

**Pinning Down the Change:
A Community-Level Study of Timberland Ownership Change**

by

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Abstract

Over the last twenty years, the forest products industry has sold much of its land base throughout the U.S. The majority of that land is being transferred from corporations in what was a traditional vertically-integrated industry to new corporate owners in the form of timber investment management organizations (TIMOs) and real estate investment trusts (REITs). A smaller portion has transferred to the public, non-governmental organizations (NGO), non-industrial private forest (NIPF) owners, and to privately-held and vertically-integrated corporations in the forest products industry. By controlling management of the forest, these new owners will directly impact ecosystems, economics, and society. Previous research has focused on national or regional trends, overlooking the major impact this development will have locally. In this study, timberland ownership change was mapped in five counties in southwest Alabama where timber production is concentrated. First, new owners were identified and organized according to ownership type and location, either absentee or local. Second, maps of new owners were analyzed to determine what variables influenced each class and where impacts of this change might be concentrated. Findings provide insight into the local effects of timberland ownership change and how those influence and interact on a regional scale.

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CHAPTER 1

Introduction

Changes that have occurred over the last twenty years in timberland ownership constitute the greatest shift of timberland from one ownership class to another in U.S. history (Bliss et al. 2010). Beginning in the 1800s, vertically integrated timber companies began purchasing millions of acres of timberland to provide fiber for their mills (Kirk 2001). This was a vital part of their business strategy, as they felt that owning the resource was the only way to ensure product flow into their mills, hedge against inflation in the timber market, and compete with other major firms (Butler and Wear 2011, O’Laughlin and Ellefson 1982). The reasons for the recent change in mindset probably varied from company to company, but many events coinciding contributed to this great land sale.

History of Timberland in Alabama

This change is of particular interest in Alabama, where timberlands are a major part of the ecology, economy, and society of the state. Seventy percent of Alabama’s land mass was covered in forestland as of 2012. (USDA Forest Service 2012). That 70% amounts to over 22 million acres, and is concentrated heavily in the southwest portion of the state. This is an area of historically rich ecology, as a part of the historical longleaf forest that dominated 92 million acres in the U.S. at the time of European settlement (Frost 1993). Longleaf pines were a source of timber and pitch across the range since the first European settlers arrived to the area. The arrival of the forest products industry in the Southeast further reduced the range, as companies cut all the available timber to maximize profits, thus severely inhibiting longleaf regeneration. Since that time, longleaf has largely been replaced across its range by loblolly pine, due in part to

loblolly pine's natural tendency to readily colonize open ground. More recently, the move by the forest products industry to plant and maintain high-intensity pine plantations has almost completely removed longleaf pine from its original range. The longleaf ecosystem is now considered one of the most endangered ecosystems in the U.S. (Noss et al. 1995). For this reason the ecological impacts of land ownership change could be dramatic for this landscape.

The economic impact of the forest products industry in Alabama is also substantial. In 2010, the forest products industry generated sales of \$11.2 billion and 122,000 jobs in the state (Fields et al. 2013). If the forest products industry is such an economic boon to the state's economy, it would stand to reason that the counties it is centered in would reflect that prosperity. However, although the forest products industry generates a great amount of wealth, the counties in which it is centered are among the poorest in the nation.

Part of the reason for the wealth disparity has to do with the means used to attract the forest products industry to these counties in the first place. Drawn to the area by its abundant forests, water, transportation, and cheap labor, the forest products industry quickly established itself in the region and by 2007 had made Alabama's forest products industry the second largest in the country (Joshi et al. 2000). Industrial timber companies first became interested in the Southern forest in the late 1800s (Williams 1992). The years following the Civil War made the underdeveloped region desperate to attract any outside investment, and timber companies facing a depletion of resources in the Lake States quickly acquired massive landbases in the South (Howze et al. 2003, Williams 1992). Eager to recruit timber companies to the area, Southern politicians successfully repealed the Southern Homestead Act, which had limited land purchases to 80 acres in an attempt to promote small landowners and break the tradition of slave-owning aristocracy in the region (Williams 1992). This move essentially opened the floodgates for

industrial timber companies, and over the next decade, 5.7 million acres of federal land and tens of millions of acres of state land was sold in the South (Fernholz et al. 2007). This time period established the ownership patterns that remained within the forest products industry to the present day, including the vast timberlands of Frederick Weyerhaeuser. Weyerhaeuser's lands would later become a part of Weyerhaeuser Company, one of the largest modern industrial timberland owners in the South.

State governments in the Southern states also actively recruited the forest products industry investment by offering extensive tax incentives, a practice which began around the late 1920s (Joshi et al. 2000). Alabama was especially aggressive in its pursuit of the forest products industry, passing the Cater Act of 1949 and the Wallace Act of 1951, which allowed municipalities to issue revenue bonds to finance plant construction and lease those plants to industry for rock bottom rates (Joshi and Bliss 1995). One of the points in Governor George Wallace's infamous "Segregation Now, Segregation Forever" speech was his assertion that "[Alabama's] native pine and forestry system produces timber faster than we can cut it and yet we have only pricked the surface of the great lumber and pulp potential" (Wallace 1963). Even after tax abatements were limited in 1992 by the Industrial Incentive Reform Act, industry continued to flock to Alabama because of its low property tax, which is the lowest in the nation (Bailey and Majumdar forthcoming).

Timberland tenure also directly impacts local well-being through property taxes. In Alabama, timberland can be taxed under current use laws, which apply taxes based on the capacity of the land to grow timber or crops (Flick et al. 1989). Current use taxes on timberland across the state average less than \$1 per acre (Hamill 2002). Tax abatements used to bring in industry have had serious negative economic repercussions for rural development, especially education (Joshi et al.

2000). Property taxes are a primary source of funding for local governments, contributing to infrastructure such as sewers, roads, police and fire services, and public schools. In communities where property taxes generate little revenue, as is the case where timberland is concentrated, local governments raise revenue by increasing sales taxes. This results in a tax burden that falls disproportionately on the poor. A high rate of absentee owned land, especially timberland, exacerbates this problem. What wealth is generated on the land is removed from the community, and owners have little incentive to pay higher taxes to fund roads and schools they may never use. Primarily benefitting large and often absentee landowners, the current use system also does little to slow urban sprawl and development (Butler et al. 2012, Meng and Zhang 2013, Wear and Newman 2004). Poor schools and an uneducated workforce are major deterrents to further economic development (Bliss et al. 1998a). Tax abatements may also attract industries that rely on cheap and unskilled labor, perpetuating low-wage employment and lack of public services (Joshi and Bliss 1995). This has led to a cycle of poverty that these counties have yet to escape.

Southwest Alabama, where timberlands and pulp and paper mills are concentrated heavily, lies within a region known as the Black Belt (Bliss et al. 1998a). The Black Belt of Alabama is defined by extremely rich soil, and was historically home of the slave-owning plantations of the Antebellum South. Counties in the Black Belt of Alabama are among the poorest in the state. Although African Americans constitute the majority of the population in these counties, there is a great divide in land ownership. African Americans make up 25% of the state of Alabama's population, yet own only 4% of Alabama's timberland. As Bliss et al. (1998a) have pointed out, there is a direct correlation between land tenure, wealth, and power in the southwestern part of the state, which falls along racial lines. The distribution of timberland in these counties today stems directly from the historical plantation system: land concentration, commercial production,

and social stratification still characterize the area (Bliss et al. 1998a, Sisock 1998).

Who Owns the Forest?

Timberland ownership has changed dramatically throughout the history of land settlement in Alabama. From Native American tribes predating European explorers to the modern forest products industry, each owner managed the forest with certain objectives in mind. By understanding who owns timberland, we gain insight into the probable objectives of the owner, and therefore how the land will be managed. Timberland owners are classified as one of four types: non-industrial private forests (NIPF), industrial, corporate, and public. A discussion of each timberland owner classification and their management objectives follows.

NIPF lands are owned by any private individual or group that is not a corporation. This classification includes individuals, families, Native American lands and unincorporated groups. NIPF owners have multiple objectives for the forest land, including financial and non-financial goals. Recreation, preserving the environment, protecting wildlife, and preserving a legacy are some non-financial goals of these owners (Butler and Wear 2011, Bliss et al. 1998b, Lutz 2008, Newman and Wear 1993). However, these owners do consider the land a long-term financial investment (Butler and Leatherby 2004). While these owners usually emphasize preserving nature and wildlife habitat, their management practices do not necessarily meet those goals. Many NIPF owners focus more on aesthetics than ecologically sound practices (Dutcher et al. 2004). Timber production for financial gain may not be a primary goal for ownership, but the majority of NIPF owners have at some point commercially harvested timber on their land (Butler and Wear 2011).

Historically, NIPF owners have made up the vast majority of timberlands in the Southeast, around 67%, but contributed only 58% of timber to the market, which had justified the forest

product industry's investment in timberlands (Newman and Wear 1993). NIPF owners do seem to put less emphasis on intensive management, with only 18% with written forest management plans, and only 42% seeking professional advice on management (Butler and Wear 2011). But although these owners' objectives might differ from industrial owners, their management and harvest decisions are heavily influenced by the market, just like their industrial counterparts (Kuuluvainen et al. 1996, Newman and Wear 1993).

Industrial forest owners are companies in the forest products industry. They are considered vertically integrated in that they own and operate mills which turn wood from the land they own into paper, lumber, plywood, or other wood-based products. This was the second largest timberland owning group behind NIPF owners until recent restructuring (Bliss et al. 1998a, Newman and Wear 1993). For the forest products industry, timberland ownership was considered a part of the vertically integrated manufacturing process. To ensure supply to their mills, as well as to compete with other forest products industry firms in the area, they purchased and managed timberlands (Butler and Wear 2011, Gunnoe and Gellert 2010). Industry did not foresee ever selling the land, and maintaining productivity well into the future was a part of the management plan.

Public forests are owned and managed by the local, state, or federal governments. In contrast to NIPF and industrial forests, public forests are maintained primarily for environmental and wildlife conservation (Bliss et al. 1998b). Public forests function differently from the private ownership categories because, although some public forests do allow timber harvest by private companies, their management objectives are shaped by public policy. Many offer recreational opportunities, but some are closed to the public or only offer limited access. This has traditionally been the smallest timberland ownership class in Alabama, a trend which carries

throughout the Southeast U.S. (Bliss et al. 1998a).

Corporate owners are private incorporated entities that own or manage timberland, but do not own manufacturing facilities. This category includes timberland investment management organizations (TIMOs) and real estate investment trusts (REITs), corporations that buy, sell, and manage timberlands on behalf of investors. Previously one of the smallest groups of timberland owners (surpassed only by public ownership), this group has recently grown substantially due to forest products industry land sales. The structure of REITs demands that 90% of the profit must be redistributed to investors, requiring them to be accountable to investor demand (Gunnoe and Gellert 2010, Mendell et al. 2008). Therefore, any investment made in the land through management must be financially justified (Clutter et al. 2005). It has been shown that TIMOs and REITs manage land differently than industry, including shorter timber rotations, fewer non-commercial treatments, and less infrastructure in the form of roads and culverts (Bliss et al. 2010, Noone et al. 2012, Rogers and Munn 2003). The reforestation rate equals industry and is higher than NIPF owners (Zhang et al. 2012). To be considered worthwhile, all management treatments must offer a certain financial return within the time frame of the investment.

The investments made by REITs and TIMOs usually operate within a 10 to 20 year time frame (Gunnoe and Gellert 2010, Clutter et al. 2005). This distinguishes this class of ownership from the three others, which treat timberland as a long-term investment. It also affects the mindset of managers, who must focus on short-term returns and make decisions with that in mind (Noone et al. 2012). As a result, biodiversity and aesthetics, which cannot be directly tied to generated income or might even reduce the short-term profit available to investors, often are not management goals (Lutz 2008). However, these potential revenue sources have been topics at recent timberland investment conferences, so it is possible that this will be a part of the income

strategy for corporate owners in the future (Bliss et al. 2010).

Because of the time frame established in corporate timberland investment and the emphasis in investor returns, about 20% of the timberland managed by REITs and TIMOs ends up being sold for highest and best use (Bliss et al. 2010). Highest and best use (HBU) sales maximize profit by converting timberland into real estate to be developed as residential or commercial property.

One of the major concerns associated with timberland divestiture by the forest products industry is that this would lead to fragmentation of forestland. This trend is especially prevalent in the urban fringe (Clutter et al. 2005, Jones 2008). Companies that use debt markets to finance timberland purchases are also more likely to sell land for HBU because of the need to quickly recoup expenses (Binkley 2007, Clutter et al. 2005).

The four categories of ownership discussed reflect the financial structure of the owners, but they can also be discussed based on their location: whether they are local to the community in which they own land, or if they instead are based in another area and manage the land as absentee owners. Local and absentee ownership receives particular emphasis in rural communities dependent on natural resources, as absentee ownership negatively correlates to community well-being (Howze et al. 2003, Bailey and Majumdar forthcoming). Extractive industries headquartered elsewhere may take the bulk of the profits away from the source (Rural Sociological Society Task Force on Persistent Rural Poverty 1993). This often creates dependency of rural areas on urban centers, making rural areas more subject to economic collapse, resource depletion, and lack of investment in local public services (Lovejoy and Krannich 1982, Peluso et al. 1994, Varghese et al. 2006). Additionally, where owners are removed from the ramifications of the extraction process, ecological damage is more likely to occur (Lovejoy and Krannich 1982). Absentee owners who are detached from a community are

likely to focus on short-term financial returns above broader issues of employee satisfaction and environmental health.

Local ownership has the potential to eliminate these disparities by increasing local financial returns, worker participation, sense of community, and local influence over broader issues (Varghese et al. 2006). Where communities are able to control or significantly influence their own destiny, they have a much greater ability to adapt to change. Local ownership is also believed to create better land stewardship, as the owners and workers must live within the environment affected. Thus, management objectives of local owners tend to be further-reaching, considering not only financial returns but worker satisfaction, environmental health, and community goals. Investments tend to focus on long-term sustainability instead of short-term profits.

Corporate, industry, public and NIPF owners can each be either local or absentee in nature. NIPF owners can either live on or adjacent to their timberlands, or they can be absentee, holding timberlands as an individual investment or purely for recreation. When industrial land is owned by large firms based in metropolitan areas, they are considered absentee. Forest products firms may own land in the same county in which they are headquartered, and would then be defined as local. Even when industry owners are considered absentee, these firms may operate similarly to local owners because of the number of local employees working for the firm (Bliss et al. 2010). Public lands can be managed by local governments or by the federal government, again forming a hybrid between absentee and local ownership. Corporate timberlands are possibly the only category that exists exclusively within a single category, as the nature of the investment usually excludes smaller institutions that might operate on a local or regional level. But it is not outside the realm of possibility that local corporations might own timberland as an investment. In order

to fully understand land ownership, it is necessary to consider all facets of land ownership at once.

Ownership Change in U.S. Timberlands

Timberland ownership has changed dramatically over the last 20 years. As the previous discussion pointed out, when landowners change, management objectives might also change. A major shift in timberland ownership, therefore, indicates a major shift in land management objectives. Before we can understand how ownership changes will impact the land and the communities around it, it is important to understand the period leading up to this event and what caused it to occur.

Beginning in the 1980s, timber companies were in a race of mergers and acquisitions. These mergers created considerable debt, and land was the most easily liquidated asset available to cover that debt (Butler and Wear 2011, Kirk 2001). At the same time, timber companies suffered from accounting standards regarding the massive amounts of timberland on their accounting ledgers. Forests cannot show increasing asset value according to the United States Generally Accepted Accounting Principles (Binkley 2007). This means that if a company were to invest \$1,000 in trees, and harvest those trees later for \$10,000, the \$9,000 profit is added to the balance sheet without being attributed to the land. By these standards, the value of forest growth cannot be accounted for, and so land-owning timber companies are seriously undervalued on paper. This realization made timber companies attractive for hostile takeovers, which resulted in the selling of timberlands for quick profit (Binkley 2007, Gunnoe and Gellert 2010).

Another factor influencing the sale of timberlands was an effort to avoid higher tax rates. The timber industry must pay corporate income taxes on revenues, around 35%, then shareholders must pay income and capital gains taxes, around 15% (Rahman et al. 2011). Corporate

timberlands, in the form of real estate investment trusts (REITs) are taxed only once at 15%. This means that whereas shareholders in industrial timberland can only retain 50% of every dollar earned on timber, shareholders in corporate timberland can retain 85% of every dollar. When it became clear that timberland could be restructured within a REIT, lands were either sold to REITS or timber firms formed REITS within the existing business structure, as in the case of Rayonier (Binkley 2007, Mendell et al. 2008). The tax incentives to convert timberland from traditional industrial ownership to corporate ownership, either by selling land or creating REITS within the timber firm, were attractive to shareholders, industry, and corporations alike. The evidence of this is most obvious in the change in industry stock values when a company committed to selling its land base. Temple Inland for example saw a stock increase of \$8 per share following the announcement that they would sell (Binkley 2007).

While the timber industry faced a growing need and desire to sell timberlands, corporate entities were finding timberland investments more and more attractive. First, timberlands offered a source of passive income, which is necessary for pension plans, endowments, and foundations, and provided a lower tax rate on profit which appealed shareholders (Binkley 2007).

Timberlands also increase the diversity of portfolios from traditional bonds, stocks, and real estate as a low-risk investment (Clutter et al. 2005, Lutz 2008). Corporate owners can use timberlands in the same way as the former industry owners as a hedge against inflation, because timberlands tend to move with inflation instead of remaining stagnant (Binkley 2007).

Timberland is also an attractive investment because of its strong performance, with consistently high returns in the real estate sector (Newell and Eves 2009).

The shift in mindset and subsequent land sale occurred so quickly in industry that the statistics of the sale are just now beginning to be collected. Although the major landowner

category, non-industrial private forests (NIPF), remains intact, somewhere around 37 million acres have been sold by the forest products industry (Rahman et al. 2011). Of that total, 15 million are now under ownership of TIMOs, 10 million belong to public or NGO owners, 10 million belong to REITs, and 2 million to private forest product companies.

It is also estimated that the bulk of this land, around 18 million acres, is in the South, making it the most affected part of the U.S. By 2010, TIMO management had increased to five times its size in 1990, from 1.39 million acres to 8.8 million acres (Clutter et al. 2005, Zhang et al. 2012). REIT ownership increased in size to about 7.7 million acres, or 4.5%. Over the same period, industrial timberland ownership fell from 20% to 4% in the South (Butler and Wear 2011, Zhang et al. 2012). The largest industrial sales have occurred in Texas, with 3 million acres, and Alabama, Georgia, and Louisiana, at 2 million acres each (Butler and Wear 2011).

An estimated 64% of land now owned or managed by REITs and TIMOs came from industrial land sales. However, this number might be skewed because prior to 2002, TIMOs and REITs were classified as NIPFs (Zhang et al. 2012). It is assumed that the 25% of land that changed hands from NIPF to corporate ownership actually already belonged to corporate owners.

The Importance of Local Change

To this point, the majority of research on timberland ownership change has been done on a national or regional level. Because this change was so massive, involving global companies and millions of acres of timberland, this seems appropriate. In order to determine what this change will mean in the communities surrounding the land, however, it is necessary to use a finer scale. If, as it has been suggested, the scale of research should be framed by the question it seeks to answer, then the effect of timberland ownership on communities should be framed by a community scale (Wiens 1989). Studying change exclusively from a coarse scale masks

variability on a fine scale (Evans et al. 2002). Regional scale research can only provide generalities, which may or may not hold true in a specific place (Meentemeyer 1989). Further, many of the regional scale trends begin with decisions made on a local level. Especially in relation to land use, regional trends may be the product of decisions made by individuals operating within communities (Evans et al. 2002, Turner 1999). Local changes simultaneously contribute to and are affected by global changes (Wilbanks and Kates 1999). This makes the local level, where regional economic, ecological, and societal trends converge, a vital starting point for unraveling complex processes.

The problem lies, of course, in the fact that fine scale research is difficult to translate to a larger scale. While regional studies may uncover generalities that may be accurate on a local scale, smaller scale variables will rarely be true across a broad space (Meentemeyer 1989, Wiens 1989, Wilbanks and Kates 1999). Local research alone does not provide sufficient insight, as it has the potential to overlook processes that may occur on a larger scale. At the same time, regional research alone can be much too general. The greatest insight can be gained by utilizing both scales, with the understanding that they are highly interconnected (Gibson et al. 2000, Turner 1999). With national and regional trends in timberland ownership in mind, community level research is the next step in understanding the outcomes of this event.

Using GIS to Study Land Ownership Change

Mapping timberland ownership provides the unique opportunity to study ownership change within spatial parameters, adding an element to our understanding that is at once obvious, necessary, and yet difficult to achieve. By analyzing timberland ownership maps in GIS, patterns, trends, and relationships can be assessed (Scott and Janikas 2010). This not only provides valuable information on relationships across space, but a visualization of what changes

have occurred and what the outcomes might be. Two specific statistical tools used in GIS to account for spatial and non-spatial data are Geographically Weighted Regression (GWR) and Hot Spot Analysis (ESRI 2011).

GWR can be used to explain with spatial and non-spatial data what influenced new timberland owners. It is a form of linear regression that accounts for spatial nonstationarity, or the variation in relationships across space, by estimating regression parameters and including a spatial weight for each data point (Brunsdon et al. 1999). This technique is valuable when explanatory variables do not have the same influence globally. It follows Tobler's law of geography, that "everything is related to everything, but near things are more related than distant things" (Tobler 1970). Maps of timberland ownership can be analyzed with GWR to determine which variables have had the most influence over each class of timberland owner in the study area. Because GWR applies a unique R^2 value to each data point, the changing accuracy of the model can be seen across space, pointing out possible changes in relationships (Brunsdon et al. 1999).

GWR analyzes important non-spatial data that contributes to land ownership change, like median housing value, income, poverty ratio, population density, and land quality (Alig 1986, Browne 2001, Nagubadi and Zhang 2010, Pan et al. 2009, Wear and Newman 2004). Large landowners are more likely to be influenced by factors related to the value of the timber resource, while smaller landowners are more likely to be influenced by socioeconomic factors, which will not only affect the class of landowner but also the potential for fragmentation of larger tracts (Pan et al. 2009). It also accounts for geographic features, such as access to roads and distance to towns or cities which also play a role in land ownership patterns (Browne 2001, Zinkhan 1993). Access to roads is more important for landowners focused on timber production,

while distance to towns or cities is more important for landowners with recreational goals. Agriculture returns, population density, median housing value, and distance to cities will contribute not only to ownership class change, but use change as well (Nagubadi and Zhang 2010, Wear and Newman 2004).

Also in ArcGIS, Hot Spot Analysis can be used to explain where those outcomes might be most pronounced. Hot Spot Analysis calculates the Getis-Ord G_i^* statistics for designated points across a space. For each feature, a z-score is calculated. Higher z-scores indicated a clustering of high values, which for this study was used to show a concentration of many new owners within each respective class. With the land ownership data accumulated in this study, concentrations, or “hot spots,” of each new ownership class could be located. Potential outcomes found in a review of literature could then be joined to the hot spots of ownership change to identify where each change would be likely to occur. Hot Spot Analysis provides a unique opportunity to pin the potential outcomes of timberland ownership change to a map.

Research Objectives

Current studies on timberland ownership change have focused on documenting change over the last twenty years, from outlining industry’s reasons for selling land to describing the surge in TIMO and REIT investment (Binkley 2007, Bliss et al. 2010, Butler and Wear 2011, Clutter et al. 2005, Gunnoe and Gellert 2010, Lutz 2008, Rahman et al. 2011). Other works have attempted to quantify the ownership changes and paint a broad picture of who the new owners are (Bliss et al. 2010, Butler and Wear 2011, Rahman et al. 2011, Zhang et al. 2012).

It has been of considerable interest to learn about the management objectives of NIPF and corporate owners, as these two classes have thus far been the major purchasers of industry lands (Binkley 2007, Bliss et al. 1998b, Butler and Leatherby 2004, Butler and Wear 2011, Dutcher et

al. 2004, Kuuluvainen et al. 1996, Lutz 2008, Newman and Wear 1993, Noone et al. 2012). Along with those categories of ownership, much research has also been done on absentee timberland owners (Beckley and Krogman 2002, Lovejoy and Krannich 1982, Bailey and Majumdar forthcoming, Varghese et al. 2006). Although many assumptions can be made based on these works, no research has yet to map where these changes have occurred so the assumptions might be tested over time. Furthermore, although many projects discuss the management objectives of new corporate timberland owners, a question still surrounds their long-term strategies. By identifying and locating corporate owners as a part of this project, there is a potential for future investigation. There is also the potential for more effective extension and outreach work to these owners. Social and economic factors are the most important drivers of ecological change, and those factors are determined by the owners of the land (Black et al. 2003). Outcomes of this project will directly serve the people of Alabama, who stand to benefit from the ability to make informed decisions about the land that surrounds them.

Up to this point, no work has been done to spatially show change in forestland ownership on a parcel level. Because of intense market pressures, many sales occurred over a short period of time. In addition, some of that land was purchased and then sold again quickly, making it difficult to track all the exchanges. Using Forest Inventory Analysis data to track change is imperfect because of the new corporate classification which did not exist in data prior to 2002 (Zhang et al. 2012). We know that ownership impacts economy, ecology, and society. There is no way to understand the potential for these changes without first identifying where lands have changed hands and who the new owners are.

This thesis examines how timberland ownership has changed in Alabama by mapping industry land sales in five counties in Alabama: Baldwin, Clarke, Conecuh, Escambia, and

Monroe. These counties had a combined 2,970,117 acres of timberland in 2012 and are located in the Southwest corner of the state, where the forest products industry has been highly concentrated (USDA Forest Service 2012). Figure 1.1 shows the acres of forest land by county in the state of Alabama in 2012, highlighting the importance of this area to forest production in the state.

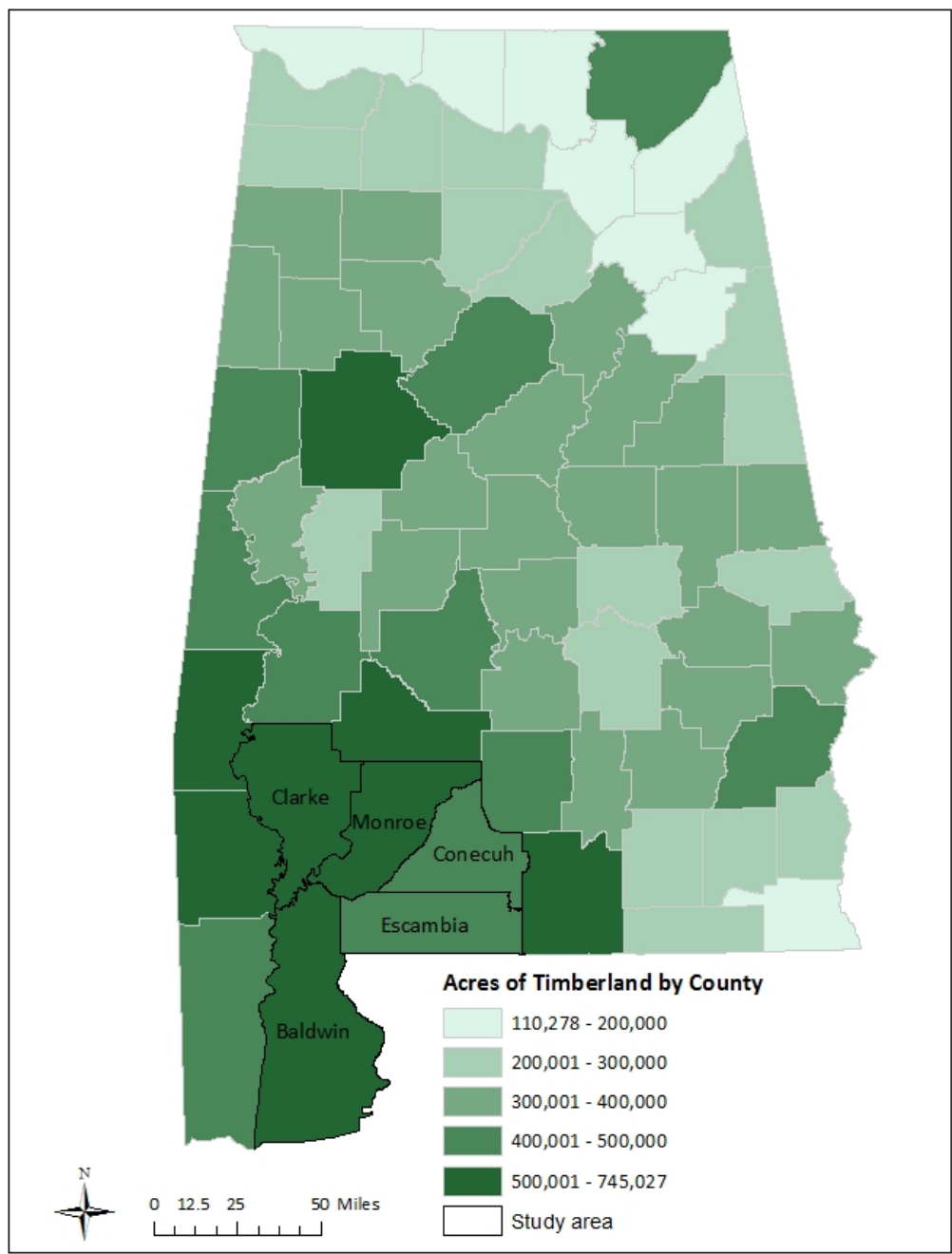


Figure 1.1: Acres of timberland in Alabama by county in 2012 (USDA Forest Service 2012).

Study Area

Four of the five counties (Baldwin being the exception) are predominately rural and timber dependent, with high levels of forest-based employment (Howze et al. 2003). Timber dependent communities depend on the forest products industry for a large proportion of total employment. This puts these communities in a precarious position, relying on one sector of the economy to provide jobs for citizens and tax revenue for local services. Timber dependency has a negative relationship with community well-being, measured by a variety of socioeconomic factors including poverty levels, income and unemployment (Howze et al. 2003). Table 1.1 shows some of the factors contributing to timber dependency as of 2012 for Baldwin, Clarke, Conecuh, Escambia, and Monroe counties. As of 2012, the percent of the population below poverty in Clarke, Conecuh, Escambia, and Monroe counties was almost 25%, 7% higher than the state. The median income in those four counties was also at least \$12,000 below the state average. Percentage of the population with high school and bachelor's degrees was also lower than the state average for those four counties.

Baldwin, a predominately urban county, was the exception in the study area. This county had higher well-being measures than the state, with only 13.3% of the population below poverty, and a higher median income and percent of population with high school and bachelor's degrees. This data reflects previous studies that did not consider Baldwin County timber dependent (Howze et al. 2003). For the purpose of this study, Baldwin County provides a comparison between predominately rural, timber dependent counties and predominately urban, non-timber dependent counties.

In addition, preliminary research seen in Figure 1.2 shows that five mills have closed in these counties since 1999 (USDA Forest Service 2005). Although a depressed housing market

contributed to the closure of wood processing mills across the country, mill closures can also provide evidence that the forest products industry is reorganizing in the area as a result of land ownership change (Hodges et al. 2011, Johnson et al. 2003).

Table 1.1: Census data as measures of community well-being for study counties in 2012 compared to state data. (U.S. Census Bureau 2007a, 2007b)

	Percent of Population Below Poverty	State Average	Average Median Income	State Average	Percent of Population with Bachelor's Degree	State Average	Percent of Population with High School Degree	State Average
Baldwin	13.3%	-4.8%	\$50,706.00	+\$7,546.00	27.7%	+5.4%	88.4%	+5.8%
Clarke	26.4%	+8.3%	\$30,954.00	-\$12,206.00	12.7%	-9.6%	78.4%	-4.2%
Conecuh	30.4%	+12.3%	\$27,064.00	-\$16,096.00	9.7%	-12.6%	75.8%	-6.8%
Escambia	24.9%	+6.8%	\$31,075.00	-\$12,085.00	12.2%	-10.1%	75.2%	-7.4%
Monroe	26.0%	+7.9%	\$30,996.00	-\$12,16.00	9.9%	-12.4%	75.9%	-6.7%
Alabama	18.1%	--	\$43,160.00	--	22.3%	--	82.6%	--

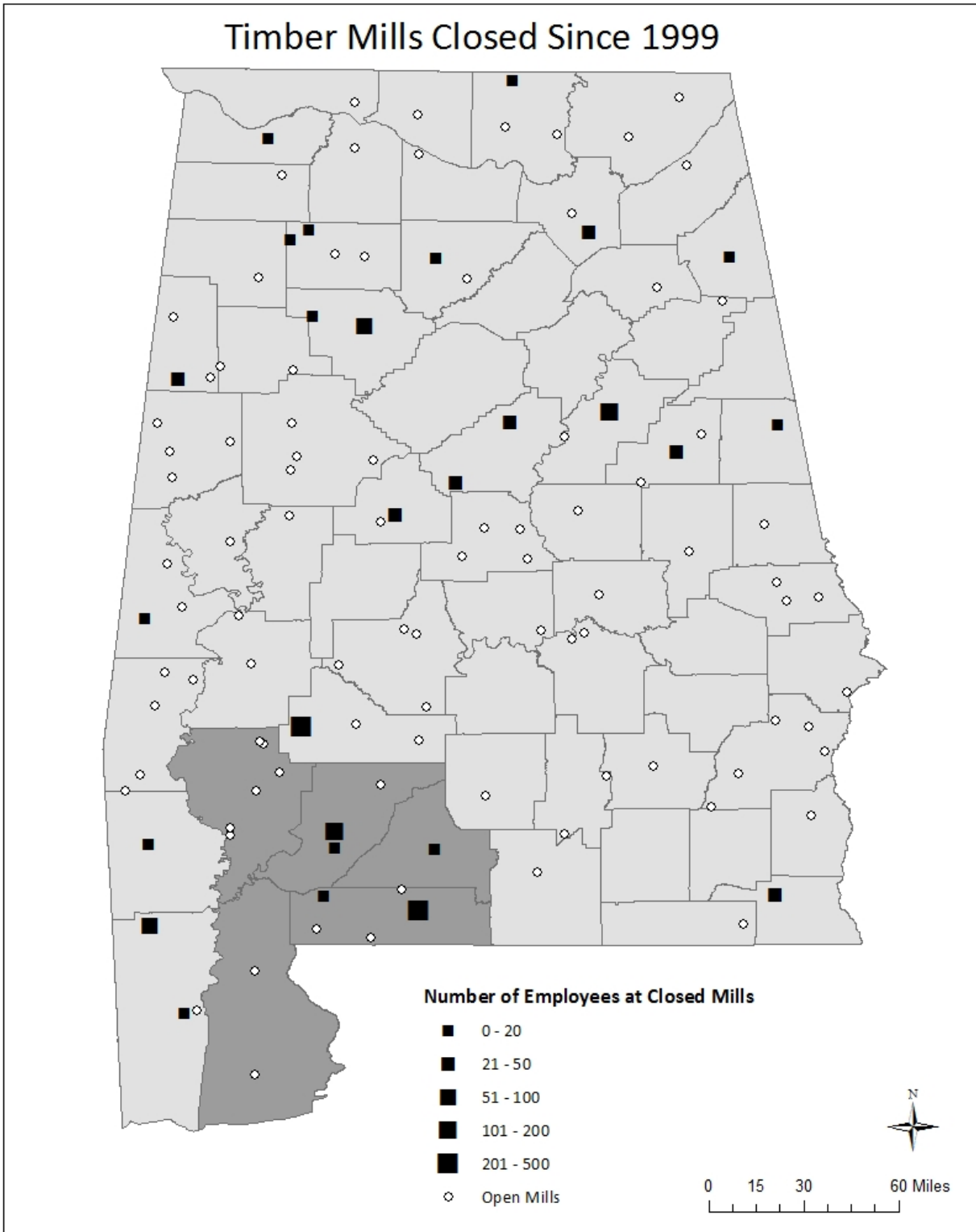


Figure 1.2: Map of forest products industry mill closures since 1999 in Alabama, with study counties highlighted (USDA Forest Service 2005).

With maps of industry lands prior to divestment, new owners can be identified, and for the first time this major change can be studied on a local level. This will not only provide a basis for future research by identifying individual owners, but it will provide the opportunity to show expected outcomes of this change spatially. To achieve these objectives, this thesis presents the results of two studies:

The first study (Chapter 2) explores the results of timberland ownership change in the five study counties. This chapter begins with review of scientific publications and “gray” literature that explain the changes in timberland ownership over the last 20 years and how timberland owners are classified. The results of mapping ownership change are discussed. The number of acres in each new ownership class is examined and top new owners of timberland are identified based on number of acres owned. Where highest and best use (HBU) change has occurred, the new uses of the land are discussed. This chapter provides the basis for predictions on the ecological, economic, and societal outcomes of this change.

The second study (Chapter 3) uses the data discussed in Chapter 1 to explain why changes have occurred, predict what the outcomes might be, and where they might be most pronounced. This chapter begins with a review of scientific publications that have presented the ecological, economic, and societal outcomes of changing land ownership, as well as a review of scientific variables associated with different types of ownership and use change. Graduated Weighted Regression is used to identify explanatory variables associated with NIPF, government, and corporate owners, as well as change in use. Hot Spot analysis in ArcGIS is used to highlight areas of potential change based on the concentration of each ownership class and fragmentation within the study area.

CHAPTER 2

Mapping timberland ownership change in five southwest Alabama counties

2.1. Introduction

From 1983 to 2009, 43.4 million acres of timberland, a resource valued at \$39.7 billion, changed ownership type in the U.S. (Rinehart 2010). Thirty-seven million acres of that land was sold by the forest products industry to new corporate owners, constituting the greatest shift of timberland from one ownership class to another in U.S. history (Bliss et al. 2010, Rahman et al. 2011). The rapid rate and scale of timberland sales have raised many questions about who owns this land now, and how will this change affects local economies, ecology, and society. While initial research seemed to view this massive change with alarm, predicting a total paradigm shift in the forest products industry, recent studies seem to show that the forest and the forest products industry continue to operate with stability (Bliss et al. 2010, Clutter et al. 2005). Because long term timber supply contracts with mills supply chains remain intact, and because timber production remains the highest and best use of the vast majority of this land, little deforestation has occurred (Ameyaw 2013). On the whole the results of this study are consistent with previous research, showing that most of the outcomes will not drastically alter the forest. This study also shows that subtle changes from one type of timberland owner to another, coupled with few occasions of dramatic change, will have an obvious impact on a local level.

Previous studies of these timberland sales have been conducted on national and regional scales. To understand the impact of this change on the well-being of a community, to which it is so closely tied, a fine scale must be used (Turner 1999). Instead of identifying broad trends in timberland ownership, the objectives of this study were to map industry owned timberland in

five southwestern Alabama counties before industry land sales, and then identify and map the new owners of those parcels. New owners were classified according to their ownership class (forest products industry, non-industrial private forest owners [NIPF], corporate, or government), and according to whether they are absentee or local owners. Parcels that have changed in use or were no longer in timber were identified as well. The goal was to identify dramatic outcomes, like land use change, as well as more subtle outcomes, like the shifting landowner objectives as timberland changed hands. This study is the first attempt to map this massive ownership change on a parcel-level, allowing not only for a close examination of what has already occurred, but for future research as well.

Literature Review

History of Forestry in Alabama

Seventy percent of Alabama's land mass was forested as of 2012 (USDA Forest Service 2012). That 70% amounts to roughly 22 million acres, which is concentrated in the southwest portion of the state (Bliss et al. 1998a). Located on the coastal plain of the Deep South, this area is a part of the ecologically rich historic longleaf forest that dominated 92 million acres in the U.S. at the time of European settlement (Frost 1993). Arrival of the forest products industry reduced the range, as companies cut all the available timber to maximize profits, thus severely inhibiting longleaf regeneration. Since that time, longleaf has largely been replaced across its range by loblolly pine, due in part to loblolly pine's natural tendency to readily colonize open ground. More recently, the move by the forest products industry to plant and maintain high-intensity pine plantations has almost completely removed longleaf pine from its original range. The longleaf ecosystem is now considered one of the most endangered ecosystems in the U.S. (Noss et al. 1995).

The economic impact of forestry in Alabama is substantial. Drawn to the area by its abundant forests, water, transportation, and cheap labor, the forest products industry quickly established itself in the region and by 2007 had made Alabama's forest products industry the second largest in the country (Joshi et al. 2000). In 2010, the forest products industry generated sales of \$11.2 billion and 122,000 jobs in the state (Fields et al. 2013). Although forestry generates a great amount of wealth, the counties in which it is centered are among the poorest in the nation.

From a social perspective, land tenure determines how humans exert claims on their resource base, and has the potential to form the basis for entitlements and responsibility within a community (Gaventa 1998, Geisler and Salamon 1993, Krueckeberg 1995). Because land ownership fundamentally affects community well-being through the distribution of wealth and power, industry land sales have a particular importance in this persistently poor area.

The Importance of Land Tenure

Many of the two million acres that changed hands in Alabama were in the southwest corner of the state, in a region known as the Black Belt. There is a direct correlation between land tenure, wealth, and power in the Black Belt of Alabama, which because of the historical social order in this area, tends to fall along racial lines (Bliss et al. 1998a). Land tenure also contributes to the disparity of wealth in timber dependent communities in Alabama. Especially in the Black Belt, large tracts of land were historically owned by white plantation families (Bliss et al. 1998b). Although African Americans constitute the majority of the population in these counties, there is a great divide in land ownership. African Americans make up 25% of the state of Alabama's population, yet own only 4% of Alabama's timberland (Rosson and Doolittle 1987). Land tracts were consolidated after the Civil War as production shifted from cotton to cattle, and finally

from cattle to timber. As pulp and paper mills and sawmills began to locate in the Black Belt around the 1950's, land was consolidated further as timber companies purchased large tracts of land in the vicinity of their mills. Thus, the distribution of land in Alabama today, especially as it relates to the timber industry, stems directly from historical land tenure (Bliss et al. 1998a).

The correlation of ownership and power can be examined from the perspective of different land-owning entities, such as private landowners, corporations, industries, and the public. Whether these entities are embedded in the community or are absentee landowners may affect their long-term goals and management strategies. Given the impact of this ownership change in Alabama, it is imperative to know who the new owners are and what their intentions might be.

Categories of Timberland Owners

Forest owners are classified as one of four types: non-industrial private forests, industrial, corporate, and public. Traditionally, NIPF land makes up the majority of timberland in Alabama at 65% (USDA Forest Service 2012), followed by private industrial land, then corporate land, and finally public land. NIPF lands are owned by any private individual or group that is not a corporation or industry. This classification includes individuals, families, Native American lands and unincorporated groups. Industrial forest owners describe the vertically integrated industrial timber companies. Public forests are owned and managed by the local, state, or federal government.

Corporate owners are private incorporated entities that own or manage timberland. This category includes timber investment management organizations (TIMOs) and real estate investment trusts (REITs). These two categories of owners deserve more attention because the structure of these timberland corporations had a great impact on the timberland ownership shift of the early 2000s. Their structure also influences the management objectives of this timberland.

TIMOs are management companies that work on behalf of institutions to buy, sell, and manage timberland (Butler and Wear 2011). With few exceptions, TIMOs are not publicly traded, and deal with pension funds, endowments, foundations, and insurance firms (Zhang et al. 2012). TIMOs do not own the timberland, but they perform all the traditional duties of a timberland owner (Binkley 2007). It is their primary responsibility to garner returns on the land for their investors.

REITs invest the capital of many investors to purchase and manage property (Butler and Wear 2011). They may be publicly traded or not, and may include institutional as well as individual investors. Most shares as of 2012 were owned by mutual funds (Zhang et al. 2012). As in the case of TIMOs, REITs may not actually own the land, but manage it on behalf of investors. Again, it is their primary responsibility to garner returns on the land for their investors.

Management Objectives by Ownership Category

NIPF owners have multiple objectives for the forest land, including financial and non-financial goals. Non-financial goals for NIPF owners include recreation, preserving the environment, protecting wildlife, preserving a legacy, and long-term investment (Bliss et al. 1998b, Butler and Leatherby 2004, Butler and Wear 2011, Lutz 2008, Newman and Wear 1993). While these owners usually emphasize preserving nature and wildlife habitat, their management practices do not necessarily meet those goals (Dutcher et al. 2004). Many NIPF owners focus more on aesthetics than ecologically sound practices. Timber production for financial gain may not be a primary goal for ownership, but the majority of NIPF owners have at some point commercially harvested timber on their land (Butler and Wear 2011).

Historically, NIPF have made up the vast majority of timberlands in the Southeast, around 67%, but contributed only 58% of timber to the market, which had justified the timber industry's

investment in timberlands (Newman and Wear 1993). NIPF owners do seem to put less emphasis on intensive management, with only 18% having written forest management plans, and only 42% seeking professional advice on management (Butler and Wear 2011). Additionally, NIPF tracts in Alabama average around 29 acres, making harvest tedious and time-consuming. These owners' objectives might differ from traditional industrial owners, but their management and harvest decisions are heavily influenced by the market, just like their industrial counterparts, and they tend to harvest at comparable rates regardless of their goals (Kuuluvainen et al. 1996, Newman and Wear 1993).

Industrial timberlands are maintained for timber production over the long-term. Before recent shifts in the mindset of timber firms, timberland ownership was considered a part of the vertically integrated manufacturing process for the major timber companies. To ensure supply to their mills, they purchased and managed timberlands (Butler and Wear 2011, Gunnoe and Gellert 2010). Because industry did not foresee ever selling the land, maintaining land health well into the future was a part of the management plan. Also influencing the industry towards land investment was the idea that timber firms were in competition to buy available land in order to shut competitors out of specific geographical areas. The fact that regions were divided almost exclusively amongst the largest 40 companies was a product of this competitive mindset (Gunnoe and Gellert 2010).

In contrast to NIPF and industrial forests, public forests usually are maintained for environmental and wildlife conservation (Bliss et al. 1998b). Public forests function differently from the private ownership categories because, although some public forests do allow timber harvest by private companies, generating a profit is not a priority. Many offer recreational opportunities, but some are closed to the public or only offer limited access.

Corporate timberland ownership is not a new phenomenon, but given the growth within this group over the last decade, it has come under much more scrutiny recently. As previously stated, this category is dominated by TIMOs and REITs, corporations that buy, sell, and manage timberlands on behalf of investors. An important factor in their management is that their underlying goal is always to earn money for investors. The structure of REITs demands that 90% of the profit must be redistributed to investors, requiring them to be accountable to investor demand (Gunnoe and Gellert 2010, Mendell et al. 2008). Therefore, any investment made in the land through management must be financially justified (Clutter et al. 2005). It has been shown that TIMOs and REITs manage land differently than industry, including shorter timber rotations, fewer non-commercial treatments, and less infrastructure in the form of roads and culverts (Bliss et al. 2010, Noone et al. 2012, Rogers and Munn 2003). The reforestation rate equals that of industry and is higher than NIPF owners (Zhang et al. 2012). To be considered worthwhile, all management treatments must offer a certain financial return within the time frame of the investment.

The investments made by REITs and TIMOs usually operate within a 10 to 20 year time frame (Gunnoe and Gellert 2010, Clutter et al. 2005). This distinguishes this class of ownership from the three others, which treat timberland as a long-term investment. It also affects the mindset of managers, who must focus on short-term returns (Noone et al. 2012). As a result, biodiversity and aesthetics, which cannot be directly tied to generated income or might even reduce the short-term profit available to investors, may not be a management goal (Lutz 2008). However, these potential revenue sources have been topics at recent timberland investment conferences, so it is possible that this will be a part of the income strategy for corporate owners in the future (Bliss et al. 2010).

Because of the time frame established in corporate timberland investment and the emphasis in investor returns, about 20% of the timberland managed by REITs and TIMOs ends up being sold for highest and best use (Bliss et al. 2010). Highest and best use (HBU) sales maximize profit by converting timberland into real estate. This land becomes residential or commercial property, fragmenting formerly massive tracts of forests. This trend is especially prevalent in fringe properties that border urban areas (Clutter et al. 2005, Jones 2008). Companies that use debt markets to finance timberland purchases are also more likely to sell land for HBU because of the need to quickly recoup expenses (Binkley 2007, Clutter et al. 2005).

Local vs. Absentee Owners

The four categories of ownership previously discussed reflect the financial structure of the owners, but they can also be discussed based on their location: whether they are local to the community in which they own land, or if they instead are based in another area and manage the land as absentee owners. Some owners may be local and absentee at the same time to varying degrees, as they may be based from another location but employ workers who live in the local community. A recurring theme in sociological theory is that local ownership contributes to the resiliency of a community, while absentee ownership serves to weaken communities. If control over land equates to wealth and power, absentee ownership removes the benefit and control from localities to distant places, disenfranchising locals. Local ownership should empower local people and return more of the rewards to the community (Beckley and Krogman 2002).

Local and absentee ownership receives particular emphasis in rural communities dependent on natural resources. Extractive industries often remove natural resources from rural areas and transport them to other areas for processing, thus taking the bulk of the profits away from the source (Rural Sociological Task Force on Persistent Rural Poverty 1993). This often creates

dependency of rural areas on urban centers, making rural areas more subject to economic collapse, resource depletion, and lack of investment in local public services (Lovejoy and Krannich 1982, Peluso et al. 1994, Varghese et al. 2006). Additionally, where owners are removed from the ramifications of the extraction process, increased pollution and ecological damage are more likely to occur (Lovejoy and Krannich 1982). Absentee owners who are detached from a community are likely to focus on short-term financial returns above broader issues of employee satisfaction and environmental health.

Local ownership has the potential to eliminate these disparities by increasing local financial returns, worker participation, sense of community, and local influence over broader issues (Varghese et al. 2006). Where communities are able to control or significantly influence their own destiny, they have a much greater ability to adapt to change. Local ownership is also believed to create better land stewardship, as the owners and workers must live within the environment affected. Thus, management objectives of local owners tend to be further-reaching, considering not only financial returns but worker satisfaction, environmental health, and community goals. Investments tend to focus on long-term sustainability instead of short-term profits.

Corporate, industry, public and NIPF owners can each be either local or absentee in nature. NIPF owners can either live on or adjacent to their timberlands, or they can be absentee, holding timberlands as an individual investment or purely for recreation. Industrial lands are typically owned by large firms based in metropolitan areas, and thus are absentee, or smaller independent firms can operate within communities as local owners. Public lands can be managed by local governments or by the federal government, which can create a similar dynamic to local or absentee owners. Corporate timberlands are possibly the only owners that exist exclusively

within a single category, as the nature of the investment usually excludes smaller institutions that might operate on a local or regional level. But it is not outside the realm of possibility that local corporate owners might invest in timberland. Also, while TIMO and REIT investors are absentee, the managers of that land can live within the community, and therefore form a hybrid of absentee and local management styles. This can also be true of government and industry owners, which will likely be based out of another location but will employ workers who live in the local community.

Importance of Local Change

To this point, the majority of research on timberland ownership change has been done on a national or regional level. Because this change was so massive, involving global companies and millions of acres of timberland, this seems appropriate. In order to determine what this change will mean in the communities surrounding the land, however, it is necessary to use a finer scale. If, as it has been suggested, the scale of research should be framed by the question it seeks to answer, then the effect of timberland ownership on communities should be framed by a community scale (Wiens 1989). Studying change exclusively from a large scale masks variability on the small scale (Evans et al. 2002). Large scale research can only provide generalities, which may or may not hold true in a specific place (Meentemeyer 1989). Further, many of the large scale trends begin with decisions made on a local level. Especially in relation to land use, regional trends may be the product of decisions made by individuals operating within communities (Evans et al. 2002, Turner 1999). Local changes simultaneously contribute to and are affected by global changes (Wilbanks and Kates 1999). This makes the local level, where regional economic, ecological, and societal trends converge, a vital starting point for unraveling complex processes.

The problem lies, of course, in the fact that small scale research is difficult to translate to a larger scale. While regional studies may uncover generalities that may be accurate on a small scale, small scale variables will rarely be true across a broad space (Meentemeyer 1989, Wiens 1989, Wilbanks and Kates 1999). Small scale research alone does not provide sufficient insight, as it has the potential to overlook processes that may occur on a larger scale. At the same time, large scale research alone can be much too general. The greatest insight can be gained by utilizing both large and small scale studies, with the understanding that both scales are highly interconnected (Gibson et al. 2000, Turner 1999). With national and regional trends in timberland ownership in mind, community level research is the next step in understanding the outcomes of this event.

Methods

The objective of the study was to document the outcomes of timberland ownership change on a local level. Because the bulk of timberland that has changed hands, an estimated 18 million acres, is in the U.S. South, and some 2 million acres have changed hands in Alabama alone, this state offers a unique opportunity to study the full effects of this event (Butler and Wear 2011, Clutter et al. 2005). For this study, five counties were chosen in the Black Belt region of Alabama: Baldwin, Clarke, Conecuh, Escambia, and Monroe. Located in the southwest corner of the state, where the forest products industry has been concentrated, these counties had a combined 2,970,117 acres of timberland in 2012 (USDA Forest Service 2012). Four of the five counties (Baldwin being the exception) are predominately rural and timber dependent, with high levels of forest-based employment (Howze et al. 2003). Preliminary research showed that five forest products mills have closed in these counties since 1999, evidence that the forest products industry is reorganizing in the area (USDA Forest Service 2005).

Hard copy ownership maps in the form of county plat books were obtained for the five study counties from years before industry land sales (Rockford Map Publishers 1983, 1985, 1988a, 1988b, 1991). Although books were not available in the same years for all five counties, the range of years acquired, 1983-1991, represents the time when industry was at its peak land ownership in the area and so was sufficient for the purpose of identifying industry's former spread. These maps were then georeferenced and digitized in ArcGIS 10.0, a software package for collecting and analyzing geographic information (ESRI 2011). Attributes for individual industry owners were added to create a complete map of industry-owned lands prior to land sales in the study area (ESRI 2011). A database of all industry owners and comparisons of industry ownership to total forestland were made.

To identify new owners of former industry land, 2012 ownership shapefiles were obtained for each county from eMap International (EMap 2012). These maps were then overlaid in ArcGIS with the 1983-1991 industry map to identify new owners. After these maps were closely examined for any errors in georeferencing, determining the new owners and assembling them into a database was completed. The new owners were then categorized according to type. Corporate owners were identified by searching Alabama's online Government Records Inquiry System, which contains the records for all business licenses applied for in the state of Alabama. If the business license listed activities similar to "Manage/Sell Timberlands" or "Buy/Own Real Property," the owner was considered to be a corporate owner. Government ownership was confirmed with the Alabama Forever Wild Land Trust online database (Alabama Forever Wild Land Trust 2009). Owners were considered industry owners if they were either the original industry owners of the land, or if they could be identified as a land and mill owning business by their Alabama business license. As industry sold land in the area they also sold mills, and some

local companies formed comparatively small, but still vertically-integrated industrial timber companies in their absence. Extra care was taken to identify where this had occurred. NIPF owners were identified by two methods. First, names were checked in the 2012 county current use tax roll for timberland. If their name appeared and if 2006 orthoimagery (aerial imagery) from the USDA that showed the parcel was still forested, they were considered NIPF owners (USDA 2006). If the name did not appear in the current use tax roll, the owner was still considered NIPF if orthoimagery could confirm that the parcel was forested. If owners could not be considered industry, corporate, or government owners, and were not present on the 2012 current use tax roll, orthoimagery was used to determine if the parcels had changed in use. A parcel was only considered to have changed in use if commercial or residential development or other non-forestry activity could be confirmed.

To identify the location of owners, the mailing address given in the county tax rolls was used. In the case of business entities, the headquarters of operations was used. In the case of family trusts, where the trust was managed by a bank or firm, the address for the family was used if it was available. These addresses were located in ArcGIS with the geocoding tool, and were marked in order to show the distance between the parcels owned in the study area and the location of the owners (ESRI 2011).

2.4. Results

2.4.1. Industry Timberland Ownership 1983 – 1991

In total, 18 industry companies were identified as landowners in the study area from the years 1983 – 1991 (Table 2.1). It should be noted that Cedar Creek is actually a wholly-owned subsidiary of T.R. Miller, but they are listed separately in this study because they still distinguish ownership of parcels between the two branches of the companies. Industry owned a combined

925,211 acres in the five study counties. Table 2.3 breaks down industry-owned land by county and as a percentage of the total land mass. Escambia County had the highest percentage of industry ownership, at 43% of all the land in the county. Baldwin County, however, had the highest number of acres owned, surpassing Escambia by over 10,000 acres. The county with the lowest acres owned by industry was Clarke County. Although Clarke County had the most acres of all five counties in timberland in 1990 at 723,500 acres (91% of its land mass), only 8% of that timberland was owned by industry (Vissage and Miller 1990). This land ownership pattern compares starkly to the other four counties, in which industry owned at least 25% of all timberland.

Table 2.1. Original industrial timberland owners and acres owned in Baldwin, Clarke, Conecuh, Escambia, and Monroe Counties, Alabama, 1983 – 1991.

Owner	Acres owned
International Paper	283,164
Scott	176,226
Container	116,263
Cedar Creek	91,613
T.R. Miller	70,726
Champion	45,288
MacMillan Bloedel	41,102
St. Regis	38,929
Union Camp	22,409
Soterra	17,566
Greif	9,720
Boise	4,795
International Paper Realty	3,739
Georgia Pacific	2,214
Champion Realty	2,066
Scotch	847
Hammermill	229

Table 2.2. Total acres owned by the forest products industry in Baldwin, Clarke, Conecuh, Escambia, and Monroe Counties, Alabama as a percentage of the total area of timberland 1990 and total land mass of the county (Vissage and Miller 1990).

County	Total Industry-Owned Acres	Industry Land as a Percent of Total Timberland	Industry Land as a Percent of Total Land Mass
Baldwin	274,632	41%	27%
Clarke	55,015	8%	7%
Conecuh	186,277	40%	34%
Escambia	263,352	55%	43%
Monroe	145,935	27%	22%
Total for all five counties:	925,211	32%	25%

Figure 2.1 shows a map of industry ownership in the study area from 1983 – 1991, with total acres owned by each company. International Paper, Scott, Container, and Cedar Creek with T.R. Miller were by far the largest industry landowners in the study counties. Champion, MacMillan Bloedel, St. Regis, and Union Camp all owned between 20,000 and 50,000 acres of land, but unlike the other smaller industry owners from this time period, they owned large, contiguous blocks of land. Industry owners of less than 20,000 acres, including Soterra, Greif, Diversified, Boise, Georgia Pacific, Scotch, and Hammermill, all owned land that was divided into smaller parcels and was not necessarily contiguous. International Paper, Champion, and Greif each had subsidiaries active in 2012: International Paper Realty, Champion Realty, and Soterra, respectively. These subsidiaries were in charge of divesting lands that were either difficult to access, of lower quality, or were more valuable for real estate development than timber production.

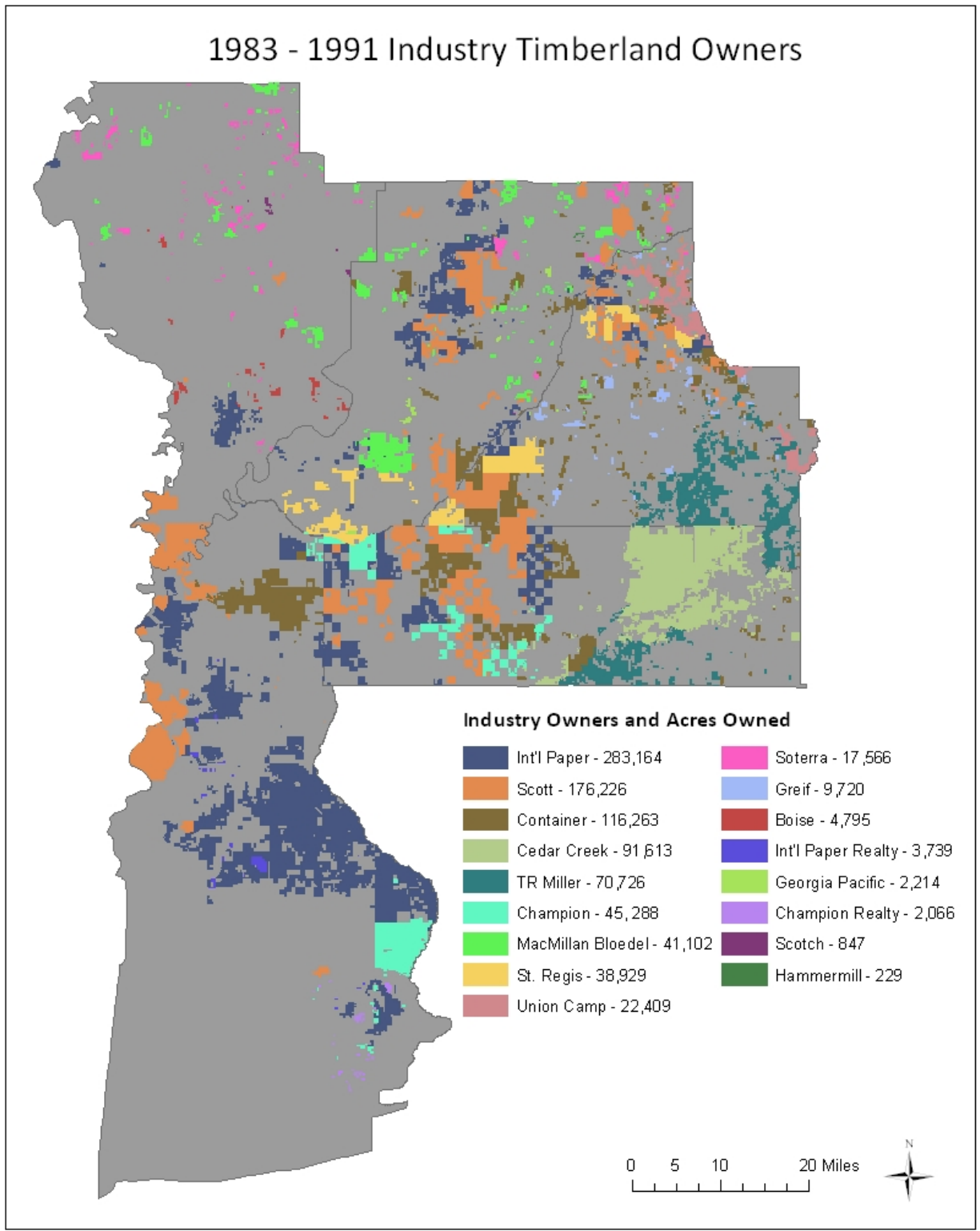


Figure 2.1. Forest products industry owners before land sales, 1983 – 1991, in Baldwin, Clarke, Conecuh, Escambia, and Monroe Counties, Alabama.

2.4.2. 2012 Owners of Former Industry Lands

Figure 2.2 shows a map of 2012 owners of former industry timberland. The only industrial owners that did not sell all timberland, or restructure their timberland as a REIT or TIMO, were Cedar Creek and T.R. Miller. The 925,211 acres formerly owned by 18 timber companies was owned by 1,822 unique owners in 2012. Eighty-seven percent of new owners owned less than 100 acres of land. That fact can be misleading, however, as 53% of this land was owned by just five owners (Table 2.3). This concentration of ownership is substantially lower than in 1983 – 1991, when the top five owners owned 84% of industry timberland. Figure 2.2 shows the concentration of ownership by displaying ownership by number of acres owned.

Table 2.3. Top five owners of former industry land with a comparison of ownership concentration before and after industry land sales, 2012.

2012 Owner	Acres Owned	Percentage of Former Industry Land
T.R. Miller and Cedar Creek	163,368	17%
Red Mountain Timber Co.	138,996	15%
Rayonier	90,877	10%
John Hancock Life Insurance Co.	61,445	7%
S A Timberlands	42,137	5%
Total for the top 5 owners in 2012:	496,823	53%
<i>Total for the top 5 owners in 1983 – 1991:</i>	<i>783,280</i>	<i>84%</i>

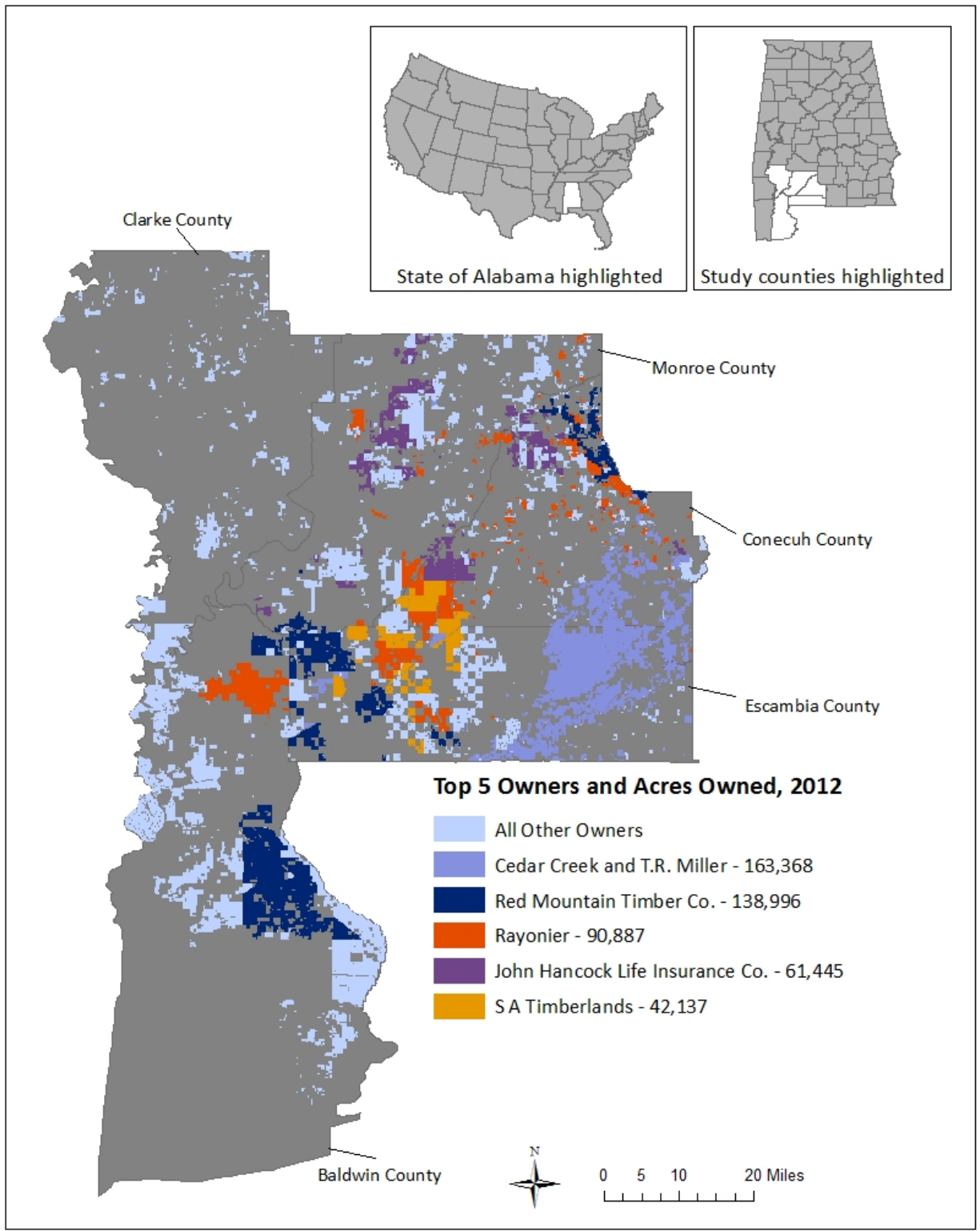


Figure 2.2. Top five forest land owners of former forest products industry land in Baldwin, Clarke, Conecuh, Escambia, and Monroe Counties, Alabama, 2012.

2.4.3. 2012 Owners by Class

Table 2.4 breaks down the 2012 owners by county. Sixty-three percent of all industry lands sold in the study counties is now considered corporate timberland. This number is supported by Table 2.3, as four of the five owners listed in that table are considered corporate. This class of owner is followed distantly by industry ownership at 18%. Industry owners include owners from 1983 – 1991 that did not sell timberland (Cedar Creek and T.R. Miller), and also any new vertically-integrated companies that have recently formed. These new industrial companies own relatively few acres of land in conjunction with a small fiber mill operation, sometimes purchased from former large industry owners. NIPF owners comprise the next largest class at 10%, followed by government at 6%. Change in use, or parcels that were no longer forested and not on the current use tax roll, accounted for 1.7% of former industry land. Figure 2.4 shows the distribution of 2012 owners in the study area.

Table 2.4. Owners of former Alabama forest products industry land in 2012, with percentages by county and by entire study area.

Counties	Industry	%	Corporate	%	NIPF	%	Gov.	%	Use Change	%
Baldwin	6,646	2%	181,109	67%	16,107	6%	56,596	21%	8,043	3%
Clarke	1,633	3%	48,788	89%	4,380	8%	0	0%	174	<1%
Conecuh	48,893	26%	118,985	64%	15,855	8%	1	<1%	667	<1%
Escambia	114,902	45%	118,969	46%	20,488	8%	65	<1%	3,039	1%
Monroe	0	0%	107,412	73%	34,388	23%	67	<1%	3,560	2%
Total:	172,074	18%	575,263	63%	91,218	10%	56,729	6%	15,483	1.7%

This hierarchy does not hold true between counties, however. Baldwin County has the largest percentage of government land at 21%, by far surpassing NIPF (6%), use change (3%), and industry (2%) within the county. Clarke has the highest percentage of corporate owners at 89%,

although the corporate acres in Clarke County are only half the corporate acres in the other four counties. Escambia County, because of the presence of Cedar Creek and T.R. Miller, has a much higher percentage of industry owners at 45%, while the number of acres owned by new corporate owners is still marginally higher at 46%. This is because of the concentration of industry owned timberland in Escambia County prior to 2012, accounting for 43% of the county's entire land mass. Conecuh and Monroe have very similar results, with new corporate owners dominating, followed with very small numbers by industry, NIPF, government, and use change.

Because of economies of scale, mechanized harvest becomes cost prohibitive on parcels less than 20 acres (Greene et al. 1997). Therefore, parcels less than 20 acres, even if they are still forested, would probably not produce forest products. In the study area, all land owners with less than 20 acres, excluding land that had changed use, were located. In 2012, there were 1,213 acres of forested land that would now be cost prohibitive to harvest due to parcel size.

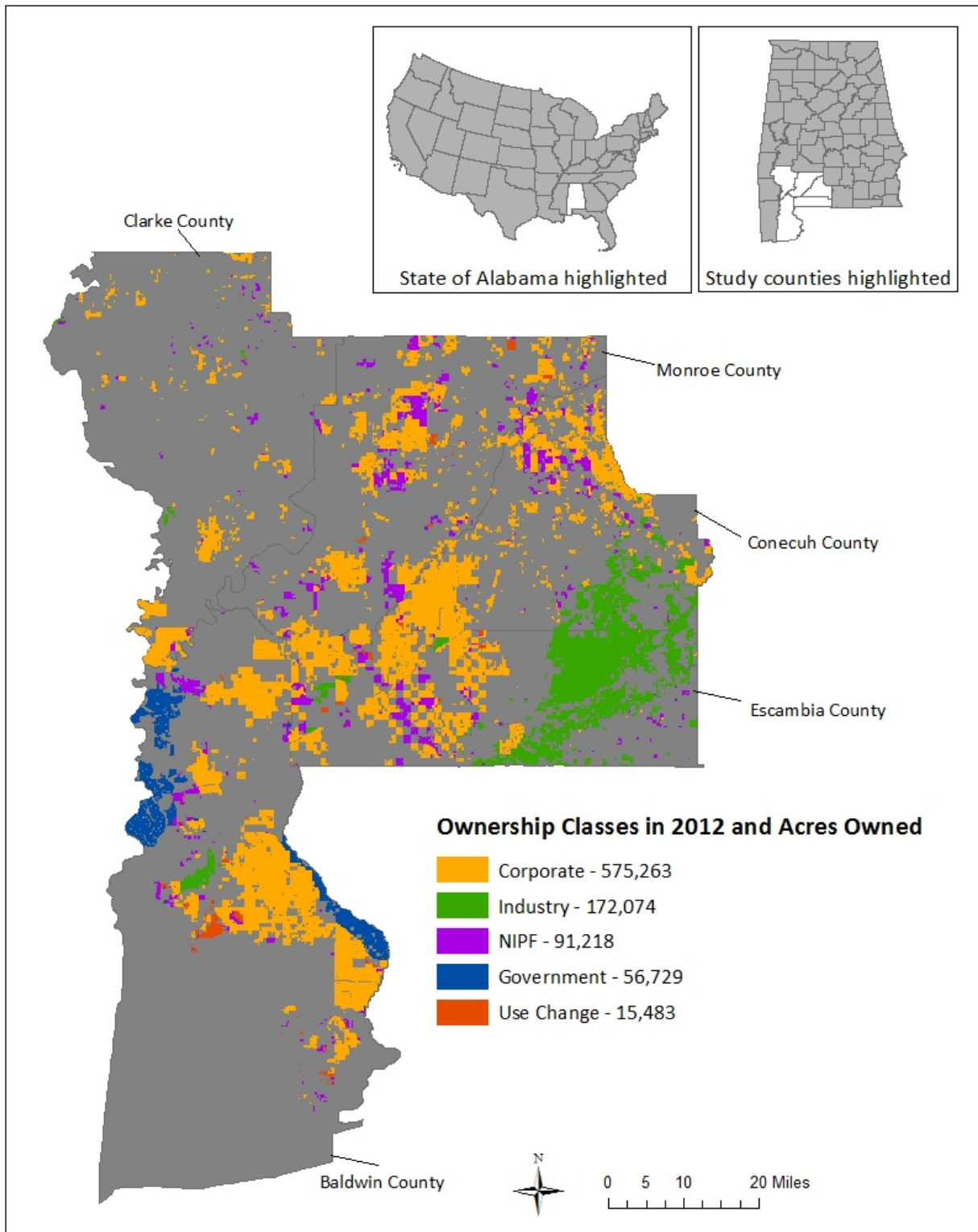


Figure 2.3. Owners of former forest products industry land in 2012 shown by class of ownership, including use change in Baldwin, Clarke, Conecuh, Escambia, and Monroe Counties, Alabama.

2.4.4. 2012 Owners by Location: Local or Absentee

Finally, the nature of the new timberland owners was studied from the perspective of their location. Owners were described as absentee if they lived outside the county of the land, and local if they lived within the county. Figure 2.5 shows a map of the spread of absentee ownership from the study area. This map shows that while there were many NIPF owners, most owned less than 2,000 acres and were located near the timberland they own. On the other hand, the corporate owners own larger tracts, and are located further away. Surprisingly, some owners of land that has been converted for other uses were located far from the land they own.

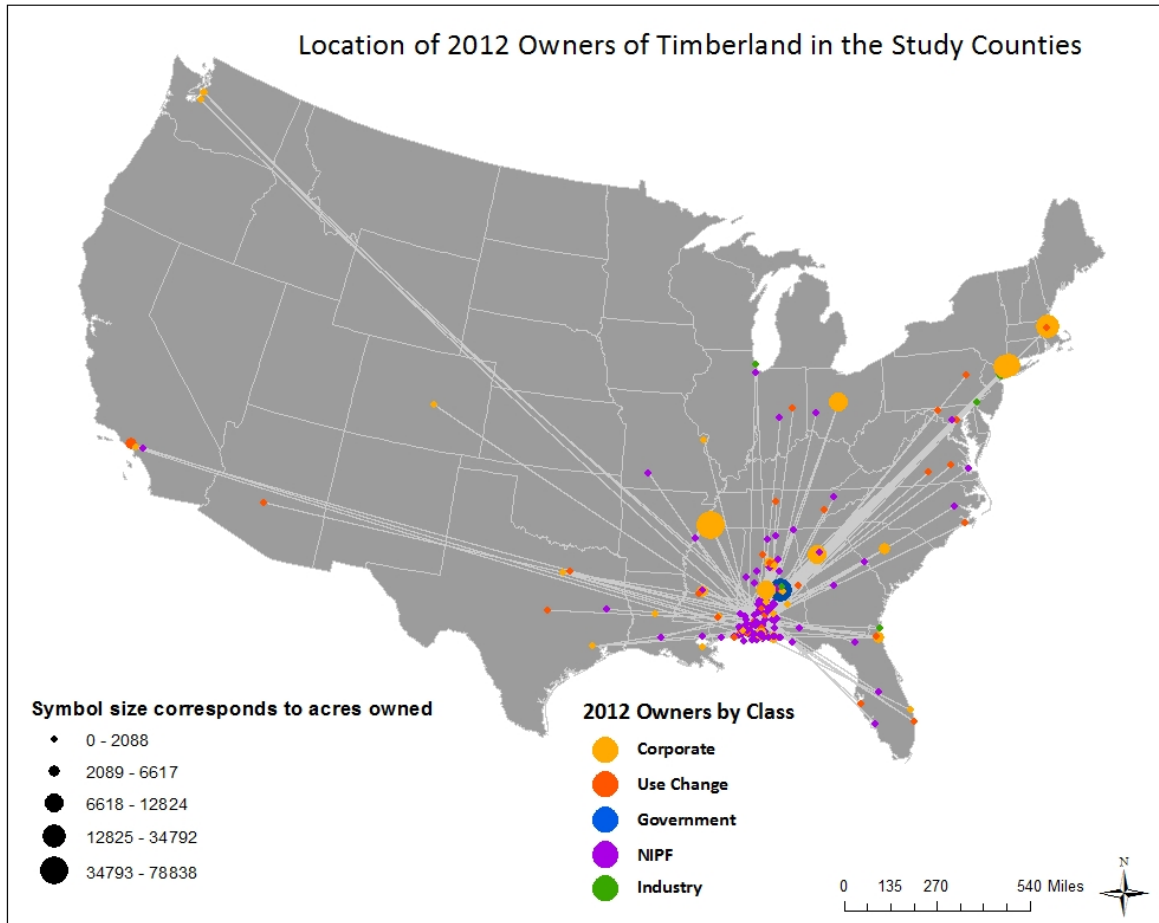


Figure 2.4. Spread of timberland owners in Baldwin, Clarke, Conecuh, Escambia, and Monroe Counties, Alabama, 2012.

The rate of absentee ownership was extremely high in 1983 – 1991, considering that the only local industry companies in the study area were T.R. Miller, Cedar Creek, and Scotch. That brought absentee industry land to a total of 771,593 and local industry land to 162,339. In 2012, absentee owned land accounted for 744,966 acres, and local land for 172,908 acres, as shown in Figure 2.6. This was an increase in local ownership of 10,569 acres. To determine if this was statistically significant, a two-sample t-test was performed. A P-value of 0.016 ($T = -40.16$, $N=1$) showed that there was a significant increase in local ownership from industry ownership in 1983 – 1991 to 2012. Although there was a significant increase in locally owned land, absentee ownership still accounted for 83% of this land, higher than the state average of 60% (Bailey and Majumdar forthcoming).

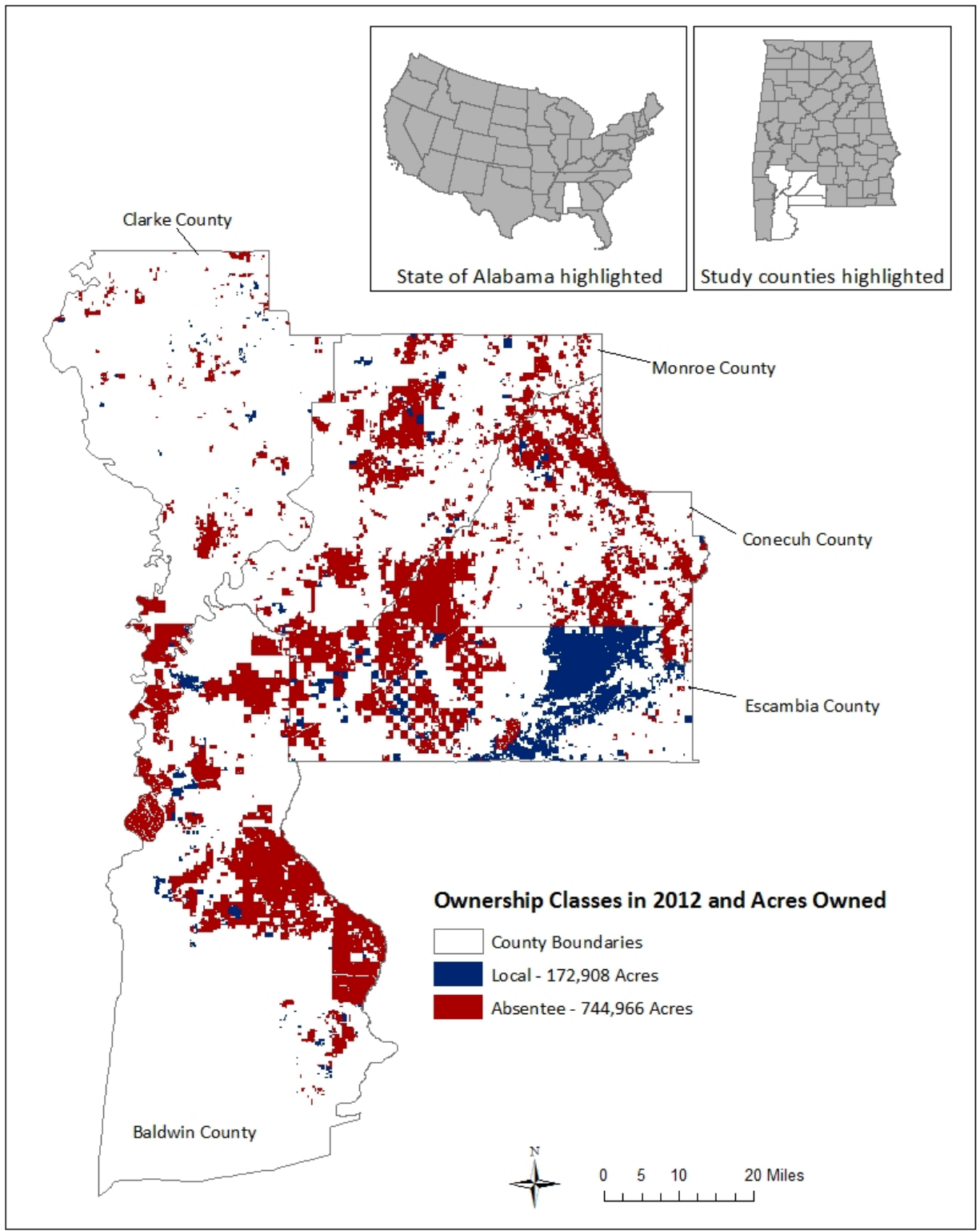


Figure 2.5. Local and absentee owners of land in Baldwin, Clarke, Conecuh, Escambia, and Monroe Counties, Alabama, 2012.

2.5. Discussion and Conclusion

The period of time used to measure industry timberland ownership, 1983 – 1991, was the beginning of a period of vast mergers and acquisitions in the timber industry. Many of the industrial timberland owners identified in this study merged with each other, consolidating the land base. Although this does not change any of the results of this study, it does add to the understanding of the state of flux that this timberland has been in for the last two decades. Figure 2.6 illustrates the mergers and acquisitions between these industry owners in the study counties, as well as details on major land sales, which probably included the lands discussed here (Timber Mart-South 1999, 2000, 2001, 2006).



Figure 2.6. Timeline of mergers, acquisitions, and timberland sales by industry owners in the study area, 1983 – 1991. [Cedar Creek, T.R. Miller, and Scotch are excluded from this table because although they have sold timberland, it was not a product of corporate mergers or acquisitions.]

Results of this study also show that industrial timberland ownership was high in four of the five counties in 1983 – 1991, with Clarke County being the exception. Clarke County, although second only to Baldwin in acres of timberland, had the lowest rate of industry ownership of all five counties by almost 100,000 acres. Timberland ownership is highly concentrated in Clarke County among major NIPF owners, not in the hands of industry. So while the other four counties

experienced shifts in ownership over the last twenty years, Clarke County has seen much less change.

In some cases, small independent timber companies have formed in the place of former industry owners. In the study counties, two small companies had purchased former industry timberland to support an existing milling operation. The headquarters for both were located within the state of Alabama, although outside the counties where the land was located.

One of the major changes in this area is the land purchased by government, primarily the State of Alabama and the federal government, totaling 56,725 acres. The acquisition included 51,734 acres of Kimberly-Clark (formerly Scott) and International Paper timberland (Alabama Forever Wild Land Trust 2009). The International Paper land was purchased in conjunction with The Nature Conservancy, who originally purchased the land then leased it to the state until the state found funds to purchase it (Alabama Forever Wild Land Trust 2009). An additional 3,624 acres were purchased by the federal government, protecting the rare longleaf pine habitat and creating a corridor for wildlife from the Florida panhandle into the state. The Mobile-Tensaw Delta and Perdido River-Longleaf Hills tracts, as these timberland purchases are now called, constitute a major addition to conservation in Alabama.

As shown in Figure 2.5, most of the new corporate owners, who stretch from coast to coast, own over 20,000 acres each. There have been some new home-grown corporate owners, however. One of the larger corporate owners in this area, RMS Timberlands, is based out of Birmingham, AL. According to the information given on their business licenses, 15 local companies have purchased timberland for the purpose of reselling it as real estate. This shows that buying and selling timberland for financial goals is not only done on a large, national scale, but also on a smaller, local scale.

The changes observed in this study reflect the findings of other studies on the sale of industry timberlands (Bliss et al. 2010, Rahman et al. 2011, Rinehart 2010). Industry owners sold almost their entire land base in the study counties. The majority of that land is now owned by corporate owners, most of whom operate outside the state of Alabama. A smaller percentage is owned by NIPF, followed by government. The study area is set apart by the presence of local industry which did not sell land, keeping the total of industry acres high. Without Cedar Creek and T.R. Miller, industry-owned forestland would be almost non-existent in 2012.

Use change in the study counties only accounted for 1.7% of all former industry timberland. Although relatively few acres changed in use, it has accounted for some drastic changes in the study area. The majority of that land, 63%, has been converted for residential use in the form of subdivisions or farmettes. One interesting find was the amount of use change that had occurred under absentee owners. Two large residential developments in the study area had been built by companies as far away as California and Tennessee. In addition to residential development, recent changes in land use can have drastic ecological impacts as well.

For example, it was determined that in the study area at least four Texas companies had purchased timberland for mineral or oil extraction in the study counties. About 500 acres were cleared for sand and gravel pits in Monroe and Conecuh counties, and another 400 acres were cleared in Escambia County for a solid waste landfill. These changes in land use can have potentially negative impacts on ecosystems, water quality, quality of life, and property values. Another primary example of negative ecological impacts is the former Flomaton Natural Area, which was the only old growth longleaf pine stand known in Alabama, and one of only four that could be considered virgin stands in the entire Southeast U.S. (Kush 1999). This stand had been preserved through various industry land sales and mergers, including St. Regis, Champion, and

finally International Paper. It was the focus of over a decade long study on the reintroduction of fire to old growth longleaf stands, the first and only one of its kind to be conducted, when the parcel was sold around 2006 by International Paper as the company divested its timberland (Kush 1999, Kush 2009). Around 2008, the Flomaton Natural Area was clearcut by its new owners to make way for what now is residential development. This is a tragic ecological loss for not only the state of Alabama, but for the ecosystem as well.

From an economic standpoint, use change and fragmentation has not caused dramatic change. In 2012, there were 1,213 acres of forested land that would now be cost prohibitive to harvest due to parcel size. This small percentage of total timberland, even when combined with land that changed in use, only accounts for 1.8% of all the land in the study area. Because so little land is leaving the productive forest, it can be assumed that current levels of fragmentation will not negatively impact harvest rates.

The fine scale used in this study has revealed these dramatic changes, proving that research on a national or regional scale does not tell the whole story. It has also shown that because of sweeping ownership change, objectives for land management will be changing as well. Driving past miles and miles of timberland in southwest Alabama, one might not notice any difference between the forests of twenty years ago and the forests of today. While none of the changes found in this area may greatly impact the forest products industry as a whole, they will undoubtedly be noticed in the small communities in which they are located. Just as the first merger in the forest products industry did not singly cause radical change in the forests but led to the phenomenon being studied today, it is likely that these timberlands will continue to change hands in the coming years. The future of the forest products industry, and indeed the forest itself, will likely be a product of the small changes that have occurred on a local level.

Continued study of these parcels will be the only way to identify exactly what this change will mean over time. The story told by the maps created in this project could be improved by adding data predating the 1990's, or by continuing to map these lands into the future. We know that the effects of any change taking place now will not be evident until some point in the future. For that reason, it would be worthwhile to continue to study the counties in this project to determine exactly how these ownership changes have affected the landscape. This study also provides a model for replication in other areas. The model could be used to study the local changes as a result of different event, or in areas of different land ownership structure or ecological significance. As the results of this study have shown, researchers should always be cognizant of the fact that land ownership is the basis of land management, and that small change is not inconsequential change.

CHAPTER 3

Using GIS Analysis to Explain Ownership Change

3.1. Introduction

From 1983 to 2009, 43.4 million acres of timberland, a resource valued at \$39.7 billion, changed ownership type in the U.S. (Rinehart 2010). Thirty-seven million acres of that land was sold by the forest products industry to new corporate owners, constituting the greatest shift of timberland from one ownership class to another in U.S. history (Bliss et al. 2010, Rahman et al. 2011). While much work has been done to describe what happened, uncertainty still surrounds why specific changes have occurred and how those changes will affect the forest products industry on a large scale, or communities on a small scale (Binkley 2007, Butler and Wear 2011, Clutter et al. 2005, Gunnoe and Gellert 2010, Mendell et al. 2008, Rahman et al. 2011). One of the major questions regarding new timberland owners is what factors influence them to purchase specific timberland parcels. Previous studies have performed regression analysis to show what variables influence different types of timberland owner (industrial, corporate, non-industrial private [NIPF], and government), but not how those owners are responding to the recent land sales by industry. Although much research has been done to predict the outcomes of these land sales, no study has attempted to pinpoint on a map the places most likely to experience those changes (Beckley and Krogman 2002, Bliss et al. 2010, Clutter et al. 2005, Gunnoe and Gellert 2010, Gustafson et al. 2007, Noone et al. 2012, Varghese et al. 2006, Stanfield et al. 2002). Using Spatial Statistics tools in ArcGIS (Geographically Weighted Regression [GWR] and Hot Spot analysis) with spatial and non-spatial data, we seek to explain in this paper where timberland ownership is concentrated, and what influenced new owners to locate in specific places in five counties in southwest Alabama.

Mapping timberland ownership provides the unique opportunity to study ownership change within spatial parameters, adding an element to our understanding that is at once obvious, necessary, and yet difficult to achieve. By analyzing timberland ownership maps in Geographic Information Systems (GIS), patterns, trends, and relationships in timberland use change can be assessed (Scott and Janikas 2010). Every owner operates with his or her unique goals, and many outside factors can influence and change those goals. However, with insight into timberland owner objectives, a better understanding into the potential outcomes of this change can be attained. GWR can be used to isolate which variables most influenced each category of timberland owner, and show how those variables changed across space (Brunsdon et al. 1999). Hot Spot analysis fills in another important gap in our knowledge of timberland ownership change, by finding clusters of specific changes across the study area and linking those to potential outcomes from research (Getis and Ord 1992). Figure 3.1 shows a diagram of potential outcomes of this event. By joining these outcomes to hot spots of change, we can show which outcomes are mostly likely to occur and where.

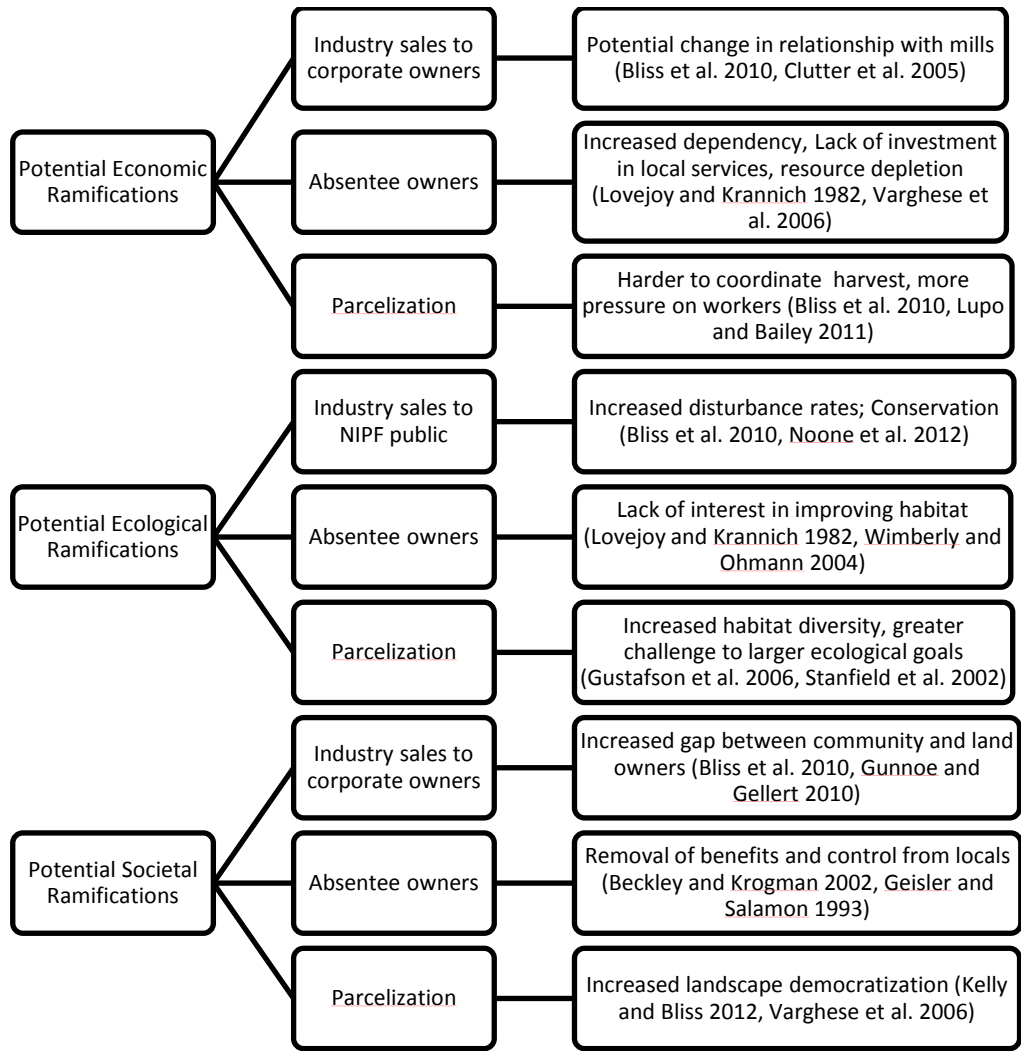


Figure 3.1: Diagram of potential outcomes of timberland ownership changes supported by literature.

3.2. Literature Review

Who Owns Timberland in the Southeastern United States?

The management objectives of timberland owners will determine how the land is used, impacting everything from harvest rates to conservation goals. Management objectives are often studied by class of owner: industry, non-industrial private forest (NIPF), corporate, or public. Management objectives can also be examined from the perspective of owner location, either local (living in the same county in which the land is located), or absentee (Bailey and Majumdar

forthcoming, Beckley and Krogman 2002, Lovejoy and Krannich 1982, Varghese et al. 2006).

As timberland ownership shifts between classes, or between local and absentee, the owner objectives can be used to predict what changes might occur.

NIPF lands are owned by any private individual or group that is not a corporation or industry. NIPF owners have multiple objectives for the forest land, including financial and non-financial goals. Non-financial goals for NIPF owners include recreation, preserving the environment, protecting wildlife, preserving a legacy, and long-term investment as most important (Butler and Leatherby 2004, Butler and Wear 2011, Bliss 1998b, Lutz 2008, Newman and Wear 1993). Timber production for financial gain may not be a primary goal for ownership, but the majority of NIPF owners have at some point commercially harvested timber on their land (Butler and Wear 2011).

Industrial forest owners are defined as being vertically integrated in that they own and operate mills which turn wood from the land they own into paper, lumber, plywood, or other wood-based products. Before recent shifts in the mindset of timber firms, timberland ownership was considered a part of the vertically integrated manufacturing process for the major timber companies. To ensure supply to their mills, they purchased and managed timberlands (Butler and Wear 2011, Gunnoe and Gellert 2010). Industry did not foresee ever selling the land, and maintaining land health well into the future was a part of the management plan.

Public forests are owned and managed by the local, state, or federal government. In contrast to NIPF and industrial forests, public forests are maintained primarily for environmental and wildlife conservation (Bliss 1998b). Public forests function differently from the private ownership categories because, although some public forests do allow timber harvest by private companies, they do not exist solely to generate a profit. Many offer recreational opportunities,

but some are closed to the public or only offer limited access.

Corporate owners are private incorporated entities that own or manage timberland. This category includes timberland investment management organizations (TIMOs) and real estate investment trusts (REITs), corporations that buy, sell, and manage timberlands on behalf of investors. The structure of REITs demands that 90% of the profit must be redistributed to investors, requiring them to be accountable to investor demand (Gunnoe and Gellert 2010, Mendell et al. 2008). Therefore, any investment made in the land through management must be financially justified (Clutter et al. 2005). It has been shown that TIMOs and REITs manage land differently than industry, including shorter timber rotations, fewer non-commercial treatments, and less infrastructure in the form of roads and culverts (Bliss et al. 2010, Noone et al. 2012, Rogers and Munn 2003). The reforestation rate equals industry and is higher than NIPF owners (Zhang et al. 2012). To be considered worthwhile, all management treatments must offer a certain financial return within the time frame of the investment, usually within 10 to 20 years (Gunnoe and Gellert 2010, Clutter et al. 2005). This distinguishes this class of ownership from the three others, which treat timberland as a long-term investment.

Why Ownership Change Matters: Economic Impacts

Classes of ownership have specific influences over forest economics, due to their contrasting management objectives. Where former industry owners maintained timberland to supply their mills, corporate owners may have no such commitment (Bliss et al. 2010, Clutter et al. 2005). If corporate owners do not use local mills, and instead find other markets for their timber, mills may struggle to acquire fiber. NIPF owners and other small-scale forestry businesses may suffer if mills shut down, as they may not have the same capability of accessing distant markets as corporate land owners (Bliss et al. 2010). Corporate owners may purchase timberland with a

long-term supply agreement with the mill, which would eliminate this problem (Kirk 2001). Efforts to cut costs and increased competition at the mill may also negatively impact workers who furnish the mill (Lupo and Bailey 2011). Parcelization will contribute to this pressure by making it more difficult to coordinate harvests (Bliss et al. 2010).

Local and absentee ownership is particularly influential in rural communities dependent on natural resources. Owners are considered absentee if they live outside the county of the land, and local if they live within the county. Extractive industries headquartered elsewhere may take the bulk of the profits away from the source (Rural Sociological Task Force on Persistent Rural Poverty 1993). This often creates dependency of rural areas on urban centers, making rural areas more subject to economic collapse, resource depletion, and lack of investment in local public services (Lovejoy and Krannich 1982, Peluso et al. 1994, Varghese et al. 2006).

Why Ownership Change Matters: Ecosystem Impacts

Ownership change to NIPF could cause an increase in disturbance rates (Bliss et al. 2010, Crow et al. 1999, Noone et al. 2012, Ohmann et al. 2007, Stanfield 2002, Turner et al. 1996). Where former industry land is purchased by conservation land trusts, private conservation groups, or local communities for preservation purposes, local habitats stand to benefit, while harvest rates will be reduced (Bliss et al. 2010, Braxton-Little 2005, Kelly and Bliss 2012).

A change in ownership could signal many things in the life of the forest ecosystem. Absentee owners who are unattached to a community may focus on short-term financial returns above broader issues of employee satisfaction and environmental health (Lovejoy and Krannich 1982). Local ownership is also believed to create better land stewardship, as the owners and workers must live within the environment affected. If land is converted from timber production to a different use, traditional forestry practices, wildlife habitat, and the potential for large-scale

conservation may be damaged (Bliss et al. 2010, Butler and Wear 2011, Jones 2008, Noss 1999, Radeloff et al. 2005). Although loss of timberland is probable near areas of dense population, this is unlikely in more rural areas. However, the greater question of ecological health may rest more in the question of changes in tree species and seral stage (Wimberly and Ohmann 2004).

Fragmentation, occurring when large tracts of land are divided but remain in timber production, can be beneficial for forest health. In fact, a diversity of management objectives and methods on timberland can actually create a greater diversity of habitats (Crow et al. 1999, Gustafson et al. 2007, Stanfield et al. 2002, Turner et al. 1996). Many owners with different management techniques, assuming that none are seriously destructive, will create a greater diversity of habitats and thus support a healthy functioning ecosystem. On the other hand, fragmentation may also serve as a roadblock for future large-scale conservation goals (Stanfield et al. 2002).

Why Ownership Change Matters: Social Impacts

As the former industry land shifts to corporate ownership, the gap between communities and land owners may increase. In the past, the forest products industry commonly identified community relationships as necessary for a functioning operation. This idea seems to have not carried over to new corporate owners. Offices are further removed from the land and objectives are removed from the scope of the community (Bliss et al. 2010). Also, corporate owners employ fewer people per acre, reducing a physical presence in the community on councils, within neighborhoods, and in associations. These new management strategies all contribute to an alienation of communities from corporate-owned land. Although much of former industry land was already absentee-owned, a shift from that structure to corporate structure widens the gap between community and landowner, as corporate owners hire fewer people per acre than former

forest products industry owners (Gunnoe and Gellert 2010).

A recurring theme in sociological theory is that local ownership contributes to the resiliency of a community, while absentee ownership serves to weaken communities. If control over land equates to wealth and power, absentee ownership removes the benefit and control from localities to distant places, disenfranchising locals. Local ownership, however, should empower local people and return more of the rewards to the community (Beckley and Krogman 2002). Local ownership has the potential to eliminate these disparities by increasing local financial returns, worker participation, sense of community, and local influence over broader issues (Varghese et al. 2006). Where communities are able to control or significantly influence their own destiny, they have a much greater ability to adapt to change.

Land sales also create the potential for landscape democratization (Bliss et al. 2010). Large tracts of land that have been owned by absentee industry for many years have recently become available on the market. New owners have the ability to purchase land and retain value within the community. Beyond the scope of small individual land purchases, some communities outside of the South have seized the opportunity to purchase timberlands and mills collectively (Beckley and Krogman 2002, Braxton-Little 2005, Kelly and Bliss 2012, Varghese et al. 2006).

Using GWR to Explain Why Changes Occur

A great deal of analysis has been done to explain changing ownership class and land use. Factors influencing land ownership include median housing value, income, poverty ratio, population density, and land quality (Alig 1986, Browne 2001, Nagubadi and Zhang 2010, Pan et al. 2009, Wear and Newman 2004). Large landowners are more likely to be influenced by factors related to the value of the timber resource, while smaller landowners are more likely to be influenced by socioeconomic factors, which will not only affect the class of landowner but also

the potential for fragmentation of larger tracts (Pan et al. 2009). Geographic features, such as access to roads and distance to towns or cities also play a role in land ownership patterns (Browne 2001, Zinkhan 1993). Access to roads is more important for landowners focused on timber production, while distance to towns or cities is more important for landowners with recreational goals. Agriculture returns, population density, median housing value, and distance to cities will contribute not only to ownership class change, but use change as well (Nagubadi and Zhang 2010, Wear and Newman 2004).

Using GWR in ArcGIS with spatial and non-spatial data we have the potential to explain how timberland ownership is influenced by variables changing across space (ESRI 2011). GWR is a form of linear regression that accounts for spatial nonstationarity or the variation in relationships across space, by estimating regression parameters and including a spatial weight for each data point (Brunsdon et al. 1999). This technique is valuable when explanatory variables do not have the same influence globally. It follows Tobler's law of geography, that "everything is related to everything, but near things are more related than distant things" (Tobler 1970). Although timberland ownership change is certainly influenced by variables changing across space, GWR has not yet been used in research to address this topic, probably because previous work has been done on such a large scale (Bliss et al. 2010, Rahman et al. 2011, Rinehart 2010).

Maps of timberland ownership can be analyzed with GWR to determine which variables have had the most influence over each class of timberland owner in a given area. Because GWR applies a unique R^2 value to each data point, the changing accuracy of the model can be seen across space, pointing out possible changes in relationships (Brunsdon et al. 1999).

Using Hot Spot Analysis to Pin Down Potential Outcomes

Hot Spot Analysis in ArcGIS applies the Getis-Ord G_i^* spatial statistic to identify significant

clusters across a space (Getis and Ord 1992). A “hot spot,” although represented by a single point on the map, is actually a collection of many points within a specified distance of one another. The Getis-Ord G_i^* statistic measures the likelihood of these points appearing by random distribution. To be defined as a hot spot, which for this study indicated a p-value of 0.05, the aggregated point must have a high value and be surrounded by other high values. In other words, a hot spot indicates that the point not only has a high value, but that surrounding points also have high values. The local sum for that point, and all its surrounding points, is compared proportionally to the sum of all points in the study area (ESRI 2013). If the local sum is higher than what is expected and the difference is too high to be random, a hot spot is identified.

The Getis-Ord G_i^* statistic is most often used to identify clusters in crime patterns or disease incidence (Burra et al. 2002, Craglia et al. 2000). In these applications, identifying hot spots provides guidance for allocating resources, predicting future events, or determining how events spread across a space. This study is the first known attempt to identify hot spots of events that have occurred and connect them to outcomes from scientific literature. Although this application of hot spot analysis is new, it follows the same theory of other frequently used applications. By identifying concentrations of events, we may better understand what caused those events to occur at a specific place and where the ramifications of events might be concentrated. Using five southwestern Alabama counties as an example, this paper outlines how timberland use change can be assessed using GWR and Hot Spot analysis to 1) determine which variables are most influential with regard to ownership changes, 2) identify clusters of NIPF, corporate, and absentee timberland owners, and 3) identify the potential for fragmentation and land use change.

3.3. Methods

For this current study, five counties were chosen in Alabama: Baldwin, Clarke, Conecuh,

Escambia, and Monroe. Located in the Southwest corner of the state, where the forest products industry has been highly concentrated, these counties had a combined 2,970,117 acres of timberland in 2012 (USDA Forest Service 2012). Four of the five counties (Baldwin being the exception) are predominately rural and timber dependent, with high levels of forest-based employment (Howze et al. 2003). Earlier analysis of this area identified 2012 owners of land that had been sold by the forest products industry since 1991. These 2012 owners were then categorized according class (NIPF, corporate, industry, and public) and by location (local or absentee). This data provided the basis for GWR and Hot Spot analysis.

Two main tasks were associated with this portion of the study. First, GWR analysis was performed in ArcGIS with ownership maps to determine which variables were most influential on each ownership class. Data was obtained from the U.S. Census Bureau for the non-spatial variables to be tested, including percent poverty, percent unemployment, median housing value, percent of the population with a high school degree, percent of the population with a bachelor's degree, median income, and population (U.S. Census Bureau 2007a, 2007b, 2007c). Analysis was performed on the census tract level so as to provide a fine gradient of change across the five counties. This data was compiled into a spreadsheet and joined to the U.S. Census tract shapefile in ArcGIS (U.S. Census Bureau 2012a). Spatial data was then collected, including bodies of water, roads, shoreline, conservation easements, and places (National Conservation Easement Database 2012, U.S. Census Bureau 2012b). Water and shores were included in this study because, although they were not mentioned by any other studies, it was assumed that land near these features might be important for recreation, especially in Baldwin County which meets the Gulf of Mexico. Only river, ocean, and bay shorelines, and primary and secondary roads were used. Places are defined as incorporated or statistical entities. At this point, a new shapefile was

made for each ownership class, (i.e., NIPF, corporate, government, industry) and use change, so that they could be studied individually. The following steps were repeated for each new class shapefile.

Euclidean distance was measured from the centroid of each ownership point on the map to each geographic feature class, providing spatial variables for analysis. The ownership point shapefile was then joined to the Census tract polygon shapefile in order to include Census data in analysis. Before GWR could be performed, the Incremental Spatial Autocorrelation tool was used to identify the distance at which spatial processes promoting clustering were most pronounced, and thus the best scale for analysis. The Generate Spatial Weights Matrix tool was then used to construct a file based on the identified spatial clustering, which would be used to define the scale of analysis for the GWR tool. The final step before performing GWR was Exploratory Regression, which analyzed every combination of explanatory variables to find the model best able to explain the dependent variable. Once the best model was found, GWR was performed with the spatial weights matrix file created earlier to account for spatial autocorrelation.

Next, Hot Spot analysis was performed in ArcGIS in order to identify clusters of NIPF, corporate, and absentee owners, as well as fragmentation and use change. Unique shapefiles were created by category (NIPF, corporate, industry and public; absentee and local; and fragmentation) so that each could be examined individually. For each shapefile, parcels were dissolved by unique owner. This polygon class was then converted to points, located at the centroid of the parcel. In order to analyze this incident data, the points were aggregated using the Integrate and Collect Events tools, consolidating points within 500 meters, the distance at which each point would be joined with at least one other point (ESRI 2011).

This process was repeated to examine fragmentation, with slight differences. A separate shapefile was created of owner points according to the former industry owner. For example, a single shapefile was created for all new owners of former Union Camp land, another shapefile was created for all new owners of former International Paper land, etc. The Integrate tool was then used with the same parameters as in the previous step for each of these shapefiles, and then all were merged together. The Collect Events tool was then used to count incidents of new owners. Parcels changed in use were not included in the analysis of fragmentation.

Hot Spot Analysis was then performed, calculating the Getis-Ord G_i^* statistics for each point. The event count field created by the Collect Events tool was used for analysis. The conceptualization of spatial relationships was set at Fixed Distance Band using Euclidean Distance, thus analyzing each point within the context of neighboring features. To ensure that every feature had at least one neighbor, the threshold distance was left blank. For each feature, a z-score was calculated. Higher z-scores indicated a clustering of high values, which for this study meant a concentration of many new owners within each respective class. Lower z-scores indicated a clustering of low values, which meant a concentration of few owners. Clusters of high z-scores, at a significance level of 0.05, were represented by red dots. With this data, the concentration of each new ownership class could be located. Potential outcomes found in a review of literature could then be joined to the hot spots of ownership change to identify where each change would be likely to occur.

3.4. Results

3.4.1. Results of GWR Analysis

Table 3.1 shows the results of GWR analysis on government, corporate, and NIPF lands, as well as lands that changed in use. Variables were significant at $p < 0.05$. Adjusted R^2 values from

Ordinary Least Squares regression are given for each variable used in the final model. Government-owned land and lands that changed in use had the highest adjusted R^2 values, suggesting that corporate and NIPF owners were influenced by factors outside of distance to roads, shore, water, and place, and quality of life indicators. While government was negatively influenced by higher quality of life values and nearness to place, use change was the opposite. Use change was likely to be located in areas of higher quality of life, closer to places and roads. Both of these groups were positively influenced by nearness to water, but for different reasons. Government land was near swamps and bogs, which were purchased for environmental conservation. Use change was located near shorelines along Mobile Bay, which had higher residential value.

Sigma values for the models, or estimated standard deviation for residuals, were low, indicating that the variables were consistently accurate across space. Analysis of NIPF ownership produced the highest Sigma value, indicating that the variables of distance to place, percentage of population with a bachelor's degree, median household income, percent unemployment, and median household value are not consistently influencing these owners in the study area. Corporate and NIPF landowners had the lowest R^2 values, indicating that an explanatory variable might be missing for these categories. Variables that were not included in the final model for each category were shown to be redundant by Exploratory Regression. Variables that were excluded from all final models include population, distance to conservation easements, distance to major shoreline, and percentage of the population with high school degrees.

Table 3.1: GWR analysis of 2012 owners of former industry land in Baldwin, Clarke, Conecuh, Escambia, and Monroe counties, Alabama.

	Explanatory Variables	Adjusted R² (OLS)	Relationship	Degrees Freedom	GWR Sigma	GWR R²	GWR R² Adjusted
Government	Percent Poverty	0.63	+	23	1.3	0.78	0.71
	Percent Population with Bachelor's Degree	0.39	-				
	Distance to Roads	0.05	+				
	Distance to Place	0.04	+				
	Distance to Water	0.04	-				
Corporate	Distance to Place	0.05	+	152	3.18	0.44	0.37
	Percent Unemployment	0.02	+				
	Median House Value	0.01	-				
	Median Household Income	0.01	-				
	Percent Population with Bachelor's Degree	0.00	-				
NIPF	Distance to Place	0.04	-	499	8.27	0.41	0.39
	Percent Population with Bachelor's Degree	0.04	-				
	Median Household Income	0.03	-				
	Percent Unemployment	0.00	+				
	Median House Value	0.00	-				
Change in Use	Percent Population with Bachelor's Degree	0.94	+	1299	2.82	0.61	0.51
	Percent Poverty	0.71	-				
	Distance to Roads	0.20	-				
	Distance to Place	0.13	-				
	Distance to Water	0.04	-				

3.4.2. Results of Hot Spot Analysis

Hot Spot Analysis provided insight into where new ownership categories and fragmentation is clustered across the study area. Hot spots of use change were identified as clusters of high values, which in this case indicated a cluster of many new owners of former timberland within a single category. The hot spots of use change identified are positioned between the cities of Spanish Fort, Daphne, and Fairhope, and the town of Loxley. The area is also less than seven miles from the city limits of Mobile, one of the largest metropolitan areas in the state. Therefore, the area was well positioned for residential development. Most of the change in use occurring in this hot spot was residential development. GWR analysis found that the percentage of the population with a bachelor's degree and percent poverty were significant explanatory variables of change in use. The hot spots identified in this analysis correlated that GWR analysis. Poverty had a negative influence on use change, while percentage of bachelor's degrees had a positive influence. Hot spots for use change in the study area were centered near cities and towns with low poverty levels (0.6 – 15.6%) and higher education attainment (Figures 3.2 and 3.3). This land is obviously more valuable due to its location and social characteristics, and it follows that development was highly concentrated in this area.

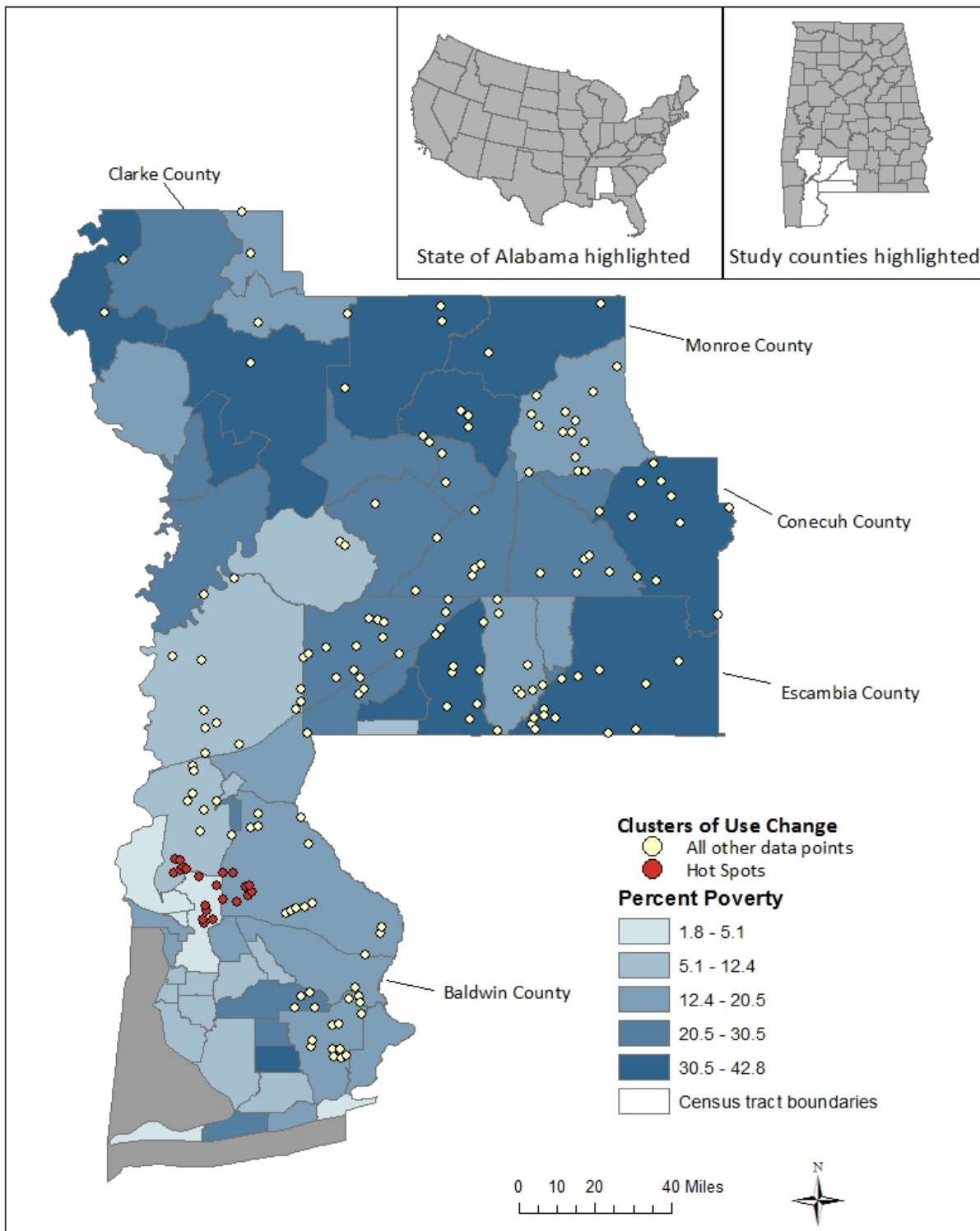


Figure 3.2: Use change hot spots in Baldwin, Clarke, Conecuh, Escambia, and Monroe counties, Alabama in 2012 as related to percent poverty.

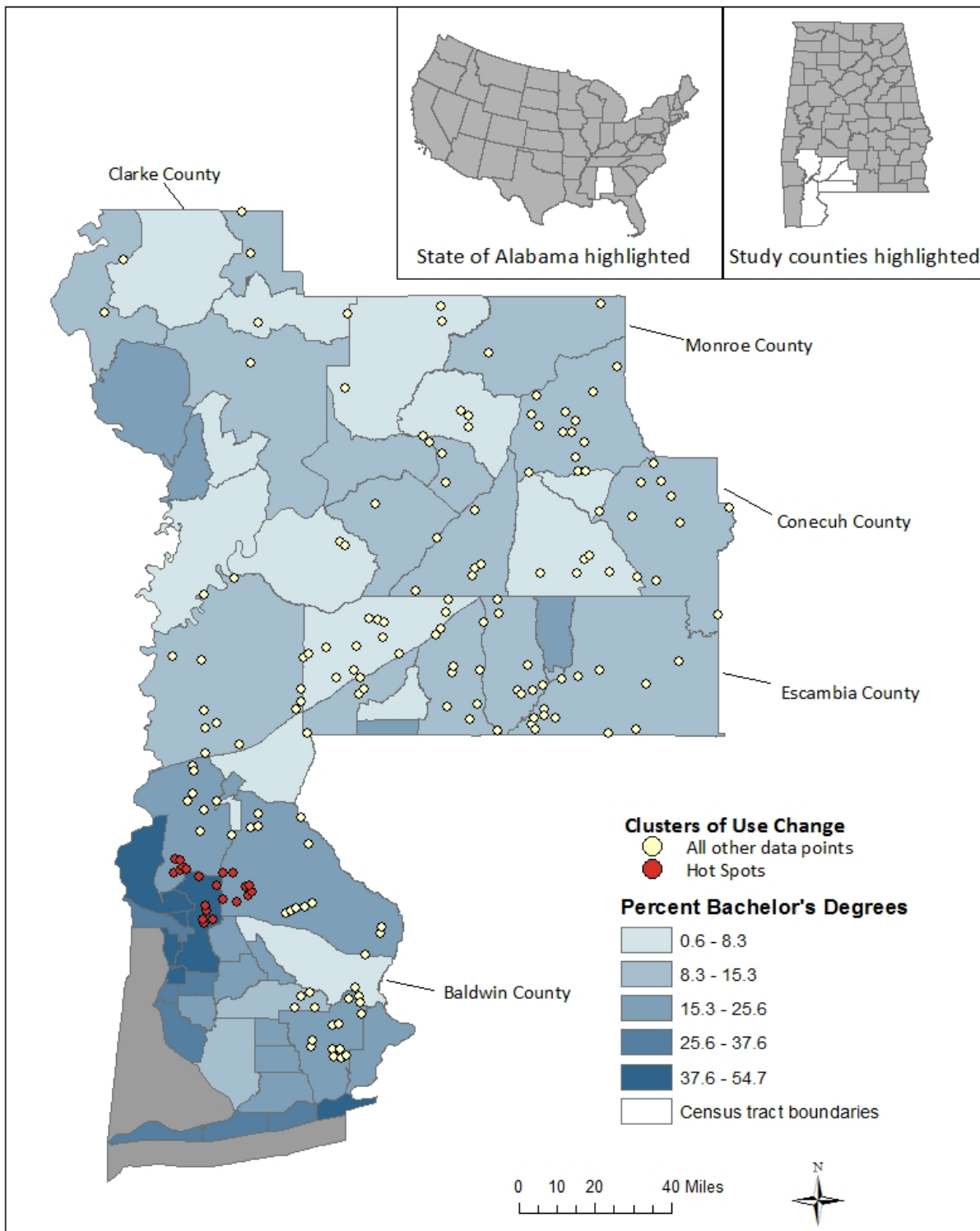


Figure 3.3: Use change hot spots in Baldwin, Clarke, Conecuh, Escambia, and Monroe counties, Alabama in 2012 as related to percentage of bachelor's degrees.

Hot spots of NIPF ownership were spread across a broader range in the study area. Like the GWR analysis of this category, the hot spots had variable explanations across their range. Distance to place and percentage of population with a bachelor's degree varied between hot spots. Most NIPF hot spots were located further from primary and secondary roads. Figure 3.4 shows the relationship between NIPF hot spots and the two most consistent explanatory variables: distance to roads and percentage of bachelor's degrees. Greater variety in the results of this analysis, coupled with the low R^2 value in GWR analysis suggests that some explanatory variable is missing.

Similar variation occurred with corporate ownership hot spots. Explanatory variables identified by GWR for corporate owners included lower percentages of bachelor's degrees, higher percentages of unemployment, and poverty, and lower median household income. Across the range of corporate hot spots, these factors varied widely. The most consistent variable among hot spots was percentage of bachelor's degrees, which ranged from 0.6% to 25% (Figure 3.5). These hot spots occurred in close proximity to NIPF hot spots, which along with the similar variation in variables and low R^2 value from GWR analysis, might indicate that these two groups are missing the same explanatory variable.

In addition to hot spots of ownership class, hot spots of timberland fragmentation were found (Figure 3.6). While parcels that had changed in use were removed from this analysis, fragmentation did occur near areas where use change was concentrated. This area had higher quality of life variables and was closer to population centers, which increased the value of the land and probably led to increased fragmentation. Absentee ownership was also analyzed to identify any hot spots in the study area, where impacts of this ownership type would be pronounced. However, because absentee ownership is so common in this area, accounting for

83% of all timberland included in the study, no hot spots were identified. Therefore although some statistically significant clusters were identified, the potential outcomes of absentee ownership will likely not be pronounced (Figure 3.7).

With a better understanding of why different ownership categories were located throughout the study area, the potential outcomes identified in the scientific literature can be pinned to the map. It is expected that the most pronounced change will occur in the hot spots of each group. Figure 3.7 combines the hot spot maps with potential outcomes of change.

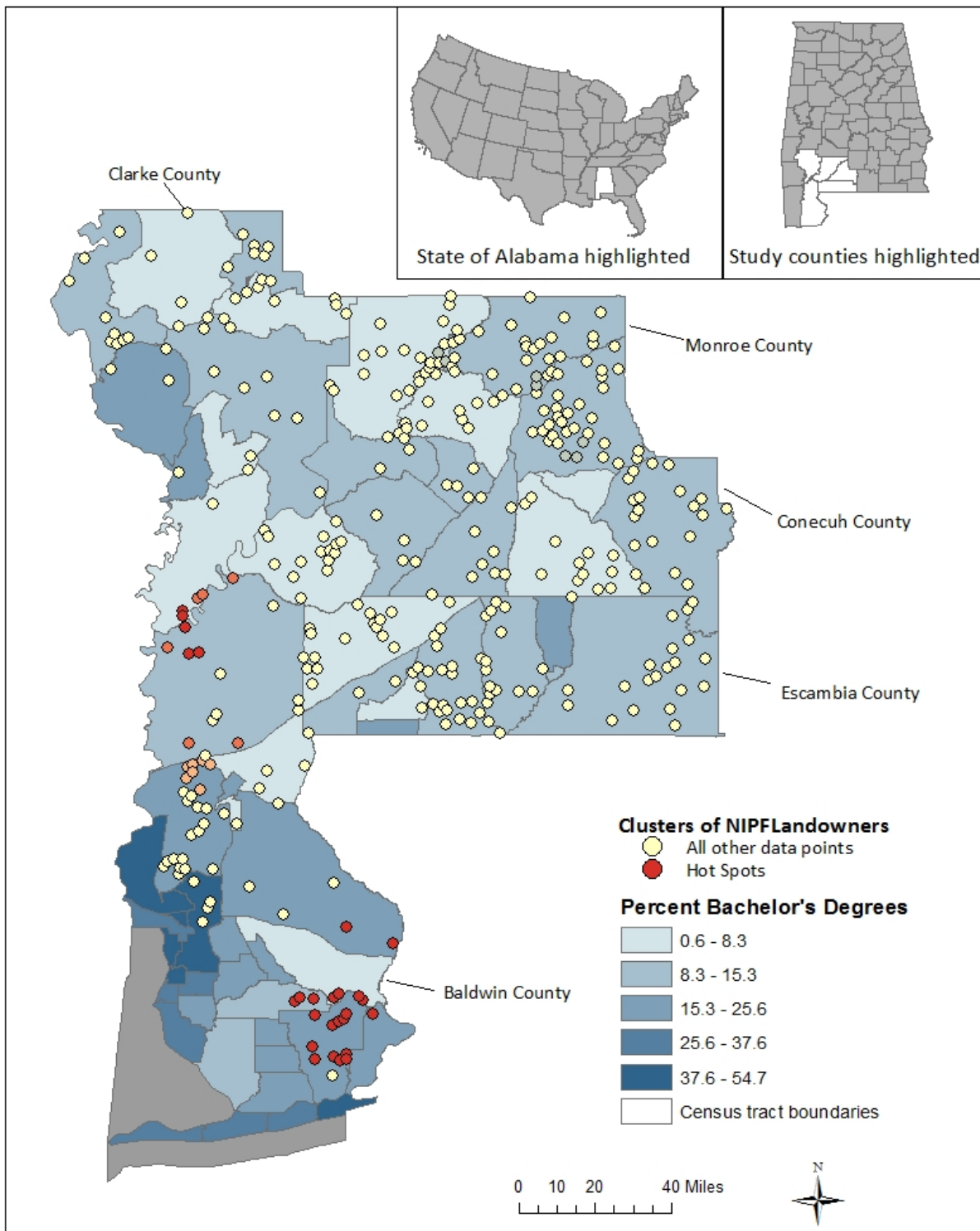


Figure 3.4: NIPF hot spots in Baldwin, Clarke, Conecuh, Escambia, and Monroe counties, Alabama in 2012 as related to related to bachelor's degrees.

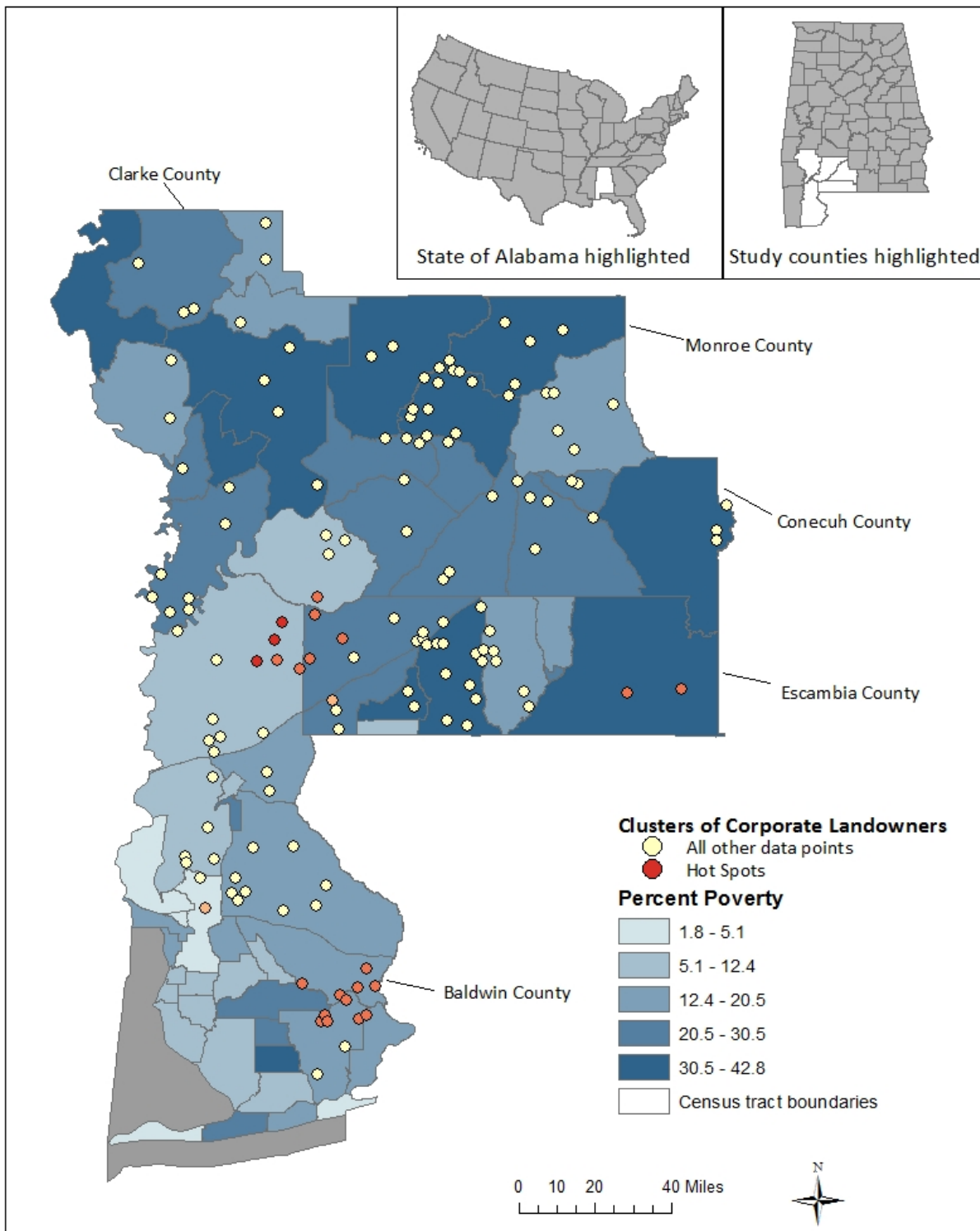


Figure 3.5: Corporate hot spots in Baldwin, Clarke, Conecuh, Escambia, and Monroe counties, Alabama in 2012 as related to percentage of poverty.

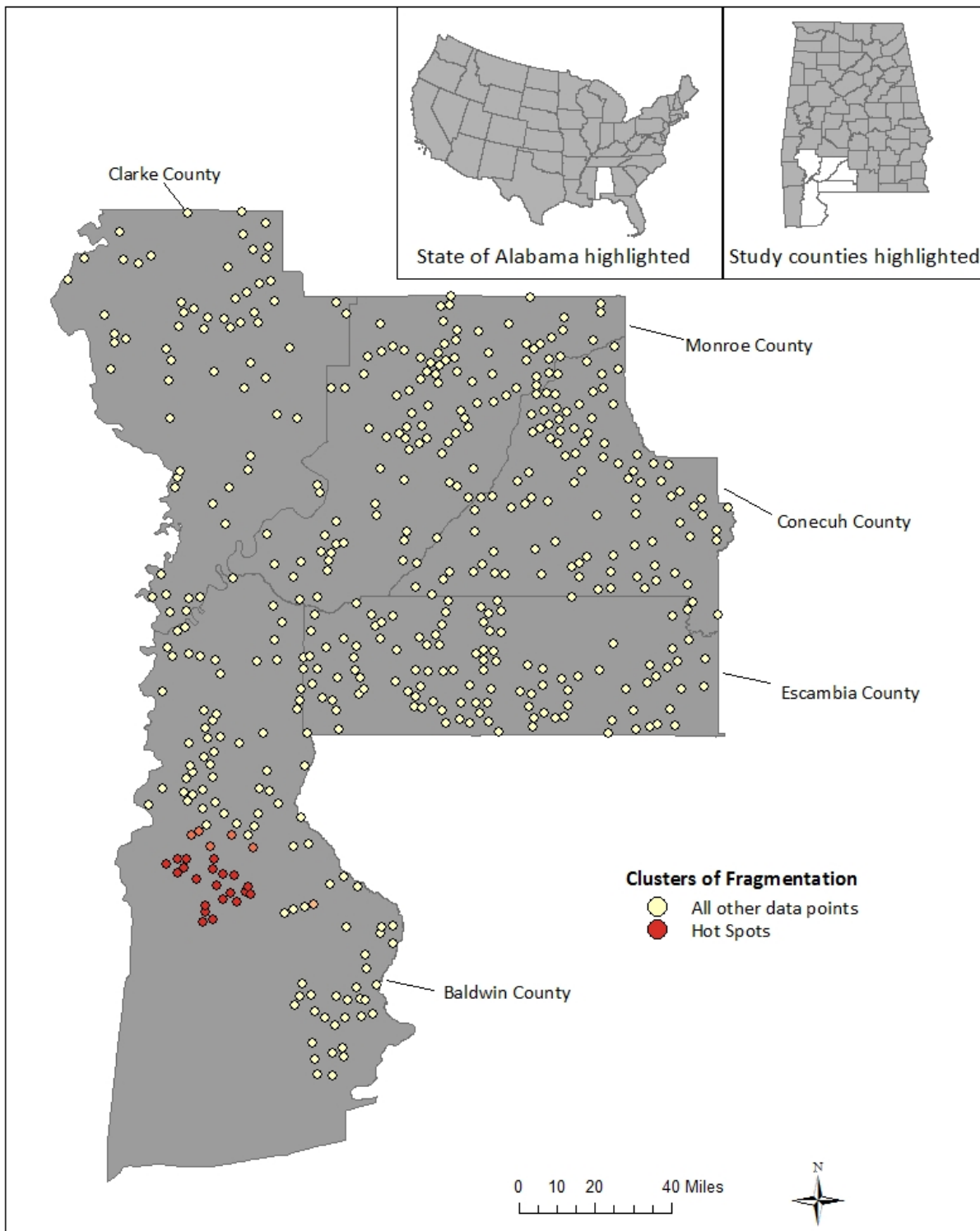


Figure 3.6: Fragmentation hot spots in Baldwin, Clarke, Conecuh, Escambia, and Monroe counties, Alabama in 2012.

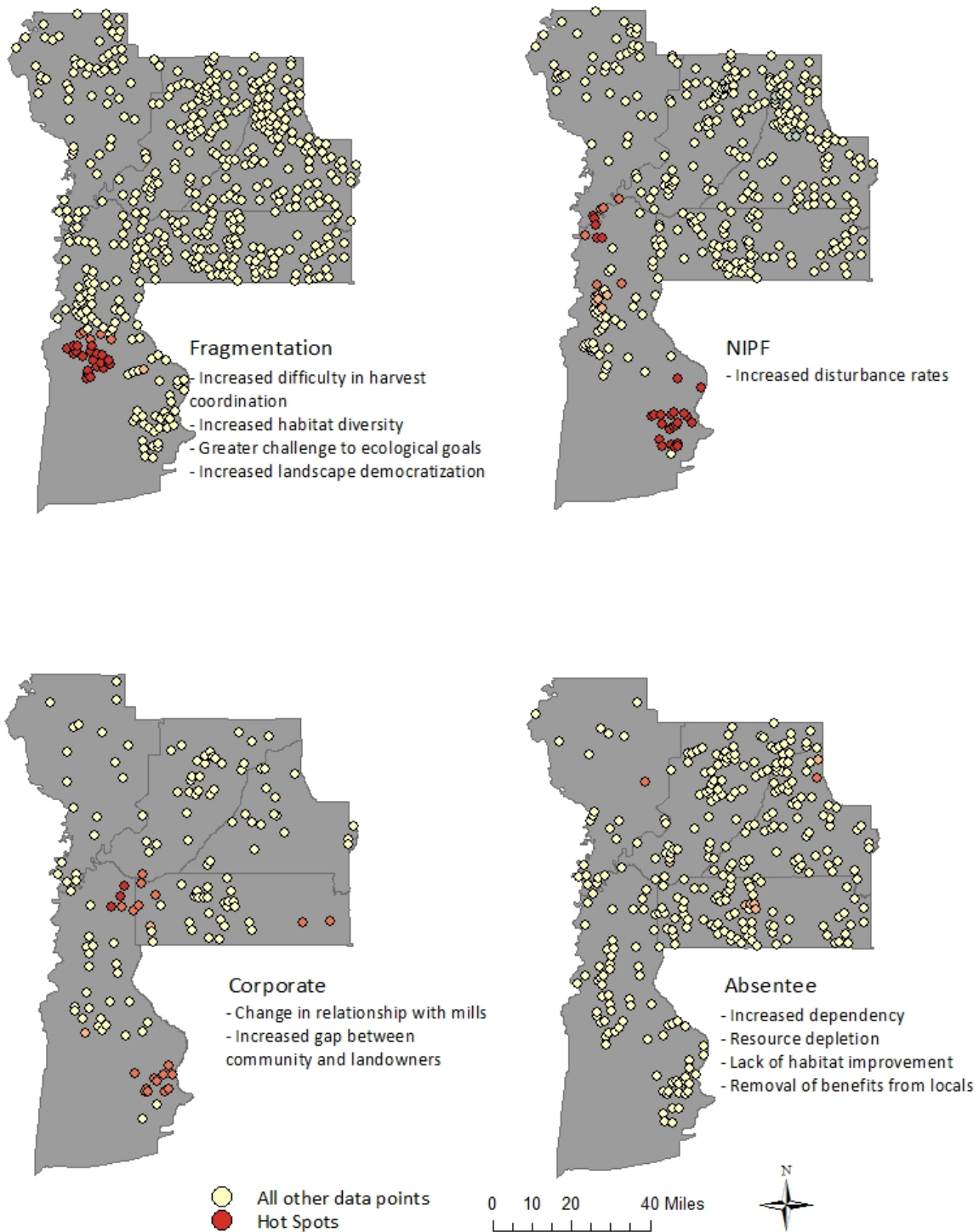


Figure 3.7: Hot Spots of ownership change in Baldwin, Clarke, Conecuh, Escambia, and Monroe counties, Alabama with potential outcomes from scientific literature.

3.5. Discussion and Conclusion

The findings of this study have provided the first GWR analysis of timberland owners in the wake of massive land sales by the forest products industry. Because GWR accounts for the influence of variables changing across space, more accurate results can be achieved than by simply performing Ordinary Least Squares regression. Using quality of life and distance to geographic features as variables, it is evident that government and NIPF ownership, as well as change in use, are influenced by the same significant variables now that they have historically followed (Alig 1986, Browne 2001, Nagubadi and Zhang 2010, Pan et al. 2009, Wear and Newman 2004, Zinkhan 1993). Corporate owners seem to behave similarly to NIPF owners, but are concentrated in areas further away from place. NIPF owners are more likely to use timberland for recreation, or may live on the land they own, and therefore would be more likely to locate near cities and towns. Corporate owners may also be interested in buying larger contiguous tracts of timberland, and may not be interested in purchasing fragmented parcels better suited for NIPF owners. Although this is not entirely surprising, this is the first finding of its kind and provides valuable insight into the behavior of new corporate timberland owners.

Hot spots of change are located in areas predicted by GWR analysis, and present areas for potential future conflict. Use change and fragmentation hot spots will likely not cause dramatic outcomes, as these occurred on the urban fringe in areas where the highest and best use of the land was not timber production, and was therefore already moving away from this use. Hot spots of absentee ownership are also unlikely to cause dramatic change, simply because of the high rate of absentee ownership that already existed in the area.

Use change was located in areas with low poverty levels and higher educational attainment. Nearness to place, roads, and water also influenced this change. Most use change occurred for

residential and commercial development, so higher quality of life and nearness to population centers make sense for this analysis. Government lands represent the opposite end of the spectrum from use change. These lands had the highest levels of poverty and the lowest levels of educational attainment. They were also a greater distance from roads and place. Surprisingly, this category was also influenced by distance to water. This variable was originally included in analysis because of the possibility that the distance to the beachfront and riverfront property would increase land values and cause change in use. While it also influenced use change, it influenced government purchases for the preservation of swamps, bogs, marshes, and sensitive wetland habitat.

Low R^2 values for NIPF and corporate owners suggest a gap in the model used. A major timberland management objective of both groups is timber production and income. The missing variable might be the quality of the land or the value of the standing timber, something for which this project was unable to account. These two groups were influenced by the exact same variables, but interestingly, while NIPF ownership was positively influenced by nearness to place, corporate ownership was negatively influenced by this variable. The other variables that these groups shared, percentage of unemployment, median house value, median income, and percentage of bachelor's degrees, all had a positive influence. The hot spots of these two groups were located in areas where these variables were in the middle of their range.

Hot spots of fragmentation were located near population centers and will probably contribute over time to a decrease in harvest rates, especially as these urban areas spread into the rural periphery. While these hot spots of fragmentation might impact ecological goals, an area where this is more likely to occur is on the west side of the study area. Here, a hot spot of NIPF and corporate owners was located at the base of a large tract purchased by the state of Alabama for

conservation. Since NIPF ownership is associated with higher disturbance rates after initial land purchase, this might serve to negate large scale conservation goals in this area.

New corporate owners in this area seem to fall somewhere between government owned lands, which are negatively correlated with higher quality of life variables and nearness to population centers, and NIPF owners, which are positively influenced by nearness to population centers. Also, corporate and NIPF owners are located near one another and share many significant variables, indicating that missing explanatory variables for these two categories may be the same. Finally, this study identifies hot spots of ownership change in the study area and connects those to specific outcomes found in scientific literature, pinning potential future changes to the map. One of the more notable hot spots of change is the hot spots of NIPF and corporate owners located near a major conservation area on the east side of Baldwin County. These hot spots could cause an increase in disturbance rates, which may conflict with conservation goals (Noone et al. 2012, Ohmann et al. 2007, Stanfield 2002).

Potential outcomes of this change, though based on thorough research on the management objectives of each group, are not set in stone. And although hot spots found in this study are likely spots for that change to occur, there is no guarantee. The sum of all the changes in the study area cannot be labeled good or bad. In fact, changes like fragmentation might have simultaneously good and bad effects. While potentially setting up a roadblock for large scale conservation efforts, fragmentation is positive from the perspective of landscape democratization, especially in this area where land ownership is highly concentrated.

This study raises new questions about new NIPF and corporate owners. How important is land or timber quality to these new owners? Are NIPF owners at all influenced by proximity to timberland they already owned? It would be advantageous for future work on this topic to center

around areas where change is clustered, interviewing new timberland owners to identify gaps in the regression model used in this study. By returning to these hot spots in the future, it can be determined if changes predicted in the scientific literature have occurred. We already know that some of the predictions, like a changed relationship between the forest and the mill, have been mitigated by supply agreements accompanying land sales (Kirk 2001). Although this study provides greater insight, the current understanding of this change is limited. As these lands continue to evolve, further research should work to answer the pressing questions of timberland ownership change.

CHAPTER 4

Conclusion

The forest products industry has sold an estimated 37 million acres in the U.S., including some two million acres in Alabama, making it one of the states most impacted by this change (Butler and Wear 2011, Rahman et al. 2011). In Alabama, the forest products industry was highly invested in the southwest portion of the state. This area is historically poor, with highly concentrated land ownership and social stratification stemming from the plantation era (Bliss et al. 1998a). Because land ownership fundamentally affects community well-being through the distribution of wealth and power, industry land sales are of particular importance in this persistently poor area.

The rapid rate and scale of the forest products industry land sales have raised many questions. Large scale research has identified trends on a national and regional level. To understand the impact of this change on the well-being of a community, to which it is so closely tied, a finer scale must be used. The local scale adds a new perspective to existing large scale studies on timberland ownership change, showing where local and regional change is interconnected, and highlighting unique community-level impacts. The change documented in this study, focusing on just five counties, will likely translate to many areas where the forest products industry was highly concentrated in the rural South. Understanding why this change has occurred, where it has occurred, and what it might mean is a powerful tool for this and similar areas as they work to address wealth generation, social stratification, and the balance between conservation and job preservation.

The five counties that comprised the study area included 925,211 acres of former industry

timberland. Each parcel was examined and new owners were identified and categorized. When industry timberlands prior to land sales were mapped, four of the five counties were found to have greater than 25% of the total county land mass owned by the forest products industry. The top five largest industry owners together owned 84% of all industry land, amounting to 22% of the land mass of all five counties combined. This confirmed that the forest products industry was heavily invested in this area of the state, and that industry ownership was highly concentrated among a few owners.

In 2012 that land continued to be highly concentrated among a few entities, with the top five owners controlling 53% of former industry timberland. This did represent a decrease in ownership concentration, and in fact 87% of new owners owned less than 100 acres of land. Many of those new owners no longer owned timberland, however. Most of the parcels of less than 100 acres changed in use by 2012, primarily for residential development. The variables influencing this change included low poverty levels and high education attainment. By far, the most change in use occurred in Baldwin County, with 8,034 acres. Only 15,483 acres, 1.7%, changed in use across the study area. An additional 1,213 forested acres were divided into parcels of 20 acres or smaller. Although these parcels were still forested, they will probably no longer produce forest products as it will be cost prohibitive for a highly mechanized harvest operation to operate on such a small scale.

While a decrease in timberland ownership concentration is a positive thing from the perspective of landscape democratization, it also contributes to forest fragmentation. This could potentially impede large conservation goals in the future. However, conservation lands have increased in the area as a result of the land sale, with 56,729 acres of former industry land being purchased by the State of Alabama's Forever Wild Land Trust. These lands were located in areas

of high poverty and low education attainment, and also bordered existing conservation property. While an increase in land in conservation does have the potential of reducing harvest rates and thus timber supply, it also preserves sensitive wetland habitats and remnants of Alabama's once vast longleaf pine range.

NIPF owners purchased 10% of all industry lands sold in the study area. Results of GWR lent little insight into why these landowners purchased land where they did, although median levels of poverty and education and nearness to place and roads were identified as explanatory. Distribution of new NIPF owners was significantly different across the counties, at least 6% in every county except Monroe at only 2.3%. Because NIPF owners may harvest more intensely than former industry owners, their concentration near one of the major conservation purchases may impede ecological goals.

The other group that significantly differed across counties was corporate owners, who purchased over 60% of industry land in every county except Escambia, where they only purchased 47%. This difference is due to the presence of T.R. Miller, a local forest products industry firm based out of Escambia County that sold only 1% of its land since 1983 – 1991. In total, corporate owners purchased 63% of all industry land across the study area. The GWR model explained only 37% of corporate owner locations, but significant variables included higher levels of poverty and lower levels of education, similar to NIPF owners. It is possible that quality of land or value of standing timber is the missing factor for both NIPF and corporate owners, since both groups emphasize timber income as a management objective. New corporate owners are primarily absentee, which coupled with a reduced number of local hires, increases the distance between them and the local communities. Corporate ownership might signal a changed relationship with local mills, but long term supply agreements would eliminate that issue at least

for the short term.

Local ownership increased on this land by 2012 by 10,569 acres. However, absentee ownership still accounted for 83% of all former industry in 2012. Two local industry owners, T.R. Miller and Cedar Creek, impacted the percentage of absentee land ownership in the study area. Most large absentee owners were corporate, and the land still produced forest products. However, some absentee owners purchased land that has now changed in use. Some of the new uses for land owned by absentee owners included large residential developments, mineral extraction, oil exploration, gravel and topsoil pits, and a solid waste landfill. No major hot spots of absentee ownership were identified, due to the widespread presence of absentee owners. Absentee ownership may cause resource dependency, lack of habitat improvement, removal of wealth, and resource depletion.

On the whole, the trend in this area seems to follow what has happened on a national scale: industry has sold almost its entire land base, and the majority of that land has been purchased by new corporate owners. The presence of local industry does make this area unique, as over 165,000 acres are still owned by vertically integrated timber companies, primarily T.R. Miller and Cedar Creek. Some of the new uses for this land are also interesting, especially where absentee investors are involved. The increase in local ownership is another interesting change in this area, although absentee owners still dominate the landscape. It is impossible to cast any part of this change in either a positive or negative light, as many of the potential outcomes may be good and bad, depending on perspective. Like a forest, it may take decades to see the results of the seeds being planted now. The data collected as a part of this project will provide the basis for understanding what this change means over time.

Future research could improve our understanding of the changes identified in this study. The

study area could be mapped again in the future to show how land ownership continues to change, and how this event has shaped the land over time. A greater understanding could also be gained by adding data from a previous point in time. Because the social, ecological, and economic impacts of land ownership change do not occur overnight, multiple points in time might highlight what factors that influenced landowners or how management objectives for the land have evolved.

The methods used in this study could be easily replicated in other areas to show if local impacts of industry land sales vary in areas with different ecology, economies, and societies. Before industry land sales, the forest products industry was also highly invested in timberland in the northern part of the state. However, land ownership patterns are very different from those of the Black Belt, favoring small independent land owners over concentrated ownership. The ecology of this area, the foothills of the Appalachian Mountains, is also very different from the Black Belt. It may also be valuable to compare primarily rural areas where forest products are the highest and best use of the land with areas where residential or commercial development might be the higher use. For instance, areas closer to population centers or with higher levels of median income would probably experience more use change than occurred in this study area. Comparing different communities could improve our understanding of this change and its impacts by showing which outcomes are similar and which vary. It could also show how decisions made on a community level influence and interact with trends on a broader scale.

The GIS analysis in this study could be improved by including more explanatory variables in the model for NIPF and corporate land owners. Land quality and the value of standing timber probably influence these two land owner groups, as they emphasize income in the management of their land. Proximity to land already owned may also be an influencing factor for NIPF

owners. Surveys of the current owners could also be conducted now that a complete list has been compiled to answer these questions and many more about current management regimes and influencing factors. Hot spot analysis performed in this study provides another opportunity for future research. By pinning expected outcomes to areas where they are most likely to occur, future studies can quickly determine if predictions from literature were correct, and how much of an impact they have had. The unique use of hot spot analysis could also be used in other studies to identify where research should focus its attention. Beyond the issue of timberland ownership change, the GIS techniques used here to study land ownership can be replicated to study changes in land ownership due to different events or in different places.

This study has contributed not only to our understanding of this major event in the forest products industry, but of the current transformation of land ownership in Alabama. In a state where 70% of the land is covered in forest, and where the forest products industry plays such a major economic role, it is essential to understand who controls that resource: the land owners. Land ownership correlates to wealth and power, impacting community well-being. This is especially relevant in timber-dependent communities in Alabama, where current use property tax laws generate little funding for local services, including education. For these reasons, land ownership, and timberland ownership in particular, should be a primary focus of any discourse on poverty in Alabama. Indeed, as this study has shown, timberland ownership should be at the forefront of our discussion of ecology, economy, and society in Alabama.

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