

Heating up: A series of articles on global warming in the American South

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ABSTRACT

SARA PEACH: Heating up: A series of articles on global warming in the American South

(Under the direction of Dr. Barbara Friedman)

Nearly all climatologists believe the planet will undergo climate change throughout the twenty-first century. In a series of three articles, this master's thesis explores the effects of the phenomenon on the American South. The first article examines the effects of carbon dioxide emissions on coral reef ecosystems in coastal Florida. The second describes the impact of climate change on North Carolina's wine industry. The final article chronicles a young Southern activist's efforts to persuade government officials to regulate greenhouse gases. Research included a literature review, interviews with more than 30 sources, as well as visits to the Florida Keys, North Carolina's vineyards, and several universities in North Carolina. The thesis suggests that climate change will have significant effects on the environments, economies and communities of the South.

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I am still always surprised when people invite me into their lives to ask nosy questions. To every source who made this thesis possible – thank you.

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INTRODUCTION

One of the American South's most distinctive features is its climate. Blistering summer heat and mild winters have had a profound effect on many aspects of Southern life, such as the economy, agriculture, architecture and diseases of the region. It is reasonable to suppose, then, that climate change will result in significant alterations in the way that Southerners live their lives. Exploring some of these possible changes – and how Southerners are getting ready for them -- is the purpose of this thesis.

The United States Census defines the South as the eleven states of the original Confederacy, in addition to Kentucky, Oklahoma, West Virginia, Maryland and Delaware (U.S. Census Bureau, 2008). “Climate” is the weather of a particular geographic region over a long period of time, usually 30 years (Baede, 2001). In the South, the climate is determined by the interactions of warm, moist air masses from the Gulf Coast, warm winds originating from the Pacific, and cold air moving south from the Arctic (Rogers, 1999). The movements of these air masses generate the long summers, regular rainfall and mild winters for which the South is known (Birdsall, Palka, Malinowski, & Price, 2005).

In 1759, Georgia Gov. Henry Ellis complained that the residents of the South “breathe a hotter air than any other people on the face of the earth” (as cited in Stewart, 2004, p. 242). For some early promoters of the southern British colonies, however, the warm climate was a selling point. The explorer Sir Walter Raleigh claimed in 1650 that

35°N, the latitude of present-day Raleigh, N.C., was equivalent to paradise (Merrens & Terry, 1984).

Indeed, the region, with its temperate to subtropical climate, was much warmer and more humid than the home countries of most European colonists (Birdsall et al., 2005). Survival in the new climate required the colonists to adopt new lifestyles and cultural practices. Wealthy Southerners, for instance, built homes with large porches that provided an escape from heat (Birdsall et al., 2005). Because oats and sheep could not thrive in the new climate, Scottish settlers in south Georgia replaced traditional oat porridge with corn grits, and they began raising pigs and cattle (Ray, 1999). Other colonists grew Mediterranean and African crops, such as tobacco, rice, indigo and cotton, which found ready buyers in European markets (Colten, 2006; Birdsall et al., 2005).

The warm climate was an important factor in the spread of mosquito-borne diseases, which contributed to short life expectancies in the South. During the eighteenth century, the majority of white residents of South Carolina did not survive beyond 40 years, in part because malaria weakened their immune systems (Merrens & Terry, 1984). One observer, referring to the late summer and fall malaria outbreaks, wrote that “Carolina is in the spring a paradise, in the summer a hell, and in the autumn a hospital” (as cited in Merrens & Terry, 1984, p. 549). Mosquito-borne disease also limited the industrial development and prosperity of the South. Yellow fever epidemics during the 1800s forced commerce to cease for up to four months at a time. In addition, wealthy northerners were reluctant to invest in Southern businesses because of the risk that cargo shipments would be halted by quarantine (Humphreys, 1992).

It is not surprising, then, that English settlers regarded the South's climate as profoundly unhealthy. By the antebellum era, white planters were using the climate as a key defense of slavery, an argument that modern historians dismiss (Kupperman, 1984). "This climate is of God's making," William Elliot declared in an 1848 speech before the State Agricultural Society of South Carolina. "[A]nd so long as it continues fatal to the white race, so long will the countries subject to it, continue to be cultivated by men of vast African stock" (as cited in Stewart, 1997, p. 240).

During the twentieth century, medical and technological innovations eradicated malaria and yellow fever and began to reshape Americans' perceptions of the South's climate (Meade & Earickson, 2000). As Arsenault (1984) has documented, air conditioning revolutionized the textile and tobacco industries by allowing workers to control humidity levels in factories, leading to better quality control. Beginning in the 1950s, when air conditioning became widespread in residential areas, the South's mild winters attracted migrants from other regions, fueling a population boom and economic growth (Colten, 2006). The South's warm climate had become an asset.

Just as the South's climate forced European immigrants to adopt new ways of life, climate change has been linked to upheavals in the region. Colten (2006) has noted that in 400 A.D., a drop in average temperatures across the South coincided with the decline of the Middle Woodland Native American culture and the abandonment of some settlements. Colten similarly argues that climate change may also have contributed to the loss of the English colony at Roanoke Island. Governor John White and more than 100 other English colonists arrived at the island in 1587, soon after massive volcanic eruptions on Bougainville Island in the South Pacific. The volcanic particles emitted to

the atmosphere disrupted the global climate, leading to the worst three-year drought the Roanoke region had experienced in 800 years.

Nearly all climatologists believe the planet will undergo climate change during the twenty-first century. The Intergovernmental Panel on Climate Change (2007) has concluded that human actions, including fossil-fuel combustion and land-use changes, are releasing heat-trapping gases to the atmosphere, decreasing the amount of thermal radiation escaping to space. As a result of global emissions, the panel projects that the Earth's average temperature will rise between 1.1 and 6.4 Celsius degrees by 2100, leading to crop failures, intense storms, droughts, sea level rise and species extinction (Intergovernmental Panel on Climate Change, 2007).

The South produces more greenhouse gases than any other U.S. region (Energy Information Administration, 2005). A rise in the average temperature of the planet is likely to cause profound changes to the Southern environment, economy and social landscape during the next 40 years. Yet most Americans, including Southerners, still perceive climate change as an abstract phenomenon likely to affect people only in distant times and places (Leiserowitz, 2007). This master's thesis project will examine regional effects of climate change that have already begun to occur in order to connect the phenomenon to everyday American experiences.

The thesis project consists of a series of three articles. The first article explores the effects of climate change on ecosystems of the South, using the coral reefs of coastal Florida as a representative example. The second explores economic effects by examining the impact of climate change on North Carolina's wine industry. Finally, the third article chronicles a young Southern activist's efforts to persuade government officials to

regulate greenhouse gases. Cumulatively, the three articles provide a glimpse of how climate change is already affecting the American South and what citizens can do about it.

LITERATURE REVIEW

To understand the environmental, economic and social effects of climate change in the South requires a review of literature from the natural sciences, the social sciences, government documents and the popular press. This literature can be divided into five categories: global climate projections; Southern climate projections, including effects of climate change on coral reefs and grape vineyards; the U.S. response to climate change; social science research that addresses how best to communicate climate information to the public; and mass media coverage of the issue.

A Warming Planet

The theory of anthropogenic climate change, also known as global warming, states that the earth's average surface temperature has risen since the Industrial Revolution and will continue to rise because of increasing concentrations of greenhouse gases in the atmosphere (IPCC, 2007). As the Intergovernmental Panel on Climate Change (2007) has noted, historical temperature records indicate that during the twentieth century, the earth's average temperature increased by about 0.74°C. Although the climate varies naturally, recent increases in average temperature can only be accounted for by including human activities.

The Intergovernmental Panel on Climate Change, a global body of scientists created in 1988 by the World Meteorological Organization and the United Nations Environmental Programme, periodically reviews the state of climate science knowledge.

Its members evaluate peer-reviewed scientific literature to prepare the panel's consensus statements on the causes, rate and likely future effects of global warming. In its most recent summary, the IPCC concluded that there is a greater than 90 percent chance that human activities are causing the planet to warm (IPCC, 2007).

Observed evidence of climate change includes melting snow and ice, rising sea levels and poleward shifts in the ranges of some plants and animals. Additional data about the history of the earth's climate is derived from ice cores, lake sediments, rocks and tree rings. Based on this evidence, the IPCC's climatologists believe that the northern hemisphere's average temperatures during the second half of the twentieth century were the highest in more than 1,000 years (IPCC, 2007).

The most important greenhouse gas, carbon dioxide, is released primarily by the combustion of fossil fuels such as coal and oil. Annual emissions of the gas grew by about 80 percent between 1970 and 2004. Depending on the amount of carbon dioxide that humans emit to the atmosphere during this century, scientists project that the earth's average temperature will rise between 1.1 and 6.4°C by 2100 (IPCC, 2007).

Climatologists have warned that rising temperatures will have negative effects on human health and on the availability of food and water. Warming could affect millions of people by increasing the risk of coastal flooding. It could also cause significant extinctions around the globe and disrupt the functioning of entire ecosystems (IPCC, 2007).

As Oreskes (2004) has noted, the scientific consensus on the theory of anthropogenic climate change is robust. Oreskes searched a database of peer-reviewed scientific journals for the words "global climate change." In an analysis of the resulting

928 abstracts, which were published between 1993 and 2003, she found that none of the papers disagreed with the position that human activities are warming the planet. She concluded: “Politicians, economists, journalists, and others may have the impression of confusion, disagreement, or discord among climate scientists, but that impression is incorrect” (p. 1686). In addition, every major scientific body in the United States whose expertise relates to climate has issued a statement in agreement with the scientific consensus (e.g., American Meteorological Society, 2005; American Geophysical Union, 2003; National Academy of Sciences, 2005).

Warming in the South

Although the scientific consensus on climate change is strong, the projected effects on specific states or regions, including the South, are more uncertain (Congressional Budget Office, 2005). Some likely effects include more frequent and severe heat waves, more extreme rainfall and more frequent droughts, decreasing Southern forest productivity, and increasingly severe forest fires (U.S. Climate Change Science Program, 2008a; U.S. Climate Change Science Program, 2008b). In addition, some climate models suggest Southern forestland eventually will be converted to savannas (U.S. Climate Change Science Program, 2008a).

In experiments, scientists have found that higher temperatures lead to a decrease in growth rates for hogs and cattle, which could affect Southern meat industries. Higher temperatures also decrease the yields of important Southern crops, including soybeans, rice, cotton, peanuts and tomatoes. Paradoxically, however, higher carbon dioxide concentrations act as a plant fertilizer, mostly offsetting the effect of a moderate temperature rise (U.S. Climate Change Science Program, 2008a).

In a report prepared for the Pew Center on Global Climate Change, Twilley (2007) indicated that the Gulf Coast regions of Louisiana and Florida may become more at risk of shoreline erosion, wetland flooding and storm surges as a result of rising sea levels. Indeed, all settlements along Southern coastlines are vulnerable to sea level rise and flooding from increasingly intense storms (U.S. Climate Change Science Program, 2008b).

Additional effects on marine ecosystems and grape growing and their significance to the South are explored in more detail below.

Reefs and climate change

Tourism is one of the largest sectors of Florida's economy (Stanton & Ackerman, 2007). Eighty-five million visitors spent \$65.5 billion in the state in 2007, generating nearly \$4 billion in sales-tax revenues (Visit Florida, 2008). Coral reefs, which stretch for more than 200 miles along Florida's southern coastline, are an important component of the tourism economy. Reef-related tourism generates \$3.4 billion in sales and income annually and supports 36,000 jobs in four of the state's southern counties (Johns, Milon, & Sayers, 2004).

As Barnes (1987) explains, a coral reef is a colony of thousands of tiny animals called polyps. Each polyp consists of a stomach, mouth, tentacles and hard skeleton. Coral polyps rely on symbiotic algae, called zooxanthellae, to provide energy through photosynthesis. The zooxanthellae live inside the coral tissue, where they supply up to 90 percent of the energy the polyps need to survive. Coral reefs provide habitat to about a quarter of all marine species, making them even more biologically diverse than tropical rain forests (Harrould-Kolieb & Savitz, 2008). In addition, a majority of federally

managed fish species rely on coral reefs for part of their life cycles (NOAA Fisheries, 2008).

Rising carbon-dioxide concentrations are putting coral reefs at risk in two different ways: by raising the average water temperature and by reducing the water's alkalinity. Abnormally warm water temperatures can cause the coral polyps to "bleach," or lose their zooxanthellae, which weakens corals and leaves them with a white appearance. Bruno et al. (2007) found that a temperature increase of just one or two degrees Celsius increases the risk of coral disease.

Harrould-Kolieb & Savitz (2008) have reported that since the beginning of the Industrial Revolution, the world's oceans have absorbed more than 460 billion metric tons of carbon dioxide. Once absorbed, the dissolved carbon dioxide forms carbonic acid. The increase in carbonic acid interferes with the formation of the coral skeletons that create reefs. By mid-century, the oceans may be so acidic that the reefs will begin to dissolve. Because of the twin threats of warming and acidification, the advocacy group Oceana has warned that unless world governments work quickly to reduce carbon dioxide emissions, at least half of the species supported by reefs could become extinct, and in turn, jeopardize the tourism industry that depends on them (Harrould-Kolieb & Savitz, 2008).

Wine and climate change

The North Carolina Department of Commerce (2007) reported that the North Carolina wine industry has expanded rapidly in recent years. The state grows 70 percent more grapes than it did a decade ago, supporting more than 70 wineries and a tourist

business that attracts 800,000 visitors annually. Winemaking in North Carolina now generates \$34 million in revenue each year and employs 5,700 workers.

As White, Diffenbaugh, Jones, Pal & Giorgi (2006) have noted, winemakers depend on a precise balance of soil chemistry, nighttime temperatures and length of growing season to produce their vintages. As the planet warms, however, production could decline in many U.S. wine regions. Climate change could alter grape ripening rates, which would change the fruit's balance of sugar and alcohol, modifying the taste of the wine.

Sara Spayd, a professor of horticulture at North Carolina State University who researches the state's grape industry, said in a recent interview that she suspects that Pierce's disease, a bacterial infection of grape vines, would limit production of some grape varieties in North Carolina in the future. Under current conditions, the bacteria are usually killed during winter freezes. In a warmer climate, however, winters may not get cold enough to kill the infected vine tissue. As a result, only vineyards in the coolest parts of the state, such as in the mountains, may be viable in the future, she said (S. Spayd, personal communication, October 4, 2008).

On the other hand, more frequent droughts could benefit grape growers. Marek Wojciechowski, owner of Chatham Hill Winery in Morrisville, N.C., said in a recent interview that he and other winemakers hope for drought: "You pick fewer grapes and the juices are more concentrated, so the wines end up being more intense, more flavorful," he said (M. Wojciechowski, personal communication, October 9, 2008).

In summary, therefore, global climate change will likely have direct effects on the South. A destabilizing climate will alter the way Southerners raise their crops, including

wine grapes, and perhaps even make it impossible to grow some grape varieties. Rising carbon dioxide concentrations also threaten Florida's coral reefs by warming the water and by increasing the acidity of seawater. Wine production and coral-reef tourism are both important sectors in the South's economy, and the loss of these industries could have negative consequences for Southerners. Nevertheless, as the next section will demonstrate, the U.S. government has been slow to take action to curb greenhouse-gas emissions.

U.S. Response to Climate Change

As Romm (2007) argues, as the scientific consensus on climate change has solidified, debate about the issue has moved from the scientific sphere to the public square. During the past decade, the U.S. avoided taking political action to reduce greenhouse gas emissions, and fossil fuel interests became aligned with the anti-government wing of the Republican Party. Working together, the two groups successfully stalled mandatory emissions cuts by casting doubt on climate science, criticizing and censoring the work of climate researchers, and by suggesting that the consequences of warming would not be as serious as environmentalists warned (Romm 2007; Bowen, 2008).

According to a March 2007 Gallup poll, a majority of Americans (58 percent) believe that "drastic measures" must be adopted to control climate change. Only 30 percent of Americans believe that the effects of climate change can be controlled with simpler, individual measures, such as driving less (Carroll, 2007). In other polls, however, few Americans rank confronting climate change as a top national priority (Leiserowitz, 2007).

Throughout its tenure, the Bush administration remained opposed to government regulation of greenhouse gases (Blanchard, 2003; Romm, 2007). The administration withdrew from the Kyoto Protocol, an international treaty on reducing greenhouse emissions, and opposed strong regulations during the 2007 international climate negotiations in Bali (Fuller & Revkin, 2007). In response to federal inaction, some states and municipalities have worked to reduce greenhouse gases on a local level. Twenty-eight states have adopted renewable energy portfolio standards, although North Carolina and Texas are the only Southern states to do so (Pew Center on Climate Change, 2009). Such standards require electricity utilities to begin obtaining some of their energy from renewable sources. At least 375 mayors have signed the U.S. Mayors Climate Protection Agreement, in which municipalities agree to reduce their emissions by the same amount that the Kyoto Protocol would have required (El Nasser, 2007). Nevertheless, according to the most recent data, U.S. greenhouse gas emissions have dropped only slightly. In 2006, emissions decreased 1.5 percent from 2005 levels (Energy Information Administration, 2007).

Many scientists believe stronger regulations that would require emissions to decrease 80 percent by 2050 must be taken to avert catastrophic climate change (Science Daily, 2007). IPCC chairman Rajendra Pachauri warned in a 2007 speech that swift action is necessary: “If there’s no action before 2012, that’s too late,” he said. “What we do in the next two to three years will determine our future. This is the defining moment” (Rosenthal, 2007, para. 9). In 2007, NASA scientist James Hansen began warning in speeches and opinion columns that unless greenhouse-gas emissions are curbed rapidly, rising temperatures will create “a different planet -- one without sea ice in the Arctic;

with worldwide, repeated coastal tragedies associated with storms and a continuously rising sea level; and with regional disruptions due to freshwater shortages” (Hansen, 2007, para. 4). Hansen has urged a national moratorium on building new coal-fired power plants until carbon-capture and storage technology is developed. Activists across the United States have responded by working to block at least 75 proposed coal plants (Sierra Club, 2008).

Young Americans have played an important role in pressing for government and corporate action. During the 2008 election season, more than 340,000 young Americans signed the Power Vote Pledge, a commitment to vote for climate-friendly candidates (Power Vote, 2008). Students at more than two dozen universities and colleges have instituted mandatory fees to pay for renewable-energy projects (Association for the Advancement of Sustainability in Higher Education, 2008). Young activists have also taken direct action against global-warming polluters and the financial institutions that fund them, for instance by chaining themselves to construction equipment at the Cliffside Steam Station in North Carolina (“Eight arrested,” 2008).

Meanwhile, some observers believe that the November 2008 election, in which Barack Obama won the presidency and Democrats made gains in both houses of Congress, could usher in strict federal regulation of greenhouse gases (Kassel, 2008; Coile, 2008). In addition, some senators signaled their willingness to adopt a carbon cap-and-trade plan, a measure that would force industries to pay for pollution permits and to gradually reduce carbon emissions (Rhee, 2008).

Climate Communication

Communication scholar Robert Cox (2007) has observed that societal failures to respond to environmental crises are accompanied by failures in communication. “Like perturbations in biological systems, distortions, ineptitudes, and system pathologies occur in our communication about the environment,” he wrote (Cox, 2007, p. 10). In climate reporting, such “system pathologies” include the complex nature of the science and policy debates, the slow-moving, diffuse nature of the problem, and the mass media’s tendency to either overplay catastrophes or ignore the issue altogether (Revkin, 2007).

Overplaying climate catastrophes may be one of the more serious mistakes a journalist can make, because by using ever-more-scary messages, environmental communicators can induce maladaptive behaviors (Moser, 2007). Such behaviors include denial of the threat, beliefs that the problem won’t happen to them, blaming others for the problem, wishful thinking or rationalization, feelings of paralysis and other counterproductive attitudes. Moser suggested that instead of focusing on doomsday scenarios, environmental communicators should provide a realistic look at climate-change facts and then examine options to remedy the problem.

Similarly, Leiserowitz (2007) examined the seeming paradox that a majority of Americans believe climate change is real, but few say confronting it should be a national priority. In a study of attitudes toward the issue, he found that most Americans view climate change as a moderate problem that will affect people far away from them or in the distant future. Leiserowitz asked study participants to provide the words or images they associated with the phrase “global warming.” The most common answers were melting ice, rising temperatures, effects on non-human nature and ozone depletion.

Leiserowitz suggested that people would respond better to education and communication strategies that highlight images closer to the everyday American experience. He proposed that environmental communicators focus on local and regional climate change effects, emphasize that climate change is happening now, draw attention to the effects of climate change on human health and extreme weather, and talk honestly about remaining scientific uncertainties.

Given the enormous potential consequences of climate change, journalists have an important role to play in helping the public make rational choices about national priorities. As the next section will demonstrate, however, most mass media articles and books about climate change do not follow Moser and Leiserowitz's recommendations to localize climate-change news and to focus on solutions.

Climate Change in the Media

Climate change has been covered extensively by American newspapers, books and magazines, both in print and online editions. A Lexis-Nexis search for the terms "global warming" in U.S. newspapers from the past year returns more than 3,000 articles. Many stories, however, are about breaking climate-change news, such as the results of international negotiations or the release of new scientific information. Climate-related feature stories, such as Baker's (2008) profile of climate activist Van Jones, often are relatively short and appear to be based on one or two interview sessions. Revkin (2007) has expressed concern that such stories do not adequately communicate the complexities of climate change to the public.

In-depth climate-change stories are rare. Elizabeth Kolbert has written several long articles about climate change for the *New Yorker*. Her 2006 book, *Field Notes From*

a Catastrophe, examined a few of the effects of a warming world: an Alaskan island town forced to relocate to the mainland because ice no longer protected it from waves, a butterfly species that now lives hundreds of miles north of its previous range, and the preparations of the Dutch government as the ocean retakes the country's land (Kolbert, 2006a). Kolbert has also written about the discovery of ocean acidification (Kolbert, 2006b). Although Kolbert's book and articles discussed solutions to climate change, her work relied heavily on the images that Leiserowitz (2007) suggested do not resonate with Americans, such as melting ice, effects on non-human nature and impacts on far-off communities.

Reporters working in the South have described climate threats to the Chesapeake Bay and the Outer Banks of North Carolina, as well as attempts by climate activists to halt the construction of a coal-fired power plant near Asheville, North Carolina (Wyatt, 2007; Sturgis, 2005; Weiss, 2008). Although it does not describe the South, perhaps the best example of regional climate reporting is a nine-part *Boston Globe* series on climate change in New England (Daley, 2007). In that series, environmental reporter Beth Daley described specific examples of how climate change will affect the region. One article considered the economic consequences of burgeoning Quebec wild blueberry production on Maine blueberry farmers. Another examined the costs of abnormally warm winters on skiers, dog sledders, ice fishers and maple syrup growers. A third article chronicled efforts in Keene, N.H., to curtail the town's greenhouse gas emissions. Daley's articles accomplished everything that Leiserowitz (2007) recommended for environmental communicators by emphasizing that climate change is happening now, examining the

effects of climate change on human health and extreme weather, and openly discussing scientific uncertainties about New England's past and future climate.

Aside from Daley's work and sporadic efforts by beat reporters, however, journalism that focuses on the effects of climate change on a specific state or region is uncommon. Moreover, no journalists have developed an in-depth series of articles about the effects of climate change in the South. Given the urgency and serious nature of climate change, it is critical to communicate the issue using methods that are salient to Americans, including Southerners. This thesis project begins to fill this gap in the literature by exploring the ecological, economic, and social effects of a warming South. In order to avoid inducing maladaptive attitudes in its audience, the thesis makes use of Leiserowitz and Moser's recommended communication strategies of focusing on local effects and solutions.

The articles included in this thesis are most relevant to Southern audiences. Therefore, they are suitable for publication in regional newspapers or magazines in the South. Two of the articles – the one focusing on a Southern climate activist and the one focusing on North Carolina's wineries – will be offered for publication in central North Carolina in the (Raleigh) *News & Observer* or the Durham-based *Independent Weekly*. The article about coral reefs is better suited for a Florida newspaper or magazine, such as *The Key Largo Independent* or *Miami Monthly Magazine*.

METHODOLOGY

To explore the ecological, economic, and social effects of climate change in the South, this master's thesis project addressed the following research questions:

1. How might climate change affect the South?
 - a. What effects could climate change have on natural species, specifically on coral reef ecosystems?
 - b. What effects could climate change have on the economy, specifically on tourism in Florida and on the wine industry in North Carolina?
2. What can be done by individuals and governmental organizations in the South to avert the worst effects of climate change?
3. What is the role of young Southern activists in trying to solve the problem?

To answer these questions, I used a journalistic, or storytelling, approach.

Guillermoprieto (2007) has argued that the best way to persuade a U.S. audience to care about issues is to tell captivating stories. Similarly, Banaszynski (2007) has noted that writers can illustrate societal problems while maintaining reader interest by telling stories about specific people or places. To collect material for my stories, I reviewed scientific literature and conducted interviews with scientists, ordinary people, business owners and advocates.

For the first article, which explored the effects of climate change on Florida's coral reefs, I traveled to the Florida Keys for five days in February 2009. There, I conducted in-depth and impromptu interviews with scientists, advocates, tourists,

business owners and workers. To develop a narrative about tourist activities in Key West, I took a glass-bottom boat tour, visited popular Key West restaurants and shops, and observed the daily sunset celebration on the west side of the island.

For the second article, which examined the effects of climate change on North Carolina's wine industry, I visited two vineyards during early February 2009. In addition, I interviewed plant pathologists, vineyard owners, winemakers and wine aficionados.

For the third story, I followed a young climate activist for nine weeks in an immersive project. I traveled with him to observe his work with other young people at Duke, UNC-Asheville, UNC-Greensboro and Grimsley High School in Greensboro. I also conducted interviews with his colleagues, students, family members and friends.

Limitations

One limitation of the project is the lack of firm scientific evidence about the effects of climate change in the South. As described above, there is a robust scientific consensus that the earth is warming and that the warming will have negative effects on people. Peer-reviewed scientific information about effects on specific regions or states is more limited and uncertainty about that information is greater. The articles attempt to describe this uncertainty and explain which questions scientists have yet to unravel.

Climate change will affect nearly every aspect of life in the South. This thesis project by necessity will only address some of these effects while excluding many others, such as effects on air quality, human health, coastal settlements, drought frequency, and the survival of many plants and animal species. This thesis is intended as a preliminary examination of how warming will affect the South.

RISING CARBON DIOXIDE LEVELS JEOPARDIZE FLORIDA REEFS

The tourists were getting restless. The 26 passengers of the glass-bottom boat *Discovery* were drifting gently over a coral reef in the Atlantic Ocean, seven nautical miles southwest of Key West. Kneeling in the vessel's darkened lower deck, they peered through glass windows, looking for barracudas, sea turtles and corals. But the water below the boat was a murky canvas of swirling green mist.

"Bummer!" said one tourist, a gray-haired woman who had been holding her camera at attention. "I don't think we're going to see anything."

She and the other visitors had each paid \$40 to see the reefs that lie in the blue-green waters near the Florida Keys. But strong winds had stirred up sediment in the water, reducing visibility to indistinct shadows. On the boat's starboard side, a toddler began to wail.

"Ladies and gentlemen," said tour guide Mikey Puntillo, "We're going to head back in. But because of our not having any visibility, we would like to offer complimentary sodas and beers." As the *Discovery* turned back to shore, its disappointed passengers headed for the snack bar.

More disappointments are likely to be in store for visitors to Key West, because something is making the coral reefs sick. In one of the first signs of trouble, the region's long-spine sea urchin population suffered a mass die-off during the early 1980s. The urchins, relatives of starfish, are spiny marine animals that resemble porcupines. Where

divers previously had discovered hundreds of urchins, suddenly they could find only handfuls. Then, the reefs themselves began to die.

Two fast-growing coral species of the genus *Acropora*, staghorn and elkhorn, have dominated Caribbean reefs for millions of years. But according to the National Oceanic and Atmospheric Administration, staghorn populations in the Florida Keys have declined by 73 percent just in the past 12 years. In a few areas, both species have virtually disappeared.

The loss of the reefs could have an enormous impact on south Florida's economy. More than four million tourists visit the region each year to take glass-bottom boat tours, fish the reefs or to go snorkeling. Many businesses – such as hotels, restaurants, gas stations and clothing shops – benefit when reef tourists patronize them during their stay in the region. In all, reef tourism generates \$5.5 billion in spending and supports about 70,000 jobs in five southern Florida counties alone, according to a recent study by the advocacy group Environmental Defense Fund. This web of industry could disintegrate if the reefs disappear.

Key West charter-boat operator Bill Wickers has observed the changes to the coral ecosystem first hand. Wickers, 62, has a slight paunch and a lined, leathered face – evidence of the four decades he's spent ferrying tourists on reef-fishing trips. Wickers' grandfather started the charter-boat business during the Great Depression, when President Franklin D. Roosevelt encouraged the island to develop its tourist economy.

"I've seen a steady decline in the reefs," he said. "You've got coral heads out there that are four or 500 years old that are just dead and covered with algae. It's terrible."

The Florida Keys are a slender chain of 1,700 islands that arc southwest from the tip of the Florida peninsula. The low-lying islands at the western end of the chain, including Key West, formed from an ancient seabed. The eastern islands, known as the Upper Keys, are the fossilized remains of a coral reef that lived during the last interglacial period.

Today, a string of barrier reefs stretches for more than 200 miles along the coast, roughly parallel to the Keys. Smaller reefs, called patch reefs, flourish in the narrow channels between the islands and in the lagoon between the islands and the barrier reef. Along the overseas highway that connects the islands, visitors can see palm trees, pelicans and the spider-like legs of red mangrove trees.

Like their counterparts around the world, Florida's reefs provide a habitat to a vast number of species. More than half of the fishery species managed by the U.S. government rely on them for part of their lifespan. In fact, about a quarter of all the ocean's life forms live on reefs.

But the Keys' corals suffer from a dizzying number of threats. Agricultural runoff from the west coast of Florida promotes algal blooms and disease. Centuries of overfishing has depleted fish stocks. Cruise ships dump untreated sewage in the water south of the islands. Small boats run aground on the reefs. Overenthusiastic divers kill corals just by touching them.

Billy Causey was one of the first people to suspect that -- in addition to all of those problems -- something bigger might be at work. Causey is the regional director of the National Oceanic and Atmospheric Association, where he oversees marine

sanctuaries in the southeast Atlantic, Gulf of Mexico and the Caribbean. He has a round face and a neatly trimmed gray mustache. His Key West office has two walls of windows that overlook the sea.

Causey has been diving on reefs since 1962, but he still remembers the shock he felt on a day in the late 1970s when he discovered dozens of dying barrel sponges. Barrel sponges are a large, hardy, slow-growing species. On that day, he found sponges that had been reduced to piles of rubble.

“The only thing that was different at that time was that the water was very warm,” he said. “It was very unusual, very unusual.”

Then, in July 1983, during another unusually warm period, Causey started receiving phone calls from dive-shop owners from across the Lower Keys. They all told him the same thing: The reefs had turned stark white, like a snowfall.

A coral reef is a colony of thousands of tiny animals called polyps, which look like upside-down jellyfish. Polyps build reefs by secreting calcium carbonate, more commonly known as limestone. For energy and nutrients, they rely on symbiotic algae called zooxanthellae. The zooxanthellae live inside coral tissue, where ordinarily they provide its brown or green color.

In a process that marine scientists do not entirely understand, when corals are stressed, they either expel or consume the zooxanthellae. This process is called “bleaching” because it leaves the corals with a white appearance. It also makes the corals brittle and prone to diseases, though they often recover their zooxanthellae when the stressor is removed.

One way to stress corals is to expose them to abnormally warm water. In a study published in 2007, University of North Carolina marine scientist John Bruno found that a temperature increase of just one or two degrees Celsius increases the risk of white syndrome, a devastating group of coral diseases.

Since the beginning of the Industrial Revolution, people have increased carbon dioxide concentrations in the atmosphere by nearly 40 percent. Burning oil, coal and other fossil fuels has already warmed the Earth by an average of one degree Celsius. Meanwhile, mass coral bleaching has become common worldwide.

“Something that we were looking at one time locally, and then we were looking at regionally, was in fact a global event driven by some global phenomenon,” Causey said.

In the winter of 1998, after years of watching bleaching and disease spread throughout the Florida Keys, Causey made an ominous observation. During a January visit to the reefs, he noticed that the corals still had not regained their zooxanthellae after the previous summer’s bleaching.

“The water never cooled down,” he said. “I was sick, because I knew we were coming into a warm period.”

That summer -- the hottest on record -- triggered another mass bleaching event. Then, on Sept. 26, 1998, Hurricane Georges swept through Key West. The storm destroyed a swath of already-weakened coral, including a place that Bill Wickers, the charter-boat captain, remembers as his own secret garden.

“That area was completely pulverized,” Wickers said. More than 10 years later, “Everything’s still completely dead.”

Bleaching is a serious threat to corals around the world and to the tourism industries that depend on them. But it's just one of two potentially devastating threats to marine ecosystems. The other is ocean acidification.

About one-third of the carbon dioxide that people have added to the atmosphere in the past 200 years has been absorbed by the oceans. This process has considerably slowed the warm-up of the atmosphere, delaying the melt of the polar ice caps, the rise of sea levels and the onset of widespread crop failures. But adding billions of tons of carbon dioxide to the seas is changing the chemistry of seawater.

Scientists use the pH scale to measure the acidity or alkalinity of a solution. At the low end of the scale are strong acids such as battery acid, and at the other end are alkaline substances such as household lye. Seawater, which contains a mixture of salts and minerals, is slightly alkaline.

When carbon dioxide mixes with seawater, it forms carbonic acid, which is harmless in small quantities. But people have already added enough of the molecule to the oceans that the alkalinity of seawater has decreased by about 30 percent.

"We're essentially committed to decreasing pH," said John Bruno, the UNC-Chapel Hill marine scientist. "There's just no way around it."

The changing chemistry of the seas interferes with the formation of calcium carbonate, which fish, lobsters, crabs and corals need to build their skeletons. As a result, some scientists believe that if carbon dioxide emissions continue unabated, coral reefs will eventually begin to dissolve.

In October 2008, an international panel of 155 scientists from 26 countries called for rapid action to curtail emissions.

“By mid-century, ocean acidification may render most regions chemically inhospitable to coral reefs,” they warned in a statement called the Monaco Declaration. “Recovery from this large, rapid, human-induced perturbation will require thousands of years.”

The ultimate fate of corals is uncertain, because it depends on how quickly people rein in carbon dioxide emissions and whether regional impacts – such as nutrient runoff – are controlled.

“I would say the outlook is positive, but I’m saying that with a great deal of caution,” said Causey, the NOAA regional director. “The thing that keeps me going to work every day is that I know corals have been around for millions of years. They’ll probably outlast us on this planet.”

Still, some forecasts suggest that coral reef ecosystems could disappear entirely by 2100, devastating the coral tourism industry worldwide – and leaving the oceans emptier.

Jeff Pearson, program assistant and education coordinator at Reef Relief, a nonprofit Key West-based advocacy organization, is not waiting to find out. His organization takes hundreds of elementary-school students on glass-bottom boat tours each year to teach them about corals. In addition, Reef Relief holds workshops across Florida and educates the hundreds of tourists who visit its Key West center every month.

“Reefs are a very resilient organism,” Pearson said. “The problem is we have to stop what’s happening immediately.”

But this gloomy message can be challenging to get out on an island that encourages visitors to shrug off the world’s troubles. In early February this year, sunshine

bathed the island at a comfortable 78 degrees, and a gentle breeze blew the scents of saltwater and cigarettes through the streets. Along Duval Street, packs of tourists with flip-flops and Boston accents wandered past merchants offering Cuban cigars, emeralds, diamonds, conch pearls, coconut heads painted like dolls, pizza, T-shirts and opportunities to see nude dancers. In Irish Kevin's bar, visitors sipped beers as they listened to a band singing, "It's just another Tuesday in paradise."

Even some tourists who sought out coral reefs seemed to be taking a relaxed approach. Pat Bonar, a retired guidance counselor from DeGraff, Ohio, took a glass-bottom boat tour with her husband and a friend.

"I think it's fascinating to see creatures in their habitat," she said. "It's one thing to see them in the aquarium, and another to see them where they live."

But she said she would have visited the island even if it didn't have coral reefs.

"Key West has a lot of romantic notions that go with it," she said. Such amusements include taking a sunset champagne cruise, eating Key lime pie dipped in chocolate and served on a stick, visiting Ernest Hemingway's house or whizzing through downtown on a train tour.

Meanwhile, for first-time visitors to the reefs, the ongoing decline of the reefs is mostly invisible.

"They still get to see pretty fish," explained Wickers, the charter-boat captain. "It's just not like it was years ago."

In other words, if there's trouble in paradise, no one may notice.

Sarah Knott is the president of the Key West Attractions Association, a trade organization whose members include operators of the island's museums, kayak tours,

hotels, banks and restaurants. She said most business owners, too, remain unconcerned about the effects of climate change.

“We’ve had a pretty cool winter down here,” she said. “It really hasn’t been that different. The seasons change like normal.” Her association is drafting guidelines for businesses that want to market themselves as environmentally friendly, but is not specifically targeting carbon-dioxide emissions.

But even if everyone who owns a business in Key West dramatically curbed his or her carbon-dioxide emissions, that would not make much of a dent in the problem. Citizens of every industrialized country contribute to a vast river of emissions pouring into the atmosphere and the oceans. The reef-tourism industry is caught in this river, drifting toward warmer, more acidic seas.

“I think in our lifetime, we’re going to have to be prepared to see corals change,” said Causey, the NOAA regional director. “The fact that corals are telling us, ‘Change is coming,’ is something we need to be paying attention to.”

GLOBAL WARMING COULD NIP NORTH CAROLINA'S WINE INDUSTRY IN THE BUD

Each spring, a colorful family of pests begins to suck the juices out of North Carolina's grape vines. In vineyards from the coast to the mountains, tens of thousands of sharpshooters – relatives of cicadas and aphids – insert their needle-like mouth parts into tender new vines and start to drink.

The blue-green sharpshooter has neon blue and orange stripes, and the broad-headed sharpshooter has mottled wings the color of a robin's egg. They're beautiful – and voracious. The glassy-winged sharpshooter is just a half-inch-long, but it can consume 10 times its weight in sap in an hour.

But North Carolina's grape growers worry less about lost sap than about an infection spread by sharpshooters and another group of insects called spittlebugs. Both are carriers of *Xylella fastidiosa*, strains of rod-shaped bacteria that cause Pierce's disease, one of the world's most feared grape killers. The bacteria can cause a vine to die in as little as two years by gumming up the plant's sap-conducting vessels. In some cases, growers can save a plant by pruning the infected areas, but if the disease spreads deep into the vine, death becomes inevitable. Pierce's disease has caused at least \$13 million in damages in California's Temecula Valley, according to the Wine Institute, a California wine advocacy group.

Fortunately for North Carolina's wine growers, the disease is sensitive to cold temperatures. In the past, that meant the disease was rare in the Piedmont and western

areas of the state. But now some plant pathologists believe that global warming is expanding the range of the disease.

“The warmer it is, the more of a problem it is,” said Turner Sutton, a professor of plant pathology at North Carolina State University. In the Yadkin Valley wine region west of Winston-Salem, for example, the disease was rare just six years ago.

“We’re seeing it more and more there,” he said. “It’s a direct result of the warmer winters we’ve been having the past few years.”

Until recently, scientists understood little about how common the disease was in insects, or even which ones were spreading it. In 2004, an N.C. State graduate student named Ashley Myers set out to find the answer. She and Sutton placed sticky yellow insect traps in vineyards across the state. Over the course of two summers, they captured thousands of sharpshooters. Back in the lab, they severed the insects’ heads from their bodies, extracted bacteria from their mouthparts, and ran DNA tests to check for *Xylella fastidiosa*. Nearly one-third of the members of some species, including the blue-green and broadheaded sharpshooters, tested positive.

Ironically, the risk of Pierce’s disease is rising just at the moment when North Carolina’s wine industry is taking off. Fueled by growth in tourism, the rise of the buy-local movement and an increased social acceptance of wine, the industry has blossomed from just a few wineries in the late 1970s to more than 70 today. Winemaking now generates \$34 million in revenue each year and employs 5,700 workers, according to the N.C. Department of Commerce.

But global warming may jeopardize the industry before it reaches its full potential. Since the beginning of the Industrial Revolution, people have increased carbon

dioxide concentrations in the atmosphere by nearly 40 percent. The carbon dioxide captures heat, much as a blanket traps warmth around a sleeping person. If emissions continue at current rates, climate scientists expect the earth's average temperature will rise between 2 and 12 degrees Fahrenheit by the end of this century. That will force wine growers and farmers across the world to deal with new and ever-changing conditions, such as longer growing seasons, warmer winters, more frequent droughts and floods, and more weeds, insect pests, and pathogens.

Even under ideal conditions, growing wine grapes is a notoriously delicate balancing act. If the weather is unusually cold, grape-sugar levels fall too low. If it's too warm, acid levels drop too far. Either condition diminishes the quality of the wine. This finicky nature helps to explain why certain grape varieties grow best in narrow climate zones; that is, why the best Bordeaux wine is produced in Bordeaux, France, and not in Sicily.

Wine's sensitivity to climate variations also suggests that it may serve as a bellwether of changes to the world's agricultural system. Ultimately, every crop depends on climate. The story of what is happening to North Carolina's vineyards is likely to be repeated elsewhere as the world warms.

In July 1584, Sir Walter Raleigh's explorer Arthur Barlowe was sailing near the shoals of what is now Roanoke Island when he and his men smelled a sweet perfume that reminded them of a garden of flowers. They came upon what Barlowe later described as a country "so full of grapes, as the very beating and surge of the Sea overflowed them, of

which we found such plentie... that I thinke in all the world the like abundance is not to be found.”

Barlowe’s crew had stumbled upon muscadines, a grape species native to the American South. The grapes are purple, black or bronze in color and have firm, thick skins. Producing muscadine wine, which is muskier and far sweeter than wines made from European grapes, quickly became an important industry. By 1840, North Carolina produced more wine than any other state. Even as late as the early twentieth century, a North Carolina muscadine wine called “Virginia Dare” – named for the first English child born in the Roanoke colony – was the best-selling wine in the country.

But the industry collapsed during Prohibition, and after the alcohol ban was lifted, California ascended as the premier wine-producing region. That state’s climate was better suited for producing wine, especially the dry European-style wines that many Americans desired.

Steve Shepard, winemaker and general manager at RayLen Vineyards in the Yadkin Valley, was an early member of the North Carolina wine renaissance, which took off in the 1990s and has continued unabated into this decade. After apprenticing with a Pennsylvania winery after college, he began work in 1989 at Westbend Vineyards in Lewisville, N.C. At that time, Westbend was one of only a handful of wineries in the state.

A decade later, Shepard helped to found RayLen Vineyard and Winery, a 40-acre vineyard on a former dairy farm near Mocksville, N.C. Today, RayLen produces up to 10,000 cases of white and red European-style wines and attracts 7,000 tourists each year, Shepard estimated.

On a gloomy late January day with occasional bouts of pouring rain, the tasting room at RayLen was relatively quiet. As Shepard relaxed at a wooden table with a mug of coffee, he conceded that the climate makes his job difficult.

“It’s totally out of our control,” he said. “We have all the makings of the proper climate to grow grapes, but we can’t turn the rain on when we need it. The further south and the further east you get -- it becomes more and more challenging.”

One of the most serious threats to vineyards in Yadkin Valley is a late spring frost. To protect tender vine shoots on chilly April nights, RayLen’s workers build bonfires in the vineyard rows. They also switch on two enormous wind-circulation machines, which mix cold, dense air near the land with warm air from above. Even so, a four-day freeze over Easter weekend in 2007 wiped out nearly all of RayLen’s white grape crop.

Despite the threat of frosts, Shepard and other vineyard managers depend on cold temperatures to protect their crops from pathogens. The bacterium that causes Pierce’s disease, *Xylella fastidiosa*, can’t survive three consecutive days of temperatures below 10 degrees.

“We like winters,” Shepard said with a laugh.

The Department of Horticultural Science at N.C. State University has produced a map showing the areas of the state most susceptible to Pierce’s disease. On the map, a red line squiggles through the western third of the state, dividing Asheville from Charlotte and Winston-Salem from Greensboro. On the western side of the line – where higher elevations mean cooler temperatures – vineyards are less likely to become infected with the disease. On the eastern side, the risk is higher.

At RayLen Vineyards, perched comfortably on the low-risk side of the line, only a few vines have ever been infected with Pierce's disease, Shepard said.

But The Winery at Iron Gate Farm, in Mebane, N.C., has not been so lucky. Owner Debbie Stikeleather and her husband bought the 60-acre farm in 2000.

"It was an old farm that I had lusted after for many, many years," she said. "Our goal was just to save this particular farm from being developed."

In 2002, a significant portion of Stikeleather's newly planted vineyard became infected with Pierce's disease.

"We ended up having to decapitate about two-thirds of our vines," she said. "It was like starting over."

Other growers said that even losing a small percentage of their yields hurts profits. Glendale Dickey owns and operates Glenmarie Winery in Burlington, N.C., with his wife, Joyce. He said he has lost about five percent of his vines to the disease over the past six years. "When you take five percent off your production, it definitely hurts," he said.

Max Lloyd, owner of Grove Winery and Vineyards in Guilford County, said that because 53 of his vines were infected last summer, he plans to spray insecticide at least twice this season. That's costly, he said. And he thinks the problem will get worse with global warming.

"We're all looking for a solution, but nobody's found it yet," he said.

During the past century, average temperatures in North Carolina rose a little more than one degree Fahrenheit, according to data from the Southeast Regional Climate Center. But winters have warmed nearly twice as fast, which means that the periods of

deep cold are coming much less frequently. As a result, future winters in western North Carolina are likely to resemble the Piedmont winters of today. Pierce's disease has already been creeping farther west, said Sutton, the N.C. State pathologist. It's possible that the disease will force wine growers to retreat to the mountains, Sutton said, and in the long run, out of the state entirely.

It's a pattern that could be replicated worldwide. A 2006 study published by the Proceedings of the National Academy of Sciences warned that extreme heat could reduce U.S. wine production by 80 percent by 2100, and that American vineyards would be restricted to narrow zones in the Northwest and in New England. Similarly, optimum wine-growing regions around the world will shift toward the poles, according to a 2005 study published in the journal Climatic Change.

The trend worries wine drinkers, said Joseph Mills, a wine enthusiast and the co-author of "A Guide to North Carolina's Wineries."

"The real concern is that vines take so long to develop," he said. "It might take you 10 or 20 years to figure out what you should be growing. With global warming, you'll figure out what you should be growing, and then it will change."

Benjamin Vineyards in Alamance County, far to the east of the Yadkin Valley, lies in the heart of Pierce's disease country.

"I haven't seen it yet, but knock on wood," said Andy Zeman, Benjamin Vineyard's co-owner. "Hopefully, this year -- with the cold weather that we've had -- that will help knock it off."

The vineyard is a retirement project for Zeman, 58, and his wife, Nancy, though they each work 70 hours a week during the summer festival and farmers' market season. Andy Zeman worked for most of his career as a manager and engineer at the Liggett & Myers Tobacco Company in Durham. He was also a home winemaker for 25 years before he and Nancy bought the vineyard land near Saxapahaw in 2000.

The vineyard is located on a quiet two-lane road surrounded by grassy pastures where cows and horses graze. On a sunny afternoon in late January, the gravel driveway was still covered in snow from a recent storm, and the rows of gnarled grape vines were as bare as the nearby trees. From the parking lot near the tasting room, the breeze smelled faintly of wine.

That afternoon, Andy Zeman spent some time showing off his disease- and pest-management systems to a visitor. He pointed out the goblet shape of his vine trellises, which promotes air circulation and reduces the risk of mildew and mold problems. Zeman also seemed proud of his elaborate sound system, which scares birds away by emitting the distress calls of a bird under attack.

"It's gut-wrenching to hear," he said, grinning ruefully.

Zeman also has a line of defense against Pierce's disease: a few acres of muscadine grapes. Perhaps because they evolved with sharpshooters and *Xylella fastidiosa*, the South's native grapes – the muscadines – are naturally resistant to Pierce's disease. Their sweet, musky wine never fell out of favor in many pockets of the state. About half of the wine the Zemans sell is made from the grape. And now it seems that if more growers are willing to plant them, muscadines may be poised for a revival.

“It’s a smart decision,” said Mills, the author of the North Carolina winery guide.

“There’s really a market here, because people love muscadines.”

THE MAKING OF A CLIMATE ACTIVIST

The zombies wanted brains. Bank executive brains.

Last Halloween, global-warming organizer and Carrboro resident Russell Anderson walked with a group of 32 young activists, disguised as the undead, in a march on the Bank of America branch on Patton Avenue in downtown Asheville.

It was one of those rare, perfectly cloudless afternoons, and against the brightness of the blue sky, the fall leaves looked like they were on fire. Along Merrimon Avenue, a four-lane road buzzing with traffic, the zombies staggered and theatrically flailed their stiff, outstretched arms at pedestrians and passing cars.

“No more coal! That’s our goal! Save your soul!” they wailed. They wore tattered clothing spattered with fake blood, and had used white and green body paint to turn their faces deathly pale. Near the head of the line, Anderson carried a plastic ax and a banner reading: “Bank of America: Coal is a Dead End.”

As the marchers wound their way closer to the bank, a zombie holding a megaphone led a call-and-response chant.

“What do we want?” he bellowed.

“BRAINS!” the zombie horde cried.

“What don’t we want?”

“CLIMATE CHANGE!”

The reasons behind the zombie attack involved remarkably advanced conceptual thinking, at least for the living dead: Bank of America is a leading funder of new coal-

burning power plants. Combusting coal in power plants releases carbon dioxide, which is the main contributor to global warming. For that reason, some climate scientists believe the U.S. must stop building new coal plants immediately, a warning that Bank of America executives have so far ignored.

The zombie march was the opening act of the three-day North Carolina Youth Energy and Sustainability Summit, a statewide gathering of dozens of young activists that Anderson helped to organize at UNC-Asheville. After removing their zombie costumes, the students discussed strategies for pressing elected officials, corporations and university administrators to cut greenhouse-gas emissions.

At age 23, Anderson has become a leader in the growing youth climate movement, a nationwide, urgent effort to slow global warming. He is the North Carolina State Organizer at the Southern Energy Network, an advocacy group that organizes youth global-warming activism in the South.

“I see three possible futures,” he said. “The first is ‘eco-apocalypse.’ The second is ‘eco-apartheid,’ where some people get to drive their hybrids and do yoga and eat organic food, but everyone else is miserable.” He grinned. “And the third option is what I call ‘eco-fun-party-time,’ where we create 40 million new green jobs and transition to a clean-energy economy. That’s my personal favorite.”

When he puts on a suit – as he sometimes does when he’s lobbying government officials -- Anderson could pass for the sort of respectable citizen who believes the best social change arrives at a moderate pace. But when he is visiting college campuses, he

dresses like a hard-core organizer: unshaven, faded T-shirt, exposed tattoo and a cigarette between his fingers. His tousled blond hair and ripped jeans round out a deliberately relaxed look that he describes as “scruffy.”

Since starting his job last July, Anderson has spent much of his time on the road, organizing protests and meetings with hundreds of students. His turf ranges across 250 miles, from N.C. State University in the Triangle to Mars Hill College in the mountains. This past fall, he worked with the Power Vote campaign, a nationwide effort to collect hundreds of thousands of pledges from young people who promised to vote for climate-friendly politicians.

Sometimes, his job is just to offer encouragement, a role that students said they appreciate. “When I feel like I’m not doing well, he’ll tell me that I’m doing well and get me back on track,” said Rhys Baker, a UNC-Asheville sophomore. Baker gathered hundreds of pledges at UNC-Asheville last fall by organizing a campus Power Vote chapter to mobilize students.

Anderson’s climate movement brims with youthful energy and – as events such as the zombie march demonstrate – its members sometimes take a lighthearted approach to serious matters.

Yet to become a climate activist requires consciously stepping out of the mainstream, a choice that can bewilder family members. It means standing up to powerful interest groups, which can leave activists feeling paranoid and burnt out. It also obliges activists, on a daily basis, to confront the most depressing facts of our time: The seas are rising. Millions may become climate refugees. The planet may become virtually uninhabitable by the end of this century.

Why would anyone want this job?

Russell Anderson grew up in Thomasville, Ga., a city of 18,000 in the flatlands of southern Georgia, less than an hour's drive north of Tallahassee, Fla. The city is best known for the festivals it holds each April to celebrate the 7,000 rose plants growing within its borders.

He was raised by his mother, Whitney Hopkins, and beginning in late childhood, by his stepfather, Robbie Hopkins. Both Whitney and Robbie worked long hours – as a 911 supervisor and a paramedic, respectively – to provide for their three sons. Robbie Hopkins sometimes took on a second job to make sure the family had everything it needed, even though that meant working more than 100 hours a week.

As a boy, Anderson loved reptiles and spent hours outdoors chasing snakes. To the consternation of his parents, he also kept a python named Sable who lurked under the coffee table and between the cushions of the couch.

“Russell thought he was Steve Irwin,” Whitney Hopkins would later recall, though Anderson prefers to say that the iconic Australian crocodile-hunter was merely a hero.

In college at Valdosta State University in Georgia, Anderson planned to major in herpetology, but he fared poorly in his first biology class. He would eventually change his major four times before settling on a self-designed course of study that blended classes in philosophy, anthropology and sociology.

Meanwhile, he spent much of his time watching television, working various part-time jobs and drinking beer. But those activities did nothing to dampen a gathering anger

he felt toward the social problems he was learning about in his anthropology and sociology classes.

“I was like, ‘Fuck America and fuck this place,’” he recalled. “I was angry, but I had no way to channel that energy. So I started recycling.”

In addition to recycling, he joined Students Against Violating the Environment, a Valdosta student organization. Anderson’s girlfriend, Mandy Hancock, who was a SAVE member and now works as an organizer for the Southern Energy Network in Florida, said that during this period, the organization was ineffective. “If you look at the meeting notes from then, they say, ‘Styrofoam sucks. Let’s have a drum circle,’” she said.

That changed after 13 SAVE members, including Anderson, attended the Southeastern Student Renewable Energy Conference in Knoxville, Tenn., an annual summit hosted by Southern Energy Network to help students learn organizing skills.

“We came back inspired and empowered,” Anderson said. Soon, SAVE members had started a comprehensive campus recycling program and won \$70,000 from university administrators to study energy-efficiency measures on campus. In the fall of 2007, his senior year, Anderson became the president of SAVE.

Not long after Anderson took the reins of SAVE, he and Hancock traveled to Thomasville, Ga., for Thanksgiving dinner with his family. At his childhood home, someone had collected chairs and set up them up in the dining room. There were seven seats: one each for Anderson’s mother, stepfather, uncle, brother, grandmother, Anderson and Hancock.

The family sat down to a dinner of turkey, sweet potato casserole, cranberries and Texas-style baked beans. Soon, the conversation turned to his plans after graduation.

I'm going to move away, maybe to the Northwest somewhere, Anderson said. I'm probably going to work with Greenpeace, doing organizing and activism.

What are you going to do for a living? his stepfather asked. He sounded angry. And what are you going to do about Mandy?

Anderson felt defensive. The position I'm applying for pays a stipend, he said.

Robbie Hopkins slammed his hand on the table.

Do you know what that means? he demanded. It means you don't get a salary. You're throwing your education away to be a damn hippie.

At Anderson's side, Hancock wished she could crawl inside her skin and disappear. Whitney Hopkins abruptly left the room and started washing dishes in the kitchen, but she could hear the conversation growing even more heated. Anderson's grandmother and uncle tried to intervene, but Robbie started shouting at them, too: This is my goddamn house, and if you don't like it, you can leave.

The next thing Whitney knew, everyone was collecting their belongings to go, even though they had eaten only a few bites of dinner. Her husband had locked himself in his room, and her son had burst into tears.

On his way out, Anderson scribbled a letter to his stepfather. Later, Anderson and his family members would describe the content of the letter as disrespectful and pompous. It accused Robbie of being too old to understand the world's problems. What family members remembered most clearly, though, was the closing line: "See you on CNN, asshole!"

Anderson stuffed the letter in his stepfather's truck, where Robbie found it the next morning. The two did not speak to each other for the next eight months.

The movement that Anderson joined faces one inescapable fact: No matter what it does, the planet is getting warmer.

If people ceased producing greenhouse gases tomorrow, the globe would still warm by about 2 degrees Fahrenheit this century. That's because heat-trapping gases released since the beginning of the Industrial Revolution have already locked us into a moderate amount of warming.

But greenhouse-gas emissions will not stop tomorrow. Recent studies have shown, in fact, that annual emissions are accelerating. As a result, climatologists estimate that the average temperature of the planet will rise between 2 and 12 degrees by the end of the century.

On its face, a temperature rise of 4 degrees doesn't seem alarming -- it sounds like stepping out of your front door to a spring day of 72 degrees rather than 68. But in fact, evidence from ice sheets and tree rings suggests that in the past, changes of only a few degrees in global average temperatures radically altered the Earth's climate. During the most recent ice age, for instance, global temperatures were just 10 degrees cooler than today.

So a small amount of warming could have cataclysmic consequences. Climatologists project that crop yields in some African countries will decline by up to 50 percent by 2020, for instance, and that one-third of species could go extinct. In the Southern United States, warmer temperatures will likely lead to coastal flooding, crop

failures and more frequent and intense storms. More people will get sick and die from heat stroke. Ground-level ozone, which is linked to heart disease and asthma, is likely to form more often because hot weather provides ideal conditions for its development.

It's a sentence that young people across the country say they have little choice but to fight.

"What's happening to the planet right now is incredibly scary," said Deirdre Lally, a 22-year-old student at the University of Massachusetts in Boston. Lally was arrested in October after she chained herself to the doors of a bank in Cambridge, Mass. "I don't think we see an option of winning or losing," she said. "We have to win."

In the past six years, U.S. banks and coal companies have been the target of at least a dozen youth-led acts of civil disobedience.

In April, police arrested eight activists who chained themselves to bulldozers at the construction site of the Cliffside coal-fired power plant in western North Carolina.

Four college students caused a traffic jam for more than two hours in June when they blockaded the entrance to Dominion Resources, an energy company based in Richmond, Va.

And in July, activists climbed flagpoles at the American Municipal Power headquarters in Columbus, Ohio, to hoist banners reading "No New Coal!" and "We Won't Stop Until You Do."

Young people are also using more mainstream tactics to build support for the movement. Last January, students and faculty at more than 1,500 universities and K-12 schools organized events for "Focus the Nation," a day-long discussion of global-warming solutions. At more than two dozen institutions, students have voted to raise fees

to pay for campus renewable energy or efficiency measures. And electoral campaigns, such as the Power Vote campaign that Anderson joined last fall, have worked to develop a climate-friendly youth voting bloc.

Unfortunately, young people have the least direct political power of any group of citizens in the U.S. No one younger than 25 is eligible to run for election to federal public office, for instance. Those younger than 18 can't even vote. And unlike the fossil fuel industries, young people have only a handful of lobbyists advocating for their interests.

But they can speak with moral authority.

"Young people have the ability to talk about this issue in a way that no one else can," said Eban Goodstein, a Lewis & Clark College economics professor who organizes the Focus the Nation discussions. "They are the only legitimate spokespeople for the future."

On a September visit to Duke University in Durham, Anderson spent a few hours conducting student outreach, accompanied by Krista Hozyash, a willowy graduate student from the School of the Environment. In the early afternoon, they approached three students sitting in rocking chairs in a plaza near the student center.

"Would you guys like to see the U.S. re-engage in global-warming solutions?" Anderson asked. The students burst into uproarious laughter.

"Climate change is a myth," one said when he had finished laughing. He wore sunglasses, a bleached-blond mohawk and a contemptuous grin. "The gravity we assign to man-made climate change is ridiculous considering the uncertainty in the scientific community."

(In fact, nearly all climate scientists believe the existence of human-caused warming is unequivocal.)

“Do you think it might be a good idea to take precautions?” Hozyash asked.

Mohawk objected without hesitation. It would hurt the economy too much.

“You’re talking to the wrong person because I’m an amoral person,” he added. “I fundamentally don’t care.”

Anderson tried to shift the conversation. Creating green jobs would help the economy, he said. Green jobs can’t get outsourced.

“That sounds protectionist,” Mohawk replied.

One of Mohawk’s companions, a young woman with long, stick-straight blond hair, pink lipstick and a bright blue Duke jacket, examined her fingernails and sighed. Anderson and Hozyash walked away. Their time is better spent, Anderson explained, reaching out to people who will be more receptive to their message.

In fact, even when Anderson finds young people who agree with him, getting them organized takes work. Filling a meeting room with young activists requires methodical adherence to what organizers refer to as the Law of Halves. The Law goes something like this: If an organizer persuades 100 students to sign a pledge card, about half of them will agree to provide their phone numbers. When the organizer calls those 50 students to invite them to a meeting, 25 will say they’re coming. Of those, 12 or 13 will actually show up. So activists are under constant pressure to contact as many people as possible.

To turn out eight students to an interest meeting on the UNC-Greensboro campus, for example, Anderson spent a day meeting dozens of students, passing out stickers,

delivering his spiel to classes and student organizations, making calls and sending text messages.

On another outreach visit, this time to Grimsley High School in Greensboro, Anderson spent some time hastily assembling a display board about the Power Vote campaign. It was during a break between the school's lunch shifts, and just a few minutes earlier, students had been swarming the Power Vote table to collect green stickers and to sign pledges. Now, crouching on the ground, Anderson used clear plastic tape to affix informational sheets to a foam display board.

"I hate using tape," he commented to a reporter standing nearby. "For one thing, you can see it. The other reason is fingerprints." Indicating the grimy fingerprints visible on the tape, he said he would never use tape on a display board or poster related to an anti-coal protest.

"I have too much paranoia that it would get confiscated," he said. "I know they put everything together."

It might sound paranoid, but Anderson's fear that police or corporate officials would obtain his fingerprints from display-board tape is not entirely unreasonable.

On Oct. 21, 2008, climate activist Josh Tulkin received a letter from the Superintendent of the Maryland State Police. Tulkin is the field director of the Energy Action Coalition, and previously worked as an activist with the Chesapeake Climate Action Network in Takoma Park, Md. The letter informed him that for a thirteen-month period starting in March 2005, he had been listed in a database of people suspected of involvement in terrorism. His file listed him under the category "Terrorism – Environmental Extremists."

At the Asheville Youth Energy and Sustainability Summit in October, Tulkin appeared unfazed as he worked to collect Power Vote pledges on a grassy quad in the center of campus. He said he has never been arrested, and that during the time he was suspected of terrorism, he was helping to pass the Maryland Healthy Air Act and serving as a youth delegate to the United Nations.

“What they did was offensive, unnecessary and scary,” he said, “but I wasn’t aware of it, so I wasn’t intimidated.”

Still, the threat of surveillance can only add to the stress of working in a field in which hours are long, pay is low and burnout is common. Anderson, who works 50 to 60 hours in an average week, earns the livable if not princely salary of \$28,000 annually. His boss, Liz Veazey, the founder and executive director of the Southern Energy Network, has grown so burned out after five years of working as an environmental advocate that she plans to leave the field altogether in the spring of 2009.

Anderson, too, plans to leave climate activism eventually. When he is in a dark mood, he speaks about the future in doomsday terms.

“I’m really getting concerned that the time frame we have to create tangible change is so limited,” he said. “The first thing that’s going to go is the grocery stores. There’s going to be mass fear, mass panic. Many people are going to turn against each other.”

At other times, though, he speaks of his dreams to earn a Ph.D. and to travel the world. He sounds confident of his choice to become an environmental activist: “We’ve only got one planet,” he said. “I’m an environmentalist because I’m a humanitarian. A lot of people are going to die. I don’t think it’s fair for people across the world to suffer.”

Meanwhile, some signs suggest that the climate movement might be winning. The Power Vote campaign collected more than 340,000 pledges, including 7,000 in North Carolina, from young people who promised to vote for climate-friendly candidates. In November, an unusually large youth voter turnout helped win the presidency for Barack Obama, who had pledged to institute climate-friendly policies. In December, Bank of America announced it would cease financing companies that practice mountain-top removal, a destructive and particularly controversial method of coal extraction. By March, the Environmental Protection Agency had signaled it would move quickly to declare global warming a threat to public health – a first step toward imposing far-reaching regulations of greenhouse gases.

On a Sunday in the first weekend in October, more than 60 activists lined up in front of the state capitol building in Raleigh, N.C. They stood next to an 18-foot inflated model of the Earth painted to look as though it was on fire, like a Macy's Day Parade float with an apocalyptic twist.

The activists formed two lines and hoisted signs spelling out this message: "WE CAN STOP GLOBAL WARMING! NO COAL NO NUKES NO KIDDING!"

But though Anderson had been a lead organizer of the spectacle, he was not in the crowd. Instead, he was nearly 250 miles away, with his family in Chimney Rock, N.C. After he graduated from college last May, he moved back to Thomasville for a few months to work on his relationship with his stepfather. These days, the two talk by phone occasionally and Anderson makes a point of spending time with his family.

“It surprised me that he became such an activist,” said his mother, Whitney Hopkins. “A lot of what he talks about is really over my head.” But, she said, “I’m very proud of him.”

When the members of the Asheville zombie horde arrived at the Bank of America branch downtown last October, they were met by five police officers who blocked the glass entrance doors with crossed arms and stern expressions. A police officer aimed a video camera at the approaching crowd.

To protest Bank of America’s financial involvement in the coal industry, some of the zombies intended to close their bank accounts. But the police and bank managers refused to allow more than one zombie to enter the bank at a time, considerably slowing the process. (Gary Knisley, the bank’s consumer-market manager, declined to comment to a reporter.)

So as they waited to close their accounts, the zombies gathered on the sidewalk in front of the bank, waving their banners and reciting Bank of America’s offenses into a megaphone: Bank of America is ruining the planet! Bank of America funds mountain-top removal and mercury emissions! One by one, the account-canceling zombies emerged from the bank, triumphantly waving cash above their heads. The officer who had been filming the scene spoke in a serious tone into a cell phone, repeating the zombie’s chants.

In the coming days and months, Anderson would lead dozens of serious discussions about stopping the worst effects of climate change. At the Youth Energy and Sustainability Summit that weekend, he and other students would begin developing strategies to push North Carolina lawmakers to adopt climate-friendly policies. The

following February, he would helm a 400-member delegation to Washington, D.C., for Power Shift 2009, a national youth climate summit. But for now, he leaned against a nearby sign, letting the other young activists take the lead.

As the sun fell in the sky, even the police officers appeared to relax. A zombie with his face painted like a skull pulled out a mandolin and plucked a few tunes. Two other zombies staged playful attacks, snarling grotesquely and nibbling at each others' stomachs. And as the officers watched the zombies' antics, they began to laugh.

REFLECTION

In his 1966 book *Round River*, naturalist Aldo Leopold described the emotional challenges of studying environmental problems. “One of the penalties of an ecological education is that one lives alone in a world of wounds,” he wrote (p. 165). He continued:

Much of the damage inflicted on land is quite invisible to laymen. An ecologist must either harden his shell and make believe that the consequences of science are none of his business, or he must be the doctor who sees the marks of death in a community that believes itself well and does not want to be told otherwise (p. 165).

Although I was operating as a journalist, not as an ecologist, I often recalled this insight as I worked on my thesis project. Reporting on climate change turned out, as Leopold suggests, to be lonely work. Carrying out the project meant confronting, day after day, the likelihood that my own future will be significantly affected by climate change. At the same time, it required me to talk with community members who either deny that the earth is warming or would rather not think about it.

As I interviewed my subjects, I was surprised by the contrast between what scientists believe is happening to the climate and what ordinary people think the future will be like. This contrast turned up in conversations with grape growers and college students, but it was most obvious in Key West, Fla.

On one day during my visit to the island, I spent a few emotionally draining hours interviewing reef scientists and advocates. Billy Causey, regional director of the National Oceanic and Atmospheric Association, told me about the shock and sadness he had felt watching reef ecosystems disintegrate during the past four decades. Jeff Pearson,

education coordinator at Reef Relief, predicted that the collapse of the reefs – and the tourism industry that depends on them – would irrevocably alter Key West culture. By the end of the interviews, I was in a somber mood.

Then I stepped back outside into the warm sun, where thousands of tourists were enjoying themselves and street performers were working to extract money from them as quickly as possible. A woman standing on the sidewalk cheerfully called out, “Come on, guys! Hot, naked ladies upstairs! Totally nude!” Like anyone who has received bad news and then been surprised that the world continues as usual, I felt disoriented and alone.

When I spoke with island residents, mentioning the words “global warming” nearly always drew responses like the one I got from Key West tour guide Mikey Puntillo: “We’ve had the coldest winter in a long time,” he said. Such statements echoed contrarian arguments – which have proliferated on the Internet in recent months – suggesting that recent cold spells mean climate change is nonexistent. In fact, most climate scientists agree that recent cool winters in North America are a result of a normal La Niña cooling event in the Pacific.

Talking about climate change also sometimes had a polarizing effect. When I described my thesis to a man I met on the bus in Key West, he accused me of being a member of PETA, the ACLU and the Democratic Party. Here, then, were people who appeared not to want to see what Leopold called “the marks of death.”

In response to such issues, I learned the importance of taking breaks. Sometimes, stopping just long enough to eat a slice of Key Lime pie helped me to continue with difficult interviews. I also learned to speak in vague terms. “I’m writing an article about the decline of coral reefs,” I would say. Or: “I’m writing about Pierce’s disease in North

Carolina.” Avoiding polarizing buzzwords such as “carbon dioxide” kept interviews from shutting down prematurely.

Deciding how to write the three articles raised another set of issues. How should I portray the people in my stories who were unconcerned about climate change? How should I “balance” the viewpoints of my subjects? Should I write “objectively,” if such a thing is possible, or as an advocate?

The norm of balance in climate reporting has come under serious criticism. Maxwell and Jules Boykoff (2004) demonstrated that in the 1990s and early 2000s, a majority of articles and stories in American prestige newspapers and network television shows used climate contrarians as sources. As a result, the stories erroneously portrayed climate science as unsettled even as the consensus on climate was growing stronger. As Corbett and Durfee (2004) have shown, the inclusion of fringe scientists may have led readers to think that the scientific community did not really know whether humans were altering the climate.

With this research in mind, I chose to include contrarians in my articles with careful contextualization. Describing characters such as “Mohawk,” the Duke University student, allowed me to portray truthfully the situations climate activists face in their work. In other cases, including a contrarian viewpoint allowed me to provide a richer depiction of the community. In the story about coral reefs, for example, it was important to show that even the people whose interests will be affected most by climate change appear unconcerned. Yet in the interest of accuracy, I let the readers know as clearly as I could that nearly all climate scientists believe that people are altering the climate – and the oceans – by burning fossil fuels.

Environmental journalists often struggle with the line between education and advocacy. In a recent interview with *Mother Jones*, food journalist Michael Pollan described the difficulty of maintaining the distinction:

You still have to draw lines between being a journalist and an activist. When Obama announced his pick for agriculture secretary I was disappointed, and I said so in some interviews. I got calls from very prominent activists saying, “You should really keep your powder dry because we want to have access to this guy.” Who is this “we”? I felt like Tonto. And I realized that if you are an activist, you do respond tactically. But as a writer you have a pact with your readers that you’ll be really straight with them (Jeffery, 2009, para. 8).

The question – advocate or observer? – may be a particularly difficult one for climate journalists. As I worked on this project, I sometimes found myself wondering, if climate change really is as serious as scientists say that it is, should I do everything in my power to stop it? Or would I lose credibility?

Meanwhile, other climate journalists have begun to speak in advocacy terms. In a 2008 speech in Pittsburgh, journalist Elizabeth Kolbert said that climate change “must be confronted in our individual lives, our communities and on Capitol Hill. It seems to me that every single one of us should be thinking about this, thinking about what we can do, and then doing it” (Steigerwald, 2008, para. 13).

Meanwhile, environmental writer Bill McKibben has plunged fully into activism. In 2006, he began leading global warming demonstrations in Vermont. In 2008, he was a member of a team of activists who founded 350.org, an international advocacy organization. “Often when I’m on TV, they’ll ask what are the three most important things for people to do,” he said in an interview with *Progressive* magazine. “I know they want me to say that people should change their light bulbs. I say the number one thing is to organize politically; number two, do some political organizing; number three, get

together with your neighbors and organize; and then if you have energy left over from all of that, change the light bulb” (Silver, 2009, para. 32).

In this project, I took a middle-ground approach between providing information and acting as an advocate. I avoided editorializing, but I chose my subject matter deliberately in the hopes of raising questions about the implications of climate change in the South. As I stated in my literature review, social scientists have suggested that localizing climate news is a way to encourage Americans to make climate change a political priority. For that reason, I chose to describe regional effects of climate change in articles about coral reefs and the wine industry in North Carolina. In addition, by describing a climate activist, I provided information about underreported options for taking action on climate change. Citizens deserve to receive information about ways in which they can respond to climate change, ranging from changing lightbulbs to politically organizing, and everything in between.

Climate change is an enormous subject, and it will continue to be an important area for rich, timely reporting. For instance, President Barack Obama campaigned on promises to invest \$150 billion in renewable energy and to institute a cap-and-trade system to regulate carbon dioxide. As a result, energy and climate are likely to be some of the biggest political and economic stories of the next four years.

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