

The North Carolina Geographer

Volume 12, 2004



FROM THE EDITORS

Dear Geographers,

Beginning with this issue, editorship of *The North Carolina Geographer* is being assumed by Mike Benedetti, Doug Gamble, Joanne Halls and Liz Hines at the University of North Carolina Wilmington. We would like to thank the UNCW Department of Earth Sciences for facilities and student support as we take this new role. Our goal is to build upon the foundation laid by Ole Gade, Deborah Dixon, Patrick Pease, and Jeff Popke over the previous eleven volumes. The goal of the journal has not changed; it is to highlight research on the geography of North Carolina, and topics of interest to geographers working in North Carolina. Toward this end, we have designed a new section that will compliment the traditional research articles in the journal. Named Carolina Landscapes, this section will include field reports, interviews, lessons plans, and book reviews to provide geographic perspectives on issues that have shaped the North Carolina landscape. We are very interested in feedback about this new feature of the journal.

For the 2004 version of Carolina Landscapes, members of the Atmospheric Science Program at East Carolina University offer a geographic perspective of the 2004 hurricane season, one of the most active on record. Justin Arnette, a geographer with the U.S. Army Corps of Engineers (and UNC-Wilmington alumnus), discusses his application of GIS skills in Afghanistan. Frank Ainsley, who was recognized as 2003 Educator of the Year by the North Carolina Geographical Society, offers a teaching lesson on cultural geography and architecture in eastern North Carolina. We look forward to an entry by Tom Ross, the 2004 recipient of the ward, in the next issue.

Finally, we wish to 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. Submit a manuscript yourself or encourage your colleagues and students. We are currently accepting submissions for the 2005 issue.

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

Sincerely,

Mike Benedetti (editor for physical geography)

Doug Gamble (editor for Carolina Landscapes)

Joanne Halls (editor for applied geography)

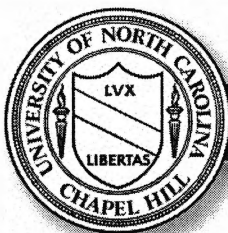
Liz Hines (editor for human geography)

Melanie Wemple (editorial assistant)

About the Cover

Greg Dobson (Appalachian State University) took this picture December, 2003, in Madison County, NC.

Authors alone are responsible for opinions voiced in this journal. Please direct inquiries concerning subscriptions and availability 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 16 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.

Undergraduate Program. UNC's Department of Geography offers a broadly based B.A. degree with concentration in three areas—the geography of human activity, earth systems science, and geographic information sciences. A well-equipped teaching lab directly supports undergraduate teaching and research in Geography, while a range of state-of-the-art facilities can be found at several venues on campus. Students are urged to participate in the University's superior undergraduate programs and resources, undergraduate research, and internships. The department has a student exchange program with Kings College London.

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Effects of Information on Knowledge about *Pfiesteria* and Seafood Consumption

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Coverage of fish kills attributed to toxic algal outbreaks by both the media and members of the scientific community have caused seafood eaters to reconsider or abandon their seafood consumption habits. One government agency (EPA) has tried to ameliorate public fears caused by misinformation by providing brochures of the best available data on safety issues involved in these outbreaks. This study addresses the effectiveness of information disseminated to the public concerning a rather complex natural phenomenon. Telephone interviews were used to access the effects of brochure information on respondents' characterization of the organism *Pfiesteria*, and their probable response in terms of seafood consumption. The random effects probit model is used as well to quantify probable effects of toxic algal outbreaks on seafood consumption in view of the respondents understanding of the phenomenon (cultural model) and socioeconomic traits.

Introduction

Pfiesteria piscicida (*Pfiesteria*), identified by Burkholder et al. in (1992), is an alga that has been associated with fish kills in Delaware, Maryland, North Carolina, and Virginia.¹ While generally not a problem to fish populations, *Pfiesteria* can, under certain conditions, exhibit toxic life phases², which when in contact with fish result in their skin lesions, paralysis, or death. *Pfiesteria* is not a form of pollution, a disease, nor a parasite, yet direct contact with the water of the kill and with the air directly above these waters is purported to cause disorientation, memory loss, and skin rashes in humans (Burkholder and Glasgow 1999; Buck et al. 1997).

The novelty and complexity of the organism, and the ensuing lack of scientific consensus, allowed for the dissemination of misleading information. News stories concerning *Pfiesteria* dramatized its "predatory" nature, giving little attention to ongoing scientific debate. Its characterization is disputed even among those who specialize in the biological sciences. Burkholder (1995) refers to the organism specifically as a "...toxic ambush-predator dinoflagellate" (p.177), while other scientists consider the organism only one

of many stressors that contribute to fish kills in degraded estuarine environments (Pearl et al. 1998).

In the late 1990s, association between fish-kills and *Pfiesteria* led to a media driven scare about seafood safety. In some cases the stories went so far as to wrongly portray *Pfiesteria* as a disease-causing pathogen. Another dramatization was to attribute all sores and lesions on fish to *Pfiesteria* (even though algae are one of the least likely causes of such maladies). Coupled with fictional stories³ and official quarantine policies (of fish kill areas), public alarm ensued. As documented by Lipton (1999), the resulting losses in the tourism and seafood industry sales in Delaware, Maryland, North Carolina, and Virginia approached 43 million and losses to recreational fishing about four million.

Problems regarding the accuracy of public understanding became especially apparent as the public ignored new information, and as public concerns about coastal pollution and food safety generated confusion and contradictory consumer behavior (Johnson and Griffith 1996). Concerns grew even as reports were published that should have reduced anxiety. In terms of human exposure to fish kill waters,

Griffith (1999) found that there was no higher incidence of disease in commercial crabbers exposed to *Pfiesteria* inhabited waters than those working in *Pfiesteria*-free waters, and Buck et al. (1997) showed that no illnesses resulted from eating fish harvested from *Pfiesteria* outbreak areas and that the air from areas adjacent to fish kill sites was not dangerous. In addition, state and federal agencies designed informational campaigns to reassure the public that seafood and coastal waters are safe. In spite of these reports, Kempton and Falk (2002) found that many people persisted in their characterization of *Pfiesteria* as a pollutant, toxin, disease, or parasite. They argued that due to socio-economic, cultural, or political reasons, many people rejected scientific evidence in favor of simplified models that coincided with individual experience and understanding. They concluded that people tended to retain these models even when faced with contrary scientifically based information.

In this paper we further consider the effects of information on knowledge about *Pfiesteria*. We specifically examine the effects of scientific information on individual intentions to reduce seafood consumption. The data is from a three-phase study. In the first phase, a telephone survey of mid-Atlantic residents was conducted to determine the degree to which concerns about *Pfiesteria* impacted their seafood consumption habits. In the second phase, respondents were mailed scientific information about associations between *Pfiesteria* and seafood safety designed to reduce public alarm. In the final phase, respondents were again surveyed to determine whether or not the information caused any significant changes in respondents' intentions to consume seafood.

We hypothesize that informational brochures produced and disseminated by government agencies of the best available scientific data concerning natural phenomena that have induced public alarm are helpful in mitigating that alarm. We also propose that the ability to assimilate and use that information in terms of risk-assessment is contingent on individual education level, as well as individual capacity to understand relatively complex cultural models that may be outside their realm of experience. In view of this, we expect socio-economic differentiation displayed within respondent data. The following sections de-

scribe the conceptual model as it informed our research hypothesis, the details of our survey methods, and the results. The final section discusses the broader implications and conclusions of information dissemination and cultural models.

Model

We consider a model of how information affects seafood consumption in two ways: directly using a linear model and indirectly through the cultural model (i.e., knowledge) of *Pfiesteria*. As defined by Kempton and Falk (2002), "a cultural model is a simplified way of understanding a complex system, shared by members of a culture." Kempton and Falk find that those who think of *Pfiesteria* in incorrect ways, as a pollutant, a toxin, or as a disease or parasite in fish, behaved in similar ways. Information in the *Pfiesteria* brochure and counter information insert asserts that marketed seafood is safe even after *Pfiesteria* outbreaks. It is proposed that this information will make it less likely that consumers will reduce their seafood consumption. Information in the *Pfiesteria* brochure describes *Pfiesteria* as a potentially toxic organism. If respondents accept this information, a more appropriate cultural model of *Pfiesteria* will be developed by the time the second survey takes place. Those respondents who consider *Pfiesteria* to be a toxic organism relative to a form of pollution or a disease in fish will be less likely to reduce their seafood consumption after *Pfiesteria* outbreaks.

We estimate the factors that affect the dependent variables using the random effects probit model ((Greene, 1998) see (1) below). The probit model is a statistical approach for analyzing the determinants of an event, or to gauge the probability of a response that can be quantified as a discrete variable. In this case, the response to a *Pfiesteria* episode may be a decrease in consumption of seafood, so the quantification of the discrete dependent variable equals one if seafood consumption is reduced and zero if it stays the same.

$$(1) \quad \begin{aligned} y_{i1t} &= \alpha_1' X_i + \beta_1' I + e_{i1t} \\ y_{i2t} &= \alpha_2' X_i + \beta_2' I + \delta y_{i1t} + e_{i2t} \end{aligned}$$

where y_{ijt} are dummy dependent variables, $i = 1, \dots, n$, $j = 1, 2$, $t = 1, 2$, α_i , β_j are parameter vectors, δ is a lone parameter, X_i is a vector of independent control variables, I is a vector of information variables, and e_{ijt} are error terms.

The dummy dependent variables measure the underlying latent continuous dependent variables

$$2) \quad y_{ijt} = \begin{cases} 0 & \text{if } y_{ijt}^* \leq 0 \\ 1 & \text{if } y_{ijt}^* > 0 \end{cases}$$

The dummy dependent variables measure knowledge about *Pfiesteria* (TOXIC, $j = 1$) and the intention to reduce seafood consumption after a *Pfiesteria* outbreak (REDUCE, $j = 2$).

The probit model estimates the probability, π , of the outcome variable using the normal distribution

$$(3) \quad \begin{aligned} \pi(y_{itl} = 1) &= \phi(\alpha_i' X_i + \beta_j' I) \\ \pi(y_{itl} = 1) &= \phi(\alpha_i' X_i + \beta_j' I + \delta y_{ijl}) \end{aligned}$$

where ϕ is the standard normal distribution function.

As analysis of discrete dependent variables is a challenge if linear models are used because of heteroskedasticity and the prediction of probabilities, the problem model imposes a functional form restriction on the data, which involves a normally distributed error term and constrains predicted probabilities to between zero and one. Since we have two observations on each dependent variable (i.e., first and second surveys) we treat the data as a panel. The random effects probit model is a panel data extension of the simple probit model where the error term accounts for the correlation across respondents. The error terms are distributed normally and are composed of two parts

$$(4) \quad e_{ijt} = v_{ij} + u_{ijt}$$

where v_{ij} is the normally distributed random error with mean zero and variance, σ_v^2 , u_{ijt} is the error common to each individual with mean zero and variance, σ_u^2 , and $\sigma_e^2 = \sigma_v^2 + \sigma_u^2$. The correlation in error terms, $\rho = \sigma_v^2 / \sigma_e^2$ is the ratio in individual

variance to total variance and is a measure of the appropriateness of the random effects specification.

Since the *Pfiesteria* brochure and counter information insert appear after the first survey ($t = 1$) the variables in the information vector take on a value of 0 in the first time period

$$5) \quad I = \begin{cases} 0 & t = 1 \\ I & t = 2 \end{cases}$$

The information variables are dummy variables for whether the respondent received the *Pfiesteria* brochure (BROCHURE = 1) and counter information insert (COUNTER = 1). If the respondent did not receive the information the values of the dummy variables are zero. Control variables are the demographics and state dummy variables found in Table 2.

Survey

A telephone-mail-telephone survey of Delaware, Maryland (including District of Columbia), North Carolina and Virginia seafood eaters was conducted from August 2000 through November 2000. The first telephone survey was designed to collect information on past and current seafood consumption patterns, prices paid for seafood, health risk perceptions, attitudes about associations between seafood and *Pfiesteria* and contingent seafood consumption, and socioeconomic information (See Haab et al. (2002) for details).

Respondents who agreed to participate in the follow-up telephone survey were sent an information mail-out consisting of four parts: a *Pfiesteria* brochure, a counter information insert, a hypothetical fish kill scenario, and a description of a seafood inspection program. The *Pfiesteria* brochure is based on the U.S. Environmental Protection Agency (2001) brochure titled "What you should know about *Pfiesteria piscicida*." The Environmental Protection Agency's brochure was shortened, simplified and revised based on comments received from focus groups and from reviews by scientists familiar with the *Pfiesteria* literature. The purpose of the brochure was to provide

descriptive information and educate respondents about *Pfiesteria*.

Some respondents received a counter information insert in the brochure. The purpose of the counter information was to provide additional information about *Pfiesteria* and seafood, swimming and boating safety and inform respondents about the governmental response to *Pfiesteria*. This information focused on the safety of these activities and emphasized that government was taking action to protect public health. About 80% of the sample received the *Pfiesteria* brochure. About 40% received the counter information. About 20% received neither sources of information.

The *Pfiesteria* brochure contained the following text about human health problems and *Pfiesteria*:

"Any human health problems associated with *Pfiesteria* are from its release of toxins into coastal waters. Preliminary evidence suggests that exposure to waters where toxic forms of *Pfiesteria* are active may cause memory loss, confusion, and a variety of other symptoms including respiratory, skin and gastrointestinal problems. ... There is no evidence that *Pfiesteria*-associated illnesses are associated with eating finfish or shellfish."

The counter information insert states: "In general, it is safe to eat seafood. There has never been a case of illness from eating finfish or shellfish exposed to *Pfiesteria*. There is no evidence of *Pfiesteria*-contaminated finfish or shellfish on the market. There is no evidence that illnesses related to *Pfiesteria* are associated with eating finfish or shellfish." The insert then recommends to obey public health advisories and to avoid contact with water and fish during a fish kill.

The second telephone survey was designed to collect information on seafood consumption patterns, health risk perceptions, seafood consumption, and attitudes about seafood and *Pfiesteria*, as well as socioeconomic information. Most of the questions were identical or similar to questions asked in the first survey. The purpose of these questions is to determine if attitudes and behavior change after receiving the scientific information.

The sample frame includes seafood eaters in all of Delaware and the eastern parts of Maryland, North Carolina and Virginia. It was stratified based on an urban/rural split and on a North Carolina/Maryland fish kill split. The goal was to conduct the survey during fish kill season: June through November. The first telephone survey was conducted from August to October. About one week after respondents agreed to participate in the second telephone survey the information booklet was mailed. About three weeks after the information was mailed interviewers attempted to contact the respondents. The second survey was conducted from October through November.

One thousand eight hundred and seven completed interviews were conducted. Dividing the completed interviews by contacts (contacts include refusals and completed interviews) yields the response rate of 61%. This response rate varies significantly by state. The response rate in North Carolina is highest at 69%. The response rates in Delaware, District of Columbia, Maryland and Virginia are described in Table 1.

Seventy percent of respondents to the first survey and 47% of those contacted for the first survey agreed to participate in the second survey. The response rate to the second survey is 73% of those who were contacted for the second survey and 28% of those contacted for the first survey. More than 77% of Delaware and Maryland respondents and a little less than 70% of North Carolina and Virginia respondents had heard about *Pfiesteria* before the first survey.

Data

Summary statistics and variable descriptions are presented in Table 2 for all those who had heard about *Pfiesteria* in the first survey and responded to both surveys (n=454). The average number of years lived in the state of residence is 29. The typical household has two parents and one child. The typical respondent is 45 years old with years of schooling is 15. Forty-one percent of the sample is male and 78% is white. Thirty-one percent live in an urban county. The average annual household income is \$57,200. Forty-two percent of the sample lives in Delaware, Maryland (including DC), and Virginia.

When asked about the safety of seafood in general, 92.5% responded that they considered seafood to be very or somewhat safe. When asked about the chances of getting sick from eating seafood, 84.4% stated it was somewhat not likely or not likely at all. When asked about how concerned they are about *Pfiesteria*, 77.6% stated they were very or somewhat concerned. Fifty five percent revealed that an outbreak of *Pfiesteria* would decrease the number of seafood meals that they consume.

Over 93% of respondents found the scientific information about *Pfiesteria* very helpful or somewhat helpful. In addition to the survey-related information, 39%, 20%, 31%, and 19% of respondents in

Delaware, Maryland, North Carolina, and Virginia had heard or read something about *Pfiesteria* between the first and second surveys. In Delaware, 76% of this information was read in the newspaper while only 18% was seen on television. In Maryland, 57% and 38% was obtained from newspapers and television. In North Carolina, 47% of respondents obtained their information from television while 43% obtained it from newspapers. In Virginia, 56% received their information from newspapers and 44% received it from television or something else.

Following Kempton and Falk (2000), respondents were then asked the closed-ended question, "to the best of your knowledge, would you say that *Pfiesteria* is a toxic organism, a form of pollution, a

TABLE 1. Area Response Rates for First and Second Seafood Surveys.

Area Covered	First Survey	Second Survey
Delaware	53%	70%
Maryland	49%	82%
District of Columbia	46%	44%
North Carolina	69%	74%
Virginia	54%	77%

TABLE 2. Data Description.

Variable	Description	Mean	Std.Dev.	MIN	MAX
STATE	Tenure in state	29.06	18.96	0	81
HOUSE	Household size	2.73	1.29	0	7
CHILDREN	Number of children	0.72	1.03	0	5
EDUC	Years of schooling	14.88	2.44	7	20
AGE	Age in years	45.04	13.90	18	100
MALE	Gender: Male=1, 0 otherwise	0.41	0.49	0	1
WHITE	Race: White=1, 0 otherwise	0.78	0.41	0	1
URBAN	Urban county = 1, 0 otherwise	0.31	0.46	0	1
INCOME2	Household income (in thousands)	57.72	26.55	5	100
DE	Delaware resident = 1, 0 otherwise	0.13	0.34	0	1
MD	Maryland/DC resident = 1, 0 otherwise	0.17	0.37	0	1
VA	Virginia resident = 1, 0 otherwise	0.12	0.32	0	1
Sample Size		454			

disease in fish, a predator that attacks fish, or a parasite in fish?" We changed one answer category from those offered by Kempton and Falk (2000). "A toxin or poison" was changed to be consistent with the EPA (2001) definition of *Pfiesteria* as "a toxic organism." In the first survey the next question began with "*Pfiesteria* is a potentially toxic organism." The *Pfiesteria* brochure contained the same definitional sentence in its description of *Pfiesteria*. The second survey asked the same knowledge question again.

While most respondents had heard about *Pfiesteria*, they had difficulty when answering the knowledge question. The item non-response rates were greater than 20% in Delaware, North Carolina, and Virginia and greater than 12% in Maryland. Thirty-five percent of respondents to the first survey answered "a toxic organism" correctly. Sixty percent of the respondents in the second survey answered correctly. About one-quarter of first survey respondents considered *Pfiesteria* to be a form of pollution or a parasite in fish. This fraction fell to about 15% for both responses. The difference in responses across surveys is significant at the $\alpha = .01$ level. Twenty-one percent answered "a toxic organism" in both surveys while 31% answered incorrectly in the first survey and correctly in the second survey suggesting that the information allowed some learning about *Pfiesteria*. Seven percent of respondents answered correctly in the first survey and incorrectly in the second (Table 3).

Respondents were then asked if they would reduce their seafood consumption in the month following a *Pfiesteria* outbreak in their home state (Table 4). REDUCE is equal to 1 if respondents would reduce their seafood consumption and zero otherwise. In the first survey 56% of respondents would reduce their seafood consumption. This number falls to 50% in the second survey suggesting that information is a somewhat effective mitigation tool.

The cultural model variable is recoded to a dummy variable (TOXIC) equal to 1 if the respondent believes *Pfiesteria* to be a toxic organism and zero otherwise. The respondents who believe that *Pfiesteria* is a toxic organism are less likely to reduce their seafood consumption. In the first survey 47% of those who believe that *Pfiesteria* is a toxic organism would

reduce seafood consumption compared to 53% of respondents who believe that *Pfiesteria* is something else. In the second survey, slightly less of those respondents who believe that *Pfiesteria* is a toxic organism (43%) would reduce their seafood consumption following a *Pfiesteria* outbreak. These differences are significant at the $\alpha = .01$ level (Table 5).

Results

We first consider how the brochure and counter information changes the correct response to the cultural model of *Pfiesteria* (TOXIC) after its recoding to a dummy dependent variable (Table 6). The results from the random effects probit model indicate that 40% of the error variance is due to the variation across respondents indicating that the random effects specification is appropriate. Those respondents who received the *Pfiesteria* brochure are significantly more likely to consider *Pfiesteria* to be "a toxic organism" relative to the other choices. This response is also more likely for white households with higher education levels. Delaware residents are more likely to consider *Pfiesteria* a toxic organism. The counter information has no effect on answering with the correct cultural model.

In the seafood consumption model, 58% of the error variance is due to the variation across respondents indicating that the random effects specification is appropriate. Those who receive the counter information are significantly less likely to reduce seafood consumption following a *Pfiesteria* outbreak. Males and white respondents are less likely to reduce seafood consumption. Those with more education and those in Virginia are less likely to reduce seafood consumption. Finally, those who believe that *Pfiesteria* is a toxic organism are significantly less likely to reduce their seafood consumption in the month following a *Pfiesteria* outbreak.

Implications and Conclusions

In this paper we present empirical results focused on the effects of scientific information on attitudes about *Pfiesteria*. Respondents receive varying amounts of information depending on whether they received the *Pfiesteria* brochure, the counter information insert, or both. The purpose of the information is to

TABLE 3. Cultural Models of Pfiesteria

	First	Second
A form of pollution	114 25.11%	66 14.54%
A disease in fish	55 12.11%	37 8.15%
A toxic organism	158 34.80%	273 60.13%
A predator that attacks fish	10 2.20%	8 1.76%
A parasite in fish	117 25.77%	70 15.42%
Total	454	

TABLE 4. Would Reduce Seafood Consumption Following Pfiesteria Event.

REDUCE	First	Second
NO	201 44.27%	229 50.44%
Yes	253 55.73%	225 49.56%

TABLE 5. Frequencies of Cultural Model and Seafood Consumption.

		First Survey		Second Survey	
		TOXIC		TOXIC	
REDUCE		No	Yes	No	Yes
No		117 39.53%	84 3.16%	74 40.88%	155 56.78%
Yes	179	74 60.47%	107 46.84%	118 59.12%	
χ^2 (df)		7.77(1)		10.97(1)	

mitigate the negative reactions to media dramatization of *Pfiesteria*-related fish kills, which may adversely affect seafood consumption unnecessarily.

In contrast to Kempton and Falk (2000) we find that respondents are receptive to scientific information about *Pfiesteria*, especially if the educational background has been obtained to appropriately interpret the data. Respondents are more likely to recognize that *Pfiesteria* is "a toxic organism", as described in the brochure, relative to the other cultural models in the second survey. This correct identification of the nature of *Pfiesteria* was found to correspond with a more appropriate risk response to seafood consumption, in other words, reassurance that seafood is safe to eat. These results do also reveal that the term "potentially toxic organism" lends itself to misinterpretation among groups unable to comprehend this fairly complex cultural model. Even though this characterization is technically correct, the lower education levels of some groups may predispose them to reject the term in its entirety and focus on the word "toxic", which is the easiest to interpret and incorporate into preexisting notions, as well as associate with previously encountered media reports. The media can be blamed only so far as they do not as actively pursue follow-up stories that may disagree with and possibly deflate previous dramatizations.

In terms of the race and gender differentiation between respondents, white males tended to respond more as hypothesized with the scientific information. The explanation for this is not in evidence, other than the possibility that women tend to be more risk averse due to their roles as caregivers, and white males may more often find themselves in positions where they must make risk-based decisions based on complex issues.

The counter information, which described which dangers may or may not be associated with the air and water in the proximity of an outbreak, is shown as effective in making respondents less likely to reduce their seafood consumption after *Pfiesteria* outbreaks.

These results reveal that when lack of knowledge, misinformation by media, and the application of inappropriate cultural models cause an overblown or incorrect assessment of risk, provision of accurate information and the proposal of government action

will mitigate the risk response. The level of mitigation is contingent, however, upon the ability of the recipients to understand and assimilate the information. As revealed in Whitehead et al. (2003), if educational background and the ability to discern information is not sufficient, then the brochure information may actually lead to an unintended result. In this case, it resulted in an increased assessment of risk and the association of the term "toxic organism" with the incorrect cultural model of toxin or poison in fish, which lead to a stated response of decreasing seafood consumption.

Pfiesteria-related fish kills in the 1990s led to a media driven scare about seafood safety and water-based recreation in the mid-Atlantic region leading to significant losses in the tourism and seafood industries. Following these losses, state and Federal government agencies responded with information campaigns to reassure the public that seafood and coastal waters were safe. We suggest that receiving scientific information is an effective mitigation strategy for some

TABLE 6. Random Effects Probit Models

Variable	TOXIC		REDUCE	
	Coeff.	t-ratio	Coeff.	t-ratio
Constant	-3.285	-5.909	2.960	4.124
PFIEBROC	1.141	7.277	0.160	0.851
COUNTER	-0.112	-0.588	-0.489	-2.271
STATE	-0.002	-0.393	0.005	0.899
HOUSE	-0.047	-0.535	0.061	0.563
CHILDREN	0.026	0.261	-0.120	-0.939
EDUC	0.163	5.321	-0.084	-2.212
AGE	0.001	0.174	-0.006	-0.861
MALE	0.240	1.802	-0.588	-3.466
WHITE	0.315	1.938	-1.188	-5.000
URBAN	0.158	0.929	-0.320	-1.489
INCOME	0.002	0.635	0.000	-0.019
DE	0.470	2.091	-0.055	-0.227
MD	-0.345	-1.582	-0.162	-0.607
VA	-0.002	-0.008	-0.443	-1.678
TOXIC			-0.341	-2.285
s	0.405	5.598	0.581	9.712
Log-L(B)	-536.82		-534.39	
Log-L(0)	-628.21		-628.11	
Sample Size	484		484	

respondents, but further research on risk communication is needed in order to develop better strategies for dealing with acute safety concerns that arise from emergent scientific phenomena.

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Endnotes

¹ The dominant species of fish found in the fish kills are menhaden (see Fig.1), a non-food species used to produce fishmeal. Less affected species that are used for human consumption and are also present in the kills include croaker, spot and flounder (Buck et al., 1997).

² This group of "dinoflagellates", which have both plant and animal characteristics, are proposed to have a complicated life cycle of more than twenty forms (Burkholder et al., 1992).

³ See ... *And the Waters Turned to Blood*, by Rodney Barker. New York: Simon & Schuster, 1997.

The Geography of Republicans in North Carolina: Voter Registration and Income

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The purpose of this research is to determine if the stereotype that Republicans are affluent is accurate; accordingly, the hypothesis is that median household income is positively correlated to the number of registered Republicans at the county level in North Carolina. Data on the number of registered Republicans and the total number of registered voters were obtained from the North Carolina State Board of Elections (2002). Median household income data was provided by the Economic Research Service of the United States Department of Agriculture (2002). The mean percentage of registered Republicans by county for North Carolina in 2002 was 31 percent with a high of 72 percent in Mitchell County and a low of 7 percent in Northampton County. The Spearman's Rank correlation coefficient for the percent registered Republicans and median household income of all North Carolina counties was 0.47 at the 1% significance level suggesting a moderate associational relationship exists between the two variables. However, the relationship between Republican affiliation and household income was not straightforward. Regional differences and nuances uncovered in this study are explained further in a discussion about the political history of the state.

Introduction

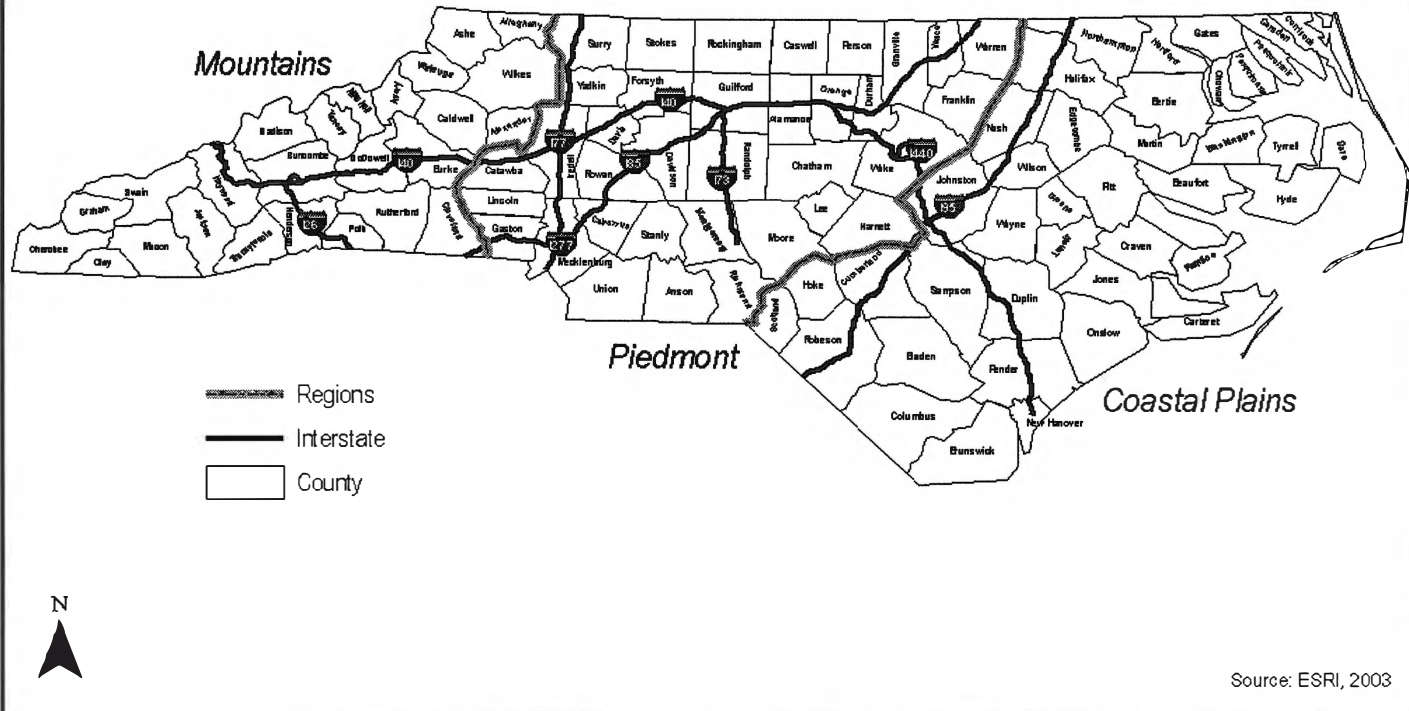
Political geographers have studied the spatial variation of voters for many years. Many variables including race, gender, educational level, poverty level and median household income can provide explanations for the spatial variation of voter behavior. The purpose of this research is to determine if the stereotype that Republicans are affluent is accurate; accordingly, the hypothesis is that median household income is positively correlated to the number of registered Republicans at the county level in North Carolina. For example, Republicans tend to support lower taxes for the rich and do not support policies that help lower income individuals through welfare programs. However, former North Carolina Senator Jesse Helms traditionally won the majority vote in several poor counties in both eastern and western North Carolina since 1973, suggesting that the Republican-income relationship may not be straightforward (North Carolina Board of Elections 1997). North Carolina (Figure 1) is an excellent area for this study because the effect of the 2001 national recession was exacerbated in North Carolina due to the state's dependence on manufacturing jobs and because the political nature

of the state is geographically complex as a result of the disparity between rural and urban counties.

Current literature on the geography of voter behavior has received much attention in the past decade. More recently, Americans interested in politics have developed a very real interest in political geography following Florida's impact on the 2000 presidential election (Warf and Waddell 2002). Race, unemployment and party registration choice are useful variables for describing the spatial variance of certain voting behaviors.

Kohfeld and Sprague (2002) analyzed the urban political geography of voter turnout and voting behavior in St. Louis, Missouri. St. Louis is a geographically segregated city, where blacks live on the North side and whites live on the South side. They examined the racial division in St. Louis to determine its influence on the structure of the city's urban politics by comparing voter turnout and neighborhood stability in two local elections in 1989 and in 1991. Neighborhood stability is defined by using the standard census measure, the percentage of people five years of age and older who have lived at the same address for five years. Results indicated that neighborhood stabil-

Figure 1: North Carolina Regions and Counties



ity is a predictor of voter turnout although race remains a substantial factor when determining voting behavior, that is:

On the North side, any candidate who receives substantial voting support gets it from black voters, and on the South side, any candidate with substantial support is receiving it from white voters. In these areas, the minority candidate, white or black typically receives very low levels of support (Kohfeld and Sprague, 2002, 184).

However, their research does not indicate whether party affiliation is driven by a person's race, only that a person is more likely to vote for a person of their own race, regardless of party.

Kim et al. (2003), examined voter behavior in the United States presidential elections from 1988 through 2000 and their impacts on the unemployment rate. They studied two voting theory models including the retrospective *reward-punishment* model and the *issue-priority* model. The retrospective reward-punishment model implies that voters re-elect incumbent administrations based on their overall level of achievement over the past term. The issue-priority theory "assumes that political parties pursue different policies by following their partisan or ideological priorities" (Kim et al, 2003, 3). This model assumes that voters know what issues parties or candidates consider important, so that even in times of uncertainty, partisan voters would rather re-elect an incumbent than risk the alternative. For example, they suggest that because Democrats in the United States are more concerned with handling unemployment while Republicans are more interested in maintaining stable economic conditions, voters would not "punish" a Democratic administration in times of high unemployment, as the Republican alternative may be even worse. The analysis found that voters in areas with high unemployment rates tend to support Democrats because "Democratic policies are more concerned with unemployment than the Republican policies" (18). However, the basic model is unable to determine whether the groups shift from one party to the other based on changes in the unemployment ratio. The extended analytical model that they used

showed the retrospective-voting model to be accurate only for the 1996 election. Their extended regression model, concluded that voters in high unemployment areas tend to support Democrats but that changes in unemployment rate do affect voting behavior.

Arrington and Grofman (1999) point out that party registration does not imply a vote for that party's candidate at the national level. This is especially true in states where there are closed primary elections and a dominant local party. They examined whether "strategic misrepresentation of party preferences still takes place in the South" by observing party registration at the county level in North Carolina in order to test their hypothesis (174). They hypothesized that for counties dominated by one party, party registration will understate the voting support in statewide elections for the minority party. North Carolina holds closed primaries and Democrats tend to dominate local party registration. However, they expected to find hidden support for the Republican Party, meaning that there are registered Democrats who often vote for a Republican in a national election. They were able to confirm their hypotheses with North Carolina data commenting that, "Hidden partisanship can be a sign of a transitional stage" (184). The transitional stage represents a period where the majority of voters are registered with the traditionally dominant party, but do not vote with their registered party. Their results indicated that "while most counties are still Democratic in voter registration, the extent of Democratic control changed greatly in the period from 1984 to 1996" (180). Thus, eroded Democratic Party support was indicated by the inverse relationship between voter registration totals and the presidential and election results in those years.

Luebke (1998) theorized that the geography of North Carolina politics can be explained by using the theory that most North Carolina politicians can be categorized as *modernizers* or as *traditionalists* and that North Carolina Republicans tend to be traditionalists, who Luebke describes as skeptical of modernization because of its reliance on a big and free-spending government and its disruption of small towns. He explains that most traditionalists are Baptists who advocate fundamentalist Christian values and gain

politically by maintaining the status quo, including the superiority of an idealized past. Traditionalists tend to work in historic industries in North Carolina such as textiles, furniture and apparel. Tobacco farmers and others associated with the agricultural economy also tend to be traditionalists. Former Senator Jesse Helms is a good example of a traditionalist (Luebke 1998).

North Carolina's modernizers support economic expansion and specific social changes that accompany economic growth. Although modernizers have a commitment to improving education, a shortage of public school buildings may be viewed as less worrisome than a missed opportunity for economic expansion. Modernizers tend to be bankers, developers and merchants who are involved in community development as well as those who expect to benefit from economic growth. The majority of modernizers live in major cities in the North Carolina Piedmont where they promote their ideal society of dynamic growth through transportation and infrastructure expansion (Luebke 1998).

In the 1980s and 90s, North Carolina's urbanized counties enjoyed unprecedented growth, while many rural counties lost population underscoring the disparity of economic boom and stagnation in the state. North Carolina's 1980 birth rate was the ninth lowest in the nation, while the state was ranked the tenth highest for in-migration, suggesting that much of the state's population growth resulted from in-migration to counties with an economic emphasis on research and development or an influx of affluent retirees and resort community development (Luebke, 1998). These radical changes in the state's demography and economic geography may indicate a systematic relationship exists between party affiliation and affluence in North Carolina's political geography.

Research Design

Do North Carolina counties with a higher percentage of registered Republicans have higher median household incomes? Table 1 shows the median household income (1999) and percentage of registered Republicans (2002) in North Carolina counties. Data on the number of registered Republicans and

the total number of registered voters were obtained from the NC State Board of Elections (2002). The percentage figure was acquired by dividing the number of registered Republicans by the total number of registered voters in each county. Household income is defined by the U.S. Census Bureau as the sum of money income received in the previous calendar year by all household members fifteen years old and over, including household members not related to the householder, people living alone, and others in non-family households. The median household income (1999) is reported in thousands of dollars. Median household income data was provided by the Economic Research Service of the United States Department of Agriculture (2002). It is understood that the use of county level data may be too general to show detailed income and voting patterns and that data analysis of census tracts and voting precincts may produce very different results. However, this analysis represents a first attempt at defining a current political geography of North Carolina.

Although it is assumed that those counties with a high percentage of registered Republicans are Republican strongholds, the residual value for each county does not also imply that the other registered voters in a county are Democrats. Although the United States is a two-party system, third parties do exist and voters are now able to choose the Reform or Libertarian party when registering to vote. Voters are also allowed to register as Independents with no party affiliation.

Furthermore, it is understood that other factors besides median household income influence a person's decision to register as a Republican. These other variables include educational level, population density, race, and gender, as well as historical and social factors such as religion and family tradition. None of these issues undermine the basic purpose of this research, which is to determine if the percentage of registered Republican voters correlate positively with above average median household incomes at the county level in North Carolina.

Table 1. North Carolina counties ranked by percentage of population registered Republicans (2002) and corresponding Median Household Income (1999). Sources: North Carolina State Board of Elections (October 2002) and Economic Research Service of the U.S. Department of Agriculture (1999).

County	% Republican	Median Income	County	% Republican	Median Income
Mitchell	72%	\$30,508	Burke	37%	\$35,629
Avery	67%	\$30,627	Brunswick	36%	\$35,888
Yadkin	61%	\$36,660	Mecklenburg	36%	\$50,579
Davie	58%	\$40,174	Wake	36%	\$54,988
Wilkes	55%	\$34,258	McDowell	36%	\$28,793
Randolph	54%	\$38,348	Alamance	36%	\$39,168
Stokes	48%	\$38,808	Onslow	35%	\$33,756
Henderson	48%	\$38,109	Nash	34%	\$37,147
Davidson	48%	\$38,640	Guilford	34%	\$42,618
Catawba	47%	\$40,536	Craven	34%	\$35,966
Caldwell	46%	\$35,739	Harnett	33%	\$35,105
Moore	46%	\$41,240	Wayne	33%	\$33,942
Ashe	45%	\$28,824	Buncombe	33%	\$36,666
Alexander	45%	\$38,684	Pender	32%	\$35,902
Graham	45%	\$26,645	Rutherford	32%	\$31,122
Union	44%	\$50,638	Dare	31%	\$42,411
Rowan	43%	\$37,494	Cleveland	30%	\$35,283
Cabarrus	43%	\$46,140	Franklin	30%	\$38,968
Iredell	42%	\$41,920	Alleghany	30%	\$29,244
Stanly	42%	\$36,898	Rockingham	30%	\$33,784
Cherokee	41%	\$27,992	Beaufort	29%	\$31,066
Clay	41%	\$31,397	Madison	29%	\$32,139
Lincoln	41%	\$41,421	Montgomery	29%	\$32,903
Macon	41%	\$32,396	Jackson	29%	\$32,552
Gaston	40%	\$39,482	Pitt	29%	\$32,868
Carteret	40%	\$38,344	Haywood	28%	\$33,922
Watauga	40%	\$32,611	Currituck	28%	\$40,822
Polk	40%	\$36,259	Wilson	28%	\$33,116
Transylvania	39%	\$38,587	Lee	28%	\$38,900
Surry	39%	\$33,046	Chatham	28%	\$42,851
Yancey	39%	\$29,674	Cumberland	27%	\$37,466
New Hanover	39%	\$40,172	Swain	26%	\$28,608
Forsyth	38%	\$42,097	Pamlico	26%	\$34,084
Johnston	38%	\$40,872	Duplin	25%	\$29,890
Sampson	37%	\$31,793	Person	24%	\$37,159

Table 1 (continued). North Carolina counties ranked by percentage of population registered Republicans (2002) and corresponding Median Household Income (1999). Sources: North Carolina State Board of Elections (October 2002) and Economic Research Service of the U.S. Department of Agriculture (1999).

County	% Republican	Median Income
Orange	23%	\$42,372
Lenoir	23%	\$31,191
Granville	22%	\$39,965
Chowan	22%	\$30,928
Durham	21%	\$43,337
Perquimans	21%	\$29,538
Pasquotank	21%	\$30,444
Camden	20%	\$39,493
Caswell	18%	\$35,018
Martin	17%	\$30,985
Hoke	17%	\$33,230
Scotland	17%	\$31,010
Richmond	17%	\$28,830
Edgecombe	16%	\$30,983
Jones	16%	\$30,882
Columbus	16%	\$26,805
Vance	15%	\$31,301
Greene	15%	\$32,074
Gates	15%	\$35,647
Halifax	14%	\$26,459
Anson	14%	\$29,849
Bladen	14%	\$26,877
Washington	13%	\$28,865
Hertford	12%	\$26,422
Hyde	11%	\$28,444
Warren	11%	\$28,351
Robeson	10%	\$28,202
Bertie	9%	\$25,177
Tyrrell	8%	\$25,684
Northampton	7%	\$26,652
Mean	31.4%	\$34,874
Standard Deviation	13.3%	\$5,758

Findings

Figure 2 illustrates the geography of registered Republicans by county in North Carolina. The mean percentage of registered Republicans by county in North Carolina in 2002 was 31 percent with a high of 72 percent in Mitchell County and a low of 7 percent in Northampton County. A belt of counties with high percentages of registered Republicans (54 to 72 percent) exists in the northwestern Piedmont and Mountain region including Mitchell, Avery, Wilkes, Yadkin, Davie and Randolph counties. The area is predominately white and rural; there, fewer than six percent of the registered voters are African-American. All of these counties are less than forty percent urbanized. Indeed, Avery and Mitchell Counties, located in the Mountains were less than one percent urban. Yadkin, Davie, Wilkes and Randolph Counties, which are outlying counties of the Piedmont Triad region, ranged between 14 and 40 percent urban.

The largest group of contiguous counties with the lowest percentage of registered Republicans (7 to 14 percent) stretches from Warren County in the northeastern Piedmont to Hyde County on the central coast. This area is rural and has a large African-American population. All of these counties are in the lowest group of median household income (\$25,170 to 29,680). Another area with similar characteristics is found in the southern interior stretching from Anson County in the southern Piedmont to Robeson, Bladen, and Anson Counties on the southern Coastal Plain.

Figure 3 illustrates the geography of median household income in North Carolina. The mean median household income for North Carolina in 1999 was \$34,874, with a high of \$54,990 in Wake County to a low of \$25,177 in Bertie County. Two contiguous groups of counties in the highest group of median household income (\$39,390 to \$54,990) exist in the Piedmont region stretching from a belt Union to Guilford County; and a group of counties in the Research Triangle region. Ten of the counties in these areas are more than fifty percent urbanized. The urbanized Piedmont counties contain most of

the largest cities in North Carolina, including Mecklenburg (Charlotte), Guilford (Greensboro and High Point), Forsyth (Winston-Salem), Wake (Raleigh), Iredell (Statesville), Orange (Chapel Hill) and Durham (Durham). A contiguous belt of nine counties with low median household incomes (\$25,170 to 29,680) exists in the northeastern Piedmont and Coastal Plains region stretching from Warren county in the northeastern Piedmont to Hyde County on the east coast.

The scatter diagram of percent registered Republicans and median household income (Figure 4) indicates that North Carolina counties with a high percentage of registered Republicans tend to have a high median household income, while counties with a low percentage of registered Republicans tend to have a low median household income (i.e., a positive linear relationship). Some anomalies exist. Mitchell County has a low median household income (\$30,508), but an extremely high percentage of registered Republicans (72 percent). By contrast, Mecklenburg and Wake Counties have only moderate percentages of registered Republicans (36 percent), but extremely high median household incomes (\$50,579 and \$54,988).

Several factors explain why Mitchell County has an extremely high percentage of registered Republicans. Mitchell County is located in the Mountains where there are few African-Americans (only 34 African-American residents in 2000). Of the seventy-three percent of Mitchell county residents who are registered to vote only 17 of those registered are African-Americans. Mitchell County has a low median household income which can be explained by the above average unemployment rate. Mitchell County is completely rural which suggests the lack of a diverse economy.

When the one hundred North Carolina counties are divided into topographical subgroups (e.g. Mountains, Piedmont and Coastal Plains), descriptive trend lines, or the line of best fit, provide interesting results (Figure 5). Both the Piedmont and Coastal Plains follow the overall positive relationship where counties with a high percentage of registered Republicans tend to have a high median household income, while counties with a low percentage of registered Republicans tend to have a low median household income. However, the descriptive trend line for the Mountain region suggests that counties with a high percentage of

Figure 2: Registered Republicans in North Carolina 2002

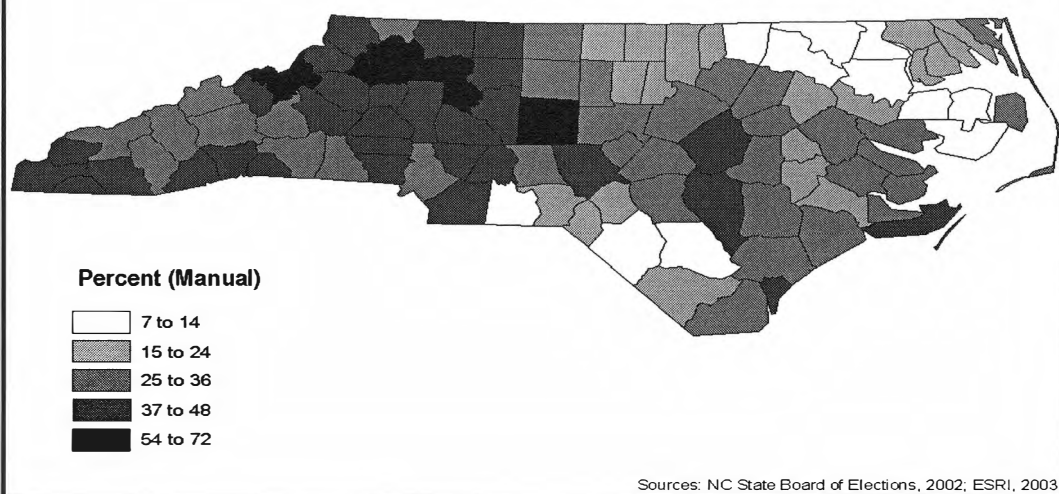
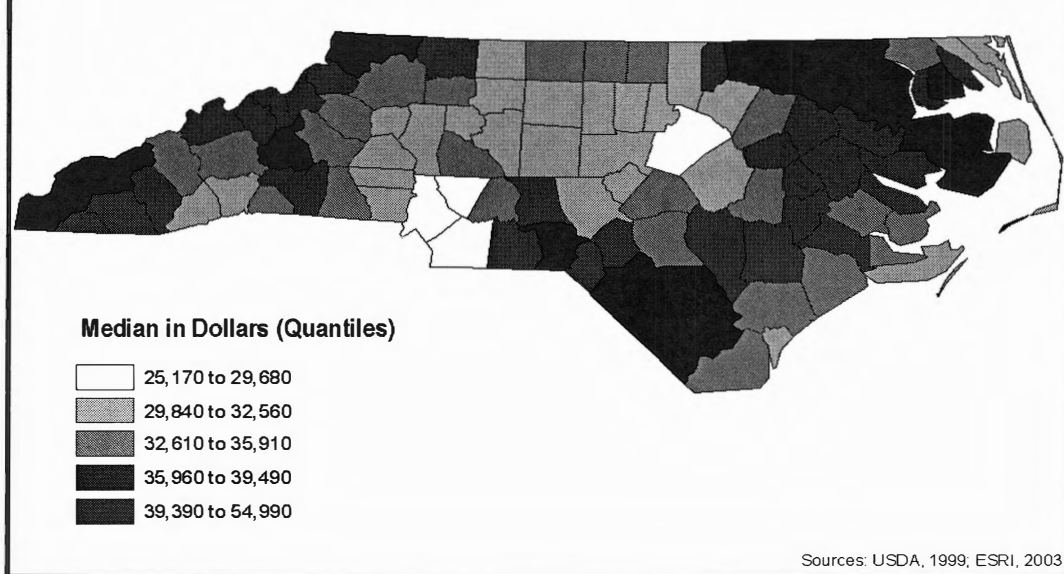


Figure 3: Household Income in North Carolina 1999

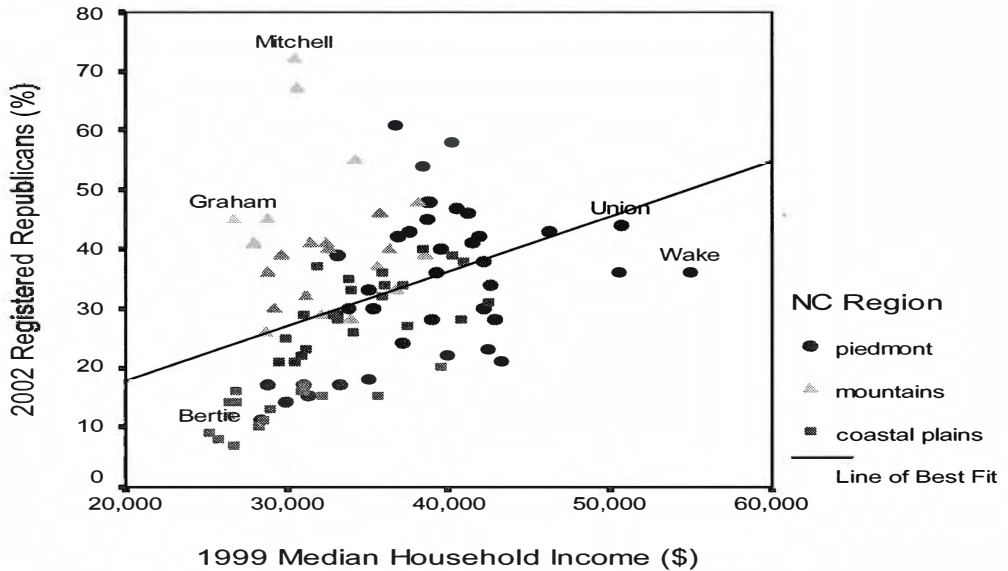
registered Republicans tend to have a low median household income, while counties with a low percentage of registered Republicans tend to have a higher median household income (i.e., an inverse relationship).

Test statistics for skewness and kurtosis verified that the registered Republican distribution had very little positive skew and some platykurtic kurtosis. However, the Shapiro-Wilk test statistic for normality indicated that the normality assumption was not appropriate at the 5% level of significance (Norusis 2002). Test statistics for skewness and kurtosis verified that the median household income distribution had some positive skew and some platykurtic kurtosis. Additionally, the Shapiro-Wilk test for normality indicated that the normality assumption was not appropriate at the 5% level of significance.

Because the Shapiro-Wilk normality test indicates that the percent registered Republicans and median household income of North Carolina counties were not normally distributed, this paper uses a non-para-

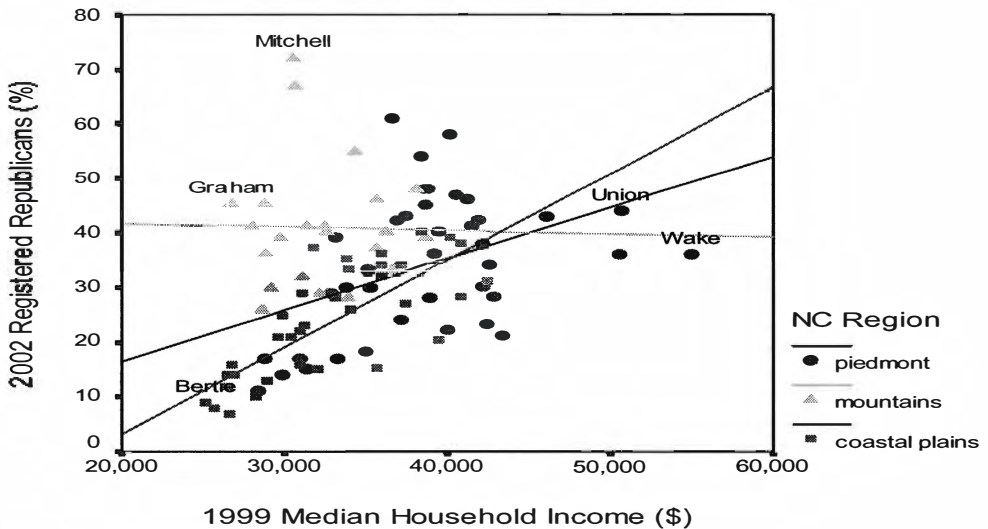
metric correlation test, Spearman's Rank correlation coefficient. The Spearman's Rank correlation coefficient for the percent registered Republicans and median household income of all North Carolina counties was 0.47 at the 1 percent significance level suggesting a moderate associational relationship exists between the percent registered Republicans and the median household income of North Carolina counties (Norusis 2002). The moderate degree of association may seem contrary to the aggregate North Carolina sample descriptive trend line that appears to display a clear positive relationship. But the descriptive trend lines of the sub-regions (Piedmont, Mountains, and Coastal Plains) within the aggregate North Carolina sample indicate how the overall association between median household income and registered Republicans in North Carolina is a combination of spatial variability in the relationship between the two variables. Accordingly, this analysis underscores the necessity for regional scale analysis for accurate assessment of the political geography of North Carolina.

Figure 4: Scatter Diagram of Registered Republicans (%) 2002 and 1999 Median Household Income for North Carolina Counties
--Line of Best Fit for NC



Sources: NC State Board of Elections, 2002
 USDA, 1999

Figure 5: Scatter Diagram of Registered Republicans (%) 2002 and 1999 Median Household Income for North Carolina Counties
--Lines of Best Fit for NC Regions



Sources: NC State Board of Elections, 2002
 USDA, 1999

Implications & Conclusions

The regional differences in North Carolina politics are not surprising and are rooted in political history, as Key noted in 1949. Key explained that "Most votes for Republican presidential and gubernatorial candidates are cast west of the fall line in counties that are more rural than urban," and that "Invariably, one Senator must come from the east and one from the west. The rule has been, too, that the governorship rotates between the east and the west." He further explained that "Many a crucial vote in North Carolina's history has divided along the fall line, which separates the Piedmont from the coastal plain..." and party loyalty has also tended to be sectional (Key 1949, 219-220).

The inverse relationship for the Mountain region where counties with a high percentage of registered Republicans tend to have a low median household income, suggests that mountain Republicanism still exists in the 21st century. Key defined Mountain Republicanism as those voters "in the highlands from southwestern Virginia to northern Alabama and in the Ozarks of Arkansas" that vote "a straight Republican ticket election after election" (280). Historically, mountain people in the South have had radically different political values than the rest of the South. When southern states began to consider secession, people of the mountains were "reluctant to abandon the Union for the cause of the planter and his slaves" (282). North Carolina's mountain region is no exception. In fact, Key states, "In the three states with considerable areas of mountain Republicanism—North Carolina, Virginia, and Tennessee—the Republican party has the strongest foundation on which to build a competing party. The existence of a two-party system virtually requires a sectionalism or an urban-rural division of sentiment" (285).

The results of the 2004 election suggest that mountain Republicanism still exists in North Carolina. Every county in the Mountain region of North Carolina supported George W. Bush, the Republican presidential candidate, in the 2004 election. Bush supporters across the state cited moral values as their number one concern, while those who supported the Democratic presidential candidate, John Kerry, were

more concerned about the economy (Christense, 2004). Research in this area should further study the 2004 election's regional differences to better understand the underlying mechanisms that shape North Carolina's mountain Republicanism.

It has become crucially important to study the geography of Republicans in North Carolina in the last decade, especially since November 1994 when the Democrats lost the majority in the North Carolina House of Representatives for the first time since 1896. The hypothesis that those counties with high percentages of registered Republicans also have high median household incomes appears correct with a correlation of 0.47 at the 1 percent level although, there are many other variables that can explain voting behavior. These variables include; race, gender, education level, population density, as well as the historical and social contexts that influence voting habits.

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The Spatial Variations of Mean Annual Snowfall in Western North Carolina

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Western North Carolina's snowfall can be highly variable. For the purpose of this study, the western North Carolina region is divided into four sub-regions. These sub-regions take into account the geographic characteristics of the region. Daily snowfall amounts from 16 National Weather Service Cooperative Observer Stations are compiled into annual means for a 20-year time period. These annual means are then analyzed to identify existing spatial patterns. Geographic characteristics such as elevation, latitude, exposure, as well as other physical and synoptic characteristics of the stations and the sub-regions are considered. Variability within the sub-regions is also analyzed. Results indicate that snowfall variability can vary dramatically between sub-regions. While there are several geographic characteristics that help explain the spatial variations of mean annual snowfall amounts, elevation is the primary one. Typically, snowfall amounts increase at higher elevations. Location and aspect also appear to be important geographic characteristics, depending on the type of weather system. By gaining a better understanding of these spatial variations, the public can potentially be better prepared for this type of weather event.

Introduction

When snowfall in western North Carolina is discussed, many people assume that the entire region receives a lot of snow each winter, certainly more than other areas of the southeastern United States (Doesken and Judson 1997). Freshmen-level physical geography courses often treat southeastern climate as a homogeneous unit (Soulé 1998). However, what most people do not realize is that western North Carolina can experience high spatial variability of mean annual snowfall amounts (Perry and Konrad 2004). These mean annual snowfall amounts can range anywhere from 10cm at the lower elevations to over 100cm at the higher elevations, with some of the highest locations receiving up to 250cm (Perry 2002). The weather and synoptic patterns that produce snowfall in this region can also be highly variable (Soulé 1998). While snowfall variability can be an interesting aspect of winter climate and have a large impact upon society, it has received little attention in climate literature, especially in the Southeast (Mote et al. 1997; Hartley 1999).

Western North Carolina, which is part of the southern Appalachian Mountain chain, lies within two physiographic provinces. These physiographic prov-

inces include the western extent of the Piedmont (Foothills) and the Blue Ridge (Raitz, et al. 1984). Continental and maritime influences both affect the climate of this region, given its relative proximity (500-800km) to the Atlantic Ocean and the Gulf of Mexico. Both of these bodies of water play major roles in determining the amount of snowfall received in this region (Whiteman 2000; Kocin and Uccellini 1990). The elevation varies from 300 meters in low-lying valleys of the Foothills to 2037 meters on top of Mt. Mitchell (USGS 1962). These factors play a key role in the spatial variations of mean annual snowfall amounts and will be considered in the analysis of this study.

Many weather forecasters have stated that the southern Appalachian region is one of the most difficult areas in the country to predict snowfall for (Keeter et al. 1995). There are many geographic, topographic, and synoptic characteristics that cause these difficulties. These geographic characteristics are attributed to the observed spatial variations of mean annual snowfall amounts within the region (Konrad 1996). According to Kocin and Uccellini (1990), some of the

geographic characteristics contributing to the difficulty in snowfall predictions and the observed snowfall variations include the influences of the Atlantic Ocean, the Gulf of Mexico, the position of the Gulf Stream, and the effects of the Appalachian Mountains on low-level temperatures and wind fields. In a study of statistical relationships between topography and precipitation patterns conducted by Basist *et al.* (1994), elevation, slope, orientation, and exposure were important factors in explaining spatial variations of snowfall in mountainous regions.

Synoptic factors that may lead to spatial variations in snowfall for this region include orographic precipitation enhancement (Fishel and Businger 1993; Dore *et al.* 1992; Whiteman 2000), cold-air damming in the lee of the Appalachian Mountains (Keeter *et al.* 1995; Bell and Bosart 1988), the paths of mid-latitude wave cyclones as they move across the southeastern United States (Maglaras *et al.* 1995), and late season cutoff lows (Sabones and Keeter 1989). Additionally, western North Carolina is located between two major winter storm tracks of the eastern United States; the Ohio Valley/eastern Great Lakes storm track and the Atlantic Coast storm track (Mote *et al.* 1997; Hartley 1998). These storm tracks may also help to explain the spatial variations of mean annual snowfall amounts within the region.

The purpose of this study is to identify spatial variations that may exist in mean annual snowfall amounts for western North Carolina. These variations may exist between locations within a certain geographic region or between different geographic regions. While similar studies have been conducted in other parts of the United States, snowfall variations in the southern Appalachian Mountains have not been widely investigated (Hartley 1998). The hypothesis of this study is that spatial variability will be high across the study area, especially in areas of higher elevation. By analyzing this type of information, a better understanding of the existing spatial patterns can potentially lead to more effective and efficient preparations, which may include better forecasts, transportation planning, and emergency preparedness (Doesken and Judson 1997).

Data and Methods

For the purpose of this study, the region of western North Carolina has been divided, on a county basis, into four sub-regions based on the geographic characteristics of each sub-region. The divisions are based on a generalization of the average exposure, elevation, relative location, and latitude of each sub-region. The four sub-regions include the Northwest Mountains, the western Piedmont (Foothills), the Asheville Basin, and the Southwest Mountains (Fig. 1). In the latter three, some counties are excluded from the study due to data availability issues. These issues relate to missing or inaccurate data that Cooperative Observing Stations within these counties contained.

Each of the regions include geographic characteristics that make them distinctively different from one another. While topography was the main geographic characteristic considered when creating the sub-regions (Fig. 2), other features such as prevailing weather patterns were considered as well. In addition, some consideration was given to how western North Carolina counties are divided by the National Weather Service (NWS) into three different county warning areas. However, it is crucial to understand that within each sub-region, and within each individual county, there can be great spatial variability in the geographic characteristics, which can also lead to great spatial variations of mean annual snowfall amounts. These sub-regions are a way of grouping together stations that may exhibit similar snowfall patterns and using them to demonstrate spatial variability throughout western North Carolina.

The data analyzed for this study were extracted from the National Climatic Data Center's Cooperative Summary of the Day CD-Rom (NCDC 2003). It includes data from the National Weather Service's (NWS) Cooperative Observer Stations that are located across western North Carolina. Since snowfall in this region is generally limited to late fall, winter, and early spring, the data that were acquired only contain daily reports from October through May of each year. Four stations with complete or nearly complete data were chosen for the analysis from each western North Carolina sub-region for a total of 16 stations. The time period of this analysis is from October 1979 to May 1999.

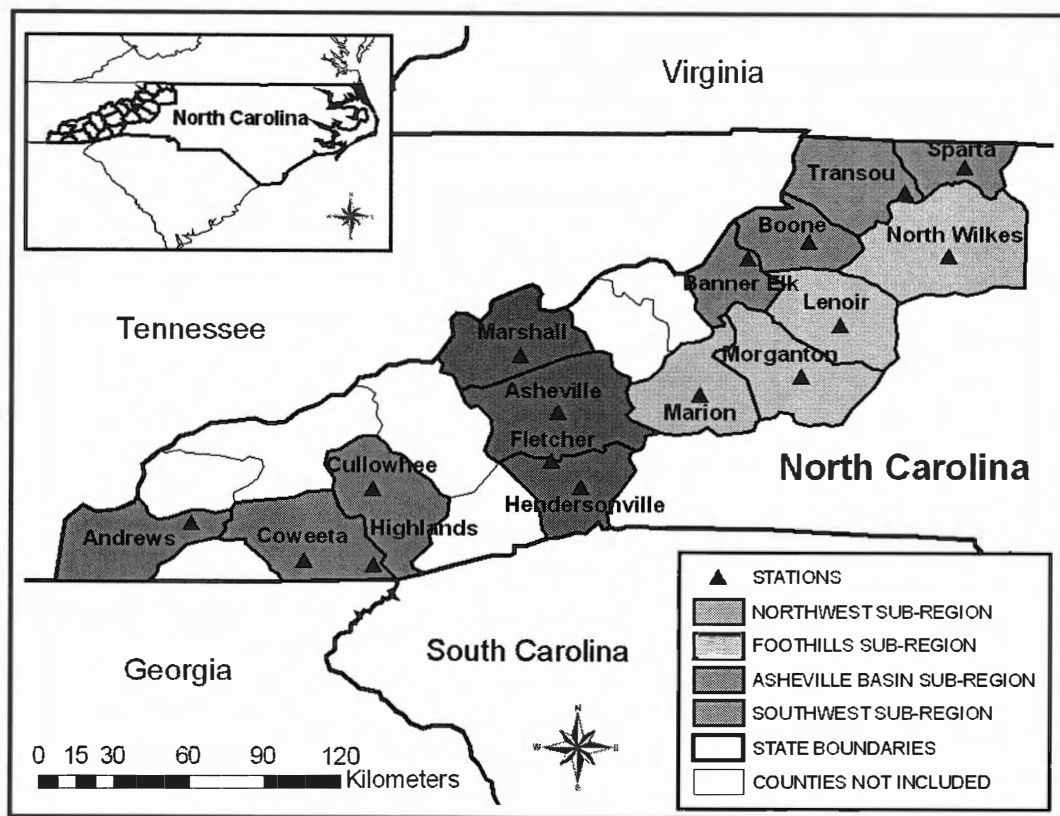


Figure 1. Area of study, including locations and names, and sub-regions.

This time period was chosen due to these 16 stations containing continuous reports for the 20-year period and not having entire years of missing data. Missing data from daily reports was treated as such and no substitutions were made. For all 16 stations that were analyzed for the 20-year period, the data completeness was 97.7%. Individual data completeness statistics for each station can be seen in Table 1.

A frequent problem with snowfall data, especially from Cooperative Observer Stations, is missing data (Suckling 1991; Robinson 1990). According to Robinson (1989), missing snowfall data is especially problematic in areas where snowfall is rare, which does include some parts of western North Carolina. Even when snowfall measurements are recorded by the

Cooperative Observers, they are not necessarily accurate. This is probably due to the lack of training that many of these Cooperative Observers receive (Robinson 1989; Doesken and Leffler 2000). This helps explain why more stations could not be utilized for the analysis of this study.

The first step of the analysis was calculating annual means and standard deviation for each station. Second, the 20-year mean was calculated for each station, as well as the 20-year mean for each sub-region. Third, a Pearson correlation coefficient was calculated between each station within each sub-region. Finally, a coefficient of variation was calculated using the mean and standard deviation of annual snowfall amounts for each station. In addition, comparisons were made

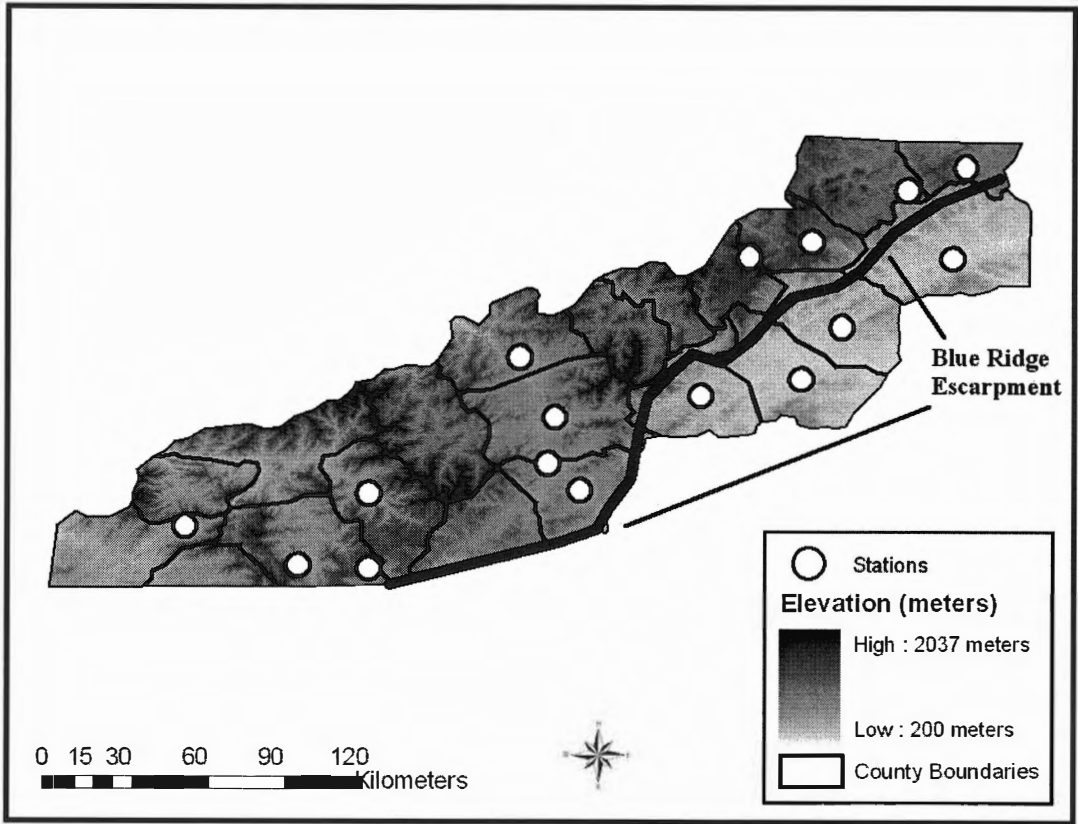


Figure 2. Digital elevation model showing the topography of the study area.

to show relationships between snowfall amounts and elevation, coefficient of variation and elevation, and snowfall amounts and latitude.

Results

Annual snowfall values for each station are presented in Table 1 and Figures 3-6. Additional results are shown in Table 2 and Figures 7-9. The Northwest sub-region clearly received the most annual snowfall for the 20-year period with a mean of 78.3cm for the entire sub-region (Fig. 3). Banner Elk and Boone received similar amounts of annual snowfall, as did Sparta and Transou. However, Banner Elk and Boone received considerably more. The Pearson correlation coefficients between Banner Elk and Boone, as well as

Sparta and Transou, were significant at the 99% confidence level (Table 2).

The Foothills sub-region received the least amount of snowfall of the four sub-regions for the 20-year period with a mean of 17.7cm (Fig. 4). All four stations in this sub-region experienced similar annual snowfall amounts. The Pearson correlation coefficients between each station were significant at the 99% confidence level (Table 2).

The Asheville Basin sub-region had the second highest 20-year mean of annual snowfall, which was 30.1cm (Fig. 5). Three of the stations in this sub-region exhibited similar annual snowfall amounts. However, Marshall received noticeably more snowfall during several winter seasons. The Pearson correlation coefficient between Marshall and the other three

Table 1. Each station's elevation in meters, mean annual snowfall in centimeters, standard deviation, coefficient of variation, and data completeness for the 20-year period.

Station	Sub-Region	Elevation	Snowfall	Std. Dev.	CV	Data Completeness
Boone	Northwest	1024	92.0	37.3	40.5	99.3%
Banner Elk	Northwest	1142	103.0	45.8	44.5	96.9%
Sparta	Northwest	916	52.5	40.6	77.3	98.2%
Transou	Northwest	876	65.8	40.5	61.5	99.5%
Lenoir	Foothills	366	17.8	21.1	118.5	99.8%
Marion	Foothills	447	19.7	19.7	100	91.5%
Morganton	Foothills	354	11.2	17.0	151.8	98.1%
North Wilkes	Foothills	341	22.1	19.8	89.6	97.8%
Asheville	Asheville Basin	683	34.3	19.3	56.3	99.9%
Fletcher	Asheville Basin	631	25.1	18.6	74.1	99.8%
Hendersonville	Asheville Basin	658	23.3	18.4	79	99.6%
Marshall	Asheville Basin	610	37.6	42.0	111.7	90.1%
Andrews	Southwest	533	21.7	20.7	95.4	96.9%
Coweeta	Southwest	686	16.6	21.0	126.5	98.6%
Cullowhee	Southwest	668	17.9	15.2	85	97.6%
Highlands	Southwest	1170	45.7	22.8	49.9	99.9%

Table 2. Relationship between stations within each sub-region based on Pearson's correlation coefficients. * Correlation significant at $\alpha = 0.05$. ** Correlation significant at $\alpha = 0.01$.

NORTHWEST	<i>Banner Elk</i>	<i>Boone</i>	<i>Sparta</i>
<i>Boone</i>	0.83**		
<i>Sparta</i>	0.47*	0.81**	
<i>Transou</i>	0.40	0.76**	0.93**
FOOTHILLS	<i>Lenoir</i>	<i>Marion</i>	<i>Morganton</i>
<i>Marion</i>	0.79**		
<i>Morganton</i>	0.82**	0.85**	
<i>North Wilkes</i>	0.78**	0.93**	0.88**
ASHEVILLE BASIN	<i>Asheville</i>	<i>Fletcher</i>	<i>Hendersonville</i>
<i>Fletcher</i>	0.90**		
<i>Hendersonville</i>	0.87**	0.91**	
<i>Marshall</i>	0.62**	0.47*	0.36
SOUTHWEST	<i>Andrews</i>	<i>Coweeta</i>	<i>Cullowhee</i>
<i>Coweeta</i>	0.75**		
<i>Cullowhee</i>	0.61**	0.71**	
<i>Highlands</i>	0.65*	0.67**	0.73**

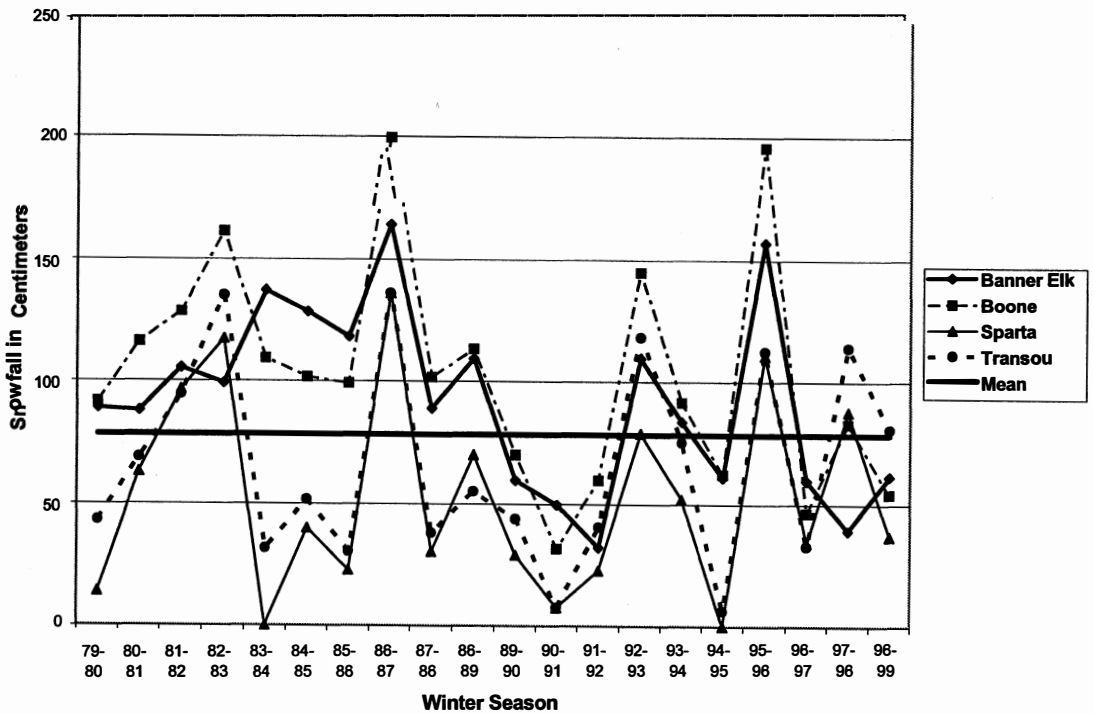


Figure 3. Graph showing the annual snowfall amounts and the sub-region 20-year mean for the Northwest sub-region.

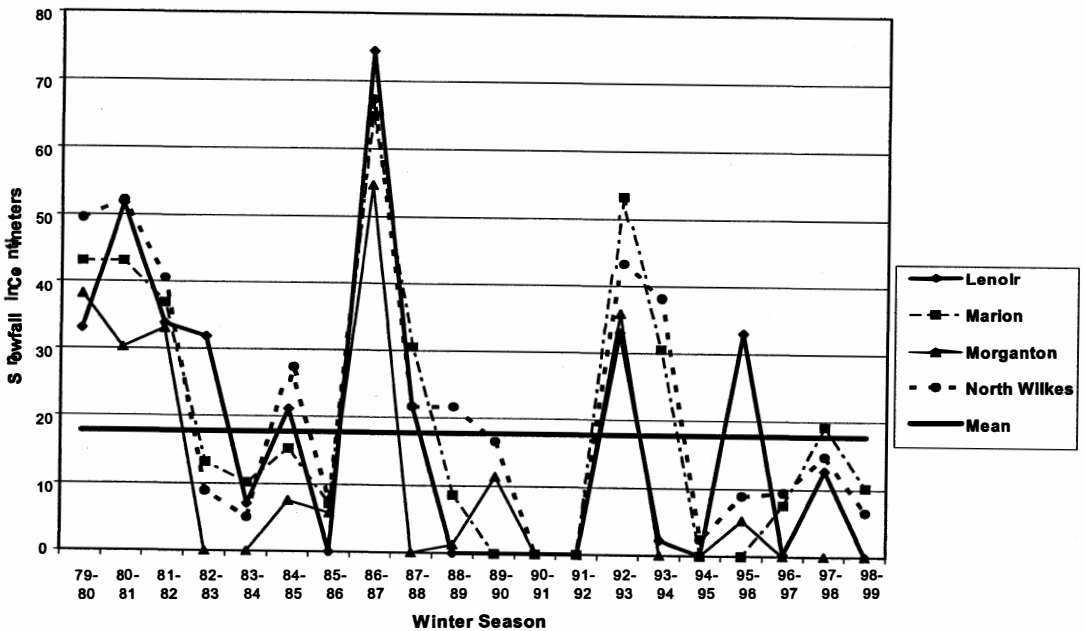


Figure 4. Graph showing the annual snowfall amounts and the sub-region 20-year mean for the Foothills sub-region.

stations was less significant than the coefficients between each of the other three stations individually (Table 2).

The Southwest sub-region had the second lowest 20-year mean of annual snowfall, which was 25.4cm (Fig. 6). Like the Asheville Basin sub-basin, three of the stations received similar mean annual snowfall amounts and have similar Pearson correlation coefficients (Table 2). However, Highlands received considerably more mean annual snowfall than did the other three stations in almost every winter season analyzed. In fact, its mean annual snowfall amount for the 20-year period was 46cm. This station exerts a large influence on the mean annual snowfall for the sub-region. Without Highlands, the Southwest sub-region 20-year mean would only be 18.6cm. A mean of 18.6cm is similar to the 20-year mean of the Foothills sub-region. Highlands was grouped within this sub-region due to geographic characteristics that will be discussed in the next section.

Discussion

In the Northwest sub-region, Boone and Banner Elk received considerably more snowfall on average than did Sparta and Transou, even though they are only 100-300 meters higher in elevation. According to Barry (1981), elevation is often a key factor with snowfall in mountainous terrain, with higher elevations potentially receiving more precipitation. The combination of elevation and colder temperatures at increased elevations could also result in more snowfall (Christopherson 2003). However, given the difference in elevation is not great, perhaps a better explanation for the observed differences could be the relative locations of the two sets of stations. Boone and Banner Elk are situated farther west of the Blue Ridge escarpment, which means they are farther away from the rain/snow line that often develops near the edge of the escarpment as a result of warmer air filtering into the area (Fig. 2). In this scenario, they are typically in the snow sector of snowfall events. Additionally, they have a better opportunity to receive increased snowfall amounts from northwest flow snowfall events (Perry and Konrad 2004).

In the case of the drastic snowfall variations that were observed between the Northwest and Foothills sub-regions (Figs. 3-4), despite their proximity to one another, elevation again may be the primary geographic characteristic causing the observed spatial variations. The Foothills sub-region is uniquely located at the foot of the Blue Ridge escarpment (Fig. 2). This escarpment is situated in a northeast-southwest elongated position. Elevations below the escarpment average around 300 meters while elevations on top of the escarpment average around 1000 meters (USGS 1962). This change in elevation takes place in a relatively short planar distance. The abrupt change in elevation often leads to an enhancement of the orographic process in which precipitation is enhanced as it is lifted up and over the mountains (Whiteman 2000; Dore *et al.* 1992). The orographic enhancement process is significantly greater for snowfall than for rainfall (Dore *et al.* 1992). As a result, all four stations in the Northwest sub-region have the potential to experience an increase in snowfall. However, this situation only occurs during certain types of snowfall events. The precipitation source, typically a mid-latitude wave cyclone, must have a southeasterly flow off of the Gulf of Mexico, or in some cases the Atlantic Ocean. The common path for storm systems in this region is to move from west to east (Mote *et al.* 1997). When these mid-latitude wave cyclones move directly south and east of the Foothills sub-region, the orographic process can affect the Northwest sub-region.

Another situation that often develops over the Foothills sub-region is a cold-air damming event. During these situations, cold arctic air at the surface funnels down the eastern spine of the Appalachians from New England and becomes trapped against the Blue Ridge escarpment (Keeter *et al.* 1995; Bell and Bosart 1988). When this occurs, elevations below the escarpment tend to receive more freezing rain and sleet, limiting the total amounts of snowfall.

In the Southwest sub-region, the orographic enhancement process also affects Highlands. It is located at the edge of the Blue Ridge escarpment at an elevation of approximately 1170 meters (USGS 1962). It is actually higher than the stations of Boone and Banner Elk in the Northwest sub-region, but its mean annual snowfall amount was less than half of what

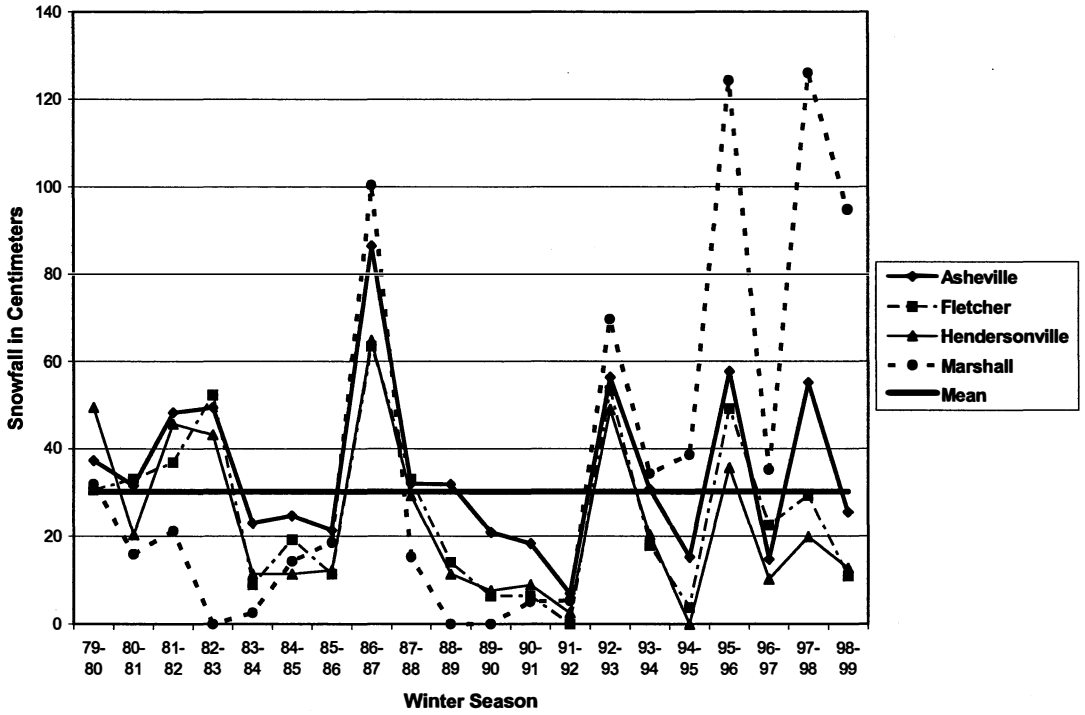


Figure 5. Graph showing the annual snowfall amounts and the sub-region 20-year mean for the Asheville Basin sub-region.

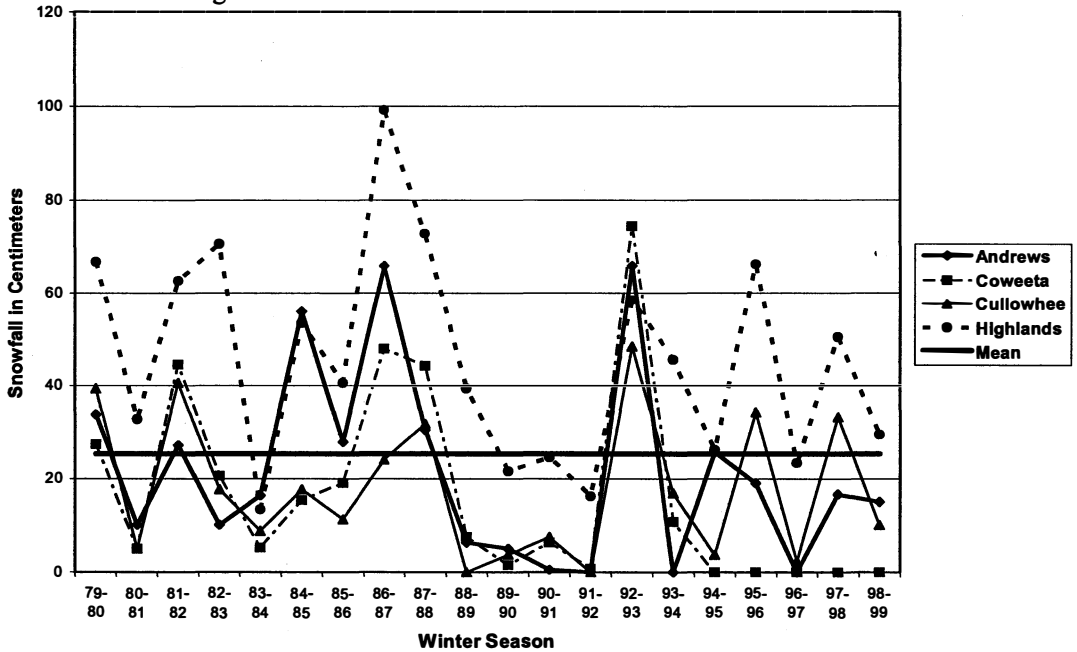


Figure 6. Graph showing the annual snowfall amounts and the sub-region 20-year mean for the Southwest sub-region.

they received for the 20-year period. This is likely a result of its more southerly location, which supports previous research findings that an increase in elevation does not always lead to an increase in snowfall amounts in western North Carolina (Konrad 1995). The southwestern extent of this study area, which includes all of the Southwest sub-region, typically experiences warmer temperatures during the winter season than areas in the northwestern part of the study area and is often caught in a transition zone between rain and snow during snowfall events (Perry 2002). However, elevation and location is the most likely explanation for Highlands receiving more snow than the rest of the stations in this sub-region.

The Asheville Basin sub-region also included one station receiving more snowfall than the other three stations during some winter seasons of the 20-year analyzed period (Fig. 5). Marshall had considerably more snowfall during the winter seasons of 1986-1987, 1992-1993, 1995-1996, 1997-1998, and 1998-1999. It is more difficult to determine why this may have occurred. The elevation factor is ruled out since it is actually lower than the other stations. One likely explanation, however, is its more northwesterly location than the other stations. Again, most weather and precipitation patterns affect this study area from west to east. This is especially true of the northwest flow snowfall events that move into the western Appalachian Mountain range, often originating in the Great Lakes region (Perry and Konrad 2004; Niziol et al. 1994; Schmidlin 1992). Northwest flow snowfall can also occur as wrap-around moisture from mid-latitude wave cyclones that have moved off to the north and east. Typically, by the time these events have moved over the mountains from the west, most of the precipitation has diminished and once they move south and east of Marshall, all of the precipitation has ended. Another explanation could be due to Marshall's location in the French Broad River Valley. It is exposed to the northwest, which could allow more cold air and snowfall to affect this station by funneling up through the river valley.

In discussing spatial variations for all of the sub-regions in western North Carolina and their 20-year mean annual snowfall amounts, one common char-

acteristic is that all stations in each sub-region experienced similar temporal patterns of year-to-year variability in their snowfall amounts. That is, years of high or low snowfall amounts were typically shown for each station within each sub-region. There were cases in which some stations in a particular sub-region received substantially more or less snowfall than its neighboring stations, but usually most of the stations experienced similar patterns (Figs. 3-6).

For the entire study area during this 20-year period, there appeared to be a positive relationship between the amount of snowfall that a station received and the elevation of the station (Fig. 7). Typically, stations with higher elevations experienced higher amounts of snowfall on an annual basis (Table 1). This agrees with the principle that higher locations receive higher amounts of precipitation and snowfall, as well as cooler temperatures (Barry 1981; Whiteman 2000). However, there are a few stations in this study area where this was not the case. The stations of Asheville and Marshall, located in the Asheville Basin sub-region (Fig. 5), received more snowfall during the 20-year analyzed period than did their neighboring stations to the south, which are located at a slightly higher elevation. These spatial variations can be attributed to weather and synoptic patterns previously discussed, such as northwest flow snowfall events.

Another aspect to the relationship between mean annual snowfall amounts and elevation is that higher elevations were typically less variable from year-to-year during this 20-year period. This indicates that there is a negative relationship between the coefficient of variation for mean annual snowfall and standard deviation as compared to elevation (Fig. 8). This relates to the fact that in any given winter season, higher elevations typically receive more snowfall due to their elevation alone, which leads to less variability between winter seasons (Whiteman 2000). Lower elevations are more dependent upon the tracks of winter storms, which can be highly variable from year-to-year (Soulé 1998). Evidence of this variability was witnessed in the Foothills sub-region (Fig. 4).

Stations located in the northern extent of

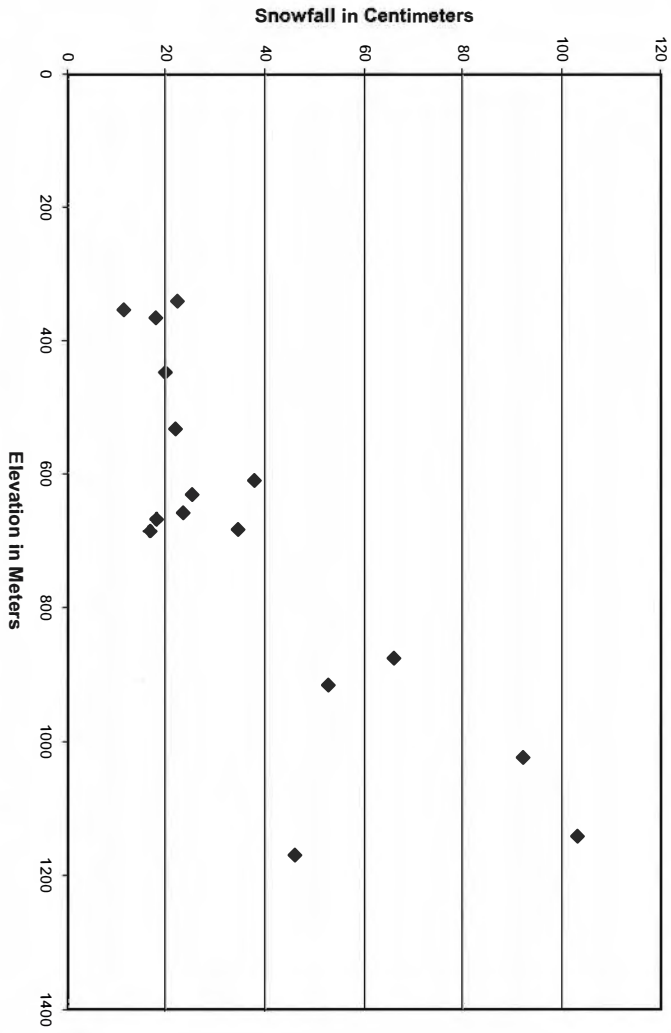


Figure 7. Relationship between mean annual snowfall and elevation.

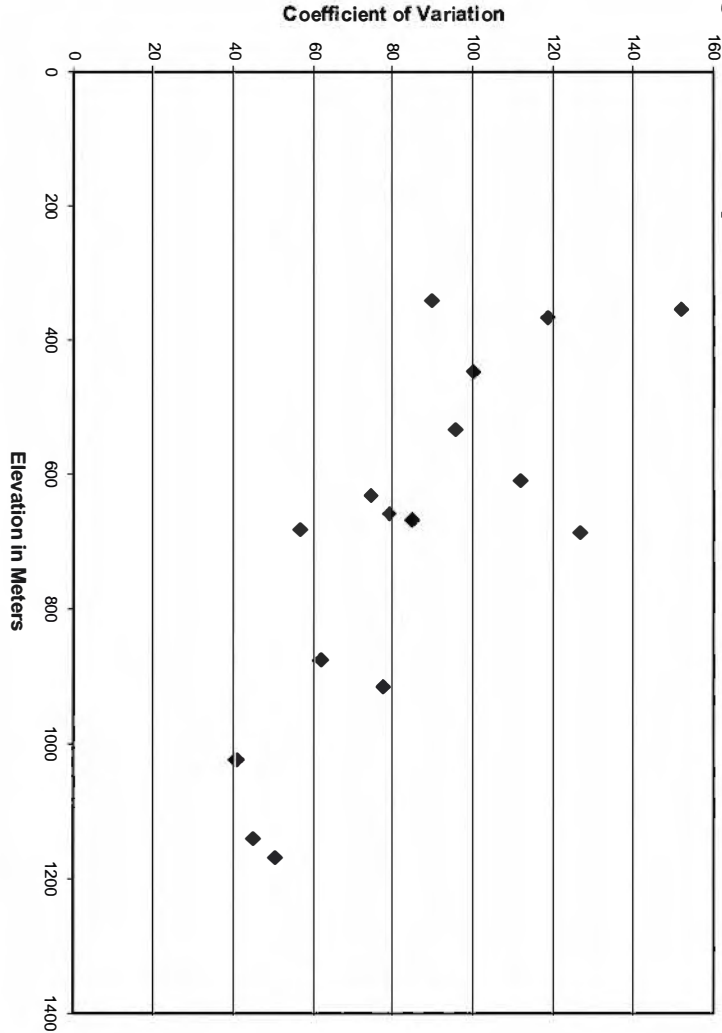


Figure 8. Relationship between the coefficient of variation (of mean annual snowfall) and station elevation.

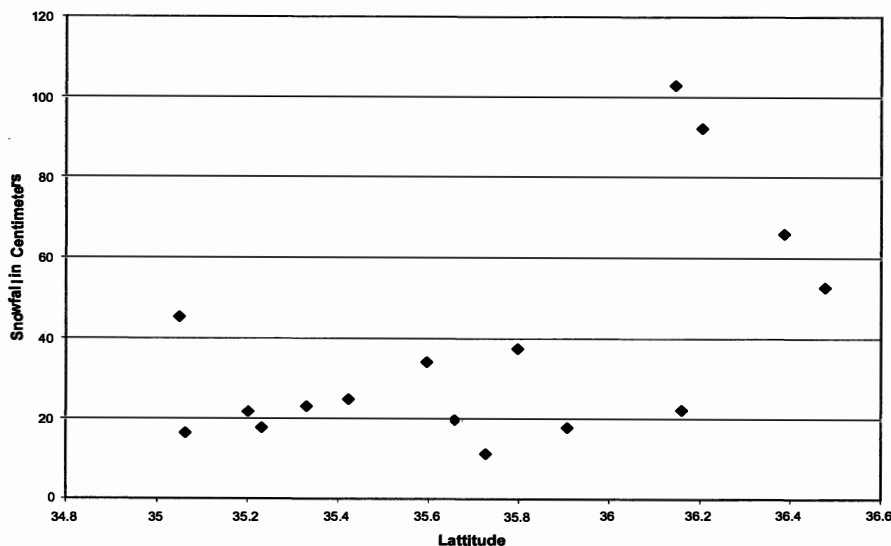


Figure 9. Relationship between mean annual snowfall and latitude.

western North Carolina, or at higher latitudes, also received more snow during the 20-year period regardless of their elevation (Fig. 9). These stations were affected more by troughs, clipper-type systems, and northwest flow snowfall events moving into the area from the north and west. The fact that the higher latitude stations received higher amounts of mean annual snowfall agrees with basic weather and synoptic principles concerning southeastern climate (Hartley 1998; Whiteman 2000). This type of pattern can typically be found anywhere north of the equator.

Summary and Conclusions

Spatial variations of mean annual snowfall were found to exist between each of the four western North Carolina sub-regions. The magnitude of the spatial variations was fairly dramatic and agreed with the initial hypothesis. Variation appeared to be greater between sub-regions as opposed to stations within each

individual sub-region. The variations found between the sub-regions can be attributed to several geographic characteristics, including elevation, latitude, physical location, and weather and synoptic patterns. The greatest magnitude was found between the Northwest and Foothills sub-regions where elevation was the primary geographic characteristic causing the observed spatial variations.

In addition to the variations between the sub-regions, there also appeared to be spatial variation between stations within some of the individual sub-regions themselves. This was the case in the Asheville Basin sub-region between Marshall and the other three stations, as well as in the Southwest sub-region where Highlands received more annual snowfall than the other three stations. These variations were attributed primarily to elevation and exposure to prevailing weather and synoptic patterns. The grouping of the 16 Cooperative Observer stations selected for this study appeared to work well, given that stations within each sub-region typically exhibited similar snowfall

patterns. However, even within individual counties in each sub-region, there can be great spatial variability due to geographic characteristics.

Further research could be conducted to gain an even better understanding of the spatial variations in snowfall that are taking place in western North Carolina. This further research could include: 1) accessing more Cooperative Observer Station data, 2) analyzing a longer time period of data, 3) developing regression models and interpolating the results to understand snowfall amounts in areas that are lacking observer stations or contain missing data and 4) a more detailed analysis of the synoptic processes that are occurring in order to characterize the spatial variations.

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Acknowledgements

The author would like to thank Dr. Pete Soulé for his encouragement and continued support with interpreting the results of the analysis for this research. Additionally, the author would also like to thank Baker Perry for his help with understanding the geographic and synoptic characteristics of the study area, Dr. Chip Konrad for the extraction and use of the climate data, and three anonymous reviewers, whose comments and suggestions greatly improved the final version of this manuscript.

Report: The 2004 Hurricane Season and Its Impacts in North Carolina

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Introduction

November 30, 2004 put a close to one of the most destructive and emotionally draining Atlantic hurricane seasons on record. In the U.S. 151 deaths were either directly or indirectly attributed to hurricanes and property damage totaled 42 billion dollars, making 2004 the costliest season on record (Levinson 2004; Nowell 2005). Florida was the target for most of the hurricanes, enduring a record four direct hits, three of them coming in the span of a month. The 2004 Hurricanes: Charley, Ivan, and Frances were rated second, third, and fourth most destructive hurricanes in U.S. history, with only Hurricane Andrew (1992) being more costly (Levinson, 2004). While Florida suffered greatly from the 2004 season, the rest of the Southeast, including North Carolina, did not escape unscathed.

North Carolina can be affected by "direct-hit" hurricanes from the Atlantic and "back-door" storms which usually hit the Gulf coast as hurricanes and make a turn to the northeast, crossing over the western mountains as extratropical storms. The former category of storm is characterized by strong winds, storm surge, and tornadoes. The latter type can be as equally devastating since mountains in the western part of the state force warm tropical air upward, dumping copious amounts of rain that can lead to flash flooding and landslides in the region's steep terrain. In 2004 North Carolina was impacted by three "direct-hit" (Alex, Charley, and Gaston) and three "back-door" hurricanes (Frances, Ivan, and Jeanne). In addition, Tropical Storm Bonnie, which hit the Florida panhandle, brought rain and a tornado to eastern North Carolina as an extratropical system. This paper summarizes the impacts of the seven tropical sys-

tems on North Carolina. In particular, we examine precipitation amounts and make some comparisons with previous hurricane seasons.

Tropical Storms and Hurricanes of 2004 and Their Impacts

Figure 1 displays the National Hurricane Center tracks of the seven weather systems with tropical origins to impact North Carolina. No other state, including Florida, had as many storms (six) pass through its borders in 2004. According to the hurricane climatology of the State Climate Office of North Carolina (<http://www.nc-climate.ncsu.edu/hurricanes/>) 2004 was the busiest season in over 50 years.

Hurricane Alex, which never made landfall, brought the strongest wind and largest storm surge to North Carolina. The Category 2 Hurricane just brushed past the Outer Banks (Fig. 1), coming within 9 nautical miles of Cape Hatteras on August 3. On that day maximum sustained winds reached 85 knots and the pressure dipped to 972 millibars. The highest estimated storm surge was 6 feet on the sound side of the Outer Banks at Buxton and Ocracoke Village. These locations were flooded and winds caused minor structural damage to homes and businesses. One person drowned in a strong rip current off the Outer Banks two days after Alex passed by. The estimated damage from Alex is not more than 5 million (Franklin 2004).

Tropical Storm Bonnie and Hurricane Charley delivered a one-two punch to eastern North Carolina as Bonnie tracked through on August 13 and Charley followed a day later. Bonnie's only reported casualties were three deaths from a tornado in Pender County

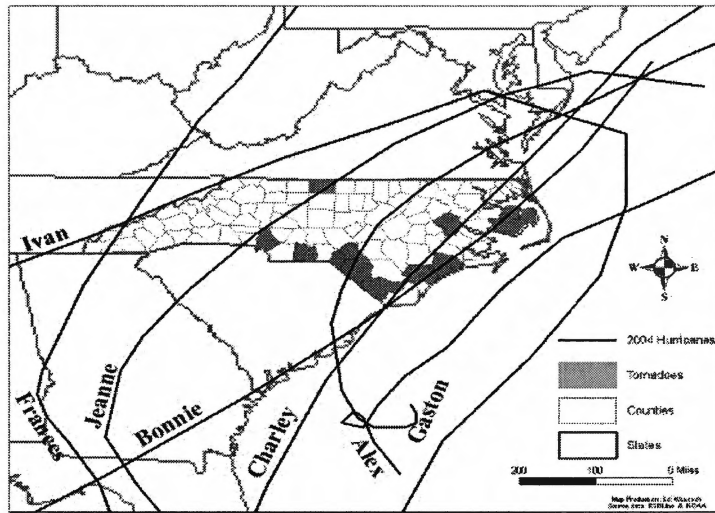


Figure 1. Tracks of the seven storms with tropical origins to impact North Carolina in 2004. The counties having confirmed reports of storm-related tornadoes are shaded.

(Avila 2004). Charley was the lone Hurricane to directly hit North Carolina. On August 14 Charley made its second landfall in the United States, after crossing Florida, at the North Carolina/South Carolina border with maximum sustained winds of 65 knots. It was downgraded to a tropical storm at landfall and quickly moved up through Duplin, Pitt, and Bertie Counties before entering the Virginia Beach area (Fig. 1). Five tornadoes in Onslow, Pitt, Hyde, Tyrrell, and Dare Counties were reported on August 14. These tornadoes did not cause any deaths but the Dare County tornado produced F1 damage in Kitty Hawk. New Hanover, Brunswick, and Columbus Counties experienced high wind speeds, uprooted trees, downed powerlines, and peeled roofs. Twenty-five million of the 4 billion dollars of U.S. property damage occurred in North Carolina (Hartsoe 2004; Pasch et al. 2004; Schreiner 2004; Schreiner and Fennell 2004).

Hurricane Gaston made landfall in the U.S. just north of Charleston, S.C. on August 30 and continued northward, entering North Carolina at Robeson County the following day as a tropical depression and then tracking through Wake and Halifax Counties before entering southeastern Virginia (Fig. 1). Two tornadoes were confirmed in Scotland and Hoke

Counties. Damage from Gaston in North Carolina included downed limbs, power outages, and beach erosion at Bald Head Island. The effects of Gaston were felt weeks afterward as the Lumber river crested nearly 8 feet above flood stage in Lumberton. Fifteen million of the 130 million dollars of U.S. property damage occurred in North Carolina (Franklin et al. 2004).

Hurricane Frances entered the far western portion of the state on September 8 as a tropical depression (Fig. 1). Of the 101 tornadoes formed by Frances 11 touched down in North Carolina in Robeson, Anson, Columbus, and Mecklenburg Counties. Most of the damage was due to heavy rains, explored in the next section, which led to flooding and six mudslides along the Blue Ridge Parkway (Beven II 2004; Mitchell and Yongquist 2004; Sparks and Yongquist 2004).

Hurricane Ivan was North Carolina's deadliest and costliest storm in 2004. It tracked to the northeast along the North Carolina-Tennessee border as a tropical depression on September 17 before curving southward over Virginia (Fig. 1). Eleven people died in North Carolina, four in the Peaks Creek community in Macon County, after water ripped mud and trees down a cove. Two residents of Florida also died

in Macon County in their attempt to escape the hurricane. A tornado touched down in Rockingham County, destroying at least five homes and damaging dozens more (Stewart 2004).

Finally, Hurricane Jeanne passed through the central portion of the state, from Gaston to Rockingham Counties, as an extratropical system on September 28 (Fig. 1). It added to the already high rainfall totals for the month. Initial damage estimates for Jeanne are at 15 million (Lawrence and Cobb 2004).

Precipitation Totals for Selected Days in August and September of September 2004

Figure 2 shows rainfall totals for selected days during Alex, Charley, Gaston, Frances, and Ivan. The data is displayed with 2 inch contours of precipitation gridded at 0.25° latitude by 0.25° longitude resolution. Rainfall estimates on August 3 and 4 are obtained from a combination of satellites calibrated to NASA's Tropical Rainfall Measuring Mission (TRMM) (<http://trmm.gsfc.nasa.gov>). Satellite information is useful in this case, as much of the rain associated with Alex was offshore and thus rain gauge recorded data was not available. The rainfall data for the remaining days is displayed through a modified Cressman gridded analysis of at least 500 stations across the United States and Mexico as produced by the Climate Prediction Center. (http://www.cpc.ncep.noaa.gov/products/precip/realtime/US_MEX/index.html).

For all tropical systems, at least two inches of rain fell somewhere in North Carolina. For Tropical Storm Alex daily rainfall totals in excess of 6 inches were centered over Cape Hatteras (Fig. 2). The Ocracoke gauge recorded 7.55 inches of rain from Alex. Tropical Storm Charley affected the coastal plain with Greenville experiencing the most rain at 5.05 inches. Gaston crossed the state in two days, dumping at least 2 inches of rain in a swath from Fayetteville to Roanoke Rapids (Fig. 2). Robeson County received five inches of rain with some local flooding. Tropical Storm Frances affected the western half of the state with a broad area receiving over 6 inches of rain (Fig. 2). The maximum reported rainfall for the duration

of Frances was 18.07 inches in Linville Falls. Almost 17 inches of rain fell in the Edgemont community along the border of Avery and Caldwell Counties, and many stations throughout the Appalachians received over 10 inches of rain. Another four inches of rain fell in the same area only nine days later as the remnants of Hurricane Ivan moved through the region (Fig. 2). Local totals reached 9.3 inches in Jackson County, 8 inches in Haywood and Burke Counties, and more than 6 inches in Buncombe, Avery, and Mitchell Counties.

Figure 3 displays August and September rainfall totals for both 2004 and the 1895 to 2004 climatology by the eight North Carolina climate divisions. Table 1 shows the exact values. Based upon climatology, North Carolina receives more rainfall in August than September and precipitation totals decrease from east to west. In August 2004 Climate Divisions 6, 7, and 8 (coastal plain and Piedmont, Fig. 3) received 183%, 168%, and 165%, respectively, of normal August precipitation (Table 1). Of the 110 years on record, August 2004 ranked as the twelfth rainiest for Climate Division 8, ninth rainiest for Climate Division 7, and fifth rainiest for Climate Division 6. The mean precipitation for North Carolina, a spatially weighted average of all eight climate divisions in the state, was the fifteenth highest value since 1895. Climate Divisions 1, 2, 4, and 5 (western half of the state) received 371%, 289%, 202%, and 228%, respectively, of normal September precipitation (Table 1), and represent the counties inundated by the rains of Frances and Ivan (Fig. 3). September 2004 ranked as the eighth rainiest for Climate Division 4, fourth rainiest for Climate Division 5, second rainiest for Climate Division 2 and the rainiest ever recorded for Climate Division 1. The time series of September precipitation for Climate Division 1 is displayed in Figure 4. The total of 15 inches in 2004 is 150% of the next highest value of approximately 10 inches in 1924. In fact, considering all months on record for Climate Division 1, September 2004 is only second in total rainfall to August 1940. The mean precipitation for the entire state of North Carolina ranked as the ninth rainiest September on record.

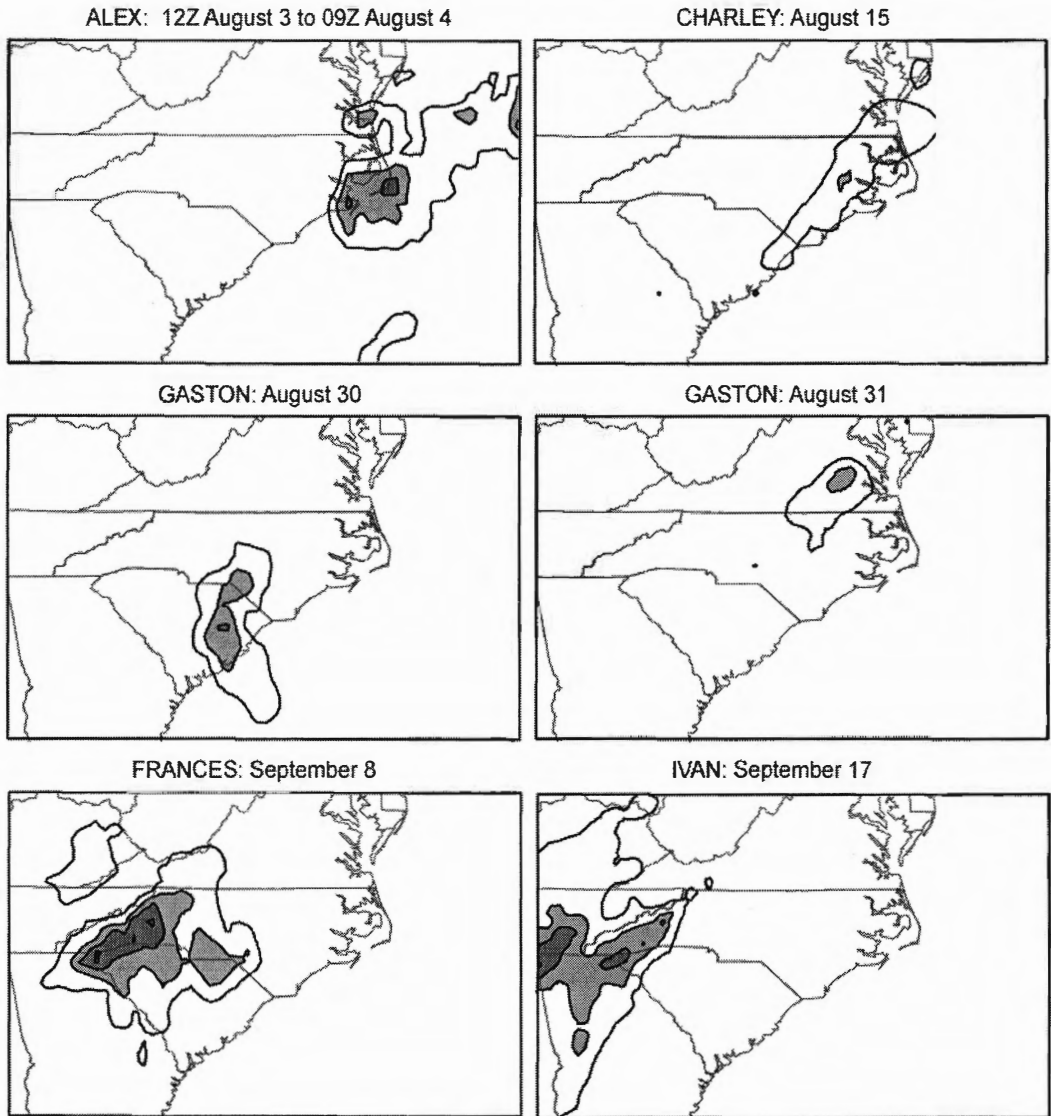


Figure 2. Daily precipitation during Alex, Charley, Gaston, Frances, and Ivan. Contour intervals are: 2 inches (no shading), 4 inches (light shading), 6 inches (medium shading), and 8 inches (dark shading).

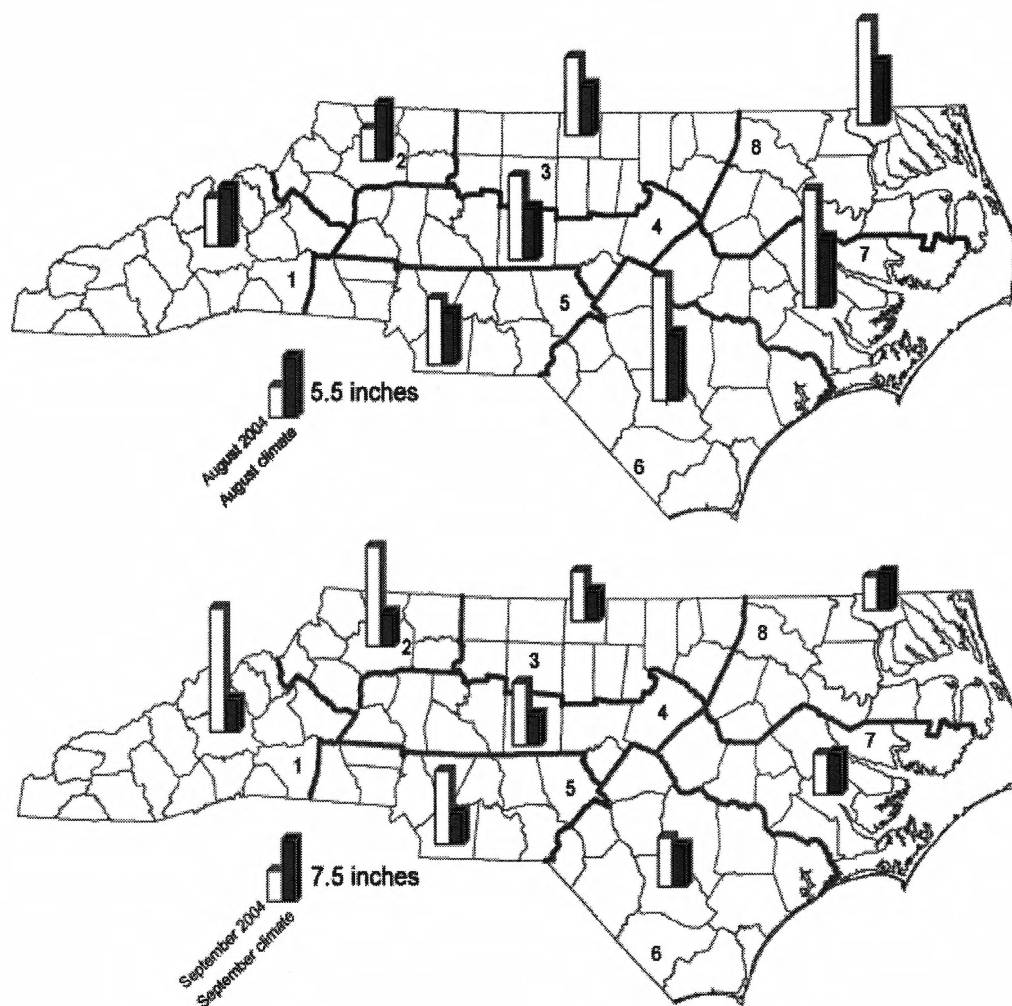


Figure 3. Precipitation (inches) for the eight climate divisions in North Carolina in August and September 2004 (open bars) and the 1895-2003 climatology (solid bars). Bars are proportional to the climatology legends: 5.5 inches for August and 7.5 inches for September.

Table 1. Precipitation (inches) for the eight climate divisions in North Carolina in August and September 2004 and the 1895-2003 climatology (AVG).

	1	2	3	4	5	6	7	8
August 2004	4.30	2.86	6.99	7.47	5.79	10.99	10.39	9.25
AVG August	5.25	5.15	4.55	4.69	4.76	6.02	6.17	5.62
September 2004	15.00	12.07	5.99	7.59	8.77	5.99	4.89	3.98
AVG September	4.04	4.17	3.7	3.76	3.85	5.10	5.14	4.58



Figure 4. Precipitation (inches) for Climate Division 1 in North Carolina for all Septembers from 1895 to 2004.

Summary

Given the focus of the media on the hurricane devastation in Florida in 2004, one may overlook the impacts of the season upon North Carolina. The state suffered over \$200 million in property damage and 15 fatalities. A total of 20 tornadoes were reported in 13 counties across the state. Rainfall records were also shattered as the western most climate division received more rainfall in September than ever before. Overall, 2004 can be considered the most active and damaging hurricane seasons for North Carolina as seven storms affected every corner of the state, making it a true state-wide disaster.

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GIS at Work: Interview with Justin Arnette

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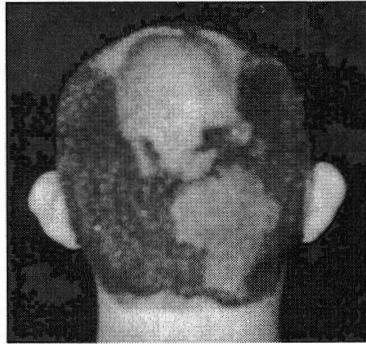


Figure 1. Justin Arnette's hair when he was a geography major at UNC-Wilmington.

Background:

Age: 27

Hometown: Carolina Beach, NC (moved from Raleigh when he was 3 years old).

Education: Graduated from UNC Wilmington in May 2002 with a B.A. in Geography and Environmental Studies.

Employment: Cartographer, U.S. Army Corps of Engineers, Wilmington Office.

Q: When did you discover your interest in Geography?

Well, I needed 5 more courses to complete an Environmental Studies degree. I found out I was good at cartography, plus I enjoyed it.

Q: Do you have plans to continue your education?

Hopefully. I'd like to complete a masters program in geography.

Time Spent in Afghanistan:

Q: What did you do while in Afghanistan?

I worked for two major organizations, the U.S. Army Corps of Engineers and the U.S. Agency for International Development (USAID). I upgraded their software and hardware first, because without it you can't do anything. They had very few maps of the area, and the ones they had were Russian maps from the early 70's that were scanned into a digital format. I was working for the military, but they weren't very forthcoming with their maps. I used older and declassified maps to help people who were traveling to get where they needed to go quickly and safely. I contacted people in the military and the Army Corps of Engineers for satellite images of the area. With those data, I created route maps for people to get to and from destinations.

With the Corps of Engineers the maps I made were mostly route maps, site maps, site layouts, and real estate maps. I helped to pick sites for border and highway police stations through topographic maps and digital imagery. These helped to make sure the sites were easily defendable and gave the people scout-

ing the sites an idea of what to expect when they got there. With USAID I worked on irrigation maps, road maps, school and clinic construction maps, and power grid maps. These were maps to help track the building of the Afghan infrastructure. In addition, these maps helped to manage the water supply for the irrigated lands used for farming.

My typical day started around 5:30. I would work for a couple hours, get some breakfast and do any field work in the morning when it was the coolest. Around 8 a.m. I'd start doing GPS work. I usually worked 15-hour days; I always wanted to meet deadlines.

Q: Who is going to use your maps?

The military used a lot of my maps for traveling, but mostly they are getting the maps to turn over to Afghanistan so that Afghans can build a new society.

Q: What was your job title?

Cartographer—that is my job title here in the States and that is what I told people there but that wasn't my official title because all the job titles there are very generic so that they can get you to work on a lot of different projects.

Q: How long were you in Afghanistan?

I was there for six months. I left Wilmington in April 2004 and returned in October.

Q: What was the international presence like?

There was definitely a military presence, a lot of Iranians and Pakistanis. I noticed a very "Russian" look—red and blonde hair with green eyes—evidence of their extended occupation in Afghanistan.

Q: Was security tight?

Yes. We weren't allowed outside of the compound unless we were in a vehicle, and even then we were not allowed outside of vehicle. I always wore a Kevlar vest that weighed about 40 lbs. We always had to have a Kevlar helmet too, but we didn't have to wear it while in the vehicle.

Q: Did your concept of the people change?

I expected nothing but desert dust and people living in little huts. But everyone was extremely nice and respectful. The only thing I didn't understand was having to eat anything that was offered to you. I'm a picky eater, so I did a lot of apologizing.

Q: How do you feel about dust now?

I hate the dust.

Q: Where does Kabul get its water?

They get their water from an underground aquifer. They like to waste water too, love to wash their cars.

Q: Did you drink the water?

We were told not drink the water unless we wanted to lose a lot of weight.

Q: Did you see drugs in the market?

No, not really. I'm sure there was, but we didn't see it. The bazaar that we went to was searched ahead of time and it actually came into our compound.

Q: Do they drive on the left or right?

They drive where ever they want to.

Q: Are there no yellow lines, stop lights or signs?

No, not really—there is a median in some places but people just drive right over it. You definitely have to be an aggressive driver.

Q: Do you think they are spending their money smartly and planning for the future?

There is still a lot of waste over there, but they seem to have really toned down the spending. The first barracks they built for US soldiers that I saw were really extravagant for soldiers. They had big single rooms and air conditioning in every room.

Q: Were you able to watch the news?

The Armed Forces Network was available, but I didn't watch any TV while I was there at all. There was only one TV in the TV room and I chose to work more than watch it.

Q: Do you have plans to go back?

I am eyeing a June return if I can work it out with my supervisors and family.

Q: What was the most rewarding part of your job?

It was great to be able to help Afghans rebuild their country.

Hearth and Home: A Lesson Plan for the Use of Cultural Geography to Identify Regional Settlement Patterns in North Carolina

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Introduction

As teachers of geography, we are constantly aware of how little our students know about the cultural landscape. Our responsibility is to create an atmosphere of excitement in which our students cannot help but be swept up by an emotional and subjective response to an awareness of human patterns upon the earth.

Cultural geography is the study of the human occupation of the earth. It looks at the question of how human beings interact and interrelate with their physical environments. In cultural geography, you study the distributions and spatial patterns of such human and cultural topics as the ways people make a living, their languages, their religions, and all aspects of their settlement patterns.¹

One of the best approaches to introducing cultural geography to the novice is to cultivate an appreciation for the cultural landscape. "Cultural landscape" is a concept introduced by geographer Carl O. Sauer in 1925.² Sauer defined the study of cultural geography as the analysis of the "cultural landscape"—the human imprint on the earth's surface. Anything that people have done to alter or change the face of the earth from a purely natural or physical landscape has created some form of human imprint or cultural landscape. All human activities—the ways we make a living, the ways we build our shelters, our food production methods, even ceremonial and religious practices—all of these help to create new varieties of cultural landscapes.

The study of material culture can be a springboard for the studying the cultural landscape. Material culture refers to any things, artifacts, or materials

that are made by people. Artifacts or objects of material culture are not only things such as tools, weapons, or ornaments; they include the larger manifestations of material culture that compose our landscapes. Houses, barns, country stores, all types of buildings, fences, roads, and even field patterns are all part of the material culture of a region. As geographers, we learn a great deal about the history and culture of places by analyzing their material cultural patterns. The first group of people to permanently settle in a region generally makes the most lasting imprint on that region. Kniffen's concept of "initial occupance"³, or Zelinsky's "doctrine of first effective settlement"⁴, can be seen best in patterns of land division and the oldest types of houses found in a region.

When we begin to study the cultural landscapes of North Carolina, we need to remember that the land survey system used here was the old British system of "metes and bounds." Because this land division system used landmarks such as "the corner oak" or "a large pine stump" or the "stone in the bend of the creek," the resulting land parcels very often were extremely irregular in shape. As a result, the road systems throughout the rural parts of our state form an irregular net across our land.⁵

Like the initial survey system, the types of buildings erected by the first permanent settlers formed the organizing framework upon which later architecture would flourish. In studying cultural landscapes, geographers usually talk about "folk housing."³ Folk houses (not planned by professional architects) are the ordinary houses, the traditional houses, the ones marketed, built, and used locally.⁶ They characterize a region, and are often referred to as vernacular, or local,

architecture. Folk houses did not change much with the passage of time. The small coastal frame cottage was very similar throughout the time span of its usage in North Carolina (Figure 1). On the other hand, folk architectural patterns varied greatly across geographic space.

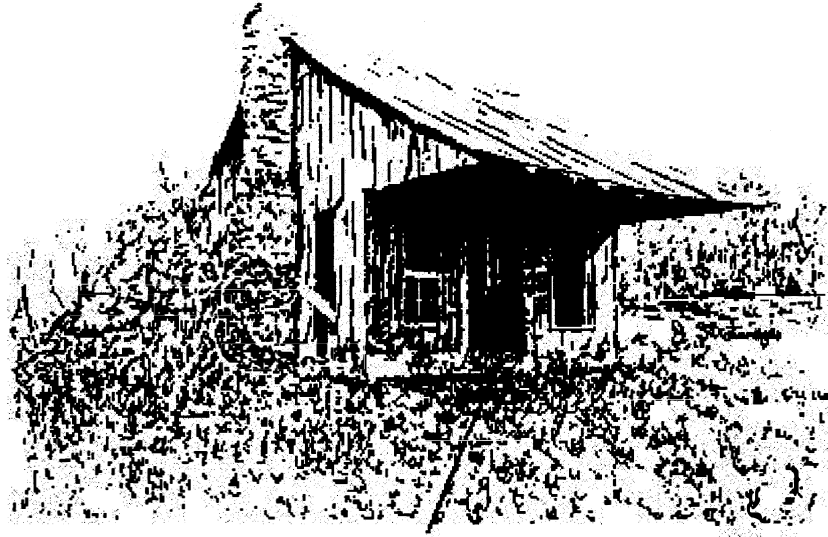


Figure 1. A typical coastal cottage.

Folk or vernacular building patterns are most often those identified with the past historical evolution of the region. In the late 1800s, new mass media building information, new building technologies, and mass milling and marketing of architectural components, brought about the beginnings of a major shift away from the pure, locally crafted folk house types. Popular styles became the norm. Older locally designed and built forms such as coastal cottages, single-room log houses, and the central hallway "I" house, began to be replaced by national house styles such as Queen Anne Victorian, foursquare houses, and bungalows.

The important question at this point is, "How do we practically apply the concepts of material culture and cultural landscapes to the teaching of geography?" Encourage students to travel with open eyes and inquisitiveness. Teach them that local geography can be exciting and interesting if they will only take time to

observe the countryside around them. A brief field trip to introduce them to material culture on the local landscape will be even more educationally rewarding.

Just as you can learn from reading a book, there is a tremendous amount of knowledge about the

world and its geography that can be gained by "reading the cultural landscape."⁷ We should encourage our students to notice the patterns of material culture that are out there on the land. They should look for any unusual or unique types of things that may help to label or identify a particular region. Travel the "blue highways!" Learn to identify traces of past human settlement and movement patterns that you can still discern. A good cultural geographer should be a "collector" of the material cultural landscape.

How do you become a "collector" of the cultural landscape? As a start, we need to become acquainted with the names of the types and styles of buildings, structures, and other objects that are found on the land. We need to be aware also of the roads, paths, fields, survey lines or markers, and communications lines that are part of a region's cultural landscape. So often we just take most of these things for granted. There are many elements of material culture that can

be collected in this fashion. Some examples are different house types, country store buildings, old hotels or taverns, modern motels and other roadside architecture, farmhouses, barns and other farm outbuildings, fences, church buildings and other religious structures, bridges, gas stations, and types of cemeteries or gravestones. Surely, we can find some elements of the cultural landscape that will stimulate the intellect of each of our students, no matter where his or her particular interests may lie.

To collect a sampling of the material culture of a region, we need to use one of the basic tools of the geographic profession—field methods. Using a good base map as a guide, (U.S.G.S. 7.5 minute quadrangles work best), a preliminary windshield survey can be made of a region. Then a more comprehensive inventory should be conducted of a selected study area. Documentation forms should be filled out and photographs taken of the material cultural objects being studied. Sketches and drawings of the structures or objects in their natural setting should also be made in order to give some overall context or sense of place to the data being collected. For secondary students, the end result of such an examination of the local cultural landscape could be the production and publication of an inventory booklet including an historical geography of their community. If such a field excursion type project is being used with elementary or middle school students, the end result could be the compilation of a class sketchbook, a photograph album, or even a poster collage illustrating the kinds of material culture they “discovered” on their trip.

Many excellent resources exist that can be used as guidebooks for such investigations of the cultural landscapes of our state’s cities and towns and rural areas. Many of these contain detailed diagrams and photographs which help the beginning cultural geographer to identify the various elements of material culture. In addition to the basic seminal works by geographers already mentioned, there are numerous “field guides” available to help one know what the artifact is and what its importance is to the region. Included in the list of end notes is a listing of some of the most helpful materials. ^{8 to 18}

Hopefully, all of us are becoming more aware of the valuable landscape “textbook” that is out there in

all of our communities and regions. Now let’s introduce our eager geography and social studies students to the endless possibilities of material culture that they can find. With a sense of exploration and discovery, and with guidebooks in hand, let’s go forward and capture that sense of landscape understanding that can make cultural geography come alive both for the student and teacher. Good hunting!

The Lesson Plan

INTRODUCTION:

Where it fits into the NC Standard Course of Study: Social Studies Objectives:

- 2.3 The student will assess similarities and differences among communities in different times and in different places
- 6.1 The student will identify and analyze changes which have occurred in communities in different settings
- 6.2 The student will assess the impact of change on the lives of people in communities studied
- 7.3 The student will identify a variety of examples of cultural traditions
- 8.1 The student will distinguish among various kinds of maps and globes and suggest their uses
- 9.1 The student will know absolute and/or relative locations of the local and other communities
- 9.5 The student will distinguish the local region from other regions of which it is a part

OBJECTIVE:

The student will identify the folk housing that reflects the Lowland South and Upland South culture regions in North Carolina.

INTRODUCTION:

Conduct a lesson on the folk house types of North Carolina’s Lowland South and Upland South culture. Review associated background information,

historic preservation vocabulary, and architectural characteristics of specific styles of the period. Use drawings and transparencies to demonstrate visually the specific characteristics, features, and functions of the buildings and structures.

Teaching activities consist of the following sections:

- I. Getting Started (inquiry question)
- 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).

The lesson plan format was designed to allow flexibility but works best if the material in each lesson plan is presented to students as described below:

I. Getting Started

Ask students to discuss possible answers to the inquiry questions that accompany the **"Getting Started"** image (Figure 2). To facilitate a whole class discussion, you may want to print the page and use it to make an overhead transparency. The purpose of the exercise is to engage students' interest in the lesson's topic by raising questions that can be answered as they complete the lesson. Rather than serving merely as illustrations for the text, images are documents that play an integral role in helping students achieve the lesson's objectives.

To assist students in learning how to "read" visual materials, have them answer the following questions about this photograph.

- a. What is the material from which this building is constructed?
- b. Of what material is the chimney built?
- c. How many rooms do you think this house contains?
- d. How many openings are on the front façade of this house?
- e. Would you classify this building as a "folk house type?"

II. Setting the Stage

This material may be read aloud to students, summarized, or better yet photocopied for students to read individually or in small groups. "Setting the Stage" material provides background information necessary to acquaint students with the topic of the lesson they will be studying.

PIONEER SETTLEMENT:

Approximately one-half of North Carolina lies outside the Coastal Plain—in the Piedmont and the Mountain regions—areas that were initially settled by an assortment of pioneers. Many of these pioneers are considered members of the Upland South culture. The Upland South culture in the United States dates back to the mid eighteenth century, when a wave of Scots-Irish and German immigrants arrived from Pennsylvania. These groups blended their experiences into what became known as the Upland South culture. They initially settled in the Piedmont hills and the Appalachian mountains where they found cheap and abundant land. With them came their cultural baggage—their ideas about building and other traditions—which they modified to fit their new environment. Historically those who made up the Upland South culture were evangelical Protestants, who held on to their independence with an unyielding tenacity, and did not accept central authority. Farming, hunting, and livestock raising were their main activities.

During the 1750's the Upland South culture came to North Carolina. They brought their culture and traditions with them. The Upland South culture was noted for its simplicity and adaptability. Its folk house types were of such a nature that they were easily duplicated. The Scots-Irish brought with them the British pen house as the basic model of their domestic architecture and the German-speaking settlers brought the central European tradition of log construction.

The few surviving Upland South buildings in North Carolina are a testimony to its pioneer heritage. Most of the buildings constructed in keeping with the Upland South culture in North Carolina are no longer standing because the early buildings were either abandoned or altered so that they were no longer recognizable as Upland South architecture.



Figure 2. Example for class room discussion.

In the Coastal Plain of North Carolina, the English settled in the mid-seventeenth century. They brought with them the traditional folk house types from southern England, and adapted those dwelling units to the flat, humid environments of the coastal region. As in the Piedmont and mountain regions, not many of the earliest buildings still exist, but the astute observer of the cultural landscape can still discover examples of a few eighteenth century structures and quite a number of nineteenth and early twentieth century folk house types.

III. Determining the Facts &

IV. Visual Evidence

Provide students with copies of the following outline of readings, drawings, and references. Again, allow students to work individually or in small groups. For the examples of each folk house type, references are given to the appropriate pages in the excellent series of three books: *A Guide to the Historic Architecture of Eastern North Carolina*, *A Guide to the Historic Architecture of Piedmont North Carolina*, *A Guide to the Historic Architecture of Western North Carolina*.¹⁹⁻²¹

Also basic references to web pages for individual houses are given. For general information and more photographs go to the following web sites:

<http://www.ncmuseums.org/history.html>

<http://memory.loc.gov/ammem/>

COMMON FOLK HOUSE TYPES IN NORTH CAROLINA: A LEARNING OUT- LINE

PIONEER HOUSE TYPES (usually built in frontier areas by first settlers):

(1) **Single pen house** (Figure 3)

- a. Usually 16 by 16 feet or 16 by 18 feet
- b. Usually built with logs, with V-notches or dove tailed notches at corners
- c. Chimney constructed of field stones, or mud and sticks built outside the walls at gable end
- d. Doors centered in front and rear walls
- e. Entire family, ate, cooked, and slept in single room
- f. Example: Davis House at Mountain Farm Museum, Great Smoky Mountains National Park, Swain County, NC (Bishir, et.al., *Western NC*, pp. 389-90)

<http://www.blueridgeviews.com>

[BR129 Davis House.htm](http://www.blueridgeviews.com/BR129_Davis_House.htm)

<http://pictures.care2.com/view/2/790526011>

- g. Importance: All pen-tradition houses consist of combinations of single-pen unit

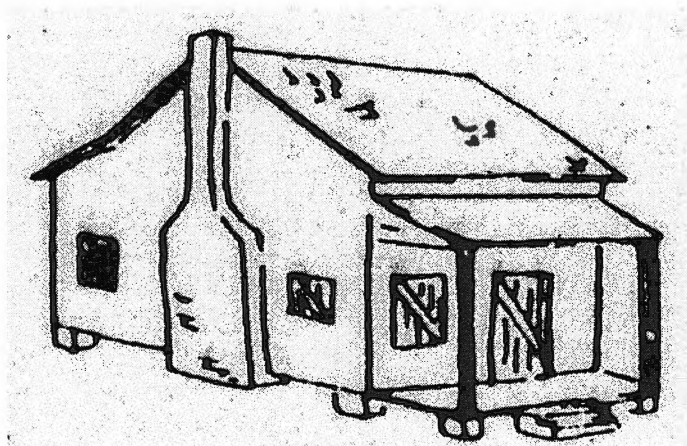


Figure 3. Single-pen house.

(2) Double pen house (Figure 4)

- a. Consists of two single pens joined gable-to-gable with chimney at either end.
- b. Core commonly ranges from 16 by 32 feet to 16 by 36 feet
- c. Commonly have galleries and rear shed rooms
- d. Doors on front and rear walls
- e. Construction techniques same as for single pen
- f. Windows often lacked glass
- g. Example: Gunter House (ca. 1875) at Fontana Village Graham County, NC (Bishir, et.al., *Western NC*, pp. 398-99)

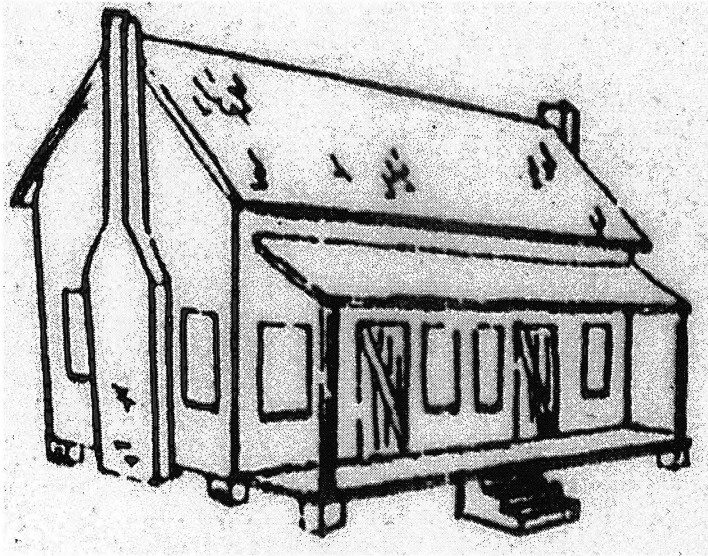


Figure 4. Double-pen house.

(3) Saddlebag house (Figure 5)

- a. Consists of two single pens joined gable-to-gable with chimney in center.
- b. Core commonly ranges from 16 by 32 feet to 16 by 36 feet
- c. Commonly have galleries and rear shed rooms
- d. Doors on front and rear walls
- e. Construction techniques same as for single pen

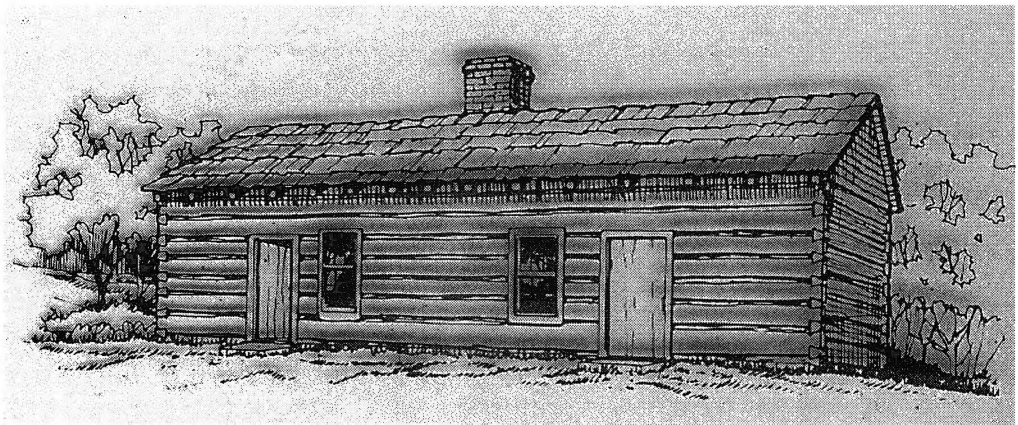


Figure 5. Saddlebag house.

(4) Dog trot house (Figure 6)

- a. Consists of two single pens separated by open, roofed passageway
- b. Open passageway is usually half the width of a single pen
- c. Usually ranges from 16 by 40 feet to 16 by 45 feet
- d. Usually has a full gallery on front and shed rooms across the rear
- e. Almost invariably one story
- f. Evolved from the British pen-house
- g. Theories about plan of Dog Trot Houses:
 - 1. Log rooms could not be attached, hence they were separated by a passageway
 - 2. Developed to cope with hot summers
 - 3. Plan came to America from Scandinavia
 - 4. Frontiersman's efforts to make a symmetrical house in the Georgian style
- h. Represented more prosperous owner than those of single and double pens
- i. Few dog trot houses remain because many were changed with time into more modern floor plans
- j. Example of dog trot house:
Log House Museum at John C. Campbell Folk School, Brasstown, Cherokee County, NC (Bishir, et.al., *Western NC*, p. 411)

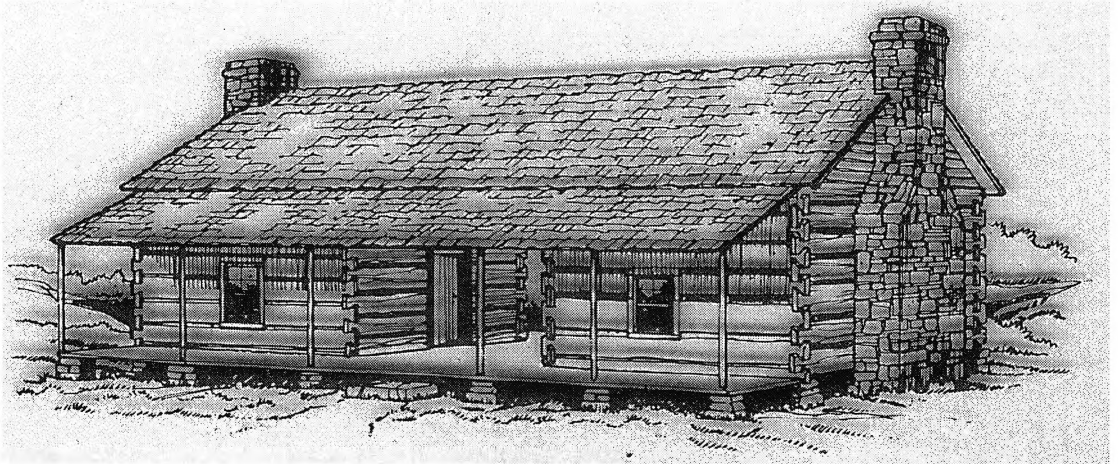


Figure 6. Dog trot house.

OLD WORLD HOUSE TYPES (folk house types brought from Europe as cultural baggage):

(5) Coastal frame cottage (Figure 7)

- a. Consists of two rooms
- b. Usually one-and-a-half story, with a storage area or sleeping loft above
- c. Constructed of frame lumber
- d. Raised above ground level (sometimes several feet) to allow ventilation
- e. Single, exterior gable end chimney
- f. Examples of coastal frame cottages:
 1. Dunn-Canady House (early 19th century), near Graingers, Lenoir County, NC (Bishir and Southern, *Eastern NC*, p. 373)
 2. Sloop Point House (1726), on Sloop Point Road, Pender County, NC (Bishir and Southern, *Eastern NC*, p. 231)
 3. David Newby House (early 19th century), at the Newbold-White House, near Hertford, Perquimans County, NC (Bishir and Southern, *Eastern NC*, p. 113)
 4. Archibald Monk House (ca. 1824), Newton Grove, Sampson County, NC (Bishir and Southern, *Eastern NC*, p. 410)

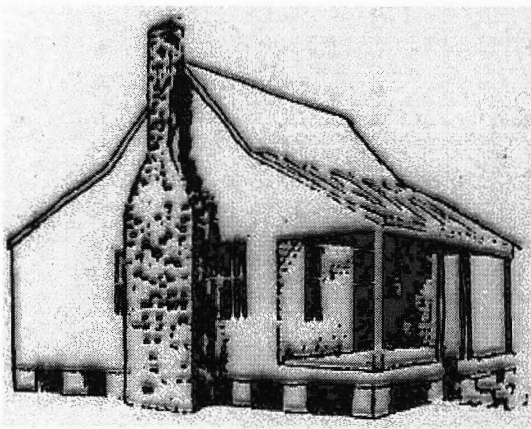


Figure 7. Coastal frame cottage.

(6) Hall-and-parlor house (Figure 8)

- a. Consists of two rooms, a large square “hall” and a smaller formal “parlor”
- b. Plan usually used in many early coastal frame cottages
- c. A one-and-a-half story house, usually with a boxed-in corner stairs
- d. Examples of hall-and-parlor houses:
 1. Newbold-White House (1729), near Hertford, Perquimans County, NC (Bishir and Southern, *Eastern NC*, pp.17, 113) <http://newboldwhitehouse.org/history.html>
 2. Jones-Litch House (ca. 1810s) (hewn log construction, rare for Coastal region), Laurinburg, Scotland County, NC (Bishir and Southern, *Eastern NC*, pp.17, 113)
 3. King-Bazemore House (1763), on grounds of Hope Plantation, Bertie County, NC (Bishir and Southern, *Eastern NC*, pp.278-79)

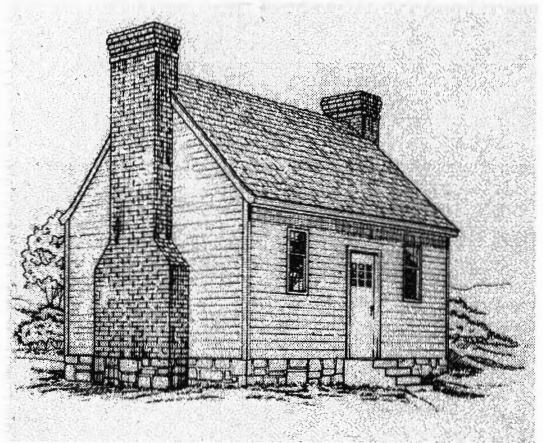


Figure 8. Hall-and-parlor house.

(7) Central hallway I-house (named by Fred Kniffen) (Figure 9)

- a. Has a central passage ("descended" from the English cross-passage house)
- b. One room deep, two or more rooms wide
- c. Two story house
- d. Chimneys usually at gable ends
- e. One story porch (sometimes two story porches) across the front façade
- f. One story shed extension across the rear
- g. Examples of the I-House:

- 1. John McNider House (ca. 1800), near Bethel, Perquimans County, NC (Bishir and Southern, *Eastern NC*, pp. 19, 114)
- 2. Duke Homestead State Historic Site (ca. 1852), Durham County, NC (Bishir and Southern, *Piedmont NC*, pp. 212-13)
<http://www.ibiblio.org/dukehome/>
- 3. Eaton Place (1843-44), Warrenton, Warren County, NC (Bishir and Southern, *Piedmont NC*, pp. 149-150)

- 4. Kelly-Farrior House (Cowan Museum) (1850s), Kenansville, Duplin County, NC (Bishir and Southern, *Eastern NC*, pp. 413-14) <http://www.cowanmuseum.com/cowaninfo.htm>

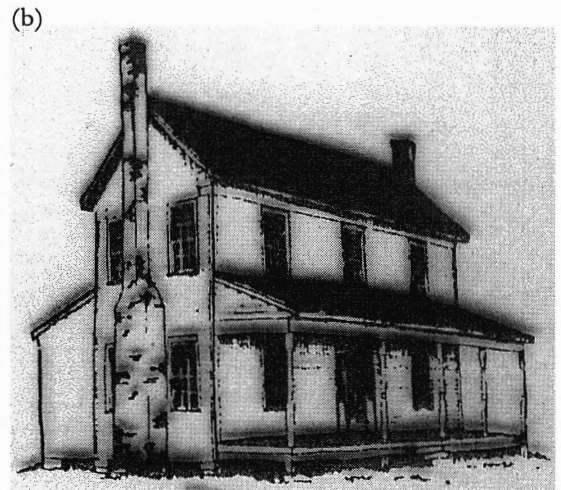
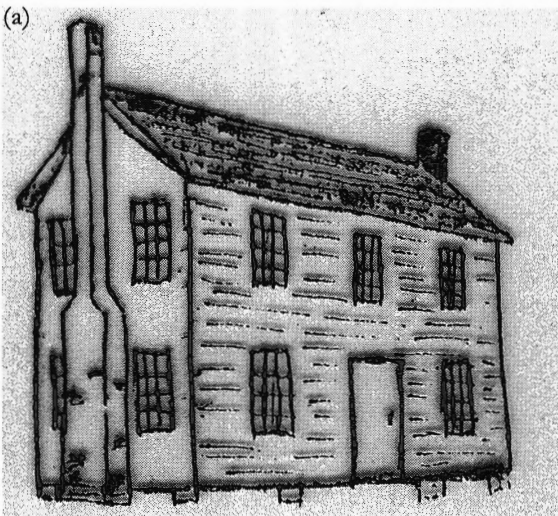


Figure 9. Central hallway I-house: (a) basic I-house and (b) Carolina I-house.

(8) Four-over-four house (Figure 10)

- a. Two story house
- b. Has a central passage
- c. Two rooms deep
- d. Chimneys symmetrically placed between front and rear rooms
- e. May have gable or hip roof
- f. May have double-tiered porches across the front façade (sometimes across the rear)
- g. Generally the homes of the wealthier people (merchants, businessmen, planters)
- h. Examples of four-over-four houses:
 1. Buckner Hill House (1859), near Faison, Duplin County, NC (Bishir and Southern, *Eastern NC*, p. 417) http://www.carolinaplantation.com/buckner_hill_main_frame.htm
 2. Tryon Palace (1767-70), New Bern, Craven County, NC (Bishir and Southern, *Eastern NC*, pp. 194-95) <http://www.tryonpalace.org/>
 3. Poplar Grove (ca. 1850), Scotts Hill, Pender County, NC (Bishir and Southern, *Eastern NC*, pp. 230-31) <http://www.poplargrove.com/>
 4. Hope Plantation (1796-1803), near Windsor, Bertie County, NC (Bishir and Southern, *Eastern NC*, p. 278) <http://www.hopeplantation.org/>

V. Locating the Sites

Next provide students with copies of a blank North Carolina map that shows the counties of the state. One is included for reproduction at the end of this lesson plan. Have the students, working in groups, locate all of the folk house types used in this exercise.

Then have the students complete the following questions. The map should familiarize students with the historic dwelling's location within the state, and more specifically within one of the physiographic regions of the state.

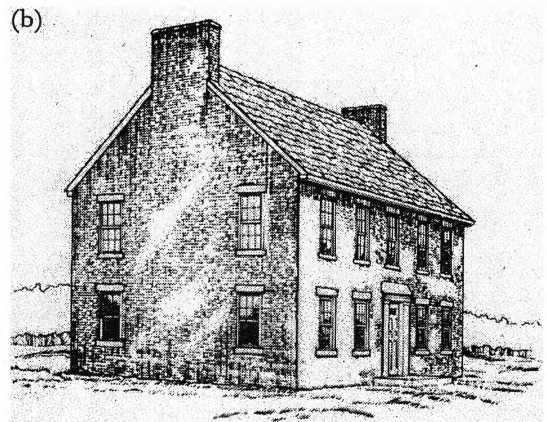
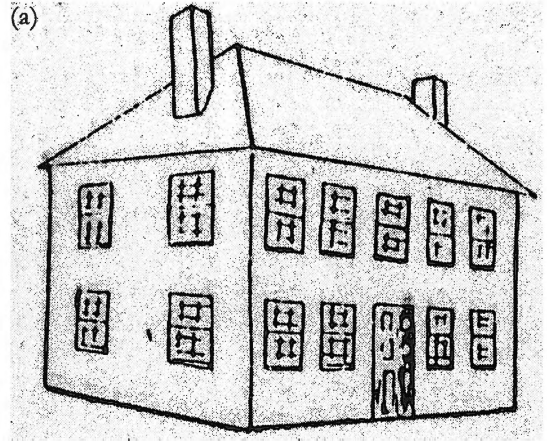


Figure 10. Four-over-four house: (a) hip roof and (b) gable roof.

Questions:

- A. From examining the eight types of folk houses, can you discuss any environmental adaptations that might have been made?
- B. Are there any obvious differences between the Coastal Plain house types and those found in the Piedmont and Mountains?
- C. Can you trace the settlement patterns of the Scots-Irish and German immigrants by looking at the folk house type regions?
- D. What are the main features of the "T" House? Is it found in more than one physiographic region of our state?
- E. Using the three guidebooks to the Historic Architecture of Eastern, Piedmont, and Western North Carolina, make a list of ten more of these folk house types around our state.

VI. Putting It All Together

After students have completed the questions that accompany the maps, readings, and visuals, they should be directed to complete the following activity. This activity engages students in a creative exercise that helps them synthesize the information they have learned and formulate conclusions.

Assign students to look for examples of these basic folk house types in their community. Have them document and research the history of the houses by photographing and drawing sketches of each of them. Have them find out as much as possible about the houses they pick: when the house was constructed; who the builder was; who has lived in it?

This can be the beginning of the students' "collections" of a sampling of the material culture of their own community. In this way, students will learn to make connections between their community and the broader themes of American cultural geography and history they encounter in their studies.

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Additional Material for students: North Carolina County Map

Book Review

Blood Done Sign My Name: A True Story

Timothy B. Tyson, Crown Publishers, New York, NY, 2004. 355 pp., bibliography. \$17.00 hardcover (ISBN 0-609-61-58-9)

Reviewed by Elizabeth Hines, University of North Carolina at Wilmington

A racially-motivated killing in the small North Carolina tobacco market town of Oxford is the focal point for Timothy Tyson's newest book. *Blood Done Sign My Name* is an enthralling historical geography of American race relations seen through a deeply personal lens. In it, Tyson recounts a particular incident, the murder of a young black man in 1970, that he deftly relates to the universal notion of race in America. *Blood* is the epitome of what Charles Joyner has praised as the modern historian's proclivity to explore "a large question in a small place." Although told in Tyson's genuinely funny Southern, sometimes homespun manner, the story is poignant to the point of tears.

A sudden and violent attack on a young black veteran, Henry Marrow, following a perceived sexual overture to the white daughter-in-law of a local merchant, Robert Teel, resulted in Marrow's essentially public execution as he was beaten and shot to death by Teel and his son in front of their convenience store at a busy crossroads in Oxford's black neighborhood known as "Grab All." The murder, and the subsequent exoneration of the Teels, threw tiny Oxford into turmoil and haunted Tyson throughout his life.

Tyson uses ethnologist Clifford Geertz's method of thick description to place the reader firmly in Oxford, a typically segregated Southern town, then casts a wide net to capture the unhappy story of race in America. As the eleven-year-old son of a recently arrived "Eleanor Roosevelt liberal" Methodist minister father and equally committed social activist mother, Tyson experienced the awful truth of the murder and its violent aftermath in Oxford. This included the sudden appearance of robed and armed Klansmen, the unhurried arrest of the murderers, the Teel's ultimate exoneration by an all-white jury and the burning of Oxford's tobacco warehouses (the town's economic

mainstay). We are quickly reminded, however, that the life and death struggles in Oxford in 1970 were not exceptional: the week before, National Guardsmen had killed four war protesters at Kent State in Ohio; the day after, six blacks died in a racially motivated riot in Augusta, Georgia; and five days later two black students died and twelve were wounded when Mississippi state troopers fired on a dormitory at the traditionally black Jackson State University.

Inter-racial sex, historically the most worrisome issue for whites and the most dangerous for blacks, is a recurring theme. However, the idea of white fears of sexual trespasses by black males over-simplifies a more complex story. Tyson explains that although sexual innuendo may have precipitated the Marrow killing, the real story had much to do with Teel's business ventures into black "Grab All" and the restlessness of blacks, especially black Vietnam veterans, as civil rights era activism waned and failed to produce what had been promised. Teel's exploitive business strategies won him few friends of either race and his Klan ties were well known. The Klan's role in the Oxford incident culminates in a succinct history of white supremacy in America.

The Reverend Tyson's racial activism and support for integration ultimately forced him from his congregation in Oxford. In an ironic twist of fate, the Tysons moved to Wilmington just in time for the school desegregation riots here, the accused instigators of which were locally (and nationally at the time) referred to as "The Wilmington Ten." It seemed to young Tim Tyson that the post-*Brown v Board of Education*/Civil Rights Act era brought only upheaval to North Carolina and his family, but, of course, the distress was nationwide.

A cast of compelling characters populate the story, including all of the Tyson clan and their "bohemian intellectual" friend, Thad Stem, poet laureate of Oxford, newsman, liberal co-conspirator of the elder Tysons, and mentor of the fledgling historian. A veritable *leit motif* throughout the book, he and the Reverend were the greatest foils to the prevalence of die-hard white supremacy in Oxford. The Reverend Benjamin Chavis (also known as Benjamin Muhammad), a native of Oxford and later one of the Wilmington Ten, and his influential family, are part of the narrative, as is North Carolina's perennial Civil Rights activist, Golden Frinks. Eddie McCoy, a Vietnam veteran and still an Oxford activist, is a steady presence and one of Tyson's most trusted and enduring sources on the events surrounding the murder and the temper of Oxford's black community.

The racism that lurks in all of us is considered on a personal and realistic, if unnerving, manner before engulfing the reader in the Civil Rights era. Tyson says that Americans have as hard a time becoming aware of white supremacy as fish have becoming aware of water, and reveals his own struggle to overcome the cultural legacy that instilled in him, as it instills in all Americans, white and black, the notion that *something is wrong with black people*. The role of religion and the ideas about the equality of humankind from the liberal left in overcoming this notion is examined from the vantage point of the last in the long line of families headed by Methodist ministers.

Blood Done Sign My Name resonates with Southern cultural geography to the native, while, I assume, it offers a regional crash course to the non-Southerner. Tyson has expertly crafted the primary Southern theme—*race*—into his personal narrative. His treatments of slavery, titular emancipation, post-Reconstruction violence, miscegenation, the myth of the black rapist, lynching and, of course, the racial caste system, universalize the story, relieving any notion that Oxford's story might be unique.

This book is a good read, difficult to put down, riveting for students, affirming for scholars. I've assigned it to two university classes on American race relations because of its accessibility and comprehensiveness, each time with appreciation from the students. And it's all true. The 322 page story is seamlessly

woven into twelve chapters, which brim with detail and insight into the small and large stories contained therein. Eighteen pages of useful chapter by chapter Notes on Sources appear at the end. The Author's Note states that this story first appeared as his master's thesis at Duke University in 1990. It's much more than a master's thesis now. What began as a memoir has blossomed into an important synthesis of our national racial consciousness under Tyson's passionate concern for the story and a professional historian's patient attention to detail. If there is a flaw in the book, it is that it lacks an index. Perhaps the second edition, and I hope that there is one, will remedy that.

Timothy Tyson was born and raised in North Carolina. He earned a Ph.D. in History from Duke University and is an Associate Professor of Afro-American Studies at the University of Wisconsin at Madison. He is the author of *Radio Free Dixie: Robert F. Williams and the Roots of Black Power*, which won the James Rawley Prize and the Frederick Jackson Turner Prize from the Organization of American Historians. *Democracy Betrayed: The Wilmington Riot of 1898 and Its Legacy*, co-edited with David S. Cecelski, won the Outstanding Book Award from the Gustavus Meyers Center for the study of Human Rights in North America. He is currently a John Hope Franklin Senior Fellow at the National Humanities Center where he is working on *Deep River: African American Freedom Movements in the 20th Century South*. Tyson calls this "history that matters."

Book Review

Looking for Longleaf: The Rise and Fall of an American Forest

Lawrence S. Earley, The University of North Carolina Press, Chapel Hill, NC, 2004. X+322 pp., \$27.50, hardcover (ISBN 0-8078-2886-6)

Reviewed by Heidi G. Frontani, Elon University

The longleaf pine (*Pinus palustris*) has needles of eight to fifteen inches and grows throughout the US southeast, from Virginia to Florida to Texas. Lawrence Earley, a freelance writer and photographer and former editor of *Wildlife in North Carolina* elegantly describes the loss of and restoration efforts of the longleaf pine throughout its range, but places particular emphasis on the longleaf in North Carolina. The book, though detailed, is written for the general public. The book's four parts describe the ecology, exploitation, forest management, and ecosystem restoration for longleaf. There are notes, a bibliography, index, and 22 pages of graphics including a map, many historical photos and sketches.

Ecologically, the most important changes for longleaf have involved fire suppression, the loss of dense stands of contiguous forest, and the removal of most of the oldest trees, those in the 400-500 year range. There are many different longleaf communities. Whereas each community is fire-dependent and has a grassy, herb-rich understory, the communities differ considerably in their plant composition. There are at least eight distinct longleaf communities in North Carolina containing 600 plant species or nearly a quarter of the state's total. Longleafs survive mostly in xeric (dry), sandier portions of North Carolina, but can grow in moister, more fertile surroundings. In more fertile grounds, longleafs do not have a competitive edge once fires are suppressed. Pines are quite prone to lightning strikes relative to beech and other trees and lightning storms are common in the south. Fires burning literally millions of acres barely made the back pages of Raleigh newspapers as recently as 1898. In the 1970s, US forester Robert Mutch went as far as to suggest that certain trees, including the longleaf, depended on regular fires and might have adapted traits such as highly flammable resin which encouraged blazes. Common species associated with longleaf communities are the burrowing gopher tor-

toise (*Gopherus polyphemus*), red-cockaded woodpecker (*Picoides borealis*), and southeastern fox squirrel (*Sciurus niger*).

Humans have shaped longleaf communities for at least 5,000 years, but the greatest impacts have come in the last four centuries. Europeans brought cattle, hogs, and started longleaf-based industries. Cattle reduced perennial grasses which fuel fires that perpetuate the forest, hogs ate the nutritious longleaf seeds and seedlings. Workers cut 'boxes' into the bases of living longleaf trunks to extract gum for processing into turpentine spirits and rosin, others felled trees entirely for timber. Often much waste was involved because longleaf supplies seemed inexhaustible. North Carolina was the south's leading exporter of lumber during the colonial period and was home to nearly one-third of all sawmills in the longleaf range. Ship builders in Europe prized the US longleaf for its rot-resistant wood and pitch which could be used to caulk seams. North Carolina also was the key state for the production of turpentine. The state had 785 stills in 1850, more than ten times the stills in all other southern states combined. Turpentine was used to treat wounds, mixed with castor oil or alcohol and burned in lamps, used in the manufacture of varnishes, paints, and oil colors. Laborers and slaves cut boxes into trees, but poorly made cuts could lead to the tree's death. Even properly boxed longleafs were more vulnerable to insect activity and hurricanes. Longleaf populations had declined considerably by the time the US turpentine industry peaked in 1909. Less destructive methods of gum extraction gained popularity when they also increased profits and production.

Forest management arose with the understanding that resources could be exhausted. Whereas the skies over North America were once blackened with passenger pigeons, the unthinkable had occurred. The passenger pigeons were no more. Foresters, especially

those trained in Europe, arrived with cautionary tales. With the Forest Reserve Act of 1891 the US president could create national forest preserves. Scientific forest management took hold, and with it notions of the need to suppress fires. Fire suppression had the unintended side effect of encouraging the growth of the fast growing, frequently seeding trees such as the loblolly pine (*Pinus taeda*) and the slash pine (*Pinus elliotii*) throughout longleaf range. Foresters soon discovered that secondary growth trees like the loblolly and slash pine had marketable qualities that the longleaf lacked. Due to their rapid growth loblolly and slash were useful to the pulp and paper industry as a source of high quality newsprint. By the 1950s, pulp was the dominant forest product of the south. Over time it was noted by hunters that some of their favored species, such as the bobwhite quail, were less prevalent than in the past and scientists and the general public alike began to believe that the decline of the longleaf and the quail were interrelated. Indeed it was found that quail could starve in a food-rich environment if food was buried under a mat of grasses no longer removed by fire. By the 1940s some foresters realized that fires are necessary for some species to thrive, but others were busy creating Smoky the Bear, a 'public education' figure in cartoon form who promoted fire suppression. It was not until the mid-1980s that the Forest Service pronounced its commitment to restoring longleaf in its historic range. By this point there were only 3.8 million acres of longleaf remaining in a region that once boasted 92 million acres.

Litigation fueled the move from exploitation and neglect to ecosystem restoration. Species such as the red-cockaded woodpecker that required hollows in older longleaf trees to survive had declined to the point of being endangered. Based on the 1976 National Forest Management Act, in the 1980s, the Forest Service was sued successfully and repeatedly by environmental groups on behalf of endangered and threatened species associated with longleaf pine communities, prompting change in forest management. It took considerable effort for the Forest Service to recruit landowners to support longleaf restoration. Years of Smoky Bear campaigns and the long-term planning required due to the slow growth of longleaf

hampered efforts. Economics slowly began to win over some land owners—the longleaf pine is more expensive to grow, but it provides high-grade saw timber and (telephone) poles that faster growing pines do not. Incentive programs, such as the Safe Harbor Program were created as well. Some landowners had cut down all of their longleaf fearing that the presence of endangered species would limit their options. Safe Harbor provided economic incentives to protect endangered species. The longleaf also provides superior needles for gardeners and landscapers. This relatively new pine straw industry created a virtual craze for the longleaf. Owners could have their properties raked once or twice a year, get immediate income, yet still be growing valuable trees. In North Carolina, by 2002, pine straw was a 50-55 million dollar a-year industry. Restoration of longleaf is not based on returning to 'pristine' or 'pre-European' conditions, but on bringing longleaf communities closer in general terms to what it might have been when there was more of it. Ironically, some of the oldest and most extensive stands of longleaf are areas not managed by the Forest Service—military bases where US Air Force bombing runs that bring about regular burns, Girl Scout camps, North Carolina's Fort Bragg Military Reservation, and elsewhere.

Earley concludes that he is cautiously optimistic about the future of the longleaf pine. Challenges to its future include the damage already done, the popularity of the south, and that the nation relies on the south for wood. The south produces 58 percent of US wood fiber and 16 percent of the world's. For the past 20 years it has also been the fastest growing region in the country.

Looking for Longleaf makes for fine reading. It will serve as a useful introduction to forest management in the US for introductory-level university courses in environmental studies and for the person with general interest in natural history. The book's North Carolina focus also makes it appropriate reading for undergraduates studying the state's coastal zone, economic geography, or human-environment interactions.



The Department of Earth Sciences 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.

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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 the third and fourth floors of a soon-to-be renovated science facility and contains three computer laboratories for work in computer cartography, GIS, and image processing. The laboratories have numerous 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 is a USGS repository, and its map library presently possesses over 100,000 maps and 5,000 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 relatively 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. Accordingly, 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
GREENSBORO

Department of Geography

Doctoral Degree in Geography

The doctoral program is centered on the research-oriented application of geographical theories to real-world problem-solving. The program provides advanced-level preparation in 3 areas: urban/regional economic development & planning, earth science/natural resource management, and geographic information science.

Master's Degree in Applied Geography

The Master's degree emphasizes the application of theoretical constructs in geography to solving problems, and also leads to the acquisition of research skills and expertise appropriate to geographic analysis, including spatial statistics, cartography, GIS, and remote sensing. Within the framework of the degree, one may also choose a concentration in urban planning and economic development.

Post-Baccalaureate Certificate in Geographic Information Science

The certificate provides professionals with the skills needed to utilize spatial analytic tools, geographic data visualization techniques, spatial programming, and geographic information and image processing software.

Post-Baccalaureate Certificate in Urban and Economic Development

This certificate requires courses emphasizing the knowledge and skills to prepare students to work in organizations focusing on urban planning and community economic development activities in the private sector, government and non-profit organizations.

Bachelor of Arts in Geography

For over half a century, our undergraduate program has prepared 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. A geography major may choose a general degree or a degree with a concentration in either geographic information science, urban planning, or earth science/environmental studies.

For Undergraduate Information:

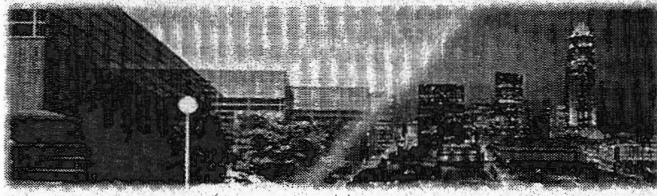
Contact: Dr. Michael Lewis
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For Graduate Information:

Contact: Dr. Elisabeth Nelson
336-334-3896
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THE UNIVERSITY OF NORTH CAROLINA AT CHARLOTTE

Master of Arts in Geography



The Master of Arts Program in Geography at UNC Charlotte emphasizes the application of skills, methods and theories to problem solving in contemporary society. Students are offered a solid foundation in research methods, problem formulation, quantitative methods, spatial analysis, and GIS skills. Our graduates have used these skills to enjoy successful careers as professional geographers, community planners, site location and marketing analysts, and private consultants. Approximately 10% of the program's 250 graduates have gone on to study in Ph.D. programs.

Program Concentrations:

Community Planning Track

Students who choose the Community Planning Track 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.

Urban-Regional Analysis

The urban-regional analysis concentration offers a broad background that provides training for public and private sector planning and development, and Geographic Information Systems. Course work may be concentrated in one of the following areas:

Community and Regional Development	Site Feasibility Analysis
GIS Analysis	Impact Analysis
Public Facility Siting	Urban Development

Location Analysis

The location Analysis concentration prepares students for jobs in location research with retailers, real estate developers, consulting firms, commercial banks, and economic development agencies.

Course work is offered in:

Retail Location	Market Area Analysis
Industrial Location	Real Estate Development
Facility Siting	Applied Population Analysis

Transportation Studies

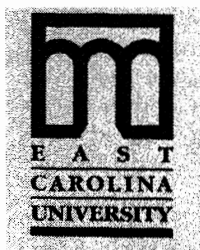
The University's Center for Transportation Policy Studies is affiliated with the department.

Careers are available in public and private sector agencies and in consulting firms. Students pursue course work in:

Transportation systems Analysis	Impact Analysis
Transportation Policy Analysis	Transportation Planning

The Internship: As a program which emphasizes applied geography, client-based internships are an important element and normally replace the traditional thesis as the capstone research project of the graduate program. Projects involve students in the execution of a substantive research task for private or public sector clients. The student is the primary investigator in a specific "real world" research project.

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



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 electronic copy and one original and two hard copies of the manuscripts. Only original, unpublished material will be accepted.
- All manuscripts should be on 8 1/2 " 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 authors last name. Please follow the *Annals of the Association of American Geographers* reference format.
- Figures and tables should be submitted on separate pages at the end of the manuscript and electronic versions of figures should be IFF format. Provide a list of figure and table captions on a page separate from the main text of the manuscript.
- High quality, black and white photographs may be included.

Send manuscripts to:

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