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REGIONAL REPORT: SOUTHEAST

EXECUTIVE SUMMARY

The Southeast Region consists of Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.

The landscapes of the Southeast are incredibly diverse, ranging from the Appalachian Mountains averaging over 3,000 ft in elevation to the beaches and coastlines that sustain fisheries, tourism, and energy extraction activities. The region is home to 80 million people and growing rapidly. However, many coastal cities and their transportation systems are frequently at or below sea level (such as New Orleans), placing their economic networks in danger of rising sea levels and increasing severe storm activity that all result from a changing climate. These climate risks are already playing out in insurance markets, where obtaining coverage for housing in vulnerable areas may differentially impact people based on socioeconomic status.

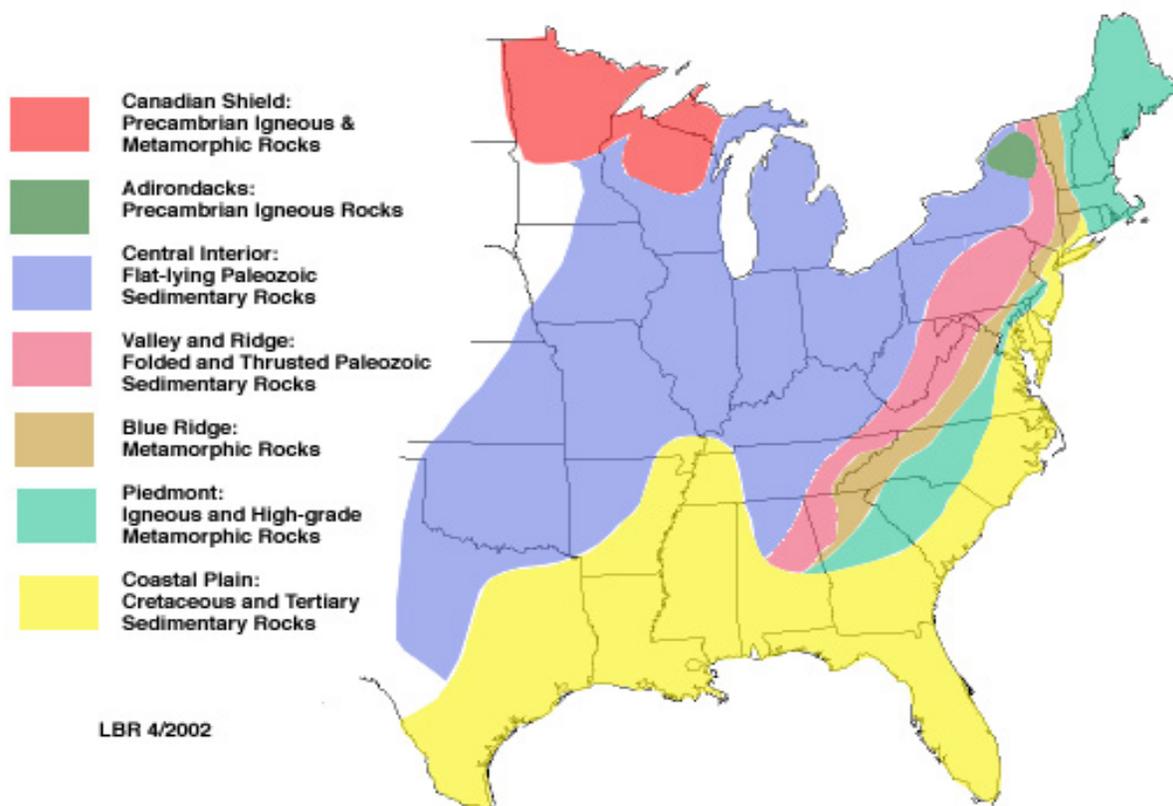
The production and transportation of energy (oil, natural gas, and coal) is central to the Southeastern economy. Stretching from Corpus Christi, TX to New Orleans, LA, the region in the Gulf Coast is home to half of all the offshore refineries in the U.S. which provide 90% of the nation's offshore energy production and 30% of its total oil and gas supply. Pollutants and contaminants produced by energy industries can damage the sensitive marine environments that provide tourism and fisheries jobs. The most prominent case in recent years is the BP/Deepwater Horizon oil spill disaster in 2010, which severely crippled local fisheries and ecosystems. Studies have shown that industrial pollutants increase the risk of reproductive and developmental problems, cancer, and various other health problems.

The local climate, geography, and transportation networks provide an ideal opportunity for the spread of invasive species and diseases. Some of the better-known invasives are the Lionfish in the Atlantic Ocean and the Burmese Python in the Florida Everglades. As temperatures warm, exotic mosquitoes are moving northward from the Caribbean and Central America, with cases of tropical diseases such as dengue and chikungunya on the rise. Travellers have returned from abroad affected by chikungunya to all but two states (as of 2015), although Florida is the only state so far where people have caught chikungunya from mosquitoes inside the US.

Regional Overview

NATURAL FEATURES

This region covers an extensive area of the US, and as such, holds a great deal of geologic, and ecologic diversity. Geologically, the Southeast has a long and complex history. Varying from the Appalachian Mountain ridge to the flat, low-lying coastal plain, there was a number of geologic forces that worked to create the southeast (see map¹). One of the biggest influences over time was the changing sea level. Sedimentary deposits, marine fossils and massive coal and natural gas deposits indicate a large portion of the southeast was once covered by an inland sea.² Over time, this sea retreated and transitioned into the large, fertile lands and network of wetlands that we see today. Contrasted with the lowlands, the Appalachian Mountains are one of the more distinct features of the southeast. They formed in the Paleozoic, and were in part shaped by volcanic activity, continental



¹ <http://www.gly.uga.edu/railsback/1121Lxr36.html>

² <http://pubs.usgs.gov/gip/continents/>

collision, metamorphic pressures and erosion.³ Over time, the region was also shaped by massive rivers, and other water bodies. Some of the most prevalent water bodies include the Atlantic Ocean, the Gulf of Mexico, many bays and deltas, the Mississippi and Missouri rivers, the Everglades, and other swamps.

The ecology is equally diverse, ranging from the hardwood forests, sand pine scrub, lowland forest, rocklands, and to the everglades, there is a great diversity of ecosystems. Some of the most biologically diverse areas of the world can be found in the southeast. Florida alone is home to about 700 vertebrates, more than 30,000 invertebrates and more than 4,000 native plant species. Florida hosts the greatest diversity of plant families of all U.S. states, and as many as 300 plants, 40 vertebrates and 400 invertebrates are found nowhere else in the world.⁴ This wealth of biodiversity is at risk, and still not yet fully understood.

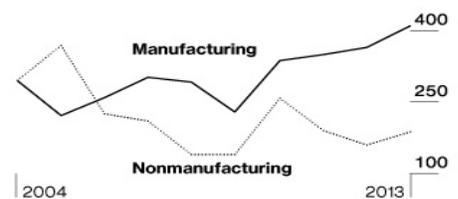
ECONOMY

States of the Southeast have been at the forefront of the progression of the American economy. The Southeast has experienced continued success in traditional industries like manufacturing, agriculture, timber, textiles, and chemicals.⁵ Over the past few decades, the Southeast has experienced dramatic diversifications in its economy. The South has expanded its economic ambitions into high-tech sectors such as energy-related technologies, information and communication technology, and advanced manufacturing.⁶ Even though the South is steeped in tradition and possess a unique microculture, every Southern state has embraced the transition from a traditional to a knowledge-based economy. State governments have realized with these high-tech companies comes increased capital investment, new projects, and most importantly, high-paying jobs.

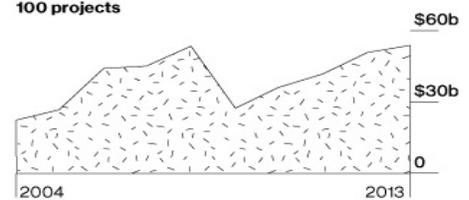
The Southeast is known for its business-friendly climate and generally low energy, land, and labor costs, which are among the lowest in the U.S. Its low tax rates, favorable government policies, and amenable regulatory

Investments Go South—in a Good Way

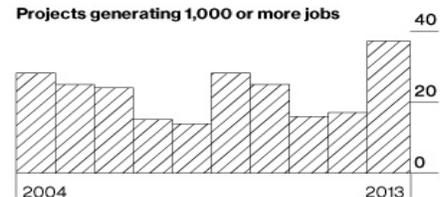
Projects in the Southern U.S. involving at least \$30 million and 200 or more jobs



Annual investment in the region's top 100 projects



Projects generating 1,000 or more jobs



DATA: SOUTHERN BUSINESS & DEVELOPMENT

³ <http://pubs.usgs.gov/gip/birth/birth.pdf>

⁴ <http://www.landscape.org/florida/plants-animals/Hotspots%20and%20Diversity/>

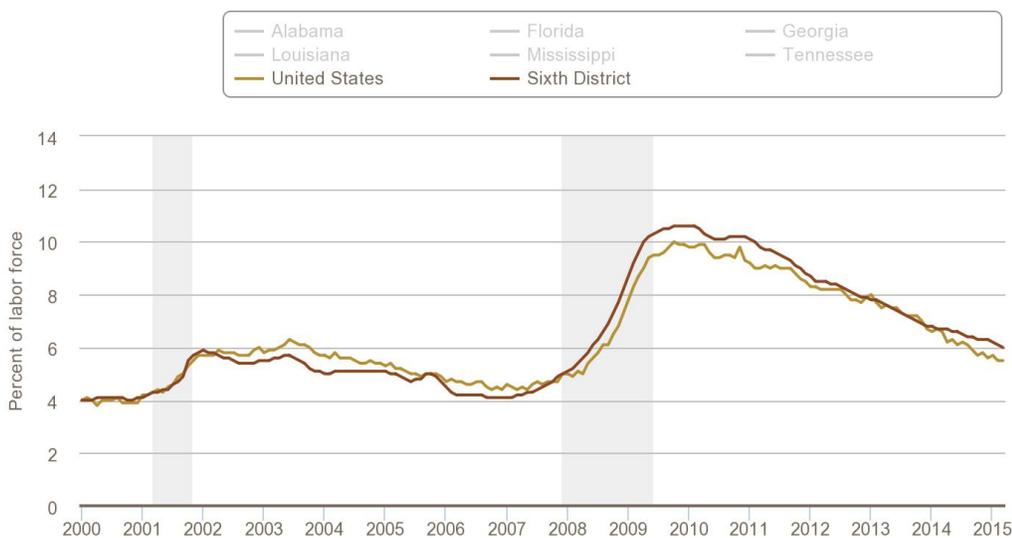
⁵ http://www.newworldencyclopedia.org/entry/Southern_United_States

⁶ <http://www.siteselection.com/issues/2012/sep/southeast-us.cfm>

agencies provide powerful incentives for companies to set up base in the South. A solid network of transportation and energy infrastructure also make up a strong foundation for any new businesses.⁷

Since manufacturing has always been a major part of the South's economy, low-cost labor is one of the region's most attractive qualities. Organizations such as the Boston Consulting Group praise southern states for their flexible unions/workers, minimal wage growth, and high worker productivity. Low levels of union presence contribute to this low cost because the lack of unionization allows companies to move workers around as they see fit. According to the Bureau of Labor statistics, union members account for less than 5% of the workforce in seven Southern states, approximately half of the 11.8% national average. Economists predict within five years costs of manufacturing in certain southeast states will be competitive with prices overseas.⁸

Unemployment Rate



Sources: U.S. Bureau of Labor Statistics

Infrastructure in the South is well-established. Transportation infrastructure include modern ports, airports, railroads, the Mississippi River, and interstates and highways at the hub of multiple transportation terminals. Metropolitan areas are located within driving distance of each other, which makes it easy for manufacturers and distributors to find ideal locations.⁹ These states continue to maintain and improve this crucial system; for example, in 2015, South Carolina has invested about \$2 billion in port-related infrastructure, including

⁷<http://www.bloomberg.com/bw/articles/2014-09-04/u-dot-s-dot-south-draws-global-manufacturers-with-low-taxes-cheap-labor>

⁸ <http://labornotes.org/2011/08/next-low-wage-haven-usa>

⁹<http://www.areadevelopment.com/RegionalReports/Q1-2014/southern-United-States-attracts-new-projects-8282711.shtml>

a harbor deepening project and increased port capacity.¹⁰

Energy industries in the South are centered on oil and natural gas, coal, nuclear, and chemical production. Stretching from Corpus Christi, TX to New Orleans, LA, the region in the Gulf Coast is home to half of all the offshore refineries in the U.S. which provide 90% of the nation's offshore energy production and 30% of its total oil and gas supply.¹¹ Louisiana is the second-highest crude oil producer and third-highest natural gas producer in the nation. A substantial amount of both oil and natural gas production comes from the federally administered Outer Continental Shelf.¹² States like Louisiana and Mississippi have resilient and diverse agricultural bases that produce raw materials for alternative fuels. A company that focuses on using biomass as a renewable energy source, Green Circle Bio Energy recently invested \$115 million into an energy wood pellet manufacturing facility in Mississippi.¹³

Even with the domestic transition from coal consumption to natural gas, coal mining still remains a major industry in the U.S. (Figure below shows areas of coal deposits) Kentucky satisfies 10.6% of coal demands from the nation's power plants and 92% of the energy produced in Kentucky was coal, making it third in the nation for coal production.¹⁴ Despite its reliance on coal, Kentucky also possesses two oil refineries and two large electric power plant.¹⁵ In order to replace lack of domestic demand, export of coal overseas to regions such as Asia has increased exponentially.¹⁶ Even though pollution and toxic chemicals from coal plants devastated surrounding communities and ecosystems, coal brought jobs. Many low-income communities depend on coal plants for economic livelihoods. Georgia Power, a coal production company, recently were forced to close down several plants due to EPA violations. Taxes rose, and job markets in neighboring rural communities became worse.¹⁷ Other mining operations include phosphate rock and iron ore. 80% of phosphate rock to satisfy U.S. demands come from Florida, which is used for fertilizer.

Most natural gas discoveries in the southeast are found in the Appalachian Basin, extending from New York all the way to Georgia and Alabama. West Virginia, like Kentucky, is also dependent on coal production; 87% of its energy production comes from coal. West Virginia's economy has been hurt recently by the decline in coal demand, but it is experience a natural gas boom, thanks to the Marcellus Shale which contains more than 50

¹⁰<http://businessfacilities.com/2013/09/feature-story-racing-to-be-ready-u-s-ports-prepare-for-post-panamax-era/>

¹¹ <http://projects.propublica.org/louisiana/>

¹² <http://www.lmoga.com/industry-sectors/>

¹³<http://www.areadevelopment.com/newsItems/7-1-2013/green-circle-bio-energy-manufacturing-facility-george-county-mississippi984783.shtml>

¹⁴<http://energy.ky.gov/Coal%20Facts%20Library/Kentucky%20Coal%20Facts%20-%202011th%20Edition%20%282009-2010%29.pdf>

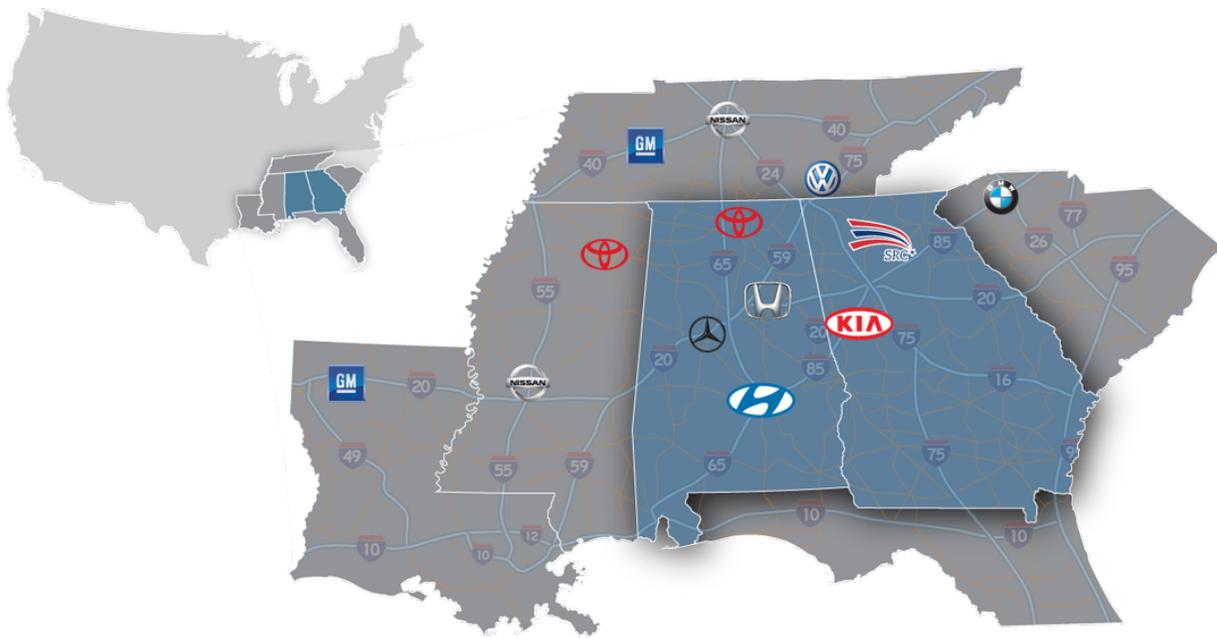
¹⁵ <http://247wallst.com/special-report/2013/07/18/ten-states-producing-most-of-the-nations-energy/2/>

¹⁶ <http://www.eia.gov/coal/production/quarterly/pdf/t7p01p1.pdf>

¹⁷ <http://www.scientificamerican.com/article/can-southern-us-cut-coal/>

trillion cubic-feet of accessible natural gas.¹⁸ On the nuclear scene, the Southeast is major contributor to the U.S. nuclear sector. Over the past decade, consolidation of nuclear energy plants helped boost energy infrastructure and solidified a stable energy market of the Southeast. For example, Entergy Corporation, based in Arkansas, Louisiana, Mississippi, and Texas, has doubled its nuclear generation capacity since 1999. Other companies have followed similar routes as expansion of plant purchases extend across the country.¹⁹

The automobile manufacturing industry is part of the Southeast's economy. Tennessee is the top car manufacturer in the Southeast.²⁰ With Volkswagen, Nissan, and General Motors, Tennessee's automobile industry employs thousands of workers.²¹ The automobile industries in Georgia and South Carolina are expected to grow as car companies such as Mercedes-Benz and Volvo are expanding into these states.^{22,23}



Tourism is another large part of the Southeast economy. In particular, for the past four years, Florida has seen a record number of tourists visit its state.²⁴ Florida's beaches

¹⁸ <http://www.areadevelopment.com/RegionalReports/Q1-2014/southern-United-States-attracts-new-projects-8282711.shtml?Page=2>

¹⁹ <http://www.world-nuclear.org/info/Country-Profiles/Countries-T-Z/USA--Nuclear-Power/>

²⁰ http://www.knoxnews.com/opinion/editorials/editorial-auto-industry-continues-to-rev-states-economy_95509398

²¹ http://www.memphismegasite.com/auto_industry.html

²² http://www.thecarconnection.com/news/1096172_mercedes-benz-confirms-its-moving-u-s-hq-to-atlanta-georgia

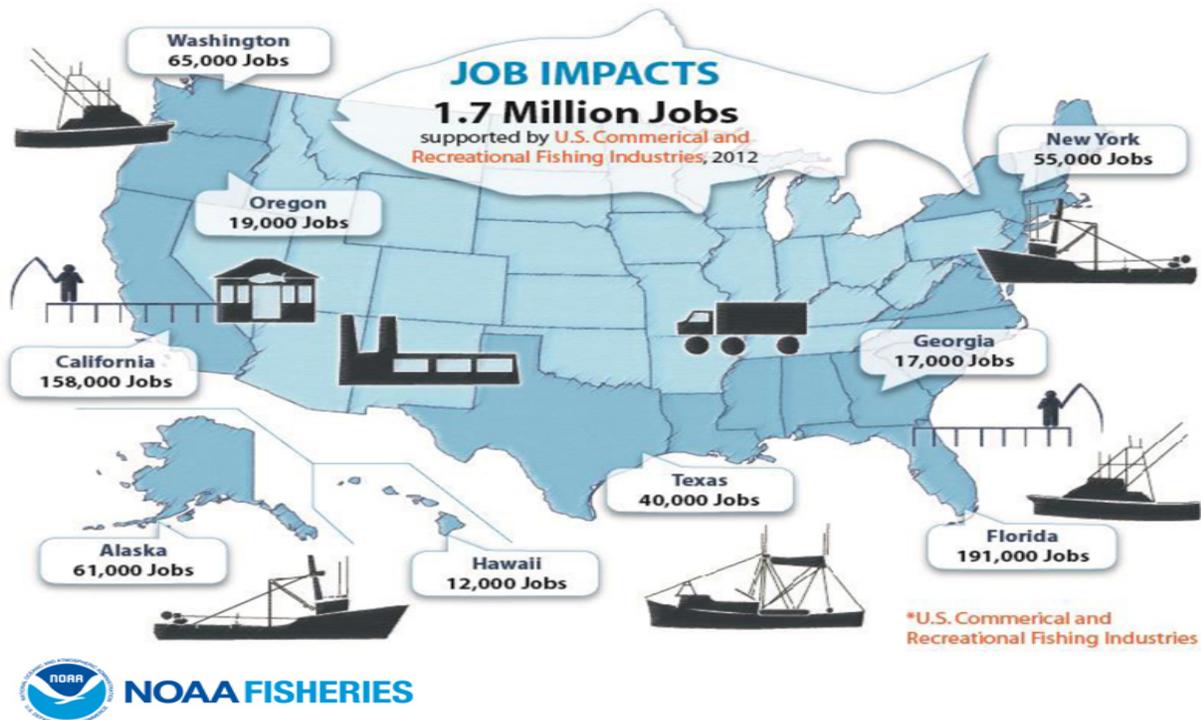
²³ <http://www.thestate.com/news/business/article13758719.html>

²⁴ http://www.baynews9.com/content/news/baynews9/news/article.html/content/news/articles/bn9/2015/2/16/record_number_of_97_.html

and theme parks are among the many attractions that draw millions of visitors each year and generate more than one million jobs.²⁵ Agritourism, which is where urban visitors can take tours of farms, is also a thriving business in the Southeast. In Tennessee, revenue from agritourism has doubled from \$34.4 million in 2006 to \$54.2 million in 2012.²⁶

AGRICULTURE

Agriculture and fishing are also sectors of the Southeast economy that will be continually affected by global change. Mississippi's number one industry is agriculture; more than 17% of the state is indirectly or directly employed by the agricultural industry.²⁷ Along with poultry, Mississippi farm products include cotton and soybeans. In 2011-2012, Florida accounted for 65% of the United States' total citrus industry.²⁸ The citrus industry generates approximately \$9 billion in revenue and more than 75,000 jobs.²⁹ However, in recent years, there has been a decline in Florida's citrus industry due to citrus greening disease.³⁰ The implications of this as well as other invasive species and diseases should be of concern to



²⁵ <http://www.visitfloridamediablog.com/home/florida-facts/research/>

²⁶ <https://ag.tennessee.edu/news/Pages/NR-2013-07-AgritourismStudy.aspx>

²⁷ <http://www.growingmississippi.org/agriculture-in-mississippi/>

²⁸ <http://www.freshfromflorida.com/Divisions-Offices/Marketing-and-Development/Education/For-Researchers/Florida-Agriculture-Overview-and-Statistics>

²⁹ <http://www.visitflorida.com/en-us/articles/2007/november/741-florida-citrus-facts.html>

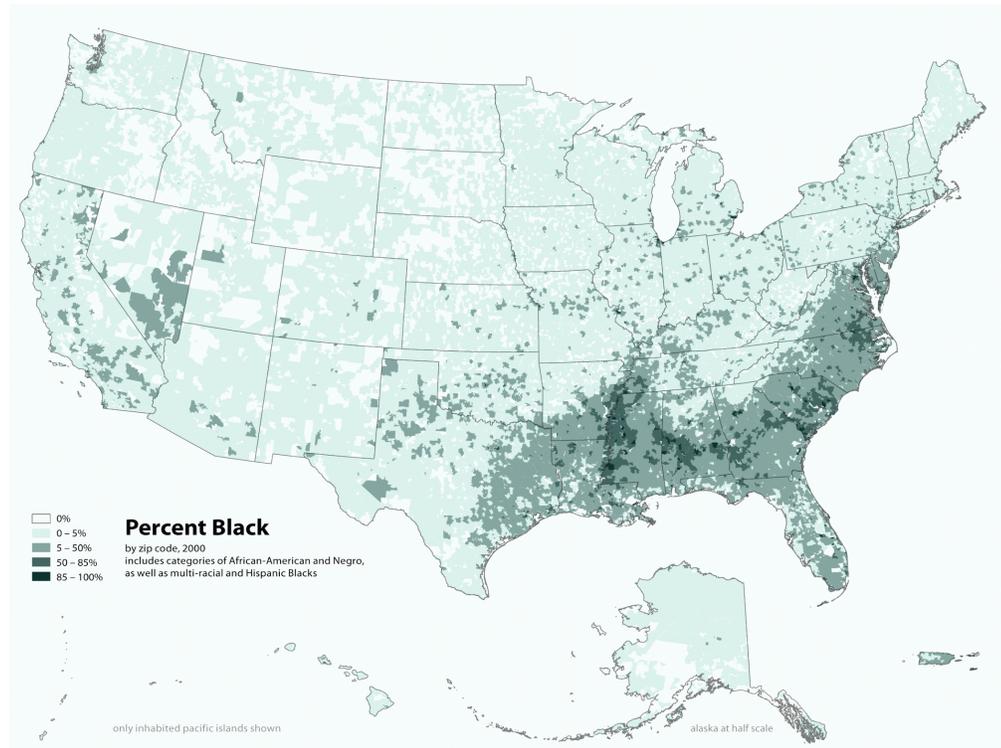
³⁰ <http://www.npr.org/sections/thesalt/2014/08/26/343211968/the-greening-of-florida-citrus-means-less-green-in-growers-pockets>

farmers, politicians, and the general public alike. Furthermore, since many states in the Southeast region neighbor the Atlantic Ocean, many citizens partake in recreational saltwater fishing. While fishing is encouraged, marine conservation efforts have been established in order to preserve marine biodiversity.³¹

DEMOGRAPHICS

The region of the Southeast we're examining has 85 million people between eleven states.³² Florida is the state with the largest population, around 19.8 million people, making it the third biggest state in the country (2014).³³

The Southeast has an important demographic representation of people, with minorities composing a large fraction of the population in the deep south states. Florida has a Hispanic population of 23%, which is higher than the national average by state (17%).³⁴ Additionally, the Southeast has a larger black population than the rest of the country. A region called the "Black Belt" is located in the southernmost US states.^{35,36} The average



³¹ http://sero.nmfs.noaa.gov/recreational_fishing/

³² http://en.wikipedia.org/wiki/Southeastern_United_States

³³ http://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_population

³⁴ <http://quickfacts.census.gov/qfd/states/12000.html>

³⁵ http://en.wikipedia.org/wiki/Black_Belt_%28U.S._region%29

³⁶ <http://www.census.gov/content/dam/Census/library/publications/2011/dec/c2010br-06.pdf>

black population by state is around 12%. In the deep South, the proportion of the population that is black is usually between 20-30%. According to the 2010 Census, 55% of individuals who identify as black live in the South.³⁷

The demographic makeup of the Southeast is important because minority and low-income people are more vulnerable to natural disasters, environmental racism, and social injustice issues.³⁸

³⁷ <https://www.census.gov/prod/cen2010/briefs/c2010br-06.pdf>

³⁸ <http://www.tandfonline.com/doi/abs/10.1111/0004-5608.00219>

Impacts of Global Change: The Science POLLUTION

One of the major pollutants in the Southeast are aquatic pollutants. The most prominent one is the infamous BP/Deepwater Horizon disaster five years ago. Coastal regions such as those in Louisiana are still struggling to heal; organisms are just recently beginning to flourish. Studies have shown that industrial pollutants increase the risk of reproductive and developmental problems, cancer, and variety of other health issues. Toxic chemicals can also cause a multitude of unforeseen side effects.³⁹

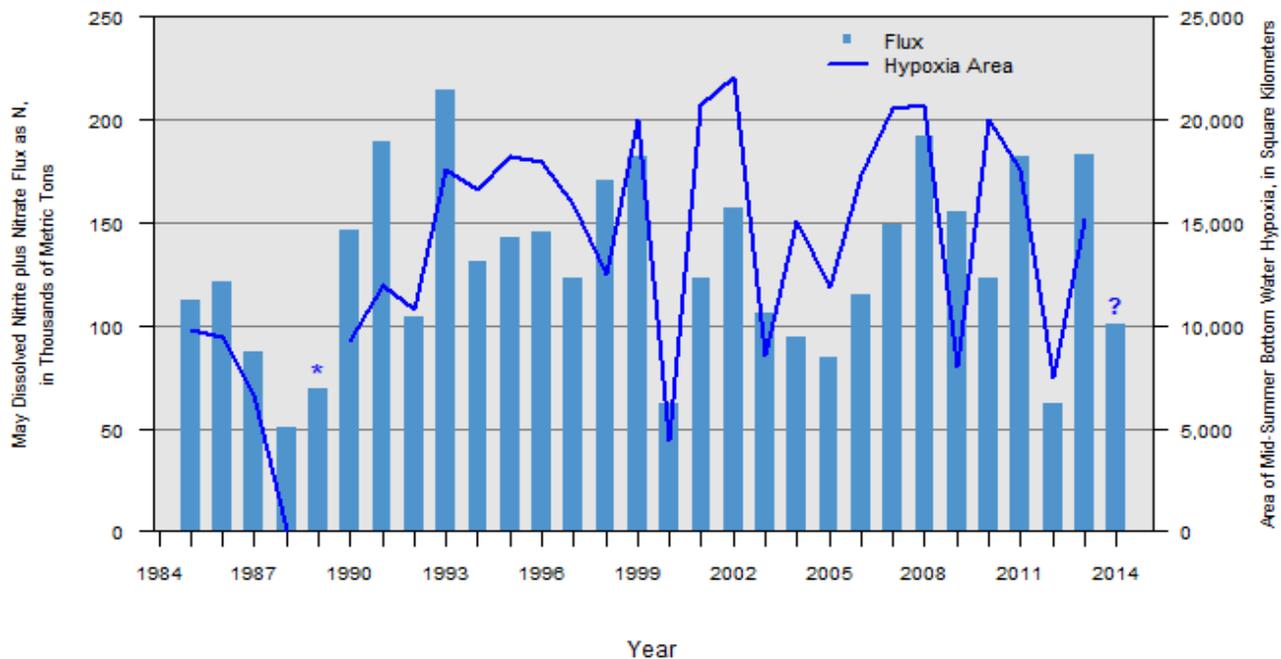


Figure 1. May dissolved nitrite plus nitrate flux to the Gulf of Mexico and area of mid-summer bottom water hypoxia (dissolved oxygen concentrations of less than 2 milligrams per liter) in the northern Gulf of Mexico. Hypoxia area data from Nancy N. Rabalais, Louisiana Universities Marine Consortium. *No hypoxia area data for 1989.



2014 Preliminary Mississippi-Atchafalaya River Basin Flux Estimate

High water temperatures and sea levels increase humidity in areas which promote parasite/pathogen proliferation. In addition to pollution, increased pathogenic contaminate domestic, agricultural, and industrial sources will not only be harmful to public health, but also detrimental for surrounding ecosystems. Runoff presents a significant issue in agricultural regions. Coastal regions already experience “dead zones” - areas where water is hypoxic because of pollution from runoff from agricultural fertilizers.⁴⁰ Aquatic ecosystems are also threatened by bad water quality and toxic chemicals caused by the extra nitrogen,

³⁹ http://www.peri.umass.edu/fileadmin/pdf/dpe/ctip/ToxicFlood_April2013.PDF

⁴⁰ <http://www.epa.gov/climatechange/impacts-adaptation/coasts.html>

phosphorus, and other pollutions in spring runoff.⁴¹

Widespread regional air pollution affects mortality rates of those living in urban areas. Effects of future climate change have not been thoroughly analyzed in terms of levels of pollution. Presence of heavy metal ions and toxic gaseous compounds in soils and water sources have presented risks for much of the population in the Southeast. These chemicals, often from runoff of large industrial plants, can leak into urban and rural areas. Occasionally there would be an oil spill, which requires emergency resources and local forces.

CLIMATE DISRUPTION

It is especially significant to understand the effects of climate disruption in the Southeast because of the agriculture and biodiversity that are native to this region. In a study that looked for trends from 1949 to 1998 in North Carolina, the winter and fall seasons show increased precipitation whereas the summer shows decreased precipitation.⁴² Furthermore, Boyles and Raman showed that it is warmer for a longer period of time during the year. These trends are expected to have an effect on land and soil though further research is needed to be done.

Additionally, sea level rise is expected to accelerate in the next century, which has negative implications for low-lying coastal regions in the Southeast. Climate change disrupts the hydrologic cycle, also known as the water cycle. Parajuli has shown that sources of drinking water such as the Upper Pearl River Watershed will be affected.⁴³ These effects are especially significant since the Upper Pearl River Watershed drains into to Ross Barnett Reservoir, which is a drinking water supply to approximately 200,000 people in the Jackson, Mississippi area.

Research has also been conducted in order to try and mitigate the effects of climate disruption. Williams in “Addressing global warming and biodiversity through forest restoration and coastal wetlands creation” mixed wood waste and low nutrient dredge material to regenerate coastal wetlands that have been lost due to climate change.⁴⁴ The potential for new research to maintain the biodiversity in the Southeast remains hopeful in the midst of climate disruption.

⁴¹ <http://www.globalchange.gov/what-we-do/assessment/previous-assessments/global-climate-change-impacts-in-the-us-2009>

⁴² Boyles, Ryan P., and S. Raman. “Analysis of climate trends in North Carolina (1949-1998).” *Environmental International* 29.2 (2003): 263-275.

⁴³ Parajuli, Prem B. “Assessing sensitivity of hydrologic responses to climate change from forested watershed in Mississippi.” *Hydrological Processes* 24.26 (Dec. 2010): 3785-3797.

⁴⁴ Williams, James R. “Addressing global warming and biodiversity through forest restoration and coastal wetlands creation.” *Science of the Total Environment* 240 (Oct. 1999): 1-9.

to help them recover from a disaster. In contrast, only a moderate hazard event would disrupt the well-being of residents in less biophysically vulnerable areas, because they tend to not have the resources to recover from small disasters in the long-term. This trend is evident in places that have experienced natural disasters, such as residents in Louisiana that were displaced due to Hurricane Katrina and, ten years later, have yet to return home.

In addition to unequal recovery from natural disasters, economic disparities also negatively affect the health of blue collar workers in the coal and energy production industries. There is controversy over the prioritization of negative health impacts versus positive economic growth that comes with the coal industry. Coal mines and toxic waste sites are generally placed in socially and economically disadvantaged communities.^{47,48} Mine workers' health can be affected by the physical, chemical, biological, ergonomic, and psychosocial occupational health hazards found in the mining sector.⁴⁹ Recently, the Office of Workers' Compensation Program proposed a rule to protect coal miners' health. The rule would give miners more access to their own health records and requires employers to pay all benefits due in a claim before they challenge the payment through modification.⁵⁰ The rule would increase the protection of coal miners with Black Lung disease because, currently, the employer can accumulate as much medical information about the miner and then choose which pieces of the data will be submitted for a claim.⁵¹ The current system does not give workers enough information about their own health and their rights. For instance, a miner whose medical record is incomplete may decide to continue to work or delay treatment. Thus, rules like the one recently proposed are essential to minimize risks and pay appropriate compensation to miners in the United States.

BIODIVERSITY LOSS

The Southeast has a unique set of geological features, including wetlands, sand shoals, shrub habitats, and caves. Sea level rise and urban development have been shown to cause habitat fragmentation and loss, which leads to a decrease in biodiversity. Small wetlands are home to a diverse set of amphibians, which would disappear with the loss of the wetlands.⁵² Thus, it is important to note that human impact not only affects geological features but the inhabiting wildlife as well. Another unique geological feature of the Southeast are the sand shoals off the coast of Louisiana. A study conducted by Dubois et al. observed the wildlife found on the Louisiana Sand Shoal, which is made up of fine sand. This

⁴⁷ Morrice, Emily and R. Colagiuri. "Coal mining, social injustice, and health: A universal conflict of power and priorities." *Health & Place* 19 (2013): 74-79.

⁴⁸ Pastor, Manuel, J. Sadd, and J. Hipp. "Which came first? toxic facilities, minority move-in, and environmental justice." *Journal of Urban Affairs* 23.1 (2001): 1-21.

⁴⁹ Donaghue, A. M. "Occupational Health: Overview." *International Encyclopedia of Public Health* (2008): 639-49. *Oxfordjournal.org*. Web. 4 June 2015.

⁵⁰ <http://www.harlandaily.com/news/news/153383574/Black-Lung-rule-proposal-protects-coal-miners-health>

⁵¹ Ibid

⁵² Semlitsch, Raymond D., and J. Russell Bodie. "Are small, isolated wetlands expendable?" *Conservation Biology* 12.5 (1998): 1129-1133.

sand can be exploited for mining purposes; however, Dubois et al. concluded that even small disturbances in Sand Shoal could create major impacts on the wildlife found there. Moreover, by 2100, shrub habitat is expected to decrease by 35-43%.⁵³ Forest areas are expected to decrease, and the loss of these forests will negatively impact migratory birds and the surrounding ecosystems. Another interesting location that is central to biodiversity is caves. Caves in Tennessee and Alabama are home to at least 21 cave-obligate species.⁵⁴ Thus, conservation efforts are especially important in order to maintain the biodiversity that lives in the Southeast region.

Preserving biodiversity has been a difficult task as habitat loss and fragmentation are occurring at such a quick rate. Studies have been conducted to try to find distinguishing ecological factors in extinction-prone freshwater fish in Virginia. Angermeier found that by studying species closely, factors that lead to extinction can be narrowed and identified.⁵⁵ Further research should be done in order to implement better conservation efforts.

INVASIVES & DISEASES

Because of extensive waterways, rivers, and inlets, along with a history of international shipping and trade, the southeast is highly susceptible to many invasive species and diseases. Some of the more well known invasives are the Lionfish in the Atlantic and Caribbean, Burmese Pythons in the Everglades, Asian Carp in the Mississippi River and the Kudzu vine, known as “the vine that swallowed the south.” Impacts of these invasive species (along with countless others) are being researched in an effort to understand them and mitigate the effects. Scientific research such as Powell et. al.’s 2013 paper, “Invasive plants have scale-dependent effects on diversity by altering species-area relationships,” discusses the direct impact that plant invasive species have on local floral diversity in Florida. They conclude that although invasives often outcompete native species, rarely do they cause complete extinction of local flora. This evidence can help develop effective management practices to combat invasive plant species. Another study may have a lead on a possible solution. Parker’s 2005 paper “Biotic resistance to plant invasions? Native herbivores prefer non-native plants,” discusses how native, generalist crayfish preferred non-native plant species over native ones. In this way, exotic plants may be preferentially consumed by the native generalist herbivores in their new ranges, suggesting that native herbivores may provide biotic resistance to plant invasions.

Along with countless other studies, researchers have begun to piece together and

⁵³ Brittain, Ross A., and C. B. Craft. “Effects of sea-level rise and anthropogenic development on priority bird species habitats in coastal Georgia, USA.” *Environmental Management* 49.2 (Feb.2012): 473-482.

⁵⁴ Dixon, Groves. “Biodiversity of cave-obligate animals on the domain of the University of the South, Franklin County, Tennessee.” Retrieved from Sewanee DSpace Repository (May 2010): 1-32.

⁵⁵ Angermeier, Paul L. “Ecological attributes of extinction-prone species: loss of freshwater fishes of Virginia.” *Conservation Biology* 9.1 (1995): 143-158.

understand the complex relationships between invasives, disease and biodiversity. A study done in Louisiana by Ezenwa et. al. in 2006, “Avian diversity and West Nile virus: testing associations between biodiversity and infectious disease risk,” delves into the cause of increased spread of West Nile Virus and how it relates to biodiversity of birds. Their findings suggest that high bird diversity may play a role in dampening West Nile Virus amplification rates in mosquitoes, minimizing human disease risk. This means that potentially, an increase in bird biodiversity can slow the spread of West Nile Virus.

Having baseline scientific data for invasive species and disease, as well as their impacts on ecosystems and communities, will allow future fluctuations to be better understood and hopefully provide the key to relieving some of the impacts.

Impacts of Global Change: Popular Media POLLUTION

Much of the discussion in the Southeast regarding pollution is related to the extensive coal industry. Along with air pollutants, coal fired power plants have other waste products that have been poorly stored and contained. Right now, the pollution is impacting local health and ecosystems, and adding to the environmental injustice already prevalent in the region. Fortunately, there is recent attention and awareness to the problem. Scrutiny of the pollution is putting pressure on the polluters (mostly coal energy production), demanding they pay for the damages and improve their practices.⁵⁶ The decline of coal, however will have serious ramifications on the regional economy in the coming years.

Other significant sources of pollution - such as agricultural runoff - have been seriously damaging the waterway health, as well as causing dramatic changes in the coastal ecosystems. Nitrogen runoff from massive agricultural practices along the Mississippi River Delta creates a dead zone in the Gulf of Mexico, killing off many fish and other organisms.⁵⁷ Continued expansion of cropland, and further damage to riparian zones are huge threats to the Gulf. Because so many people rely on the coasts for fishing and ecosystem services, the pollution damage has serious impacts on the fishing population and the coastal economies. Recently, there has been pressure to more rigidly monitor the nutrient runoff and efforts to regulate it.

The coasts suffer many other threats from pollution, including plastic debris pollution on beaches, and residual impacts from the BP Oil Spill.⁵⁸ Cleaning up the coastline is becoming increasingly important for the wealth of the ecosystems, and the economy, considering the huge financial significance of tourism in the region. Even years later, the BP oil spill is a commonly discussed issue, and its effects are still stabilizing. The damage done to coastlines, infrastructure and ecosystems is immense, and so will likely remain a topic of discussion for years to come. There is fear of another event like this spill, making local residents more wary of the oil industry.⁵⁹

⁵⁶ <http://www.foxnews.com/us/2015/05/15/duke-energy-pleads-guilty-fined-102m-in-connection-with-2014-coal-ash-spill/>

⁵⁷ <http://www.rrstar.com/article/20150420/NEWS/150429898>

⁵⁸ <http://www.myfoxdc.com/story/29225090/deadline-wednesday-to-volunteer-for-clean-the-bay-day>

⁵⁹ <http://www.wfsb.com/story/29229155/bp-oil-spill-settlement-money-used-in-project-to-restore-dolive-creek>



A still from the animation showing the oil trajectory after 130 days⁶⁰

CLIMATE DISRUPTION

Climate disruption has three major impacts on the Southeast region of the US. Firstly, there's the impact on coastal resources. Local land elevation, relative to sea level, is sinking in TX and LA. In Grand Isle, LA, and plan of Mississippi River delta, sea level is rising at an alarming rate of 0.32 inches per year. Low-lying coastal communities, such as southern districts of New Orleans are especially at risk because they sit on subsiding land which is vulnerable to sea level rise. Hurricanes and flooding now occur more often in these low-level areas, destroying homes and infrastructure because the ocean surface continues to warm. These natural disasters also destroy ecosystems and communities, such as swamplands.

Climate disruption can also affect water resources. Higher temperatures in region increase evaporation and water loss from plants; increased intensity and duration of droughts have also put a strain on freshwater resources. This strain causes depletion of underground water supplies, making it worse for the future of the region. Saltwater now intrude and mix with freshwater aquifers in areas such as LA and FL , due to changes in

⁶⁰ <https://www2.ucar.edu/atmosnews/news/2154/ocean-currents-likely-carry-oil-along-atlantic-coast>

water runoff and rising sea levels. Industries and large manufacturing plants put additional pressure on freshwater sources.

Lastly, climate disruption negatively impacts human health. Warmer temperature and more frequent heat waves have caused an increase in respiratory illnesses and respiratory problems caused by poor air quality. Increased frequency of natural disasters have proved extremely taxing on public health and emergency services. Bacteria such as *Vibrio parahaemolyticus* have increased in number of cases by 41% in the past 2 decades.

POPULATION CHANGE

Regarding the problem “Population Change,” the Southeast suffers from issues regarding energy production and use. Kentucky’s coal production is slowing down and miners are being laid off more frequently as it is difficult to take coal out of the seams, and natural gas is cheaper to produce.⁶¹ In response, the US Department of Labor is funding programs to help train laid-off miners for different jobs.⁶² In the past, miners have been laid off of work temporarily, due to natural fluctuations in the economy. Now, exit from mining seems permanent and requires a new solution.

Additionally, farming and food production are being affected by changes in weather patterns. Extreme and changing weather patterns make the news because of the way these disasters affect local populations. Floods, water availability, and increased vector diseases are expected to rise in the future⁶³. Our article collection already reflects these topics. They will likely be linked to environmental justice issues as well, because vulnerable populations will need more help recovering from disasters.

In the coming years, climate changes like rising temperatures will be affecting human healthy. The region report for the Southeast found that, on days with temperatures exceeding 95 degrees, the number of deaths is above average.⁶⁴ Moreover, increased temperatures increase the formation of harmful air pollutants and allergens. Hospitals will see a rise in admissions due to respiratory illnesses, like asthma, as temperatures rise. Already, articles are published to educate the public on safe behaviors during heat waves or storms.

⁶¹ http://www.kentucky.com/2015/04/30/3828148_report-kentucky-lost-more-than.html?rh=1

⁶² <http://thinkprogress.org/climate/2014/06/06/3445537/kentucky-coal-miners/>

⁶³ Carter, Lynne M., and James W. Jones. Southeast and the Caribbean." *Climate Change Impacts in the United States: The Third National Climate Assessment*. Eds. Leonard Berry, et al. U.S. Global Change Research Program, 2014. 396-417.

⁶⁴ Ibid

BIODIVERSITY LOSS

Recent climate change has affected ecosystems and species directly in the Southeast. Media coverage on biodiversity loss has started to increase recently because of the noticeable changes in the environment. Warmer temperatures have increased outbreaks of certain pests, such as the Southern pine beetle. These Southern pine beetles have infested many pine species in the Southeast, including the shortleaf and Virginia pines (see photo).⁶⁵



Figure 1. Range map for southern pine beetle; Mexico distribution adapted from Salinas-Moreno et al. 2004.

There has been biodiversity loss in the marine ecosystem as well. Increasing temperatures of the ocean cause coral reefs off the Gulf Coast to become permanently stressed and result in coral die-offs. The oyster parasite can cause large oyster die-offs because it tends to expand to waters with higher temperatures. Additionally, many coldwater fish are losing habitats due to rising temperatures and have forced warmwater species to move to other regions. As the marine ecosystems are being affected, sea level rise may flood certain barrier islands and eliminate populations of organisms.

On a positive note, there have been instances of ecosystem recovery in the Southeast. In Jekyll Island, Georgia, there was the largest number of sea turtles released after spending a year in a rehabilitation center.⁶⁶ Cleanup of more than 700,000 tires off the ocean floor of South Florida has begun.⁶⁷ Citizens have become more involved in realizing their own

⁶⁵ http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fsbdev2_042840.pdf

⁶⁶ <http://www.wsav.com/story/29084994/largest-release-of-sea-turtles-takes-place-on-jekyll-island>

⁶⁷ <http://www.latimes.com/nation/la-na-florida-tires-20150524-story.html>

impact on the surrounding environment. Youth programs have been established to educate children on urban farming and conservation.⁶⁸ Teaching people that they can have both negative and positively impacts on the environment provides a hopeful solution to the issue of biodiversity loss.

INVASIVES & DISEASES

Popular media have been reporting on invasive species and diseases as the consequences of these species and diseases are affecting the general public. Ensuring that the general public understands the consequences of invasive species and diseases is crucial to limiting the negative impacts of non-native species disturbing the habitats and ecosystems of the Southeast region. Invasive species can be harmful to humans, ecosystems, and economies. Injuries have been reported from close contact with invasive species, whether in the form of a venomous bite or a disease.

Large animals such as the Burmese python capture many people's attention and thus get a lot of news coverage. These Burmese pythons are native to Southeast Asia but have been found in Florida since the 1970s. They prey on smaller creatures and take over habitats. From both a conservationist's point of view in trying to protect wildlife as well as the general public's desire for safety, it is beneficial to track, research, and limit the Burmese pythons that have invaded the Everglades in Florida.

Additionally, lionfish are another invasive species found in the waters around the Southeast region. Lionfish are predatory fish that reproduce quickly. These lionfish affect both the ecosystem and the economy. The lionfish prey on other fish that would be normally caught and sold by fishermen. To combat this issue, Florida has "lionfish derbies" to sell and eat the invasive species (see photo⁶⁹); however, it is not done quickly enough to combat the rate at which the lionfish reproduce. Scientific researchers are continuing to study these lionfish in order to understand the ways they affect their surrounding ecosystems.



⁶⁸ <http://atlantablackstar.com/2014/07/25/gyfs-urban-conservation-training-institute-hopes-game-changer-atlantas-youth/>

⁶⁹ <http://keysnews.com/node/30416>