Journal of Rural Social Sciences

Visualizing Food System Concentration and Consolidation

Philip H. Howard
Michigan State University

Recommended Citation

VISUALIZING FOOD SYSTEM CONCENTRATION AND CONSOLIDATION[*]

PHILIP H. HOWARD

MICHIGAN STATE UNIVERSITY

ABSTRACT

Visualization of the changing structure of the food system has played an important role in the Missouri School of Agrifood Studies' research and outreach. The analogies and diagrams Missouri researchers have used to describe concentration and consolidation have aided our understanding of the extent of these phenomena, as well as their social impacts. This article discusses why visualization is effective for analyzing and presenting data. Recent advances in visualizing concentration and consolidation are described—these methods include 1) treemaps, 2) cartographic maps, 3) cluster diagrams, 4) taxonomic tree/timelines, and 5) animations. Examples utilizing data from the North American organic food industry illustrate the potential of visualization to improve analysis of recent structural changes, and to increase public awareness of the unequal distribution of power in the food system.

Key strengths of the Missouri School of Agrifood Studies, and particularly the work of Dr. Bill Heffernan, include its emphasis on addressing practical research questions, as well as sharing knowledge with the people who are affected by the social forces under study. This knowledge has been utilized by movements to oppose the increasing dominance of multinational corporations, and to attempt to establish a more participatory democracy (see Bonanno 2009). Presenting information visually, through analogies and diagrams, has been an effective component of these efforts.

The first time I saw Dr. Bill Heffernan give a public talk was in October 1999 at a conference in Kansas City, Missouri. This event was organized to encourage people to travel to Seattle the following month to protest the World Trade Organization (WTO) meetings. While the conference addressed many issues, Dr. Heffernan focused on one that was to feature prominently in the "Battle of Seattle"—food and agriculture. Early in his speech, he pulled out a tow chain, a tool that he used frequently on his farm. He used this prop to explain that our food system had many stages, or links in a chain, as food was passed from the farm to the fork. I was a graduate student at the time, and knew little about these steps, which

87

88   SOUTHERN RURAL SOCIOLOGY

include grain collection, various types of grain processing, production of animals for meat, and processing of these animals. The analogy of the chain helped members of the audience, including myself, to understand the socioeconomic implications of the vertical integration, or ownership of multiple stages in the food chain, that was rapidly occurring.

Dr. Heffernan also uses the analogy of an hourglass to describe the food system, with the wide bulb at the top representing producers, the wide bulb at the bottom representing people who eat food, and the narrow neck of the hourglass representing the much smaller number of firms that control how food is passed between the two larger groups (Heffernan 1998). This structural position gives these firms an enormous amount of power over everyone else in this system, including decisions about who produces food, and who gets to eat. This analogy has been cited by a diverse group of writers, including journalists (Schlosser 2001), textbook authors (Harper and Le Beau 2002), and academics (Morgan, Marsden, and Murdoch 2006). It was also extended further by Bill Vorley (2003), who graphed the relative narrowness of the bottlenecks between producers and consumers for several commodities in the UK.

In 2000, I traveled with Dr. Bill Heffernan and Dr. Mary Hendrickson to a meeting in Northern Missouri, organized by the Missouri Farmers Union. They were invited to discuss their report to the National Farmers Union on consolidation in the food system (Heffernan, Hendrickson, and Gronski 1999). What struck me most was that after the formal talk, farmers gathered in small groups, each huddled around copies of the diagrams of emerging food chain clusters included in the report. They were quite familiar with many firms depicted on these diagrams because they bought from and/or sold to them regularly, but were not aware of all of the relationships between the firms. The intense discussions that I observed reinforced the power of visualization as an outreach tool, particularly for fostering dialogue and deliberation.

My subsequent work with Dr. Hendrickson and Dr. Heffernan to investigate change in the retail and dairy sectors convinced me of the usefulness of visualization as a tool for research as well. Putting together diagrams of the complicated connections between various firms was a very effective way to see the full scope of what was happening. The process helped us to recognize that food chain clusters were starting to extend to the retail stage, and gave us a better comprehension of the increasing scale of industry consolidation, for example (Hendrickson et al. 2001).

While I had an intuitive understanding of the effectiveness of these visuals, I did not know *why* they were so effective. Questions that I have explored in subsequent research include: 1) How can we improve our visuals? In other words, how do we design them to better assist us with recognizing patterns and gaps in our data, and to develop our theories? 2) More specifically, which types of visuals are most useful for studying and communicating structural change in the food system?

This article addresses these questions by describing how visualization assists the analysis and presentation of data, and the principles that can be used to increase the impact of visuals, based on research from cognitive psychology. I also review recent advances in computing that make it easier for agrifood researchers (and others) to produce their own powerful information graphics. I detail five techniques that are particularly suited to the study of concentration and consolidation, a major focus of the Missouri School of Agrifood Studies. For each of these techniques I discuss their relative strengths, as well as some potential applications.

The examples in this paper are from my research on the US organic food system. Organic is an interesting sector because although it has its origins in creating an alternative to the dominant system, as it became more successful it attracted the entrance of more powerful economic actors (Fromartz 2006; Guthman 2004; Pollan 2001). As a result, organic has become increasingly similar to the dominant food system in key respects, such as increasing levels of concentration (Buck, Getz, and Guthman 1997). More specifically, these examples focus on recent changes in the production and distribution stages of the organic food system.

EFFECTIVE VISUALIZATION

Visuals are effective tools because our eyes can take in far more information than our other sensory organs. Researchers in the field of visualization often describe this as the 'high bandwidth' of vision. To use another analogy, which compares our minds with computers, this allows for 'massively parallel processing.' The result is that well-designed visualizations take advantage of our enormous cognitive capacities through this channel. They also reduce the burdens on our more limited cognitive capacities, particularly our short-term memories (Mayer and Moreno 2003). Experiments suggest that our short-term memories can store just 5 to 9 'chunks' of information (e.g., words, digits, letters) at a given time (Miller 1956). This limitation can be overcome through external aids that amplify the process of cognition (Scaife & Rogers 1996). Even simple arithmetic tasks involving numbers with multiple digits are very difficult to complete without external aids like a pencil and paper, for example (Card, Mackinlay, and Shneiderman 1999).

90   SOUTHERN RURAL SOCIOLOGY

Some principles that have been identified as effective means of amplifying cognition through visualizations include the following: 1) showing both the context and specific details, 2) including features that 'pop out,' 3) reducing search time, 4) avoiding extraneous or distracting material, and 5) integrating words and images.

Showing Context and Detail

Our vision can take in specific details that are the focus of our attention, while simultaneously integrating fewer specific details at the periphery (Ware 2004). Good visualizations therefore show the forest and the trees, the whole and the part. One technique for doing so is to provide two images, as with a map that contains an inset displayed at a different scale. Another is to de-emphasize objects that are not the focal point, such as with a fisheye view. A third approach is to present all of the data at once, but to employ 'pop out' features that allow specific items or classes of items to be viewed selectively.

Including Features that 'Pop Out'

Table 1 shows a series of values. Find the total number of values greater than 0.9, and note how long this task takes.

Table 1. FIND THE VALUES GREATER THAN 0.9

0.170	0.204	0.132	0.507	0.779
0.444	0.986	0.567	0.619	0.757
0.990	0.782	0.152	0.469	0.838
0.323	0.115	0.890	0.221	0.933

Now perform the same task with Table 2, which displays values greater than 0.9 in a larger font, and note how long it takes.

Table 2. FIND THE VALUES GREATER THAN 0.9

0.170	0.204	0.132	0.507	0.779	0.173	0.901	0.366	0.215	0.241
0.444	0.986	0.567	0.619	0.757	0.025	0.717	0.912	0.941	0.130
0.990	0.782	0.152	0.469	0.838	0.195	0.356	0.093	0.406	0.637
0.323	0.115	0.890	0.221	0.933	0.324	0.505	0.663	0.040	0.338
0.708	0.658	0.603	0.690	0.524	0.822	0.736	0.422	0.378	0.609
0.818	0.252	0.636	0.444	0.800	0.654	0.381	0.624	0.851	0.794

Although Table 2 contains three times the number of data points as Table 1, you can probably perform the task much faster (Tidwell 2005). This 'pop out' effect is also called pre-attentive processing, because experiments suggest that we can identify these differences in less than a quarter of a second, or less time than it takes to pay conscious attention (Healey, Booth and Enns 1996). There are four categories of features that can be used to make features pop out, and reduce the conscious effort needed to recognize them: 1) color, 2) form, 3) movement, and 4) spatial position (Ware 2004). Several specific cues within these categories may be used, such as hue or intensity for color; size or shape for form; direction or flicker (on and off) for movement; and depth or concavity for position.

Items of interest, or entire classes of objects, can be represented using these pop out features to show how they are connected to each other, and different from the other features in a visual. Pop out features may be utilized for more than one class of object, an approach called layering (Tidwell 2005). While multiple pop out features can highlight different data layers (and accentuate the context and detail principle, as noted above), using too many can overload our cognitive capacities. When using the layering approach, cognitive load is reduced when cues contrast significantly, such as representing one variable with color and another with a shape, rather than relying entirely on shapes (Ware 2004).

Reducing Search Time

Presenting all of the data in one place, such as a single computer screen, reduces the time required to search for data points of interest, or to compare them with other variables. This reduces the burden on short-term memory that would be required if the data were spread across multiple locations. If all of the data will not fit on one canvas or screen, it should be shown nearby or in succession. One technique for reducing search time is called "small multiples" (Tufte 1990). It

involves displaying successive sets of data in the same format to make comparisons easier. This often requires reducing the size of the graphics, so that they all fit on one page, for example, even if this means a loss of some detail within each graphic.

Avoiding Extraneous Material

Avoiding extraneous or distracting material is another way to reduce cognitive load. The use of pop out features such as color should be deliberate, not something to dress up a poor visualization and shift attention away from the data of interest. Some effects available in programs like Excel, such as 3-dimensions, shadows and color gradients applied equally to the data, are good examples of distracting elements. Edward Tufte has spent a career developing principles for eliminating such extraneous material, which he calls "chartjunk" (2006). This includes de-emphasing reference lines and other features that are not of key interest by reducing their thickness and color contrast.

Integrating Words and Images

Words and images are particularly effective when they are tightly integrated. Burdens on short-term memory are high if a text-based explanation is separated from a visual, and you have to search for and mentally process potential connections (Mayer and Moreno 2003; Sweller, van Merrienboer, and Paas 1998). This cognitive load is reduced by bringing the text as close as possible to the images they relate to or describe. Robert Horn (1999) suggests the integration of images and words with attention to the strengths of each forms a 'visual language' with its own syntax, which may be more effective for communication than either words or images alone. This may explain the global popularity of comics as a format, particularly when intersecting combinations of words and images require the reader to engage with both to fully comprehend the story (McCloud 1994, 2006). Words are typically best suited for specific names and abstract concepts (like democracy), while images are best suited for spatial information and detail (Ware 2004).

TECHNIQUES FOR VISUALIZING CONCENTRATION AND CONSOLIDATION

Technological advances in desktop computing and computer graphics are making it increasingly easier to take advantage of the principles described above to analyze structural change in food and agriculture. While there are numerous types of visualizations to choose from, I demonstrate and discuss five that are well-suited for concentration and consolidation studies. These are: 1) treemaps, 2) cartographic

maps, 3) cluster diagrams, 4) taxonomic tree/timelines, and 5) animations. The description of treemaps uses an example from certified organic farming in the Southern US, while the remaining types are illustrated with data from the national organic/natural foods distribution industry. Different visualizations of the same data demonstrate the relative strengths of each type, as well as the benefits of simultaneously using multiple techniques, especially for exploratory stages of analysis.
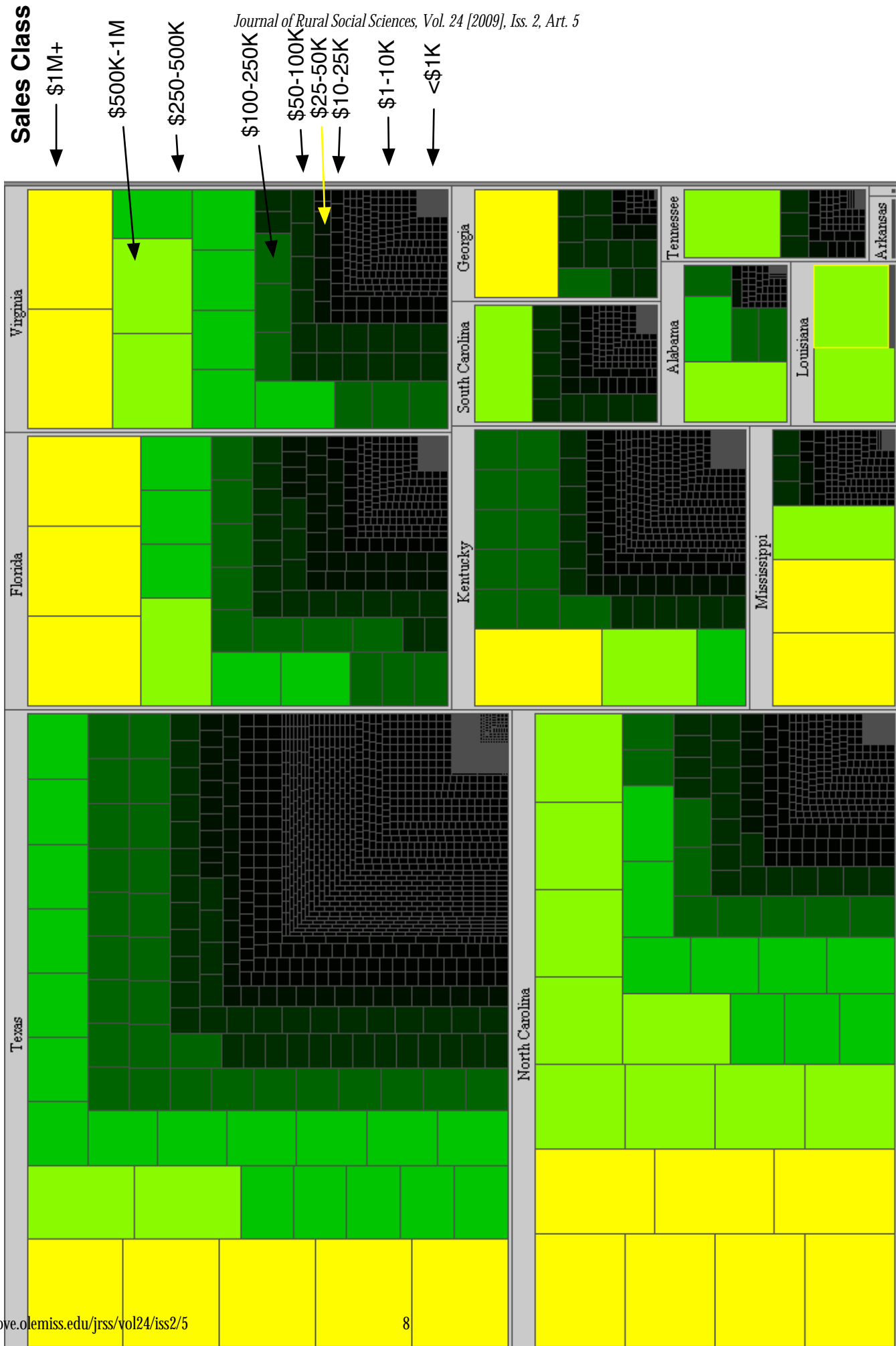
Treemaps

Treemaps are a recent innovation in displaying data visually (Shneiderman 1992). The word 'tree' refers to a hierarchical or parent-child relationship, as in a family tree. Treemaps were first developed to map computer hard drives, and quickly locate large files, or large groups of small files, when the drive was full. They visualize hierarchical relationships by making complete use of a constrained space, such as a computer screen. An algorithm is employed to divide the data into rectangles (parents), and further into subrectangles (children) based on defined classes, while filling the entire screen.

This technique has since been applied to many other areas, including stock market data (Wattenberg 1998), news reporting (Weskamp 2002), and election results. While other types of visualizations discussed below also are also effective for displaying hierarchical information, treemaps have an advantage for displaying quantitative attributes, since the treemap algorithm can automatically define them with the pop out features of color and/or size. This allows researchers to explore how concentration relates to variables that would otherwise be difficult to visualize, for example.

Figure 1 shows a treemap of certified organic farms in Southern states, using data from the 2002 USDA Census of Agriculture. Each cell represents a single farm. There were just less than 4,000 certified organic farms in the South in 2002, and they are classed by state. The size of each cell is proportional to the farm's annual sales class, as indicated in the figure. The size represents the midpoint of each range, except the '$1 million or more in annual sales' class, which represents the minimum of the range. This top category may be misleading if a farm's annual sales are substantially higher than $1 million.

Beyond the pop out cue of size, color is used to help distinguish the sales class categories. Yellow represents farms with $1 million or more in sales, black represents farms with less than $1,000 in sales, and different shades of green represent the categories between. Color could potentially be used to display a

Figure 1. Treemap of 2002 Sales of Certified Organic Commodities by Farm, Southern States

Sales Class

$1M+
$500K-1M
$250-500K
$100-250K
$50-100K
$25-50K
$10-25K
$1-10K
<$1K

Virginia

Georgia

Tennessee

Arkansas

Alabama

Louisiana

South Carolina

Florida

Kentucky

Mississippi

Texas

North Carolina

different quantitative attribute. If data for the years the operator had farmed organically were available, for example, this could be represented with a color gradient. This could indicate the extent to which the largest farms (represented by size) are recent converts to organic, as the conventionalization thesis might suggest (Constance, Choi, and Lyke-Ho-Gland 2008).

Figure 1 suggests important differences at the state level, such as many larger farms and fewer smaller farms in North Carolina when compared with Texas. It also indicates how concentrated organic farming was in 2002, demonstrating disproportionality, or the influence that a few can have relative to the many (Freudenburg 2005). It should be noted that California's distribution is even more disproportionate than Southern states—more than two-thirds of the sales in California are from farms earning $1 million or more annually (USDA 2002). This is a point that could be discussed when conducting outreach: the unequal impact that specific individuals, firms, or regions have with respect to commodity production.

Figure 2 examines farm concentration for the number of acres certified organic. Because the data combine crops and rangeland, this figure should be interpreted with caution. What is readily apparent, however, is that Texas has more certified organic acres than the rest of the Southern states combined. North Carolina is the only other state with more than one farm of 2000 or more acres.

Albrecht (1998) suggests that geographic differences in concentration and their potential explanations, such as ecological factors, have not been adequately explored, but these types of investigations could be improved by using treemaps to look for patterns. The analysis of temporal differences in concentration might also be assisted with treemaps—USDA figures for certified organic production are currently only available for one year, but when the 2007 Census of Agriculture figures are released they can be compared visually to the 2002 data.

There are numerous types of software available for creating treemaps, although some are limited to mapping hard drives. Figures 1 and 2 were produced using Treemap 4.1.1, a PC program that is free for academic use (University of Maryland 2004). Other options for displaying research data in treemap form include JTreeMap, an open-source Java program, and commercial software, such as Panopticon or Macrofocus Treemap. There is even an Excel Add-In called Treemapper available from Microsoft Research.

Figure 2. Treemap of 2002 Acres of Certified Organic Commodities by Farm, Southern States
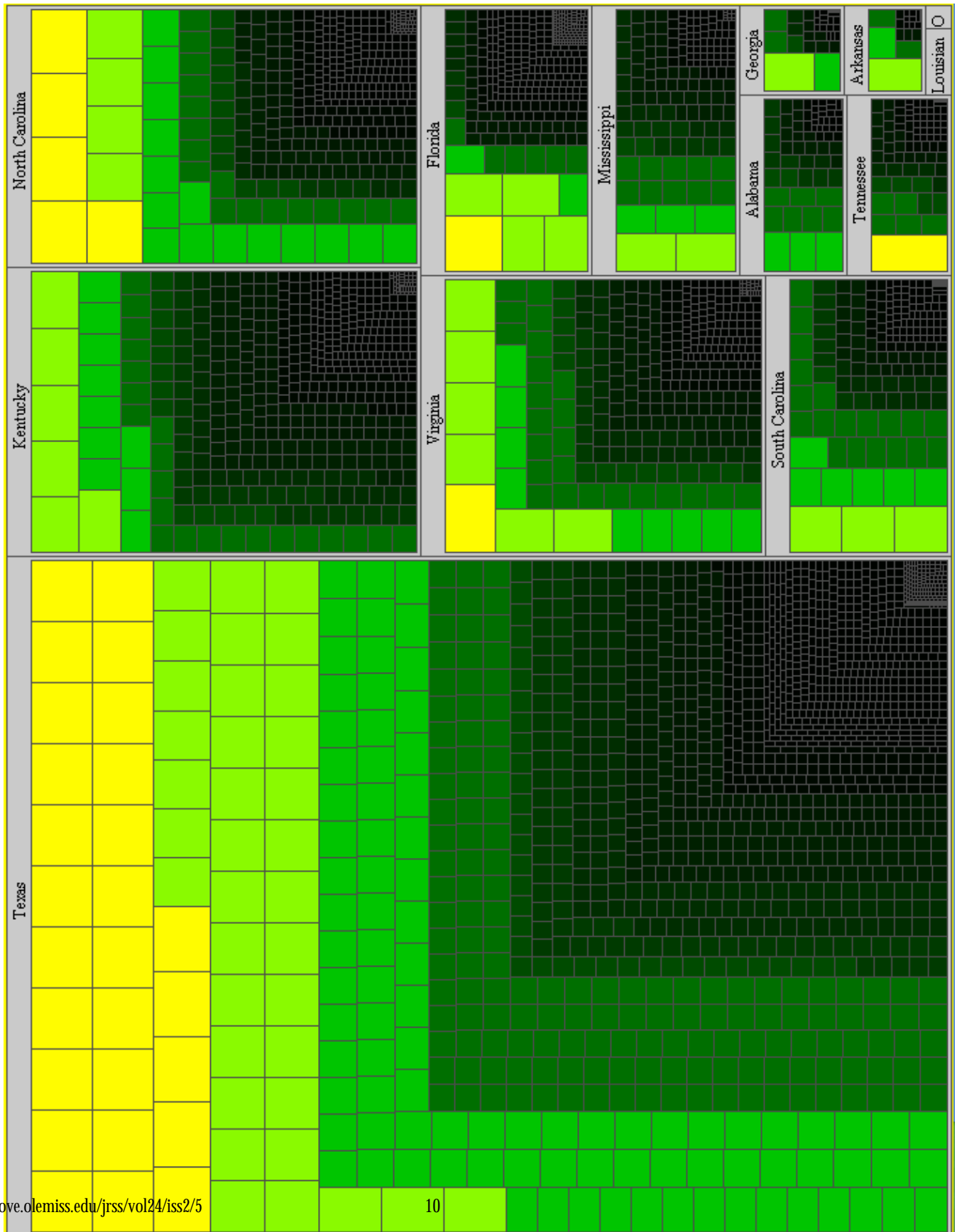
Cartographic Maps

In contrast to treemaps, cartographic maps, which display three-dimensional spatial variables on a two-dimensional surface, are not a recent innovation. They have become much easier to make, however. Maps are no longer the exclusive domain of cartography/geography, and are increasingly utilized by researchers in other disciplines, such as sociology (Lobao, Hooks, and Tickamyer 2007).

Figure 3 shows the decline in cooperative organic/natural food distributors in the United States geographically using data from Northeast Cooperatives (cited in Gutknecht 2003). This decline is in part due to the difficulty cooperatives had in obtaining capital to keep pace with a rapidly growing industry. In 1982 there were 28 cooperatively owned distributors, dispersed throughout the West Coast and the South, and more concentrated on the East Coast and in the Upper Midwest. In 1989 14 were remaining, and by 2002 there were only six (including two locations resulting from a merger of Northeast Cooperatives and Federation of Ohio River Cooperatives, and two locations operated by Blooming Prairie). At this point the cooperative distributors still in business were most concentrated in the Upper Midwest. Just one year later, in 2003, the number operating declined to three. One was highly specialized, focused on processing and distributing herbs and spices (Frontier), and the other two (Tucson and Ozark) were relatively small operations. As of 2008, only Frontier is still in business, although it nearly folded in the early 2000s.

This figure illustrates the principle of reducing search time with small multiples by using the same scale for comparison. Another good example of small multiples, which shows the opposite pattern—the geographic expansion of one firm in the agrifood industry—was developed by the economist Thomas Holmes (2005, 2008). He visualized the openings of Wal-Mart stores from 1962 to 2004 with a series of 42 maps, or one for each year. An animation of these maps represents new stores as red circles, and existing stores are subsequently represented as blue circles. The animation was posted on YouTube, and viewed more than 90,000 times in just two years (animations are discussed further below).

Simple maps may be created with a vector graphics editor, such as Adobe Illustrator or the open source program Inkscape. Figure 3 was produced with OmniGraffle, a diagramming and charting software available for Mac OSX (Omni Group 2008). A template of the United States was selected and the points and associated text were added manually. OmniGraffle has several features that make it easy to make professional looking visualizations, such as guides for spacing and aligning objects, and the ability to select and edit similar features simultaneously.

Figure 3. Cartographic Map of Cooperative Distributors, 1982-2008
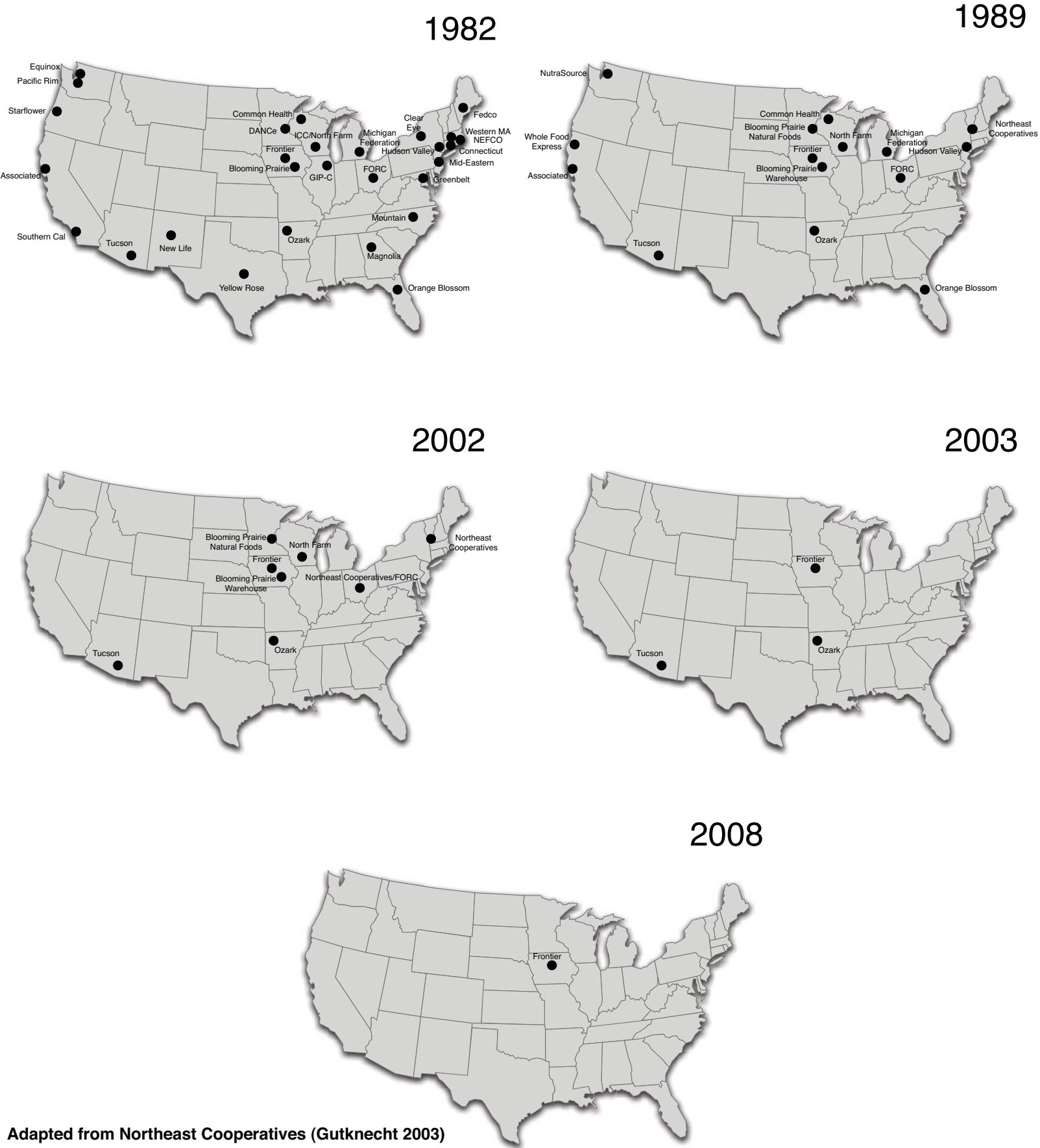
Adapted from Northeast Cooperatives (Gutknecht 2003)

Geographic Information Systems (GIS) may also be used for mapping, with the added advantage of conducting and displaying spatial analyses. To show the limited availability of processing plants within a typical driving distance of poultry farmers (Heffernan and Lind 2000, cited in Heffernan and Hendrickson 2002), for example, a map could display the approximately 240 processing plants with points, surrounded by a 30-mile radius polygon (e.g., a circle). A color gradient could denote the few that have overlapping polygons, and visualize the lack of competition. Alternatively, a more sophisticated buffer that takes into account transportation networks and average driving times could be implemented (Upchurch et al. 2004). While commercial GIS software such as ArcView and MapInfo are commonly used, free and open source programs like MapWindow are also available.

Cluster Diagrams

Cluster diagrams represent relationships between hierarchically structured data elements, and can display more complex relationships than treemaps, such as strategic alliances. They are well-suited for visualizing the consolidation that is occurring in industries that are still 'fragmented,' and for showing firms that are most active in making acquisitions. Figure 4 shows firms in the organic/natural food distribution industry in the US, and the acquisitions that have led to a highly consolidated industry by 2008 (though it focuses on distributors of processed organic foods, and does not show some much smaller, regional distributors involved in fresh, organic produce). The relationships between firms are indicated using the pop out feature of proximity (acquired firms are closer to their parent firms) and the form of connecting arrows. The hierarchical relationships are represented with pop out features of size and color. Parent firms are larger, and shaded light gray, while acquired firms are smaller and shaded medium gray or black (the latter denote they were once cooperatively owned).

The size of parent firms is also proportional to the most recent annual sales figures. United Natural Foods, Inc. (UNFI) is currently more than five times the size of Tree of Life, the only other national distributor of organic and natural foods. UNFI's most recent annual report stated sales of $2.75 billion (2007). Tree of Life held a 30% share of the natural foods market in 1995, but management mistakes have led to a loss of market dominance in recent years. The current CEO of Tree of Life is not ruling out a sale or merger with a competitor, such as United Natural Foods, or a vertically integrated distributor/retailer with little current presence in organic, Nash Finch (Betten Financial News 2008).

100   SOUTHERN RURAL SOCIOLOGY

Figure 4 was produced with OmniGraffle, but presentation software such PowerPoint, Keynote, or Impress could also be used, since the features (circles and connecting lines) are simple. Drawing a cluster diagram by hand is also an option; I prefer to draw rough sketches on paper while collecting the data, and then to transfer the information into OmniGraffle for a more polished, final version.

Taxonomic Tree/Timelines

A timeline is a type of graphic designed to show the importance of time-related variables. Typically they are displayed linearly, with time proceeding from left to right at regularly spaced intervals so that location is a pop out feature. A taxonomic tree is a diagram that shows hierarchical relationships with a branching structure. One type of taxonomic tree is a cladogram, which indicates the evolutionary relationships between species. Cladograms typically show speciation from common ancestors with a high degree of branching from a few initial nodes. A taxonomic tree combined with a timeline shows the hierarchical relationships of industry consolidation as essentially 'speciation in reverse.'

One limitation of this format when compared to cluster maps is that a few firms can be displayed on one page, due to each taking up all of the space from left to right. Taxonomic tree/timelines are therefore better for focusing on a few consolidated firms, as in a 'mature' industry, rather than showing the full extent of a 'fragmented' industry.

Figure 5 shows the mergers and acquisitions that have led to the domination of US organic/natural foods distribution by United Natural Foods, Inc., and Tree of Life. The thicker lines from left to right indicate national firms. For UNFI this transition occurred in 1997, after a series of major acquisitions by Cornucopia Natural Foods led to a name change and a public stock offering. One way to improve this graphic, if the data were available for all years, would be to weight the lines according to sales. Firms with the highest sales would have thicker lines than those with the smallest sales, and the thickness of the lines would often increase over time with both acquisitions and growing sales for each firm. By using size as a pop out feature in this manner the growth of firms relative to each other could be quickly comprehended.

Compared with the cluster diagram, seeing the significance of the year 2002 is much easier (although sale dates are shown with integrated text in Figure 4's cluster diagram, they are not designed to pop out). In that year the three largest cooperatives disappeared: 1) UNFI merged with Blooming Prairie, 2) UNFI acquired Northeast Cooperatives, and 3) North Farm Cooperative, which had

Figure 4. Cluster Diagram of Major Organic/Natural Foods Distributors, 2008
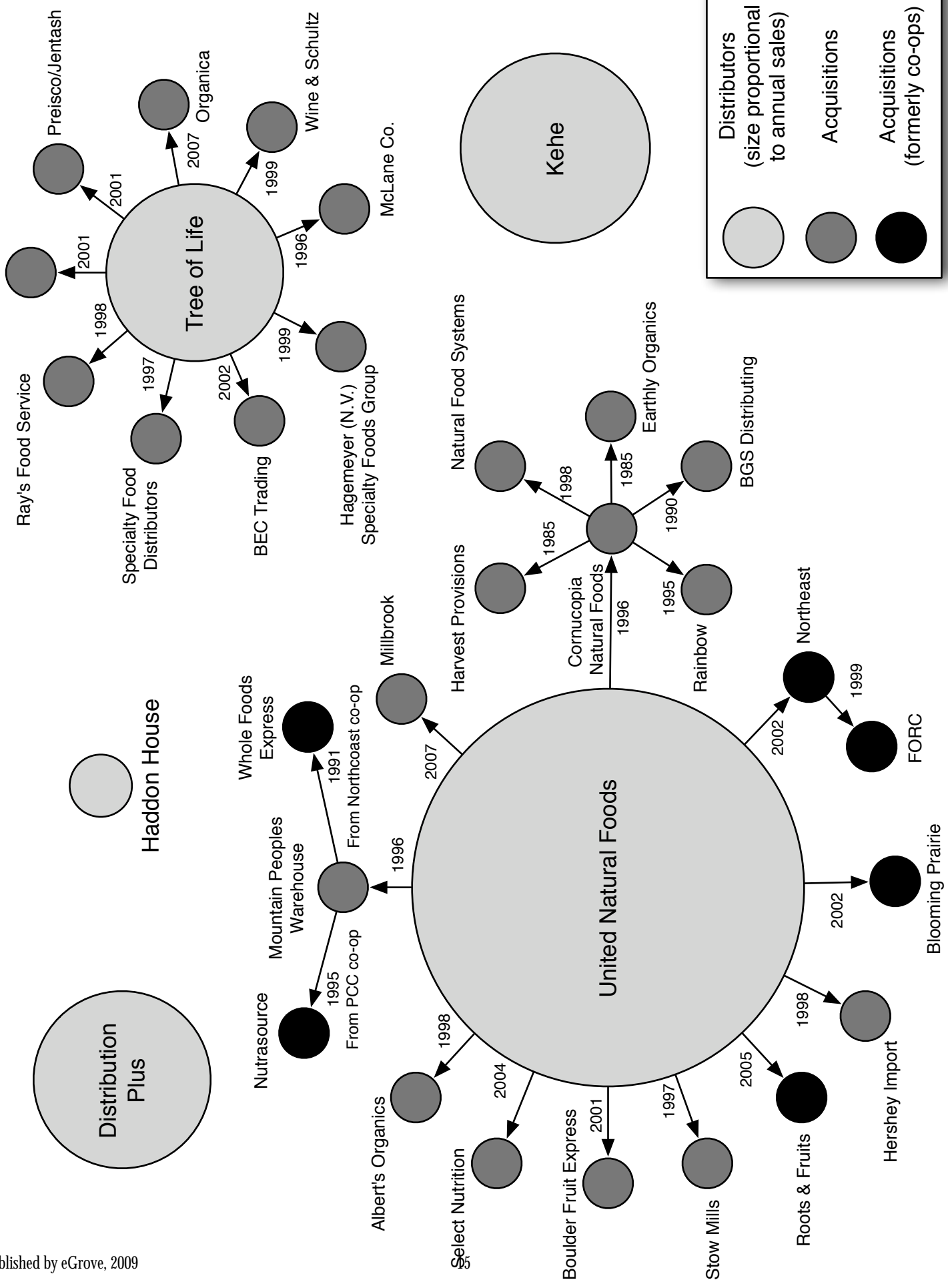
Figure 5. Taxonomic Tree/Timeline of National Organic/Natural Foods Distributors, 1984-2007

16
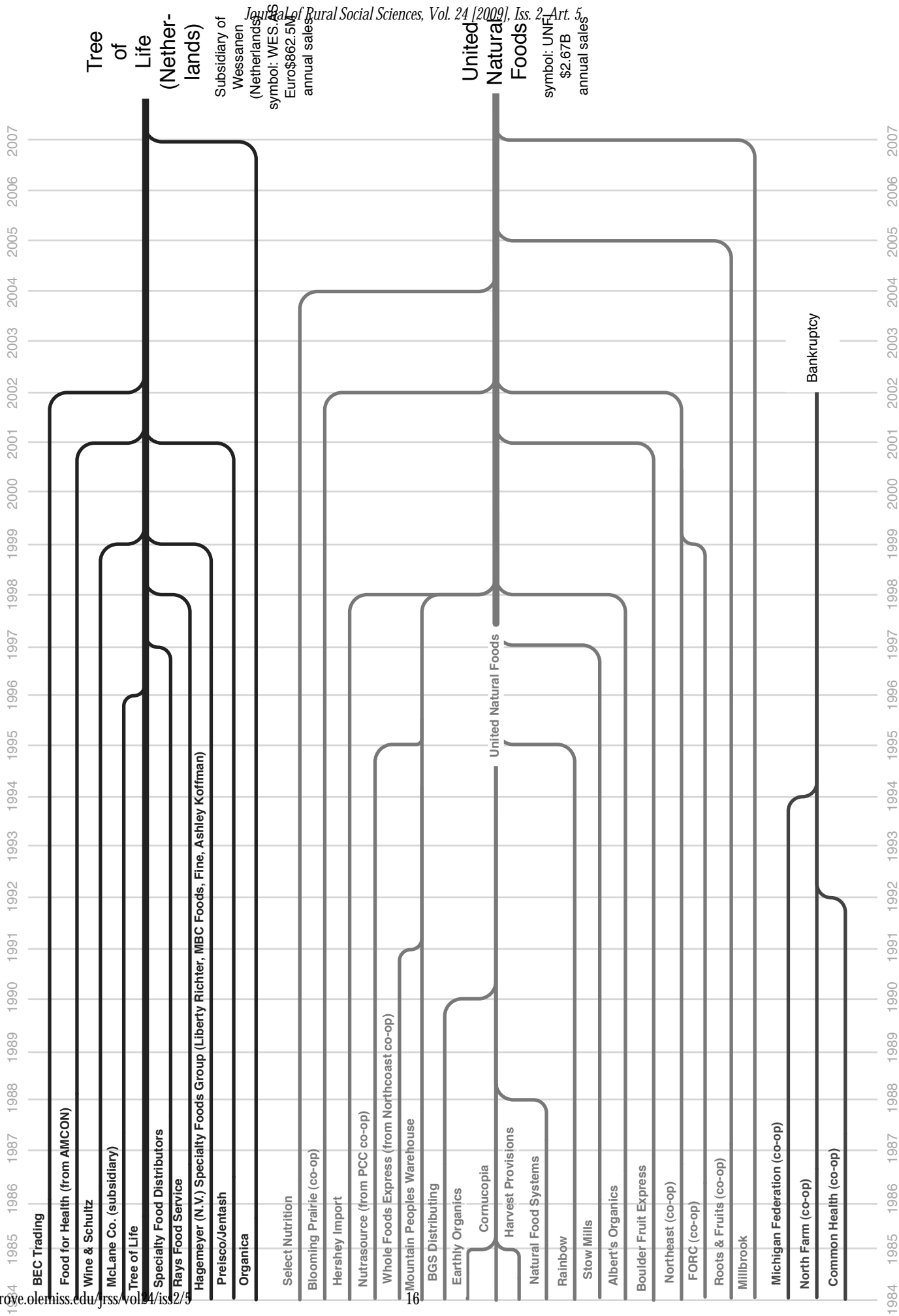
previously merged with Michigan Federation Cooperative and Common Health Cooperative, went bankrupt. This figure removes extraneous detail by using thin, solid, light gray markers from top to bottom for time, rather than a more distracting design, such as stronger dashed lines.

Figure 5 was produced with OmniGraffle. Other options for creating these types of graphics include diagramming software such as Microsoft Visio or open source alternatives like Dia. These programs may be best suited for early stages of exploration and layout, however. More aesthetic final versions could be created with a vector graphics editor like Inkscape or Illustrator.
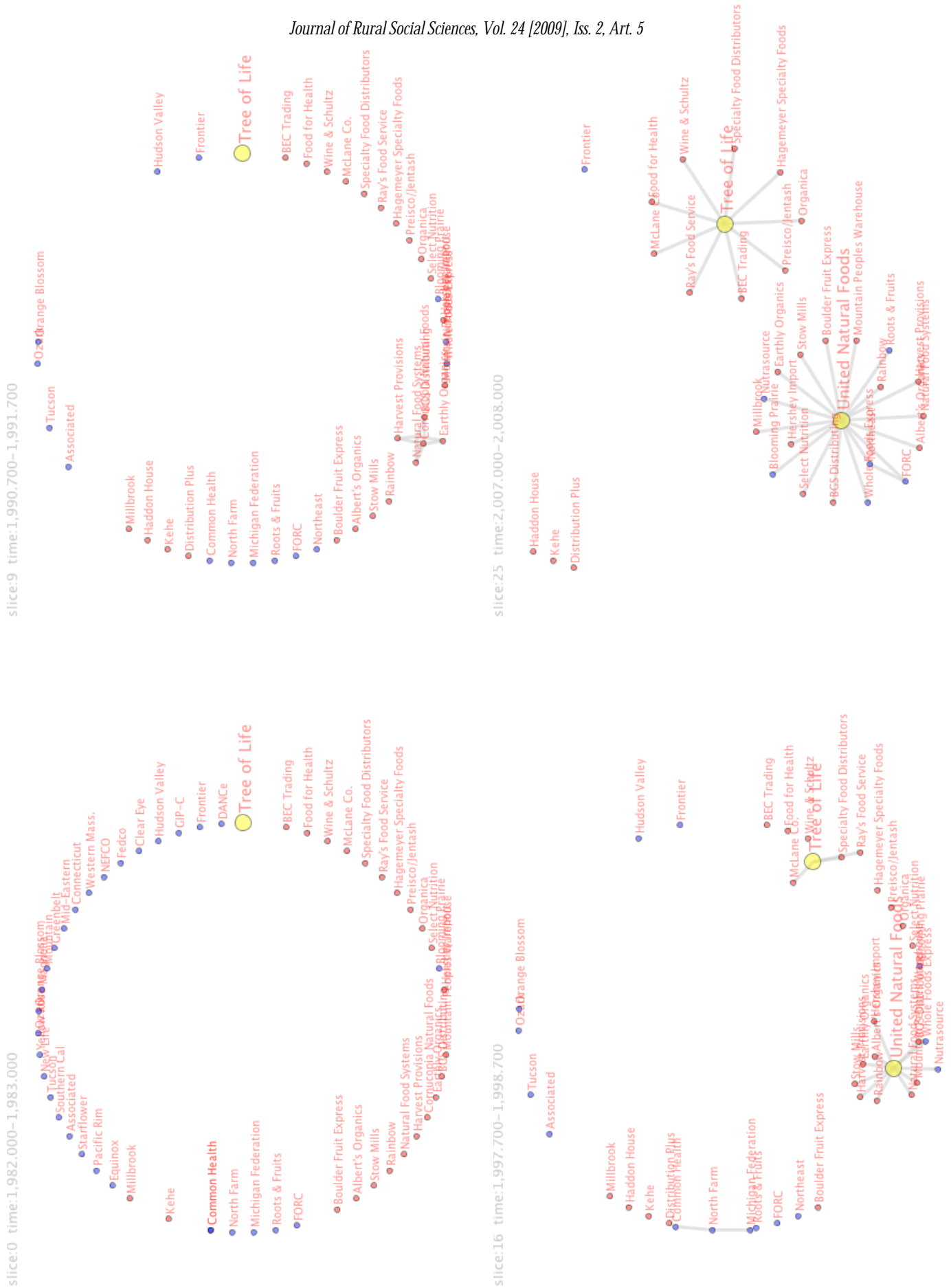
Animations

Animations are a sequence of images displayed one after another to form a movie. An animation could be created from any of the types of visualizations discussed above, providing an advantage of displaying more data with successive frames, while maintaining a small search space. A sequence of visuals is often better suited for showing both context and detail in large, complex datasets. They also allow for the pop out feature of movement.

Figure 6 shows scenes from a cluster diagram animation of the organic/natural distribution industry, by showing changes over time with movement.[1] The first frame shows the state of the industry in the period 1982 to 1983; the date is displayed in light gray text at the top left of each image. At this time the industry was composed of 29 cooperatively owned firms (blue circles), 23 additional regional distributors (red circles), and one national firm, Tree of Life (larger yellow circle). The second frame shows that by 1990 to 1991, only 15 cooperatives remained, and Cornucopia Natural Foods had made four acquisitions. The third frame indicates that by 1998 to 1999, Cornucopia had metamorphosized into the national distributor United Natural Foods through more acquisitions, including cooperatives. Also by this time Tree of Life and some remaining cooperatively owned firms began to engage in mergers and acquisitions. The final frame shows that by 2007 to 2008, Frontier was the only cooperatively owned distributor, and only three regional distributors remained to compete with United Natural Foods and Tree of Life.

---

[1] The complete animation, distributors.mov, can be accessed at http://www.msu.edu/~howardp/distributors.mov

Figure 6. Scenes from Animation of Organic/Natural Food Distribution Industry, 1982-2008

This animation combines the advantages of the cluster diagram and the taxonomic tree/timeline of this industry by presenting all of the data, and making the scope of industry consolidation more apparent. One disadvantage of this format is that a video monitor or projector is required to view the full movie, and it does not fit into a traditional journal format. A second disadvantage is that the animation must be paused to examine the details of specific periods closely.

The animation was produced with SoNIA - Social Network Image Animator, an open-source, cross-platform Java-based application (Bender-deMoll and McFarland 2002). Because the software automatically lays out the data with one of a half dozen algorithms, it is much easier to create than the static examples shown above, once the data is in the right format. An alternative program for animating networks is PieSpy. There are several software options for animating a series of static visuals like cartographic maps or treemaps, including graphics editors like Adobe Photoshop or GIMP (open source), and multimedia software like Adobe Flash.

THE FUTURE OF VISUALIZATION IN AGRIFOOD STUDIES

Visualization has tremendous promise for agrifood studies, even beyond the subjects of concentration and consolidation. For research, it provides another means of engaging with the data, which may lead to new theoretical insights (Moody, McFarland and Bender-deMoll 2005). Visualization of increasingly accessible large datasets may assist our investigations of the big sociological questions, such as comprehending the dynamic but structural features of agrifood systems that lead to inequality and conflict (Green and Heffernan 1984). Another possibility lies in collaboration; by putting our data into the form of maps and diagrams we can communicate quickly with other researchers, and identify promising similarities and differences to explore further.

The potential for visualizations to communicate our research quickly also makes them an unparalleled outreach tool. People who might never read a 30-page report may at least glance at a one page visual. Most major newspapers are taking advantage of our capacity to absorb data visually by establishing information graphics departments. Online versions of these newspapers have provided another outlet for visualizations, including multimedia presentations that incorporate animation and sound. The increasing popularity of blogs is also creating a demand for visuals to accompany posts or stories. Rural sociologists can take advantage of this demand by presenting research in a visual format. Well-designed visualizations that tell an interesting story are likely to be rapidly linked to numerous websites,

and communicate the findings to wider networks of people. This will extend the influence of our discipline on society as a whole.

Web sites such as IBM's "Many Eyes" and Geocommons.com are blurring the boundary between research and outreach by allowing people to upload their own data and create their own visualizations. The frontier of visualization research involves creating opportunities for interaction, and understanding how individuals and communities query and display data to answer their own questions. We can contribute to this by including visualization in the development of 'organic' public sociology (Burawoy 2003) and community-based research (Kleiner and Green 2008).

New practitioners of visualization will need to be aware of its disadvantages, however. The process necessarily involves abstraction and leaving out data, at a price of distorting reality to some extent. Visualizations are only as good as the data that go into them, which means poor input is certain to provide poor results. Such critiques could probably be applied to all research, but visualization is unique in requiring visual literacy by its practitioners and intended audiences. Until visual literacy becomes more widespread, information graphics are subject to ambiguous interpretation and potentially misleading reliability (Bresciani and Eppler 2008).

Despite these disadvantages, visualization is a highly valuable tool, and one that the Missouri School has utilized effectively in research and outreach. Many more practitioners are needed to bring visualization to bear on the challenges facing our food system. The opportunities to do so are rapidly increasing. Computer software has become more user-friendly, as well as more powerful, making it easier for those without programming skills to create visualizations of their data. Because of this, as well as their utility as cognitive aids for experts and non-experts, I envision that maps, diagrams and animations will soon become as widely used in agrifood studies as typologies and statistical tables.

REFERENCES

Albrecht, Don. E. 1998 "Agricultural Concentration: An Analysis by Commodity." *Southern Rural Sociology* 14(1):18–40.

Bender-deMoll, Skye, and Daniel A. McFarland. 2002. *SoNIA* (Social Network Image Animator). Retrieved July 24, 2008 (http://sonia.stanford.edu/).

Betten Financial News. 2008. "Wessanen Houdt Diverse Opties Open Voor Dochter Tree of Life." *Betten Financial News.* April 15. Retrieved November 1, 2008 (http://www.beleggersbelangen.nl/web/Nieuws/Artikel/Wessanen-houdt-diverse-opties-open-voor-dochter-Tree-of-Life.htm).

Bonanno, Alessandro. 2009. "Sociology of Agriculture and Food Beginning and Maturity: The Contribution of the Missouri School (1976–1994)." *Southern Rural Sociology* 24(2):29–47.

Bresciani, Sabrina and Martin J. Eppler. 2008. "The Risks of Visualization. A Classification of Disadvantages Associated with Graphic Representations of Information." *ICA Working Paper #1/2008*. Lugano, Switzerland: University of Lugano. Retrieved November 8, 2008 (http://www.knowledge-communication.org/Bresciani_Eppler_Risks_of_Visualization_working%20paper_2008.pdf).

Buck, Daniel, Christine Getz, and Julie Guthman. 1997. "From Farm to Table: The Organic Vegetable Commodity Chain of Northern California." *Sociologia Ruralis* 37(1):3–20.

Burawoy, Michael. 2003. "Public Sociologies: Contradictions, Dilemmas, and Possibilities." *Social Forces* 82(4):1603–18.

Card, Stuart K., Jock Mackinlay, and Ben Shneiderman. 1999. *Readings in Information Visualization: Using Vision to Think*. San Francisco, CA: Morgan Kaufmann.

Constance, Douglas H., Jin Young Choi, and Holly Lyke-Ho-Gland. 2008. "Conventionalization, Bifurcation, and Quality of Life: Certified and Non-Certified Organic Farmers in Texas." *Southern Rural Sociology* 23(1):208–34.

Fromartz, Samuel. 2006. *Organic, Inc.: Natural Foods and How They Grew*. Orlando, FL: Harcourt.

Freudenburg, William R. 2005. "Privileged Access, Privileged Accounts: Toward a Socially Structured Theory of Resources and Discourses." *Social Forces* 84(1):89–114.

Green, Gary P. and William D. Heffernan. 1984. "Economic Dualism in American Agriculture." *Southern Rural Sociology* 2(1):201–10. Retrieved April 12, 2008 (http://www.ag.auburn.edu/auxiliary/srsa/pages/Articles/SRS%201984%202.02%201-10.pdf).

Guthman, Julie. 2004. *Agrarian Dreams: The Paradox of Organic Farming in California*. Berkeley, CA: University of California Press.

Gutknecht, Dave. 2003. "Co-op devolution Part 2: Northeast Cooperatives to Fold, United Natural Foods, Inc. Assuming Services After Merger Vote." *Cooperative Grocer* 104 (January-February). Retrieved March 7, 2006 (http://www.cooperativegrocer.coop/articles/index.php?id=424).

Harper, Charles L., and Brian F. Le Beau. 2002. *Food, Society, and Environment*. Upper Saddle River, NJ: Prentice Hall.

108   SOUTHERN RURAL SOCIOLOGY

Healey, Christopher G., Kellogg S. Booth, and James T. Enns. 1996. "High-Speed Visual Estimation Using Preattentive Processing." *ACM Transactions on Human Computer Interaction* 3(2):107–35, 1996. Retrieved November 10, 2008 (http://www.csc.ncsu.edu/faculty/healey/download/tochi.96.pdf).

Heffernan, William D. 1998. "Societal Concerns Raised by CAFOs." Presented at the Manure Management Conference, sponsored by the West Central Region of the Soil and Water Conservation Society, February 10-12, Ames, Iowa. Retrieved October 25, 2008 (http://www.p2pays.org/ref/21/20524/ManureMgmt/85.html).

Heffernan, William D., Mary Hendrickson, and Robert Gronski. 1999. "Consolidation in the Food and Agricultural System." Washington, DC: National Farmers Union.

Heffernan, William D. and Hendrickson, Mary K. 2002. "Multi-national Concentrated Food Processing and Marketing Systems and the Farm Crisis." Presented at the Annual Meeting of the American Association for the Advancement of Science Symposium: Science and Sustainability, February 14–19, Boston, MA.

Heffernan, William D. and David H. Lind. 2000. "Changing Structure in the Broiler Industry: The Third Phase of a Thirty Year Longitudinal Study." Final report for research project *The Changing Structure of Agriculture in the Southern United States.* Athens, GA: Southern SARE.

Hendrickson, Mary, William D. Heffernan, Philip H. Howard, and Judith B. Heffernan. 2001. "Consolidation in Food Retailing and Dairy." *British Food Journal* 103(10):715–28.

Holmes, Thomas. 2005. "The Diffusion of Wal-Mart and Economies of Density [animation]." Retrieved April 9, 2007 (http://www.youtube.com/watch?v=EGzHBtoVvpc).

_____. 2008. "The Diffusion of Wal-Mart and Economies of Density." Washington, DC: National Bureau of Economic Research Working Paper. Retrieved October 16, 2008 (http://www.econ.umn.edu/~holmes/papers/diffusion_walmart_jan2008.pdf).

Horn, Robert E. 1999. *Visual Language: Global Communication for the 21st Century.* Bainbridge Island, WA: MacroVU, Inc.

Kleiner, Anna M. and John J. Green. 2008. "Expanding the Marketing Opportunities and Sustainable Production Potential for Minority and Limited-Resource Agricultural Producers in Louisiana and Mississippi." *Southern Rural Sociology* 23(1):149–69.

Lobao, Linda M., Gregory Hooks, and Ann R. Tickamyer. 2007. "Introduction: Advancing the Sociology of Spatial Inequality." Pp. 1–25 in *The Sociology of Spatial Inequality*, edited by L. Lobao, G. Hooks, and A. Tickamyer. Albany, NY: The State University of New York Press.

Mayer, Richard E. and Roxana Moreno. 2003. "Nine Ways to Reduce Cognitive Load in Multimedia Learning." *Educational Psychologist* 38(1):43–52.

McCloud, Scott. 1994. *Understanding Comics: The Invisible Art*. New York, NY: Harper.

———. 2006. *Making Comics: Storytelling Secrets of Comics, Manga and Graphic Novels*. New York, NY: Harper.

Miller, George A. 1956. "The Magical Number Seven, Plus or Minus Two: Some Limits on our Capacity for Processing Information." *Psychological Review* 63(2):81–97.

Moody, James, Daniel A. McFarland, and Skye Bender-DeMoll. 2005. "Dynamic Network Visualization." *American Journal of Sociology* 110(4):1206–41.

Morgan, Kevin, Terry Marsden, and Jonathan Murdoch. 2006. *Worlds of Food: Place, Power, and Provenance in the Food Chain*. Oxford, UK: Oxford University Press.

Omni Group. 2008. *OmniGraffle Pro 4.1.2*. Seattle, WA.

Pollan, Michael. 2001. "Behind the Organic-Industrial Complex." *New York Times Magazine*, May 13, pp. 30–40.

Scaife, Mike and Yvonne Rogers. 1996. "External Cognition: How Do Graphical Representations Work?" *International Journal of Human-Computer Studies* 45(2):185–213.

Schlosser, Eric. 2001. *Fast Food Nation: The Dark Side of the All-American Meal*. Boston, MA: Houghton Mifflin.

Shneiderman, Ben. 1992. "Tree Visualization with Tree-maps: 2-d Space-filling Approach." *ACM Transactions on Graphics* 11(1): 92–9.

Sweller, John, Jeroen J.G. van Merrienboer, and Fred G.W.C. Paas. 1998. "Cognitive architecture and instructional design." *Educational Psychology Review* 10(3): 251–96.

Tidwell, Jenifer. 2005. *Designing Interfaces: Patterns for Effective Interaction Design*. Sebastopol, CA: O'Reilly Media, Inc.

Tufte, Edward R. 1990. *Envisioning Information*. Chesire, CT: Graphics Press.

———. 2006. *Beautiful Evidence*. Chesire, CT: Graphics Press.

110   SOUTHERN RURAL SOCIOLOGY

UNFI (United Natural Foods, Inc). 2007. *United Natural Foods Annual Report*. Retrieved October 21, 2008 (http://library.corporate-ir.net/library/93/932/93228/items/272336/2007_Annual_Report.pdf).

Upchurch, Craig, Michael Kuby, Michael Zoldak, and Anthony Barranda. 2004. "Using GIS to Generate Mutually Exclusive Service Areas Linking Travel on and off a Network." *Journal of Transport Geography* 12(1):23–33.

University of Maryland. 2004. *Treemap 4.1.1*. Retrieved March 14, 2007 (http://www.cs.umd.edu/hcil/treemap/).

USDA (US Department of Agriculture). 2002. *The Census of Agriculture*. Washington DC: National Agricultural Statistics Service.

Vorley, Bill. 2003. *Food Inc.: Corporate Concentration from Farm to Consumer*. London, UK: UK Food Group and the International Institute for Environment and Development. Retrieved July 26, 2008 (http://www.ukfg.org.uk/docs/UKFG-Foodinc-Nov03.pdf).

Ware, Colin. 2004. *Information Visualization: Perception for Design*. 2nd ed. San Francisco, CA: Morgan Kaufmann.

Wattenberg, Martin. 1998. "Map of the Market." *SmartMoney*. Retrieved May 11, 2008 (http://www.smartmoney.com/map-of-the-market/).

Weskamp, Marcos. 2002. "Newsmap." Retrieved May 11, 2008 (http://marumushi.com/apps/newsmap/newsmap.cfm).