities were incorporated between 1980 and 2002 in the study area; four between 1997 and 2000; two between 2000 and 2002. Eight of the ten new incorporations were in Union County, one of the major growth corridors for the Charlotte metropolitan area.

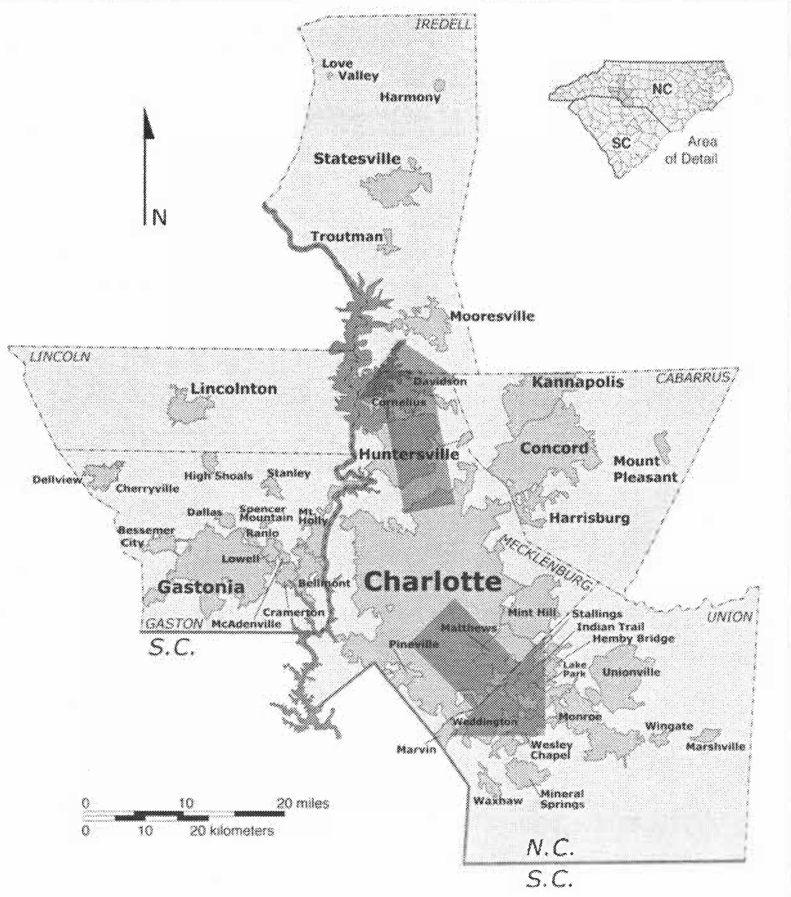

Figure 2. Major Growth Corridors in Charlotte Urban Region, 1970-2000. There have been two major growth corridors in the Charlotte Urban Region. One major corridor was from the central Charlotte south into Union County; the other was from central Charlotte outward to the north and northeast towards southern Iredell County and Cabarrus County.

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Based on these data we offer three interpretations. First, while incorporation has not caused extensive fragmentation of the government structure in the study area, creation of new municipal governments increased markedly during the 1990s. Second, every new municipality created in the study area during the 1990s was in one county, Union, which is in Charlotte's southern, high growth corridor. Finally, the newly incorporated places in the study area during the 1990s seem to have been created as a defensive mechanism. Most offered no public services, had no permanent employees and had total annual town budgets of less than $50,000. Their tax rates ranged from $0.02 to $0.04 per $100 of assessed valuation.

Results—The Pattern of Annexations In the Study Area.

The municipalities in the study area have annexed extensively during the last twenty years. In the 1980s, five municipalities in the study area were among the top 20 annexing municipalities statewide (by both population and area annexed). In the 1990s, eight of the study area municipalities were among

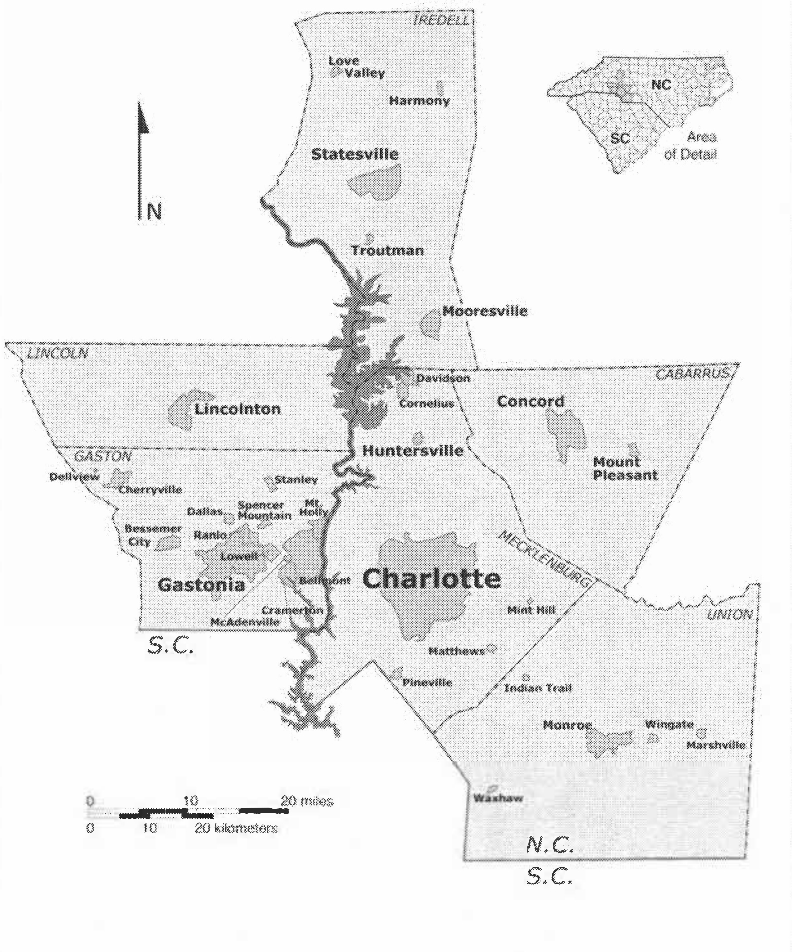

Figure 3. The Study Area, 1970. In 1970 many of the current day municipalities already existed as incorporated places. This figure provides the locations of all incorporated places and their legal boundaries as of December 1970.

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the state's top twenty in terms of size of area or population annexed (See Table 3; Morgan and Tillman 1999). Some of the increases in municipal population and area are dramatic. For example, Huntersville went from a population of 3,023 in 1990 to 24,960 in 2000. Indian Trail grew from 1,942 people in 1990 to 11,905 in 2000. Huntersville is in the north growth corridor; Indian Trail in the southeast (Office of State Budget and Management 2001). Many municipalities in North Carolina annexed considerably more population than was annexed by all municipalities in other entire states in the US. The total population residing in areas annexed by Charlotte during the period 1990-1995 was greater than the sum of all population annexed in 17 of the 29 US states that reported municipal annexations during this period (Hemming Information Services 1997, 36-37).

Conclusions and Implications

Why does Charlotte differ so markedly from examples of fragmentation found elsewhere in the United States? Why has there not been more incorporation in this rapidly growing urban region? The

Table 2. Number of Municipalities Nationwide and Study Area, 1967-2002

Nationwide								
Year	1967	1972	1977	1982	1987	1992	1997	2002
Number	18,048	18,517	18,862	19,076	19,200	19,279	19,372	19,429
Study Area								
Year	1967	1972	1977	1982	1987	1992	1997	2002
Number	32	33	36	36	38	38	40	46

Source: Adapted from US Bureau of the Census, Census of Governments, 1967 to 2002.

answer to these questions comes in two parts: the role of North Carolina's urban-friendly incorporation and annexation statutes and the influence of a previous cultural and economic heritage.

Understanding how North Carolina's urban expansion pattern has emerged rests on a set of constitutional provisions and state statutes governing how cities may incorporate and how they can deal with population growth and suburbanization through annexation. The information and analysis in this paper demonstrates the impact of these legal arrangements on the level of fragmentation. If cities adopt a regular policy, as Charlotte has, of reviewing for possible annexation developing areas around the fringe, growth outside the city is soon absorbed into the city.

The cultural and economic landscape in which the Charlotte urban region is now expanding also contributes to the current lack of fragmentation. Stuart (1972) labeled this landscape "dispersed urbanization." This concept describes the pattern of small towns and cities, which grew up during the expansion of the textile industry during the last 20 years of the 19th century and the first 30 years of the 20th century. Each small town in the region competed with others to attract, and even finance on their own initiative, textile mills. In less than 50 years most of the textile industry migrated from New England to the Piedmont region of the South and Charlotte became a major center of this new industry. In 1930, more than 300 cotton mills and more than half of all the looms in the South were within 100 miles of downtown Charlotte (Tomkins 1989). The result was a landscape dotted by small towns, many with only one mill, and a few others with dozens of mills, for example Charlotte, Gastonia, and Kannapolis.[3] These mills dominated the economy, and the life of the community often focused on activities that centered on the mill. And as the textile economy expanded so did the number of incorporated places. Thus, much like its northern urban counterparts, Charlotte's explosion of incorporation accompanied industrialization; only it occurred before the turn of the 20th century, more than a century before the recent urban expansion.

This pattern of population distribution where small towns and economic centers were dominant was in place as the economy of the region began to shift during the last quarter of the 20th century. As employment shifted away from industry towards the service sector, North Carolina's two major urban centers — Charlotte and Raleigh — led a shift into new urban, economic and cultural pathways. The spatial explosion of Charlotte, however, was largely absorbed within the existing local government framework. The municipalities that had been created a century before simply shifted from industrial centers to bedroom communities, albeit ones that were not contiguous to Charlotte. By the time the urban explosion occurred, the statutes favoring annexation over incorporation were in place. Although some areas were able to incorporate in defense of being annexed, few new towns were created and the existing towns, for the most part, simply annexed to absorb the rapidly increasing urban population.

What of the Future?

Interestingly enough, were it not for the one county to Charlotte's south, there would have been virtually no increase in the level of fragmentation during the period we examined. Currently, anecdotal evidence suggests that the existing cities may be positioning themselves to absorb most of the future growth as well. A series of annexation spheres

Table 3. Selected Municipalities in the Study Area: As Ranked by Total Population and Area Annexed

1980 – 1989				
Municipality	Population Annexed	State Rank	Area Annexed (sq.mi.)	State Rank
Charlotte	45,303	2	35.79 sq. mi.	1
Matthews	13,556	8	10.76 sq. mi.	9
Concord	11,449	9	13.76 sq. mi.	7
Gastonia	7,021	15	9.26 sq. mi.	12
Belmont	4,937	20	3.41 sq. mi.	*
Total	82,266		72.98	
1990 – 1999				
Municipality	Population Annexed	State Rank	Area Annexed (sq.mi.)	State Rank
Charlotte	81,245	1	66.25 sq. mi.	1
Huntersville	19,357	7	27.14 sq. mi.	5
Concord	17,847	9	30.14 sq. mi.	3
Indian Trial	7,899	14	12.08 sq. mi.	16
Cornelius	7,399	15	4.66 sq. mi.	*
Gastonia	5,995	17	14.54 sq. mi.	14
Kannapolis	5,097	*	14.82 sq. mi.	13
Monroe	4,454	*	10.67 sq.mi.	18
Total	149,293		180.3	
*Ranked below top twenty				

Source: Adapted from Office of State Budget and Management, 2001.

of influence agreements have been negotiated in Mecklenburg and between towns in Union and Mecklenburg that would essentially divide up the areas of future population expansion well into the next decade. Apparently, once these towns have been created they are loath to see new competition for future expansion.

Local conditions and politics across the region vary, however, and the pattern seen in Mecklenburg and some of the other counties may not hold. Consider annexation practices in this one metropolitan area. For decades, Charlotte, the largest city in this metropolitan area, has, as a matter of policy, regularly evaluated areas for annexation. Few, if any, other cities in the region have done so. Then there are possible changes in policies and practices of incorporation. The recent incorporations in Union, the county to the south of Mecklenburg, appear to have been defensive; the residents that fought to incorporate new municipalities did so to ward off annexation. Furthermore, given statewide policy restricting incorporation, residents in newly minted municipalities must have found a sympathetic ear in the General Assembly to sponsor special legislation.

As growth continues to spill into the rural areas surrounding municipalities in the urban region, the pressure to incorporate may grow in other areas and there may be other sympathetic legislators. If recent events in the counties surrounding Mecklenburg are any clue, more defensive incorporations will be attempted (McClury 2005).

Footnotes

[1] Although York County, South Carolina was within the Charlotte-Gastonia-Rock Hill Metropolitan Statistical Area in 2001 and borders on Mecklenburg County, it was not included in the study. State laws governing incorporation and annexation in York County differ from those in North Carolina. Other applicable laws, such as those governing local taxation, also differ.

[2] Of course this is nowhere near the fabled exploits of Houston which annexed 200 square miles during the 1950s and 1960s, or Oklahoma City, which annexed its way from 50 square miles in 1950 to a city covering 620 square miles in 1962 (Barlow, 1981).

[3] Kannapolis, North Carolina was incorporated in 1984. Prior to this, it was the largest unincorporated urban area in the United States. It had been a mill community owned by Canon Mills and the owners provided housing, utilities, and streets. When the mill was sold the company ceased provision of these services.

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Spatial Variability of Temperature Trends in Urbanized and Urbanizing Areas of North Carolina

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This paper investigates the differences in temperature trends during a 40-year period in urbanized and urbanizing areas in North Carolina. Urbanized sites are in the urban cores of the selected regions; urbanizing sites are in outlying suburban locations characterized by lower development intensities than their respective urban cores. We examined maximum and minimum temperatures for four seasons represented by the months of March, June, September, and December. This study shows that the heavily urbanized downtown areas did not exhibit significant increasing trend in temperatures. Rather, the significant increases in temperatures occurred in suburban areas that experienced varying degrees of urbanization during the past 40 years. We conclude that although some urbanized areas may have higher temperatures than areas in their surrounding regions, urbanizing locations outside of central cities may be closing that gap, possibly due to the process of urbanization.

Introduction

The concept that humans may be contributing to an atypical warming of Earth's atmosphere—through emission of greenhouse gases and alteration of natural landscapes—has received increasing attention in the scientific community in recent decades. Because of its implications, the issue has pervaded a wide range of scientific fields. The impacts of climate change have been modeled or studied, for example, in relation to infectious diseases (Patz et al. 1996), wildlife (Anderson et al. 1993), coral reefs (Pittock 1999, Pandolfi, 1999), agriculture (Lewandrowski and Schimmelpfennig 1999), glaciation (Haeberli et al. 1999), hurricane intensity (Knutson 1998), and foreign policy (Ott 2001).

Climate is not constant; Earth's climatic history is characterized by fluctuations in atmospheric composition, temperature, and precipitation (Schneider 1994). It is widely accepted, however, that worldwide temperatures have exhibited a general increase in the last 40 years that is probably not due to natural climatic fluctuations. Concurrent increases in world population and atmospheric concentrations of greenhouse gases have fostered the assertion that humans are in large part responsible for current climatic change at both global and local scales (Schneider 1994). Some scientists disagree. For example, Michaels and Balling (2000) contend that Earth's climate *has* experienced distinct natural warming (and cooling) phases, even in relatively recent history. They specifically argue that not enough evidence exists to conclude that climate is changing abnormally. They also note that while many temperature readings admittedly indicate warming trends, most weather stations in the more developed countries are located in or near cities, which often exhibit distinct microclimates relative to surrounding rural areas. The issue, they claim, is warming at the regional, rather than the global scale.

Partially due to the increased focus on climate change or global warming, regional and urban climate change has also received attention. The urban heat island has been addressed empirically by, among others, Oke (1973), Karaca et al. (1995), Bohm (1998), Klysik and Fortuniak (1999), and Tumanov et al. (1999). Further, it has been established that nationwide growth during roughly our period of study (1960-2000) has occurred largely outside of established urban cores, and that in most cases, communities and regions have consumed land for urbanization at a faster rate than their populations have grown, indicating that many communities outside of urban cores are urbanizing.

As regions become urbanized, the character of the natural landscape is altered in a variety of ways. Development for urban purposes (housing, factories, skyscrapers, roads) necessarily removes natural vegetation, replacing it with impervious surface materials. Common materials in urban construction such as asphalt, cement, and roofing tile have a higher heat capacity than the vegetation and other natural features being displaced (Rodgers and Stone 2001). Large quantities of thermal energy are absorbed by these materials during daylight hours, and re-emitted to the atmosphere at night. Loss of vegetation also limits evapotranspiration, a natural cooling method employed by plants using solar radiation to convert water to vapor. The energy trapped by vegetation is not available to heat urban structures or the ground surface, and the release of water vapor to the air serves to decrease the ambient air temperature (Mixon 1994, Rodgers and Stone 2001). Michaels and Balling (2000) contend that the primary cause of urban warming is the waterproofing of the urban land surface with impervious paving and construction materials. Aside from the removal of existing vegetation and the higher heat capacity of urban structures, impervious surfaces induce rapid rainfall runoff, allowing for little soil moisture and groundwater recharge . With less near-surface moisture, more solar energy is involved in directly heating the surface (Michaels and Balling 2000). Other factors contribute to urban heat retention as well. High traffic volume, energy consumption (especially fossil fuels used in heating and cooling), pollution concentration, and the lower reflectivity of many urban surfaces relative to the natural surfaces displaced, combine to enhance the urban heat island effect.

Due to these factors, urbanized regions may exhibit heat island intensities of 6-8 Fahrenheit (4-6 Celsius) degrees, especially at night. (Oke 1973, Rodgers and Stone 2001). Like absorption of thermal energy, the heat island effect is cumulative; as urban regions absorb higher levels of energy during daylight hours, they emit more heat at night, increasing ambient surface temperature. (Fehr-Snyder 1999).

The effects of urbanization on urban and regional climate are complex and difficult to quantify. Early attempts to verify and analyze the urban heat excess did so by calculating the difference between urban and rural temperatures. This became the standard formula for heat island intensity (Oke 1973). Others have examined urban cross-sections by collecting temperature measurements along transects through urbanized areas. This method provides greater evidence of the distribution and "shape" of the heat island (Tumanov et al. 1999, Unger et al. 2001). More recently, long term (>30 years) temperature data from fixed stations have been used to describe heat islands, particularly in Europe and the Middle East. These studies have the distinct advantage of exhibiting specific seasonal and/or diurnal patterns of urban heat island development. Goldreich (1995) reviews a number of studies in Israel, some of which combine the transect and fixed-station collection methods. Separate studies have analyzed heat island intensity and form in the U.S. (Quattrochi et al. 2000, Rodgers and Stone 2001, Lo and Quattrochi 2003); as well as in Istanbul, Ankara (Karaca et al. 1995), Bucharest (Tumanov et al. 1999), Vienna (Böhm 1998), and Lodz, Poland (Klysik and Fortuniak 1999). In the cases of Vienna and Bucharest, the authors examine temperature time series from multiple urban and rural stations. This approach seems to offer the most information about the spatial distribution and intensity of urban heat excess.

These studies lead to certain conclusions. First, it seems that formation of an urban heat island depends more on the physical characteristics of the built landscapes than on demographic variables (Klysik and Fortuniak 1999). For example, in certain cases population growth and population density have been rejected as meaningful indicators of urban warming (Bohm 1998). Second, heat island intensity is generally greatest during the high-sun season, when urban structures and materials absorb the greatest amounts of solar radiation. Finally, heat island intensity tends to be greatest among minimum temperatures, usually at night or early in the morning. It is generally accepted that urban areas are warmer than their surrounding suburban and rural areas, especially at night.

The need for a larger inventory of empirical evidence regarding trends in regional and global climate is clear. Based on existing findings that world-wide temperatures may be increasing, and that urban temperatures are generally increasing at greater rates than those in suburban and rural locations, the purpose of this paper is to investigate the long-term urban heat island effect and its spatial variability in selected areas of North Carolina. The specific objectives are: 1) determine trends in air temperature over a 40-year period in urbanized and urbanizing areas; 2) analyze the differences in temperature trends between urbanized and urbanizing areas; and 3) examine the spatial, temporal, and diurnal variability of urban climatic change in different parts of metropolitan regions.

Study Area

Our study area includes the Asheville and Raleigh regions of North Carolina (Figure 1). These two regions represent certain physiographic segments of the state—Asheville the mountainous western portion, and Raleigh the piedmont/coastal plain transition of the east-central portion. The regions are far enough from each other to be independent in terms of temperature. Thus, localized warming in Asheville will have no direct impact on temperatures in Raleigh, and vice versa.

In each region, we selected weather stations and classified them either 'urbanized' or 'urbanizing' (Table 1). One location in the urban core of each region was classified 'urbanized'. These stations are in established downtown areas, surrounded by significant development, including roads, commercial and residential structures, pavement, and other artificial surfaces. The sites lack dense or extensive vegetation. Three weather stations in each region were classified 'urbanizing'. The 'urbanizing' sites are in outlying areas that have experienced some degree of urbanization during the last forty years, but are clearly distinct from the urbanized stations due to their lack of intensely urbanized landscapes. Natural surfaces are more abundant in the immediate surroundings of these sites than the 'urbanized' ones. For example, the weather stations at the airports in the respective regions are in the proximity of the terminals, the runways are paved, and the surroundings are less rural than they were in 1960, but in neither case is the landscape intensely urbanized. The distance between weather stations (> five miles in all cases) should be sufficient to isolate variations in trends between individual sites.

Asheville Region

Asheville is located in Buncombe County in western North Carolina, in the foothills of the Appalachian Mountains, near Great Smoky Mountains National Park. The region is approximately 2,100 feet above mean sea level, but exhibits significant relief. For purposes of this study, the Asheville region consists of three counties: Madison, Buncombe, and Henderson.

'Asheville 1' is the 'urbanized' station in the region, located in the northeast quadrant of downtown Asheville. The first 'urbanizing' station, 'Hendersonville 1NE,' is in a suburban setting in the town of Hendersonville, 19 miles south of Asheville. The second 'urbanizing' station, 'Regional Airport,' is located in the airfield of Asheville Regional Airport, surrounded in large part by open grassy and wooded areas. The 'Marshall' station is the third 'urbanizing' station in the Asheville region, in the rural community of Marshall, around 15 miles north of Asheville.

Raleigh Region

Raleigh is in Wake County near the center of the state, at an approximate elevation of 300 feet above mean sea level. The Raleigh region includes Wake and Johnston Counties. The Raleigh St. University station is the urbanized site in the Raleigh region, and is in a heavily urbanized setting near the campus of North Carolina State University in

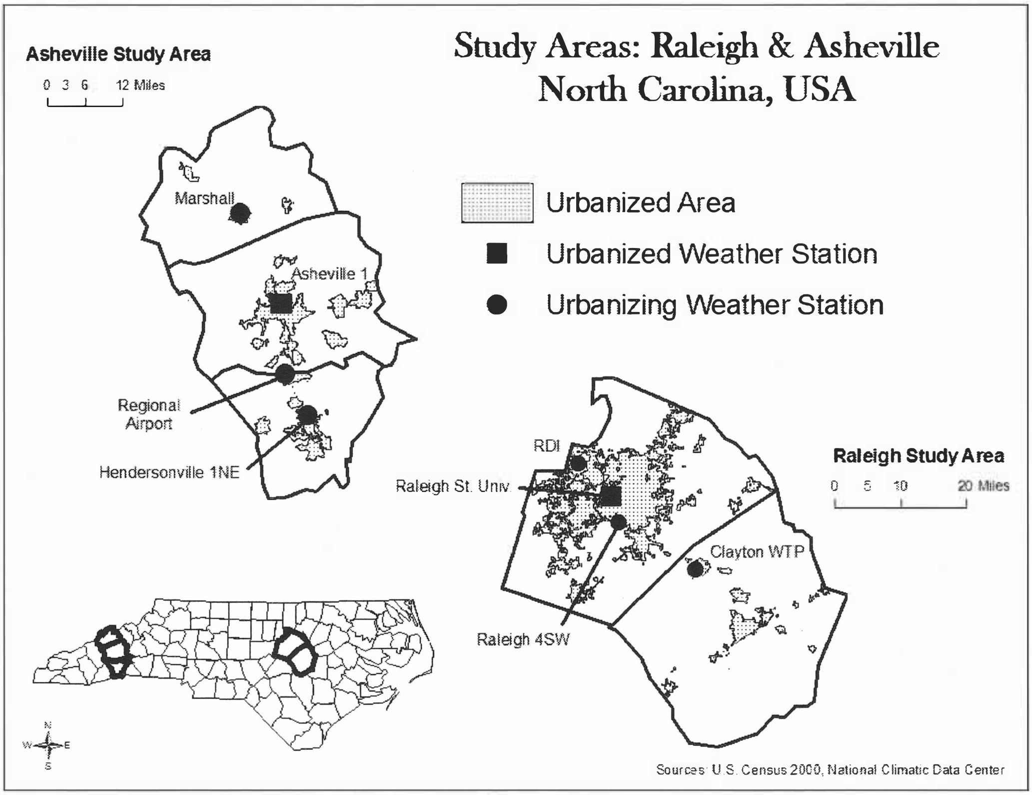

Figure 1. Location of weather stations analyzed in this study.

the western portion of the city of Raleigh. The first of three urbanizing sites in the region is Raleigh 4SW, on the North Carolina State University farms approximately 6 miles south of Raleigh. The second urbanizing site is RDI, located in the airfield at Raleigh-Durham International Airport. The Clayton WTP station is the third urbanizing station, located in an urbanizing area on the outskirts of the community of Clayton, approximately 15 miles southeast of Raleigh.

Data

We acquired temperature data for eight weather stations, four in each region (Table 1, Figure 1), from online records of the National Climatic Data Center (2004). Daily maximum and minimum temperatures from each station were collected for March, June, September, and December (to represent seasonality) over the period 1960 – 2000. From these data, we calculated means of maximum and minimum temperature for each of the four months at each weather station. In the case of small discontinuities (no more than one year), values were interpolated using the data from the previous year and the following year (less than one percent of data values). The resulting 41-year time series of mean maximum and minimum temperature at each location for each of the four months were analyzed for trends. These trends were also compared with raw temperature values to clarify the relationship between the Kendall Coefficient and actual temperature change.

Methods

There are various methods of trend analysis available for long-term temperature data. In this

Table 1. Weather station names and locations analyzed in this study as identified by the National Climatic Data Center (2004).

Station Name	Lat. / Lon.	Station Type*	Elevation (ft)	Period of Record **
Asheville 1	35°36′ N/82°32′ W	Urbanized	2,240	1960-2000
Asheville Regional Airport	35°26′ N/82°32′ W	Urbanizing	2,140	1965-2000
Marshall	35°48′ N/82°40′ W	Urbanizing	2,000	1960-2000
Hendersonville 1NE	35°20′ N/82°27′ W	Urbanizing	2,160	1960-2000
Raleigh St. Univ.	35°48′ N/78°42′ W	Urbanized	400	1960-2000
Raleigh-Durham Intl. Airport	35°52′ N/78°47′ W	Urbanizing	416	1960-2000
Raleigh 4SW	35°44′ N/78°41′ W	Urbanizing	420	1960-2000
Clayton WTP	35°38′ N/78°28′ W	Urbanizing	300	1960-2000

* Urbanized sites are in the urban cores of the regions. Urbanizing sites are in outlying suburban areas with less intense urban development characteristics.

** In some cases, one or two years were missing from the beginning of the study period; these values could not be interpolated. Thus, the period of record varies slightly at certain locations.

study, we used a sequential version of the Mann-Kendall rank statistic because this method allows detection of abrupt climatic change (Goosens and Berger 1986, Karaca et al. 1995). In this study, we applied the test to both daytime (maximum) and nighttime (minimum) temperature values. Examining monthly mean temperatures rather than annual means also allows for discussion of seasonal variation during the period of study.

The Mann-Kendall test is a non-parametric test that is applicable under the hypothesis of a stable climate, in which a series of values are independent and exhibit a constant probability distribution (Goosens and Berger 1986). For each term x_i in a series of N terms, y_i is the number of terms (x_j) preceding x_i ($i > j$), where $x_i > x_j$. The sum of these values, denoted z_N, is calculated:

$$(1) \qquad z_N = \text{Sum}\ (y_i)$$

For large N (> 30), under the hypothesis of no change, z_N will be normally distributed with an expected value (E) of:

$$(2) \qquad E(z_N) = N(N-1)/4$$

and a variance of:

(3) $V(z_N) = N(N-1)(2N+5)/72$

The standard deviation s_z of each population is given as:

(4) $s_z = [\ V(z_N)\ ]^{1/2}$

The Kendall Coefficient m_z is obtained by:

(5) $m_z = [z_N - E(z_N)]\ /\ s_z$

The Kendall Coefficient (m_z) has a standard normal distribution with a mean of zero ($E(z_N) = 0$) and a variance of one ($V(z_N) = 1$). The graphical representation of this series of values along the time axis is analyzed for trends. For purposes of analysis, a 95% confidence level was selected so that the series exhibits a significant trend when m_z falls outside the interval -1.96 to 1.96 (the pair of dotted lines on Figure 2a). The sign of m_z indicates the direction of trend, in this case towards warming (+) or cooling (-). In addition, we examined raw temperature values for trend by plotting the time series of each data set and fitting a regression line by least squares to each time series plot (the dotted line on Figure 2b).

In some cases a data set exhibited a Kendall Coefficient that only achieved statistical significance for a year or two. Due to the nature of the Mann-Kendall test, in which the Kendall Coefficient (m_z) is calculated based on previous values in the series, a few warm (or cool) years can produce high (or low) values of m_z. In the context of climate change, trends that reach statistical significance for only one or two years do not indicate a meaningful trend in temperature. However, for trends to remain significant for several years, actual temperature values must exhibit more consistent change in the direction of trend, and must be warmer (or cooler) than a significant portion of the temperatures from prior years in the series. The greater the number of years that the Kendall Coefficient falls outside the selected confidence interval, the stronger is the indication of a persistent and meaningful trend in temperature. Comparison of the test statistic results with time series plots of real temperature values confirms this relationship.

For example, certain time series indicated trends that achieved statistical significance for less than four years. While these short-term trends are of interest at a different spatial scale (i.e. community rather than regional scale), we focused instead on the occurrence of persistent trends indicative of more than random fluctuations in order to highlight variations in temperature change across different parts of the selected metro regions. Unless persistent trends were observed at all of the stations in a selected region, we could conclude that localized instances of trends were not the result of a broader regional trend in temperature. Next, we present those data sets in which persistent trends were identified.

Results - Asheville Region

No significant trend was observed for any time series of maximum temperatures in the Asheville region. Among a total of 32 data sets for the Asheville region (maximum and minimum temperature for each of four months at each of four weather stations), only five exhibited trends of long-term significance; each of the five occurred among minimum temperature data. These five data sets are examined below in detail.

Substantial significant trends existed at the Regional Airport station for June minimum temperature and at the Hendersonville station for minimum temperatures in March, June, September, and December. June minima clearly showed a warming trend at Asheville Regional Airport, beginning around 1966, achieving significance at different points in the time series, but remaining strongly positive and fluctuating near significance from 1980-2000. Raw values of June mean minimum temperature at Regional Airport support the indication of a warming trend (Figure 2).

March minima at Hendersonville exhibited a sharp increase from 1971-2000, becoming significant around 1990 (Figure 3). The data fluctuations around the significance line from 1990-2000 indicate that mean minimum temperatures were nearly constant during the period, and warmer than at the beginning of the time series. June minima at Hendersonville exhibited a drastic warming trend beginning around 1974, following a period of no discernible change. The trend increased from the early 1980s through the year 2000. This indicates substantial warming for the data set. The graph of September minima indicates significant warming beginning around 1969, following some 10 years of significant cooling. The warming trend remained significant from 1987-2000.

December minima at Hendersonville also exhibited significant warming, but not at the magnitude observed for March, June, or September. The fluctuation of the data values indicates less drastic warming than the Hendersonville minimum temperature observations for the other three months. However, because the Kendall Coefficient remains strongly positive throughout, and is significant at several points in the series, we may conclude that minimum temperatures exhibited meaningful increase for the period of analysis. Again, raw mean minimum temperature values for each of the four months at Hendersonville reinforce the evidence of a warming trend (Figure 3).

The urbanized downtown station, Asheville 1, exhibited no significant trends among any data sets. A representative plot of temperatures from the Asheville 1 station is indicative of the absence of significant temperature change during the period of study (Figure 4). The urbanizing Marshall station also showed no persistent trends in any data set. Thus, warming trends in the Asheville region during the last 40 years appear to have been confined to outlying, urbanizing areas in the southern portion of the study area.

Results - Raleigh Region

Only four data sets from the Raleigh region indicated significant, relatively long-term temperature change; each exhibited significant warming. Two of the four occurred among maximum temperature data. June mean maxima exhibited persistent positive trends only at the RDI and Clayton stations. At RDI, the trend was significant for much of the final decade of study, and raw temperature values indicate slight warming during the period of record (Figure 5). The warming trend among June maxima at Clayton was also significant for much of the final ten years of study, and raw temperatures indicate slight warming, similar to the change observed among the RDI June maxima (Figure 6).

Interestingly, persistent trends among minimum temperatures in the Raleigh region were observed for June at the same locations as trends in maximum temperatures. June mean minima at RDI showed a significant cooling trend early in the time series, followed by significant warming towards the end. Slight warming at RDI for the period of record is also indicated by June minimum raw temperature values (Figure 5). Kendall Coefficients for minimum temperatures for June at Clayton exhibited a warming trend late in the time series, which is supported by slight warming in raw temperature values (Figure 6).

The urbanized downtown station, Raleigh St. University, exhibited no persistent trends among any data sets. A plot of temperatures from Raleigh St. University (Figure 4) provides representative evidence that temperature change in downtown Raleigh was insignificant during the period of study, much like in downtown Asheville. Likewise, data from the urbanizing Raleigh 4SW station registered no persistent trends. Thus, in the Raleigh region during the period 1960 - 2000, the month of June experienced a warming trend among both maximum and minimum temperatures in outlying, urbanizing areas on opposite sides of the study area (RDI to the west, Clayton to the east).

The Clayton and RDI June data sets exhibited a striking temporal similarity. Each of the four sets showed negative values early in the series, followed by steady increase to positive significance within the last ten years of study. While the trend for each series was clearly positive, the true magnitude of change may be questionable. Although each plot line achieved significance late in the series, none remained significant for a large number of consecutive years. They tended to fluctuate around the significance line through the end of the period of the study. This indicates that actual temperatures in the last decade of the series were generally

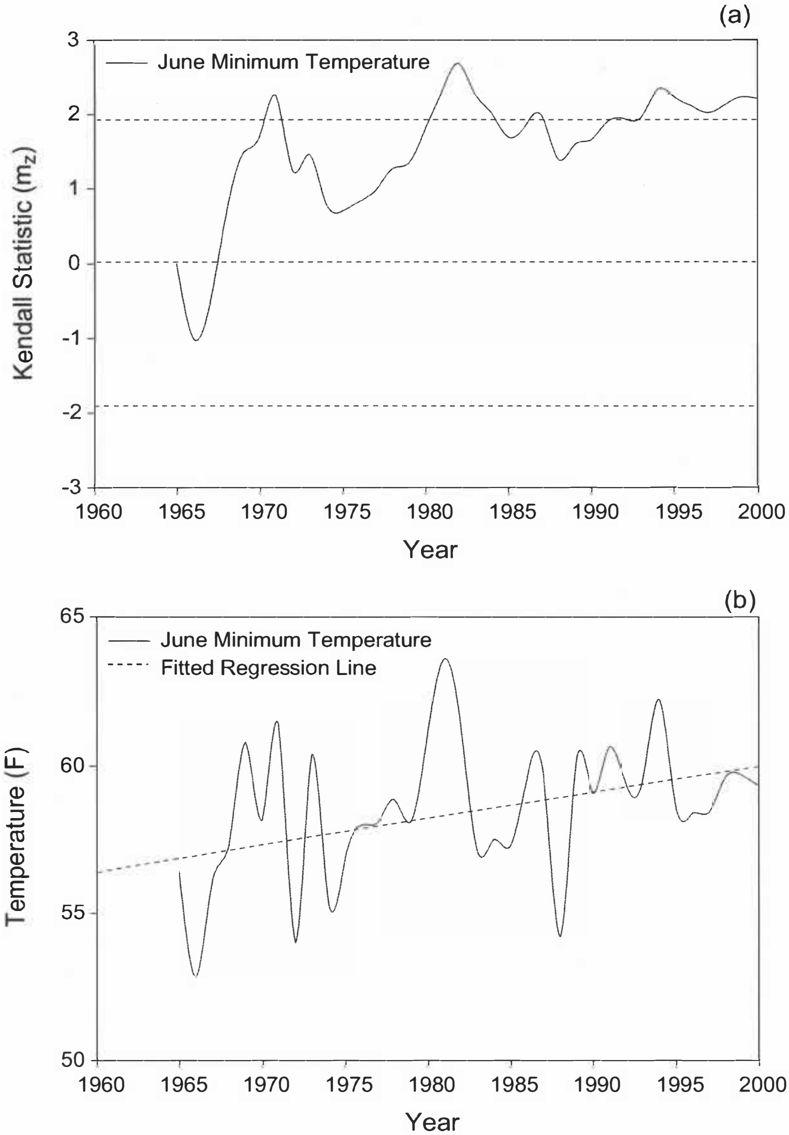

Figure 2. Data for Asheville Regional Airport. (a) Time series plot of the Kendall Coefficient (m_z); parallel dotted lines indicate 95% confidence interval. Trends are significant when values of m_z are greater than 1.96 or less than -1.96. (b) Time series plot of monthly mean temperatures.

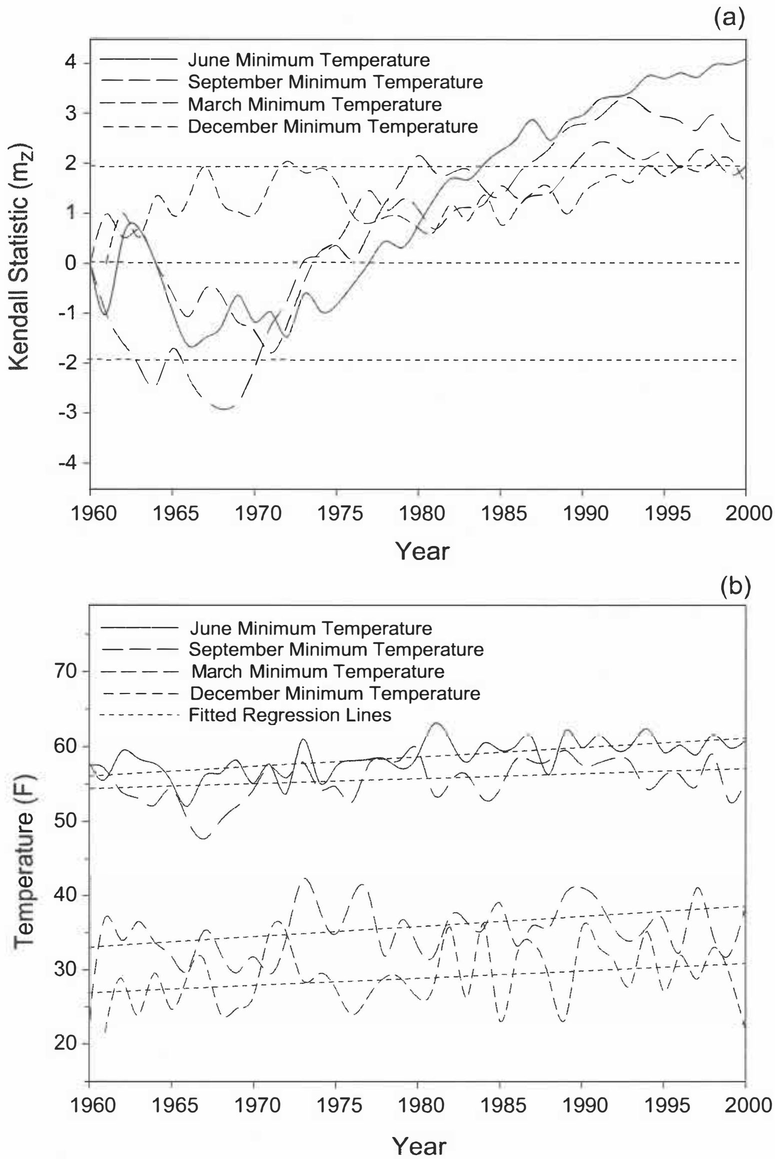

Figure 3. Data for Hendersonville 1NE. (a) Time series plots of the Kendall Coefficient. (b) Time series plots of monthly mean temperatures.

warmer than early in the series, but were not increasing at such a rate as to exhibit a strongly significant trend. These findings are supported by examination of the related raw temperature observations.

Discussion and Conclusions

The downtown weather station in the Asheville region (Asheville 1) exhibited no meaningful trend over the past forty years. The first urbanizing station (Hendersonville) exhibited significant warming among minimum temperature data sets for all four months of study. The only other instance of persistent warming at an urbanizing collection station occurred at Asheville Regional Airport, and only for mean minimum June temperatures.

The observed warming trend at the Hendersonville station may have been influenced by urbanization. It is possible that both the rate and magnitude of urbanization are greater over the last forty years in the Hendersonville area than in other parts of the Asheville region, including the central city of Asheville. The lack of a warming trend in downtown Asheville indicates the possibility that the city itself was highly urbanized at the beginning of the period of record, but did not experience a significant increase in urban characteristics during the forty-year period of study. A comparison of raw December mean minimum temperatures between the Asheville 1 and Hendersonville stations (Figures 3 and 4) indicates that December low temperatures were slightly higher in downtown Asheville than in Hendersonville during the study

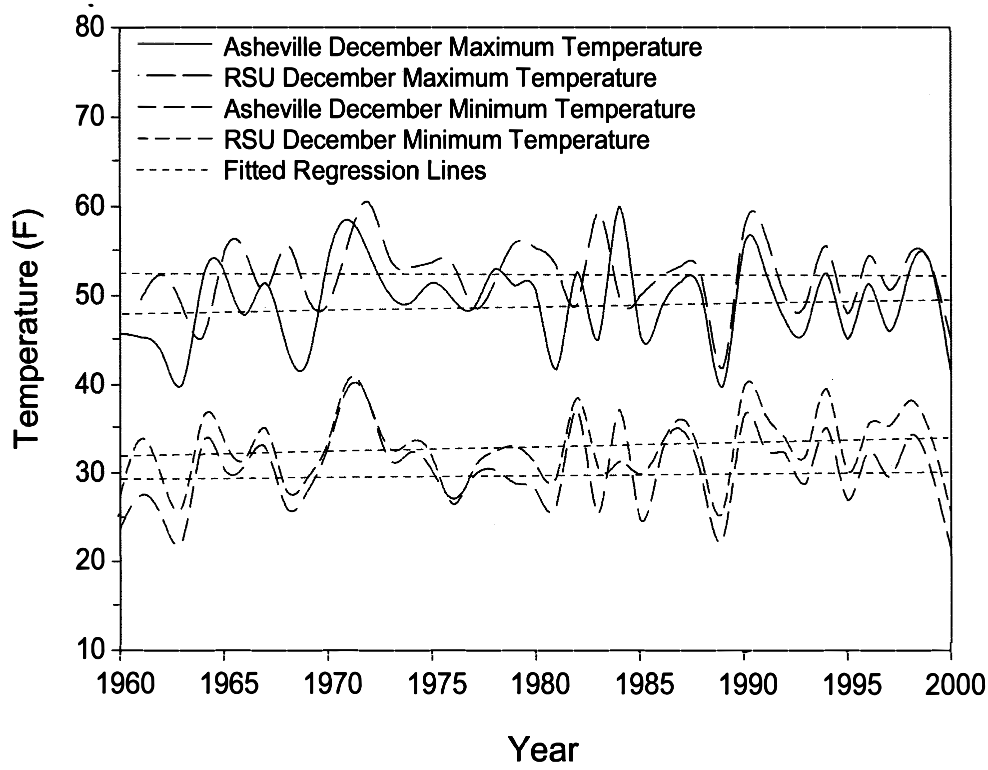

Figure 4. Sample time series plots of monthly mean temperatures for the two urbanized sites, Asheville 1 and Raleigh St. University (RSU), showing no warming trends.

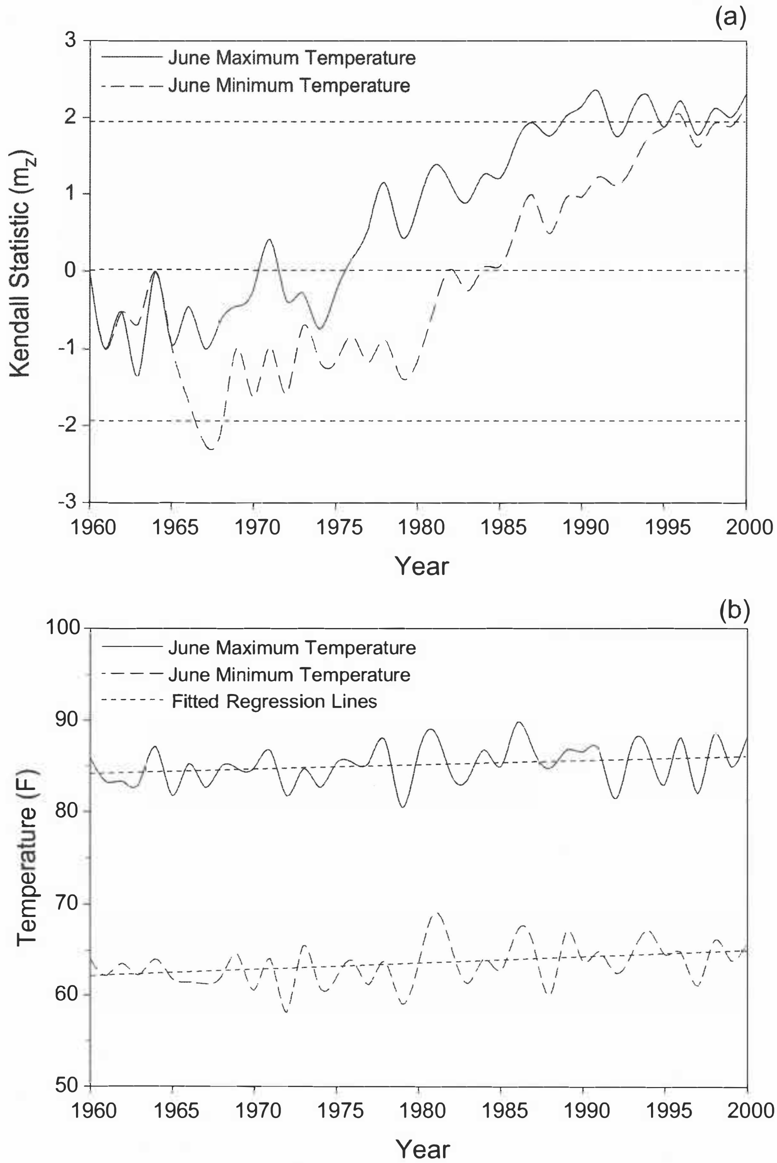

Figure 5. Data for Raleigh Durham International Airport. (a) Time series plots of the Kendall Coefficient. (b) Time series plots of monthly mean temperatures.

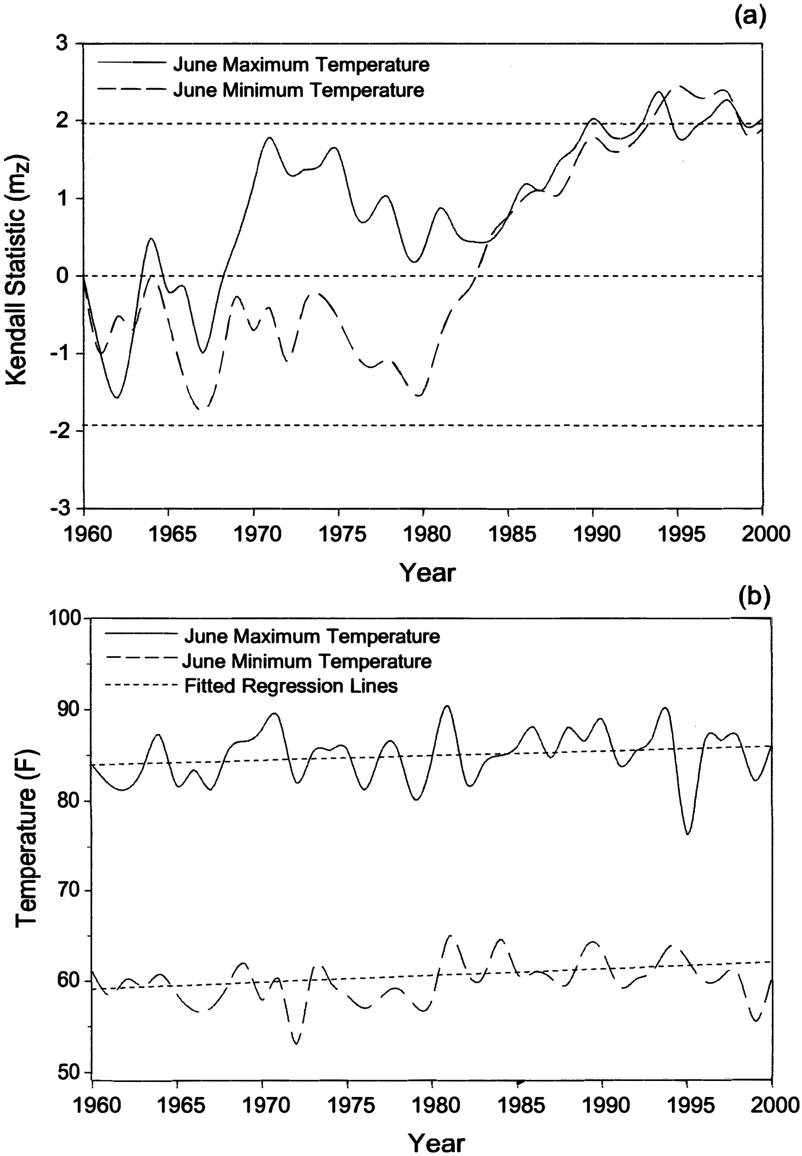

Figure 6. Data for Clayton WTP. (a) Time series plots of the Kendall Coefficient. (b) Time series plots of monthly mean temperatures.

period, but that temperatures in Hendersonville had narrowed that gap considerably by the last decade of study.

Meaningful trends in the Asheville region were found for minimum temperature data sets only. This indicates a trend toward increased overnight, as opposed to daytime, temperatures. These findings are in agreement with many studies of urban heat islands. Meaningful warming trends in the region reached significance around the mid-1980s, and generally remained significant through 2000. This indicates that temperature increases were more substantial during the past 10-15 years of the study period. Thus, future study might focus on the context of physical changes in the region during the stated period. It may be that the timing of the start of warming trends coincides with significant increases in urban development in the region, especially near the Hendersonville station. Because two weather staare still in less-urbanized settings, their surroundings likely underwent more development during the period of study than State University, the surroundings of which were constantly urban.

The absence of significant temperature change at the other two sites in the region (Raleigh 4SW and Raleigh St. University) again leads us to conclude that the observed warming trends are localized around RDI and Clayton, and are not the result of regional climate change.

Our study shows that increasing trends in temperature occurred in both study areas. Meaningful warming trends were observed outside of the heavily urbanized areas of the two regions. The most pronounced warming in the Asheville region occurred in suburban Hendersonville. Likewise in the Raleigh region—both instances of significant warming occurred at weather stations in less urbanized locations, while the more urbanized area exhibited no trends. Thus, urbanizing areas appear more likely to experience an increase in temperature through time than established urban areas. The implication is that the process of urbanization, rather than the existence of an urban landscape, may be responsible for urban temperature change. While urbanized areas may exhibit warmer temperatures on average, outlying urbanizing areas are more likely to experience warming trends. The most significant trends in the two study areas occurred in places that were somewhat isolated from urban activity in 1960, but were approached more closely by urban development during the period of study. The trend toward warming in urbanizing areas could be a result of the overall expansion of the urbanized areas in the two regions.

This study may lead to a variety of future works. The direct results would be helpful in a more detailed analysis of urban temperature variability in the Asheville and Raleigh areas. Specifically, the relationship between the concentration of warming in suburban areas and the coincident patterns and rates of urbanization in those areas begs analysis, possibly incorporating remotely sensed imagery or other methods of quantifying urbanization in different parts of the study areas. Further, the results may inform future hypotheses of the spatial organization of the urban heat island, particularly by suggesting the need for increased focus on what may now be the issue of suburban – rather than urban – warming.

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Hispanic Clusters and the Local Labor Market: Preliminary Analysis from North Carolina

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Over the past decade the Hispanic population has been the fastest growing race/ethnic group in the United States. North Carolina is one state that has experienced a Hispanic population boom. However, this growth is not evenly distributed throughout the state. Some counties have experienced large increases in the number of Hispanics, while Hispanics are almost nonexistent in other counties. This research questions the driving forces that determine the location and growth mechanisms of Hispanic population clusters in the state. North Carolina has a long history of providing agricultural and manufacturing jobs and has experienced a recent construction boom. Such low-skill, low-wage jobs typically attract unskilled workers. This paper hypothesizes a correlation between the percentage of manufacturing, construction, and agricultural jobs available in selected counties and the location of Hispanic migrant enclaves in the state. Our research shows that there is a strong relationship between Hispanic population and worker clusters and agricultural jobs, and to a lesser extent with manufacturing jobs. The correlation between construction jobs and Hispanic population is weaker than that expected.

"Mexicans and other Hispanics have come here to stay, contribute to the economy, and be part of the NC Landscape for many generations to come" – Enrique Gomez Palacio

Introduction

For two decades the Hispanic population has been the fastest growing race/ethnic group in both the United States and North Carolina (Fig 1). According to the 2000 U.S. Census, Hispanics surpassed the African American population (which makes up 12.3 percent of the U.S. population) and became the largest minority in the U.S., comprising 12.5 percent of the nation's total population. Unlike the African American population, the Hispanic population is growing both through high birth rates as well as by immigration to the U.S. In addition, there has been a significant movement of Hispanics within the U.S, away from areas such as the Southwest U.S. (where Hispanic occupancy began long before these areas were part of the U.S.) and from the larger cities of states such as Florida, California, and New York (where the recent immigrant population has had a tendency to settle). The combination of both trends has been the rapid growth of Hispanic populations throughout the country as smaller and more rural states have begun to receive an influx of Hispanic migrants (Torres et al. 2003). North Carolina in particular has experienced a large influx of Hispanics, with a 394 percent increase between 1990 and 2000 (U.S. Bureau of Census 2000). If this trend continues 15-20 percent of North Carolina's population will be Hispanic by 2010 (Johnson-Webb 2002; CNN 2004).

However, North Carolina's Hispanic population increase is not evenly distributed across the state, and varies widely from county to county. Some areas have received large numbers of Hispanics who have grouped into large clusters, while other counties have few Hispanics (Palacio 2003). Although the influx of Hispanics into North Carolina has received much attention in the media over the years, little scholarly research has focused on how this phenomenon affects local labor markets and the availability of jobs. This issue can be contentious, as Hispanics may be incorrectly identified as foreign immigrants, leading to speculation about whether immigrants displace native born Americans from jobs. Thus, it is essential to understand the relationships between this clustering process and local labor markets.

Until recently much of our understanding of ethnic labor market operation comes from studying the process in such major cities as New York, Los Angeles, and Miami. However, that knowledge is not adequate to explain the consequences for North Carolina's cities and rural areas, because they typically do not have well developed ethnic enclaves or gateways for immigrants. Therefore, it is essential to learn in which sectors Hispanic migrants gain entry into the workforce, how and where ethnic niches develop, and if the migrants displace natives in the state's workforce. This research explores the associated factors that contribute to the formation of Hispanic population clusters in North Carolina. It is expected that the growth processes of this population is similar to previous migrant waves, and that

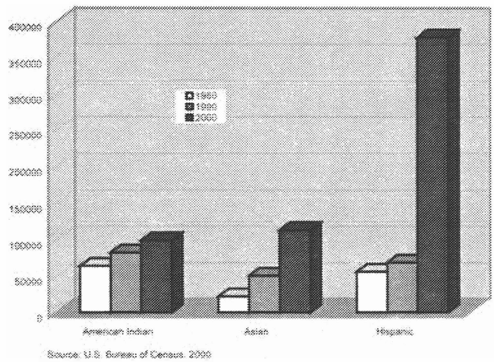

Figure 1: Population Growth from 1980-2000 by Selected Ethnic Groups in NC

Hispanics concentrate in areas that are associated with particular jobs markets. This can lead to prediction of future Hispanic growth patterns and concentrations within the state.

This paper is divided into four sections. The first section considers the existing literature on ethnic migration and settlement. The second section includes an analysis of the study area and the research methods and data sets. The results of the analysis are presented in the third section. The last section provides our conclusions, commentary and ideas for further study.

Ethnic Migration and Settlement

Our understanding of ethnic clusters and labor markets come from work that has focused on these phenomena in major urban areas, such as Atlanta, Detroit, Los Angeles, Miami, and New York. Many of those studies have attempted to link Hispanic clusters to several related factors including ethnic employment niches, labor market segregation and discrimination, and Hispanic enclaves. Implicit in this work is the fact that geographic or occupational clusters of a particular racial or ethnic group are not random, but can be linked to particular social and spatial processes. These processes can result in clusters or enclaves of a particular ethnic group, as well as associations with ethnic groups and particular industries or occupations called ethnic niches. These issues have been extensively studied. Although this work is typically based on large cities, it provides insights for the smaller cities and rural areas of North Carolina.

What is an Ethnic Enclave?

Immigrants often cluster together in a neighborhood, district or suburb, which come known as enclaves. Miami, Florida provides a prime example of urban ethnic enclaves. Known especially for its Cuban population, many other ethnic groups are clustered in Miami's neighborhoods. Wilson and Portes (1980) explain that enclaves occur when immigrants arrive with similar social and economic status, find similar jobs, and therefore stick together. Subsequent immigrants of similar backgrounds are drawn to the "opportunities offered by a preexisting immigrant colony abroad" (p. 302), and settle in the same neighborhoods. For that reason, enclaves offer a sense of stability and community to the newly arrived immigrants and provide a set of declining costs and risks for them in the destination communities (Massey, *et al.* 1994). The enclaves also may form from discrimination in the housing market (Ihlandfeldt and Sjoquist 1998). In this case, immigrants face restrictions in the housing market and they are segregated in an enclave, which may be distant from employment opportunities. Additionally, because recent immigrants will not likely have much money to allocate on housing, they will be forced to live in poor quality housing, also resulting in the concentration of co-ethnics.

Theoretical Perspective on Emergence of Ethnic Niches

Just as migrant groups may end up in a particular self-perpetuating geographic location, they may also end up concentrated in a particular occupation or industry, called an ethnic niche. Wang and Pandit (2003) have described ethnic niches as "occupations or industries that are dominated or over represented by a particular ethnic group" (p. 159). A niche may arise from the activities of entrepreneurs, acting as separate entities or jointly, or from the activities of workers, possibly in conjunction with entrepreneurs. In general, a niche is related to the concentration and specialization of an ethnic group's labor market activities. This is based on members' ability to meet labor demand through the formation of social network and community ties, and in some instances, based on their possession of special skills, experience, or other attributes that employers consider relevant to productivity (Wilson 2003). Los Angeles, Miami, and New York, are urban areas with both a large number of immigrants and a long history of supporting ethnic niches. Migrant enclaves in other areas have a more recent history. Atlanta has recently experienced a surge in immigration and is beginning to see ethnic niches emerge among immigrant groups (Wang and Pandit 2003). Similar developments can be expected in other growing metropolitan areas, such as those of North Carolina.

Much research suggests that labor market niches are associated with the flow of migrants from a single origin to a particular destination (Wilson 2003). Migrants do not select destinations randomly, rather they move to places where there is an existing social network (either through friends or relatives). In this view pioneer migrants establish a presence in a given labor market and others of similar backgrounds quickly follow the trend. The functioning of the ethnic social network in the creation of an ethnic employment niche can be seen through referral hiring. Elliot (2001) states that "members of a particular ethnic group concentrate in particular jobs, and when new employment opportunities become available at their workplace, they pass this information along to social contacts, often of the same race and ethnic background" (p. 401). In turn, the greater "the concentration of the group's employment in specific industries, the greater the likelihood that ethnic contacts will channel newcomers into these industries" (Ellis and Wright 1999, p. 28). A recent example of niche specialization is that of Hispanic workers in slaughterhouses in Great Plains' states, particularly in Colorado (Schlosser, 2001). The miserable working conditions and low pay attract few workers who have employment alternatives . Thus, slaughterhouse management recruits large numbers of workers from Mexico, Guatemala, and El Salvador. The majority of the workers are illiterate, are often undocumented, and have very high turnover rates. While an extreme example, even in these cases ethnic niches may provide both a secure environment for vulnerable newcomers as well as leading an ethnic group into a particular labor market.

Job Segregation involving Hispanics

Another aspect of employment niches is the issue of job segregation. This is common among Hispanic immigrants and has been occurring for some time, as evidenced by the widespread employment discrimination experienced by Hispanics during the 1920s in Detroit and its environs (Clete 1996). More recently, the United States passed stringent laws regarding the granting of work visas, based primarily on the stated occupation of the immigrant.

Wilson and Portes (1980) found that those who worked in the professions of "physicians and surgeons, nurses, speech therapists, pharmacists, and dieticians" (p. 299) were more likely to be admitted rapidly into the United States than those in the secondary labor force. Hispanic immigrants to the United States are traditionally in the latter class. Thus, employment discrimination exists before many immigrants even enter the country.

Once Hispanics have arrived in the country or a region, labor market discrimination against migrants may also lead to formation of ethnic niches. In this sense, niches may emerge not just through self selection or discrimination but rather because certain groups are more or less forced to accept whatever jobs are available. Because Hispanic migrants tend to have lower levels of education, they may find it difficult to compete for skilled jobs, and so can remain in manual or lower skilled occupations and take the jobs that others do not want (NCIOM, 2003, Wang and Pandit 2003). Catanzarite (2002) found that in Los Angeles "Hispanics are vastly overrepresented in a set of low-skilled occupations….and occupational segregation of recent immigrant Hispanics from natives is pronounced and rising" (p. 302), especially in manufacturing. Hispanics often comprise almost the entire work force for certain manufacturing companies, such as construction, services, and agriculture. Gonzales (2004) states that almost 80 percent of the agriculture workers, 67 percent of the dishwashers, 58 percent of the cooks, and 53 percent of the housekeepers in California are Hispanics. According to Jeter (2004), Hispanics account for 25 percent of construction workers nationally. F.L. Crane and Sons Construction Company in Mississippi is a prime example of this phenomenon, as 75 percent of its workers are Hispanics (Jeter, 2004).

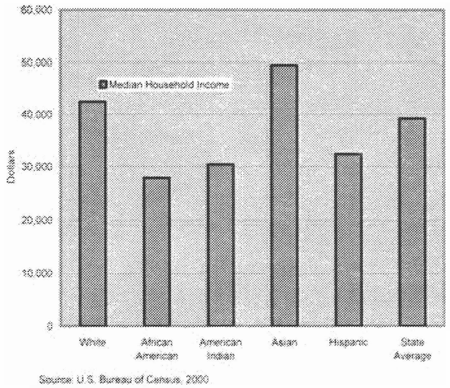

Figure 2: Median Household Income by Ethnic Groups in NC, 2000

Similarly, in Atlanta, Wang and Pandit (2003) noted that in 1990 there were no Hispanics employed in the following sectors: mathematical-computer, social scientists/urban planner, social /recreation/religious worker, lawyer/judge, artist/athlete, and health services. They noted that Hispanics were significantly represented in food services (5.1 percent), farm/forestry/fishing (2.3 percent), construction (6.1 percent), and operators/fabricators/laborer sectors (2.3 percent). In Atlanta Hispanics are segregated from the mainstream white collar work force, and generally relegated to lower skilled and lower paying blue collar jobs. It can be expected that similar processes have been at work in North Carolina.

Study Area and Data Analysis

The study area for this paper is the state of North Carolina (NC), whose Hispanic population has quadrupled since 1990. Such a rapid rate of growth is primarily the result of in-migration of Hispanics from other parts of the country (particularly California, New York, Texas, and Florida) or foreign countries, though during the early 1990s only about 18 percent were likely to be foreign citizens (Johnson et al.*Sultana & Miller* 1999). Despite this rapid growth, Hispanics currently comprise only 4.7 percent of the state's population, compared to the national average of 12.5 percent. This population is unevenly distributed, as only one quarter of North Carolina's 100 counties have a population that is at least 5 percent Hispanic (Table 1).

According to the Census Bureau (2000), the median household income for Hispanics in NC is $32,353, which is below the state's median household income ($39,184) (Table 2 and Figure 2), and marginally higher than the African American and American Indian median incomes. Even though Hispanics have the lowest unemployment rate in

NC (NCPB, 2001), 25 percent of Hispanics live at or below the poverty line, a greater percentage than any of NC's other ethnic groups (Table 2 and Figure 3). Like other states in the U.S., fewer Hispanics in NC have undergraduate or graduate degrees (7.22 percent), which is 13 percentage points below the state average and 36 percentage points below the Asian average. Similarly, about 55 percent of NC's Hispanics have not graduated from high school, which is almost three times higher than the state average (Table 2 and Figure 3).

North Carolina has a strong agricultural and manufacturing history. Each year, agriculture contributes $46 billion to North Carolina's economy, and manufacturing jobs, (especially apparel, textiles and wood), employed 45,000 people in 2001 (NCPB, 2001). The state has also recently experienced a boom in construction work as a result of the rapid economic and population growth throughout the state. However, North Carolina is trying to break away from its traditional economy based on primary and secondary sectors. Many jobs are being created each year in high-technology industries such as computers and biotechnology. In fact, 31,100 high technology jobs have been created since 1994 (NCPB, 2001). The creation of highly skilled jobs does not eliminate low-skilled agricultural, construction, manufacturing, cleaning, and food service positions. It is to these jobs that low skilled workers are attracted.

Because the Hispanic population is overrepresented in primary sector activities at the national level, this makes North Carolina a good place to analyze Hispanic population clusters and their employment behavior. This paper hypothesizes that there is a strong correlation between the percentage of manufacturing, construction, and agricultural jobs available and the existence of Hispanic concentrations in twenty five of North Carolina's counties. It is expected that this population will concentrate in areas that are associated with these particular job markets. As this research focuses on concentrations of Hispanics, the 25 counties that are at least 5 percent Hispanic are used in this analysis (Figure 4 and Table 1).

The demographic and industrial classification data for this research came from the Census 2000 Summery File 3 (SF3), which was downloaded from the Census Bureau web page. Occupations are classified into three groups using standard census-defined categories. The primary sector includes farming jobs such as agriculture, forestry, fishing, hunting, as well as extractive industries such as mining. Construction jobs are defined as construction and maintenance occupations. Manufacturing jobs are defined as activities such as production, transportation, grading and hauling. All types of professional jobs are defined here as other job types.

Results

Hispanic Enclaves and Labor Markets

Figure 4 shows the Hispanic population distribution by county in North Carolina. Although Hispanics comprise about 5 percent of North Carolina's total population (Bureau of Census 2000), they are not evenly distributed across the state. It was expected that the highest Hispanic percent would be found in metropolitan counties, such as those including Charlotte or Raleigh-Durham. However this was not the case. Rather, the highest percentages of Hispanics were found in Duplin, Lee, Samson, Montgomery, Chatham, and Greene counties (Figure 4 and Table 3), which are rural in character and also have the largest proportion of farming sector jobs. This is therefore an early indication of an association between Hispanic concentrations and jobs within a particular economic sector, and therefore of niche employment. It is also important to note that Hispanic concentrations are found as well in those counties (e.g., Montgomery, Randolph, Lee, Surry, and Yadkin) that have the highest proportion of manufacturing jobs (Table 3). Additionally, counties with higher mean percentages of construction jobs appear to attract Hispanics at above the state average. While in the mid 1990s the Hispanic population was said to reflect the location of military communities and the I-85 corridor (Johnson et al. 1999), by 2000 this was no longer the case, and Hispanics are more widely distributed in the state.

Figure 5 and Table 4 show mean value of selected variables for the top 25 counties by Hispanic population in North Carolina. While an average of six percent of workers in these 25 counties are Hispanics (U.S. Census Bureau 2000), it is notable that of all Hispanic workers, 58 percent of them entered the farming, construction and manufacturing labor market sectors. Obviously, many Hispanics are not working in these traditional niche jobs, but these numbers clearly indicate that a very large number are. Those counties have an average of one percent of employment in the farming sector, 10 percent in construction, and 16 percent manufacturing jobs. While the farming sector comprises one percent of total jobs in 25 counties of North Carolina, 0.2 percent of these jobs are done by Hispanic workers. However, of all Hispanic workers, almost four percent of them are involved in farming occupations. In some counties, such as Sampson and Greene, about 30 percent of Hispanics work in agriculture (Table 3).

Similarly, in NC 10 percent or the workforce is in construction and 16 percent in manufacturing jobs, but Hispanic representation in these sectors is important as they constitute almost two percent of the labor force for both of these sectors. Among Hispanic workers, 26 percent work in construction and 29 percent are in manufacturing jobs (Table 4 and Fig. 5). In many counties these values are much higher. For example, in Johnston County over 45 percent of Hispanics work in construction (though only 15 percent of all workers do), while in Montgomery, Randolph, and Lincoln counties at least 60 percent of Hispanics are employed in manufacturing jobs (although no more than 32 percent of all workers are) (Table 3). These numbers clearly support the idea of ethnic niches, as well as concentrations or enclaves.

Jobs Associated With Hispanic Enclaves

A measure of association was conducted to explain what types of jobs are associated with Hispanic concentrations (Table 5). The Spearman rank correlation coefficient is used here as the variables are not normally distributed. The association between percent of farming sector jobs and the percent of Hispanic population is .715, showing a strong and positive correlation with a significance level of $p = .01$. This result is consistent with our expectations and with other research (Torres et al.*Sultana & Miller* 2003). Therefore, the growth of the Hispanic population in North Carolina is certainly associated with its large agricultural sector, and the uneven distribution of these jobs. Therefore, although Hispanic migrants in North Carolina are more likely to be employed than members of other ethnic groups, they appear to often occupy less desirable, low-skilled farming jobs.

It is also notable that there is a positive association between the concentration of manufacturing jobs and Hispanic enclaves, even though the relationships are not that strong. This may result from the recent trend of industrial jobs disappearing from the state (Johnson-Webb 2002). It is surprising however, given the large Hispanic presence in construction jobs in many counties throughout the state, that our results do not find any significant positive relationship between construction jobs and Hispanic population clusters. It may be that while the construction industry has a large Hispanic component, the constantly changing geographic locations of construction jobs overrides any strong correlation with residential population and employment. There is a strong negative association (-.605) between the location of other job types, which are mostly high status to moderately high status jobs, and Hispanic population concentrations. This result is consistent with our expectations that Hispanics are overrepresented in low status jobs. The long-time residents and native-born working and middle classes are finding greater opportunities for employment advancement. As their careers evolve, they leave behind the less glamorous and low-paying jobs for more prestigious and profitable jobs, making way for a new working class, the Hispanic migrants (Wilson 2003).

Population concentration is not the only factor to be considered when relating Hispanic enclaves to employment. Because economic activities such as farming and manufacturing vary considerably by county, the concentration of Hispanics in the workforce in counties may be a strong indicator of ethnic niche formation. Therefore, this research also tested whether Hispanic workers were strongly associated with primary and secondary occupations in those counties where they comprise larger percentages of the total workforce (Table

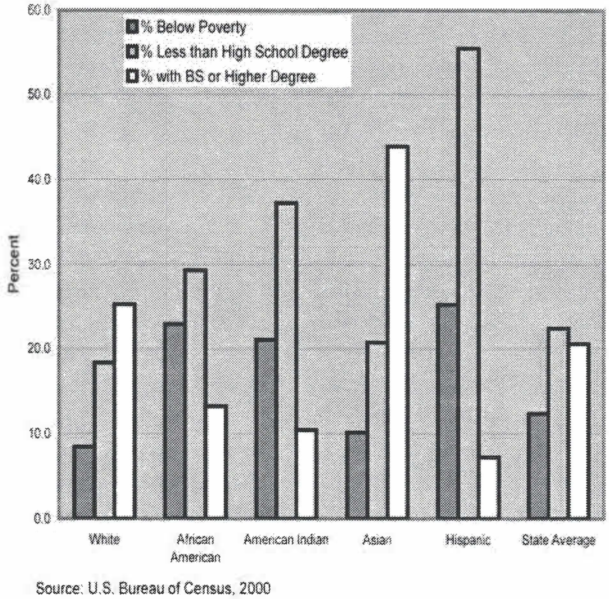

Figure 3: Poverty and Educational Attainment Status by Ethnic Groups in NC, 2000

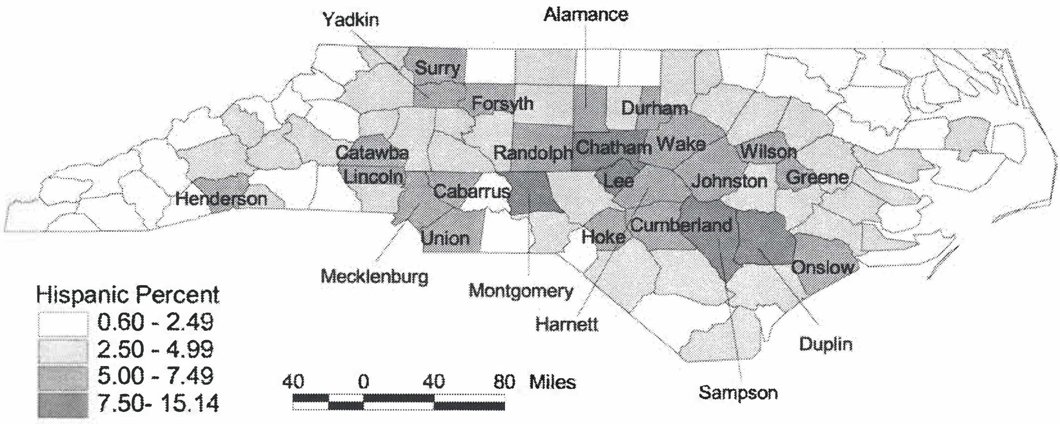

Figure 4: Percentage of Hispanics by County in North Carolina, 2000

Table 1: Counties of North Carolina with Five or More Percent Hispanics, 2000

Counties	Total Population	Total Hispanic	PCT Hispanic
Duplin	49,063	7,318	14.9
Lee	49,040	5,665	11.6
Sampson	60,161	6,390	10.6
Montgomery	26,822	2,729	10.2
Chatham	49,329	4,813	9.8
Greene	18,974	1,524	8.0
Durham	223,314	16,994	7.6
Johnston	121,965	9,014	7.4
Onslow	150,355	10,766	7.2
Hoke	33,646	2,357	7.0
Cumberland	302,963	20,637	6.8
Alamance	130,800	8,759	6.7
Yadkin	36,348	2,432	6.7
Randolph	130,454	8,593	6.6
Mecklenburg	695,454	44,954	6.5
Forsyth	306,067	19,687	6.4
Union	123,677	7,726	6.2
Surry	71,219	4,378	6.1
Harnett	91,025	5,179	5.7
Wilson	73,814	4,122	5.6
Lincoln	63,780	3,517	5.5
Catawba	141,685	7,812	5.5
Henderson	89,173	4,882	5.5
Wake	627,846	34,135	5.4
Cabarrus	131,063	6,623	5.1

Source: U.S. Census Bureau, 2000

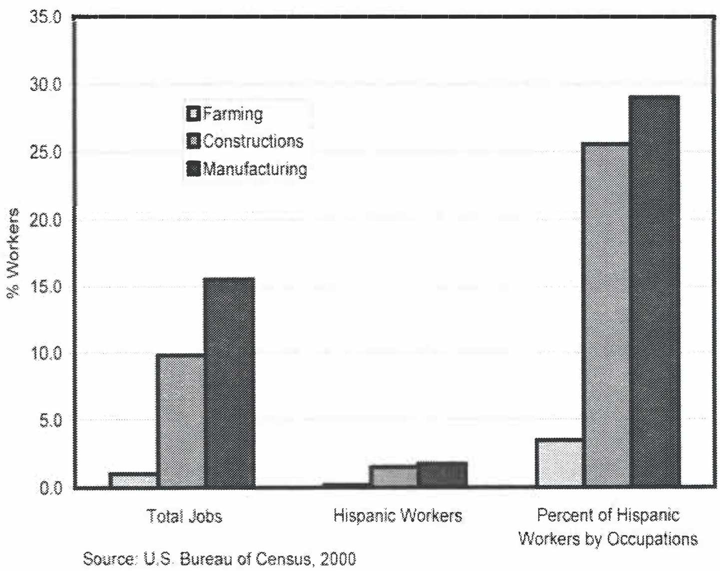

Figure 5: Percentage of Hispanic Workers in three Job Sectors in NC, 2000

Table 2: Socioeconomic Status of Hispanic Population compared to Other Ethnic Groups in NC, 2000

Race	Median Household Income ($)	% Live Below Poverty Level	% Less than High School Degree	% With BS or More Degree
White	42,530	8.4	18.3	25.21
African American	27,845	22.9	29.3	13.15
American Indian	30,390	21.0	37.3	10.40
Asian	49,497	10.1	20.7	43.88
Hispanic	32,353	25.2	55.5	7.22
State Average	39,184	12.3	22.4	20.53

Source: U.S. Census Bureau, 2000

Table 3: Percent of Hispanic Workers by County in Selected Occupation Sectors in NC, 2000

Counties	% Hispanic	% Hispanic Workers	% Farming Jobs	% Construction Jobs	% Manufact-uring Jobs	% Hispanic Workers in Farming of all Hispanic Workers	% Hispanic Construction Workers of all Hispanic Workers	% Hispanic Manufact-uring Workers of all Hispanic Workers
Duplin	14.9	14.9	45.5	13.4	24.7	18.5	18.8	45.1
Lee	11.6	11.1	0.6	13.6	25.3	1.4	17.7	59.1
Sampson	10.6	9.1	5.9	11.4	25.3	29.0	13.8	37.5
Montgomery	10.2	9.4	1.6	12.4	32.7	4.2	10.5	64.8
Chatham	9.8	9.6	1.1	11.4	20.4	1.3	16.5	59.5
Greene	8.0	8.5	4.9	12.3	25.0	30.2	8.3	38.5
Durham	7.6	7.3	0.2	8.3	9.0	1.0	42.3	14.7
Johnston	7.4	5.2	0.7	15.5	16.4	6.5	45.4	21.6
Onslow	7.2	4.9	1.2	14.1	11.4	3.3	19.7	9.0
Hoke	7.0	7.7	1.6	12.8	25.1	3.7	20.5	42.4
Cumberland	6.8	5.0	0.4	10.5	16.6	0.9	12.1	17.6

5). As expected, farming and manufacturing jobs are positively correlated with high percentages of Hispanic workers, while high status jobs are negatively correlated with large concentrations of this group in the workforce (Table 5).

As noted above, there is a weak positive relationship between Hispanic population and construction work, but this changes to a weak negative relationship when the percentage of workers who are Hispanic is measured. It is also noteworthy that the relationship between Hispanics and both farming and other jobs weakens when employment percentages are used. This suggests that Hispanics have created an ethnic niche in manufacturing, but their residences are dispersed among several counties. In contrast, farm workers reside in agricultural areas in greater numbers than their workforce participation suggests. This indicates that agricultural counties serve as source areas for workers in other sectors, especially manufacturing. Niche theory suggests that new migrants are likely to settle where there is an already defined Hispanic population, so this pattern may continue even if Hispanic workers shift away from agricultural employment.

Discussion and Conclusion

This research examined Hispanic population growth in North Carolina. Our research shows a strong relationship between Hispanic population and employment clusters and agricultural and, to lesser extent, with manufacturing jobs. This is not surprising as North Carolina counties have strong agricultural and manufacturing traditions (Leiter and Tomaskovic-Devey 2002). An abundance of farm and factory work is available in North Carolina in comparison to other states, making it an attractive destination for unskilled and semi-skilled labor. These jobs are generally rejected by affluent, well-educated workers (Leiter and Tomaskovic-Devey 2002), and are increasingly filled by Hispanic workers. These results are consistent with the expectations of the ethnic enclave/niche literature, although they apply here to rural populations rather than the large urban enclaves typically studied.

North Carolina is also experiencing rapid development in many counties with a concomitant construction boom that has created many new jobs that are appealing to newcomers with limited skills. However, our results did not find a strong correla-

Table 4: Percent of Hispanic Workers in NC in Selected Occupation Sectors, 2000

Types of Jobs	% Total Jobs	% Hispanic Workers	% Hispanic Workers by Occupation
Farming	1.0	.2	3.5
Constructions	9.8	1.5	25.5
Manufacturing	15.5	1.8	29.0
Others	73.6	2.5	42.0
Total	100	6.0	100

Source: U.S. Census Bureau, 2000

tion between construction jobs and Hispanic population, and there is actually an inverse relationship with worker concentrations. These do not appear to be niches for this population, though they may be elsewhere in the country. The fact that over a third of the Hispanic population works outside these occupations does not invalidate the niche idea, as they may still end up in low wage and low skilled urban service occupations that could serve as ethnic niches. The concentrations near Fort Bragg, along with an over-representation of Puerto Ricans in the area (Johnson et al. 1999), suggests the possibility that the military also serves as an ethnic niche, or helps to create ethnic enclaves. Because Hispanic migrants tend to settle in established enclaves, each county's history of increase in Hispanics should be investigated to more fully understand how these concentrations were formed and sustained.

Hispanics will become an increasingly important part of the state labor market, but due to their background they will not likely expand evenly throughout the labor force, or geographically within the state. Because they are tied to particular sectors, they run the risk of being vulnerable to the decline of particular economic activities in the state or to the savage cost cutting strategies of firms, which have been well documented for low wage/ low skill industries (Schlosser, 2001). There is therefore a vital need for understanding the potential impact on families within these niches. As the Hispanic population of North Carolina is more likely to live in poverty than other groups, each county's standard cost of living index and mean personal income data should also be considered when examining concentrations.

Also, because Hispanics are not necessarily concentrated in easily identifiable neighborhoods in large cities they, and the social networks that sustain them, may be easy to overlook. This is especially true for manufacturing workers, who appear to be residentially dispersed to a greater extent than others. These are particular concerns as strong negative attitudes towards Hispanics have already been documented in North Carolina (Johnson et al. 1999). These are unfortunately most common in the Piedmont area where many of the largest population concentrations are located. Allowing the exclusion of the most rapidly growing component of the population from wider participation in the state's

Table 5: Spearman's Correlation Coefficient of Hispanic Clusters and Job Types in NC, 2000

	% Hispanics	% Hispanic Workers
% Farming Jobs	.723**	.429**
% Construction Jobs	.125	-.117
% Manufacturing Jobs	.235*	.443**
% Other Jobs	-.605**	-.459**

** Correlation is statistically significant at the .05 level
* Correlation is statistically significant at the .10 level

economy would clearly be disastrous. Steps should be taken by state and local governments to encourage greater opportunities for Hispanic beyond current established ethnic niches.

The growth of the Hispanic population of North Carolina appears to fit many of the expectations of the geographic literature, including an association between the kinds of jobs available and the presence of Hispanics. Because the literature on niches and enclaves allows for a range of processes to create similar outcomes, it is not possible to definitively state that enclaves are responsible for these associations. However, this correspondence suggests that geographic analysis is very useful for understanding the future growth and economic potential of this population, and provides a promising method for conceptualizing and assessing changing population and employment trends in the state.

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A Brief History of Debris Flow Occurrence in the French Broad River Watershed,Western North Carolina

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The Appalachian mountains of North Carolina have a long history of producing destructive debris flows. Steep slopes, a thin soil mantle, and extreme precipitation events all exacerbate the probability of slope instability in the region. For this study, modern accounts of debris flows have been reviewed to construct a history and estimate the frequency of debris flows in the French Broad watershed. Major debris flow forming events occurred in 1876, 1901, 1916, 1940, 1977, and 2004. In western North Carolina, debris flows are activated primarily by either a series of two storms or hurricanes tracking through the area within a 6-20 day period or a prolonged moderate rainfall event lasting several days. In general, precipitation greater than 125 mm (~5 inches) in a 24-hour period can generate debris flows. Although the recurrence interval of individual debris flows may be on the order of thousands of years, when assessed at the level of the French Broad watershed, the average frequency of mass wasting from 1876-2004 is 16 years. Individuals living in the mountainous regions of western North Carolina must be vigilant in monitoring weather conditions and steep hillslopes, especially during intense rainfall events.

Introduction

The Appalachian Mountains have a long history of producing destructive debris flows. Throughout the Pleistocene, temperature and moisture fluctuations associated with the transition from glacial to interglacial ages, destabilized exposed soil and rock. These prehistoric debris flows helped to form prominent modern landforms and a rolling topography (Jacobson et al. 1989b). Written records of flooding in western North Carolina exist back into the 1700s but no descriptive information about debris flows exists before the mid-1800s. Since the early 1900s, several well documented intense storms and hurricanes have tracked through western North Carolina, initiating over 1000 debris flows and causing severe flooding (North Carolina Geological Survey 2006). In the Appalachian Mountains, it has been estimated that several thousand debris flows may have occurred in the 20th Century, killing at least 200 people and destroying thousands of acres of farm and forested land (Scott 1972, Bogucki 1976, Clark 1987, Gryta and Bartholomew 1987, Jacobson et al. 1989a, Wieczorek et al. 2004).

For this investigation, information from historical documents, scientific literature, and first-hand accounts from newspapers have been collected to synthesize a history and estimate the frequency of known debris flow occurrences in the French Broad Watershed. Continued study of the history of debris flows will help identify triggering mechanisms that are particular to western North Carolina and areas that are susceptible to slope movements.

Debris Flows

Of the several types of slope movements that occur in the Appalachians, rapid mass movement, particularly debris flows, are considered the most dangerous and will be the focus of this paper. In the Appalachian Mountains, steep slopes, a thin soil mantle, and extreme precipitation events all increase the risk of slope instability, slope movement and failure (Gryta and Bartholomew 1983, Neary and Swift 1987, Wieczorek 1996).

The term "debris flow" is used herein to describe swift-moving mass-wasting events that occur predominantly in shallow, silty-to-gravelly soil on steep slopes (greater than 30 degrees) during periods of exceptionally heavy precipitation (Cruden and Varnes 1996). Debris flows often begin in concavities or mountain hollows that concentrate subsurface flow and move downslope following preexisting drainage channels (Figure 1). Debris flows can travel for several kilometers before releasing their suspended load and coming to rest upon reaching an area of low gradient (Ritter et al. 2002).

In western North Carolina, debris flows are activated primarily by either localized severe storms that produce intense rainfall for several hours or by more regional moderate storms that may last for several days (Wieczorek 1996). Most debris-flow-producing storms can be linked to the incursion of warm, tropical air masses over the mountains between May and November (Kochel 1990).

The heavily forested slopes of the Appalachians are generally stable under normal rainfall conditions (Kochel 1990). Therefore certain thresholds of rainfall intensity and duration must be reached before slope movements will occur (Figure 2). Precipitation rates that readily induce debris flows in western North Carolina range from 125 mm/day (Neary and Swift 1987) to the upper end of observed precipitation (560 mm/day). Under these conditions, rapid infiltration and a corresponding increase in soil saturation brings the soil mantle to field capacity. This tends to occur in shallow (<1 m thick) mountain soils on slopes averaging 25-40 degrees, overlying an impermeable horizon of bedrock or saprolite (Eschner and Patric 1982). A temporary rise in piezometric pressure within slope sediment causes an increase in shear stress while decreasing shear strength. This, combined with a decrease in soil and root cohesion, reduces the shear strength enough to lessen the stability of the soil and eventually induce failure (Neary and Swift 1987). In North Carolina, the most common movement interface is between the bedrock-soil contact (Clark 1987) but slippage often occurs parallel to the dipslope or along preexisting areas of weakness such as a fracture zone.

Road construction is also a major contributor to slope failure and their mitigation can often incur enormous public cost. Excavation of the toe of a hillslope by emplacing a road, quarry, canal, or other type of cut, removes support and may induce an-

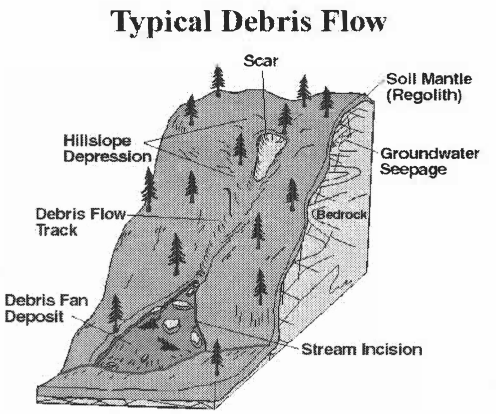

Figure 1: The morphology of a typical debris flow found in the Southern Appalachians (after Gryta and Bartholomew, 1983).

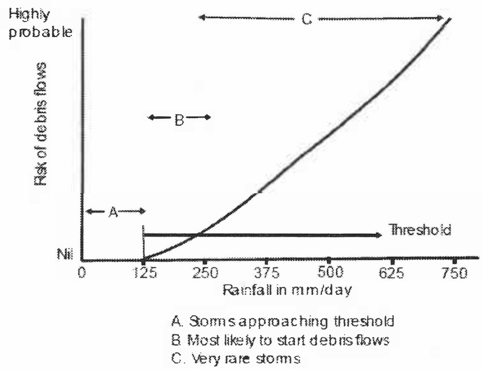

Figure 2: Threshold precipitation values necessary for producing debris flows in the southern Appalachian Mountains. Storms likely to start debris flows occur above the 125 mm/d threshold. Storms with precipitation values higher than 250mm/d are deemed "rare" but do occur in North Carolina (after Eschner and Patric, 1982).

thropogenic slope moment (Cruden and Varnes 1996). Road fill and traffic also increases weight on a hillslope, increasing shear stress on materials. In developed areas, slope saturation may occur, even during moderate recharge events, because of concentrated run-off from rerouting of drainage systems during road construction and from man-made structures such as drainpipes, buildings, and paved impervious surfaces.

The major hazard to human life and property from debris flows is from burial or impact by boulders and other debris. Debris flows can accelerate to speeds between 15-55 kph and often strike without warning (Highland et al. 2004). Because of their relatively high density and viscosity, debris flows can move and even carry away vehicles, bridges and other large objects (Cruden and Varnes 1996). They have been known to remove a home from its foundation and obliterate it completely.

Study Area

This study focuses primarily on the area of the French Broad River watershed within western North Carolina: an area comprising over 7,000 km^2 (Figure 3). The French Broad River itself flows through the City of Asheville, a major commercial and manufacturing center, and a popular mountain resort and tourist destination. According to data collected by the U.S. Census Bureau (2000), approximately 426,000 people live within the French Broad watershed and this population is predicted to increase, particularly in and around the City of Asheville. Two major interstates, Interstate 40 and Interstate 26, cross the basin, as does the Blue Ridge Parkway. Debris flows hazards are a major concern in mountainous areas; debris fans are favored areas of development due to their flat building surface and location above the floodplain (Ritter et al. 2002, Bechtel 2005). With continued development and tourism in the forested areas of the Blue Ridge, the risk to people and property will increase because of debris flows, especially during periods of high precipitation.

Geology and Soils

Given the large size of the French Broad River basin, 40 geologic units and 17 general soil types have been mapped within the watershed by North Carolina agencies. The watershed lies within both the Blue Ridge Belt and, to the east, a small portion of the Inner Piedmont Belt. Bedrock consists of sedimentary, metasedimentary, and intrusive igneous rock of Proterozoic and Paleozoic age (North Carolina Geological Survey 1985). Strike is generally towards the northeast with a dip to the southeast.

Geologic structure and bedrock orientation play a more important role in slope stability than rock type in the Southern Appalachians (Scott 1972). When soils are formed on weathered bedrock surfaces that are nearly coincident with the dip surface, sliding is more likely to occur between the soil-rock interface. Control on groundwater flow by joints and other fractures also can create areas of slope instability. This is particularly true when fracture surfaces are parallel to the dip surface. It was observed in the study area that even during a light precipitation event, groundwater flow through fracture zones was swift. This concentration of groundwater could quickly cause an increase in pore-water pressure in soils on a slope or create ephemeral channels for debris flows to follow. A similar correlation between joint orientation, direction of groundwater flow, and debris-flow initiation was noted in the Coweeta Basin, an experimental forest and research station just south of the watershed (Grant 1988).

The types of soil in the French Broad watershed reflect the regional geology because variation in bedrock mineralogy partly controls soil mineralogy. Steep relief, broad ridges, and humid temperatures allow for a wide range of soil-forming conditions. Soil cover varies in thickness and development depending upon slope and weathering and can range from less than one meter to several meters in depth (Clark 1987). On steep side-slopes, Inceptisols are common whereas Ultisols are found on gently sloping areas (Graham and Buol 1990). Soil textures range from fine clay and silt to sandy- and gravelly-loam (U.S. Department of Agriculture

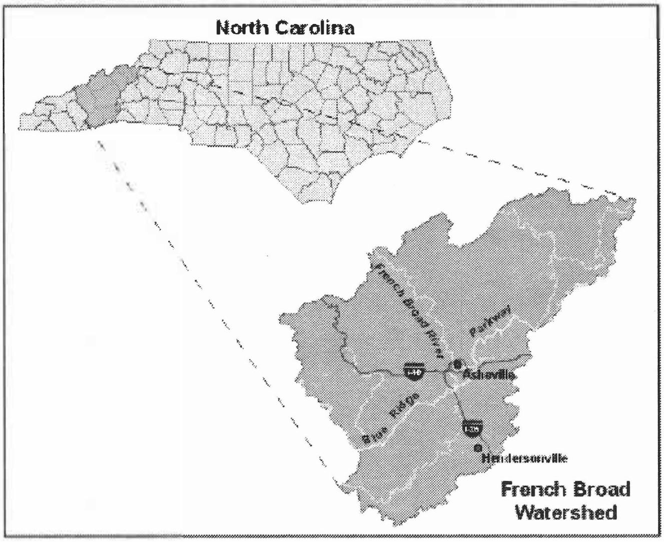

Figure 3: Location map of the French Broad watershed in North Carolina. The watershed includes portions of 8 counties and has an area greater than 7000 km².

1998). Generally, soils with a high susceptibility of failure tend to have a large mica content and develop over micaceous schist, slate, and phyllite (Scott 1972).

Climate

Due to the variation of altitude (460-2073 m) within the French Broad watershed, temperature and moisture regimes vary greatly from one place to another. In fact, the mountains have some of the wettest and driest weather in North Carolina (Daniels et al. 1999). The greatest 24-hour rainfall total in the State (565 mm) was measured in the watershed at Altapass in Mitchell County on July 15-16, 1916 when a hurricane passed through the area. In contrast, the station with the driest weather on average is located in downtown Asheville in Buncombe County (State Climate Office of North Carolina 2003).

Mean annual rainfall in the southern Appalachians ranges from 1000 to 2700 mm with snowfall only contributing 5 percent of the total precipitation (Neary and Swift 1987). Rainfall occurs frequently as small, low-intensity rains in all seasons but precipitation is usually greater during the winter and spring, with March being the wettest average month. The highest maximum precipitation amounts have been recorded in the summer months when localized, high-intensity thunderstorms and hurricanes are more common. As a result, a majority of debris-forming rainfall events in the Blue Ridge occur in June, July, and August (Clark 1987). No debris flows have been reported in the months of December, January or February.

Orographic influences generate extremely heavy rainfall in localized mountainous areas, even in storms with weak pressure gradients and gentle air circulation (Scott 1972). Generally, rainfall increases with elevation at a rate of 5 percent per 100 m but altitude is not as important as orographic boundaries (Swift et al. 1988). The Blue Ridge produces an elongate area of high values of mean precipitation (Jacobson et al. 1989b).

Vegetation

Like rainfall, vegetation within the watershed varies with the topography. Slope aspect and shading by adjacent higher mountains also influences the distribution of major tree species (Daniels et al. 1999). At lower elevations (below 1400 m) hardwoods, oak, hemlock and pine forests dominate. Hardwoods such as yellow poplar, ash, and black cherry are found in coves and along steep slopes whereas several varieties of pine and oak thrive in open areas (Scott 1972). Except for the most rugged terrain, the region's forestland has been cut or burned at least once since European settlement (Clark 1987).

In the very high mountainous areas of the watershed (above 1400 m) distinctive ecological systems have been established as a result of the cool year-round temperatures. Areas are often windswept and trees are damaged by ice and winter wind. Red spruce, mountain ash and Fraser fir are common with the latter dominating above 1890 m (Daniels et al. 1999). Grass balds and areas dominated by low shrub like rhododendron and laurel are common on southern-facing exposures (Daniels et al. 1999). These plants create extensive root systems or mats that increase soil and root cohesion, imparting stabilizing influences to the underlying soil.

Quaternary Debris Flows

Quaternary geomorphic features in the Appalachian Mountains are primary the result of Cenozoic uplift and subsequent post-orogenic denudation controlled by climatic variations (Soller and Mills 1991). Much of the terrain is mantled with a thin layer of discontinuous surficial deposits and individual ancient mass movements have recently been identified, dated and studied in the Blue Ridge Province. Studies of these deposits have quantified the rate of soil development and erosion, catastrophic debris-flow frequency and triggering events, and the possible role of periglacial processes in the Appalachians during the late Pleistocene and early Holocene (Table 1).

Pre-historic debris-flow deposits form undulating, hummocky topography and elongated lobes or fans that are expressed as step-like landforms. Debris fans tend to be coarse-grained and poorly sorted, but may be either matrix-or-clast-supported. Typically, fans are composites of several mass-wasting events with a weathered surface on each colluvial unit in the sequence. This indicates that there may be great differences in age between the units and upwards of several thousand years may have elapsed between debris-flow-forming events (Kochel 1990). In the Great Smoky Mountains, characteristic recurrence intervals for debris flows on specific fans are on the order of 400 to 1600 years (Kochel 1990) whereas catastrophic debris flows have been estimated to occur every 3000-6000 years in Nelson County, Virginia (Kochel 1984, Kochel and Johnson 1984). Based on radiocarbon dating, Eaton et al. (2003b) approximate a recurrence interval of debris-flow activity of roughly 2500 years in Madison County, VA.

Numerous studies (Table 1) hypothesize that major Quaternary climate change and periglacial environmental conditions have encouraged the formation of a number of debris flows in the southern Blue Ridge during the Pleistocene. In the last 850 kyr, there have been at least ten major ice advances that have glaciated much of the northern Appalachians and brought periglacial conditions to the southern Appalachians (Braun 1989). It has been suggested that periglacial conditions may have extended as far south as the mountains of Georgia during glacial maxima (Jackson 1997).

During glacial periods, western North Carolina experienced a greater frequency of freeze-thaw cycles and physical weathering. Rock exposed at high elevations decomposed to a thin loose soil mantle (Mills 2000). At the same time, atmospheric circulation would have been unfavorable for the movement of significant tropical air masses into the region (Kochel 1990). In modern polar climates, monthly temperatures average below 10°C year-round, resulting in little to no tree growth providing little inherent root cohesion (Lydolph 1985). These three conditions set the stage for later slope instability during warmer interglacial intervals.

Although a polar climate can create a ready supply of sediment through erosion and physical weathering, the lack of localized high-intensity precipitation inhibits the formation of debris flows. In contrast, slow mass movements, such as solifluction and creep, are common (Ritter et al. 2002). In Virginia, slope wash of material may have proliferated more than debris flows during the Pleistocene (Eaton et al. 1997).

Table 1: Prehistoric debris flow studies in the southern Blue Ridge and the age-dating techniques utilized.

Reference	Year	Dating Technique	Location	Age of Features
Kochel	1987	Radiocarbon	Davis Creek, VA	> 11,000 BP
Jacobson et al.	1989b	Radiocarbon	West Virginia	10,000 - 12,000 BP; 315 BP
Behling et al.	1993	Radiocarbon	West Virginia	17,000 - 22,000 BP
Kochel	1990	Radiocarbon	Appalachian Mountains, NC	16,000 - 25,000 BP
Eaton et al.	1997	Radiocarbon	Upper Rapidan River Basin, VA	2,200 - 50,800 BP
Eaton et al.	2003a	Radiocarbon	Madison Co., VA	15,000 - 27,410 BP
Shafer	1988	Thermoluminescence	Flat Laurel Gap, NC	Late Quaternary
Mills	1982	Relative-age	North Carolina	?
Mills and Allison	1995a	Relative-age /paleomagnetism	Watauga County, NC	780 ka - 1Ma
Mills and Allison	1995b	Relative-age	Haywood County, NC	?
Liebens and Schaetzl	1997	Relative-age	Macon and Swain Co., NC	?
Mills	2000	Relative-age	Appalachians	?

After the late Wisconsin glacial maximum, near the end of the Pleistocene, the northward migration of the polar front would have allowed tropical moisture to reenter the Central and Southern Appalachians during the summer months (Kochel 1987). Previously undisturbed weathered and frost shattered soil and rock then became exposed to heavy precipitation. Slopes that were still sparsely vegetated (due to cold winter temperatures) became saturated and unstable, creating numerous large debris flows. Repeated intervals of glacial and interglacial climate on a periglacial landscape probably created episodic sequences of catastrophic mass wasting during the Pleistocene and early Holocene (Kochel 1990). Several large prehistoric debris flows have been identified in the southern Blue Ridge and the region of the Great Smoky Mountains (Hatcher et al. 1996). These debris flows originated at high elevations (>1100 m), produced large volumes of colluvium (>106 m^3) and may have transported material as far as 8 km in a single event (Hatcher et al. 1996). Hillslopes remained generally unstable during the late Wisconsin glaciation, but transitioned to a period of less-frequent landsliding during the Holocene (Jacobson et al. 1989b).

Modern Flooding and Debris Flows

The first recorded instance of a major flood in the French Broad watershed occurred in April 1791, six years before the city of Asheville was incorporated with its present name (Tennessee Valley Authority 1960). While precipitation records do not exist for this event, anecdotal accounts describe the water level as having been as high or a few meters higher than the well documented flood of 1916 (Tennessee Valley Authority, 1960). Since that time, the French Broad watershed has been plagued by repeated sequences of flooding and slope instability.

June, 1876

The first detailed historical reference of debris flows affecting the North Carolina Blue Ridge occurred on June 15, 1876. At least 40-60 slope movements were reported in a 1554 km2 area of Macon and Jackson counties (Clingman 1877). These debris flows accompanied flooding that is often called the "June Freshet," one of the greatest floods in the upper reaches of the French Broad watershed (Tennessee Valley Authority 1960). Rainfall data is extremely sparse as only two known stations were reporting in the vicinity of the debris flows in 1876 (Franklin, NC and Lenoir, NC). The station at Franklin, only about 8 miles from where the debris flows occurred, reported 165 mm of rainfall on June 15 (NC Agricultural Experiment Station 1892). Anecdotal reports indicate that rainfall was not exceedingly heavy, but had been falling steadily throughout the day (Clingman 1877).

At the time, a debris flow was generally attributed to a "waterspout" (i.e., a sudden funnel-shaped cascade of water falling from the sky during a torrential rain event) (Clingman 1877). It was believed that the force of the falling water ripped away the soil from the side of the mountain, leaving only solid bedrock. Thus, Clingman (1877) used the term waterspout not only to describe a meteorological event but also the geomorphic feature created by this event. Although Clingman (1877) did not provide a reasonable mechanism for the waterspouts, his detailed descriptions of the event, and the geomorphic features produced by the storm are excellent.

Two debris flows occurred in Macon County near the crest of Fishhawk Mountain and the Tessantee River on the afternoon of June 15, 1876. There were no known fatalities, but the Conley family witnessed the debris flow across the river from their home:

> "They saw a large mass of water and timber, heavy trees floating on the top, which appeared ten or fifteen feet high, moving rapidly towards them, as if it might sweep directly across the Tessantee and overwhelm them. Fortunately, however, sixty or seventy yards beyond the creek the ground became comparatively level, and the water expanded itself, became thus shallower, and leaving many of the trees strewn for a hundred yards along the ground, entered the creek with a moderate current." (Clingman 1877, 69)

Another flow also occurred on the opposite side of Fishhawk Mountain. The lengths of both of these debris flows were estimated to be two miles. The location of these slides is noteworthy because Fishhawk Mountain is the same area where four people and an unborn child were killed and several houses destroyed in a debris flow that occurred on September 16, 2004 (see below).

May, 1901

From May 18 to 23, 1901 a series of low-pressure systems passed through western North Carolina and brought heavy rain, with the heaviest precipitation occurring on May 21-22. The storm was centered near the Black Mountains of North Carolina. Total precipitation amounts ranged from 22.8 cm in Marion to 12.8 cm in Asheville (Myers 1902). Extreme flooding affected portions of the Nolichucky, Watauga, Little Tennessee, and Catawba Rivers systems (Myers 1902, Scott 1972). Later flooding in the spring and summer only added to the destruction. Total damage to farms, bridges, highways, and buildings in the French Broad watershed was estimated to be $4M dollars (U. S. Department of Agriculture 1902).

Most of the debris flows associated with the 1901 storm occurred in Buncombe, Henderson, Mitchell and McDowell Counties (Scott 1972). The Southern Railroad Company was particularly affected as a number of slides buried tracks for hundreds of meters or washed away portions of track in the associated flooding. A resident of Marion, George Bird, reported that a number of slides occurred in the surrounding hills near his home and generated large piles of timber (Holmes 1917). Landslides and waterspouts seemed to have been particularly prevalent in Mitchell County where as many as 17 slides were observed on one hill by Myers (1902) (Figure 4). Myers (1902, 104) de-

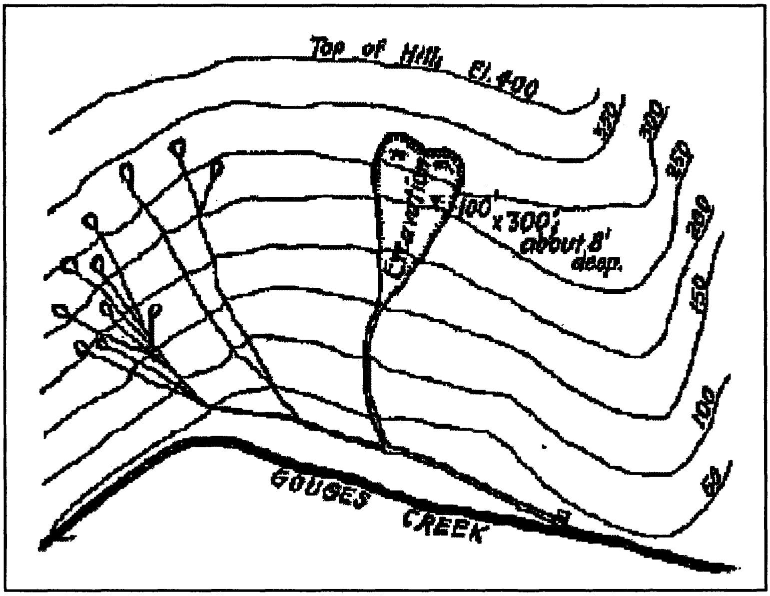

Figure 4: Sketch map of debris flows that occurred along Gouges Creek in Mitchell County, North Carolina in May 1901 (Myers, 1902).

scribes in detail one of the largest slides he encountered:

> "...the excavated area was roughly heartshaped, having an extreme breath of about 100 ft., the distance from head to point being about 300 ft., and it was located on a hillside, sloping from 80° to 45° and having its head about 200 ft. below the crest of the hill, which was as high as any nearby... From the lower end of the cavity a sharp and well-defined channel led down the hill to the stream at the base, this channel being from 5 to 6 ft. wide and from 4 to 5 ft. deep with side walls practically vertical cut down though a gravelly clay... It is estimated that the excavation has a total content of about 2,500 cubic yards of earth which seems to have disappeared utterly."

The particular slide described by Myers (1902) destroyed a log house that was in the flow path. Other accounts by area residents describe cloudbursts of extreme intensity accompanying the waterspouts and that water bubbled and then burst from the ground at the head of many smaller slides (Myers 1902). It can be assumed from these descriptions that the mass movements in Mitchell County were debris flows, given their high water-and-debris content, characteristic flow path, and rupture surface.

July, 1916

In July of 1916, the precipitation from two tropical cyclones moved through the French Broad watershed causing extensive flooding and numerous debris flows. During the night of July 5-6, 1916 a weak hurricane passed over the Mississippi and Alabama coast and followed a slow, sinuous course northeast (Henry 1916) (Figure 5). Eventually the storm deteriorated into a tropical depression by the time heavy rains reached western North Carolina on July 9 (Henry 1916). This storm produced 10 to 25 cm of rain but did not create any known debris flows. Not long afterwards on July 14, another hurricane made landfall near Charleston, South Carolina and traveled rapidly northwest into the mountains of North Carolina (Figure 5). By the morning of July 15, the center of the pow-

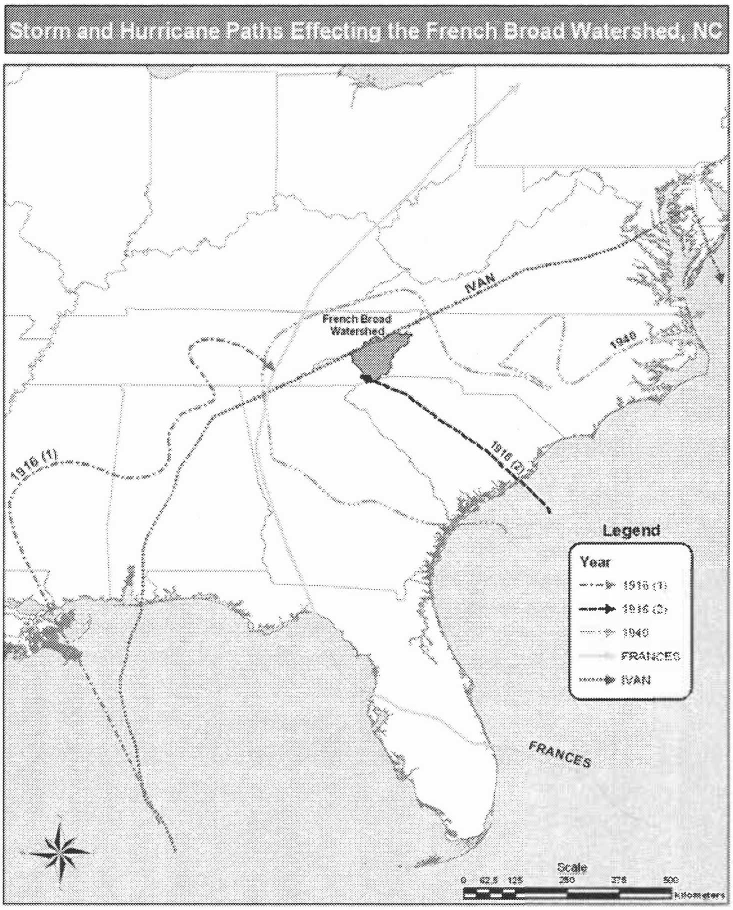

Figure 5: Map showing some of the hurricane paths that have affected western North Carolina as reported by the U.S. National Hurricane Center and the U.S. Geological Survey – Water Resources Branch (1949).

erful storm had already reached western North Carolina. Beginning in the afternoon of that day, unprecedented amounts of rain fell for 24 hours (Henry 1916).

The flood of July 14-16, 1916 was the largest recorded flood on the French Broad River at Asheville. The peak streamflow on July 16 was 3115 m^3/s (110,000 ft^3/s), several times greater than any other recorded streamflow at that station (Figure 6). The storm also triggered numerous debris flows in the mountains. Rainfall totals for the 1916 storm were exceedingly heavy with nearly all of the eastern slopes of the North Carolina Blue Ridge receiving 25 cm of rain or more (Scott 1972). The greatest amount of rain was recorded in the French Broad watershed at Altapass, where 56 cm fell in a 24-hour period (Hudgins 2000). This is also the greatest 24-hour rainfall total ever recorded in North Carolina.

Generally, the storms of 1916 produced two distinct regions of exceptionally heavy precipitation, one in Mitchell, Avery, and Caldwell counties, and the other in Transylvania and Henderson counties (Figure 7). The first storm had already thoroughly soaked the soil, increasing antecedent moisture conditions, and filled most streams nearly to flood stage (Scott 1972). Runoff from the second storm was estimated to be as high as 80-90 percent

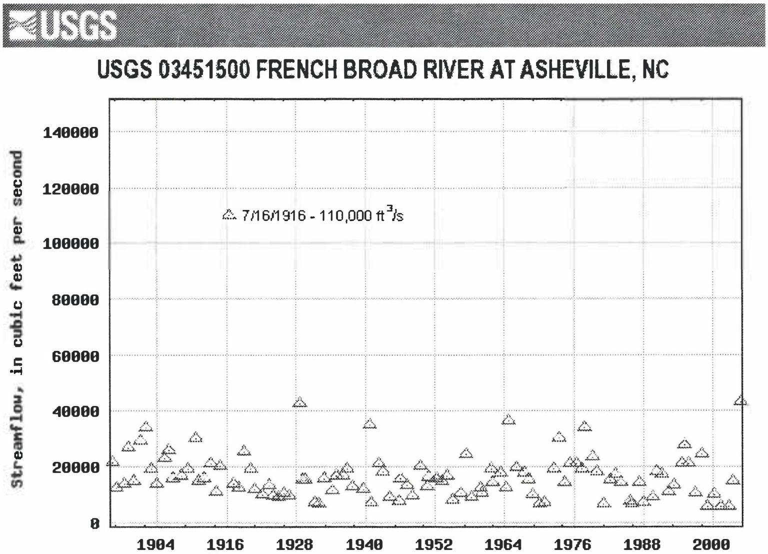

Figure 6: U. S. Geological Survey peak streamflow data for the French Broad River in Asheville from 1896-2004. The maximum peak streamflow recorded at this station (110,000 ft^3/s) was on July 16, 1916; an amount nearly three times greater than any other recorded streamflow.

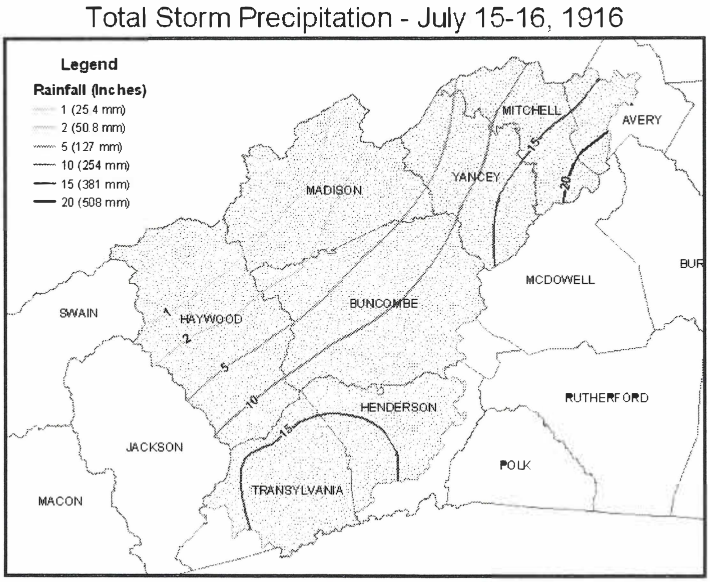

Figure 7: Total storm precipitation for July 14-16, 1916 (adapted from Scott, 1972).

of precipitation and only exacerbated flood conditions (Henry 1916).

The July 1916 storms killed approximately 80 people and caused $22M in damages (Southern Railway Company 1917). In Asheville, flooding destroyed several homes and buildings and four of the main river bridges were washed away (Tennessee Valley Authority 1960). The Southern Railway Company suffered extreme financial losses and transportation within western North Carolina was disrupted for several days. Many railway lines were covered by debris flows, trapping freight and passenger trains between terminals. The Southern Railway Company (1917) reported that almost every mile of track between Asheville and Statesville was covered by debris or washed out. At some places, track was suspended in mid-air after the fill below was washed away (Southern Railway Company 1917).

Generally, debris flows were reported along the Blue Ridge Mountains to the east, southeast, and south of Asheville (Holmes 1917, Scott 1972). Most slides occurred between 5 p.m., July 15 and 7 a.m., July 16. The flows began before dark and could be heard throughout the night during the period of heaviest rainfall. They typically developed in topographic hollows where the soil was thick, near the head of surface streams. Flow thicknesses ranged from 0.6-6.0 m and averaged 1.5-1.8 m. Bedrock was seldom exposed anywhere along any slide (Holmes 1917).

August, 1940

In August of 1940, a pair of storms caused significant flooding and numerous debris flows in the western mountains of North Carolina; the first occurred from August 13-15 and the other from August 28-31. These storms also brought record flooding to portions of Virginia, Tennessee, and South Carolina. Approximately 30 to 40 lives were lost and there were at least $30M in damages (U.S. Geological Survey 1949). The situation was similar to that of 1916, with two large storms occurring in the same month. The 1940 mid-August storm was strikingly similar to the second 1916 storm in terms of rainfall intensity and storm path (Figure 5). However, unlike the 1916 storm, the antecedent moisture conditions in 1940 were relatively dry, allowing for increased infiltration and lower flood discharge levels (U.S. Geological Survey 1949).

The first storm in 1940, an unnamed hurricane, made landfall between Beaufort, South Carolina and Savannah, Georgia on August 11, 1940. Although no wind speeds were recorded, damage reports indicate that trees were uprooted and broken, many buildings were damaged or destroyed, and 20 coastal residents were killed (U.S. Geological Survey 1949). An unusually high tide was reported, reflecting the storm surge. The storm then moved inland and curved northward following the Savannah River Valley, weakening significantly. It followed a semi-circular path through Georgia, Tennessee and Virginia, and then back into North Carolina before it moved offshore on August 16, just south of Norfolk, Virginia (Figure 5).

This mid-August hurricane of 1940 did not affect the French Broad Watershed until August 13-14 (Tennessee Valley Authority 1960). While rainfall intensities were moderate, the slow rate of movement allowed for heavy precipitation for several days over the North Carolina Blue Ridge, resulting in high rainfall totals (Figure 8a). Maximum precipitation totals ranged from 33-41 cm at to as little as 13 cm in Asheville (Tennessee Valley Authority 1960). A series of well-defined storms, centered over the Appalachians Mountains, extended toward the northeast from Blue Ridge, Georgia to Luray, Virginia, apparently due to an orographic influence on the storm precipitation (U.S. Geological Survey 1949).

The second storm in 1940 occurred during the period of August 28-31, but intense rainfall did not begin until the morning of August 29. Rain continued to fall until August 30 when it abruptly ended around noon. By August 31, only passing showers remained (U.S. Geological Survey 1949). This storm was a relatively local meteorological disturbance that only affected the French Broad and Little Tennessee watersheds. Precipitation was shorter in duration and smaller in aerial extent than the mid-August storm, but of higher intensity (Figure 8b).

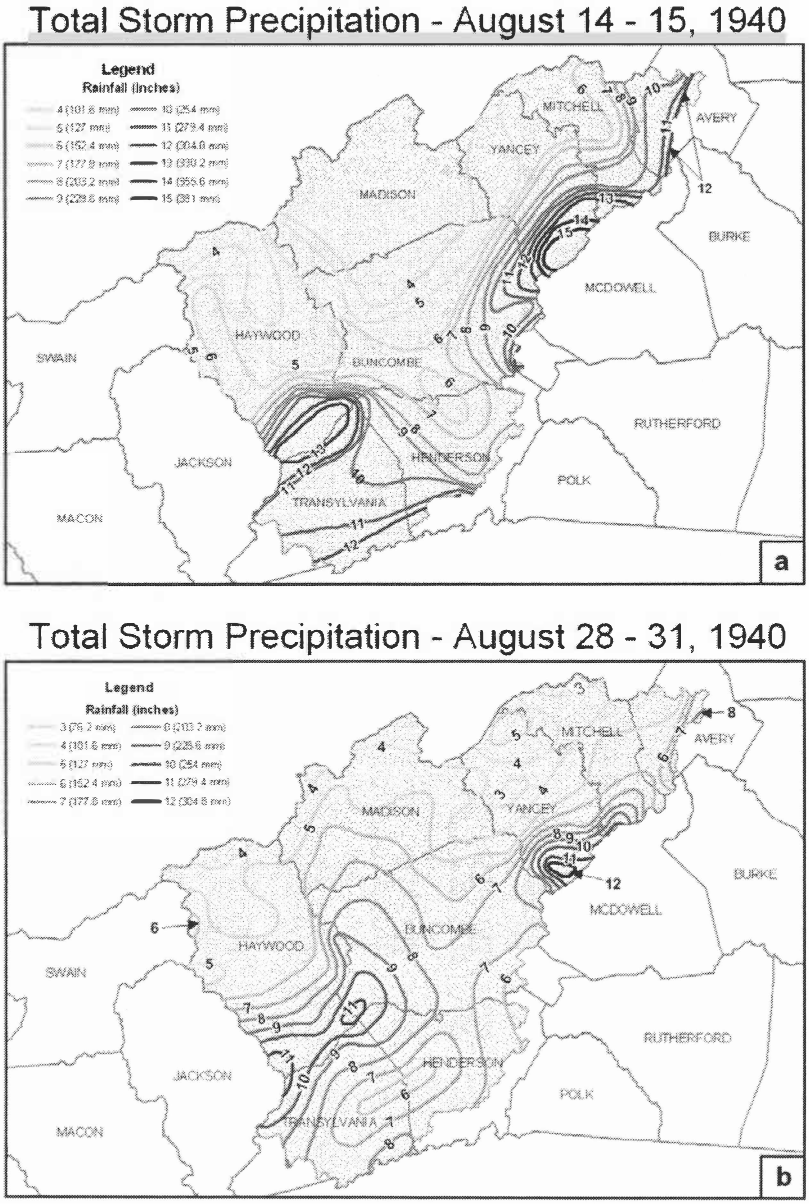

Figure 8: Total storm precipitation for August 14-15, 1940 (a) and August 28-31, 1940 (b) (adapted from U. S. Geological Survey, 1949).

Rainfall amounts ranged from 20-33 cm on the western slopes of the Blue Ridge in 20-30 hours (U.S. Geological Survey 1949). Given the antecedent moisture conditions due to the earlier storm, flooding was more severe near the storm center but overall was not as widespread.

The 200-300 debris flows associated with both 1940 storms, contributed greatly to the devastation wrought by the floods (Scott 1981). These slides occurred near the centers of both storms in shallow saturated soils on steep slopes. Debris flows were up to 91 m wide and 805 m long (U.S. Geological Survey 1949). They originated on shoulder slopes 91-122 m from the tops of mountains and then continued downslope following stream valleys, uprooting trees and destroying structures (Wieczorek et al. 2004).

During the mid-August storm of 1940, debris flows mainly occurred in the Blue Ridge Mountains, from the North Fork of the Catawba River northward into Watauga County near the North Carolina – Virginia border. During the late August storm, debris flows occurred primarily in the Upper Pigeon and Tuskasgee River basins. Because of the concentration of high-intensity rainfall within a small area, more than 200 debris flows occurred in an area of only 388 km^2 (U.S. Geological Survey 1949).

November, 1977

In early November 1977, a storm system that had formed as a low-pressure system in the Gulf of Mexico moved northwestward into the Appalachian Mountains (Neary and Swift 1987). Rainfall began in western North Carolina in the early morning of November 2 and continued at a steady rate (20-50 mm/day) until November 5. This steady rain was followed by intense downpours (102 mm/hr) on the night of November 5-6, during which most of the debris flows were initiated (Nearly and Swift 1987). This heavy precipitation, as in 1916 and 1940, was produced by convection associated with orographic lifting over the southern Appalachians. Four areas of exceptionally heavy precipitation (20-32 cm) were produced along the southeast ridges of the North Carolina Blue Ridge (Neary and Swift 1987). Two of these areas were within the French Broad watershed (Figure 9).

Although the heaviest rainfall in 1977 occurred in the vicinity of Mt. Mitchell, the best information about debris flows and flooding came from the Bent Creek watershed, located about 15 km southwest of Asheville. A survey was conducted here immediately following the storm (Neary and Swift 1987, Otteman 2001). At least seven major flows and other small failures were identified in this area (Neary and Swift 1987). Most of these debris flows occurred on steep slopes (26°-46°) at high elevations (945-1100 m) and flowed downhill following ephemeral creekbeds or along hillslope depressions (Pomeroy 1991). Scarps occurred in shallow residual soils less than 1 m deep over gneissic bedrock (Neary et al. 1986). All of the flows occurred in undisturbed, forested areas (Neary et al. 1986).

Topography in the Bent Creek watershed is at least partially controlled by the underlying concentration of tension joints in the bedrock. Where there is a greater amount of jointing, topographic hollows tend to develop. These joints allow for the infiltration of groundwater, enhancing breakdown of the rock. This accelerates weathering, providing loose material for mass wasting (Pomeroy 1991). Debris flows seem to originate on the bedrock-soil or bedrock-colluvium interface within these hollows.

The November 1977 flood killed at least thirteen people and sixteen counties in western North Carolina were declared disaster areas. The most serious flooding occurred along the French Broad River downstream from Asheville and in Yancey County where nearly every bridge was washed out (Stewart et al. 1978, Eshner and Patric 1982). Flooding destroyed 384 homes, 622 km of highway, and 12 dams. In total there was over $50M in damages associated with this storm (Stewart et al. 1978).

In 1977, precipitation, slope, and topography all contributed to the initiation of debris flows southeast of Asheville (Pomeroy 1991). Compared with other debris flow producing events, the maximum intensities associated with the 1977 storm were in the middle-to-low range but antecedent moisture was exceptionally high (177% above normal) for the two months preceding the storm (Neary and Swift 1987). The combination of very wet antecedent conditions and high-intensity, short-duration rainfall created excellent conditions for debris flows to form.

September, 2004

The 2004 Atlantic hurricane season was exceptionally brutal for western North Carolina. Of the fifteen tropical or subtropical storms that formed in the North Atlantic, nine achieved hurricane intensity (National Weather Service 2004a). In North Carolina, the remnants of three tropical systems (Hurricanes Frances, Ivan and Jeanne) impacted the western part of the state in rapid succession in September. Frances and Ivan caused extreme flooding in Asheville and several debris flows and rockslides in the mountains, causing closures of Interstate 40. Rainfall totals for the month over much of western North Carolina ranged from 25- 64 cm. This was 2-5 times greater than normal (Badgett et al. 2004).

Hurricane Frances struck the east coast of Florida early on September 5, 2004 and quickly weakened into a tropical storm (National Weather Service 2004a). The storm then rapidly moved across the state, through the panhandle of Florida, and northeastward across the eastern United States (Figure 5). The effects of hurricane Frances could first be felt in North Carolina on September 6 around 6:00 p.m. (Boyle 2004) but most of the flooding and mass wasting occurred on September 8.

The heaviest precipitation occurred slightly east of the French Broad watershed in Transylvania, Yancy and McDowell Counties (Figure 10a). The highest precipitation total was recorded in Edgemont 130 km northeast of Asheville, which received 42 cm of rain. One hundred kilometers southwest of Asheville, Lake Toxaway received 36 cm of rain (Nowell 2004). In total, 17 western counties were affected by flooding, hundreds of people were evacuated from their homes and several had to be rescued from the rising water (Nowell 2004). Areas of Asheville located near the

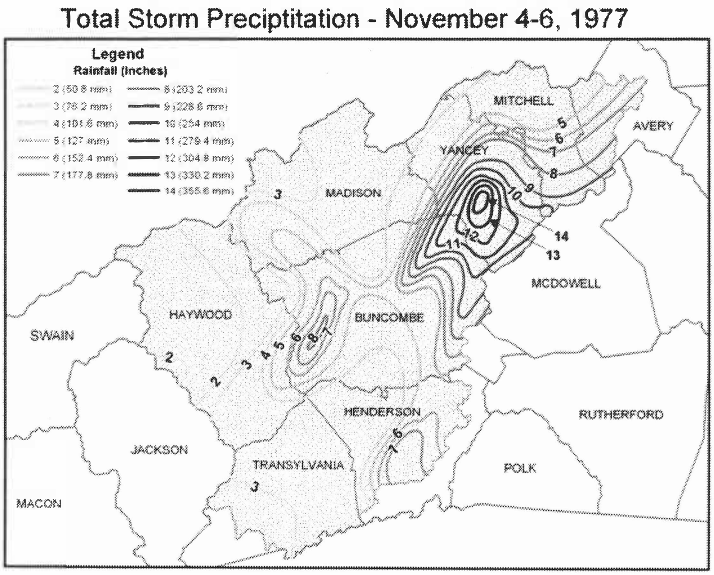

Figure 9: Total storm precipitation for November 2-5, 1977 (adapted from Neary and Swift, 1987).

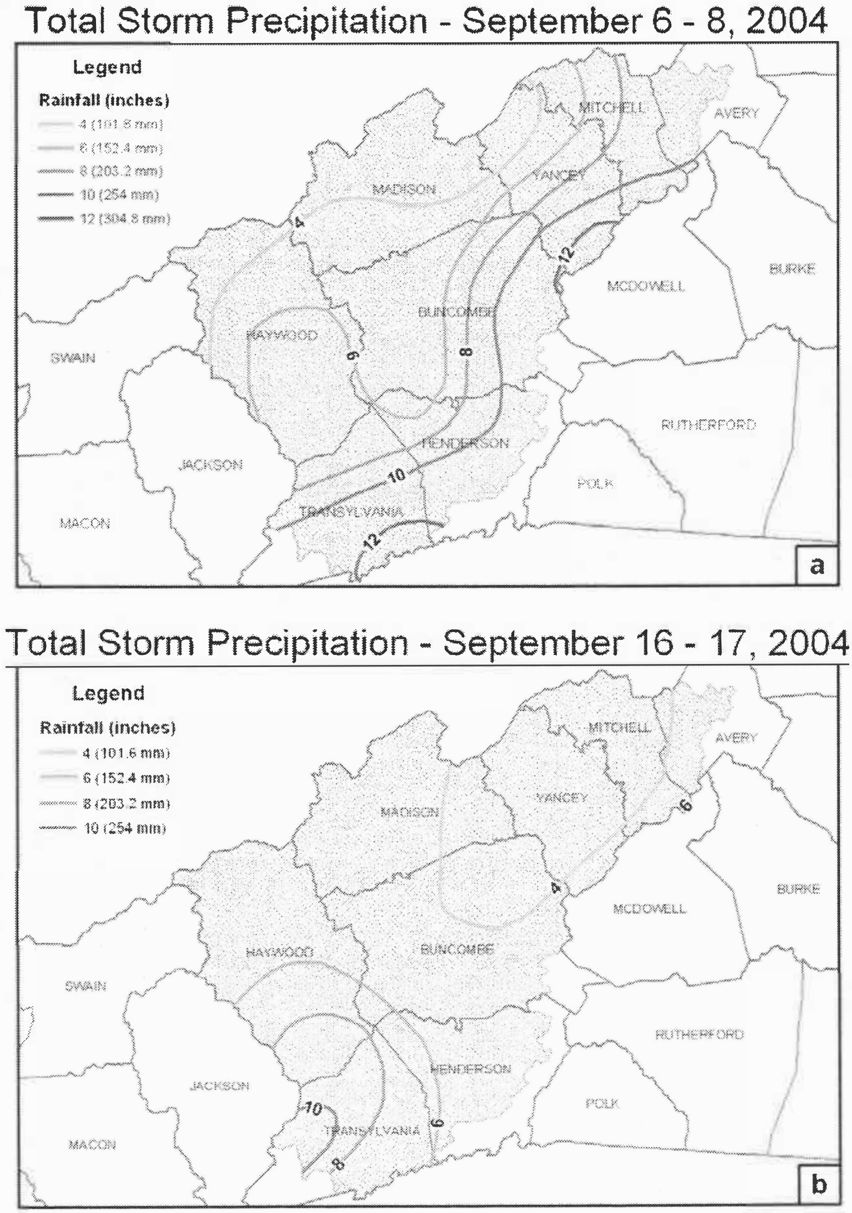

Figure 10: Total storm precipitation for the remnants of (a) Hurricane Frances (September 6-8, 2004) and the remnants of (b) Hurricane Ivan (September 16-17, 2004) (adapted from National Weather Service, 2004b and 2004c).

Swannanoa River were flooded, particularly the shopping center near the entrance to the Biltmore Estate, where water stood as much as 1.5 m deep (Nowell 2004). In Haywood County, flooding along the Pigeon River also inundated downtown Canton and Clyde.

The remnants of hurricane Frances caused at least 21 reported incidents of mass wasting along several major roadways in seven western North Carolina counties. However, only three counties within the boundaries of the French Broad Watershed experienced debris flows (Avery, Henderson, and Transylvania). One of the largest reported debris flows occurred east of Asheville on Interstate 40, near Old Fort Mountain in McDowell County. This flow crossed the westbound lane and the median to block four of the six lanes of an eight-kilometer stretch of Interstate 40 (Nowell 2004). In Watauga County, one house was destroyed and eight others condemned when a debris flow tore through a subdivision (North Carolina Geological Survey 2004a). Portions of the Blue Ridge Parkway were closed when at least six debris flows destroyed the roadway in four areas between Linville Falls and Waynesville (Ball 2004). About 250 roads became impassable or were closed due to flooding and mass wasting (Barrett 2004). Most of the road damage was in Buncombe County (Ball 2004).

Ivan was an unusually long-lived hurricane that made landfall along the United States coast twice. Ivan struck the Alabama coast early on September 16 as a Category 3 hurricane and gradually weakened as it moved northeastward into the southeastern United States (Figure 5). After emerging off of the Delmarva Peninsula on September 19, remnants of the storm moved southwestward, crossed over Florida and then into the Gulf of Mexico. By September 23, the remnants of Ivan had restrengthened into a tropical storm that made landfall for the second time on September 24 over southwestern Louisiana (National Weather Service 2004a).

The remnants of Ivan moved into western North Carolina early on September 16. Although Ivan had weakened to a tropical storm by the time it reached North Carolina, it still packed powerful winds and heavy rain. Rainfall was not as heavy as rainfall from Frances, mainly because the storm moved rapidly northeastward, but the western portion of the state still received 10-20 cm of rain. The heaviest precipitation fell in Transylvania, Jackson and McDowell Counties at high elevations. Black Mountain (near Asheville) received 29 cm of precipitation and Sapphire (in Transylvania County) reported 38 cm (Figure 10b).

Although Ivan produced less rain than Frances, high antecedent-moisture conditions and saturated soils allowed for more slope movements to be produced. A total of 53 reported slope movements have been attributed to hurricane Ivan (Cabe 2004). But several other slope movements may also have occurred in undisturbed or rural areas and were not reported by either the North Carolina Department of Transportation (NCDOT) or major news agencies. Further work will have to be conducted to obtain a complete record of these slope movements.

Slope movements, downed trees, and flooding obstructed several roads throughout western North Carolina, stranding residents in several communities in Avery, Jackson and Haywood Counties. A major slope movement occurred in the westbound lane of Interstate 40 in Haywood County. Farther to the west, near the North Carolina-Tennessee border, a large portion of the eastbound lane of Interstate 40 collapsed due to undercutting by the swollen Pigeon River. A major debris flow also destroyed a home in Candler in Buncombe County (Cantley-Falk 2004).

The worst damage occurred in the community of Peeks Creek in Macon County. At around 10:10 p.m. on September 16, a debris flow originating near the peak of Fishhawk Mountain destroyed at least fifteen houses, injured several people, and resulted in the deaths of four people (and an unborn baby). The debris flow traveled approximately 3.6 km dropping nearly 670 m in elevation as it progressed down a mountain cove and into the north fork of Peeks Creek (Cabe 2004). The velocity of the flow was estimated to be 33 kph near the scarp and 53.5 kph just upstream of the area of major damage (Cabe 2004). The force of the flow scoured the streambed, ripped trees down and left others striped of bark; houses were removed from their foundations (North Carolina Geological Survey 2004b). The flow probably originated as a debris slide; a slab of cohesive rock, debris and earth the size of a football field detached from the side of the mountain and quickly disintegrated into a debris flow as more water mixed with the slide material (Cabe 2004) (Figure 11).

What is remarkable about the Peeks Creek disaster is that this location is the same area where two large debris flows occurred in 1876 (Clingman 1877). Observations of residents living in the area were strikingly similar in both incidents. Clingman (1877) describes trees stripped of bark and limbs, a "clean, broad furrow more than two miles" long carved into the side of the mountain, and boulders weighing several tons moved by the flow, similar to what was found after the Peeks Creek flow (Figure 12). Residents during both the 1876 and 2004 incidents reported seeing or hearing a tornado or "waterspout" just before or during the debris flow. In 1876, residents described seeing funnel-shaped spinning masses of water near the crest of the mountain (Clingman 1877). In the light of an exploding electrical transformer, one resident described seeing debris spinning and flying around in the air in a circular motion above their house (Biesecker and Shaffer 2004). The National Weather Service (2004c) reported that a storm cell that spawned a tornado in Georgia moved over the Peeks Creek area around the time that the debris flow occurred. Tornadoes are fairly rare in mountainous areas, but do occasionally develop. While there was wind damage throughout the Peeks Creek area after the passage of Ivan, this damage was more consistent with wind shear. So far, the National Weather Service has not been able to conclude if a tornado actually did touch down on Fishhawk Mountain, but they do not discount the eyewitness accounts of local residents (Cabe 2004).

The question remains as to why mass movements occurred in these Macon County areas as opposed to elsewhere. In the Peeks Creek flow, fracture planes in the rock, sloping 35-55 degrees, provided a smooth slip surface near the headscarp. Soil layers over this bedrock were thin, generally less than 1 m deep (Cabe 2004). Meteorologically, the rainfall rates from the remnants of hurricanes Frances and Ivan were not unusually intense for

Figure 11: The head scarp of the Peeks Creek flow near the crest of Fishhawk Mountain. The overlying soil was ripped away, exposing the underlying bedrock for several hundred meters down the channel of the flow (courtesy of the North Carolina Geological Survey).

Figure 12: Large imbricated boulders and woody debris in the main channel of the Peeks Creek debris flow (note geologist for scale). Features such as these indicate the velocity of the material moving in the channel during the failure (courtesy of the North Carolina Geological Survey).

either event. However, the combined rainfall totals were exceptionally heavy. The rainfall produced by Frances initially saturated mountain soils and slopes. Before the soil had a chance to drain sufficiently, Ivan moved through the area, bringing even more rain to already waterlogged soils. The rainfall from Ivan may have caused even higher soil-water pressure on slopes, explaining why there was more mass wasting during the second storm. Ultimately, the exact reasons why debris flows occur in one area and not another, under similar meteorological and physical conditions, are not fully understood.

Precipitation Thresholds and Debris Flow Frequency: Lessons Learned

Most of the rainfall totals associated with the 1876, 1901, 1916, 1940, 1977 and 2004 events are well within the 125-250 mm/d precipitation thresholds suggested by Eschner and Patric (1982) as necessary for debris-flow generation in the Southern Appalachians (Figure 2). Average 24-hour rainfall totals were greater than 125 mm/d (the minimum precipitation necessary to saturate soil and set the stage for debris flows) in 7 out of 9 cases (Table 2). Extreme precipitation does not necessarily guarantee that debris flows will occur, as during the July 5-6, 1916 storm, but extreme precipitation certainly increases the risk of slope instability. In many cases, such as with the Peeks Creek debris flow and the 1977 storm, rainfall intensity is an extremely important triggering agent.

Few studies have attempted to delineate a recurrence interval for debris flow activity in small mountain watersheds in the Appalachians based purely on historical documentation. Studies have instead relied on dating techniques to determine the age of sequences of preserved ancient debris flow deposits. Recurrence intervals for individual first-order drainages may be on the order of thousands of years (Eaton et al. 2003b). As the area of interest increases in size, the probability of debris-flow activity also increases. Based on the occurrence of major debris-flow triggering storms from the historical record (those that have extensive amounts of precipitation and debris-flow location data), a frequency of slope instability can be estimated for the French Broad watershed. The average frequency of mass wasting from 1876-2004 (for eight events) is 16 years. This calculation excludes

Table 2: Major debris flow producing storms within the French Broad Watershed: minimum, average, and maximum precipitation amounts and the approximate duration of the storm.

STORM DATE	Min. (mm)	Avg. (mm)	Max. (mm)	Duration (hr)
1876*	110	138	165	24(?)
1901	128	178	228	48(?)
1916 (1)**	102	178	254	48
1916 (2)	25	254	564	24
1940 (1)	102	330	406	48
1940 (2)	76	203	330	24
1977***	51	203	356	72
2004 (Frances)	102	262	422	48
2004 (Ivan)	102	241	381	24

* rain gauge data limited to two stations

** no debris flows produced

*** most intense rain occurred in the 24-hr period when debris flows occurred the first 1916 storm, as no debris flows were triggered during this event. The return interval for such storms has varied from as few as 15 years to as many as 37 years. On human timescales, this is still enough time for people to forget that mass wasting can occur in their area.

Nearly all of the major events that caused debris flows in western North Carolina occurred when two storm systems, producing heavy precipitation, traveled over the area within 6-20 days of each other. Antecedent moisture and rainfall intensity seems to play a crucial role in predisposing slopes to debris-flow generation. The locations of prehistoric and modern debris flows, and their associated geomorphic features, are also a good indicator of areas that may be prone to slope instability. Geoscientists, emergency management, and citizens must be cautious when modifying slopes and building homes and critical structures in these mountainous areas. It will also be necessary to be vigilant in monitoring weather conditions, particularly with repeated sequences of heavy rain events.

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Report: The Role of Corporations in the Transformation of a North Carolina Urban Landscape

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Introduction

Perhaps no North Carolina city has experienced as great a transition as Charlotte over the past 15 years. Since 1990 the city has transformed itself from one dominated by low-wage manufacturing and distribution industries into one of the nation's preeminent banking centers. This transformation has led to the creation of 175,000 jobs in Mecklenburg county, nearly 20% of the state's total. Much of this growth germinates from two local firms that are now among the state's largest employers, Bank of America and Wachovia. Charlotte's two banks actively guided local urban redevelopment in order to enhance their competitive position in the global economy.

Privately Funded Economic Development

Charlotte's redevelopment was necessary to create a city that met the geographic requirements of a major bank headquarters site. First, they need a prominent and prestigious location for their offices in order to appeal to their depositors' need for security – thus downtown locations are mandatory. Second, since banks compete for executive talent in a global market, they must draw workers from other financial centers such as New York, San Francisco and London; therefore, they must be located in a place that offers a similar level of urban amenities in order to successfully recruit executives.

While Charlotte has been home to North Carolina's largest banks for over half a century, its downtown was openly ridiculed throughout the 1970s, 1980s and early 1990s. It was viewed as either dangerous (its police district had the highest homicide rate in the US briefly during the 1970s (Alexander 1982) or boring (the *Atlanta Journal-Constitution* labeled Charlotte "the city that always sleeps" in 1994). In spite of its reputation, this urban setting served as the backdrop for one of the most rapid expansions in financial industry history, Bank of America's transformation from a regional bank into the first truly national bank. As early as 1979, Bank of America became aware that the city of Charlotte was meeting few of its needs. The city's increasingly suburban local customer base viewed downtown with disdain. And, more critically, the bank faced difficulty recruiting the executives it needed to support its expansion beyond North Carolina. Arriving executives were appalled to find that Charlotte was simply a collection of suburbs that offered none of the urban amenities to which financial industry executives had become accustomed. It was clear that Charlotte's image was an impediment to the bank's planned expansion in the 1980s.

Faced with a recruiting crisis, Bank of America had three options. First, it could leave Charlotte and relocate its corporate headquarters to a city that appealed to its new hires. Second, it could appeal to the city to revitalize Charlotte into a metropolis better suited for a major financial firm. Or finally, it could rectify the problems associated with its hometown on its own.

Corporate relocation was a feasible option given Bank of America's voracious acquisition of banks from larger cities (Graves 2001). However, relocation was rejected, in part, because Charlotte was the home of many of the bank's original executive core, executives who espoused a strong allegiance to their communities. Publicly funded urban revitalization was politically impossible since the vast majority of Charlotte's residents lived and worked in suburban areas and thus resented significant public expenditure on center city redevelopment. Because of this political situation, privately financed urban revitalization was the only viable option for Bank of America to create conditions that would accommodate its expansion.

Charlotte's downtown redevelopment was financed largely by the Community Development Corporation (CDC), a non-profit subsidiary of Bank of America. The CDC provided more than $11 million in subsidized loans to individuals willing to refurbish (and inhabit) downtown housing by 1979 (NCNB CDC 1989). In addition to subsidies for loans to individual homeowners, Charlotte's private firms, led by Bank of America, invested more than $2.3 billion dollars in center city by 1995. Much of this was used to create new office space, multi-family housing and space for retail and entertainment activities downtown. Public expenditures on downtown projects during this period totaled less than $300 million; the majority of these funds were for infrastructure unrelated to banking such as a new courthouse and jail (Chapman 1996).

By 2005, private investment had wholly revitalized Charlotte's center city. The CDC had initiated the creation of residential space for nearly 10,000 residents at a variety of price points. In addition, CDC and corporate investments created one of the largest concentrations of office space in the state, daycare centers, grocery stores, and an entertainment district. From a corporate perspective, the addition of more than 10,000 jobs (with an average wage of $85,000) to Bank of America's Charlotte offices suggests the redevelopment was successful. The visible presence of residents and visitors downtown after working hours suggests the public has embraced the redevelopment as well (Smith and Graves 2005).

The most striking characteristic of Charlotte's downtown redevelopment was the source of its funding. Comparatively little public investment was used in the redevelopment process. Since the use of private investment to create economic infrastructure is almost unheard of in this era of public subsidies, why did Bank of America's finance this economic development project?

Restarting the Growth Machine

Private companies were the primary financiers of economic development projects in the pre-global economy. Most firms were dependent on the economic health of their local markets to ensure revenue growth. Bank of America's investment in the Charlotte economy is, in part, a product of this history. Before North Carolina's banks were permitted to expand out of the state, the Charlotte market was Bank of America's primary profit center. Promoting Charlotte as a great place to live resulted in more deposits, more loans and greater profits. Banks, real estate developers and utilities formed an informal coalition that actively perused policies that would facilitate job growth in the region.

Such growth machines have produced great success in North Carolina. The state's most dramatic example of privately funded economic development was the creation of Duke Power Company out of the earnings of James B. Duke's American Tobacco Company. Because the electric utility was among the first in the South, it was forced to stimulate industrial development in order to operate profitably. This industrial development fulfilled Duke's desire to contribute to the economy of his home state as well as fund his charitable endowment for the Carolina's (see Durden 2003).

These growth machines were thought to be destroyed by the emergence of the global economy. Purcell (2000) among others suggested that once firms began to operate in national and global markets the significance of home markets declines. The case of Bank of America illustrates that the corporate involvement in urban growth is not as simple as some would believe. Corporate expenditures on urban growth were often contrary to the economic interests of a bank that had numerous opportunities to relocate to a bigger city in order to facilitate hiring. However, Bank of America executive personnel had a strong sense of place, these personal ties were the product of the firm's creation and maturation within North Carolina. These personal ties to Charlotte led to the recreation of the corporate growth machine and dramatic investments in the bank's hometown.

Global firms that lack personal ties to a region are firms with little motivation to make community investments. These placeless firms are driven by economic forces to accept public incentives and remain only until a better deal can be cultivated elsewhere. These same economic forces doom state incentives programs to low returns and limited local impacts in most cases. In contrast, the profits generated by firms with historic ties to a place are likely to be reinvested locally.

The Future of the Modern Company Town

Charlotte's recent experience tells us that private firms are willing to fund economic development in certain contexts. While this development process is not without costs to the public (particularly in terms of a lack of political control of the process), this mode of development is likely preferable to the increased use of public subsidies to attract jobs. A secondary benefit of corporate driven urban growth is the degree to which these firms become invested in the locality. Firms that invest large sums in a place may be more likely to promote local growth via charitable contribution, financing for emerging companies and the fostering of local linkages.

This unusual relationship between town and firm will certainly create risks; an exaggerated municipal dependence on a single firm can increase the volatility of the local job market. In addition, this 'eggs in one basket' strategy may displace unrelated industries, in Charlotte's case there is considerable concern that funds budgeted towards the new rail transit system (a project identified as serving the bankers due to its downtown focus) diverts funds from road projects that would serve the region's remaining, largely suburban, manufacturing firms.

Despite the risks of this form of urban development it has worked exceptionally well in the Charlotte context. The success of this urban development strategy in other settings is still in question. Such close relationships between firm and city are, in one sense, simply a continuation of the mill village culture which built the Piedmont South. The region's history of corporate involvement in urban development provides an intriguing counterbalance to academic studies of globalizing cities which ignore the role of local history in global city transformations.

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North Carolina American Indians and Cultural Geography: A Lesson Plan

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Introduction

There is no single definition for cultural geography, but it includes the study of culture, culture area, cultural landscape, culture history, and cultural ecology. *Culture* is defined as the way of life of a group of people. It includes *cultural traits* or the learned ways of doing things, such as language, religion, politics, economics, and social mannerisms. Cultural geographers compare cultures of peoples from place to place.

Culture area refers to the spatial or territorial extent of a culture. It is also a *region*. Geographers use three types of spatial categories: points, such as cultural hearths and centers; lines or avenues of diffusion [dissemination]; and continuous or fragmented areas of occurrence of given culture types. *Cultural landscape* is the total changes human beings have made to the natural landscape and includes buildings, bridges, farms, and urban settings.

People make changes to the physical environment to enhance their standard of life. On the other hand, the physical environment will affect how the cultural landscape looks. For example, in rugged terrain, houses will be constructed on hillsides or in narrow valleys and roads will wind and curve around the hills. In level terrain, house sites are readily available, and the highways generally lack sharp curves.

Culture history shows that many places have been inhabited by many different cultures. This is referred to as sequent occupance. Study of culture history provides insight into the development of cultural traits, place names, distribution of previous cultures, and the level of development of prior cultures. Culture history provides insight into migration patterns and redistribution of the world's population. Terms such as acculturation, assimilation, frontiers, and colonies are associated with culture history.

Cultural ecology involves the processes that occurred during a sequence of events. For example, it might describe how a society evolved into an agricultural powerhouse, or lost its agricultural ability because of environmental degradation of soils.

The Lesson Plan

Introduction

This lesson plan is constructed to be used in eighth grade level social studies classes in North Carolina. It addresses the following Social Studies Objectives in the North Carolina Standard Course of Study (NC Public Schools, http://www.ncpublicschools.org/ curriculum/socialstudies/scos/2003-04/050eightgrade):

1.02 Identify and describe American Indians who inhabited the regions that became Carolina and assess their impact on the colony.

1.07 Describe the roles and contributions of . . . American Indians , . . . to everyday life in colonial North Carolina.

8.01 Describe the . . . demographics [of American Indians] in North Carolina and analyze their significance for North Carolina's society and economy.

Objective

The student will identify the American Indian tribes that lived in North Carolina during the Colonial Period as well as the Indians that live in the state in the twenty-first century. Some aspects of culture of the two time periods will also be presented.

Introduction

The purpose of this paper is to develop a lesson to explain the spatial aspects of American Indians in North Carolina and the changing demographics of the American Indian population in the state. In addition, the teacher should have knowledge of the available resources on the topics and construct visual aids to enhance the discussion, including maps showing tribal locations. Transparencies of graphs showing population change over time should also be incorporated into the lesson.

Frank Ainsley (2004), in the inaugural lesson plan published in this journal, devised the following approach, which I have adapted for this lesson:

Teaching activities consist of the following sections:

I. Getting Started (inquiry questions)
II. Setting the Stage (historical background)
III. Determining the Facts (readings, documents, charts)
IV. Visual Evidence (photographs and other graphic documents)
V. Locating the Site (maps)
VI. Putting it All Together (activities).

I. Getting Started

Most students are fascinated with American Indians and will quickly become involved in a discussion about the American Indians that lived the region that eventually came to be North Carolina at the time of European contact. The teacher should provide the information presented in this article to the students. Additional material is available about sixteenth century Carolina American Indians in books by Swanton 1946; South 1970; Perdue 1985; and Ross 1999.

Slides and transparencies of American Indians at work and play in the sixteenth century can be produced from published works, including some of those listed above. An especially valuable group of drawings is that of John White, made during his visits to coastal North Carolina in the mid 1580s. Although the original White drawings are in the British Museum, they have been reproduced in books published in the United States and one is included in this paper (Figure 1).

II. Setting the Stage

The peoples referred to as Indians, American Indians, or Native Americans, as some prefer to be

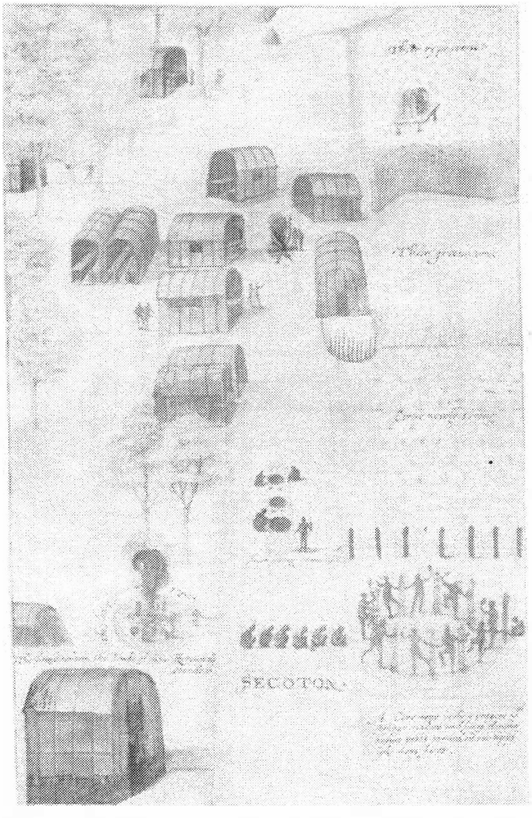

Figure 1. One example of John White drawing (1585) from the British Museum portraying layout of the Secoton Village and Native American dancing, cooking and farming. (Source: Ross).

called, have lived in what is now North Carolina for about 12,000 years. Although most American Indian scholars accept the theory that the ancestors of modern Indians came to the Americas by walking across the Bering Strait during the Ice Ages, other theories must also be taken into account. Geographer George Carter (1980) has suggested that ***prehistoric peoples*** from places other than Asia arrived thousands of years earlier than those American Indians that came by the Bering land bridge. He argues that at least some of these early migrants may have sailed by boat, having taken advantage of the many ocean currents that flow to the Americas from Asia, Africa and the Pacific regions. Thus, if this is the case, all American Indians in the Americas are probably not ***genetically*** or ***culturally*** related and we should be cautious about claiming that all American Indians throughout the Americas walked over the Bering ***land bridge*** then dispersed in many directions to inhabit two continents.

Geographical Background of North Carolina

North Carolina possesses a wide variety of physiographic regions, ranging from Tidewater at sea level to almost four dozen mountains higher than 6,000 feet above ***mean sea level.*** Between these two extremes lies a great expanse of mostly level to gently undulating Coastal Plain and rolling Piedmont. American Indians lived in all of these regions at the time of European contact.

The climate of most of the state consists of mild winters and long, hot summers; conditions conducive to the growth of many species of trees and plants. Agricultural activities also thrive in such a climate, especially in the more fertile river ***floodplains***, but productive farmland is found in all regions of the state. The sandy coastal plain with its transported soils to ***alluvial*** soils of mountain valleys and the mineral rich clays of the Piedmont have long been noted for their agricultural productivity. Thus, American Indians, for hundreds of years before the arrival of Europeans, had been raising a wide range of crops that flourished in the mild climatic conditions and fairly good soils of the state. American Indian ***"old fields,"*** highly prized for farm sites by the early white settlers, are relics of a time before European contact when the Indians cleared the forests to plant crops.

The cultural geography of the area to later become North Carolina also exhibited many contrasts. Prior to the European arrival, a great number of distinct American Indian groups lived in the state, with significant differences in languages, customs, and ways of living. In the Piedmont and parts of the coastal plain, Siouan-speaking tribes dominated. A group of Iroquoian-speakers, the Cherokee, lived in the mountains. On a broader scale, hundreds of languages were spoken by American Indians in what is now the United States and Canada at the time of the European invasion. The ***language subfamilies*** (subfamilies include languages with linguistic similarities) of North American Indians illustrate the diversity of Native languages and included the subfamilies of Algonquian, Athabaskan, Caddoan, Eskimo-Aleut, Iroquoian, Kiowa-Tanoan, Muskogean, Penutian, Salish, Siouan, and Uto-Aztecan. As mentioned previously, each subfamily includes languages that differ from those of other subfamilies. For example, Shawnee, an Algonquian language "is as different from the Athabaskan Navajo language as French is from Chinese" (Frazier 1996, 100).

Religion was highly structured among many of these peoples. Because of that, one of the most important buildings in the village was the temple. Unlike the other buildings, its walls and roof, or covering, differed in that thatched grass was used rather than bark or animal skins (Figure 2). Another difference in the temple was that it was square and usually built upon a mound. Other public buildings were built in which the leaders of the village would meet and discuss issues relevant to the settlement. These buildings were not elevated on a mound (Figure 2).

III. Facts and Evidence

European contact

Though hard to determine a definitive number, about 50,000 American Indians, dispersed among two dozen or so American Indian nations, lived in scattered areas across North Carolina at the time of European contact. Vin Steponaitis, a specialist in ancient American Indian cultures in the South, has documented that population densities were not uniform in the region. The archaeological and ethnohistorical evidence, according to Steponaitis (personal communication 1999), "makes it abundantly clear that most of the Southeastern landscape (including what is now North Carolina) was unoccupied most of the time. In other words, there were small clumps of population separated by large areas of empty space that served as 'buffer zones', if you will". Mooney estimates that "in 1584, before European diseases dissipated the population, there were approximately 17,800 Indians upon the Carolina coastal plains" (Johnson 1972:10). However, Lawrence Lee, the noted historian, estimates that there were 30,000 Indian people living in the coastal plain at the time of European colonization (Lee 1963,67). Peter Wood (1989), a Duke University professor and nationally recognized authority on colonial populations, estimates that the population was "a minimum of 50,000 . . . .". This figure, as are all others, is subject to considerable debate.

Massive changes occurred in American Indian *cultures* as the many different tribes, clans, bands and groups were thrust into contact with totally alien cultures from across the Atlantic Ocean. The Europeans were arriving in the Carolinas in ever increasing numbers and with an almost insatiable demand for American Indian lands. As Europeans took the land they desired, the American Indians suffered loss of life as well as loss of land.

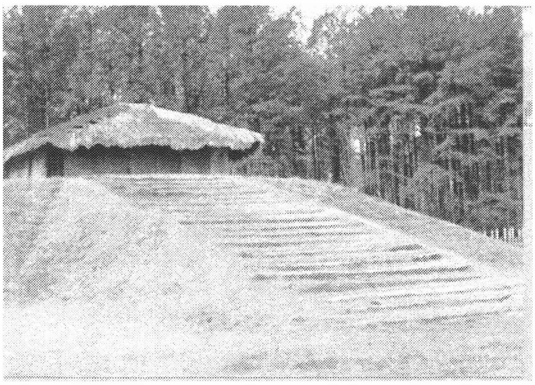

Figure 2. Reconstruction of American Indian temple at Town Creek, NC (Source: Ross).

Within a few years of contact the American Indians experienced a significant population decline. Many of the American Indians who escaped with their lives found that their numbers had declined to such an extent that they could no longer function as a tribal unit. Many tribes became totally *extinct* within a century of contact. To maintain their cultures, many of the survivors joined with other tribes, losing along the way their historical tribal identification. Others sought refuge from the Europeans in swamps and other isolated lands, sometimes sacrificing their American Indian identity and heritage. Consequently, the European desire for American Indian lands would eventually threaten the very survival of American Indian groups.

Some American Indians did survive, however, and some even prospered. A few members of individual tribes retained an oral tradition of their American Indian background, and as a result of this perseverance, several American Indian tribes with ties to those American Indian *nations* once thought vanquished have arisen as if from the ashes of the dead. As we enter the twenty-first century, more people labeled as American Indians live in North Carolina than did at the time of contact.

American Indians at time of European contact

The following vignettes of American Indians in North Carolina shortly after European contact are based largely on the work of Swanton (1946). With the exception of the Cherokee, all of the following tribes were either Coastal Plains or Piedmont American Indians. According to Swanton:

> . . . the tendency of the coast peoples was toward small units which only sporadically were gathered into larger bodies. . . . The Siouan tribes of the Piedmont country were also for the most part small, but a tendency is evident among these to form larger groups or confederations such as . . . the associations of tribes at Fort Christanna, and on the upper Pee Dee, while there is some reason to think that many of the southern Siouans

had broken away from the Catawba at an early period (1946, 19).

It is important to note that with the seemingly endless discussion and debate over a blood quantum in today's tribes, that Swanton (1946, 20) found "nearly all of the tribes were homogeneous internally in respect to language and culture, not so much so as regards race". At the time of the Revolutionary War, for example, the Catawaba had already absorbed many tribes, and it is likely that the bulk of the small coastal communities had merged with each other as a defensive measure as well as a means of survival of people with common cultures that differed from those of the newcomer Europeans.

Cape Fear

These American Indians were concentrated in current Brunswick County along the Cape Fear River. They were Siouan speaking American Indians and "may have been a part of the Waccamaw tribe, as no native name for them has been preserved, merely the name of a village, Necoes, and a chief, Wat Coosa." Swanton describes several attempts of European settlement in the vicinity of the Cape Fear villages, none of which were successful. A colony from New England arrived in 1661, but were driven off because they angered the American Indians by "seizing and sending away their children under the pretense of having them educated." Another group of European settlers, from Barbados this time, attempted to settle near them in 1663, but they were also repelled by the Cape Fears. A third white colony settled at the mouth of Oldtown Creek in 1665, but although the American Indians tolerated them, they too soon departed the region, leaving it once again to the American Indians.

The Cape Fear American Indians were forced to move west of Charleston, South Carolina after the Yemassee War. A census taken in 1715, just prior to the Yemassee War, showed a population of 206. By 1808, "only one mixed-blood woman survived" (Swanton 1946: 103). Her name was Hannah Blute [Blate, or Blake] and her mother was called "Indian Sarah." (Taukchiray, personal communication, 1997).

Catawba

In 1701 the Catawba probably consisted of two separate bands, one called the Catawba and the other the Iswa, a Catawba word for "river." The Catawba was the largest of the Siouan tribes at the time of European contact, but afterwards their population dwindled quickly. In 1763 a reservation of about 10,000 acres (15 square miles) was established for them in South Carolina along the state boundary with North Carolina. In 1840, they signed a treaty with the State of South Carolina in which they ceded their lands to the state. Most members of the tribe then moved to Haywood County in North Carolina but returned to South Carolina less than two years later because North Carolina would not sell land to them for a reservation. Back in South Carolina, they established a small reservation of 800 acres. Some of the Catawba subsequently moved to Cherokee country and lived with the Cherokee. A few families have remained with the Cherokee tribe in North Carolina. According to the 1910 Census, six Catawba lived in North Carolina.

Cheraw (Saraw, Sara)

The Cheraw American re a Siouan tribe first contacted by the Spaniards in the northwestern corner of South Carolina. Several years later they had moved east of Asheville. Lederer placed them even further east, "perhaps on the Yadkin River, and in 1673 they are placed by Wood between the Cape Fear and Yadkin" (Swanton 1946: 110). About two decades later, in 1700, they had moved into southern Virginia and built two villages, Upper Saura Village and Lower Saura Village, on the Dan River. The Iroquois attacked in 1710 and forced them to surrender the Dan villages. They moved southeast and joined the Keyauwee. Eventually they settled in the Pee Dee River basin. As a result of conflict with South Carolina settlers, they were driven from their homes and eventually located near the Catawba. Swanton thinks that they "probably united with the Catawba and became wholly merged with them though a part are undoubtedly represented among the Siouan [Lumbee] Indians of the Lumber River" (Swanton 1946, 110).

Cherokee

The first use of the term Cherokee in English narratives was made in 1674 in which Woodward states that the "Chorakae Indians lived on the head branches of the Savannah" River (Swanton 1946, 111). The Cherokee Tribe was the largest in the southeast at the time of European contact. Its homeland is in the southern Appalachians, in the present day states of North Carolina, South Carolina, Tennessee, Georgia, Kentucky, Alabama, Virginia, and West Virginia, but the origin of the tribe is in the north, where other Iroquoian tribes lived.

Early Spanish explorers (De Soto narratives) referred to an American Indian town called Guasili, which was located near what is now Murphy, North Carolina. According to Swanton (1946, 110), this town "may be identified as perhaps occupied by real Cherokee Indians". After contact with Europeans some Cherokee went west, to Texas and Arkansas, but most remained in the southern Appalachians where the culture experienced major changes. A momentous transformation was that the Appalachian Cherokee established a government in 1820 that followed the organization of the government of the United States. The next year, 1821, Sequoya developed an alphabet for the Cherokee language that made possible written communication in the tribal language.

In the 1820s gold was discovered on Cherokee lands in Georgia. Whites demanded that the Cherokee cede the land to them and used violent methods to drive the Cherokee from their homes. Some Cherokees had moved west in 1829, following the earlier migrants, but after the Treaty of New Echota (December 1835), most of the Cherokee were forced to leave the east. By 1839 almost all of the American Indians had been "removed," forcibly, to the west. This removal is chronicled in history as the "Trail of Tears." The few hundred Cherokee that escaped the intensive search by armed troops hid in the rugged mountains. In 1842 the federal government agreed that it would not force them to leave. A reservation for these American Indians was established in western North Carolina, officially called the Qualla Boundary, and is now home to The Eastern Band of Cherokee Indians.

The Cherokee population in 1650 has been estimated at 22,000. By 1715 the number had declined to about 11,200. An estimate in 1729 fixed the population at about 20,000. According to Swanton (1946, 114), "A town by town census in 1808-9 gave a total population of 12,395 in the east. In 1819 it was estimated that the tribe numbered about 15,000, of whom one-third were already west of the Mississippi". A census in 1835, just prior to removal, listed a total of 16,542 Cherokee, with 3,644 in North Carolina. A census of the eastern Cherokee in 1884 counted 2,956 but "there was some demur among the American Indians as to the legitimacy of the claims of some of those classed as Cherokee" (Swanton 1946, 114). Censuses in 1895 and 1900 showed 1,479 and 1,376, respectively. Swanton postulates that the greatly reduced numbers were the result of a "purified roll," in which it is presumed that persons with much white ancestry and little American Indian ancestry were purged from the roll.

Chowanoc

The homeland of the Chowanoc was near the junction of the Meherrin and Nottaway Rivers. In 1584-85, when the English (Raleigh's colonists) made contact with them, they were the most powerful tribe in the region, with a population of several thousand. By 1701, however, the Chowanoc lived in a single village on Bennetts Creek and in 1713 they were given a small reservation on Bennetts and Catherines Creeks for their estimated 240 members. A 30-acre Chowanoc Reservation, named "Indian Town," was founded in 1782 for the Robbins family as heirs of the Chowanoc (Taukchiray 1997 and Gates County Deed Book 10). According to Swanton (1946), they were extinct by 1820. Taukchiray (1997), however, noted that their population in Chowan County in 1954 consisted of two men and five women.

Coree (Coranine)

This small tribe lived on a peninsula south of the mouth of the Neuse River. Swanton (1946, 126) wrote that "It is probably the tribe intended by the CwarEnoc of Hariot's map, for Lawson calls them in one place Connamox". In the late sixteenth century, after European contact, most of the tribe was killed by Machapunga Indians. In 1715 the remnants of the Coree and the Machanpunga were jointly assigned land on Lake Mattamuskeet in Hyde County "where it is probable that they remained until they became extinct" (Swanton 1946:126).

Eno

In 1654 Governor Yardley called them the Haynoke, "a great nation by whom the northward advance of the Spaniards had been valiantly resisted" (Swanton 1946: 130). The Eno may have also been identical with the Weanoc or Wyanoke American Indians from the James River region of Virginia who moved south into North Carolina during the last decade of the seventeenth century. Swanton disagreed that the Eno and Wyanoke were the same tribe, suggesting that they were Siouan and had migrated from the south.

Lederer wrote that they lived near the headwaters of the Tar and Neuse Rivers in 1670. By 1701 Lawson found their village (Adshusheer) on the Eno River near Hillsborough, North Carolina. They eventually moved to South Carolina and most of the tribe joined with the Catawba. More recently, Taukchiray (1992) wrote that "several explorers, officials, traders, and others . . . did find a people in what is now upper North Carolina near the present Virginia line, from 1650-1712, known as the Cacore, Shakori, or Shoccorie." He further added that based on primary sources, these people had two branches, one known as the Sissipahaw, or Saxapahaw and the other as the Eno, Aeno, Haynoke, Eeno. From 1712 to 1743 they lived within the Catawba Nation and as late as 1743 "the group consisted of an enclave within Cheraw Town in the Catawba Nation, . . . still having its own government and its warriors still speaking their own language, which was never recorded"(Taukchiray, personal communcitation, 1992).

Hatteras

The Hatteras were an Algonquian people who in 1709 lived near Cape Hatteras. The Hatteras were a mixed race. According to Swanton (1946, 137) they "showed traces of white blood and claimed to have had some white ancestors. Therefore, they may have been identical with the Croatan American Indians with whom Raleigh's colonists are supposed to have taken refuge. Nothing further is heard regarding them". The Hatteras had but one village, called Sandbanks, and a population of about 90 persons in 1709. In 1788, Mary and Elizabeth Elks, "Indians," sold the site of the old American Indian town on Hatteras Banks to Nathan Midyett (Taukchiray 1997 and Currituck Deed Book 5). The census of 1850 identified one American Indian child named Elks as still living in the county.

Keyauwee

The Keyauwee lived near High Point in 1701. Lawson (1967) wrote that they lived in a palisaded village and that the males wore beards and mustaches. The chief of the tribe was a Congaree who had married the chieftainess of the Keyauwee. After 1701 they moved "toward the white settlements about Albemarle Sound" and in 1733 moved again, this time south to the Pee Dee River. There is evidence that they were absorbed into the Catawba and lost their identity as a tribe, "though some are probably perpetuated in the so called Croatans" (Swanton 1946, 145). The Croatans are today called Lumbee American Indians and live near the Lumber River in south-central North Carolina.

Machapunga

This tribe of about 125 persons lived in a single village called Mattamuskeet, located between the Albemarle and Pamlico Sounds, in 1701. With the Coree, they were given land on Lake Mattamuskeet in 1715. They eventually were absorbed into the surrounding non-American Indian population but in 1792 seven resident members were identified: four women, two boys and a girl (Taukchiray, personal communication, 1997). The descendants "of this tribe were still living in the geographic center of the old 45 square mile Machapunga reservation, sold by the tribe in its entirety in 1761 and again in 1792" (Taukchiray, personal communication, 1997).

Meherrin

Europeans visited this tribe of about 200 persons in 1650, referring to them as the "Maharineck." Another spelling, in 1669, was given as "Menheyricks." After 1675 the Meherrin accepted some Susquehana American Indians into their tribe. The Meherrin appear to have abandoned their ancient homeland at the mouth of the Meherrin River because of attacks from Catawba American Indians. The Meherrin, southern Tuscarora, and southern Saponi moved near the Roanoke River in 1761. Swanton (1946, 149) is of the opinion that the Meherrin probably were assimilated into the Tuscarora Tribe. Taukchiray (personal communication, 1997) believes they continued on, numbering seven or eight men. He argues that "Mouzon's map of 1775 shows them not at their old reserve, but instead . . . on Potecasai Creek" in Hertford County.

Moratok

This was a tiny Algonquian tribe that lived in 1585-86 on the Roanoke River. It is now extinct.

Neusiok

The Neusiok, in 1584, lived on the south side of the Neuse River in what is now Craven and Carteret Counties. Their numbers declined after European contact and by 1700 they had but two villages. They probably joined with the Tuscarora Tribe at the time of the Tuscarora War (1711-1713). In 1709 the tribe had only 15 warriors and probably fewer than 75 total members.

Nottaway (Notowega, Nittaweega, or Nautaugue)

Nottaway, or a version thereof, is a name many times given to enemy tribes by Algonquian American Indians. The name was particularly applied to enemy tribes of Iroquoian stock. In the case of North Carolina American Indians, it was used to identify an Iroquoian tribe living on the Nottaway River in Virginia. Swanton wrote that they "first appear in the narratives of the Raleigh expeditions to North Carolina under another Algonquian name, Mangoac." A band of American Indians called the Notowega lived in South Carolina in the eighteenth century. In about 1754 they apparently merged with the Cherokee and the tribal identity is lost.

Occaneechi

The homeland of the Occaneechi was an island in the Roanoke River near Clarksville, Virginia. First European knowledge of this small tribe occurred in 1650, but Europeans did not visit them at this time. They were visited in 1670 by Lederer, who described them as middlemen in the trade of the region. A few years later, 1676, Saponi and Tutelo American Indians moved to the Roanoke River area and settled near the Occaneechi, as did the Conestoga. The Conestoga, though, were repelled because they attempted to take the homes of the Occaneechi. The Conestoga probably then moved in with the Meherrin. The Occaneechi were defeated in a battle by Nathaniel Bacon and moved to a village on the Eno River, near Hillsborough, North Carolina, in 1701. In 1714 they were taken to Fort Christanna in Virginia and later (about 1740) went north with the Tutelo, Manahoac and other tribes. By this time they were calling themselves Saponi. In 1709 the estimated combined population of the Occaneechi, Shakori, Saponi, Tutelo and Keyauwee was 750.

Pamlico

The Pamlico American Indians' earliest known home was near the mouth of the Pamlico River. The English made contact with them in 1584-85. Most of the tribe was killed by a smallpox epidemic in 1696. By 1710 they lived in one village with an estimated population of 75 persons. In the Tuscarora War they were allies of the Tuscarora, but under terms of the treaty with the English, the Tuscarora agreed to exterminate the Pamlico. Those that survived were probably taken into the Tuscarora tribe as slaves. Swanton (1946, 170) notes that the Pamlico are the only "Algonquian people of North Carolina from whom a vocabulary has been preserved". In 1718, "it looks as if only seven or eight Pamlico were left alive, all fugitives, in their old country. No word on them since" (Taukchiray, personal communication, 1997).

Saponi

The name Saponi is probably a contraction of Monasukapanough, a tribe that lived near the site of Charlottesville, Virginia. They moved from there to Campbell County, Virginia and eventually to the Yadkin River basin near Salisbury, North Carolina. Lawson found them there in 1701. The Tutelo traveled with the Saponi during this time. The joined with the Occaneechi and created a new settlement called Sapona Town, a few miles east of the Roanoke River and about 15 miles west of Windsor, Bertie County, North Carolina. They were taken to Fort Christanna in 1714. Some of the Saponi and Tutelo moved north in 1740 and were formally taken into or adopted by the Cayuga in 1753. But all of the Saponi did not go north. A small group of Saponi had settled in Granville County, North Carolina by 1755. Swanton (1946, 178) extends the possibility that some of them "are perhaps still represented by a body of "Croatan Indians" in Person County". The several hundred descendants of this band are now referred to as the Sappony Indians of Person County. In 1997 they were officially recognized as an Indian tribe by North Carolina.

Shakori

The home of the Shakori was most likely in South Carolina. In 1521 a member of this tribe was taken to Spain by a Spanish expedition. By 1650 the Shakori had moved north into North Carolina and "Schockoores" old fields were reported to be located between the Nottaway and Meherrin Rivers. The Shakori were neighbors of the Eno, and Lawson (1967) found Eno and Shakori living in one village called Adshusheer, on the Eno River about 14 miles east of the Occaneechi village, near the site of Durham. The Shakori have been identified with the Sissipahaw, which indicates that they probably were two bands or groups of the same people. The Eno became the dominant group and Shakori tribal name disappeared. Both the Eno and Shakori probably blended into the Catawba. One Tuscarora described the Shakori, or as he called them "Cacores," as dwarf-like but brave warriors and said that the Tuscaroras had never defeated the Shakori in battle.

Sissipahaw (Haw)

Apparently the first report of this tribe was in 1567 (Juan Pardo's expedition) when it was referred to as Sauxpa or Sauapa, living near the Santee River in South Carolina. The homeland and major settlement was probably near Saxapahaw on Haw River, North Carolina. They were closely related to the Shakori and after 1715 presumably joined with the Keyauwee, Shakori, Eno and Cheraw, and some eventually joined with the Catawba. Swanton (1946, 186) states that "others are no doubt represented among the Indians of Lumber River". Although no population data are available for the Sissipahaw, the Haw Old Fields area was noted as the largest body of fertile land in the region.

Sugeree

This small tribe lived in many settlements on or near Sugar Creek (Mecklenburg County, NC and York County, SC) in 1701. They were part of the Catawba Nation and were also perhaps a branch of the Shakori. No population data exist for this tribe.

Tuscarora

The name Tuscarora is applied to a tribe or confederation of tribes that European explorers encountered on the Roanoke, Neuse, Tar, and Pamlico Rivers in North Carolina. In 1650 they were mentioned as "Tuscarood" and cited as a powerful tribe with great interests in trading and commerce. After the Tuscarora War of 1711-13 and the defeat of the American Indians, most of the Tuscaroras moved to New York. The Tuscaroras who had not fought the whites in the Tuscarora War remained in North Carolina until 1802, when they too moved north to rejoin their tribe. In 1709 their population was estimated to include about 1,200 warriors. Extrapolation of this number suggests a population of at least 3,500.

Waccamaw

In 1670 the Waccamaw were found along the Waccamaw River in North Carolina and Pee Dee River in South Carolina. They lived near and were probably related to the Winyaw and Pedee tribes. The Cherokee and their allies, the Natchez, reported in 1755 that they had killed some Pedee and Waccamaw American Indians who were in white settlements. Some of the Waccamaws' descendants probably joined the Catawba, but "it is more likely that they are tō be found among the Lumber River Indians whose homes are a little farther north" (Swanton 1946, 203). In 1715, the census reported the existence of six Waccamaw villages and a population of 610. In 1720 the population was estimated at 350. In that same year, 60 Waccamaw were killed or captured. Those few that were not killed presumably were shipped to the West Indies as slaves. These may be the same as the Woccon.

Waxhaw

When the English moved into Union and Mecklenburg Counties, NC, they found a small tribe called the Waxhaw. Lederer calls them Wiusacky, and "they may have been the Weesock of Gabriel Arthur, reputed to be held as a subject caste by the Yuchi" (Swanton 1946, 206). The Waxhaw occupied at least two villages in 1710. The tribe was attacked by the Catawba in 1715 and most of them were killed. The survivors joined the Cheraw and they and the Cheraw probably later merged with the Catawba. Some of the Waxhaw are most likely "represented among the Lumber River Indians" (Swanton 1946, 206).

Weapemeoc

The Weapemeoc, a small tribe or tribal confederation that included the Yeopim, Pasquotank, Poteskeet and Perquiman Tribes, lived north of Albemarle Sound in northeastern North Carolina in 1584. The population in 1600 has been estimated at 800 persons.

Woccon

Nothing is known of this tribe before the eighteenth century unless they were a branch of the Waccamaw. According to Lawson, two Woccon villages (Yupwauremau and Tooptatmeer) were located on the lower Neuse River near the present location of Goldsboro in 1709 and were inhabited by 120 warriors. Mooney estimated their population to be about 600 in 1600. It is thought that they merged into either the Tuscarora after the 1711-13 war or with the Catawba. According to Swanton (1946, 208), "it is the only one belonging to the Catawba group of Siouans besides the Catawba itself, of which a vocabulary has been preserved".

Post-European contact and modern period

Based upon official government census documents, of all the states in the Union, North Carolina has witnessed the largest increase in Native American population during the past 100 years. The U.S. Census of 1890 listed only 1,516 American Indians in the state and furthermore, according to the data, most were Cherokee American Indians in western North Carolina. It is important to note that, however, the United States did not enumerate American Indians as a separate population category until the Census of 1870. Prior to that time, American Indians were counted as "*free colored.*" The 1890 Census reported a few individual American Indians (no distinct tribal affiliation) throughout other parts of the state.

The 2000 U. S. Census of Population listed about 99,600 American Indians as residents of North Carolina, twice the number living here when the first Europeans reached these shores. The majority of those belong to the Lumbee Tribe, a tribal name that did not even exist officially until the middle of the twentieth century. The Eastern Band of Cherokees, the largest tribe in the southeast at the time of European contact, is the second largest Native American group in the state. American Indians are found in every county in the state, but most live in the Coastal Plain section of rural southeastern North Carolina. Only six states had larger numbers of American Indians in 2000: Oklahoma, California, Arizona, New Mexico, Alaska, and Washington.

American Indian population will continue to increase in North Carolina as almost forgotten American Indian cultural traditions are reestablished. A few additional groups will be recognized as Indians because it appears that today, more so than in the past, society in general tends to be more receptive to accepting them as American Indians. American Indians most certainly have not yet won all the legal battles of recognition, but they are winning some.

Since 1986 three state-recognized American Indian tribes have been added to the roster in North Carolina: the Meherrins, Sappony Indians of Person County, and the Occaneechi-Saponi Band. All are small tribes. The Sapony and Occaneechi are concentrated in the northern Piedmont while the Meherrin are in the northeastern part of the state. The tribes have significant associations, past and present, with American Indians across the border in Virginia.

The approximately 100,000 people identified as American Indians include some mixed-race and mixed-tribal groups that are not recognized as American Indians by the state or federal governments. Most federally recognized American Indian groups also refuse to recognize them. Nevertheless the mixed-race people are attempting to establish their Indian *legacy* and gain acceptance as American Indians. Many of their supporters argue that race, or bloodline, is not important because these groups are culturally distinct, and American Indian. Yet paradoxically, few people among these exhibit *cultural traits* commonly attributed specifically to American Indians. To explain this apparent lack of American Indian cultures, it is common for the groups to argue that their American Indian culture has been assimilated into the dominant European culture. Then, in what could be a contradiction to the proposal that "race is not important," they claim justification for their existence, and recognition as American Indians, on the tradition and/or official record, that somewhere in the past American Indians became a part of their bloodlines. For example, most of the groups can identify at least one person living more than one hundred years ago who was American Indian and from whom they are descended. However, even among the federally recognized American Indians, the amount of Indian blood varies from very little to *full-blooded Indian* (a person with no non-American Indian ancestors). There are probably fewer than 500 full-blooded American Indians in the state, most of whom are Cherokee living in the Snowbird community in western North Carolina.

Nevertheless, American Indian culture, at least the early twenty-first century version, is a vibrant force in North Carolina. Numerous American Indians in the state, recognized and non-recognized alike, "participate in Indian 'pow-wows' and other cultural events that enhance their Indian heritage and support the claims that they are a separate people, different, perhaps just symbolically, but still distinctly different, from others with whom they share the land" (Moore and Ross 1996: 129).

To protect their American Indian heritage, the Carolina, and other American Indians in the eastern United States, borrow American Indian traits and traditions. For example, most of the groups incorporate cultural traits from American Indians in all parts of the United States into their cultural activities. Thus it is not uncommon to see Plains or Southwestern American Indian dances being performed by Carolina American Indians dressed in the costume of the tribe that developed the dance. The racial and tribal *amalgamations* of these groups have left very little of the original tribal traditions of pre-colonial Carolina American Indians. It should be emphasized that North Carolina's American Indians are generally not attempting to reconstruct American Indian cultures that have long been extinguished in the state, but they are incorporating the American Indian traits that suit the specific and particular needs of their societies. They are creating distinctive American Indian cultures that are *pan-American Indian* rather than based on a specific tribe. In this regard, they are paralleling other cultures worldwide that are constantly modifying their cultures in order to survive in an ever-changing world.

American Indians in North Carolina are much better off economically than the reservation American Indians west of the Mississippi. The Cherokee, however, as federally recognized American Indians, benefit from many federal programs that add to their average per capita income, most of which is generated in the non-American Indian economic environment and in the Cherokee tourist industry. The Cherokee are also cashing in on gambling activities, now legal on the reservation. The Lumbee have discovered *capitalism*, and many of the *entrepreneurs* among them are doing very well. Their success encourages other American Indian groups. The smaller, state recognized tribes in North Carolina fare better than their black neighbors, but not as well as whites. The standard of living among the American Indians is in general aided by the close proximity to non-American Indian economic activities and the American Indians' willingness to interact and work among non-American Indians.

Economically the American Indians will make many gains, which could conceivably affect in a negative way their sense of "community." By this I mean that if the economy is good, and if the next generation of American Indians is not as economically deprived as those in times past, some of the incentives and motives to pursue American Indian heritages may diminish. In other words, the good life and its material rewards could dampen the desire and commitment to live life as a Native American. If that occurs, the end result will be fewer American Indian groups and tribes seeking recognition during the next few decades. The American Indian groups now existing in the state, however, will continue to function as American Indians.

The Dichotomy Between Coastal Plain and Highlands

One interesting geographic pattern is that most of the American Indian tribes and groups that have been recognized, or are seeking recognition, are located on the Coastal Plain. Notable exceptions are the Cherokee, of course, and the two Piedmont tribes, the Sappony Indians of Person County and the Occaneechi. In addition to the Coastal Plain tribes of Coharie, Lumbee, Meherrin, and Waccamaw Siouan, and many members of the Haliwa-Saponi, several other groups claiming to be American Indians reside on the Coastal Plain.

That most of the groups presently seeking recognition as American Indians are Coastal Plains residents raises the question "Why so many on the

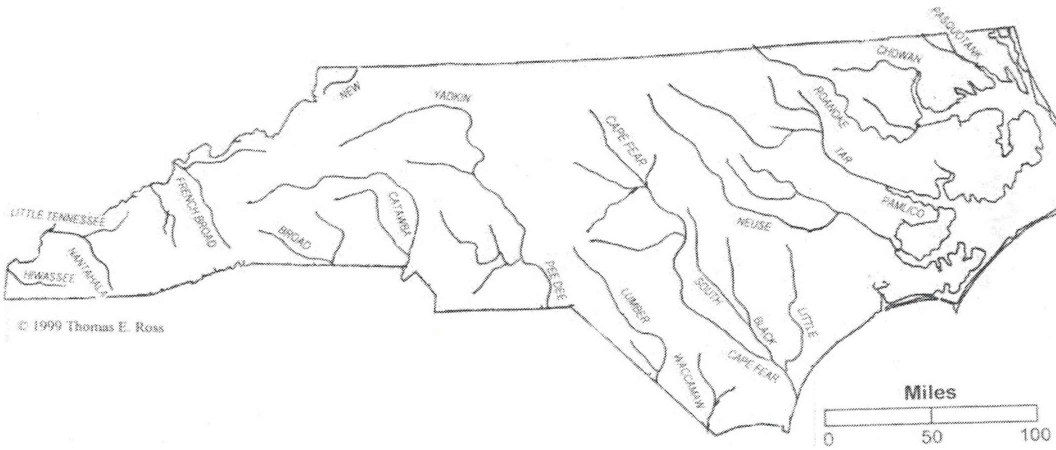

Figure 3. Outline map of North Carolina rivers (Source: Ross).

Coastal Plain?" The argument by the Coastal Plain American Indians about "isolation" being a major contributing factor to their survival appears to be just as applicable to mountainous regions. It is clear that the mountains and foothills provide numerous isolated areas, as do isolated coastal swamps where a tribal group could gather and survive. The one instance of a non-recognized group in the highlands is the Southern Metis, who apparently have no intention of seeking recognition. But they have no history of living as a separate culture; they are simply a collection of people from many different backgrounds with some American Indian ancestry, most of whom have probably identified as "white" most of their lives.

Some scholars have argued that racial mixing between American Indians, blacks and whites in the Coastal Plain was responsible for many of the groups that now claim American Indian heritage (Beale 1957, 1972; Griessman 1972; Johnson 1972; and Price 1953). Such mixing most certainly did occur in many parts of the state, but in the mountains most of the racial mixing involved American Indians and whites. Some of those offspring have chosen the "white" world while others have selected the American Indian. That the descendants with both American Indian and white blood did not choose to create a separate tribe can be explained by their options of calling themselves American Indian or white, which historically have been more economically and socially advantageous than being identified as black, which in many instances was the only option available to the Coastal Plains American Indians.

The cultural climate of the past was one in which blacks and people with black ancestry, however minuscule the black ancestry might have been, were the victims of racial prejudice. This discrimination based upon racial background could have influenced those persons with some American Indian ancestry to band together in a group as a means to overcome the institutionalized discrimination against blacks. As time passed, the group moved further away from identification with their black and white ancestors, while keeping alive the tradition of their American Indian heritage. Although along the way they lost most, if not all, aspects of American Indian culture and most groups had become assimilated into the Euro-American culture system to the point that although they might self-identify as American Indians, they were in reality a sub-set of the dominant Euro-American culture.

American Indian culture, however, is being reworked by these American Indians who are molding a new, modern culture that is a blend of traditional American Indian ways, from many different

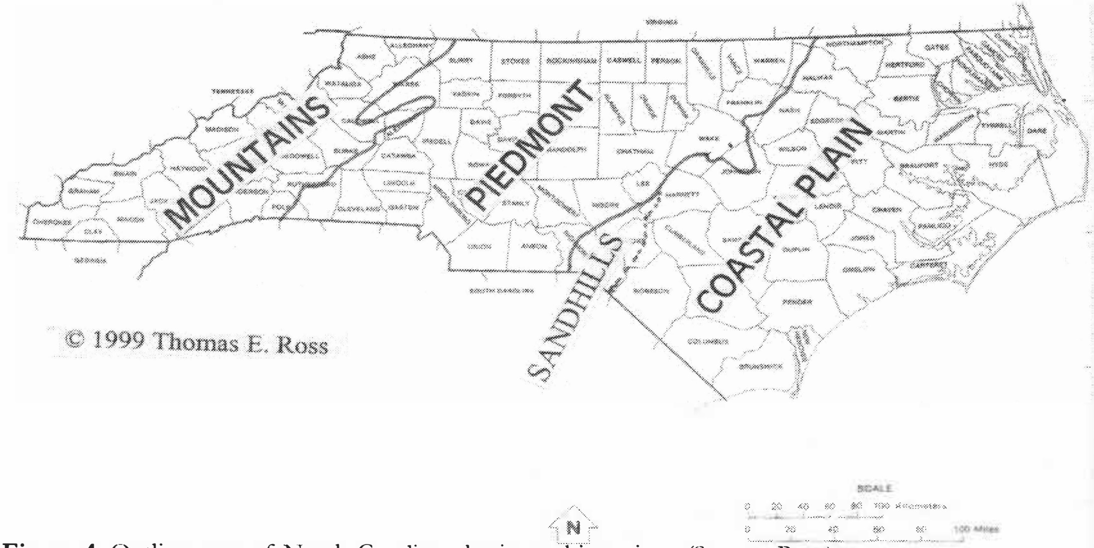

Figure 4. Outline map of North Carolina physiographic regions (Source: Ross).

tribes throughout the United States, and the highly technological world in which they must live. Although a non-American Indian might refer to it as a new creation with little connection to the American Indians that lived on the Coastal Plains of North Carolina five hundred years ago, this culture is definitely American Indian.

In conclusion, regardless of the reason, the fact is that most of the American Indians, recognized and non-recognized, in North Carolina are found on the Coastal Plain. Furthermore, there is little or no reason to expect any change in this pattern. In fact, it is likely that a few more Coastal Plains groups will apply for state recognition within the next decade while only one or two groups in the Piedmont will do so. The recognition issue, at both state and federal levels, will continue to dominate American Indian politics during the next few decades. Most of those already recognized by the state will try to gain federal recognition. A few more unrecognized groups will probably emerge, most of whom will be splinter groups of larger tribes persons in isolated areas reclaiming an American Indian heritage long dormant. These too may also eventually seek recognition from state and federal agencies.

IV. ACTIVITIES

1. To begin the lesson, I would make a transparency or graph of the first column of Table 1, with the names of colonial American Indian tribes, and ask students the following questions:
   a. How many of these tribes have you heard of before?
   b. Use the third column to explain where they were located within the state?
   c. Use the fourth column to determine their current status.
2. Task 1 can be followed with a graphic that uses some of the drawings of White and others. Ask students:
   a. What is distinctive about their dress?
   b. What materials do they use to make their tools?
   c. Were you aware of how American Indian villages and towns were arranged?
3. Use the rivers outline map (Figure 3) to show where the American Indian tribes mentioned in the preceding text were located. [Label each tribe's approximate location; label the rivers]
4. Were rivers important in the various tribe's location decisions? If you think they were, explain why.

Figure 5. Outline map of North Carolina county boundaries (Source: Ross).

Table 1. American Indians in North Carolina during the Colonial Period.

Tribe	Population	Location	Status
Cape Fear	not available	South-central NC to eastern SC	Extinct
Catawba	4600 in 1682	One band in western SC; another in central SC	Live on reservation in York County, SC
Cheraw	1000 in 1600 510 in 1715	Northwest SC to western NC to central NC to central SC	Most likely merged with Catawba, but some could have moved into Robeson and surrounding counties in NC
Cherokee	8,000 in 1600	Western NC & SC	Live on reservation in western NC (Swain, Graham, Jackson Co.]
Chowanoc	240 in 1713	Chowan River northcentral NC	Extinct
Coree	75 in 1709	Neuse River NC	Extinct
Eno	750 in 1600	Tar & Neuse Rivers in NC to Hillsboro, NC to SC	Merged with Catawba
Hatteras	89 in 1709	Cape Hatteras, NC	Extinct
Keyauwee	500 in 1600	High Point, NC to Albemarle Sound to Pee Dee River, SC	Merged with Catawba
Machapunga	260 in 1709	Pee Dee R., SC to Albemarle and Pamlico Sounds	Extinct
Meherrin	not available	Roanoke River, NC	Merged w/Tuscarora ?
Moratok	not available	Roanoke River, NC	Extinct
Neusiok	not available	Neuse R. Craven/Carteret, NC	Merged w/Tuscarora ?
Nottoway	300 in 1715	Western North Carolina	Merged with Cherokee ?
Occaneechi	750 in 1709	Orange County, NC	Removed to northern US, ca 1740
Pamlico	75 in 1709	Pamlico R. coastal NC	Enslaved & merged into Tuscarora
Saponi	750 in 1709	Yadkin R., Salisbury, NC	Migrated north, one band stayed in Granville County, NC
Shakori	not available	SC to Nottoway R, NC to Eno R., near Durham, NC	Merged with Eno, then finally blended with Catawba
Sissipahaw	not available	Santee River, SC to Haw River, NC	Merged with Catawba, some may have moved to Lumber River, NC
Sugeree	not available	Mecklenburg County, NC and York, SC	Merged with Catawba
Tuscarora	1,200 warriors in 1709	Roanoke, Neuse, Tar and Pamlico rivers, NC	Migrated to New York and other northern states
Waccamaw	610 in 1715	Waccamaw River, NC and Lower Pee Dee, SC	Merged with Catawba, some may have moved to Lumber River, NC
Waxhaw	not available	Western SC (North Augusta) to Lancaster, SC to Mecklenburg and Union counties, NC	Merged with Cheraw, later with Catawba, some may have moved to Lumber River, NC
Weapeneocs	800 in 1600 40 in 1701	Northeast NC	Extinct
Woccon	600 in 1600	Goldsboro, NC	Some merged with Tuscarora, some with Catawba
Source: Swanton, J. R. 1946. *Indians of the southeastern United States*. pp. 90-213. Washington, DC: Smithsonian Institution Press.			

Table 2. American Indians in North Carolina: 2000

Indians in North Carolina, 2000			
County	Total Population	American Indians	
		Number	Pct.
Alamance	130,800	462	0.35
Alexander	33,603	50	0.15
Alleghany	10,677	28	0.26
Anson	25,275	113	0.45
Ashe	24,384	79	0.32
Avery	17,167	58	0.34
Beaufort	44,958	74	0.16
Bertie	19,773	87	0.44
Bladen	32,278	657	2.04
Brunswick	73,143	494	0.68
Buncombe	206,330	803	0.39
Burke	89,148	270	0.30
Cabarrus	131,063	443	0.34
Caldwell	77,415	162	0.21
Camden	6,886	29	0.42
Carteret	59,383	258	0.43
Caswell	23,501	45	0.19
Catawba	141,685	365	0.26
Chatham	49,329	201	0.41
Cherokee	24,298	396	1.63
Chowan	14,526	43	0.30
Clay	8,775	29	0.33
Cleveland	96,287	145	0.15
Columbus	54,749	1,706	3.12
Craven	91,436	388	0.42
Cumberland	302,963	4,691	1.55
Currituck	18,190	83	0.46
Dare	29,967	83	0.28
Davidson	147,246	545	0.37
Davie	34,835	79	0.23
Duplin	49,063	113	0.23
Durham	223,314	660	0.30
Edgecombe	55,606	109	0.20
Forsyth	306,067	923	0.30
Franklin	47,260	208	0.44
Gaston	190,365	525	0.28
Gates	10,516	44	0.42
Graham	7,993	547	6.84
Granville	48,498	222	0.46
Greene	18,974	57	0.30
Guilford	421,048	1,944	0.46
Halifax	57,370	1,801	3.14
Harnett	91,025	794	0.87
Haywood	54,033	266	0.49
Henderson	89,173	245	0.27
Hertford	22,601	269	1.19
Hoke	33,646	3,852	11.45
Hyde	5,826	18	0.31
Iredell	122,660	328	0.27
Jackson	33,121	3,379	10.20
Johnson	121,965	494	0.41
Jones	10,381	37	0.36
Lee	49,040	206	0.42
Lenoir	59,648	106	0.18
Lincoln	63,780	172	0.27
McDowell	42,151	122	0.29
Macon	29,811	84	0.28
Madison	19,635	53	0.27
Martin	25,593	74	0.29
Mecklenburg	695,454	2,439	0.35
Mitchell	15,687	70	0.45
Montgomery	26,822	108	0.40
Moore	74,769	506	0.68
Nash	87,420	397	0.45
New Hanover	160,307	627	0.39
Northampton	22,086	71	0.32
Onslow	150,355	1,108	0.74
Orange	118,227	457	0.39
Pamlico	12,934	68	0.53
Pasquotank	34,897	130	0.37
Pender	41,082	201	0.49
Perquimans	11,368	20	0.18
Person	35,623	218	0.61
Pitt	133,798	357	0.27
Polk	18,324	34	0.19
Randolph	130,454	582	0.45
Richmond	46,564	770	1.65

Table 2 (continued). American Indians in North Carolina: 2000

Robeson	123,339	46,896	38.02
Rockingham	91,928	250	0.27
Rowan	130,340	433	0.33
Rutherford	62,899	125	0.20
Sampson	60,161	1,086	1.81
Scotland	35,998	3,197	8.88
Stanly	58,100	144	0.25
Stokes	44,711	109	0.24
Surry	71,219	165	0.23
Swain	12,968	3,765	29.03
Transylvania	29,334	83	0.28
Tyrrell	4,149	8	0.19
Union	123,677	475	0.38
Vance	42,954	85	0.20
Wake	627,846	2,152	0.34
Warren	19,972	957	4.79
Washington	13,723	7	0.05
Watauga	42,695	108	0.25
Wayne	113,329	412	0.36
Wilkes	65,632	95	0.14
Wilson	73,814	199	0.27
Yadkin	36,348	59	0.16
Yancey	17,774	60	0.34
STATE	**8,049,313**	**99,551**	**1.24**

5. Based upon what you have mapped for Task 3, do you think there was, or could have been, interaction between any of the tribes? If so, which ones and why did they interact?
6. Draw the general migration route of the following tribes: Cheraw, Eno, Keyauwee, Machapunga, Shakori, Sissipahaw, and Tuscarora. Use a separate symbol–solid line, broken line, double-line, etc. for each tribe. (See material provided in the Table 1)
7. Which Piedmont/Coastal Plain river basin contained the most American Indians at time of contact? Offer some explanations why so many American Indians chose to live here.
8. Use physiographic regions of NC map to locate the American Indian tribes living in the Mountains, Piedmont, Coastal Plain.
9. American Indians spoke many different languages when Europeans arrived here. Identify two or three tribes whose language was included in the following language subfamilies:
   a. Iroquoian
   b. Siouan
   c. Algonquian

Use Table 2 to respond to the following:

10. Construct a map (Figure 5) showing the ten counties in the state where American Indians make up more than two (2) percent of the total county population in 2000 (Table 2) and make a list of counties with 10 percent or more of total population listed as American Indians.
11. Use data provided in the 2000 population data table (Table 2) to construct a map of Native American distribution in North Carolina. Create five categories and symbols to show distribution patterns.

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Eratum

The Geography of Republicans in North Carolina: Voter Registration and Income
Libby Brown and Keith Debbage

The North Carolina Geographer 12: 10-20.

There was an editorial error in *The North Carolina Geographer* Volume 12 article "The Geography of Republicans on North Carolina: Voter Registration and Income" by Libby Brown and Keith Debbage. During the copy editing phase of journal production, an incorrect version of "Figure 3: Household Income in North Carolina, 1999" was placed in the manuscript on p. 17. The correct version of Figure 3 is displayed below. A pdf file of the article with the correct figure is available free of charge. If you desire a copy of the correct manuscript please contact Doug Gamble (gambled@uncw.edu).

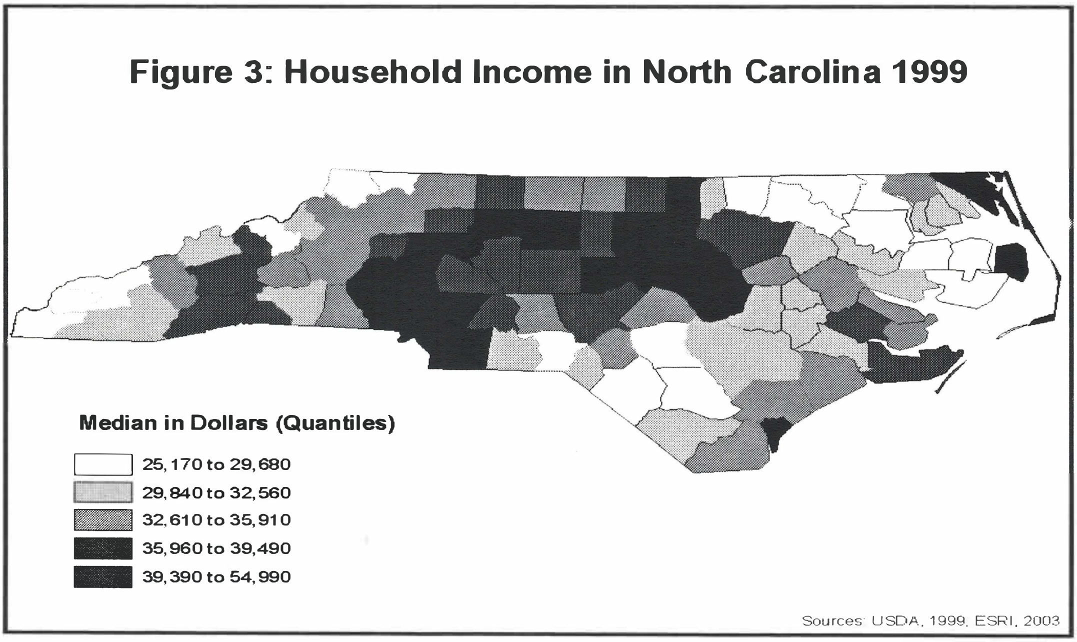

Figure 3: Household Income in North Carolina 1999

UNCW

The Department of Geography and Geology at the University of North Carolina Wilmington offers a Bachelor of Arts degree in Geography. Students who pursue the B.A. degree in geography may choose from a broad, flexible program that meets personal educational goals and interests, including careers and graduate study in physical or human geography, planning or applied geography. The Department of Earth Sciences also offers a certificate in Geographic Information Science (GIS). The certificate enables students to achieve a documented expertise in geographic techniques which can then be leveraged to gain employment in the expanding GIS job market. UNCW Geography also supports a vibrant internship program that places students in a wide variety of professional agencies in southeastern North Carolina.

There are three options of concentration for students in the Geography Program at UNCW:

The **applied geography** option is designed for students who are interested in careers as planners, GIS specialists, and historic preservationists.

The **human geography** option is designed for students who wish to pursue a career as regional specialists, international business officials, and social scientists.

The **physical geography** option is designed for students planning careers as meteorologists, climatologists, geomorphologists, and hydrologists.

Faculty research interests include settlement geography of the South, the urban georgaphy of Moscow, fluvial systems of the Coastal Plain, applied climatology of islands and coasts, GIS applications in watershed management, and the racial landscape of the South. Students are encouraged to participate with faculty in their research and also pursue individual research projects. The geography program makes extensive use of computers for both laboratory and classroom instruction. The department maintains state-of-the-art Spatial Analysis Laboratory (SAL), Cartography Laboratory, the Laboratory for Applied Climate Research (LACR), and a Sediment Analysis Laboratory.

For more information, contact
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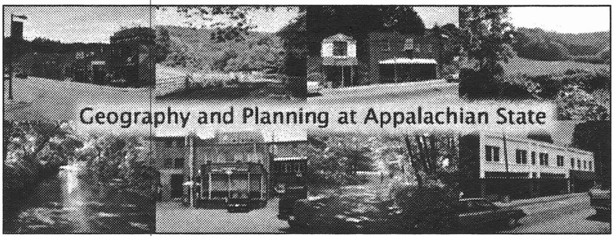

APPALACHIAN STATE UNIVERSITY
Department of Geography & Planning
www.geo.appstate.edu

DEGREES OFFERED

B.A in Geography
B.S. in Geography (teaching)
B.S. in Geography (general concentration)
B.S. in Geography (geographic information systems)
B.S. in Community and Regional Planning
M.A. in Geography with thesis or non-thesis (general geography or planning concentrations) options

RESEARCH FACILITIES

The Department occupies part of a renovated science facility and contains two computer laboratories for work in computer cartography, GIS, and image processing. The laboratories have microcomputers networked to each other and to the campus mainframe cluster. Appropriate peripherals include digitizers, scanners, printers, and plotters. The Department maintains a full suite of professional GIS, image processing, graphic design and statistical software applications in its laboratories. The Department map library presently possesses over 50,000 maps and 1,000 volumes of atlases, journals, and periodicals; and is also a repository for census material available on CD-ROM including TIGER files, DLGs, and other digital data.

GRADUATE PROGRAM

The Masters program in geography is designed to provide students with a broad range of academic and professional options, preparing them for Ph.D. work in geography and planning, professional applications in GIS, or opportunities in teaching at all educational levels. Thesis or non-thesis options are offered, with the non-thesis option requiring an internship in regional, urban, or environmental analysis and planning. In addition, the Department participates in a program leading to the Master of Arts degree in Social Science with preparation in geographic education.

For further information, please contact:

Department Chair: Dr. Jim Young (youngje@appstate.edu)
Graduate Program Coordinator: Dr. Kathleen Schroeder (schroederk@appstate.edu)
Program Inquiries: Kathy Brown (brownkv@appstate.edu)

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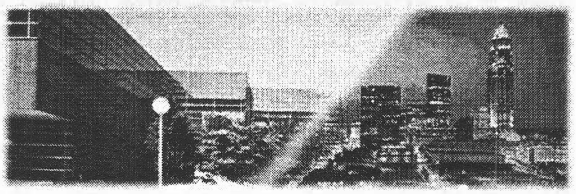
The University of North Carolina at Charlotte Master of Arts in Geography



Our graduates enjoy successful careers as site location and marketing analysts, community planners, and GIS analysts. Approximately 10% of the program's 260 graduates have gone on to study in Ph.D. programs.

Program Concentrations

Community Planning Track students are awarded the M.A. in Geography and complete a formally structured multi-disciplinary core curriculum with course work in Geography, Architecture, Economics and Public Administration. The Track has Academic Common Market approval for in-state tuition status for qualified applicants.

Location Analysis Concentration students prepare for careers with retailers, real estate developers, consulting firms, commercial banks, and economic development agencies. Course work is offered by practicing professionals and focuses in: Retail Location, Market Area Analysis, Real Estate Development, Applied Population Analysis, Real Estate Development, and Industrial Location.

Urban-Regional Analysis Concentration trains students for public and private sector planning economic development and Geographic Information Science. Course work may be concentrated in one of the following areas: Economic and Regional Development, Site Feasibility Analysis, Urban Development, and Geographic Information Science.

Financial Support includes a limited number of out-of-state tuition waivers and a significant number of graduate teaching or research assistantships. Typical stipends include awards of $10,000 for the academic year, and the program is recruiting research assistants for the Center for Applied Geographic Information Science at up to $11,000 for the academic year. All current full-time students receive financial support via assistantships or via contract work.

For further information, visit our website at **http:// www.geoearth.uncc.edu/** or contact Dr. Tyrel G. Moore, Graduate Coordinator, Geography M.A. Program at tgmoore@email.uncc.edu, or via telephone (704-687-4250).

THE UNIVERSITY OF NORTH CAROLINA

GREENSBORO

DEPARTMENT of GEOGRAPHY

UNDERGRADUATE PROGRAM:

For over half a century, the Geography Department at UNCG has developed its programs and resources to prepare students for careers and advanced research in Geography. Today the program is characterized by a strong integration of the human, physical, and technical components of the discipline. The geography major can choose a general degree or a degree with a concentration in Urban Planning or Earth Science/Environmental Studies.

MASTERS in APPLIED GEOGRAPHY:

This program focuses on the application of geographic theory and methods toward the understanding of problems related to land use, economic development, environmental quality, population dynamics and social well being in different locational contexts: urban, rural, regional, and international. The curriculum leads to the acquisition of the theoretical constructs of geography and the research skills appropriate to geographic analysis, including spatial statistics, cartography, remote sensing and GIS.

POST-BACCALAUREATE CERTIFICATE in GEOGRAPHIC INFORMATION SCIENCE:

The Department offers an innovative Post-Baccalaureate Certificate in Geographic Information Science. The 18 hour program provides professionals with the knowledge and skills needed to effectively utilize spatial analytic tools, geographic data visualization techniques, spatial programming, mapping, and geographic image processing software. Emphasis is on the application Geographic Information Science in the fields of planning, environmental assessment, remote sensing, cartography, and economic development.

ANNOUNCING THE NEW Ph.D. PROGRAM in GEOGRAPHY:

Beginning in the Fall of 2004 the Department of Geography will offer a new graduate program of study leading to the Ph.D. in Geography. Building on the traditional strengths of the department and the anticipated addition of three new faculty lines the program will be an innovative doctoral program designed primarily for persons who are preparing for careers which apply geographic theory, method, information theory, and other skills to solving real-world spatial problems.

FOR UNDERGRADUATE INFORMATION:

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melewis@uncg.edu

FOR GRADUATE INFORMATION:

Contact: Dr. Elisabeth Nelson
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esnelso2@uncg.edu

EAST CAROLINA UNIVERSITY

Department of Geography

PROGRAMS AND RESEARCH FACILITIES

Undergraduate tracks include the B.A. in Geography and the B.S. in Applied Geography. The former is a broadly-based geography program, drawing courses from human and physical geography, as well as techniques. The latter has a strong emphasis on spatial analysis, and requires an internship in a state agency or private firm.

At the graduate level the Department specializes in human geography, physical geography and spatial information technologies, and supports a variety of philosophical and methodological approaches within each of these areas. Students are encouraged to develop their research in conjunction with faculty, and to disseminate their findings via professional meetings and journals. Faculty expertise is clustered around the following:

Economic Geography: development policies, practices, and impacts; urban and rural restructuring; and geographic thought (political economy, feminist theory, critical geopolitics).

Cultural Geography: community development; tourist landscapes; cultural ecology; and field methods.

Coastal Plain Geomorphology: coastal geomorphology (aeolian processes and dune formation); drainage basin hydrology; fluvial geomorphology; soil geomorphology; and environmental management (natural hazards research, land and water use planning).

Spatial Information Technologies: geographic information systems (watershed/ environmental modeling, topographic effects on digital data); remote sensing and image processing, computer cartography (global databases and map projections), and spatial quantitative methods.

Regional Specializations: Africa-East; Africa-South; Asia-South; Caribbean; Middle East; North Carolina; Western Europe.

Faculty are actively engaged in research in all four clusters, and have received multiple-year grants from, amongst others, the U.S. Department of Agriculture, the National Science Foundation, the New Jersey Sea Grant Program, N.A.S.A. and the U.S. Forest Service.

The department maintains both a fully equipped physical geography laboratory and a Unix-based Spatial Data Analysis Laboratory. The physical geography laboratory is designed for mechanical analyses of soil and sediment, but also includes state-of-the-art GPS, electronic surveying equipment, and instrumentation for monitoring hydrologic and aeolian processes and responses. The spatial laboratory consists of ten Sun workstations, a large format digitizer, and an Esize DesignJet plotter for teaching and research. Primary software includes Arc/Info, ArcView, and Imagine. A PC-based cartography laboratory was recently established. Students also have access to a wide variety of university facilities including the Institute for Coastal and Marine Resources, the Regional Development Institute, International Programs, and the Y.H. Kim Social Sciences Computer Laboratory. The Kim laboratory provides access to PC-based software such as Adobe Illustrator, ArcView, Atlas*GIS, IDRISI, SAS, SPSS, and Surfer.

FOR CATALOG AND FURTHER INFORMATION WRITE TO:

Undergraduate Catalog: Director of Admissions, Office of Undergraduate Admissions, East Carolina University, Greenville, North Carolina 27858-4353.
Tel.: (919) 328-6640. World Wide Web: http:/www.ecu.edu/geog
Graduate Catalog: Graduate School, East Carolina University, Greenville, North Carolina 27858-4353.
Tel.: (919) 328-6012. Fax: (919) 328-6054.

Guidelines for Authors

The North Carolina Geographer is an annual, peer-reviewed journal published by the North Carolina Geographical Society and serves as a medium for the dissemination of research concerning phenomena of regional interest. Contributions are welcome and should conform to the Guidelines for Authors presented below.

All manuscripts submitted to *The North Carolina Geographer* should be in acceptable form and ready for peer-review. Contributions should adhere to the following general guidelines.

- Send one elctronic copy and one original and two hard copies of the manuscripts. Only original, unpublished material will be accepted.

- All manuscripts should be on 8 ½ " x 11" paper. Type on only one side of the page. Type should be 10 or 12 point font and double-spaced. One inch margins should be used on all sides.

- References are to be listed on separate pages, double spaced, and in alphabetical order by author's last name. Please follow the *Annals of the Association of American Geographers* refrence format.

- Figures and tables should be submitted on separate pages at the end of the manuscript and electronic versions of figures should be TIFF format. Privide a list of figure and table captions on a page seperate from the main text of the manuscript.

- High quality, black and white photographs may be included.

Send manuscripts to:
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Volume 13, 2005

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