



FACT SHEET

Bioenergy Threatens the Heart of North American Wetland Forests

The Natural Resources Defense Council (NRDC) has produced a [first-of-its-kind report](#) that reveals the potential scale of the threat to southeastern bottomland hardwood forests from wood pellet mills in the region. Millions of acres of vulnerable bottomland hardwood forests—which provide critical habitat to a host of rare species and deliver important ecosystem services to local communities—are in the bull’s eye of existing and proposed wood pellet mills’ potential sourcing areas.

Working with the Conservation Biology Institute (CBI), NRDC compiled data showing the geographic nexus between the region’s unprotected forests and existing and proposed wood pellet manufacturing facilities, placing the threats to these forests in stark visual relief.

Existing and proposed pellet mills, such as those owned by U.S. pellet manufacturing giant Enviva and British utility company Drax Power, are sited within harvest range not only of tree plantations but of unprotected, natural bottomland hardwood forests. The potential sourcing area for nearly every proposed pellet plant—and several currently operating plants—include critical habitat for up

to 25 different species that are federally listed as imperiled or endangered. Seen here in totality for the first time, the pressure on forests in U.S. Southeast from the biomass industry is nearly ubiquitous.

Our analysis identifies hot spots—regions of exceptionally heavy wood sourcing where there are particularly high concentrations of established and proposed pellet facilities. Our analysis illuminates and displays the significant degree of overlap between these sourcing hot spots and the millions of acres of unprotected and vulnerable bottomland hardwoods that fall within them.

- In Hot Spot 1, the Virginia–North Carolina border, approximately 1.63 million acres of unprotected wetland forests fall within the assumed 75-mile sourcing radius of pellet facilities.
- In Hot Spot 2, southeastern Georgia, some 5.06 million acres of unprotected wetland forests fall within the assumed 75-mile sourcing radius.
- In Hot Spot 3, the Alabama–Mississippi border, approximately 4.19 million acres of unprotected wetland forests fall within the assumed 75-mile sourcing radius.
- And in an emerging hot spot, Louisiana, about 4.1 million acres of unprotected wetland forests fall within the assumed 75-mile sourcing area of pellet facilities.

Only 10 percent of all bottomland hardwood forest in the Southeast is fully protected from commercial logging.¹ The pressure to log them is mounting: wood pellet exports from the United States doubled from 1.6 million tons in 2012 to 3.2 million tons in 2013. They increased again by nearly 40 percent from 2013 to 2014 and are expected to reach 5.7 million tons in 2015.²

OVERVIEW OF THE SOUTHEAST'S BIODIVERSE AND UNIQUE FORESTS

Some of the most biologically rich forests in North America can be found in areas adjacent to streams and rivers in the southern United States.³ These wetland forests, also known as bottomland hardwood forests, are composed of a mixed canopy of trees, such as towering bald cypress and swamp tupelo, red maple, green ash, American elm, and black gum, as well as numerous species of oak trees that can live for hundreds of years and are considered integral to river and coastal wetland systems.

Nearly all of the region's bottomland hardwood forests have been impacted ever since European settlement began. Large areas were, and continue to be, drained and converted to agriculture and pine plantations, or were devoured by urban development. It has been estimated that only around 20 percent of all pre-settlement bottomland hardwood forests remain today.⁴

For these remaining bottomland hardwood forests, successive waves of logging over many decades have razed one forest after another, with slow recovery in between.

As a result, what some call “old growth” forests in the region may be only 80 years old. Rare and precious, these mature forests are the heart of the region's natural ecosystem, supporting globally outstanding biodiversity and unique natural communities and providing a host of vital ecosystem services to the people of the region. They help filter and clean drinking water, protecting the health of an increasingly strained freshwater supply for the region's growing population, and they reduce or prevent periodic damaging floods by creating areas to hold floodwater. They form and protect productive soils, and they capture carbon dioxide from the atmosphere, thus making a critical contribution to tackling climate change. In addition, they provide critical habitat that supports thousands of species, some of which are imperiled or on the brink of extinction. These include numerous songbirds, Louisiana black bears, endangered bats and butterflies, and even rare varieties of synchronous fireflies, about which researchers are still learning.^{5,6,7}

According to the most recent forest data managed by the USDA Forest Service Forest Inventory and Analysis (FIA) program, there are slightly more than 24 million acres of bottomland hardwood forests in the southeastern United States, but only 3 million acres (12 percent) more than 80 years old, the approximate age at which a forest of this type is considered mature. Broken down by state, Table 1 lists total acres of bottomland hardwood forests and the proportion of “old acres.”

A common misconception is that forestry in the U.S. is strictly regulated to ensure responsible harvesting and safeguarding of sensitive ecosystems. In reality, only 10 percent of all bottomland hardwood forest in the Southeast is fully protected from commercial logging.⁸ Forestry on private land in the Southeast—which constitutes more than 80 percent of forests in the region—is conducted with few restrictions and little oversight. Practices such as large-scale clearcutting, old-growth logging, wetland logging, and the conversion of natural forests to plantations are mostly unregulated and are often practiced in sensitive habitats with little protection for species. In addition to the weak legal and regulatory environment in the region, very few forest acres are certified by any sustainability regime, and there is disproportionate reliance on the least rigorous certification systems.⁹

Table 1. Total acres of bottomland hardwood forests, and proportion more than 80 years old, by state

State	Total Acres	Old Acres	Percent Old
Alabama	2,670,224	139,201	5.21%
Florida	3,599,146	909,517	25.27%
Georgia	3,770,688	405,208	10.75%
Louisiana	4,991,000	507,393	10.17%
Mississippi	3,723,746	117,005	3.14%
North Carolina	2,349,710	354,092	15.07%
South Carolina	2,417,638	327,088	13.53%
Virginia	749,927	133,510	17.80%

THE EMERGING BIOMASS THREAT

Unfortunately, energy markets are now driving a new and frenzied demand for trees from the region. The epicenter of this new market demand is Europe, where power companies are seeking alternatives to coal and other fossil fuels and increasingly turning to wood to fuel their power plants. Many of Europe's forests are highly regulated, so European power companies have had to look abroad to source wood fuel, turning to the largely unregulated forests of the American South for fresh supplies. Together, eight states in the southeastern United States—Alabama, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, and Virginia—now make up the top exporting region for wood pellets to the European Union. The United Kingdom, the Netherlands, and Belgium are the top importers.¹⁰

Wood pellet exports from the United States doubled from 1.6 million tons in 2012 to 3.2 million tons in 2013. They increased again by nearly 40 percent from 2013 to 2014 and are expected to reach 5.7 million tons in 2015. Wood pellet manufacturing in the region is expected to further skyrocket, with production estimates as high as 70 million metric tons by 2020.¹¹

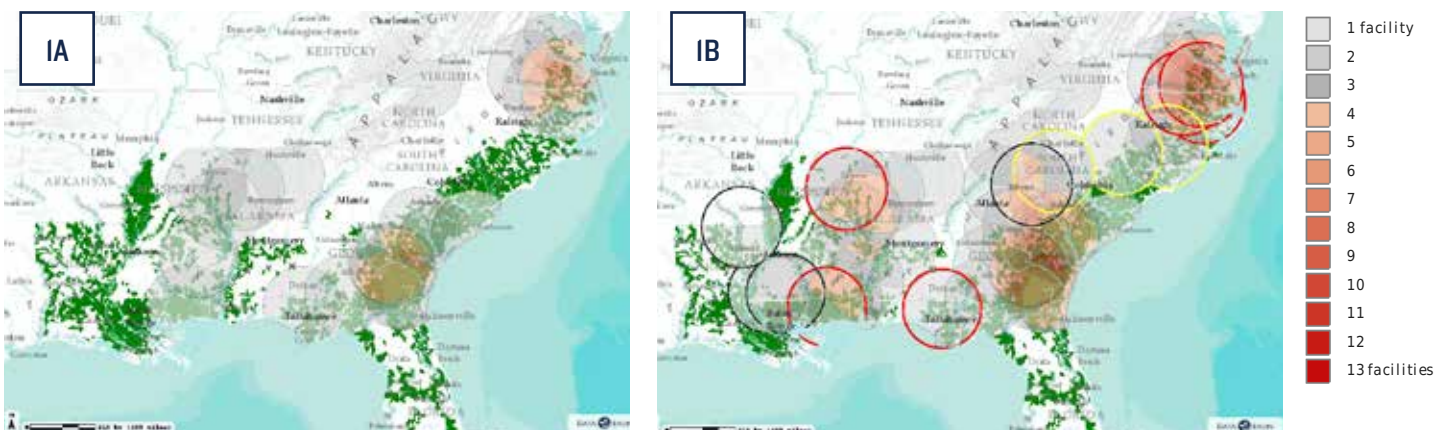
To manufacture wood pellets, mills in the Southeast cart in truckload after truckload of raw material harvested from the region's forests to their facilities, where they compress sawdust or ground-up whole trees and other large forest residuals into uniform pellets. These pellets are then loaded onto ships and transported across the Atlantic Ocean to be burned in European power stations.

Wood pellet manufacturers and their major customers claim that pellets from these mills are composed entirely of sawdust and other mill residues, tree trimmings, and diseased or "problem" trees not suitable as timber.¹² However, studies have concluded that logging residuals alone are unlikely to meet biomass fuel market demands and that healthy, whole trees (e.g., pulpwood) will be needed.¹³ Our research, along with the research of other organizations, shows that the harvest of whole trees is already taking place—and not only from plantations.^{14,15}

Millions of acres of the remaining unprotected bottomland hardwood forests are the bull's-eyes of existing and proposed wood pellet mills' potential target sourcing areas. There are a total of 51 operating or proposed pellet mills in the region, and our analysis illuminates both the places where there are particularly high concentrations of facilities (the Virginia–North Carolina border, southeastern Georgia, and along the Alabama–Mississippi border) as well as the acres of vulnerable bottomland hardwoods in their sourcing areas. As new wood pellet mills start up, their potential sourcing areas may overlap with the assumed sourcing areas of existing facilities to create what we refer to as hot spots—areas of heavy wood sourcing. These are indicated by red and peach colors on Maps 1A and 1B below. While a single high-production fuel pellet facility may significantly impact a bottomland hardwood forest, the potential damage is intensified if multiple facilities are sourcing from the same geographic area.

Maps 1A and 1B. Intensity of assumed sourcing from currently operating pellet processing facilities (A) and from current plus proposed facilities (B) in the southeastern United States (B). (Operating Enviva facilities are outlined in red; proposed Enviva facilities in yellow; and proposed Drax facilities in black; Source: Southern Environmental Law Center, 2014). Green polygons are those watersheds containing >3,000 acres of woody wetlands. Source: Conservation Biology Institute. See Appendix A for details.

To illustrate the threat these facilities pose to these valuable ecosystems, hot spots of pellet industry expansion and overlap were overlaid with spatial datasets that show where the remaining bottomland hardwood forests are located.¹⁶ Growth is explosive in these locations now, without checks on the industry, so hot spots are almost certain to grow, and new hot spots will likely emerge in the coming years. The focus on these three regions does not discount the need for further attention to all areas where pellet mills are moving in within sourcing range of vulnerable bottomland hardwood forests. In fact, a fourth region—Louisiana—is a potential new hot spot in the making, with a high level of bottomland hardwood forests and wood pellet facilities currently being established.



Source: Southern Environmental Law Center, 2014; Conservation Biology Institute. See Appendix A of full report for details. Green polygons are those watersheds containing more than 3,000 acres of woody wetlands.

HOT SPOT I: VIRGINIA-NORTH CAROLINA BORDER

The region spanning the Virginia and North Carolina border is already experiencing intense sourcing of wood for pellet manufacturing mills, most notably by U.S. pellet giant Enviva, which also has operations in Mississippi and Florida and another planned for South Carolina. Enviva is the major wood pellet manufacturer in this region,

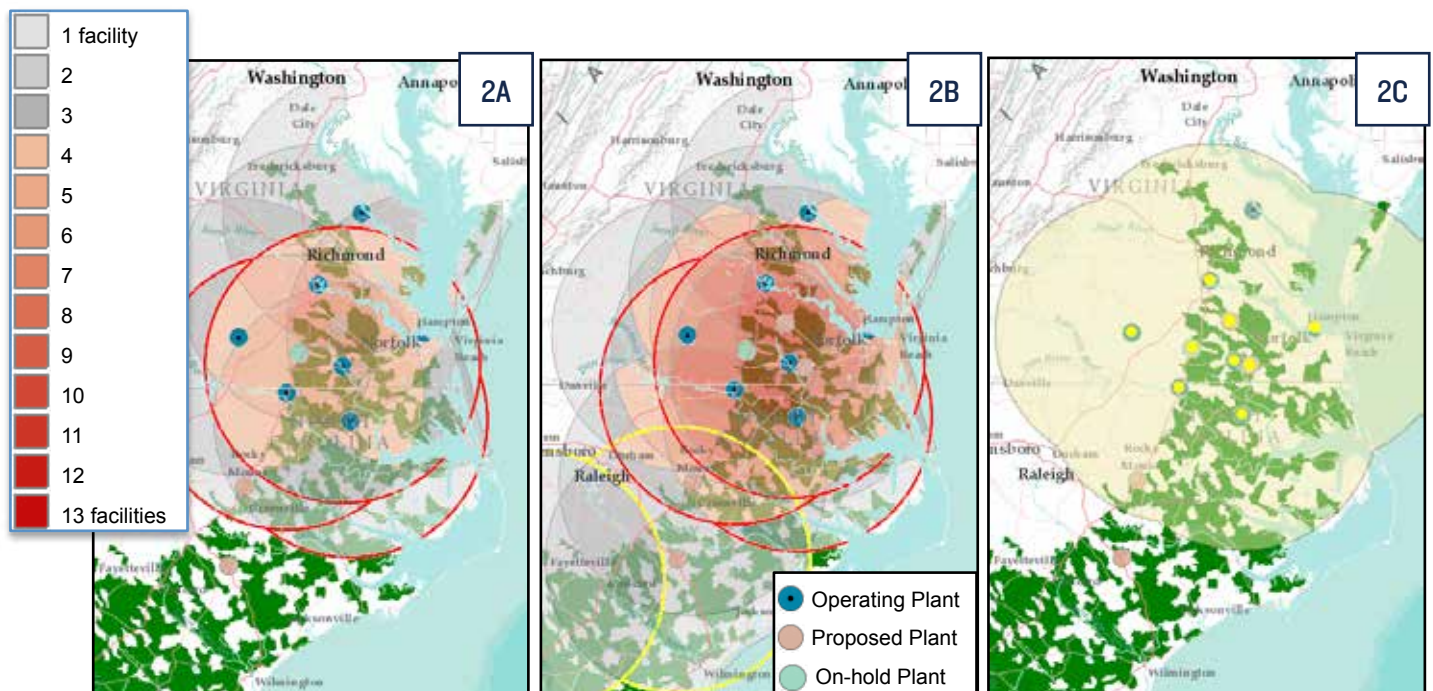
operating three facilities in Southampton County, Virginia, and Northampton and Hertford Counties, North Carolina. It also operates a local port facility to move pellets overseas. The company's activities in this region are also spreading southward. Enviva has begun planning two more facilities in North Carolina's Richmond and Sampson Counties, intensifying its potential impact and expanding this hot spot.

Number of operating and proposed mills	9
Expected production level for all operating and proposed wood pellet mills in this hot spot	2.6 million dry metric tons per year
Percentage of woody wetland acres that are unprotected and vulnerable	86% in Virginia 86% in North Carolina
Amount of unprotected woody wetland acres within the assumed 75-mile sourcing radius of pellet facilities ¹⁷ *	Virginia: 537,500 acres— 60% of all unprotected acres in the state North Carolina: 1.1 million acres— 40% of all unprotected acres in the state
Number of species of interest/concern	74
Examples of imperiled/threatened/endangered species in the region	Red wolf Delmarva fox squirrel Roanoke logperch Atlantic sturgeon Green pitcher plant
Miles of impaired freshwater rivers and streams in the region ¹⁸	8,500 miles ¹⁹

*Data derived from Table 2 of the full report

MAP 2. VIRGINIA–NORTH CAROLINA HOT SPOT.

Close-up view of estimated intensity of operating (A) and operating plus proposed (B) wood pellet facilities, highlighting watersheds with >3,000 acres of vulnerable (unprotected) woody wetlands (green). These watersheds could experience significant degradation. Potential sourcing areas for the three current Enviva mills are outlined in red and the two proposed mills in yellow. Panel C highlights the area used to summarize table results for this hot spot.



Source: Southern Environmental Law Center, 2014; Conservation Biology Institute. See Appendix A of full report for details. Green polygons are those watersheds containing more than 3,000 acres of woody wetlands.

HOT SPOT 2: SOUTHEASTERN GEORGIA

Georgia has the third-highest number of acres of bottomland hardwood forest, after Louisiana and Mississippi, and

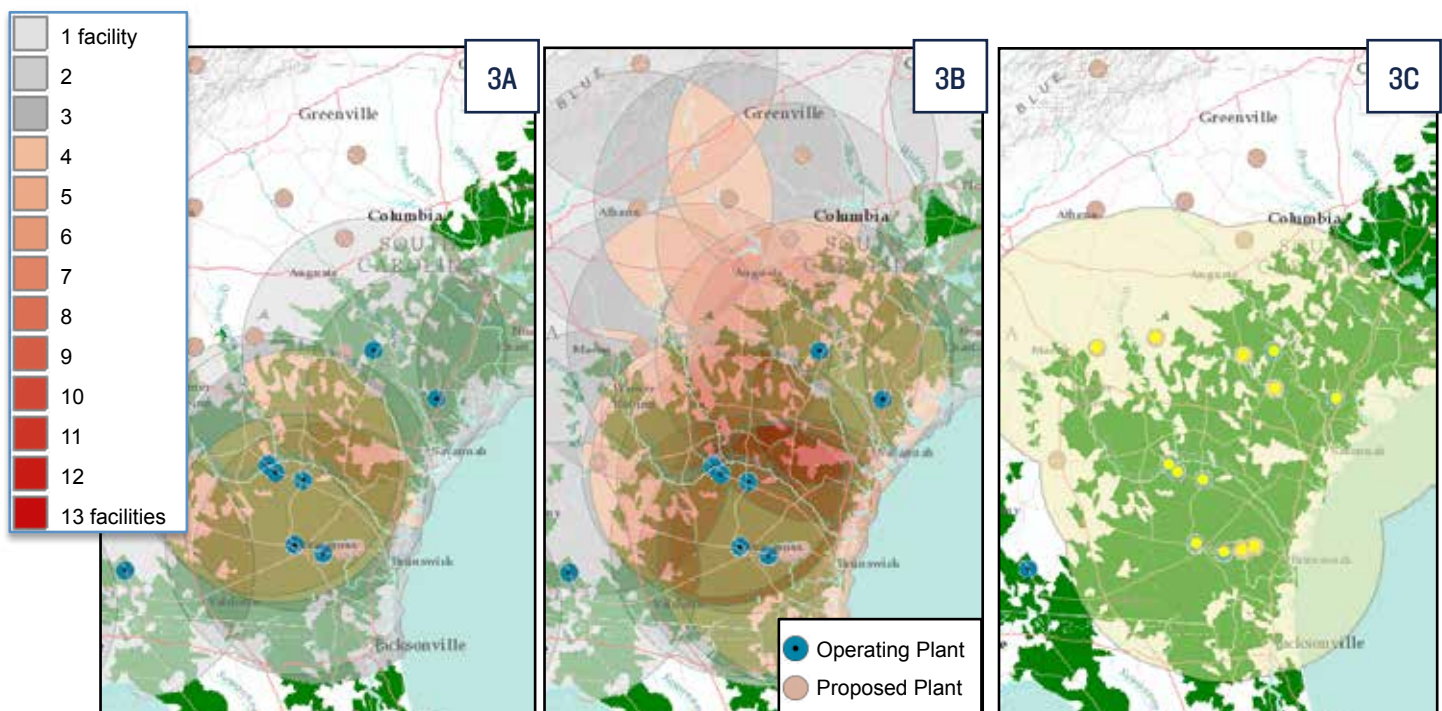
the third-largest acreage of mature forest. The state is experiencing intense wood sourcing for pellet production and contains the largest number of woody wetland acres under threat, mostly from currently operating facilities.

Number of operating and proposed mills	13
Expected production level for all operating and proposed wood pellet mills in this hot spot	3.5 million dry metric tons per year
Percentage of woody wetland acres that are unprotected and vulnerable	90% in Georgia 93% in South Carolina 80% in Florida
Amount of unprotected woody wetland acres within the assumed 75-mile sourcing radius of pellet facilities*	Georgia: 3.6 million acres— 85% of all unprotected acres in the state South Carolina: 1.1 million acres— 41% of all unprotected areas in the state Florida: 359,000 acres— 11% of all unprotected acres in the state
Number of species of interest/concern	152
Examples of imperiled/threatened/endangered species in the region	West Indian manatee Frosted flatwoods salamander Wood stork Gray bat Amber darter Altamaha spiny mussel Relict trillium
Miles of impaired freshwater rivers and streams in the region	1,652 miles

*Data derived from Table 2 of the full report

MAP 3. SOUTHEASTERN GEORGIA HOT SPOT:

Close-up view of estimated intensity of operating (A) and operating plus proposed (B) wood pellet facilities, highlighting watersheds of vulnerable (unprotected) woody wetlands (green). These watersheds could experience significant degradation. Panel C highlights the area used to summarize table results for this hot spot.



Source: Southern Environmental Law Center, 2014; Conservation Biology Institute. See Appendix A of full report for details. Green polygons are those watersheds containing more than 3,000 acres of woody wetlands.

HOT SPOT 3: ALABAMA–MISSISSIPPI BORDER

Bottomland hardwood forests in this region are highly vulnerable, and the wood pellet industry is moving in fast.

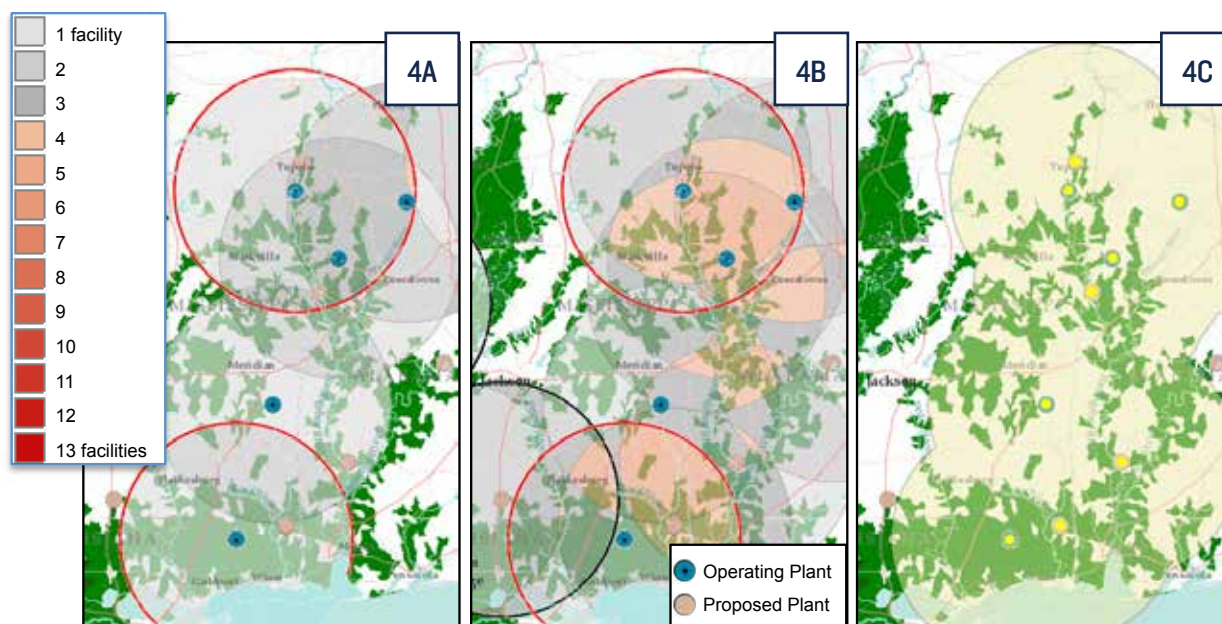
As shown in Map 4, this hot spot is just getting started with five proposed facilities being added to five existing ones. Two of the five operating facilities are owned by Enviva.

Number of operating and proposed pellet mills	10
Expected production level for all operating and proposed wood pellet mills in this hot spot	2.6 million dry metric tons per year
Percentage of woody wetland acres that are unprotected and vulnerable	96% in Alabama 95% in Mississippi 94% in Louisiana 80% in Florida
Amount of unprotected woody wetland acres within the assumed 75-mile sourcing radius of pellet facilities*	Alabama: 1.6 million acres— 74% of all unprotected acres in the state Mississippi: 2.2 million acres— 63% of all unprotected areas in the state Louisiana: 283,000 acres— 6% of all unprotected acres in the state Florida: 107,000 acres— 3% of all unprotected acres in the state
Number of species of interest/concern	306
Examples of threatened/endangered species in the region	Louisiana black bear Northern long-eared bat Wood stork Mississippi sandhill crane Alabama sturgeon Alabama spike mussel Red Hills salamander
Miles of impaired freshwater rivers and streams in the region	4,106 miles

*Data derived from Table 2 of the full report

MAP 4. ALABAMA–MISSISSIPPI BORDER HOT SPOT:

Close-up view of estimated intensity of operating (A) and operating plus proposed (B) wood pellet facilities, highlighting watersheds of vulnerable (unprotected) woody wetlands (green). These watersheds could experience the greatest losses. Potential sourcing areas for the two current Enviva mills are shown in red and for the proposed Drax mill in black. Panel C highlights the area used to summarize table results for this hotspot.



Source: Southern Environmental Law Center, 2014; Conservation Biology Institute. See Appendix A of full report for details. Green polygons are those watersheds containing more than 3,000 acres of woody wetlands.

THE NEXT HOT SPOT: LOUISIANA?

Louisiana has both the most bottomland hardwood forests of any southeastern state (5 million acres) and the highest number of vulnerable acres lacking protection from commercial logging.²⁰ Two facilities were recently opened by the U.K.'s Drax Power to supply biomass to its power plant near Leeds, England, and a third Drax plant

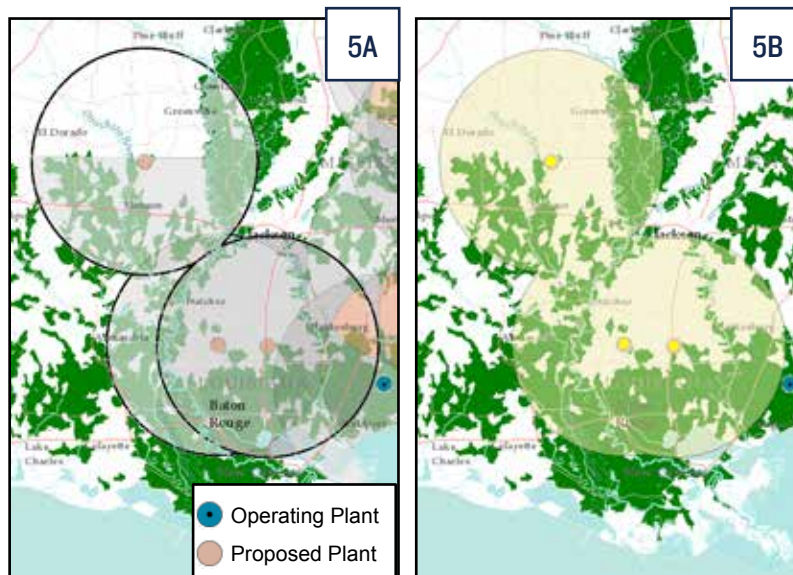
has been proposed. Combined, these facilities would have the capacity to produce nearly 1 million short tons of wood pellets annually. At the time of this writing, Drax-Morehouse Bioenergy, located in Morehouse Parish, Louisiana, and Drax-Amite Bioenergy, in Amite County, Mississippi, are already approaching their anticipated output of 450,000 metric tons/yr.²²

Table 5. Louisiana Key Impact Criteria	
Number of operating and proposed mills	3
Expected production level for all operating and proposed wood pellet mills in this hot spot	1.35 million dry metric tons/yr
Percentage of woody wetland acres that are unprotected and vulnerable	94% in Louisiana 95% in Mississippi
Amount of unprotected woody wetland acres within the assumed 75-mile sourcing radius of pellet facilities*	Louisiana: 2.9 million acres— 58% of all unprotected acres in the state Mississippi: 1.2 million acres— 34% of all unprotected acres in the state
Number of species of interest/concern	74
Examples of imperiled/endangered species in the region	Louisiana black bear West Indian manatee Ringed map turtle Dusky gopher frog Pallid sturgeon Alabama heelsplitter mussel Louisiana quillwort
Miles of impaired freshwater rivers and streams in the region	4,069 miles

*Data derived from Table 2 of the full report

MAP 5. POTENTIAL LOUISIANA HOT SPOT:

Close-up view (left) of Drax wood pellet facilities' assumed sourcing areas in Louisiana–Mississippi, highlighting watersheds of vulnerable (unprotected) woody wetlands (green). These watersheds could experience the greatest losses. Panel at right highlights the area used to summarize table results for this hot spot.



Source: Southern Environmental Law Center, 2014; Conservation Biology Institute. See Appendix A of full report for details. Green polygons are those watersheds containing more than 3,000 acres of woody wetlands.

POLICY REFORMS ARE NEEDED TO ENSURE BIOMASS ENERGY DOESN'T POLLUTE OUR CLIMATE OR THREATEN OUR FORESTS

It is clear that the massive additional demand for biomass being driven by the biomass energy industry now threatens to destroy ecosystems that can never be replaced. A small amount of biopower requires a very large quantity of biomass and can drive enormous shifts in the landscape. Thus, even a limited number of conversions to biopower can have major impacts on the ground.

It is important to remember that the wood pellet industry has emerged not in a vacuum, but in response to specific policy incentives. Today demand for wood pellet exports out of the U.S. Southeast is being driven almost exclusively by climate and energy policies in the UK and European Union. However, it is imperative that policymakers in both the EU and the United States implement key policy reforms and avoid making specific policy errors with respect to biomass energy. We recommend the following:

Sustainability standards must be paired with sound carbon accounting.

It is critical that policymakers reject the assumption that all biomass is carbon-neutral and restrict public subsidies and other support mechanisms to sources of biomass fuel that demonstrably reduce carbon emissions within a time frame relevant to tackling climate change. Recent science and our own modeling show that wood pellets made in part of whole trees from bottomland hardwoods in the Atlantic plain of the U.S. Southeast—even in relatively small proportions—will emit carbon pollution comparable to or in excess of fossil fuels for approximately five decades.²³ This five-decade time period is significant: climate policy imperatives require dramatic short-term reductions in greenhouse gas emissions, and emissions from these pellets will persist in the atmosphere well past the time that significant reductions are needed. Under the right circumstances, true wood waste could serve as a lower-carbon option for producing pellets. For example, sawdust and chips from sawmills that would otherwise quickly decompose and release carbon anyway could be a low-carbon source.

Sustainability standards must be rigorous, require on-the-ground monitoring, and be verified by an independent third party.

When it comes to sustainability standards, very few forest acres in the Southeast are certified by any sustainability regime. There is also a disproportionate use of the least rigorous certification options, such as the Sustainable Forestry Initiative (SFI) and American Tree Farm System (ATFS). These systems allow the conversion of natural forests with high biodiversity and high carbon values to low-biodiversity forests with low carbon storage value, industrial tree plantations, or development. Both also fail to ensure adequate protection for the habitats of endangered and threatened species and for special, rare, or disappearing ecosystems.²⁴ Of the region's certified forests, only a tiny fraction is certified with the Forest Stewardship Council (FSC), the strongest certification system.

Biomass for energy should be capped to reflect the limited supplies of truly sustainable low-carbon sources.

Studies have concluded that true wood waste alone will likely be unable to meet bioenergy demands in the southern region.²⁵ Given that lower-carbon biomass sources are limited in supply, it is equally important that a cap be imposed on the use of biomass at levels that can be sustainably sourced (taking into consideration other competing uses—the existing traditional forest-products industry—and the pressing need to increase protected areas for sensitive forest types).

Getting this policy signal right is critical to steering the industry away from high-carbon, ecologically damaging sources of biomass and ensuring that bioenergy projects do not increase carbon emissions and adversely impact forests, carbon sinks, soil, wildlife habitat, biodiversity, and water resources. It will also help direct both public resources and private investments toward energy efficiency and truly clean technologies such as wind, solar, and geothermal. Failure to do so risks distorting the marketplace toward greater use of unsustainable and high-carbon sources of biomass, with significant risks to our climate, forests, and the valuable ecosystem services they provide.

ENDNOTES

- 1 Our analysis uses a slightly modified bottomland hardwood forest dataset called woody wetlands (see Appendix A of the full report), which allows more detailed summarization with the current protected-lands data. Only about 10% of this current forest type in the region is protected, leaving 90% vulnerable to ongoing disturbance or conversion.
- 2 Wood Resources International LLC, “Global Timber and Wood Products Market Update,” news brief, October 11, 2012.
- 3 T. Ricketts et al., *Terrestrial Ecoregions of North America: A Conservation Assessment* (Washington D.C.: Island Press, 1999), 33-59.
- 4 Michael J. Mac et al., “Status and Trends of the Nation’s Biological Resources,” U.S. Geological Survey (USGS), 1998.
- 5 Dr. Frank Henning, Dr. David C. Shelley and Dr. Jonathan Copeland, “Synchronic Firefly Research at Congaree National Park,” National Park Service, Old-Growth Bottomland Forest Research and Education Center. www.nps.gov/rlc/ogbfrec/research.htm (accessed September 17, 2015).
- 6 World Wildlife Fund, “Middle Atlantic Coastal Forests,” www.worldwildlife.org/ecoregions/na0517 (accessed September 17, 2015).
- 7 Louisiana Wildlife and Fisheries, “Natural Communities of Louisiana: Bottomland Hardwood Forest,” www.wlf.louisiana.gov/sites/default/files/pdf/fact_sheet_community/32338-Bottomland%20Hardwood%20Forest/bottomland_hardwood_forest.pdf (accessed September 17, 2015).
- 8 Note: Analysis based on woody wetland acreage totals, which are slightly higher than those for bottomland hardwood forests. The primary source for specific bottomland hardwood data (organized by county) was the USDA Forest Service’s Forest Inventory and Analysis (FIA) Program, which was downloaded from its online data management system, called FIDO (apps.fs.fed.us/fia/fido/index.html). Data were searched and downloaded for each county according to forest type group (i.e., bottomland hardwood forest), stand age class, and reserved status. Using these data, we created spatial representations of bottomland hardwoods for each county in each state. See Appendix A of the full report for additional details.
- 9 Natural Resources Defense Council (NRDC), “The Truth About the Biomass Industry: How Wood Pellet Exports Pollute Our Climate and Damage Our Forests,” fact sheet, August 2014, www.nrdc.org/energy/files/wood-pellet-biomass-pollution-FS.pdf.
- 10 U.S. Department of Commerce, International Trade Administration, “Renewable Energy Top Markets for U.S. Exports 2014–2015,” February 26, 2014.
- 11 Wood Resources International LLC, “Global Timber and Wood Products Market Update.”
- 12 See, for instance, Enviva company website, www.envivabiomass.com/biomass-products/enviva-wood-pellets/ (accessed September 17, 2015).
- 13 Christopher S. Galik, Robert C. Abt, and Yun Wu, “Forest Biomass Supply in the Southeastern United States: Implications for Industrial Roundwood and Bioenergy Production,” *Journal of Forestry* 107, no. 2 (March 2009): 69-77, www.nicholasinstitute.duke.edu/sites/default/files/publications/forest-biomass-supply-in-the-southeastern-united-states-implications-for-industrial-roundwood-and-bioenergy-production-paper.pdf.
- 14 NRDC, “Wood Pellet Feedstock Investigation in Ahoskie, North Carolina: December, 2014,” www.nrdc.org/land/files/wood-pellet-feedstock-investigation.pdf.
- 15 Thomas Buchholz and John Gunn, “Carbon Emission Estimates for Drax Biomass Power Plants in the UK Sourcing from Enviva Pellet Mills in U.S. Southeastern Hardwoods Using BEAC Model,” Southern Environmental Law Center, May 27, 2015, www.southernenvironment.org/uploads/audio/2015-05-27_BEAC_calculations_SE_hardwoods.pdf.
- 16 A slightly modified bottomland hardwood forest dataset called woody wetlands was used to calculate vulnerable acres, which allows more detailed summarization with current protected-lands data.
- 17 Seventy-five miles is the distance generally considered to be economical for transporting logs to processing facilities. This radius is the “sourcing area” from which facilities could potentially source their fiber.
- 18 Length of rivers and streams listed as impaired by the U.S. Environmental Protection Agency (EPA).
- 19 Determination of impaired waters is managed by each state based on guidelines from the EPA. Some (e.g., Virginia) map at greater detail, resulting in much larger total stream lengths.
- 20 USDA Forest Service (Forest Inventory and Assessment) October, 2014.
- 21 U.S. Energy Information Administration, “UK’s Renewable Energy Targets Drive Increases in U.S. Wood Pellet Exports,” *Today in Energy*, April 22, 2015, www.eia.gov/todayinenergy/detail.cfm?id=20912 (accessed September 10, 2015).
- 22 Katie Fletcher, “Drax Biomass’ First Vessel Sails from Port of Baton Rouge,” Biomass Magazine, April 20, 2015, www.biomassmagazine.com/articles/11835/drax-biomass-first-vessel-sails-from-port-of-baton-rouge.
- 23 NRDC, “Think Wood Pellets Are Green? Think Again,” issue brief, May 2015, www.nrdc.org/land/files/bioenergy-modelling-IB.pdf.
- 24 “On the Ground 2011: The Controversies of PEFC and SFI,” published by Climate for Ideas (United Kingdom), Forests of the World (Denmark), Dogwood Alliance (United States), Hnutí DUHA (Friends of the Earth Czech Republic), Les Amis de la Terre (Friends of the Earth France), Greenpeace, Sierra Club of British Columbia, Suomen Luonnonsuojeluliitto (Finnish Association for Nature Conservation), Netherlands Centre for Indigenous Peoples, September 2011.
- 25 Christopher S. Galik, Robert C. Abt, and Yun Wu, “Forest Biomass Supply in the Southeastern United States.”