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Using GIS Information for Library Service Planning

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# Library Service Planning with GIS and Census Data

by Denice Adkins and Denyse K. Sturges

## *Abstract*

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## *Introduction*

Geographic Information Systems (GIS) are popping up everywhere. The MapQuest directions you printed out for your journey, your new car with the OnStar navigational system, and your wristwatch with a Global Positioning System chip all use GIS to orient you to the world around you. The GPS chip in your dashboard sends a signal saying that you are at a particular location. That information is combined with a roadmap containing latitudinal and longitudinal measurements, and as a result, your car can tell you which streets to take to reach your destination.

GIS software works by combining maps with “geocoded” information.<sup>1</sup> The process of geocoding information links that information with a particular place on a digitized map. The map already contains the “picture” of the information: you can see where the streets are and estimate

your journey's length. The information added to that map brings more meaning to it. For instance, information can be added which give street names, tells you which streets are one-way, where traffic jams are likely to occur, and which intersections have high accident rates. With this added information, the map is more useful to the driver. An added benefit to using a GIS system is that information can be updated relatively quickly. If an influx of winter visitors changes traffic flow in a city, that information can be added to the map for the winter months, or taken away for the summer. Although street maps and driving directions may have some applicability to public librarians who need to travel from one branch to another, or bookmobile drivers faced with new routes, the real benefit of using GIS in public libraries is in its ability to present information about the library's service community.

In this paper, we review how Census 2000 information and GIS software can be used to plan library services. We'll look at real data from two branches in the Phoenix (Arizona) Public Library system, the Ocotillo Branch in the less-developed southwestern part of the city, and the Yucca Branch, in the heart of the city. Data from these two branches will be used to show how GIS software can connect the library service mission to each branch's unique demographic situation.

[Insert Figure 1 about here.]

### *How Will GIS Software Improve Public Library Service?*

GIS software allows you to visually represent and manipulate information about your service population. Geographically-bound data, such as census demographics, can be connected to other geographically-bound data. The map image can be quickly changed to present different perspectives on your information – one image could represent the number of children in your service area, while another portrays the locations of laundromats and grocery stores. Pictures and maps communicate more than tables and text, making presentations to the library board of trustees or city commissioners more memorable and meaningful.

GIS software has the potential to improve public library service by increasing libraries' awareness of the communities surrounding them. Libraries need to know who their communities really are, beyond just the small percentage who show up in the library on a regular basis. This tool allows libraries to see who lives and works in their neighborhood, what kinds of materials they need, where the library should increase outreach, and which areas remain unserved.

### *The Method*

In addition to the decennial census, the United States Census Bureau also makes geographical information available. An easy way to learn more about your patron base is to connect that physical and demographic information to a map of your service area. The first step is to create that map of your service area. Tiger Files created by the U.S. Census Bureau allow librarians to download county road maps to their GIS program. Library locations are then geocoded into those

road maps by searching for the library's address or nearest cross-streets. Then the library service area can be defined, either by creating an organic shape around the library, like a circle surrounding the library point, or a more specific shape decided upon by the library. Some libraries even use census tracts to delineate their service areas. After the library's location has been geocoded into the map, information about the library can be added to the map. Specifics about the library, including its name, size of the building, the number of staff, or the size of the collection can be added to the map at this point.

Information about the library is then combined with Census 2000 demographic information, by downloading census data files and importing the data into your GIS program. You can then identify the census blocks, block groups, and tracts which intersect your library's service area, and pull results from that specific area. A census block is the smallest unit for which aggregate census data is collected. The physical size of a census block can be very small, in densely populated areas, or very large, in sparsely populated areas.<sup>2</sup> Tracts are designed to be relatively permanent comparison areas, and are generally bounded by permanent visible features or state and county boundaries.<sup>3</sup> Census 2000 demographic files are available by county, and are layered over the road map and library service areas already extant in the GIS program. Then the program takes demographic data from the area where the demographic layer intersects with the library service area layer. The resulting demographics from the library service area are displayed in tabular format when the user clicks on the library service area.

The Census Bureau has released four Summary Files from Census 2000 data. Summary File 1 (SF1) was collected from the Census 2000 short form, and contains total 2000 population, race, age, number of households, number of families, and number of housing units, per census block. SF2 is grouped per census tract, and contains more detailed data on United States households, including the ages and relationships between householders.<sup>4</sup> Detailed tables break down housing statistics by race, ethnic origin, and to a limited extent, tribal affiliation. SF3 data is collected from the Census 2000 long form, sent to one out of six households, and linked to Census block groups. SF4 information is also taken from the long form, but presented by census tract. SF3 and SF4 describe ancestry, language use, education levels, income, occupation, socioeconomic class, and data about household facilities.<sup>5</sup> For this demonstration article, data were taken from SF1 and SF3 files.

### *Connecting Library Service Areas to Demographic Information*

Public libraries exist to serve the public, and to do this, they need to know who their public is and what their public wants. In 1949, Bernard Berelson maintained that public libraries were used by people living relatively close to the public library.<sup>6</sup> Christine M. Koontz reviewed more recent research which supports branch proximity as a factor in patron usage. However, she points out that obstacles such as raised highways or railroad tracks may serve as barriers to library use in the service area.<sup>7</sup> Additionally, some libraries create artificially-bounded service areas for their branches in order to maintain an equitable distribution of libraries per capita. Regardless of the shape or area chosen as a library's service area, it remains important to know who you're going to be serving and how to reach them.

Even in the same city, two branches can have dramatically different service populations. In our example, the Ocotillo and Yucca branches are only nine miles apart as the crow flies. However, the service population is fundamentally different between these two locations. Materials and services appropriate for one branch may not be appropriate to meet the needs of the population at the other branch. The images produced by our GIS package have helped to make this difference visible.

#### *Connecting Demographics to Collection Development*

Once we have linked the demographic data with the maps of our service areas, we have a better idea of who our potential patrons are. Knowing this gives us an advantage when we try to develop the collection. The Ocotillo Branch, for example, has a greater percentage of children in its service area than does the Yucca Branch, 37 percent compared to 27 percent. Collection development funds for Ocotillo Branch might be adjusted to allow Ocotillo Branch to purchase more children's and school-related books.

[Insert Figure 2 about here.]

By contrast, the Yucca Branch has a greater percentage of older adults and senior citizens than the Ocotillo Branch, 11 percent compared to 7 percent. The Yucca Branch has an older population, and 66 percent of those who worked outside the home traveled alone in their own

vehicles to their workplace. This branch might want to expend more on its large print and audiobook collection, for its older patron population.

[Insert Figure 3 about here.]

We can also see that, while the Ocotillo and Yucca Branches both have significant Hispanic populations in their service area, over 75 percent of the Ocotillo Branch's patronage is Hispanic. Over half of the Ocotillo Branch population use Spanish in their homes. This suggests that Ocotillo Branch patrons might need more materials in Spanish and more English as a Second or Other Language (ESOL) materials.

[Insert Figures 4 and 5 about here.]

Looking at educational attainment reveals that less than 6 percent of the service population have completed bachelor's degree programs, and only 48 percent of the population have completed high school. Materials geared toward lower reading levels might be appropriate for this community, with the understanding that patrons may request materials through system transfers at any time. By contrast, 78 percent of Yucca Branch patrons have graduated from high school and another 22 percent have completed bachelor's degree programs. The collection development plan for this library could safely include materials written for an academic audience.

[Insert Figures 6 and 7 about here.]

Further investigation of our Census data shows that almost 30 percent of Yucca Branch residents hold managerial and professional occupations, compared to 14 percent of Ocotillo Branch residents. Sales and office occupations were held by 28 percent of Yucca Branch and 25 percent of Ocotillo Branch residents. Ocotillo Branch residents were represented in manual trades to a greater degree than Yucca Branch residents: 22 percent held positions in the production, transportation, and materials moving occupations, 17 percent held positions in construction-related occupations, and 10 percent in groundskeeping and maintenance occupations. Yucca Branch percentages for these occupations were 12 percent, 13 percent, and 5 percent respectively. The occupational differences here suggest different work-related information needs, as well as different leisure-time pursuits, and perhaps even different leisure time budgets. Construction workers might be employed seasonally and have more free time in the winter, compared to managers who work year-round.

### *Connecting Demographics to Circulation Data*

Once you've developed a collection, you might be interested to know which materials are most popular at the branches, and where your collection goes after it is checked out. Researchers at Indiana University tracked the circulation of types of materials in the Indianapolis-Marion County Public Library.<sup>8</sup> In 1995, when this study was conducted, the researchers had to decide which census tracts most closely corresponded to branch service populations. Only after that data had been sifted through could database software connect it to circulation data. Statistics would have had to be manually added to the map of libraries and census tracts. When GIS technology became available to him in 1997, one of the researchers was later able to map patron usage for a

particular branch, connect branch usage to census tract demographics, and correlate videotape circulation with income level.<sup>9</sup> These studies used 1990 census data, which was available only at the census tract level. Technological advances now make it possible for the Census Bureau to release information at the finer block-group or block level. To replicate this example today, library circulation data could be imported into a GIS system, and linked with community demographic data with relative ease. Many integrated library systems (ILS) are structured around relational databases, enabling systems personnel to save circulation data or patron addresses in formats accessible to desktop database packages such as Microsoft Access. The resulting files can be imported directly into the GIS program.

An Australian geographer took this a step further and mapped patron data, to determine whether certain areas of a town were being served by the library.<sup>10</sup> Jones produced a map of active and inactive library users and their proximity to the library. A sample of daily circulation records could be mapped in this same fashion, connecting relevant data about the item circulated to a patron address and a branch indicator. In this way, we could estimate how many Yucca Branch residents travel to use the Ocotillo Branch facilities, or whether Ocotillo Branch patrons are making heavy use of the Economics and Finance books from the Yucca Branch. This circulation tracking mechanism would allow libraries to see exactly what types of books are popular in which neighborhoods, allowing them to develop more responsive collections. The information gathered could also help distinguish between the designated and actual library service area. As with any project in which identifying information is used, however, it is vitally important to guarantee patron confidentiality.

### *Connecting Demographics to Staffing*

Previous research suggests that children make frequent use of the library, and adults with children are more likely to use the library than adults without.<sup>11</sup> As the Ocotillo Branch has a large percentage of children in its service area, the library director might want to allocate extra after-school staff to that branch. The Yucca Branch is located in close proximity to several major retail centers. This branch may wish to keep “retail” hours, encouraging families to stop at the library on the way to or from the shopping center. The programming staff might be encouraged to offer family-oriented program on weekend afternoons, as well as age-specific programs on weekday mornings.

Another element of staffing to be considered: the Ocotillo Branch has a very high percentage of Hispanic people in its service area, many of whom use Spanish as their home language. When a new staff position comes up, the library might be able to make Spanish fluency a priority qualification for hiring. This extra consideration would ensure better communication between patrons and their library, and this extra staff member would be in a better position to implement bilingual programming and Spanish-language collection development than an English-monolingual staff would.

The library system can also make staffing decisions based on library usage, by adding a “library visits per capita” indicator to branch data. Increased staff might be allocated to branches with higher patron counts. Nevertheless, previous studies by Christine M. Koontz and Dean K. Jue suggest that library usage cannot always be equated with circulation rates. Koontz and Jue studied “majority-minority” libraries, libraries for which the majority of the service population were racial or ethnic minorities. They found that although circulation rates for majority-minority branches were lower than those of other branches, program attendance and building use were equal to or higher than rates for those other branches.<sup>12</sup> People differ in their reasons for using the libraries, and libraries might want to use the most responsive usage indicators for their branches, to reflect that difference in library use.

### *Connecting Demographics to Outreach*

Not only can GIS data tell you which resources are popular and where, you can also use this data to provide customized outreach efforts to particular neighborhoods. If you have a general idea of who your service population is, it’s also useful to know how to reach them – particularly if they aren’t coming to the library. Ocotillo Branch demographics reveal a population that is very young and primarily Hispanic. Yucca Branch demographics suggest an older middle class community. Even knowing this little information gives you a better idea of where to focus your outreach efforts. However, you can also add another layer to your GIS map, a layer which represents community agencies and gathering places. This layer can include schools, recreation areas, senior centers, and other gathering places, suggesting where your outreach efforts should be focused.

The Yucca Branch example demonstrates a variety of outreach possibilities. Programs could be conducted at the neighboring shopping center or park. The opportunity exists for storytime visits to elementary schools and bibliographic instruction sessions at middle and high schools. School statistics include descriptive data such as the total number of teachers, total number of students, students receiving free or reduced lunch, racial and ethnic data on students, or student-teacher ratio. Upon learning that there are 603 kindergarten students, 872 first graders, and 677 second graders attending school in their service area, Yucca Branch children's librarians might decide to do a story telling and library card sign-up blitz during the school year. Young adult librarians can use ethnicity data to determine whether to translate Teen Read Week flyers into Spanish for a particular school. The more you know about a population, the easier it will be to design services to meet its needs.

### *Connecting Demographics to Branch Location and Service Hours*

If your city is fortunate enough to build a new branch library, your GIS-based demographic data will help determine the best location to build that new library. Mapping new library locations can be reduced to pinpointing a prospective location for the new branch and gathering demographic data for the surrounding area. You can move your hypothetical new branch to different locations on the map, to see which location will reach the greatest number of people. In addition, knowing the languages spoken by the people in the library service area could help the library develop appropriate signage and promotional advertising for your new branch.

In addition to information on race, ethnicity, and home language, SF3 includes information about people with disabilities and types of disabilities. When constructing a new branch or remodeling an old one, this information can be shared with architects and contractors, to help them understand the importance of accessible design. The population in the Ocotillo Branch service area had 1,876 sensory disabilities (impaired or disrupted sensory perception). Over 4,000 physical disabilities were tallied for this population, as were 2,532 mental disabilities. As the population ages, the number of people with mild and serious disabilities will increase. If the library is to serve the entire community, it will be necessary to accommodate people across all ranges of ability.

Another statistic available via SF3 is workers' travel time from home to workplace, and the time they leave to arrive at their workplace. In the Yucca Branch service area, 57 percent of workers leave for work between 5 a.m. and 8 a.m. Over 80 percent of all Yucca Branch workers have a travel time of less than 35 minutes. Knowing this, we can estimate the best library service hours for the majority of working Yucca Branch patrons. If we assume one hour of total travel time, and nine hours of work time, we can also assume that working Yucca Branch patrons would not be able to use the library any earlier than 3 p.m. Of course, planning for workers excludes those who do not work and those who are looking for work. Another section of SF3 tells us that in 4 percent of Yucca Branch families, someone is unemployed and looking for work. Another 43 percent of families contain someone who is unemployed and not looking for work, such as

retirees and stay-at-home parents. These people are presumably able to use the library at any time, but may prefer to visit before the afternoon crowds.

### *Working with GIS Software*

At the present time, there are several options for libraries wishing to use GIS. The first option is to do it yourself. Your library may already have a database or systems specialist working with local data, or someone who wants to experiment with new technology. GIS software is available from many vendors, and public libraries may qualify for discounted pricing. The package used for this example was ArcView 3.1, created by ESRI, Inc. ESRI (<http://www.esri.com/>) is probably the best-known GIS software provider, especially for the general desktop user. The software has a fairly steep learning curve, but university and vendor-sponsored classes are available to reduce that curve. Other GIS vendors and software can be located through the GIS Monitor web site (<http://www.gismonitor.com/>).

At least two kinds of data should be included in a library's GIS package: library-specific data and demographic data. The data a library chooses to include in its GIS system will vary, depending upon the problems the library is trying to solve. However, some of that data will be readily available through the library's ILS, including circulation rate, collection size, collection age, numbers and types of materials checked out, and patrons' registered addresses or birthdates. Number of staff, number of programs conducted, in-library use of materials, number of reference

transactions, and building size are all factors that may affect library use by a community. This information may need to be manually collected and entered.

Demographic data can be downloaded for free from the Census Bureau ([http://www.census.gov/census\\_2000/states](http://www.census.gov/census_2000/states)); however, this data comes as flat ASCII files, and must be converted into a form that ArcView can use. Fortunately, the Census Bureau also provides instructions and templates for some popular software packages, to simplify the file conversion. Alternatively, demographic and other data can be purchased. Both ESRI and Proximity (<http://proximityone.com/>) sell demographic data and offer instructions on how to use it. Combined with library-related information, community demographics help the library understand its services in light of its community. It gives a visual referent, which indicates where the library specifically needs to target its efforts. If, for instance, our Yucca Branch were to hold English as a Second Language classes, we would know that advertising those classes in the northeast quadrant of their service area would bring little return compared to advertising in the southwest quadrant.

For those who have reservations about using Census 2000 data as the decade wears on, the Census Bureau will be updating their population and housing demographics throughout the decade, via the American Community Survey.<sup>13</sup> The American Community Survey is an annual survey of a sample of American households, based on information normally gathered in the Census long form. While this sample data will not be as comprehensive as the population

demographics available from the Census Bureau's Summary File 1, it will provide an overall picture of community change.

GIS software is relatively inexpensive, and the data can be had for free. However, the library may be duplicating efforts already underway in the municipal planning department, and it may be possible to piggyback onto their service. Your library may be the only one in the community asking the planning department for help, but it is not the only agency in the community which needs information. Talk with other agencies to find out what their information needs are and what background work you might do to help the planning department meet both agencies' needs. Community data might not be immediately available in the format needed, so libraries should be prepared to work with the planning department and spell out their needs. A disadvantage to contracting through another governmental agency is the lack of control over the data. City planners may not want to spend time importing and making available library-related data. An additional concern comes in when sharing sensitive data like patron addresses; will the municipal planning department treat that information as the library would wish? However, a relationship between the library and the planning department could prove useful in the long term as communities and their data change.

Some public libraries have turned to another alternative: a product called LibraryDecision (<http://www.librarydecision.com/>), offered by CIVIC Technologies. Billed by *American Libraries* as a "product to watch," LibraryDecision allows libraries to map their service areas and

library measures to census information, then access those results via a Web browser.<sup>14</sup> “We wanted to provide an out-of-the-box solution for libraries that would give immediate results for decision-making,” said CIVIC Technologies president Marc Futterman. Using a preformatted interface, libraries provide data on library usage, facilities, holdings, and operations.

LibraryDecision adds this to census and geographic data and produces a map showing library locations, demographic data, and library indicators. Libraries can access this information over the World Wide Web, so that library staff and patrons can determine how well their community is being served. While libraries are limited in the type of data that can be included in the LibraryDecision package, they have the advantage of working with a library-oriented company.

An ESRI press release names several public libraries already using this service.<sup>15</sup> Libraries will also realize a considerable time savings using LibraryDecision over implementing their own GIS system. CybraryN, which produces public access computer security products, also has a GIS package available called CybraryView

(<http://www.cybraryn.com/products/Mapping/cybraryview.asp>). Libraries wishing to use this product must also use CybraryN.

You can get a taste of your library’s demographic situation without purchasing software or downloading data by using the Public Library Geographic Database, developed at the University of South Florida.<sup>16</sup> This GIS map of public libraries in the United States allows librarians to look at communities surrounding their library buildings, and as demographics are included, will allow libraries to plan branch locations. Including Federal State Cooperative System library public library data expands the utility of this service by allowing libraries to compare themselves to

other libraries in other states. A project on this nationwide scale may make it difficult for individual libraries to include the data points that are meaningful to them, if those data are not meaningful to the thousands of other libraries in the United States. However, the PLGDB includes important national data such as political and school district boundaries, and represents a huge step toward mapping public libraries and their communities. A similar project is available for libraries in the State of Illinois. The Illinois Public Library GIS Project (<http://gis.iit.edu/website/iplgis/viewer.htm>) provides a GIS map of library service areas, school districts, and census demographics for the State of Illinois. This project is a joint product of the Illinois State Library and the Illinois Institute of Technology.

Another way to access demographic information comes from the American FactFinder (AFF), which accesses tract-level data from the census Summary Files. These files are freely accessible at <http://factfinder.census.gov/>. By entering a library street address, the library can retrieve information about the census tract, block group, and block in which the library is located. Most urban libraries serve multiple blocks and block groups, making the tract the most relevant portion of data accessible from AFF. Using AFF, a basic map of the census tract area can be produced, showing the boundaries of the tract and the area served. Although library service areas may not directly correspond with census tracts, AFF is a valuable source of demographic information for your community.

### *What Else Can Be Done?*

GIS systems provide an alternate way for public libraries to use Census data and present it to their communities. Collecting demographics over time could be used to document the rate of community change; further, this information might be valuable to municipal historians as well as librarians. A library could keep track of people using Internet services, to determine how far the library has reached through its provision of free Internet services.

However, once a GIS system is in place, its utility can be extended beyond just keeping track of community demographics. A librarian might map her outreach contacts, and then gather the addresses of patrons attending a library program, to determine which contacts were fruitful and where she needs to increase her outreach efforts. She might document classroom visits by school, using that information to predict children's demand for services. GIS systems can be used for planning services in the building as well as in the community. If she wished to keep track of in-house use of materials, a librarian might use a digital map of the library to determine where people linger, and at which times of the day. The periodicals section may get more morning use, but the computers more afternoon use. A building supervisor concerned about traffic flow in the library could use that digital map to simulate library disaster response in varying situations, to determine the quickest way to control a dangerous situation.

### *Conclusion*

GIS systems combine digital images with information. In 2000, GraceAnne A. DeCandido wrote that GIS systems “allow problem solving to happen in a new and different way, by the visual inclusion of spatial data in the analysis of spatial problems.”<sup>17</sup> GIS provides libraries with a visual image of their service area and allows them to combine that with community-specific information. Libraries can look to GIS maps to see which neighborhoods are well-served by the library and which have not been reached, where materials circulate, and where the population congregates.

A librarian’s job is to be informed: to know what kind of service she wants to provide and how she will use information generated to help provide that service. Libraries may generate the same types of basic statistics, but each will have different support personnel, infrastructures, funding, and communities. The better a library knows itself and its community, the better it will be able to provide meaningful services to that community. Although GIS systems require an investment of time and money, the information they generate help create a more responsive public library.

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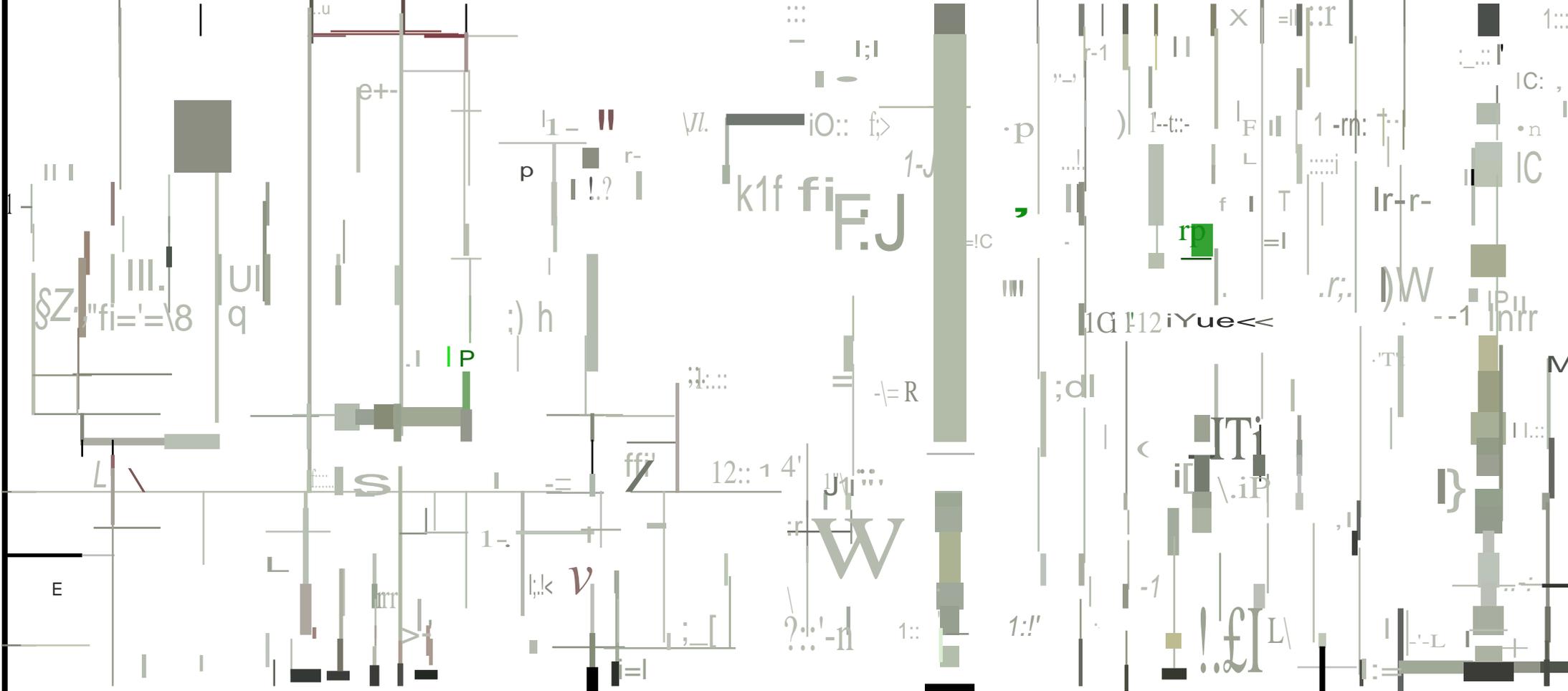


Figure 1. Branch library service areas. Letters represent Parks, Shopping centers, Elementary schools, Middle schools, and High schools.

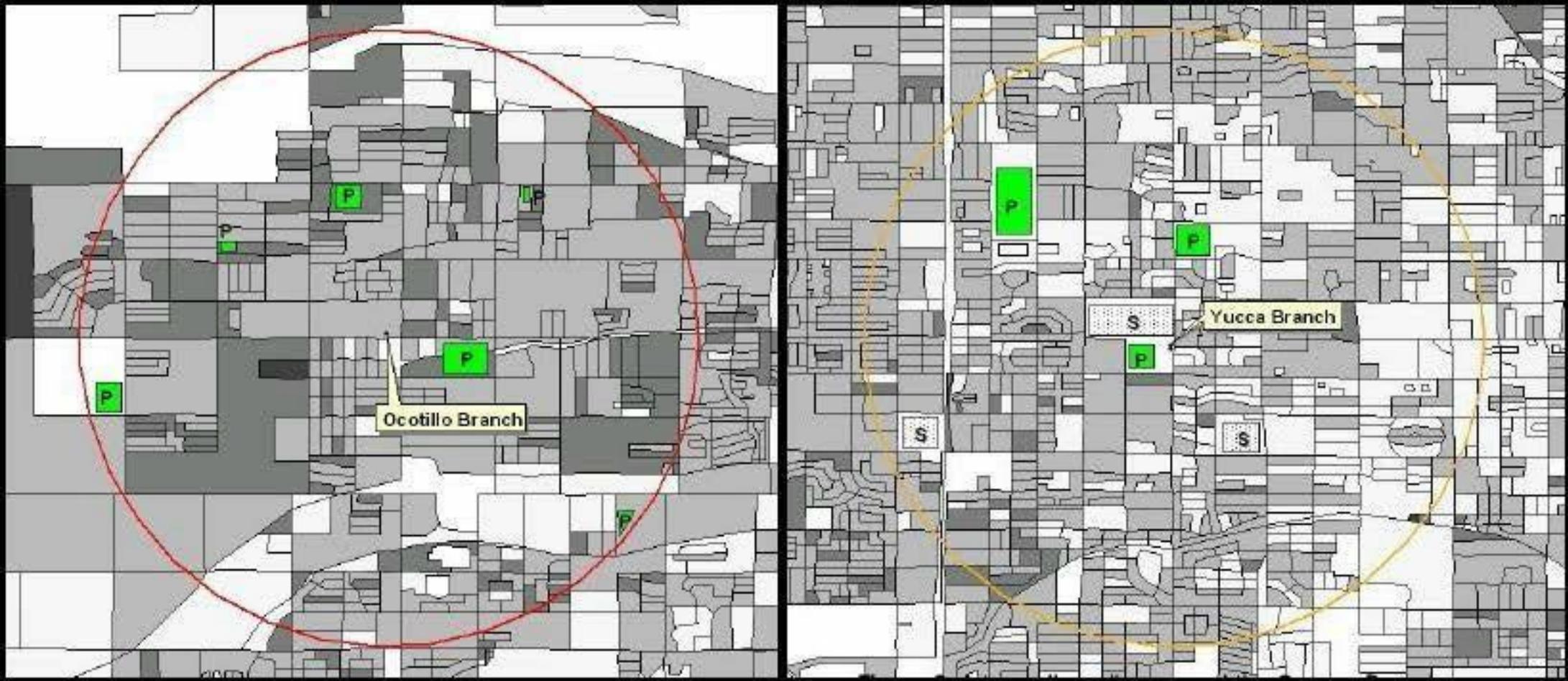


Figure 2. Distribution of children. birth to age 17, per census block. Darker colors indicate a greater percentage of children per block.

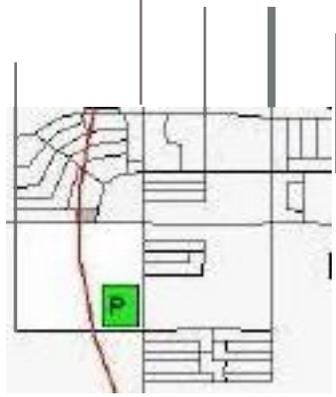


Figure 3. Distribution of people aged 65 and over, per census block. Darker colors indicate a greater percentage of people aged 65 and over.

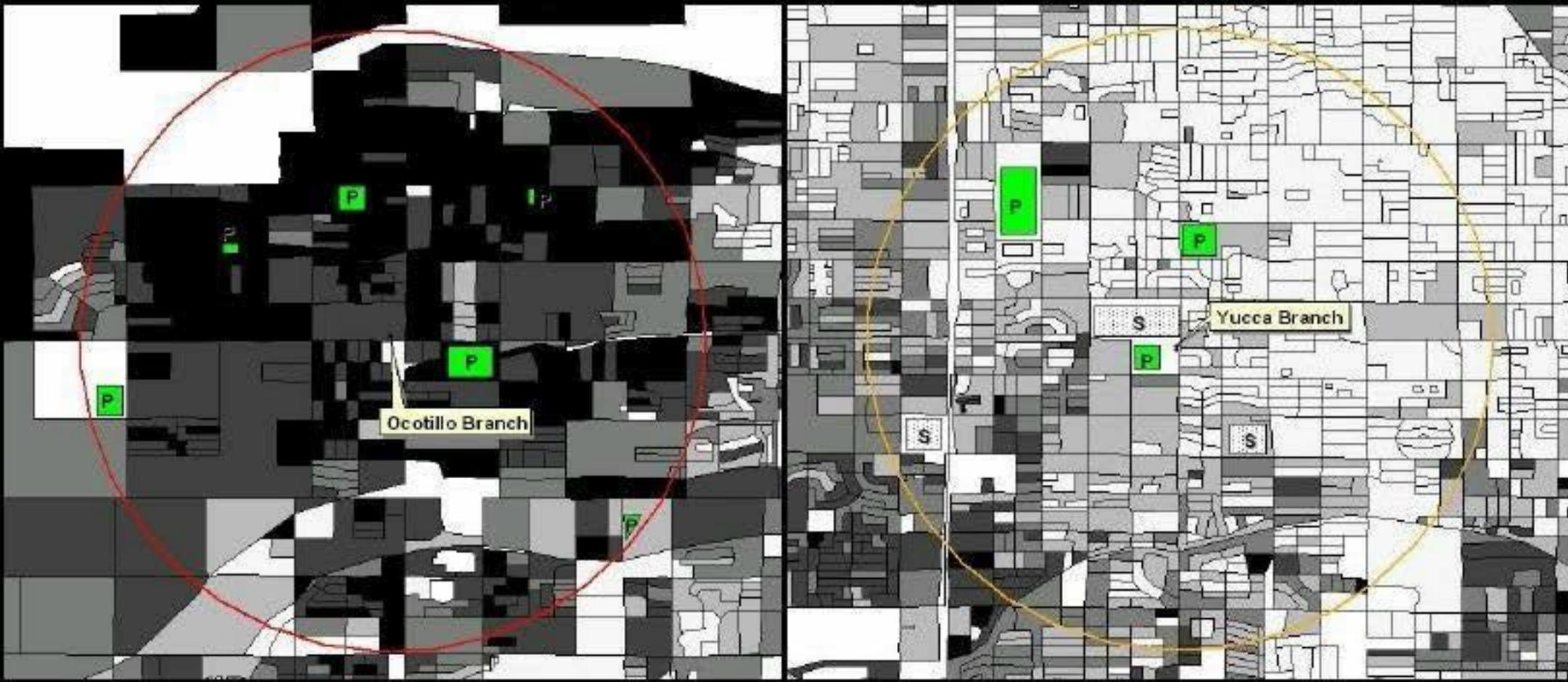


Figure 4. Distribution of people of Hispanic origin per census block. Darker colors indicate a greater percentage of Hispanic people



Figure 5. Distribution of people who speak Spanish as their home language, by block group. Darker colors indicate a greater percentage of Spanish-speakers.

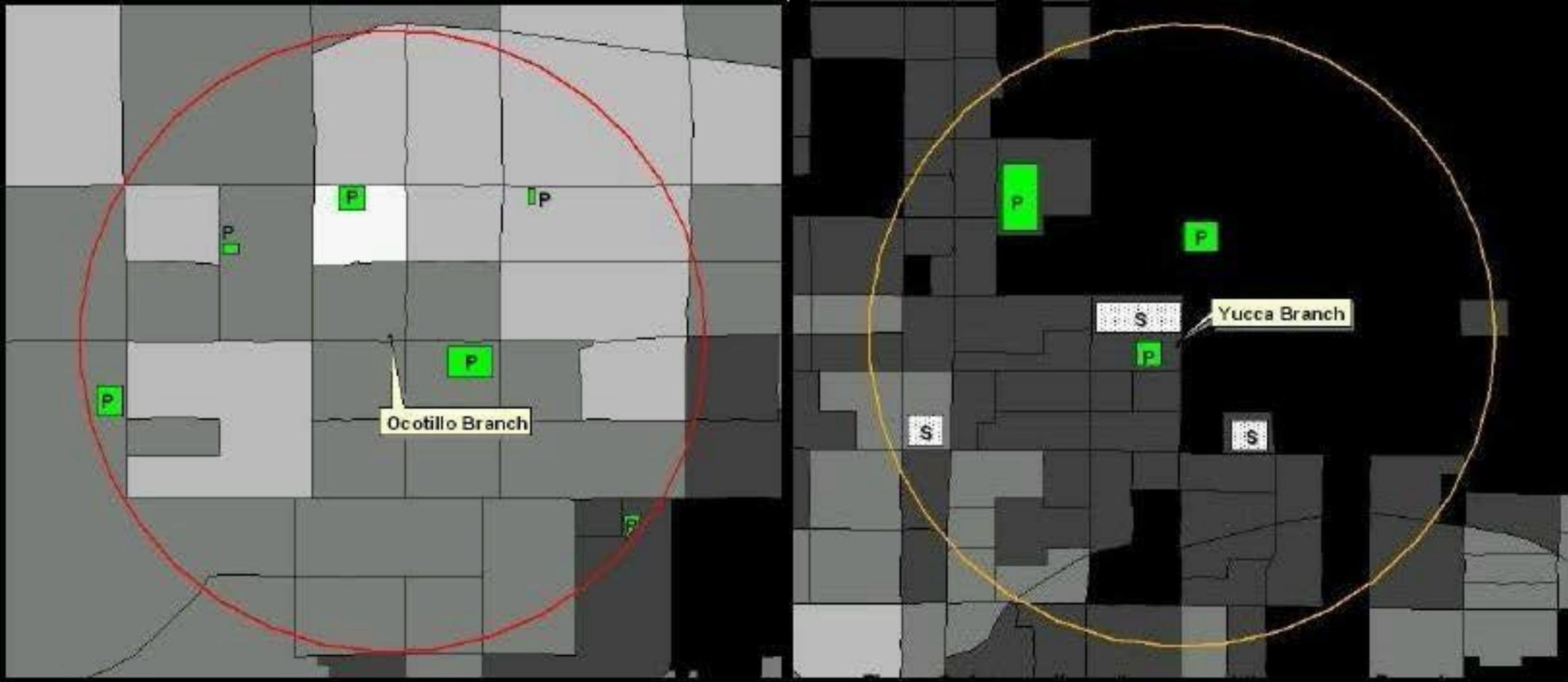


Figure 6. Distribution of high school graduates per census block group. Darker colors indicate a greater percentage of high school graduates.

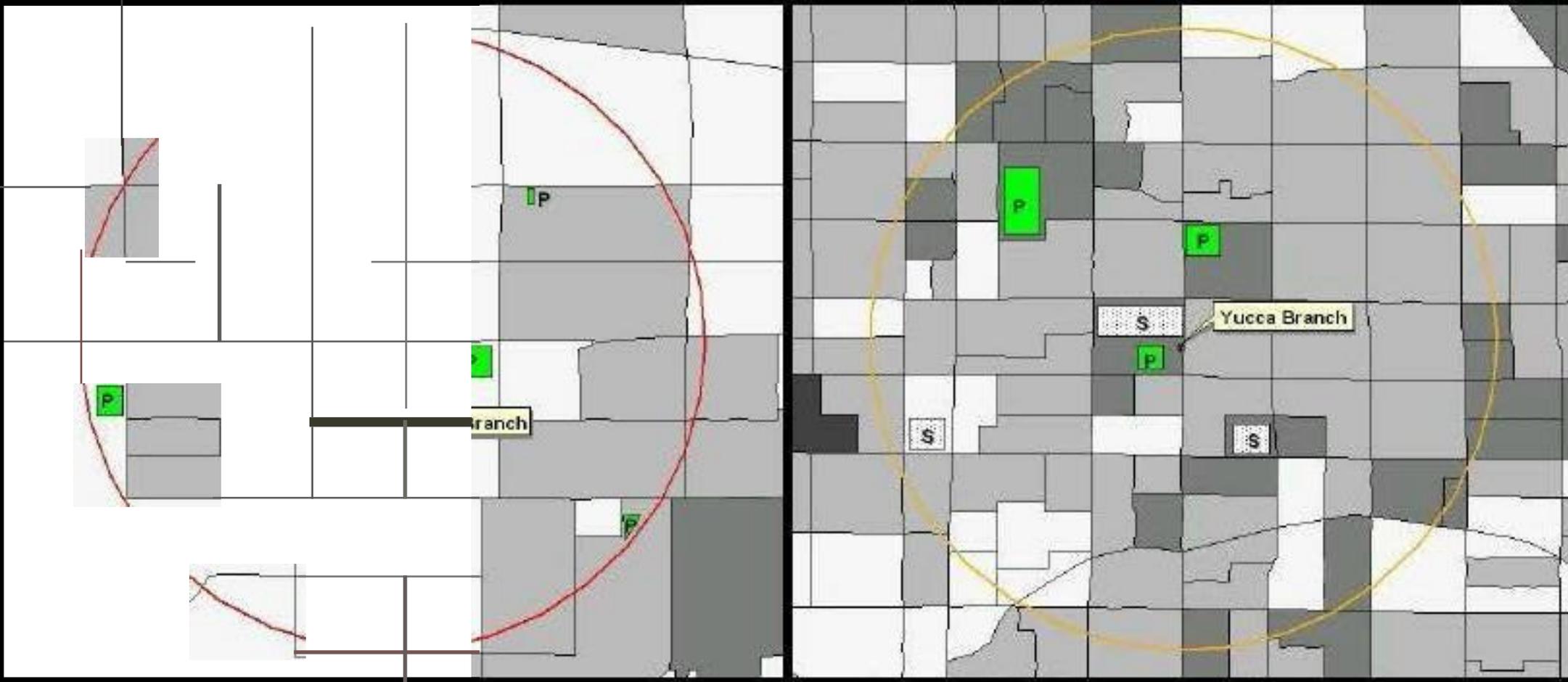


Figure 7. Distribution of college graduates per census block group. Darker colors indicate a greater percentage of college graduates.