Monitoring Well-being and Changing Environmental Conditions in Coastal Communities: Development of an Assessment Method

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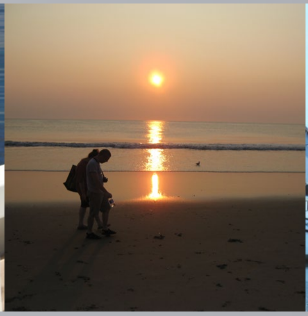

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ABOUT THIS DOCUMENT

The intersection of social and environmental forces is complex in coastal communities. The well-being of a coastal community is caught up in the health of its environment, the stability of its economy, the provision of services to its residents, and a multitude of other factors. With this in mind, the project investigators sought to develop an approach that would enable researchers to measure these social and environmental interactions. The concept of well-being proved extremely useful for this purpose. Using the Gulf of Mexico as a regional case study, the research team developed a set of composite indicators to be used for monitoring well-being at the county-level. The indicators selected for the study were: Social Connectedness, Economic Security, Basic Needs, Health, Access to Social Services, Education, Safety, Governance, and Environmental Condition. For each of the 37 sample counties included in the study region, investigators collected and consolidated existing, secondary data representing multiple aspects of objective well-being. To conduct a longitudinal assessment of changing well-being and environmental conditions, data were collected for the period of 2000 to 2010. The team focused on the Gulf of Mexico because the development of a baseline of well-being would allow NOAA and other agencies to better understand progress made toward recovery in communities affected by the Deepwater Horizon oil spill. However, the broader purpose of the project was to conceptualize and develop an approach that could be adapted to monitor how coastal communities are doing in relation to a variety of ecosystem disruptions and associated interventions across all coastal regions in the U.S. and its Territories. The method and models developed provide substantial insight into the structure and significance of relationships between community well-being and environmental conditions. Further, this project has laid the groundwork for future investigation, providing a clear path forward for integrated monitoring of our nation's coasts. The research and monitoring capability described in this document will substantially help counties, local organizations, as well state and federal agencies that are striving to improve all facets of community well-being.

For more information on this effort please visit:
http://coastalscience.noaa.gov/projects/

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CHAPTER 1: INTRODUCTION

1.1. TRACING LINKS BETWEEN ECOSYSTEMS AND COMMUNITIES

The National Oceanic and Atmospheric Administration (NOAA) has primary responsibility for monitoring, forecasting and managing the nation's coastal and marine ecosystems. It is the first-order steward of resources derived from these ecosystems, a role that the agency undertakes to protect and benefit the nation. For instance, NOAA monitors and manages biological resources, such as marine fisheries, which are an important component of regional, national and global commerce. Marine and coastal ecosystems, and their associated resources, are of central importance to coastal communities. It is at the local level where individuals, families and, frequently, entire communities depend upon the sea for their livelihood, food and leisure-time pursuits. Millions of Americans live, work and play along our nation's coasts.

A beach community in Apalachicola, Florida.
Credit: Theresa Goedeke

Coastal living, however, presents unique challenges to individuals and communities, as well as to the government agencies that serve and protect them. When a community's culture and economy are closely intertwined with coastal and marine ecosystems, a decline in the condition of these ecosystems can mean trouble for both. Coastal areas are especially sensitive to large-scale natural and technological disasters. For example, tropical storms and hurricanes cause immediate issues related to public safety and can dramatically alter habitat in areas hardest hit. Serious alteration of habitat can subsequently compromise the short or long-term health of local ecosystems, particularly where human disturbance has reduced an ecosystem's capacity for resilience (Greening et al. 2006; Conner et al. 1989). In the aftermath of large-scale natural events, the culture, economy and demographic composition of communities can also be transformed, due in part to interruptions or alterations to the historic connectivity between communities and ecosystems.

Similarly, human-induced events along our nation's coasts, such as oil/chemical spills, water/air pollution, hypoxic events and harmful algal blooms, can also harm or degrade ecosystems. Such events can markedly reduce the health and productivity of ecosystems, or lead to the perception of declines in ecosystem health, making life more difficult for residents of coastal communities (Arata et al. 2000; Fall et al. 2001; Picou et al. 1992). Human-induced events can threaten the short term health of people (Diaz 2011; Meo et al. 2009; Suarez et al. 2005). Moreover, there is reason to suspect that human health can be impacted over the long-term after such events (Adeola 2000; Diaz 2011; Gill and Picou 1998; Devi 2010).

However, with the possible exception of the Exxon Valdes oil spill, the long-term, cumulative impacts of human-induced environmental hazards on communities are not routinely studied. This gap in research represents a significant driver of the present project. Oil spills, in particular, are examples of human-induced events that have devastated marine and coastal ecosystems in the United States (U.S.), causing both immediate and chronic disruptions to resource-dependent communities along our nation's coasts (Dyer et al. 1992; Freudenburg 1997). These communities are particularly vulnerable to such events because their culture and economies are often intimately intertwined with ecosystems (Picou et al. 2004).

As an agency, NOAA plays a critical role in anticipating, monitoring and mitigating the harmful influence of natural and human-induced events in marine and coastal environments. Further, in many cases, the agency is responsible for restoring ecosystems or resources that have been injured or degraded. Ultimately, restoration activities are undertaken to make whole again the communities that rely directly on these ecosystems. The 2012 NOAA Annual Guidance Memorandum (Lubchenco 2012: 2), which summarizes and directs research at the agency, states:

> "NOAA continues to contribute to the recovery of the Gulf and the long-term sustainability of Gulf Coast communities by protecting wildlife, restoring habitat, and providing scientific advice for coastal and fisheries management."

In recent years, NOAA has grown increasingly interested in learning more about the nature of the relationship between coastal communities and the ecosystems upon which they depend. Further, leadership at NOAA now routinely ask: How effective have our policies, programs and activities been at improving the condition of both ecosystems and people? It is a challenging question to answer. Nevertheless, work has begun at the agency to unpack the complex relationship between people and coastal/marine ecosystems. NOAA is developing cost-effective yet methodologically robust approaches for detecting and monitoring the interdependent condition of people and ecosystems. Thus, an evolving goal for NOAA is to better understand the many needs of the public, as well as the agency's success at meeting these needs.

Using the Gulf of Mexico as an inaugural case study, the present research project was initiated to help move NOAA toward achievement of the aforementioned goal. The specific objectives of the project were to:

1) develop a method for measuring the status of coastal communities in relation to environmental condition; and

2) establish a baseline for monitoring changes in the well-being of residents along the Gulf of Mexico in counties impacted by coastal contamination from the Deepwater Horizon industrial disaster.

The investigators' vision for the current project was to develop a method and analytical protocol that could be employed over the long-term to detect change in coastal counties once post-spill recovery programs were undertaken. Such a capability would allow NOAA and other government agencies at the local, state and federal levels to better understand progress made toward recovery, as well as the challenges not met to recover impacted communities. More broadly, the investigators strove to conceptualize and develop an approach that could be adapted to monitor how coastal communities are doing in relation to a variety of ecosystem disruptions and associated interventions, across all coastal regions in the U.S. and its Territories.

1.2. CONCEPTUAL APPROACH: HUMAN WELL-BEING AND ECOSYSTEMS

A central premise of the present study was that humans, their communities, culture, economy and society, are best understood in the context of the natural environment, or ecosystems, wherein they exist. This is because ecosystems, even in highly urbanized areas, serve as the basic foundation for human life (Bolund and Hunhammar 1999). Ecosystems provide humans with the essentials of life and socio-cultural fulfillment by serving as a source of renewable and non-renewable resources, repository for waste, as well as space for living, playing and working (Dunlap 1993; Wallace 2007). These "ecosystem services" are the "conditions and processes through which natural ecosystems…sustain and fulfill human life" (Daily 1997: 3). For instance, there is evidence that living in near proximity to coastal areas positively influences human health and "well-being" (Bauman et al. 1999; Wheeler et al. 2012).

People tend to benefit from ecosystem services when those systems remain healthy, that is, when they are functioning well or within normal parameters. However, if an ecosystem's functioning is compromised, then the provision of these services can be interrupted, perhaps reducing the well-being of people who use or depend upon those services (Butler and Oluoch-Kosura 2006; Costanza et al. 1997; MEA 2005). Thus, the concept of well-being is useful when one wishes to consider the nature of the relationship between coastal communities and the ecosystems upon which they depend.

But what is well-being? In general, well-being is a concept used to assess the status of people, either individually or collectively, at multiple scales (e.g., individual, community, county, national or international) (Costanza et al.

2007). It is used to determine if people are thriving, struggling or failing relative to some optimum standard of life experience (Doyal and Gough 1991).

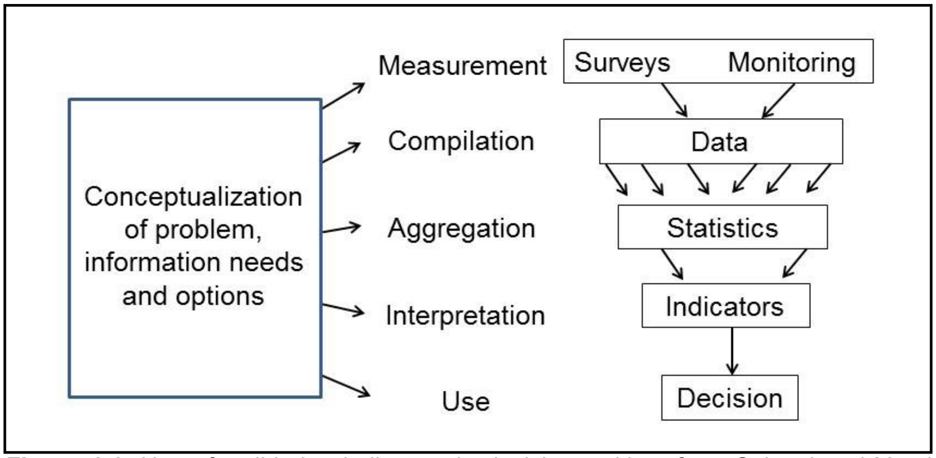

Figure 1.1. Use of well-being indicators in decision-making, from Spiegel and Yassi (1997).

Well-being assessments are generally used by decision-makers to inform policies and programs geared toward improving the condition of a population. Spiegel and Yassi (1997), shown in Figure 1.1, depict the process of using indicators, which are measurable conditions used to indicate the status of an individual or population, in the decision-making process. First, assessors, such as a research team, will help decision-makers to articulate the problem that needs attention in a target population. Once the problem is defined, assessors will then collect and analyze data that can be used to interpret the status of the population: the indicators. The decision-makers then take the results of this assessment, drawing conclusions about the status of the population, and decide how best to influence change in their status.

However, it is important to note that there is no universal standard for what well-being is and what it is not, with the possible exception of absolute poverty (UNESCO 2012). In other words, what constitutes well-being remains relative across culture, time and space, and is ultimately contextually dependent (Gough 2004; MEA 2005; Wallace 2007). For instance, there can be major differences between cultures about what level of resource consumption is adequate to meet needs versus satisfy lifestyle choices (Wallace 2003). For this reason, before one can determine if a population has achieved well-being, decisions must be made about which components of well-being are important in the focal context, and what standards one will use as the litmus test to gauge its achievement. Doyal and Gough (1991) argued that an appropriate standard for assessing human needs is achievement of an optimum level in all categories of indicators.

Well-being has been conceptualized in multiple ways. For instance, it can be defined as a state of perceived happiness, contentment or fulfillment as reported by people directly. This approach is generally termed “subjective well-being” because well-being is defined by those for whom the assessment is undertaken (Gasper 2004). Diener (2006: 2) defines subjective well-being as “the different valuations people make regarding their lives, the events happening to them, their bodies and minds, and the circumstances in which they live.” Subjective well-being frequently measures one’s overall well-being in comparison to peers. Examples of common indicators of subjective well-being include happiness, life-satisfaction, equity and self-actualization (Maslow 1943; Costanza et al. 2007). Information collected from a population allows the researcher to understand not only how that group defines well-being, but also communicates whether or not the population has achieved this preferred state.

A second approach to conceptualizing well-being is that of objective well-being. Using this approach, one must choose the indicators that best describe or characterize well-being, which are then measured using objective information (Sharpe 1999). Historically, much of the work related to objective well-being was defined in economic terms. For example, the Organization for Economic Cooperation and Development (OECD), which has long monitored societal progress internationally, traditionally used macroeconomic variables to determine if countries were progressing or not (OECD 2011). More recently, assessors, including the OECD, have pursued a broader conceptualization of what constitutes well-being to include non-economic components (Land 2000; Costanza et al. 2007). In fact, to achieve self-actualized well-being, Gough (2004) argued that all people must first be able to meet the basic needs of physical health and autonomy. With these needs met, there are then eleven essential intermediate needs, including:

- adequate nutritional food and water,
- adequate protective housing,

- non-hazardous work and physical environments,
- appropriate health care,
- security in childhood,
- significant primary relationships,
- physical and economic security,
- safe birth control and childbearing, and
- appropriate basic and cross-cultural education.

According to Gough (2004: 293), since these basic and intermediate needs are "based on the codified knowledge of the natural and social sciences," they may be considered universal and cross-culturally relevant in some fashion, although the local context must still be considered. The Human Development Index (HDI) is an example of a well-known objective measurement of well-being and is comprised of life expectancy, literacy, educational attainment and per capita GDP (Gross Domestic Product) (UNDP 1990).

Costanza et al. (2007: 268) argued that "objective measures are actually proxies for experience identified through subjective associations of decision-makers." Thus, many models of well-being will include components that are both subjective and objective in nature (Costanza et al. 2007; Pollnac et al. 2006). Recent well-being assessments and human development models have attempted to integrate objective and subjective well-being, inclusive of social, economic and environmental indicators, such as the Gross National Happiness Index, Chinese University of Hong Kong (CUHK) Hong Kong Quality of Life Index, Happy Planet Index and Canadian Index of Well-being (Chan et al. 2005; Ura 2008; Marks et al. 2006).

Whether based on subjective, objective or both approaches to well-being, decisions about which components to include in an assessment of well-being are often based on previous research (Hagerty et al. 2001). These decisions may also be based on policy goals or specific objectives related to evaluation or assessment. For instance, assessors interested in the relationship between people and ecosystems have developed heuristic models to map the potential connections, direct and indirect, between well-being and ecosystem services. Cox et al. (2004) identified social capital, economic resources and human health as the primary components of well-being in their model of the potential routes of impact to human well-being as a consequence of change in environmental condition.

Similarly, in their effort to document existing linkages between ecosystem services and well-being, Smith et al. (2013) identified nine components of well-being that had been used in various well-being indices. These components included: health, social cohesion, education, safety and security, living standards, leisure time, spiritual and cultural fulfillment, life satisfaction and happiness, and connection to nature. Finally, according to authors of the Millennium Ecosystem Assessment (2003), human well-being is ideally comprised of five components that must be present at some level in order for well-being to be achieved. These constituents are: basic material need, freedom and choice, health, social relations and security. Therefore, in order to have well-being, a community, for example, must have a citizenry whose basic material needs are met, a social system characterized by freedom and choice, evidence of good health, social relations and security at the community level.

Once assessors have determined which components, or indicators, of well-being are most important, they then determine how to effectively operationalize these indicators. This is so that the status of populations can be effectively documented and compared using the indicators. Well-being indicators may be operationalized using one measure or multiple measures, and multiple measures may be combined into one or more indices. For example, Gyawali et al. (2009), looking at land cover types and well-being, used only three indicators of well-being, including education, income and employment. Each indicator served as its own measure. They then developed an index of well-being using these three indicators to test the relationship between land cover type and well-being at the sub-county level (Gyawali et al. 2009). Conversely, Cox et al. (2004), referenced above, identified three indicators of well-being. They then operationalized each of these indicators with multiple measures. To operationalize their "economic resources" component they used aquaculture, commercial/recreational fishing and tourism as the economic measures most meaningfully linked to environmental condition. Similarly, in an effort to assess the well-being of fishing communities, Helies et al. (2010) created fourteen indexed indicators, among them poverty, community reliance on commercial fishing, using multiple measures for each index. Finally, the five constituents of well-being used in the Millennium Ecosystem Assessment were each assessed by a combination of measures, shown in Table 1.1 (MEA 2005).

Whether researchers use single indicators, multiple measure indicators or indices, decisions must also be made about how to interpret scores from the chosen indicators in order to assess well-being. To assess well-being of a community, researchers may compare a community's performance to some standard or benchmark of performance. This normative approach requires that: "(a) the society agrees about what needs improving [and] (b) it is possible to decide unambiguously what 'getting better' means" (Land 1983: 4). For example, in the U.S. poverty is officially measured for policy purposes. One's poverty level determines whether or not one qualifies for social services. Threshold levels are calculated each year based on household income and other criteria, and poverty is determined by comparing a household's income to these federally defined poverty thresholds. Often, economic and health indicators are more amenable to this type of approach because consensus on what is "good" versus "bad" can be more easily achieved for these indicators, as opposed to more subjective indicators, such as social connections or happiness.

Table 1.1. *Millennium ecosystem assessment indicators and measures.*

Indicator	Measures Identified
Basic Material for a Good Life	Adequate livelihoods Sufficient nutritious food Shelter Access to goods
Freedom and Choice of Action	Opportunity to achieve what an individual values doing and being
Health	Strength Feeling well Access to clean air and water
Good Social Relations	Social cohesion Mutual respect Ability to help others
Security	Personal safety Secure resource access Security from disasters

Although a less common approach, assessors may choose to monitor indicator or index scores across time to track changes in well-being compared with a temporal baseline, perhaps a past time point, or some normative standard or benchmark (Land 1983). The Millennium Development Goals (MDG) Progress Index, created by the Center for Global Development, tracks performance trends within countries on four indicators (i.e., extreme poverty, hunger, HIV/AIDs and water), comparing change across two years, 2010 and 2011 (Leo and Thuotte 2011). However, because of the challenge of obtaining time series data, over-time assessments are generally focused on single populations. For instance, the Gallup Healthways Well-being Index provides "an in-depth, real-time view of Americans' well-being" by tracking an indexed well-being score and component scores for only the U.S.; these data are reported at multiple temporal scales (i.e., daily, monthly and yearly) (Gallup 2009).

On the other hand, assessors may be interested in evaluating well-being by comparing indicators or indices across populations. These types of ranking or comparative analyses tend to be conducted for a single time point or period, while including multiple populations, such as counties, states or countries. One of the most prominent examples of this approach is the County Health Rankings, which is conducted by the Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute. For this effort, the assessors compare the health outcomes for U.S. counties based on several objective indicators: health behaviors, clinical care, social and economic factors, and physical environment. Within a single state, the assessors rank the well-being of counties or county equivalents against each other (Booske et al. 2010). Policy-makers may then look at the rank of a particular county compared with the other counties in a state to determine its relative status. A second example is the State of the Commonwealth Index, derived by the state of Kentucky to assess the state's well-being compared with other U.S. states in five categories: communities, education, economy, environment and government (Watts 2006). Finally, the OECD's Better Life Index provides rankings for countries based on eleven components of both objective and subjective well-being, including community, education, environment, civic engagement, health, housing, income, jobs, life satisfaction, safety and work-life balance (OECD 2013).

Finally, in some cases, assessors compare well-being both across geographies and over time. For example, since 1995, the Heritage Foundation (2013) has maintained the Index of Economic Freedom, the goal of which is to track indicators (i.e., rule of law, limited government, regulatory efficiency and open markets) of a country's economic freedom and prosperity. Data users are encouraged to compare countries, as well as to look at trends for one country over time. Finally, looking specifically at quality of life and its relationship to locational amenities for U.S. states, Gabriel et al. (2003) investigated the change of quality of life rankings for multiple states over time.

Regardless of the approach used by assessors of well-being, the goal is always to determine the status of a population. As mentioned previously, efforts have been underway to conceptualize and assess human well-being specifically in relation to ecosystem services; the body of scholarship in this area is broad and quite diverse (c.f., Coulthard et al. 2011; Keles 2012; Raudsepp-Hearne et al. 2010). Additionally, scholars have long examined the interaction between well-being and specific environmental conditions during exceptional circumstances, such as during technological events or disasters (Bevc et al. 2007; Gill and Picou 1998; Picou et al. 2009). Both scholarly endeavors are undertaken because an increasingly pressing policy question has become: How effective are policies, programs or interventions at improving the condition of ecosystems and people? Much of the work in this substantive area, including the present study, seeks to contribute to answering this question. The end goal continues to be development of effective models that empirically link well-being with ecosystem services so that efforts to improve either well-being or ecosystem health may be evaluated and improved, for the betterment of both (Jordan et al. 2010).

CHAPTER 2: CASE STUDY APPROACH AND SAMPLING

In research focused on human communities, case studies are useful to explore in-depth how and why social phenomena, such as social conflict (e.g., war) or social change (e.g., expansion of voting rights), occur. Case-oriented research can be focused on an individual, community, region, nation or any other unit that is studied as a whole (Schutt 2001). Researchers use cases to test interventions, or to develop theories, methods or management strategies. For example, an agency may evaluate the efficacy of a social program in one community before they decide to start the same program elsewhere. For the current study, the research team chose to define and evaluate several states and counties in the Gulf of Mexico as a regional case study. The intention was to develop a method for measuring the well-being of coastal communities in relation to environmental condition. The investigators chose a regional scale to more completely capture the inter-relationship of community and environment on an ecosystem level.

Aerial view of a portion of Grand Bay National Estuarine Research Reserve in Alabama that demonstrates some of the diverse habitat characteristics of the Gulf of Mexico.
Credit: P.R. Hoar NOAA/NESDIS/NCDDC

2.1. GULF OF MEXICO: A REGIONAL CASE STUDY

The Gulf of Mexico is a large marine ecosystem bordered by three countries: the U.S., Mexico and Cuba (Sherman 1999). The U.S. has approximately 47,000 miles of shoreline along the Gulf, spanning five states: Texas, Louisiana, Mississippi, Alabama and Florida (NOAA 2011). Because of its diverse array of coastal and marine habitats, the Gulf of Mexico is a highly productive ecosystem. Thirty-three river systems drain into the Gulf of Mexico creating thousands of acres of wetlands and estuaries, which serve as nursery grounds for economically and ecologically important fish species and habitat for a myriad of coastal wildlife (Giattina and Altsman 1999). Additionally, the Gulf of Mexico has a variety of near and off-shore marine habitats that are home to a host of plankton, fish, turtles, marine mammals and other species. The Gulf of Mexico has an extensive system of barrier islands and over 54% of the coastal wetlands in the contiguous United States (Field et al. 1991; Giattina and Altsman 1999). Finally, the Gulf region's coastal wetlands and estuaries provide over 90% of the region's commercial finfish and shellfish annual landings, serve as a critical resource for recreational fishing for the entire nation, and offer storm protection for major ports (NOAA 2011).

In short, the Gulf of Mexico is rich in natural resources that are highly valued by people, from crude oil to white sand beaches. Due in part to the proximity to these resources, about 21 million people lived in the Gulf Coast region in 2010. The Gulf Coast region includes all counties within the coastal watershed of the Gulf of Mexico (NOAA 2011). Coastal shoreline counties are a subset of the counties in the Gulf Coast region (Figure 2.1). Approximately 14.3 million Americans, roughly 25% of all persons living in the Gulf Coast region, live in one of the 56 coastal shoreline counties, meaning counties that touch the Gulf of Mexico.

Many of the natural resources of the Gulf of Mexico are utilized for commercial purposes. The business sectors most dependent on the region's coastal and marine natural resources are the oil and gas, commercial fishing, marine transportation and shipping, and recreation/tourism (including recreational fishing) industries. Not coincidentally, these are also some of the most important industries to the region (Adams et al. 2004). In particular, the oil/gas and commercial fishing industries of the Gulf of Mexico are among the most economically productive in the nation. As of April 15 2013, there were about 2,774 active oil platforms in the Gulf of Mexico (DOI 2013[a]). Total oil production for the Gulf of Mexico region averaged about 480 million barrels of oil (BBLS) annually from 1995 to 2010, with some 566 million BBLS produced in 2010 (DOI 2013[b]). In 2010, commercial fishers landed approximately 583,153 metric tons of fish and other commercially harvested resources from the Gulf of Mexico, worth $638,860,057 (NOAA 2013). Add to this the region's many ports and tourist destinations, and it is not surprising that in 2009 the five Gulf States accounted for approximately 17% of the nation's Gross Domestic Product

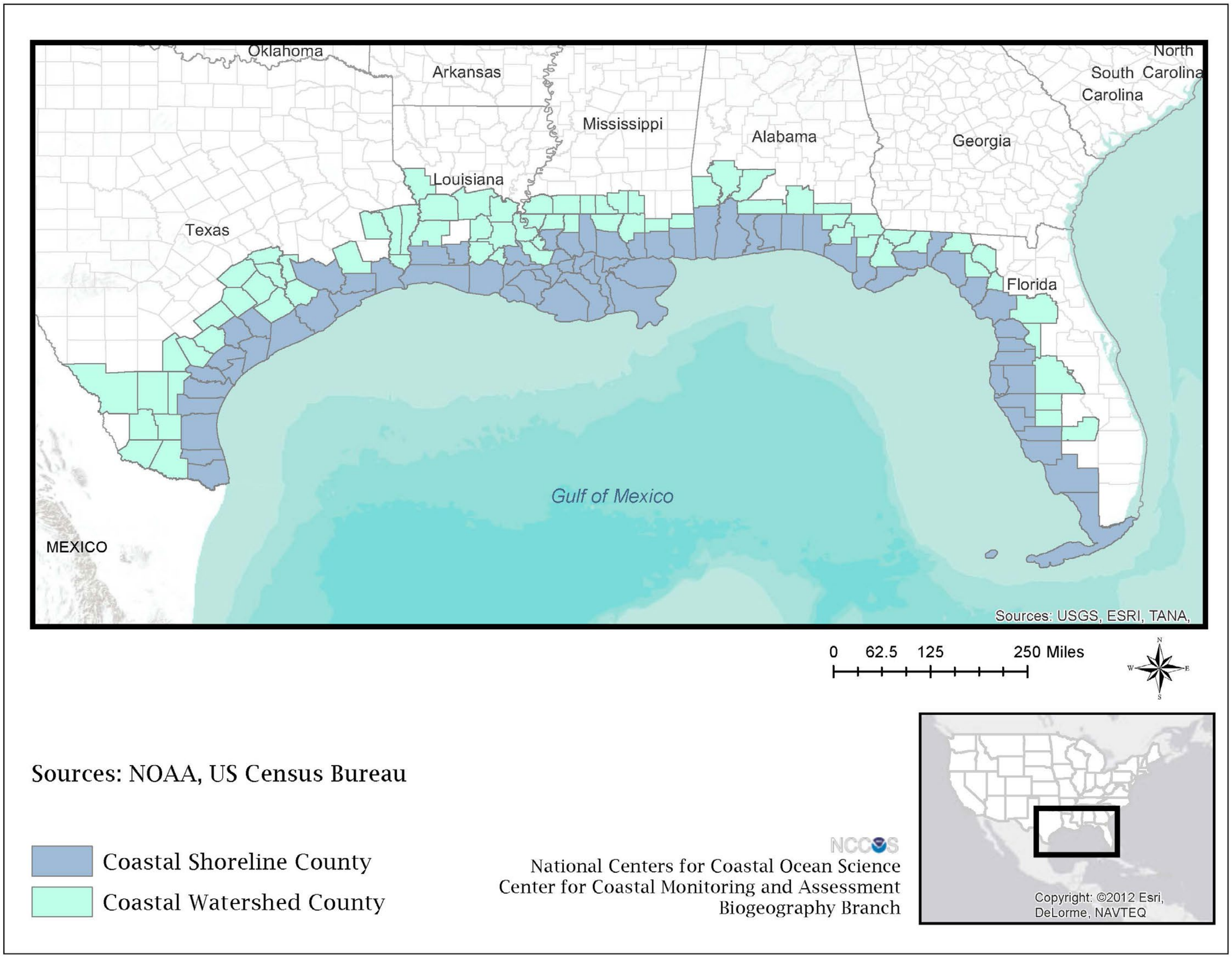

Figure 2.1. Map of coastal shoreline and coastal watershed counties in the Gulf of Mexico region.

(GDP) across all business sectors (U.S. Census Bureau 2012). The habitats and ecosystems that support the economic growth and vitality of the Gulf Coast region also offer cultural value to residents. Ultimately, the health of these ecosystems directly influences the full range of resources that define the region and contribute to the lifestyle of nearby communities.

While the Gulf Coast region is incredibly productive, both from an ecological and economic standpoint, disasters and hazards are not uncommon (Figure 2.2). Such events can affect the region's productivity, as well as the stability of communities. For example, the Gulf of Mexico frequently experiences tropical storms and hurricanes. Since 1900, twenty-one of the thirty costliest storms in U.S. history made landfall in a county along the Gulf of Mexico (Blake et al. 2011). In 2005, Hurricane Katrina, the third most deadly and the most costly storm in the nation since 1900, displaced hundreds of thousands of people in Louisiana, Mississippi and Alabama and caused an estimated $180 billion dollars in damages (Gabe et al. 2005; Blake et al. 2011). Hurricanes and tropical storm events, even relatively minor storms, can have significant impacts on coastal communities because of their proximity to high hazard zones. Damage from storm events can range from physical destruction of the natural environment or man-made infrastructure to harm to local economies and sociocultural systems (e.g., social networks) (Elliott and Pais 2006).

Other large-scale hazards of importance in the Gulf of Mexico are the hypoxic zone and harmful algal blooms (HABs). The hypoxic zone in the Northern Gulf of Mexico, estimated to be about 18,000 km^2 annually, is one of the world's largest anthropogenic hypoxic zones (Rabalais et al. 2002). Within this "Dead Zone" marine life is negatively impacted (Rabalais et al. 2002). HABs are also a significant problem in many Gulf of Mexico estuar-

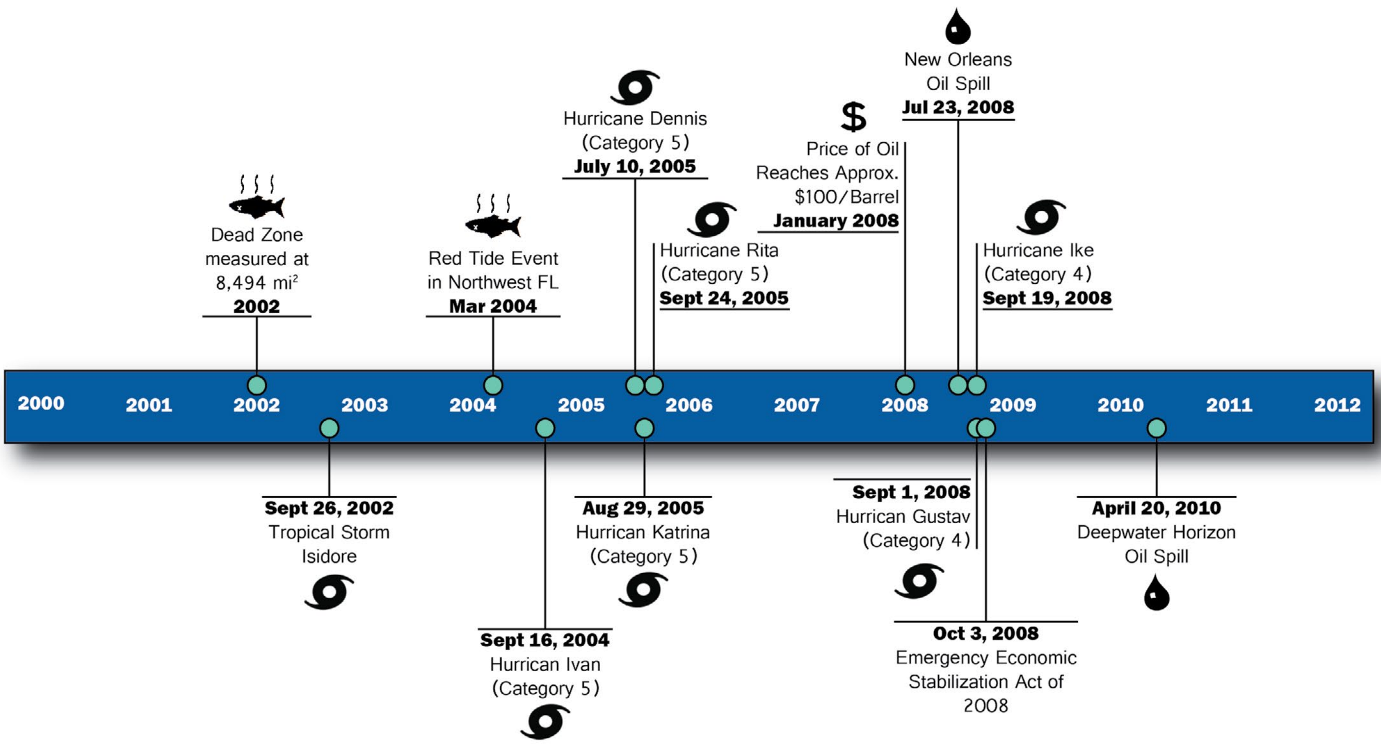

Figure 2.2. Timeline of select events affecting the Gulf of Mexico region.

ies; in 1996, HAB events occurred in all five Gulf States (Bricker et al. 2008; 1999; Pennock et al. 2004). The economic consequences of HABs in the Gulf of Mexico because of shellfish harvest area closures, fish kills and beach advisories can cost $20 million for each major event (Pennock et al. 2004).

Finally, coastal communities struggle to varying degrees with coastal erosion or land subsidence, and sometimes both. The primary causes of such land loss includes anthropogenic forces such as altered hydrology from canal dredging, channelization, flood control structures, dredge and fill activities, and oil and gas extraction (Morton et al. 2002). Simultaneously, marsh and shoreline areas are degraded by the forces of hurricanes and other storm events, natural cycles of erosion, accretion and subsidence, fluctuation in sea level due to sea level rise and the physical disturbance of vegetation and sediment by invasive species (LCWCRTF and WCRA 1998).

In addition to harmful "natural" events, technological disasters have also posed a problem for the region. From 2000 to 2011, the U.S. Coast Guard investigated 10,226 oil spill incidents in the Gulf of Mexico; spills that cumulatively resulted in the release of approximately 210 million gallons of oil over the 11-year period (U.S. Coast Guard 2012). The largest spill to date for the region took place in 2010. On April 20, 2010 an explosion occurred on British Petroleum's (BP) Deepwater Horizon oil rig, which was located approximately 50 miles off of Louisiana's coast. The accident caused a breach in a well on the Macondo Prospect, leading to a voluminous and steady outflow of oil into the Gulf of Mexico. The discharge of oil lasted for 111 days. Government estimates indicate that some 4.9 million barrels of oil and 1.07 million gallons of chemical dispersants were released into the Gulf as a result of the incident (Restore the Gulf 2011). The disaster, termed the Deepwater Horizon MC252 oil spill, was and remains unprecedented in the U.S.

As seen in Figure 2.3, oiling occurred from Louisiana to the Florida Panhandle, affecting many different shoreline habitats, including beaches, marshes and estuaries. The worst oiling occurred west of the Mississippi River, along barrier islands, and on beaches from Dauphin Island, Alabama to Gulf Breeze, Florida (Restore the Gulf 2011). As the oil coated marine and coastal areas, fish and wildlife were covered and smothered as well. Some of the most dramatic images during the spill were of oil-soaked seabirds, grounded, dead or dying along formerly white-sand beaches. Although not all recorded wildlife mortality was directly linked to contamination from the spill, the carcasses of 6,147 birds were collected by the U.S. Fish and Wildlife Service during this period, along with 613 sea turtles and 157 mammals (USFWS 2011).

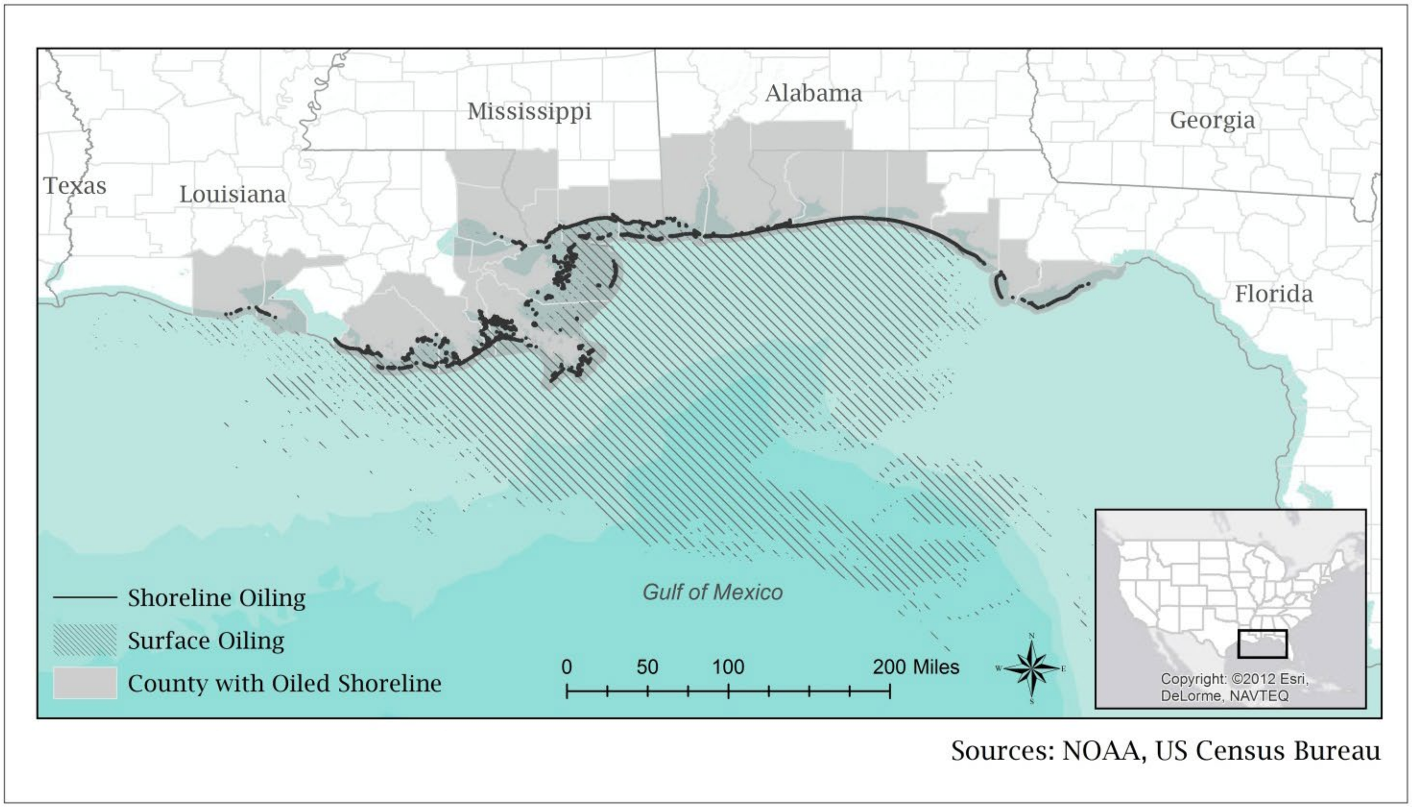

Figure 2.3. Map of the extent of oiling in the Gulf of Mexico region.

In many coastal communities, oil coated the pilings of piers and docks, the hulls of boats and shoreline adjacent to coastal homes and waterfront districts. The impact on affected communities was often intense, particularly in towns reliant on beach tourism and seafood production. For example, the oil spill led to the closure of beaches popular with residents and tourists. According to the Natural Resources Defense Council (NRDC 2011), by 15 June 2011, there had been 9,474 days of oil-related beach notices, advisories and closures for beaches along the Gulf Coast due the spill. Water quality issues stemming from the spill persisted at beaches in coastal communities across four Gulf States into 2012 (NRDC 2012).

Fishing boats, crews and mariculturists were idled across the region for months as a result of the spill. By June 2010, the NOAA National Marine Fisheries Services (NMFS) had closed nearly 37% of fishing areas in the Gulf of Mexico's Exclusive Economic Zone (EEZ) (NOAA 2013). A full year later, on 19 April 2011, NOAA opened the last fishery previously closed due to the disaster (Restore the Gulf 2011). In an attempt to mitigate some of the economic damage to the fishing industry, BP hired approximately 3,500 fishing boats and crews to assist with the response (Upton 2011). Nevertheless, forecasted losses to the Gulf of Mexico fishing industry as a result of the spill are in the billions of dollars (Sumaila et al. 2012). Finally, a six month drilling moratorium was implemented by the Obama administration as oil continued to flow from BP's Macondo well.

The impacts discussed represent only a small fraction of the total consequence of an event of this magnitude. To date, BP and its associates have paid over 7 billion dollars in economic, property and medical claims to the victims of the oil spill and over the next 5 years it will pay approximately 4.5 billion dollars in criminal penalties (British Petroleum 2013). However, for the communities of the Gulf of Mexico, social, mental and physical health, and legal impacts continue (Devi 2010). No doubt, daily life was, and in some cases remains, negatively transformed for many communities along the Gulf of Mexico.

Because of its marked social, cultural and economic dependence on marine and coastal ecosystems, as well as its history of notable challenges that result from natural and technological disruptions to this dependency, the Gulf of Mexico region is an ideal place to examine how changes in environmental condition may or may not influence community status. While the Gulf of Mexico may have many qualities unique to the region, both ecologically and culturally, these qualities do not negate the usefulness of the region as an inaugural case study for the present project. In fact, because the interconnectivity of communities and the environment is very pronounced in the Gulf of Mexico, it is an ideal starting point to develop a method for assessing the status of coastal communities. We make the assumption that this high degree of interconnectivity enhances one's ability to empirically test the influence of environmental condition on community status (or vice-versa). Further, the challenges faced by coastal communities in the Gulf of Mexico region due to natural and technological disasters, viewed historically, allow for a quasi-experimental approach to the study. In other words, by using a retrospective, time series approach, community status may be evaluated in relation to other known, historical events of varying magnitudes that negatively impacted coastal and marine ecosystems in the region.

2.2. SAMPLE SELECTION FOR THE CASE STUDY

To develop the well-being assessment protocol, the researchers opted to focus efforts on a selection of communities within the Gulf of Mexico region. The idea was to use this selection to build a useful set of indicators, in proof of concept. There were several decision points along the way as the assessment team refined and narrowed the scope of the project. The first decision point was how to define "community."

Community may be defined in a number ways. Community boundaries may be determined based on legal, political, physical or symbolic criteria (Cohen 1985; Clay and Olson 2008). For example, a community may be defined using a group's subjective identity, that is, the community members themselves decide what constitutes the community and how people qualify for membership (Clay and Olson 2008; Jacob et al 2002). Alternatively, a community may be defined by some form of social behavior, such as participation in an activity or engagement in social networks (Putnam 2000; Tropman et al. 2001). Definitions of community may or may not be geographically bounded; meaning that community members need not be located in the same physical space in order to qualify as a community (Gusfield 1975). For the purposes of this project, the investigators opted to use an administrative boundary to define communities of interest, one that has both a political and a geographic basis. Specifically, while acknowledging the importance of community as a social construct, "community" in this project is defined as a county or parish. It should be noted that counties represent one way of defining communities, but other scales may be applied with equal validity. Within NOAA, researchers have chosen to define community in a variety of ways, each uniquely suited to the purpose of that research. For example, in studying fisheries communities, the National Marine Fisheries Service uses Census defined place as the unit of study (Jepson and Colburn 2013) and the National Estuarine Research Reserves uses the watershed scale in community characterizations for management planning (Dalton 2005). The researchers acknowledge that the county scale can mask some of the variability in the conditions of smaller social groups. Making inferences about a smaller unit of analysis using county level data requires a fair amount of caution, as is the case for any generalization from a smaller unit of analysis to a larger unit (e.g., from household to county). However, there are strengths to using the county level. The county unit of analysis was chosen for this project because counties and parishes:

- are temporally consistent administrative units;
- correspond to units used in the political and policy-making processes;
- have geospatial dimensions that are often connected to the monitoring and management of environmental conditions;
- are associated with a broad range of existing, secondary data; and
- as nested geographic units, may be aggregated up to show trends at the regional, state or national levels.

Additionally, by choosing the county or parish level, we gained the added advantage of ready transferability, meaning that the protocol developed for assessment of well-being can be more easily employed in other coastal and non-coastal regions of the U.S.

2.3. SAMPLE SELECTION

Once the unit of analysis was defined, the next step was to determine which counties within the Gulf of Mexico would be selected for well-being indicator development. Again, the primary goal of the project was to establish a baseline of well-being that could be used to assess and monitor counties affected by the Deepwater Horizon oil spill. This overarching goal served to guide county selection for the sample. Researchers selected counties that met the following criteria:

- were coastal counties according to NOAA's definition;
- were representative of the Gulf of Mexico region or comparable to the Gulf of Mexico region on key features; and
- would be useful for future efforts at monitoring the status of counties that were impacted by the oil spill.

The research team conceptualized the Gulf of Mexico region as including all of those counties falling within the boundary of what NOAA terms "coastal counties" (Figure 2.4) in the Gulf region. NOAA's coastal county designation includes counties both directly on the shoreline, as well as those with a substantial land area in the coastal watershed (NOAA's List of Coastal Counties for the U.S. Census Bureau Statistical Abstract Series, n.d.).

From within this grouping of coastal counties, the investigators then narrowed the field further by selecting all Gulf of Mexico region counties that experienced oiling along their shoreline during the Deepwater Horizon event. Additional coastal counties were selected to serve as reference counties. The reference counties included several counties not found within the Gulf of Mexico region, located instead in South Carolina. All of the sampled counties have similar demographic characteristics and geomorphology, as well as comparable exposure to environmental threats. The final sample included 37 coastal counties (see Table 2.1, Figure 2.4).

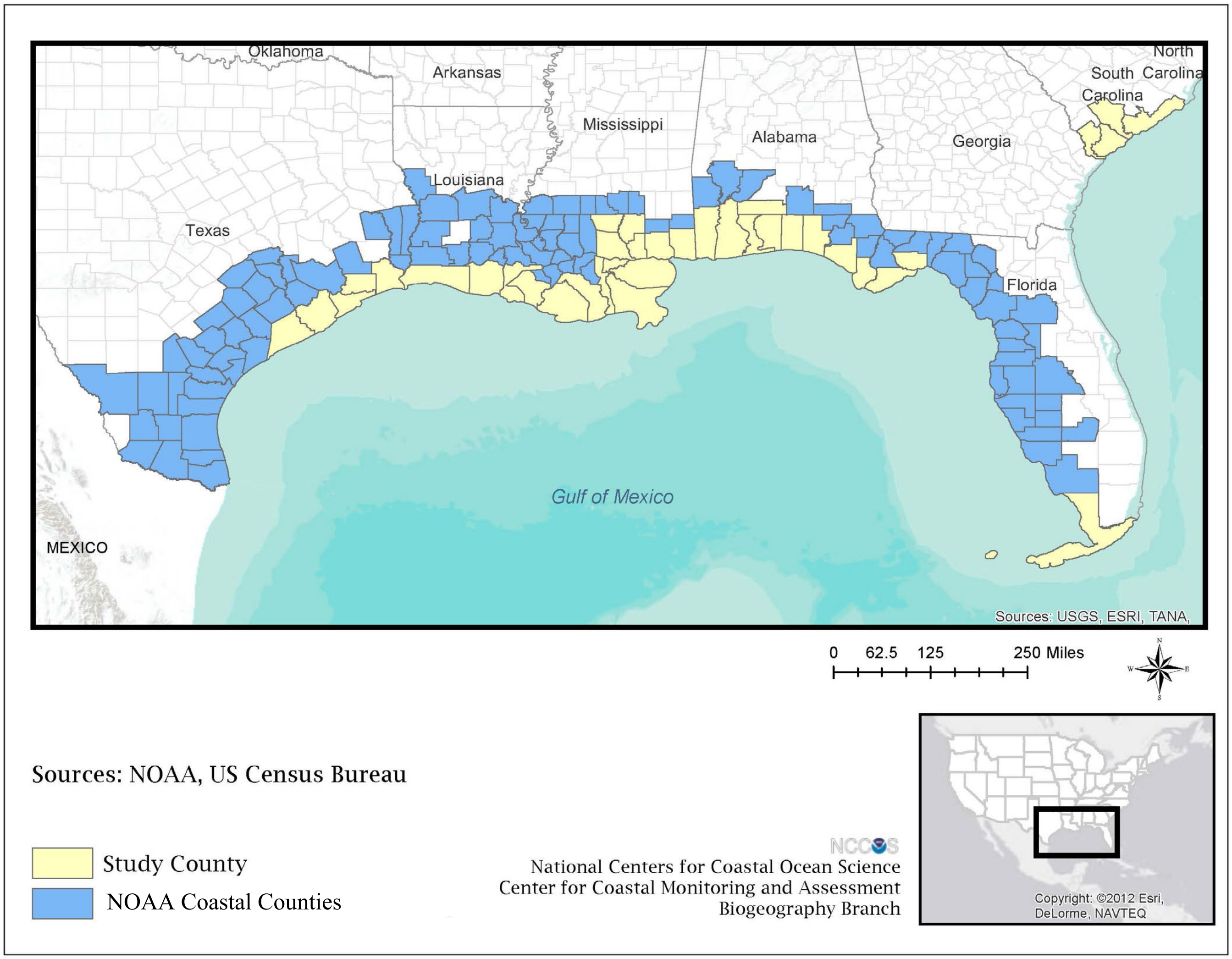

Figure 2.4. Map of the study counties and NOAA coastal watershed counties in the Gulf of Mexico region.

While a focal goal of the project was to develop a methodological protocol that could be used to monitor Gulf communities harmed by the Deepwater Horizon event, it is important to note that data availability curtailed efforts in the present study to assess well-being in relation to the oil spill. In many instances, datasets (or complete datasets) for 2010 and subsequent years were not yet available during the project period. Therefore, this assessment relied upon data for the period of 2000-2009.

The goal of the study was thus focused on developing a methodology that could be repeated with updated data (when available) to detect and understand any changes in dimensions of well-being that may have occurred as a result of the Deepwater Horizon disaster. In the future, the reference counties can be used to determine whether changes in community well-being are related to the Deepwater Horizon oil spill or some other factor (e.g., the global economic downturn). Thinking toward a long-term monitoring approach, other environmental events also became important to the present investigation, such as Hurricane Katrina, which occurred in 2005. Because such large-scale events happened in the Gulf of Mexico, and were captured in our study period, these events provided investigators with a way to evaluate the efficacy of well-being indicators in detecting change related to major disasters.

2.4. CONCLUSION

The Gulf of Mexico case study serves an application of the method for monitoring community well-being in conjunction with environmental condition, including both the development of the indicators and the analysis of the counties using the indicators. The method can continue to be used to monitor the region over time to observe changes brought on by natural or man-made events as well as program or policy interventions. Such information can be used to evaluate intervention programs and management actions, and guide decisions that can increase the resilience of communities and improve the condition of coastal ecosystems.

Table 2.1. Sample counties.

Deepwater Horizon	
Oiled Counties	**Reference Counties**
Alabama	
Baldwin, AL	Escambia, AL
Mobile, AL	
Florida	
Bay, FL	Monroe, FL
Escambia, FL	Wakulla, FL
Franklin, FL	
Gulf, FL	
Okaloosa, FL	
Santa Rosa, FL	
Walton, FL	
Louisiana	
Iberia, LA	Cameron, LA
Jefferson, LA	St. Mary, LA
Lafourche, LA	Vermilion, LA
Orleans, LA	Washington, LA
Plaquemines, LA	
St. Bernard, LA	
St. Tammany, LA	
Terrebonne, LA	
Mississippi	
Hancock, MS	Pearl River, MS
Harrison, MS	
Jackson, MS	
South Carolina	
	Beaufort, SC
	Charleston, SC
	Colleton, SC
	Jasper, SC
Texas	
	Brazoria, TX
	Chambers, TX
	Galveston, TX
	Jefferson, TX

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CHAPTER 3: METHODS

3.1. OVERVIEW OF THE STUDY

Human well-being is a concept that goes beyond economic factors to include social and environmental conditions that contribute to the quality of life experienced by people. It is equally important to consider social, cultural, health and environmental factors alongside economic factors. Indicators and indices have been successfully employed by natural resource managers to measure and monitor a variety of biophysical phenomena (e.g., the U.S. Environmental Protection Agency's (EPA) National Coastal Condition Reports, the EPA Pro Air Quality Index, and NOAA's Mussel Watch Contaminant Monitoring), as well as by researchers in international and community development, public health and education to track development, outcomes and performance (e.g., the World Health Organization's monitoring of maternal, newborn, child and adolescent health; the U.S. Department of Education's Adequate Yearly Progress Indicators as part of the Elementary and Secondary Education Act).

A marina near Gulf Port, Mississippi.
Credit: Maria Dillard.

Assessments that currently employ indicators of well-being and environmental condition include the Genuine Progress Indicator (Talberth et al. 2006), Index of Social Progress (Porter et al. 2013), the Provincial and Community Index of Well-Being in Canada (Sharpe 1999), and assessments conducted by the U.S. EPA (Smith et al. 2013) and U.S. Forest Service (Donoghue and Sturtevant 2007). Increasingly, government and non-government entities responsible for coastal and marine ecosystem based management are identifying "enhanced human well-being" as a policy goal (Interagency Ocean Policy Task Force 2010; NOAA OCRM 2013; Packard Foundation 2009). While linkages between a community's well-being and regional ecosystem condition are intuitive, only a few examples exist of assessors actually measuring and monitoring these relationships at the regional or local level (MEA 2005).

The investigators of this project determined that a necessary feature of well-being research for marine and coastal resource management agencies should be the development of a comprehensive index of well-being that is reflective of environmental condition and the contribution of ecosystem services to quality of life. Hence, the purpose of this study was to establish a baseline for monitoring changes in the well-being of coastal communities. This baseline was intended to account for changes in well-being in relation to changes in environmental condition. As a result, a methodological approach for the quantification of community well-being at the county level has been developed in order to explore the impacts of environmental events on Gulf Coast communities, including the Deepwater Horizon disaster. This section will explain the methodological approach developed through the course of the project, specifically highlighting the methods for constructing the measurement of well-being and environmental condition of coastal counties.

Why Composite Indicators?

Indicators are "quantitative or qualitative measures derived from a series of observed facts that can reveal relative position in a given area and, when measured over time, can point out the direction of change" (Freudenberg 2003: 7). Indicators can be measured in a variety of ways. In this study, each indicator of community well-being was operationalized as a composite indicator or index. A composite indicator is an aggregation of multiple measures using mathematical computation in order to produce a single value (Sasiana and Tarantola 2002). For the present study, investigators generated composite indicators for well-being and environmental condition. Composite indicators are valued for their ability to more simply document and communicate complex relationships; though they pose methodological challenges for this very reason (Freudenberg 2003). Despite potential challenges in their application, composite indicators "answer a practical need to rate individual units… for some assigned purpose" (Paruolo et al. 2012: 1).

For this study, investigators generated composite indicators for well-being and environmental condition. Each composite indicator represents a multidimensional concept that would not have been adequately assessed by a single measure, so instead is represented by a collection of individual measures (OECD and JRC 2008). For example, visually depicted in Figure 3.1, the indicator of *Safety* was defined as security of person and property. No single measure could be identified to assess both aspects of safety, so measures for each aspect of safety were identified and combined to assess the whole concept. In this instance, the research team used four measures to operationalize *Safety*, including violent crime rate, property crime rate, hurricane and tropical storm events, and tornados and thunderstorm events.

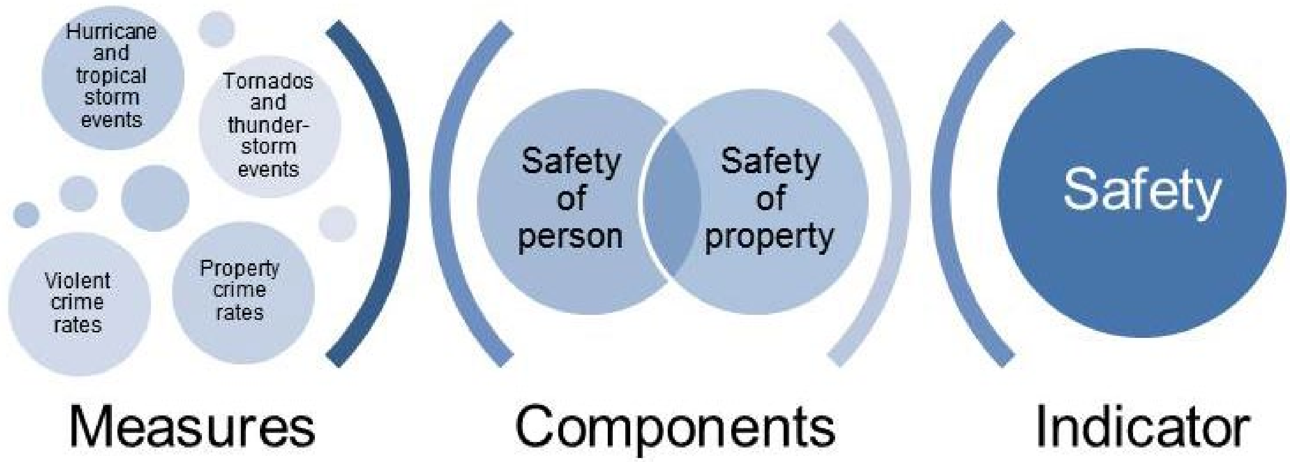

Figure 3.1. Illustration of the complexity of well-being indicators.

Composite indicators have been used to measure social vulnerability to natural and technological hazards (e.g., SoVI, Cutter et al. 2003), disaster resilience (e.g. Cutter et al. 2010), sustainable development (e.g., Human Development Index, UNDP 1990, 2005; Environmental Sustainability Index, Esty et al. 2005), national well-being (e.g., Prescott- Allen 2001), and vulnerability of coastal environments to sea level rise (e.g., Boruff et al. 2005; Pethick and Crooks 2000). They are increasingly used in policy-making and public communication contexts, which gives composite indicators an advantage over other indicator types. The information provided by composite indicators can be used for many forms of evaluation, including identifying drivers of disaster resilience at the community level or other community planning purposes (Saisana and Cartwright 2007).

Selecting and Using Secondary Data

Only existing, secondary data were used in this study. Data are considered "secondary" when collected by someone other than the secondary user, often for a purpose different than the secondary use (Schutt 2001). In other words, the data used for this study were collected by other agencies or organizations with a purpose not necessarily related to the measurement or monitoring of well-being. As can be seen in Appendix A, Tables 1 and 2, many of the data sources relied upon came from collections by federal government agencies. Secondary data most often refers to quantitative data (Schutt 2001), as is the case for this project.

There are pros and cons to using secondary data to assess human well-being. One of the major advantages of using secondary data is that government agencies, in particular, are likely to collect data consistently over uniformly-defined geographic areas, such as a state, region or county. The U.S. Census Bureau, for example, collects data consistently across the U.S. at a variety of geographic scales. A second major advantage to using secondary data is that for the secondary user, it is a relatively inexpensive way to procure useful data without incurring the cost of a primary data collection.

Another advantage of secondary data is that data are often collected and made available over long periods of time. This characteristic of secondary data makes the design and implementation of time series studies possible. However, when using secondary data, availability of current data is often an important constraint. There is frequently a multi-year lag in the release of the new data. This lag is a result of the geographic scale of many collections, the time needed to process and clean larger datasets, as well as fiscal and administrative challenges. This lag in the availability of current secondary data was a limitation for the present study.

Although this project was funded as a result of the Deepwater Horizon oil disaster, the data for the year of the disaster and the subsequent years were not available when this study was conducted. Researchers utilized data for 2000-2009 to develop a methodology that can be repeated to examine out-years as new data become available, and as funding permits, to better understand changes to well-being in Gulf Coast counties as a result of the Deepwater Horizon disaster. Thus, the focus was to develop a methodological protocol that could then be used to monitor Gulf communities into the future once additional updates to required data became available.

Apart from delays in the release of current data, the most difficult challenge of working with secondary data is that the ideal measures and time points are not always available. Mostly, this occurs because the data were not originally collected for the purpose of answering the secondary user's research question. In the case of the present project, data were not tailored to well-being assessment or to the ideal time series. As a result, development of a research design to assess well-being with secondary data required diligence, flexibility, as well as creativity in finding ways to use available measures and time points to reach desired outcomes. By setting criteria for the secondary data used in the study, investigators helped to ensure high quality results. Overall, the many benefits that come with the use of secondary data far outweigh the minor challenges of time lags and imperfect data, challenges best recognized as common to all research endeavors.

There are multiple characteristics that make existing datasets ideal choices for secondary use. Datasets that have been collected consistently over long periods are very desirable. This is because there will be more time points available for assessors to use when monitoring well-being over time, as well as to conduct analysis retrospectively. Of course, it is also important for datasets to be of high quality, meaning that the data were reliably collected using well designed, transparent methods. Finally, it is advantageous to choose datasets that are collected, maintained, and served by stable public agencies (e.g., federal government, state health department, etc.). This is helpful because there will be a greater likelihood for those datasets to continue to be available in the future. The datasets used for the present study met these critical criteria. The following additional criteria were used to evaluate datasets for inclusion in the present study:

- Documentation - Does the dataset have clear and appropriate documentation?
- Accessibility - Is the dataset accessible online and available for download in standard data file formats?
- Time series - Are the data available at multiple time points?
- Geographic coverage - Does the dataset represent broad geographic coverage both within the study area and beyond?
- Quality - Has the dataset been subject to a quality assurance and quality control process (i.e., data are clean, without missing values and ready for use)?
- Unique information - Does the dataset contain data that are unique or uniquely compiled?

These criteria were established and implemented to set the bar high enough to require careful consideration and justification for use of data that did not meet the standard. For a complete description of data sources used for this project, see Appendix A, Table 2.

In addition to being secondary in nature, the data used for this study are appropriately described as "objective", meaning that they document the actual behavior, status or activity of someone (e.g., charitable contributions) or something (e.g., government expenditure on education). The data used in this study measure the actual change and/or response in the community and its members within a geographic area. Conversely, subjective data documents the perceptions or opinions of individuals. The choice to employ only objective data in the present study was largely a result of the scale and scope of the study, and corresponding data limitations. In order to include measures of subject well-being in the present study, the research team would have needed survey data from a representative sample within each county that were replicated across the region since 2000. This type of data was not available. By focusing on objective data that is already collected in a similar way for the entire U.S., the monitoring method produced gained strength for future application in other regions.

3.2. RESEARCH DESIGN

To document and assess well-being, composite indicators and secondary data were used with the goal of comparing the well-being between counties within the sample. The study also relied on a longitudinal trend design to allow for observations of change in Gulf Coast communities over time. Longitudinal studies are those where data are collected for two or more distinct time periods and in which data are compared across time (Menard 2002). Trend data contribute to predictive models that are used to assess future change. For coastal monitoring and decision making, it is believed that socioeconomic data collected at regular intervals is of more use than single or sporadic collection efforts (Salz and Loomis 2005). The present study ultimately employed a number of methodological approaches in concert to achieve three objectives: 1) develop a method of monitoring county level well-being and environmental condition, 2) assess the changes in well-being of coastal counties over time, and 3) explore the relationship between environmental condition and county well-being. To meet these objectives, the study was executed in four sequential phases:

- Phase 1 – Indicator construction for well-being and environmental condition
- Phase 2 – Assessment of counties on indicators of well-being and environmental condition
- Phase 3 – Evaluation of change over time
- Phase 4 – Measurement of relationships between environmental condition and community well-being

In phase 1, indicators of public health, social and economic well-being, and environmental condition in coastal counties were selected and operationalized by the research team. Operationalization involves developing a specific measurement for a given concept or indicator, often one that is not directly measurable (Schutt 2001). Each indicator was developed by combining a collection of measures that appropriately assessed the complexity of the indicator concept. Using the newly constructed indicators, the counties were scored on each dimension of community well-being and environmental condition. These scores were used to assess and rank the counties in relation to one another in phase 2. Next, in phase 3, the rankings were used to analyze county changes over time. This phase of the research sought to determine whether the counties experienced a rise or fall in ranking in dimensions of well-being and environmental condition, within the context of the study sample. Finally, in phase 4, the indicators of well-being and environmental condition were used to analyze the dynamic relationship between the ecosystem services that people regularly enjoy and dimensions of community well-being. These phases are described in detail in the remainder of this chapter.

Phases 1: Well-being Model Development

Phase 1 of the research design closely followed that of indicator development efforts in a variety of applied research fields, ranging from international development to public health (see specifically, OECD and JRC 2008; Booske et al. 2010). The subsequent sections describe in detail the process of well-being model development and the assessment of counties based on indicators of well-being and environmental condition, beginning with the development of the theoretical framework and concluding with the presentation and dissemination steps below (Figure 3.2).

The investigators first developed a theoretical framework that would help determine the selection and combination of indicators and measures. Measure selection was then conducted using criteria that included analytical soundness, measurability, geographic coverage and relationship to other measures. Once the data collection was complete for all measures, missing data was imputed for the combined time points used in the analysis. Exploratory analysis was used to investigate the general

Steps for Composite Indicator Development

Adapted from OECD & JRC 2008

- Theoretical framework
- Data and measure selection
- Imputation of missing values
- Exploratory analysis
- Normalization
- Aggregation
- Deconstructing composite indicators
- Linking back to other variables
- Presentation and dissemination

Figure 3.2. Steps for composite indicator development.

structure of the indicators, assess the suitability of the measures selected, and to explain the methodological choices made in the subsequent steps of the indicator development process. The measures (i.e., components) of the composite indicators were normalized to ensure comparability across a range of distinct measures with varying units. The measures were then aggregated in accordance with the theoretical framework of indicators of well-being and environmental condition. In order to deconstruct the composite indicators, the investigators worked back to the true values of the components of the composite indicators; this was useful for examining the meaning of the indicator value in relation to its components.

The scores created during phase 1 were then used to assess and rank the counties in relation to one another in phase 2. Relationships between composite indicators of well-being were examined, as well as relationships between composite indicators and other well-known, existing indicators of well-being. Finally, the study culminated in the selection of ways to present and visualize the indicator scores.

Theoretical Framework
The process of developing the theoretical framework began with the clarification of the concept of community well-being through literature review and examination of existing indices of well-being and related concepts. Next, ideal indicators of community well-being were identified. Using a modified Delphi process, an iterative process for prioritizing and reaching consensus, experts brought together for a workshop in 2011 identified and prioritized well-being indicators (Lovelace et al. 2012).

Following the workshop, all indicators were entered into a database with possible measures, data sources and references. This database served as the foundation for the indicator development process. The list of indicators prioritized by workshop participants is presented in Figure 3.3, alongside the final list of indicators. Finalization of the indicators required moving from the set of ideal indicators identified during the workshop to a set that could be operationalized and monitored over time for the Gulf of Mexico region. For the final selection, researchers relied on both theoretical and methodological determinants.

Theoretical determinants used in indicator selection were three-fold. First, investigators consulted existing theory on well-being, as a general concept, as well as literature on which component indicators are most critical for conceptualizing well-being alone and in relation to ecosystem servic-

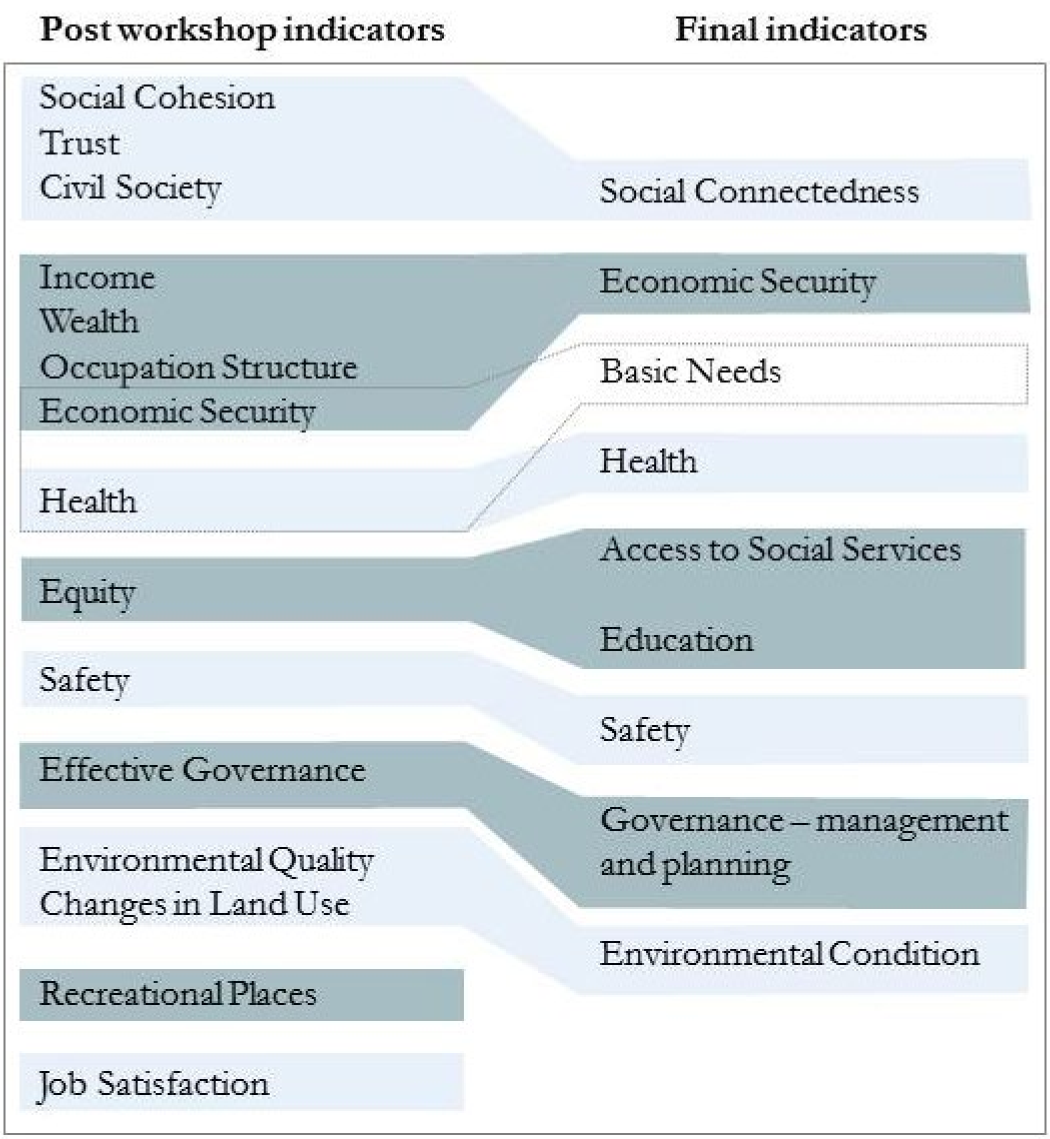

Figure 3.3. Indicators resulting from modified Delphi process and final indicators.

es. Concerted effort was made to operationalize our indicators in a manner consistent with key heuristic models that have been proposed to link well-being and ecosystem services. The key heuristic frameworks and models influencing the present research included that proposed by Doyal and Gough (1991), Smith et al. (2013) and the Millennium Ecosystem Assessment (2005).

Second, investigators made certain to appropriately align the current study approach with existing indices of well-being, quality of life, human development and related concepts. This included careful consideration of how indices for established assessments are constructed and, ultimately, how these indices are used to inform and evaluate decisions, program design and broader policy debates. In the present case, the investigators carefully weighed assessments that focused on monitoring the status of communities over time and, where available, studies that targeted populations after disruptive events. A summary of outcomes from this exercise are provided in Chapter 4 below, which relates to the selection of measures to operationalize chosen indicators. Connecting back to the body of well-being scholarship was critical because identifying points of consensus across fields and disciplines where well-being and related concepts are used was an important component of final indicator selection.

Among the methodological determinants that helped guide the final selection of indicators were: available data sources, geographic level of existing data, feasibility of data acquisition, data reliability and comparability of data across geographies. The level of analysis was also an important consideration. In order for the indicators to be relevant, they needed to measure meaningful aspects of the county. Not all indicators met this condition. For example, job satisfaction is an indicator that has been closely linked to well-being and quality of life in previous research, especially research focused on coastal communities (Apostle et al. 1985; Pollnac and Poggie 1988; Gatewood and McCay 1990). Not surprisingly, workshop participants identified job satisfaction as an indicator of great importance. However, upon consideration, the research team found that this indicator was not functional at a county level, primarily due to questions about meaning once this concept is measured at an individual level then aggregated up to a county level. This example illustrates how measurement issues and questions about the meaning of particular measures at varying scales and units of analysis limited the usefulness of some indicators employed by other assessors.

The final list of indicators represents a few other departures from the original list prioritized by our expert panel during the 2011 workshop. It will be helpful to walk through the transformation of the initial list of indicators to the final set, which is visually depicted in Figure 3.3, above.

- Elements of *Social cohesion, Trust,* and *Civil Society* were carried forward in the new *Social Connectedness* indicator. Despite the theoretical strength of the concepts of civil society and social cohesion, the investigators chose to create a new indicator because of the challenge of capturing the well-known dimensions of these concepts with secondary data.
- *Income, Wealth,* and *Occupation Structure* were subsumed by *Economic Security* during phase 1 of the project upon review of the exploratory analyses. *Job Satisfaction*, as stated above, was eliminated.
- *Access to Social Services* and *Education* cover aspects of *Equity*, though the *Equity* indicator was also removed from the final list.
- *Health, Safety, Effective Governance,* and *Economic Security* all became part of the final indicators list.
- *Basic Needs* was a new addition to the final indicators list, though its components of access to safe water, healthy food and adequate housing were components of indicators of *Health, Safety* and *Economic Security* on the previous list.
- *Environmental Quantity* and *Recreational Places* were originally combined in the indicator *Environmental Use*. This indicator was eliminated during phase 1 due to inconsistencies in available data. *Environmental Quality* was combined with *Changes in Land Use* to create the new *Environmental Condition* indicator.

The final framework is visually depicted in Figure 3.4.

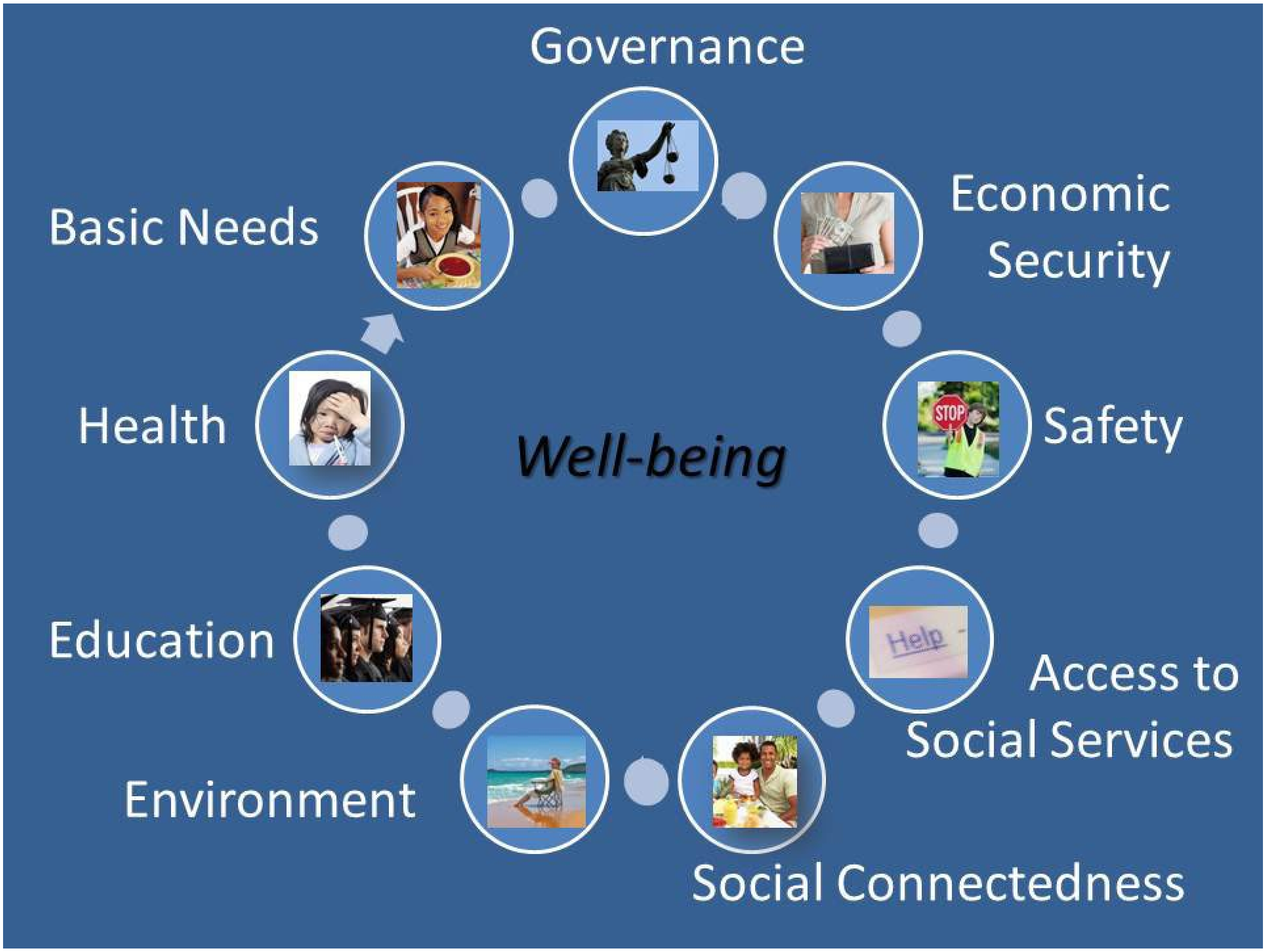

Figure 3.4. Well-being framework.

Data and Measure Selection

Upon finalization of the indicators of well-being to be used in the study, measures were identified and selected for each indicator. The possible measures used to operationalize each indicator were initially chosen based on data availability and literature or prior index support, again maintaining both a theoretical and methodological basis for the selection. As previously discussed, a fixed list of possible measures is a limitation imposed by secondary data. However, it is important to note that for this study, the list was neither small nor one-dimensional. In fact, a tremendous amount of data were compiled and evaluated. The extensive data collection process was tracked through a spreadsheet which contained the final indicators, possible and ideal measures of the indicators, and data sources. The tracking spreadsheet also included units for which the data were collected and years of available data within the 2000-2011 range. The project investigators took a broad approach to the collection of data, focusing on the ideal sources and maximizing effort by collecting as many different types of data as possible for as many measures as possible. This approach allowed the selection of measures to remain a distinct task.

Once the data collection process was brought to a close, measure selection began. Composite indicator construction can take many approaches, specifically with respect to how component measures are selected. In this case, theoretical, methodological and statistical performance of the measures was evaluated in order to devise the best possible indicators of well-being. Below is a summarized process outline for how the team worked through the evaluation of measures. It is important to note that the measures were combined to assess the indicators selected for this study and focused on the concepts of well-being and environmental condition. However, for future studies, the same measures could be combined differently to form new composite indicators or even used independently to examine different questions.

The measure selection process was dependent on three sets of factors that were taken into account with each decision regarding an indicator component. The following outline represents each set of factors and the corresponding questions used to evaluate a given measure. Figure 3.5 visually depicts the process of choosing the measures.

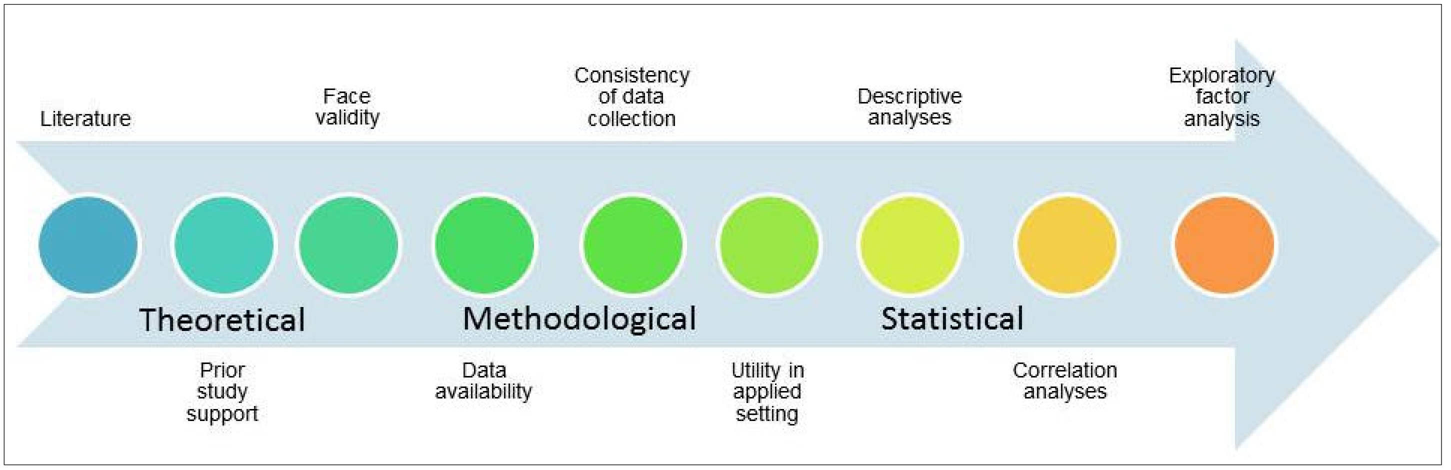

Figure 3.5. Illustrating the measure selection process.

Theoretical Factors

- Literature
  - o What does the literature say about the relationships between these measures and indicators of well-being?
- Prior study support
  - o How are the measures used in other indices?
- Face validity
  - o Do the measures make sense together to address the given concept?

Methodological Factors

- Data availability
  - o Does the data fill in across all time points?
  - o Across all geographies?
- Consistency of data collection
  - o What does the collection look like past, present, and (anticipated) future?
- Utility in applied setting
  - o Are the measures easy to understand and communicate?

Statistical Factors

- Descriptive analyses
  - o What shape does the distribution take?
  - o What is the central tendency?
  - o How are the data dispersed?
- Correlation analyses
  - o Which measures are significantly related to each other?
  - o In what direction and how strongly are they related?
- Exploratory factor analysis
  - o How do the measures combine using statistical properties alone?
  - o Are the indicators a combination of numerous factors?

Though measure selection is presented in the outline above and in Figure 3.5 as a linear process, the true nature of the process included more flow between steps and folding back to prior factors in order to revisit a previously answered question in light of new information arising at a later step of the selection process. To illustrate this evaluation process, examples are provided below of the iterative and adaptive analysis used during measure selection in phase 1.

- *Illustrative Example 1: Components of Education* - In many cases, there are various measures that can illustrate a single concept. For example, educational attainment may be measured by the percentage of adults 25 and older who have completed high school or equivalent, some college, a bachelor's degree or a graduate or professional degree. In this case, the measures were evaluated using the measure selection process described above. The theoretical determinants for choosing the components of the *Education* indicator were nearly conclusive: "the percentage of adults 25 and older who have completed high school or equivalent" is a regularly used measure of educational attainment. However, descriptive statistics and correlations for various levels of educational attainment were examined to verify whether or not a high school diploma was the most meaningful level of educational attainment for the population being studied. The "high school or equivalent" education attainment level was more strongly associated with the other measures of education (such as expenditure) and the demographic and economic variables to which education is known to be related (e.g., race, income). Thus, this measure was selected.

- *Illustrative Example 2: Components of Health* - Another example of measure selection can be illustrated by the selection and analysis of components for the *Health* indicator. "Infant mortality rate" and "fertility rate" are regular components of quality of life and well-being in international assessments. Therefore, both measures met with strong support from our expert workshop participants as well as the body of scholarship on well-being assessment, largely from the theoretical perspective. Therefore, both measures were collected from existing data and, although fertility depended on estimate data for two of the three time points, the data were consistent and available for most of the sample. Furthermore, the measures showed great potential utility for communicating about county health. However, when exploratory analyses were conducted to examine the variables in relation to one another, other variables served in a far stronger capacity. Following the statistical analyses portion of the measure examination, "infant mortality rate" and "fertility rate" were eliminated as components of the *Health* indicator. "Birth rate" was selected over both "infant mortality rate" and "fertility rate" to be a part of the composite indicator of health. The single measure, "birth rate" captures information about both population births and as a result, population fertility. Single measures that are centrally collected and consistent across geography and time reduce data compilation effort and sources of error making them beneficial for long term monitoring efforts.

The measurement of mental health also posed a challenge for the *Health* indicator. Among the original intentions of the investigators was the inclusion of both physical and mental health in the model of well-being. Strong theoretical support exists, both from literature and other experts, for mental health being an important indicator of well-being for people post-disaster or who live in industrial zones (Bourque et al. 2006; Downey and Van Willgen 2005; Picou et al. 1992; Gill and Picou 1998). The best source of secondary data on mental health data in the U.S. is the Behavioral Risk Factor Surveillance System (BRFSS) data, which collects self-reported mental health status from respondents. While a common critique of such data is focused on reliance on individuals' subjective mental health status as a measure of objective mental health (Andresen et al. 2003; Pierannunzi et al 2013), the primary reason that this data could not be used in the present study was methodological. With the exception of a selection of local area estimates for counties and metropolitan/micropolitan statistical areas of a particular population size, the majority of BRFSS data is collected and aggregated to the state level (CDC 2013). Therefore, these data were not statistically robust at the county level.

These examples highlight the iterative nature of the process used to examine and select measures, thereby building the indicators. Each indicator was subjected to this same kind of process, although the flow of the process differed from indicator to indicator.

Imputation of Missing Values

The development of composite indicators required a clean dataset. Following measure selection, missing data was imputed using single imputation methods with explicit modeling. In the case of single imputations, values are drawn from a predictive distribution of missing values; the distribution is generated through a model that employs the observed data (OECD and JRC 2008). The model is termed "explicit" when statistical assumptions are fully developed and made openly. An example is the assumption that the sample's average rate of change for a given value is a reasonable estimate of the actual change of the county.

For this study, missing data varied by data source, county and time point. For each composite indicator a report on missing data was created in order to develop comprehensive and consistent procedures for imputing missing values. The report included an assessment of the total number of missing values per component measure and time point, impacted cases, plan for imputation, specific variables imputed (according to their database parameter identification code) and other general method notes. Once the report was complete, the imputation procedures were applied by dataset, in most cases. For example, the same procedures were used to impute all missing data within the American Community Survey dataset. A more detailed review of the imputation methods employed can be found in Appendix A.

Exploratory Analysis

During this step of the indicator development process, exploratory analysis was used to investigate the general structure of the indicators, assess the suitability of the measures selected and to provide rationale for the methodological choices made in the subsequent steps of the process (OECD and JRC 2008). The components of each composite indicator were explored through a series of analyses starting with case summaries for each county, descriptive analysis, correlation analysis and exploratory factor analysis. The results provided the information necessary to make final decisions about component measures to exclude, indicators to strengthen with additional measures and additional transformation of variables.

For example, "severe storm warnings" performed like "storm event counts" in correlations and factor analyses, so the measure was duplicative. In the case of the severe weather variables, the choice was simple because one set of variables was a reflection of the actual events as opposed to the potential for a severe storm event and meteorologists' capacity to predict severe weather. A choice was also made between measures of household economic security. Both "median household income" and "poverty" were similarly correlated and explained much of the same variance in analyses. In this instance, the research team chose "median household income" as the measure to represent household economic security while using a poverty measure as a means of measuring the economic security of children.

Table 3.1. Descriptive statistics for component measures of safety.

Variables	N		Mean	Median	Mode	Std. Deviation
	Valid	Missing				
Number of violent crimes known to police	41	0	1,631.7	345	74	4,134.5
Number of property crimes known to police	41	0	10,329.0	2,537	131[a]	22,815.03
Total Warning Count for severe thunderstorms and tornados	41	0	21.1	17	5	14.31
Total Event Count for severe thunderstorm and tornados	41	0	6.3	4	4	5.17
Total event count for tropical storms and hurricanes	41	0	2.9	3	4	1.56
Total property damage attributed to tornados (thousands$)	41	0	191.5	0	0	803.13
Total property damage attributed to tropical storms and hurricanes (thousands$)	41	0	5,513,479.8	1,603,650	16,995,500	6,743,782.14

Notes: [a] Indicates that multiple modes exist; the smallest modal value is shown.

The results occasionally pointed to components ideal for combining in a single composite. For example, several components of occupation structure were merged into *Economic Security* to create a single composite indicator. Overall, this step highlighted strengths and weaknesses of the component measures and provided the research team with objective guidance for addressing both aspects of the measures.

To further explain this process, an example of the use of exploratory analyses can be drawn from the development of the *Safety* indicator. The first series of analyses used to explore measures of *Safety* provide a sense of the distribution of the values across the counties, as well as the central tendency of each measure (Table 3.1). There was substantial range for both the number of property crimes, as well as the damage from tropical storms and hurricanes. Next, by exploring the correlations between measures of safety (Table 3.2), the research team learned that “total severe thunderstorms and tornado counts” was significantly and positively correlated to both crime measures, as well as the total warnings issued for thunderstorms and tornado events. Likewise, there was a strong correlation between the measures of property and violent crime. In the same analysis, the results showed that the total property damage caused by tropical storms and hurricanes was only significantly correlated to the total number of these events (Table 3.2).

Finally, exploratory factor analysis demonstrated the tendency of the measures of safety to cluster. For example, the crime measures are grouped with the total number of severe thunderstorm and tornado events in Component 1 of the factor solution, while Component 2 includes the total number of tropical storms and hurricanes as well

Table 3.2. Correlation analysis with component measures of safety.

		Number of violent crimes known to police	Number of property crimes known to police	Total Warning Count for severe thunderstorms and tornados	Total Event Count for severe thunderstorms and tornados	Total event count for tropical storms and hurricanes	Total property damage attributed to tornados	Total property damage attributed to tropical storms and hurricanes
Number of violent crimes known to police	Pearson Correlation	1						
	Sig. (2-tailed)							
Number of property crimes known to police	Pearson Correlation	.993**	1					
	Sig. (2-tailed)	.000						
Total Warning Count for severe thunderstorms and tornados	Pearson Correlation	.187	.220	1				
	Sig. (2-tailed)	.241	.167					
Total Event Count for severe thunderstorms and tornados	Pearson Correlation	.535**	.562**	.573**	1			
	Sig. (2-tailed)	.000	.000	.000				
Total event count for tropical storms and hurricanes	Pearson Correlation	.230	.251	.613**	.194	1		
	Sig. (2-tailed)	.149	.114	.000	.225			
Total property damage attributed to tornados	Pearson Correlation	-.071	-.072	.088	-.108	.234	1	
	Sig. (2-tailed)	.660	.653	.584	.501	.141		
Total property damage attributed to tropical storms and hurricanes	Pearson Correlation	.176	.185	.196	-.035	.331*	-.160	1
	Sig. (2-tailed)	.270	.246	.220	.828	.035	.316	

Notes: All correlations are 2 tailed; ** indicates significance at the $p \leq 0.01$ level; * indicates significance at the $p \leq 0.05$ level.

as the total warnings for severe thunderstorm and tornado events (Table 3.3). The two measures of property damage fill out Component 3. The results reflecting the grouping of measures in Component 1, as well as the overall strength of the items in Components 1 and 2 as well as the total variance explained by the first 2 factors add support for the reliance on the storm event counts in conjunction with the crime measures to create a measure of safety. The results also suggested that while measures of property damage formed a coherent factor, these measures were not proxies for the threat of a severe storm event itself. With *Safety*, as with many of the indicators, the exploratory analyses conducted with the initial measures selected identified areas of weakness and strength.

Table 3.3. Principle component analysis rotated component matrix with component measures of safety.

	Component		
	1	**2**	**3**
Number of property crimes known to police	.938	.093	.152
Number of violent crimes known to police	.932	.065	.151
Total event count for severe thunderstorms and tornados	.762	.270	-.147
Total event count for tropical storms and hurricanes	.113	.877	.116
Total warning count for severe thunderstorms and tornados	.272	.813	-.038
Total property damage attributed to tropical storms and hurricanes	-.016	.382	.836
Total property damage attributed to tornados	-.167	.415	-.635

Note: Rotation converged in 4 iterations.

Normalization and Aggregation

To combine the selected measures into a composite indicator that would serve to operationalize each of the indicators of well-being, several transformations to the data were required. First, measures had to be adjusted to account for the county level of analysis. In example, several measures had to be adjusted for population size and computed as a rate. For instance, the measure “total number of physicians” became the “number of physicians per 1,000 people” and “total public school enrollment” became the “proportion of the total school age population taking part in public education.” By transforming the measures in this way they were standardized across counties and could then be compared without concern for the differences of county population size, which varies significantly across the sample counties. These transformations led to measures that were not unfairly skewed toward counties with a larger population.

Second, there were a number of different units present in the raw data including, but not limited to, rates, ratios, percentages, dollars, storms and housing units. However, all values had to be converted into comparable units before being combined into a composite indicator. A methodological strategy was needed to account for the different reporting units. After consideration of the trade-offs between standardization and normalization, as well as the varied methods of index construction (Salzman 2003; Freudenberg 2003; OECD and JRC 2008; and Booske et al. 2010), a statistical operation known as linear scaling technique was applied using Equations 1 and 2, below, where *x* is the value of a given variable, *min* is the minimum value in the distribution and *max* is the maximum value in the distribution.

Equation 1: Positive component measure

$$\frac{x - min}{max - min} = x_{norm}$$

Equation 2: Negative component measure

$$\frac{max - x}{max - min} = x_{norm}$$

The linear scaling technique, which uses a normalization equation, is recommended as a best practice in the creation of composite indicators for two primary reasons: 1) the procedure has low implicit weighting and 2) it deals with directionality (Salzman 2003). Because it standardizes the range, linear scaling assigns the lowest implicit weights of a variety of possible standardizing procedures. The influence of weights not intentionally added to the components of an indicator can be dramatic and misleading, allowing a variable with great variance to have a much stronger effect on the indicator. This technique also allows the assessor to deal with the directionality issues.

This is ideal because component measures will contribute differently to the composite construct, in this case well-being. Positive component measures are those that contribute positively to well-being, (i.e., higher values are better). Negative component measures are those for which higher values are worse for well-being. The general linear scaling method allows for all components to be scaled in the same direction prior to being combined together in a composite indicator. Overall, linear scaling provides a consistent way to aggregate a diverse set of variables (Salzman 2003).

Once the measures were normalized, the new scores for each of the component measures were combined in an additive composite indicator. The investigators chose to assign a priori equal weights to the component measures. This means that each measure within a given composite indicator has the same impact as any other measure in the indicator, as opposed to weighting measures that are believed to be more important to well-being compared to others. The assignment of equal weights is an explicit weighting scheme. This approach makes the choice of weighting less subjective and keeps the discussion of variable importance and inclusion on a more fundamental level (Salzman 2003). Because weights are often perceived as indicative of the relative importance of measures, decisions related to weighting are undertaken with caution by well-being assessors (Freudenberg 2003; Salzman 2003). Assigning weights often leads to models that are highly dependent on the normative views of the assessors (Paruolo et al. 2013) and, thus, less methodologically defensible.

Nevertheless, it is important to acknowledge that, in reality, some aspects of well-being will certainly have more influence on total well-being than others and that an equal weighting approach does not reflect this relativity. Whether the differential impact is contributed to some external reality or the statistical behavior of the variables in relation to one another, the perception that weighting is a function of importance alone is not based on statistical reality of how variables behave collectively and in relation to one another (Paruolo, Saisana, and Saltelli 2013). Yet this approach is the best choice for development of new models of well-being where extensive support for relative importance of all measures is not available. However, as the monitoring effort matures using the composite indicators, further refinement of the weighting approach would be a natural progression to strengthen the statistical performance of the indicators.

Deconstructing Indicators

In order to better understand the meaning of the composite indicator scores, investigators deconstructed the final scores by returning to the true values of the underlying indicator components. This deconstruction is helpful for interpretation of the composite indicator scores because it gives the reader context for understanding what a particular score means, relative to other scores for a given indicator in the sample. The deconstructed indicators for high and low scoring counties provide reference points at each end of the spectrum for a reader to use when trying to understand what a score might mean for a county that they have interest in, relative to the region.

For example, the highest scoring county for *Health* was examined for its original values on birth rate, male and female life expectancy, morbidity associated with cancer, respiratory and cardiovascular disease, and access to recreational facilities. Reaching back to the original component values (i.e., values prior to normalization procedures) allowed for improved understanding of the meaning of the indicator score in practical terms. As this project does not include judgment about an ideal standard for well-being, the deconstruction process provides a guided interpretation of the inputs to the indicator scores. Furthermore, with the methods of presenting the composite indicator scores discussed below, the deconstruction process adds depth to the seemingly simple values that are presented. In this way, the underlying complexity of the composite indicators was neither hidden nor minimized by the presentation. Selected indicator results are deconstructed and presented in the Chapter 5.

Phase 2: Assessment of Counties on Indicators of Well-being and Environmental Condition

Presentation of Results

To make the composite indicator scores easy to understand and interpret, each score was next converted into a percent. This transformation allowed for comparisons and visual representation of all composite indicator scores, each of which had a different number of component measures. This transformation was accomplished using Equation 3.

Equation 3: Formula used for the conversion of the composite indicator score to a percentage

$$\left[\frac{\textit{Composite Indicator Score}}{\textit{Number of Component Measures}}\right] * 100$$

To summarize, each indicator became a composite indicator whose component values were normalized through the linear scaling method, summed as scores and then computed as percent of possible score.

Finally, for the purposes of presenting results and over time analysis, the percent scores were used to rank the counties in the sample on each indicator for each time point. Quintile rankings were also produced for each composite indicator at each time point in order to represent the general trends in maps and other visual displays. Quintile rankings are a form of percentile ranks that utilize the rank order of the scores for a given indicator to assign percentiles to the cases. Both rankings and percentile rankings are common approaches to the presentation of composite indicator data (OECD and JRC 2008, Paruolo et al. 2013).

The rank and percentile rank easily communicate complex information by highlighting relationships between the cases and for displaying change over time (WEF 2012). Identifying an effective presentation format for the results of the indicators is essential to projects like this one where the results must be immediately comprehensible and user friendly (Bobbit et al. 2005). Ranks and quintile ranks meet the additional recommendation set forth by the Indicators for Community Well-being workshop participants of being simple and easy to interpret, which is particularly important for the public sector (Lovelace et al. 2012).

Ongoing Development of Composite Indicators of Well-being

Among the steps in the composite indicator development process presented in Figure 3.2 are uncertainty and sensitivity analysis and linking back to other variables. These steps of indicator development could not be carried out to the extent desired, due to sample size constraints. An important aspect of future work with the composite indicators of well-being and environmental condition developed in this study will involve evaluating the robustness and sensitivity of the composite indicators with a larger sample of coastal counties, ideally for counties in multiple regions of the U.S. Using an iterative approach to uncertainty and sensitivity analysis in the ongoing development of composite indicators of well-being stands to improve the structure of the indicators (Saisana et al. 2005; Gall 2007). The outcome of such analyses should not provide reason for outright discounting of indicators, but should provide insight into the improvements needed to formulate stronger, more robust indicators (UN 1992; OECD and JRC 2008).

Similarly, future validation work should include further exploration and testing of the linkages between the composite indicators developed in this study to existing indicators of well-being, both objective and subjective. The relationship of objective and subjective well-being has been explored in other studies (Oswald and Wu 2010; Costanza et al. 2007; Pollnac et al. 2006) and is relevant to determinations about ongoing well-being monitoring efforts.

Phase 3: Evaluation of Change Over Time

Longitudinal research designs allow for the assessment of differences in variables from one time point to another (Menard 2002). Longitudinal trend analysis has two primary purposes, to describe patterns of change and to establish direction and magnitude of causal relationships (Menard 2002). In developing the approach for this project, investigators recognized the importance of measuring changes in well-being and environmental condition to ultimately determine the impact of environmental events like the Deepwater Horizon oil spill. If cumulative impacts from environmental events can be highlighted by shifting baselines measured in a consistent way over time, then assessors will have better information or clues about where to focus their investigations to determine causal relationships between changing environmental and social conditions.

Table 3.4. Study time points.

Time points	Period represented
1	2000-01
2	2004-05
3	2008-09

The investigators chose a 10 year study period due to an interest in detecting potential long-term changes in well-being resulting from Deepwater Horizon and other environmental events. This is because many types of social and economic impacts from such events are likely to appear in the data only after years, as opposed to months. Furthermore, social, economic and health data are typically collected and reported annually. Data used to monitor environmental conditions may be reported even less often. Therefore, to assess the associated changes in well-being and environmental condition, a longitudinal approach was important for practical reasons like data availability, as well as fundamental ones like the slow pace of change where environmental conditions are involved. Using data collected for the 10 year period, the indicator construction and subsequent analyses utilized three time points that spanned two years each to maximize data coverage and minimize the degree of missing value replacement. These time points are provided in Table 3.4.

The time points do not represent averaged data for both years. Rather, the time points include values from the single year that best captures the component measures. For example, county housing and population data were available for the year 2000 through the Decennial Census data as well as from 2005 onward through the American Community Survey data. Environmental monitoring datasets, on the other hand, were released in 2001 and 2006 with data measurements taken in the year prior to each release (2000 and 2005, respectively). In each of these cases, the selection of the single year that best captured the measure was straightforward. This approach allowed for the examination of changes in each county's rank on dimensions of well-being across three time points spanning the 10 year period.

After composite indicator construction, analyses were conducted on the well-being and environmental condition indicators, using county rankings organized by the three time points. Each county's change in ranking was calculated for time point 1 to time point 2 (T1 to T2) and time point 2 to time point 3 (T2 to T3) using Equation 4.

Equation 4: Change in ranking between periods

$$\Delta^{ranking} = t^{y} - t^{x}$$

Phase 4: Measurement of Relationships Between Environmental Condition and Community Well-being

In phase 4, the investigators evaluated relationships between community well-being and environmental condition. The theoretical framework used to guide indicator development for this study included a hypothesized series of relationships between environmental condition, the corresponding ecosystem services, and dimensions of well-being. These relationships were investigated through a series of analyses.

First, the investigators tested for relationships between the composite indicators of environmental condition and of well-being using correlation and bivariate analyses. Next, bivariate regression analyses were used to examine relationships between all components of the composite indicators and the environmental condition composite. This approach has been previously used following the development of composite indicators and served as a valuable means of exploring associations between composite indicators, as well as their component measures (Booske et al. 2010).

Finally, the results of the bivariate regression analyses were used to refine theoretical models of linkages between dimensions of well-being and environmental condition. The theoretical models were then tested with a larger sample of Gulf of Mexico coastal counties (N=139) using multivariate regression analyses. Differences between coastal and shoreline counties (e.g., health, demographics and economics) as well as coastal and non-coastal counties (e.g., economic diversity) were also explored in this phase. Results from these analyses are discussed in Chapter 5.

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CHAPTER 4: JUSTIFICATION OF MEASURES

4.1 OPERATIONALIZATION OF INDICATORS: MEASURE SELECTION

The first task associated with this project was the identification and selection of the indicators that would be used to assess human well-being and environmental condition. As discussed previously, the indicators chosen for this study were selected with the assistance of experts in the field of well-being research using a Delphi process, and then refined based on theoretical and methodological determinants. Once the final indicators were selected (see Figure 3.4, above), the next challenge was to operationalize these indicators, that is, to choose the measures that would be used to assess each of the indicators.

Following manual cleanup at Fourchon Beach, La., on May 27, 2010, booms made out of pom-poms are set to protect the sandy beach area. Plastic pom-poms are effective and low-cost tools that attract and hold oil. *Credit: NOAA.*

The selection of measures is extremely important. It is at this stage that the theoretical imperatives of well-being are meaningfully translated into measureable concepts that reflect the status of a population and, most critically, can be clearly connected to actual data. Stated differently, the measures must be selected carefully to ensure that they can and do measure what the researchers hope to assess with the indicator. To accomplish the task of measure selection, assessors must determine the best way to characterize an indicator given the range of possible measures and, in the case of studies using secondary data, determine if data exists to operationalize chosen measures in the desired way.

Social indicators should be an aid in describing changing social conditions and should have an explanatory or theoretical function.... (Duncan 1974)

Assessors must decide, based on the goals of the assessment and characterization of the indicators, which measures most aptly operationalize the different indicators. As discussed previously, assessors may operationalize indicators with one or multiple measures. In the present study, the research team opted to assess well-being and environmental condition by employing multiple measures per indicator. Similar to the selection of the indicators, the research team based decisions about which measures to use on multiple criteria, including: expert opinion, theoretical and methodological determinants, and data quality and availability.

The relationships and interaction affects between the different components of well-being are complex in reality. One of the consequences of this complexity is that one measure may effectively represent multiple indicators. Assessors may opt to use one measure to operationalize multiple indicators or they may treat measures discretely, using them for only one indicator. However, when developing a model for the measurement of a single concept such as well-being, indicators should be measured uniquely without repeated use of the same measures. In the present research, the indicators measure distinct, yet related, aspects of the same concept. Thus, measures were used only once for the indicator that they most meaningfully contributed to. Although the investigators did not sum the indicators into a single value to represent well-being, this would be possible given the approach to measurement. Also, by treating the measures as discrete entities, it enabled exploration of relationships between indicators through statistical analyses.

Below is a summary of the measures employed for each of the indicators used in the study. An overview of the rationale for measures selected, including relevant theoretical support, will enable readers to understand more clearly the basis for using these particular measures. The table included at the beginning of each discussion depicts the final measures selected for each composite indicator. A complete list of all indicators and measures, and their contribution to well-being, can be found in Appendix A.

Basic Needs

Table 4.1. Detailed description of the measures used to operationalize the basic needs indicator.

Indicator: Basic Needs			
Measure Category	**Measure**	**Operationalized Measure**	**Source of Data**
Housing	housing value	median value of housing units	U.S. Census Bureau
	housing facilities	percentage of total housing units without complete kitchen facilities	U.S. Census Bureau
	housing facilities and waste disposal	proportion of total housing units without complete plumbing	U.S. Census Bureau
	housing size	average rooms per person in average household	U.S. Census Bureau
	housing availability	number of total housing units available per household	U.S. Census Bureau
	housing age	median age of housing units	U.S. Census Bureau
Water Security	availability of clean water	proportion of total population served by public water supply	U.S. Census Bureau - Censtats/U.S. Geological Survey
Food Security	availability of healthy food	healthy food outlets per 1,000 people	Project Collection (original data: U.S. Census Bureau - County Business Patterns, Censtats)

Basic needs are the rudimentary elements required to sustain human life, such as adequate food, water and shelter (Doyal and Gough, 1991). Measures of the availability, accessibility and consumption of these basic resources have long been used by agencies and organizations, such as the World Bank, U.S. Department of Agriculture, United Nations Food and Agricultural Organization, and the United Nations Housing Rights Programme, to monitor the status and improvement of achieving minimum survival requirements across human populations. Contemporary well-being assessments generally incorporate at least one measure of basic needs. The authors of the Millennium Ecosystem Assessment (2005) argued that "basic material for a good life" must be considered when assessing the status of human well-being. There are essentially three categories of measures of basic needs: food security, water security and housing security.

A lack of safe, nutritional food in adequate amounts can cause physical and psychological harm to people (Butler and Oluoch-Kosura 2006). Consequently, food security is a component of a basic needs indicator. According to Helen Jensen (2002: 1218), people are food secure if they have ready access to "nutritionally adequate and safe foods" and they can acquire these foods in "socially acceptable ways." Further, research has shown that persons are more likely to eat a healthful diet when they have access to such food choices (Cheadle et al. 1991; O'Connell et al. 2011).

Food insecurity, then, is a matter of both the availability of food and access to it (Jensen 2002). In the United States, access to food is the more common issue (Jensen 2002). While there is generally enough food produced and available in the U.S., barriers remain that restrict people's access to it. Access barriers can be at the individual (e.g., a person cannot afford to purchase food) or system (e.g., food shipments are interrupted due to a disaster or some other circumstance) level. In exceptional circumstances, however, food availability can also be a problem in the U.S., especially for agricultural and other resource-dependent communities. In such cases, it is often ecological factors that limit food supply. For instance, subsistence crops may fail due to pests or drought, or seafood harvesting may be banned because fish and shellfish become contaminated. People who are engaged in subsistence agriculture or harvest are typically more vulnerable to ecological events that compromise food availability (Fall et al. 2001).

Food security and water security are often closely tied together because water is a necessary input for agricultural production (Postel 2000). Humans need reliable access to safe, clean water in order to survive and stay in good health. Water is also necessary for many daily household and economic activities. Thus, there are multiple, often competing, demands on the Earth's finite water supply. Not surprisingly, water scarcity has become a concern globally as the human population increases and withdrawals of freshwater have surpassed the ability of ecosystems to keep up with demand (Dimitrov 2002). Water security depends upon the availability of usable freshwater, demand from all social sectors (e.g., household, agriculture, industrial, etc.), as well as the systems and structures in place for management and allocation of water resources (Postel 2000; Sullivan 2002; Wallace et al. 2003). Wallace et al. (2003: 47) wrote "…while domestic water needs are absolutely fundamental to our survival, emphasis placed upon them within many water management strategies is rather low." In other words, while there is enough water available, access may be the limiting factor for people in need.

Food security includes access to healthy food choices like fruits and vegetables. *Credit: Theresa Goedeke.*

Finally, people require adequate shelter to protect them from the natural elements, such as pests, heat, cold, and storms. In this sense, shelter is a basic requirement for survival, ergo well-being. The question of what amounts to adequate housing, however, is one that is contextually relative. Is protection from the elements adequate to meet basic needs or must the housing have indoor plumbing or some form of heating/cooling system to be adequate? Similar to food security, there are also important issues of availability and access related to housing.

In the U.S. a fair amount of data is collected and used by federal agencies, such as the U.S. Census Bureau and the U.S. Department of Housing and Urban Development, to profile and track housing availability and public access to housing. The Census Bureau's American Community Survey, for instance, collects a variety of housing oriented data to characterize housing patterns in the U.S.; measures include value and age of the housing structures, number of rooms, presence of plumbing or other facilities, etc. At the national level, median housing value has also been used to measure well-being (Rentfrow et al. 2009). On the international level, the U.N. Housing Rights Programme monitors a variety of measures related to housing security, such as available housing stock, tenure, presence of plumbing, age of housing structures, and cost or affordability (Tsenkova and French 2011). The OECD "Your Better Life Index" (2011) monitors housing using the number of rooms per person per dwelling and presence/absence of "basic facilities" within the dwelling unit.

There is substantial evidence that many Americans, at some point during their lives, may not have the means to meet basic materials needs, such as access to clean water, enough nutritional food or protective shelter. For example, according to the U.S. Department of Agriculture's Economic Research Service, 14.9 percent (17.9 million) of the households in the U.S. were "food insecure" in 2011, which means that at some point during the year they lacked resources to feed everyone in the household (Coleman-Jensen et al. 2012). While there is at present adequate water in the U.S. to meet current demand, localized availability and access issues occur as a result of hazards and other events, such as hurricanes, droughts, water contamination or failure of infrastructure (USGS 2010). Homelessness is also a common social problem in the U.S. In a twelve month period from October 2009 to September 2010, approximately 1.6 million people accessed an emergency homeless shelter or joined a transitional housing program (SAMHSA 2011). For some people in the U.S., there is still a struggle to secure adequate food, water and housing.

For this study, the investigators opted to include a *Basic Needs* indicator to evaluate the success of a county in achieving well-being. When selecting measures to operationalize the *Basic Needs* indicator, investigators prioritized eight measures to address three dimensions of the basic needs indicator, including food security, water availability and housing. To operationalize food security, the investigators focused on the availability of healthy food, such as fresh fruits and vegetables, creating a measure of healthy food outlets per 1,000 people in a county. To measure water security, the investigators used the proportion of total population served by public water supply. Finally, for housing security, the investigators employed six separate measures to capture both the concept of basic sheltering, as well as a more contextually relevant perspective of housing quality. The measures included were: median value of housing units, percentage of total housing units without complete kitchen facilities, proportion of total housing units without complete plumbing, average number of rooms per person in the average household, number of total housing units available per household and median age of housing units.

Health

Table 4.2. Detailed description of the measures used to operationalize the health indicator.

Indicator: Health			
Measure Category	**Measure**	**Operationalized Measure**	**Source of Data**
Births	fertility, population health/ well-being	birth rate (births per 1,000 people)	U.S. Census Bureau - Censtats
Life Expectancy	life expectancy	male life expectancy	Institute for Health Metrics and Evaluation
	life expectancy	female life expectancy	Institute for Health Metrics and Evaluation
Mortality	mortality due to chronic disease	deaths caused by major cardiovascular diseases	Project Collection (original data: state health departments)
	mortality due to chronic disease	deaths caused by lower respiratory diseases	Project Collection (original data: state health departments)
	mortality due to chronic disease	deaths caused by all cancers	Project Collection (original data: state health departments)
Healthful Lifestyle Opportunity	recreational opportunity	recreational facilities per 1,000 people	Project Collection (original data: U.S. Census Bureau - County Business Patterns, Censtats)

Health, both physical and mental, contributes tremendously to an individual's well-being. When an individual's health is seriously compromised the result can be an impairment or disability that reduces his or her ability to meet basic needs and, consequently, their autonomy (Doyal and Gough 1991). Without the ability to act on one's own behalf to achieve well-being, dependency relationships become critical, which could be either informal (e.g., family and friends) or formal (e.g., government social services, health insurance providers). At a population level, a high percentage of persons in ill-health can mean a high percentage of community members with degraded well-being and a community that is burdened with helping to mitigate the loss of their fellows' autonomy. Thus, good health is also important for population level well-being. The economic and social cost of impaired health can be significant for both the individual and the society in which they live (Mariotto et al. 2011; Heidenreich et al. 2011; Soni 2009). For this reason, the improvement of human health is a common policy goal and, as a result, there are hosts of health intervention and improvement programs at the local, state, national and international levels.

Because many health improvement programs exist, *Health* is an indicator that has been measured and monitored by many entities using a variety of different measures. For example, the United Nation's World Health Organization (WHO) runs the most widely known public health monitoring initiative, which consolidates data to assess the state of public health at the national level across the globe. WHO utilizes many different measures to assess the status of public health, including cause-specific mortality rate and life expectancy. At a national level, the U.S. Centers for Disease Control's (CDC) "Healthy People Initiative" monitors multiple dimensions of public health to determine if improvements are being made in health status, risk reduction, etc. CDC monitors a number of measures, such as life expectancy, incidence of disease, cause-specific mortality, rates of disease treatment, disease survivorship, healthful activities and behavior, access to healthcare facilities and services, etc. Similarly, the County Health Rankings and Roadmaps initiative tracks human health at the community level in the U.S. Assessors use the County Health Rankings to monitor individual health behaviors, presence of a healthful environmental context, and healthcare options on two outcome variables, which are mortality and morbidity. For the present study, investigators included several measures to operationalize health including deaths due to cardiovascular, respiratory and cancer diseases, life expectancy, birth rate (births per 1,000 people) and recreational facilities per 1,000 people.

Birth rate was selected to operationalize the health indicator because of its statistical performance and because it captures information about population births. Life expectancy is an important proxy for public health. *Credit: Microsoft.*

At the most basic level, the wellness of a population is typically tracked by monitoring trends in mortality, usually cause-specific mortality, meaning death resulting from a particular cause like disease, accident or violence (Weeks 1999). Monitoring mortality is important because it can communicate a great deal about population-level risk factors for exposure or development of disease, access to and quality of healthcare, along with disparities and differentials in health care and disease outcomes (Weeks 1999). In the U.S., there are several diseases that take a heavy toll on individuals and communities, two of which are cardiovascular disease and cancer. According to the CDC, in 2010, cardiovascular disease was the leading cause of mortality in the U.S., with the majority of deaths occurring in the 65 and older age category. Second only to heart disease, cancer is also a leading cause of death for Americans. While older people still accounted for most of the annual deaths from cancer in 2010, it was the leading cause of death for people aged 45 to 64 and the second most common cause of death for persons aged 25 to 44 (CDC 2011). Both WHO and CDC monitor mortality caused by cardiovascular diseases and cancer.

While not a leading cause of death in the U.S., acute and chronic respiratory diseases, such as asthma, emphysema, bronchitis and sinusitis, are also important health issues. According to the CDC, the preliminary, age-adjusted death rate for chronic lower respiratory disease was 42.7 persons per 100,000 U.S. standard population in 2011 (Hoyert et al. 2012). However, different groups of people are more likely to suffer or die from these types of diseases. For instance, persons 65 years and over have higher death rates from lower respiratory conditions (Hoyert et al. 2012). Additionally, research suggests that poor adults are more likely to suffer from respiratory conditions than non-poor adults (Schiller et al. 2012). Finally, in the Gulf of Mexico, incidence of and death from respiratory issues is regionally relevant. Acute respiratory conditions are common ailments that are directly related to hazardous environmental events and conditions, such as oil spills and harmful algal blooms (Zock et al. 2011; Diaz 2011; Meo et al. 2009; Suarez et al. 2005; Kirkpatrick et al. 2006; Hoagland et al. 2009).

Life expectancy, incorporating dimensions of fitness at both the individual and population level, is also an important proxy for public health because it is highly dependent upon the social context in which people live (Weeks 1999). There are many factors that can support or degrade human health, including genetic predisposition to diseases, individual choices and behavior, cultural norms and traditions, and access to and use of healthcare or healthful infrastructure (Homer et al. 2008). From an interpretive standpoint, an increase in life expectancy results from a reduction in one or more forms of cause-specific mortality. For example, in the U.S., if mortality rates due to cardiovascular disease and cancer were reduced, a concomitant increase in life expectancy could be expected, unless some other cause-specific mortality rate increased at the same time. Reductions in the incidence of these diseases, or mortality related to them, might be achieved in many ways: increased healthful behaviors at the individual level, improvement in medical technology, reduction in exposure rates, increased access to preventative healthcare, increased access to disease treatment, among others.

Infant mortality rate is often used as a measure of health in a population. As discussed previously, however, infant mortality rate and fertility rate were eliminated as components of the *Health* indicator because of their performance during the statistical analysis portion of the measure selection process. Birth rate was selected instead because of its statistical performance and because it captures information about population births. Further, in an international context, low birth rates have historically been associated with greater economic progress and modernization. A common postulate related to this form of demographic transition is that as women attain greater access to educational and economic opportunities, combined with greater self-determination over personal reproductive goals, the result has generally been a decline in birth rate (Preston 1986). Recently, in the U.S., a decline in birth rate has been associated with broader economic trends, such that birth rates decline during times of recession and increase when economies are robust (Taylor et al. 2011).

Finally, part of healthy living includes engaging in physical activities, such as recreational activities that provide an individual with physical exercise. Evidence suggests that proximity to recreational opportunities, both green (e.g., parks) and built, is a predictor of the likelihood of a population engaging in physical activity (Cohen et al. 2007). Specifically related to coastal communities, a study in New Zealand found that people living within coastal areas were less likely to be sedentary and more likely to report levels of activity considered adequate for health (Bauman et al. 1999). Proximity to recreational facilities has been used by several assessors to gauge the opportunity within a community to engage in physical activity. For example, as a part of its "Healthy People Initiative," the CDC monitors access to school physical activity facilities in their effort to track progress toward achieving positive health outcomes related to physical activity in the U.S. Similarly, the U.S. Department of Agriculture considers the availability of recreational facilities within communities as a part of their monitoring in relation to the Food Access Research Atlas (ERS 2013).

As discussed previously, mental health has consistently been identified as an important facet of well-being, particularly in the event of a disaster. Unfortunately, no datasets could be located at the county level for all counties in the sample. The investigators investigated the possibility of including measures of mental health by utilizing the Behavioral Risk Factor Surveillance System (BRFSS) data, which collects self-reported mental health status from respondents. However, the BRFSS data is collected and aggregated only to the state level. Thus, this dataset was not reliable for use at the county level. Exclusion of this important element of health was a consequence of the availability of secondary data, and the remaining measures focus on physical health.

Safety

Table 4.3. Detailed description of the measures used to operationalize the safety indicator.

Indicator: Safety			
Measure Category	**Measure**	**Operationalized Measure**	**Source of Data**
Safety from Natural Disaster	vulnerability to flood events	population density in the SFHA zone	Project Collection (original data: U.S. Census Bureau and FEMA)
	exposure to severe storms	total severe thunderstorm and tornado events	NOAA NCDC Storm Events
	exposure to severe storms	total tropical storm and hurricane events	NOAA NCDC Storm Events
Safety from Crime	exposure to property crime	property crime rate (known incidents per 1,000 people)	FBI Uniform Crime Report
	exposure to violent crime	violent crime rate (known incidents per 1,000 people)	FBI Uniform Crime Report

Another important part of well-being is safety. Safety can mean both safety of person and safety of property from actions or events that cause damage, harm or impede one's access to needed resources (MEA 2005). Safety can be compromised by accidents, violence (e.g., crime or war) or hazardous events (Bourque et al. 2006; Doyal and Gough 1991; Mileti 1999). Measures to monitor safety are used in many assessments, such as the Health Indicators Warehouse that measures injury, violence and occupational safety. Other assessments have operationalized safety in terms of crime rate, assault rate, homicide rate and suicide rate (OECD 2012). For the present project, the investigators have included five measures to operationalize the *Safety* indicator. Two measures are focused on safety as it relates to crime against both person and property. The remaining three measures are focused on safety as it relates to natural hazards, specifically, floods and storm events.

Crime can compromise well-being both at the individual and the community level. At the individual level, persons who become victims of crime may suffer physically, emotionally or financially (McCollister et al. 2010). For example, victims of arson may suffer physical and emotional injuries, as well as incur financial losses from recovery and medical expenses due to the crime. High crime rates can also take a toll on community level well-being by increasing the cost of the criminal justice process (e.g., prosecution and corrections) (McCollister et al. 2010). Research indicates that life expectancy is higher in areas with lower crime rates (Poudyal et al. 2009). More than this, research indicates that high crime rates may erode social connectedness in a community, although subjective perception of safety from crime may be less important when forming place-based attachments to community (Sampson 2002; Saegert and Winkel 2004; Gallup 2009). In any case, assessors commonly monitor crime rates as an indication of how communities are faring (Center for Research, Regional Education and Outreach, 2010; County Health Rankings 2013).

The safety indicator is operationalized using measures related to crimes against persons and property, as well as exposure to natural hazards. *Credit: Microsoft.*

Safety of person and property are frequently threatened by natural elements and events such thunderstorms, tornados, tropical storms, hurricanes, flooding, wildfire, landslides, tsunamis and earthquakes. As discussed previously, in the Gulf of Mexico region residents are regularly confronted with a host of natural hazard events. During Hurricane Katrina in 2005, which resulted in massive flooding and wind damage, there were 971 deaths in Louisiana alone, many of which were attributable to drowning or physical trauma (Brunkard et al. 2008). Such events can decimate households, neighborhoods and, sometimes, entire communities. Persons in poverty are particularly vulnerable to disaster events (Fothergill and Peek 2004). The aftermath of such events can, in the short-term, impede access to basic resources and create unhealthy environmental conditions. In the long-term, individuals, families and communities can experience substantial economic, social and cultural losses that can take years to recover from (Cutter et al. 2013).

Access to Social Services

Table 4.4. Detailed description of the measures used to operationalize the access to social services indicator.

Indicator: Access to Social Services			
Measure Category	**Measure**	**Operationalized Measure**	**Source of Data**
Social Support	nutrition assistance	proportion of those in poverty participating in supplementatal nutrition assistance program (SNAP)	USDA Food & Nutrition Service
	human services	human services organizations per 1,000 people	National Center for Charitable Statistics
Availability of Medical Care	medical facilities	hospital beds per 1,000 people	Area Resources File
	medical care	physicians per 1,000 people	U.S. Census Bureau - Censtats/American Medical Association
Mobility	transportation	percentage of households without a vehicle	U.S. Census Bureau

Where decision-making affecting quality of life has been decentralized to the local level, access to social services becomes an important indicator of quality of life because the performance of local governments at providing services can vary significantly across jurisdictions (Gonzalez et al. 2010). Doyal and Gough (1991) have suggested that access to basic social services and healthcare are required for people to reach an intermediate level of well-being. Thus, many well-being assessments have included some form of indicator related to the accessibility of social and health support services. For instance, Gallup (2009) monitors "Basic Access" with 13 measures, including access to a doctor and enough money for food in their "Healthways Well-being Index." Gallup also assessed availability of "Basic Services," including availability of quality healthcare and availability of affording housing, in their assessment conducted for the Knight Foundation (2010). Other assessments with similar access indicators are the Domains of Livability and Quality of Life (Van Kamp et al. 2003), Index of Social Health (Miringoff and Miringoff 1999) and the RAND Levers for Building Community Resilience.

Medical care is only helpful to secure community well-being if medical resources exist and people have the ability to access these facilities. *Credit: Microsoft.*

As discussed previously in the context of the *Basic Needs* indicator, while most residents in the U.S. do have access to resources required for basic survival, many do still face challenges in obtaining such resources. For those people who cannot reliably secure resources for adequate levels of well-being, access to social services can help them sustain or even recover from adversity. For the purposes of this research access to social services is conceptualized broadly as how easily community members can access social support and medical services, in terms of either availability of those services or physical access.

Two measures employed in this study relate specifically to the availability of support services, in the form of participation in the U.S. Department of Agriculture's Supplemental Nutrition Assistance Program (SNAP), along with the availability of non-governmental social service organizations in a community. Eligibility for SNAP is based on federal income eligibility guidelines, which are set annually. For example, for the period of July 1, 2009 to June 30, 2010, a family of 4 would have been eligible for participation in the program with an income at or below $40,793 per year (Federal Register 2009). Because of their inability to obtain needed resources, persons in poverty are most like to be in jeopardy of food insecurity. Thus, understanding the number of persons participating in a program like SNAP relative to the number of persons in poverty is indicative of the successful acquisition of a government-sponsored social service by vulnerable segments of the population. Conversely, the availability of non-governmental social service organizations is indicative of the informal social support network existing in a community. For instance, a community with many more people in poverty than are enrolled in government programs may still have acceptable levels of well-being if those vulnerable residents instead have assistance from charitable organizations.

In additional to social support services, the present study also operationalizes the availability of medical care, specifically hospital beds and physicians, and access to these resources in the form of personal transportation. Like food security, medical care is only helpful to secure community well-being if an adequate amount of medical resources exist within a population and people have the ability to physically reach these facilities. Studies have indicated that availability and access to medical resources can be an issue for regions underserved in the U.S., such as sparsely populated rural areas (Carr et al. 2009; Joynt et al. 2011; Bodenheimer and Pham 2010). In fact, many counties across the U.S. have been designated by the U.S. Department of Health and Human Services as "Medically Underserved Areas/Populations" (specifically, areas having too few primary care providers, high infant mortality, high poverty and/or high elderly population) or "Health Professional Shortage Areas". Moreover, in regions where medical resources are geographically dispersed, transportation can become a significant barrier to accessing these resources even when they exist. For instance, research shows that elderly people, particularly African-Americans, in rural areas have difficulty securing transportation to access needed services, including medical services (Sook et al. 2010; Arcury et al. 2005).

In the Gulf region, access to basic resources, along with social and medical services, has been interrupted episodically and chronically, both in the short and long-term, as a result of large-scale disasters, such as hurricanes. For example, after Hurricane Katrina in 2005, the health care system in the Gulf region was significantly degraded, leaving residents without reliable access to medical facilities or other medical resources (Rudowitz et al. 2006; Jones et al. 2009). Thus, access to social services is an important indicator for county level well-being in this region.

Social Connectedness

Table 4.5. Detailed description of the measures used to operationalize the social connectedness indicator.

Indicator: Social Connectedness			
Measure Category	**Measure**	**Operationalized Measure**	**Source of Data**
Opportunities for Participation	participation in democracy	percent turnout of registered voters in national/ presidential election	US Election Atlas - David Leip Election Data
	social gathering places	religious organizations per 1,000 people	National Center for Charitable Statistics
	arts and culture	arts and humanities organizations per 1,000 people	National Center for Charitable Statistics
	charitable giving	proportion of itemized tax returns reporting charitable contributions	National Center for Charitable Statistics
	access to communication	percentage of households without telephone service	US Census Bureau
	tenure in community	median year householder moved into unit	US Census Bureau

The benefits of social connectedness are diverse. For example, after disasters, those with strong social networks (i.e., connections to neighbors, family, friends and coworkers) are better able to get much needed help and support, often faster than through outside services and emergency responders (Bourque et al. 2006). Researchers have found that among low income groups, participation in social aid and pleasure organizations resulted in collective resources that helped compensate for the lack of individual resources during disaster recovery (Weil 2010). Chandra and colleagues (2011) describe social connectedness as effective for the exchange of resources, social cohesion, response and recovery. From an environmental perspective, societies with high social capital transform environmental utilization into well-being more efficiently (Knight and Rosa 2010) thus capitalizing on the availability of ecosystem services.

During the initial workshop that was convened to help identify indicators for the present research, participants considered "social connectedness" an important indicator for this study (Lovelace et al. 2012). Likewise, many existing indices have either proposed or employed a similar indicator; examples include "community connectedness" in the Australian Unity Well-being Index (Cummins et al. 2003), "social connectedness" in the New Quality of Life in Twelve New Zealand Cities (Jamieson 2007), "social cohesion" in the Human Dimensions of Oil Spills work by the Social and Environmental Research Institute (Dow et al. 2010) and in the Environmental Protection Agency's well-being model (Smith et al. 2010), "social well-being" in RAND Corporation's Levers for Building Community Resilience (Chandra et al. 2011), and "community solidarity" in social impact assessment well-being models (Pollnac et al. 2006).

A variety of concepts are useful for understanding the social connections within a community, including but not limited to civil society, social capital and social cohesion. Civil society refers to the sphere of society outside of government in which organizations and individuals interact to express the interests and values of their members or others "based on ethical, cultural, political, scientific, religious or philanthropic considerations" (The World Bank 2013). Practically, civil society is evidenced by citizen engagement with society's non-governmental organizations, including everything from civic groups to labor unions to churches. A robust civil society builds trust, shared values and social capital, all of which are essential for establishing and maintaining a cohesive community (Putnam 2000). Social capital is, in essence, a form of social currency that can be mobilized to create or gain resources (Portes 1998). Social cohesion is reflected by strong attachment and attraction to a social group or community (Friedkin 2004). It is a mobilizing asset for a community as it helps stimulate the productive use of resources for desired outcomes (Donoghue and Sturtevant 2007). Ultimately, the above concepts integrate aspects of community involvement, social interaction, social networks and trust, all of which play a role in the overall well-being of a society (Cox et al. 2003, Yip et al. 2007).

Opportunity for participation and engagement in community churches and spiritual organizations is one measure of social connectedness. *Credit: Video Blocks.*

For the purpose of this study, the *Social Connectedness* indicator combines elements of civil society and social cohesion to represent community members' connectivity and engagement in the public sphere. Specifically, social connectedness includes participation in democracy, opportunity for community participation and investment in community. In a well-being context, social connectedness is often applied and measured at the individual level, focusing on support networks for individuals (e.g., Doyal and Gough 1991). However, for the present study the investigators were interested in connectedness at the group-level and so expanded the individual conception of social connectedness to encompass elements of civil society and social cohesion for the collective.

Participation in organizations can have a positive effect on the development of social institutions, such as law, politics or education, by serving as a space for open dialogue and civic socialization (Fung 2003). This function of civil society is important to good governance and development of a participatory democracy (Perrow 1991; Putnam 2000; Kaldor 2003).This is because the learning that comes from participation in civil society is focused on becoming a good citizen and this civic socialization includes participation in democratic processes (Putnam 2000; Andrews and Edwards 2004). Thus, evidence of participation in democratic processes is evidence of a robust civic society. Political participation has been included in quality of life assessments as a component of community development (Mitchell 2000) and in community status indices (Watts 2006). In the present project, participation in democracy is measured by the percent of registered voters that turnout to vote in national elections.

Two of the measures used for *Social Connectedness* assess the opportunity for participation and engagement in the community in churches and spiritual organizations, or through arts and culture. These include the number of churches and spiritual organizations and the number of arts and humanities organizations per 1,000 people. Arts and culture contribute to strong communities and are recognized as spaces that enhance communication across diverse social, economic, racial and ethnic groups (Jamieson 2007). Likewise, churches and spiritual organizations serve an important role within communities, often as a central gathering place for those who are members (Jamieson 2007), as well as a space for support and shared values, each of which contribute to social connectedness. Previous studies found that church members have higher levels of civic engagement when compared to non-members (Weil 2010). Measures of access to and participation in churches, social organizations, and arts and cultural events have been used in measures of well-being and community attachment (Center for Research, Regional Education and Outreach 2010; Knight Foundation 2010).

Presence and strength of social networks, meaning the absence of social isolation, are important components of social connectedness (Doyal and Gough 1991; Keyes 1998). Social isolation puts people at greater risk of experiencing a variety of impacts including those associated with extreme weather events (Klinenberg 2002), psychological issues (Oliver 2003), as well as aging and immobility (Gilleard et al. 2007). Therefore, access to communication, important for maintaining social networks and avoiding social isolation, is used as another means of assessing the opportunity for community participation and social interaction. This is particularly true in modern times when the cell phone serves as the primary means of connection between family and friends, and even information related to things like events and severe weather. Though many have argued that technology access is increasing social isolation and weakening social networks, a survey conducted by the Pew Research Center found just the opposite. Americans are not as socially isolated as previously reported, social networks are more diverse as a result of technology, and many important social ties are maintained and strengthened by use of technology (Hampton et al. 2009). Access to communication was operationalized as the percent of households without access to phone service.

The final category of *Social Connectedness* measures is community investment, which is specifically operationalized as charitable giving and tenure within a community. Charitable giving is measured by the proportion of itemized tax returns reporting charitable contributions. While this is a more limited definition of charitable giving in that is does not encompass the true extent of charitable giving in the population, it is the best measure available given the study criteria. The measure, operationalized in the same way, was used in the State of the Commonwealth Index (Watts 2006). Voluntarism and charitable giving are behaviors strongly related to civil society (Putnam 2000). Therefore, higher levels of charitable giving, whether of money or time, lead to increased investment in a community and greater social connectedness. Charity can also be understood as a method of resource exchange, which is an important aspect of social connectedness that aids recovery after a major disaster (Chandra et al. 2011) and improves equity within a community through investment in collective resources (Weil 2010).

Finally, the length of residence in a community is a measure of place attachment and has been linked to greater investments in a community through social connectedness, social cohesion and social capital (Cox et al. 2003; Gilleard, Hyde and Higgs 2007; Weil 2010). Greater place attachment or sense of place is positively associated with strong social networks in the community, increased participation in community organizations and a greater sense of community identity (Putnam 2000; Williams et al. 2008) all of which support well-being (Keyes 1998). Population growth and corresponding movement into and out of communities negatively impacts social relationships as well as sense of community (Jamieson 2007). Tenure is used to assess the broader conditions that create the aforementioned impacts on social connectedness, whether positive or negative. The Knight Foundation (2010) uses tenure in a community as a means of measuring attachment.

Governance – Planning and Management

Table 4.6. Detailed description of the measures used to operationalize the governance indicator.

Indicator: Governance - Planning and Management			
Measure Category	**Measure**	**Operationalized Measure**	**Source of Data**
Management	proactive management	FEMA's Community Rating System county score	Project Collection (original data: Natural Hazards Insurance Services Office and National Flood Insurance Program)
Planning	proactive planning	years since comprehensive plan was adopted	Project Collection

Government institutions and systems of governance, the latter defined as "the interactions among structures, processes and traditions" (Plumptre and Graham 1999), are important components of well-being because they influence many other components of well-being, both directly and indirectly. Beyond the obvious violations of human rights committed by some governments against its citizens, well-being can be eroded as a result of government "corruption and weak systems of regulation or accountability" (Doyal and Gough 1991; MEA 2005). Conversely, well-being can be heightened with proactive, effective and efficient government institutions, along with equitable, participatory governance processes (Huther and Shah 2005).

Because of the prominence and multi-faceted nature of governance within people's daily lives, Helliwell (2003) argued that its importance to quality of life dwarfs that of even economic development. Moreover, governance is a critical concept when considering linkages between ecosystems and well-being because many environmental problems are larger than just one county, state or nation. Thus, the ability of multiple governments, stakeholders and citizenry to coordinate planning and management, as well as to uniformly pursue shared goals and outcomes is central to the success of many ecosystem-level efforts (MEA 2005).

Comprehensive plans often include enviromental protection or preservation of open/green spaces such as this park in Gulf county, Florida.
Credit: Theresa Goedeke.

Governance, or good governance, has been operationalized in many ways, including effective delivery of public and social services, citizen engagement in decision-making, degree of civil liberties and freedoms, transparency and accountability in governance processes, political stability, level of corruption in governance processes, level of public or state-sponsored violence, parity of political representation among social groups, amount of tax burden and public debt, among many others (SUNY 2010; Bovaird and Loffler 2003; Thomas 2009; Prescott-Allen 2001). The measures used in the present study were selected based on their connection to environmental conditions and events. Specifically, governance was operationalized as: 1) the number of years since a county adopted a county-wide comprehensive plan and 2) the value of a county's Community Rating Score (CRS).

Comprehensive plans are important artifacts of governance because they represent the process of planning for how a county will develop and, generally, grow into the future. Such a plan might include any number of components or guidelines meant to govern the expansion and distribution of development, infrastructure or human population/activity. Typical elements of comprehensive plans relate to transportation, environmental protection, open or green-space, public infrastructure, neighborhoods, historic preservation, housing, social equity, etcetera (Kelly 2010).

State and local governments typically adopt their own elements as necessary within the bounds of applicable administrative requirements. For instance, per Florida state law, Florida counties must address nine major elements in their county comprehensive plans and coastal counties must have an additional coastal management element ("Community Planning Act", §163.3161(1)). However, not all states require county-level comprehensive planning or, if they have requirements, may not implement deadlines for creation or adoption of plans. In such cases, this measure of governance is even more useful because it is a good indication of a county's proactivity toward planning for economic, environmental and social progress.

The second measure chosen for the present study is a county's Community Rating System rating, which is based on a score that is awarded to participating counties by the U.S. Federal Emergency Management Agency's (FEMA) through their CRS program. Separately or as part of comprehensive planning, counties or parishes can join the CRS program, which was first implemented in 1990. CRS was implemented by FEMA's National Flood Insurance Program (NFIP) for "recognizing and encouraging community floodplain management activities that exceed the minimum NFIP standards" (http://www.fema.gov/business/nfip/crs.shtm). Simply put, the goal of the program is to reduce the number of lives lost and amount property damaged during floods and similar hazards, such as storm surge. By implementing flood reduction and management strategies, local communities can secure significant reductions in flood insurance rate premiums. These reductions are based on their CRS class score, ranging from 1 to 10, which is awarded to them by FEMA for completion of specific tasks. This program provides residents with social, health and economic benefits by way of proactive government emergency planning and protection. Both of the measures are ideal because they represent aspects of governance that at once related to environmental and public safety conditions within the community.

Economic Security

Table 4.7. Detailed description of the measures used to operationalize the economic security indicator.

Indicator: Economic Security			
Measure Category	**Measure**	**Operationalized Measure**	**Source of Data**
Government Economy Security	federal government contribution to economy	federal government expenditure per 1,000 people	US Census Bureau - Censtats
	economic security of local government	local government revenues per 1, 000 people	National Center for Educational Statistics
Industry Economic Security	industry contribution to county	gross domestic product, total for all industries (year 2000 value)	NOAA National Ocean Economics Program
	economic diversity	economic diversity of employment	Project Collection (original data: US Census Bureau - Censtats/BEA and NOAA National Ocean Economics Program)
Household Economic Security	economic security of household	median household income	US Census Bureau
Individual Economic Security	employment security of individuals	civilian labor force unemployment rate	US Census Bureau/BEA
	economic security of children	percent of people under 18 years of age in poverty	US Census Bureau

Economic insecurity has been defined “as the objective risk of an unacceptable decline in someone’s standard of living, where ‘unacceptable’ refers to a threat to their capacity to participate in their form of life” (Doyal and Gough 1991: 211). Economic security, then, can be defined as the condition of having sufficient resources to support one’s standard of living that at least meets basic needs, now and in the foreseeable future. Because economic security encompasses the ability of people to sustain their autonomy and secure the resources that they need, the concept goes beyond traditional measures of economic performance, such as GDP, to include additional factors that contribute to economic well-being. Availability and access to market and non-market resources, income distribution and equality-inequality, and employment are often considered in indices of economic security (Ruitenbeek 1996; Osberg and Sharpe 2002; USEPA 2013a).

Nesadurai (2004) conceptualizes economic security as a state of economic stability where there is little chance of interruption to or loss of income and consumption streams necessary for individual well-being, the income-generating potential of an economy and a minimal level of distributional equity. Nesadurai’s (2004) definition takes into account aspects of governance, macroeconomic resilience and growth, and individual economic security, all of which are included in the measures for economic security assembled by the investigators of this study. There are seven measures included in the county-level *Economic Security* indicator for this study. The measures fall into four categories: 1) economic security in government, 2) economic growth, 3) household economic security and 4) occupational structure.

Economic security in government is defined by the measures federal government expenditure and local government revenue. Economic growth is included in the indicator in the form of the GDP index. Children in poverty and median household income together make up the household economic security category. Finally, occupational structure is described by the measures economic diversity of employment and unemployment rate. Elements of economic security have been found to be related to other indicators of well-being. For example, communities with higher poverty rates and low median incomes are associated with a higher frequency of self-reported unhealthy days among residents (Jia et al. 2009). Where social cohesion is weak or fragile, economic disruptions may cause social conflicts (Nesadurai 2004).

Economic security is defined as having sufficient resources to support ones standard of living. Employment is one way of achieving economic security. *Credit: Microsoft.*

Expenditure by federal government has been linked to economic growth and can be vital to ameliorating financial stresses due to disparities at the county level (Liu and Hsu 2008; Warner 1999). Local governments have unequal capacity to generate revenue, depending on location and the well-being of residents. High tax revenue at the local level may indicate a strong tax base, which necessarily depends on the economic success of its citizens (Warner 1999). Therefore, higher levels of expenditure by the federal government at a local level combined with robust local revenue serve to increase economic security. Additionally, county governments with greater institutional capacity (i.e., financial autonomy and centralization) have been shown to do better at alleviating poverty and stimulating job growth (Lobao et al. 2012). Government spending was included as a measure in the Index of Economic Well-being (IEBW) for Canada (Sharpe 1999). For the present study, data for federal government expenditure per 1,000 people was obtained from the U.S. Census Bureau. Also, data on local government revenues per 1,000 people were obtained from the National Center for Educational Statistics.

Gross Domestic Product is a common measure of economic growth that is used to measure the market value of an economy. GDP includes expenditures for individual consumption of goods and services, private investment, government purchases of goods and services for consumption and investment, and net exports (Colgan 2007). The National Ocean Economics program (2013) gathers data on the contribution of the ocean to the economies of coastal and watershed counties. The program publishes GDP information for these counties on an annual basis. GDP was included as one measure of economic security because it serves as a measure of market contribution to overall economic security of a county.

Since the 1970s, a large body of literature has been assembled that argues for the inclusion of other variables into an index to measure the economic performance of a society. The Genuine Progress Indicator (GPI), Human Development Index (HDI), and Index of Economic Well-being (IWEB) are a few examples of alternative indexes of economic and social well-being (Sharpe 1999). These indicators take into account market values in addition to non-market economic and social measures. Thus, the investigators of the present study include GDP in the *Economic Security* indicator as an important measure of the market value of an economy. However, rather than being a stand-alone indicator, GDP in only one of seven measures selected that, together, provide a comprehensive view of economic security.

Household economic security focuses more closely on the economic experience of a population, as opposed to the government. This measure ties more closely to individual economic security, at an aggregate level. By examining trends in household income and poverty measures, the investigators can compare the performance of sample counties on the individual measures, as well as evaluate the counties for income disparities and inequalities that indicate low economic security. This is because the economic security of households in a county influences economic security at a community level (Osberg and Sharpe 2002). For instance, if within a county there are large numbers of households with high incomes and large numbers of children in poverty this may be indicative of issues with income distribution, possibly related to ineffectual social welfare programs. These kinds of income flows and inequalities are taken into account in other indicators of economic well-being, including Canada's Index of Economic Well-being (IWEB) (Osberg and Sharpe 2002). Similarly, the EPA's Green Communities (2013a) indicators include measures of household poverty levels. For the present research, investigators used U.S. Census Bureau estimates of median household income and percent of people under 18 in poverty on an annual basis at the county level.

Finally, for occupational structure, unemployment rate and economic diversity are two measures that indicate the strength and resilience of the occupational structure of economies. Unemployment is included in other indices of economic well-being (Osberg and Sharpe 2011; Sharpe 1999). On the individual level, high unemployment rates have been linked to indicators of psychological stress (Brenner 1977). Employment status before a disaster may be a predictor of higher rates of stress after a disaster occurs (Tobin and Ollenburger 1996). Unemployment rates on the county, regional and national level are considered important indicators of labor market performance. For example, the USDA tracks unemployment rates on a county level as a measure of community well-being, as part of the Economic Research Service (2012).

The diversity of the business or industrial landscape within an economy can be an important indication of that economy's potential resilience, that is, its robustness and ability to recover after disruption. Evidence suggests that large-scale disasters and other events (e.g., social, political, legal or regulatory changes) can lead to significant restructuring in economies at multiple scales. Such restructuring can have negative or positive influences on those economies. Thus, economic diversity is a plausible measure of county-level economic resilience: a higher percentage of employment in different industries makes an economy more resilient to changes in market demands or impacts from disasters (USEPA 2013a). Conventional wisdom in economics suggests that diversity allows an economy to be less sensitive to fluctuations and hence promotes stability, while the theory of comparative advantage emphasizes economic specialization leads to efficient outcomes and economic growth (Wagner 2000). The investigators chose to prioritize the stability after change over growth in the assessment of *Economic Security*.

Education

Table 4.8. Detailed description of the measures used to operationalize the education indicator.

Indicator: Education			
Measure Category	**Measure**	**Operationalized Measure**	**Source of Data**
Investment in Education	expenditure	average education expenditure per student enrolled in public school (K-12)	National Center for Educational Statistics
Educational Attainment	attainment	percent of total population over 25 years of age with at least a high school diploma or equivalent	US Census Bureau
Access to Education	enrollment	proportion of total school age population enrolled in public school	US Census Bureau - Censtats

For people to gain the autonomy necessary for achievement of personal, cultural and social goals some degree of learning or education is required. Through education, people gain knowledge and learn the practices and skills required for successful performance of daily social and economic activities, although the type of learning most helpful for achievement of well-being can be context or culture specific (Doyal and Gough 1991). Basic knowledge and skillsets, such as reading (i.e., literacy), are necessary to achieve requisite degrees of autonomy in modern society (Doyal and Gough 1991). In fact, research indicates that well-being typically increases with each increment of educational advancement (Keyes 1998). Generally, educational attainment is correlated with higher levels of economic achievement at both the individual and population level (Weeks 1999). At the population level, higher educational attainment has been associated with "better labor market outcomes including higher earnings, lower poverty and lower unemployment" (USDOC 2011:17).

Doyal and Gough (1991) argued that "appropriate formal education" is a requirement for achievement of well-being and the best measures relate to access within a population to formal education (i.e., school-based curricula), such as level of educational attainment and presence or lack of culturally relevant qualifications (e.g., a diploma). Looking at the range of measures used to assess education, the Urban Institute compiled measures from a host of well-being assessments. Among the measures they documented were rates of enrollment, completion, literacy and drop-out (the former two measures at multiple educational levels from pre-school to college), along with subject area competency scores and the cost of education (de Leon and Boris 2010).

The Organization for Economic Cooperation and Development (OECD), in the multi-national assessment, used two measures of education, including "educational attainment of the adult population" and "literacy of 15-years old students" (2011). According to the OECD, these measures are useful because they evaluate the competencies that "help individuals undertake a broad range of tasks necessary to live in modern societies" (2011: 24). Assessors with the County Health Rankings initiative, operationalized education using educational attainment, specifically, high school graduation rates and percentage of the adult population with some college education. Similarly, enrollment rates, particularly at the pre-kindergarten and primary school level are also commonly used measures of education. Certainly, educational attainment is a well vetted measure of how a society is doing, in terms of socioeconomic achievement and well-being.


Higher educational attainment has been associated with increased well-being. *Credit: Microsoft.*

Building on this foundation, in the present study, *Education* is operationalized using three measures. The first two are related to attainment and enrollment, specifically: 1) the population over 25 years of age with at least a high school diploma or equivalent and 2) proportion of total school age population enrolled in public school. The third measure relates to expenditure or investment in public education, that is, average education expenditure per student enrolled in public school (K-12). This measure was chosen because public investment in education has been the "traditional means of encouraging education" (United Kingdom Statistics Authority 2012: 3). Additionally, public investment in education has been associated with improvements in well-being among some segments of the population, particularly those at lower income levels (Smeeding et al. 1993).

Environmental Condition

Table 4.9. Detailed description of the measures used to operationalize the environmental condition indicator.

Indicator: Environmental Condition			
Measure Category	**Measure**	**Operationalized Measure**	**Source of Data**
Air Quality	unhealthy levels of air pollutants	person days that the ozone level was above the regulatory standard	Environmental Protection Agency (EPA) and the Center for Disease Control (CDC)
		person days that particulate matter was above the regulatory standard	
Coastal Condition	water quality	Water Quality Index	National Coastal Condition Reports I-IV (NCCR)
	presence of contaminants in sediment	Sediment Quality Index	
Land Cover/Land Change	land cover type	percent developed land cover	NOAA's Coastal Change Analysis Program (C-CAP)

Environmental condition is a comprehensive term that takes into account the quality of air, water, land and entire ecosystems. Various aspects of environmental condition are monitored in order to detect changes in the environment over time. Monitoring and analysis of environmental condition data may show changes in the environment due to policy or management actions, restoration activities, natural disasters or increased development, analysis of which can help inform planning and decision making (UNESCO 2003; Doren et al. 2009). Frequently, researchers and policy-makers investigate relationships between environmental condition and human well-being. For example, Poudyal et al. (2009) found that proximity to natural resource amenities (e.g., percent forest cover, mild climate and proximity to outdoor recreation areas) had a positive effect on human life expectancy. The condition of the environment in and around communities influences human health and well-being, due to the intricate links between ecosystems and the ecosystem services that positively contribute to human quality of life (WHOQOL 2005).

Clean air is vital to the health of living organisms. For this study two air quality measures were used to help evaluate environmental condition. *Credit: Microsoft.*

Indicators of environmental condition are often classified in a manner that accommodates the goals of researchers, who may wish to monitor and communicate distinct aspects of environmental condition on local, national and global scales. For example, the state of California assembled individual indicators for air quality, water quality, human health and ecosystem health, among others, to look retrospectively at trends in data over time (OEHHA 2007). Environmental indicators may also be used to compare measures in different geographies, such as counties, cities or countries. The Local Indicators for Excellence (L.I.F.E.) project in Fond du Lac County, Wisconsin examined trends in air quality, wind power, soil erosion, watershed quality and municipal water quality on both local and regional levels (2013). Other assessments of environmental condition are global in nature and may be focused on monitoring different types of ecosystems.

The *Environmental Condition* indicator was operationalized using measures that: a) could give a comprehensive view of the state of the environment in coastal counties; b) could be potentially related to other aspects of community well-being; and c) possessed complete datasets for the counties of interest during the time points of the analysis. Ultimately, the measures that were chosen to describe the *Environmental Condition* indicator were: person days that the ozone level was above the regulatory standard, person days that particulate matter was above the regulatory standard (air quality), water quality and sediment quality (coastal condition), and percent developed land cover (land cover/land change). These measures are representative of air quality, coastal condition and land cover/ land change, which together create a comprehensive indicator of *Environmental Condition* for the study region.

Clean air is vital to the health of living organisms. Decreased air quality has been attributed to fossil fuel consumption, forest fires, agricultural waste burning and other biomass burning activities (Akimoto 2003). Air pollution may cause asthma, eye irritation and other respiratory diseases in people that live in areas prone to high levels of pollutants (OEHHA 2007). At a global level, air pollution causes changes in climate forces and may negatively affect agricultural systems and natural ecosystems (Akimoto 2003). Air pollutants include ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide and particulate matter. The Environmental Protection Agency (EPA) and the Center for Disease Control (CDC) formed a partnership in part to monitor, model and predict levels of ozone and particulate matter in communities across the U.S. (CDC 2012). After careful study, the EPA and CDC found that air pollution modeled predictions are very similar to actual monitoring data in areas where the two can be compared. Two air quality measures that contribute to the *Environmental Condition* indicator for this study are reported by the EPA/CDC partnership: person days that the ozone level was above the regulatory standard and person days that particulate matter was above the regulatory standard. These measures provide information about how many days per year people and other organisms in a given area may be exposed to unhealthy levels of ozone and particulate matter.

Coastal condition, for this study, includes the ecological and environmental condition of coastal areas. Coastal areas are some of the most ecologically diverse and productive areas in the world, and they support a large percentage of the human population (UNEP 2006). Coastal areas provide shoreline protection against storms, food and recreational areas for people, nursery areas for marine and estuarine species, and habitat for wildlife, among other services (USEPA 2012). The National Coastal Assessment Program (NCA) measures and monitors coastal condition in the U.S. by compiling multiple datasets into indices that characterize water quality, sediment quality, benthic diversity, coastal habitat change and fish tissue contaminants (USEPA 2013b). For coastal regions of the U.S., these indices are ranked from “poor” to “good” on a five-point scale, and the values are reported in the National Coastal Condition Reports I-IV (NCCR). For this study, the water quality and sediment quality indices from the National Coastal Assessment Program were included in the *Environmental Condition* indicator. As a result of the regional focus on the NCCR, data for the water and sediment quality indices proved to have the best coverage for the sample counties, whereas the indices for benthic quality and fish tissue contaminants were lacking. The water and sediment quality indices were also conceptually appropriate for the purpose of assessing county level environmental condition as it relates to human well-being.

The NCCR's Water Quality Index (WQI) consists of an amalgam of five component indicators: dissolved inorganic nitrogen (DIN), dissolved inorganic phosphorus (DIP), Chlorophyll a concentrations, water clarity from turbidity measurements and dissolved oxygen conditions (DO); high values for each of these parameters would indicate a lower WQI score. The Sediment Quality Index (SQI) consists of three component indicators: sediment toxicity, sediment contaminants and sediment TOC (total organic carbon) concentrations; high values for each of these parameters also indicate a lower SQI score. Poor water quality and poor sediment quality may be indicative of problems that lead to diminished human health, such as the presence of pathogens from sewage overflows (Ferguson et al. 1996). Low scores on these indicators may also reflect harm being done to marine and coastal ecosystems through high nitrogen loading from urban and agricultural land uses, which in turn affect the health and economic well-being of humans that depend on healthy marine and coastal ecosystems (Dauer 2000).

In addition to urban and agricultural land uses, other land cover types may be indicative of the environmental condition of a coastal area. Developed land, particularly impervious cover, can be used as a proxy for detrimental changes in living resources and the chemical/physical systems of coastal areas by pollution (Holland et al. 2004). In contrast to the negative ecological value that developed urban and agricultural areas often contribute to marine and coastal environments, wetlands provide many services, such as protection from storm surge, nitrogen removal and nursery habitat for marine life. Thus, a decrease in wetland cover area may lead to a decline in the quality of coastal and marine environments (Corn and Copeland 2010). The final measure included in the *Environmental Condition* indicator for this study is percent developed land cover, in which a high percentage of developed land refers to a lower environmental condition score. NOAA's Coastal Change Analysis Program (C-CAP) is a national standard database of land cover and land change information for the coastal regions of the U.S. (NOAA 2012). C-CAP products provide inventories of a range of land cover types, including developed area, area of water, wetlands and terrestrial/vegetated ecosystems, with the goal of monitoring change every five years (NOAA 2012).

CHAPTER 5: RESULTS

The purpose of this section is to highlight potential applications of the composite indicators of well-being and environmental condition that were developed for the Gulf of Mexico. To do so, a variety of results are presented as examples of the utility of the indicators for conducting a broad range of analyses and empirical investigations. An overview of the following is provided: utility of descriptive statistics for contextualization, the usefulness and interpretation of indicator scores for comparisons within a region and over time, the value of deconstructing indicators to better understand the meaning of indicator scores, and the potential value of further analyzing the relationships between indicators, measures and environmental condition variables. By exploring examples of the results through narrative and graphic displays, the investigators wish to highlight the range of possible analyses and products that arise from the underlying method developed through the course of this project.

The inclusion of the Environmental Condition indicator advances understanding about how communities fare in relation to the ecosystems upon which they depend. *Credit: Microsoft.*

5.1 DESCRIPTIVE STATISTICS FOR STUDY COUNTIES

Before discussing the results of the indicator analysis, it will be useful to provide some descriptive information on the study counties. In addition to the measures included in the indicators of well-being, county data on demographic and physical characteristics were also collected and analyzed. The thirty-seven counties selected for this study varied greatly in terms of demographic characteristics, including population size, racial composition, and percent of people in poverty. This variation translated into interesting patterns when it came to measuring indicators of well-being and environmental condition, as will be discussed in the subsequent sections.

Perhaps the most important county feature that was taken into account in the development of well-being indicators and controlled for in all analyses was population. For population size, the range is dramatic with the smallest county, in terms of population, comprised of less than 10,000 residents and the largest county comprised of over 400,000 residents. In general, over 75% of the sample counties had populations under 200,000 people, and approximately one-third of the counties had fewer than 50,000 people. Between Times 1 and 2, six counties experienced more than a 15% increase in their population, a growth trend which continued for these counties in the next period, albeit at a smaller rate. Between Times 2 and 3, four counties experienced more than a 25% decrease in their population, including Orleans Parish, Louisiana which experienced the loss of more than one-third of its residents following Hurricane Katrina (Appendix B, Tables 1-3).

When assessing the racial diversity of the sample, Jefferson Parish, Louisiana, Galveston County, Texas, and Jefferson County, Texas were some of the most racially diverse counties with large populations of both Black and Hispanic residents. Santa Rosa County, Florida, Cameron Parish, Louisiana, and Hancock County, Mississippi were some of the least racially diverse counties with a consistently small minority population of 11% or less. Approximately half of the study counties had more than 20% Black residents, while only three counties had populations that were less than 60% White. In Time 3, six counties had populations of more than 15% Hispanic. This represented a change from Time 1 when only four counties had Hispanic populations of this size.

Turning to poverty, the average percent of people of all ages in poverty for the sample counties was roughly between 15% and 16% for all time points. Alternately, the U.S. average poverty rate for 2008 was 13.2% (DeNavas-Walt et al. 2009). Sample counties with the highest percentage of people in poverty shifted between time points, but Orleans Parish, Louisiana was consistently in the top five most impoverished counties. Washington Parish and Jasper Parish, both in Louisiana, also had high poverty rates when compared to the other sample counties. Two Florida counties, Okaloosa and Santa Rosa, consistently had some of the lowest poverty rates among sample counties. When further analyzing county well-being, it was critical to take into account the nuanced relationship of the general well-being of a county in relation to the population that is the least well off. Monitoring the percentage of the population in poverty and related measures of deprivation can provide researchers important information about which counties are expected to have lower scores for particular well-being indicators. If these scores do not follow expectation, more in depth investigation may be required to assess whether there is great disparity within the county population.

5.2 DESCRIPTIVE STATISTICS FOR INDICATORS

As presented in Chapter 3, indicator scores were calculated by summing the normalized component values for a given indicator at each time point. For example, the *Access to Social Services* indicator is a sum of normalized values for "Human service organizations per 1,000 people", "Percent of people in poverty receiving SNAP benefits", "Hospital beds per 1,000 people", "Physicians per 1,000 people", and "Percent of all households with no vehicle". Indicator scores are presented as percentages with 100% being the highest possible score. It is important to note that indicator scores represent values in relation to the sample and cannot be interpreted as independent measures outside of this context. Hence, if County X has a score of 75% for *Access to Social Services*, it should be interpreted as follows: In relation to the sample, County X scored a 75% for *Access to Social Services*.

Once indicators scores were calculated for each of the 37 sample counties, descriptive statistics were compiled to compare the central tendency and distribution of the indicator scores across the sample counties at each of the three time points. Using the percent scores, the sample mean, minimum, maximum and standard deviation are presented for each of the composite indicators at all three time points and can be found in Appendix B, Table 13. The sample mean provides a way of interpreting the score of the individual counties in relation to the sample by making comparisons to the average possible. The indicator scores at +/-1 and +/-2 standard deviations are presented below in Tables 5.1-5.3. *Governance*, *Environmental Condition* and *Safety* consistently had higher standard deviations from the mean when compared to the other indicators, indicating great variation between counties on these indicators. On average, counties consistently scored higher on *Environmental Condition*, compared to indicators of well-being.

Table 5.1. Time 1 (2000-01) deviation from the mean for well-being and environmental condition indicators.

Indicators	Mean	Std. Deviation	Std. Deviations from Mean +/-1, +/-2			
	Statistic	Statistic	SD +1	SD -1	SD +2	SD -2
Access to services	44.93	10.61	55.54	34.32	66.15	23.71
Basic Needs	52.25	12.02	64.27	40.23	76.29	28.21
Economic Security	47.21	11.68	58.89	35.52	70.57	23.84
Education	39.05	10.31	49.36	28.74	59.67	18.43
Governance	22.70	29.17	51.87	-6.47	81.04	-35.64
Health	62.97	9.81	72.78	53.16	82.59	43.35
Safety	70.43	13.04	83.47	57.39	96.51	44.35
Social Connectedness	44.20	9.10	53.30	35.10	62.40	26.00
Environmental Condition	79.84	13.20	93.05	66.64	106.25	53.44

Table 5.2. Time 2 (2004-05) deviation from the mean for well-being and environmental condition indicators.

Indicators	Mean	Std. Deviation	Std. Deviations from Mean +/-1, +/-2			
	Statistic	Statistic	SD +1	SD -1	SD +2	SD -2
Access to services	43.41	10.22	53.63	33.20	63.85	22.98
Basic Needs	47.93	10.38	58.31	37.55	68.69	27.18
Economic Security	47.31	11.81	59.12	35.50	70.92	23.70
Education	36.11	12.16	48.27	23.95	60.43	11.79
Governance	27.39	30.40	57.78	-3.01	88.18	-33.41
Health	65.42	10.32	75.73	55.10	86.05	44.78
Safety	64.85	12.60	77.45	52.25	90.05	39.65
Social Connectedness	45.68	10.82	56.50	34.85	67.32	24.03
Environmental Condition	73.81	12.87	86.68	60.94	99.55	48.07

Table 5.3. Time 3 (2008-09) deviation from the mean for well-being and environmental condition indicators.

Indicators	Mean	Std. Deviation	Std. Deviations from Mean +/-1, +/-2			
	Statistic	Statistic	SD +1	SD -1	SD +2	SD -2
Access to services	42.38	9.48	51.86	32.90	61.34	23.42
Basic Needs	52.90	8.77	61.66	44.13	70.43	35.36
Economic Security	44.08	11.74	55.82	32.34	67.56	20.60
Education	36.92	12.85	49.77	24.08	62.62	11.23
Governance	31.08	33.14	64.22	-2.06	97.36	-35.20
Health	63.43	10.03	73.47	53.40	83.50	43.37
Safety	70.24	13.79	84.02	56.45	97.81	42.66
Social Connectedness	62.87	12.86	75.73	50.01	88.59	37.15
Environmental Condition	73.81	12.87	86.68	60.94	99.55	48.07

5.3. COMPARING ACROSS GEOGRAPHIES

In order to compare across geographies, meaning counties, a selection of indicator score results are presented as percentages, rankings and quintile rankings. These scores are presented in a variety of ways in order to highlight different ways of summarizing the similarities and differences between counties. The indicator scores for all counties and all time points can be viewed in full in Appendix B, Tables 4-6. Indicator rankings and quintile rankings are available in Appendix B, Tables 7-12.

There are several general patterns that were detected with the indicator scores. For example, *Access to Social Services* was highest for counties that encompassed a metropolitan area. These higher values result from a larger population requiring the services as well as greater infrastructure, tax base and economic activity in most cases. Another pattern that became evident in the evaluation of indicator scores was the presence of high values for *Social Connectedness* in counties with some combination of relatively low values for the other indicators of well-being. This finding may suggest that *Social Connectedness* is emphasized and invested in by counties that have identified weaknesses in other areas like *Economic Security* and *Safety*. Additional investigation could uncover the underlying mechanisms that are operating in counties scoring high on select indicators and low on others. Bar graphs depicting the indicator scores by county, organized in descending order, for the latest time point (2008-09) are also contained within Appendix B, Figures 29-37. Examples of these bar graphs are presented in Figures 5.1 and 5.2 for *Safety* and *Social Connectedness*.

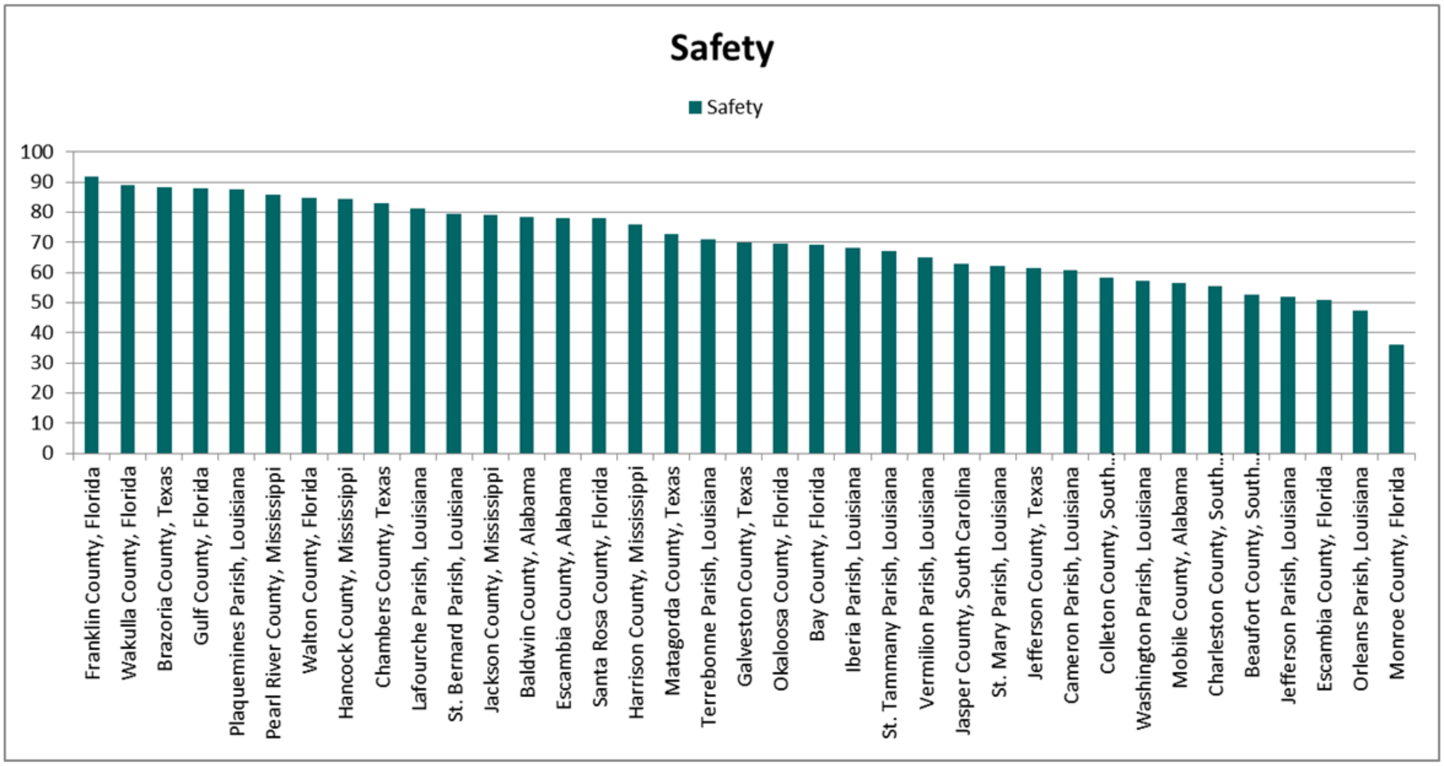

Figure 5.1. County scores for safety indicator, Time 3.

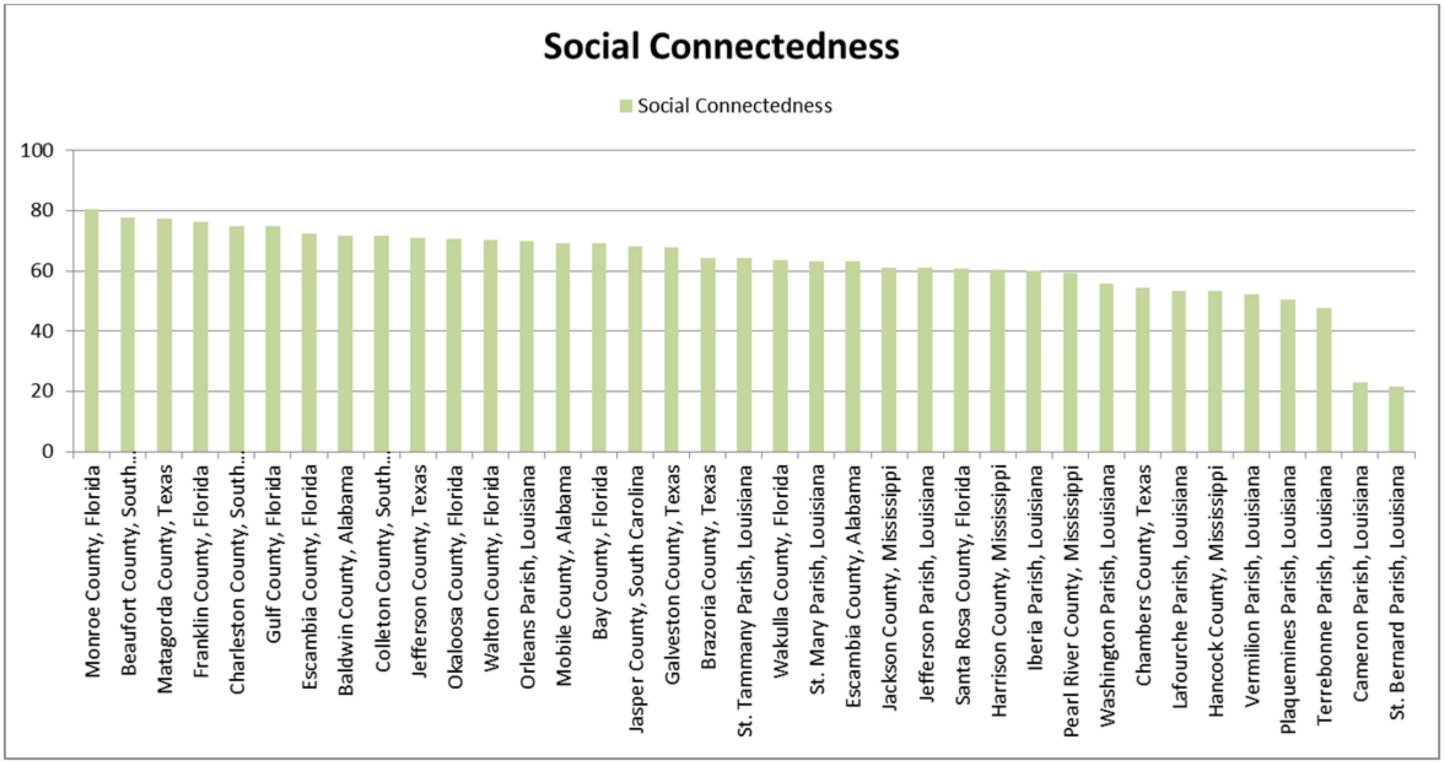

Figure 5.2. County scores for social connectedness indicator, Time 3.

Counties Compared to Sample Mean

Radar graphs are used to graphically display the indicator scores for a county alongside the average scores for the sample. For example, Figure 5.3 displays indicator scores for Bay County, Florida, at Time 1, as well as the average scores for the sample for the same time point. The average scores are presented as the sample mean. Radar graphs are ideal for well-being indicator scores because they present values in relation to a center point and are best used when categories are not directly comparable. While the well-being indicators contribute to a complete picture of well-being, the project investigators did not assume that the ideal level of well-being is composed of equal parts of each indicator. Instead, it is very likely that some indicators are more important than others when assessing total well-being. As a result, direct comparison of the indicator scores to each other, (e.g., comparing *Basic Needs* to *Safety*) was not the intention of the results. Instead, the focus of the results for the indicators was the relative position of each county in relation to the sample.

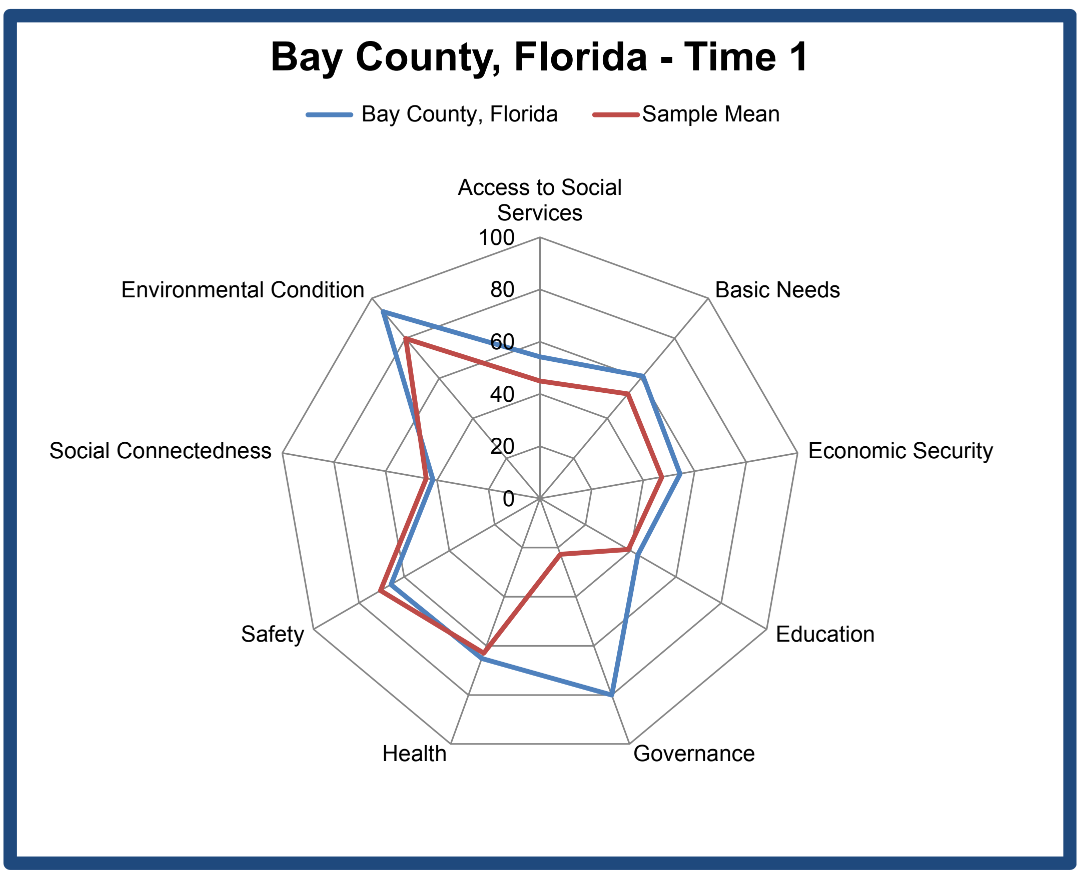

Figure 5.3. Radar graph for Bay County, Florida.

As previously stated, the sample mean was included because it provided a way of interpreting the individual county scores in relation to the sample by making possible comparisons to the average. To interpret this graph, the reader should first take note of the areas where the sample mean (red line) and county score (blue line) match and where they are separated by some distance. The lines almost directly overlap for *Health, Safety*, and *Social Connectedness*, whereas there is a larger gap between scores for *Environmental Condition, Access to Social Service, Basic Needs, Economic Security* and *Education*. The most striking distance is between the average score for *Governance* (just above 20%) and the score for Bay County (approximately 80%). Bay County scores just below average on *Safety* and *Social Connectedness*.

The next radar graph (Figure 5.4) displays the indicator scores for Terrebonne Parish, Louisiana at Time 3, as well as the sample mean for Time 3. Similarly, by assessing where the sample mean (red line) and county score (orange line) match and where they are separated by some distance provides a sense of the performance of Terrebonne Parish in relation to the other counties included in the sample. Terrebonne Parish scores higher than the sample mean on *Access to Social Services*, *Economic Security*, *Governance*, and *Environmental Condition* and lower on *Basic Needs* and *Education*.

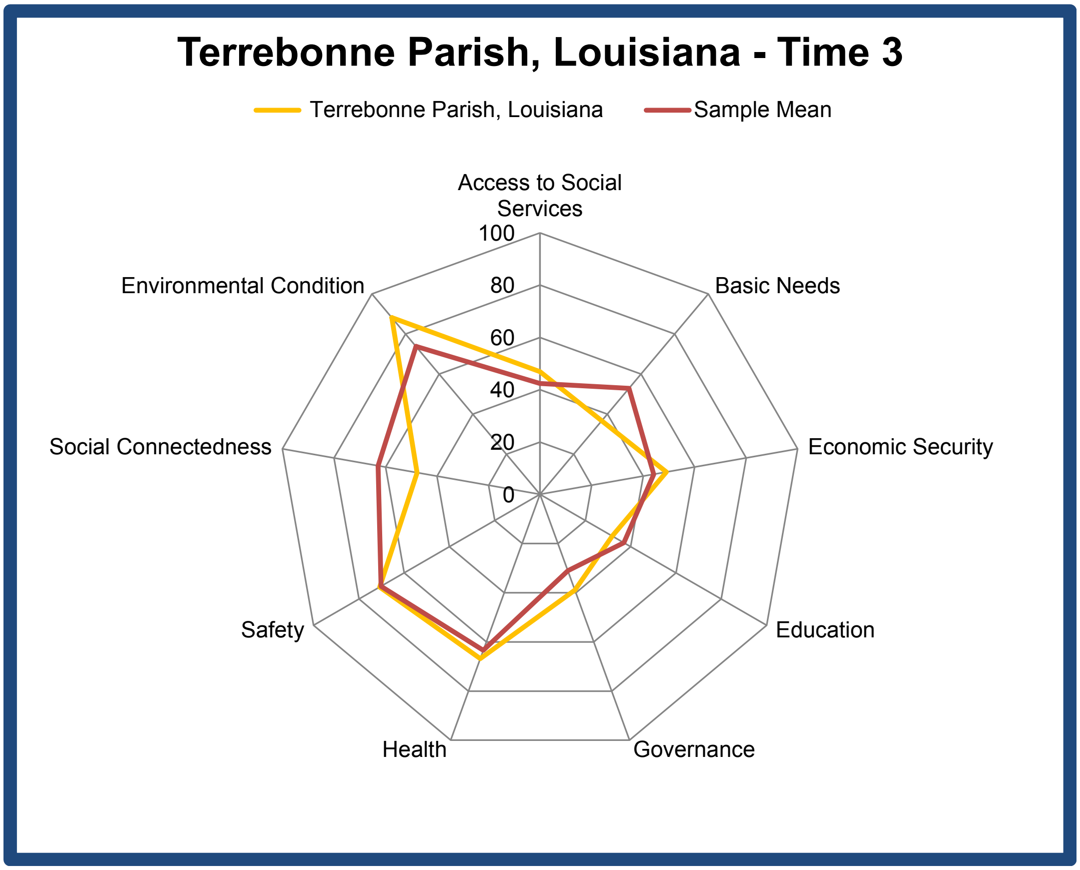

Figure 5.4. Radar graph for Terrebonne Parish, Louisiana.

Once again, the lines are nearly overlapping with *Health* and *Safety*, while with *Social Connectedness* there is a greater gap with the sample outperforming the county with an average score above 60%. There is also a large distance between the sample mean and Terrebonne Parish for *Basic Needs*. The sample mean and county score are nearly 20% apart with the sample mean as the higher score.

County Profiles

As a variation of the radar graphs presented above, county well-being and *Environmental Condition* scores can be presented alongside county demographic information for a more complete profile (see Figure 5.5). Such profiles may be useful for county managers who need contextually relevant information organized in a single space. By including the sample averages for both indicator scores and the demographic information, the regional average can serve as a direct point of comparison for the county data.

County Rankings

To effectively compare indicator scores between sample counties, scores were transformed into rankings (Appendix B, Tables 7-9). Rankings ranged from 1 to 37, with a ranking of 1 representing the county with the highest score among the sample and a ranking of 37 representing the lowest score. Counties that received a low ranking for one indicator may have received a high ranking for another. This variability across the different components of well-being represents one of the reasons for maintaining distinct indicators of well-being as opposed to combining them into a single measure. For example, while Okaloosa County, Florida was ranked 1st for *Economic Security* at Time 2, it was also ranked 25th for *Education* at the same time point.

There was some variation among county rankings between time points with some counties demonstrating clear improvement and others experiencing a decline in select indicators of well-being. Generally, Louisiana parishes, Vermillion and Orleans, received relatively poor rankings across the indicators for all time points. In contrast, Florida counties, Santa Rosa, Franklin and Okaloosa, received relatively good rankings across the indicators for all time points. For the *Environmental Condition* indicator, several Florida counties rank in the top, while the poorest ranked counties were distributed across the states of Louisiana, Alabama and Texas. At the time of publication of this report, the data needed to calculate indicator ranking scores for *Environmental Condition* at Time 3 were not available, so the scores and rankings are carried over from Time 2.

A selection of the rankings for *Safety* and *Environmental Condition* is presented in Table 5.4 to illustrate the rankings and to compare the top and bottom ranked counties for these particular indicators. For both indicators, Gulf County, Florida ranked in the top five, whereas Mobile County, Alabama in the bottom ten. Within the sample, it was not uncommon for counties to rank poorly in one indicator and well in another,

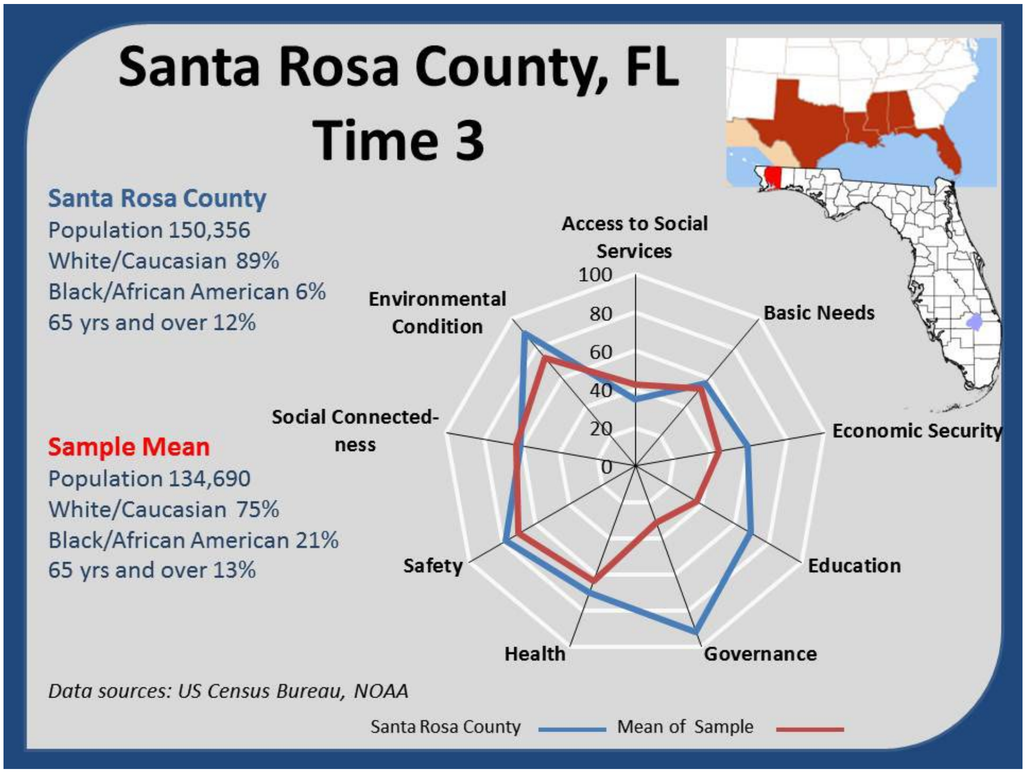

Figure 5.5. County profile for Santa Rosa, Florida.

Table 5.4. Select ranking of counties by safety and environmental condition composite indicators, Time 3 (2008-09).

County/Parish	Safety	County/Parish	Environ. Condition
Franklin County, Florida	1	Gulf County, Florida	1
Wakulla County, Florida	2	Franklin County, Florida	2
Brazoria County, Texas	3	Walton County, Florida	3
Gulf County, Florida	4	Santa Rosa County, Florida	4
Plaquemines Parish, Louisiana	5	Terrebonne Parish, Louisiana	5
Pearl River County, Mississippi	6	Jasper County, South Carolina	6
Walton County, Florida	7	Cameron Parish, Louisiana	7
Hancock County, Mississippi	8	Colleton County, South Carolina	8
Chambers County, Texas	9	Wakulla County, Florida	9
Lafourche Parish, Louisiana	10	Matagorda County, Texas	10
Cameron Parish, Louisiana	28	Escambia County, Florida	28
Colleton County, South Carolina	29	Iberia Parish, Louisiana	29
Washington Parish, Louisiana	30	Harrison County, Mississippi	30
Mobile County, Alabama	31	Vermilion Parish, Louisiana	31
Charleston County, South Carolina	32	Galveston County, Texas	32
Beaufort County, South Carolina	33	Charleston County, South Carolina	33
Jefferson Parish, Louisiana	34	St. Mary Parish, Louisiana	34
Escambia County, Florida	35	Brazoria County, Texas	35
Orleans Parish, Louisiana	36	Mobile County, Alabama	36
Monroe County, Florida	37	Jefferson Parish, Louisiana	37

which is best exemplified by Cameron Parish, Louisiana. Cameron Parish ranked in the bottom ten for *Safety* and in the top ten for *Environmental Condition*.

County Quintiles

Alongside rankings, investigators also computed quintile rankings for the counties in the sample. Quintiles allowed the counties to be grouped according to their performance on indicators of well-being and *Environmental Condition* at each time point. The benefit of quintiles is most easily demonstrated by its simplicity for the purposes of presentation. However, quintiles may also be useful for identifying larger patterns within the data because they eliminate the degree of variation and group according to common characteristics, in this case, indicator scores. In Figure 5.6, the bar graph displays data for all indicators for a small selection of counties within a single time point. In this figure, for each county in Alabama that was included in the sample, the reader can examine the quintile for each indicator of well-being and for *Environmental Condition*. Comparisons can be made across the counties based on the height of the bar (or the quintile rank). For example, Escambia and Baldwin Counties have the same quintile rank of 4 for *Access to Social Services*, but they differ on all other indicators. Overall, Mobile County performs better across more indicators, when compared to the other Alabama counties. Baldwin has a low quintile rank on the most indicators, therefore performing least well. Comparisons between counties may be valuable for determining paths for improvement in counties that are lower performing, for serving as an aid in determining which counties need investments and in what aspect of well-being, and for understanding the distribution of potential vulnerabilities, whether social or environmental.

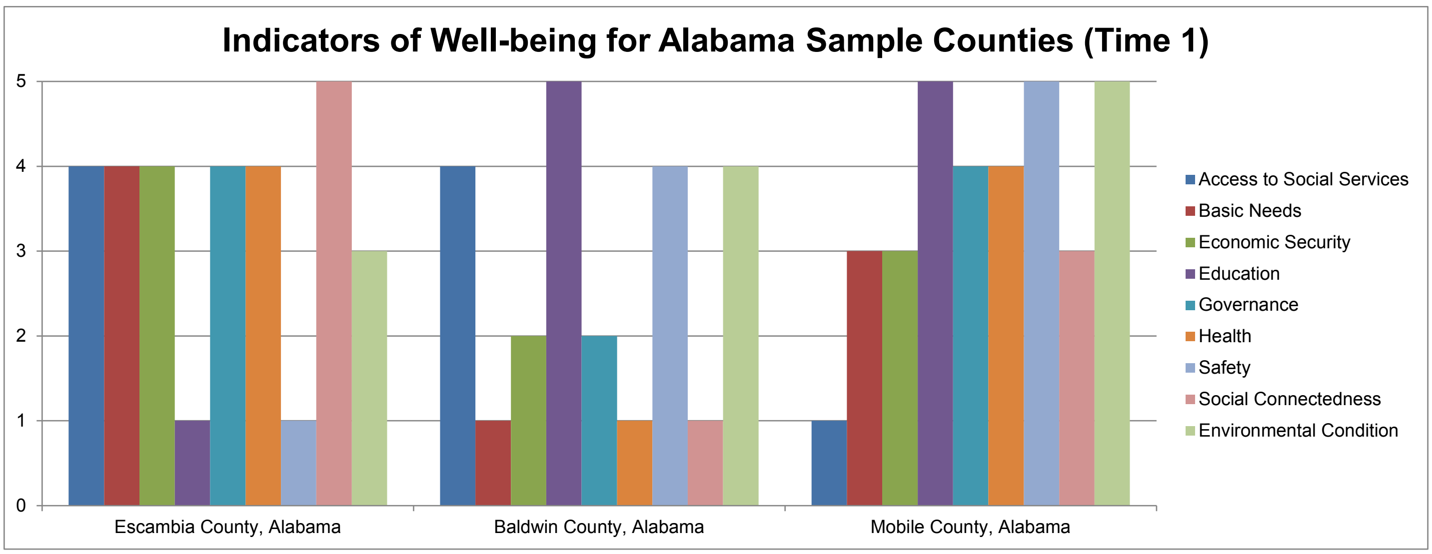

Figure 5.6. Indicators of well-being, quintile scores.

5.4. COMPARING ACROSS TIME: ASSESSING CHANGES IN WELL-BEING OVER TIME

To highlight differences in a county's well-being and environmental conditions over time, the change in the indicator rankings was calculated between Times 1 and 2, as well as Times 2 and 3 (Appendix B, Tables 17-18). Time 1 represents data from the years 2000-01, Time 2 includes data from the years 2004-05 and Time 3 includes 2008-09 data. This calculation highlighted dramatic changes in the indicators from one time point to the next and demonstrated which counties and indicators showed stability across the study period. While stable indicators are associated with greater predictive power, the project investigators also recognized that responsive indicators that move with major changes in society (e.g., implementation of a new policy, major economic decline, etc.) and the environment are also powerful. Select results of particular note or interest are discussed below. The reader should note that this discussion does not represent a full summary of the baseline data or results for change over time for all study counties. Rather, the purpose of this section is to provide a quick overview of some of the key findings and offer examples so that data featured in the Appendices can be examined more closely.

For *Access to Social Services*, Gulf County, Florida experienced a negative change of 19 points between Time 1 and Time 2, indicating a great decrease in rank compared to other sample counties (Figure 5.7). The largest positive increase in ranking for the *Access to Social Services* indicator was for Baldwin County, Alabama, which experienced a positive change of 7 points from Time 2 to Time 3 (Figure 5.8). St. Tammany Parish, Louisiana, on the other hand, had the greatest fall in ranking for *Basic Needs* with a 24 point change between Time 1 and Time 2 (see Table 17, Appendix B). However, the same parish experienced a positive change in *Basic Needs* between Times 2 and 3, moving from last place in the sample to 18th, such that the county returned to a ranking much closer to its Time 1 ranking (see Table 18, Appendix B). These three examples illustrate the variability of the underlying data and the potentially dramatic shifts that can occur between time periods.

Plaquemines Parish and St. Tammany Parish, both in Louisiana, experienced decreases in the *Economic Security* ranking between all three time points. Meanwhile, Beaufort County, South Carolina and Colleton County South Carolina improved in their rankings relative to other counties for *Economic Security* (see Tables 17-18, Appendix B). The South Carolina counties also tended to have less variation across all indicators over time relative to many Louisiana parishes. Mobile County, Alabama (see Table 17, Appendix B) and Harrison County, Mississippi (Figure 5.9) both experienced a large gain in ranking on *Governance* between Time 1 and 2. However, with so few measures included in this indicator *Governance* rankings may be more susceptible to volatility because of increased sensitivity to change in either measure.

One final point to highlight is the large change in the *Health* indicator ranking for Plaquemines Parish between Times 2 and 3 (Figure 5.10). Plaquemines Parish's ranking improved by 30 points among the sample counties. The improvement in *Health* may be related to population changes following the many severe storm events

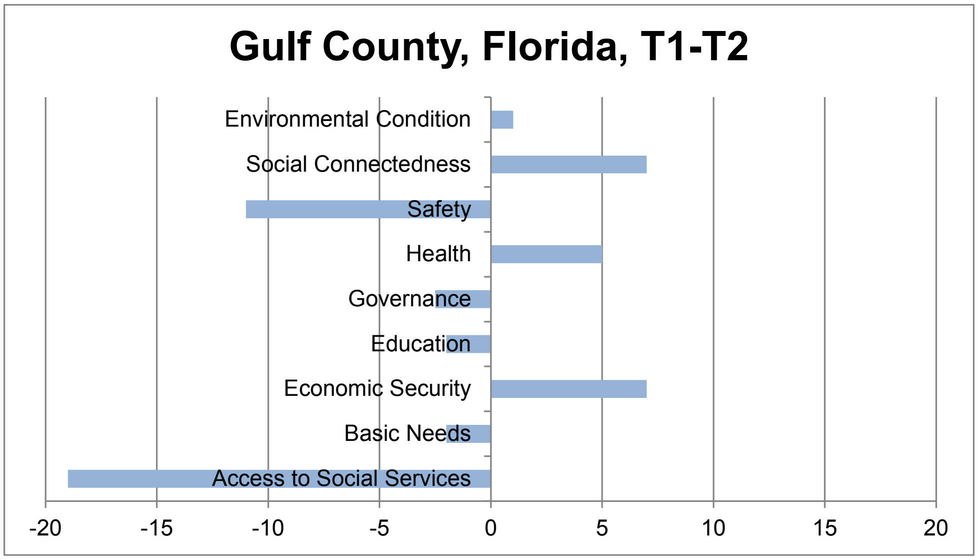

Figure 5.7. Changes in indicators of well-being in Gulf County, Time 1 to Time 2.

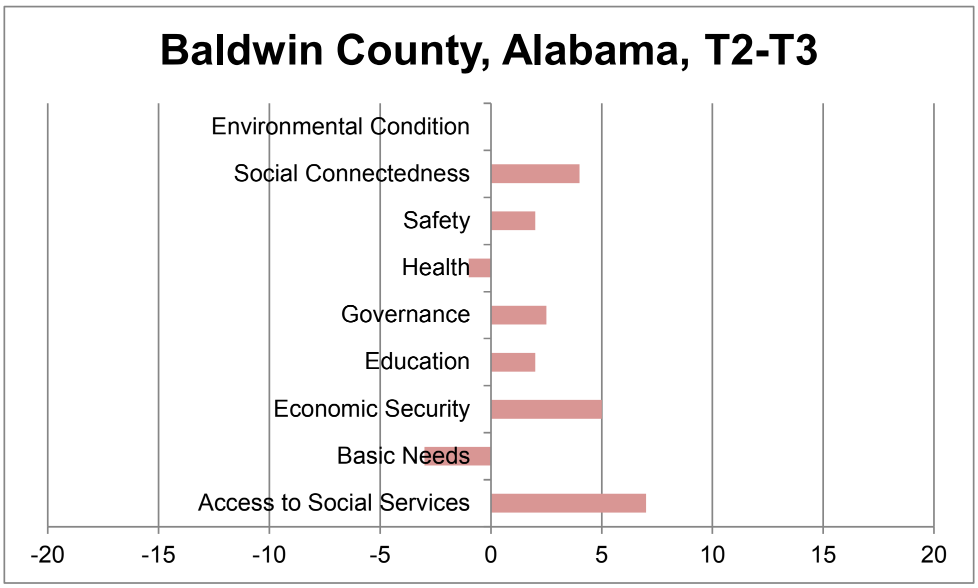

Figure 5.8. Changes in indicators of well-being in Baldwin County, Time 2 to Time 3.

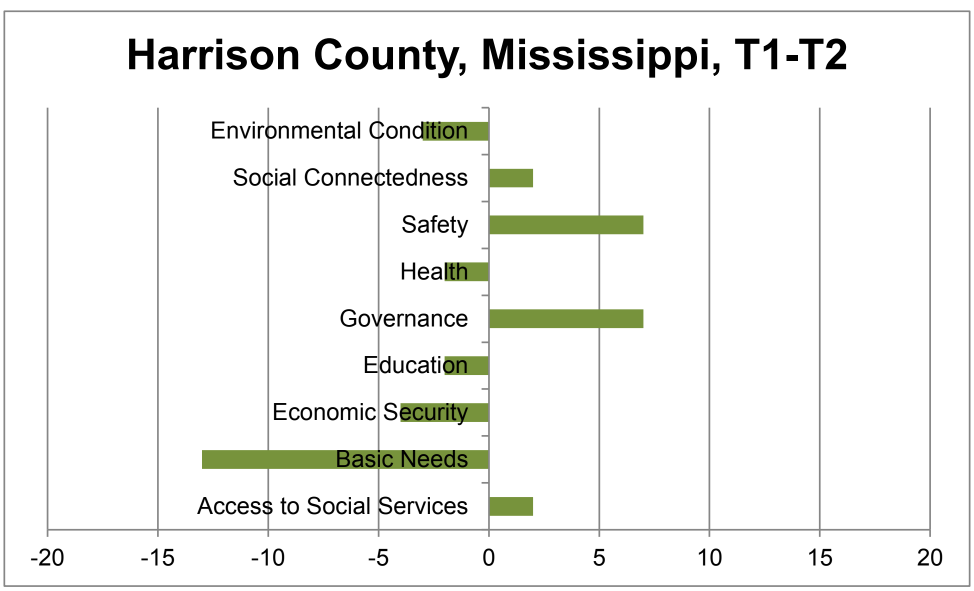

Figure 5.9. Changes in indicators of well-being in Harrison County, Time 1 to Time 2.

in Time 2, as well as investment in social services immediately following the disasters.

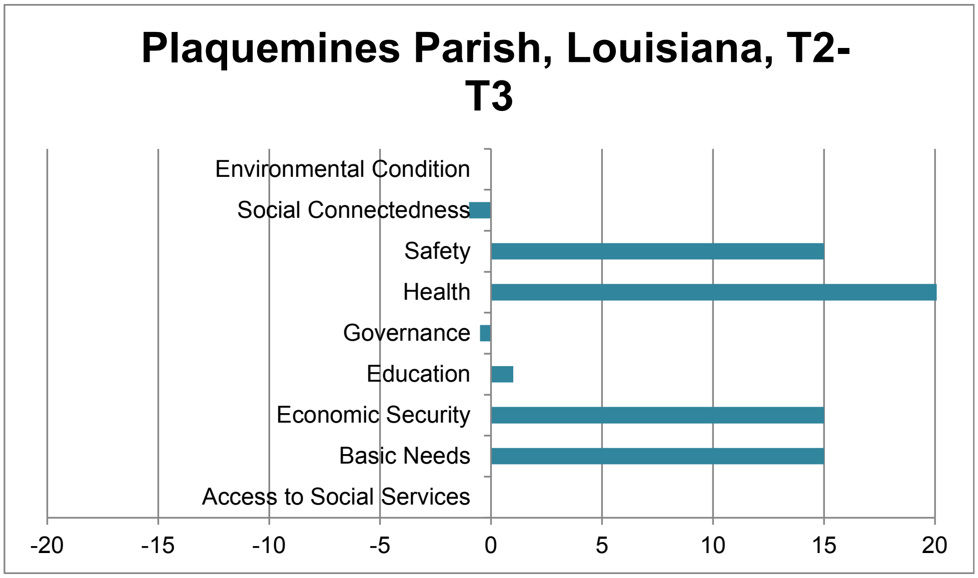

Figure 5.10. Changes in indicators of well-being in Plaquemines Parish, Time 2 to Time 3.

Finally, between Times 1 and 2, there was a change of great magnitude in the rankings for *Environmental Condition* among several of the sample counties. Bay County, Florida plummeted 20 points from a Time 1 ranking of 4 to a ranking of 24. Okaloosa County, Florida also decreased in ranking score by 18 points, going from a well ranked 3 to 21 between the two time points. Finally, Charleston County, South Carolina also lowered in rank with a loss of 18 points for *Environmental Condition*. Significant increases in *Environmental Condition* scores between Times 1 and 2 were noted for Santa Rosa County, Florida, Orleans Parish, Louisiana, and Jefferson County, Texas. Due to the use of Time 2 values as a placeholder for Time 3, change scores were not calculated for the latter period. Figure 5.11 depicts several of the largest changes in ranking for *Environmental Condition*. The bars that fall below 0 indicate a decline in *Environmental Condition*, while the bars above 0 represent a positive gain, relative to the sample.

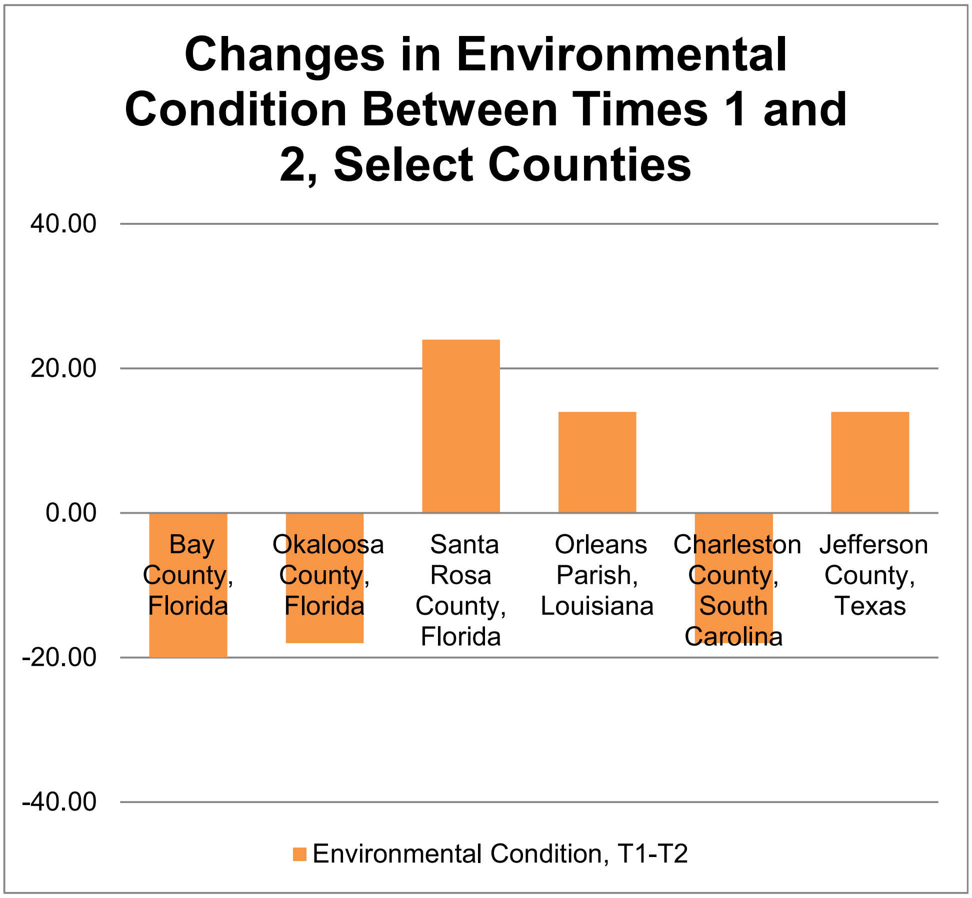

Figure 5.11. Changes in the environmental condition for selected counties.

Comparisons across time are important for tracking changes in social and environmental conditions which allow researchers to predict future outcomes in relation to particular disturbances or events. That said, in addition to examining changes over time and differences between counties as distinct, the investigators also chose to make a comparison across both geography and time. Using a series of maps for each indicator, comparisons can be made between sample counties and across Times 1, 2 and 3. Each map displays a single well-being indicator and the quintile rankings for the sample counties at each time point. The color scale is always presented with the darkest of the gradient being the counties in the lowest scoring quintile, while the lightest represents the highest scoring. An example for *Access to Social Services* is presented in Figure 5.12, while the complete series of maps can be found in Appendix B, Figures 38-46.

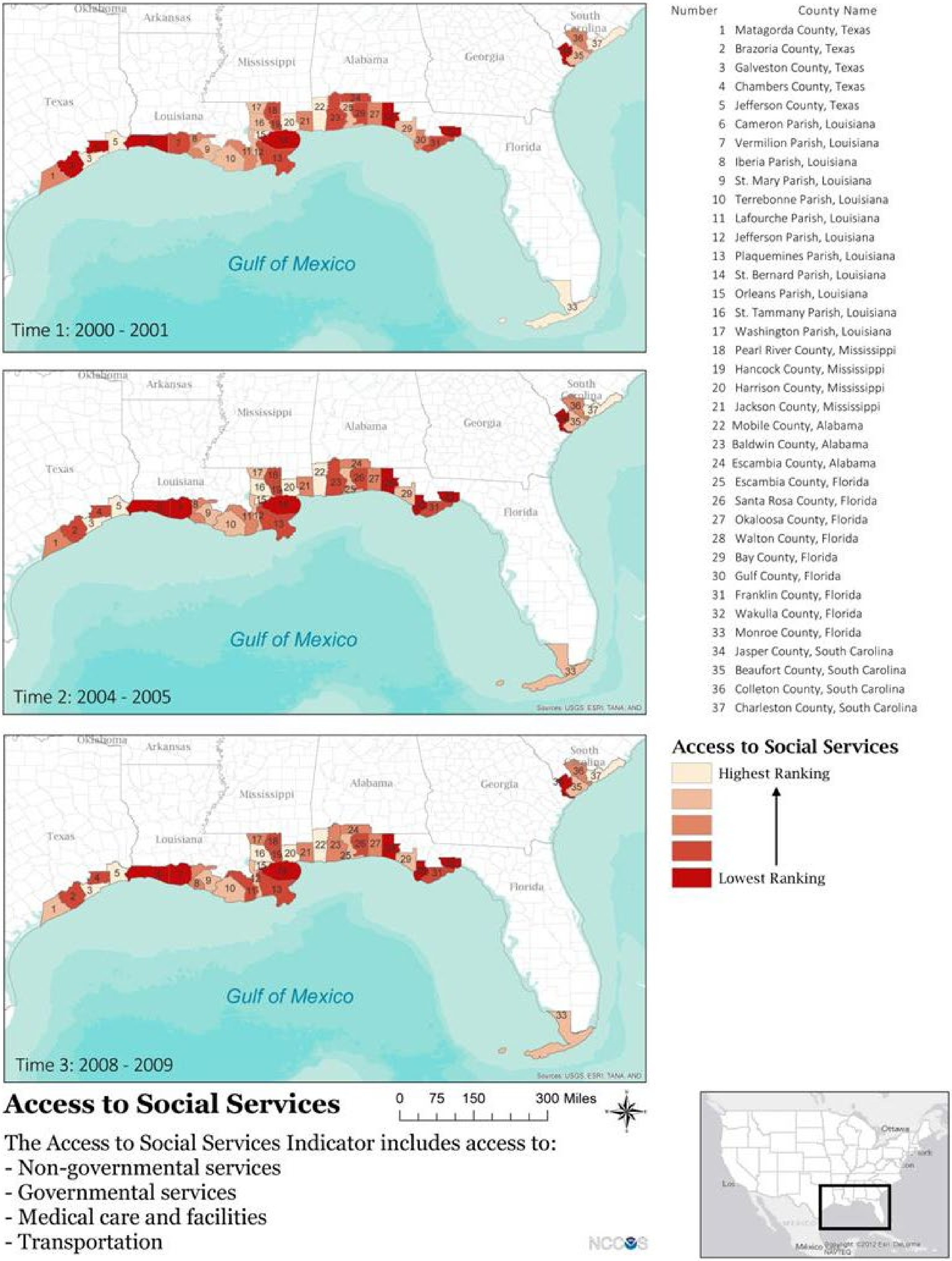

Figure 5.12. Comparing across geography and time.

5.5. DECONSTRUCTING INDICATORS

As described in Chapter 3, to help the researchers and others understand what the composite indicator scores mean on the ground, it is necessary to deconstruct the indicators to examine the actual values for the individual component measures for a selection of counties at each time point. In other words, looking at the underlying values of the measures that make up an indicator for a given county is helpful for communicating and understanding the relative meaning of both indicator scores and rankings. Thus, these values are presented in the original units, prior to being normalized across the sample counties. Using rankings, investigators selected the top three and bottom three performing counties for each indicator at each time point and worked through a process of deconstructing each indicator score to examine its components.

In Appendix B (Figures 2-28), investigators present the top ranking (high scoring) or bottom ranking (low scoring) counties and their values for each measure of the indicator in a series of figures. The tables provided in the figures present examples of measure values for counties that ranked high or low for each composite indicator. Along with these descriptions, a doughnut graphic portrays the score for the indicator at the time point specified. Again, it is important to note that the indicator scores have been determined in relation to the sample. In the text below, examples of the deconstructed indicators are presented for *Basic Needs* and *Economic Security*.

For instance, in Time 1 a county that scores best for *Basic Needs*, such as Monroe County or Franklin County, Florida has a value profile like the following:

- Ninety-nine homes out of every 100 get their water from a public supply.
- There are 7 healthy food outlets per 10,000 people.
- All of the homes will have complete plumbing.
- Less than 0.5% of homes have an incomplete kitchen.
- The median value of home is $241,200.
- Those homes will have an average of 2.23 rooms per person in an average sized household.
- There are 1.67 houses available per average household.
- The median age of the home is about 15 years or the median year they were built is 1986.
- Values like those presented correspond to a high score, relative to the sample, of approximately 79% of the 100% possible for *Basic Needs*.

In contrast, a county that ranks low in *Basic Needs*, such as Washington Parish, Louisiana or Matagorda County, Texas might have these characteristics:

- Fifty-nine homes out of every hundred have public water.
- There are 3 healthy food outlets per 10,000 people.
- Two homes out of 100 lack complete plumbing.
- Over 4% of homes will have incomplete kitchens.
- The median home value will be $ 54,200.
- Those homes will have an average of 1.78 rooms per person in an average sized household.
- There are 1.06 total homes available per household.
- The median age of the home is about 29 years or the median year they were built is 1972.
- Values like those presented correspond to a low score, relative to the sample, of approximately 30% for *Basic Needs*.

In another example for Time 3, Plaquemines Parish, Louisiana, Santa Rosa County, Florida and Brazoria County, Texas had the highest *Economic Security* scores. Using these counties as a guide, a similar high ranking county may have these characteristics:

- The federal government spends $55,465.84 per 1,000 people.
- Local government revenues are $4,213,333.68 per 1,000 people.
- The median household income is $63,959.
- Nearly 13% of people under the age of 18 live in poverty.
- The gross domestic product (GDP, 2000 value) is $7,503,886,446.
- There is a 4.3 % civilian unemployment rate

- The score for economic diversity is 0.10 (where 0 represents the greatest diversity)
- Overall, a high scoring county with values like those above would have earned an approximate score of 60 out of the 100% possible for *Economic Security*.

In contrast, low scoring counties such as Washington Parish, Louisiana and Escambia County, Alabama would have an *Economic Security* profile similar to the one below:

- The federal government spends $7382.02 per 1,000 people.
- Local government revenues are $1,675,849.94 per 1,000 people.
- The median household income is $30,725.
- Over 34% percent of people under the age of 18 live in poverty.
- The gross domestic product (GDP, 2000 value) is $449,038,653.
- The civilian unemployment rate is 8.3%
- The score for economic diversity is 0.48 (where 0 represents the greatest diversity).
- Overall, a low scoring county with values like those above would have earned an approximate score of 23% for *Economic Security*.

As discussed previously, assessors of well-being are often interested in comparing well-being across populations. As this was a goal for the present research, the deconstruction of the indicators for the aforementioned counties helps the user of the data to contextualize the meaning of these comparisons. The deconstruction also aids in understanding the meaning of the composite indicator scores in real world units such as dollars and households.

5.6. RELATIONSHIP BETWEEN WELL-BEING AND ENVIRONMENTAL CONDITION

In this section, the results of a series of three analyses are presented. The analyses explored relationships between the indicators of well-being and *Environmental Condition* through correlations, bivariate and multivariate regressions. The analyses presented below demonstrate, most importantly, that there are relationships between select indicators of well-being and *Environmental Condition*. The results also demonstrate that there are relationships between component measures of indicators of well-being and *Environmental Condition*. Finally, the discussion and highlighted results represent the potential for the well-being indicators and their component measures to be used for a number of analytic investigations related to linkages between communities and the environment.

Correlation Matrices

One of the goals of the study was to investigate the relationship between people and the ecosystems upon which they depend using the derived indicators. Thus, correlations were run between well-being indicators and the *Environmental Condition* indicator for the three time points. This analysis was completed to look more closely at the relationship between the well-being indicators and the changing status of ecosystems, and how this relationship might be changing over time.

For example, significant negative correlations were identified between *Access to Social Services* and *Environmental Condition* for all three time points, though there was some range in strength and significance level. This means that an increase in the score for *Access to Social Services* is correlated with a decrease in the score for *Environmental Condition*. These results suggest a more complex relationship between these two indicators. As a result, this association was further explored through regression analyses presented in the next section.

At Time 1, there was also a positive correlation between *Governance* and *Environmental Condition*. At Time 2, there were three weak, positive correlations between *Environmental Condition* and the well-being indicators: 1) *Basic Needs* (.357); 2) *Education* (.340); and 3) *Governance* (.349). *Economic Security* (-.354), *Education* (.368) and *Safety* (.403) indicators also weakly correlated with the *Environmental Condition* score at Time 3. An example of the summarized results of the correlation analysis is presented below for Time 3 (Table 5.5). The correlation matrices, organized by time point, are presented in Appendix B, Tables 14-16. The correlations indicated a variety of linkages between indicators that were further explored in the bivariate and multivariate regression analyses.

Table 5.5. Correlation matrix for composite indicators of well-being and environmental condition for Time 3 (2008-09).

	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connectedness	Environmental Condition
Access to Social Services	Gray								
Basic Needs	Gray	Gray							
Economic Security	Gray	Gray	Gray						
Education	Red	Gray	Gray	Gray					
Governance	Gray	Green	Gray	Gray	Gray				
Health	Gray	Gray	Green	Gray	Green	Gray			
Safety	Red	Gray	Gray	Green	Gray	Gray	Gray		
Social Connectedness	Red	Gray	Gray	Gray	Red	Gray	Gray	Gray	
Environmental Condition	Red	Gray	Red	Green	Gray	Gray	Green	Gray	Gray

Notes: Red=negative correlation; Green=positive correlation; Gray=no significant correlation.

Correlations between the indicators of well-being were also of interest for the investigators. For example, *Social Connectedness* was found to be positively correlated to *Governance* across all time points, though at varying significance levels (see Appendix B, Tables 14-16). However, these correlations are not discussed in favor of a focus on the interplay between well-being and environment.

Bivariate Regression Results

To further unpack the relationship between the indicators of well-being and status of ecosystems, as operationalized by *Environmental Condition*, bivariate regression analyses were run between well-being indicators and the *Environmental Condition* indicator for the T1 to T2 scores and then for the T2 to T3 scores. In each model, the dependent variable is always drawn from the latter time point so as to take into account the time lag effect. For example, if *Environmental Condition* is predicting *Health* (dependent variable), the investigators used the *Environmental Condition* indicator value from Time 1 and the *Health* indicator value from Time 2. This way, changes in *Environmental Condition* in Time 1 are being used to predict any effect on *Health* in Time 2.

More specifically, the purpose of the regression analyses was to determine patterns of relationships between indicators of well-being and *Environmental Condition*, as well as between component measures of the indicators and *Environmental Condition*. By first examining correlations between the indicators developed for this project, the investigators had some basis for expectation of certain relationships. However, the statistical test allowed the investigators to determine the significance, direction and strength of the relationship. Further analyses may help establish causal effects.

Because the direction of the theorized relationship between indicators of well-being and *Environmental Condition* was not always the same, regression analyses were conducted in the direction that best corresponded with theory and that met the necessary conditions for causation. One set of well-being indicators and their components were examined as independent variables, with *Environmental Condition* serving as the dependent variable (Figure 5.13).

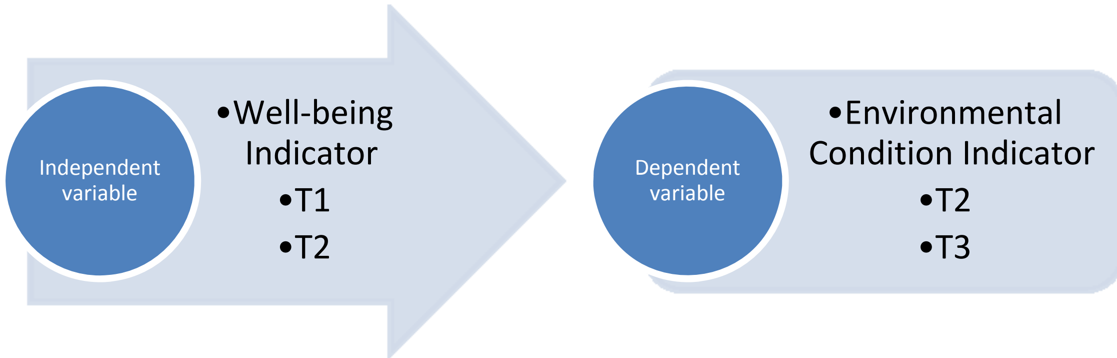

Figure 5.13. Testing effects of indicators of well-being on environmental condition.

The other set was examined as the dependent variable, with *Environmental Condition* serving as the independent variable (Figure 5.14).

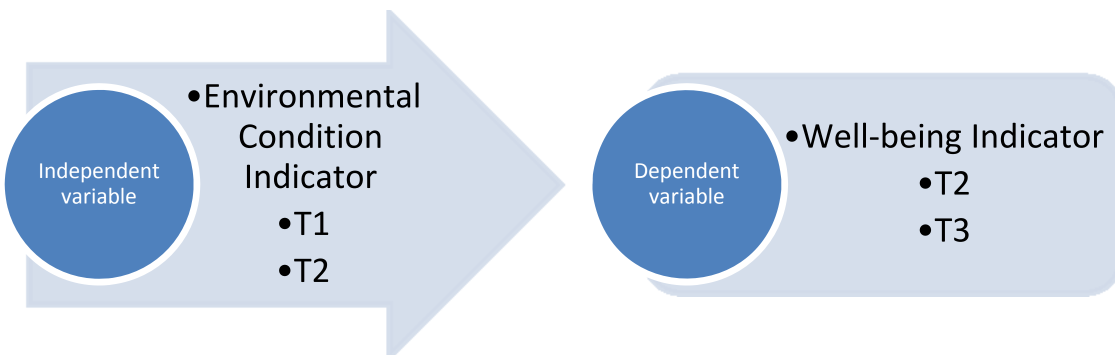

Figure 5.14. Testing effects of environmental condition on well-being.

Finally, with some well-being indicators, where causal direction was unclear and could be supported more than one way by theory, both directions were tested. Some highlights from these results are described in the following three sections and the results of these analyses are presented in Tables 5.6 and 5.7 below.

Well-being Indicators as the Dependent Variables

The indicators *Health, Basic Needs, Social Connectedness* and *Safety* were tested with *Environmental Condition* as the independent variable (IV). Here, investigators were interested in whether the condition of the environment in a county or parish had an effect on the status of the indicators of well-being, like the health of the population or its safety. Of these relationships, *Environmental Condition* had significant relationships with the *Basic Needs* indicator for one of the time series tested (Table 5.6). *Environmental Condition* was positively associated with *Basic Needs* for T1 to T2 ($p \leq 0.05$), meaning that in sample counties with a high score for *Environmental Condition*, more basic needs are being addressed. Relationships between *Environmental Condition* and other indicators were not significant at the indicator level.

Within the indicators of well-being, *Environmental Condition* had a variety of significant relationships with individual measures of *Basic Needs, Health, Social Connectedness* and *Safety*. Increases in *Environmental Condition* were associated with several measures of improved housing, including housing availability, space per person, and age of housing in at least one of the time periods tested. However, only the median age of housing was positively impacted by *Environmental Condition* in both time periods tested ($p \leq 0.001$ T1 to T2 and $p \leq 0.05$, T2 to T3). Counties and parishes with a higher *Environmental Condition* score were associated with more adequate housing, a crucial component of basic needs for the population.

Table 5.6. Bivariate regression analyses, environmental condition as the independent variable.

Dependent Variables	Unstandardized Coefficients			
	B	*Std. Error*	*Sig*	*Adj. r square*
Basic Needs Indicator (T2)*	0.256	0.126	0.050	0.080
Significant Components				
Housing units per average household (T2)*	0.004	0.002	0.104	0.047
Average ratio of rooms to people in housing units (T2)*	0.005	0.002	0.021	0.120
Median year structure built (T2)*	0.340	0.083	0.000	0.304
Housing units per average household (T3)**	0.008	0.002	0.003	0.204
Median year structure built (T3)**	0.230	0.103	0.032	0.100
Health				
Significant Components				
Male life expectancy (T2)*	0.043	0.025	0.100	0.049
Births per 1,000 population 2000 (T3)**	-0.076	0.026	0.006	0.173

Independent variables:
*Environmental Condition Indicator T1 percent score
**Environmental Condition Indicator T2 percent score

Environmental Condition had a significant, negative relationship with the *Health* component measure, birth rate for T2 to T3 (p≤0.01), such that counties with a lower *Environmental Condition* in T2 are associated with a higher birth rate in T3. This relationship is somewhat contradictory to the expectations of the investigators, for as *Environmental Condition* improves, birth rates decrease. As birth rate was used as a positive measure of well-being, this finding warrants further investigation. Though the relationship is weaker, higher *Environmental Condition* for T1 was also associated with an increase in male life expectancy for T2 (p≤0.1). Among measures used for the *Social Connectedness* indicator, an increase in *Environmental Condition* in T1 and T2 was related to higher distribution of religious organizations and a lower rate of charitable contributions in T2 and T3, respectively. As *Environmental Condition* increased in T2, overall *Safety* increased in T3; and specifically, increasing *Environmental Condition* was associated with a decrease in the rate of property crime in T3.

In conclusion, many of the indicators of well-being and their components performed as expected in the bivariate regression analysis with *Environmental Condition* as the independent variable. The direction of the significant relationships noted above coincides with literature reviews and expected relationships described in Chapter 4 above, Justification of Measures. For example, based on the results of previous research, one would expect that counties with high scores for *Environmental Condition* would be higher performing in other areas of well-being. This was proven true for sample counties in this study in positive relationships between *Environmental Condition* and the *Basic Needs* and *Safety* indicators. Other significant relationships were revealed between *Environmental Condition* and individual measures of many of the indicators that follow the expected pattern of high *Environmental Condition* leading to improvements in measures of well-being. The only discrepancy is the relationship between low *Environmental Condition* scores and high birth rates.

Environmental Condition as the Dependent Variable

The following relationships were tested with *Environmental Condition* as the dependent variable (DV): *Access to Social Services*, *Economic Security*, *Governance*, *Education*, *Social Connectedness* and *Safety* (Table 5.7). In this case, investigators were examining whether indicators of well-being were related to a change in *Environmental Condition* for the next time point. Of these indicators, *Access to Social Services* (p≤0.001) and *Education* (p≤0.01) had significant relationships with *Environmental Condition* in both T1 to T2 and T2 to T3, while *Governance* was related in T1 to T2 (p≤0.05).

Among the sample counties, an increase in a county's score for *Governance* in T1 was associated with an increase in the score for *Environmental Condition* in T2. Furthermore, the more years a county had been operating under a comprehensive plan, the better *Environmental Condition* was in both time points. Comprehensive planning is intended to balance the needs of development with the protection of environmental resources. Likewise, proactive management and planning efforts are intended to improve the condition of the environment and maintain the provision of ecosystem services. Hence, these relationships are both expected and highly desirable because they provide evidence of the efficacy of comprehensive plans and proactive management efforts. Within *Safety*, exposure to tropical storms and hurricanes is related to higher scores for *Environmental Condition*, although exposure to property crime in T1 is related to lower scores for *Environmental Condition* in T2.

Education was associated with positive gains in *Environmental Condition* for both time periods tested. The measure for access to education, particularly, was related such that a higher proportion of school age population enrolled in public school was associated with better *Environmental Condition*. Within Social Connectedness, the measure for access to churches and spiritual organizations was positively related to *Environmental Condition*, while the measure for charitable contributions had a negative relationship. The connection between *Environmental Condition* and access to education and religion may be partially aided by both education and religious institutions serving as spaces in public

Table 5.6. Bivariate regression analyses, environmental condition as the dependent variable.

Dependent Variables	**Unstandardized Coefficients**			
	B	***Std. Error***	***Sig***	***Adj. r square***
Access to Social Services Indicator (T1)*	-0.488	0.188	0.014	0.138
Access to Social Services Indicator (T2)**	-0.669	0.180	0.001	0.262
Significant Components				
Hospital beds per 1,000 people (T1)*	-2.366	1.039	0.029	0.104
Physicians per 1,000 people (T1)*	-1.669	0.559	0.005	0.180
Hospital beds per 1,000 people (T2)**	-2.825	1.026	0.009	0.155
Physicians per 1,000 people (T2)**	-1.907	0.588	0.003	0.209
Economic Security Indicator				
Significant Components				
Gross domestic product in 2000 values, all industries (T1)*	-1.55E-09	0.000	0.000	0.306
Local government general revenues per 1,000 (T1)*	8.76E-06	0.000	0.037	0.093
Economic diversity of employment, National Index Method (T1)*	14.338	5.095	0.008	0.161
Gross domestic product in 2000 values, all industries (T2)**	-2.00E-09	0.000	0.000	0.373
Local government general revenues per 1,000 (T2)**	5.87E-06	0.000	0.029	0.104
Economic diversity of employment, National Index Method (T2)**	13.319	5.585	0.023	0.115
Education Indicator (T1)*	0.546	0.190	0.007	0.168
Education Indicator (T2)**	0.360	0.168	0.039	0.091
Significant Components				
Proportion of school age population enrolled in public school (T1)*	48.336	23.088	0.044	0.086
Proportion of school age population enrolled in public school (T2)**	37.886	21.542	0.087	0.055
Governance Indicator (T1)*	0.143	0.071	0.051	0.079
Significant Components				
Years since comprehensive plan was adopted (T1)*	1.650	0.484	0.002	0.228
Years since comprehensive plan was adopted (T2)**	0.949	0.330	0.007	0.168
Safety Indicator (T1)*	0.432	0.166	0.013	0.138
Significant Components				
Total event count for tropical storms and hurricanes (T1)*	6.617	3.455	0.064	0.069
Property crime rate, incidents known to police per 1000 people (T1)*	-0.259	0.116	0.033	0.099
Social Connectedness Indicator				
Significant Components				
Religious organizations per 1,000 people (T1)*	21.220	8.089	0.013	0.140
Proportion of total itemized tax returns reporting charitable contributions (T1)*	-136.327	44.723	0.004	0.187
Religious organizations per 1,000 people (T2)**	14.467	6.468	0.032	0.100
Proportion of total itemized tax returns reporting charitable contributions (T2)**	-123.976	49.293	0.017	0.129

Dependent variables:
*Environmental Condition Indicator T2 percent score
**Environmental Condition Indicator T3 percent score

life where an environmental ethic may be acquired (Drew 2011), much as individuals learn to be good citizens through civil society.

Select components of *Economic Security* were significantly related to *Environmental Condition*, including Gross Domestic Product (GDP), local government revenues and economic diversity. While increasing GDP is associated with worsening *Environmental Condition*, higher local government revenues and economic diversity of employment are associated with higher scores for *Environmental Condition*. The relationships between measures of *Economic Security* and *Environmental Condition* indicate a combination of economic forces at work. First, the regression results indicate that GDP for the county, which is the measure of economic growth from industry, appears to be in conflict with *Environmental Condition* in that an increase in GDP at one time point is associated with a decrease in *Environmental Condition* at the next time point. However, greater local revenues and corresponding investment along with diversity of employment sectors appear to be supportive of *Environmental Condition*.

Like GDP, *Access to Social Services* was negatively associated with gains in *Environmental Condition* for both time periods tested. This relationship was maintained by all the components of the *Access to Social Services* indicator. Therefore, increased *Access to Social Services* was linked to decreased *Environmental Condition*. The negative relationships found between *Environmental Condition* and both the indicator of *Access to Social Services* and its component measures may seem contradictory, but are easily explained. Counties with greater infrastructure and better access are also the counties with larger populations and more development, both of which are tied to increased environmental impact. Aspects of well-being and *Environmental Condition* do not always co-exist, particularly not without tradeoffs. Community well-being requires that societies adequately provide for communities and ensure that services meet the needs of the people living there. Meanwhile, *Environmental Condition* requires that societies manage the environmental impact of growing populations, increased development and expanding infrastructure demands. The need for a balanced approach is ever present so that communities do not prioritize protection of the environment over provision of services that protect health or vice versa. Communities that identify the connections and interplay of components of well-being will be better positioned to achieve this balance.

The results of the bivariate regression analyses reinforce the notion that the concept of community well-being and its interrelations are inherently complex. The presentation of results from the analyses highlights statistical evidence for the linkages between well-being and *Environmental Condition* that are supported by theory, expert opinion and prior research. The investigators strongly recommend ongoing monitoring and continued assessment of the relationships that are supported by these early efforts to analyze connections between dimensions of well-being and *Environmental Condition* within coastal communities.

Multivariate Regression Results

While the composite indicators of well-being are not best used for establishing causation (Moore et al. 2003), the indicators are useful for the demonstration of trends in communities that should matter to resource managers interested in ecosystem-based management in coastal and marine systems. Furthermore, the collection of the component measures represents a tremendous base from which a variety of specific questions can be explored in more depth, ranging from relationships between measures of health and air quality to government investment and coastal condition.

Due to the sample size, project investigators did not run multivariate regression analyses for the study sample (i.e., the sample of counties used to build the well-being indicators). However, several of the component measures used to develop the indicators were collected for all Gulf of Mexico coastal counties. This larger group of counties represented a means of further exploring the relationships uncovered in the prior analyses. In the examples presented below, a sample of Gulf of Mexico coastal counties (N=139) was used. Primary areas of focus for exploration were interrelations between environmental measures, health and economic security. In Models 1 and 2, measures of *Environmental Condition* are examined for their relationship to cancer and respiratory disease morbidity, while controlling for a variety of factors, including demographics, health insurance, and income (Tables 5.8 and 5.9).

The controls included in Model 1 include: population size, sex, the population over 65 years of age without health insurance, and income. In Model 1 (Table 5.8), cancer morbidity for Gulf of Mexico coastal counties was significantly related to the size of the total population, the number of uninsured people over 65, air quality as measured for particulate matter, developed land cover and new housing authorized by building permits. Despite the significance levels of the relationships, many of the coefficients are small. The most striking relationship was that of developed land cover to cancer morbidity. On average, every additional 10 square miles of developed land cover was associated with 35 additional cancer deaths per year for Gulf of Mexico coastal counties (p≤0.001). The overall model explained 96.8% of the variance in cancer morbidity.

Table 5.8. Multivariate regression Model 1 for health and environmental condition. Model 1 examines the relationship between environmental factors and cancer morbidity.

Independent Variables	**Unstandardized Coefficients**		**Sig.**
	B	*Std. Error*	
(Constant)	-106.026	137.454	.441
All persons under 65 years without health insurance	**-.002**	**.000**	**.000**
Median household income	.002	.001	.235
Resident total population estimate	**.002**	**.000**	**.000**
Resident population: total females, percent	.494	2.605	.850
Number of person-days with PM2.5 over NAAQS	**.000**	**.000**	**.001**
Number of person-days with maximum 8-hour average ozone concentration over NAAQS	.000	.000	.552
Developed square miles of land cover	**3.527**	**.433**	**.000**
New private housing units authorized by building permits	**-.027**	**.006**	**.000**
Adjusted R Square	.968		

Dependent Variable: Number of deaths caused by all cancers

The controls included in Model 2 include: population size, age, sex, the population over 65 years of age without health insurance and income. In Model 2 (Table 5.9), respiratory disease morbidity for Gulf of Mexico coastal counties was significantly related to the size of the total population, the number of uninsured people over 65, air quality as measured for particulate matter, developed land cover and the resident population over 65. Despite the significance levels of the relationships, the coefficients for population, uninsured population over 65 and air quality remain small. In this model, the most important relationships were that of developed land cover and age to respiratory disease morbidity. On average, every additional 10 square miles of developed land cover was associated with nearly 4.5 additional respiratory disease deaths per year for Gulf of Mexico coastal counties (p≤0.01). Also, for Gulf of Mexico coastal counties, every one percent increase in the population of residents 65 and over was associated with a corresponding increase of almost four respiratory disease deaths each year on average (p≤0.001). The overall model explained 93.7% of the variance in respiratory disease morbidity.

Table 5.9. Multivariate regression Model 2 for health and environmental condition. Model 2 examines the relationship between environmental factors and respiratory disease morbidity.

Independent Variables	**Unstandardized Coefficients**		**Sig.**
	B	*Std. Error*	
(Constant)	-44.772	47.298	.346
All persons under 65 years without health insurance	**-.001**	**.000**	**.000**
Median household income	.000	.000	.273
Resident total population estimate	**.001**	**.000**	**.000**
Resident population: total females, percent	-.605	.904	.504
Number of person-days with PM2.5 over NAAQS	**.000**	**.000**	**.000**
Number of person-days with maximum 8-hour average ozone concentration over NAAQS	.000	.000	.674
Developed square miles of land cover	**.440**	**.169**	**.010**
New private housing units authorized by building permits	-.002	.002	.369
Resident population 65 years and over, percent	**3.865**	**.634**	**.000**
Adjusted R Square	.937		

Dependent Variable: Number of deaths caused by all lower respiratory system diseases

5.7. DISCUSSION AND CONCLUSION

The results of this project represent both the application of the method development via the indicators of well-being and *Environmental Condition*, as well as the exploration of the relationships between measures of community well-being and *Environmental Condition*. Many of the results reinforce the reality – the interaction between a community and its environment is highly complex. When it comes to major environmental change and its impact on communities, the direction and nature of causation is far from clear. That being said, the research conducted for this project contributes greatly to future investigations of causal mechanisms by providing a basis for ongoing study. Through baseline data, a monitoring method and the development of metrics by which dimensions of community well-being and *Environmental Condition* can be measured, this research has advanced the capacity of NOAA to model the social and economic aspects of coastal communities alongside the environmental.

The results of this project showcase the potential of the methodological approach and the indicators of well-being that have been developed through this research. By conducting a series of distinct analyses and presenting the range of possible products and uses of the data, the investigators have highlighted the breadth of opportunity that exists within well-being measurement and modeling. The concluding chapter will take this examination a step further by projecting into the future to consider the ways in which this project can contribute to NOAA's mission.

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CHAPTER 6: INTEGRATING SOCIAL MONITORING DATA INTO NOAA PROJECTS AND PROGRAMS

6.1. REFLECTIONS ON THE PROJECT: FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

In recent years, NOAA has invested in the development of cost-effective yet methodologically robust approaches for detecting and monitoring the interdependent condition of people and ecosystems. This is because the agency desires to continually improve its understanding of the needs of the nation relative to its mission. Additionally, NOAA is interested in ascertaining its own success at meeting these evolving needs. The present research project was initiated to help move NOAA toward achievement of these goals. The investigators' embarked on this study with a vision for developing a method and analytical protocol that could be employed over the long-term to detect change in coastal counties in relation to changing ecological conditions.

Using the Gulf of Mexico as a regional case study, the research team acquired data, developed indicators and employed these indicators in order to compare the relative well-being of coastal counties and the changes in well-being over time. The team focused on the Gulf region because such a capability would allow NOAA and other agencies to better understand progress made toward recovery in communities affected by the Deepwater Horizon oil spill. More broadly, however, the investigators strove to create an approach that could be adapted to monitor how coastal communities are doing in relation to a variety of ecosystem disruptions and associated interventions, across all coastal regions in the U.S. and its Territories. In summary, the project objectives were to:

1) develop a method for measuring the status of coastal communities in relation to environmental condition, and

2) establish a baseline for monitoring changes in the well-being of residents along the Gulf of Mexico in counties impacted by coastal contamination from the Deepwater Horizon industrial disaster.

With the project concluded, the research team may now evaluate the preliminary success of the approach for assessing the status of coastal communities relative to environmental condition, its usefulness for monitoring the well-being of coastal communities, and its potential for answering other questions of interest to NOAA. This

Riverside park with shrimp boats in Apalachicola, Florida.
Credit: Theresa Goedeke.

chapter summarizes the research team's perspective on how the method worked and what might be done to continue to refine and apply it to critical management questions.

6.2. EFFICACY AND UTILITY OF THE METHOD DEVELOPED

The results summarized within this report evidence the utility of the method developed by the research team to meet both project objectives. After exploring and vetting a variety of potential measures, the investigators ultimately constructed eight composite indicators that can be used to gauge how a county is doing relative to eight dimensions of well-being. Additionally, the team created an indicator of environmental condition that can be used to understand the state of the environment in relation to the status of well-being. Together, these indicators provide a greater understanding of what is going on in these counties, socially, and how these social conditions vary in association with the status of environmental condition.

There are many strengths of the method developed as a consequence of this research. One of the major strengths of this approach is its flexibility in how one makes comparisons. Because of methodological and data-availability challenges, often social indicators are constructed to compare well-being either across geography or over time, but typically not both. In the present research, the investigators developed a method that can be used to robustly examine well-being between geographies, meaning between counties, as well for a single county over time. This flexibility is possible because of the type and amount of data included in the models, as well as the techniques used to create the composite indicators.

For all of the indicators, the interpretive statistic, meaning the well-being score, allows one to look at a county's ranking to determine how that county is doing relative to other counties for a particular dimension of well-being. The score also makes it easy for one to look at how a county's ranking has changed over time, relative to other counties in the region. As demonstrated in the results discussion, the indicators developed enabled investigators to effectively compare the well-being of counties along the Gulf of Mexico.

The decision to include longitudinal data in this study was critical because doing so enabled comparisons across time. To accomplish this task, the investigators made use of longitudinally collected data from over 50 different secondary sources. The effort to locate, procure and prepare this data was well worth the investment of time and resources, however, because this ensured the ability to describe temporal patterns of change in well-being. Moreover, with the addition of time points, investigators will begin to more clearly establish the direction and magnitude of causal relationships between the indicators, and between the indicators and their component measures. Without this approach to well-being assessment, monitoring would not be possible.

Undoubtedly, the decision to develop a method with the capability to monitor trends presented some unique challenges for the research team. Most of these challenges related to the availability of data at ideal time points. When relying on existing, secondary data, delays in the release of current data as well as the availability of data at ideal time points meant that preferred time points were not possible in practice. For example, it would have been ideal to have annual values for all measures included in the indicators. Unfortunately, this was not possible without a substantial reduction of measures for all indicators and possibly the complete elimination of some well-being dimensions. Therefore, development of a research design to assess well-being with secondary data required a great deal of flexibility and creativity, and much exploration, to find time points that could be effectively used. The investigators were ultimately successful, however, because of their diligence in pulling potential data from many datasets and tenacity in exploring all potential combinations of measures available at a wide range of time points.

To a lesser degree, availability of data also posed a challenge for identifying ideal measures to be included in some indicators, such as *Environmental Condition* and *Governance*. Certainly, work should continue to locate additional measures to augment and refine these indicators. However, generally speaking, consideration of a wide palette of measures when building the indicators allowed development of highly refined and robust composite indicators. The investigators took into account a tremendous breadth of possible measures that could be used to build the indicators. Thus, they were able to systematically narrow the selection to include only the best measures available, theoretically and statistically, as opposed to limiting that choice early in the research process.

In the view of the research team and several reviewers of the method, the use of multiple indicators, rather than a single index for well-being, is a noteworthy strength of this method as well. Having multiple indicators, as opposed to one combined index, highlights the multi-faceted nature of well-being. The eight dimensions of well-being are distinct and, consequently, one may see where the most change has occurred across them. This is useful because scholarship in this field indicates that well-being is highly complex and culturally contextual. Therefore, the nuances of well-being can be lost upon aggregation. Yet, it should be acknowledged that the use of multiple indicators could pose a challenge in terms of the communicability of results to policy-makers. Policy-makers may prefer one all-encompassing score because interpretation or application of findings could be unclear with multiple indicators. Although nuanced explanatory power would be lost, a single score may be possible with model refinement, which is discussed further below.

Finally, the inclusion of the *Environmental Condition* indicator, which corresponds to a socio-political boundary, is a unique contribution to well-being assessment and critical for advancing understanding about how communities fare in relation to the ecosystems upon which they depend. The strengths, power and potential of the method developed in this project warrant continued research and development. Specific recommendations for a path forward are provided in the section following.

6.3. NEAR-TERM: RECOMMENDED PRIORITIES FOR FUTURE WORK

To further develop the method proposed herein, the investigators recommend four distinct paths in the near-term:

1) further refine and validate the indicator models with additional empirical testing;

2) develop standards to objectively assess county-level well-being;

3) establish a monitoring program to assess the well-being of coastal counties in the Gulf of Mexico that were affected by the Deepwater Horizon oil spill that extends well-being data collection into the future with additional post-DWH time points; and

4) extend the geography of the present study to develop a baseline of well-being for all coastal counties in the U.S. and its Territories.

Undertaking the first item is critical and should be completed prior to moving the method to operations. Further refinement and validation of the models would greatly advance the utility of the method by strengthening the internal validity of the indicators, as well as more fully linking the well-being indicators to environmental condition. Methods to engage the agencies partners and stakeholders in the northern Gulf of Mexico region are necessary to validate, or "ground truth," the well-being status represented by the indictors. Further work will allow investigators to define minimum standards of well-being upon which management decisions can be founded.

The development of minimum standards to objectively assess county-level well-being is important because this step could help NOAA work toward achieving a single "well-being score," which might be compared across geographies. With a minimum standard in place, researchers would be able to clearly state whether a county has achieved, surpassed or failed to achieve a recognized minimum level of well-being. Further, the standard could be used to determine future goals for improved well-being that allows a county's progress to be measured over time. It is the well-being assessors, working in concert with policy and decision-makers at several levels of management, who identify and set meaningful standards against which well-being can be assessed within a particular context. Development of appropriate standards requires an intentional process of evaluating empirical evidence and prioritizing policy imperatives. This process is distinct from development of the indicators.

With completion of refinement and validation, the method should then be moved into operation. The most logical steps to do so are, first, to establish a monitoring program for the Gulf of Mexico to evaluate long term change and community recovery after the 2010 oil spill and, second, develop a baseline of well-being for all coastal counties. As discussed previously, adequate assessment of the well-being of coastal counties along the Gulf of Mexico in relation to the Deepwater Horizon oil spill was not possible for the present project. This was because data for recent time-points, that is, post-oil spill time points, were not yet available for most datasets, including those required for the *Environmental Condition* indicator.

However, in anticipation of this monitoring effort, the research team chose a 10 year study period that could be used to detect the long-term changes in well-being resulting from the Deepwater Horizon oil spill. Further, although a robust set of measures was used to operationalize the indicators generally, some measures were chosen because they clearly linked the indicators to the oil spill disaster, such as respiratory disease and water/sediment quality. Consequently, moving the method into operation for the purpose of monitoring the status and recovery of Gulf Coast counties from the oil spill could be readily accomplished with additional investment of resources. Continuation and extension of the case study to time points beyond the oil spill will allow NOAA to better understand the impacts of such disasters upon the communities reliant upon the Gulf of Mexico.

Finally, the investigators recommend the development of a unique, refined set of indicators that could be used by NOAA to monitor and assess the well-being of all coastal counties in the U.S. and its Territories relative to the condition of coastal and marine resources, generally. Regional environmental challenges, political landscape, economic diversity and cultural variation create very different social contexts in coastal areas. The method proposed herein was developed with transferability as a goal. Collecting similar data in different regions could illuminate systematic differences in well-being along the nation's coasts. Such an effort would be valuable because monitoring social indicators would enable resource manager and regulators to understand how coastal communities are changing. With this knowledge, government agencies would know which communities might be in need of additional attention, support or consideration.

Coastal communities are key stakeholders of the agency. They are the benefactors of many of NOAA's research and management programs, as well as the communities closest to many of the agency's regulated resources. Therefore, it would be beneficial for NOAA to develop a baseline of well-being for these counties and to implement a program to monitor the status of these communities over time. Such monitoring could be tailored by the choice of measures and time points in order to track the influence of particular NOAA products, services and regulations, as well as other activities and investments of relevance. Additionally, monitoring inland counties alongside coastline counties could be used to understand the differences between these communities.

To accomplish this type of monitoring effort some retooling of the indicators would be required. The measures would need to be refined to include meaningful items available across a wide geography. Moreover, with the development of a standard for assessing county-level well-being for all coastal counties, the second near-term priority task described above, a national scoring system may eventually be possible.

6.4. LONG-RANGE: POTENTIAL, FUTURE APPLICATIONS OF METHOD

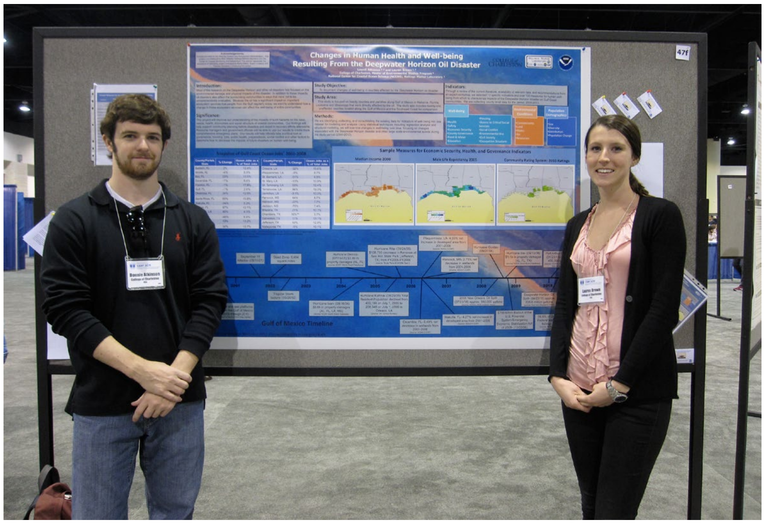
While the project team would urge investment in the near-term priorities described above, it is important to note that the method developed also holds potential for wider application to management tasks common at NOAA. Specifically, the indicators developed herein, or the method used to build these indicators, could be further developed and tailored to answer policy and management questions typically informed by forecasting, project or program evaluation, or Integrated Ecosystem Assessments. These applications, briefly described below, would be possible with a long-term commitment to model development and data collection/management.

Forecasting

A benefit of geographically broad, longitudinal studies is that they allow assessors to anticipate the future based on information from the past. In other words, the collection and analysis of historic data would enable assessors to predict how well-being will change when similar events or perturbations occur in the future. Thus, with a targeted forecasting goal identified, it would be possible to use the composite indicators used in this study, or similar indicators, to predict well-being outcomes for counties associated with particular types of events. For example, if NOAA were interested in anticipating the impact of an oil spill on the well-being of a particular county or region, this type of forecasting could be possible. Such an effort would require the identification of a clear forecasting goal, knowledge of measures that are causally connected to oil spill events (as well as the degree and direction of those relationships), availability of data at a sufficient number of time points across the focal geography and the development of robust forecasting models for each of the indicators.

Evaluation

Evaluation research is employed to measure the success of programs, policies and regulations. It is also used to assess the efficacy of programs in achieving stated goals, evaluating return on investment, etc. Social and economic indicators have regularly been used by agencies and organizations as metrics to evaluate the success of programs, policies and regulations. With development of appropriate study designs that are tailored to particular evaluation goals, the indicators created for this project, or similar indicators, could be used to evaluate programs, policies and regulations at NOAA. Effective use of these indicators for evaluation purposes would require identification of clear evaluation goals, evidence of the causal relationship between available measures and the program to be evaluated and data availability at appropriate geographies and time points to causally link change in well-being (or change in a specific indicator of well-being) to the intervention being evaluated.



Students presenting project overview at a conference in Daytona Beach. *Credit: Susan Lovelace.*

Integrated Ecosystem Assessment

NOAA has invested in the planning and execution of Integrated Ecosystem Assessments, recently starting up the Integrated Ecosystem Assessment (IEA) Program. The goal of this program is to support ecosystem based management in NOAA's five management regions of the U.S. The potential for developing one or multiple sets of well-being indicators to feed into IEAs is tremendous. Social, health and economic indicators could be used alongside physical, biological and ecological data when developing ecosystem-based models. Including communities as part of the IEAs would provide a better opportunity to understand how humans and coastal communities are integrated into large marine ecosystems.

The method and indicators developed for this project could undoubtedly be used in many more ways than have been discussed in this document, particularly with specific project scoping and directed model development. Similarly, the project team amassed volumes of secondary data, resulting in the availability of numerous variables that could be used for many different purposes and in a variety of analyses. However, the items described above offer the most promise for moving NOAA closer to its strategic goals.

6.5. OTHER PROJECT OUTCOMES

The main objectives of the project were to develop a method for measuring well-being and establish a baseline for the Gulf of Mexico. However, there were a number of informal project outcomes that are worth noting. Foremost, a number of research collaborations and professional interactions were established to further research on indicators as a community of practice. For example, investigators with the National Marine Fisheries Service who are developing indicators for use in fishing-dependent communities (Jepson and Colburn 2013) provided input into the present project and vice versa. Similarly, investigators with this team provided input to the development of the National Climate Assessment indicator framework. The opportunity to leverage intellectual resources inside and outside of NOAA helped the project team improve both methods and indicators.

In addition to expanding professional and research collaborations, the project paid for or facilitated research opportunities for a number of students who used project data, indicators or both for their own research. Graduate assistant Lauren Brown used NOAA storm event, crime and demographic data along with a set of divorce and domestic violence data to explore the relationships between social conflict and major storm events. Jason Wong, a Hollings Scholar in 2012, collected and analyzed economic data on county employment and earnings to develop several measures of economic diversity, one of which was used as a component of the economic security indicator. Graduate assistant Robert Crimian used the data and similar methods to develop comparable zip code level indicators to measure well-being in a project focused on attitudes toward restoration. Finally, graduate assistant, Lowell Atkinson used data collected to understand the ecosystem services needs of parishes in lower Louisiana. More detailed descriptions of student research projects are available in Appendix C.

6.6. SUMMARY AND CONCLUSIONS

Our coastlines and marine ecosystems are constantly in flux due to changing climate and currents, natural disasters, anthropogenic pollution and industrial disasters at different scales. Human communities are always changing in relation to ecological conditions, as well as economic, social and political pressures. Obviously, the interaction between ecosystems and communities is highly dynamic and extremely important. Unpacking the intricacies of these interdependencies is rapidly becoming a political and management imperative. In completing this case study, the investigators have begun to demonstrate the benefit of assessing these changes objectively and systematically. The research project described in this report has helped to move NOAA closer to its goals of 1) detecting and monitoring the interdependent condition of people and ecosystems and 2) improving its understanding of the needs of the nation relative to its mission.

Specifically related to the Gulf of Mexico region, continuing data collection into the future would enable investigators to assess the impacts of the Deepwater Horizon oil spill, the largest oil spill in U.S. history to date. This knowledge would allow local organizations, state agencies and NOAA to design appropriate interventions, if necessary, to help communities in this region recover. Further, long-term monitoring would help decision-makers understand changes in well-being that accompany both short and long-term changes in ecosystem condition in the Gulf of Mexico.

The complexity of the intersection of social and environmental forces is pronounced in coastal communities. In fact, because culture and economy are tied to marine resources, coastal communities are often defined by this intersection. As a result, the well-being of a coastal community is caught up in the health of its environment, the stability of its economy, the provision of services to its residents and a multitude of other factors. With this in mind, the project investigators sought to develop an approach that would enable researchers to measure these social and environmental interactions. The concept of well-being proved extremely useful for this purpose. The method and models developed provided substantial insight into the structure and significance of relationships between community well-being and environmental conditions. By developing a method that both embraces and accounts for the complexity of interactions between society and environment, the project brings the field of well-being research a step closer to modeling the reality of coastal communities. Further, this project has laid the groundwork for further investigation, providing a clear path forward for integrated monitoring of our nation's coasts. The research and monitoring capability described in this document will substantially help counties, local organizations, as well state and federal agencies that are striving to improve all facets of community well-being.

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Appendix A

Supporting Materials for Chapter 3 - Methods

Developing a database for long term monitoring of county well-being

Well-being and environmental condition data was collected from a wide variety of sources including federal, state, and local government agencies as well as non-governmental organizations and academic institutions. Each indicator of well-being is comprised of a suite of measures that are combined to form a composite indicator. The datasets and sources from which the measures were obtained are described in Appendix A, Table 1. Because each composite indicator is comprised of multiple measures, each composite indicator draws from a variety of data sources. Much of the data used in our measurement of well-being is collected at the county level by the state or federal government. The units for which the data are collected range from individuals to households to counties. The data are generally collected in annual increments, though some measures have more limited time coverage.

Data was collected from over 50 sources. The comprehensive longitudinal database developed to store and organize the data presently draws from nearly 9000 variables. The initial data collection and compilation consolidated numerous formats and sources so as to produce a single database in a SQL format with appropriate metadata documenting the original sources and any modifications. Metadata and reference material for each data collection were linked within the database. In combining data from a variety of counties, states, and sources, methodological strategies for ensuring comparability are essential. In the development of the database, the following issues were addressed: data consistency across collection methods, concepts, indices, units, and times; variations in terminology and definitions; rules for aggregation; and ways of producing calculated rates. The variables were rarely transformed prior to import into the database; instead, data transformations occur in separate software are saved within new data files so that the original data can be brought back at any time necessary.

Data were generally downloaded in a standard data file format (e.g., csv, xls, txt) and then cleaned and edited in order to prepare for entry into the database. All data file editing was completed by trained members of the project team. When necessary, single data entry with a multi-person team for data checking/cleaning was used, particularly in cases where data only available in a non-compatible file format (e.g., pdf). Data collections were updated as data become available; release times vary widely.

All data collected and compiled were evaluated for errors, and subjected to data validation procedures. Quality assurance for the secondary data compiled was tied back to the original source, though the project team contributed its own methods for ensuring the quality of the collection. Data were downloaded from original sources, along with relevant reference materials (e.g. data manuals, codebooks, and other documentation). The data were then imported into a comprehensive database where minor data cleaning and transformations occur and were recorded. The data parameters were coded to signify data source, data year, and parameter label (short description). A metadata standard was applied. Careful documentation of all data downloads and edits have been maintained in a data log, along with a clean set of original data files for reference. All data editing was restricted to the co-investigators of the project and required documentation in the data log.

The collected data are already publicly available and aggregated to the county level and are therefore not considered sensitive. However, access to the database has been restricted to data managers and project investigators for the duration of the research phase of the project. This restriction was enacted in order to protect the quality and integrity of the data.

Imputing Missing Values: The Process of Creating a Functional Dataset

For this study, missing data varied by data source, county, and time point. In most cases, the imputation procedures were applied by dataset. Each of the methods employed are described below.

General Missing Values Procedure

A major advantage of the broader time series collection becomes evident when addressing missing values (Allison 2002). For minor missing value issues that were case specific and limited to select time points, actual data from a nearby time point was used for replacement (e.g., a year to either side of the time series breakdown).

David Leip's Presidential Election Data

David Leip's Presidential Election Data for voter turnout dataset had four counties with missing values for Time 1. The approach for imputation with USGS water usage data was replicated with these data. Missing values were predicted for Time 1 by calculating the average rate of change for the sample between Time 1 and Time 2 and then computing Time 1 by reversing the equation using Time 2 values as the base, such that,

$$x^{T1} = x^{T2} - (x^{T2} \times \Delta x)$$

EPA National Coastal Condition Report Data

For the rare instance where a county had a missing value at one time point of the National Coastal Conditions Data (this applied to two cases), the average rate of change for the sample was used with the actual value for the county to estimate the missing value, such that

$$x^{T2} = (x^{T1} \times \Delta x) + x^{T1}$$

$$x^{T1} = x^{T2} - (x^{T2} \times \Delta x)$$

For the three counties that have no GoM shoreline and therefore, no coastal condition data, the state average for each time point was utilized.

State Health Departments' Vital Statistics Data

Three of the component measures for *Health*, cardiovascular disease deaths, cancer deaths, and lower respiratory disease deaths, had missing values due to data suppression, which is used by health departments to minimize the risk that an individual may be identified. Values for these variables that are between 1 and 5 were given a special code. These values were replaced with a 1, as a conservative estimate for the number of deaths attributable to each of the disease categories.

US Census Bureau, American Community Survey Data

For data from the American Community Survey (ACS), missing values were consistent across cases, though not across time (i.e., certain counties were missing data for all variables in Time 2, others in Time 3, and some counties in Times 2 and 3). In all cases where ACS data was used, there was an actual value for Time 1 originating from the 2000 Decennial Census dataset. This actual value served as the basis for the imputation procedure. To impute missing values for the ACS dataset, an estimate was developed by taking the sample mean for each time point, calculating the average rate of change for the sample between T1 and T2 as well as T1 and T3, and then using the average rate of change to calculate the missing values. The following equation was used,

$$x^{T2} = (x^{T1} \times \Delta x) + x^{T1}$$

$$x^{T3} = (x^{T1} \times \Delta x) + x^{T1}$$

These equations were used to predict the future values based on the average rate of change between time points for the sample. Where values were present for both T2 and T3 for the same variables across cases, an imputed estimate was calculated according to the impute method. The resulting figure was then compared with the actual data from ACS. This approach was designed to expose major discrepancies between the estimated values and the imputed estimates; fortunately, the estimated and actual data were closely aligned. The imputation approach employed with these data is similar to both an unconditional mean imputation and a regression imputation in that the general trends of the sample are used in concert with the existing value for the case to predict values for the next time points in the series. Of note, this method was not used to replace values for all cases across an entire time point, but to replace values for select cases.

US Geological Service Water Usage Data

For US Geological Service Water Usage Data, missing values were predicted for Time 1 by calculating the average rate of change for the sample between Time 1 and Time 2 and then computing Time 1 by reversing the equation using Time 2 values as the base, such that,

$$x^{T1} = x^{T2} - (x^{T2} \times \Delta x)$$

Environmental Condition Data

The environmental composite indicator components were only available for two time points. This was not a typical missing value issue in that the data for Time 3 had not been released for any of the three datasets used for this indicator. However, the importance of demonstrating the time series for all indicators led to the decision to treat the missing values with a simple replacement. Values from the last available time point, T2, were used as a placeholder for Time 3. Values for Time 3 will be updated as data are available.

Appendix A. Table 1 - Indicators and Measures

WELL-BEING COMPOSITE INDICATORS							
Components	**Measure Description**	**Contribution to Well-being**	**Source**	**Uniform Resource Locator (URL)**	**Time Point 1 (T1)**	**Time Point 2 (T2)**	**Time Point 3 (T3)**
Access to Social Services							
nutrition assistance	proportion of those in poverty participating in Supplemental Nutrition Assistance Program (SNAP)	positive	USDA Food & Nutrition Service	http://www.fns.usda.gov/pd/snapmain.htm	2000	2005	2008
medical facilities	hospital beds per 1000 people	positive	Area Resources File, HRSA	http://arf.hrsa.gov/	2000	2005	2007
human services	human services organizations per 1000 people	positive	National Center for Charitable Statistics	http://nccs.urban.org/NCCS-Databases-and-Tools.cfm	2000	2005	2008
medical care	physicians per 1000 people	positive	US Census Bureau - Censtats/American Medical Association	http://censtats.census.gov/usa/usa.shtml	2003	2005	2008
transportation	percentage of households without a vehicle	negative	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005-07	2008-10
Basic Needs							
housing value	median value of housing units	positive	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005-07	2008-10
housing facilities	proportion of total housing units without complete kitchen facilities	negative	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005-07	2008-10
housing facilities and waste disposal	proportion of total housing units without complete plumbing	negative	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005-07	2008-10
housing size	average rooms per person in average household	positive	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005-07	2008-10
housing availability	number of total housing units available per household	positive	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005	2008
housing age	median age of housing units	positive	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005-07	2008-10
availability of clean water	proportion of total population served by public water supply	positive	US Census Bureau - Censtats/US Geological Survey	http://water.usgs.gov/watuse/data/2005/index.html ; http://censtats.census.gov/usa/usa.shtml	2000	2005	2005 (r)
availability of healthy food	healthy food outlets per 1000 people	positive	Project Collection (original data: US Census Bureau - County Business Patterns, Censtats)	http://www.census.gov/econ/cbp/	2000	2005	2008
Economic Security							
federal government contribution to economy	federal government expenditure per 1000 people	positive	US Census Bureau - Censtats	http://censtats.census.gov/usa/usa.shtml	2000	2005	2008
economic security of local government	local government revenues per 1000 people	positive	National Center for Educational Statistics	http://nces.ed.gov/	2000-01	2005-06	2007-08
economic security of children	percent of people under 18 years of age in poverty	negative	US Census Bureau	http://censtats.census.gov/usa/usa.shtml	2000	2005	2008
economic security of household	median household income	positive	US Census Bureau	http://censtats.census.gov/usa/usa.shtml	2000	2005	2008
employment security of individuals	civilian labor force unemployment rate	negative	US Census Bureau/BEA	http://censtats.census.gov/usa/usa.shtml	2000	2005	2008
industry contribution to county	gross domestic product, total for all industries (year 2000 value)	positive	NOAA National Ocean Economics Program	http://coastalsocioeconomics.noaa.gov/download/download2.html	2000	2005	2008
economic diversity	economic diversity of employment	positive	Project Collection (original data: US Census Bureau - Censtats/BEA and NOAA National Ocean Economics Program)		2001	2005	2007
Education							
expenditure	average education expenditure per student enrolled in public school (K-12)	positive	National Center for Educational Statistics	http://nces.ed.gov/	2000-01	2004-05	2007-08
attainment	percent of total population over 25 years of age with at least a high school diploma or equivalent	positive	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005-07	2008-10

Appendix A. Table 1 - Indicators and Measures

WELL-BEING COMPOSITE INDICATORS							
Components	**Measure Description**	**Contribution to Well-being**	**Source**	**Uniform Resource Locator (URL)**	**Time Point 1 (T1)**	**Time Point 2 (T2)**	**Time Point 3 (T3)**
enrollment	proportion of total school age population enrolled in public school	positive	US Census Bureau - Censtats	http://censtats.census.gov/usa/usa.shtml	2000-01	2004-05	2007-08
Governance - Planning and Management							
county management	FEMA's Community Rating System county score	positive	Project Collection (original data: Natural Hazards Insurance Services Office and National Flood Insurance Program)		2000	2005	2008
county planning	years since comprehensive plan was adopted	positive	Project Collection		2000	2005	2008
Health							
fertility, population health/well-being	birth rate (births per 1000 people)	positive	US Census Bureau - Censtats	http://censtats.census.gov/usa/usa.shtml	2000	2005	2007
life expectancy	male life expectancy	positive	Institute for Health Metrics and Evaluation	http://ghdx.healthmetricsandevaluation.org/record/united-states-adult-life-expectancy-county-1987-2007	2000	2005	2008
life expectancy	female life expectancy	positive	Institute for Health Metrics and Evaluation	http://ghdx.healthmetricsandevaluation.org/record/united-states-adult-life-expectancy-county-1987-2007	2000	2005	2008
mortality due to chronic disease	deaths caused by major cardiovascular diseases	negative	Project Collection (original data: state health departments)		2000	2005	2008
mortality due to chronic disease	deaths caused by lower respiratory diseases	negative	Project Collection (original data: state health departments)		2000	2005	2008
mortality due to chronic disease	deaths caused by all cancers	negative	Project Collection (original data: state health departments)		2000	2005	2008
recreational opportunity	recreational facilities per 1000 people	positive	Project Collection (original data: US Census Bureau - County Business Patterns, Censtats)	http://www.census.gov/econ/cbp/	2000	2005	2008
Social Connectedness							
participation in democracy	percent turnout of registered voters in national/ presidential election	positive	US Election Atlas - David Leip Election Data	http://uselectionatlas.org/	2000	2004	2008
access to communication	percentage of households without telephone service	positive	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005-07	2008-10
social gathering places	religious organizations per 1000 people	positive	National Center for Charitable Statistics	http://nccs.urban.org/NCCS-Databases-and-Tools.cfm	2000	2004	2008
arts and culture	arts and humanities organizations per 1000 people	positive	National Center for Charitable Statistics	http://nccs.urban.org/NCCS-Databases-and-Tools.cfm	2000	2004	2008
charitable giving	proportion of itemized tax returns reporting charitable contributions	positive	National Center for Charitable Statistics	http://nccs.urban.org/NCCS-Databases-and-Tools.cfm	2002	2004	2006
tenure in community	median year householder moved into unit	positive	US Census Bureau	http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml	2000	2005-07	2008-10
Safety							
exposure/vulnerability to flood events	population density in the SFHA zone	negative	Project Collection (original data: US Census Bureau and FEMA)		2000	2005 (i)	2010
exposure/vulnerability to property crime	property crime rate (known incidents per 1000 people)	negative	FBI Uniform Crime Report	http://www.fbi.gov/stats-services/crimestats	2000	2005	2008
exposure/vulnerability to violent crime	violent crime rate (known incidents per 1000 people)	negative	FBI Uniform Crime Report	http://www.fbi.gov/stats-services/crimestats	2000	2005	2008
exposure/vulnerability to severe storms	total severe thunderstorm and tornado events	negative	NOAA NCDC Storm Events	http://www.ncdc.noaa.gov/stormevents/	2000	2005	2008
exposure/vulnerability to severe storms	total tropical storm and hurricane events	negative	NOAA NCDC Storm Events	http://www.ncdc.noaa.gov/stormevents/	2000	2005	2008

Notes: i=imputed values for time point; r=repeated values for time point

Appendix A. Table 1 - Indicators and Measures

ENVIRONMENTAL CONDITION COMPOSITE INDICATOR							
Components	**Measure Description**	**Contribution to Well-being**	**Source**	**Uniform Resource Locator (URL)**	**Time Point 1 (T1)**	**Time Point 2 (T2)**	**Time Point 3 (T3)**
impervious cover	percentage of total land cover that is developed (square miles)	negative	NOAA Coastal Change Analysis Program	http://www.csc.noaa.gov/digitalcoast/data/ccapregional/index.html	2001	2006	2006 (r)
coastal water quality	water quality index score	positive	EPA National Coastal Condition Report	http://water.epa.gov/type/oceb/assessmonitor/nccr/index.cfm	2001	2005-06	2005-06 (r)
coastal sediment quality	sediment quality index score	positive	EPA National Coastal Condition Report	http://water.epa.gov/type/oceb/assessmonitor/nccr/index.cfm	2001	2005-06	2005-06 (r)
air quality - ozone	number of person-days with maximum 8-hour average ozone concentration over National Ambient Air Quality Standard	negative	CDC & EPA - National Environmental Public Health Tracking	http://ephtracking.cdc.gov/	2001	2006	2006 (r)
air quality - particulate matter	number of person-days with PM2.5 over National Ambient Air Quality Standard	negative	CDC & EPA - National Environmental Public Health Tracking	http://ephtracking.cdc.gov/	2001	2006	2006 (r)

Notes: i=imputed values for time point; r=repeated values for time point

ADDITIONAL MEASURES							
Components	**Measure Description**	**Contribution to Well-being**	**Source**	**Uniform Resource Locator (URL)**	**Time Point 1 (T1)**	**Time Point 2 (T2)**	**Time Point 3 (T3)**
Measures used to adjust for county level of analysis:							
County population	Population estimate/count	N/A	US Census Bureau	http://www.census.gov/	2000-01	2004-05	2008-09
County housing units	Housing unit total	N/A	US Census Bureau	http://www.census.gov/	2000-01	2004-05	2008-09
County population under 18 yrs/ School age	Population under 18 years of age	N/A	US Census Bureau	http://www.census.gov/	2000-01	2004-05	2007-08
County population in poverty	Poverty estimate	N/A	US Census Bureau	http://www.census.gov/	2000	2005	2008
County average household size	Average household size	N/A	US Census Bureau	http://www.census.gov/	2000	2005	2008
County area (sq mi)	County area (sq mi)	N/A	Project Collection (original data: US Census Bureau, FEMA)		2000	2000	2000
County total itemized tax returns	Itemized tax return total	N/A	National Center for Charitable Statistics	http://nccs.urban.org/NCCS-Databases-and-Tools.cfm	2002	2004	2006

Notes: i=imputed values for time point; r=repeated values for time point

Appendix A. Table 2 - Data Sources

Data Sources for Well-being and Environmental Condition Composite Indicators	
Source	Description
Area Resource File (ARF), U.S. Department of Health and Human Services, Health Resources and Services Administration, Bureau of Health Professions, National Center for Health Workforce Analysis.	Area Resource File (ARF) 2009-2010 Release, Version 2. The Area Resource File (ARF) system is a computer based health information system with broad analytical capabilities. It utilizes health personnel and related secondary data that are available on a compatible basis for all counties in the U.S. The Area Resource File is made available by the Bureau of Health Professions, though original data are compiled from a variety of sources including: American Dental Association, the American Hospital Association, the American Medical Association, and InterStudy.
Association of Statisticians of American Religious Bodies (ASARB).	The Religious Congregations and Membership Study: The Association of Statisticians of American Religious Bodies (ASARB) designed and conducted a study in 2000 which represents statistics for 149 religious bodies on the number of congregations within each county of the United States. Where available, the data collection also included actual membership (as defined by the religious body) and total adherents data. Participants included 149 Christian denominations, associations, or communions (including Latter-day Saints and Unitarian/Universalist groups); two specially defined groups of independent Christian churches; Jewish and Islamic totals; and counts of temples for six Eastern religions.
Centers for Disease Control (CDC) and U.S. Environmental Protection Agency (EPA).	National Environmental Public Health Tracking Network - Air Quality Data from U.S. EPA: Air monitoring in the United States is conducted by many federal, state, local, and tribal air agencies. The Environmental Protection Agency (EPA) provides air pollution data about ozone and particulate matter (PM2.5) to CDC for the Tracking Network. The EPA maintains a database called the Air Quality System (AQS) which contains data from approximately 4,000 monitoring stations around the country, mainly in urban areas. Data from the AQS is considered the “”gold standard”” for determining outdoor air pollution. However, AQS data are limited because the monitoring stations are usually in urban areas or cities and because they only take air samples for some air pollutants every three days or during times of the year when air pollution is very high. CDC and EPA have worked together to develop a statistical model (Hierarchical Bayesian) to make modeled predictions available for environmental public health tracking purposes in areas of the country that do not have monitors and to fill in the time gaps when monitors may not be recording data. After careful study, EPA and CDC found that air pollution modeled predictions are very similar to actual monitor data in areas where the two can be compared.
Community Emergency Response Team (CERT) Memberships and Comprehensive Management Plans.	County Governance Planning and Response: Community Emergency Response Teams (CERT) are a subsidiary of FEMA’s Citizen Corps. Data on county membership in CERTs and date of formation were collected for the study. Additionally, the presence/absence of a Comprehensive (Master) Plan and year of adoption were compiled for each county and parish. Data were compiled by social scientists at the NOAA Hollings Marine Laboratory (NOS/NCCOS/HML) from a wide variety of sources including: state and county/parish websites, personal correspondence with staff in county/parish offices, previous studies, and other archival material.

Appendix A. Table 2 - Data Sources

Data Sources for Well-being and Environmental Condition Composite Indicators	
Source	Description
County Shoreline and Beaches.	County Shoreline and Beach Length: Data for amount of shoreline and beaches for 41 coastal counties in the Gulf of Mexico, Southeast Florida and South Carolina were calculated and compiled by social scientists in the NOAA Center for Coastal Monitoring and Assessment (NOS/NCCOS/CCMA). Original datasets and sources include: NOAA Composite Shoreline; EPA Reach Address Database (RAD) Event Program Data for Beaches; and U.S. Census 2010 TIGER/line shapefiles on the county level.
David Leip, Election Data.	Dave Leip's Atlas of U.S. Presidential Elections: The Atlas is a free internet resource providing results of U.S. Presidential Elections to the world community. Data is collected from many official sources and presented here in one convenient location. In addition, the Atlas makes available high quality, detailed election data spreadsheets compiled from official sources for purchase. The election data covers presidential, congressional, gubernatorial, and other races over time. The voter turnout data used for this study was purchased and obtained in 2011. (Source: Leip, David. 2011. Dave Leip's Atlas of U.S. Presidential Elections; http://www.uselectionatlas.org)
Economic Diversity Index.	Economic Diversity of County Employment and Earnings: Using the US Census Bureau, Censtats, USA Counties collection for 2001 through 2007, measures of economic diversity were calculated by NOAA Hollings Scholar, Jason Wong in conjunction with NOAA social scientists (NOS/NCCOS/HML) using two methods, the Ogive (Oi) and National Average (Ni) for both employment and earnings by industry. The Ni here measures deviation from the State's industrial composition; and the Ogive measures deviation from an equiproportional standpoint (assuming highest diversity is when each of the industries employ equal share of the economy). Data are originally taken from BEA and therefore, reflect only non-farm industry.
Federal Bureau of Investigation (FBI) Uniform Crime Reports.	Uniform Crime Statistics for U.S. Counties: The Uniform Crime Reporting (UCR) Program was conceived in 1929 by the International Association of Chiefs of Police to meet a need for reliable, uniform crime statistics for the nation. In 1930, the FBI was tasked with collecting, publishing, and archiving those statistics. Today, several annual statistical publications, such as the comprehensive Crime in the United States, are produced from data provided by nearly 17,000 law enforcement agencies across the United States. The FBI's primary objective with UCR Data is to generate a reliable set of crime statistics for use in law enforcement administration, operation, and management. The FBI does not provide a ranking of agencies but merely alphabetical tabulations of states, metropolitan statistical areas, cities, metropolitan and nonmetropolitan counties, and colleges and universities.
Federal Emergency Management Agency (FEMA) 100-year Coastal Flood Hazard Area (SFHA) and County Population.	FEMA Flood Plain and Population: This data includes the results of calculations for US Census population and housing units within the FEMA 100-year Coastal Flood Hazard Area (SFHA) for 41 coastal counties along the the Gulf of Mexico, and in Florida and South Carolina for 2000 and 2010. The calculations were completed by social scientists in the Biogeography Branch of NOAA (NOS/NCCOS/CCMA). The document detailing the procedure used to arrive at these figures is titled ""Procedure for Calculating Population and Housing Units in FEMA SFHA Flood Zones"". Original data sources include: Census Summary File 1 (SF 1) 2000 and 2010; TIGER/line shapefiles; FEMA SFHA shapefile.

Appendix A. Table 2 - Data Sources

Data Sources for Well-being and Environmental Condition Composite Indicators	
Source	Description
Federal Emergency Management Agency (FEMA), National Flood Insurance Program (NFIP), Community Rating System (CRS).	County Governance Management: The CRS was implemented in 1990 as a program for recognizing and encouraging community floodplain management activities that exceed the minimum NFIP standards. There are ten CRS classes: class 1 requires the most risk prevention activity and provides communities the most benefit; class 10 receives no insurance premium reduction. The CRS recognizes 18 creditable activities, organized under four categories numbered 300 through 600: Public Information, Mapping and Regulations, Flood Damage Reduction, and Flood Preparedness. Data on CRS scores for counties/parishes were compiled by social scientists at the NOAA Hollings Marine Laboratory (NOS/NCCOS/HML). Sources include personal correspondence with the Natural Hazards Insurance Services Office, as well as information made available by the National Flood Insurance Program.
Institute for Health Metrics and Evaluation (IHME)	Adult Life Expectancy by U.S. Count 1987-2007 (2011): The Institute for Health Metrics and Evaluation (IHME) provides a series for life expectancy from 1987 to 2007 for all U.S. counties. The IHME is funded by the Bill and Melinda Gates Foundation and the state of Washington.
National Oceanic and Atmospheric Administration (NOAA) Investment.	NOAA Investments by State and Year: The total expenditure of NOAA in each Gulf of Mexico state for labor, corp labor, and non-labor were cleaned and compiled by state and year for the study period. The original data file was provided by NOAA's Chief of Budget in the Office of the Chief Financial Officer.
National Oceanic and Atmospheric Administration (NOAA), Coastal Change Analysis Program (CCAP).	National Oceanic and Atmospheric Administration, Coastal Change Analysis Program (CCAP) Regional Land Cover Data (2012): The Coastal Change Analysis Program (C-CAP) produces a nationally standardized database of land cover and land change information for the coastal regions of the U.S. C-CAP products are developed using multiple dates of remotely sensed imagery and consist of raster-based land cover maps for each date of analysis, as well as a file that highlights what changes have occurred between these dates and where the changes were located. NOAA produces high resolution C-CAP land cover products, for select geographies. GIS and tabular data was accessed June 2012 and prepared for the project by NOAA Coastal Services Center, Charleston SC (http://www.csc.noaa.gov/digitalcoast/data/ccapregional).
National Oceanic and Atmospheric Administration (NOAA), National Geodetic Survey (NGS).	County Height, NOAA National Geodetic Survey: For this dataset, the benchmark nearest to the centroid of the county was used to calculate each county's height in meters. Each PID is accompanied by its own set of metadata, which is hyperlinked from the spreadsheet. PID---This is a permanent Identifier, which is a unique identifier in the National Spatial Reference System database. This identifier refers to the individual survey disc, or benchmark, and its associated information. This should be preserved with the data. Designation---Each survey point in the United States physically consists of a brass, bronze or aluminum disc placed in a stable structure. The disc, or benchmark, is engraved with identifying marks when caste. When set into the ground or structure, a designation code or name is stamped into the benchmark. These designations are not unique identifiers. However, they are critical for undertaking geodetic leveling, the process by which height is determined using benchmarks.

Appendix A. Table 2 - Data Sources

Data Sources for Well-being and Environmental Condition Composite Indicators	
Source	Description
National Oceanic and Atmospheric Administration (NOAA), National Ocean Economics Program (NOEP)	National Oceanic and Atmospheric Administration, National Ocean Economics Program (NOEP) Data: The NOEP provides coastal economy variables by county through a comprehensive set of measures of changes in economic activity throughout the coastal regions of the United States. The sources of data include: Bureau of Labor Statistics (BLS) - Quarterly Census of Employment and Wages (QCEW) and Bureau of Economic Analysis (BEA).
National Oceanic and Atmospheric Administration, National Weather Services (NWS), Storm Data.	National Oceanic and Atmospheric Administration, National Weather Service Storm Event Data: Available through the National Climatic Data Center (NCDC), Storm Data is an official publication of the National Oceanic and Atmospheric Administration (NOAA) which documents the occurrence of storms and other significant weather phenomena having sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. In addition, it is a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event. Some information appearing in Storm Data may be provided by or gathered from sources outside the National Weather Service (NWS), such as the media, law enforcement and/or other government agencies, private companies, and individuals.
National Oceanic and Atmospheric Administration, National Weather Services (NWS), Verifications Data.	National Oceanic and Atmospheric Administration, National Weather Service Storm Verifications Data: The severe weather verification database is comprised of events and warnings for tornadoes and severe thunderstorms. The warnings are automatically collected and parsed, and event data are automatically extracted from the Storm Data reports using the personal computer program “”StormDat.”” The warnings and event reports are “”matched up”” to generate verification statistics.
U.S. Census Bureau, Censtats, USA Counties.	Censtats, USA Counties Data: The USA Counties collection encompasses overs 6,800 data items from the states and counties from federal agencies including the U.S. Census Bureau, the Bureau of Economic Analysis, the Bureau of Labor Statistics, the Federal Bureau of Investigation, and the Social Security Administration. The files include data published for 2009 estimates and many items from the 2000 Census of Population and Housing, the 1990 census, the 1980 census and the 2002, 1997, 1992, 1987, 1982 and 1977 economic censuses.
U.S. Department of Education, National Center for Education Statistics (NCES)	National Center for Educational Statistics, Expenditure Data: The Common Core of Data (CCD) is a program of the U.S. Department of Education’s National Center for Education Statistics that annually collects fiscal and non-fiscal data about all public schools, public school districts and state education agencies in the United States. The data are supplied by state education agency officials and include information that describes schools and school districts, including name, address, and phone number; descriptive information about students and staff, including demographics; and fiscal data, including revenues and current expenditures. (Source: National Center for Education Statistics, Educational Expenditures Report from the Common Core of Data (CCD); “”School District Finance Survey (Form F-33)””.)

Appendix A. Table 2 - Data Sources

Data Sources for Well-being and Environmental Condition Composite Indicators	
Source	Description
U.S. Census Bureau, American Community Survey (ACS).	U.S. Census Bureau, American Community Survey Data: The American Community Survey (ACS) is a household survey conducted by the U.S. Census Bureau that currently has an annual sample size of about 3.5 million addresses. The ACS data provides communities with the current information they need to plan investments and services. Information from the survey generates data that help determine how more than $400 billion in federal and state funds are distributed annually. Each year the survey produces data that cover the periods of 1-year, 3-year, and 5-year estimates for geographic areas in the United States and Puerto Rico, ranging from neighborhoods to Congressional districts to the entire nation. The ACS-SF contains the sample data, which is information about the characteristics of local communities compiled from the questions asked of a sample of people and housing units. The topics covered by the ACS and focus on demographic, social, housing, and economic characteristics and cover a broad spectrum of geographic areas in the United States and Puerto Rico. (Source: U.S. Census Bureau, 2005-2007 American Community Survey; 2008-2010 American Community Survey.)
U.S. Census Bureau, Decennial Census.	U.S Census Bureau, Decennial Census Data: U.S. Census Bureau, 2000 Census, Summary Files 1 and 3; The U.S. Census counts every resident in the United States. It is mandated by Article I, Section 2 of the Constitution and takes place every 10 years. The data collected by the decennial census determine the number of seats each state has in the U.S. House of Representatives and is also used to distribute billions in federal funds to local communities. Census 2000/2010 Summary File 1 (SF 1) presents counts and basic cross-tabulations of information collected from all people and housing units. SF 1 provides population counts for 63 race categories and Hispanic or Latino, and population counts for many detailed race and Hispanic or Latino categories, and American Indian and Alaska Native tribes [Urban/rural data are on the final national file]. Census 2000/2010 Summary File 3 (SF 3) contains tables with social, economic and housing characteristics compiled from a sample of approximately 19 million housing units (about 1-in-6 households) that received the Census 2000 long-form questionnaire. Many tables are given for nine major race and Hispanic or Latino groups. Ancestry group population counts are included.
U.S. Census Bureau-County Business Patterns.	U.S. Census Bureau, County Business Patterns Data: These data provide annual statistics for businesses with paid employees within the U.S., Puerto Rico, and Island Areas (Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, and the U.S. Virgin Islands) at a detailed geography and industry level. This program is authorized under the United States Code, Titles 13 and 26. County Business Patterns provides subnational economic data by industry each year. This series includes the number of establishments, employment during the week of March 12, first quarter payroll, and annual payroll. This data is useful for studying the economic activity of small areas; analyzing economic changes over time; and as a benchmark for other statistical series, surveys, and databases between economic censuses. ZIP Code Business Patterns data are available shortly after the release of County Business Patterns. It provides the number of establishments by employment-size classes by detailed industry in the U.S.

Appendix A. Table 2 - Data Sources

Data Sources for Well-being and Environmental Condition Composite Indicators	
Source	Description
U.S. Department of Agriculture (USDA), Economic Research Service (ERS) and Food & Nutrition Service (FNS), Supplemental Nutrition Assistance Program (SNAP).	Supplemental Nutrition Assistance Program (SNAP) Data: The states report SNAP "participation counts" twice per year: January and July. States report counts by "project area," which is usually the same as a county because benefits are typically issued from county social service offices. Data files are drawn from the NATIONAL DATA BANK VERSION 8.2 - SUPPLEMENTAL NUTRITION ASSISTANCE PROGRAM, STATISTICAL SUMMARY OF OPERATIONS - FNS 388A - By State (SNAP-R19), Calc: FSP Total PA and Non-PA People-STATE BY PROJECT AREA 20XX, SNAP-R19 - Submission Data. Data were provided by SNAP Program, U.S. Department of Agriculture, Food & Nutrition Service (FNS), Office of Research and Analysis for the project in November 2011.
U.S. Environmental Protection Agency, National Coastal Conditions Reports (NCCR).	EPA National Coastal Conditions Reports Data: For years 2000 – 2006, the EPA's Office of Water, Office of Research and Development aggregated data on water quality, sediment quality, benthic diversity, coastal habitat change, and fish tissue contaminants in support of an ongoing effort to define the condition of the nation's coastal environments. The data were used to calculate and compile mean scores for several of the index scores (Water Quality Index, Sediment Quality Index, Benthic Index, and Fish Tissue Contaminants Index) by county by sampling year. These data were analyzed for the county level analysis by scientists in the NOAA Center for Coastal Monitoring and Assessment (NOS/NCCOS/CCMA).
Urban Institute, National Center for Charitable Statistics (NCCS).	National Center for Charitable Statistics (NCCS) Non-profit Organization Data: The NCCR serves as the national clearinghouse of data on the non-profit sector in the United States. Reports on organizations registered within each county according to tax filings and annual giving by county are available through its online database.
Alabama Center for Health Statistics, Statistical Analysis Division, Department of Public Health.	Data on marriages and divorce, deaths and domestic violence were compiled by social scientists at the NOAA Hollings Marine Laboratory (NOS/NCCOS/HML) for all states in the study area. Data comes from the state health departments' annual vital statistics collections.
Florida Office of Vital Statistics, Department of Health.	Data on marriages and divorce, deaths and domestic violence were compiled by social scientists at the NOAA Hollings Marine Laboratory (NOS/NCCOS/HML) for all states in the study area. Data comes from the state health departments' annual vital statistics collections.
Louisiana State Center for Health Statistics, Department of Health and Hospitals, Office of Public Health.	Data on marriages and divorce, deaths and domestic violence were compiled by social scientists at the NOAA Hollings Marine Laboratory (NOS/NCCOS/HML) for all states in the study area. Data comes from the state health departments' annual vital statistics collections.
Mississippi Public Health Statistics Division, State Department of Health.	Data on marriages and divorce, deaths and domestic violence were compiled by social scientists at the NOAA Hollings Marine Laboratory (NOS/NCCOS/HML) for all states in the study area. Data comes from the state health departments' annual vital statistics collections.

Appendix A. Table 2 - Data Sources

Data Sources for Well-being and Environmental Condition Composite Indicators	
Source	Description
South Carolina Division of Biostatistics. Office of Public Health Statistics and Information Services, South Carolina Department of Health and Environmental Control.	Data on marriages and divorce, deaths and domestic violence were compiled by social scientists at the NOAA Hollings Marine Laboratory (NOS/NCCOS/HML) for all states in the study area. Data comes from the state health departments' annual vital statistics collections.
Texas Center For Health Statistics, Department of State Health Services.	Data on marriages and divorce, deaths and domestic violence were compiled by social scientists at the NOAA Hollings Marine Laboratory (NOS/NCCOS/HML) for all states in the study area. Data comes from the state health departments' annual vital statistics collections.

Appendix B

Supporting Materials for Chapter 5 - Results

Figure 1.

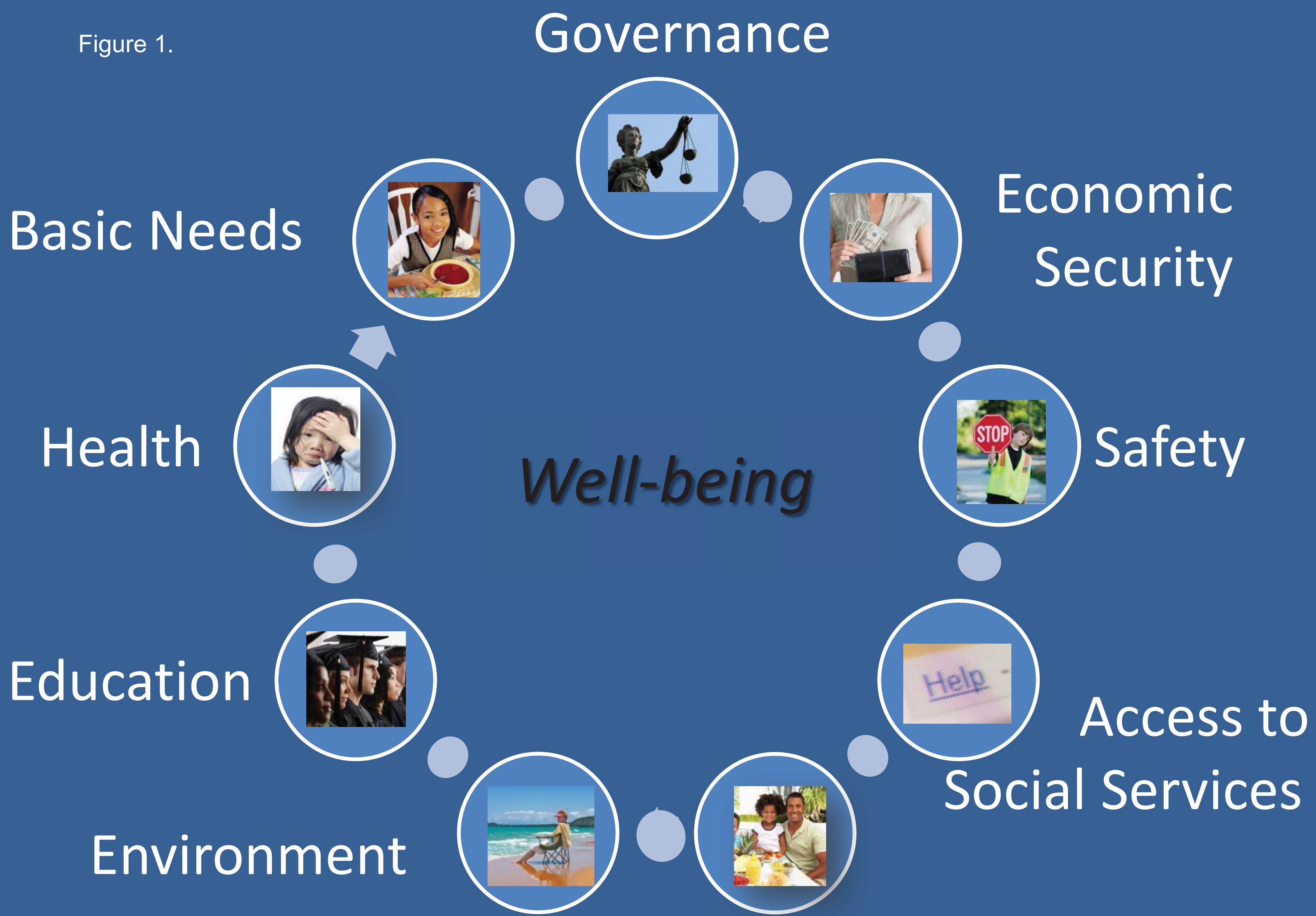

Governance
Economic Security
Safety
Access to Social Services
Social Connectedness
Environment
Education
Health
Basic Needs
Well-being
STOP
Help

Table 1. Demographic Statistics for Sample Counties, Time 1 (2000-01).

County/Parish	Total Pop (est.)	% in Poverty	% Female	% Under 18 yrs	% Over 65 yrs	Net int'l migration	Net domestic migration	% Black	% Asian	% White	% Hispanic or Latino
Baldwin County, Alabama	140,415	10	51	24	16	45	836	10	0	88	2
Escambia County, Alabama	38,440	19	49	24	14	0	-66	31	0	65	1
Mobile County, Alabama	399,843	17	52	27	12	154	-521	34	1	64	1
Bay County, Florida	148,217	13	51	24	13	82	-167	11	2	85	2
Escambia County, Florida	294,410	15	50	24	13	228	-125	22	2	73	3
Franklin County, Florida	11,057	16	49	20	18	1	23	12	0	87	1
Gulf County, Florida	13,332	19	43	20	15	0	40	20	0	77	3
Monroe County, Florida	79,589	10	47	17	15	174	-304	5	1	93	16
Okaloosa County, Florida	170,498	9	50	25	12	209	-64	9	3	85	4
Santa Rosa County, Florida	117,743	10	50	27	11	63	475	4	1	92	3
Wakulla County, Florida	22,863	12	48	26	10	1	85	12	0	87	2
Walton County, Florida	40,601	15	49	22	16	13	240	7	1	89	2
Cameron Parish, Louisiana	9,991	11	50	28	11	0	-45	4	1	95	2
Iberia Parish, Louisiana	73,266	19	52	30	11	4	-193	31	2	66	2
Jefferson Parish, Louisiana	455,466	14	52	25	12	292	-1585	23	3	72	7
Lafourche Parish, Louisiana	89,974	14	51	27	11	17	-181	13	1	84	1
Orleans Parish, Louisiana	484,674	25	53	27	12	202	-1642	68	2	29	3
Plaquemines Parish, Louisiana	26,757	15	50	29	10	4	-60	24	3	71	2
St. Bernard Parish, Louisiana	67,229	13	52	25	14	3	-251	8	1	89	5
St. Mary Parish, Louisiana	53,500	20	51	30	11	4	-316	32	2	64	2
St. Tammany Parish, Louisiana	191,268	10	51	28	10	31	586	10	1	88	3
Terrebonne Parish, Louisiana	104,503	16	51	29	10	16	-294	18	1	75	2
Vermilion Parish, Louisiana	53,807	18	52	28	14	15	-123	14	2	83	1
Washington Parish, Louisiana	43,926	23	51	27	14	1	-61	32	0	68	1
Hancock County, Mississippi	42,967	14	50	25	14	3	286	7	1	91	2
Harrison County, Mississippi	189,601	15	50	26	11	160	-152	21	3	74	3
Jackson County, Mississippi	131,420	13	50	28	10	73	167	21	2	76	2
Pearl River County, Mississippi	48,621	18	51	27	13	4	89	12	0	86	1
Beaufort County, South Carolina	120,937	10	49	23	16	275	661	24	1	74	7
Charleston County, South Carolina	309,969	14	52	24	12	258	242	35	1	63	2
Colleton County, South Carolina	38,264	19	52	27	13	5	62	42	0	56	1
Jasper County, South Carolina	20,678	22	47	27	11	29	-26	53	1	46	6
Brazoria County, Texas	241,767	10	48	29	9	216	641	9	2	88	23
Chambers County, Texas	26,031	10	50	29	9	8	89	10	1	88	11
Galveston County, Texas	250,158	12	51	27	11	236	-53	16	2	81	18
Jefferson County, Texas	252,051	17	50	26	14	161	-743	34	3	62	11
Matagorda County, Texas	37,957	16	50	30	12	53	-81	13	3	83	32

Table 2. Demographic Statistics for Sample Counties, Time 2 (2004-05).

County/Parish	Total Pop (est.)	% in Poverty	% Female	% Under 18 yrs	% Over 65 yrs	Net int'l migration	Net domestic migration	% Black	% Asian	% White	% Hispanic or Latino
Baldwin County, Alabama	162,564	11	51	24	16	237	5190	10	1	88	2
Escambia County, Alabama	37,642	22	49	23	14	13	-212	32	0	64	1
Mobile County, Alabama	398,369	20	52	27	12	530	-1128	34	2	63	2
Bay County, Florida	161,586	14	51	23	14	95	2908	11	2	84	3
Escambia County, Florida	302,476	16	51	23	14	177	-248	22	3	72	3
Franklin County, Florida	10,055	18	49	20	17	3	63	11	0	87	2
Gulf County, Florida	15,658	18	41	17	15	0	314	21	0	76	4
Monroe County, Florida	76,135	11	47	16	15	419	-2174	6	1	92	18
Okaloosa County, Florida	183,398	10	50	24	13	28	-44	10	3	84	5
Santa Rosa County, Florida	142,364	9	50	24	12	54	3525	5	2	90	3
Wakulla County, Florida	27,799	12	47	22	12	8	1015	12	0	86	3
Walton County, Florida	49,581	13	49	21	15	48	1834	7	1	89	3
Cameron Parish, Louisiana	9,576	13	50	24	12	15	-82	5	1	94	3
Iberia Parish, Louisiana	73,599	23	52	28	12	33	-220	32	2	65	2
Jefferson Parish, Louisiana	451,652	16	52	25	13	924	-4014	26	4	69	9
Lafourche Parish, Louisiana	91,362	15	51	25	12	58	-681	13	1	83	2
Orleans Parish, Louisiana	455,188	26	53	25	12	527	-9091	67	2	29	4
Plaquemines Parish, Louisiana	28,549	15	50	28	10	-5	-195	24	3	70	3
St. Bernard Parish, Louisiana	64,951	17	52	24	13	28	-528	10	2	86	6
St. Mary Parish, Louisiana	50,871	22	51	27	12	32	-922	32	2	64	3
St. Tammany Parish, Louisiana	217,407	11	51	27	11	112	4700	12	1	86	3
Terrebonne Parish, Louisiana	106,192	18	51	27	11	66	-41	18	1	74	2
Vermilion Parish, Louisiana	54,909	21	52	26	13	51	229	14	2	82	2
Washington Parish, Louisiana	43,919	25	51	26	14	6	220	31	0	68	1
Hancock County, Mississippi	46,097	16	51	24	15	19	587	7	1	90	2
Harrison County, Mississippi	195,843	16	51	27	12	91	173	22	3	72	4
Jackson County, Mississippi	134,474	15	51	27	12	146	-341	22	2	75	3
Pearl River County, Mississippi	51,764	23	51	26	13	8	402	13	0	85	2
Beaufort County, South Carolina	139,458	12	50	24	17	531	3116	22	1	76	9
Charleston County, South Carolina	337,584	16	52	24	12	655	1450	32	2	65	3
Colleton County, South Carolina	38,990	22	52	26	13	43	-15	41	0	57	2
Jasper County, South Carolina	21,308	25	47	26	12	144	0	50	1	49	11
Brazoria County, Texas	274,045	12	49	28	9	600	3318	10	4	85	25
Chambers County, Texas	28,035	11	50	26	9	56	172	11	1	87	15
Galveston County, Texas	274,494	13	51	26	11	697	2912	15	3	81	20
Jefferson County, Texas	246,063	20	49	25	13	430	-1883	35	3	61	13
Matagorda County, Texas	37,320	21	50	28	13	141	-593	12	2	83	35

Table 3. Demographic Statistics for Sample Counties, Time 3 (2008-09).

County/Parish	Total Pop (est.)	% in Poverty	% Female	% Under 18 yrs	% Over 65 yrs	Net int'l migration	Net domestic migration	% Black	% Asian	% White	% Hispanic or Latino
Baldwin County, Alabama	176,212	10	51	23	16	215	2637	10	1	88	3
Escambia County, Alabama	37,532	24	49	23	15	12	-173	32	0	63	2
Mobile County, Alabama	409,132	19	52	26	12	486	1298	34	2	62	2
Bay County, Florida	163,802	12	51	23	15	150	-449	12	2	83	4
Escambia County, Florida	302,776	16	51	22	15	345	-1435	23	3	71	4
Franklin County, Florida	11,247	23	44	18	16	3	-52	16	0	81	2
Gulf County, Florida	15,683	21	41	16	15	1	-49	21	0	76	4
Monroe County, Florida	73,298	10	47	16	16	396	-630	6	1	91	19
Okaloosa County, Florida	179,529	9	50	24	14	203	-2857	10	3	83	6
Santa Rosa County, Florida	150,356	11	50	23	12	95	1707	6	2	89	4
Wakulla County, Florida	31,142	13	47	21	13	8	775	13	0	85	3
Walton County, Florida	53,920	15	49	21	16	49	978	7	1	89	4
Cameron Parish, Louisiana	7,100	13	48	21	12	11	-190	4	1	94	4
Iberia Parish, Louisiana	75,020	19	52	27	12	29	-371	32	2	64	2
Jefferson Parish, Louisiana	444,655	13	52	24	14	845	-5063	27	4	68	9
Lafourche Parish, Louisiana	93,556	16	51	24	12	53	77	14	1	82	2
Orleans Parish, Louisiana	336,644	23	53	21	12	487	22535	63	3	33	5
Plaquemines Parish, Louisiana	21,138	15	50	26	11	1	-393	21	3	72	4
St. Bernard Parish, Louisiana	37,669	20	51	20	9	31	3797	15	2	80	8
St. Mary Parish, Louisiana	51,005	19	51	26	14	34	-600	32	2	63	3
St. Tammany Parish, Louisiana	229,384	10	51	26	12	116	1591	12	1	85	4
Terrebonne Parish, Louisiana	109,161	16	51	27	11	59	-424	18	1	74	3
Vermilion Parish, Louisiana	56,068	18	51	26	13	50	65	15	2	82	2
Washington Parish, Louisiana	45,554	24	51	26	14	8	369	31	0	68	1
Hancock County, Mississippi	40,493	17	51	24	14	21	578	7	1	90	3
Harrison County, Mississippi	179,322	16	51	27	12	169	1558	22	3	71	4
Jackson County, Mississippi	132,010	13	51	26	12	179	52	22	2	74	4
Pearl River County, Mississippi	57,770	20	51	26	13	10	398	13	0	85	2
Beaufort County, South Carolina	152,164	10	51	24	19	527	2480	20	1	77	10
Charleston County, South Carolina	349,778	15	52	23	13	606	2496	31	2	66	4
Colleton County, South Carolina	39,349	21	53	25	14	42	57	41	0	58	2
Jasper County, South Carolina	22,746	20	46	26	13	132	170	47	1	51	14
Brazoria County, Texas	301,228	10	49	28	9	523	4581	11	5	82	26
Chambers County, Texas	29,366	9	50	25	10	50	293	11	1	87	17
Galveston County, Texas	288,489	12	51	26	11	624	2402	15	3	81	21
Jefferson County, Texas	242,201	17	49	24	13	375	-568	35	3	61	15
Matagorda County, Texas	37,038	18	50	27	14	130	-66	12	2	84	37

Table 4. County Percent Scores for Well-being and Environmental Condition Composite Indicators, Time 1 (2000-01).

FIPS	County/Parish	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connected-ness	Environ. Condition
1003	Baldwin County, Alabama	41.4	63.0	56.2	28.0	20.0	71.4	62.9	57.9	76.3
1053	Escambia County, Alabama	41.5	48.1	38.3	48.1	0.0	59.8	85.2	36.5	79.5
1097	Mobile County, Alabama	60.0	48.4	48.9	27.8	0.0	61.5	50.4	44.0	66.4
12005	Bay County, Florida	54.2	61.1	54.3	43.1	80.0	65.2	65.8	41.6	93.3
12033	Escambia County, Florida	53.2	57.9	53.9	35.4	55.0	64.3	65.4	54.0	78.3
12037	Franklin County, Florida	39.2	74.9	30.5	45.3	70.0	54.3	49.6	49.7	99.2
12045	Gulf County, Florida	46.2	62.7	31.2	51.6	70.0	48.2	74.4	52.6	99.1
12087	Monroe County, Florida	55.4	76.7	59.2	30.0	45.0	81.9	61.9	53.4	79.0
12091	Okaloosa County, Florida	46.3	64.2	70.5	34.3	90.0	71.0	72.8	49.2	93.4
12113	Santa Rosa County, Florida	40.2	60.6	66.9	63.2	90.0	67.5	78.9	44.3	75.5
12129	Wakulla County, Florida	28.4	45.8	50.4	41.1	45.0	62.2	57.1	37.7	89.6
12131	Walton County, Florida	30.4	74.5	42.0	39.5	45.0	62.0	66.2	50.2	89.1
22023	Cameron Parish, Louisiana	30.7	54.1	36.6	38.9	0.0	60.8	80.2	29.0	89.0
22045	Iberia Parish, Louisiana	43.5	42.2	35.8	36.8	0.0	69.6	92.6	41.7	57.7
22051	Jefferson Parish, Louisiana	51.7	57.3	51.7	18.9	30.0	65.9	61.9	56.6	48.1
22057	Lafourche Parish, Louisiana	42.5	49.2	49.3	47.0	20.0	67.0	82.7	47.8	84.9
22071	Orleans Parish, Louisiana	65.8	39.3	52.1	33.0	20.0	55.8	41.7	51.0	41.3
22075	Plaquemines Parish, Louisiana	36.0	42.4	43.6	45.8	0.0	59.2	83.3	44.2	88.2
22087	St. Bernard Parish, Louisiana	34.4	56.0	43.6	33.7	0.0	57.0	98.4	62.4	86.7
22101	St. Mary Parish, Louisiana	52.4	48.0	28.0	42.4	0.0	60.9	68.4	36.6	76.9
22103	St. Tammany Parish, Louisiana	50.9	56.1	60.2	20.7	20.0	72.5	68.4	51.3	85.9
22109	Terrebonne Parish, Louisiana	51.3	42.4	44.3	38.3	20.0	68.9	64.6	36.1	87.6
22113	Vermilion Parish, Louisiana	34.9	40.7	33.7	32.3	0.0	67.8	89.1	36.2	71.3
22117	Washington Parish, Louisiana	50.6	35.5	26.4	33.2	0.0	51.9	67.9	38.3	86.0
28045	Hancock County, Mississippi	36.3	50.0	50.0	37.5	0.0	63.8	79.7	37.0	74.4
28047	Harrison County, Mississippi	56.0	49.2	48.9	39.2	5.0	63.0	59.7	38.9	75.6
28059	Jackson County, Mississippi	43.8	46.4	52.9	38.2	0.0	62.2	71.7	39.1	80.2
28109	Pearl River County, Mississippi	38.0	42.7	33.0	42.9	0.0	58.5	85.9	29.1	88.4
45013	Beaufort County, South Carolina	53.2	79.2	63.6	18.7	45.0	85.3	64.1	53.9	88.8
45019	Charleston County, South Carolina	66.0	61.8	65.7	23.7	55.0	70.3	48.4	50.0	86.8
45029	Colleton County, South Carolina	42.3	41.2	41.2	40.7	0.0	56.0	59.8	40.6	89.3
45053	Jasper County, South Carolina	23.2	32.4	37.1	42.4	15.0	55.7	59.9	25.0	90.0
48039	Brazoria County, Texas	33.8	49.0	56.6	44.8	0.0	71.8	84.0	40.1	63.1
48071	Chambers County, Texas	32.0	51.4	56.8	53.0	0.0	60.3	83.9	30.2	77.4
48167	Galveston County, Texas	56.9	52.9	57.7	57.9	0.0	67.5	75.4	40.5	69.7
48245	Jefferson County, Texas	58.0	46.2	43.6	40.8	0.0	63.4	67.6	57.1	59.2
48321	Matagorda County, Texas	41.6	30.2	32.1	56.3	0.0	25.5	76.1	51.4	89.1

Table 5. County Percent Scores for Well-being and Environmental Condition Composite Indicators, Time 2 (2004-05).

FIPS	County/Parish	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connected-ness	Environ. Condition
1003	Baldwin County, Alabama	37.5	59.0	52.4	24.4	16.7	72.9	69.7	51.2	69.9
1053	Escambia County, Alabama	42.5	38.9	34.7	39.2	0.0	60.2	60.7	41.0	78.9
1097	Mobile County, Alabama	55.4	44.5	48.5	25.2	8.3	64.6	46.1	48.5	47.0
12005	Bay County, Florida	47.9	59.5	55.3	38.2	83.3	69.9	53.3	53.2	70.6
12033	Escambia County, Florida	48.3	54.4	56.7	32.1	73.3	68.8	39.9	51.1	68.4
12037	Franklin County, Florida	39.5	71.8	37.9	40.5	75.0	69.3	71.5	66.6	99.2
12045	Gulf County, Florida	26.2	57.0	40.1	49.3	66.7	59.7	59.5	68.2	99.2
12087	Monroe County, Florida	49.7	65.0	56.8	32.4	55.0	81.8	48.8	56.1	79.0
12091	Okaloosa County, Florida	42.0	58.3	68.4	30.2	91.7	76.0	53.4	44.9	74.1
12113	Santa Rosa County, Florida	37.4	52.7	68.0	61.4	83.3	70.4	50.4	38.1	90.2
12129	Wakulla County, Florida	26.8	48.7	48.0	39.5	50.0	68.2	71.8	49.0	79.5
12131	Walton County, Florida	31.1	69.9	51.3	29.7	46.7	64.8	65.8	52.6	97.4
22023	Cameron Parish, Louisiana	28.1	50.0	40.5	46.6	0.0	52.6	74.0	22.7	79.6
22045	Iberia Parish, Louisiana	45.7	44.3	34.7	24.0	0.0	68.7	95.7	48.9	66.7
22051	Jefferson Parish, Louisiana	54.3	49.1	58.7	19.1	40.0	64.5	44.8	50.6	35.2
22057	Lafourche Parish, Louisiana	45.7	32.1	48.3	58.2	8.3	68.4	66.4	51.2	68.6
22071	Orleans Parish, Louisiana	59.8	32.9	55.5	21.5	25.0	47.2	47.5	47.0	70.6
22075	Plaquemines Parish, Louisiana	37.8	45.5	52.8	52.4	0.0	52.9	65.0	30.7	79.1
22087	St. Bernard Parish, Louisiana	26.5	52.0	54.1	33.9	0.0	55.6	71.0	56.2	77.5
22101	St. Mary Parish, Louisiana	51.6	41.5	31.4	49.0	10.0	63.4	71.6	51.4	59.6
22103	St. Tammany Parish, Louisiana	55.2	28.6	65.7	23.4	30.0	71.0	68.4	48.0	69.4
22109	Terrebonne Parish, Louisiana	49.3	33.7	40.4	32.2	31.7	70.8	61.5	34.3	88.2
22113	Vermilion Parish, Louisiana	31.9	40.1	34.6	29.4	0.0	63.9	88.8	38.5	64.7
22117	Washington Parish, Louisiana	48.4	42.2	23.6	33.8	0.0	51.2	72.7	40.2	78.2
28045	Hancock County, Mississippi	36.9	45.3	42.8	28.9	0.0	67.9	71.4	27.6	76.0
28047	Harrison County, Mississippi	56.3	35.7	44.6	33.4	45.0	64.9	60.4	41.9	64.8
28059	Jackson County, Mississippi	40.4	38.3	53.7	35.2	0.0	66.6	63.9	33.8	70.9
28109	Pearl River County, Mississippi	38.8	45.3	28.7	40.8	0.0	64.2	78.3	29.7	76.7
45013	Beaufort County, South Carolina	47.0	60.3	56.2	12.5	51.7	88.5	59.5	58.2	78.6
45019	Charleston County, South Carolina	62.6	52.6	61.4	13.8	70.0	77.6	49.9	55.5	60.4
45029	Colleton County, South Carolina	45.5	44.9	31.9	26.7	25.0	60.3	65.3	50.0	79.6
45053	Jasper County, South Carolina	25.5	45.1	31.6	40.3	26.7	70.9	55.9	33.5	80.0
48039	Brazoria County, Texas	38.6	46.2	56.2	37.6	0.0	72.1	83.0	40.4	57.7
48071	Chambers County, Texas	37.6	59.0	53.9	54.2	0.0	67.8	81.0	26.9	77.8
48167	Galveston County, Texas	57.8	46.5	56.7	52.1	0.0	69.8	70.4	44.0	62.8
48245	Jefferson County, Texas	56.0	45.2	45.2	39.7	0.0	64.7	64.4	49.6	75.8
48321	Matagorda County, Texas	44.9	37.5	29.3	55.0	0.0	28.0	77.6	58.6	79.3

Table 6. County Percent Scores for Well-being and Environmental Condition Composite Indicators, Time 3 (2008-09).

FIPS	County/Parish	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connected-ness	Environ. Condition
1003	Baldwin County, Alabama	42.0	60.1	51.1	29.2	33.3	70.9	78.4	71.7	69.9
1053	Escambia County, Alabama	39.9	56.3	23.2	48.1	0.0	57.1	78.2	63.2	78.9
1097	Mobile County, Alabama	54.9	51.2	44.0	27.8	0.0	61.5	56.4	69.1	47.0
12005	Bay County, Florida	48.1	59.1	46.2	37.6	100.0	64.1	69.2	69.1	70.6
12033	Escambia County, Florida	47.1	53.0	42.0	30.8	75.0	65.1	50.7	72.3	68.4
12037	Franklin County, Florida	37.8	70.8	29.6	37.3	75.0	56.4	91.7	76.1	99.2
12045	Gulf County, Florida	29.1	60.7	28.3	49.9	75.0	54.7	88.0	74.7	99.2
12087	Monroe County, Florida	50.0	53.0	52.2	34.7	55.6	80.0	36.0	80.6	79.0
12091	Okaloosa County, Florida	43.7	62.8	58.2	29.9	91.7	73.9	69.4	70.8	74.1
12113	Santa Rosa County, Florida	34.9	56.5	59.4	69.2	91.7	69.9	77.9	60.9	90.2
12129	Wakulla County, Florida	29.0	45.7	45.4	37.3	69.4	67.5	89.0	63.4	79.5
12131	Walton County, Florida	25.4	69.4	40.0	29.6	47.2	61.5	84.7	70.2	97.4
22023	Cameron Parish, Louisiana	23.1	62.9	43.5	61.8	0.0	54.0	60.8	22.9	79.6
22045	Iberia Parish, Louisiana	44.8	50.0	41.2	30.9	2.8	64.8	68.1	60.0	66.7
22051	Jefferson Parish, Louisiana	50.5	55.2	56.4	21.3	47.2	66.2	51.9	61.2	35.2
22057	Lafourche Parish, Louisiana	39.0	41.7	55.0	52.6	8.3	65.7	81.2	53.3	68.6
22071	Orleans Parish, Louisiana	55.3	50.0	47.7	26.5	25.0	61.2	47.4	69.9	70.6
22075	Plaquemines Parish, Louisiana	37.9	63.7	63.0	52.7	0.0	74.0	87.6	50.6	79.1
22087	St. Bernard Parish, Louisiana	25.6	57.2	45.5	37.3	0.0	53.5	79.6	21.4	77.5
22101	St. Mary Parish, Louisiana	44.9	47.0	39.9	48.5	16.7	62.0	62.3	63.3	59.6
22103	St. Tammany Parish, Louisiana	53.0	52.7	58.5	21.9	36.1	70.1	67.1	64.2	69.4
22109	Terrebonne Parish, Louisiana	46.9	36.7	49.0	31.9	38.9	66.9	70.8	47.8	88.2
22113	Vermilion Parish, Louisiana	33.4	44.5	36.7	18.3	0.0	61.7	65.1	52.4	64.7
22117	Washington Parish, Louisiana	42.1	43.7	23.2	33.4	0.0	50.9	57.2	55.9	78.2
28045	Hancock County, Mississippi	36.1	56.5	39.5	28.8	0.0	62.6	84.3	53.2	76.0
28047	Harrison County, Mississippi	59.6	46.4	43.7	35.5	50.0	64.6	76.1	60.3	64.8
28059	Jackson County, Mississippi	43.4	47.0	50.1	36.6	0.0	62.9	79.1	61.2	70.9
28109	Pearl River County, Mississippi	37.0	48.3	25.3	31.6	0.0	59.0	85.7	59.3	76.7
45013	Beaufort County, South Carolina	47.7	70.1	48.9	12.1	63.9	85.0	52.7	77.7	78.6
45019	Charleston County, South Carolina	58.8	62.7	55.1	13.1	75.0	73.1	55.5	74.9	60.4
45029	Colleton County, South Carolina	42.9	47.1	21.4	40.8	33.3	55.6	58.4	71.6	79.6
45053	Jasper County, South Carolina	32.5	35.1	27.2	41.8	30.6	61.4	63.0	68.1	80.0
48039	Brazoria County, Texas	39.2	47.8	58.5	32.6	0.0	70.7	88.2	64.4	57.7
48071	Chambers County, Texas	38.3	52.6	55.1	59.8	0.0	66.8	82.9	54.5	77.8
48167	Galveston County, Texas	54.8	48.3	56.9	47.4	0.0	67.2	69.9	67.9	62.8
48245	Jefferson County, Texas	54.3	47.0	41.6	42.3	8.3	62.1	61.4	71.0	75.8
48321	Matagorda County, Texas	45.4	44.2	28.4	45.5	0.0	22.4	72.8	77.3	79.3

Table 7. Ranking of Counties by Well-being and Environmental Condition Composite Indicators, Time 1 (2000-01).

FIPS	County/Parish	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connected-ness	Environ. Condition
1003	Baldwin County, Alabama	24	6	10	32	15	5	27	2	26
1053	Escambia County, Alabama	23	23	27	6	29	27	5	31	21
1097	Mobile County, Alabama	3	22	20	33	29	23	34	19	32
12005	Bay County, Florida	8	9	11	11	3	15	23	21	4
12033	Escambia County, Florida	9	11	12	25	7	16	24	5	23
12037	Franklin County, Florida	26	3	35	9	5	34	35	14	1
12045	Gulf County, Florida	17	7	34	5	5	36	15	8	2
12087	Monroe County, Florida	7	2	6	31	10	2	28	7	22
12091	Okaloosa County, Florida	16	5	1	26	2	6	16	15	3
12113	Santa Rosa County, Florida	25	10	2	1	2	12	12	17	28
12129	Wakulla County, Florida	36	27	16	15	10	20	33	28	6
12131	Walton County, Florida	35	4	25	18	10	22	22	12	9
22023	Cameron Parish, Louisiana	34	15	29	20	29	25	10	36	10
22045	Iberia Parish, Louisiana	19	31	30	24	29	8	2	20	35
22051	Jefferson Parish, Louisiana	12	12	15	36	12	14	29	4	36
22057	Lafourche Parish, Louisiana	20	19	18	7	15	13	9	16	19
22071	Orleans Parish, Louisiana	2	34	14	29	15	32	37	11	37
22075	Plaquemines Parish, Louisiana	29	29	23	8	29	28	8	18	13
22087	St. Bernard Parish, Louisiana	31	14	24	27	29	30	1	1	16
22101	St. Mary Parish, Louisiana	11	24	36	14	29	24	19	30	25
22103	St. Tammany Parish, Louisiana	14	13	5	35	15	3	18	10	18
22109	Terrebonne Parish, Louisiana	13	30	21	21	15	9	25	33	14
22113	Vermilion Parish, Louisiana	30	33	31	30	29	10	3	32	30
22117	Washington Parish, Louisiana	15	35	37	28	29	35	20	27	17
28045	Hancock County, Mississippi	28	18	17	23	29	17	11	29	29
28047	Harrison County, Mississippi	6	20	19	19	19	19	32	26	27
28059	Jackson County, Mississippi	18	25	13	22	29	21	17	25	20
28109	Pearl River County, Mississippi	27	28	32	12	29	29	4	35	12
45013	Beaufort County, South Carolina	10	1	4	37	10	1	26	6	11
45019	Charleston County, South Carolina	1	8	3	34	7	7	36	13	15
45029	Colleton County, South Carolina	21	32	26	17	29	31	31	22	7
45053	Jasper County, South Carolina	37	36	28	13	18	33	30	37	5
48039	Brazoria County, Texas	32	21	9	10	29	4	6	24	33
48071	Chambers County, Texas	33	17	8	4	29	26	7	34	24
48167	Galveston County, Texas	5	16	7	2	29	11	14	23	31
48245	Jefferson County, Texas	4	26	22	16	29	18	21	3	34
48321	Matagorda County, Texas	22	37	33	3	29	37	13	9	8

Notes: 1=highest; mean rank assigned to ties.

Table 8. Ranking of Counties by Well-being and Environmental Condition Composite Indicators, Time 2 (2004-05).

FIPS	County/Parish	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connected-ness	Environ. Condition
1003	Baldwin County, Alabama	28	6	17	31	19	5	15	12	25
1053	Escambia County, Alabama	20	30	30	15	30	30	24	25	13
1097	Mobile County, Alabama	6	25	19	30	22	24	35	19	36
12005	Bay County, Florida	14	5	12	16	3	11	30	8	24
12033	Escambia County, Florida	13	10	8	24	5	14	37	13	28
12037	Franklin County, Florida	23	1	28	11	4	13	11	2	2
12045	Gulf County, Florida	36	9	27	7	7	31	26	1	1
12087	Monroe County, Florida	10	3	6	22	8	2	33	6	12
12091	Okaloosa County, Florida	21	8	1	25	1	4	29	22	21
12113	Santa Rosa County, Florida	29	11	2	1	3	10	31	29	4
12129	Wakulla County, Florida	34	16	21	14	10	17	9	17	9
12131	Walton County, Florida	32	2	18	26	11	22	18	9	3
22023	Cameron Parish, Louisiana	33	14	25	9	30	34	7	37	7
22045	Iberia Parish, Louisiana	17	26	29	32	30	15	1	18	29
22051	Jefferson Parish, Louisiana	8	15	5	35	13	25	36	14	37
22057	Lafourche Parish, Louisiana	16	36	20	2	22	16	17	11	27
22071	Orleans Parish, Louisiana	2	35	11	34	18	36	34	21	23
22075	Plaquemines Parish, Louisiana	26	19	16	5	30	33	20	33	11
22087	St. Bernard Parish, Louisiana	35	13	13	19	30	32	13	5	17
22101	St. Mary Parish, Louisiana	9	28	34	8	20	28	10	10	34
22103	St. Tammany Parish, Louisiana	7	37	3	33	15	7	16	20	26
22109	Terrebonne Parish, Louisiana	11	34	26	23	14	9	23	30	5
22113	Vermilion Parish, Louisiana	31	29	31	27	30	27	2	28	31
22117	Washington Parish, Louisiana	12	27	37	20	30	35	8	27	15
28045	Hancock County, Mississippi	30	21	24	28	30	18	12	35	19
28047	Harrison County, Mississippi	4	33	23	21	12	21	25	24	30
28059	Jackson County, Mississippi	22	31	15	18	30	20	22	31	22
28109	Pearl River County, Mississippi	24	20	36	10	30	26	5	34	18
45013	Beaufort County, South Carolina	15	4	9	37	9	1	27	4	14
45019	Charleston County, South Carolina	1	12	4	36	6	3	32	7	33
45029	Colleton County, South Carolina	18	24	32	29	18	29	19	15	8
45053	Jasper County, South Carolina	37	23	33	12	16	8	28	32	6
48039	Brazoria County, Texas	25	18	10	17	30	6	3	26	35
48071	Chambers County, Texas	27	7	14	4	30	19	4	36	16
48167	Galveston County, Texas	3	17	7	6	30	12	14	23	32
48245	Jefferson County, Texas	5	22	22	13	30	23	21	16	20
48321	Matagorda County, Texas	19	32	35	3	30	37	6	3	10

Notes: 1=highest; mean rank assigned to ties.

Table 9. Ranking of Counties by Well-being and Environmental Condition Composite Indicators, Time 3 (2008-09).

FIPS	County/Parish	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connected-ness	Environ. Condition
1003	Baldwin County, Alabama	21	9	12	29	17	6	13	8	25
1053	Escambia County, Alabama	22	14	36	8	31	30	14	22	13
1097	Mobile County, Alabama	4	20	20	31	31	25	31	14	36
12005	Bay County, Florida	10	10	17	14	1	19	21	15	24
12033	Escambia County, Florida	12	16	23	26	6	16	35	7	28
12037	Franklin County, Florida	27	1	30	17	6	31	1	4	2
12045	Gulf County, Florida	33	8	32	6	6	33	4	6	1
12087	Monroe County, Florida	9	17	11	20	10	2	37	1	12
12091	Okaloosa County, Florida	17	6	5	27	3	4	20	11	21
12113	Santa Rosa County, Florida	30	13	2	1	3	9	15	25	4
12129	Wakulla County, Florida	34	31	19	16	8	10	2	20	9
12131	Walton County, Florida	36	3	26	28	13	26	7	12	3
22023	Cameron Parish, Louisiana	37	5	22	2	31	34	28	36	7
22045	Iberia Parish, Louisiana	16	22	25	25	23	17	22	27	29
22051	Jefferson Parish, Louisiana	8	15	7	34	13	14	34	24	37
22057	Lafourche Parish, Louisiana	24	35	10	5	22	15	10	31	27
22071	Orleans Parish, Louisiana	3	21	16	32	19	28	36	13	23
22075	Plaquemines Parish, Louisiana	26	4	1	4	31	3	5	34	11
22087	St. Bernard Parish, Louisiana	35	11	18	15	31	35	11	37	17
22101	St. Mary Parish, Louisiana	15	29	27	7	20	23	26	21	34
22103	St. Tammany Parish, Louisiana	7	18	4	33	15	8	23	19	26
22109	Terrebonne Parish, Louisiana	13	36	14	23	14	12	18	35	5
22113	Vermilion Parish, Louisiana	31	32	29	35	31	24	24	33	31
22117	Washington Parish, Louisiana	20	34	35	21	31	36	30	29	15
28045	Hancock County, Mississippi	29	12	28	30	31	21	8	32	19
28047	Harrison County, Mississippi	1	30	21	19	11	18	16	26	30
28059	Jackson County, Mississippi	18	27	13	18	31	20	12	23	22
28109	Pearl River County, Mississippi	28	23	34	24	31	29	6	28	18
45013	Beaufort County, South Carolina	11	2	15	37	9	1	33	2	14
45019	Charleston County, South Carolina	2	7	8	36	6	5	32	5	33
45029	Colleton County, South Carolina	19	26	37	13	17	32	29	9	8
45053	Jasper County, South Carolina	32	37	33	12	18	27	25	16	6
48039	Brazoria County, Texas	23	25	3	22	31	7	3	18	35
48071	Chambers County, Texas	25	19	9	3	31	13	9	30	16
48167	Galveston County, Texas	5	24	6	9	31	11	19	17	32
48245	Jefferson County, Texas	6	28	24	11	22	22	27	10	20
48321	Matagorda County, Texas	14	33	31	10	31	37	17	3	10

Notes: 1=highest; mean rank assigned to ties.

Table 10. Quintile Ranking of Counties by Well-being and Environmental Condition Composite Indicators, Time 1 (2000-01).

FIPS	County/Parish	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connected-ness	Environ. Condition
1003	Baldwin County, Alabama	4	1	2	5	2	1	4	1	4
1053	Escambia County, Alabama	4	4	4	1	4	4	1	5	3
1097	Mobile County, Alabama	1	3	3	5	4	4	5	3	5
12005	Bay County, Florida	2	2	2	2	1	2	4	3	1
12033	Escambia County, Florida	2	2	2	4	1	3	4	1	4
12037	Franklin County, Florida	4	1	5	2	1	5	5	2	1
12045	Gulf County, Florida	3	1	5	1	1	5	2	2	1
12087	Monroe County, Florida	1	1	1	5	2	1	4	1	3
12091	Okaloosa County, Florida	3	1	1	4	1	1	3	2	1
12113	Santa Rosa County, Florida	4	2	1	1	1	2	2	3	4
12129	Wakulla County, Florida	5	4	3	2	2	3	5	4	1
12131	Walton County, Florida	5	1	4	3	2	3	3	2	2
22023	Cameron Parish, Louisiana	5	2	4	3	4	4	2	5	2
22045	Iberia Parish, Louisiana	3	5	4	4	4	2	1	3	5
22051	Jefferson Parish, Louisiana	2	2	2	5	2	2	4	1	5
22057	Lafourche Parish, Louisiana	3	3	3	1	2	2	2	3	3
22071	Orleans Parish, Louisiana	1	5	2	4	2	5	5	2	5
22075	Plaquemines Parish, Louisiana	4	4	4	2	4	4	2	3	2
22087	St. Bernard Parish, Louisiana	5	2	4	4	4	4	1	1	3
22101	St. Mary Parish, Louisiana	2	4	5	2	4	4	3	4	4
22103	St. Tammany Parish, Louisiana	2	2	1	5	2	1	3	2	3
22109	Terrebonne Parish, Louisiana	2	4	3	3	2	2	4	5	2
22113	Vermilion Parish, Louisiana	4	5	5	4	4	2	1	5	4
22117	Washington Parish, Louisiana	2	5	5	4	4	5	3	4	3
28045	Hancock County, Mississippi	4	3	3	4	4	3	2	4	4
28047	Harrison County, Mississippi	1	3	3	3	3	3	5	4	4
28059	Jackson County, Mississippi	3	4	2	3	4	3	3	4	3
28109	Pearl River County, Mississippi	4	4	5	2	4	4	1	5	2
45013	Beaufort County, South Carolina	2	1	1	5	2	1	4	1	2
45019	Charleston County, South Carolina	1	2	1	5	1	1	5	2	2
45029	Colleton County, South Carolina	3	5	4	3	4	5	5	3	1
45053	Jasper County, South Carolina	5	5	4	2	3	5	4	5	1
48039	Brazoria County, Texas	5	3	2	2	4	1	1	4	5
48071	Chambers County, Texas	5	3	2	1	4	4	1	5	4
48167	Galveston County, Texas	1	3	1	1	4	2	2	4	5
48245	Jefferson County, Texas	1	4	3	3	4	3	3	1	5
48321	Matagorda County, Texas	3	5	5	1	4	5	2	2	2

Notes: 1=highest; mean rank assigned to ties.

Table 11. Quintile Ranking of Counties by Well-being and Environmental Condition Composite Indicators, Time 2 (2004-05).

FIPS	County/Parish	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connected-ness	Environ. Condition
1003	Baldwin County, Alabama	4	1	3	5	3	1	2	2	4
1053	Escambia County, Alabama	3	4	4	2	4	4	4	4	2
1097	Mobile County, Alabama	1	4	3	4	3	4	5	3	5
12005	Bay County, Florida	2	1	2	3	1	2	4	2	4
12033	Escambia County, Florida	2	2	2	4	1	2	5	2	4
12037	Franklin County, Florida	4	1	4	2	1	2	2	1	1
12045	Gulf County, Florida	5	2	4	1	1	5	4	1	1
12087	Monroe County, Florida	2	1	1	3	2	1	5	1	2
12091	Okaloosa County, Florida	3	2	1	4	1	1	4	3	3
12113	Santa Rosa County, Florida	4	2	1	1	1	2	5	4	1
12129	Wakulla County, Florida	5	3	3	2	2	3	2	3	2
12131	Walton County, Florida	5	1	3	4	2	3	3	2	1
22023	Cameron Parish, Louisiana	5	2	4	2	4	5	1	5	1
22045	Iberia Parish, Louisiana	3	4	4	5	4	2	1	3	4
22051	Jefferson Parish, Louisiana	2	2	1	5	2	4	5	2	5
22057	Lafourche Parish, Louisiana	3	5	3	1	3	3	3	2	4
22071	Orleans Parish, Louisiana	1	5	2	5	3	5	5	3	4
22075	Plaquemines Parish, Louisiana	4	3	3	1	4	5	3	5	2
22087	St. Bernard Parish, Louisiana	5	2	2	3	4	5	2	1	3
22101	St. Mary Parish, Louisiana	2	4	5	2	3	4	2	2	5
22103	St. Tammany Parish, Louisiana	1	5	1	5	2	1	3	3	4
22109	Terrebonne Parish, Louisiana	2	5	4	4	2	2	4	4	1
22113	Vermilion Parish, Louisiana	5	4	5	4	4	4	1	4	5
22117	Washington Parish, Louisiana	2	4	5	3	4	5	2	4	2
28045	Hancock County, Mississippi	4	3	4	4	4	3	2	5	3
28047	Harrison County, Mississippi	1	5	4	3	2	3	4	4	4
28059	Jackson County, Mississippi	3	5	2	3	4	3	3	5	3
28109	Pearl River County, Mississippi	4	3	5	2	4	4	1	5	3
45013	Beaufort County, South Carolina	2	1	2	5	2	1	4	1	2
45019	Charleston County, South Carolina	1	2	1	5	1	1	5	1	5
45029	Colleton County, South Carolina	3	4	5	4	3	4	3	2	2
45053	Jasper County, South Carolina	5	4	5	2	3	2	4	5	1
48039	Brazoria County, Texas	4	3	2	3	4	1	1	4	5
48071	Chambers County, Texas	4	1	2	1	4	3	1	5	3
48167	Galveston County, Texas	1	3	1	1	4	2	2	4	5
48245	Jefferson County, Texas	1	3	3	2	4	4	3	3	3
48321	Matagorda County, Texas	3	5	5	1	4	5	1	1	2

Notes: 1=highest; mean rank assigned to ties.

Table 12. Quintile Ranking of Counties by Well-being and Environmental Condition Composite Indicators, Time 3 (2008-09).

FIPS	County/Parish	Access to Social Services	Basic Needs	Economic Security	Education	Governance	Health	Safety	Social Connected-ness	Environ. Condition
1003	Baldwin County, Alabama	3	2	2	4	3	1	2	2	4
1053	Escambia County, Alabama	3	2	5	2	5	4	2	3	2
1097	Mobile County, Alabama	1	3	3	5	5	4	5	2	5
12005	Bay County, Florida	2	2	3	2	1	3	3	2	4
12033	Escambia County, Florida	2	3	4	4	1	3	5	1	4
12037	Franklin County, Florida	4	1	4	3	1	5	1	1	1
12045	Gulf County, Florida	5	2	5	1	1	5	1	1	1
12087	Monroe County, Florida	2	3	2	3	2	1	5	1	2
12091	Okaloosa County, Florida	3	1	1	4	1	1	3	2	3
12113	Santa Rosa County, Florida	4	2	1	1	1	2	2	4	1
12129	Wakulla County, Florida	5	5	3	3	2	2	1	3	2
12131	Walton County, Florida	5	1	4	4	2	4	1	2	1
22023	Cameron Parish, Louisiana	5	1	3	1	5	5	4	5	1
22045	Iberia Parish, Louisiana	3	3	4	4	4	3	3	4	4
22051	Jefferson Parish, Louisiana	2	2	1	5	2	2	5	4	5
22057	Lafourche Parish, Louisiana	4	5	2	1	3	2	2	5	4
22071	Orleans Parish, Louisiana	1	3	3	5	3	4	5	2	4
22075	Plaquemines Parish, Louisiana	4	1	1	1	5	1	1	5	2
22087	St. Bernard Parish, Louisiana	5	2	3	2	5	5	2	5	3
22101	St. Mary Parish, Louisiana	2	4	4	1	3	4	4	3	5
22103	St. Tammany Parish, Louisiana	1	3	1	5	2	2	4	3	4
22109	Terrebonne Parish, Louisiana	2	5	2	4	2	2	3	5	1
22113	Vermilion Parish, Louisiana	5	5	4	5	5	4	4	5	5
22117	Washington Parish, Louisiana	3	5	5	3	5	5	4	4	2
28045	Hancock County, Mississippi	4	2	4	4	5	3	2	5	3
28047	Harrison County, Mississippi	1	4	3	3	2	3	3	4	4
28059	Jackson County, Mississippi	3	4	2	3	5	3	2	4	3
28109	Pearl River County, Mississippi	4	4	5	4	5	4	1	4	3
45013	Beaufort County, South Carolina	2	1	2	5	2	1	5	1	2
45019	Charleston County, South Carolina	1	1	2	5	1	1	5	1	5
45029	Colleton County, South Carolina	3	4	5	2	3	5	4	2	2
45053	Jasper County, South Carolina	5	5	5	2	3	4	4	3	1
48039	Brazoria County, Texas	4	4	1	3	5	1	1	3	5
48071	Chambers County, Texas	4	3	2	1	5	2	2	4	3
48167	Galveston County, Texas	1	4	1	2	5	2	3	3	5
48245	Jefferson County, Texas	1	4	4	2	3	3	4	2	3
48321	Matagorda County, Texas	2	5	5	2	5	5	3	1	2

Notes: 1=highest; mean rank assigned to ties.

Table 13. Descriptive Statistics for Indicators by Time Period.

Descriptive Statistics, Time 1 (2000-01)

Indicators	N	Minimum	Maximum	Mean	Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic
Access to services	37	23.23	66.04	44.93	10.61
Basic Needs	37	30.15	79.17	52.25	12.02
Economic Security	37	26.43	70.51	47.21	11.68
Education	37	18.72	63.15	39.05	10.31
Governance	37	0.00	90.00	22.70	29.17
Health	37	25.52	85.34	62.97	9.81
Safety	37	41.73	98.39	70.43	13.04
Social Connectedness	37	24.98	62.36	44.20	9.10
Environmental Condition	37	41.29	99.16	79.84	13.20

Descriptive Statistics, Time 2 (2004-05)

Indicators	N	Minimum	Maximum	Mean	Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic
Access to services	37	25.49	62.59	43.41	10.22
Basic Needs	37	28.59	71.80	47.93	10.38
Economic Security	37	23.64	68.42	47.31	11.81
Education	37	12.52	61.35	36.11	12.16
Governance	37	0.00	91.67	27.39	30.40
Health	37	28.03	88.54	65.42	10.32
Safety	37	39.89	95.72	64.85	12.60
Social Connectedness	37	22.73	68.18	45.68	10.82
Environmental Condition	37	35.22	99.18	73.81	12.87

Descriptive Statistics, Time 3 (2008-09)

Indicators	N	Minimum	Maximum	Mean	Std. Deviation
	Statistic	Statistic	Statistic	Statistic	Statistic
Access to services	37	23.07	59.61	42.38	9.48
Basic Needs	37	35.09	70.80	52.90	8.77
Economic Security	37	21.35	63.03	44.08	11.74
Education	37	12.10	69.16	36.92	12.85
Governance	37	0.00	100.00	31.08	33.14
Health	37	22.36	84.99	63.43	10.03
Safety	37	35.96	91.71	70.24	13.79
Social Connectedness	37	21.41	80.59	62.87	12.86
Environmental Condition	37	35.22	99.18	73.81	12.87

Table 14. Correlations of Composite Indicators of Well-being and Environmental Condition for Time 1 (2000-01).

		access to social services	basic needs	economic security	education	governance	health	safety	social connected ness	environmental condition
access to social services	Pearson Correlation	1								
	Sig. (2-tailed)									
	N	37								
basic needs	Pearson Correlation	.151	1							
	Sig. (2-tailed)	.373								
	N	37	37							
economic security	Pearson Correlation	.304	.458**	1						
	Sig. (2-tailed)	.067	.004							
	N	37	37	37						
education	Pearson Correlation	-.355*	-.253	-.234	1					
	Sig. (2-tailed)	.031	.130	.163						
	N	37	37	37	37					
governance	Pearson Correlation	.150	.659**	.426**	.002	1				
	Sig. (2-tailed)	.377	.000	.009	.991					
	N	37	37	37	37	37				
health	Pearson Correlation	.225	.533**	.641**	-.483**	.225	1			
	Sig. (2-tailed)	.180	.001	.000	.002	.180				
	N	37	37	37	37	37	37			
safety	Pearson Correlation	-.513**	-.193	-.193	.366*	-.338*	-.040	1		
	Sig. (2-tailed)	.001	.253	.253	.026	.041	.814			
	N	37	37	37	37	37	37	37		
social connectedness	Pearson Correlation	.411*	.503**	.306	-.354*	.360*	.115	-.195	1	
	Sig. (2-tailed)	.012	.002	.065	.032	.029	.497	.246		
	N	37	37	37	37	37	37	37	37	
environmental condition	Pearson Correlation	-.359*	.243	-.162	.195	.349*	-.191	.059	-.130	1
	Sig. (2-tailed)	.029	.147	.337	.247	.034	.258	.727	.442	
	N	37	37	37	37	37	37	37	37	37

Notes: All correlations are 2-tailed; * significant at the p≤0.05 level, ** significant at the p≤0.01 level.

Table 15. Correlations of Composite Indicators of Well-being and Environmental Condition for Time 2 (2004-05).

		access to social services	basic needs	economic security	education	governance	health	safety	social connected ness	environmental condition
access to social services	Pearson Correlation	1								
	Sig. (2-tailed)									
	N	37								
basic needs	Pearson Correlation	-.315	1							
	Sig. (2-tailed)	.058								
	N	37	37							
economic security	Pearson Correlation	.220	.258	1						
	Sig. (2-tailed)	.190	.123							
	N	37	37	37						
education	Pearson Correlation	-.336*	-.056	-.175	1					
	Sig. (2-tailed)	.042	.744	.301						
	N	37	37	37	37					
governance	Pearson Correlation	.068	.533**	.466**	-.167	1				
	Sig. (2-tailed)	.688	.001	.004	.323					
	N	37	37	37	37	37				
health	Pearson Correlation	.104	.385*	.467**	-.350*	.439**	1			
	Sig. (2-tailed)	.540	.019	.004	.034	.007				
	N	37	37	37	37	37	37			
safety	Pearson Correlation	-.369*	-.151	-.481**	.228	-.607**	-.212	1		
	Sig. (2-tailed)	.025	.372	.003	.174	.000	.209			
	N	37	37	37	37	37	37	37		
social connectedness	Pearson Correlation	.201	.352*	.105	-.213	.470**	.077	-.239	1	
	Sig. (2-tailed)	.233	.032	.535	.207	.003	.650	.154		
	N	37	37	37	37	37	37	37	37	
environmental condition	Pearson Correlation	-.531**	.357*	-.208	.340*	.244	-.089	.127	.075	1
	Sig. (2-tailed)	.001	.030	.216	.039	.146	.600	.454	.660	
	N	37	37	37	37	37	37	37	37	37

Notes: All correlations are 2-tailed; * significant at the p≤0.05 level, ** significant at the p≤0.01 level.

Table 16. Correlations of Composite Indicators of Well-being and Environmental Condition for Time 3 (2008-09).

		access to social services	basic needs	economic security	education	governance	health	safety	social connected ness	environmental condition
access to social services	Pearson Correlation	1								
	Sig. (2-tailed)									
	N	37								
basic needs	Pearson Correlation	-.173	1							
	Sig. (2-tailed)	.305								
	N	37	37							
economic security	Pearson Correlation	.268	.191	1						
	Sig. (2-tailed)	.109	.257							
	N	37	37	37						
education	Pearson Correlation	-.394*	-.101	-.028	1					
	Sig. (2-tailed)	.016	.553	.870						
	N	37	37	37	37					
governance	Pearson Correlation	.109	.406*	.163	-.152	1				
	Sig. (2-tailed)	.520	.013	.334	.369					
	N	37	37	37	37	37				
health	Pearson Correlation	.239	.261	.658**	-.279	.351*	1			
	Sig. (2-tailed)	.154	.119	.000	.095	.033				
	N	37	37	37	37	37	37			
safety	Pearson Correlation	-.537**	.129	-.032	.356*	-.112	-.166	1		
	Sig. (2-tailed)	.001	.446	.852	.031	.510	.326			
	N	37	37	37	37	37	37	37		
social connectedness	Pearson Correlation	.485**	.103	-.103	-.302	.465**	.146	-.229	1	
	Sig. (2-tailed)	.002	.542	.543	.069	.004	.388	.173		
	N	37	37	37	37	37	37	37	37	
environmental condition	Pearson Correlation	-.545**	.257	-.354*	.368*	.242	-.190	.403*	.012	1
	Sig. (2-tailed)	.000	.125	.032	.025	.149	.260	.013	.944	
	N	37	37	37	37	37	37	37	37	37

Notes: All correlations are 2-tailed; * significant at the p≤0.05 level, ** significant at the p≤0.01 level.

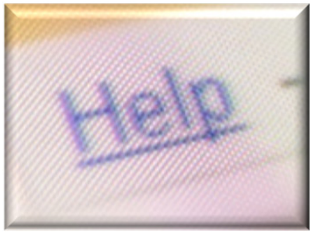
Table 17. Change in Well-being Indicators from Time 1 to Time 2 by County.

FIPS	County/Parish	Change in access t1 to t2	Change in basic needs t1 to t2	Change in economic security t1 to t2	Change in education t1 to t2	Change in governance t1 to t2	Change in health t1 to t2	Change in safety t1 to t2	Change in social connectedness t1 to t2	Change in environmental condition t1 to t2
1003	Baldwin County, Alabama	-4.00	0.00	-7.00	1.00	-4.00	0.00	12.00	-10.00	1.00
1053	Escambia County, Alabama	3.00	-7.00	-3.00	-9.00	-1.50	-3.00	-19.00	6.00	8.00
1097	Mobile County, Alabama	-3.00	-3.00	1.00	3.00	7.00	-1.00	-1.00	0.00	-4.00
12005	Bay County, Florida	-6.00	4.00	-1.00	-5.00	0.50	4.00	-7.00	13.00	-20.00
12033	Escambia County, Florida	-4.00	1.00	4.00	1.00	1.50	2.00	-13.00	-8.00	-5.00
12037	Franklin County, Florida	3.00	2.00	7.00	-2.00	0.50	21.00	24.00	12.00	-1.00
12045	Gulf County, Florida	-19.00	-2.00	7.00	-2.00	-2.50	5.00	-11.00	7.00	1.00
12087	Monroe County, Florida	-3.00	-1.00	0.00	9.00	1.50	0.00	-5.00	1.00	10.00
12091	Okaloosa County, Florida	-5.00	-3.00	0.00	1.00	0.50	2.00	-13.00	-7.00	-18.00
12113	Santa Rosa County, Florida	-4.00	-1.00	0.00	0.00	-1.00	2.00	-19.00	-12.00	24.00
12129	Wakulla County, Florida	2.00	11.00	-5.00	1.00	-0.50	3.00	24.00	11.00	-3.00
12131	Walton County, Florida	3.00	2.00	7.00	-8.00	-1.50	0.00	4.00	3.00	6.00
22023	Cameron Parish, Louisiana	1.00	1.00	4.00	11.00	-1.50	-9.00	3.00	-1.00	3.00
22045	Iberia Parish, Louisiana	2.00	5.00	1.00	-8.00	-1.50	-7.00	1.00	2.00	6.00
22051	Jefferson Parish, Louisiana	4.00	-3.00	10.00	1.00	-1.00	-11.00	-7.00	-10.00	-1.00
22057	Lafourche Parish, Louisiana	4.00	-17.00	-2.00	5.00	-6.50	-3.00	-8.00	5.00	-8.00
22071	Orleans Parish, Louisiana	0.00	-1.00	3.00	-5.00	-2.50	-4.00	3.00	-10.00	14.00
22075	Plaquemines Parish, Louisiana	3.00	10.00	7.00	3.00	-1.50	-5.00	-12.00	-15.00	2.00
22087	St. Bernard Parish, Louisiana	-4.00	1.00	11.00	8.00	-1.50	-2.00	-12.00	-4.00	-1.00
22101	St. Mary Parish, Louisiana	2.00	-4.00	2.00	6.00	8.50	-4.00	9.00	20.00	-9.00
22103	St. Tammany Parish, Louisiana	7.00	-24.00	2.00	2.00	0.00	-4.00	2.00	-10.00	-8.00
22109	Terrebonne Parish, Louisiana	2.00	-4.00	-5.00	-2.00	1.00	0.00	2.00	3.00	9.00
22113	Vermilion Parish, Louisiana	-1.00	4.00	0.00	3.00	-1.50	-17.00	1.00	4.00	-1.00
22117	Washington Parish, Louisiana	3.00	8.00	0.00	8.00	-1.50	0.00	12.00	0.00	2.00
28045	Hancock County, Mississippi	-2.00	-3.00	-7.00	-5.00	-1.50	-1.00	-1.00	-6.00	10.00
28047	Harrison County, Mississippi	2.00	-13.00	-4.00	-2.00	7.00	-2.00	7.00	2.00	-3.00
28059	Jackson County, Mississippi	-4.00	-6.00	-2.00	4.00	-1.50	1.00	-5.00	-6.00	-2.00
28109	Pearl River County, Mississippi	3.00	8.00	-4.00	2.00	-1.50	3.00	-1.00	1.00	-6.00
45013	Beaufort County, South Carolina	-5.00	-3.00	-5.00	0.00	0.50	0.00	-1.00	2.00	-3.00
45019	Charleston County, South Carolina	0.00	-4.00	-1.00	-2.00	0.50	4.00	4.00	6.00	-18.00
45029	Colleton County, South Carolina	3.00	8.00	-6.00	-12.00	11.00	2.00	12.00	7.00	-1.00
45053	Jasper County, South Carolina	0.00	13.00	-5.00	1.00	2.00	25.00	2.00	5.00	-1.00
48039	Brazoria County, Texas	7.00	3.00	-1.00	-7.00	-1.50	-2.00	3.00	-2.00	-2.00
48071	Chambers County, Texas	6.00	10.00	-6.00	0.00	-1.50	7.00	3.00	-2.00	8.00
48167	Galveston County, Texas	2.00	-1.00	0.00	-4.00	-1.50	-1.00	0.00	0.00	-1.00
48245	Jefferson County, Texas	-1.00	4.00	0.00	3.00	-1.50	-5.00	0.00	-13.00	14.00
48321	Matagorda County, Texas	3.00	5.00	-2.00	0.00	-1.50	0.00	7.00	6.00	-2.00

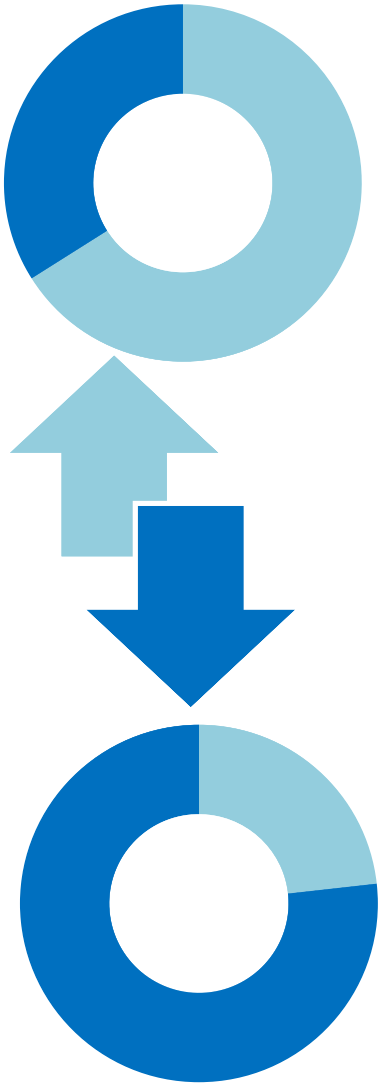
Table 18. Change in Well-being Indicators from Time 2 to Time 3 by County.

FIPS	County/Parish	Change in access t2 to t3	Change in basic needs t2 to t3	Change in economic security t2 to t3	Change in education t2 to t3	Change in governance t2 to t3	Change in health t2 to t3	Change in safety t2 to t3	Change in social connectedness t2 to t3	Change in environmental condition t2 to t3
1003	Baldwin County, Alabama	7.00	-3.00	5.00	2.00	2.50	-1.00	2.00	4.00	0.00
1053	Escambia County, Alabama	-2.00	16.00	-6.00	7.00	-0.50	0.00	10.00	3.00	0.00
1097	Mobile County, Alabama	2.00	5.00	-1.00	-1.00	-9.00	-1.00	4.00	5.00	0.00
12005	Bay County, Florida	4.00	-5.00	-5.00	2.00	1.50	-8.00	9.00	-7.00	0.00
12033	Escambia County, Florida	1.00	-6.00	-15.00	-2.00	-0.50	-2.00	2.00	6.00	0.00
12037	Franklin County, Florida	-4.00	0.00	-2.00	-6.00	-1.50	-18.00	10.00	-2.00	0.00
12045	Gulf County, Florida	3.00	1.00	-5.00	1.00	1.50	-2.00	22.00	-5.00	0.00
12087	Monroe County, Florida	1.00	-14.00	-5.00	2.00	-2.00	0.00	-4.00	5.00	0.00
12091	Okaloosa County, Florida	4.00	2.00	-4.00	-2.00	-1.50	0.00	9.00	11.00	0.00
12113	Santa Rosa County, Florida	-1.00	-2.00	0.00	0.00	0.00	1.00	16.00	4.00	0.00
12129	Wakulla County, Florida	0.00	-15.00	2.00	-2.00	2.00	7.00	7.00	-3.00	0.00
12131	Walton County, Florida	-4.00	-1.00	-8.00	-2.00	-1.50	-4.00	11.00	-3.00	0.00
22023	Cameron Parish, Louisiana	-4.00	9.00	3.00	7.00	-0.50	0.00	-21.00	1.00	0.00
22045	Iberia Parish, Louisiana	1.00	4.00	4.00	7.00	7.00	-2.00	-21.00	-9.00	0.00
22051	Jefferson Parish, Louisiana	0.00	0.00	-2.00	1.00	0.50	11.00	2.00	-10.00	0.00
22057	Lafourche Parish, Louisiana	-8.00	1.00	10.00	-3.00	0.00	1.00	7.00	-20.00	0.00
22071	Orleans Parish, Louisiana	-1.00	14.00	-5.00	2.00	-1.50	8.00	-2.00	8.00	0.00
22075	Plaquemines Parish, Louisiana	0.00	15.00	15.00	1.00	-0.50	30.00	15.00	-1.00	0.00
22087	St. Bernard Parish, Louisiana	0.00	2.00	-5.00	4.00	-0.50	-3.00	2.00	-32.00	0.00
22101	St. Mary Parish, Louisiana	-6.00	-1.00	7.00	1.00	0.00	5.00	-16.00	-11.00	0.00
22103	St. Tammany Parish, Louisiana	0.00	19.00	-1.00	0.00	0.00	-1.00	-7.00	1.00	0.00
22109	Terrebonne Parish, Louisiana	-2.00	-2.00	12.00	0.00	0.00	-3.00	5.00	-5.00	0.00
22113	Vermilion Parish, Louisiana	0.00	-3.00	2.00	-8.00	-0.50	3.00	-22.00	-5.00	0.00
22117	Washington Parish, Louisiana	-8.00	-7.00	2.00	-1.00	-0.50	-1.00	-22.00	-2.00	0.00
28045	Hancock County, Mississippi	1.00	9.00	-4.00	-2.00	-0.50	-3.00	4.00	3.00	0.00
28047	Harrison County, Mississippi	3.00	3.00	2.00	2.00	1.00	3.00	9.00	-2.00	0.00
28059	Jackson County, Mississippi	4.00	4.00	2.00	0.00	-0.50	0.00	10.00	8.00	0.00
28109	Pearl River County, Mississippi	-4.00	-3.00	2.00	-14.00	-0.50	-3.00	-1.00	6.00	0.00
45013	Beaufort County, South Carolina	4.00	2.00	-6.00	0.00	0.00	0.00	-6.00	2.00	0.00
45019	Charleston County, South Carolina	-1.00	5.00	-4.00	0.00	0.50	-2.00	0.00	2.00	0.00
45029	Colleton County, South Carolina	-1.00	-2.00	-5.00	16.00	1.00	-3.00	-10.00	6.00	0.00
45053	Jasper County, South Carolina	5.00	-14.00	0.00	0.00	-2.00	-19.00	3.00	16.00	0.00
48039	Brazoria County, Texas	2.00	-7.00	7.00	-5.00	-0.50	-1.00	0.00	8.00	0.00
48071	Chambers County, Texas	2.00	-12.00	5.00	1.00	-0.50	6.00	-5.00	6.00	0.00
48167	Galveston County, Texas	-2.00	-7.00	1.00	-3.00	-0.50	1.00	-5.00	6.00	0.00
48245	Jefferson County, Texas	-1.00	-6.00	-2.00	2.00	8.50	1.00	-6.00	6.00	0.00
48321	Matagorda County, Texas	5.00	-1.00	4.00	-7.00	-0.50	0.00	-11.00	0.00	0.00

Figure 2.



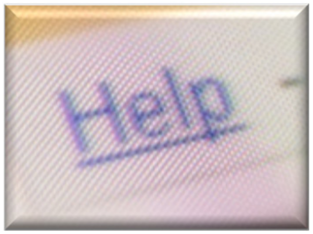
Access to Social Services
Time 1



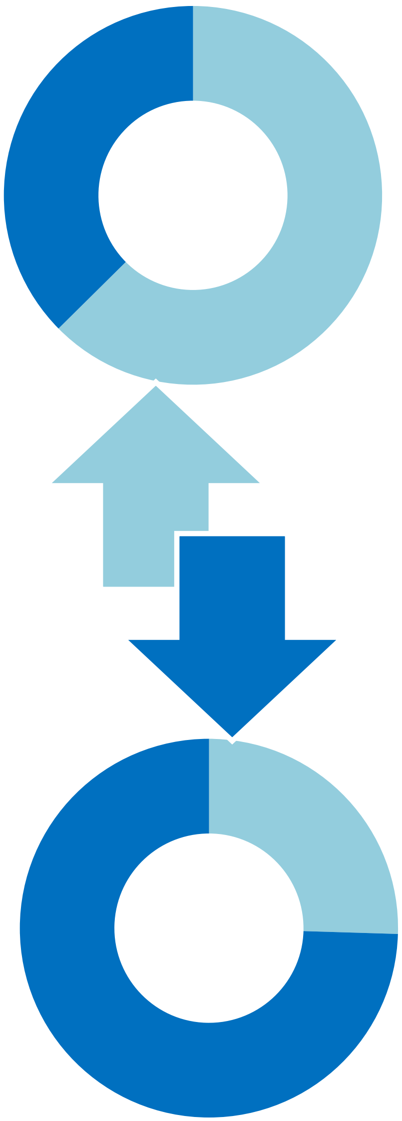
1.22 Human service organizations per 1000 people	83 out of 100 people in poverty are participants of Supplemental Nutrition Assistance Program	7 Hospital beds per 1000 people	15.79 Physicians per 1000 people	8.12 Percentage of households without a vehicle
0.19 Human service organizations per 1000 people	36 out of 100 people in poverty are participants of Supplemental Nutrition Assistance Program	0 Hospital beds per 1000 people	1.30 Physicians per 1000 people	10.77 Percentage of households without a vehicle

% score out of 100% of possible score
% of no score

Figure 3.



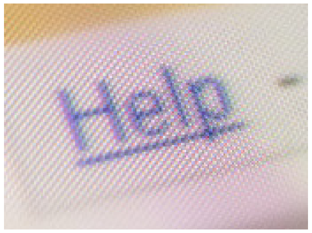
Access to Social Services Time 2



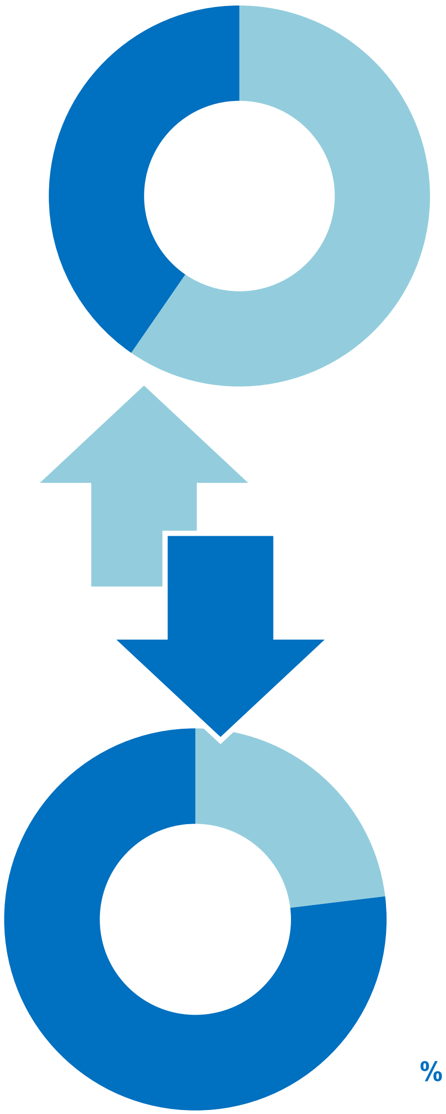
1.64 Human service organizations per 1000 people	100 out of 100 people in poverty are participants of Supplemental Nutrition Assistance Program	5.36 Hospital beds per 1000 people	15.00 Physicians per 1000 people	6.40 Percentage of households without a vehicle
0.33 Human service organizations per 1000 people	47 out of 100 people in poverty are participants of Supplemental Nutrition Assistance Program	0.00 Hospital beds per 1000 people	0.74 Physicians per 1000 people	9.03 Percentage of households without a vehicle

% score out of 100% of possible score
% of no score

Figure 4.



Access to Social Services Time 3



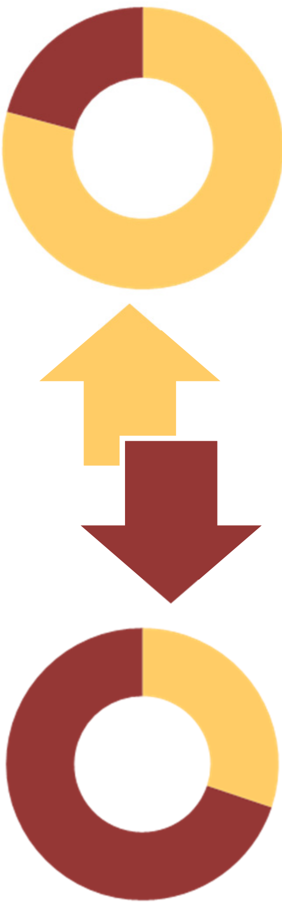
2.09 Human service organizations per 1000 people	70 out of 100 people in poverty are participants of Supplemental Nutrition Assistance Program	9.75 Hospital beds per 1000 people	16.19 Physicians per 1000 people	4.7% of households without a vehicle
0.54 Human service organizations per 1000 people	33 out of 100 people in poverty are participants of Supplemental Nutrition Assistance Program	0.00 Hospital beds per 1000 people	0.28 Physicians per 1000 people	5.6% of households without a vehicle

% score out of 100% of possible score

% of no score

Figure 5.

Basic Needs Time 1



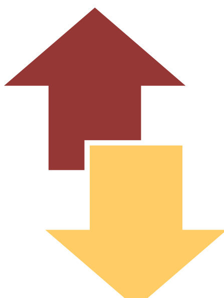
99 homes out of every 100 have public water	0.71 healthy food outlets per 1000 people	0 housing units out of 100 are lacking complete plumbing	0.37 % of houses have incomplete kitchens	$241.200 median value of housing	2.23 average rooms per person (in an average household)	1.67 total housing available per household	1986 median year housing units built
59 homes out of every hundred have public water	0.29 healthy food outlets per 1000 people	2 housing units out of 100 are lacking complete plumbing	4.04% of housing units have incomplete kitchens	$ 54,200 median value of housing	1.78 average rooms per person	1.06 total housing available per household	1972 median year housing units built

% score out of 100% of possible score

% of no score

Figure 6.

Basic Needs Time 2



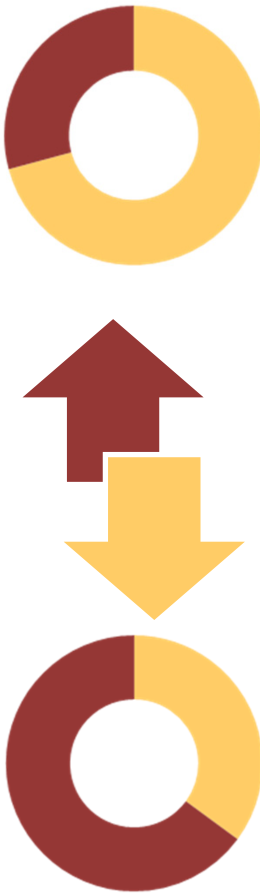
100 homes out of every 100 have public water	0.70 healthy food outlets per 1000 people	0 housing units out of 100 are lacking complete plumbing	0.6 % of housing units have incomplete kitchens	$671,800 median value of housing	2.24 average rooms per person (in an average household)	1.83 total housing available per household	1991 median year housing units built
63 homes out of every hundred have public water	0.14 healthy food outlets per 1000 people	1 housing unit out of 100 are lacking complete plumbing	1.8 % of housing units have incomplete kitchens	$ 98,800 median value of housing	1.11 average rooms per person	1.11 total housing available per household	1952 median year housing units built

% score out of 100% of possible score

% of no score

Figure 7.

Basic Needs Time 3



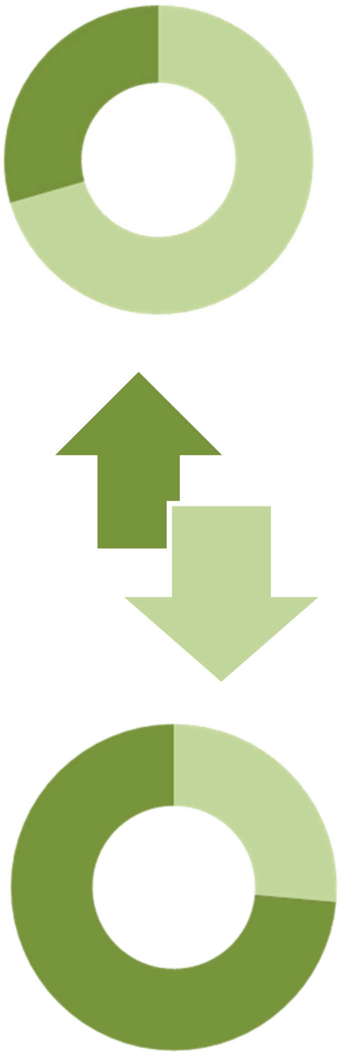
96 homes out of every 100 have public water	0.44 healthy food outlets per 1000 people	0 housing units out of 100 are lacking complete plumbing	0.6% of housing units have incomplete kitchens	$281,000 median value of housing	2.31 average rooms per person (in an average household)	1.85 total housing available per household	1994 median year housing units built
49 homes out of every hundred have public water	0.13 healthy food outlets per 1000 people	2 housing units out of 100 are lacking complete plumbing	2.4 % of housing units have incomplete kitchens	$ 112,300 median value of housing	1.90 average rooms per person	1.09 total housing available per household	1976 median year housing units built

% score out of 100% of possible score

% of no score

Figure 8.

Economic Security Time 1



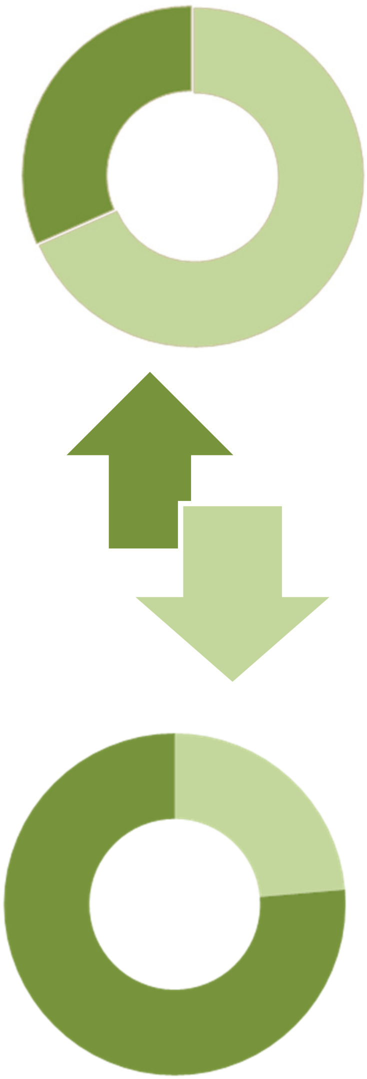
$12,537.63 Federal dollars spent per 1000 people	$ 3,449,162 Local government revenues per 1000 people	$42,626 Median household income	14.30% People under 18 in poverty	$12,368,211,277 Gross domestic product (GDP, 2000 values)	3.20% civilian unemployment	0.09 Economic diversity using the National Index Method (0=most diverse)
$4838.78 Federal dollars spent per 1000 people	$1,155,573 Local government revenues per 1000 people	$25,052 Median household income	31.90% People under 18 in poverty	$142,914,239 Gross domestic product (GDP, 2000 values)	6.90% civilian unemployment	1.51 Economic diversity using the National Index Method

% score out of 100% of possible score

% of no score

Figure 9.

Economic Security Time 2



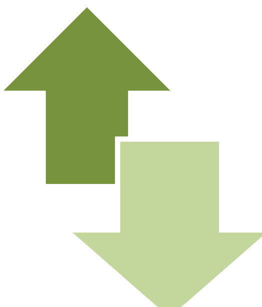
$16,591.28 Federal dollars spent per 1000 people	$ 3,889,958 Local government revenues per 1000 people	$53,654 Median household income	13.20% People under 18 in poverty	$4,942,524,585 Gross domestic product (GDP, 2000 values)	0.00% civilian unemployment	0.50 Economic diversity using the National Index Method (0=most diverse)
$5,517.44 Federal dollars spent per 1000 people	$1,566,358 Local government revenues per 1000 people	$27,284 Median household income	37.50% People under 18 in poverty	$426,390,564 Gross domestic product (GDP, 2000 values)	9.60% civilian unemployment	0.91 Economic diversity using the National Index Method

% score out of 100% of possible score

% of no score

Figure 10.

Economic Security
Time 3



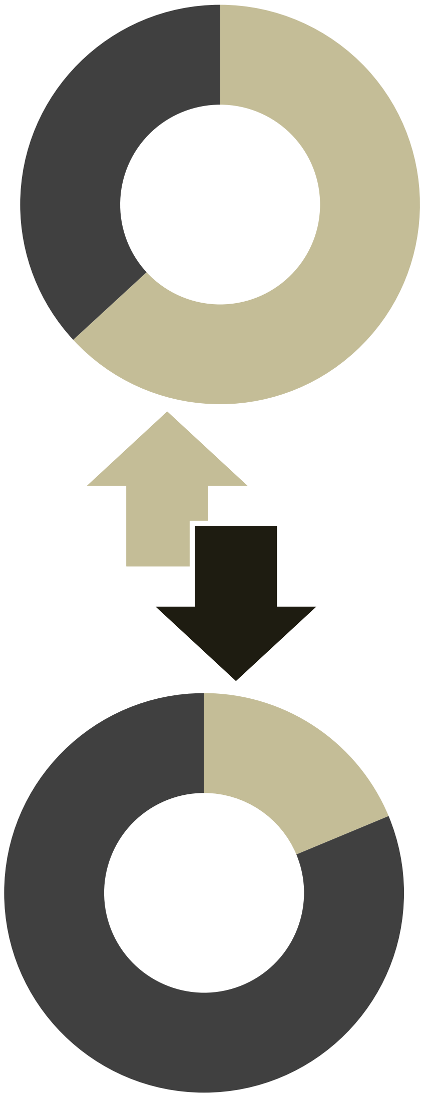
$55,465.84 Federal dollars spent per 1000 people	$4,213,333 Local government revenues per 1000 people	$63,959 Median household income	12.50% People under 18 in poverty	$7,503,886,446 gross domestic product (GDP, 2000 values)	4.30% civilian unemployment	0.10 Economic diversity using the National Index Method (0=most diverse)
$7382.02 Federal dollars spent per 1000 people	$1,675,849 Local government revenues per 1000 people	$30,725 Median household income	34.20% People under 18 in poverty	$449,038,653 gross domestic product (GDP, 2000 values)	8.30% civilian unemployment	0.48 Economic diversity using the National Index Method

% score out of 100% of possible score

% of no score

Figure 11.

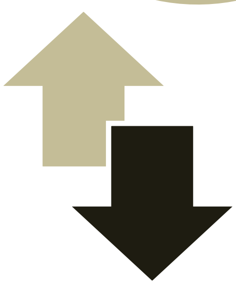
Education Time 1

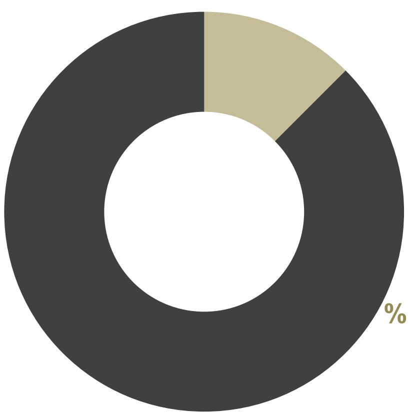


$14,822 Average educational expenditure per student enrolled in public schools (K-12)	52.10% of total population over 25 years of age with at least a high school diploma or equivalent	99 of 100 school age children enrolled in public schools
$6195 Average educational expenditure per student enrolled in public schools (K-12)	51.5 % of total population over 25 years of age with at least a high school diploma or equivalent	44 of 100 school age children enrolled in public schools

Figure 12.

Education Time 2

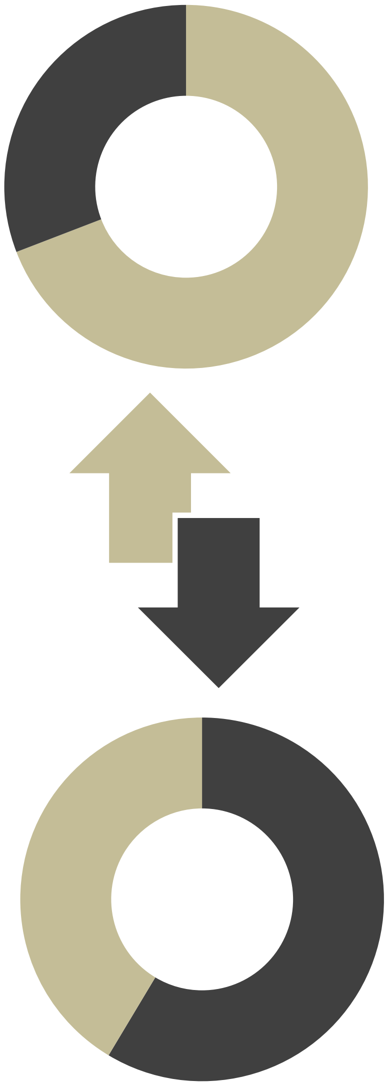




$16,987 Average educational expenditure per student enrolled in public schools (K-12)	56.5% of total population over 25 years of age with at least a high school diploma or equivalent	76 of 100 school age children enrolled in public schools
$7913 Average educational expenditure per student enrolled in public schools (K-12)	55.0 % of total population over 25 years of age with at least a high school diploma or equivalent	46 of 100 school age children enrolled in public schools

Figure 13.

Education Time 3



$20590 Average educational expenditure per student enrolled in public schools (K-12)	52.9 % of total population over 25 years of age with at least a high school diploma or equivalent	100 of 100 school age children enrolled in public schools
$8754 Average educational expenditure per student enrolled in public schools (K-12)	58.6% of total population over 25 years of age with at least a high school diploma or equivalent	52 of 100 school age children enrolled in public schools

% score out of 100% of possible score

% of no score

Figure 14.

Environmental Condition Time 1

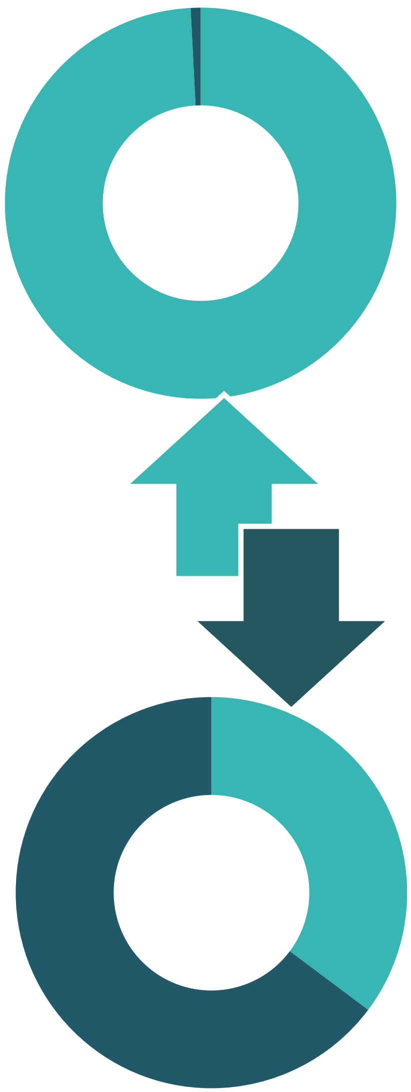
1.75% Developed land cover	5/5 water quality score	5/5 sediment quality score	9893 person-days with PM 2.5 over the standard	0.00 person-days with max. 8-hr average ozone concentration over standard
42.91% Developed land cover	3/5 water quality score	3/5 sediment quality score	1,099,050 person-days with PM 2.5 over the standard	7,231,696 person-days with max. 8-hr average ozone concentration over standard

% score out of 100% of possible score

% of no score

Figure 15.

Environmental Condition Time 2



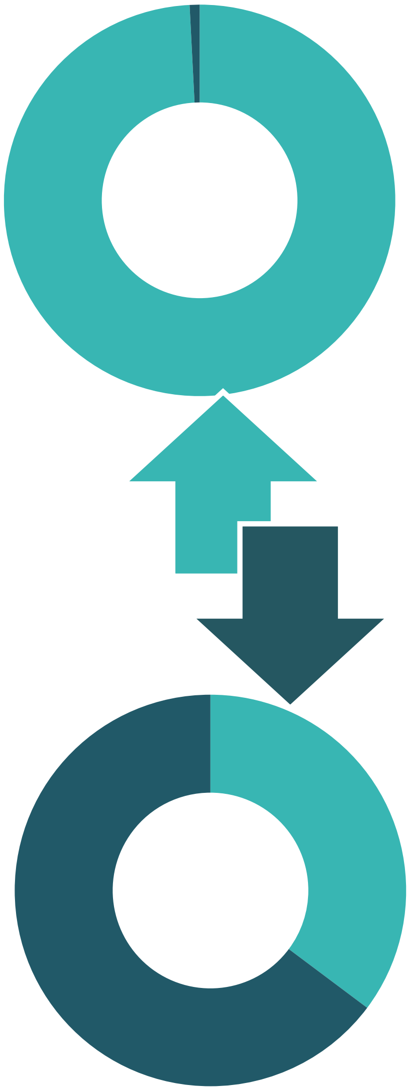
1.73% Developed land cover	5/5 water quality score	5/5 sediment quality score	11,152 person-days with PM 2.5 over the standard	0.00 person-days with max. 8-hr average ozone concentration over standard
29.76% Developed land cover	3/5 water quality score	5/5 sediment quality score	1,266,666 person-days with PM 2.5 over the standard	7,660,008 person-days with max. 8-hr average ozone concentration over standard

% score out of 100% of possible score

% of no score

Figure 16.

Environmental Condition Time 3 (Repeat of Time 2)



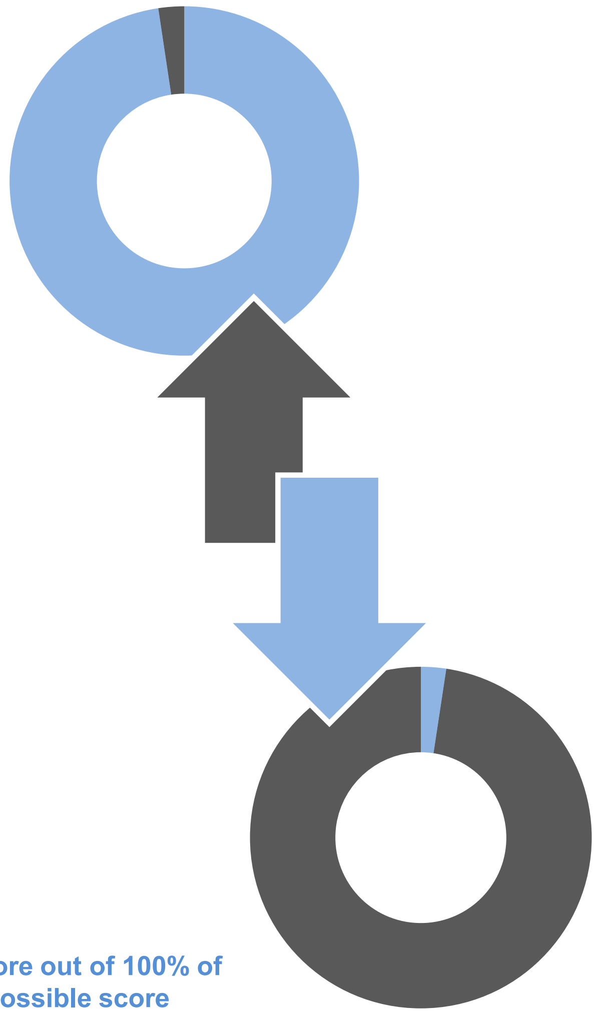
1.73% Developed land cover	5/5 water quality score	5/5 sediment quality score	11,152 person-days with PM 2.5 over the standard	0.00 person-days with max. 8-hr average ozone concentration over standard
29.76% Developed land cover	3/5 water quality score	5/5 sediment quality score	1,266,666 person-days with PM 2.5 over the standard	7,660,008 person-days with max. 8-hr average ozone concentration over standard

% score out of 100% of possible score

% of no score

Figure 17.

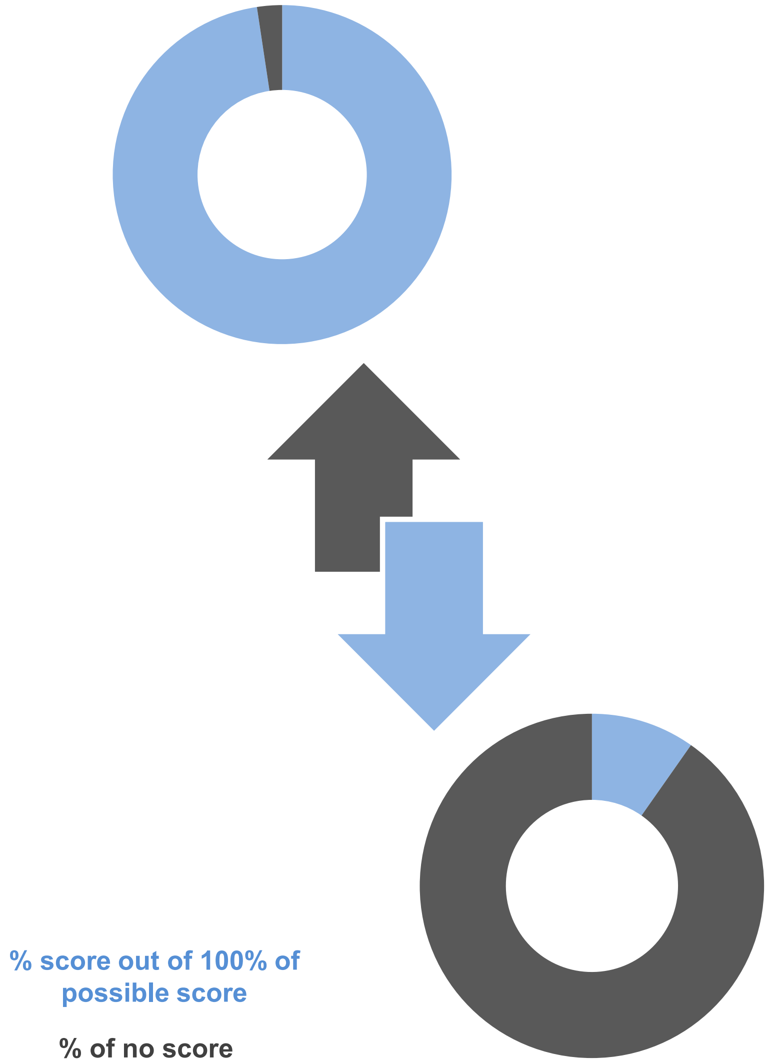
Governance Time 1



7 FEMA Community Rating Score (highest score=1)	10 years with comprehensive plan
No FEMA Community Rating Score	0 years with comprehensive plan

Figure 18.

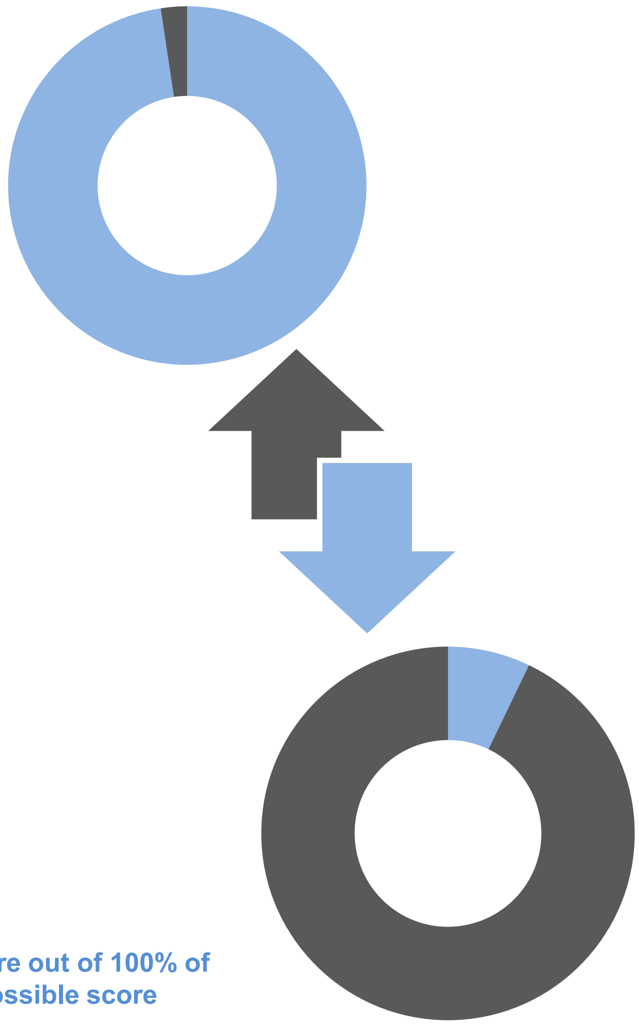
Governance Time 2



7 FEMA Community Rating Score (highest score=1)	15 years with comprehensive plan
No FEMA Community Rating Score	0 years with comprehensive plan

Figure 19.

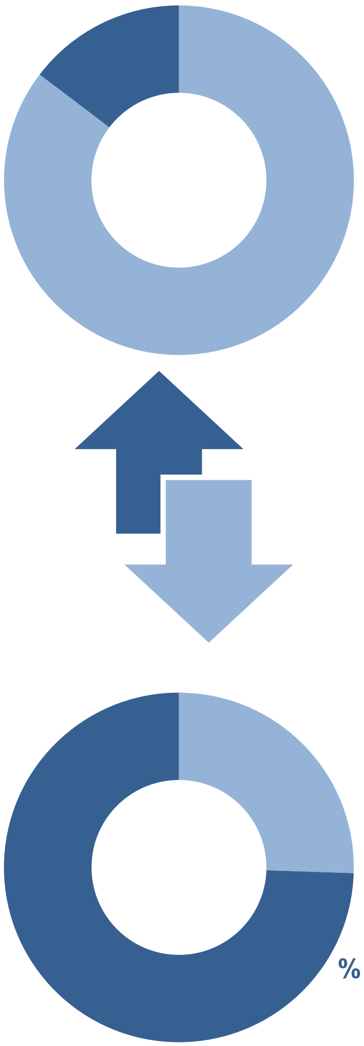
Governance Time 3



6 FEMA Community Rating Score (highest score=1)	18 years with comprehensive plan
No FEMA Community Rating Score	0 years with comprehensive plan

Figure 20.

Health Time 1



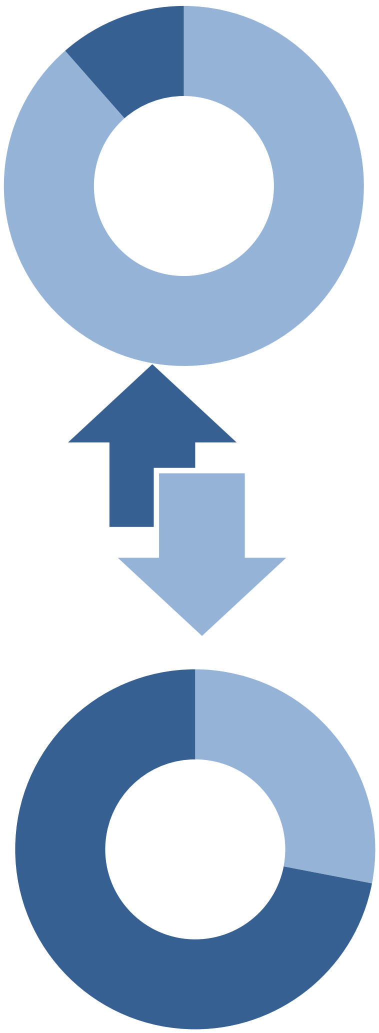
15.5 Births per 1000 people	0.22 deaths caused by cardiovascular disease	0.04 deaths caused by lower respiratory diseases	0.23 deaths by all cancers	76.20 yrs ♂ life expectancy	80.80 yrs ♀ life expectancy	0.36 recreational facilities per 1000 people
8.7 Births per 1000 people	1.53 deaths caused by cardiovascular disease	0.17 deaths caused by lower respiratory diseases	1.23 deaths by all cancers	68.8 yrs ♂ life expectancy	75.80 yrs ♀ life expectancy	0.02 recreational facilities per 1000 people

% score out of 100% of possible score

% of no score

Figure 21.

Health Time 2



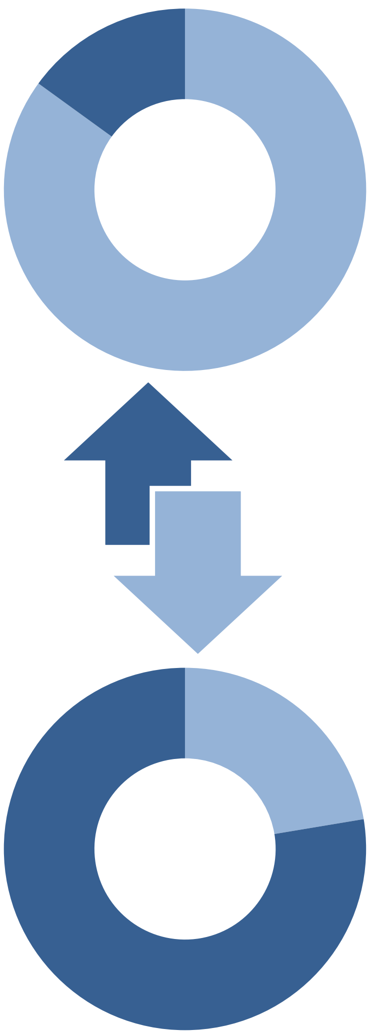
16.2 Births per 1000 people	0.22 deaths caused by cardiovascular disease	0.04 deaths caused by lower respiratory diseases	0.21 deaths by all cancers	76.9 yrs ♂ life expectancy	82.0 yrs ♀ life expectancy	0.26 recreational facilities per 1000 people
10.2 Births per 1000 people	1.50 deaths caused by cardiovascular disease	0.28 deaths caused by lower respiratory diseases	1.33 deaths by all cancers	65.9 yrs ♂ life expectancy	78.2 yrs ♀ life expectancy	0.00 recreational facilities per 1000 people

% score out of 100% of possible score

% of no score

Figure 22.

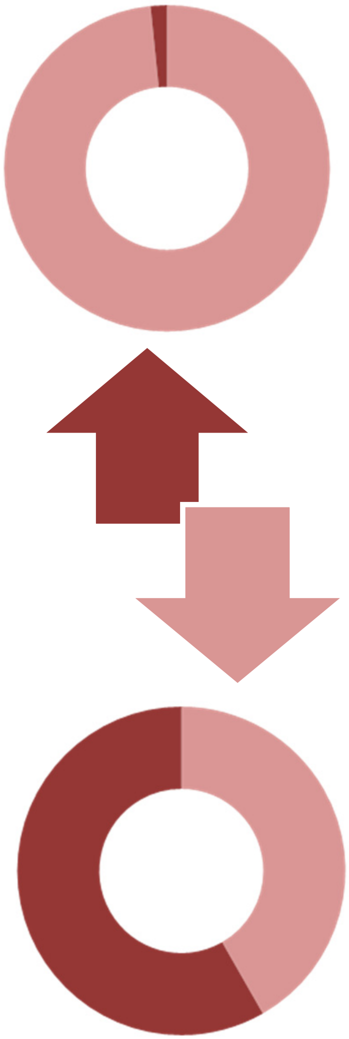
Health Time 3



16.3 Births per 1000 people	0.21 deaths caused by cardiovascular disease	0.05 deaths caused by lower respiratory diseases	0.23 deaths by all cancers	78 yrs ♂ life expectancy	83.30 yrs ♀ life expectancy	0.22 recreational facilities per 1000 people
12.3 Births per 1000 people	1.2 deaths caused by cardiovascular disease	0.28 deaths caused by lower respiratory diseases	1.16 deaths by all cancers	68.8 yrs ♂ life expectancy	75.70 yrs ♀ life expectancy	0.08 recreational facilities per 1000 people

Figure 23.

Safety Time 1



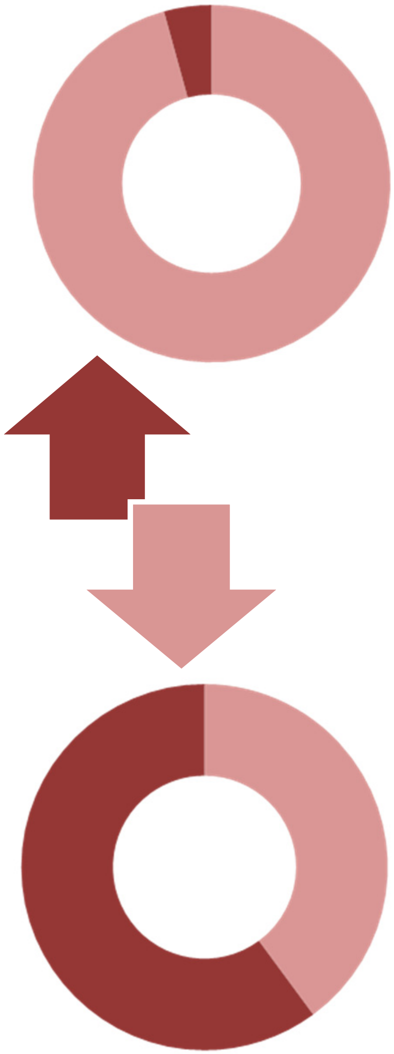
0 Violent crimes per 1000 people	0 Property crimes per 1000 people	0 Tropical storm and hurricane events	0 Tornados and severe thunder-storms	29.9 people per square mile living in flood plain
10.7 Violent crimes per 1000 people	63.3 Property crimes per 1000 people	2 Tropical storm and hurricane events	5 Tornados and severe thunder-storms	2514.5 people per square mile living in flood plain

% score out of 100% of possible score

% of no score

Figure 24.

Safety Time 2



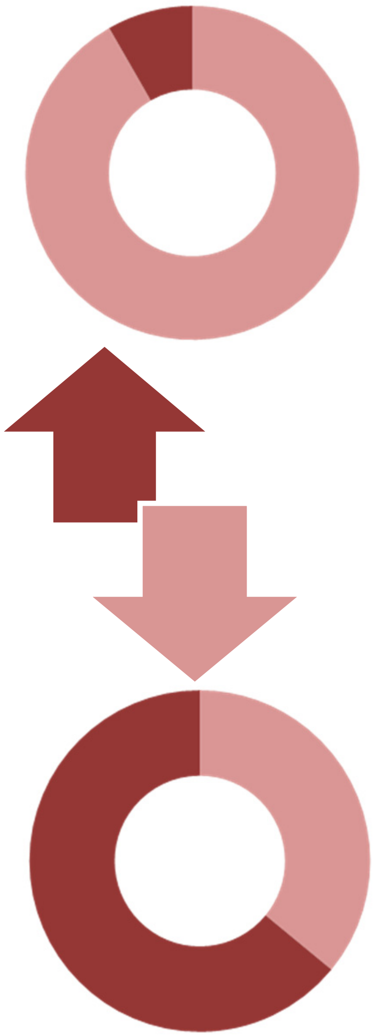
0.14 Violent crimes per 1000 people	1.78 Property crimes per 1000 people	1 Tropical storm and hurricane events	0 Tornados and severe thunder-storms	25.8 People per square mile living in flood plain
8.0 Violent crimes per 1000 people	46.7 Property crimes per 1000 people	5 Tropical storm and hurricane events	4 Tornados and severe thunder-storms	1326.4 People per square mile living in flood plain

% score out of 100% of possible score

% of no score

Figure 25.

Safety Time 3



1.94 Violent crimes per 1000 people	15.47 Property crimes per 1000 people	0 Tropical storm and hurricane events	0 Tornados and severe thunder-storms	12.0 People per square mile living in flood plain
9.01 Violent crimes per 1000 people	54.86 Property crimes per 1000 people	4 Tropical storm and hurricane events	7 Tornados and severe thunder-storms	1664.9 People per square mile living in flood plain

% score out of 100% of possible score

% of no score

Figure 26.

Social Connectedness
Time 1

.51 Religious orgs per 1000 people	0.33 Arts and humanities orgs per 1000 people	0.9 out of 100 Itemized tax returns reporting charitable contributions	73% Turnout of registered voters in national election	1990 Median year householders moved into current dwellings	3% of Households without telephone service
0.00 religious orgs per 1000 people	0.10 Arts and humanities orgs per 1000 people	0.8 out of 100 Itemized tax returns reporting charitable contributions	56% Turnout of registered voters in national election	1994 Median year householders moved into current dwellings	6% of Households without telephone service

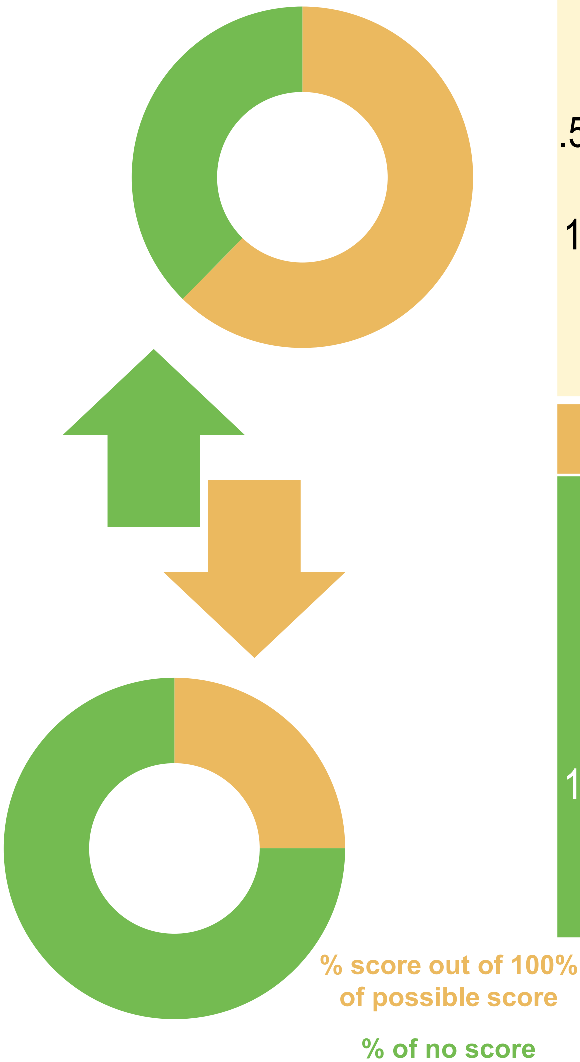


Figure 27.

Social Connectedness Time 2

1.37 Religious orgs per 1000 people	0.83 Arts and humanities orgs per 1000 people	0.8 out of 100 Itemized tax returns reporting charitable contributions	78% Turnout of registered voters in national election	1998 Median year householders moved into current dwellings	2% of Households without telephone service
0.00 Religious orgs per 1000 people	0.10 arts and humanities orgs per 1000 people	0.7 out of 100 Itemized tax returns reporting charitable contributions	62% Turnout of registered voters in national election	2002 Median year householders moved into current dwellings	12% of Households without telephone service

% score out of 100% of possible score

% of no score

Figure 28.

Social Connectedness Time 3

1.32 Religious orgs per 1000 people	0.82 Arts and humanities orgs per 1000 people	0.9 out of 100 Itemized tax returns reporting charitable contributions	81% Turnout of registered voters in national election	2002 Median year householders moved into current dwellings	1% of Households without telephone service
0.14 Religious orgs per 1000 people	0.13 Arts and humanities orgs per 1000 people	0.6 out of 100 Itemized tax returns reporting charitable contributions	47% Turnout of registered voters in national election	2001 Median year householders moved into current dwellings	17% of Households without telephone service

% score out of 100% of possible score

% of no score

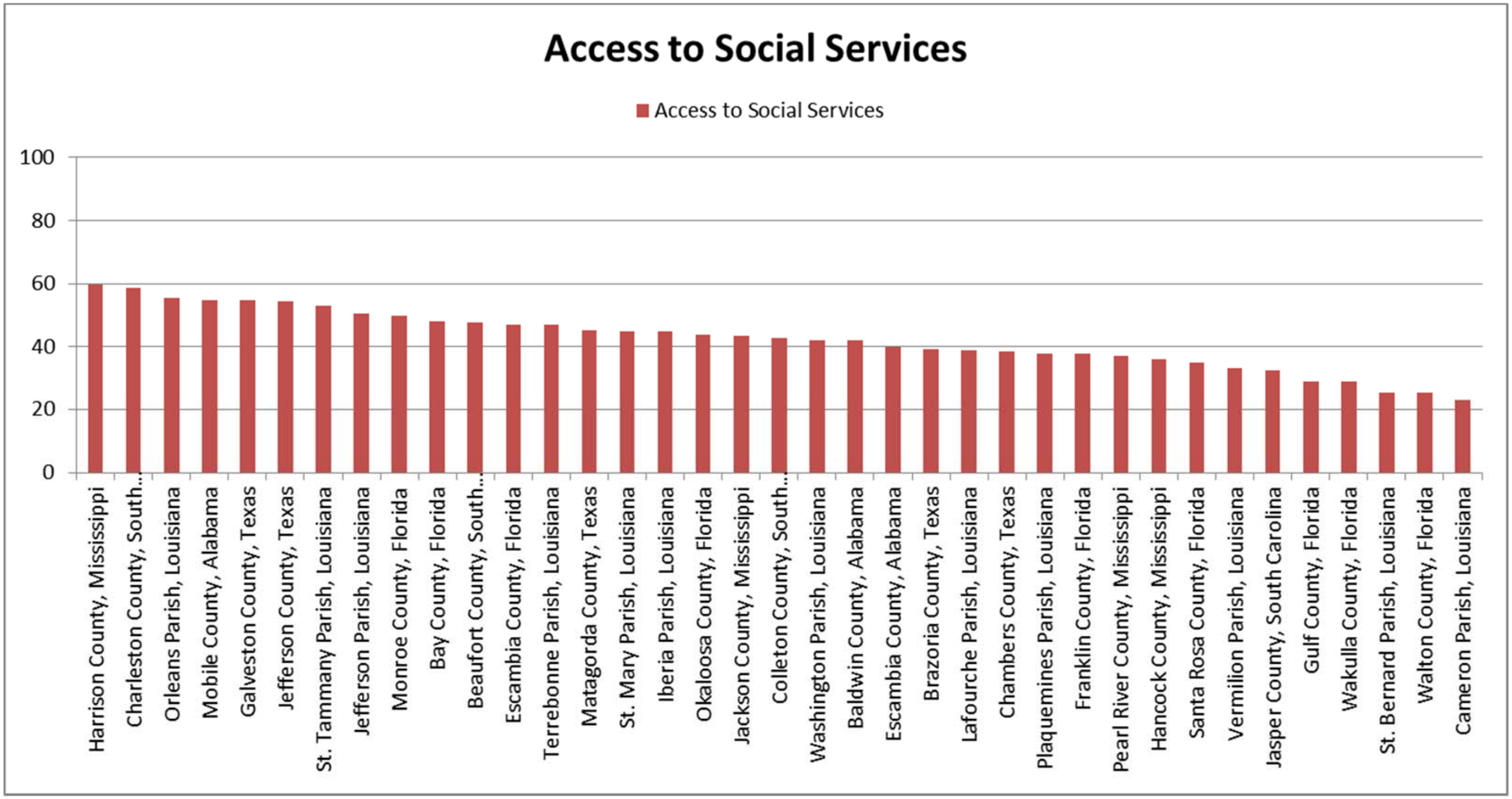


Figure 29. Time 3 Indicator Scores for Access to Social Services.

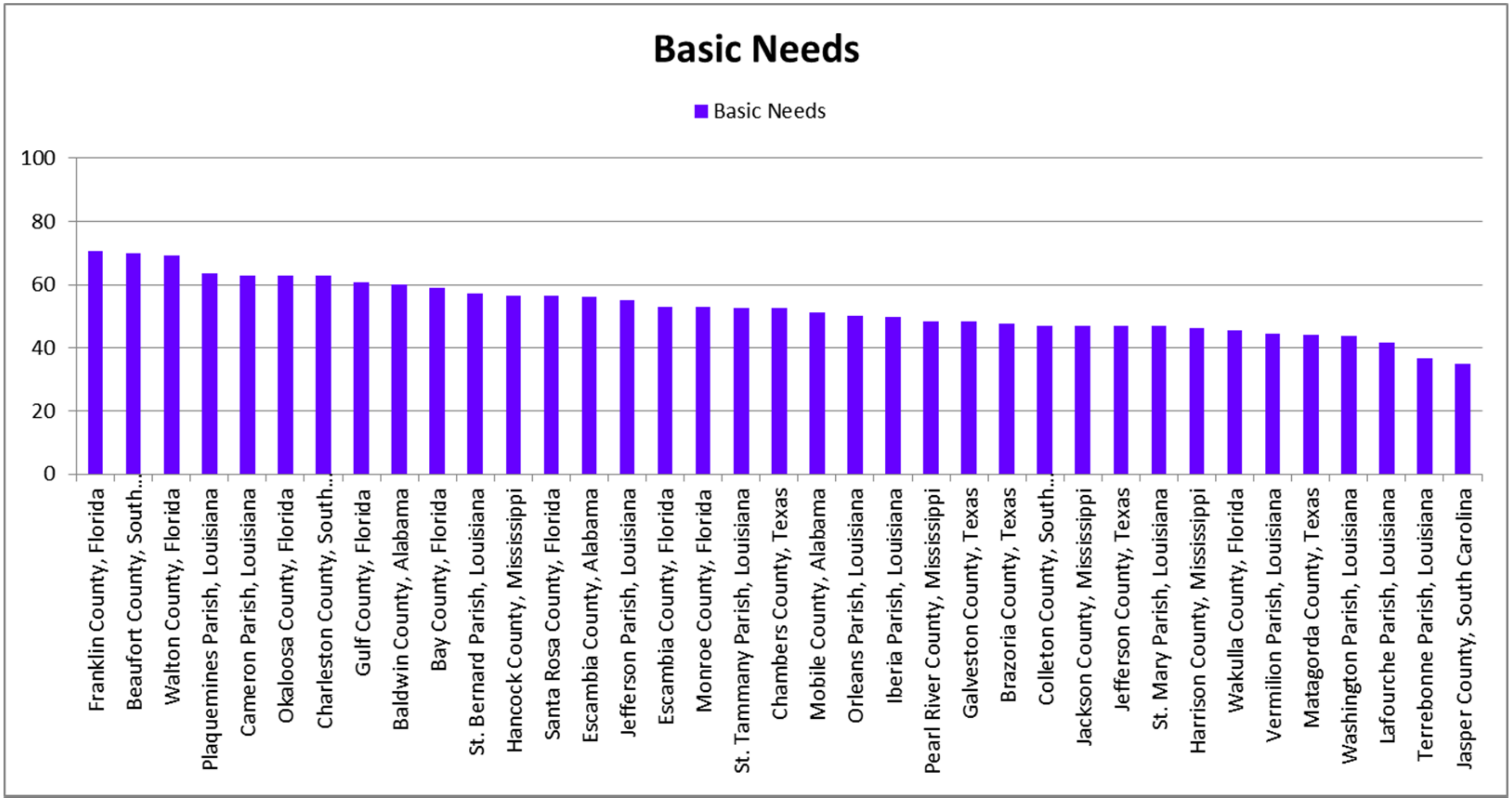


Figure 30. Time 3 Indicator Scores for Basic Needs.

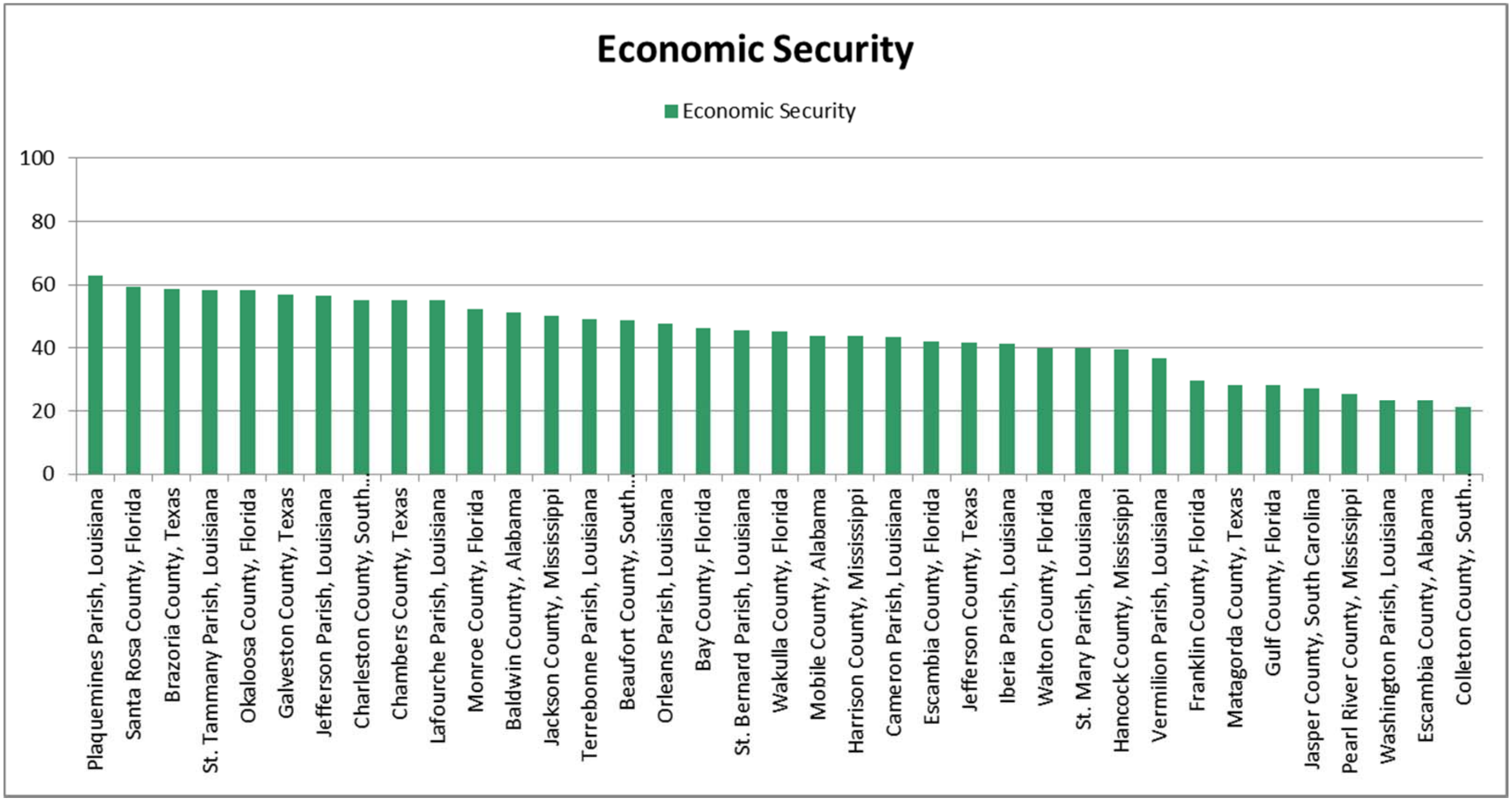


Figure 31. Time 3 Indicator Scores for Economic Security.

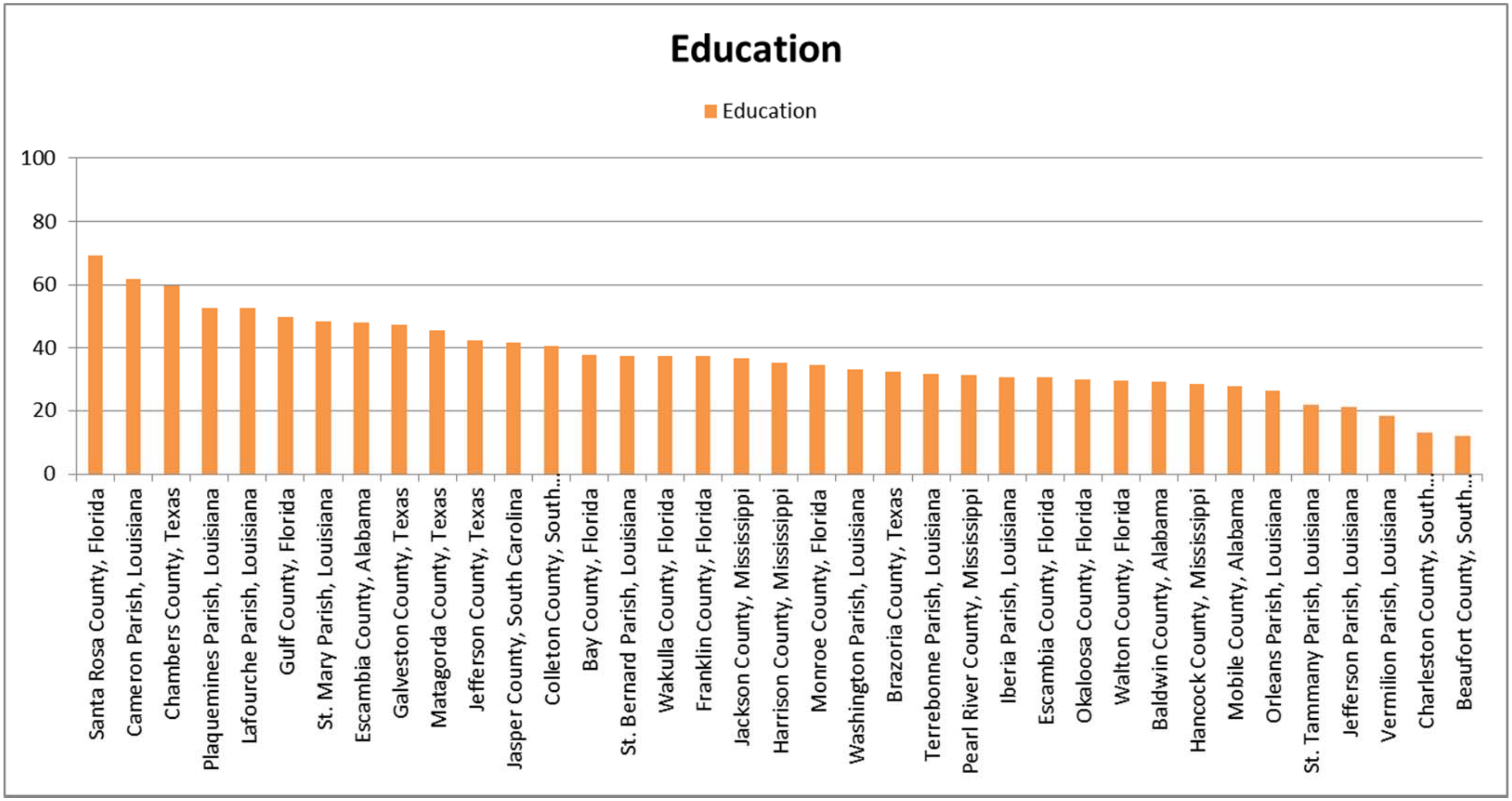


Figure 32. Time 3 Indicator Scores for Education.

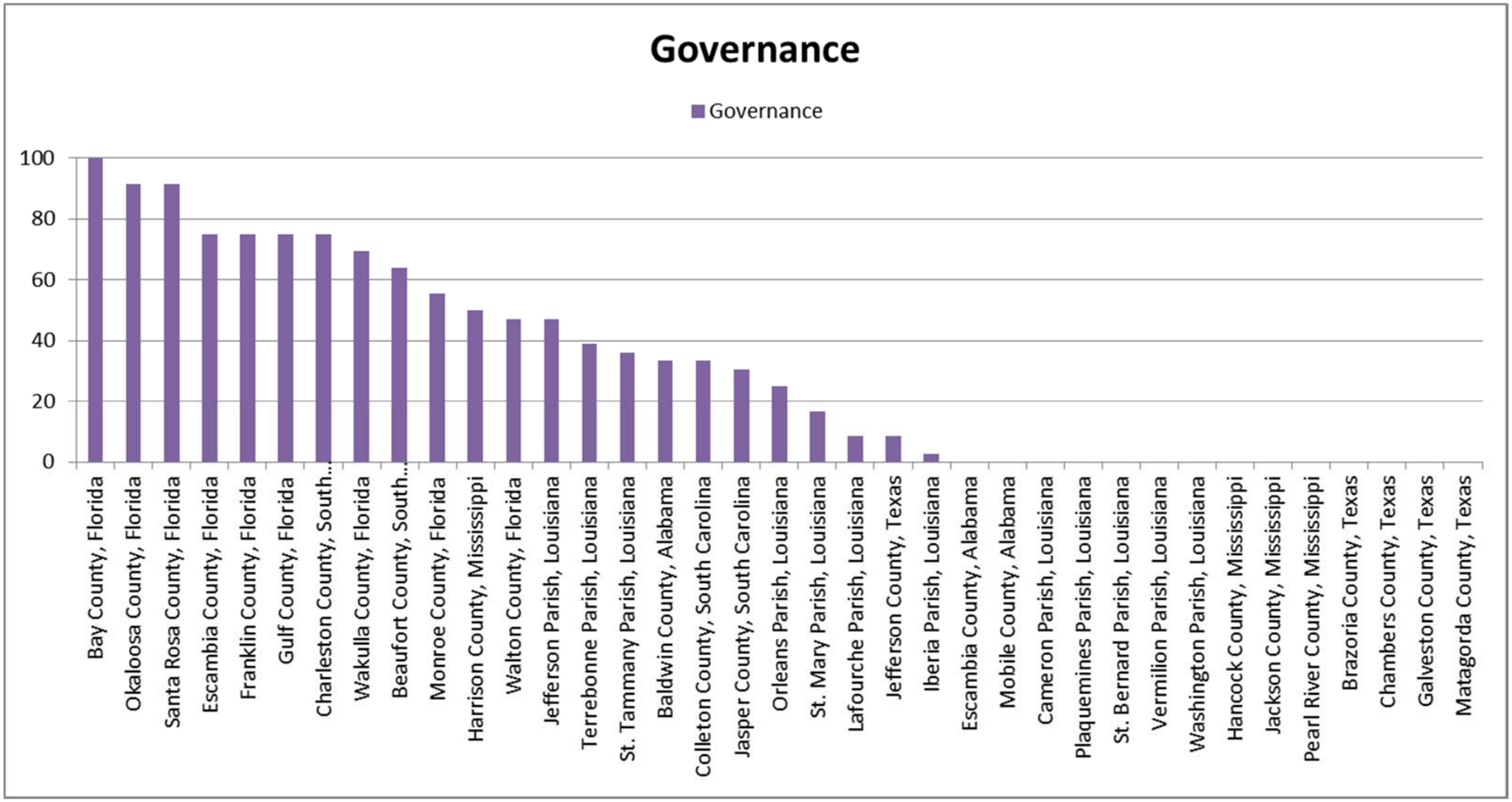


Figure 33. Time 3 Indicator Scores for Governance.

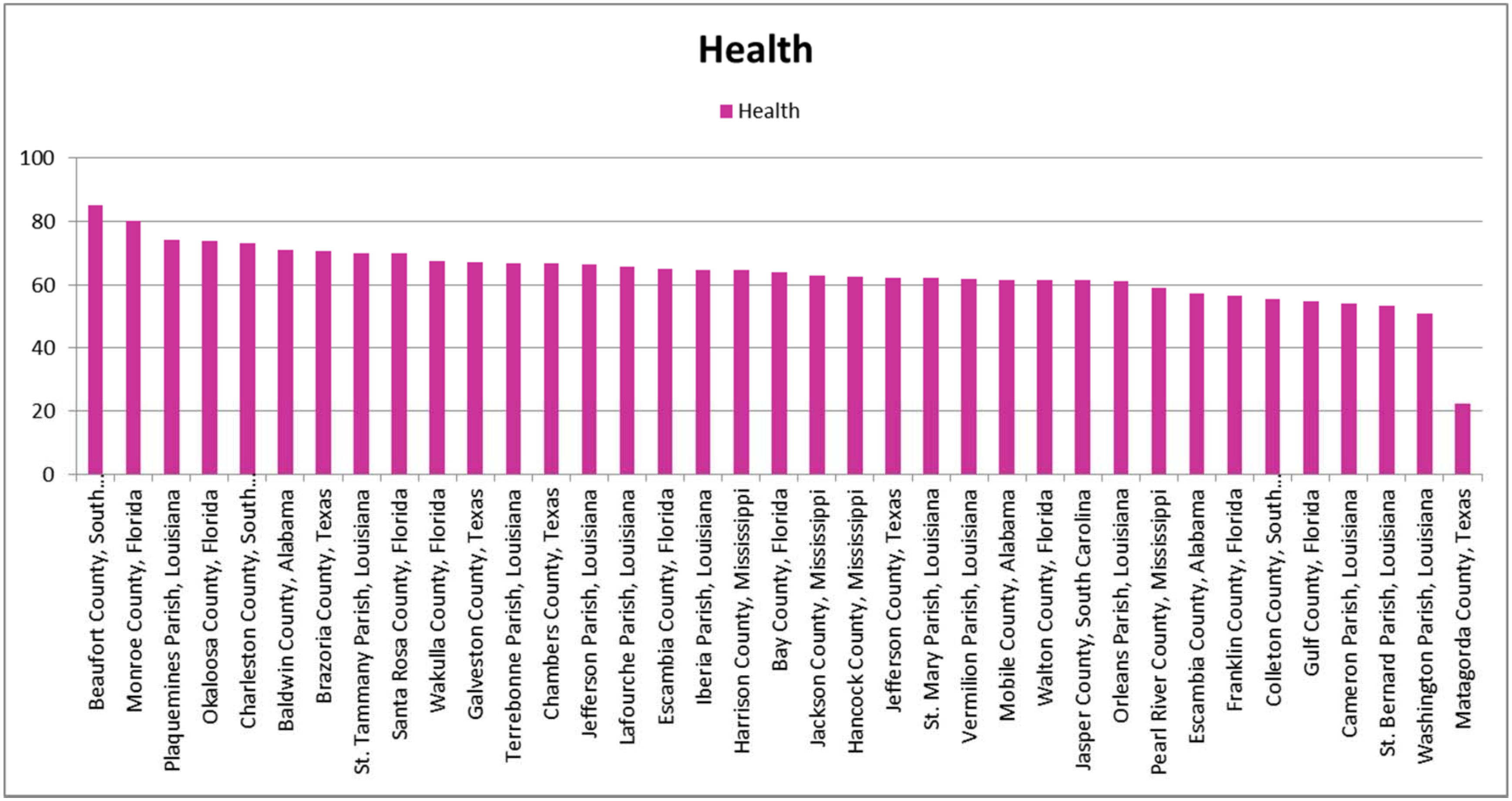


Figure 34. Time 3 Indicator Scores for Health.

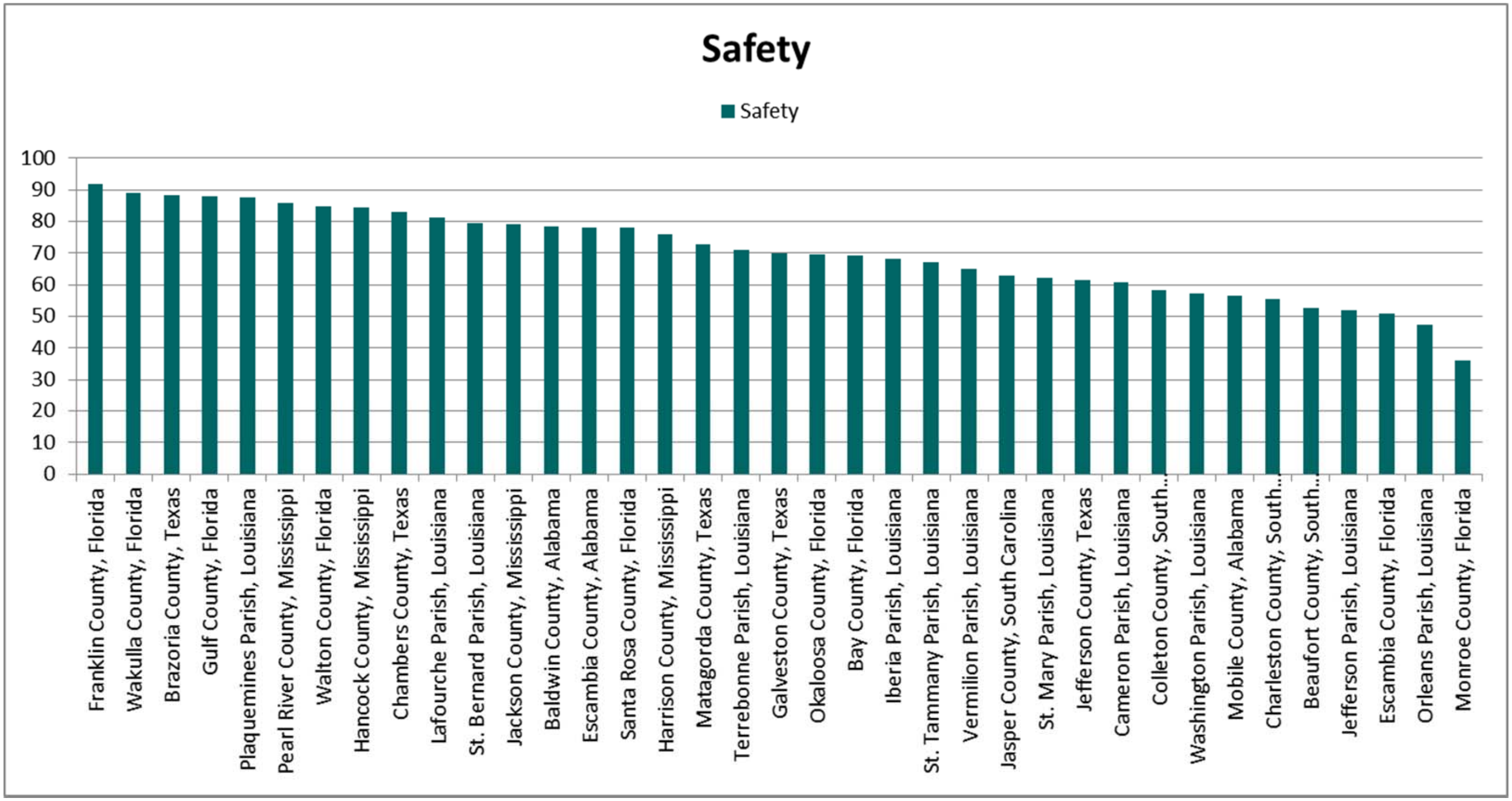


Figure 35. Time 3 Indicator Scores for Safety.

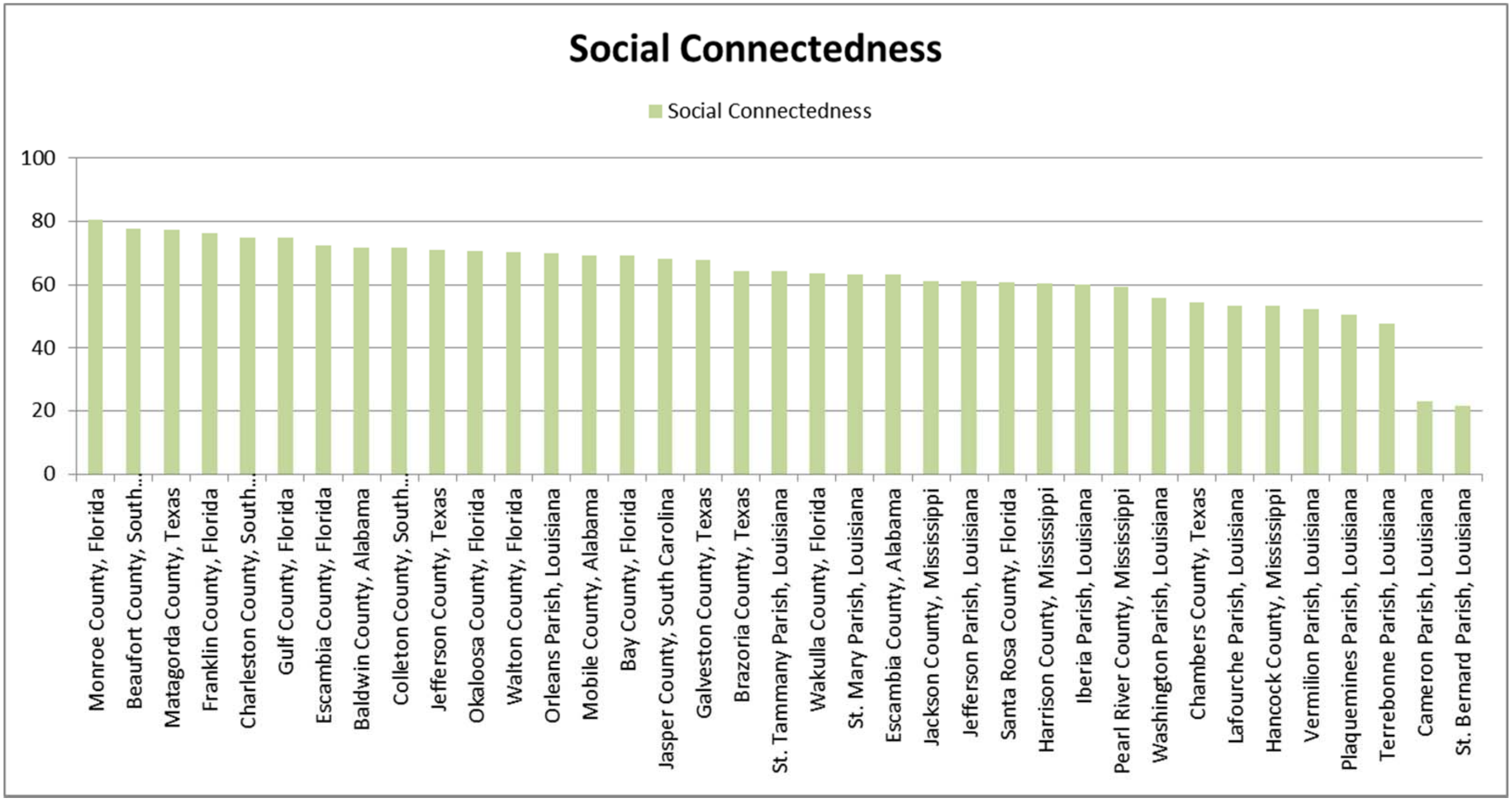


Figure 36. Time 3 Indicator Scores for Social Connectedness.

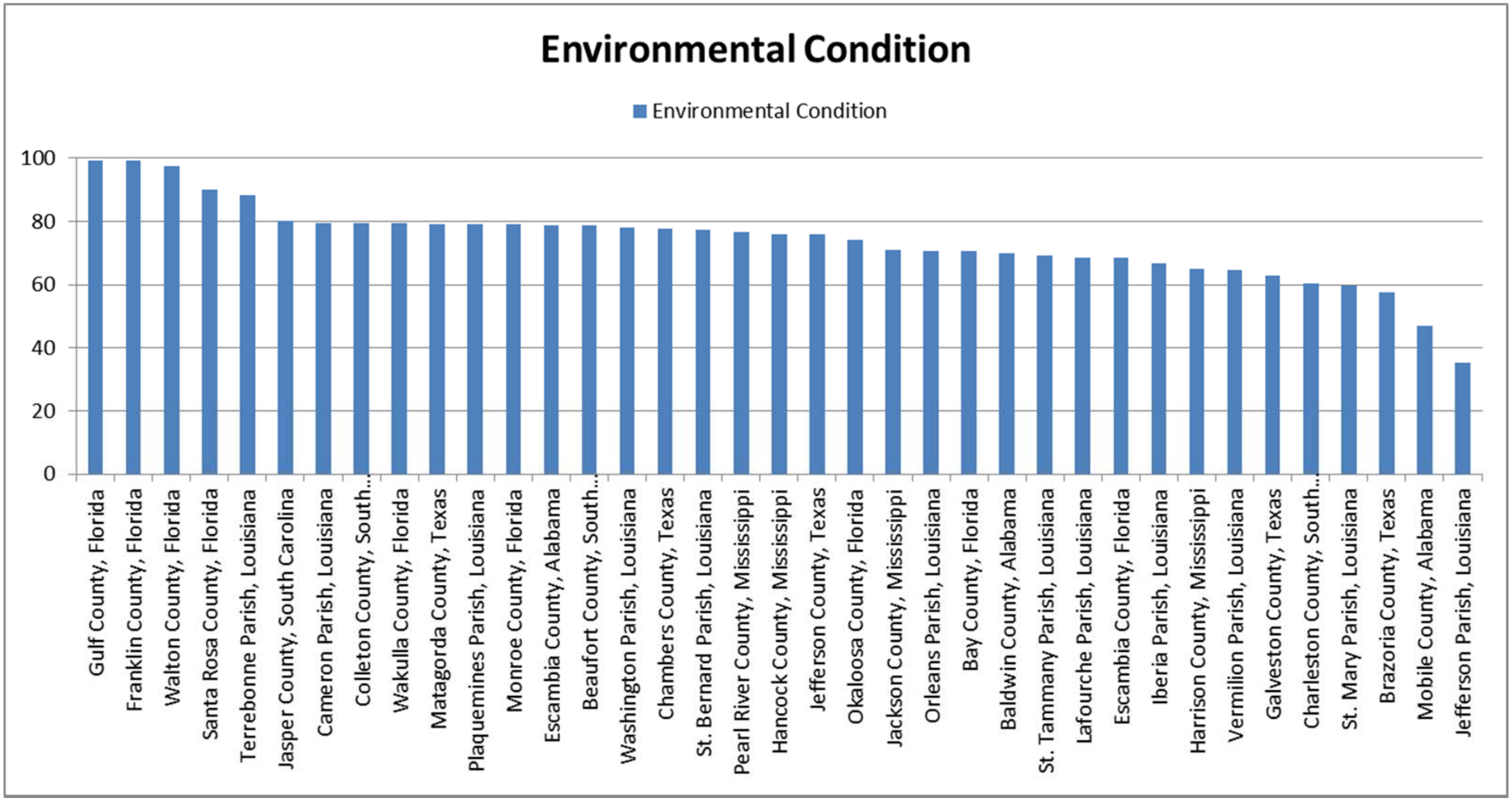
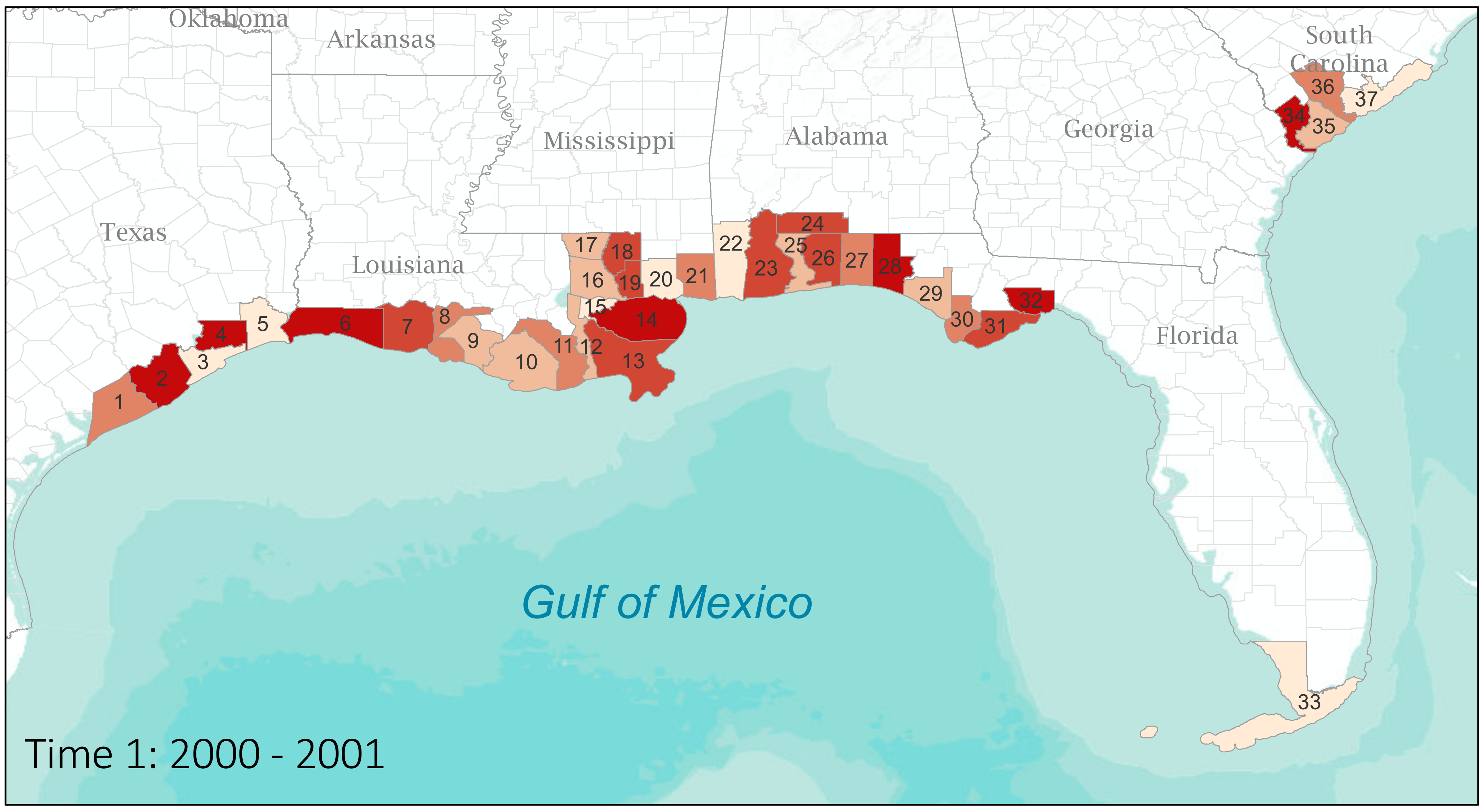
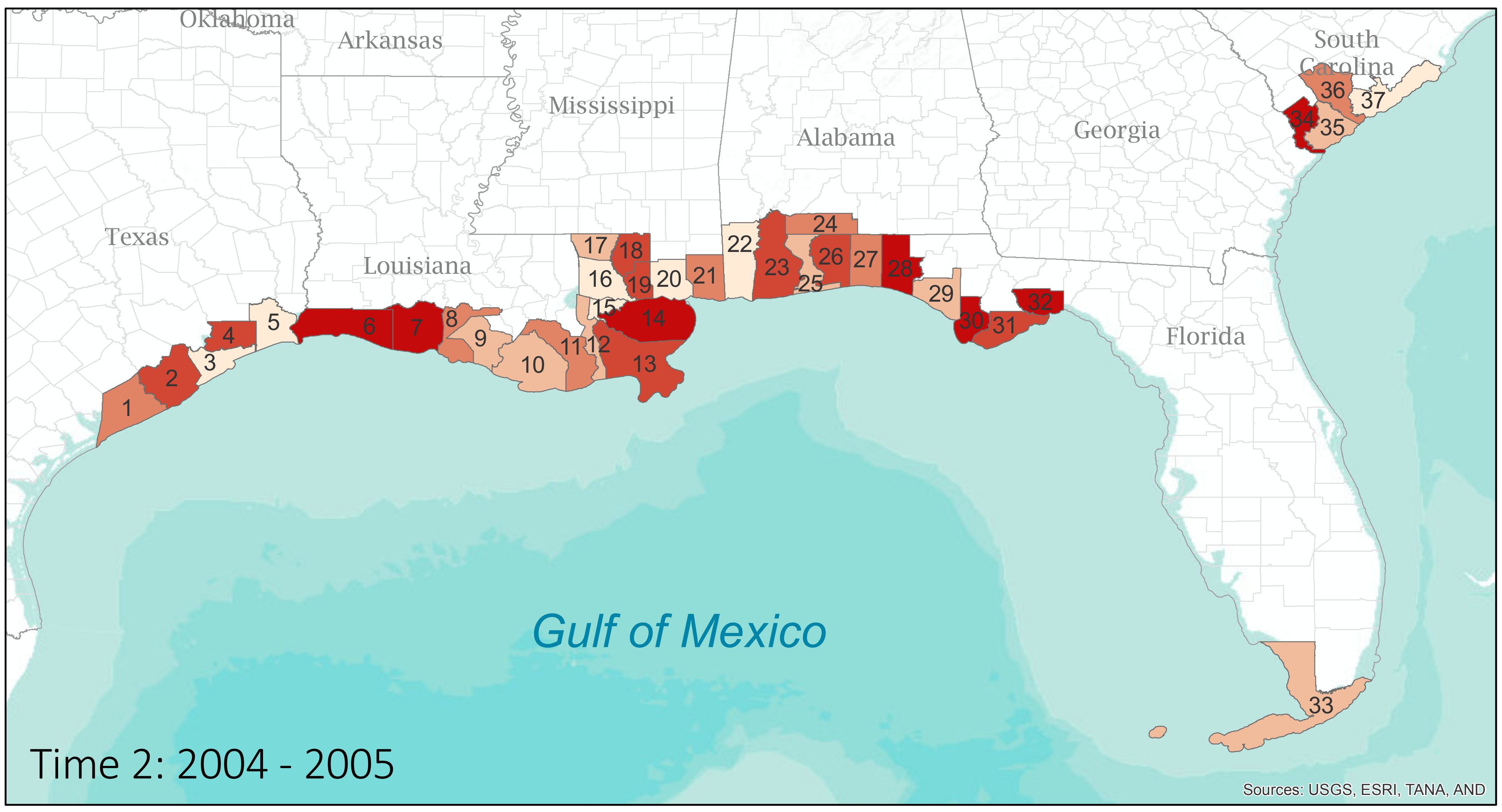
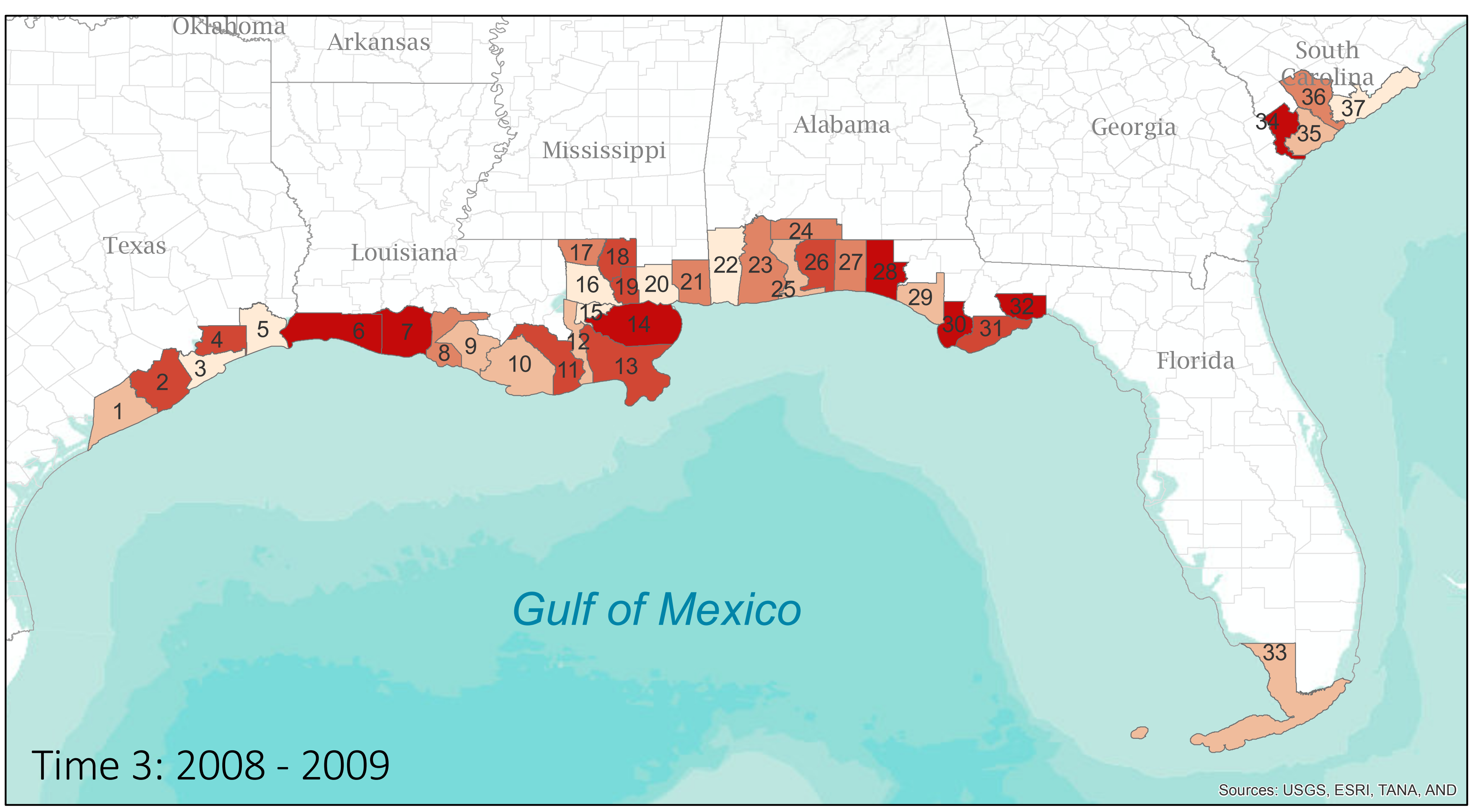


Figure 37. Time 3 Indicator Scores for Environmental Condition.







Number	County Name
1	Matagorda County, Texas
2	Brazoria County, Texas
3	Galveston County, Texas
4	Chambers County, Texas
5	Jefferson County, Texas
6	Cameron Parish, Louisiana
7	Vermilion Parish, Louisiana
8	Iberia Parish, Louisiana
9	St. Mary Parish, Louisiana
10	Terrebonne Parish, Louisiana
11	Lafourche Parish, Louisiana
12	Jefferson Parish, Louisiana
13	Plaquemines Parish, Louisiana
14	St. Bernard Parish, Louisiana
15	Orleans Parish, Louisiana
16	St. Tammany Parish, Louisiana
17	Washington Parish, Louisiana
18	Pearl River County, Mississippi
19	Hancock County, Mississippi
20	Harrison County, Mississippi
21	Jackson County, Mississippi
22	Mobile County, Alabama
23	Baldwin County, Alabama
24	Escambia County, Alabama
25	Escambia County, Florida
26	Santa Rosa County, Florida
27	Okaloosa County, Florida
28	Walton County, Florida
29	Bay County, Florida
30	Gulf County, Florida
31	Franklin County, Florida
32	Wakulla County, Florida
33	Monroe County, Florida
34	Jasper County, South Carolina
35	Beaufort County, South Carolina
36	Colleton County, South Carolina
37	Charleston County, South Carolina

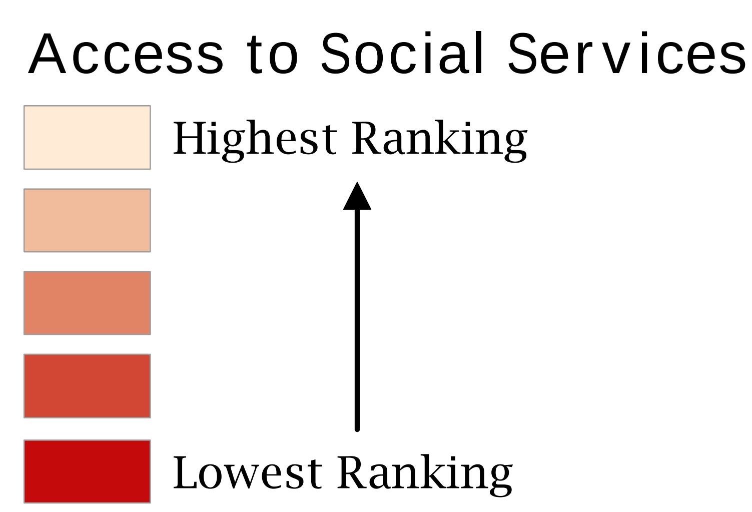
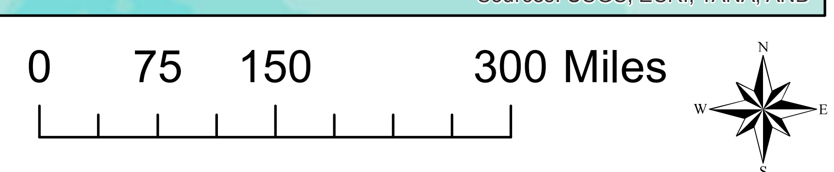


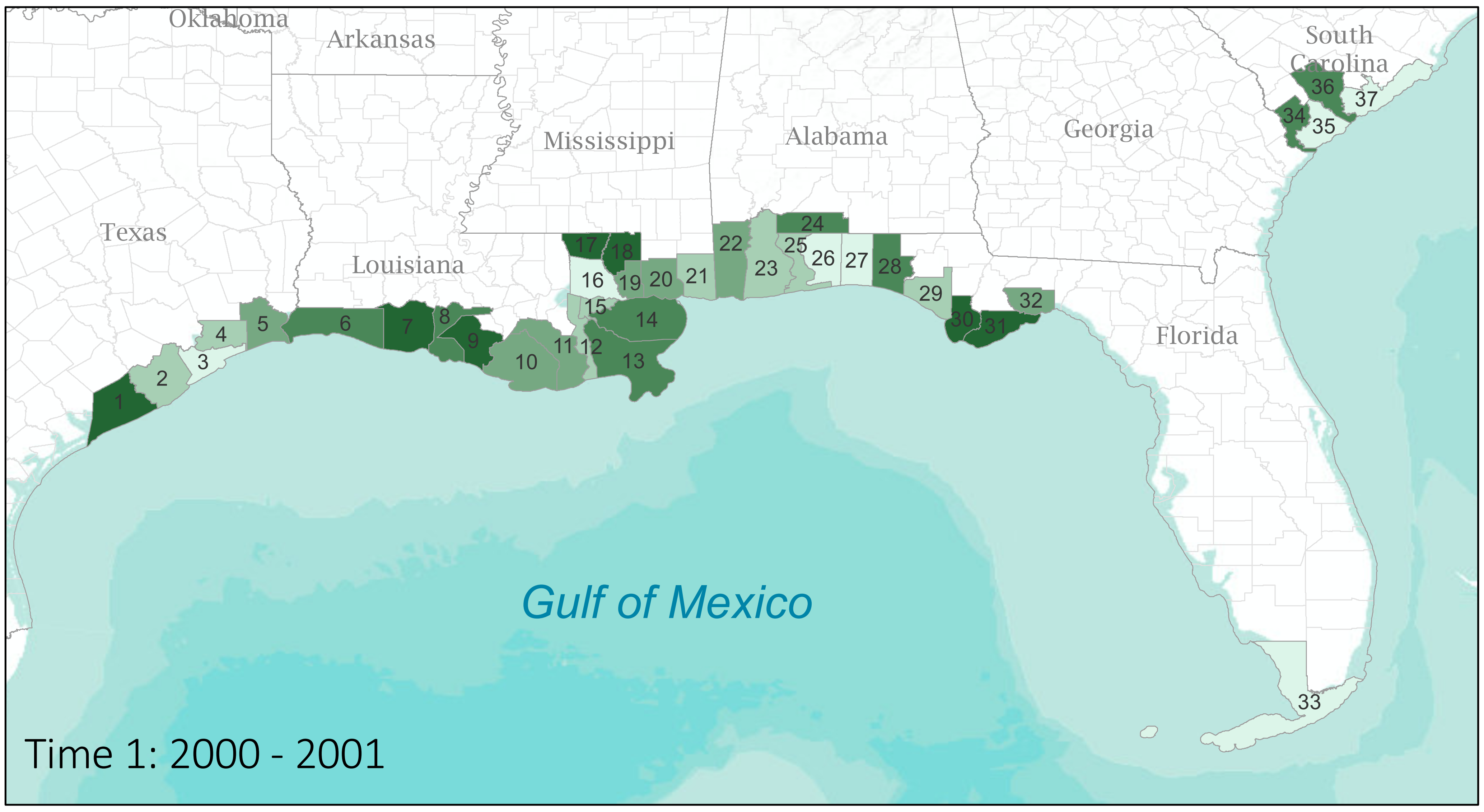
Figure 38.

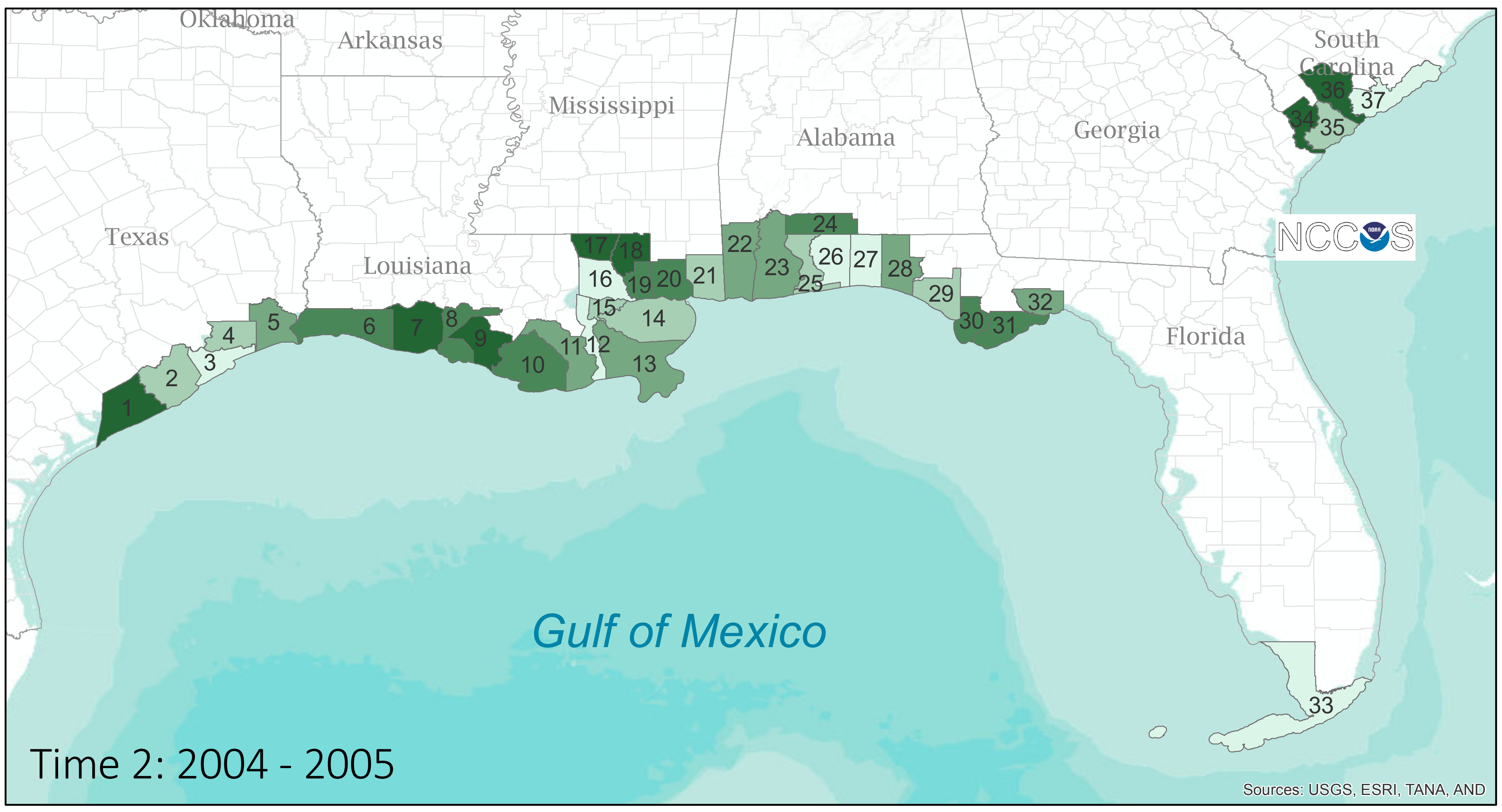
Access to Social Services

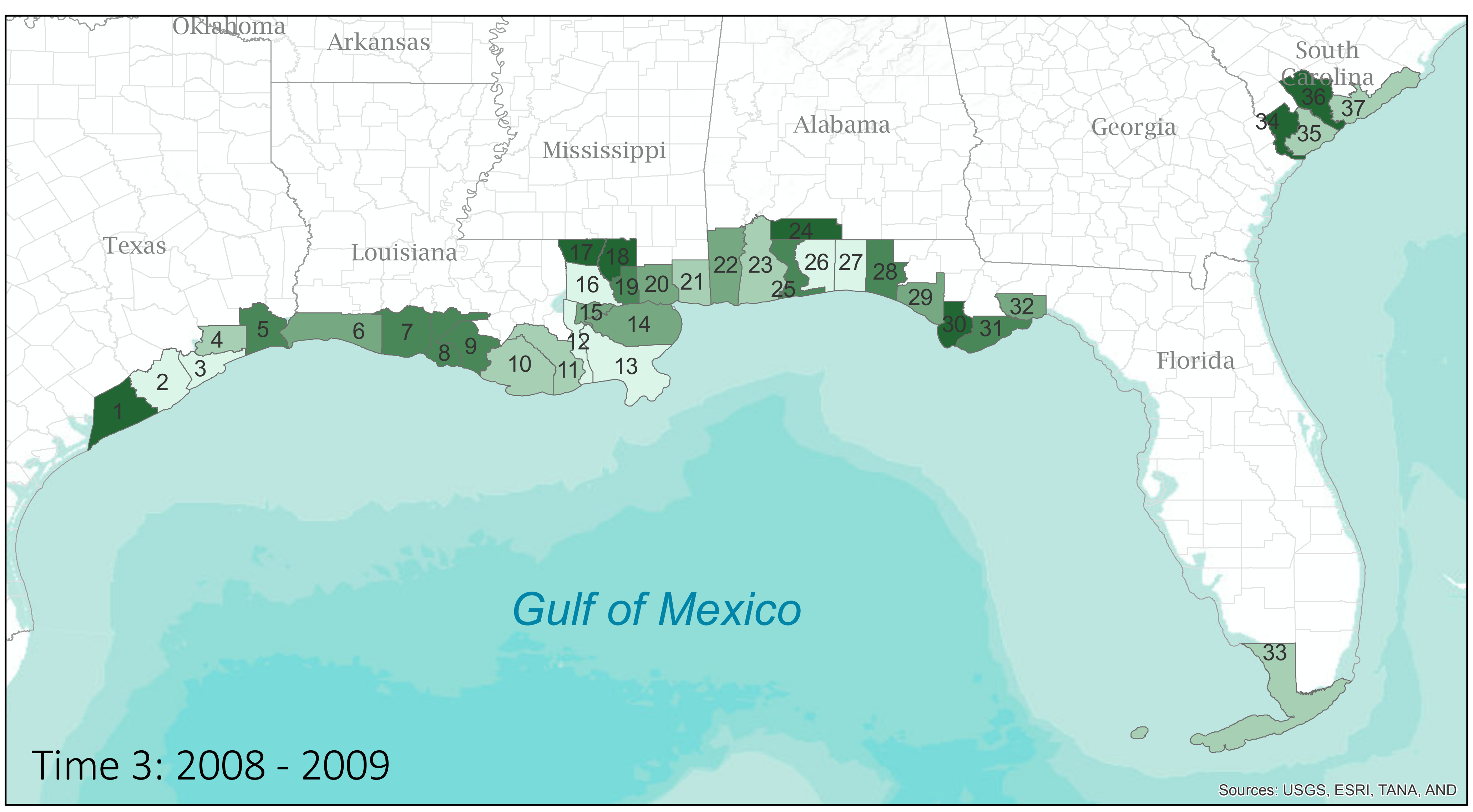


The Access to Social Services Indicator includes access to:

- Non-governmental services
- Governmental services
- Medical care and facilities
- Transportation







Number	County Name
1	Matagorda County, Texas
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7	Vermilion Parish, Louisiana
8	Iberia Parish, Louisiana
9	St. Mary Parish, Louisiana
10	Terrebonne Parish, Louisiana
11	Lafourche Parish, Louisiana
12	Jefferson Parish, Louisiana
13	Plaquemines Parish, Louisiana
14	St. Bernard Parish, Louisiana
15	Orleans Parish, Louisiana
16	St. Tammany Parish, Louisiana
17	Washington Parish, Louisiana
18	Pearl River County, Mississippi
19	Hancock County, Mississippi
20	Harrison County, Mississippi
21	Jackson County, Mississippi
22	Mobile County, Alabama
23	Baldwin County, Alabama
24	Escambia County, Alabama
25	Escambia County, Florida
26	Santa Rosa County, Florida
27	Okaloosa County, Florida
28	Walton County, Florida
29	Bay County, Florida
30	Gulf County, Florida
31	Franklin County, Florida
32	Wakulla County, Florida
33	Monroe County, Florida
34	Jasper County, South Carolina
35	Beaufort County, South Carolina
36	Colleton County, South Carolina
37	Charleston County, South Carolina

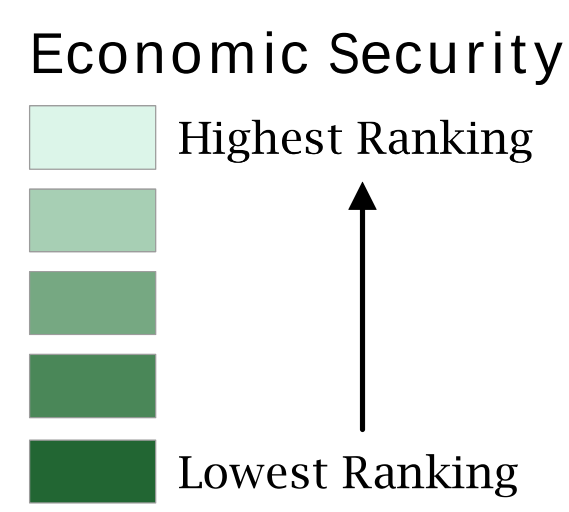
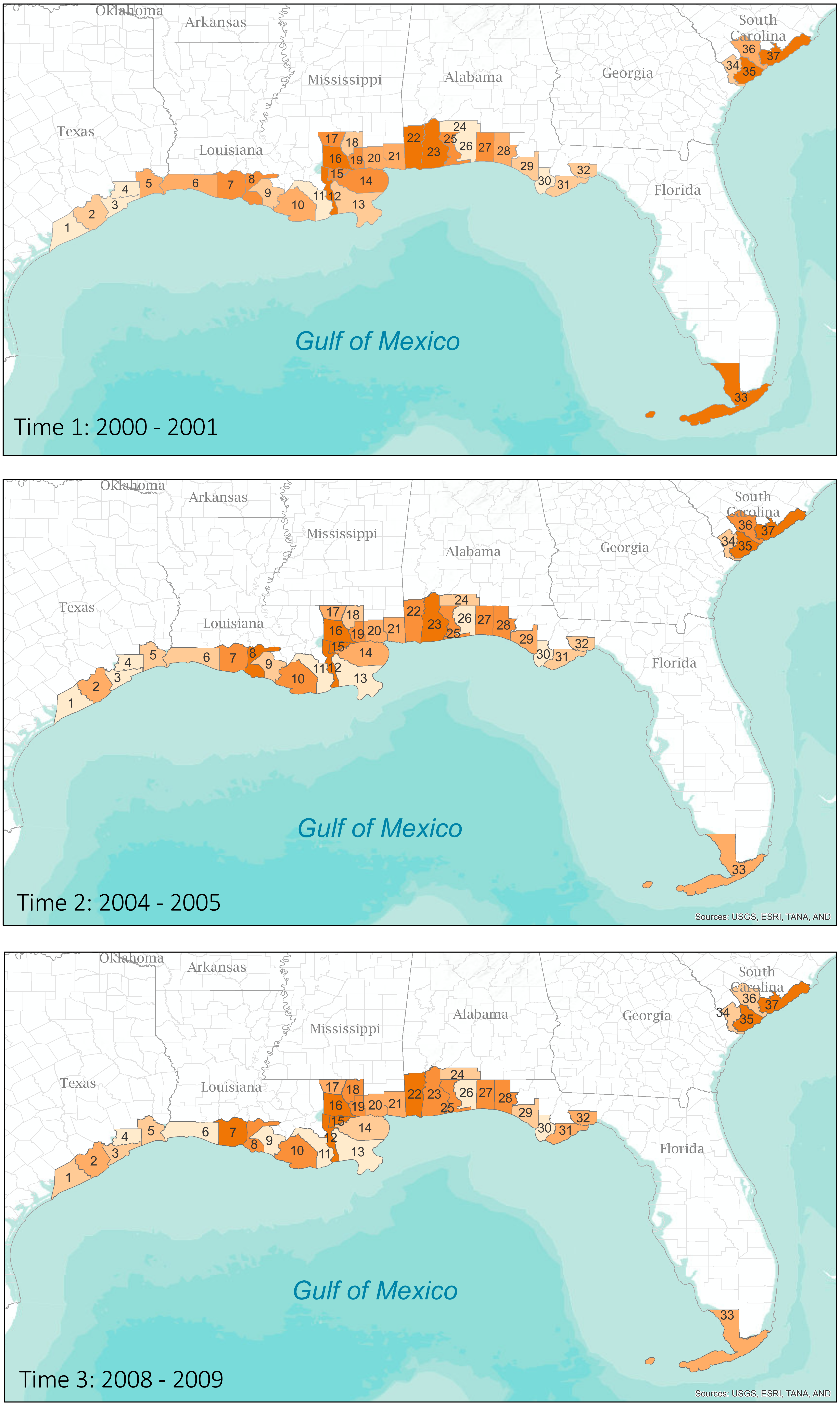


Figure 39.

Economic Security

0 75 150 300 Miles

The Economic Security indicator includes:
- Federal and local government investment
- Value of goods and services
- Economic diversity
- Household income
- Poverty among children



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33	Monroe County, Florida
34	Jasper County, South Carolina
35	Beaufort County, South Carolina
36	Colleton County, South Carolina
37	Charleston County, South Carolina

Education

Highest Ranking

Lowest Ranking

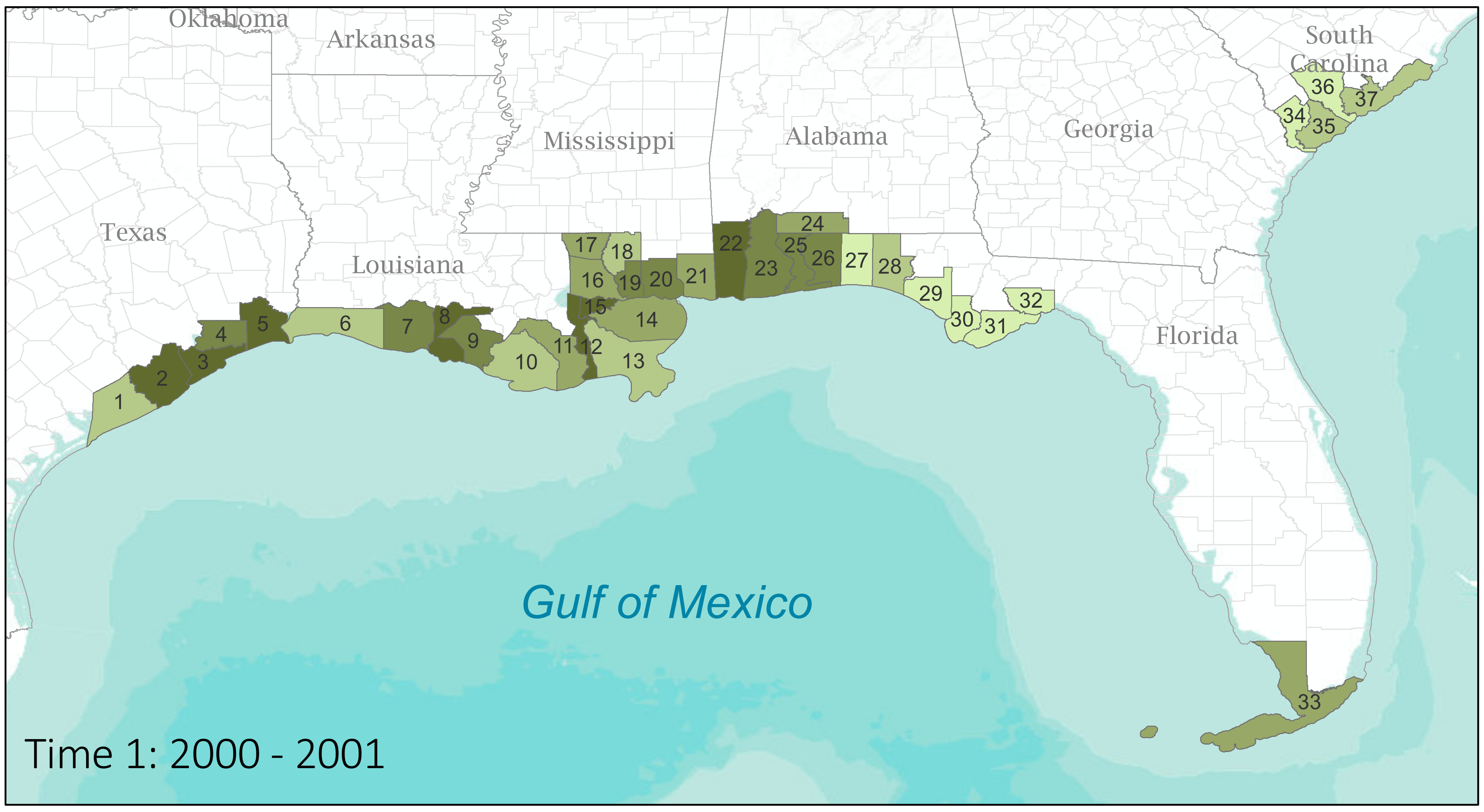
Figure 40.

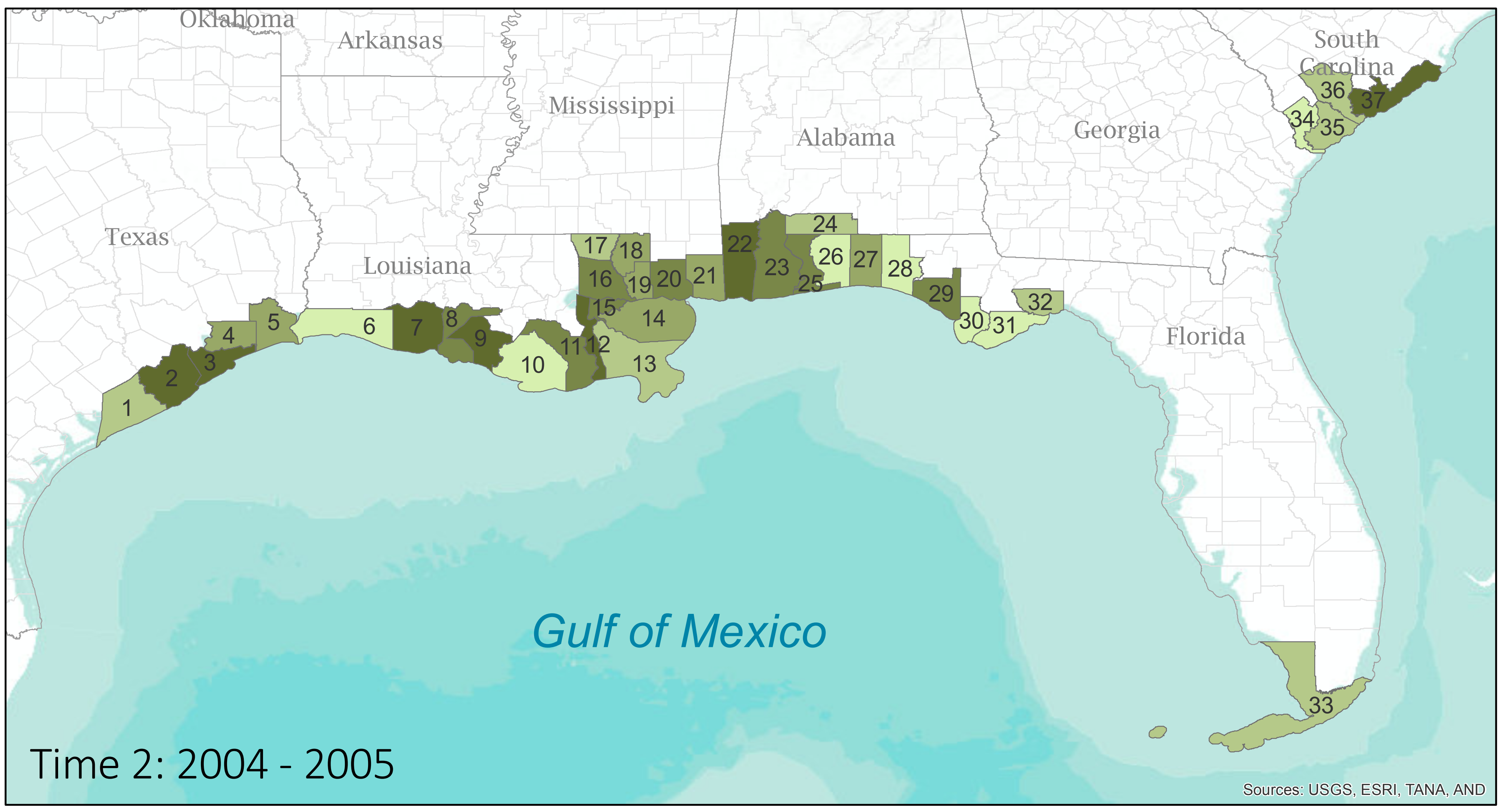
Education

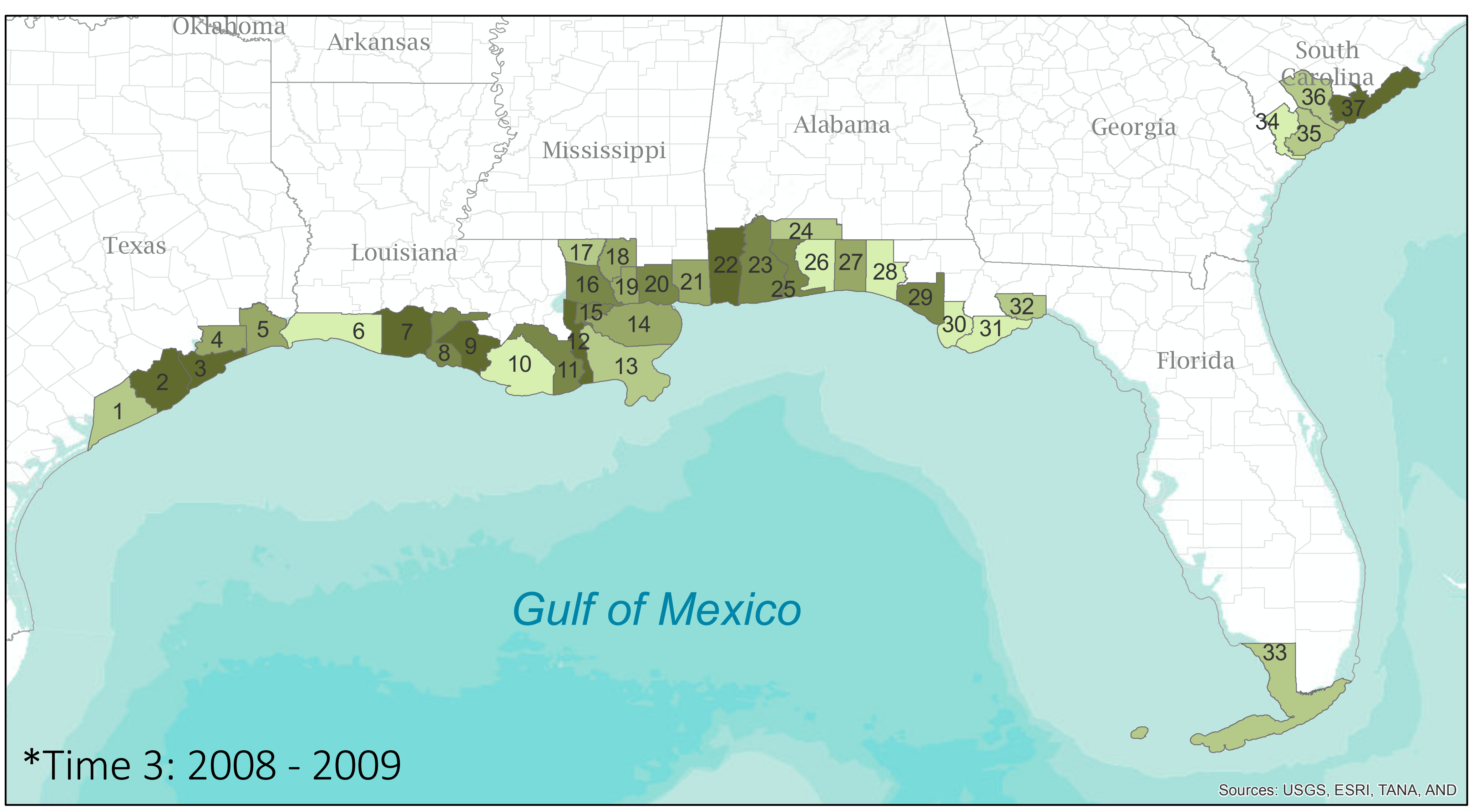
0 75 150 300 Miles

The Education indicator includes:
- Enrollment in public schools
- Expenditure per student
- Educational attainment

NCCOS







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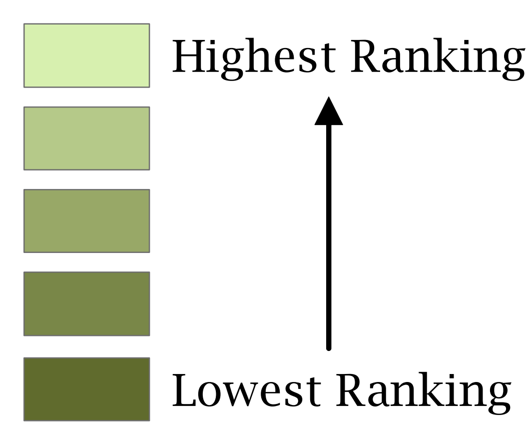
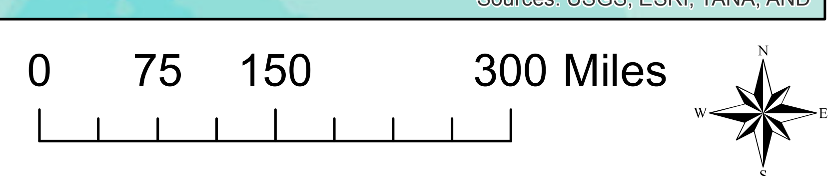
Environmental Condition



**Note: Time 2 data are repeated in Time 3; data will be updated as available.*

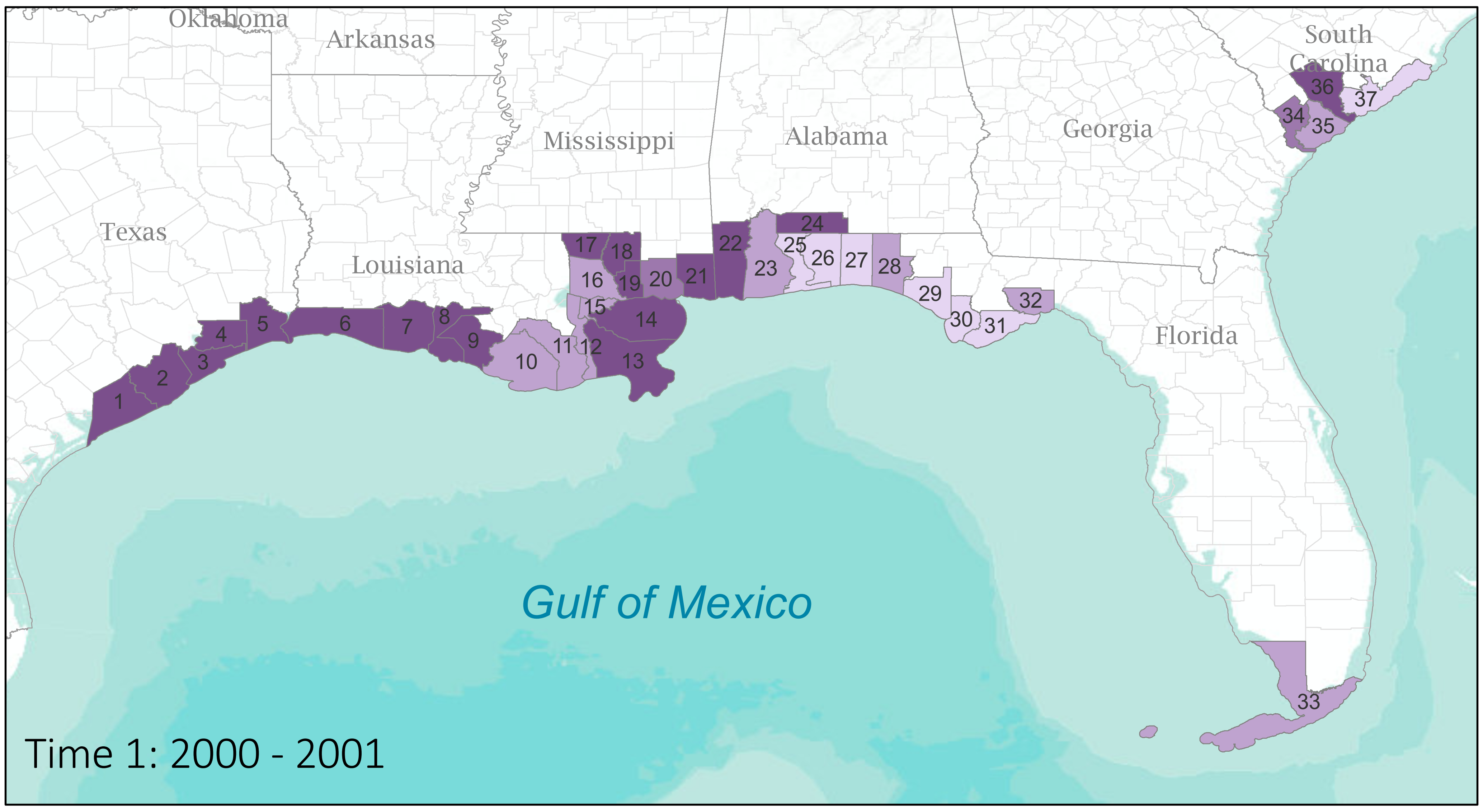
Figure 41.

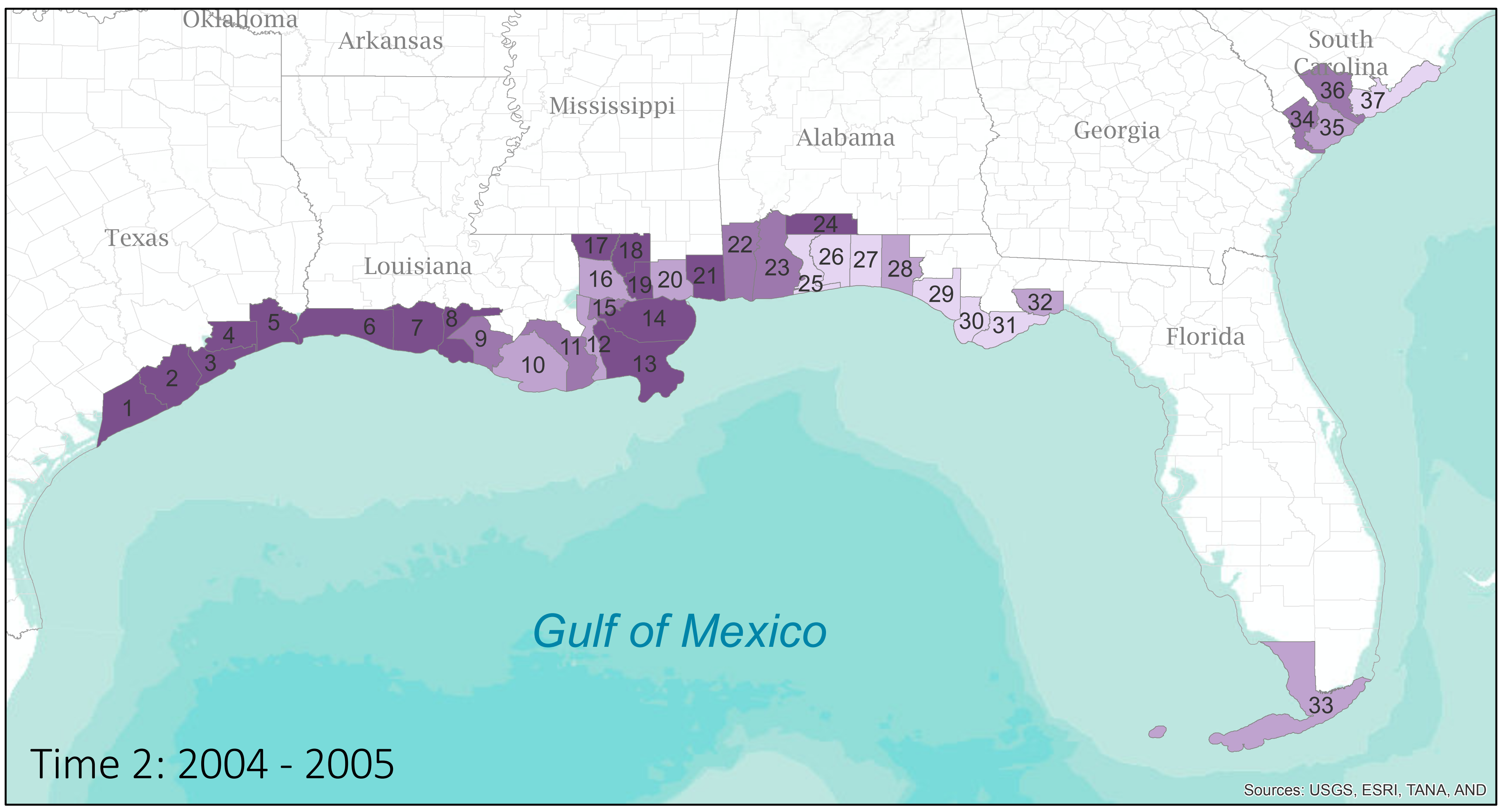
Environmental Condition

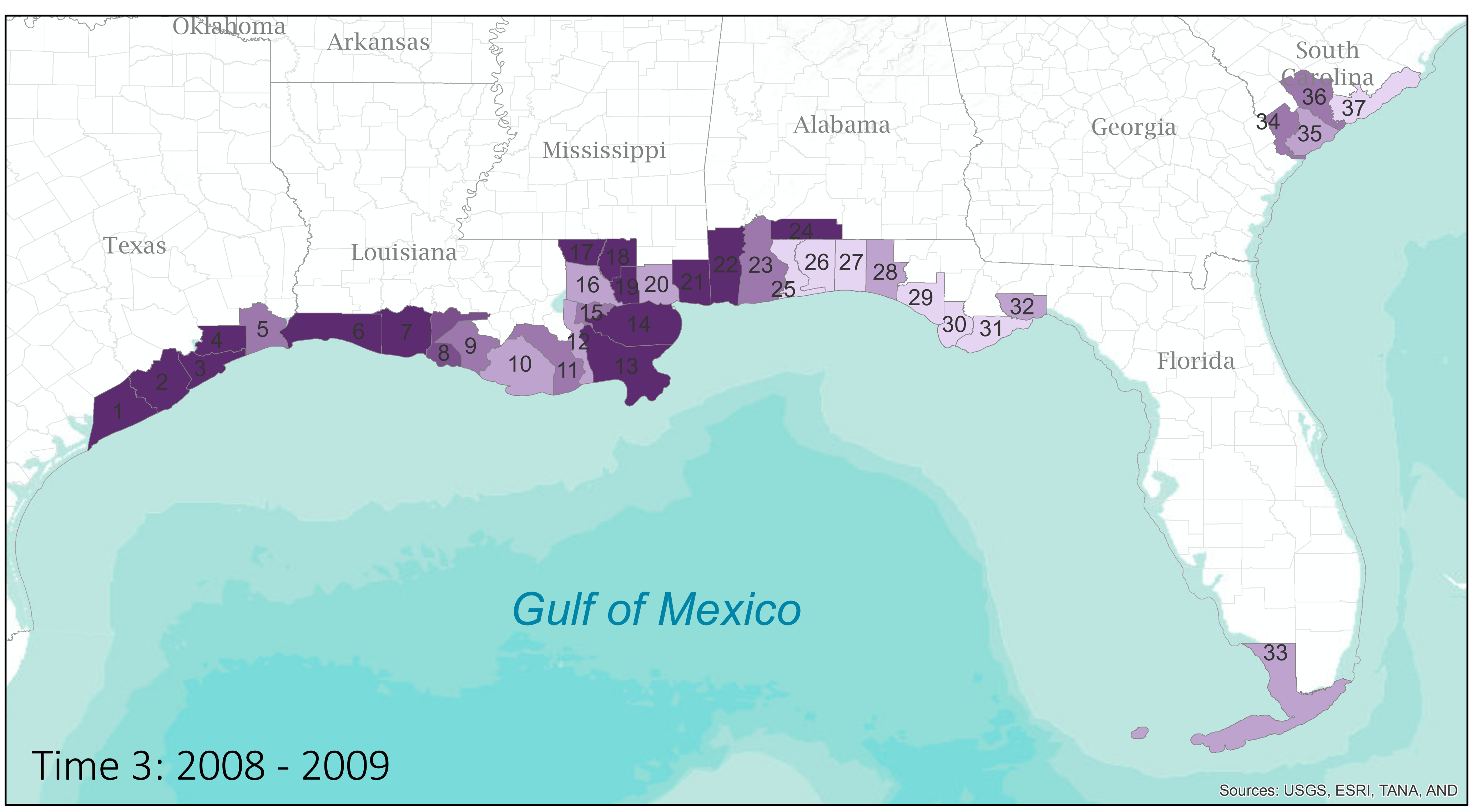


The Environmental Condition indicator includes:
- Air quality
- Sediment quality
- Water quality
- Impervious land cover

NCCOS







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36	Colleton County, South Carolina
37	Charleston County, South Carolina

Governance

Highest Ranking

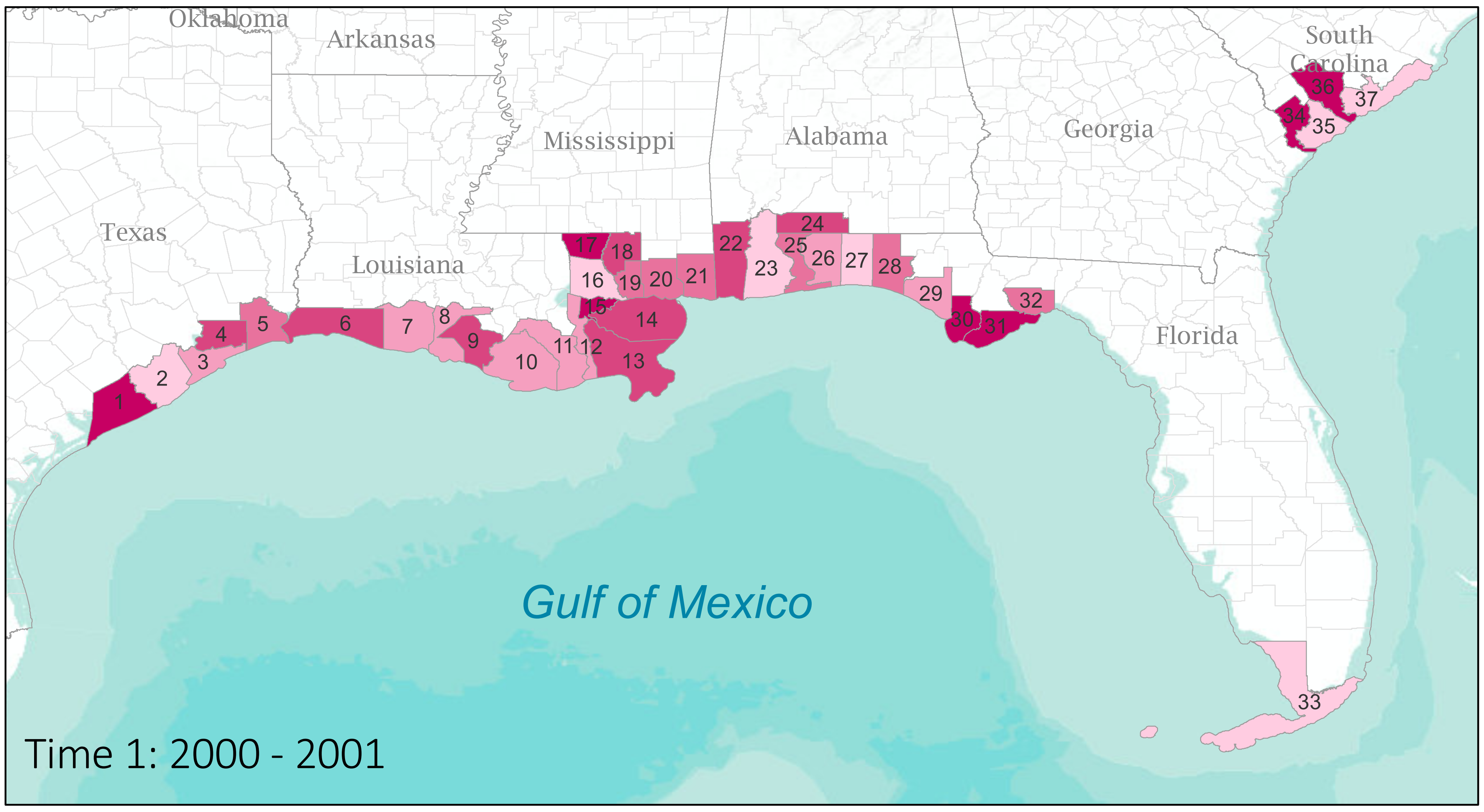
Lowest Ranking

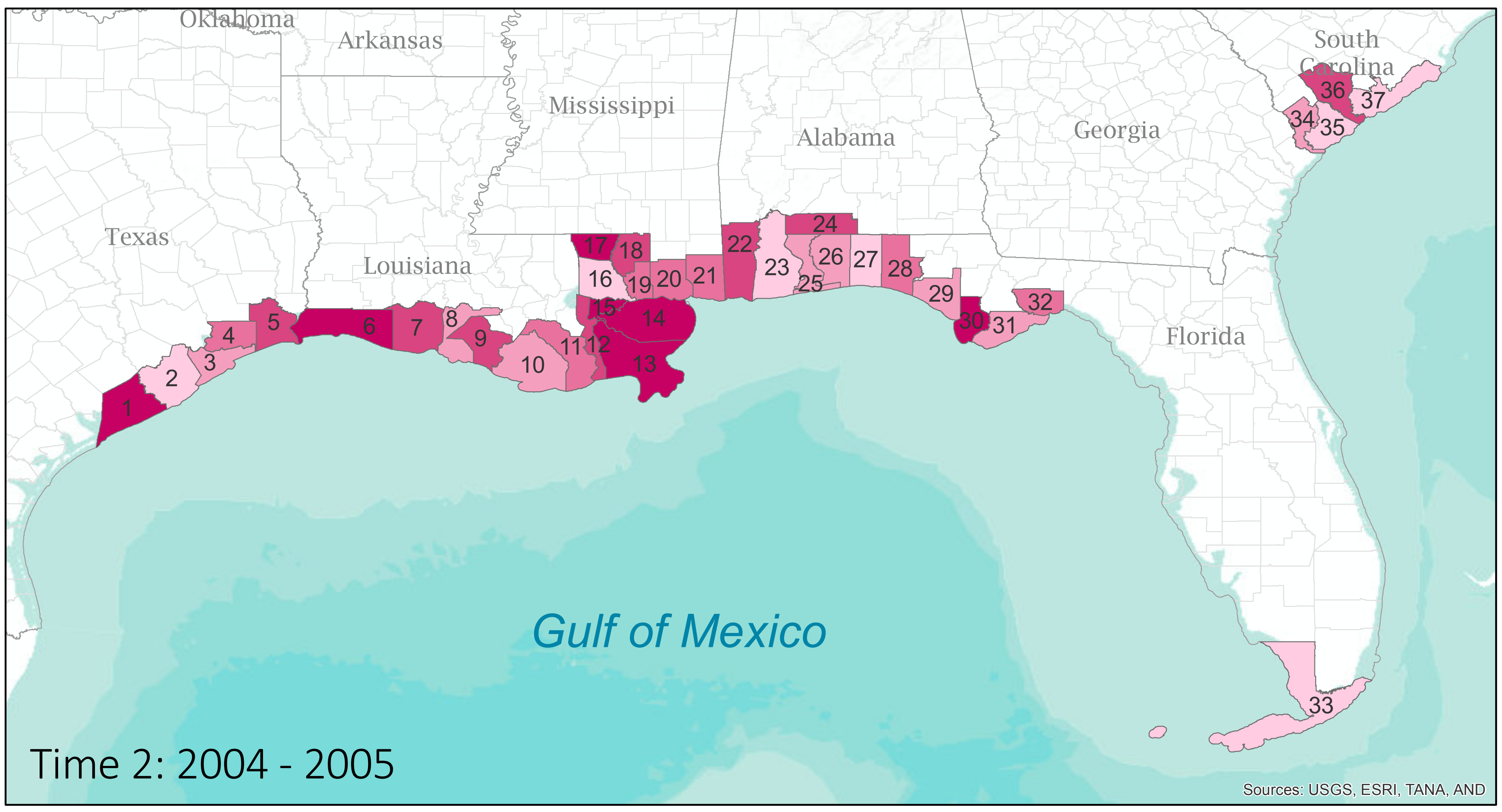
Figure 42.

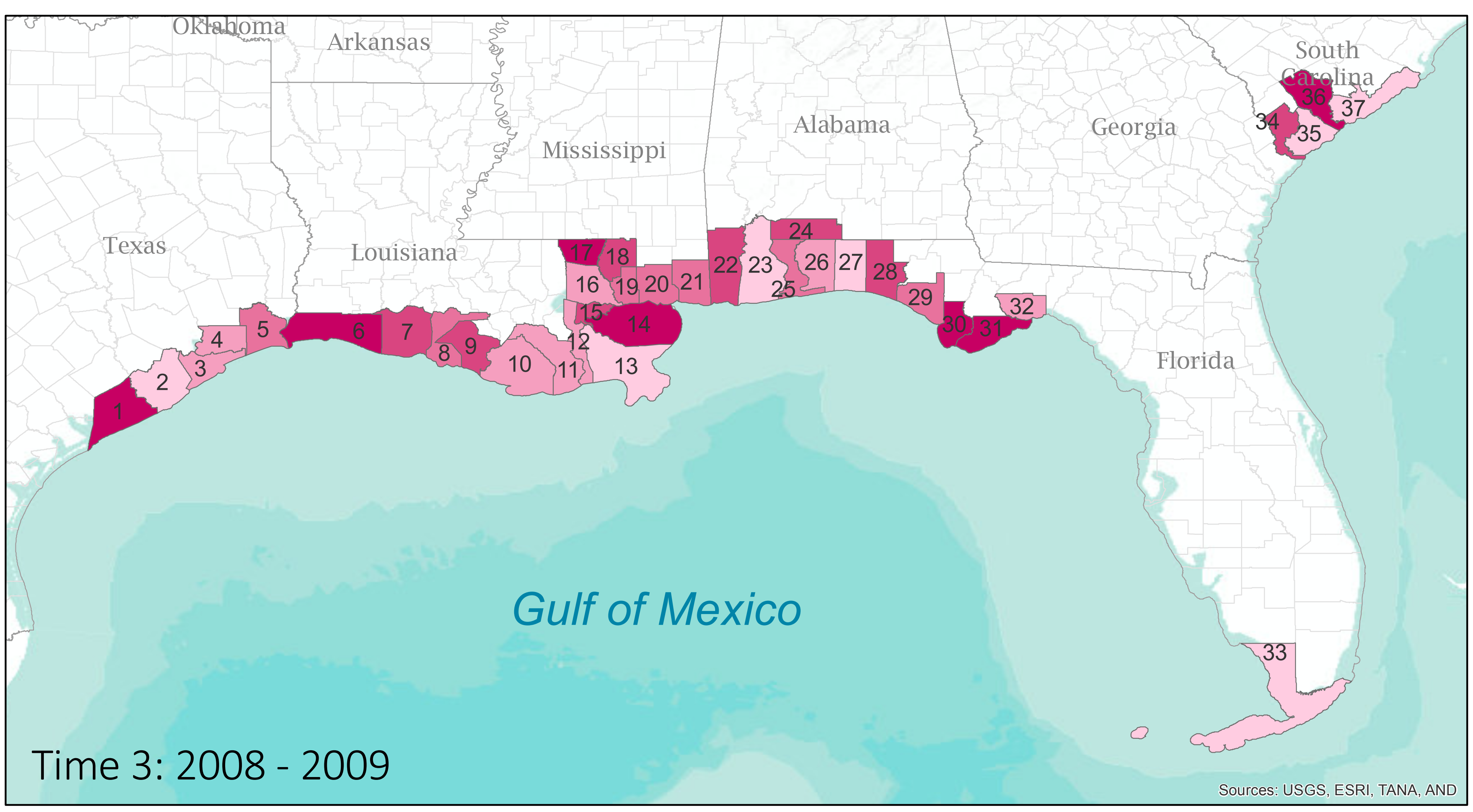
Governance - Planning and Management

0 75 150 300 Miles

The Governance indicator includes:
- County planning
- County management







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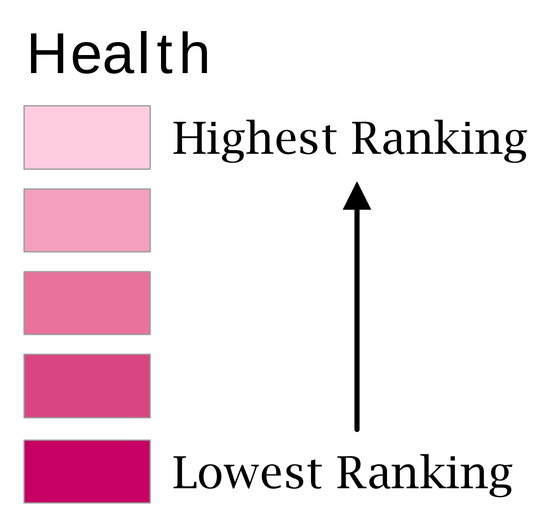
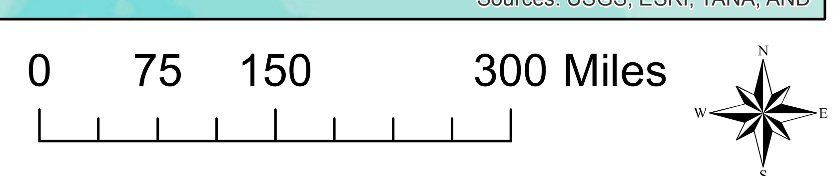
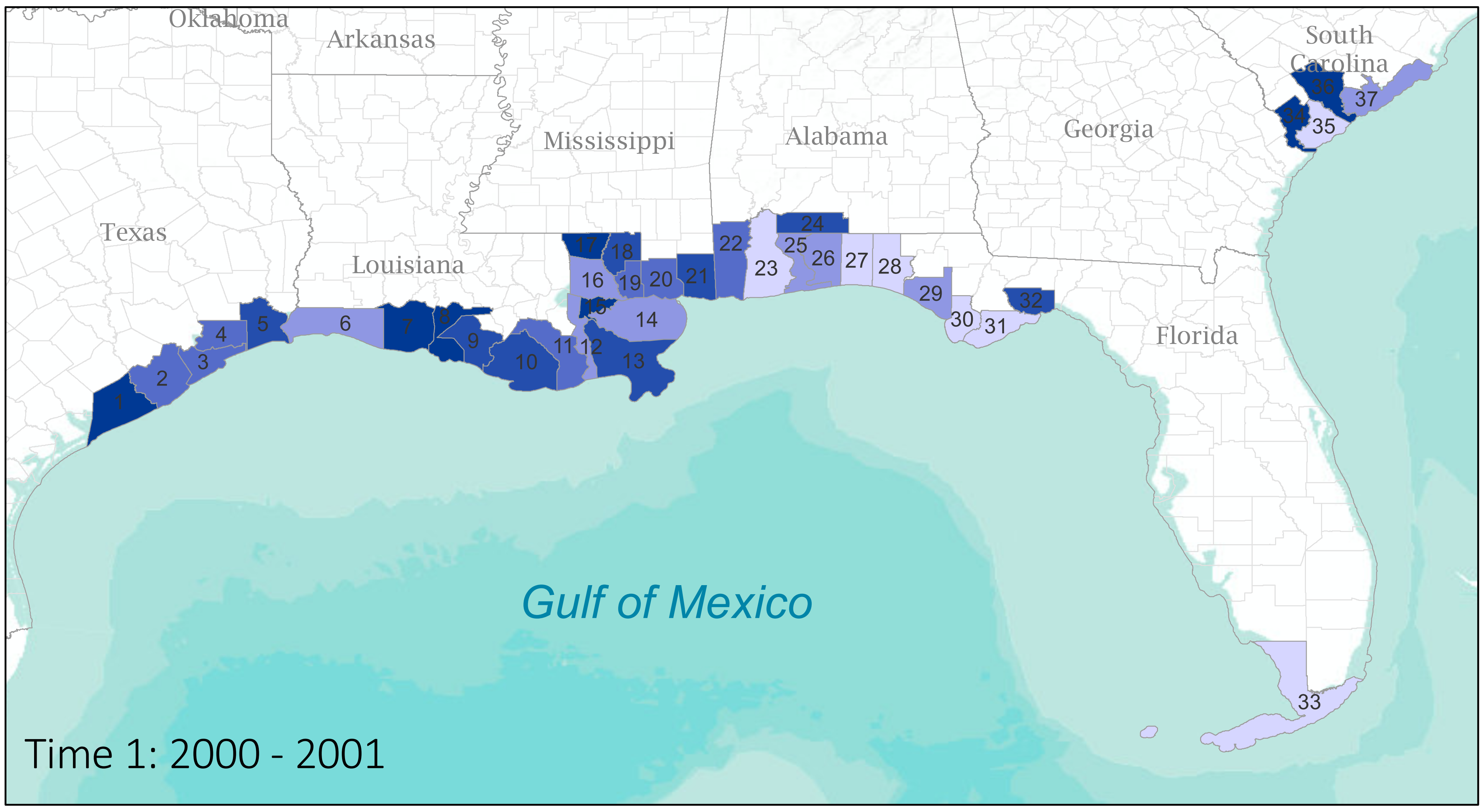


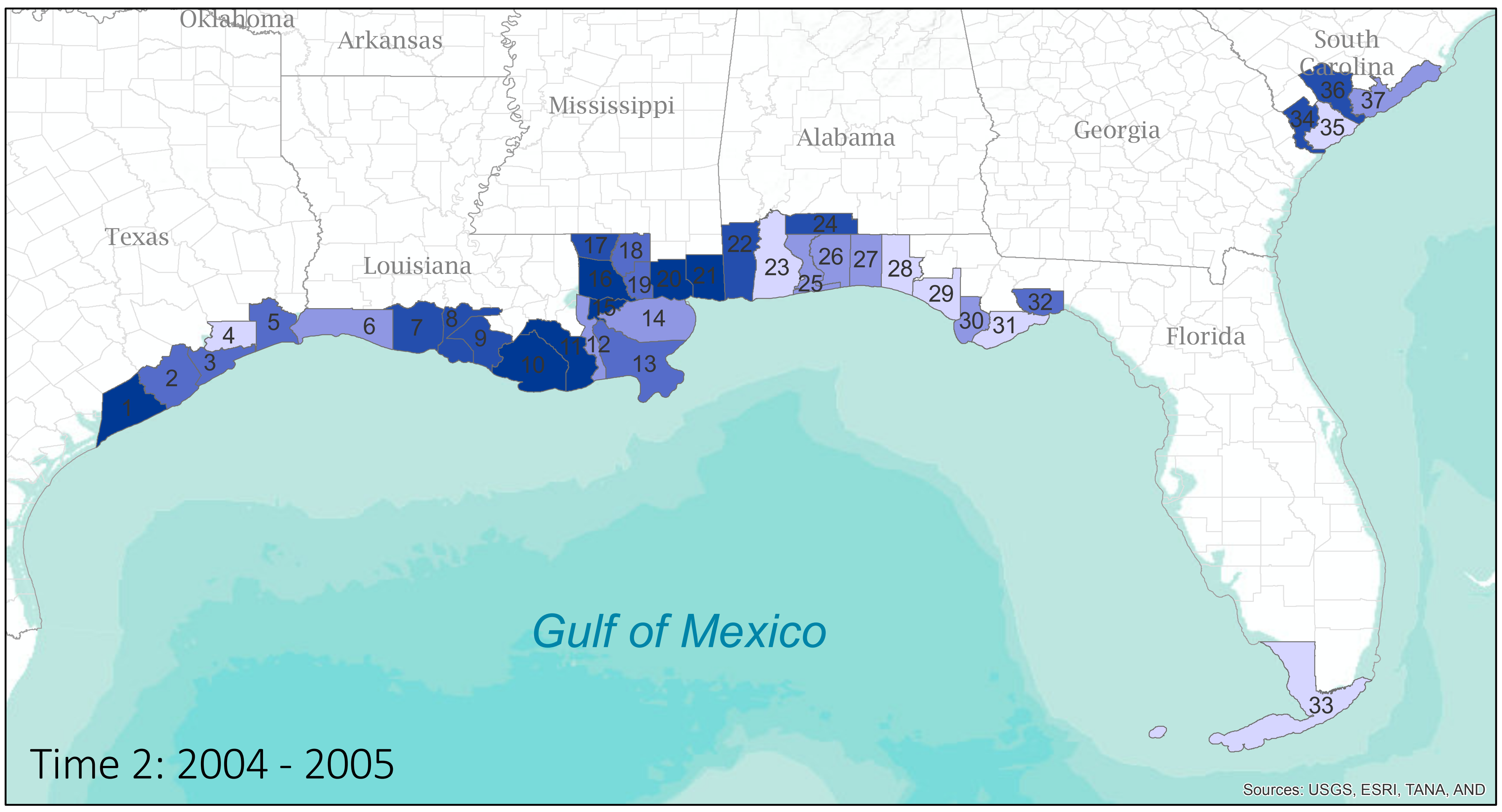
Figure 43.

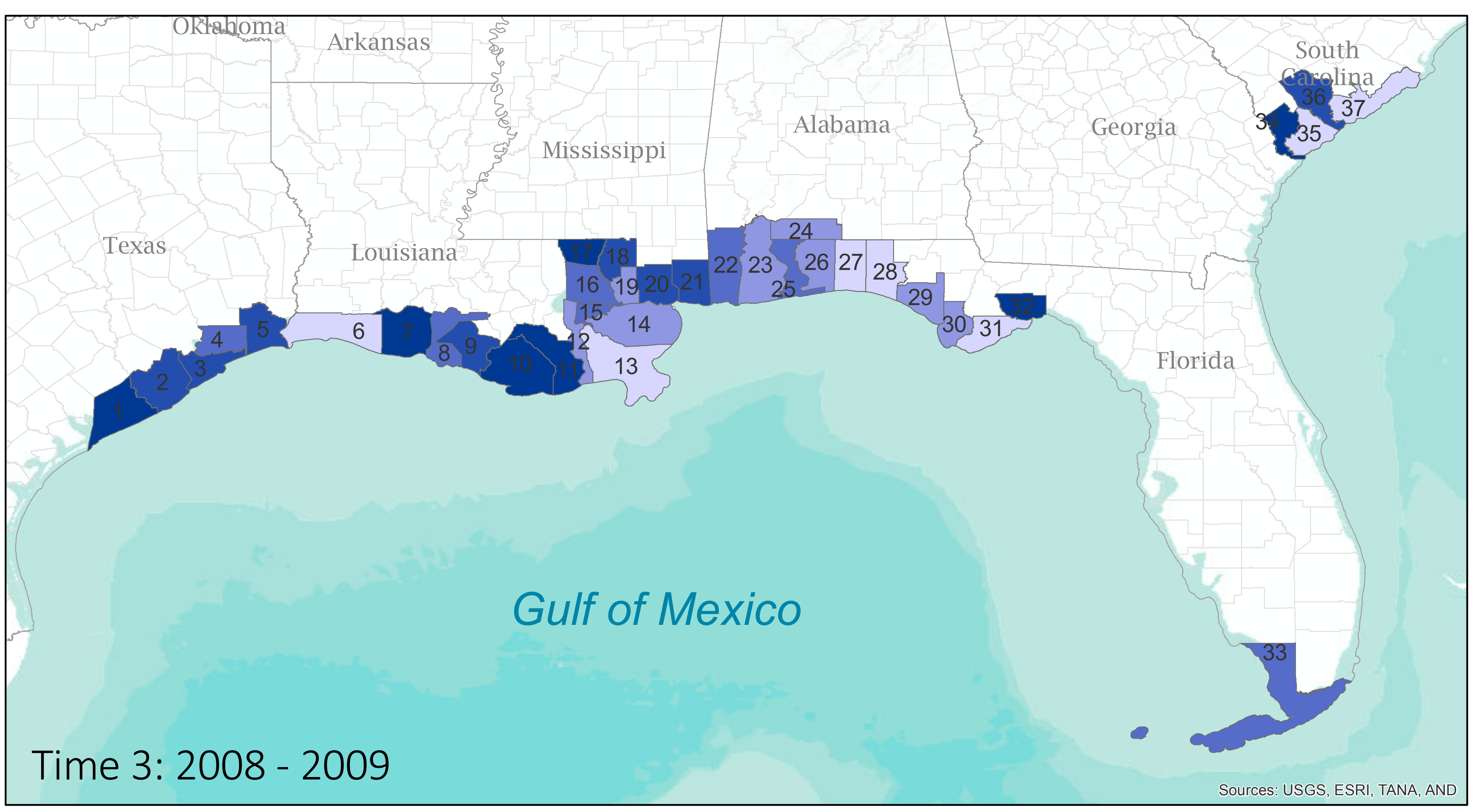
Health

The Health indicator includes:
- Birth rate
- Life expectancy
- Incidence of disease
- Availability of recreational facilities









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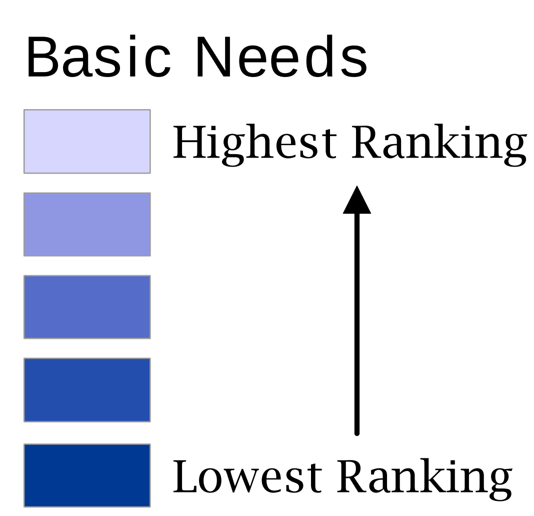
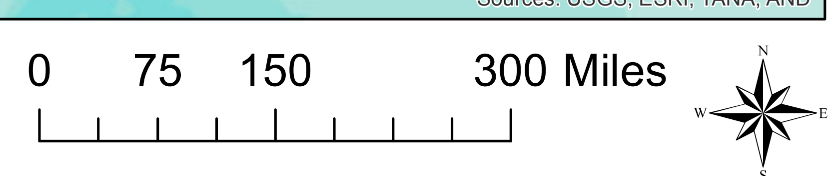


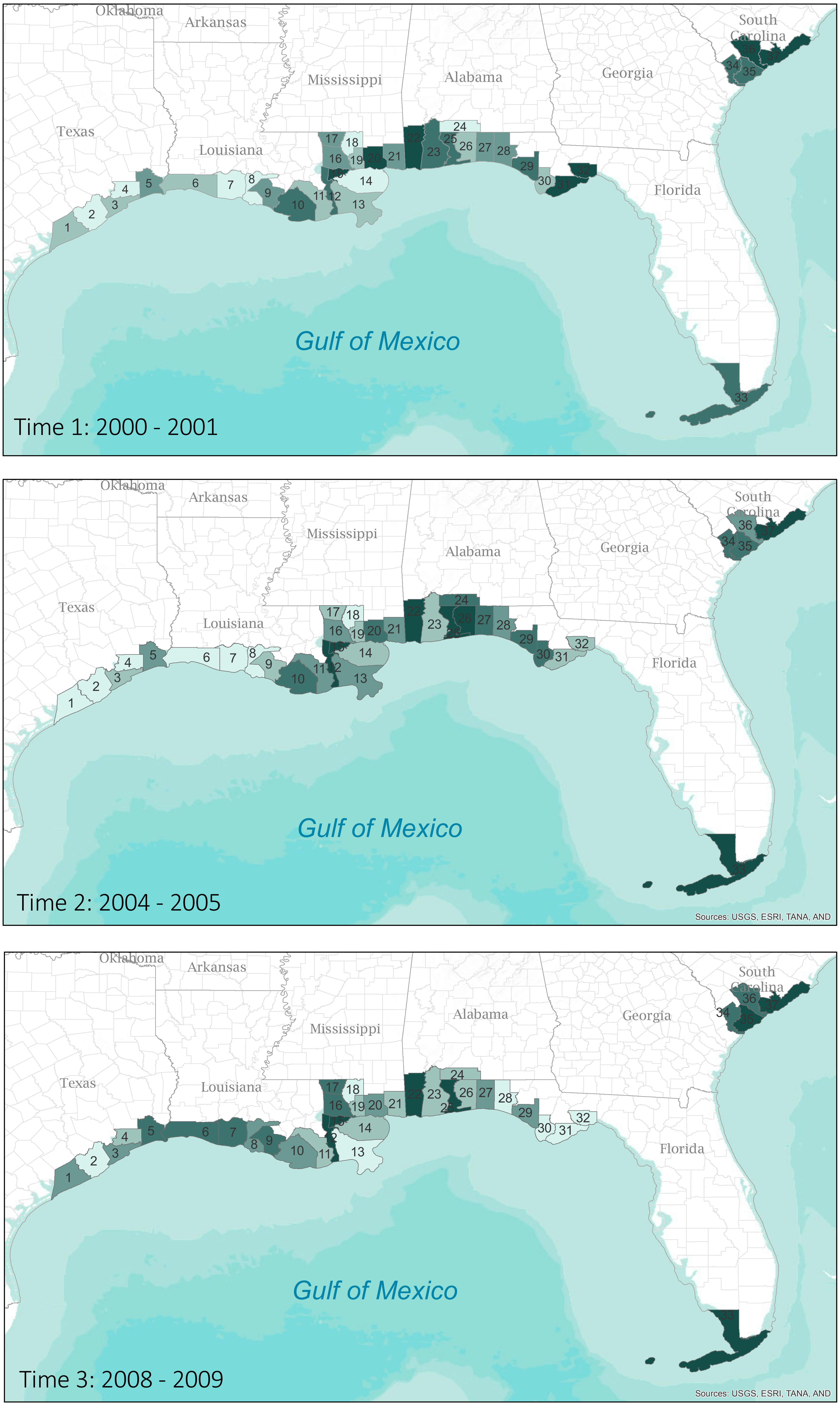
Figure 44.

Basic Needs



The Basic Needs indicator includes:
- Clean water
- Healthy food
- Adequate housing

NCCOS



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Safety

Highest Ranking

Lowest Ranking

Figure 45.

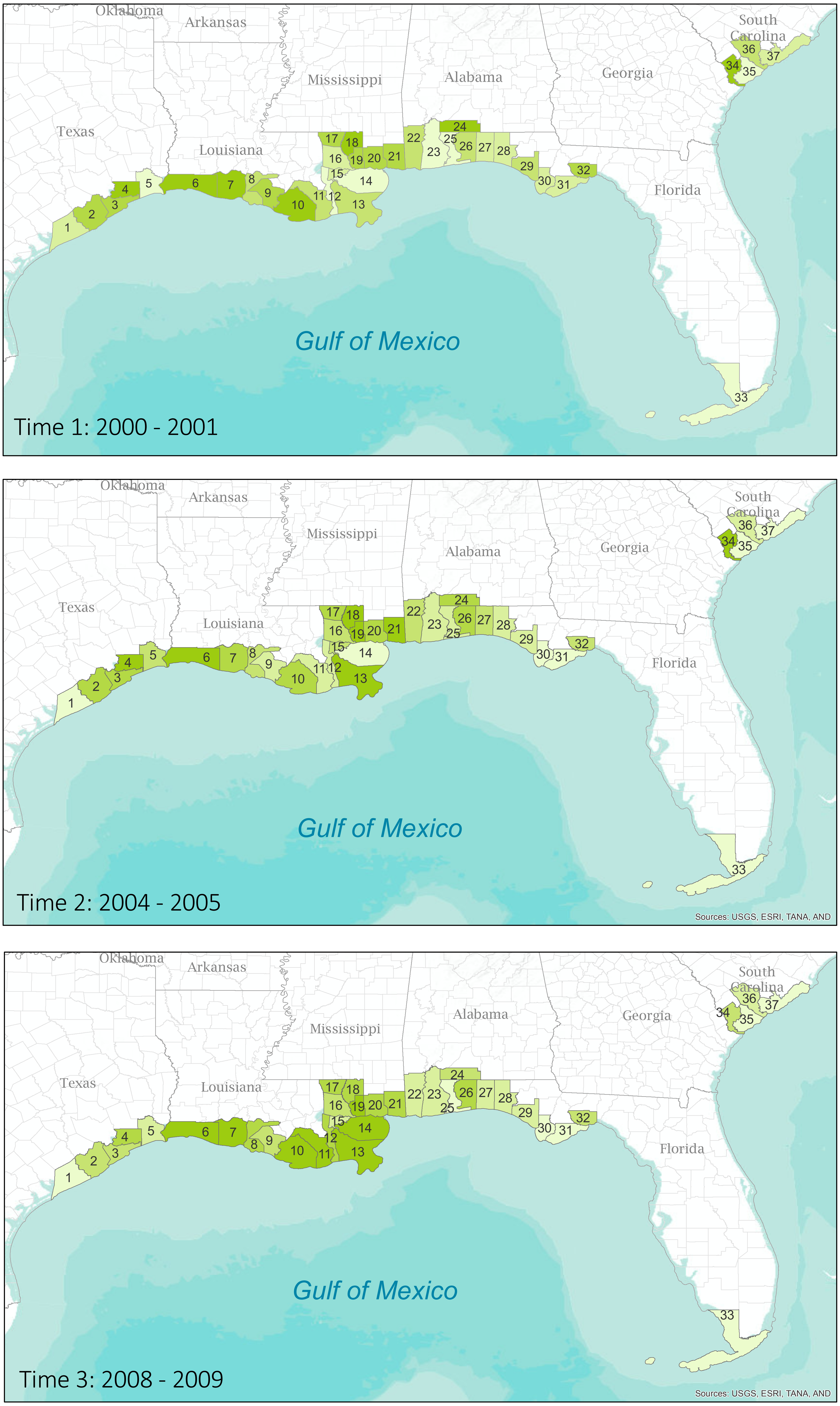
0 75 150 300 Miles

Safety

The Safety indicator includes exposure and vulnerability of the population to:

- Storm events
- Flooding
- Crime

NCCOS



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Social Connectedness

Highest Ranking

Lowest Ranking

Figure 46.

Social Connectedness

0 75 150 300 Miles

The Social Connectedness indicator includes:
- Participation in governance and charity
- Presence of churches, spiritual organizations, and arts and humanities
- Tenure in community
- Communication

Appendix C

Supporting Materials for Chapter 6 - Integrating Social Monitoring Data into NOAA Projects and Programs

Table 1. Presentations at Conferences and Meetings

Date/Conference or Meeting	Format/Title
2011 Deepwater Horizon Principle Investigators Meeting	Poster: Changes in Health and Well-being in Communities Affected by the Deepwater Horizon Disaster
2011 Coastal and Estuarine Research Federation	Invited Talk: Linking ecosystem services with health and well-being in the wake of the Deepwater Horizon industrial disaster
	Talk: Changing Dimensions of Community Well-Being in the Wake of the Deepwater Horizon Disaster
	Poster: Changes in human health and well-being resulting from the Deep Water Horizon oil disaster
2012 Society for Applied Anthropology	Talk: Linking Indicators of Well-being, Health & Ecosystem Services in the US Gulf of Mexico
2012 Social Coast Forum	Interactive Session: Indicators of Change
2012 The Coastal Society conference	Extended Session: We're Looking Out for You: Using indicators to observe social, economic, and environmental conditions at multiple scales
	Talk: Prioritizing County-Level Well-Being: Moving Toward Assessment of Gulf Coast Counties Impacted by the Deepwater Horizon Industrial Disaster
2012 NOAA Coastal Services Center	Seminar: Indications of Change—Health, Social, Environmental and Economic Well-being in the Gulf Coast States
2012 NOAA Hollings Marine Laboratory Seminar Series	Seminar: Indications of Change—Health, Social, Environmental and Economic Well-being in the Gulf Coast States
2012 Hollings Scholar Presentation	Talk: Economic Resilience and Well-being of Gulf Communities: Environmental Disaster Events and Changes in Economic Diversity
2013 Gulf of Mexico Oil Spill and Ecosystem Science Conference	Talk: Developing a barometer of health and balance: Measuring community well-being for coastal counties in the Gulf of Mexico
	Talk: Your good humor may depend on Mother Nature- Identifying relationships between coastal environmental health and well-being in the Gulf of Mexico
2013 American Association for the Advancement of Science	Invited Talk: Developing Indicators of Well-being and Ecosystem Condition in the Gulf Coastal Counties

Ecological and Societal Benefits Derived from Coastal Restoration in Southern Louisiana

Lowell Atkinson, MS Environmental Studies, MPA
College of Charleston, December 2012
NOAA Hollings Marine Laboratory

Abstract

This project examines specific coastal restoration projects in southern Louisiana to develop a method for determining which kinds of projects will most effectively enhance the social, economic, cultural, and environmental conditions of the surrounding region through physical improvement of the habitat. By applying an extensive review of the literature, examination of project compliance documents, and analysis of secondary data characterizing the well-being of parishes near selected restoration projects, I explored, conceptualized, and confirmed the relationship between specific, local ecosystem services (e.g. provisioning, regulating, supporting, cultural services) and various elements of human well-being (e.g. health, safety, economic security) impacted by four restoration projects and their respective restoration techniques: dredged material placement, sediment diversion, and artificial oyster reefs. Finally, I developed a Restoration Evaluation Framework (REF) through which these projects and techniques were analyzed for their potential benefit to regional ecosystem services, and – through associations previously established on the national and regional scale – I made connections between these enhanced ecological services and the impact to community well-being.

Introduction

Coastal Louisiana experienced a net land loss of approximately 1,883 square miles from 1932 to 2010 with accelerated loss among its estuarine marshes, forested wetlands, and fragile shoreline; with over 60% of the coastal wetland area in the Northern Gulf of Mexico (Lindstedt et al., 1991), Louisiana also accounts for 90% of total wetland loss in the conterminous United States (Couvillion et al., 2011). Primary agents of this land loss include anthropogenic (altered hydrology, dredge and fill activities, oil and gas extraction, and excessive boat wake) and natural forces (hurricanes, natural subsidence and sea level rise, and Nutria) - the majority of which are persistent and chronic. Ecological restoration is the process of restoring processes, functions, and attributes of an ecosystem in an attempt to recreate the ecosystem's original conditions. When restored, wetlands more effectively enhance ecosystem services such as gas regulation, disturbance regulation, water supply, nutrient cycling, soil erosion control, commodities, biodiversity, and recreation than any other ecoregion in the conterminous United States (Dodds et al., 2008), and through enhancing ecosystem services, wetland restoration will have a concomitant impact on well-being and quality of life while supporting regional economic interests.

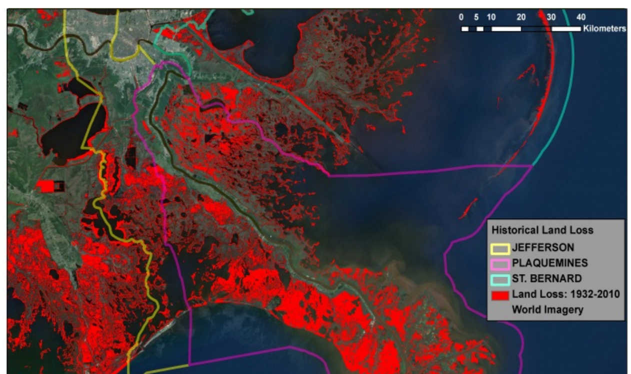

Figure 1. Historical Land Loss in Southeast Louisiana

Ecosystem services are those intrinsic and extrinsic benefits humans receive from natural ecosystems, and human well-being - defined by various social, economic, and cultural indicators - is a concept describing what constitutes a good life. Through the Millennium Ecosystem Assessment (2005), linkages between certain ecosystem services and elements of well-being have been established and were applied to this research (Figure 2). To convey connections between ecosystem services and well-being of coastal Louisiana, I developed the Restoration Evaluation Framework (REF) to analyze selected restoration projects and techniques for their potential benefit to regional ecosystem services, and I then made connections between these enhanced ecological services and the impact to community well-being.

Methods

Methods included the initial restoration project selection, data collection, and development of a Restoration Evaluation Framework (REF) consisting of a Restoration Project Evaluation Matrix (RPEM) and a Restoration Regime Scoring Matrix (RRSM). Selection of the restoration projects was based on funding sources (NOAA, ARRA, or CWPPRA), geographic boundaries (Coast 2050/CWPPRA Region 2), restoration method (dredged material placement, diversion, and artificial oyster reef), and project status (completed, ongoing, planning and design phase, etc.). Data collection included the integration of secondary data on twenty-three parameters of community well-being defined by NOAA researchers (NOAA NOS/NCCOS Technical Memo 146); analysis of these data allowed me to characterize certain social, cultural, economic, and environmental conditions of coastal Louisiana and particularly those parishes in closest proximity to the selected restoration projects: Jefferson, Plaquemines, and St. Bernard Parishes.

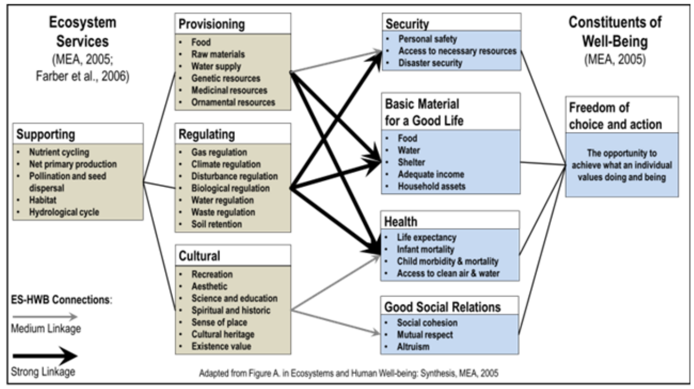

Figure 2. Conceptual Diagram Connecting Ecosystem Services and Well-being

The REF consists of extensive literature review, examination of compliance and project-specific documents, qualitative and quantitative assessments of ecosystem service provisions, and integration of online mapping, monitoring, and database tools (e.g. CWPPRA's Coastwide Reference Monitoring System). The project matrix (RPEM) defines each restoration project's impact on twenty-five ecosystem services of coastal Louisiana, and each project's comparative impact from this matrix was then used to assign final scores to each restoration method in the regime matrix (RRSM). Final regime scores describe the comparative ability of each restoration method to enhance regional ecosystem services as well as aspects of community well-being.

For the project analysis, I calculated quantitative provision estimates for five ecosystem services potentially enhanced through the wetland created from all four projects and separately calculated provision estimates for two ecosystem services potentially enhanced through reef creation. In addition, a qualitative assessment was conducted to describe each project's impact on a suite of twenty-five ecosystem services largely agreed to constitute provisioning, regulating, supporting, and cultural benefits derived from ecological systems. Finally, secondary data from twenty-three well-being parameters were selected and analyzed for Jefferson, Plaquemines, and St. Bernard Parish; a needs assessment was then conducted to evaluate each parish's performance on eleven of these parameters as well as to identify how a project's impact to ecosystem services may improve certain aspects of community well-being and quality of life.

For the regime analysis, I compared both the short-term and long-term benefits[1] associated with each project as well as how each project would impact each of the twenty-five ecosystem

[1] For the purposes of this research project, a short-term benefit has been associated with an ecosystem service that will be significantly enhanced within two years of the project completion while a long-term benefit has been

services (RPEM); then, using an established diagram (Figure 2) conveying realized connections between ecosystem services and well-being, I provide suggestions as to how each project's impact on ecosystem services could also impact certain aspects of community well-being. Finally, I developed the Restoration Regime Scoring Matrix to describe how each technique could comparatively improve well-being and which of the three techniques is the most effective at doing so (Table 2).

Discussion of Results

Projects selected for case study analysis include the Mississippi River Sediment Delivery System - Bayou Dupont (BA-39) as a dredged material placement project, Delta Management at Fort St. Philip (BS-11) as a sediment diversion project, and the Grand Isle and St. Bernard Marsh Shoreline Protection Projects as two large-scale artificial oyster reef creation projects. As Table 1 conveys, all three projects will enhance roughly the same collective number of ecosystem services, yet - based on the provision of short-term benefits - Bayou Dupont and both TNC oyster reef projects will more effectively enhance the ecosystem services of coastal Louisiana than that of the Fort St. Philip project. The RPEM also shows that each project's provision of short-term benefits varies across the four service typologies (provisioning, regulating, cultural, and supporting). While both Bayou Dupont and the TNC projects produce similar short-term impacts from regulating services, Bayou Dupont offers the most from supporting services, and the TNC projects provide the most from cultural services. Short-term benefits from enhanced provisioning services - while favoring Bayou Dupont - are not significant enough to assign a marginal advantage to a specific project in the matrix. Incorporating the results of Table 1 and the linkages diagram from Figure 2, I then established a scoring matrix from which to compare how each restoration method analyzed in this research would comparatively impact certain aspects of community well-being (Table 2). Interpreting this matrix as a social opportunity cost assessment, an artificial oyster reef - followed closely by dredged material placement and then constructed crevasses - will be the most efficient restoration investment and will provide the most positive impact to the well-being of individuals and communities.

	Bayou Dupont			Fort St. Philip			Grand Isle and St. Bernard marsh		
		Benefits			Benefits			Benefits	
Ecosystem Services	Number of Services	Short-term*	Long-term*	Number of Services	Short-term*	Long-term*	Number of Services	Short-term*	Long-term*
Provisioning	5 +	1 +	4 +	5 +	0 +	4 +	5 +	0 +	4 +
Regulating	6 +	5 +	6 +	6 +	1 +	6 +	5 +	4 +	4 +
Cultural	5 +	0 +	6 +	6 +	0 +	6 +	7 +	4 +	6 +
Supporting	4 +	4 +	4 +	4 +	2 +	4 +	4 +	2 +	2 +
Totals	**20 +**	**10 +**	**19 +**	**21 +**	**3 +**	**19 +**	**21 +**	**10 +**	**16 +**

* Short-term was identified as less than 24 months, and long-term was identified as longer than 24 months.

Table 1. Results of the Restoration Project Evaluation Matrix (RPEM)

associated with an ecosystem service that will be significantly enhanced more than two years after project completion and/or that which will exist in perpetuity.

	Dimensions of Well-Being (MEA, 2005)	Dredged Material Placement (BA-39)	Constructed Crevasses (BS-11)	Artificial Oyster Reefs (TNC Reefs)
Provisioning	Security	x	x	x
	Basic Needs	x	x	x
	Health	x	x	x
	Good Social Relations			
Regulating	Security	x		x
	Basic Needs	x		x
	Health	x		x
	Good Social Relations			
Cultural	Security			
	Basic Needs			
	Health			x
	Good Social Relations			x
Supporting	Security			
	Basic Needs			
	Health			
	Good Social Relations			
Total	Security	xx	x	xx
	Basic Needs	xx	x	xx
	Health	xx	x	xxx
	Good Social Relations			x
Total Scores		6	3	8

Table 2. Results of the Restoration Regime Evaluation Matrix (RREM)

Conclusions and Implications for the Future

Considering each technique's effect on social, economic, cultural, and environmental conditions, dredged material placement and artificial oyster reefs represent the most effective methods through which to incrementally and holistically repair the coastal landscape, economy, and culture of southern Louisiana. Through the incremental and adaptive application of dredged material placement and artificial oyster reef projects, public resource managers and restoration practitioners can build more land at a quicker rate, protect more of the fragile coastline and finite natural resources, and offer greater economic opportunities for coastal communities than with the application of constructed crevasses or other diversion techniques.

A recent study found that fines paid in response to the 2010 oil spill could create up to 57,697 new jobs in coastal restoration projects over the next ten years (Mather Economics, 2012); $2.4 billion of the total $4.5 billion criminal settlement recently agreed to by British Petroleum will be dedicated to environmental restoration, preservation, and conservation efforts in the Gulf region (Madere, 2012) – an investment sure to catalyze economic investment in this critical industrial sector. Restoration concepts and applications should be vetted to gauge their influence in restoring coastal Louisiana and the Gulf region as a whole – a process that must be dynamic in nature to achieve long-term success.

By the development or utility of social, human, built, and natural capital, all humans satisfy their basic needs and improve their quality of life (Costanza et al., 2007), and - hence - decision-makers should better understand these community needs and work diligently to support them. In coastal Louisiana, conservation and restoration programs should enhance social capital through cooperative network building and community involvement, human capital through indigenous workforce development and labor-recruitment, built capital through effective infrastructure and public works projects, and natural capital through restored, healthy ecological systems.

Future Word Needed

There is still a substantial body of work needed to effectively define the social, economic, cultural, and environmental conditions of coastal Louisiana and the Gulf region as well as the conservation and restoration strategies most qualified to enhance these conditions. As a continuation of this research project, more localized research is required to define the quality and quantity of all ecosystem services native to Louisiana and the Northern Gulf of Mexico, and considerable energy should be directed towards effectively quantifying the delivery of provisioning, regulating, cultural, and supporting services associated with the selected restoration regimes and for specific wetland environments of coastal Louisiana and the Gulf.

Furthermore, as this research focused on only three methods of ecological restoration, further inspection of other restoration techniques - such as barrier island restoration, hydrological restoration, other types of freshwater and sediment diversions, outfall management, sediment and nutrient trapping, vegetation planting, ridge restoration, and fast land elevation - will be required to gauge their respective contribution to ecosystem services and community well-being. Because of its simplistic approach, the adopted methodology from this project can be tested and applied in other geographic areas and among multiple biomes and eco-regions. For example, the Restoration Evaluation Framework (REF) can be just as easily applied to mangrove forests in Southeast Asia as it can to coral reefs in Hawaii or boreal forests in Western Canada, and the final output of those analyses would still relate the extrinsic and intrinsic value of those ecosystems to their respective human communities. In the long-term effort to protect and restore healthy ecosystems, decision-makers and resource managers must actively engage rising generations to become environmental stewards and to understand the irrefragable connections between the environment and society and how natural capital can reap significant benefits for themselves, their family, and their community.

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Societal responses following disaster: Exploring the association between social conflict and environmental disaster events

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Photo Credit: NOAA Photo Library

Introduction

Natural disasters are uncontrollable, inevitable events that have the potential to disrupt individual lives as well as family and community structures (Miller and Kraus, 1994). Between 2000 and 2010, there were 642 major disaster declarations in the United States (FEMA, 2011). This number is predicted to rise in the future due to the increasing effects of climate change on the frequency and magnitude of natural disaster events worldwide (Field *et al.*, 2007; Schneider *et al.*, 2007). Stressful conditions brought about by these events have been shown to expose aspects of social life that are typically inconspicuous in a person's less stressful everyday life (Wilson *et al.*, 1998). Determining steps to take to be prepared for and to help mitigate social conflict after disaster may help communities rebound after disaster events. This objective of this study is to determine the effects natural disasters have on social conflict, specifically crime, divorce, and domestic violence, and to predict how conflict events may be affected by climate change in the Gulf Coast region.

Problem and Research Questions

Increases in social conflict can be a result of the existence of additional stressors long after disaster. Some studies have shown social conflict such as divorce, domestic violence, family conflict, and violent crime have all significantly increased after environmental disaster events (Adams and Adams, 1984; Anderson and Anderson, 1984; Rotton and Frey, 1985; Cotton, 1986; Cohn, 1990; Cohan and Cole, 2002; Picou and Martin, 2006; Buttell and Carney, 2009; Harville *et al.*, 2011), while others have produced mixed results. As part of a study to explore the changes in well-being in the Gulf Coast states impacted by the 2010 Deepwater Horizon Oil Disaster, this project leveraged data collected from Gulf Coast counties for a ten year period to understand the relationships between the environment and this aspect of public health. This study aimed to answer the following questions: 1) To what extent do natural disaster events affect social conflict in the northern Gulf of Mexico? What types of social conflict are most affected? 2) Does the frequency of social conflict increase in the northern Gulf of Mexico after natural disaster events? 3)

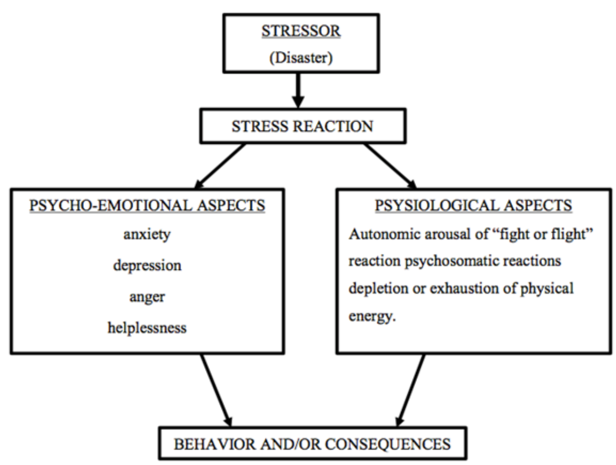
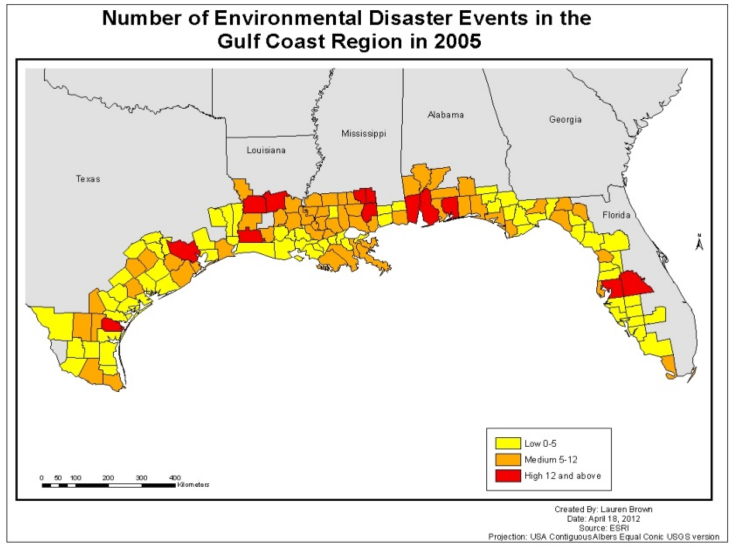


Figure 1. A proposed disaster-outcome stress reaction model (Adams and Adams, 1984)

What predictions can be made about the impact of global climate change on the relationship between natural disaster events and social conflict?

Methods



A county level analysis was chosen for this study in order to take a look at how whole communities, as opposed to specific groups of individuals, respond to environmental disaster events. For county data to be included in this study the following criteria must be met: the county must be a coastal county in the northern Gulf of Mexico region, the county must be a county included in the Federal Emergency Management Agency's (FEMA) major disaster declarations or emergency list for the natural disaster events chosen for this study, and at least two years of post-event data must be available for at least two to three measures of social conflict being evaluated in this study. Following these criteria, a total of 139 counties were included in this study. Annual totals of all variables included in this study were collected at the county level for the years 2003-2007, depending on availability. The measures of social conflict chosen for this study were total crime, divorce, and domestic violence. Hurricanes, tropical storms, tornados, and severe thunderstorms were the four environmental disaster events chosen for this study. This study included the collection of a wide variety of socioeconomic and demographic variables to be used as control measures. The demographic variables include race/ethnicity, sex, population, and age and the socioeconomic variables include income, unemployment, and educational attainment. Descriptive statistics were performed for all variables included in this study. Correlation analyses were also used to establish statistical links between the independent and dependent variables, as well as control. Simple linear regression analyses were also performed to determine if there was a relationship between the dependent variables (social conflict measures) and the independent variable (environmental disaster events). Additionally, a hierarchical multiple regression analysis was performed for each of the social conflict variables to determine whether or not the number of environmental disaster events are significantly related to the amount of social conflict at the county level, while controlling for a variety of demographic and socioeconomic factors that are known to be related to social conflict events. The same set of demographic and socioeconomic variables were controlled for in each of the hierarchical multiple regression analyses. A paired samples t-test was also conducted to determine if the means of the social conflict variables were statistically different from each other for the years 2003 and 2007.

Results

Results of this study suggest environmental disaster events may be a predictor of divorce but not of crime or domestic violence in the Gulf Coast region and that disaster events could have a negative effect on well-being at both the individual and community level. When controlling for multiple demographic and social variable the regression of divorce on environmental disaster events, environmental disaster events did prove to be a positive and significant predictor of divorce (β=.047, p<.05)(Table 1.). Thus, while controlling for population, race, gender/sex, unemployment, income, age, and education, 13.447 more divorces will take place in Gulf Coast region counties with each additional environmental disaster event that occurs. While further work will refine this study, the findings indicate that emergency and disaster planners in the northern Gulf of Mexico might use this information in preparing for social resiliency following storm events.

Table 1. Regression of divorce on environmental disaster events

Independent Variables	**Model 1**		**Model 2**	
	B	**β**	**B**	**β**
Age 18-65	7.762	(.020)	3.163	(.008)
Female	-16.845	(-.037)	-21.691*	(-.047)
Resident population	.003***	(.733)	.003***	(.707)
Minorities	-3.888**	(-.060)	-3.541**	(-.055)
High school diploma or equivalent	.007**	(.235)	.007**	(.233)
Unemployment	21.308*	(.038)	18.703	(.034)
Income	.013**	(.069)	.014**	(.071)
Environmental disaster events			13.447*	(.047)
R Square	.959		.960	
R Square Change			**.001**	

Notes: B=Unstandardized coefficients. β=Standardized coefficients. ***p<.001 **p<.01 *p<.05 (two-tailed tests). N=137. All social conflict variables are measured as the total number of occurrences.

Implications for the Future

Climate change science has determined that the frequency and intensity of environmental disaster events are going to increase in the future (Emanuel, 2005; Field *et al.*, 2007; IPCC, 2007; Schneider *et al.*, 2007). Specifically, in the Gulf Coast region, it has been predicted that the intensity of peak wind speeds and the total and peak precipitation associated with tropical cyclones are likely to increase as climate change progresses (Twilley *et al.*, 2001). More frequent, more intense storms coupled with land subsidence and sea level rise, are going to pose an increased amount of stressors on individuals' daily lives. Preparedness is going to play a key role in mitigating the effects these storms may have on residents of the Gulf Coast region. Even though the Gulf Coast region experiences numerous environmental disaster events on a yearly basis, more frequent and more intense storms can bring additional stressors that residents in this area are not accustomed to. Social conflict will continue to occur following the predicted effects of climate change. According to the results of this study, more frequent and intense storms will continue to present stressful conditions that lead to marital problems and eventually result in divorce. As the effects of climate change become more prominent, proper disaster preparedness will prove to be imperative to community resilience following environmental disaster events in the Gulf Coast region. Future research on the social impacts of climate change will be necessary to ensure the employment of planning strategies that aim to prevent and mitigate social conflict in this region following more frequent and more intense storms.

Significance

Social conflict events can negatively affect individuals' lives as well as whole community structures. Social conflict has the ability to lead to destructive, unhealthy relationships between both individuals and groups and can even result in violence (Fisher, 2000). Social conflict events are also capable of affecting the health and well-being of those individuals involved due to the excess stress they present in an individual's life. Social conflict events that negatively affect the individual can have an impact at a larger societal level. Community involvement, social interaction, social networks, and trust of others within a community are all aspects that can affect the social capital of an area, which plays a role in the overall well-being of a society (Cox *et al.*, 2003). Due to the detrimental effects social conflict imposes on people's lives and the severe nature and frequent occurrence of natural disaster events in the northern Gulf Coast Region, it is important to determine how disaster events affect intimate areas of social conflict so that communities with populations most sensitive to disaster can develop mitigation and response plans to deal with these social conflict events in the future.

Outreach

- **Public Thesis Defense Presentation,** Hollings Marine Laboratory, Charleston, SC June 27, 2012, **"**Societal responses following disaster: Exploring the association between social conflict and environmental disaster events"
- **Sixth Annual Graduate Research Poster Session**, College of Charleston, Charleston, SC, January 19, 2012, Poster Presentation "Societal Responses Following Disaster: Exploring the Association between Social Conflict and Environmental Disaster Events"
- **21st Biennial Conference of the Coastal & Estuarine Research Federation**, Daytona Beach, FL, November 6-10, 2011, Poster Presentation "Changes in Human Health and Well-being Resulting from the Deepwater Horizon Oil Disaster"

Bio

Lauren obtained her M.S. in Environmental Studies from the College of Charleston in 2012. Her interests include human health and well-being, natural resource management and conservation, sustainability, and climate change.

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