Sherrill W. Stockton III

The Cognitive Ecology of the Upper Chattahoochee Watershed

(Under the Direction of Ben S. Blount)

ABSTRACT

A challenge to all temporally resilient human groups is to 'acquire' and 'process' ecological knowledge in a manner that permits the collective recognition of important natural environmental fluctuations, random disturbance processes, and anthropogenically-induced disturbance regimes. This project attempts to capture some regional parameters of ecological knowledge of both rural and urban inhabitants of the Upper Chattahoochee Watershed in north Georgia, the sole catchment area for the troubled water supply of the metropolitan Atlanta area.

The hypotheses of the study were based on a well-developed literature indicating that high income, positive environmental attitude, greater age, higher education level, and male gender were associated with greater ecological knowledge. It was hypothesized that previous studies privileged urban, educated markers of ecological knowledge by measuring *general* knowledge of ecology --which may have little importance toward ecological behavior in particular contexts. In contrast, this project developed measures of local, in-situ ecological knowledge more relevant to ecological behavior and motivation due to their inherent measurement correspondence. It was hypothesized that using the new measures, 'first-hand' knowledge (situated knowledge that springs from experience) would be more prevalent in the rural areas, and that 'second-hand' knowledge (from cultural sources) would be more prevalent in the urban areas of the watershed.

While the results of the study mirrored the central hypotheses, the findings were not significant. However, because a significant *inverse* relationship was found between overall ecological knowledge and environmental attitude in the rural respondents, it is argued that the nascent 'first-hand' and 'second-hand' knowledge measures were both capturing 'first-hand' knowledge. Importantly, then, rural respondents—contrary to the literature but predicted by our original hypotheses -- scored higher than urban respondents on this knowledge measure, and did not at all share the environmental attitude of the urban region. Thus new measures of ecological knowledge may yield different and more relevant results toward the question of urban and rural ecological knowledge and attitude.

INDEX WORDS: Cognitive ecology, Ecological Knowledge, Rural Knowledge, Urban Knowledge, Ecological Attitude, Situated Knowledge, Local Knowledge, Ethnoecology, Upper Chattahoochee Watershed, Georgia.

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by

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DEDICATION

This paper is dedicated to my niece, Isabel, who never ceases to amaze and inspire me.

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I learned more than I ever thought possible during my tenure at The University of Georgia. For that I owe great thanks and praise to my instructors, and to Charlotte Blume. To accomplish this degree, I stacked the papers, and Charlotte did the work. I have it on good authority that the whole school is jealous of our department solely because of Charlotte. Second, I want to thank Michael Olien, for serving on my committee, late in the game, and despite me never having taken one of his classes. Second, I would like to thank Steve Kowalewski. I took every class I could with Steve, and was lucky to have him for Intro to Theory. He also offered his support on several key occasions when I needed it most. Why is it that whenever I am reading or writing anthropology I think to myself "I wonder what Steve would think . . . " Peter Brosius provided me a rich introduction and steeping in the art of critical theory and the power of discourse. This has taken me so far toward understanding not just contemporary anthropology, but numerous other fields equally swayed by critical theory. Pete, however, never seems to get credit for his ability to design and deliver classes that beautifully blend the 'post-structural' with the 'traditional' questions in anthropology. Charles Peters showed inexhaustible commitment to my development as a student of anthropology, and to his teaching generally. He also managed to inspire me with even the simplest exchange. Finally, I have to bow to Ben Blount, who rescued me from a fast-sinking pirate ship. Ben has been nothing but pleasant, helpful, and encouraging ever since. Luckily, his area of expertise echoes old interests. Thank you.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

A challenge to temporally resilient human groups is to 'acquire' and to 'process' ecological information[1] in a manner that permits the collective recognition of important natural environmental fluctuations, random disturbance processes, and anthropogenically-induced disturbance regimes (Ponting 1991). This acquisition and processing of ecological information is presumably necessary for human-system response to environmental change and has been termed "feedback" from the environment (McGovern et al. 1988). However, keeping feedback information from the environment current and complete is challenging "even for electronically literate modern states" (McGovern 1988:245, Rappaport 1979, Moran 1984). According to McGovern, human groups of individuals unable to cognize sufficient and relevant ecological information suffer from 'information flow pathology' and are unable to respond to ecological challenges (McGovern 1988:245).

However, existing notions of environmental 'feedback' and 'information flow pathology', developed to help explain how small-scale human groups recognize and respond to ecological changes in their respective environments, are not well developed. They are a collection of notions without explicit assumptions or a substantive description or theory concerning how these processes actually occur. In addition, the notions of feedback and information flow pathology need further articulation when applied to complex

[1] Information and knowledge are used virtually interchangeably, as per the following definitions. *Knowledge*: something that is or may be known; information. *Information*: knowledge communicated or received concerning a particular fact or circumstance.

societies. In large complex societies, individual ecological knowledge content should be less homogenous than in simpler societies, where distribution is mediated by training or education (Richardson et al., 1996, Arcury, Johnson, Scallay 1986, Lovrich et al. 1986, Pierce et al. 1989), social position (Ellen 1993, Buttel 1987), age (Mohai and Twight 1987, Buttel 1987, Dunlap and Catton 1979) subsistence strategy and/or available technology (Brown 1976), and urban residence (Van Lierre and Dunlap 1980). Thus, in complex societies, the *processing* ('distribution' and 'movement') of ecological information should be as crucial to the development of ecological "feedbacks" as information *acquisition*. Thus, elaborating the distribution and sources of ecological "feedbacks"—knowledge--in a complex society may be a worthwhile goal.

An important subset of relevant issues surrounding the 'processing' or 'movement' of ecological knowledge in complex societies involves the role of *scientific* knowledge in society. In complex societies, scientific findings (and subsequent claims about their meaning or relevance) are often used to validate policy and resource use decisions (Rabinow 1996). Accordingly, there is often the assumption that scientific knowledge makes the knowledge of the general population irrelevant, or that the scientists provide an absolute, all encompassing understanding of the "natural" world. In reality, however, there are several reasons why the knowledge of the general population is important. First, environmental risk is "constructed" differently by different institutions, persons and groups for myriad reasons, and a large literature asserts that scientific knowledge is no different (Killingsworth and Palmer 1990, 1996). Therefore, local knowledges have particular geneses, and particular applications that should not be discounted. Second, and assuming that scientific knowledges are more "accurate" than all other knowledges, the delivery of this knowledge to the general population is so difficult that it requires "translation" and has led to the development of its own field of study in the university setting. Third, the scientific institutions that are responsible for monitoring water quality, for instance, often employ volunteer citizens to produce the scientific knowledge. For example, volunteer citizens supply water quality data in and around Atlanta (Georgia Department of Natural Resources 1996, Riverkeeper 2000). Finally, in complex societies, resource policy, consumption, and/or conservation are increasingly the results of political processes that themselves involve the knowledge of the public (Pelstring 1994, Lovrich et al. 1986). Thus the knowledge of the population has real world affects concerning ecological "feedbacks" in complex societies.

For the reasons given above, the first and primary goal of this project will be to explore the 'distribution' of ecological information in a complex society, and then some of the manners of its 'processing.' Drawing theoretically and methodologically from the fields of cognition, ethnoecology, and cultural models, it will propose several hypotheses and involve numerous quantitative and qualitative data toward the elicitation of ecological knowledge distribution in the Upper Chattahoochee.

A second implicit and related goal will be the development of relevant knowledge measures that permit the articulation of particular knowledge suites in complex societies as well as receptivity to further knowledge acquisition. Research inventories utilized in this project will include both discrete measures of ecological "knowledge", "environmental attitude" measures, and direct techniques to inventory the spatial coherence of similar 'cultural models,' all against several hypotheses developed with respect to the contemporary literature concerning ecological knowledge in complex societies. At best, the project may contribute to predictive theory concerning the quality and quantity of knowledge about particular resources in complex societies using demographic and spatial variables as predictors. It may also contribute directly to the literature on the informational and ethnoecologies of complex societies, environmental sociology and anthropology, and human ecology generally. At the very least, it will be a descriptive and informative account of the cognitive ecology of the Upper Chattahoochee watershed.

For heuristic and simplification purposes, this project will focus on a single variable out of the enormous domain of ecological variables. Water was selected, as it is a useful resource of study for several reasons. First, it is a necessary resource for all human groups, regardless of subsistence strategy, and thus water resources are present and cognized in various manners in all cultures. Thus all groups have the potential of developing ethnoecological indicators of water quality. Second, human groups are rapidly and directly effected by water contamination (nitrites, E-coli, viruses) precisely because it is a necessary resource, and one that is often used untreated or unaltered.

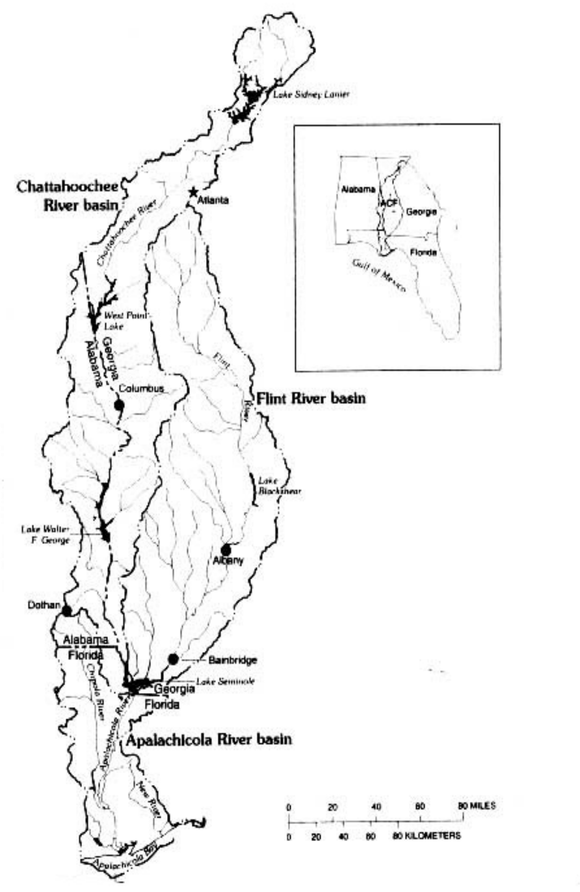
A final reason for selecting water as the resource of choice for this study is that water will be the most critical natural resource of the 21st century. Before the effects of global warming make themselves clearly felt on the earth's ecosystems, water *quantity* and *quality* will long since have been a bane to most of earth's human inhabitants (Young et al. 1994). Fresh water is, and will increasingly be, the source of local, regional, national and international conflict (Johnston and Donahue 1998, Ohlsson 1995) as aquifers and wells for drinking, industry and agriculture are depleted and populations soar (Young et al. 1994). In fact, it is predicted that by 2025, 34 countries will face life-threatening water shortages (Task Force of Research Innovations for Productivity and Sustainability 1995). Moreover, these problems are not limited to the 'developing' nations. In the United States, the depletion of the Ogllala aquifer in the West and Midwest, and the continued degradation of water quality and quantity elsewhere are of major concern (Ohlsson 1995). The development of potable water systems is a top development priority not simply because it is biologically necessary for human survival, but because safe water supplies and sanitation are also vital for improving health, protecting the environment, alleviating poverty (Horchani 1992), and even promoting sustainable development (Young 1994). Finally, and more relevant to the project, Atlanta has a host of ecological problems involving their water resource.

Study Region Selection

This project intends to further investigate how human societies ‘acquire’ and ‘process’ relevant ecological information from the non-human environment. The selected research region should therefore be one where anthropogenic or earth-system fluctuation is affecting the well-being or production systems of the human inhabitants in some way, subsequently influencing the knowledge suites available to the inhabitants. For these reasons, the proposed research will be carried out in the Upper Chattahoochee watershed in central and north central Georgia (see Figure 1.1). Metropolitan Atlanta, the largest and fastest growing metropolitan region in the southeast, sits near the basin’s headwaters and at the foot of the Upper Chattahoochee Watershed which provides the water catchment for the water supply to it’s citizens. The basin’s growing population presents challenges to balancing human and ecosystem needs for water of sufficient quantity and quality. The watershed catchment area relative to the population it serves is smaller than for any other city in the United States (Riverkeeper 2000). However, this small area demonstrates great diversity in water and land use. There is a concomitant diversity in demographic profile and types of point and non-point source pollution. At the basin’s terminus, the Apalachicola River and Bay are regionally and globally significant for their biological productivity and diversity.

Atlanta's history as a nodal economic center accounts for some of its water problems. The city of Atlanta developed as a transportation center around the railroads, unlike many large cities that began as ports at the mouths of large rivers. As the railroads were generally built on ridges, Atlanta grew at the intersection of several ridges on the drainage divide between the Atlantic Ocean and the Gulf of Mexico. Consequently, most streams in the Atlanta area are small and many are severely affected by prolonged droughts. The only sizable stream that flows through the metropolitan area is the Chattahoochee River. The history of water quality in the basin reflects the nature of the boom-bust cycles of exploitation and remediation, and the meeting of water quality problems with short-term solutions (Fricke et al. 1988).

Figure1.1: The Apalachicola-Chattahoochee-Flint River Basin



The first distribution of public water to Atlanta was from a reservoir on Poole's Creek, a tributary of the South River. The Chattahoochee became the source for Atlanta's drinking water in 1893. The first sewer system in Atlanta was a rock filled ditch built in 1880. In 1908, after the 20 county metropolitan Atlanta population exceeded half a million people, the first three treatment tanks to digest settleable solids in the US were added to the Atlanta sewer systems. In 1933, the Works Progress Administration provided funds for Atlanta to build modern sewage treatment plants at South River, Intrenchment Creek, and on the Chattahoochee River.

The post World War II era found an increasing pesticide load in the basin and the population in the area exceeded one million in 1951. The use of organochlorine compounds was banned during the 1970s and 80s, but the use of phenoxy-acid herbicides and organophosphate insecticides have not been banned, and still promote water quality problems (Stell et al., 1995). In 1993, an analysis of the 'urban watershed' in Atlanta revealed 18 herbicides and 7 insecticides in use. One, simazine, was above safe drinking water levels, but the median concentration for all samples was only 3 percent of the maximum contaminant level for drinking water. However, the five detectable insecticides and median concentrations of chloropyrifos and diazinon exceeded guidelines for protection of aquatic life (Fricke et al. 1998).

Water quantity is a great concern as well, and Atlanta is currently part of a legal battle involving the allocation of water. For a decade, the states of Georgia, Alabama and Florida have argued over the use of the waterways in the Apalachicola-Chattahoochee-Flint and Alabama-Coosa-Tallapoosa River Basins. These two basins comprise 40,000 square miles of land, rivers, and lakes that straddle the three states. The battle over the use of the water resources is known as the 'tri-state water wars', and achieving equitable apportionment of these waters is among the most complex resource allocation issues in the nation (Riverkeeper 1999). The implications of the outcome of the water wars are notable. The Apalachicola-Chattahoochee-Flint and Alabama-Coosa-Tallapoosa River Basins provide drinking water for more than five million people, harbor a diverse array of aquatic species, and offer outstanding recreational opportunities. The following chapter provides a more detailed explanation of water quantity and quality issues in the Apalachicola-Chattahoochee-Flint and Alabama-Coosa-Tallapoosa River Basins and the Upper Chattahoochee Watershed.

Regional Approach

This project will utilize a regional approach. The study region is the entire Upper Chattahoochee Watershed boundary. The term 'regional' can have several meanings in social science research. First, it can allude to a *quality* of research that values variable levels of analysis, and the integration of micro and macro level processes for example. Regional analysis, for example, permits larger data sets, the inclusion of spatial relationships, and the manipulation of scale to gain/lose research resolution and background noise (Kowalewski and Fish 1990). However, the term 'regional' studies can simply designate the *scale* of research and can mean simply the designation of a research area larger than the city and smaller than nation-state, for example. Here in the term is used more in the latter sense, as the focus is primarily on the individual as the unit of analysis, although many other system-level variables will be discussed, including the effect of the individual and his/her knowledge suites 'writ large' into the larger socio-political context.

Regional analyses have been utilized in archeological work (Adams 1981), and regional approaches have been central to anthropological approaches to economics (Smith 1978), and geography (Haggett et al. 1977). Few researchers, however, have utilized regional approaches while researching cognitive and ecological phenomena. Atran (1999) uses cognitive data from three ethnic groups in a 'region' in the Maya lowlands. But this treatment is not truly regional. Christianson and Arcury (1992) do manage a truly regional project ascertaining the regional diversity in environmental attitudes and knowledge in the Kentucky River Basin.

For the purposes of this project, a regional approach affords the ability to obtain spatially specific data. The project can determine the frequency of different suites of information in geographic space with initial regard to certain *spatial* variables, but without initial regard to others (sex, ethnicity, age, etc). Thus, using statistical analyses, the variance within/between different regions can be determined. Using various techniques from disparate fields of inquiry, the project will "map" the distribution of particular suites of ecological knowledge between research regions.

Another reason for the regional approach is that the hypotheses developed herein concerning the acquisition and processing of ecological information ultimately rely on demographic variables that correspond to demographic patterns as driving variables. Therefore, by selecting a region with diverse land-use patterns, a diverse physiography, and one with a strong urban-rural gradient, the researcher hoped to maximize the potential intra-group homogeneity of measured ecological information sets, and maximize extra-group variation. Finally, the selected region is an ecologically relevant region that does not correspond to political boundaries (for more detail, see Chapter 3).

Summation

A challenge to temporally resilient human groups is to 'acquire' and to 'process' ecological information in a manner that permits the collective recognition of important natural environmental fluctuations, random disturbance processes, and anthropogenically-induced disturbance regimes (Ponting 1991). Despite this challenge, very little literature has been devoted to the study of ecological knowledge in complex societies. The very same literature, however, is quite developed for small-scale societies. This is unfortunate, for in large complex societies individual ecological knowledge content should be less homogenous than in simpler societies, and the public's knowledge of ecological issues and events is increasingly important in resource decisions (Pelstring 1994). Thus, in complex societies, the *processing* ('distribution' and 'movement') of ecological information should be as crucial to the development of ecological "feedbacks" as is information *acquisition* (as demonstrated by distribution).

In complex societies, scientific findings (and subsequent claims about their meaning or relevance) are often used to validate policy and resource use decisions (Rabinow 1996). But local knowledges have particular geneses, and particular applications that should not be discounted. Even assuming that scientific knowledges are more "accurate" than all others, the delivery of this knowledge to the general population is so difficult that it requires "translation" and has led to the development of its own field of study in the university setting. Additionally, scientific institutions that are responsible for monitoring water quality, for instance, often employ volunteer citizens to produce the scientific knowledge. For example, volunteer citizens supply water quality data in and around Atlanta (Georgia Department of Natural Resources 1996, Riverkeeper 2000). Finally, in complex societies, resource policy, consumption, and/or conservation are often and are increasingly the result of political processes that themselves involve the knowledge of the public (Pelstring 1994). Thus the knowledge of the population has real world affects concerning ecological "feedbacks" in complex societies.

The research questions of the Upper Chattahoochee Watershed project involve measuring the knowledge distribution of the inhabitants of the Upper Chattahoochee Watershed--the sole catchment and water source for Atlanta, Georgia--but also the sources of extent knowledge to better understand knowledge "movement." Using a regional approach, the project hopes to develop and test hypotheses concerning the distribution and sharing or 'movement' of ecological knowledge in the study area.

Summary of Chapters

Chapter 2 will introduce the Upper Chattahoochee Watershed Study Region more thoroughly. The study area itself will be resolved from the Apalachicola-Chattahoochee-Flint River basin. Then, the physiography, climate, and geology of the Upper Chattahoochee Watershed will be described, and a thorough discussion of the point source and non-point source pollutants in the Upper Chattahoochee Watershed will be given. Following this, pesticide data is presented, as well as the influence of environmental and anthropogenic factors in the Upper Chattahoochee Watershed.

Chapter 3 outlines the study regions, the demographic patterns, and describes the urban-rural gradient that exists in the study region. The urban-rural gradient is important toward insuring that the research populations can and should represent urban and rural qualities as predicted by the literature. The demographic profile of the project counties includes a comparison of the earnings, education, rurality index, and inter-county worker flow rates. In addition, the chapter addresses the ideological implications of the urban-rural gradient and its role in the construction of 'urban' and 'rural' identity in the study area.

Chapter 4 will introduce the fields of study relevant to this project and their basic conceptual devices. The first section deals with 'cultural knowledge and its structures,' and it provides some overall organization to some of the relevant conceptual devices. Following this, the chapter discusses 'discrete knowledge and its techniques.' Herein, ethnoecological inventories and free-listing techniques are explained. Next, cognitive model research is introduced, as well as some techniques for elucidating cognitive models. Environmental knowledge is discussed by providing a sample of the literature and a description of some field methods. Finally, the environmental attitude measure, taken from the New Environmental Paradigm inventory, is described.

Chapter 5 is a discussion of the exigencies of studying the distribution of water knowledge as opposed to other natural resources. The physiological primacy of water for humans is discussed, in addition to the necessity of water toward the complexification of human systems generally. Finally, the chapter details the particular opportunities for knowledge acquisition granted in the particular infrastructural, cultural and economic contexts of the rural and urban study regions in the study regions of the Upper Chattahoochee Watershed.

Chapter 6 is devoted to the elaboration of research questions and a description of the project hypotheses. The hypotheses are organized in reference to the study questions. Thus, the first set of hypotheses involves ecological knowledge distribution. The second set of hypotheses concern the sharing of ecological knowledge. Finally, the third set of hypotheses involves the acquisition of ecological information.

Chapter 7 provides a description of the project data collection techniques and the results of the analyses of the formal project hypotheses. First, the four-part basic research inventory is explained. Then, the scoring of each question of the research inventory is explained. In addition, the recombination of research inventory questions into new measures is outlined. The various measures of environmental knowledge are adapted to the five hypotheses developed in Chapter 4 and are subsequently tested. The results of the testing of the formal hypotheses are provided.

The first concern of Chapter 8 is to discuss the results involving the formal hypotheses of the project. Following this discussion, the chapter provides the results of other project measures that do not involve the formal hypotheses of the project. These findings include the role of the automobile in structuring knowledge of the water bodies in the watershed, as well as the existence of 'second-order' indicators of environmental fluctuation. Finally, some results are given concerning the accuracy of the watershed respondents in naming the most important pollutants in their area, but also in estimating the quality of water in their closest tributary of the Chattahoochee River.

Chapter 9 addresses some of the larger conclusions of the project. The results of the formal hypothesis testing are provided. The relevance of the findings concerning the research hypotheses are explored, especially the relevance of the negative correlation between the 'Total Environmental Knowledge' measure and the 'Environmental Attitude' measure, as it relates to the possible maintenance of some of the research hypotheses.

Chapter 10 offers some of the limitations of the project. Limitations discussed include both theoretical limitations endemic to the relevant fields of study, but also limitations arising from some qualities of the sample populations in the study area that limited the resolution of the data. Another possible limitation involved the method and techniques of the data gathering itself (telephone interviews). In addition to its anthropological implications, the chapter discusses the culturally mediated implications for project participation.

CHAPTER 2

HYDROLOGIC AND ANTHROPOGENIC CONTRIBUTIONS TO WATER QUANTITY AND QUALITY IN THE APALACHICOLA-CHATTAHOOCHEE-FLINT RIVER BASIN AND THE UPPER CHATTAHOOCHEE WATERSHED

This paper is concerned with various measures used to determine the distribution of knowledge relating to water quantity and quality in the Upper Chattahoochee Watershed and its co-relation with ecological attitude. Towards this goal, this chapter will provide an overview of the physiographic, hydrological and anthropogenic factors that affect water quantity and quality in the Upper Chattahoochee Watershed.

The Upper Chattahoochee Watershed is a portion of the larger hydrological unit known as the Apalachicola-Chattahoochee-Flint River Basin (see Figure 1.1). The United States Geological Survey (USGS) studies riverine systems in terms of these hydrological units. The USGS conducts many ongoing research projects in the Apalachicola-Chattahoochee-Flint basin, many of which will be cited here. One such study involves the North American Water Quality Assurance NAWQA) program conducted by the USGS. The Apalachicola-Chattahoochee-Flint River basin (NAWQA) study area is about 20,400 mi2. This number includes the drainage area at the mouth of the Apalachicola River (19,600 mi2) (US Army Corps of Engineers 1985); the New River Watershed (about 510 mi2) (USGS 1996); and the Apalachicola Bay and surrounding coastal areas and barrier islands (about 270 mi2) (USGS 1996). The Chattahoochee and Flint rivers merge in Lake Seminole to form the Apalachicola River that flows through the panhandle of Florida in to Apalachicola Bay, and discharges into the Gulf of Mexico. The Apalachicola-

Chattahoochee-Flint river basin NAWQA study area is further divided according to 14 cataloging units shown on hydrologic unit maps (USGS 1975). These cataloging units referred to as subbasins in the USGA reports and herein, have differing physiography, climate, hydrological characteristics, population densities and land and water uses resulting in differences in surface-water and groundwater quality.

In 1990, the population of the Apalachicola-Chattahoochee-Flint River basin was about 2.64 million persons, with 905,000 of them residing in the Upper Chattahoochee Watershed. Of all of the subbasins of the Apalachicola-Chattahoochee-Flint basins, the greatest population densities occur in the Upper Chattahoochee Watershed subbasin. However, this is largely the result of the majority of the population of Atlanta's falling squarely within the Upper Chattahoochee Watershed, and the fact that sixty percent of the population of the Apalachicola-Chattahoochee-Flint River basin lives in Atlanta. The population of the Upper Chattahoochee Watershed grew by eleven percent between the census years 1980 and 1990. Forest and agriculture were the dominant land cover and land use within the Apalachicola-Chattahoochee-Flint River basin accounting for fifty-nine and twenty-nine percent of the basin respectively. In the Upper Chattahoochee Watershed proper, however, the same profile is fifty-nine and fourteen percent, respectively (USGS 1975).

Each of the subbasins has different physiographic and hydrological characteristics, climate, population densities, and land and water uses. These different uses result in different uses of surface-water resources, and thus differences in surface-water and groundwater quality. Physiographically, the upper Chattahoochee River subbasin is in the Blue Ridge province.

The course of the Chattahoochee River is strongly controlled by geologic structures (primarily faults) and has a rectangular drainage pattern. In all the Chattahoochee River drains 8770 mi2 and flows 430 miles. Sixteen reservoirs have altered the flow of the Rivers in the Apalachicola-Chattahoochee-Flint river basins, and there are three reservoirs in the Chattahoochee system, which are used for surface storage. Nine of 10 other rivers are run-off-the-river reservoirs with little or no storage capacity (Couch et al. 1996). In the Upper Chattahoochee Watershed, the aquifers are generally of the crystalline rock variety of Pre-Cambrian to Permian metamorphic and igneous rock of the Blue Ridge and Piedmont Provinces. Pockets of regolith (weathered, unconsolidated rock debris) of varying thicknesses overlie the rocks of this crystalline aquifer. The greatest thicknesses of regolith are in draws and valleys. Due to the structure of crystalline rock, water is obtained in these areas primarily from the regolith and from the concomitant fractures in the rock. Reported yields of wells completed in these areas range from 0 to 471 gallons per minute (gal/m), but are commonly less than 50 gal/m (Cressler 1983, Chapman 1993). In general, these rocks supply small amounts of ground water although increasing population is causing renewed interest in developing ground water as a source of public supply.

The regional direction of ground-water flow is from north to south; but local flow directions vary, especially in the vicinity of streams and areas having large ground water withdrawals. Rivers and streams in the Coastal Plain province commonly are deeply incised into the underlying aquifers and receive substantial amounts of ground-water discharge. Strata associated with the Floridian aquifer systems are exposed along sections of the Apalachicola, Chattahoochee, and Flint Rivers (Maslia and Hayes, 1988). As a result, ground water discharge plays a role in the baseflow in the Flint and Chattahoochee River systems. However, the contribution to the baseflow in the Flint River is estimated to be five times greater than the contribution to the Chattahoochee (Torek et al. 1991).

Environmental and Anthropogenic Contributions in the Apalachicola-Chattahoochee-Flint River Basin

Interacting natural and anthropogenic factors in the Apalachicola-Chattahoochee-Flint River basin have created many unique contrasts in the patterns of land and water use that influence the Apalachicola-Chattahoochee-Flint River basin's aquatic ecosystem. According to the USGS, the basin's physiography, climate, and hydrology provide natural conditions that have supported a rich and abundant diversity of plants and animals. In the waterways in and around Atlanta, for example, are found at least thirty-five species of native and non-native fishes, three of which are endemic ((USGS 1995). Superimposed on these natural conditions are human influences that vary in relation to the population at different points of the watershed, and their use of land and water resources. Metropolitan Atlanta, the largest and fastest growing metropolitan are in the southeast, sits near the basin's headwaters, and at the foot of the Upper Chattahoochee Watershed which provides the water to its citizens. The basin's growing population presents challenges to balancing human and ecosystem needs for water of sufficient quantity and quality. The manner in which Atlanta treats its water is significant, as at the basin's terminus, the Apalachicola River and Bay are regionally and globally significant for their biological productivity and diversity (USGS 1996).

Within the Apalachicola-Chattahoochee-Flint River basin, the Chattahoochee River basin is the most influenced by urban and suburban land uses, and has the most heavily used water resources both in the Apalachicola-Chattahoochee-Flint and the state of Georgia. The Chattahoochee River basin contains the largest population centers and receives the majority of the Apalachicola-Chattahoochee-Flint's municipal wastewater discharges. While the headwaters of the Flint River are in Metropolitan Atlanta, its water quality is less influenced by wastewater discharge because of the diversion of the effluent from two Metropolitan Atlanta municipal wastewater facilities after the 1985 from the Flint River to the Chattahoochee River. However, the Flint River is influenced by wastewater discharges from Albany, Ga., and other smaller communities (USGS 1996).

According to the USGS, the quality of wastewater effluent has improved since the 1980s as a result of treatment facility improvements and the recent phosphate-detergent ban by the Georgia Legislature. Since the mid-1970s, water quality of municipal wastewater effluent has greatly improved with construction of advanced wastewater treatment facilities. Prior to the 1970s, large quantities of raw industrial and sewage wastewater were released into the Chattahoochee Flint River systems. Downstream from Atlanta, the Chattahoochee was classified as extremely polluted, with high biochemical oxygen demands, low dissolved oxygen concentrations, exceedingly high fecal-coliform counts, and biota dominated by worms and the bacterium Sphaerotilus (Georgia Water Quality Control Board 1979).

The relative water quality downstream from Atlanta in the Chattahoochee River can be obtained from the USEPA's National Study of Chemical Residues in Fish. Fish tissue was tested for a total of sixty chemicals in the National Study. Testing sites were selected near potential point and non-point sources of contamination and at background sites expected to have little or no contamination. Eleven sites were selected on the Apalachicola-Chattahoochee-Flint River basin. Three testing sites were in the Chattahoochee River, and fish tissue samples here were among the highest in the nation. One or more of these three sites ranked in the top five for chemical concentrations, including four dioxin or furan compounds, pentachlororanisole, 1,2,3 trichlorobenzene, chlordane, five chlordane congeners, chlorpyrifos, and methoxylchlor (U.S. Environmental Protection Agency 1991).

Further data is supplied by reports prepared by the State of Georgia toward meeting the requirements of Section 305 (b) of the Clean Water Act (PL 92-500). These data determine the extent to which waters in the Apalachicola-Chattahoochee-Flint basin support designated water-use classifications. The quality of each water body is measured against existing water quality standards for designated uses, including standards for drinking water, fishing, swimming, and aquatic life. There are 938 miles of stream not meeting or only partially meeting designated uses in Georgia. Two-thirds of those not only partially meeting designated use quality levels are in the Chattahoochee and Flint River basins in Georgia. Thirty-four percent of the total Georgia stream-miles that do *not* support designated uses are located in the Apalachicola-Chattahoochee-Flint basin (Georgia Department of Natural Resources 1992). Fishing is the use designation not met in greater than eighty percent of impaired stream miles. In the reach of the Chattahoochee River from Atlanta to Whitesburg, Georgia, non-point source loads for most constituents are greater than points source loads, and constituent yields generally increase with increasing urbanization (Stamer et al. 1979). Violations for metals (fifty percent of total violations) and fecal coliform bacteria (39 percent of total violations) are the most frequently cited reasons for not meeting stream use designations. In 72 percent of water-quality violations, urban runoff of unknown non-point source pollution is given as the cause of not meeting designated uses. The remaining causes cited are combined sewer overflows in the Atlanta area, and municipal or industrial wastewater-treatment facilities having limited capabilities or operational deficiencies.

Most of the lakes in the Georgia portion of the Apalachicola-Chattahoochee-Flint River basin are classified eutrophic. In 1991, Lake Blackshear had the highest value statewide for the trophic state index, and seven basin lakes fell in the top ten of twenty-seven lakes rated statewide. Even in their eutrophic condition, most lakes in the Apalachicola-Chattahoochee-Flint River basin supported designated uses. Lake Sidney Lanier and all of West Point Lake were designated as partially supporting uses. Lake Sidney Lanier has been most affected by municipal wastewater discharge, and Lake West Point has been affected by accelerated eutrophication and currently is under a fish consumption advisory due to chlordane levels in fish. The advisory issued by the Georgia Department of Natural Resources is for catfish, carp, and hybrid bass caught between State Highway 92 bridge to West Point Dam.

Outside of urban centers, most of the landscape of the Apalachicola-Chattahoochee-Flint River basin is used to produce silvicultural or agricultural products. Silvicultural and agricultural activities can influence aquatic ecosystems primarily through non-point source inputs of pesticides, nutrients and sediment, and by the physical alteration of riparian and stream margin habitats. The cumulative effect of these activities on aquatic ecosystems in the Apalachicola-Chattahoochee-Flint basin, particularly the smaller tributaries and streams which are most at risk, has not been systematically evaluated.

Potential effects of silvicultural management on aquatic ecosystems are primarily alterations in physical habitat such as increased temperature due to loss of shade from riparian vegetation, and increased sedimentation. For example, timber harvesting in the Upper Chattahoochee watershed, which disturbed a relatively small area, (1 to 2 mi^2) increased sheet erosion by several orders of magnitude (Faye et al. 1980).

Agricultural influences on aquatic ecosystems differ with the type of agriculture. Confined feeding for poultry and livestock production dominate in the Piedmont Province, and row-crop agriculture dominates in the Coastal Plain. Potential effects on aquatic ecosystems in the Piedmont Province primarily are enrichment from nutrients from manure disposal and riparian degradations and stream-bank erosion caused by livestock grazing. Aquatic ecosystems in areas of row-crop production are at risk of receiving pesticides and chemical fertilizers. In 1987, the approximately three and one-half million acres of agricultural lands in the basin received 2-million acre treatments of pesticides, and 1.3 million acre treatments of chemical fertilizers (U. S. Bureau of the Census, 1989 a,b,c). Radtke et al. (1980) studied the effects of agriculture on stream quality in the Spring Creek basin in southwestern Georgia. Pesticides were detected in surface water collected during active farming periods. However, concentrations and yields of total nitrogen per and phosphorous were found to be low, even during periods of storm runoff (USGS 1996).

In addition to anthropogenic influences on water quality, aquatic ecosystems of the Apalachicola-Chattahoochee-Flint River basin are influenced by hydrologic alterations resulting from hydropower operations and the maintenance of navigation channels. In contrast to the Flint and Apalachicola Rivers, the hydrology of the Chattahoochee River is regulated by a system of thirteen dams. Prior to the construction of dams, the basin supported important commercial freshwater fisheries. Construction of dams, particularly Jim Woodruff Dam, adversely affected a once-thriving commercial sturgeon fishery by limiting range and access to important spawning grounds. Sturgeons have not been caught commercially since 1970 (Leitman et al. 1991). The majority of the economic value of the fishery currently in the entire Chattahoochee watershed is from trout fishing in the upper basin and warm water fishing in the reservoirs.

Chemical and organic pollution are commonly perceived (USGS 1996) as the greatest threats to aquatic fauna, and are of primary concern to human-health and water-quality monitoring programs. However, Allen and Flecker (1990) have shown that habitat loss and degradation and over-harvesting are the most significant factors contributing to species population declines and extinctions in most watersheds internationally. According to the USGS (1996), the same factors appear to be responsible for the listing of Apalachicola-Chattahoochee-Flint River basin aquatic fauna under the Federal Endangered Species Act. For example, the American alligator, the alligator snapping turtle, and Barbour's map turtle are all on the list due to overharvesting (1996). A challenge to the basin's fish and mussel population are the habitat loss and sedimentation caused by reservoir construction and sedimentation. A whole series of dams on the Chattahoochee greatly restrict access to the spawning grounds of anadromous fish, including the sturgeon, as mentioned, and the striped bass. These fishes are the hosts to the larvae of unionid species and thus their inability to spawn may influence the mussel populations as well. A 1993 survey by the USFWS found nearly all unionid species to be extirpated in the main stream of the Chattahoochee River, with declining populations in the Flint River (Williams and Brim-Box 1993).

Poor water quality and contaminants are not direct causes for the listing of the basins aquatic fauna under the Federal Endangered Species Act, but these factors have contributed to declines of biological communities in some reaches of the Chattahoochee River. The fishing-use designation is not met in eighty percent of impaired stream miles in Georgia. There has only been limited study of the influence of water quality on fish populations in the basin as a whole (USGS 1996). The fish community present in the Chattahoochee River south of the confluence Peachtree creek, and down to Whitesburg, Ga., is substandard to similar Georgia streams. (Mauldin and McCollum 1992). The biotic integrity of the fish community in this section of the river was between 37 to 57 percent of normal. Carp compromised 75 percent of the biomass. Further, some sections of this reach are under fish-consumption advisories from chlordane contamination (GDNR 1992). Other factors contributing to the lowered biotic integrity include the loss of habitat due to deposition of silt, the presence of contaminants at levels below detection limits, and chronic fish kills in tributary streams (Mauldin and Mc Collum 1992).

The Upper Chattahoochee Watershed

"Chattahoochee" is a Creek Indian word that means "river of painted rocks". The Chattahoochee River begins in the north Georgia Mountains at a spring on Coon Den Ridge in southeastern Union County. The headwaters of the Chattahoochee River above Atlanta comprise the smallest drinking water catchment area of any major metropolitan area in the country (Riverkeeper 2000).

The Upper Chattahoochee Watershed, like the rest of the Apalachicola-Chattahoochee-Flint (Apalachicola-Chattahoochee-Flint) River basin, enjoys a warm, temperate, subtropical climate zone that is moist year round and has hot summers. Average annual precipitation ranges form 45–60 inches primarily as rainfall (Hodler and Schretter1986). Average annual runoff ranges form 12-40 inches in the Apalachicola-Chattahoochee-Flint River basin (Stokes and McFarlane1993). Average annual temperature ranges are around 60° F. Evapotransporation is around thirty-two inches in the Upper Chattahoochee Watershed.

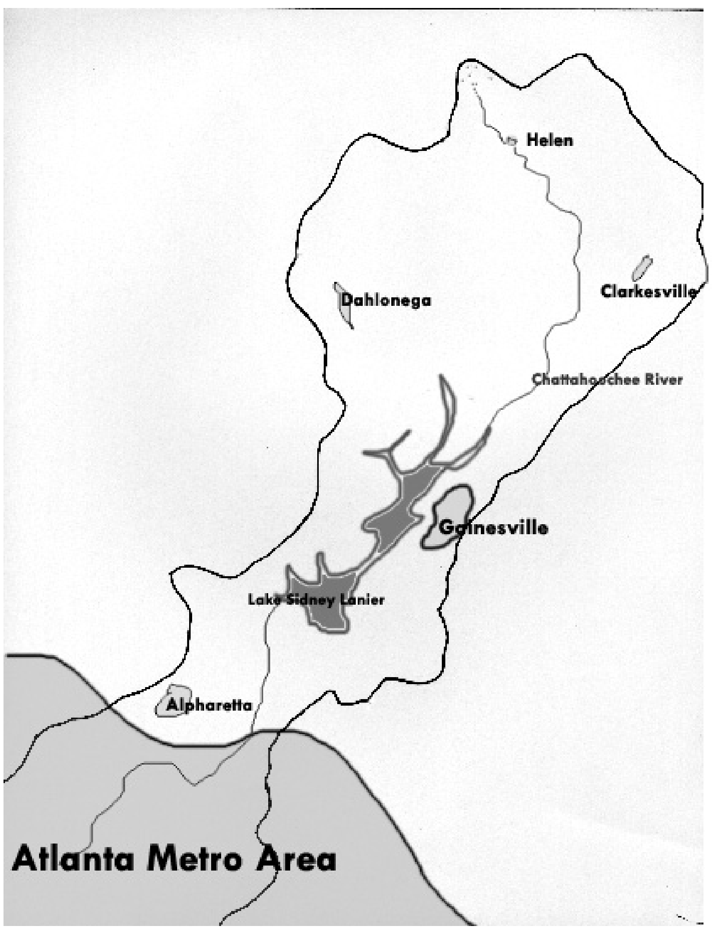
A line between the township of Dallas, Georgia, and the Northeast corner of Clayton County, Georgia forms the southern boundary of the region (See Map 2.1). The west, north and east boundaries are formed by the watershed boundaries proper. The Upper Chattahoochee River basin covers approximately 1428 square miles. The rivers of the upper Chattahoochee catchment form the Chattahoochee itself and eventually merge with the Flint River in Lake Seminole, forming the Apalachicola River, which flows through the panhandle of Florida in to Apalachicola bay, and discharges into the gulf of Mexico.

The upper Chattahoochee River area is hydrologically one subbasin of the larger Apalachicola/Chattahoochee/Flint (Apalachicola-Chattahoochee-Flint) River basin proper.

Hydrological and Anthropogenic Contributions to Water Quantity and Quality in the Upper Chattahoochee Watershed

Point Source Pollution

Map 2.1: The UCW Study Area



Point sources are discharged directly into surface or ground water or are applied to land surfaces in a confined area or point. Point sources may include municipal and industrial storm drains that transport water directly from streets and other impervious surfaces; wastewater effluent; and combined sewer overflows (CSOs); and untreated wastes or runoff from illegal outfall pipes. Storm sewer overflows (SSOs) transport raw sewage to waste water treatment facilities and have overflow mechanisms where excess sewage spills to streams instead of backing up into houses and buildings. Combined sewer overflows primarily transport a combination of raw sewage and storm runoff. During heavy rain events, however, the volume of runoff often exceeds the capacity of combined sewers causing a mixture of untreated sewage and storm runoff to overflow directly into streams.

Effluent from wastewater treatment facilities only accounted for about one percent of the total nitrogen sources and about two percent of estimated phosphorous sources into the Apalachicola-Chattahoochee-Flint basin in 1990. According to the USGS, while the studied inputs are small in comparison to the total loads, they are very important because these sources deliver effluent directly into the hydrological system. Metropolitan Atlanta combined sewer overflows discharge into Peachtree, Proctor, and Utoy Creeks which feed the Chattahoochee River (USGS 1996). However, according to the USGS, data is insufficient to estimate the annual nutrient loads from combined sewer overflows from these tributaries.

In 1990, the Georgia legislature amended the Water Quality Control Act to require cities to eliminate combined sewer overflows or treat overflow to meet state water quality standards. From 1985-97, the city of Atlanta has implemented the following abatement methods to treat overflow from, or to eliminate altogether, combined sewer overflows. The first method is to screen combined sewage to remove trash and solids. Next, the city adds chorine to overflows to kill bacteria before discharging wastewater. Off-line storage is provided for combined sewage overflows for later treatment at a waste-water treatment facility. And finally, Atlanta is attempting to separate combined sewers into sanitary sewers and storm drains (USGS 1996).

There are six wastewater treatment plants that handle more than one million gallons per day in the Upper Chattahoochee Watershed. These plants include one in the city of Cornelia, 2 plants in the city of Gainesville, a plant in Gwinnett County and two plants in Fulton county. John's creek Water Pollution Control Plant (WPCP) in Fulton county is the only plant that currently exceeds the permitted amount of discharge as set forth by the state of Georgia as part of the National Pollution Discharge Elimination System, administered by the Environmental Protection Agency. In John's creek, for example, the allowable discharge is 5 (Mgal/d), and in 1990 exceeded this level by .47 Mgal/d.

Non-point Source Pollution

The Upper Chattahoochee Watershed is host to numerous non-point source loads thanks to its land use, which is dominated by commercial beef and poultry production. The sources of nutrient loads of ammonia as nitrogen were 11.7 tons, and total phosphorous on John's creek was 6.46 tons. Nutrient inputs from animal manure by county as measured in tons per square mile were ten to twenty times higher in the upper Chattahoochee watershed than in virtually all other Chattahoochee counties, except for Carroll county, which roughly equaled the inputs of all of the counties that comprise the Upper Chattahoochee Watershed. For the Chattahoochee-Flint River Basin in general, the major sources of both nitrogen and phosphorous loads in the watershed as a whole are poultry and livestock waste runoff. Poultry and livestock and inorganic sources of agricultural fertilizer combined discharged 200,000 tons of N into the Apalachicola-Chattahoochee-Flint river basin in 1990 (USGS 1996). Total phosphorous loads were 47,000 tons in 1990.

Pesticides

A pesticide is defined as any substance or mixture of substances intended to prevent, destroy, repel, or mitigate any pest or intended for use as a plant regulator, defoliant, or desiccant, according to The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (Meister 1992). Pesticides are used to control insects, mites, nematodes, fungi, molds, weeds, birds, rodents, and microorganisms. Pesticides specifically applied to treat plants are called herbicides. Other kinds of pesticides are insecticides, nematocides, algaecides, miticides, and rodenticides. Pesticides are comprised of several classes of compounds on the basis of their chemical structure. Major classes of pesticides include the organochlorines or chlorinated hydrocarbons, organophosphates, carbomates, thiocarbomates, substituted acid amides, phenoxy acids, triazines, substitued ureas, dinitroanilines, bypyridiums, benzoic acids, synthetic pyrithrens or pyrethroids, aliphatic hydrocarbons, organometallic complexes, and inorganic pesticides (Delaplane 1991). Environmental fate and transport of pesticides is dependent in part upon their physical and chemical properties and the degradation processes for these compounds. Important physical and chemical properties include solubility in water, vapor pressure, octanol-water partitioning coefficient, soil-sorption coefficient, acid/base ionization equilibrium constants, and field half-life (USGS 1996).

Pesticides that have the highest tendency to be transported to ground water (leached) are those compounds that are relatively persistent in the soil and have little tendency to sorb onto soil organic material and clay minerals. The physical and chemical properties most associated with leaching in this area are those substances with high water solubility, low vapor pressure, and long field half-life. The pesticides having the greatest leaching potentials generally have water solubilities greater than thirty milligrams per liter (30/mg/L), a soil-sorption coefficient of less than 300 to 500, and field half-lives greater than twenty-one days. In addition, agricultural practices, and soil and aquifer properties also influence the transport of agricultural chemicals to ground water (USGS 1996).

Pesticide Data Sources and Methods of Analysis

Pesticides data is available for the period from 1971 through 1989 in the U.S. Geological Survey National Water Information System (NWIS) and for the period from 1960 through 1991in the U.S. Environmental Protection Agency Storage and Retrieval System (STORET). The data were analyzed to describe the occurrence and distribution of pesticides in water resources of the Apalachicola/Flint/Chattahoochee River basin. Collectively, the NWIS and STORET databases contain about 19,600 individual analyses for pesticide concentration in the Apalachicola-Chattahoochee-Flint River Basin. Pesticide concentrations were at or above minimum reporting level in about five percent of all analyses. Most of the pesticide analyses and most of the analyses having concentrations above minimum reporting levels in these databases are for organochloride insecticides in samples collected five or more years before the USGA study. With few exceptions, most of the organochlorine insecticides are now banned from use in the United States. Concentrations of pesticides were at or above a minimum reporting level in about .3 percent of the analyses in 1991 (USGS 1995).

Pesticide occurrence and distribution of pesticides in the Apalachicola-Chattahoochee-Flint River Basin (as defined by data collected during 1960-91) were defined mostly by land use patterns. DDT (together with DDD and DDE) was detected in wide distribution in the sediments and aquatic biota of primarily mainstream and reservoir sites in the Chattahoochee, Flint, and Apalachicola drainage. DDT was used through 1973 as an insecticide on cotton, fruits, and vegetables. It was also used for mosquito control, and thus its widespread occurrence in both urban and agricultural settings is consistent with its use pattern (USGS 1995).

Chlordane, heptachlor, dieldrin, and related compounds were agriculturally used through 1974, but predominantly as termitacides through the late 1980s. Compounds in these groups have been found in sediments and aquatic biota of tributary streams draining the Atlanta Metropolitan area and in mainstream reaches of the Chattahoochee downstream of Atlanta and Columbus GA. The phenoxy-acid herbicides are widely used in residential, commercial, industrial, agricultural, and silvicultural area of the Apalachicola-Chattahoochee-Flint River basin. Finally, detectable concentrations of 2, 4, D were found in most of the surface-waters sampled in the Atlanta Metropolitan area (USGS 1995).

According to the USGS, only limited inference can be drawn from temporal patterns because many of the Federal and State agency pesticide-monitoring programs have been targeted to known sources and areas of contamination, an approach consistent with regulatory requirements focused on human health. Thus the studies were either synoptic in nature or were conducted during a limited period of time. Thus, the composite temporal picture represented by these sampling efforts is inherently patchy (USGS 1995).

Summation

The Upper Chattahoochee Watershed study area is part of a large, complex hydrological system known as the Apalachicola-Chattahoochee-Flint River Basin. This basin is vitally important to a large human population as well as an array of ecologically diverse ecosystems. More importantly, the Upper Chattahoochee River Watershed itself is host to Atlanta, the largest population center of the Apalachicola-Chattahoochee-Flint River basin. Accordingly, the watershed faces a host of problems and pollutants that are the result of Atlanta's water system and human population, but also from the geological and environmental influences on aquatic ecosystems in the region. Of major importance to the project is simply that the watershed is home to a host of compelling water issues and water quality failures, which makes the Upper Chattahoochee Watershed a useful study area for the hypotheses of the project.

CHAPTER 3

STUDY REGIONS, DEMOGRAPHY, AND THE URBAN-RURAL GRADIENT

A primary goal of the project is to investigate ecological knowledge and attitude distribution in rural and urban populations within an ecologically defined region. Thus, the project necessarily requires a study area of both urban and rural populations that share a common resource. The Upper Chattahoochee Watershed was selected because it provided just such a study area. In the Upper Chattahoochee Watershed, in the length of three counties, a highly urban, completely built environment gives way to counties that are far more rural than the urban ones. This 'urban-rural gradient' is highly pronounced in the selected study region. The Upper Chattahoochee Watershed was therefore divided into three study regions to permit the testing of hypotheses and the comparison of data.

The urban area of the Upper Chattahoochee Watershed will be called the urban region. It consists of four of the most urban counties that comprise the thirteen county Atlanta metropolitan area and includes Cobb, Fulton, Gwinnett, and DeKalb counties. The northern, rural-most, least populated counties that fall mostly within the watershed boundary will comprise the rural study region and will be referred to accordingly—as the rural region. It consists of Habersham, Lumpkin, and White counties. The region in between, consisting of relatively more urban-linked rural areas with relatively heavy development along highway corridors, but more sparse development many other locations will be called the hinterland region. It consists of Forsyth and Hall counties.

It is worth remembering that within any large region, rural areas are often associated with a suite of mutually influencing factors including distinct land use patterns, particular demographic profiles (in relation to urban demographics), and physiographic profiles. The locations of most large U.S. cities were the result of relatively flat terrain, ready water availability, and nearby alluvial soils. Today, as cities sprawl outward, areas with the inverse of these qualities—hilly terrain, scant surface water resources, and inhospitable terrain for agriculture—are well positioned to remain relatively more rural than other areas.

In the Upper Chattahoochee Watershed, these features all point to a meaningfully rural region. In terms of land-use and physiography, the urban region is relatively flat, with an almost entirely built environment and commercial land-use. The rural region includes several small town centers that subsist largely on tourism, limited mixed mountain agriculture (cattle, poultry production), timber harvesting, and various state and federal parklands. Importantly, the rural region is increasingly mountainous toward the northeast, and in the far reaches of the region, it reaches an altitude of around 5,000 feet above sea level, and the surrounding terrain is largely prohibitive of development. The hinterland region includes the brunt of the land use transition and some of the physiographic transition. It includes an interstate corridor, rolling terrain and the foothills of the rural region, with highway-related city development and lake-related development. Thus, the land use and physiographic profile of the rural region both indicate and reinforce the notion that the rural region is indeed meaningfully rural, and that there is indeed an urban-rural gradient. Finally, Atlanta has a rank-size distribution that indicates a 'steeper' than average gradient between urban and rural areas. Thus, physiography, in addition to two-dimensional factors, influences the "range" function of Atlanta's hinterlands and their central places (Purrington 1984, Lewis 1984).

Given the goals of the project, it is important to establish that each study region is representative of its label. While there is little doubt that the metropolitan Atlanta region is an urban region, there may be some doubt as to the rurality of the rural study region outlined above. After all, the relatively small length of the Upper Chattahoochee Watershed and the demographic changes taking place in many formerly rural regions of the United States beg a more detailed analysis of the rural region of the Upper Chattahoochee Watershed. Further, anthropological studies and anthropologists themselves have tended to reify and romanticize small communities (Creed and Ching 1997) —in this case a small rural region. The question is especially important, as the selected region needs to hold a meaningfully rural population and thus yield 'rural' informants toward the project goals. In what follows, the region will be shown to be meaningfully rural using rurality population measures, demographic features, and data on commuting activity. Following this, the question of rural identity will also be considered.

Rurality Index

Population measures such as Smith and Parvin's rurality index provide some evidence attesting to the rurality of the rural region. Following the rural development act of 1972, Senator Talmadge of Georgia articulated the need for a concrete definition in order to permit the delivery of federal funds. Thus Smith and Parvin's rurality index was developed in response to this legislative need to quantify and determine rural areas from urban ones.

There are different objective measures of rurality. The Bureau of the Census considers the rural population to consist of all places of less than 2,500 persons, while the Farmer's

Home Administration defined rural areas as places that do not exceed 5,500 persons. The Rural Development Act ultimately defined rural areas as places of 10,000 persons or less with certain exceptions and qualifications. Smith and Parvin (1976) noted that these definitions were inconsistent and overly broad for most purposes.

Smith and Parvin reasoned that definitions of rurality should “encompass commonly held subjective notions people have about the essential differences between rural and urban places. Probably the most popular notion regarding rural is the sense of space, or openness, while the clustering of people and houses is the principal notion associated with [the] urban” (Smith and Parvin 1976).

Psychosocial, cultural and demographic characteristics had all been used by sociologists to delineate urban and rural populations. Dewey (1960) provided a critique of early definitions, and concluded that earlier work failed to separate the influences of density and population size from cultural influences.

While previous definitions only permitted the binary classification of counties into those that were ‘rural’ or ‘not rural’, Smith and Parvin developed an urban-rural index for Georgia in 1970 that ranked all counties from most rural to most urban using three variables determined to represent rural areas by factor analysis. The three factors chosen for the final formulation were drawn from eleven basic factors in nineteen various forms. Ultimately, there were three factors used to calculate the rurality of all Georgia counties in 1970 by Smith and Parvin. The first variable was the number of persons not employed in selected industries thought to involve open spaces (agriculture, forestry or fisheries). Second was a calculation of population-proximity, which was the sum of the total population in each county and the sum of ratios of the number of persons in all counties within 125 miles of the reference county divided by the distance in miles between the county seat in the reference county and the county seat in each county within the specified distance. Finally, the index included population density, which was simply the total population of each county divided by the number of square miles in the county.

Smith and Parvin's work produced both an index value (ranging from 18 in the most rural incidence to 1,077 for the most urban), scaled so that the mean of all index values equaled 100, but also a ranking of counties from most rural to most urban.

Smith and Parvin noted that all of the measures used in the calculation of the index were "quite by coincidence . . . well accepted by sociologists" (1976). Importantly, Stewart said "the size of the small settlement is certainly less important for its participation in urban life and outlook than its location relative to large towns and cities" (1958). The work of Smith and Parvin therefore came on the heels of Christaller's central place theories and foreshadowed future trends in economic anthropology and further work in the development of locational economics.

Smith and Parvin's urban-rural index is useful because it establishes the rural and urban natures of the study regions thirty years ago. However, the calculation is relevant to contemporary questions posed by this research project. First, the index can be compared to contemporary demographic and spatial data to understand the rural and urban natures of the study regions. Further, even if the relative rurality of the rural region in the project has become relatively more urban, or even patently urban, the socio-cultural artifacts may still be relevant to the research as we may find rural values, attitudes, knowledge suites present in the population maintained through the social environment.

Rurality Index Measures: 1970

As mentioned, the rural region in the project included the counties of White, Habersham, and Lumpkin. The rural index scores for these counties were White (58), Habersham (84), and Lumpkin (60). Thus the mean of each county's score in the rural region was 67.3. The counties of the hinterlands region include Forsyth and Hall counties, whose index values were Forsyth (89) and Hall (151). Thus the mean value for the region was 120. The urban region includes the counties of Fulton, DeKalb, Gwinnett, and Cobb, whose index values were Cobb (434), DeKalb (950), Gwinnett (180), and Fulton (1077), the highest county score in the state. The mean of the urban region rural-urban index values was 660.25. The rural-urban index appears to represent the relative urbanity and of the urban region in 1970. The sprawl growth that has more recently characterized Atlanta was not yet clearly evident, and was the result of economic incentives in the 1980s and 1990s to produce growth distal to African-american urban cores and into outlying edge city regions to the north away from southside African-american housing centers (Keating 2001).

Mean index values underscore the rural-urban gradient present in the 1970s. The mean score of the rural region, 67.3, indicates that the three county region is only 67% of the mean score for the entire state—in a largely rural state with only one main nodal center as demonstrated by rank size analyses. Conversely, the urban region was six times the mean value for ruralness. Subsequently, in the length of three counties very roughly one hundred miles in length, we find highly rural and highly urban regions. In fact, in no other three county area is there such a marked and rapid gradient, as such a gradient can only be found around Atlanta due to the relative urbanity of the Atlanta counties. And only toward the northeast, up the Chattahoochee Watershed corridor and toward a physiographic landscape that inhibits infrastructural development might we find just such a gradient.

Rurality Index Measures: 1990-2000

Our next task is to relate the findings in 1970 to the contemporary demographic lifescape in the study regions. To do this we will use some of the same measures used by Smith and Parvin to establish the rural, but with adjustments that reflect changes to both rural and urban economies. The two major demographic change occurring between 1970 and 1990 and 2000 (census years) are a very large increase in population, but also the expansion and extension of infrastructure and nodal centers, including edge cities, toward the North and North-northwest and the Northeast from Atlanta's core (Keating 2001). A key question then becomes whether or not these changes in the regional economy and lifescape have effectively converted the rural study region into one that is not meaningfully rural. That is, clearly the urban has sprawled outward, but can we say that this sprawl has effectively transformed the rural region?

There is much evidence to indicate that in fact the rural study region remains rural by many measures. First we will revisit some of Smith and Parvin's population density measures. Population densities in the urban region in 2000 were 1692 persons per square mile (p/m^2). In the hinterlands region, that figure was 356 (p/m^2). Finally, in the rural region, the figure was 103 (p/m^2).

Perhaps more importantly, population densities in the hinterland region increased 70% between 1990 and 2000, outpacing the increase in both the rural and urban regions by nearly two times (1.7 times the increase in the rural region and 2.05 times the increase in the urban region)(U.S. Census 1990 and 2000). This echoes Keating's (2001) suggestion that the hinterland region is experiencing a greater than state average in-migration. The percent population density increase between 1990 and 2000 was thirty-nine percent for the rural region, thirty-four percent for the urban region, seventy percent for the hinterland region, and twenty-six percent statewide. However, the statewide figure includes the south and southeastern counties where many counties experienced negative population density growth. Thus, while most of north Georgia is experiencing population density increases, the density growth rates between regions indicates that Atlanta sprawl is absorbed in the hinterland region to a much greater extent than in the rural region of the study area. The data do not suggest that in the rural region there is a large in-migration of urbanites commuting to/from Atlanta's urban sectors or the rural study area.

Regional Worker Flow

In addition to the population density measures detailed above, a more specific measure of the effect of outward sprawl and commuting behavior is provided by region to region commuter data. In the Upper Chattahoochee Watershed, the data strongly suggest what Keeting (2001) and the population density data suggest: the hinterland region is increasingly urban-linked, but the brunt of the changes fall short of the rural region in the Upper Chattahoochee Watershed study area.

Commuter data is only available from the1990 Census. However, the findings indicate that the relatively few urbanites have relocated to the rural region to commute to either the hinterland or urban study regions. The rural study counties (Lumpkin, White, and Habersham) combined had 26,226 commuting workers in 1990 according to the US Census. Of these, seventy-three percent (19,354 workers) remain in the rural study region for their employment. Only thirteen percent of the rural region commuting workforce (3498 workers) commute into the hinterland region, and only four percent (1285 workers) from the rural region commute to the urban study region. Thus, there is little evidence that the rural region serves as a bedroom community for urbanites working in either the urban region or hinterland region. Thus, there is much indication that the sample region is meaningfully rural.

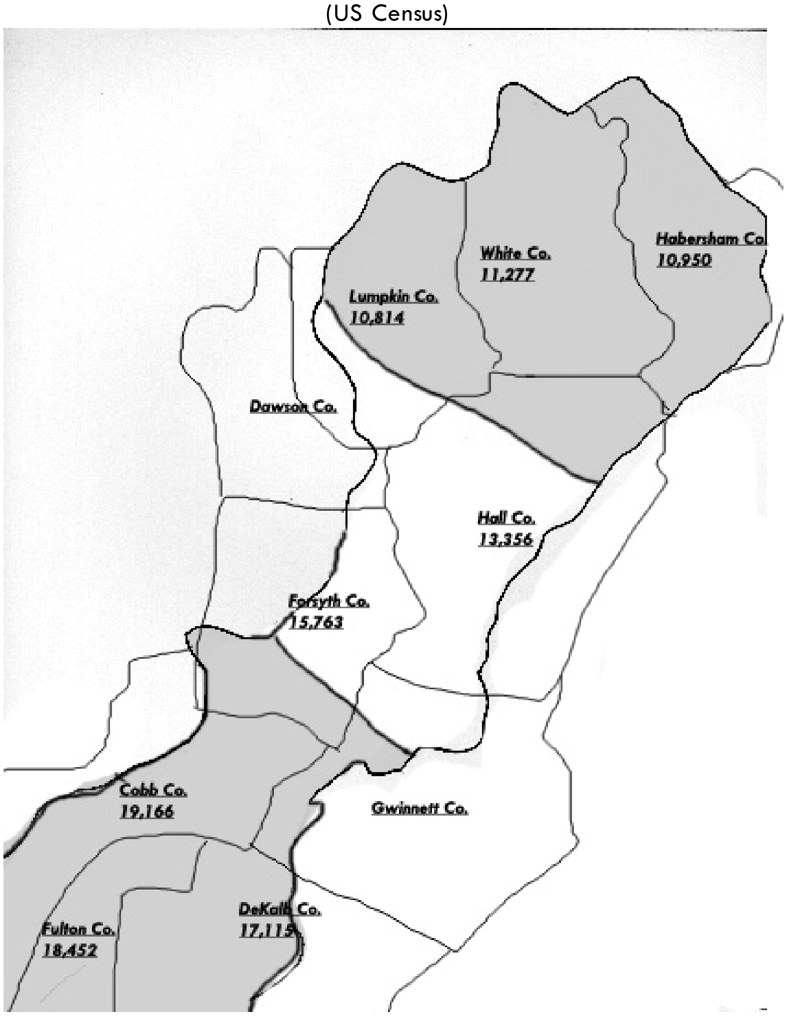
Rural Demographic Profile

Figure 3.1: % Holding High School and Bachelor's Degrees
(US Census 1990)

A final and important measure of the rurality of the rural study region is provided by demographic data. For numerous related reasons, rural regions typically demonstrate a suite of demographic markers and include lower earnings and lower education in comparison to relevant urban regions. Establishing the rural demographic profile, in sharp contrast to the nearby urban region, is particularly important for this study as it directly affects the generation of hypotheses based on rural and urban knowledge suites, respectively.

The urban and rural study regions demonstrate urban and rural demographic qualities. In the study area, the urban region counties (Cobb, Fulton, DeKalb, and Gwinnett counties) each have statistically significant higher educational attainment and median household income than the counties of the rural region (Lumpkin, White, and Habersham). The counties of region two (Hall and Forsyth) fall somewhere in between. The mean of all median household incomes in the urban region according to the 1990 census was $37246. In contrast, the mean of all median household incomes in the rural region counties was $24912. In the rural region (Forsyth and Hall counties), the mean of all median household incomes in region two was $33208 (see Figures 3.1 and 3.2).

Figure 3.2: Counties and Per Capita Income 1990
(US Census)



Educational attainment is often congruous with urban residence and class in the U.S., and in the Upper Chattahoochee Watershed the same is true. According to the 1990 U.S. Census, the percentage of the population holding a terminal high-school diploma or bachelor's degree in the urban region was 51.5 percent and 31 percent, respectively. In the rural region, the same figures were 13.6 percent and fifty percent respectively. In region two, the percentage of the population holding a terminal high-school diploma or bachelor's degree was 15.5 percent and fifty-three percent respectively. Importantly, the percentage of the population holding high-school diplomas as their terminal level of education in each of the counties of the study region is roughly equal. The greatest differences occur in college-level education.

The Rural-Urban Gradient and Rural Ideology and Identity

Using rurality index measures, commuter data, and demographic data, we have established that the rural region drawn for this research remains a meaningfully rural region using objective measures. Further, while the rural study region is not the *most* rural three-county region in Georgia, Atlanta's extreme urbanity and the rural region's physiography guarantee that this ten county region—three counties in length--holds one of the strongest urban-rural gradients in the state.

However, another important implication of the urban-rural gradient involves its role in the development and maintenance of rural ideologies and identity. Concerning rural lifeways and agricultural pursuits, Raymond Williams wrote in *The Country and the City* that the country/city distinction was "for many millions of people a direct and intense preoccupation" (1973: 3). Williams wrote further that the attitude toward rural people, and their quintessential trade—agriculture—spoke volumes about the American industrial machine and its relation with identity politics. He wrote:

> "It is one of the most striking deformations of industrial capitalism that one of our most central and urgent and necessary activities [agriculture] could have been so displaced . . . that it can be plausibly associated only with the past or with distant lands" (1973:300).

While humans utilize an enormous array of signifiers to generate perceived difference, the country/city distinction is nearly universal in scope and potent in its ability to engender identity. The universality of the urban/rural distinction is highlighted by several roughly concurrent events. As the Oklahoma City bombing brought fresh notions of rurality to urbanites in 1995, in China a high ranking communist official commented at an agricultural work conference that increasing rural/urban differentiation was threatening the country's stability (Creed and Ching 1997). At the same time, post-communist elections in eastern Europe reflected deep rifts between the rural and urban populations (Creed 1993), while Misha Glenny "suggest[ed] that the battle for Sarajevo was not a nationalist conflict but rather 'a struggle between the rural and the urban, the primitive and the cosmopolitan, and above all, between chaos and reason' " (Creed and Ching, 1997, quoting Glenny 1992:38).

Both rural and urban identities are more often developed with regard to nearby 'others' than with any objectively measurable suite of variables. Even in the absence of a 'truly' rural population, human groups may commonly discriminate relatively more urban people from those relatively more rural. As Creed and Ching put it, "the rural/urban distinction signifies far more powerfully than physical appearances suggest; inhabitants of areas where town and country seem nearly indistinguishable may nevertheless elaborate a difference through extensive cultural discourse. Where visible differences do exist, cultural oppositions may exaggerate them and erase countervailing similarities" (1997:2-3). Thus, we might expect that the relative strength of urban and rural signifiers or the proximity of urban areas to objectively rural ones might potentiate the prevalence of place-based identities. Thus, due to the urban-rural gradient explored outlined earlier, rural and urban identities may be particularly important to inhabitants of the Upper Chattahoochee Watershed.

In the United States specifically, there are numerous threads of political history that continue to reproduce the rural imaginary. This imaginary, or set of myths and assumptions about the nature of rurality and its inhabitants, places, and lifeways are associated with romanticized moments of American history. In addition to the myths involving the wild, wide-open spaces of the American Western frontier era and the dissolution of communal responsibility (Smith 1950), another enduring myth--the "heartland myth"--was born in the period that corresponds to the mid-19th century free enterprise. It was modeled on the agrarian idealism of Jefferson, and his belief that the small rural farmer was a foundation for egalitarian social life in both small, rural towns but also on the farm itself. Farmers and communities were supposedly founded by and filled with individuals exuding a Christian morality, hard work, honesty, and a patriotic readiness (Tauxe 1998). These were indeed Jefferson's yeoman farmers, marked by the "firm handshake, fair skin, and steady gaze of the iconic heartland villager" (Tauxe 1998). Echoing this belief, in congressional debates before the passage of the Homestead Act of 1862, the evils of class and caste distinction were countered only by the "democratic benefits of rural society based on small independent farms"(1998).

Contemporarily, the heartland myth is exemplified in numerous examples, but often in the context of commerce or raw politics. Ronald Reagan often alluded to rural communities as the bedrock of America, where "neighbors help one another, where families bring up kids together, where American values are born." More recently Robert Dole called on his rural upbringing in small town Kansas to establish his utterly American credentials. And the idea of Jefferson's rural farmers as the bastions of democracy is not supported by historical fact, (Griswold 1947), but it certainly was a central image in the

Grange and Populist Movements, and numerous contemporary radical farming movements (Berry 1977) (as cited in Tauxe 1998). Additionally, the heartland myth is used to sell everything from sport utility vehicles to individual communities through the effort of chambers of commerce (1998). In the Upper Chattahoochee Watershed, again because of the strong urban-rural gradient, we may expect that communities would attempt to lure affluent city dwellers to their towns by allusion to rusticity and the lifeways and images of the rural. Thus they might rely on the heartland myth itself, which is part of a larger national communization process that constructs an authoritative tradition of a rural past. This version of the past, rendered "as common American experience, is portrayed as an ideal that lingers on as reality" in rural areas, and as "representing values that bind the American people together as a nation and to which we can (and should) all return in order to regain our true identity"(Tauxe 1998: 3). Thus rural communities serve as "an ever-renewed yet nostalgically traditional utopia, eternally reenacting the foundation of Euro–America" (1998).

Thus, because of the striking urban-rural gradient, the reification, production and commodification of place-based ideologies and identities may be common in the Upper Chattahoochee Watershed, and supplant the formative influence of material variables toward the production and maintenance of rural ideologies and identities from within the social environment.

Summation

The study area for the Upper Chattahoochee Watershed project includes the entire Chattahoochee catchment above Atlanta. The upper Chattahoochee watershed was divided into three study regions based on county boundaries and land-use and demographic pattern. The regions are the urban region, consisting of four counties of the Atlanta Metropolitan Region; the hinterland region, that includes two counties on the outskirts of Atlanta; and the rural region, consisting of three mountainous counties in the extreme northwest, upstream end of the watershed catchment. The most striking features of the study area is the rapid change in land-use, development, and physiography that occurs between the urban and rural regions. This “urban-rural gradient” marks the Upper Chattahoochee watershed as a suitable study area because it holds both “urban” and “rural” populations within the same ecological boundary. Rurality indexes were used to help determine the relative rurality of the rural study region, but also the strength of the urban-rural gradient. All indications are that the study region boasts one of the strongest urban-rural gradients of any three-county transect in the state of Georgia. Additionally, regional work flow and commuting data is used to further argue that the rural study region is indeed rural, and that its population is fit for a comparison of urban and rural knowledge suites. Finally, demographic data are used to characterize the rural nature of the rural study area.

The second part of the chapter concerned itself with ideological concerns of the urban-rural gradient. It is argued that the rural-urban distinction—so central to identity construction in the U.S.—may be particularly relevant in the Upper Chattahoochee Watershed due to the urban-rural gradient.

CHAPTER 4

DEVELOPING A COGNITIVE ECOLOGY

We have seen that the citizens of Atlanta Georgia and other inhabitants of the Upper Chattahoochee Watershed face short and long-term challenges to water quality and quantity. Therefore, the citizenry's knowledge concerning water quality, quantity, and notions of hydrology—and the implications of that knowledge--can and should be meaningfully explored. First, a formal working definition of 'cognitive ecology' is necessary.

Dukas (1998) provides a useful starting point toward a definition of cognitive ecology. Dukas writes:

> to define cognitive ecology, it is useful to first define "cognition," "ecology," and the tightly linked term "evolution." Cognition may be characterized as the neuronal processes concerned with the acquisition and manipulation of information . . . Ecology is the study of interactions between the organism and their surrounding biotic and abiotic environments . . . as the product of cognition and ecology, cognitive ecology focuses on the effects of information processing and decision making on animal fitness (1998: 1).

Preliminarily, then, human cognitive ecology seeks to better understand how individuals 'acquire' and 'process' ecological 'information.' 'Acquisition' in this case refers to the attempt to measure and explain individual knowledge suites of particular ecological features or processes. The 'processing' component of cognitive ecology seeks to explore the ‘movement’ of knowledge (as surmised by self-report knowledge ‘sourcing’) but also the related question of how knowledge distribution in a given region may effect larger political processes. Because it inherently involves the “movement” of second-hand knowledge, its goals inherently overlap with the goals of elaborating the ‘acquisition’ component of cognitive ecology.

However, the goal and emphasis of this cognitive ecology is placed squarely on the *individual*, and his/her *lifeworld*— and the situated political, economic, structural and cultural dimensions of their lives that has permitted, or will permit the acquisition of ecological knowledge. Therefore, the ‘acquisition’ component is much more emphasized herein. Towards this goal, a distinction is made in the “lifeworld” of the subjects between “first-hand” and “second-hand” knowledge. First-hand knowledge is gained ‘first-hand” from direct experience with the referent in question—in this case some kind of ecological process or discrete feature of the “environment. ” This knowledge is important because it can provide novel ecological information that is not from other cultural sources, and because the knowledge is highly *situated* in the lifeworlds of the subject and may therefore have greater application and different behavioral and political implications, and greater measurement correspondence[2], than general “knowledge.” “Second-hand” knowledge is knowledge derived from other cultural sources—through the linguistic domain, television, roommates, parents, formal or informal education, etc.

Cognitive ecology is therefore focused on the individual’s lifeworld, and the factors surrounding the acquisition of ecological knowledge, and the implications of the distribution of the ecological knowledge in a larger cultural and political context. The ‘processing’ component of cognitive ecology is an attempt to relate the possible and

[2] See Chapter 8 for a discussion of the concept of measurement correspondence and its relevance to “first-hand” knowledge.

extant implications of the distribution of particular knowledge suites in a particular ecological, political and infrastructural context. However, cognitive ecology is *not* herein an attempt to study regional or macro-level politics or other political ecological studies in and of themselves. Rather, it hopes to develop new measures of extant and potential *individual* ecological knowledge and-- drawing on the available literature--consider some system-level ramifications of the distribution of the particular suites of *individual* knowledge. It is then the study of the ecological knowledge of individuals writ large.

Relevant questions that naturally follow from this definition of cognitive ecology echo the research questions of the project. How do individuals in the Upper Chattahoochee Watershed acquire ecological information? How is their knowledge distributed, and can individuals in the watershed 'cognize' ecological change? More formally, how is ecological 'information' acquired and shared as evidenced by its a) 'distribution' and b) 'movement?'

There is little research that deals with these 'cognitive ecological' issues of ecological knowledge in complex societies. This is understandable, as there is no single over-arching theory of cognition in wide use among contemporary cognitive scientists. Therefore, it is no surprise that there are no well-developed theories utilizing coherent theory and numerous measures to create a well-defined cognitive ecology. Despite this fact, there are many disparate fields of knowledge, each with its own theoretical moorings and field techniques, which contribute to a quilt-work understanding of human-cognition-in-environments. But there are no accepted, formally delimited amalgamations of these fields consistently used to provide a holistic measure of ecological knowledge. This project, however, will attempt to utilize the techniques and measures—and by extension the theoretical moorings—of an array of approaches that have been used to broach the subject of ecological knowledge and attitude. This project hopes to use an eclectic blend of techniques to achieve a novel but meaningful measure of ecological knowledge and attitude that may in fact capture a different type of knowledge than previously measures. First, however, the challenges to such a measure are outlined below.

Previous Work and Challenges

There is a plethora of research concerning the categorization of natural objects (e.g. ethnobotany) in foraging, horticultural and small-scale agricultural societies, but little in complex ones. Perhaps this is due in part to the assumption that individuals in industrialized nations have and communicate relatively more ‘accurate’ representations of how ‘nature’ (the non-human environment) operates due to their ready access to biological and ecological scientific endeavors at the nearest university. Also involved may be anthropology’s relatively recent full acceptance of the complex society as an appropriate site for anthropological research.

The ecological and ‘local’ knowledge of individuals in complex societies should be considered important for both theoretical and applied reasons despite the lack of scholarly writings on the subject. First, many scholars have devoted much energy toward legitimizing ‘local’ or ‘folk’ knowledges in small-scale societies. Many provide critiques of the privileging of ‘centralized’ scientific approaches to knowledge and contrast them with the more ‘local’, place sensitive and culturally relevant vision of the natural world (Ellen 2000). ‘Local’ perception of water quality changes due to ‘local’ indictors of ecological change, for example--both ‘scientific’ and ‘folk’--may therefore be important informational pathways.

Local knowledges may in fact be as important in complex societies as they are in simpler ones for the reasons outlined earlier: scientific knowledge is difficult to transfer outside of it's parent 'discourse community.' and local knowledge loses its ontogenic roots when it is decontextualized, codified, and transferred (Agrawal 1995); local, 'first-hand" knowledge is *a priori* situated knowledge with high measurement correspondence (See Chapter 8); and as mentioned previously, keeping feedback information from the environment current and complete is challenging "even for electronically literate modern states" (McGovern 1988:245, Rappaport 1979, Moran 1984). Finally, any large-scale response to ecological change in complex societies would necessarily involve not just the 'recognition' of salient ecological changes but also various political processes. Ecological knowledge and attitude do play a role in structuring 'ecological behaviors' (Kaiser et al. 1999) and thus the population's mean environmental knowledge may affect human responses to ecological change.

Like research that attempts to discern some features of human categorization of the 'natural' objects, research to discern the 'distribution' of different suites of environmental knowledge in populations is not new but has been concentrated on particular production systems and populations. Ethnobiological research has traditionally dealt with knowledge 'distribution' in indigenous populations (Bellon 1991, Brush 1992), but more recently has begun to expand to include the study of ethnobotanical inventories under other production systems. Sometimes this work deals with folk knowledge of individuals in industrial societies, although often the focus is still on indigenous individuals or groups with other signifiers of particular interest that exist under the umbrella of nation-states (Kempton, Boster, and Hartley 1995). While not specifically focused on the distribution of ecological knowledge in a complex society, Brown (1985) extended the inquiry from the distribution of knowledge in simpler societies into more complex arenas by comparing different production modalities and the concomitant depth of their taxonomies. In other words, he was in effect testing whether discrete ethnoecological knowledge ablated or accumulated, as subsistence systems become more complex. He found in his cross-cultural survey that in fact small-scale agriculturists identify more plant and animal species than hunters and gatherers. Brown gave four explanations for this phenomenon. The additive theory suggested that agriculture is an extension of hunting and gathering and therefore knowledge remains in tact after the transition to agriculture. The displacement theory holds that agriculture takes place in more complex biological arenas than hunting and gathering. A third theory held that the sedentism associated with agriculture provides a more stable context in which to accumulate environmental inventories. Despite this comparative work, there exists little work on ethnoecological inventories or inventories of environmental knowledge generally in complex industrialized societies.

Even less work attempts to understand the ways that ecological information 'moves,' or, more accurately, the ways in which it is 'transmitted.' Social network analysis has been used in small populations to highlight the social network connections between people and to attempt to discern the weight of the connections. Ellen (1999) utilized this approach toward discerning the "movement" of ecological information among three social groups sharing a particular 'environment', in this case the areas surrounding Guatemala's department of El Peten. Ellen used Granovetter (1979) and Hammer's (1983) methodologies to discern the "communication networks for forest information."

Knowledge 'Structures' of the Environment and Relevant Fields of Study

In the attempt to understand knowledge acquisition and 'movement' in the Upper Chattahoochee Watershed, the project draws on several areas of inquiry into the nature and structures of cultural knowledge of ecology and their concomitant techniques and purported knowledge 'structures.' These lines of inquiry were developed from several disparate fields, however all indications are that they are related conceptually (Strauss and Quinn 1997), and perhaps neurally as well in various as-yet unexplained ways (Lakoff 1987). Herein, we will treat them as related conceptually. The simplest of these lines of inquiry attempts to uncover examples of *discrete* knowledge—simple facts pertaining to the local ecology that at least outwardly seem to require little if any scaffolding or other knowledge 'structures' to support their retrieval from memory. However, discrete knowledge is purportedly structured by deeper entities of the mind. These deeper entities are not discrete 'facts' but are relational, complex webs of meaning. Cognitive 'schemata' and cognitive 'models' are purported cognitive 'structures' that unfold as packages of thought or understanding concerning a particular domain of knowledge (Strauss and Quinn 1997) as evidenced by verbal behavior. Cognitive 'schemata' and cognitive 'models' are purported mediators that *provide structure* to the knowledge 'discretes' mentioned above (Lackoff 1987, Holland and Quinn). The packaging of this knowledge and the nature of its retrieval may be the result of network or even connectionist architecture (global patterns of neuronal activity that yield semanticity) (Strauss and Quinn 1997, Smolensky1995).

Finally, the project will measure the ecological attitude of subjects, again measuring the coherence of the groups with an eye toward spatial and demographic variables. Environmental 'attitude' is also a measure influenced by the underlying structures (cognitive models, schemata) that are the result of experience. In fact, various researches have found a relationship between relatively high environmental knowledge and an 'ecological' environmental attitude (Arcury Johnson and Scollay 1986, Pierce et al.1989, Mohai and Twight 1987). All of the fields of inquiry drawn upon in this project are considered to be 'structured' by the deeper 'relational' knowledge structures as provided by experience in particular social and ecological environments (Holland and Quinn 1987, 1997).

Therefore, when social environments are relatively bounded (via cultural or spatial isolation), we may expect that knowledge is present or absent accordingly, or that a symmetry of cultural meaning is developed or maintained. The relevant and contributing fields of inquiry are outlined below, and their relevance to the proposed project is explained.

Discrete Knowledge Inventories and their Techniques (Ethnoecology)

In this project, free-listing techniques will be used to measure some parameters of discrete ecological knowledge. The original work in ethnoecology catalogued the cognitive domains of natural objects (Conklin 1954, Pike 1954), but later became an attempt to understand human universals of classification (Berlin et al.1993). The human classification of the natural world was immediately seized upon as a measure of a particular parameter of human knowledge of the natural world. This knowledge was measured by various techniques including free-listing, decision trees, triadic comparisons, and other class inclusion techniques that purported to demonstrate at least knowledge structures, and at best meaningful human cognitive categories that could be related to behavior. The application of ethnoecological methodologies to decision-making was initiated by the work of Quinn (1978), Gladwin (1989), and Boster (1984). Quinn and Gladwin applied local taxonomies to natural resource management decision-making strategies, and Boster demonstrated the relationship between cognitive classification and relational models of natural processes, and agricultural variety selection behavior.

Eventually, a lengthy literature best exemplified by Ellen (1993) challenged restrictive notions of universal classification and their relevance to decision making, behavior, and even cognition. Ethnoecological work began to highlight how the seemingly fixed local knowledge captured by the 'universal' taxonomies was in fact more fluid, dynamic, and context dependent than previously thought, sensitive to training or education (Richardson et al, 1996), social position (Ellen 1993), subsistence strategy and/or available technology (Brown 1976). Even generic level classifiers were in the end "fuzzy" at the boundaries and contextually sensitive. Finally, the formal taxonomy itself was challenged, not just the details of its "horizontal dimension" (Rosch 1978). Hunn's natural core model described a general purpose, polythetic core of taxa with special purpose monothetic concepts surrounding the core (1982) that was apparently in complete opposition to the formal taxonomic system. Posey (1984) countered with an explanation that salvaged both formal taxonomic processes and Hunn's "core" by distinguishing between classification *purpose* and *process*.

Contemporary scholars may find fault with earlier attempts to associate ethnoecological free-listed domains with general knowledge for at least two reasons. First, much knowledge is non-linguistic, or is at least transformed as it becomes linguistic (Bloch 1998). Second, sentential models of human cognitive processing have given way to more connectionist models that emphasize the importance of contextual meaning and minimize checklist notions of meaning and knowledge (Maturana and Varela 1992).

Cognitive Models

Cognitive models, as mentioned, are purported to structure the vast storehouse of discrete knowledge at the disposal of human actors. Cultural models find their academic genesis in *mental model* research. Early work in mental models includes work by Johnson-Laird (1980), and Gentner and Stevens (1983). According to these theorists, 'mental models' are used to understand experience. These models are representations of how the world works that are constantly altered, and then tested and re-tested. Therefore these 'models' and other heuristics can be helpful toward achieving goals. They can also make goals more difficult, however, as McClosky (1983) demonstrates.

The ability to cognize new ecological information from the non-human environment is in part related to the existing knowledge structures of the individual. These structures (schemata, image-schemas, prototypes, use-values, and affordances) are apparently developed in the individual via a history of similar experiences in the social environment and are best considered tendencies of objects or events to evoke particular interpretations (Strauss and Quinn 1997, Bloch 1998). [3] Strauss and Quinn explain the process of cultural model development in *individuals* by various 'centripetal' tendencies that lead to 'durability' of particular cognitive models of the individual (1997:89). One centripetal tendency is that experience with particular co-occurring objects or events lead to neural restructuring in the *individual* that permits the easy recognition of the co-occurring features. These schemas then reinforce themselves even with only some of the original identifying features present. These knowledge structures are not a complete 'veil', however, and schemas can be challenged and altered in response to new [ecological, first-hand] information (D'Andrade 1991). Put simply, information stored as cognitive models (ecological knowledge) can *structure* and *potentiate* further knowledge (Lowrich et al.1986, Holland and Quinn 1997).

To the extent that other members of a society share particular interpretive tendencies, they are 'cultural models.' Strauss and Quinn suggest that some major features

[3] Maturana and Varela (1992: 201) explain a similar concept, "Those behavior patterns which have been acquired ontogenically in the communicative dynamics of a social environment and which have been stable through generations, we shall call cultural behaviors. The name should not be surprising, for it refers to the whole body of ontogenically acquired communicative interactions that give a certain continuity to the history of a group, beyond the particular history of the participating individuals."

of the modal patterns (centripetal tendencies) of cultural model similarity within and between human *groups* include similar socialization practices, the sharing of a common language, and shared task solutions. Further, according to Strauss and Quinn, much of the world is organized in "exactly such a way as to ensure that people in the same social environment will indeed experience many of the same typical [interpretive] patterns" (1997: 123). Very relevant to this project is the work of Kempton, Boster and Hartley (1995) who used elicited 'mental models' to determine the variation and coherence of environmentalist understanding and attitude in the United States. Specific mental model methodologies will be discussed in the Research Design section.

Environmental Knowledge

'Environmental knowledge' is any discrete ecological informational "bit" that is elicited from individuals by various means. Shared discrete environmental knowledge has been termed 'local' or 'indigenous' knowledge in the literature. In complex societies, this knowledge is usually called 'environmental knowledge'.

Research on public environmental knowledge has been fairly limited. In the 1970s, three projects were completed using special samples. Maloney and Ward (1973) compared college students, member of a conservation group, and a non-randomly selected group of non-college educated adults—all from the Los Angeles, CA area. There findings indicated that education and conservation group involvement were associated with environmental knowledge. Ramsey and Rickson (1976) tested for an association between pro-environmental attitude and knowledge in three high schools. They found that knowledge moderated attitude. Finally, Arbuthnot (1977) compared eighty-five recyclers with sixty conservative church members. The author found that those with detailed sources of information, liberal political views, and the belief that "actions have potential impact" all are associated with environmental knowledge ((1977: 229).

Early in the 1980s, a national survey included measures of environmental knowledge (Council of Environmental Quality, from Arcury 1990). Nine items of knowledge were examined, and only twenty percent of the sample population was able to answer seventy percent of the questions correctly. Later in the eighties, Arcury and others (Arcury et al.1986, 1987; Arcury and Johnson 1987) examined the data from several statewide surveys. Arcury et al. (1987) explored how gender structures environmental knowledge and concern. The research focused primarily on acid rain, and male gender, access to TV, and higher education were all associated with greater knowledge and concern. Arcury et al. (1986) found an association between environmental worldview (using the New Environmental Paradigm measure, below) and ecological knowledge. They also found that income, gender (male) , and education each had an independent association with knowledge. Arcury (1990: 301) comments that the weakness of the study was the self-report methodology. Respondents "estimated their level of knowledge on specific topics rather than responding o question with correct and incorrect answers."

Finally, Arcury and Johnson (1987) measured actual knowledge by repeating the questions of the 1980 Council on Environmental Quality survey. The questions concerned knowledge of state environmental issues. Analysis showed that knowledge levels were low, and comparable in 1985 to the 1980 survey results. Further, they found that education, income and gender (male) were all correlated with knowledge. More recently other research has been directed toward new variables that may mediate ecological knowledge. For example, Benton (1994) found that U.S. business students were not less environmentally knowledgeable, but demonstrated less concern for the environment on several scales than non-business students. Further, in the study men were found to have greater knowledge but women greater concern for the environment. Other studies have looked at environmental knowledge cross-culturally in "developed" nations. Holden (1995) found that the U.S. ranks seventh out of twenty nations tested in environmental knowledge. Finally, Kaloff and Dietz (2001) have recently added to the relatively recent literature on race and environmental knowledge. They found that randomly selected white males in the U.S. scored lower than blacks and Hispanics of both sexes in both environmental belief and values.

In this project, environmental knowledge will be instantiated with verbal responses to concrete questions about physical properties of the watershed, but also questions concerning water quantity and quality, and personal indicators (signs of water quality available to the senses) of water quality. Measuring environmental knowledge will be particularly relevant because of the literature cited above, where environmental knowledge and variables such as high income, positive environmental attitude, greater age, higher education level, and male gender are correlated (Arcury Johnson and Scollay 1986, Pierce et al.1989, Mohai and Twight 1987). Because income and education may be distributed with meaningful variation in the study region, environmental knowledge may be a spatially relevant variable.

Environmental Attitude

How people feel about the value and quality of the physical environment has been variously called environmental attitude, concern, and worldview (Arcury 1992). Our interest here is toward the correlation of particular 'environmental attitudes' with particular suites of knowledge. Environmental attitude, as mentioned, is assumed to be related to ‘ecological’ cognitive models and schema, transmitted in the social environments between subjects in communicative proximity (Pelstring 1994).

What is attitude? Fishbein and Ajzen (1975: 6) define attitude as "a learned predisposition to respond in a consistently favorable or unfavorable manner with respect to a given object." The researchers break the definition into three components: attitude is learned; it predisposes action; and such action or behavior is generally consistent. Attitude is evaluative in nature--evaluative toward, for instance, pollution or wildlife--and such evaluations are based on beliefs (Pelstring 1994).

With the above elements in mind, "environmental" attitude can then be defined as "a learned predisposition to respond consistently favorable or unfavorable manner with respect" to the environment. There are many scales available that attempt to measure many aspects of people's attitudes toward the environment--attitudes toward wildlife, pollution, habitat are just several examples (Pelstring 1994).

Dunlap and Van Liere (1978) were the original researchers to posit that a new world-view was emerging--one that differed dramatically from the Dominant Social Paradigm which involved the public's belief in progress and development, science and technology, and a laissez-faire economy. Calling it the New Environmental Paradigm (NEP), the authors assert that this emerging outlook comprised such concepts as limits to growth, steady-state economy, and natural resource preservation. Dunlap and Van Liere developed an instrument to measure public acceptance of the New Environmental Paradigm that has subsequently been tested by other researchers and is still being used today. The original testing instrument comprised twelve statements listed below:

- We are approaching the limit of the number of people the earth can support.
- The balance of nature is very delicate and easily upset.
- Humans have the right to modify the natural environment.

- Humankind was created to rule over the rest of nature.
- When humans interfere with nature it often produces disastrous consequences.
- Plants and animals exist primarily to be used by humans.
- To maintain a healthy economy we will have to develop a "steady state" economy where industrial growth is controlled.
- Humans must live in harmony with nature in order to survive.
- The earth is like a spaceship with only limited room and resources.
- Humans need not adapt to the natural environment because they can remake it to suit their needs.
- There are limits to growth beyond which our industrialized society cannot expand.
- Mankind is severely abusing the environment.

Understanding and measuring environmental attitude has become increasingly important as the number of environmental conflicts have increased throughout the Unites States and the world. Paralleling an increase in environmental conflicts is the growing trend toward greater public involvement in their resolution (Pelstring 1997).

One significant issue raised concerning the New Environmental Paradigm scale is whether it is unidimensional or multidimensional. Is the concept of environmental attitude really only one concept, or does it comprise several concepts or dimensions? Albrecht et al. (1982) conducted a replicative study to assess the New Environmental Paradigm scale's reliability, validity, and unidimensionality. The authors surveyed farmers and urbanites and found that the New Environmental Paradigm scale had three dimensions (unlike Dunlap and Van Liere who found the scale to be unidimensional). Factor analysis showed that these dimensions included the balance of nature, limits to growth, and concepts of "man" over nature.

Geller and Lasley (1985) also tested the dimensionality of the twelve-item New Environmental Paradigm scale using samples from the Van Liere study and from the 1982 Albrecht et al. study. While Dunlap found the original twelve-item scale to be unidimensional and Albrecht found it to consist of three factors, Geller and Lasley were unable to confirm either researcher's configuration using confirmatory factor analysis. "Only by reducing the scale to nine items were Geller and Lasley able to 'cautiously accept' Albrecht et al.'s finding of three factors: balance of nature, limits to growth, and man over nature" (Pelstring 1994).

Researchers Scott and Willits (1994) conducted a 1990 statewide survey examining Pennsylvania residents' opinions about the New Environmental Paradigm and pro-environment behaviors. They found that while most respondents expressed support for the New Environmental Paradigm, most did not participate in pro-environment behaviors. This finding echoed some past results that environmental attitudes were not predictors of pro-environmental behavior. But more importantly, they too raised questions over the NEP scale's possible unidimensionality. Scott and Willits found only two underlying dimensions: a humans-with-nature factor and a balance of nature/limits to growth factor (Pelstring 1994).

In several National Park Service studies, Noe and Snow (1990) applied the New Environmental Paradigm scale in surveys of visitors to five southwestern parks. The authors hypothesized that park visitors would support a more ecological view of man and nature, and that the scale items would show consistency and unidimensionality. Results indicated that the New Environmental Paradigm scale was multidimensional with only two factors--balance of nature and man over nature--and that some items used in the original New

Environmental Paradigm scale could be dropped (Pelstring 1994). Gray (1985) questions "whether any measure of environmental paradigms can be unidimensional" and asserts that "beliefs in such a complex domain as ecology are not likely to be simple...but complex and multidimensional." For these reasons, the current project will use the total score only to achieve an 'environmental attitude' measure. The sub-scales will not be calculated.

Summation

Dukas writes, "as the product of cognition and ecology, cognitive ecology focuses on the effects of information processing and decision making on animal fitness" (1998: 1). Cognitive ecology, then, is well developed and studied in the context of small-scale societies. However, little work is done toward the elaboration of cognitive ecological research in complex societies. In complex societies, what cognitive ecology hopes to measure is important because it can contrast scientific approaches to knowledge with the more 'local', place sensitive and culturally relevant vision of the natural world (Ellen 2000). It can also help keep 'feedback' information from the environment current and complete (McGovern 1988:245, Rappaport 1979, Moran 1984). Therefore, it was argued that the elaboration of the distribution and sharing of ecological knowledge in the Upper Chattahoochee Watershed should be a worthwhile undertaking.

The following fields (and their concomitant techniques) were explained above and were used in the study: cultural models, ethnoecology and free listing techniques, environmental knowledge, and environmental attitude. These fields and their techniques were chosen in light of the research questions and hypotheses, which are introduced in chapter 6.

CHAPTER 5

WATER AS A DOMAIN OF ECOLOGICAL KNOWLEDGE

As outlined in Chapter 4, the cognitive ecology outlined herein seeks to better understand how individual humans 'acquire' and 'process' ecological 'information.' The major emphasis of cognitive ecology is thus on the *individual*, and his/her *lifeworld*—the situated political, economic, infrastructural and cultural dimensions of their lives that permit the acquisition of ecological knowledge. However, biological resources are dynamic "inputs" into human subsistence systems, and their weight in influencing system trajectory is the result of numerous factors: the availability of the resource itself; the primacy of the resource toward the maintenance of human physiology and cultural systems; the extant technologies capable of capturing or developing the resource in question (e.g. optimal foraging and development theories); and numerous others. This chapter explores the considerations specifically concerning investigating the cognitive ecology of *water* and its relation to the "political, economic, infrastructural and cultural dimensions" of human subsistence systems. First will be a consideration of how the very nature of water appropriation in particular political and ecological contexts throughout the world co-relates with particular management structures that permit or obfuscate the acquisition of new ecological knowledge. Then we will turn our attention to the study regions of the Upper Chattahoochee Project and investigate how the cultural and infrastructural factors of living—the lifeworlds of subjects—permit the 'acquisition' of ecological knowledge.

Drawing on the forthcoming discussion of water system structure, the role of water appropriation in structuring the cognition of water knowledge in the study regions of the Upper Chattahoochee Watershed will be explored. Additionally, we will explore how rural and urban contexts might permit “first” and “second-hand” knowledge acquisition differently.

Ecological and Water Knowledge

Ecological knowledge—loosely defined--is arguably the most primary of all human knowledge. Human knowledge implicitly involves the maintenance of the human biological system by obtaining various food resources via subsistence strategies that ultimately require—or demonstrate to the observer-- various types of ecological knowledge. For precisely this reason, anthropologists have long had an interest in the ecological knowledge and ethnoclassification of the natural world by various indigenous peoples. By studying ethnoclassification, the researcher was thought to be able to “tap a central portion” of the ecological knowledge of groups (Frake 1962). The divisions of labor, for example, should result in specialized knowledge suites. In highly complex societies, ecological knowledge should be more highly distributed still, and individuals will demonstrate different degrees of knowledge of *general* ecological concepts, and different degrees of knowledge concerning their local environments based on their subsistence and leisure activities.

Water is a particularly interesting and relevant resource of study as it relates to human systems for at least two reasons. First, water is a necessary resource for all human groups, and with the exception of airborne oxygen, it must be obtained more continually than all other resources in the human subsistence environment. While oxygen availability limits permanent human settlements to below 17,000 (approximately 5000 meters) even after ontogenetic adaptation to high altitude (Whiteman 1988), water is much less consistent in its distribution, and even where seemingly plentiful is often subject to macro-cycle fluctuation.

Second, water is increasingly a troubled resource. Today, water quantity for both agriculture, industry, and domestic use is problematic in many parts of the world, as surface and sub-surface resources are increasingly in short supply. Water *quantity* and *quality* is the most pressing global ecological problem (Young et al. 1994). As a result, fresh water is, and will increasingly be, the source of local, regional, national and international conflict (Johnston and Donahue 1998, Ohlsson 1995) as aquifers and wells for drinking, industry and agriculture are depleted and populations increase (Young et al. 1994). In the United States, the depletion of the Ogllala aquifer in the West and Midwest, and the continued degradation of water quality and quantity elsewhere are of major concern (Ohlsson 1995).

Because humans need a nearly constant access to sufficiently clean water in sufficient quantity, the geography and scope of human settlements is shaped by water quality, quantity and distribution--and its eventual harness toward agricultural and domestic use. Human societies and water capturing technologies are therefore intimately co-related, often exhibiting recursive, stochastic, or emergent development (Uphoff 1992). And precisely because water is so necessary for human consumption and for the intensification of human settlements, all human groups have the potential for developing ethnoecological indicators of water quality. And, in the event of shortage, all groups have the need to monitor water quantity.

Water knowledge is therefore primary to human systems. In what follow we will explore how water knowledge suites are mediated by one of the more primary modes of technological advancement--the role of water capturing technologies.

Water Capture, Delivery Management, and Structures

In many complex human systems, the contexts of the end-uses of water are far removed from their original sources. Thus human systems involve various means of water capture, delivery, and management. The infrastructural and management requirements of water capturing technologies co-relate with the processes of state formation, institutional evolution, political struggle, ecological constraints, and the role of individual and collective (common pool) decision making. Thus water-capturing technologies provide the anthropologist with a host of far-reaching questions and problematics that, when addressed properly, yield both theoretical and system-specific insights that strike at the very heart of age-old anthropological queries. Work in the field has been extensive, and has produced such classics as Wittfogel's (1957) ground-breaking explication of despotic rule in the hydraulic kingdoms of yore, as well as Lansing's (1991) explication of sociogenically constituted power and "ritual technology" (Condominas 1977) at work in the Balinese water temple systems.

Because of their complexity, human water capturing systems are often described post hoc, in functionalist terms—almost as if the subjects were parachuted into their respective environments and forced to find a solution to their water needs vis-à-vis their particular economic and ecological constraints. The knowledge required to develop and maintain these systems, therefore, is often considered a priori to system construction. Perhaps more realistically, the systems can be understood as a process of organic development involving environmental affordances in conjunction with the recursive evolution of knowledge and technology that lead to particular system development and maintenance solutions. Importantly, these same factors must be implicated in the production of knowledge suites, and thus their explanation has relevance to this study.

A quick survey of the water capturing technologies from increasingly complex societies demonstrates both the integration of water-capturing systems and management structure, but also the great diversity of structures developed to deliver water in particular contexts. By exploring water capture and delivery arrangements in different contexts, the relation between economic, political and ecological system variables and particular "windows" of knowledge can be articulated for the Upper Chattahoochee Watershed.

Water Capturing Systems

According to Uphoff (1991), potable water and irrigation systems must facilitate decision making and planning, resource mobilization and management, communication and coordination (between managers and users), and conflict resolution between all system users. Overlapping these structures and mechanisms, water systems must meet the following management *objectives*: increasing production, improving distribution, conflict reduction, resource mobilization (the collection of fees for upkeep, or communal responsibility), and sustained production (Uphoff 1986, 1991). These contexts change greatly from small indigenous potable water and irrigation systems with little organization, to more complex indigenous systems with highly organized delivery systems, to complex state societies that utilize municipal (local), state, and federal funds for infrastructural development.

A first water system example is drawn from the central Peruvian highlands, Quinua district, with the *Lurin Sayoc* irrigation system. The administration of this system is largely unstructured. The irrigated terrain of the *Lurin Sayoc* is generally found on the steeper slopes, although land may be sown at the bottom of some of the larger ravines that are not subject to frequent flooding. The system in *Lurin Sayoc* consists of a cement diversion structure which directs water via cement canals to a large feeder canal which delivers water to field grids after passing through a system of headgates. The source is a rather large catchment, the Huamanagura ravine. The system is considered an example of "district irrigation," as it connects several villages but is still relatively small and only runs several miles total (Mitchell 1977).

Water allocation in *Lurin Sayoc* system is determined by the individual water users. It is the responsibility of the individual water user to both literally "work the system", that is, fill the delivery reservoir, and to remove the obstacles to its flow onto his/her property, and to simultaneously ensure that theft does not occur by placing *guardiantes* (guards) at major branches of canals.

The agricultural system of *Lurin Sayoc* can be a considered not only an adaptation to variable rainfall, but also to high altitude (Mitchell 1977). One major goal of the system is to deliver a very limited supply of water to discrete irrigation spaces where it can be best utilized by an agricultural system that simultaneously exploits various altitudinal zones in a specific seasonal arrangement. This arrangement once necessitated a *varayoc* (rural political organization) that allocated the waters to the users, but following the end of this system in 1970, the allocation and delivery has been in the hands of the users without the benefit of even the most meager enforcement institution.

Conflict management was much more successful with the *varayoc* organization than it has been since. Today, disagreements are apparently common, problematic, and are often decided by force. Ultimately, those persons with large amounts of capital and resources are able to access more water. Maintenance, however, is much more formalized and complex (Freeman 1989). In *Lurin Sayoc*, the maintenance is organized around irrigation cult holidays that extend beyond the *Lurin Sayoc* system itself. There are multiple forms of *corvee* labor organization just as in the *Zanjera Danum* (discussed below). The first form is the *Yarga Aspiy*, or cleaning organization. This takes place in July in the *Lurin Sayoc* system just before the initiation of the growing season. A second form is the *Yarga Ruway*. This organization serves a more festival purpose, requiring that systems users walk the system and hold particular festivals and meals at strategic locations along the system. Each family that receives water must furnish a worker for the *Yarga Aspiy* and *Yarga Ruway*. Lists are kept of those families that do indeed participate. In *Lurin Sayoc*, then, system conflict is problematic, as delivery is uncertain and not equitable. Further, the users have little representation in the system. Other systems might quickly collapse given these shortcomings, but in *Lurin Sayoc*, system maintenance institutions remain active due to their historic inertia. One only needs argue then that individual, rational actors might as well remain in the water system, as responsibilities are ritualized and mandatory, and even inequitable systems deliver water *sometimes*.

In contrast to the *Lurin Sayoc* system, the Zanjera Danum irrigation system, located on the Ilocos Coast in the extreme northwest portion of the island of Luzon in the Philippines, meets many of the water system management objectives in novel ways. The Zanjera Danum system consists of 1500 ha of rice paddy cultivation. The system encompasses one village and parts of two others. Each village is broken down into individual hamlets which are compact units spread through out the delivery area. Each hamlet has associated with it a *sitio*, which is a group of irrigated fields. There are 32 hamlets in the *Zanjera Danum* system (Wernstedt and Spencer 1967).

Despite the fact that system structure, goals, contexts, size, and organization are linked to different degrees by various social and physical parameters and even historical precedent, in the *Zanjera Danum* context, water allocation and conflict management are very intimately connected (Siy 1982). In this system comprised of share tenants and typically absent landowners, the structural components of the system itself and the allocation of water rights within the delivery grid helps to minimize conflict and maximize equity. Briefly explained, the delivery system consists of a main canal fed by a natural diversion, and lateral canals which supply water to *sitios*, or field delivery units, that are further divided into blocks that are arranged *perpendicular to the lateral canal*. The perpendicular orientation of the lateral canal guarantees that all plots within each block are more or less equidistant from the water source, because several small plots in various blocks characterize the use unit of water, the atar. Ideally, the user of the first plot in the first block is also the user of the first plot in the second block, etc. This provides for the "unusual possibilit[y] for relatively equitable patterns of water distribution to all users" (Coward 1979:30), as it attenuates problems between those at the "head' and the "tail" of the system, a common stumbling block in irrigation management. In the context of the *Zanjera Danum*, the design of the *atar* is particularly important as water availability is highly variable, and during drought farmers in a particular *sitio* can turn off water to lower portions of the *sitio* and still maintain equity. Finally, the system and its intentional equitable design is reminiscent of Leach's description of *Pul Eliya* irrigation in Sri Lanka (1961). The paucity of such calculated concern for delivery equity, and the awareness of the physical system designs' role in achieving these ends, may point to a diffusionary genesis for similar systems in the region and beyond.

It would seem, however, that time allocation might be compromised by such meticulous concern with equity (there would be a decrease in cultivation efficiency for example) as the agriculturist moves from plot to plot, etc. But certainly this disadvantage, if relevant to the *Zanjera Danum* context at all, is modest in contrast to the clear benefits of water allocation and soil quality equality, thus permitting collective functioning.

In the *Zanjera Danum* system, resource mobilization is also organized in a manner that decreases conflict. *Dagup* labor is necessary when all workers are needed to achieve important, pressing maintenance that is not expected. *Sarunkar* labor, however, a form of c*orvee* that involves only two members for every ten *atars* in the *sitios*, helps to ensure conflict in minimized by the "cross-cutting of group membership" (Coward 1979: 33). Potential antagonists share some local identities, which should minimize corporate group formation and strife in general (Downing 1974). Finally, another quality of the *Zanjera Danum* system is that responsibilities seem to mirror system benefits in a logical and consistent fashion.

A final example of delivery system is from a more complex society. The *Alicante* system is located in a small coastal plain bordering the Mediterranean about two thirds of the way between Valencia and Murcia in southeastern Spain. The climate is mild, and is typically Mediterranean. The soil here is deeply fertile, and thus agriculture is limited by water and not soil quality.

The *Alicante* system consists of 3700 ha of irrigated land and produces principally almonds and wheat. A small surface catchment of the Monnegre River was not sufficient to the needs of the agriculture, or more accurately, was not sufficient to its potential given the fertility of the soil and the availability of markets for the goods produced. A dam added a 3.7 hm3 to the capacity of the systems and ameliorated the highly variable flow of the river. Below the dam, two small holding reservoirs feed the irrigation grid via two main channels. This water supply is still not enough, as several deep well have been drilled recently to supply water to the system by connector canals from outside the system boundaries proper.

In the *Alicante* system, water allocation and the right to access water resources is not a question of communal, absentee or even sharecropper rights. In the *Alicante* system, the rights to water have been almost entirely desegregated from the usufruct or outright ownership of land. In this system, water rights are bought and sold in both formal and informal markets. Formal markets for trading scrips (albalaes) include those sold by the irrigation syndicate that controls 90 hours of irrigation and functions in some ways as a second level management organization. Water from private wells, a necessity in the *Alicante* system, is also bought and sold. Attempts to limit water rights to land holders have failed repeatedly. A final attempt came with the construction of the Tibi dam. Ironically, rights to water held before the development of the Tibi dam (which was built to increase irrigation capacity) were intended for sale but “new water” rights were *not* to be sold. In the end the water was sold anyway, as farmers without the necessary “old” water rights sell unneeded water to achieve limited and sub-par irrigation goals or they supplement their “new” rations with private water from one of the nearby deep wells. Ditch riders or *acequieros* actually deliver the water to each farmer. An inspector is responsible for the water from the time it leaves the storage basins below Tibi until it reaches the *acequieros*. Finally, there are damkeepers (*pantaneros*) and guards.

In the *Alicante* system, the formalized water court provides for the formalization and standardization of systems rules followed up with strict enforcement, which tempers a major cause of conflict (Uphoff 1991). Other factors (such as water shortages) that often lead to conflicts are dealt with by market principles. In times of relative scarcity, water prices increase and help decrease demand for water accordingly. The court is private and maintains jurisdictional control only over issues of water management. Decisions by the court are discretional but also have formalized upper and lower limits. Further, the decisions of the court are final—there is no appeal process. Water guards provide enforcement.

System maintenance is achieved by a formal taxing structure. The executive commission of each community elects a director who is responsible for executing the operating procedure for delivering the water. All budgetary, tax, and maintenance decisions and the supervising of employees is the responsibility of the committee and the appointed director, but must be approved by the general assembly before implementation. Interestingly, participation in the general assembly elections requires that the owners/users hold 1.8 ha of land. Despite this gatekeeper approach to participation, the inequality does not compound with increasing landholdings. The largest landholders are still only entitled to one vote in the general assembly. This system, then, demonstrates a highly commodified and stratified irrigation environment where water functions almost completely as an economic good, and the more powerful, landed entities enjoy the right to representation in the election process.

The *Alicante* water system in Spain represents a water delivery system developed in the context of rich soil, moderate infrastructural development, but limited water quantities. This particular irrigation context is increasingly similar to U.S. contexts, and accordingly in California and Florida water rights are being sold in manners similar to those in the Alicante system.

How do these systems structure the knowledge of end-users of water? End-users in these relatively small systems are well positioned to cognize many water quantity and quality issues as the result of the system *scale*. Because of the small size of the systems, many users can be periodically involved in the management structures, and thus become familiar with water quality and quantity issues. Further, they have the chance to understand the system from a managerial perspective, and this can aid in the mobilization of maintenance of resources, and maintains the responsiveness of the systems generally.

An additional consideration of these systems is that water quality and quantity knowledge can be gleaned from these systems without managerial experience. In many contexts, irrigation delivery also serves as potable water delivery, and thus quality can be determined by whichever means local people utilize (color, taste, odor, physiological sensitivity, etc). Further, in the absence of political or managerial structure turmoil, and when systems guarantee equitable use, changes in water quantity at the household spigot or in the field delivery unit can be assumed to be indicators of a decrease in water quantity. Finally, to the extent that irrigation and potable water systems deliver plentiful water, direct knowledge of water quantity fluctuation may be limited by delivery systems, especially when more proximal proxy sources of water quantity information are non-existent.

U.S. Water Systems

In the United States, water systems and their managers must deal with the same factors of water development and management as those presented above. Many rural community sub-surface systems in the U.S. mirror the small Alicante systems in scale, management structures and resource mobilization strategies employed to maintain them. Many systems in the U.S., however, surpass the former systems in their scale. But as we shall see momentarily, some of the larger systems in the U.S. are having to alter their management structures and objectives as water resources dwindle, populations increase, and laws governing water use become supra-regional and supra-system.

In the U.S., fifteen percent of the total cropland is heavily irrigated, but that fifteen-percent account for forty percent of the agricultural value of total cropland (ERS 1997). Most of this prime agricultural land is highly concentrated in specific regions (e.g. the San Joaquin Valley, the “breadbasket” states, coastal and central Florida). Thus potable water system development has become more important in constraining the development of cities and towns than irrigation development. However, in areas such as the southwest U.S., heavy additional infrastructural development has meant that entire supra-regions of the U.S. are becoming linked via water delivery systems. Thus, there are increasing conflicts between industry, agriculture, environmental use and municipalities that arise not from a shortage of water in single-system delivery, but from a shortage of water from supra-*regional* surface and sub-surface resources (ERS 1997). For example, the Southwest, the first region to fully utilize available water resources in the U.S., also became the first region to begin abandoning irrigated land as the result of growing water demand for urban and environmental uses (ERS 1997). But in addition to supra-regional shortages based on infrastructural and geographical connectedness of water components and resources, these areas are becoming merged into huge water systems as supraregional and interstate water use law is increasingly involves in meeting managerial objectives of these supersystems.

For example, in the eastern U.S., Georgia, Alabama and Florida are involved in similar supra-region conflict management process that has little procedural precedent, and even less managerial precedent (Kundle 1998). In the eastern U.S., for example, water law followed on the heels of English common law, and in 1830 distinct legal categories were in place for ground and surface water usage. Both were based on land ownership overlaying or adjacent to water resources. Under the “natural flow” surface water doctrine, all landowners had water rights for domestic uses only. Industrialization and population growth required a transition to a "reasonable use " theory whereby the use of the resource must not impinge on others downstream (Kundle 1998). Groundwater allocation originally held that the landowner had absolute rights over sub-surface water resources. As groundwater resources dwindle, and because groundwater stores rarely follow private property boundaries, groundwater eventually fell under a "reasonable use" doctrine. Thus the "reasonable use" for surface and groundwater were somewhat different: groundwater use might be unlimited if used "reasonably" but surface use must be reasonable with regard to *others* (downstream effects).

As a result of the evolution of water law, the increase in water consumption, and the awareness of the relatedness of many seemingly disparate water resources, developing legal structures have mean that entire regions are now huge water systems sharing many of the objectives of water management. In the western U.S. this is often the result of new infrastructural linkages between large groundwater resource delivery systems. In the eastern U.S., however, it more often involves the litigation regarding the reasonable use of surface resources under common law. But the shortcoming of the current "riparian" or "common law" approach to many water management objectives is striking. According to Kundle (1998), riparian law fails to prioritize problems in water usage, utilizes a mechanism of conflict resolution (litigation) that is too slow and expensive for system sustainability or responsiveness, doesn't secure predictable water rights, and it fails to adequately appreciate the ground-surface water relationship.

In short, the management objectives and structures of newly linked new supra-regional water systems are a work in progress. There is little "fit" between system infrastructure and management goals as demonstrated in *Lurin Sayoc*, and the same can be said for the resource mobilization and conflict resolution in these systems. Even the *Alicante* system, with its highly bureaucratized and legalistic system, is under the management constraints of a single entity that has some historic inertia. In the tri-state water wars in the southeast U.S., however, new legal rulings change the management structure and goals almost weekly, while most of the infrastructure remains the same. Further, the privatization of water delivery underway in many municipalities will only complicate further the supraregional needs for an effective, structured management that meets most of the requirements outlined by Uphoff (1992) above.

The Study Area: Urban vs. Rural Knowledge Suites

Like the *Alicante*, *Lurin Sayoc*, and *Zanjera Danum* systems, the outcomes of a particular infrastructural system and managerial structure arrangement can effect end-user water knowledge "windows" in the Upper Chattahoochee Watershed study area. How do more local infrastructural and managerial contexts help to structure the availability of water knowledge in the study area?

Georgia is one of the 20 major irrigation states in the U.S. Of these twenty major states, it is one of only five---the others being Arkansas. Florida, Mississippi, and Louisiana -- that are in humid areas where irrigation supplements usually adequate precipitation (ERS 1997). Despite this fact, irrigation is barely extant in North Georgia, the study area for this project. Orographic lift from the mountains ensures that much of the Gulf moisture available in the atmosphere falls in and around the mountains unlike lower elevations. Therefore, the management structures and objectives of water delivery are employed in various potable water systems in the rural and urban study areas.

The most pressing question to this project concerning the rural and urban study regions involves the knowledge "windows" provided by the various water systems in particular contexts. For example, how does system infrastructure, management organization, and lifeways of the urban and rural residents permit the 'cognition' of changes in water quantity or quality?

Urban Water Knowledge

The urban study region encompasses the large municipal systems of Atlanta that draw water from the Chattahoochee and various feeder creeks and thus is implicated directly in the tri-state water wars. The term "Atlanta water system" here refers collectively to both the water system of the city of Atlanta proper, and also the outlying Metropolitan Atlanta region including the Atlanta-Fulton County, Cobb-Marietta, DeKalb County, East Point, Clayton County, and Gwinnett County Water Systems.

Metropolitan Atlanta has a complex network of interconnected water systems. Large water systems utilize surface water, primarily the Chattahoochee River and its tributaries because of the developmental history of Atlanta. The city of Atlanta developed as a transportation center around the railroads, not rivers. Thus Atlanta developed at the intersection of several ridges on the drainage divide between the Atlantic Ocean and the Gulf of Mexico. Consequently, most streams in the Atlanta area are small and many are severely affected by prolonged droughts. The Chattahoochee River is of marginal size to supply a metropolitan area the size of Atlanta's, and ground-water resources in the area are comparatively limited. As Atlanta expanded physically and in its demand for water, water systems began to withdraw from Lake Allatoona in the Coosa River basin, and from the Flint and Altamaha River basins (Fanning 1997).

All of the above mentioned water systems in the Upper Chattahoochee project urban study area utilize somewhat different managerial structures and resource mobilization strategies. For example, the city of Atlanta proper recently approved a contract for United Water Resources to operate and maintain the city's water system. The contract, approved by Atlanta City Council, turns over to United Water—a for-profit commercial entity--operation of two water treatment plants, twelve water storage tanks, seven transfer pumping stations, 25,000 fire hydrants and 2,400 miles of water mains, on December 1, 1998. The 20-year agreement will cost Atlanta $21.4 million annually, but Atlanta Mayor Bill Campbell said the contract will save the city $28 million a year. The city will provide compliance oversight and monitor the performance of United Water over the life of the contract. Computer systems will be installed to monitor all repairs and maintenance, and reports will be available on-line at all times. All billing, collection and customer service activities will be managed by United Water.

In contrast, for example, the Cobb County continues to administer its own water system management, but some of the treatment responsibilities are outsourced to the Cobb County-Marietta Water Authority (CCMWA), a regional wholesale water utility.
Cobb County's drinking water is drawn from the Chattahoochee River and
Lake Allatoona and is treated by the Cobb County-Marietta Water Authority.

For the purposes of this project, the infrastructural and managerial arrangements of the water delivery systems of the Atlanta Metropolitan Region permit largely identical knowledge acquisition "windows" to the end-users. There are some intra-system differences between treatment methods and water sources in the Atlanta Metropolitan Area. And system failure and subsequent contamination are not unheard of in Atlanta or in any other major metropolitan area. But in the Atlanta Metropolitan Region, while infrastructural development provides a delivery system that *might* promote rapid water quality evaluation by many populations, the treatment systems provide a nearly total buffer to the acquisition of system-related water quality knowledge in the urban study area.

The structure of the Atlanta Metropolitan Region's water systems do however provide for water quantity knowledge. So far, there have been no complete delivery failures that were the result of water shortage, in part because agencies have begun to utilize auxiliary groundwater after costly projects. For example, the Cobb County-Marietta Water Authority recently brought an auxiliary well online to meet peak demand during drought conditions. But the infrastructural and (rapidly changing) management structures of the regional water systems do play a role in the encouragement of water quantity "signals." For example, because of recent drought conditions and increasing population pressure, water mangers, in conjunction with local agencies and governments have begun to enact water use restrictions. The restrictions are often poorly enforced, but as water quantity issues become more urgent, enforcement efforts should follow suite. At the time of this writing, Cobb County, for example, has a mandatory water use ban in effect. Customer is initially notified of violation and fine for future violations by personal notification or notice posting at property. A second violation will result in a fine of up to $500 per code section violation. Thus, these rapidly emerging enforcement and mobilization issues are isomorphic to many system troubles of the smaller water delivery systems outlined earlier, only their scale is even more unwieldy, and often legal issues involve numerous legal jurisdictions at varying local, state and federal levels.

Thus, while urban residents have not yet noticed direct water availability fluctuation, they are made aware of water shortage via numerous "second-hand" sources—that all carry the threat of legal action in the event of the improper use of the water resource. In the cultural context of Atlanta, it might be surmised that the water restrictions are particularly salient to the more affluent members of the society. Despite the fact that golf greens are noticeably exempt from the restrictions, lawn and landscape maintenance through-puts are not, and it may be argued that these are more of concern to wealthier citizens.

In addition to the infrastructural water delivery considerations, other features of the individuals cultural, political and ecological context also impact their baseline ability to cognize water knowledge. Highly urban areas are particularly poor environments to glean water quantity information, even in addition to their ability to mask regional water quality and quantity through their delivery systems. In a non-built environment, exposure to surface resources can provide valuable indications of water quantity fluctuation, and even water quality changes (smells, turbidity, fish kills, etc.). However, the urban environment necessarily obfuscates much information available to inhabitants from surface resources due to the prevalence of wastewater engineering and flood control. Additionally, the vast majority of Atlantans work in the Atlanta Metropolitan Region (USGS 2000), and thus rarely experience less-built environments in the course of their subsistence activities. Under the water restrictions, however, urban residents may be less buffered from water quantity issues that involve *local rainfall*, as increasingly local rainfall will be required to change their urban landscapes from green to brown. Again, lawn and garden maintenance may provide one of the few “direct” measures of water quantity in a manner consistent with the rural knowledge discussed below.

Rural Water Knowledge

The rural region includes numerous small municipal systems in the rural region (using mostly surface resources) as well as individual and collective systems in the more rural regions (that use mostly groundwater resources). As mentioned, irrigation in the rural region is almost non-existent, with the exception of home irrigation systems that draw from potable sources, and thus they will be included in the discussion of potable resources.

Rural water knowledge suites can be expected to be somewhat different than urban ones due to a combination of infrastructural and cultural factors. Infrastructurally, the water systems in the rural study area can be quite different from the urban example. For example, sixty four percent of rural respondents reported that their potable water source was a well, and another seventeen percent weren't sure of the source of their water. Only eleven percent of the rural respondents reported municipal water service.

In the case of well water, system users are most often the system managers (in the case of collectives), or the consumer serves as both consumer and manger in the case of individual systems. In both cases these systems have to solve equitability and resource mobilization issues, and the collectives in particular may be thought of as operating similar to the *Lurin Sayoc* system in regards to the informal management structures utilized by, and consisting of consumers. Unlike larger municipal systems, decreases in supply are not masked by the system, and no manger buys additional wholesale water or adds additional auxiliary wells *unbeknownst to the consumer*. In these smaller systems, *immediate* and *direct* knowledge of quantity and quality fluctuation is as close as the nearest tap.

The population in the rural study area might have greater baseline access to water knowledge than do their urban region counterparts, even when served by the small municipal systems like the combined surface and groundwater systems of the town of Dahlonega in Lumpkin County. The proximity to a rural or semi-rural landscape should provide a more productive environment in which to ascertain knowledge concerning water quality and quantity. Sub-surface engineering should be less extensive, and thus less obfuscate riverine resources. Finally, subsistence in the rural region might be more likely to include activities that involve or necessitate direct perception of water quantity and quality. Examples include row agriculture, cattle farming, chicken and hog production, commercial well drillers, and home gardeners.

Agriculture can provide a means of acquiring various types of ecological knowledge, and certainly these suites of knowledge should be confined more readily to the rural study area. The most obvious examples of agricultural knowledge suites for our purposes are soil knowledge, and knowledge of water quantity and quality (in the case of irrigation) and water quantity and perhaps quality in the case of rain-fed agriculture. Even more interesting and perhaps powerful are the complex windows of ecological knowledge provided not by water delivery system structure and development, but by the ontogenetic structure of particular cultivars or varieties of farm plants and animals. The ontogenic development of production systems based on the interaction of particular cultivars in particular production system, in particular ecological contexts (specific light, humidity, temperature regimes, etc) can permit can permit the acquisition of supra-human environmental knowledge. For instance, as increase in mean yearly temperature of as little as two degrees Celsius can halt fruit production in certain cultivars, and agriculturists familiar with the cultivars may glean supra-human sensitivity without "scientific" instrumentation. Important also is the fact that this environmental knowledge—more so than TV news of global warming—would be relevant to the life worlds of the farmers, and probably more apt to influence environmentally oriented behavior.

Summation

As outlined in Chapter 4, the cognitive ecology outlined herein seeks to better understand how individual humans 'acquire' and 'process' ecological 'information.' The major emphasis of cognitive ecology is thus on the *individual*, and his/her *lifeworld*—the situated political, economic, infrastructural and cultural dimensions of their lives that permit the acquisition of ecological knowledge. However, biological resources are dynamic "inputs" into human subsistence systems, and their weight in influencing system trajectory is the result of numerous factors: the availability of the resource itself; the primacy of the resource to the biological and cultural structure of the individual and his/her society; the extant technologies capable of capturing or developing the resource in question e.g. optimal foraging and development theories); and numerous others. This chapter explored these considerations specifically concerning *water* and its relation to the "political, economic, infrastructural and cultural dimensions" of human subsistence systems. First the chapter considered how the very nature of water appropriation in particular political and ecological contexts throughout the world co-relates with particular management structures that permit or obfuscate the acquisition of new ecological knowledge. Then the chapter applies this understanding and the various necessities of water management to the study regions of the Upper Chattahoochee Watershed. The knowledge suites encouraged by the urban and rural water delivery contexts are outlined, and an explanation is developed of how the cultural and infrastructural factors of living—the lifeworlds of subjects—permit the 'acquisition' of ecological knowledge.

CHAPTER 6

RESEARCH QUESTIONS AND HYPOTHESES

Human cognitive ecology seeks to understand how individual humans 'acquire' and 'process' ecological 'information.' Toward this goal, we can develop several research questions. First, how is ecological knowledge 'distributed' in the Upper Chattahoochee Watershed? Second, how does ecological information 'move' *between* individuals? Third, are there spatial or demographic variables that influence the ability of persons to 'cognize' ecological change (or 'novel' ecological information)? Finally, what are some of potential implications of this extant distribution pattern on larger political/ecological processes?

In order to address the research questions, a general theoretical framework concerning the distribution and movement of ecological information in complex societies must be developed. As determined by the research questions, the framework must be able to accommodate hypotheses concerning the *distribution* and *movement* of ecological knowledge as well as provide measures that could resolve the ability of particular sub-populations to *cognize 'novel' ecological information*. Below is provided a rough framework involving the distribution and movement of ecological information in complex societies. The theoretical framework and its concomitant hypotheses are described under the appropriate headings of *Knowledge Distribution, Knowledge Movement*, and *'Novel' Knowledge Acquisition*, below.

Hypotheses Concerning Knowledge Distribution

The hypotheses concerning the distribution of knowledge in the Upper Chattahoochee Watershed are the most important hypotheses of the project for several reasons. First, they are the only hypotheses fully grounded by previous research. The other hypotheses are implicitly exploratory in nature as they have little theoretical or practical background in the literature. As a result of the previous work, the hypotheses concerning the distribution of ecological knowledge and attitude will be better informed, and any results can be more meaningfully interpreted. Secondly, the hypotheses concerning the distribution of ecological knowledge and attitude offer a challenge to that same well-developed literature.

The hypotheses involving the distribution of knowledge and attitude are based on the literature and the demographic qualities of the Watershed. According to the literature, the distribution of environmental knowledge in the U.S. is correlated with higher earnings, higher education, male sex, urban residence, and more 'environmental' attitudes (Arcury, Johnson and Scollay 1986, Arcury Scollay and Johnson 1987, Arcury and Johnson 1987, Lovrich et al. 1986, Pierce et al. 1989). Further, earlier work on environmental attitude indicated that age, education, urban residence, and more liberal political ideologies were linked to a positive environmental attitude. And as outlined in Chapter 3, the Upper Chattahoochee Watershed study area enjoys a very strong rural-urban gradient that reflects classic "urban-elite" and "rural" demographic profiles. Therefore, the region is well suited to formulate hypotheses relevant to the literature.

Recall that the median household income in the rural region counties was $24912. In the rural region (Forsyth and Hall counties), the mean of all median household incomes in region two was $33208 (see Chapter 3). Similarly, Educational attainment is often congruous with urban residence and class in the U.S., and in the Upper Chattahoochee Watershed the same is true. According to the 1990 U.S. Census, the percentage of the population holding a terminal high-school diploma or bachelor's degree in the urban region was 51.5 percent and 31 percent, respectively. In the rural region, the same figures were 13.6 percent and 52 percent respectively. In region two, the percentage of the population holding a terminal high-school diploma or bachelor's degree was 15.5 percent and 53 percent respectively. The greatest differences occur in college-level education.

Because of the strong urban-rural gradient of the Upper Chattahoochee Watershed study area and its association with particular demographic variables, the literature would predict more 'knowledge' and more 'ecological' attitude in the urban area of the Upper Chattahoochee Watershed generally. However, the first and primary hypothesis of this project provides an alternative to the explanation given by the literature. The 'alternative' hypotheses hold that the former findings in the literature are the result of a privileging of urban-elite constructions of knowledge due in large part to an unwieldy, improperly resolved episteme concerning cognition, and the nature and definition of knowledge. A more sophisticated epistemic foundation might provide proper knowledge measures indicating that rural persons hold more ecological knowledge than urban ones. This privileging of urban knowledge goes beyond relativistic ethical arguments concerning the relevance of "local" knowledge. Instead, the privileging is the result of the long-standing *representational* or *cognitivist* approach which forms the largely invisible, unquestioned foundation for most of the recent work in cognitive science and cognitive anthropology.

Several assumptions demonstrate the representational approach to cognition and knowledge. Representationalism assumes that information is stored in the brain where it is organized and processed in a fashion similar to how a computer stores and retrieves data. The representational or *intentional* states are physically represented as a symbolic code whose syntax determines its semantic properties. Thus humans beings are seen as organisms that *receive* or *select* information from their respective social and ecological environments via the process of representation. Applied to human ecology, then, representationalism asks that the researcher measure the "fit" between the knowledge suites of the individual—the syntax of the information stored in the brain of the subject--and that of the 'real world.'

Enactive Approaches to Cognition and Knowledge

The 'alternative hypotheses' were developed with respect to a relatively new, related conceptions of cognition and knowledge promoted by the likes of Maturana and Verela in cognitive science, Lackoff and Mark Johnson in linguistics, Richard Rorty and Hubert Dreyfuss in philosophy, Jerome Bruner in cognitive psychology, and Tim Ingold in anthropology. These approaches-alternately called 'emergent,' 'enactive,' or 'embodied' approaches, contend that the environment is not anything 'out there,' and cognition and knowledge do not involve computational semantically or syntactic structure 'inside of people's heads' as the well-entrenched representational epistemes holds. Instead, cognition is best understood by allusion to 'humans-in-environments,' where the knowledge of the organism and its purported 'knowing' are wholly *enmeshed* with its environment. This enmeshment is not philosophical but actual and practical: acts that constitute knowledge are the result of the organism's ontogenic history of interactions with the environment that permits increasingly complex couplings.

These new approaches greatly simplify many difficult issues in the fields of anthropology and cognition, and they provide relevant explanations of the nature and definition of 'knowledge' as required by a close examination of the nature of the relationship of organism to environment. Within anthropology, for example, the approach offers an alternative explanation of 'culture' and 'environment' that transcends the difficulty of an anthropological conundrum. The conundrum involves two competing, sacred archetypes of ecological anthropological thought--which are logically at odds—which have co-existed in the center of the ecological and cognitive anthropological universes for a long time (Ingold 1992). On the one hand is the notion that human cultural systems symbolically constitute and construct nature. On the other is the root assumption that culture is the medium through which humans "adapt" to the non-human environment. How can these two basal assumptions co-exist? If culture structures nature, then nature is void of form and inherent meaning. To what then does human culture adapt? Ingold remarks concerning this issue:

> either we must abandon the view, central to ecological anthropology, that culture is an adaptive system attuned to given environmental constraints, or we have to abandon the idea that human beings inhabit worlds that are themselves culturally constructed. Otherwise . . . we would be caught between the imperatives of culture and practical reason . . . for it is supposed that persons can neither know nor act upon their environments directly, but only indirectly through the medium of their cultural representations. This supposition rests upon a cognitivist account of the perception whose roots lie deep in the western dualistic worldview. My aim is to substitute or this nature-culture dualism an understanding that proceeds from a notion of mutualism of person and environment. To achieve this, an alternative theory of

> perception is required that shows how it is possible for persons to acquire direct knowledge of their environments in the course of their practical activities. [This approach], in explicit opposition to the prevalent cognitivism of mainstream psychology, offer a way out for the conceptual prison of the nature–culture dichotomy which is of immense significance for ecological anthropology (Ingold 1992: 39-40)

The 'alternative' hypotheses of this project were specifically developed to articulate how humans might "acquire *direct* knowledge of their environments in the course of their practical activities" To do so, however, required new knowledge measures, and a distinction between 'first' and 'second-hand' knowledge (see Chapter 7). Also, a

The same epistemological 'shift' has further application to the goals of this project. The representational approach would have us believe that the goal and measure of knowledge are not determined by context, but determined by the concrete possession of 'information' in the heads of actors, elicited by various means. Knowledge is therefore objectified, unchanging, and *portable*. Thus, the scientific knowledge suites of the urban elite can only be differentiated from "rural" suites by allusion to the accuracy and completeness of their *content*, and any argument for 'local' knowledge is largely on ethical grounds. This epistemology of knowledge thus obfuscates the difference between general knowledge of 'ecology' as developed in the sciences and measured as 'expert' or 'urban' knowledge, and the situated, demonstrated knowledge in particular contexts (e.g. rural knowledge suites).

Thus, the enmeshment of humans with their environments is necessary for the ontogeny of knowledge itself, the purported witnessing of 'knowledge' (when these acts--the result of coupling—are witnessed by outside observers) and meaning. Subsequently, both the definition of knowledge and the requirements for its instantiation are markedly *contextual*. Thus, this project seeks to develop measures that permit the differentiation between general knowledge from cultural sources, and between *situated knowledge* that informs behavior in particular contexts in the presence of particular contextually mediated cues.

Therefore, a first hypothesis of the project is that properly developed measures may indicate that *first-hand* ecological knowledge is more prevalent in rural areas, and that second-hand ecological knowledge is in fact more prevalent in the urban areas and indicative of previous research. If this hypothesis can be rejected, then earlier findings have again been corroborated, and we can turn our attention to the finer articulation of the environmental knowledge measures and their distribution in the watershed.

Other hypotheses were also developed in case the above hypothesis was not corroborated, and/or to help explain knowledge distribution in the watershed. Subjects with 'ecological' environmental attitudes, which involve relational second-hand knowledge suites of meaning, should be especially prevalent in the urban-elite areas and in areas of high educational attainment. More educated inhabitants of urban-elite areas should score higher on general environmental knowledge and attitude inventories than others *within* each region. Conversely, the literature would expect relatively less 'knowledge' and less 'environmental' attitude in the rural areas. Thus, the other formal hypotheses generated toward the explanation of knowledge and attitude distribution are 'environmental knowledge scores will generally be statistically higher in the urban area than in the rural area,' 'environmental attitude indices will generally be higher (more 'ecological') in the urban study region than the rural region,' 'environmental knowledge scores will correlate with earnings and education within groups,' and 'environmental attitude scores will correlate with earnings and education within groups.'

Hypotheses Concerning Information 'Transmission' or 'Movement'

If the project is to address all of the research questions outlined previously, hypotheses must be generated that address the *movement* of ecological information. Capturing some inkling of the movement of information is a difficult task as very little research to date has addressed this issue theoretically or methodologically. These were highly exploratory hypotheses and were implicitly experimental in nature. Due to the difficulties involved and the complexity of information 'flows,' the project will attempt to capture only the grossest of processes.

The project posits several major pathways for the sharing of information in social networks. These include (and affect the role of experience and the development of cognitive models, Chapter 3) universal education, person to person networks, text-based media, Internet resources, and certainly other media sources delivered via the television (teleconditioning). Simultaneously, local or "rural" suites of knowledge, their concomitant vocabularies and related lifeways are (decreasingly?) reproduced and maintained in the hinterlands, perhaps with less ability to 'transmit' their suites of knowledge to the urban-elite. Therefore, we may expect to find urban knowledge suites in rural areas more readily than rural knowledge in the urban areas.

More important than the identification or weighting of the media sources themselves is the overall 'direction' of transmission. "Urban-elite" knowledge suites, held by urban, educated persons, as outlined in hypothesis one, may enjoy more 'network' potential due to infrastructural and locational economics. Urban information networks are centers of knowledge production, and as such are relatively better equipped to 'transmit' their knowledge suites via countless cultural media, but also via formal presentation scientific knowledges (e.g. agricultural extension, universal education). Exposure to television news programs, for example, is correlated with environmental knowledge and attitude (Arcury, Johnson and Scollay, 1986, Christianson and Arcury 1992). Hypothesis two, then, is that connectivity to and use of media resources and education will both correlate with greater 'environmental attitude' of populations within and between regions.

Hypotheses Concerning 'Novel' Environmental Information Acquisition

The third requirement of a theoretical framework capable of answering the research questions is that it addresses and permits the measure of 'novel' ecological information from the non-human environment. In order to address this issue, the human ecological cognitive ecology must be sub-divided into two major informational pathways: *first-hand* information from "nature," (the non-human environment) and *second-hand* information about the non-human environment from *cultural* sources. These were described briefly in an earlier chapter.

First-hand information is situated knowledge gleaned 'directly' from the non-human environment based on the experience of the individual. First-hand knowledge might provide *novel* information that challenges or informs existing discrete and relational knowledge structures about the non-human environment that could permit the cognition of, and therefore response to, ecological fluctuation (Holland and Quinn 1987, Strauss and Quinn 1997). Second-hand information—also structured by culture (as described under cognitive models, above)—involves the storage, modification and sharing of ecological information *by* and *between* individuals whose origin is from second-hand, cultural sources. Second-hand information can include discrete information bits, but also can include aggregations of more relational knowledge, such as what have been referred to as 'schemata' (Bartlett 1932, Lakoff 1987) and 'mental models' (Johnson-Laird 1980, Gentner and Stevens 1983), which develop either through enculturation or more formal 'transmission' via verbal representation. Both are critical components of the human environmental cognitive ecology. The formulation of the first-hand and second-hand *measures* will be provided in Chapter 7: Data Collection, Analysis, and Results of Formal Hypotheses.

As outlined above, again the project proposes that environmental knowledge and attitude, as measured and studied previously, is to some extent a measure of urban or "urban-elite" suites of knowledge and ideology that may be more related to second-hand knowledge, as outlined above. Urban, educated, wealthy individuals should be steeped in scientifically structured environmental explanation, etc., but should also hold knowledge that is relatively less concrete, and less 'situated' than the knowledge suites of rural persons. For example, concerning environmental knowledge, we may expect that individuals in "urban-elite" areas demonstrate relatively well developed notions of the 'hydrological cycle,' issues concerning the 'watershed,' and 'ecosystem dynamics,' and the concomitant vocabulary necessary to operate in that discourse community. However, they may hold relatively little knowledge of concrete water bodies or other specifics of the watershed generally. Similarly, concerning environmental attitude, we may expect that urban, wealthy, educated persons score "high" on environmental attitude scores, in part because of their exposure to the specific language environment of environmental discourse, prevalent in urban and university settings, for example.

Conversely, it is proposed that rural knowledge suites may be more associated with first-hand knowledge and offer a greater ability to 'cognize' ecological information. Recall that ecological knowledge and its measures are in part measures of particular types of understanding and particular words and ideas associated with particular knowledge communities. In rural areas, the access to urban-elite constructions may be lacking (see section above), but relative access to the ‘environment’ should be more readily achieved, promoting more opportunity for monitoring water quality and quantity changes. Further, as outlined in Chapter 2, knowledge suites are impacted by life-ways and subsistence strategies (Brown 1976, Ellen 1993) and many inhabitants of the rural region of the Upper Chattahoochee Watershed are directly or indirectly involved with pursuits that involve relatively more interaction with the non-human environment than individuals in the urban region. As ethnoecological approaches have demonstrated, the ‘structural coupling’ (Maturana and Varela 1992, Ingold 1992) between subsistence technologies and the knowledge necessary to utilize them permits the acquisition of particular suites of ecological knowledge by individuals in certain contexts, while simultaneously excluding other possible ecological information (Boster 1984). Therefore, individuals in the rural region may not score well on the formal ‘knowledge’ or ‘attitudinal’ inventories used herein, but may be able to offer long lists of local indicators of water quality and quantity indicators based on their situated, local knowledge. This, combined with greater interaction with and exposure to “nature” (in contrast to urban dwellers) should permit more ‘sensitivity’ to ecological fluctuation as measured by more exhaustive lists of local indicators of water quality, and more exhaustive lists of bodies of water. Therefore, rural inhabitants with sufficient local indicators of water quantity and quality should be better prepared to notice water quantity and quality fluctuations than their urban counterparts.

Irrigation is an example of a specific rural production mode that produces specific knowledge suites with specific water indicators. Irrigation involves tracking subsurface water levels, water quality, and/or rainfall amounts. In the ontogeny of the entire system, knowledge is enacted and evident in the equipment and tools of the system itself. As mentioned earlier, a more complex example might be the sudden, first-time failure of fruit formation or pollination in a fruit production system. This coupling between the physiology of the fruit trees and the knowledge of the production system may indicate a change in mean temperature or the lack of pollinators respectively. Thus the perceptual apparatus of the farmer concerning environmental change becomes “superhuman” through the indirect knowledge provided by cultivation. A less complex example would be the knowledge required (and held) by commercial well drillers. Deep wells are a common necessity in the rural area of the Upper Chattahoochee Watershed, and the knowledge of hydroecology and hydrogeology supplied by this work might be notable. Conceivably, the cognitive models—and the sensitivity to perceive novel ecological change—would be significantly “higher” in the well worker than in the average the rural region inhabitant.

In the Atlanta ‘built’ environment, water is provided via public systems that buffer water quality changes at the user end. Discrete knowledge about water features and human made objects should be limited. Therefore, urban region inhabitants, while expressing relatively higher levels of ecological knowledge generally, should have less ability to ‘cognize’ actual changes in water quality and quantity as determined by the ‘first’ and ‘second-hand’ knowledge measures.

A final hypothesis is that the population of the rural region will demonstrate more novel (first-hand) ecological ‘information’ as measured by a large list of water quality indicators. Conversely, the urban region participants will demonstrate relatively high levels of ecological knowledge generally, and will have less ability to ‘cognize’ actual water changes as measured by the number of reported water quality indicators listed.

<u>Summation</u>

Based on the previous research indicating that the distribution of environmental knowledge in the U.S. is correlated with higher earnings, higher education, male sex, urban residence, and based also on the demographic profile of the Upper Chattahoochee Watershed, several hypotheses were developed concerning ecological knowledge in the watershed. While the previous literature would predict more knowledge and more ecological attitude in the urban region of the watershed, the first hypothesis developed for the project presents an alternative explanation of previous findings as being an artifact of a faulty epistemology of knowledge. Knowledge properly understood requires new measures that distinguish between 'first' and 'second-hand' knowledge, which are novel, situated knowledge directly acquired from 'nature,' and existing knowledge obtained form cultural sources, respectively. Proper measures of these different knowledges (explained fully in Chapter 7) will indicate greater *first-hand knowledge* in the rural region, and greater *second-hand knowledge* in the urban region.

The next several proposed hypotheses involving the distribution of knowledge in the watershed were developed directly from the literature. The other formal hypotheses generated toward the explanation of knowledge and attitude distribution were 'environmental knowledge scores will generally be statistically higher in the urban area than in the rural area,' 'environmental attitude indices will generally be higher (more 'ecological') in the urban study region than the rural region,' 'environmental knowledge scores will correlate with earnings and education within groups,' and 'environmental attitude scores will correlate with earnings and education within groups.'

Research question two generated hypotheses toward the movement of ecological knowledge in the Upper Chattahoochee Watershed. These were highly exploratory hypotheses and were implicitly experimental in nature. The hypotheses were 'connectivity to and use of media resources (the 'Total Media' measure) will correlate with greater 'environmental attitude' of populations within and between regions,' and 'the 'Education' measure will correlate with greater 'environmental attitude' of populations within and between regions.'

Research question three generated some hypotheses toward the movement of ecological knowledge in the Upper Chattahoochee Watershed. They were intended to be further articulations of the pre-established relationship between demographic factors and environmental attitude and knowledge. The hypotheses were 'urban region inhabitants, while having relatively high levels of ecological knowledge generally, should have less ability to 'cognize' actual changes in water quality and quantity as measured by water quality judgements in local waters and local indicators of water quality.' Therefore, urban inhabitants should demonstrate less first-hand knowledge and but more second-hand knowledge.

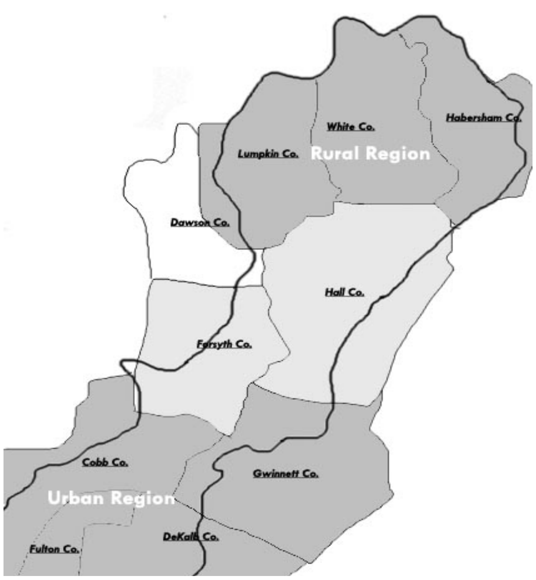
Additionally, there were two other hypotheses. The first was that 'first-hand knowledge will be higher in the rural region than in the urban region, exceptions being recreationalists and others with first hand experience with water resources.' Additionally, the last hypotheses was 'first-hand knowledge in the rural region will be correlated to residence length.' In the following chapter, all of the above hypotheses will be tested by various analyses. Chapter 8 will discuss the findings not related to the above hypotheses.

CHAPTER 7

DATA COLLECTION, ANALYSIS, AND RESULTS OF FORMAL HYPOTHESES TESTS

This paper has so far provided a description of the study areas, the contributing fields of research, and the research hypotheses of the project based on the research questions. This chapter deals primarily with the data collection and analysis of the research project. Only the results of the formal research hypotheses are provided in this chapter. However, the research design was developed to permit general findings and numerous qualitative analyses of the research results. The qualitative results of the research findings will not be presented in this chapter but instead in Chapter 8.

Figure 7.1: The Study Regions and their Representative Counties



Data Collection: The Sub-Regions

The population for the proposed study was all of the inhabitants of the Upper Chattahoochee watershed region. The research *region* described earlier was divided into three 'sub-regions:' the upper-catchment region that includes the head waters of the Chattahoochee system as well as the townships of Cleveland and Dahlonega (the 'rural' region), the Lake Sidney Lanier region (the 'hinterlands' region), and the greater metropolitan Atlanta region (the 'urban' region). The rural study region is a highly forested region with small towns and areas of mixed mountain agriculture. The hinterland region is comprised of a large reservoir that serves as a recreational location for many residents of Atlanta. The urban region is almost exclusively urban.

Originally, each region was then sub-divided into 'micro-regions' by a ten-mile quad to maintain the spatial primacy of the inventories and to permit the possible elaboration of information networks. The micro-regions were delimited without regard to physiography to minimize unintended confounds. There were approximately eighteen quads that met these criteria. Originally, the intent of the researcher was to find an equal number of willing respondents in each micro-region. However, in practice this proved both difficult and unnecessary, as water knowledge was generally limited throughout all regions thus making intra-micro and sub-region distinctions in knowledge both difficult and non-significant. Therefore, the sub-region became the important spatial variable for the study. Eventually, respondents were only drawn from the urban region and the rural region to better highlight differences between a poorly differentiated data set (see Data Collection Issues, below). Because the micro-regions were ultimately unnecessary, the term 'region' will be used for the rural and urban study areas instead of 'sub-region.'

Participating individuals were given a basic research inventory (below) intended to elicit a package of water related ecological knowledge. Other non-random data was gathered from respondents including Sierra Club members, participants in a church workshop sponsored by Upper Chattahoochee Riverkeeper, and two groups of college students. Only the randomly selected participants are discussed in this chapter, as the research design required random sampling.

Data Collection: The Interview Schedule

As mentioned, the research inventory was completed with all participants to elicit a measure of discrete and relational forms of ecological knowledge. Part one of the research inventory began with a demographic section. The demographic section included the following data: name, address, sex, ethnicity, age, religious affiliation, years living in the study area, occupation, hours watching television per week, hours of internet use per week, highest level of education attained, area of study, and yearly earnings.

Part two of the research inventory was developed to measure a broad spectrum of both discrete and relational knowledge concerning the watershed. This section included questions designed to elicit knowledge about their respective drinking water systems, their perception of water quality and quantity, their understanding of hydrology as it relates to their drinking water, and their understanding of the most important contaminants in their local water systems. The questions were a combination of free response (FR), fixed-response format (FF), and free listing (FL). However, for all of the questions in this section, the interviewer encouraged paragraph length answers. As described earlier, this semi-structured interview methodology (Kempton, Boster and Hartley 1995) was included toward the elicitation of relational knowledge structures such as 'cognitive models' (Holland and Quinn 1987, also see Bernard 1994 for discussion).

In part two of the interview, participants were asked

1) to name as "as many streams, rivers, creeks as you can." in the area (FL);
2) to explain where their water comes from (drinking) (FR);
3) to explain the ultimate hydrological source of their local supply (FR);
4) to explain the local wastewater disposition process (FR);

5) to explain how they might ascertain the "quality of water in a nearby stream" (via interaction but no 'scientific' instruments).
6) to explain how their water is treated (FR);
7) to list the sources of pollution, in order of importance, in the nearest tributary (FL).
8) to label the quality of water in X (their closest tributary to the Chattahoochee River, or the river itself) using fixed response ratio values (1-10). (FF)
9) to label the quality of water in X (their closest tributary to the Chattahoochee River, or the river itself) using fixed response nominal format (I would drink/swim/go near/avoid the water)(FF).
10) to list all of the water problems or water issues in the area (from the North Georgia mountains to Atlanta proper).

In addition to encouraging paragraph length answers to each of the above questions, participants were also asked to "source" their knowledge in an attempt to capture some parameters of the 'movement' of information within the confines of a patently synchronic research design.

Part three of the research inventory included the administration of the New Environmental Paradigm (NEP) inventory (Dunlap and Van Liere 1978). The inventory includes a series of 12 questions used to determine environmental attitude, with responses including the categories "strongly agree," "agree," "disagree," and "strongly disagree." The NEP survey can be considered a multi-dimensional survey with sub-scales of particular modalities of environmental attitude (Albrecht 1992, Noe and Snow 1990). The three sub-scales measure attitudes toward a) the balance of nature b) the limits to growth and c) human dominion over nature. Each sub-scale has a range from 1-16, with a total range of 48. The original inventory statements were:

- We are approaching the limit of the number of people the earth can support.
- The balance of nature is very delicate and easily upset.
- Humans have the right to modify the natural environment.
- Humankind was created to rule over the rest of nature.
- When humans interfere with nature it often produces disastrous consequences.
- Plants and animals exist primarily to be used by humans.
- To maintain a healthy economy we will have to develop a "steady state" economy where industrial growth is controlled.
- Humans must live in harmony with nature in order to survive.
- The earth is like a spaceship with only limited room and resources.
- Humans need not adapt to the natural environment because they can remake it to suit their needs.
- There are limits to growth beyond which our industrialized society cannot expand.
- Mankind is severely abusing the environment.

The statements were minimally altered to be more gender inclusive and to ensure that the statements were understandable to individuals with different cultural backgrounds. For the research inventory, the statements were:

- We are approaching the limit of the number of people the earth can support.
- The balance of nature is very delicate and easily upset.
- Humans have the right to modify the natural environment.
- Humankind was created to rule over the rest of nature.

- When humans interfere with nature it often produces disastrous consequences.
- Plants and animals exist primarily to be used by humans.
- To maintain a healthy economy we will have to control industrial growth.
- Humans must live in harmony with nature in order to survive.
- The earth is like a spaceship with only limited room and resources.
- Humans need not adapt to the natural environment because they can remake it to suit their needs.
- There are limits to growth beyond which our industrialized society cannot expand.
- Humans are severely abusing the environment.

Finally, in part four of the research inventory, informants were asked to answer a set of questions designed to elicit some knowledge network relationships. The impetus behind the questions was formal social network analysis (Granovetter 1979). In the context of this project, network analysis was to measure the centrality of each respondent in an informational network. The number and proximity of information network members to the core of the network was to help determine the groups' ability to accumulate new information (Ford 1976, Hammer 1983, Atran 1999). However, individuals were much more likely to cite institutions and organizations as sources of their knowledge, thus making the 'snowball' step of network analysis impossible. Despite this, respondents were still asked to list, in order of importance, the 'individuals, agencies, experiences or media sources' that most contribute to what they know as an adult. Following this, and much more to the point of the study, the respondents were asked who they would contact for help or information if they had a question about their drinking water, water quality or water quantity. These two questions represent the social informational and expert networks of the informant, respectively.

Data Collection: Methods

The goals and hypotheses of the Upper Chattahoochee Research project determined the data collection methods. One concern of the project was to test hypotheses concerning the existence, distribution, and sharing of different ecological knowledge suites that were supposedly endemic to particular regions of the watershed. Thus, a *spatially representative* and *random* sample was an absolute necessity, and one that necessarily overshadowed other concerns of data collection technique. Because the project required a random sample, the telephone was seen as the only spatially viable technique to contact potential research participants. Prospective participants were contacted by phone using an area code map for the area code to ensure proper residence location, and relevant prefixes were rotated as random suffixes were dialed. Further, it was thought that contacting possible participants by phone would be more acceptable than knocking on doors both in terms of participation and research efficiency.

While contacting possible participants by phone was perhaps the most efficient method, contactees agreeing to participate were rarely willing to complete the research inventories. Eventually, individuals who agreed to participate were given the choice between an in-person interview and a phone interview. Most respondents chose to complete the phone interview, the exception being the non-randomly selected groups mentioned below.

Like all data collection techniques and designs, contacting respondents by phone should have had particular ramifications. However, many of the potential limitations of phone interviewing were made somewhat irrelevant by the requirements of the basic research inventory itself. The basic research inventory required only verbal response methodologies (as opposed to sorting tasks, participant observation, etc.). Even the free response questions, which were to be used to highlight 'cognitive models' of the participants, could be completed via telephone. Importantly, however, most of the non-random respondents were interviewed in person. Thus, while the non-random respondents cannot be used in the data analysis of certain hypotheses, they can be used in other general findings. Further, they provide insight into the relative limitations of the phone methodology in a given region with a given research inventory.

Knowledge 'Quantity' and Participation Level

The original research expectation was to draw one informant from each quad for an extended research inventory (ERI), which was to include network analysis and cultural model inventories. However, as mentioned above, some types of knowledge--particularly free response questions that could yield 'cognitive models' of the water cycle--were extremely limited in the watershed sample population. Therefore the formal comparative analysis of 'cognitive models' between groups was not possible. Instead, instances that relate to the expression of cultural models would be sited individually as relevant (see Chapter 8). Additionally, when participants were asked questions intending to elicit human knowledge networks (formal network analysis), the participants' responses led not to individuals, but to institutions and media sources. Therefore, a "snowball" analysis of information networks was not possible. Instead, intimations of information networks were ascertained by asking subjects to "source" their knowledge for most free-response questions.

Perhaps also due to the lack of water knowledge in the region, willingness to participate in this "water" research was very low among the randomly selected potential respondents, and in some contact-calling sessions success was as low as one scheduled interview for every sixty calls. This phenomenon was more marked in the urban region. While not all of the sixty calls mentioned above were refusals, this figure is worth noting.

The implication of the low participation is that given the available research resources, the number of respondents was less than originally planned. As a result, while N=176 respondents (including two groups of college students, nine Sierra Club Members, eight participants in an Upper Chattahoochee Riverkeeper workshop, and various others), N=35 for the random sample. However, using Borg and Gall's (1979) calculation, the sample size is more than sufficient for both the environmental knowledge and attitude measures--the measures of central importance to the project-- at the .15 level of significance. Thus completing further inefficient research inventories using random selection procedures was discontinued in favor of sampling the non-random groups mentioned above.

Low data volume (low demonstrated relational knowledge) and low participation is certainly not the preferred outcome of any project. However, the literature indicates that environmental knowledge inventories are consistently low, and therefore this outcome was expected. Low participation is less welcome as it may contribute to the prevalence of sampling error.

It is thus important to make clear what affects these two factors may have had on the effectiveness of the data collection process as a whole. There were two primary casualties in the original research design as a result of low demonstrated knowledge and low participation within the watershed regions. The first was a loss of research *breadth* due to the inability to ascertain "cognitive models" of research participants concerning the water cycle (hydrology), and perhaps water treatment operations. Therefore, the analysis of participant knowledge depended on what we have termed 'discrete' knowledge, and less on relational knowledge structures—cognitive models, prototypes and the like. Importantly, however, the intention of resolving 'cognitive models' from the participants' responses involved only one mode of questioning of at least four academic subfields (see Chapter 3). Further, the environmental attitude inventory certainly involved issues relating to relational knowledge. Finally, it is important to note that in the data-poor sample, the lack of data was not due to incorrect methodology or technique. There was simply little understanding of important, relevant ecological processes, and this was expected based on the work of others (Arcury 1992). Thus the lack of data is useful toward understanding knowledge in the region, and incidences of some type of relational understanding are, while too few to be comparable, compelling.

The second casualty in the original research design as a result of low demonstrated knowledge and low participation within the watershed regions was the decrease in the *spatial resolution* of the project brought about by the low participation. Thus, it becomes impossible to question or discover smaller, local variations in knowledge suites that may have been helpful/significant to the research project.   Neither of these casualties, however, was so compelling as to warrant a reconsideration of the project. On the contrary, findings take on additional significance in such a context.

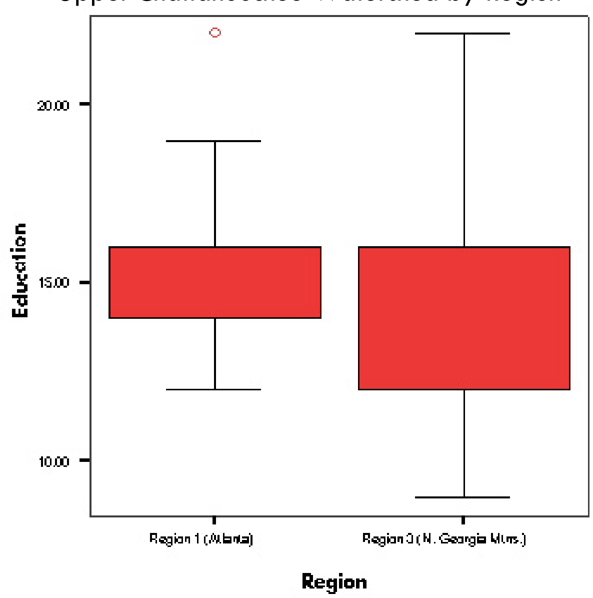
The Research Sample

In Chapter 3, much time was spent demonstrating the 'ruralness' of the rural study region especially given its proximity to the urban study region. But proving that a study region itself is pertinent to research goals in no way guarantees that the research sample is representative of that region. While issues of sampling error and self-selection will be addressed later, this section will introduce the sample respondents in greater detail.

Demographic Profiles of Rural and Urban Region Respondents

Rural areas are typically differentiated from relevant urban areas by lower earnings and less education. In the research sample, the mean of household incomes in the urban region sample was US $70,000, and in the rural region $43,000. This roughly parallels the earnings of the urban and rural respondents from the 1990 Census figures indicating a representative sample for this variable. Unlike the earnings figures, educational attainment figures do not mirror Census figures nearly as well. The mean level of educational attainment in both regions was markedly similar. Level of educational attainment was coded by applying a value roughly equivalent to the number of years it takes to achieve the given level of education. In the rural region, the mean value of educational attainment was 13.64 (completing junior college or having attended college but not finishing was coded as a value of fourteen). Conversely, in the urban region, the mean value of educational attainment was 14.6. However, due to the small sample size, a more

Figure 7.2: Boxplot of Educational Attainment in the Upper Chattahoochee Watershed by Region



accurate assessment of the educational attainment of the rural region is supplied by analyzing a boxplot of educational attainment in both regions.

The box represents the interquartile range that contains 50% of the values (see Figure 7.2). The whiskers are lines that extend from the box to the highest and lowest values, excluding outliers. A line across the box indicates the median. The middle fifty percent of respondents in the rural region are distributed between the values twelve and sixteen, with the overall mean value of 13.64, as mentioned. The middle fifty percent of the urban region, while more varied than its rural counterpart, is noticeably higher than the rural box. This may indicate a self-selection skew leading to some non-representational outliers in the rural area. However, the box holding 50% of the values may indicate that the brunt of the rural region was representative in terms of this variable. Additional evidence comes from the qualitative data supplied by the research.

Summary of Rural Respondents

Qualitative and quantitative data gleaned from the research can contribute to the question of representativeness of the study sample. In addition to sequestering from the respondents the New Environmental Paradigm survey responses and their answers to questions concerning their environmental knowledge, general ethnographic data was also gained through the interviews. While this data is not critical to the formal hypotheses of the paper, and in addition to contributing to questions of representativeness, it may well be helpful toward explaining oddities in the formal research findings, and toward providing the reader with a 'feel' for the respondents. Basic data about each respondent from the rural region will be briefly given here, as well as some relevant knowledge demonstrated by each respondent. Findings concerning the knowledge suites demonstrated by the respondents will be discussed in the following chapter.

Respondent sixteen is a twenty-six year white old female living on the outskirts of Cleveland, Georgia. Unlike many other respondents from the region, she reported no religious affiliation. She was born and grew up just west of the rural region study region in Gainesville Georgia. At the age of twenty-four she moved to Cleveland where she is renting a house and works part-time as an ultrasound-tech which she became qualified for by attending technical school in Gainesville. She was unwilling to disclose her earnings. Much of her spare time is spent watching television. Respondent sixteen, despite being a native of the region, demonstrated very low knowledge of the watershed. Her extant knowledge included knowing the name of Lake Lanier and the belief that it is polluted, and the low water there is due to local draught conditions. Further, she reported that her water supply was from a private well in her backyard. Her description of Lake Lanier was that it was "very dirty," and she reported that she would not enter the water. Her greatest concern for Lake Lanier (the only water body she was able to name) was that "people need to use water better . . . the lake has gone down a lot." Later she commented that "people use too much [water]. We just had a draught, [but] people still water and everything." The 'Total Knowledge' measure score for this respondent, after being adjusted into "ntile" scores with ten categories, was two (the possible range was one to ten as mentioned). Finally, respondent number sixteen scored thirty-four on the New Environmental Paradigm scale (recall the test has a range of twelve to for—48 purportedly indicating a 'biocentric' attitude). Grouped into "ntile" scores with a range of one to ten, her environmental attitude score was six.

Respondent seven is from the town of Cleveland Georgia. She is a twenty-eight year-old "Christian" white female who moved to her current home in 1998. She works as a 4th

grade science teacher in a public school in town after graduating from college as a Bachelor of Science in Geography. She earns "between thirty and forty thousand dollars." She lives less than 5 miles from her school, watches television fifteen hours a week on average, and enjoys "outdoor recreation." When asked about the nature of this recreation, she mentioned driving to outdoor parks and nature areas more than other activities, but hiking was mentioned as well. Her husband, however, is an avid outdoorsman and fishes "all over the state." Respondent seven did demonstrate more knowledge than respondent sixteen. The 'Total Knowledge' score for this respondent was four. She knew that her water was from the city's treatment center, and she knew its location, as well as the riverine source for the water (the Chattahoochee). She also demonstrated an understanding of physiography and its relation to surface water resources. She described in some detail that the headwaters of the Chattahoochee "came up from the ground" and combined with surface water "up north of Helen in the National Forest." Her listing of indicators of water quality included that "trout" were indicators of good water quality. This was one of only several such indicators given by respondents. Her ntile adjusted environmental attitude score was eight (the 80^{th} percentile in terms of 'environmental' attitude).

Participant number thirty-four is an eighty-nine year old white male Baptist who lives in Dahlonega Georgia in what now is part of the town proper. He was born in 1911 in Dahlonega and has lived there all of his life. He retired in 1976 after 36 years of working in the food service industry. He demonstrated good knowledge of local creeks and rivers, and had good knowledge of his city municipal water system including water sources and treatment plant location. The 'Total Knowledge' score for this respondent was one, or the 10^{th} percentile. His ntile adjusted environmental attitude score was seven (the 70^{th} percentile in terms of biocentric attitude—or 30^{th} percentile of anthropocentric attitude). Two other features made this respondent particularly helpful. First, he demonstrated a great deal of knowledge about area history, and pre-colonial history in the region. Second, he made very clear his strong Baptist beliefs, and these beliefs clearly influenced his responses to the environmental attitude inventory. For example, when asked to either agree, disagree, strongly disagree, or strongly agree with the statement "The earth is like a spaceship with only limited room and resources," he disagreed, citing that God has control over such problems, and that if need be, the "Lord will make a way." "God" was also listed as the primary expert to whom the respondent would go should he have problems or questions about water quality. These comments are particularly important as fully thirty percent of the rural respondents were self-described Baptists. Further, only seventeen percent of the rural respondents reported holding no religion, with the rest reporting some variant of a Christian religious outlook.

Rural respondent number thirteen is a 27 year-old white female from outside of Cleveland Georgia. She is a practicing Catholic. She moved to Cleveland from "another state" in 1994 after completing her Master's degree in special education. She commutes fifteen miles to work in Cleveland where she is a schoolteacher teaching special education and earning between thirty-five and forty-five thousand dollars annually. This respondent demonstrated good knowledge of local waterways (she named five creeks), which were the result of recreational fishing activities. Her overall 'Total Knowledge' quotient was seven. She was cognizant of the source of her drinking water, and also that she was on a septic system. Like many respondents, she was very confident of the quality of the water in the nearby branch of the Chattahoochee rating it an eight out of ten, but commenting that the quality of the same river further down stream should be "much lower." Her ntile adjusted environmental attitude score was six (the 60^{th} percentile in terms of biocentric attitude—or 40^{th} percentile of anthropocentric attitude).

Rural respondent number five is a 63 year-old white male residing in Cleveland Georgia. This respondent resided in Stone Mountain Georgia (Atlanta) for 28 years before moving to Cleveland in 1996. He holds Master's degrees in both religion and history, and a Ph.D. in history, and earns "more than fifty-thousand dollars" annually following his career as a history professor at Georgia Perimeter College. He describes himself as a "brand-new" Baptist. He enjoys conoeing, and he accordingly listed ten creeks/rivers in the watershed. This knowledge was apparently from canoeing but also from "watching the small feeder creeks flow into" the rivers he canoes. His "Total Knowledge" score was 10, or the 100th percentile of all respondents, and his 'attitude' was eight, or the 80th percentile, and thus his scores reflect what the literature holds: that well-educated (formerly) urban people demonstrate high environmental attitude and knowledge. He feels that the quality of the Chattahoochee near Helen (north of his hometown) and near his town is very high, nine on a scale of ten. His explanation is that the pollutants are very limited. Cattle manure, for example, is limited in the river as "farmlands around here are not extensive. The area is mostly wooded." He feels like most of the concern for water quality in the area and watershed is misguided. He feels that more attention should be paid to population control than to water policy.

Respondent number eleven is a forty-six year-old white female living outside of Cleveland Georgia. She has lived in her present house for four years, but prior to that she lived in Cleveland proper for 8 years. She holds an associate's degree from a community college in history and works as an accountant in Cleveland earning more than $50,000 annually. She considers herself "spiritual" but "not religious." She knows the source of her drinking water and sewage disposal (well and septic, respectively), but, ethno-hydrologically, did not explain how water reaches the well, or the source of that water. She listed nine local rivers, all the result of recreational conoeing. Her 'Total Knowledge' score was four, and her environmental attitude was in the 100th percentile.

Respondent number twenty is a thirty-five year old white female living outside of Dahlonega Georgia. She has lived all of her life in rural Georgia, but not in the Upper Chattahoochee Watershed. She is a Baptist, and holds a high-school diploma. She moved to her current home in June of 2000, and gained employment in Cumming Georgia at a garage changing oil. Her commute is 45 minutes. She earns "under $30,000" annually. This respondent mentioned eleven local streams, rivers, and lakes, which she knew from "exploring" and because her husband hunts wild animals in the area. Her "Total Knowledge" score was nine, and her environmental attitude was in the 40th percentile. This respondent felt that Lake Lanier was unclean, commenting that her daughter "had a rash after swimming in it, so I wouldn't eat the fish out of there." She also had interesting observations concerning the draught, commenting, "we used to have a pond, [but the] creek's dried up . . . only time since years and years and years . . . 20-30 years."

Respondent number fifteen is a sixty-two year old white male who resides near Cleveland Georgia. He believes in a "Supreme Being" but follows no formal religion. He moved to Cleveland in 1997. He completed two years of college in mechanical engineering, and currently works as a welder/electrician earning under $40,000 year. He was able to report that his water is from a well—a new one had to be drilled as the old one went dry—and he knew that his waste water went into a septic system. He mentioned five creeks in the region, reported some of the mechanics of soil "leaching," and was the only respondent to mention gold mine dredging as a threat to water quality in the region, although respondent number thirty-four had mentioned that gold mining used to be common nearby. His 'Total Knowledge" score was two, and his ntile adjusted to percentile New Environmental Paradigm score was six, or the 60th percentile.

Respondent number fourteen is a forty-two year-old white male Protestant living outside of Cleveland Georgia. This respondent moved to North Georgia and the Cleveland area in June of 1999 from Florida. He worked in Florida and continues to work as an engineer. This respondent reported that his water source was a well system and that his treatment was provided by a septic system. He was able to name three bodies of water in total, which he attributed to having driven over them numerous occasions. Respondent fourteen scored in the 30th percentile on the New Environmental Paradigm inventory, and seven on the 'Total Knowledge' score. He demonstrated an understanding of sub-surface hydrology with his allusion to the "water table" that delivers water to the wells.

Rural respondent number seventeen is a twenty-one year-old Catholic white female from Dahlonega Georgia. She moved to Dahlonega to attend college at North Georgia College. She is a junior at the college, having moved to Dahlonega from Stone Mountain Georgia in June of 1999. This respondent was familiar with a number of riverine resources, listing six in the immediate area, attributable to her classes at college and recreational hiking. She reported that the source of her drinking water was a well, but she also commented that she wasn't "sure about that." She had no knowledge of where the wastewater from her house went or was treated. She mentioned underground springs as potential sources of water for her well, which she explained are fed by rainfall. This respondent scored in the 40th percentile in terms of her "Total Knowledge," but in the 100th percentile for environmental attitude.

Respondent number ten is a 43 year-old white male living near Cleveland Georgia. He reports a Baptist faith, and has lived in Cleveland since in May of 1999 from the hinterlands region. He is a college graduate, and earns "well over" $50,000 annually as a builder after having studied "two years of psychology, two years of biology, before finishing in construction management." He reports that his drinking water comes from a well, and that his wastewater treatment is provided by a septic system. This respondent listed thirteen bodies of water, and spoke at relative length about hydrology, and about how water enters the aquifer. He is very familiar with the issues of water quality that surround commercial building and development generally. He reported crayfish as a biological indicator of "good" water quality. He scored in the 100th percentile in terms of water knowledge, but in the 20th percentile in terms of environmental attitude.

Respondent number twelve is a sixty-four year-old white female living near Cleveland Georgia. She holds a high-school diploma and worked as an emergency medical technician in Pennsylvania for 13 years prior to moving to Cleveland in 1995. Currently, she works as a certified nurse's aid in Cleveland earning "around eleven thousand dollars a year, give or take." This respondent was able to list two riverine resources in the area, and did not know where her drinking water comes from, although she reported that it often smelled like chlorine. She reports that the quality of the Chattahoochee Rive near her home is extremely clean, and that she would drink it straight in an emergency, and would swim in it without hesitation. Her score was in the 30th percentile in terms of water knowledge, but her attitude was in the 20th percentile.

Respondent number nine is a forty–seven year-old white female who lives in Cleveland, Georgia proper. She is a Latter-Day-Saint who has lived in Cleveland since she moved to Cleveland from western Texas in May of 2000. She holds a high-school diploma and does not work but draws $6,330 annually as she is disabled and remains in a wheelchair. She holds no knowledge of the source of, or wastewater treatment of her drinking water. She lists three bodies of water in the region, and reports that Lake Lanier has a strange color, and that she wouldn't eat the fish from the lake or go near the water. She reports that a major water problem in the area is the drought, and her religious beliefs were cited while she answered the environmental attitude inventory. Her score was in the 70th percentile in terms of water knowledge, and her attitude was in the 70th percentile.

Respondent number six is a thirty-eight year old white male from Cleveland Georgia. He moved to Cleveland in 1998. He is a Baptist, he holds a high school diploma, and he earns more than $60,000 annually working in telecommunications. He listed seventeen separate riverine resources in the region, which he attributes to recreational fishing and "exploring for places to fish." He reports knowledge of his household water source, and reports that his home uses a septic treatment system. He mentioned both "crayfish" and "trout" both as biological indicators of high quality water, and reports that he has and would again drink from the Chestatee River, which he said was "very clean." He scored eight out of ten in terms of water quality. This respondent seemed very knowledgeable about water quality problems in Atlanta proper, and he had concerns about population growth locally. His score was in the 70th percentile in terms of water knowledge, and his attitude was in the 50th percentile.

Data Analysis

Analysis of the data collected in the research inventory involved converting individual and combined questions into measurable nominal, ordinal, interval, and ratio data relevant toward rejecting the hypotheses of the study. The raw and combined measures are described below. The treatment of each individual inventory question is provided first. Following this, the combinations of inventory questions toward particular measures are described.

Scoring Individual Research Inventory Questions

As outlined earlier, part one of the research inventory was the demographic section that included questions concerning the participants' name, address, sex, ethnicity, age, religious affiliation, years living in the study area, occupation, hours watching television per week, hours of internet use per week, highest level of education attained, area of study, and yearly earnings. Thus, 'Name,' 'Address,' 'Sex,' 'Ethnicity,' 'Religious Affiliation,' 'Occupation,' and 'Area of Study' became nominal level measures that were named and will be discussed as labeled above. Additionally, the measure of location of inhabitance, ascertained from the 'address' question above, will be referred to simply as 'Region' below.

The research inventory question involving the respondent's level of education produced nominal level data that was re-coded into the interval level measure 'Education,' whose value represented the typical number of school years required to achieve the education level described by the participant. Thus, completing Jr. high school would require a value of nine for the 'Education' measure. Completing high school earned a value of twelve for the measure. An associate's degree was scored as fourteen, a college degree sixteen, a master's degree nineteen, and a Ph.D. twenty-two. Values were allowed to represent incomplete studies as well. For example, the participant might say "I have finished high school and took some classes at a community college." This response was coded as a value of thirteen.

The questions concerning the participants' age, years living in the study area, hours watching television and using the internet per week, and yearly combined household earnings became the measures 'Age,' 'Years in Place,' 'TV Hours,' 'Internet Hours,' and 'Earnings'. These interval/ratio level data were used directly and raw in analyses (unless otherwise indicated below) and will be discussed as labeled above.

As mentioned above, part two of the research inventory consisted of ten questions, and in this section we will outline the initial treatment of each research inventory question. The first question of Part two of the research inventory concerned the ability of the participants to name bodies of water within the watershed boundary. The respondents were asked to name "as many streams, rivers, creeks as you can." in the area. This free listing exercise, drawing from ethno-scientific techniques, was considered a measure of discrete environmental knowledge. The total numbers of legitimate responses to this question were counted, providing an ordinal measure of environmental knowledge. This measure is referred to as the 'Total Water Bodies' (TWB) measure.

The second question of Part two of the research inventory concerned the ability of the participants to explain the source of their drinking water. This free response question was designed to provide ordinal level data concerning the infrastructural considerations of water delivery (participants either have a correct answer or not), but also to provide data toward the resolving of cognitive models. Knowledge was limited and therefore no systematic cognitive model analyses were carried out. However, the data were used as ordinal measures, with no knowledge of water supply being scored as zero, and knowing the location of the source river or treatment facility indicating a value of one. This measure is referred to as 'H2O Source.'

Question three of Part two of the research inventory was intended to uncover relational knowledge concerning the water cycle and hydrology. The participants were asked to explain how water arrives at the source given in the previous question. For example, if a participant indicated that their water came from the Chattahoochee River to a treatment plant and then to the home, the respondent would be asked how water gets in to the Chattahoochee River in the first place. Then, for every answer given, further explanation was requested until responses were exhausted. Alternately, if the respondent indicated on the previous question that their water was from a local well or other subsurface source, the researcher would ask them how the water arrived in the well. Then, for every answer given, further explanation was requested until responses were exhausted. This measure was called 'Ultimate Source.'

Next, respondents were asked to explain the household's wastewater disposition process. Like the 'H2O Treat' measures, knowledge was limited and therefore no systematic cognitive model analyses were carried out. However, the data were used as ordinal measures, with no knowledge of wastewater treatment being assigned a score of zero. The indication of legitimate knowledge concerning wastewater treatment was assigned a value of one. Therefore, this measure could be used later as an indicator of ecological knowledge. This measure is referred to as 'H2O Goes.'

In question five of Part two of the research inventory, respondents were asked how they might "determine the quality of water in a nearby body of water " (via interaction but without the use of formal 'scientific' instruments). They were encouraged to give both "good" and "bad" indicators of water quality in order of their importance/utility. This measure, drawn from ethnoecological research, was intended to capture some inkling of the ability of different respondents to know water quality changes if/when they happen. This measure was necessary based on the hypotheses of the project involving first hand and second-hand knowledge. Thus, it was a measure of individual 'sensitivity' to ecological (aquatic) fluctuation. Alternatively, it might also be thought of as a measure of ‘indicators’ of water quality. Counting appropriate responses to this question provided ratio level data that could be used as a measure of environmental knowledge. Further, from the free lists of indicators of both “good” and “bad” water quality, thirty-nine categories were developed so that the responses could be analyzed for frequency and importance/utility. The raw count measure of appropriate responses is called ‘Sensitivity.’

Question six asked respondents how their water was treated. Originally, the question was designed to elicit both ordinal data and relational (cognitive model) data. Like question four, above, however, knowledge was limited and therefore no systematic cognitive model analyses were carried out. However, the data were used as ordinal measures, with no knowledge of drinking water treatment being assigned a score of zero. The indication of legitimate knowledge concerning drinking water treatment was assigned a value of one. Therefore, this measure could be used later as an indicator of ecological knowledge. This measure is referred to as ‘H2O Treat.’

Next, the respondents were asked to “list the sources of pollution, in order of importance, in the nearest tributary of the Chattahoochee River (or, if irrelevant, the nearest known body of water). This was designed to provide another measure of environmental knowledge. Like the ‘Sensitivity” measure, however, it was scored using a count of the appropriate responses. Also like the ‘Sensitivity’ measure, the free responses were placed into twenty separate categories, which permitted the determination of the frequency and perceived importance of each response category across all respondents. The raw count of this measure is termed ‘Hooch Pollute.’

In question eight of Part two of the research inventory, respondents were asked to label the quality of water in the closest tributary to the Chattahoochee River (or the river itself) using fixed response ordinal values from one (most dirty-sewer sludge) to ten (most clean-crystal clear glacier water). This score provided an ordinal measure of the perceived water quality of the Chattahoochee River. This measure is called 'Hooch Quality.' Similarly, in question nine, water quality was also measured based on a fixed response nominal format (I would drink/swim/go near/avoid the water). This measure was called 'Hooch Action.'

Question ten of Part two of the research inventory asked subjects to list all of their known water problems or water issues in the area in order of importance. Again, the total number of acceptable answers was totaled to arrive at one potential measure of environmental knowledge of the region. This measure was called 'Issue Total.' All of the responses to this question were categorized and because responses were given in order of importance, the frequency and perceived importance of each water issue was ascertained.

The third part of the research inventory was the NEP environmental attitude survey described in Chapter Three. The raw scores from this inventory were used for all data analyses unless otherwise indicated below. The raw score measure from the NEP inventory is called 'Environmental Attitude.'

The final two questions of the research inventory were originally an attempt to measure the sharing or 'movement' of ecological information in social networks. The impetus behind the questions was formal social network analysis (Granovetter 1979). In the context of this project, network analysis was to measure the centrality of each respondent in an informational network. The number and proximity of information network members to the core of the network was to help determine the groups' ability to accumulate new information (Ford 1976, Hammer 1983, Atran 1999). However, individuals were much more likely to cite institutions and organizations as sources of their knowledge, thus making the 'snowball' step of network analysis impossible. Social network analysis was therefore not utilized in this project. However, respondents were asked to list, in order of importance, the 'individuals, agencies, experiences or media sources' that most contribute to what they know as an adult, in order of importance.

Following this, and much more to the point of the study, the respondents were asked who they would contact for help or information if they had a question about their drinking water, water quality or water quantity, in order of importance. These two questions represent the social informational and expert informants, respectively. Again, for both questions, the number of acceptable responses was counted to provide a measure of ecological knowledge called 'Issues Total' and 'Water Issues Total,' respectively.

Scoring Synthetic Research Inventory Measures

In order to permit the testing of the project hypotheses, more specific measures were needed. Therefore, the single measures above were combined to develop new measures appropriate to the project. The new measures include 'First Hand Knowledge,' 'Second Hand Knowledge,' 'Total Media,' and 'Total Environmental Knowledge.' 'First Hand Knowledge' is a synthetic measure combing the relevant single measures from the research inventory. As mentioned in Chapter Four, one assumption of the project was that current environmental knowledge and attitude measures are in part measures of "urban-elite" (the urban region) knowledge suites and attitudes. Therefore, the project needed to attempt to develop measures that honored other knowledge suites—in this case measures that might permit the 'cognizing' of "novel" environmental information (first-hand knowledge). 'Cognizing' novel first-hand information from the environment would require knowledge of or access to the resource in question, but also sufficient background knowledge. Thus, the first-hand measure combined 'TWB' and 'Sensitivity, ' respectively. That is, the TWB measure indicates some knowledge of concrete, local resources (bodies of water), and 'Sensitivity' should potentiate respondents to notice ecological change in said bodies of water (an example of first-hand knowledge cognition).

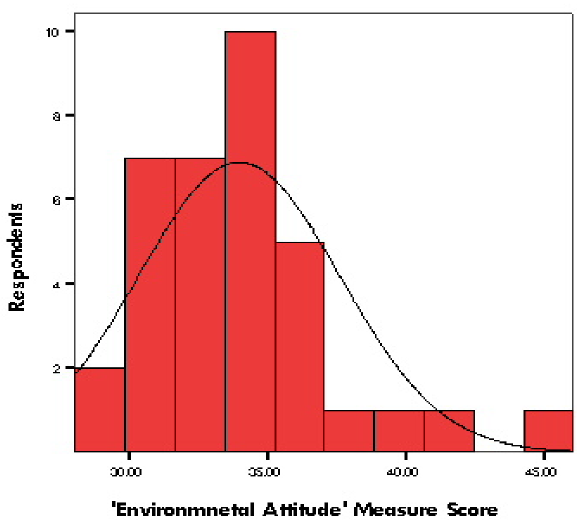
One problem with combining 'TWB' and 'Sensitivity' was that they had entirely different ranges. The total number of responses for each question was therefore converted from continuous numeric data into six discrete categories (based on dividing the range of answers into percentiles of 16.6percent) to achieve equal value for each variable toward the 'First-hand Knowledge" measure. In this way both 'TWB' and 'Sensitivity' measures were equally weighted toward the final 'First-hand Knowledge' measure.

The second hand knowledge measure was similarly developed by combining single measures from the research inventory. In the case of second-hand knowledge, the single measures utilized were the 'Issues Total' and 'Hooch Pollute' measures. Both of these measures were thought to properly represent knowledge that was not gained by first hand experience, but instead by knowledge 'sharing' among the "urban-elite" individuals that share an environmental value. The 'Issues Total,' question, for example, involves knowledge that is perhaps more relevant to urban environmentalists. That is, the knowledge concerns not any problem in particular involving production, for example, but instead a more global concern for the environmental integrity of the watershed itself. Similarly, it was thought that acceptable responses to the 'Hooch Pollute' question would be the domain of urban environmentalists, not less environmentally inclined rural individuals. Again, however, scores were re-categorized into "ntile" scores before counting toward the 'Second-hand Knowledge' measure as per the first-hand example above. In this way the contribution of 'Hooch Pollute' and 'Issues Total' were equally weighted toward the final 'Second-hand Knowledge' measure.

The 'Total Media' measure combined the raw scores of the 'TV Hours' and 'Internet Hours' single measures. Again, however, the total number of responses for each question was converted from continuous numeric data into six discrete categories (based on dividing the range of answers into percentiles of 16.6percent). This allowed for equal value for each variable toward the 'Total Media' measure, which was simply the sum of the two 'ntile' scores. Finally, 'Total Environmental Knowledge,' was a synthetic measure derived from the combination of the measures 'First-hand Knowledge' and 'Second-hand Knowledge,' above.

Before closing, it is important to note that these constructions of knowledge involving various data collection techniques (and their respective theoretical backgrounds as per Chapter 3) and their use toward developing 'new' measures of particular types of knowledge (first and second-hand knowledge, for example) have not been tested for validity. Further, they lack theoretical structure that might permit a more useful or even valid measure of different types of knowledge.

Figure 7.3: Distribution of the 'Environmental Attitude' Measure Scores



Results of the Formal Hypotheses

This section presents the outcomes of the statistical analysis of the above measures and their application to the research hypotheses. Many of the findings of the project, however, did not involve the hypotheses and will also be presented in the following chapter.

The first set of hypotheses involves the *distribution* of knowledge and attitude in the Upper Chattahoochee Watershed. That 'Total Environmental Knowledge' and 'Environmental Attitude' measures, and their predicted relationship with the 'Earnings,' 'Education' and 'Region' measures, were used to test the hypotheses.

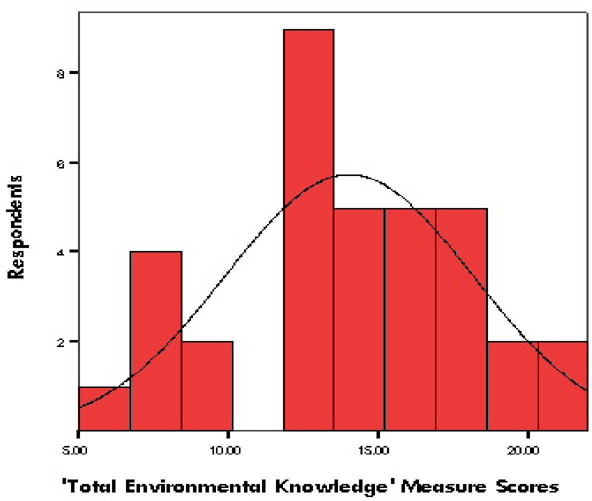
As described in Chapter 6, the first two hypotheses challenged the existing literature. The first hypotheses were that second-hand knowledge scores (the 'Second-hand Knowledge' measure) would be higher in the urban region than in the rural region, and that first-hand knowledge of the environment (the proposed 'First-hand Knowledge' measure) would be higher in the rural region than in the urban region. The hypotheses were not be corroborated. However, because there *was* found more knowledge in the rural region using the TOTKNOW measure (a combination of 'First' and 'Second-hand Knowledge measures), the lack of corroboration may be the result of improperly refined measures and not a faulty hypothesis. The implications of these findings will be discussed in the following chapter. The results of these hypotheses are discussed further as Hypotheses 3 and 4 as they are identical to the hypotheses concerning the acquisition of novel information.

The remainder of the first set of hypotheses were developed to corroborate that earlier findings concerning demography and environmental attitude and knowledge in the U.S. generally are *realized in the study area*. It was thought that if the null hypotheses can be rejected for these hypotheses, then earlier findings have again been corroborated, and we could turn our attention to the proposed measures that further articulates environmental knowledge and its distribution in the watershed.

Before performing tests, however, a first concern was to make sure that both "Total Environmental Knowledge' and 'Environmental Attitude' measures displayed a normal distribution in order to determine which statistical analyses to apply. A histogram revealed that 'Total Environmental Knowledge' and 'Environmental Attitude' both yielded roughly normal distributions and therefore required parametric tests. On both histograms, the left axis represents the number of respondents (see Figures 7.3 and 7.4).

Hypotheses H1a was 'Total Environmental Knowledge' will generally be statistically higher in the urban region than in the rural region. In order to reject the null for H1a, an independent sample t-tests was performed with the 'Total Environmental Knowledge' measure being the dependent variable and 'Region' being the independent variable. The null hypothesis could not be rejected, as the 2-tailed test was not found to be significant (see Figure 7.8, at the end of the chapter). Therefore, the hypothesis stating that "the 'Total Environmental Knowledge' measure will be statistically higher in the urban region than in the rural region" can be rejected. Importantly, not only was the relationship not significant, it was a (non-statistically significant) negative relationship. 'Total Environmental Knowledge' was higher in the rural region than the urban region. This significant finding again may indicate that the H1 hypothesis is valid. This finding will be addressed in the following chapter.

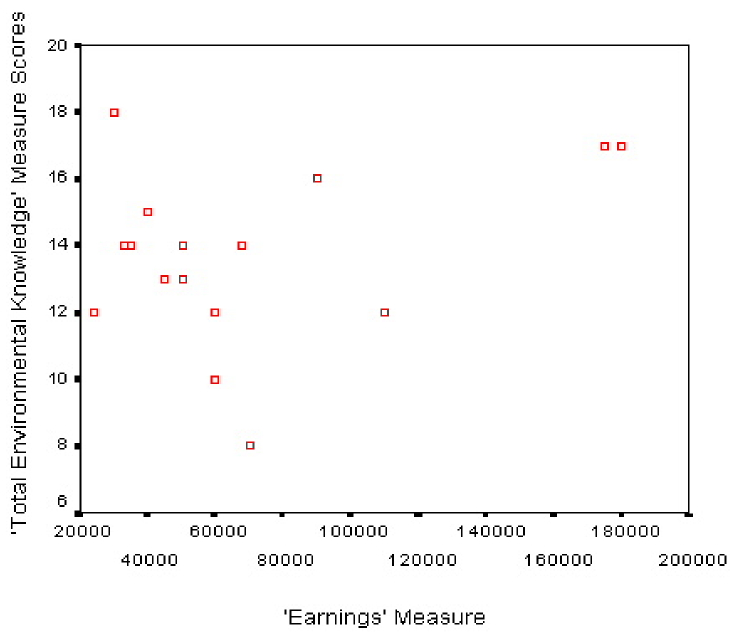
Figure 7.4: Distribution of the 'Total Environmental Knowledge' Measure Scores



In order to reject the null for H1b, an independent sample t-tests was performed with the 'Environmental Attitude' measure being the dependent variable and 'Region' being the independent variable. The null hypothesis could not be rejected (see Figure 7.9, at the end of the chapter), as the two-tailed test was not significant. Therefore, the hypothesis stating that "the 'Environmental Attitude' measure will be statistically higher in the urban region than in the rural region" can be rejected. Importantly, 'Environmental Attitude' was *lower* in the urban region than in the rural region, contrary to much literature on the subject. The significance of this finding will be discussed in the following chapter.

Next, H1c was tested for the null hypothesis. The null hypothesis for H1c states that 'Total Environmental Knowledge' measures will not correlate with the measures 'Education' and 'Earnings' within groups. In order to test this hypothesis properly, the linearity of relationship between the relevant variables needed to be established. Figures 7.5 and 7.6 show the relationship of the 'Total Environmental Knowledge' measures and 'Environmental Attitude' measures in the urban region and three. The relationship between the variables is negatively and then positively linear in both cases, respectively. That is, in the urban region, 'Total Environmental Knowledge' decreases as 'Earnings' increases. Conversely, in the rural region, 'Total Environmental Knowledge' increases as 'Earnings' increases. Therefore, tests that require linearity can be used to analyze the hypotheses.

Figure 7.5: Relation of 'Total Environmental Knowledge' to 'Earnings' in the Urban Region

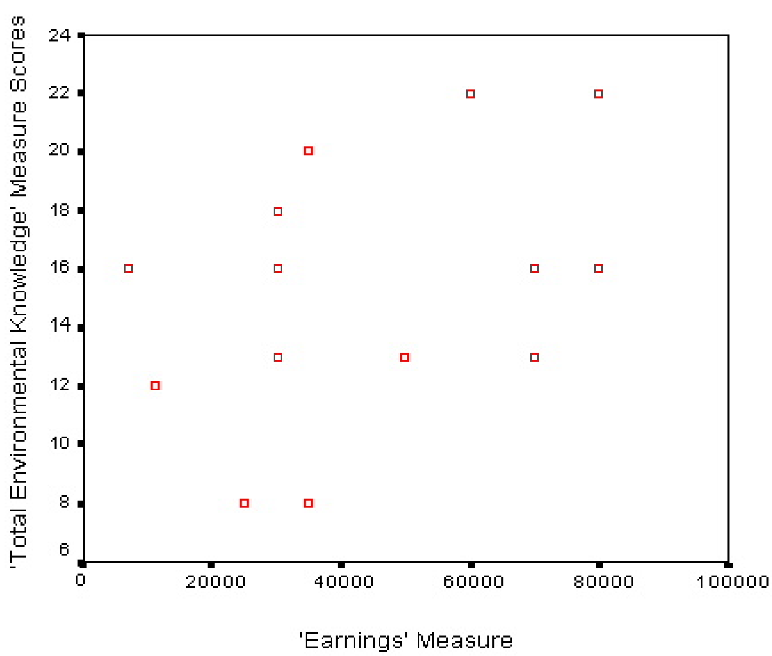


Using linear regression analysis the relationships were analyzed more closely. Table 5.3 shows the result of a regression analysis for the dependent variable 'Total

Environmental Knowledge' and the predictors 'Earnings' and 'Education' in region 1. The results were not significant. Also below, Figure 7.10 shows the result of a regression analysis for the dependent variable 'Total Environmental Knowledge' and the predictors 'Earnings' and 'Education' in region 3. No significant findings were uncovered in either case. Therefore, the insignificant regression analyses leads to the conclusion that the null hypothesis for H1c cannot be rejected. That is, there is no apparent relationship between the environmental knowledge of individuals in the study area and their yearly household earnings ('Earnings') or their level of educational attainment (the 'Education' measure).

Next, we must test hypothesis H1d and its null hypothesis. The null hypothesis states that 'Environmental Attitude' measure scores will not be significantly correlated with the 'Earnings' or 'Education' measure values within groups. Figure 7.12 provides the result of a regression analysis for the dependent variable 'Environmental Attitude' and the predictors 'Earnings' and 'Education' in the urban region. No significant findings were uncovered. Also below, Figure 7.13 shows the result of a regression analysis for the dependent variable 'Environmental Attitude' and the predictors 'Earnings' and 'Education' in the rural region. Again, no significant findings were

Figure 7.6: Relation of Total Environmental Knowledge to Household Income within the Rural Region



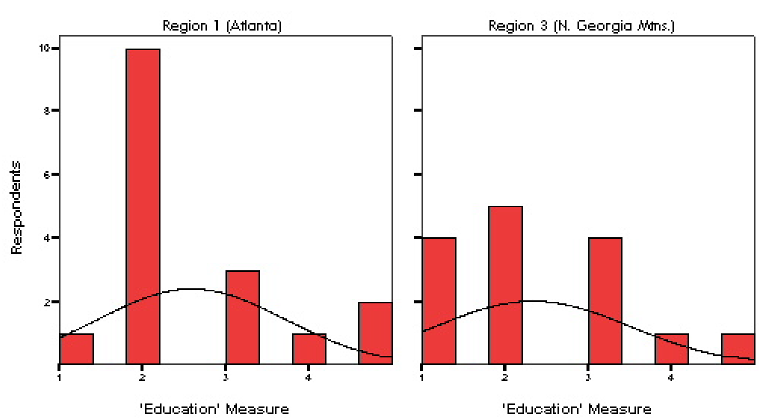
uncovered. The null hypotheses were not rejected in either case. Thus, there is no apparent relationship between the environmental attitudes of individuals in the study area and their yearly household earnings ('Earnings'), or their level of educational attainment (the 'Education' measure).

Hypothesis 2a and 2b must be addressed next. Hypothesis 2a and 2b were that educational attainment (captured by the 'Education' measure) and media consumption (captured by the 'Total Media' measure) would be correlated with environmental attitude ('Environmental Attitude' scores) within and between regions.

In order to test these hypotheses, a histogram was created to test for the normal distribution of the 'Education' and 'Total Media' measures in the sample (see Figure 7.7 below for the 'Education' histogram for both regions—'Total Media' not shown). In both instances, the distributions were normal, so independent t-tests could be applied.

The independent t-test found no significant relationship between 'Education' and 'Environmental Attitude' between groups (Hypothesis 2b). The independent t-test also found no significant relationship between the 'Total Media' measure and 'Environmental Attitude' between groups. Within groups, bivariate correlations were used to determine if there were significant relationships between the 'Education' measure and the 'Environmental Attitude' measure. Bivariate correlations were also used to determine if

Figure 7.7: Histogram of the 'Education' Measures in the Rural and Urban Regions



there were significant relationships between the 'Total Media' and 'Environmental Attitude' measures within groups. In both examples, however, their were no findings of significance, and thus the null hypotheses could not be rejected (see Figures 7.14 and 7.15 at the end of the chapter). Broadly, there was found no relationship between either educational attainment (the 'Education' measure), access to and consumption of media sources (the 'Total Media' measure), and the environmental attitude of the sample population of Upper Chattahoochee Watershed inhabitants (the 'Environmental Attitude' measure).

Hypotheses three (H3) and four (H4) were similar to the first 'alternative' hypotheses: second-hand knowledge scores (the 'Second-hand Knowledge' measure) will be higher in the urban region than in the rural region, and that first-hand knowledge of the environment (the proposed 'First-hand Knowledge' measure) will be higher in the rural region than in the urban region, with exceptions perhaps including recreationalists or others with direct experience or interaction with water resources in the non-built environment. As mentioned earlier, computing the 'First-hand' and 'Second-hand Knowledge' measure was a several step process that has net been standardized or tested for validity (see Scoring Synthetic Research Inventory Measures, above). Figures 7.16 and 7.17 (at the end of the chapter) show the results of independent sample t-tests for 'First-hand' and 'Second-hand Knowledge' by region, respectively. Neither of the results was significant. The null hypotheses for both H3 and H4 were rejected. These findings, however, may be significant, and this is discussed in Chapter 8.

Hypothesis five (H5) was that first-hand knowledge (the measure 'First-hand Knowledge') in the rural region would be correlated with the length of time the respondents had lived in the region (the 'Years in Place' measure). A Pearson's r was used to determine if there was a significant relationship between the two variables within the rural region. No significant results were found. Figure 7.18 shows the results. Therefore, there can be no significant relationship between first-hand knowledge and length of residence in the rural region of the Upper Chattahoochee Watershed study area.

Figures

Figure 7.8: Independent Samples T-test for Equality of Means of 'Environmental Attitude' (NEP Scores) by Region

		t	df	Sig. (2-tailed)	Mean Difference	Std. Error	95% Confidence Interval of the Difference	
							Lower	Upper
Equal variances assumed		-1.557	33	.129	-1.8824	1.2091	-4.3422	.5775
Equal variances not assumed		-1.542	28.6	.134	-1.8824	1.2211	-4.3811	.6164

Figure 7.9: Independent Samples T-test of ‘Total Environmental Knowledge’ Measure Scores by ‘Region’

	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Differ.	95% Confidence Interval of the Difference	
								Lower	Upper
Equal varian.	3.863	.058	-.898	33	.376	-1.2582	1.4008	-4.1082	1.5918
Unequal varian.			-.889	28.12	.382	-1.2582	1.4158	-4.1578	1.6415

Figure 7.10: Regression Analysis for the Dependent Variable 'Total Environmental Knowledge' and the Predictors 'Earnings' and 'Education' in Region 1.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	12.756	2	6.378	.914	.425(a)
Residual	90.681	13	6.975		
Total	103.438	15			

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
(Constant)	11.492	2.229		5.157	.000
Household income	1.899	.000	.344	1.313	.212
Level of Education	.355	.714	.130	.498	.627

Figure 7.11: Regression Analysis for the Dependent Variable 'Total Environmental Knowledge' and the Predictors 'Earnings' and 'Education' in Region 3.

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	44.929	2	22.464	1.180	.343(a)
	Residual	209.428	11	19.039		
	Total	254.357	13			

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
	(Constant)	11.107	3.029		3.667	.004
	Household income	6.093E-05	.000	.338	1.175	.265
	Level of Education	.611	1.045	.168	.584	.571

Figure 7.12: Regression Analysis for the Dependent Variable 'Environmental Attitude' and the Predictors 'Earnings' and 'Education' in Region 1.

Model	Sum of Squares	df	Mean Square	F	Sig.
Regression	11.790	2	5.895	.576	.576(a)
Residual	133.148	13	10.242		
Total	144.938	15			

	Unstandardized Coefficients		Standardized Coefficients		
Model	B	Std. Error	Beta	t	Sig.
(Constant)	33.551	2.700		12.425	.000
Household income	-1.694E-05	.000	-.259	-.967	.351
Level of Education	.286	.865	.089	.331	.746

Figure 7.13: Regression Analysis for the Dependent Variable 'Environmental Attitude' and the Predictors 'Earnings' and 'Education' in Region 1.

Model		Sum of Squares	df	Mean Square	F	Sig.
	Regression	11.314	2	5.657	.262	.774(a)
	Residual	237.543	11	21.595		
	Total	248.857	13			

		Unstandardized Coefficients		Standardized Coefficients		
Model		B	Std. Error	Beta	t	Sig.
	(Constant)	37.393	3.226		11.592	.000
	Household income	-2.826E-05	.000	-.158	-.512	.619
	Level of Education	-.369	1.113	-.103	-.332	.746

Figure 7.14: Bivariate Correlation of the ‘Education’ Measure and the ‘Environmental Attitude’ Measure Within Region 1

		Level of Education	ENVATT
Education	Pearson Correlation	1.000	.055
	Sig. (2-tailed)	.	.833
	N	17	17
ENVATT	Pearson Correlation	.055	1.000
	Sig. (2-tailed)	.833	.
	N	17	18

Figure 7.15: Bivariate Correlation of the 'Education' Measure and the 'Environmental Attitude' Measure Within Region 3

		Level of Education	ENVATT
Education	Pearson Correlation	1.000	-.144
	Sig. (2-tailed)	.	.609
	N	15	15
ENVATT	Pearson Correlation	-.144	1.000
	Sig. (2-tailed)	.609	.
	N	15	17

Figure 7.16: Independent Samples T-Test for the 'Second-hand Knowledge' Measure by Region

Region	N	Mean	Std. Deviation	Std. Error Mean
Region 1 (Atlanta)	18	6.4444	2.0643	.4866
Region 3 (N. Georgia Mtns.)	17	7.5294	2.8310	.6866

Independent Samples Test

	Levene's Test for Equality of Variances		T-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	3.771	.061	-1.301	33	.202	-1.0850	.8340	-2.7818	.6118
Equal variances not assumed			-1.289	29.1	.207	-1.0850	.8415	-2.8057	.6357

Figure 7.17: Independent Samples T-Test for Measure 'First-hand Knowledge' by Region

Group Statistics

	Region	N	Mean	Std. Deviation	Std. Error Mean
	Region 1 (Atlanta)	18	6.9444	2.5546	.6021
	Region 3 (N. Georgia Mtns.)	17	7.1176	3.1201	.7567

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	1.084	.305	-.180	33	.858	-.1732	.9615	-2.12	1.7829
Equal variances not assumed			-.179	30.9	.859	-.1732	.9671	-2.14	1.7992

Figure 7.18: Pearson's Correlation Coefficient (r) for the 'First-hand Knowledge' and 'Years in Place' Measures

		FH Knowledge Measure	Years in Watershed
FH Knowledge Measure	Pearson Correlation	1.000	-.063
	Sig. (2-tailed)	.	.810
	N	17	17
Years in Watershed	Pearson Correlation	-.063	1.000
	Sig. (2-tailed)	.810	.
	N	17	17

Summation

This chapter has provided a description of the project data collection techniques and the results of the analyses of the formal project hypotheses. The four-part basic research inventory designed to measure ecological knowledge was administered to 176 persons. Included in this figure were nine Sierra Club members, respondents from two college campuses, and people attending a meeting of Upper Chattahoochee Riverkeeper. This figure includes 35 randomly sampled respondents. Answers to the research inventory were coded into various measures of knowledge in an attempt to develop a more selective measure of environmental knowledge than the literature permits. The various measures of environmental knowledge were adapted to the five hypotheses developed in Chapter 4 and were subsequently tested. Of the five formal hypotheses, none were able to reject their respective null hypotheses. However, the baseline hypotheses designed to enable the elaboration of further knowledge distinctions and based on the literature and the demographic profile of the Upper Chattahoochee Watershed could not be corroborated either. However, the findings were *negatively* significant. This finding may be significant, and is discussed in the following chapter.

CHAPTER 8

DISCUSSION: RESEARCH FINDINGS AND THEIR ECOLOGICAL IMPLICATIONS

There were a host of research findings in the Upper Chattahoochee Watershed project. Some findings--for example the relative dearth of ecological knowledge in the study area--were expected because of earlier findings in the field (Maloney and Ward 1973, Council of Environmental Quality 1980, Arcury 1992). Other findings were not expected. For instance, while many of the ancillary hypotheses were not corroborated, the primary hypothesis of the project which spurred the development of first and second-hand knowledge measures (that "rural" knowledge properly measured was found to equal or surpass "urban" knowledge), generated potentially contributory results. These results—and the finding that environmental attitude and knowledge were inversely correlated--beg explanation viewed against the backdrop of much previous research to the contrary. Why did the project obtain the results that it did? A first priority of this chapter will therefore be to explain the research findings in anthropological terms using research results and available data. Following this, some of the other possible anthropological and ecological implications of all of the findings will be provided.

Explanation of Findings Involving the Formal Hypotheses

There were two important findings. An important finding of the project that needs to be addressed is the inverse, significant *(p=.05)* relationship between environmental knowledge and attitude in the rural region. These findings were not expected by the literature. Another finding that needs attention is that in the Upper Chattahoochee Watershed, using the measures designed for this project, rural respondents demonstrated higher levels of ecological knowledge than urban residents of the watershed. This finding, while not statistically significant, is notable nonetheless, especially given the prevalence of data to the contrary and also the rural-urban gradient.

However, the explanation of both of these findings is not made easily or using one simple explanation. To the contrary, it seems several factors may have contributed to both of the findings. Here I will discuss three major factors: the knowledge measures themselves, the study regions, and possible skews of the data.

Explanation: Different Knowledge Measures

The knowledge measures used in this project differed significantly both theoretically and practically from the knowledge measures used in previous research. The measures used in this study were an attempt to measure 'knowledge' with respect to some relatively new approaches to cognition, linguistics, and the philosophy of knowledge. These were described in earlier chapters, and are outlined briefly below.

There has been a recent rebirth of 'embodied' approaches in the cognitive science and related fields. Following the early work of Husserl and the later work of Merleau-Ponty, the approach has been re-introduced by Maturana and Verela in cognitive science, Lackoff and Mark Johnson in linguistics, Richard Rorty and Hubert Dreyfuss in philosophy, Jerome Bruner in cognitive psychology, and Tim Ingold in anthropology. All of these approaches emphasize that the structure of human knowledge, understanding, and even the experience of meaning are best understood not by classical notions of the computational representation of 'knowledge' in the heads of humans, but by allusion to 'humans-in-environments.' These approaches tend not to view the environment as anything ‘out there,’ and knowledge is not thought of as being computationally represented ‘inside of people’s heads’. On the contrary, the knowledge of the organism and its ‘knowing’ are wholly enmeshed with its environment. Acts that constitute knowledge are the result of the organism’s ontogenic history of interactions with the environment and the ontogenetic history of humans-in-environments that leads to increasingly complex coupling between organism and environment. Thus, the enmeshment of humans with their environments is necessary for the ontogeny of knowledge itself, the purported witnessing of ‘knowledge’ (when these acts--the result of coupling—are witnessed by outside observers) and meaning. Subsequently, both the definition of knowledge and the requirements for its instantiation are markedly different under this episteme.

Under this episteme, ‘knowledge’ is simply effective action in a particular context, and knowledge is admitted when the behavior is expected and witnessed by an outside observer. Thus defined, however, behaviors that instantiate knowledge include both “situated” behavior of humans-in-environments (and other animals-in-environments) but also verbal behavior in the human languaging environment.

The notion that knowledge is the result of structural coupling and not discrete computational representation, and its emphasis on the importance of context toward structuring behavior, mirrors some recent work that is more closely related to anthropological pursuits. In ethnoecology, ethnobotany, and cognition, for example, an attempt is made to highlight the differences between “indigenous,” “situated” knowledge and other, usually “scientific” knowledge suites (for example see Posey 2000, Ellen and Harris, 2000). Ellen has made clear the need for research approaches that attempt to measure classification *in situ*—in the act of behavior, not in a post hoc analysis of that (classifying) behavior that requires classifying referents using data gleaned from the human languaging environment. From this perspective, classical, taxonomic structures studied by the universalist ethnoscientists may be post-hoc descriptions by subjects of life-as-lived that bears little resemblance to effective living behavior that is the result of the history of interactions between humans and their environment.

Embodied approaches also have implications for survey and other types of anthropological research. As mentioned, behaviors that instantiate knowledge from the embodied perspective include both the observation of expected "situated" behavior of humans-in-environments by outside observers, but also verbal behavior in the human languaging environment. Instantiating knowledge on the basis of human languaging environments is complicated theoretically by some of same critiques outlined by Ellen involving the decontextualization of knowledge, and the distinction between behavior in situ and its post-hoc analysis. This issue is pursued by various other anthropologically oriented researchers, including Holland and Quinn (1987), who must grapple with this issue towards the construction of 'cognitive models' which are instantiated entirely using verbal behavior.

When applied to this project, the question becomes one of the ability of verbal behavior to instantiate *meaningful* ecological knowledge. In keeping with 'embodied' conceptions of knowledge, the project attempted to improve the measures of ecological knowledge by making a distinction between non-situated, general knowledge about the 'environment,' and 'local,' or first-hand novel 'knowledge' generated by the subject in the context of their own situated condition, or *life-world*. This local knowledge was thought to be more relevant toward possible behaviors of the subjects in their *life-worlds*, but also able to permit the recognition of local ecological change by the participants.

This distinction may be involved in the failure of researchers to consistently relate environmental attitude (measured using verbal behavior) with actual 'pro-environmental' behavior. Drawing from the embodied approaches to cognition and their insistence on the role of context toward the behaviors associated with "knowing," environmental attitude, when measured using verbal behavior, may be little more than the measure of centrality in an urban elite languaging environment (discourse community) that has little relation to the subjects' life-world. Thus Van Lierre and Noe (1981) write that there is a weak connection between environmental attitudes and behavior when "a general attitude is correlated with a specific behavior . . . higher associations might be found if environmental attitudes were measured at a more specific level (such as campers' concerns about pollution in campgrounds)" (511). It might be argued then that Van Lierre and Noe are underlining the importance of context and situatedness towards the instantiation of knowledge as permitted by this more 'situated' 'pro-environmental' behavior.

A prime motivator in the development of the "first" and "second-hand" knowledge measures for this project, then, was the recognition that earlier research had utilized knowledge measures that privileged the knowledge of particular knowledge communities—typically scientific institutional ones--while failing to measure the relevant, contexualized knowledge suites of people in real places.

One of the earliest examples of literature involving environmental knowledge came from Maloney and Ward (1973). Their knowledge inventory involved non-situated knowledge questions that measured knowledge as a familiarity with highly-specific scientific ideas about ecology, and did not measure the informants' situated knowledge or their ability to learn or understand their own local places. While Maloney and Ward did not provide a list of all of their research inventory questions, the exemplary questions are telling. Their ecological knowledge inventory questions included "Which of the following materials usually takes longest to decompose? A) Tin B) Iron C) Aluminum D) Copper E) Steel." Another question was "Mercury has been found in unacceptable levels in A) Fruit B) Vegetables C) Seafood D) Beef E) Soft drinks." Thus, in this instance, while the questions must necessarily rely on verbal behavior to instantiate knowledge, the domain of knowledge being tested is an un-situated, non-local knowledge that can only be known by participation and involvement in particular languaging and knowledge environments. Thus it privileges centralized, scientific knowledges over place-specific, 'first-hand' knowledge.

Christianson and Arcury (1992), in their study of rural and urban region water knowledge and attitude in Kentucky, used similar knowledge inventory questions as Maloney and Ward. Christianson and Arcury's research included two types of questions. The first concerned the physical attributes of the Kentucky River, and included multiple choice questions over such topics as the length of the river (three choices were given), the county of the river's origin (four choices), the city at which the river's three forks converge to form the mainstream (three choices), and the city near the river's terminus (four choices). The other type of question required open-ended answers and asked respondents to give the number of dams and locks on the river, as well as the number of counties in the Kentucky River Drainage Basin. In these exemplary questions, it is clearly general-purpose second-hand knowledge being measured. Ecological knowledge—in this case water knowledge--is measured using knowledge that is relevant to a regional land manager, but much less so to individuals in particular situated contexts.

The knowledge measures of this project—while necessarily relying on verbal data to instantiate knowledge—asked questions that were meant to measure situated ecological knowledge, and intended to avoid simply capturing knowledge from a particular language environment (or discourse community). Instead, the measures tried to capture several separate components of situated knowledge, but also *potential* knowledge about the environment, by combining measures of the individuals' knowledge of actual water bodies with the number of relevant 'indicators' of both 'good' and 'bad' water quality.

The ecological knowledge measures used in this project were scored by combining questions concerning the participants' exposure to, and knowledge of, local water bodies and the number of accurate water quality indicators given. Thus, one factor in the finding of greater water knowledge in the rural areas was probably the result of the theoretical and practical differences between previous and present water knowledge measures. By changing the nature of the knowledge measures away from urban-elite 'knowledge' markers, we might expect that environmental attitude measures (which went unchanged) would then be negatively correlated with new knowledge measures, but also urban value scales (for example the New Environmental Paradigm scale).

Explanation: the Study Region

In addition to the different knowledge measures, another factor that may have contributed somewhat to the rural knowledge findings of the present study involve the study region itself. Although the rural quality of the rural study region was established earlier in this paper and the demographic profile is clearly rural, there are several additional qualities of the study area worth exploring. The physiography of this mountain region serves to differentiate the rural region from other flatland regions in at least two ways. First, the physiography of the landscape has proscribed a number of development patterns. In Appalachia generally, an era of successful valley non-commercial farming gave way in the "great transformation" between 1880 and 1930 to extraction when corporate interests tried to capitalize on the cheap operating costs and ready labor of poor rural people that the Appalachia region provided (Beaver 1984). In the rural study region the same was true, as extractive gold and timbering industries, in conjunction with the slope angle of the mountains and the lack of bottomland, managed to concentrate the population geographically, but not toward the maintenance of agriculturally oriented towns and communities. Instead, the towns were work towns related to extraction, and this may have contributed to the class-consciousness and identity of rural peoples throughout Appalachia generally (Lewis 1984).

Another factor in the development of the rural study region involves the much more recent transformation of the rural mountain regions from industrial extraction to urban ideological consumption. The mountainous land-tracts of the Blue Ridge, once largely undervalued, have become prime locations for urban-elite recreational activity and relaxation. The extension of nodal economic centers to meet the demand for vacationing populace has made buying and building in many of these areas an investment of choice for the summering urban-elite seeking to capture the quaint, authentic rusticity of the mountain environ (Nash 1999). According to Douglas Bachtel, a University of Georgia population expert, growth in many Blue Ridge counties is “phenomenal.” In White County, Georgia, one of the counties in the rural study area of this project, the percentage of population change between 1990 and 1995 was 17.9 percent, with the average percentage per year of the county being 3.53 percent. The newcomers are often only seasonal residents of their vacation homes, and thus are invisible to the Census. Bachtel explains that the locals call newcomers “half-backs”. “What they often have is people from up north who moved to Florida. Then they get sick of Florida, and they move to Northeast Georgia, and so they are considered to be ‘halfway back’ home” (Nash 1999: 93. For example, see respondent number fourteen, Chapter 7).

Thus there is the possibility that these invisible newcomers, who bring urban knowledge and attitude suites into the rural study area, contributed to the research findings. While the respondents in the rural region did not indicate previous residence in Florida, some of the respondents were professionals that had relocated to the region from elsewhere.

Newcomers from other rural or other urban regions may bring with them particular ideas about the landscape and its rurality. This might be especially true of urban or suburban professionals moving into rural area. This may be particularly true in the study area with its very strong urban-rural gradient. The gradient helps ensure that the study area capture urban and rural populations that necessarily their class and cultural counterpoints—that they construct both rural and urban identities perhaps more strongly than the demographic data indicate any rural or urban "reality."

Explanation: Sampling Error

First, we will consider the possibility that the results obtained (the inability to reject the null statement for hypothesis one) were the result of a non-representative sample of the populations in question. As mentioned previously, the Upper Chattahoochee Watershed study area enjoys a very strong rural-urban gradient as it runs from the North Georgia Mountains to the Atlanta Metropolitan Area. The urban/rural gradient of the Upper Chattahoochee Watershed was expected to predict environmental attitude and environmental knowledge based on the strong findings of previous literature. Previous work on the relationship between environmental knowledge and demographic variables indicates that income, education, gender, and environmental attitude have a consistent statistically significant positive association with public environmental knowledge in the U.S. (Arcury, Johnson and Scollay 1986, Arcury Scollay and Johnson 1987, Arcury and Johnson 1987, Lovrich et al. 1986, Pierce et al. 1989). And in the study area, the urban region counties (Cobb, Fulton, DeKalb, and Gwinnett counties) each have higher educational attainment and median household income than the counties of the rural region (Lumpkin, White, Habersham). For example, the mean of all median household incomes in the urban region according to the 1990 census was $37246. In contrast, the mean of all median household incomes in the rural region counties was $24912.

Despite the previous research on environmental knowledge and attitude in the U.S. and the demographic profile of the study area, no statistically significant relationships were found between groups as predicted by the formal hypotheses. A first explanation for the above involves a skewing of the sample via self-selection. As mentioned, contacting potential respondents in the random sample was carried out by phone, and especially in the urban region, refusals were common. An example of a typical call session included 89 phone calls, 4 refusals, and no interviews. Another exemplary session, in the more forgiving rural region, involved 55 calls, 5 acceptances, and 9 refusals. This ratio of acceptances to refusals leaves great opportunity for self-selection of particular suites of respondents. Several possible skews can be imagined. First, given the lack of general knowledge about many of the concrete features of the watershed and its systemic problems, the perceived importance of participating (the motivation for participating) might be low. Perhaps these respondents were relatively more or less knowledgeable than those potential respondents that refused to participate. Conceivably, important issues that directly affect the populace--water shortage in the home, or pollution at the faucet--might motivate individuals to respond more frequently to such an inquiry.

Another conceivable self-selection skew involves higher education and earnings generally. Population census figures (year 2000, updated from the above) indicate that the mean of all median household incomes in the urban region was $47,711. In contrast, the mean of all median household incomes in the rural region counties was $33,850. Of the respondents in the study, however, the median in each region was $55,000 and $43,785 respectively. Therefore, while the sample was apparently of sufficient size using Borg and Gall's calculation, the sample population reported earnings higher than census figures would suggest. Education measures were perhaps also skewed in the sample population. As mentioned, there were no significant differences between education level in the urban region and the rural region, despite census data to the contrary. Further those with a greater "environmental attitude"—those with values that are expected culturally to support "protection of the environment" may have responded to the questionnaire more than others, skewing results and explaining the relatively homogenous results concerning environmental attitude. If indeed the sample was skewed resulting in poor data, the possibility exists that some of the hypotheses were improperly falsified.

Explanation: Poorly drawn measures, faulty hypotheses

A separate explanation for the inability of the baseline hypothesis to be corroborated is that the measures and hypotheses themselves were ill conceived. This of course remains a distinct possibility. There are, in fact, reasons to believe that much of the findings were the result of incorrectly articulated 'First-hand' and 'Second-hand Knowledge' measures, respectively. Simultaneously, however, the same evidence suggests that both 'First' and 'Second-hand Knowledge' measures were effectively capturing first-hand knowledge. Evidence for this claim comes from the *expected* outcomes of properly articulated first-hand and second-hand knowledge measures in the highly graded Upper Chattahoochee Watershed demographic profile, and the actual measures obtained.

The expected measure of a properly resolved first-hand and second-hand knowledge measure would yield the results shown in Figure 8.1. That is, according to the hypotheses outlined in Chapter 6, environmental attitude, being a measure of urban-elite values, should in fact be distributed as predicted by the literature. Additionally, second-hand knowledge should be distributed as predicted by the literature. First-hand knowledge, however, should be greater in the rural region.

Figure 8.1: Statistically Significant Findings as predicted by the Literature in the Upper Chattahoochee Watershed

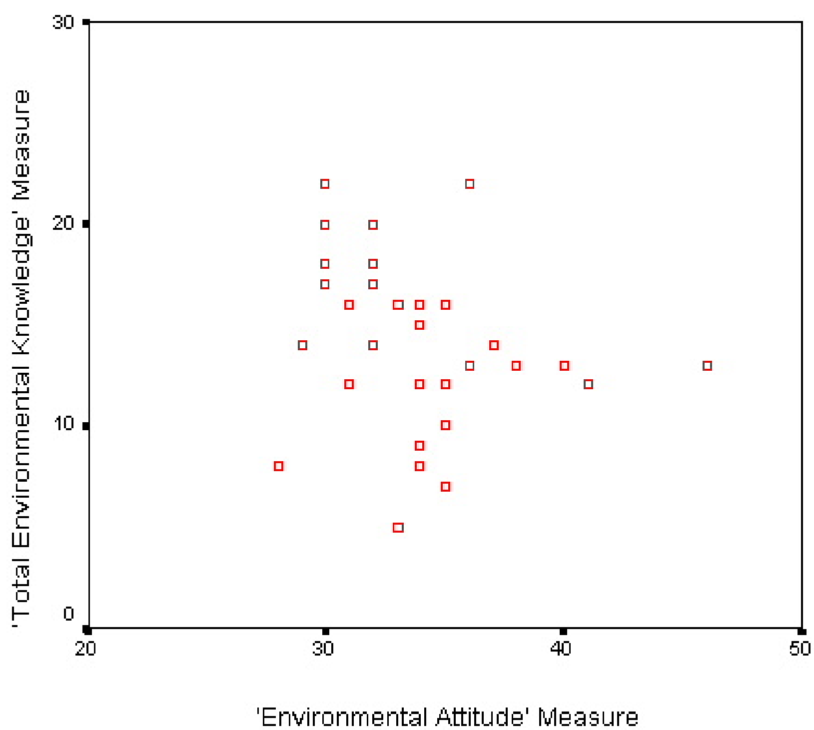
Urban Region		**Rural Region**
Low 'First-hand Knowledge' Measure		High 'First-hand Knowledge' Measure
High 'Second-hand Knowledge' Measure		Low 'Second-hand Knowledge' Measure
High Environmental Attitude ('Environmental Attitude' measure)		Low Environmental Attitude ('Environmental Attitude' measure)

In the Upper Chattahoochee Watershed, however, what was found is partially represented by the right column in Figure 8.1: a significant *negative* correlation between the research measure 'Total Environmental Knowledge' and the 'Environmental Attitude' measures. Using Spearman's correlation co-efficient for non-parametric data, 'Total Environmental Knowledge' and the 'Environmental Attitude' measures in the Upper Chattahoochee Watershed study area are shown to be not only unrelated, as expected, but *negatively related* (see Figure 8.2, and 8.3). Again, this is not predicted by the literature, and helps to rule out the improper sampling concern, as even self-selected respondents should not permit the significant findings described above.

Figure 8.2: Spearman's Correlation Co-efficient for the 'Total Environmental Knowledge' and 'Environmental Attitude' Measure Scores in the Upper Chattahoochee Watershed Study Region

			ENVATT	TOTKNOW
Kendall's tau_b	ENVATT	Correlation Coefficient	1.000	-.254(*)
		Sig. (2-tailed)	.	.044
		N	35	35
	TOTKNOW	Correlation Coefficient	-.254(*)	1.000
		Sig. (2-tailed)	.044	.
		N	35	35
Spearman's rho	ENVATT	Correlation Coefficient	1.000	-.356(*)
		Sig. (2-tailed)	.	.036
		N	35	35
	TOTKNOW	Correlation Coefficient	-.356(*)	1.000
		Sig. (2-tailed)	.036	.
		N	35	35

Figure 8.3: Scatterplot of 'Total Environmental Knowledge' Measure and 'Environmental Attitude' Measure in the UCW Study Area



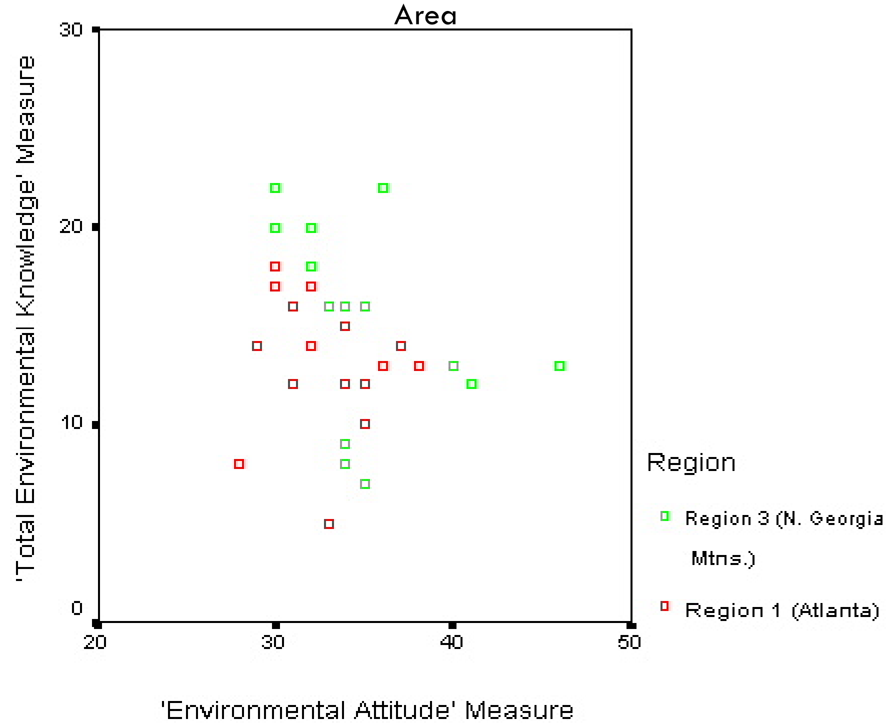
Importantly, however, the overall negative correlation of 'Environmental Attitude' measures and 'Total Environmental Knowledge' measures in the Upper Chattahoochee Watershed generally is the result of the strong correlation between the 'Environmental Attitude' and

'Total Environmental Knowledge' measures in *the rural region.* Respondents in the urban region alone exhibit no relationship between the 'Environmental Attitude' and 'Total Environmental Knowledge' measures. Figure 8.4, below, represents the same Scatterplot as Figure 8.3, but with the urban region and three individuals differentiated.

In summary, individuals in the rural region demonstrate a negative relationship between the 'Environmental Attitude' and 'Total Environmental Knowledge' measures, but the population of the urban region exhibit no relationship between environmental knowledge and attitude.

One interpretation of the statistically significant negative relationship between 'Environmental Attitude' and 'Total Environmental Knowledge' measures in the rural region is, as intimated by Figure 8.1, that there are indeed different knowledges evident in the study area, as the original hypotheses indicated, but that the knowledges were improperly resolved by the research inventory and the experimental, synthetic measures outlined in Chapter 7. Recall that the original notions that fueled the

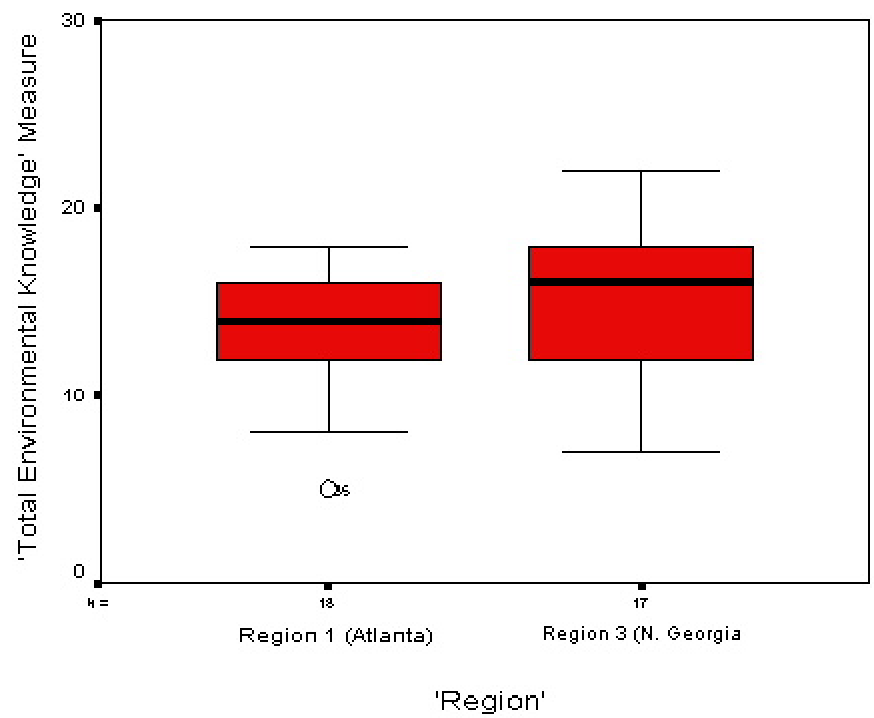
Figure 8.4: Scatterplot of 'Total Environmental Knowledge' Measure and 'Environmental Attitude' Measure in the UCW Study Area



research hypotheses were that there are important distinctions between "urban-elite" constructions of knowledge (and their measures—second-hand knowledge) and direct knowledge of the environment (first-hand knowledge). These distinctions were thought to explain previous findings on the relation between environmental attitude and knowledge. The measures of previous research privileged "urban" or "urban-elite" constructions of knowledge and attitude. Capturing these different knowledges required the construction of new, untested measures of both first-hand and second-hand knowledge, for which no statistically significant findings were uncovered. However, for several reasons the significant negative relationship between environmental knowledge and attitude in the rural region may indicate that *the measures were imprecise but that the knowledges are indeed different.*

The significant negative relationship between environmental knowledge and attitude in the rural region is not easily explained by self-selection alone. Self-selection toward either more or less knowledgeable respondents, for example, should have yielded relatively higher and lower measures of 'environmental attitude,' respectively, in a normal population. And this was not the case. Further, according to previous research, any measure of environmental knowledge should have predicted that "urban-elite" respondents would have more knowledge generally. This was not the case in the study area.

Figure 8.5: Boxplot of 'Total Environmental Knowledge' Measure in the Urban (left) and Rural (right) Study Regions



Therefore, while it seems likely that the research inventory measures for first and second hand knowledge ('first-hand' and 'second-hand knowledge' measures respectively) were inaccurately articulated, the 'Total Environmental Knowledge' measure was more accurately a measure of 'First-hand Knowledge' as defined by the hypotheses. It seems likely that the 'Total Environmental Knowledge' measure was of a particular knowledge, one that is relatively unrelated to urban-elite knowledge and that therefore is poorly associated with urban-elite environmental attitude. This interpretation would require not only the original negative relationship between environmental attitude and knowledge, but also that, in spite of much previous research, rural region respondents would score higher on the knowledge inventory. This was indeed the case in the rural region. Chart Figure 8.5 depicts the 'Total Environmental Knowledge' measure in the urban region and the rural region, respectively.

Finally, and perhaps importantly, if the explanation we have just given is indeed responsible for the (lack of) research findings involving the first set of (baseline) hypotheses, the same explanation applies to many of the other un-rejected null hypotheses in the Upper Chattahoochee Watershed Project regarding environmental knowledge.

Explanation: Ideology

Ideology is worth briefly noting in the context of the research findings. Because the research questions and techniques were drawn from a host of fields, there was and is no unified theory of ecological knowledge, but this paper sketched out several modalities of ecological knowledge acquisition. The first 'classical' set of ideas held that any expected findings concerning the relation between urbanity, rurality, and particular ecological knowledge suites would be the result of living in a particular rural context and sharing similar experiences in manners similar to Holland and Quinn's explanation of cognitive model acquisition. Later in the paper, the 'alternative' hypotheses are outlined that offer and alternative explanation for the findings in the literature concerning ecological knowledge, attitude, and rurality/urbanity. This explanation drew on a different episteme and proposed that due to the nature of knowledge and knowledge acquisition itself, knowledge is inherently situated and special measures might produce different results with more application to the relevant questions at hand in the watershed.

Both of these approaches, however, do not directly address the question of ideology. In the study region, ideology must be considered important for two reasons. The first reason involves the nature of the rural urban distinction in the imaginary of the United States and its centrality in the production of identity in the U.S., as outlined in Chapter 3. The second reason involves the rural-urban gradient in the study region as a whole. As outlined in Chapter 3, the gradient may accentuate the differences between the rural and the urban ideologies. The third reason involves the nature of the research sample itself, and presumably the rural study region itself. The rural population in the study area was not typically 'native' to the rural study area. Most were indeed from other rural areas, but relatively few were born and raised in the study area. Others had moved to the rural areas from urban ones. Thus, the respondents in the rural study area were perhaps more consistently *ideologically* rural than they were *locally* rural (born and raised in the study area), having chosen to live in the rural study area. For these reasons, some of the results of the project might be more succinctly explained by allusion to ideology than to the modal patterns (centripetal tendencies) of cultural model similarity within and between human groups Strauss and Quinn 1997), or to the situated lifeworlds of the subjects. However, despite this fact, the relevance of the 'first-hand' knowledge measure remains relevant to both the newly arrived rural, the newly rural, and the locally rural.

A Note on Religion

Before concluding the discussion of the explanation of project findings, the effect of religion on the results of the study should be briefly mentioned. A full thirty percent of rural region respondents were self-described Baptists, and because Baptists in this region are known for their conservatism, this may have affected at least the environmental attitude results. Evidence stems from the comments of the respondents themselves. For example, respondent number thirty-four used the bible directly to inform and justify his answers to the environmental attitude questions. In response to the statement "the earth is like a spaceship with only limited room and resources," respondent thirty-four commented that he disagreed, as resource limits were less than important because "The Lord will make a way [for humans to survive]." Following the statement "Humans have the right to modify the natural environment," respondent thirty-four agreed, commenting "Humanity is on his own . . . the earth is the Lord and the fullness thereof; the cattle of the hills, all of it belongs to him." Respondent number nine, in responding to the research question 'Humankind was created to rule over the rest of nature" commented that "Biblically that is correct" and thus she agreed with the statement. Similarly, respondent number eight, in responding to the research question 'Humankind was created to rule over the rest of nature" commented that indeed "we have dominion over nature. It is ours to use as we see fit."

The importance of the religiosity of rural region respondents is not herein considered a challenge to the research results, as the conservative political and religious ideology is part of the expected suite of variables in 'rural' regions used to produce the previous literature referred to so often throughout the text.

Ecological Implications of Formal Research Findings

Both of the important findings of the Upper Chattahoochee Watershed project deserve attention as they apply to ecological outcomes in the watershed. Chapter 5 outlined the prospective "windows" into water resource quality and quantity available to rural and urban subjects in the study region on the basis of their exposure to water bodies and their infrastructural water delivery arrangements, etc. The first and second-hand knowledge measures, in conjunction with other inventory questions, were developed and intended to capture which "windows" were being utilized by subjects, and which windows might be utilized in the event of system fluctuation (water quality or quantity). In this section, we will explore some of the possible implications of the research findings. That is, because the first-hand knowledge measures used herein may have captured a different, more situated and potential knowledge, we should consider the implications of the attitude and knowledge suites of the Upper Chattahoochee Watershed, and their possible relation to behavior. If the knowledge measures used in the current project are indeed different than those that were previously used, what might be some of the implications of this "first-hand" knowledge and its inverse relation to environmental attitude in terms of behavior?

In the study area, the project found that individuals in the rural region held slightly more ecological knowledge than did their urban counterparts, but also that this knowledge was negatively correlated with environmental attitude. Some previous work on the relation between attitude and knowledge has indicated that environmental knowledge builds environmental attitude, which is implicated in motivating environmental behavior (Dunlap and Van Liere 1978, Scott and Willits 1994). Thus, if this logic is applied to the Upper Chattahoochee Watershed, the individuals most able to "cognize" ecological change—rural respondents with more general and "first-hand" knowledge—are the individuals least likely to respond to ecological change with ecological behavior.

This conclusion, however, may be premature for two related reasons. The first reason involves the nature of the knowledge measures used. As discussed above, the "First-hand Knowledge" measure (and arguably the "Second-Hand" measure) was capturing situated knowledge unlike previous work that had captured more general knowledge. The domain of situated knowledge should have some bearing on the willingness to respond to ecological challenges. First-hand knowledge has in some sense 'built-in' *measurement correspondence*—measuring concepts on the same level of specificity. Recall that Van Liere and Noe (1981) wrote that there is little correlation between attitude and behavior when "a general attitude is correlated with a specific behavior . . . higher associations might be found if environmental attitudes were measured at a more specific level (such as campers' concerns about pollution in campgrounds)" (511). Situated knowledge measures are at the same "level of specificity" as behavior, and thus should be more easily translated motivationally into action. For example, the knowledge inventory questions used by Maloney and Ward (1973) ("Which of the following materials usually takes longest to decompose?") are general questions about ecology but are also questions that do not have local or specific outcomes in the lives of subjects. Questions concerning knowledge and attitude surrounding changes cognized by the subject help to ensure a greater potential for ecological behavior because of the situatedness of knowledge and subsequent values surrounding them.

The second and related reason that rural respondents with more general and "first-hand" knowledge are not less likely to respond with ecological behavior involves new frameworks in attitude and behavior. Environmental attitude is one of the most studied phenomena in ecological psychology, and its is one of the most promising concepts (Newhouse 1990). Despite this effort, however, the relationship between the two appears moderate at best (Hines et al.1986/87). This has led to pessimism about its ultimate potential toward significant contributions to the field. Kaiser et al.(1999), however, propose one theoretical and two methodological reasons that explain the predictive power of attitude, and the weaknesses of earlier work. Theoretically, different concepts of attitude have been used, some multi-scalar involving cognitive affective and intentional components (Rosenburg and Hovland 1960), others using single components, like the New Environmental Paradigm measure used herein (Dunlap and Van Liere 1978). Previous work fails to distinguish between attitude about the environment and attitude toward environmental behavior. Methodological shortcomings of most of the work involve a lack of measurement correspondence between attitude and measured behavior, as well as failure to consider situational influences on behavior.

Kaiser et al. (1999) adapt Ajzen and Fishbein's theory of planned behavior--which provides a frame of orientation that encompasses most of the single and multi-dimensional measures of attitude—and produce a framework that seeks to more accurately capture attitude as a predictor of behavior. Their results were highly significant, indicating that environmental attitude can be a powerful predictor of behavior.

The knowledge measures used in this project captured more "situated" knowledge than earlier work in the field. Given the shortcomings of most attitudinal research and the subjective nature of the New Environmental Paradigm specifically, it should be no surprise that the knowledge measures are negatively correlated with the attitudinal measures. In short, there is little reason to believe there are any particular implications of the finding that environmental knowledge and attitude are negatively correlated. If anything, the finding indicates that environmental knowledge measures are in need of as much critical improvement, and that knowledge must be concerned with measurement correspondence, as the environmental attitude measures that Kaiser et al. address. Further, it indicates that a novel knowledge was indeed captured by the "First Hand" and Second Hand Knowledge" measures.

Presentation and Ecological Implications of General Research Findings

The various data concerning knowledge distribution in the Upper Chattahoochee Watershed project not presented previously will be presented here. Beyond simply presenting the data, the additional goal of this section is to outline the potential ecological implications of the given distribution of knowledge and attitude in the Upper Chattahoochee Watershed.

Environmental knowledge and attitude can be important issues as they relate to larger ecological processes. First, environmental knowledge and attitude can lead to direct environmental involvement in local or regional issues of concern, especially when those concerns are borne-out with local consequences (Kaiser et al.1999). Additionally, however, public knowledge is important because it affects the development of resource use policy. Arguably, this has always been the case indirectly, as government policy is indirectly related to voters, and the policies of private industries can be changed either through government regulation (again with voter input) or via consumer behavior feedbacks. More recently, however, changes in organizational theory and resource use management strategies have meant that public involvement is an increasingly important factor in the development and implementation of environmental policies (Pelstring 1997), which directly relate to the environmental attitude and knowledge of the populace.

The Environmental Protection Agency (EPA), the National Forest Service (NFS), and the Bureau of Land Management (BLM), for example, have all stated their intention toward increased public involvement in policy making. Further, all three have produced innovative new ways for the public to voice their opinion to these agencies. The EPA, for example, has begun hosting an online dialogue about how to improve public involvement in EPA's decision-making. The dialogue, which is focused on EPA's draft Public Participation Policy, ran July 10 – 20, 2001. Over 1000 registrants contributed their ideas and suggestions for improving public involvement in issues, such as permitting, Superfund sites, new rules, and issues involving environmental justice (EPA 2001). Similarly, the NFS is implementing a policy toward greater communication and public involvement via recently endorsed liberal “public involvement principles” (EPA 2001).

Despite this concern for public involvement, however, public involvement is tempered by the public’s awareness of environmental problems and environmental knowledge as well. For example, Lovrich et al. found that the perceived seriousness of a water problems to be positively associated with environmental knowledge (1986). Much of the data obtained in the Upper Chattahoochee Watershed Project study addresses just such cognitive ecological issues relating to the basal knowledge that provides awareness of ecological issues in the watershed.

A very basic measure pertinent to public involvement was the elicitation of a list 'water problems' from all participants. Identifying water problems—especially 'local' ones—should motivate the respondents to be involved in the publicly informed policy development process. When asked to list 'water problems' in the area, the findings were as follows (N=176 including the random, non-random and targeted samples):

- of the respondents, 83% listed "pollution" as a water problem in their area. Of those listing pollution, only 34% mentioned another 'water problem' in the area.
- of the respondents, 40% mentioned a reference to 'drought' or another water quantity problem. Of these, 27% of respondents mentioned no other water problems in the region.
- of the respondents, 7% mentioned erosion as a particular problem in the watershed. In 25% of the cases, erosion was the only water problem listed.

These figures are interesting as they represent a notable lack of awareness concerning watershed-wide issues in spite of much media attention to numerous water issues in the region. For example, since 1985 there have been over seventy articles discussing the tri-state water wars and eight hundred and fifty articles involving topics related to water shortages. In 2001 alone, one hundred and forty one articles have run on water shortage issues (Atlanta Journal Constitution, 2001). Thus, the implications of the lack of water-related knowledge and attitude in the watershed mean that little can be expected from the area residents in ecological behavior toward general, watershed-level resource issues or problems in the Upper Chattahoochee Watershed. This lack of knowledge, however, does not necessarily preclude ecological knowledge (or subsequent behavior) toward local, in-situ knowledge.

Cognitive models

While there were no formal analyses of cognitive models in the study due to lack of volume of relevant data between regions, some of the respondents did provide insight into some components of their relational understanding of ecological processes. Responses to one question originally designed to elicit cognitive models are included here. Respondents were first asked to explain where their drinking water comes from (responses included 'a well,' 'treatment plant,' or the name of a particular river). The following question asked respondents to explain how water *reached* the well or river in question. Then, for every explanation given, such as 'water falls from the sky in the form of rain,' the respondents are asked where *that* water came from, or how that process takes place. In short, the question attempts to elicit a full description of the respondents' understanding of the surface or ground water hydrological cycle.

Comparison between the rural region and the urban region respondents is made difficult by the fact that many rural region respondents have wells for their water supply. Thus, for this question, they described groundwater hydrology accordingly and not surface water hydrology. In contrast, most of the urban region respondents have city or county water and thus described very general sources for their water treatment facilities.

Cautiously, however, we can say that the rural region respondents demonstrated more depth of understanding than their urban region counterparts. This claim is substantiated by three factors. First, rural region respondents gave appropriate answers more consistently than the urban region respondents. Second, rural region respondents demonstrated more thorough responses even when discussing the source of water for treatment plants. Finally, we can say that the rural region respondents demonstrated more depth of understanding than their urban region counterparts because they used more specialized words than their urban region counterparts, both when describing surface *and* groundwater hydrological processes.

Figure 8.6 below presents some of the responses that intimate cognitive models. Responses from the urban region have been randomly paired with responses from the rural region (an attempt was made to pair surface water descriptions—"treat"—with ground water descriptions—"well").

In the table below, "**" indicates that the respondent was asked for further information concerning the preceding statement and that further statements were given.

Figure 8.6: Comparison of Themes Concerning Surface and Subsurface Hydrological Processes

Source	Region One	Source	Region Two
treat	No knowledge	treat	"The water comes from a spring in the ground up north of Helen in the National Forest."
treat	No knowledge	treat	"The water comes from the base of the mountains in an area called 'Blue ridge Circle.' Then it comes down to Helen."
treat	"Water comes from the Rivers and creeks in North Georgia"	treat	"Water comes from the Tenestanee up in the hills. It's spring fed and comes down."
treat	No knowledge	treat	No knowledge
treat	"Rainfall forms the rivers that flow into the Chattahoochee"	?	No knowledge.
treat	No knowledge	treat	No knowledge.
treat	"Water comes from rivers in Tennessee and Alabama"	well	"Water comes form the underground aquifer. It seeps down there. It forms underground rivers. The well gets at the underground rivers."
treat	"Water comes from God's creation"	well	"[Water comes from] the ground somewhere."

treat	" It rains in the mountains. The water collects to form the Chattahoochee River that flows down into Atlanta."	well	"There is water in the water table. That's the water table level. Our water comes from the water table."
treat	no knowledge	well	"Water comes through the soil by 'leaching.'"
treat	no knowledge	well	"I'm not sure [where the water comes from]. An underground creek I guess."
treat	no knowledge	well	"The water comes from the rain and underground springs."
treat	"Water comes into the treatment facility from the Chattahoochee and the underground water table. The underground water table is from annual rainfall, which is filtered by clouds from the ocean a long, long time ago." ** "The clouds filter the rain from the ocean."	well	"Our water comes from the water table. Rain equals water. It is absorbed into the ground. I'm paying for last year's drought."
treat	"The rain falls into a catchment that becomes the river."		"[Water comes from a] natural spring?"
treat	"Water comes from the North Georgia mountains and forms the Chattahoochee River and then is pumped into t treatment plant."		"[Water comes] from the aquifer. It's sealed off from groundwater. It's sealed off around the water. The water is in the aquifer." ** "It's always been there"
treat	"The water comes form north Georgia, I think."	well	No knowledge.
treat	"Lake Lanier? I don't know."	well	"There is a certain level down there. It seeps through the rock over a period of time."** "I'm not sure how it gets replaced."
treat	"[Water comes from] rainfall in the mountains, I guess."		

Some of the repeated themes for surface waters include the overt and implied notions of a catchment—the words "collect," and 'catchment' were both used above. For subsurface hydrology, we may intimate a them involving percolation—"seeps," "absorption," leaching," are all used. Also, we have the notion of a certain 'level' of water that is maintained but that can drop—"water table" is used twice, in addition to "underground spring" and "underground creek" and "underground rivers" are all mentioned indicating a theme that water flows freely underground. Finally, the word "aquifer" is used twice indicating some specialized knowledge concerning underground water resources.

For comparative purposes, and to establish the domain and range of knowledge, included below are several responses to the question above designed to elicit cognitive models. In this example, the respondents are Sierra Club members (a non-random sample group) from various chapters in the Atlanta region.

A first respondent explains the ultimate source of his drinking water like this: "Simply, water comes from the ocean, it comes down in the form of rain and snow. Its all the same water going around in a huge circle." A second respondent commented, "My water comes from the Etowah River. There is a dam near Red Top Mountain that holds the water. The rain ultimately comes from the clouds into the mountains." A third respondent uses very specific terminology from the environmental 'discourse community' that presumably is associated closely with scientifically oriented cognitive models and ecological research. He comments, "Rain events create runoff that percolates through the leaf litter and into the ground, eventually emerging as springs and seeps."

Ultimately, it appears that the knowledge of Upper Chattahoochee Watershed residents is lacking in terms of its relational understanding of the hydrological cycle. Certainly, this finding may further reinforce the implications of the general lack of knowledge outlined earlier, especially as it applies to environmental behavior and participation in policy formation. Further, the importance of specific water quality problems may be underestimated as the result of a failure to understand the implications of relational hydrological knowledge.

Knowledge 'Movement'

There were at minimum two questions in the inventory that were to be used to help understand the sources of knowledge and the water knowledge experts in the region. The understanding of information flows in the watershed, while having little direct effect on the foreseeable ecological outcomes, are important because they represent the ability of residents to sequester ecological knowledge in the event of a particular concern about water quantity or quality.

The first question asked respondents to list the 'individuals, agencies, media sources, or experiences' in their lives that most contributed to their knowledge as an adult. Respondents almost exclusively cited institutions and organizations as sources of their knowledge. This made it unnecessary to complete formal network calculations (Ford 1976, Hammer 1983, Atran 1999), and the institutional lists were helpful in understanding the potential of respondents to gather information about water resources. Following this, and much more to the point of the study, the respondents were asked who they would contact for help or information if they had a question about their drinking water, water quality or water quantity. These two questions represent the social informational and expert networks of the informant, respectively. In addition to the these network questions and any novel follow-up questions, recall that respondents were asked to attempt to 'source' their knowledge for *all* research inventory questions that they answered giving an indication of the major sources of their knowledge about water resources. Results are discussed later in this Chapter and in the conclusion.

Respondents reported that the two most important sources of information in their lives were books and their formal education. Each accounted for 11.43 percent of the total responses. The water expert question, however, found that municipal water supply utilities would be the most important source of information in the event of concern over water quality or quantity. City/county authorities were listed as the most important source of information by 29.4 percent of respondents, and city/county authorities composed 35.1 percent of total responses. Controlling for respondents who reported having well water, 57 percent of respondents mentioned the city/county water authority as an expert source concerning water quantity and quality, 30.7 percent of which offered the city/county as the most important source.

The Georgia Environmental Protection Division (EPD), the Environmental Protection Agency (EPA), and the Georgia Division of Natural Resources (DNR) were mentioned relatively often in the expert measure. Combined, they are mentioned with relative frequency. The EPD was mentioned as the most important 'expert' in 2.9 percent of the responses, but composed 2.7 percent of overall responses. The EPA was mentioned as the most important 'expert' in 11.4 percent of the responses, and composed 9.4 percent of overall responses. The DNR was mentioned as the most important 'expert' in 2.9 percent of the responses, and composed 4.9 percent of overall responses.

Overall, 17.6 percent of respondents listed one of the agencies (EPA, EPD, or DNR) as the most important 'expert' of water issues/problems, and they received 6.16 percent of the overall responses.

One interesting note concerning the above data is that several respondents mentioned concern over the accuracy of water quality information. That is, they report that they would be skeptical of information provided by the city/county water authorities. In fact, when the conversation involved the threat of contaminated water, several respondents shifted to this stance of distrust. For example, one gentleman explained his distrust of water quality information after describing the mailer received from the Cobb County water authority. He noted “I don’t trust those things.” When asked to give further details, he added “if they have to tell you how clean it is, I don’t trust them.” This may help explain the results above. That is, while the city/county water authorities are considered an important source of information, outside regulatory agencies may provide a “second opinion” of the situation in question.

Estimation of pollution sources

Other findings of interest involve past literature concerning the perceived threats to water quality and aquatic biota. Some previous work indicates that environmental knowledge is implicated in motivating environmental behavior (Dunlap and Van Liere 1978, Scott and Willits 1994). These measures might have direct effect on political activity and environmental behavior in the Upper Chattahoochee Watershed.

According to the USGS (1996), habitat loss and degradation and over-harvesting are the most significant factors contributing to the listing of Apalachicola-Chattahoochee-Flint River basin aquatic fauna under the Federal Endangered Species Act. As mentioned, however, chemical and organic pollution are commonly perceived (USGS 1996) as the greatest threats to aquatic fauna, and are of primary concern to human-health and water-quality monitoring programs.

The respondents in the watershed cited various organic and chemical pollutants in the Chattahoochee and its tributaries. The most oft-mentioned sources of contamination were human waste, industrial point-source pollutants, and trash, all earning twelve percent of the total contaminants mentioned. However, in terms of importance, agricultural wastes and fossil urban runoff were cited most commonly as the most egregious pollutants in the watershed, each earning 11.42 percent of the total contaminants listed as "most important."

This is an interesting finding as in the Chattahoochee-Flint River Basin in general, the major sources of both nitrogen and phosphorous loads in the watershed as a whole are poultry and livestock waste runoff. Poultry and livestock and inorganic sources of agricultural fertilizer combined discharged 200,000 tons of N into the Apalachicola-Chattahoochee-Flint river basin in 1990. Total phosphorous loads were 47,000 tons in 1990 alone (USGS 1996).

Finally, and of particular importance, was the determination of water quality in the watershed. Respondents in the urban region, when asked to rate the quality of the Chattahoochee nearest to them using a scalar measure (one—extremely dirty—to ten) reported a mean water quality at 2.85, and a median value of 3.00. In contrast, the rural region respondents rated their nearest section or tributary of the Upper Chattahoochee with a mean quality value of 7.25, and the median value at 8.00. Therefore, although assigning a simple numerical value to the quality of the Chattahoochee River anywhere along its course does no justice to the complexity of water chemistry, the loads of most major pollutants in the Chattahoochee do increase from North to South along the run of the river. As mentioned in Chapter 2, the heavy loads of phosphorous and nitrogen tend to move down river, and accumulate with the waste-water treatment facility contributions, the combined sewer overflows, and the illegal out-fall pipes as the waterway approaches the Atlanta metropolitan region. Thus, the rural region and the urban region inhabitants do seem to be able to make gross judgements concerning water quality between regions.

Several mutually-influencing factors can be imagined to explain this awareness on the part of the respondents. First, direct experience of the respondents with their local riverine resources (and the concomitant awareness of water quality indicators) may have been responsible for the findings. Second, the knowledge may have been obtained as 'second-hand knowledge' concerning their local riverine resource. Finally, a general cognitive model of the surface hydrology of the Chattahoochee may be involved, which would require at minimum the awareness of downstream bio-accumulation, and therefore would require also knowledge of the "source" region of the Chattahoochee and the rough direction of flow.

Water sources

For many people in the Upper Chattahoochee Watershed, the Chattahoochee River is most often experienced by the drinking water it offers their tap. However, in the Upper Chattahoochee Watershed, knowledge concerning the source of water and the routing of municipal systems is often lacking. In the Upper Chattahoochee Watershed, thirty-seven percent of the Upper Chattahoochee Watershed randomly selected respondents were unsure of the source of their residential water supply. Broken down by region, fifty percent of the respondents in the urban region had no knowledge of the water resource that contributed to their residential water supply. In the rural region, twenty-three percent had no knowledge of the water resource that contributes to their residential water supply. In part, these figures represent the effect of infrastructural investment in the urban areas. In the urban areas, responsibility for the maintenance of water delivery is almost always the job of the city or county government, and thus knowledge of the system is largely unnecessary. Even in the rural regions however, almost one quarter of respondents had no knowledge of the source of their drinking water.

This finding has several potential ramifications. We have already noted that ecological behavior is most probable in the event of ecological challenges that directly effect the consumer, and where there is high measurement correspondence (Kaiser et al. 1999). Therefore, the lack of water source knowledge could conceivably limit the importance of specific second-hand water knowledge in the behavior of the subject. For example, heavy pollution in any given water source may be considered irrelevant unless it is understood as the source of the subjects' drinking water.

'First-hand' Information Acquisition

This project attempted to develop specific informational pathways. F*irst-hand* information is knowledge gleaned directly from "nature," (the non-human environment). Sec*ond-hand* information is knowledge about the non-human environment from *cultural* sources. While the data indicate that both measures may have been capturing first-hand knowledge, there may be some important implications of the first-hand knowledge (and the development of measures to highlight it).

In relatively simple societies, environmental knowledge, attitude, and relevant relational structures (cognitive models, image schemas) are reproduced in part by participation in production practices that often involve the 'capturing' of particular suites of ecological knowledge. In urban areas of complex societies, the built environment removes the population from necessary exposure to "nature" in the process of production (see Chapter 5 for more details). Therefore, while the population of the Atlanta metropolitan area depends on the watershed for it's drinking water, the water resources in and around Atlanta are largely invisible to the population. While most respondents knew of the existence of the Chattahoochee River, for example, few had consistent exposure to the rivers, and fewer still possessed an understanding of the surface hydrology of the area as indicated by their inability to explain the hydrological relationships between primary and secondary rivers, for example.

However, given the lack of recreation or subsistence exposure to the waterways of the watershed, some of the knowledge 'sourcing' questions of the Upper Chattahoochee Watershed Project indicate that direct experience with water resources—first-hand knowledge—provided a majority of the extant knowledge of the watershed in many categories. For example, the life-worlds of the urban subjects are enmeshed in a rich infrastructural network of roads and bridges. Traveling the roads and bridges proved a a major source of first-hand, novel water knowledge in the urban region.

Over forty-eight percent of the respondents indicated that "driving by" the water resources in question instructed their knowledge about those resources. However, driving by water resources affected more than just the ability of respondents to list water bodies. Coupled with 'accurate' local indicators of water quality, the drive-bys contributed significant knowledge to the respondents, at least in terms of drought and turbidity.

For example, a respondent from Dahlonega, describing why she thought that a drought was a relevant water problem on her area, remarked that while driving by Lake Lanier, "the entire swimming area was dry. The buoys were lying in the ground." A respondent from Cleveland gave a similar report. "I drive over the lake all of the time. Now the water is real low. The lake is down fifteen feet."

Others made judgements about water quality while driving over the lake. Interestingly, the most salient example comes from a respondent who is new to the area, and presumably whose cognitive model of water cleanliness does not include the silt loads common in Georgia streams after rain events. The respondent commented, " . . . when I first came to Atlanta four and-a-half years ago, [from Michigan] I can remember driving over the [Chattahoochee] bridge the first time . . . [the water was] so dirty brown from agriculture . . .it always looks brown to me. I'm not used to muddy rivers. My rivers and lakes are blue. I miss the blue waters in Michigan. When you come from a place where the water is clear and pretty, you ask, 'where are the blue lakes?' So I wouldn't [swim in] the Chattahoochee."

Additionally, sixty-four percent of respondents indicated that their knowledge of one or more bodies of water was the result of recreational activities on or around the bodies of water mentioned. Fishing was the most commonly mentioned discrete category of recreational activity, although knowledge of fishing seems to yield little knowledge of water quality (see next section). Roughly twenty percent of respondents indicated they fished for recreation. Sixteen percent of the respondents report that their knowledge of one or more bodies of water was the result of boating activities. The rest of the respondents were composed of hikers (eight percent of recreationalists) and other assorted activities (forty-four percent of recreationalists).

Local indicators

An important and interesting measure in the study concerned the 'local indicators' of water quality measure. As mentioned earlier, this measure involved asking respondents how they might determine the quality of water in a nearby body of water. Of particular interest to this measure was the fact that the respondents were able to describe interacting with water in numerous ways to explain how they would ascertain water quality. It was thought that this question might permit the identification of 'cognitive models', or that it would be a question that provided for easy differentiation between respondents concerning the complexity of their knowledge. For example, respondents might explain that they would look for particular aquatic insect species, or that they might consider particular species of plants and animals as indicative of water quality—herein referred to as 'second order' knowledge.

This was rarely the case in the study population. While some respondents mentioned folk-kingdom and life-form ranked "animals" and "fish" as indicators of "good" water quality, few mentioned particular species of fish or plants as specific indicators of good or bad water quality. However, there were five exceptions. Three respondents (eight percent of the sample) mentioned a folk-specific category "trout" as being indicative of "good" water quality, and two of these were recreational fishers. Interestingly, however, historically there were fifty species of fishes known in the waters in and around Atlanta. Of these, at least thirty-four are still extant in the area (USGS 1995). Many of these are known to biologists as being indicative of poor water quality, including carp and mosquito fish.

Two others (five percent of the sample) mentioned that "algae" were indicative of poor water quality. In contrast, the vast majority of respondents listed clarity as the premier indicator of water quality. Interestingly and perhaps related, are that fully sixteen percent of respondents indicated that they would drink the water directly from the Chattahoochee River.

Yet another interesting finding was a positive correlation between the 'sensitivity' measure and the age of the respondent using Pearson's r correlation (see Table 6.2, below). Recall that the 'Sensitivity' measure was developed from question five in part two of the research inventory, where respondents were asked how they might "determine the quality of water in a nearby body of water " (via interaction with the body of water but without the use of formal 'scientific' instruments). They were encouraged to give both "good" and "bad" indicators of water quality in order of their importance/utility.

Counting appropriate responses to this question provided ratio level data that could be used as a measure of environmental knowledge. The raw count measure of appropriate responses was labeled 'Sensitivity.'

That older individuals would have more water knowledge then younger persons is not surprising in an intuitive sense, or from the perspective of the literature (Mohai and Twight 1987, Buttel 1987, Dunlap and Catton 1979). Intuitively, if we assume that knowledge can be stored, and that 'learning' takes place throughout life, we should assume that older individuals would demonstrate more knowledge as measured by 'Sensitivity.'

Figure 8.7: *Pearson's r* correlation of the 'Age' and 'Sensitivity' Measure

Correlations

		AGE	Sensitivity
AGE	Pearson Correlation	1.000	-.397(*)
	Sig. (2-tailed)	.	.018
	N	35	35
Sensitivity	Pearson Correlation	-.397(*)	1.000
	Sig. (2-tailed)	.018	.
	N	35	35

Summation

This chapter began by offering some analysis of the findings concerning the formal hypotheses of the project. Two findings were discussed. The first was the negative relationship between environmental attitude and knowledge in the rural study region. the second was the finding of greater knowledge in the rural study region. The explanation for both findings involved multiple factors including the knowledge measures themselves, the physiographic and demographic qualities of the study region, and self-selection and other sampling skews.

The possibility of a poor sample was explored first toward ruling out Type I Error. It was argued that the populations may have been less than ideally representative (they did not mirror 2000 Census findings) as the result of various self-selection skews potentiated by a cultural reluctance to participate in water research or accept phone calls at home.

Other issues concerning the falsification of the hypotheses include the finding of a negative relationship between the measures 'Total Environmental Knowledge' and 'Environmental Attitude' in the study region fueled by the same strong relationship in the rural region. Accordingly, it was argued that some of the original hypotheses could be true (Type I error) but that the articulation of the 'First-hand' and 'Second-hand Knowledge' measures were all "First-hand Knowledge" measures. The implications of this relationship are discussed.

Secondly, the chapter reported findings not directly related to the formal hypotheses of the project. Environmental knowledge and attitude can be important issues as they relate to larger ecological processes. First, environmental knowledge and attitude can lead to direct environmental involvement in local or regional issues of concern, especially when those concerns are borne-out with local consequences (Kaiser et al.1999). Additionally, however, public knowledge is important because it affects the development of resource use policy. Recent changes in organizational theory and resource use management strategies have meant that public involvement is an increasingly important factor in the development and implementation of environmental policies (Pelstring 1997), which directly relate to the environmental attitude and knowledge of the populace.

A very basic measure pertinent to public involvement was the elicitation of a list 'water problems' from all participants. When asked to list 'water problems' in the area, (N=176 including the random, non-random and targeted samples), eighty three percent of the respondents listed “pollution” as a water problem in their area. Of those listing “pollution,” only thirty-four percent mentioned another ‘water problem’ in the area.

Forty-two percent of respondents referenced ‘drought’ or another water quantity problem. Of these, twenty-seven percent of respondents mentioned no other water problems in the region. Seven percent of the respondents mention erosion as a particular problem in the watershed. In twenty-five percent of the cases, erosion was the only water problem given.

Other findings highlighted in the chapter include the importance of experience—first-hand knowledge—toward the ability to list water resources in the Upper Chattahoochee Watershed study area. As outlined in Chapter 5, the ‘life-worlds’ of urban and rural region subjects are different in terms of their “windows” of potential first hand knowledge. Urban subjects living in the built environment have limited “windows,” but their scant knowledge of water problems in the region is provided mostly via their transportation activities. Over forty-eight percent of the respondents indicated that their knowledge of one or more of bodies of water was the result of driving over them. Also involving first-hand knowledge and experience, sixty-four percent of respondents indicated that their knowledge of one or more bodies of water was the result of recreational activities on or around the bodies of water mentioned.

There were precious few ‘second-order’ indicators of water quality mentioned during the interviews. Three respondents (eight percent of the sample) mentioned a folk-specific category “trout” as being indicative of “good” water quality, and two of these were recreational fishers. Two others (five percent of the sample) mentioned that “algae” were indicative of poor water quality. In contrast, the vast majority of respondents listed clarity as the premier indicator of water quality.

A relationship was found between 'Age' and 'Sensitivity' measures that was not surprising from the perspective of the literature or an intuitive understanding of knowledge accumulation. Finally, respondents in the watershed accurately indicated that farming waste was the most important contaminant in the Chattahoochee. Further inhabitants of the rural region accurately rated the quality of their water significantly higher than urban region respondents.

While there was relatively little knowledge indicated toward the development of cognitive models, some of the data was presented. Some of the repeated themes for surface waters include the overt and implied notions of a catchment—the words "collect," and 'catchment' were both used above. For subsurface hydrology, we may intimate a them involving percolation—"seeps," "absorption," leaching," are all used. Also, we have the notion of a certain 'level' of water that is maintained but that can drop—"water table" is used twice, in addition to "underground spring" and "underground creek" and underground rivers" are all mentioned indicating a theme that water flows freely underground. Finally, the word "aquifer" is used twice indicating some specialized knowledge concerning underground water resources.

Concerning the 'movement' of knowledge in the Upper Chattahoochee Watershed, respondents reported that the two most important sources of information in their lives were books and their formal education. Each accounted for 11.43 percent of the total responses. The water expert question, however, found that municipal water supply utilities would be the most important source of information in the event of concern over water quality or quantity. City/county authorities were listed as the most important source of information by 29.4 percent of respondents, and city/county authorities composed 35.1 percent of total responses. Controlling for respondents who reported having well water, 57 percent of respondents mentioned the city/county water authority as an expert source concerning water quantity and quality, 30.7 percent of which offered the city/county as the most important source.

Still other findings involved the estimation of pollution sources in the Upper Chattahoochee Watershed. The respondents in the watershed cited various organic and chemical pollutants in the Chattahoochee and its tributaries. The most oft-mentioned sources of contamination were human waste, industrial point-source pollutants, and trash, all earning twelve percent of the total contaminants mentioned. However, in terms of importance, agricultural wastes and fossil urban runoff were sighted most commonly as the most egregious pollutants in the watershed, each earning 11.42 percent of the total contaminants listed as "most important." This is an interesting finding as in the Chattahoochee-Flint River Basin in general, the major sources of both nitrogen and phosphorous loads in the watershed as a whole are poultry and livestock waste runoff. Poultry and livestock and inorganic sources of agricultural fertilizer combined discharged 200,000 tons of N into the Apalachicola-Chattahoochee-Flint river basin in 1990. Total phosphorous loads were 47,000 tons in 1990 alone (USGS 1996).

Finally, and of particular importance, was the determination of water quality in the watershed. Respondents in the urban region, when asked to rate the quality of the Chattahoochee nearest to them using a scalar measure (one—extremely dirty—to ten) reported a mean water quality at 2.85, and a median value of 3.00. In contrast, the rural region respondents rated their nearest section or tributary of the Upper Chattahoochee with a mean quality value of 7.25, and the median value at 8.00. Therefore, the loads of most major pollutants in the Chattahoochee do increase from north to south along the run of the river.

As mentioned in Chapter 2, the heavy loads of phosphorous and nitrogen tend to move down river, and accumulate with the waste-water treatment facility contributions, the combined sewer overflows, and the illegal out-fall pipes as the waterway approaches the Atlanta metropolitan region. Therefore, the rural region and the urban region inhabitants do seem to be able to make gross judgements concerning water quality between regions. Several mutually influencing factors can be imagined to explain this awareness on the part of the respondents. First, direct experience of the respondents with their local riverine resources (and the concomitant awareness of water quality indicators) may have been responsible for the findings. Second, the knowledge may have been obtained as 'second-hand knowledge' concerning their local riverine resource. Finally, a general cognitive model of the surface hydrology of the Chattahoochee may be involved, which would require at minimum the awareness of downstream bio-accumulation, and therefore would require also knowledge of the "source" region of the Chattahoochee and the rough direction of flow.

CHAPTER 9

LIMITATIONS

The Upper Chattahoochee Research Project faced a number of challenges toward developing a scaling, spatially relevant account of the 'distribution,' 'movement' and potential 'acquisition of novel ecological knowledge' in the Upper Chattahoochee Watershed. A primary issue was the lack of a coherent, unified theoretical background spanning the sub-fields utilized in the project. There are few over-arching theories of cognition and fewer still that might meaningfully be extended out of the theoretical realm and applied to the subfields utilized by this project. Nor was there any procedure or previously developed measures of knowledge that might help elicit first-hand and second-hand type knowledge. The knowledge measures of this study, therefore, were developed 'on the run,' without a testing period to ensure their validity, either combined or separately, and without a unified theoretical backdrop. Further study will help discern rural, ecologically sensitive knowledge suites from urban knowledge suites. Towards this goal, some of the research findings did indicate that perhaps the 'total knowledge' measure used in the study might meaningfully be used as a measure of "first hand" or local knowledge in future research.

A second limitation was the apparent lack of environmental "knowledge" in the watershed itself, at least in the domains measured herein. On many inventory questions, valid responses were so few that articulating differences between individuals, and certainly between populations, was difficult at best. Even basic questions concerning the source of residential water or its treatment enjoyed few responses and thus few opportunities to elaborate on the distinction between individual and population level differences in knowledge. Importantly, and in combination with the limitation below (low respondents) it also led to the inability to attempt to discern differences in knowledge between micro-regions as originally planned. Ultimately, however, this ‘limitation’ was to some extent expected, as Maloney and Ward 1973, Council of Environmental Quality 1980, and Arcury 1992 all indicated. Therefore, the extant knowledge in the study areas became more meaningful.

Another broad limitation of the Upper Chattahoochee Research Project followed from various cultural factors that affected the research. The number of fully random, properly drawn respondents was relatively low, although the sample was statistically adequate. This result, however, was probably due in part to the system used to contact potential respondents: the telephone. It would seem that at least part of the low acceptance rate of the respondents were the result of the prevalence of direct to the home phone marketing campaigns. This conclusion is reached because numerous potential respondents said, “I don’t want to buy anything” numerous times during and after the initial introduction by the researcher. After repeated attempts to convince them otherwise, some of the potential respondents chose to participate.

A final limitation involves the use of phone conversations as the predominant data gathering technique toward the completion of the random research inventories. Phone interviews were selected as the primary data-gathering device for the *randomly* selected respondents for several reasons. Much of the previous work done on environmental knowledge was completed via the phone interview format, and thus it was thought that a parallel methodology would make good use of a data set that was already expected to be less than rich (Maloney and Ward 1973, Council of Environmental Quality 1980, Arcury 1992). Also, as mentioned, the research questions of the project demanded a random sample from the research population. And contacting the potential respondents by phone was deemed the most amenable contact method to ensure randomness. However, the use of the phone brought with it several ramifications. First, while it was originally planned to contact the respondents by phone and to complete the surveys in person, in practice this was difficult to achieve. As mentioned, participation was low, and respondents were even less likely to agree to a formal meeting. A second ramification involves the first: how were the project findings limited or affected by the lack of personal contact with the respondents? Or, more strongly, how might a different research design involving intensive fieldwork affect the findings of the research?

It is difficult to foresee what intensive 'on the ground' fieldwork might have achieved. First, the original intention, as mentioned, was to do the interviews in person for the random sample respondents, much like the other non-randomly selected respondents that were interviewed in person. Further, the original design also called for a follow-up inventory to be administered to a subset of the original sample, chiefly involving the articulation of 'cognitive models.' This would have looked much more like traditional notions of fieldwork. It was quickly noted that because the 'relational' knowledge of hydrology and water treatment, for example, were so limited, every question should be asked in such a way as to encourage the articulation of cognitive models. Another impetus behind the follow-up surveys was to collect formal network data from respondents. Once again, the measure was largely irrelevant, as respondents cited institutions and media sources as their primary sources of knowledge concerning the environment (as opposed to people) thus making the 'snowball' measure impossible. Finally, the phone interviews themselves were relatively rich, and some interviews lasted over an hour, and few lasted less than thirty minutes.

In person interviews were easily obtained from interested target groups (Sierra Club members, and the Upper Chattahoochee Riverkeeper groups, for example) but this population could not provide the random data needed to try and meet the project objectives. It did indicate, however, that given the research inventory in question, there were no particular advantages to the in-person, on-the-ground fieldwork, as data in each case appeared no 'richer' than phone interviews. An exception is the data gathered from the Sierra Club respondents, who offered more depth in their responses. However, it is thought that the richer data in this case is more the result of a more knowledgeable sub-group than the nature of the fieldwork method, as other 'in-person' respondents demonstrated no such richness in their responses. Therefore, it can be safely assumed that data richness (or lack thereof) was more the result of a lack of knowledge and/or a poor research design, but not a limitation wrought of the phone methodology.

A second point of importance concerning the phone-based research involves the close association of any given field method to the nature of the research question. In a typical fieldwork example, the relative lack of data volume and 'richness' should naturally point to more intensive fieldwork methodologies to discern intra-population differences in knowledge. However, in the Upper Chattahoochee Watershed example, it is arguable that the nature of the research questions (that demanded initial phone contact) and the nature of the knowledge distribution (highly dispersed data points) call precisely for phone interviews. In other words, when the data are rich, rich methodologies should follow. But because this study was measuring the random distribution of ecological knowledge—admittedly dispersed in complex societies—phone methodologies are perhaps justified. Using the phone contacting method seems especially appropriate given the relative unwillingness of phone-contacted individuals to permit an in-person interview.

CHAPTER 10

CONCLUSIONS

The primary goals of this project were to explore how individuals 'acquire' and 'process' ecological information. 'Acquisition' in this case refers to the attempt to measure and explain the distribution of individual knowledge suites of particular ecological features or processes. The 'processing' component of cognitive ecology seeks to explore the 'movement' of knowledge (as surmised by self-report knowledge 'sourcing') but also the related question of how a particular environmental knowledge and attitude distribution in a given region might effect larger political processes as determined by previous research. Finally, an additional implicit and related goal was the development of relevant knowledge measures that permit the articulation of particular knowledge suites in complex societies and that might augment the understanding of knowledge acquisition.

In the first chapter, the project goals were clearly stated. Further, it was written 'at best, the project may contribute to predictive theory concerning the quality and quantity of knowledge about particular resources in complex societies using demographic and spatial variables as predictors. It may also contribute directly to the literature on the informational and ethnoecologies of complex societies, environmental sociology and anthropology, and human ecology generally. At the very least, it will be a descriptive and informative account of the cognitive ecology of the Upper Chattahoochee watershed.' All of the project goals were accomplished. First, the *distribution* of knowledge as represented by a number of water-related measures was determined. Chapter 5 considered how the particular political, ecological, cultural and infrastructural factors of living in the rural and urban regions—the lifeworlds of the subjects— permit or obfuscate the acquisition of new ecological knowledge. Chapter 8 provided raw data from general research items, as well as an explanation of the formal and general findings with reference to ecological implications based on the available literature.

In contrast, this chapter will provide a brief summary of the project findings, but will also outline the *contributions* of the project and intimate some directions for further research. A summary of most of the relevant findings is presented below.

<u>Summary: Formal Hypotheses</u>

Formal hypotheses were developed toward the further elaboration of the already well-developed literature on the relationship between a host of demographic variables and environmental attitude and knowledge. However, several 'alternative' hypotheses were developed charging that previous findings were epistemologically crude, and as a result privileged urban knowledge/attitude suites due to a methodology that ultimately begged the development of the special 'first' and 'second-hand' knowledge measures used herein. Then, in case the 'alternative' hypotheses failed, other hypotheses were developed that were representative of the previous research, and attempted to further resolve the nature of the relationship between knowledge and attitude on the one hand, and age, sex, earnings, education, and residence (urban vs. rural) on the other.

However, none of the formal hypotheses were corroborated. In fact, most of the hypotheses, built as they were on the foundation of previous research, were unlikely to be corroborated after it was found that the most primary experimental relationship predicted by the literature—higher knowledge and attitude in urban region, lower in rural region--was not corroborated.

Typically, the lack of results against such a rich literature would indicate a faulty sample. However, in the case of this project, the results may indicate that some components of the 'alternative hypotheses' and its measures warrant further consideration. For a discussion of these findings, see "Contributions and Directions for Further Research," below.

Summary: General Findings

The most striking general finding of the study was the lack of relative knowledge about basic water resources—both in terms of basic domestic delivery systems and hydrological/physiographic knowledge—but also the anthropogenic threats to the water supply. However, while the extant ecological knowledge in the Upper Chattahoochee Watershed appears minimal, this was to be expected from much previous research (Maloney and Ward 1973, Council of Environmental Quality 1980, Arcury 1992), and only highlights further the formal and informal findings of the project.

There were some obvious differences between rural and urban respondents' knowledge of their local water supplies. A very basic measure pertinent to public involvement (and thus ecological outcomes) was the elicitation of a list 'water problems' from all participants. When asked to list 'water problems' in the area, (N=176 including the random, non-random and targeted samples), eighty three percent of the respondents listed "pollution" as a water problem in their area. Of those listing "pollution," only thirty-four percent mentioned another 'water problem' in the area. Forty-two percent of respondents referenced 'drought' or another water quantity problem. Of these, twenty-seven percent of respondents mentioned no other water problems in the region. Seven percent of the respondents mention erosion as a particular problem in the watershed. In twenty-five percent of the cases, erosion was the only water problem given.

Additionally, sixty-four percent of respondents indicated that their knowledge of one or more bodies of water was the result of recreational activities on or around the bodies of water mentioned. Fishing was the most commonly mentioned discrete category of recreational activity, although knowledge of fishing seems to yield little knowledge of water quality (see next section). Roughly twenty percent of respondents indicated they fished for recreation. Sixteen percent of the respondents report that their knowledge of one or more bodies of water was the result of boating activities. The rest of the respondents were composed of hikers (eight percent of recreationalists) and other assorted activities (forty-four percent of recreationalists).

There were precious few 'second-order' indicators of water quality mentioned during the interviews. Three respondents (eight percent of the sample) mentioned a folk-specific category "trout" as being indicative of "good" water quality, and two of these were recreational fishers. Two others (five percent of the sample) mentioned that "algae" were indicative of poor water quality. In contrast, the vast majority of respondents listed clarity as the premier indicator of water quality.

A relation ship was found between 'Age' and 'Sensitivity' measures that was not surprising from the perspective of the literature or an intuitive understanding of knowledge accumulation. Finally, respondents in the watershed accurately indicated that farming waste was the most important contaminant in the Chattahoochee. Further, inhabitants of the rural region accurately rated the quality of their water significantly higher than the urban region respondents.

While there was relatively little knowledge indicated toward the development of cognitive models, some of the data was presented. Some of the repeated themes for surface waters include the overt and implied notions of a catchment—the words "collect," and 'catchment' were both used above. For subsurface hydrology, we may intimate a them involving percolation—"seeps," "absorption," "leaching," are all used. Also, we have the notion of a certain 'level' of water that is maintained but that can drop—"water table" is used twice, in addition to "underground spring" and "underground creek" and underground rivers" are all mentioned indicating a theme that water flows freely underground. Finally, the word "aquifer" is used twice indicating some specialized knowledge concerning underground water resources.

Concerning the 'movement' of knowledge in the Upper Chattahoochee Watershed, respondents reported that the two most important sources of information in their lives were books and their formal education. Each accounted for 11.43 percent of the total responses. The water expert question, however, found that municipal water supply utilities would be the most important source of information in the event of concern over water quality or quantity. City/county authorities were listed as the most important source of information by 29.4 percent of respondents, and city/county authorities composed 35.1 percent of total responses. Controlling for respondents who reported having well water, fifty-seven percent of respondents mentioned the city/county water authority as an expert source concerning water quantity and quality, 30.7 percent of which offered the city/county as the most important source.

Still other findings involved the estimation of pollution sources in the Upper Chattahoochee Watershed. The respondents in the watershed cited various organic and chemical pollutants in the Chattahoochee and its tributaries. The most oft-mentioned sources of contamination were human waste, industrial point-source pollutants, and trash, all earning twelve percent of the total contaminants mentioned. However, in terms of importance, agricultural wastes and fossil urban runoff were sighted most commonly as the most egregious pollutants in the watershed, each earning 11.42 percent of the total contaminants listed as "most important." This is an interesting finding as in the

Chattahoochee-Flint River Basin in general, the major sources of both nitrogen and phosphorous loads in the watershed as a whole are poultry and livestock waste runoff. Poultry and livestock and inorganic sources of agricultural fertilizer combined discharged 200,000 tons of N into the Apalachicola-Chattahoochee-Flint river basin in 1990. Total phosphorous loads were 47,000 tons in 1990 alone (USGS 1996).

Finally, and of particular importance, was the determination of water quality in the watershed. Respondents in the urban region, when asked to rate the quality of the Chattahoochee nearest to them using a scalar measure (one—extremely dirty—to ten) reported a mean water quality at 2.85, and a median value of 3.00. In contrast, rural region respondents rated their nearest section or tributary of the Upper Chattahoochee with a mean quality value of 7.25, and the median value at 8.00. Therefore, although assigning a simple numerical value to the quality of the Chattahoochee River anywhere along its course does no justice to the complexity of water chemistry, the loads of most major pollutants in the Chattahoochee do increase from North to South along the run of the river. As mentioned in Chapter 2, the heavy loads of phosphorous and nitrogen tend to move down river, and accumulate with the WWTF contributions, the combined sewer overflows, and the illegal out-fall pipes as the waterway approaches the Atlanta metropolitan region. Therefore, rural region and the urban region inhabitants do seem to be able to make gross judgements concerning water quality between regions.

Several mutually influencing factors can be imagined to explain this awareness on the part of the respondents. First, direct experience of the respondents with their local riverine resources (and the concomitant awareness of water quality indicators) may have been responsible for the findings. Second, the knowledge may have been obtained as 'second-hand knowledge' concerning their local riverine resource. Finally, a general cognitive model of the surface hydrology of the Chattahoochee may be involved, which would require at minimum the awareness of downstream bio-accumulation, and therefore would require also knowledge of the "source" region of the Chattahoochee and the rough direction of flow.

Ecological Considerations of General Findings

Because ecological knowledge can affect policy development and resource management generally, the distribution of knowledge has real implications for the trajectory of resource use patterns. Importantly, rural participants in the Upper Chattahoochee Watershed demonstrated more knowledge and higher 'attitude' scores than their urban region counterparts. However, with increasing knowledge the rural subjects demonstrated less environmental attitude. And conversely in urban areas where environmental attitude is (supposedly) higher, first-hand knowledge is difficult to obtain because of the built environment and infrastructural buffers. Both of these findings may bode poorly for the political ecology of the watershed, as previous work on the relation between attitude and knowledge has indicated that environmental knowledge builds environmental attitude, which is implicated in motivating environmental behavior (Dunlap and Van Liere 1978, Scott and Willits 1994). These would seemingly be important findings in and of themselves. Thus, if this logic is applied to the Upper Chattahoochee Watershed, the individuals most able to "cognize" ecological change—rural respondents with more general and "first-hand" knowledge—are the individuals least likely to respond to ecological change with ecological behavior.

However, due to other findings of the project, this conclusion was argued to be faulty for two related reasons. The first reason involves the nature of the knowledge measures used. As discussed above, the "First-hand Knowledge" measure (and arguably the “Second-Hand” measure) was capturing situated knowledge unlike previous work that had captured more general knowledge. The domain of situated knowledge should have some bearing on the willingness to respond to ecological challenges. First-hand knowledge has in some sense ‘built-in’ *measurement correspondence*.

The second and related reason that rural respondents with more general and “first-hand” knowledge are not less likely to respond with ecological behavior involves new frameworks in attitude and behavior. Theoretically, different concepts of attitude have been used, some multi-scalar involving cognitive affective and intentional components (Rosenburg and Hovland 1960), others using single components, like the New Environmental Paradigm measure used herein (Dunlap and Van Liere 1978). Attitude measures fail to distinguish between attitude about the environment and attitude toward environmental behavior. Methodological shortcomings of most of the work involve a lack of measurement correspondence between attitude and measured behavior, as well as failure to consider situational influences on behavior. The knowledge measures used herein avoid some of these shortfalls, and are discussed below.

Of much more relevance to the political ecology of the region, an important conclusion involves the earlier findings that knowledge of water resources is generally low in most domains tested. Because public involvement is an important factor in the development and implementation of environmental policies, (Pelstring 1997) the population’s mean environmental knowledge may impact human responses to ecological change.

Contributions and Directions for Future Research

Specifically, there were two formal findings (associated with hypothesis testing) and several general ones that may indicate the value of the 'alternative' hypothesis and/or its measures. The two formal findings were the greater knowledge measures in the rural region, and the negative relationship between environmental attitude and knowledge in the rural region. The argument relating these findings to the 'alternative' hypotheses was made in Chapter 8. Below is discussed some of the practical ecological implications of the findings, as well as some the implications for the field and the study of ecological knowledge generally.

Many of the general findings also echoed the 'alternative' hypotheses' insistence that first-hand knowledge—the experience or 'lifeworld' of the subject—is primary to the acquisition of knowledge. For example, Chapter 8 outlined how the situated acts of transportation (in the urban region) and recreation (in the rural and urban regions) were responsible for more self-reported knowledge of the environment than knowledge gained from second-hand sources. This calls into question the whole of the former research that relates environmental knowledge and attitude with rurality and urbanity. The former research measured *general* knowledge, while the subjects both reported greater knowledge from direct experience, but also demonstrated greater knowledge as defined by the new measures.

The implications of the findings may go beyond the importance of 'situatedness' of the measures. 'First-hand' knowledge measures are more ecologically relevant than previous measures because they are proximal to the concerns of the subjects, and maintain ‘measurement correspondence’ in the lifeworld of the individual (Kaiser et al., 1999). Therefore, the very nature of situated knowledge is that it is well positioned to motivate ecological behavior.

The knowledge measures used herein, and the epistemological challenges to classical knowledge inventories that spawned them, deserve further consideration. The project produced measures of knowledge that permitted both a measure of current knowledge, but also—because of the nature of the questions developed--a measure of the subjects’ probability of noticing water quantity and quality changes in the future. The local knowledge measures might provide alternative explanations to the well-developed literature on environmental knowledge, *and* deliver knowledge measures with an inherent relevance to for ‘ecological behavior’ due to the correspondence of the acquisition of knowledge to the life-world of the subject. Further, however, they also may help to clarify some of the long-standing complexities that relate ecological knowledge and attitude to behavior, and that conflate notions of knowledge as portable, discrete and objective, with notions of knowledge as locally enacted and contextual.

Close

Every human society faces the challenge of ‘cognizing’ important ecological fluctuation, especially those changes that result from anthropogenic perturbation (Ponting 1991). The ability of any society to meet this challenge is related to the distribution and depth of individual knowledge suites. In complex societies, ecological knowledge distribution can be the result of particular trajectories of knowledge in particular times and places, in particular environments, under particular production regimes.

In the United States, the 'particular trajectories of knowledge . . . under particular production regimes' has resulted in a distribution of knowledge that is apparently highly distributed on the basis of education (Richardson et al. 1996), class (Ellen 1993, Buttel 1987), age (Mohai and Twight 1987) subsistence strategy and/or available technology (Brown 1976), and urban residence (Van Lierre and Dunlap 1980). More importantly, the overall quantity of ecological knowledge is very low. According to a recent National Survey by the National Environmental Education and Training Foundation (NEETF), less than one-third of people in the United States know the basic causes of, or content central to, key environmental concerns. And this lack of knowledge has implications. According to the National Environmental Education and Training Foundation,

> There is a knowledge gap that impairs citizens from recognizing what they might do to improve local environmental conditions . . . knowledge of environmental issues positively influences people to participate in pro-environment activities. For example, when people know that garbage ends up in landfills, they are more likely to recycle and cut down on household trash . . . Without support from knowledgeable citizens who understand the issues, policy makers are thwarted in their efforts to solve complex environmental problems . . . Not all of the news is bad, however . . . 90% routinely try to conserve energy, save water, recycle, and actively help protect the environment (Public Relations Society of America, 1998, 1).

This knowledge gap seemingly calls for more environmental education and the increased emphasis on teaching 'second-hand,' general ecological knowledge. However, because knowledge is very specific to particular contexts and involves 'situated social practices' (Hobart 1993), we cannot rely on scientific knowledge to help us 'cognize' all relevant ecological fluctuation. In the Upper Chattahoochee Watershed, much knowledge is provided by the experience of individuals. In societies where scientists "stand in for nature " and provide most of the ecological knowledge, we can expect that local knowledge will be lost, along with representation for local water quality and quantity issues, as people respond most when the ecological domain in peril is their own backyard. General knowledge, after all, has no real home, or application to any place in particular (Taylor and Buttel 1992).

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