

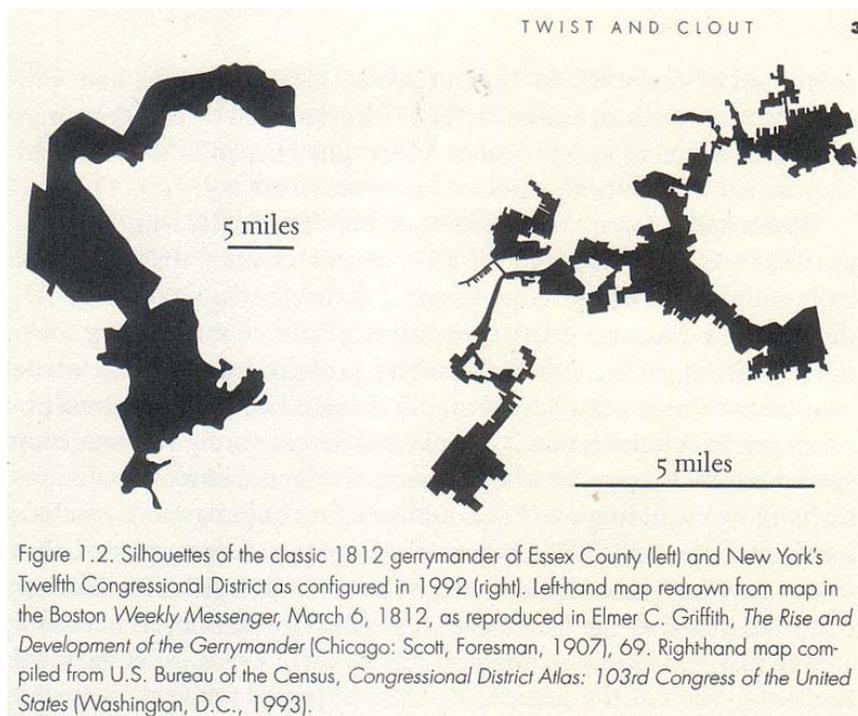
The Art and Science of Redistricting

How Demographic Information is used to Manipulate Elections

The principal source for materials I use in this talk is Mark Monmonier, <http://www.markmonmonier.com/>

Perhaps one of the earliest instances of Gerrymandering was exhibited by Patrick Henry, who, while drawing districts in Virginia in the late 1790's was an opponent of James Madison over states' rights issues and his feeling that the U.S. Constitution, in development, granted too much power to the federal government (in the office of the president.) To be sure, Patrick Henry is credited with helping include the Bill of Rights in the Constitution. But Patrick Henry joined the aristocracy by marriage, not by inheritance. So he remained an ardent opponent of James Madison and when the power to do so presented itself, he drew James Madison's house out of the district he was trying to run in. Thomas Jefferson intervened to rescue Madison's path to the presidency.

Elbridge Gerry was the governor of Massachusetts in 1812 when his party, Thomas Jefferson's Republican Democrats controlled the state legislature, which allowed them to redraw the senatorial district boundaries based on the 1810 census. The Jeffersonians hatched a plot to pack the Federalists into a few districts while snaking a long, thin district from a strip on the north, down along the west side and then over (this is the serpentine figure shown to the left below.)



More recently, Journalists excited the popular imagination by labeling the 103rd Congress of the US the "Bullwinkle District," after the talkative moose from the Saturday morning cartoons. Is Bullwinkle a creation of Boris and Natasha? Maybe...or Carl Rovian types.

The American Heritage Dictionary [1] defines *gerrymandering* as the act of "dividing a geographic area into voting districts so as to give unfair advantage to one party in elections."

Here is the cartoon by Elkanah Tisdale that appeared in the Boston Gazette for March 26, 1812, lampooning the newly configured Essex County, Massachusetts.



The emergence of Bullwinkle-shaped districts of the early 1990's stems, in part, from the 1965 Voting Rights Act that that outlawed various discriminatory voting practices that had been responsible for the widespread disenfranchisement of African Americans in the U.S. Echoing the language of the 15th Amendment, the Act prohibits states from imposing any "voting qualification or prerequisite to voting, or standard, practice, or procedure ... to deny or abridge the right of any citizen of the United States to vote on account of race or color." Specifically, Congress intended the Act to outlaw the practice of requiring otherwise qualified voters to pass literacy tests in order to register to vote, a principal means by which Southern states had prevented African Americans from exercising the franchise. The Act was signed into law by President Lyndon B. Johnson, who had earlier signed the landmark Civil Rights Act of 1964 into law.

Here are some highlights along the path of freeing the slaves:

- The Dred Scott Decision (1857) that people of African descent brought into the United States and held as slaves (or their descendants, whether or not they were slaves) were not protected by the Constitution and were not U.S. citizens.

- The Emancipation Proclamation (1862).

1862/02
By the President of the United States of America.

A Proclamation.

I, Abraham Lincoln, President of the United States of America, and Commander-in-Chief of the Army and Navy thereof, do hereby proclaim and declare that hereafter, as heretofore, the war will be prosecuted for the object of practically restoring the constitutional relation between the United States, and each of the States, and the people thereof, in which States that relation is, or may be, suspended or disturbed.

That it is my purpose, upon the next meeting of Congress to again recommend the adoption of a practical measure tendering pecuniary aid to the free acceptance or rejection of all slave States, so called, the people whereof may not then be in rebellion against the United States ^{and which States} may then have voluntarily adopted, or thereafter may voluntarily adopt, immediate or gradual abolishment of slavery within their respective limits; and that the effort

93

“ . . . on the first day of January . . . all persons held as slaves within any State, or designated part of a State, the people whereof shall then be in rebellion against the United States shall be then, thenceforward, and forever free.”

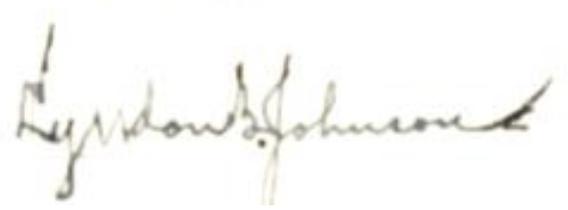
– President Abraham Lincoln, [preliminary Emancipation Proclamation](#), September 22, 1862

- The 14th Amendment (1868) overturned the Dred decision and, like the 5th Amendment, includes a due process clause which can be traced back to the Magna Carta (1215). It also has an equal protection clause, which was decisive in the 1954 Brown vs. the Board of Education decision, which was intended to desegregate public education.
- The 14th Amendment also rendered moot the “3/5 compromise” of 1787, by specifically stating that “Representatives shall be apportioned ...counting the whole number of persons in each State, excluding Indians not taxed...”
- The 15th Amendment (1870) prohibits each government in the United States from denying a citizen the right to vote based on that citizen's "race, color, or previous condition of servitude" (for example, slavery).
- The Voting Rights Act (1965) outlawed discriminatory voting practices that had been responsible for the widespread disenfranchisement of African Americans in mostly southern states (so-called "covered jurisdictions") These states cannot implement any change affecting voting without first obtaining the approval of the Department of Justice.

Speaker of the House of Representatives

Hubert H. Humphrey
Vice President of the United States and
President of the [unclear]

APPROVED
AUG 1 1967


Lyndon B. Johnson

Before the 1960's, districts were highly unregulated.

After mid-1960's, districts had to

- Reconfigure every 10 years
- Minimize variation in population size among districts

By the 1990's,

- Computers, detailed maps and more detailed census data make manipulation easier
- DOJ ready to reject plans that ignore possible minority-majority districts
- If necessary, connect geographically separated minority neighborhoods with thin corridors inhabited by few non-minority "filler people."
- This is how the Bullwinkle district was created, a polygon with 813 sides¹ and whose legislation required 217 lines of verbal description, reading like a crooked taxi driver's itinerary. For instance, the boundary between districts 12 and 10 shown below

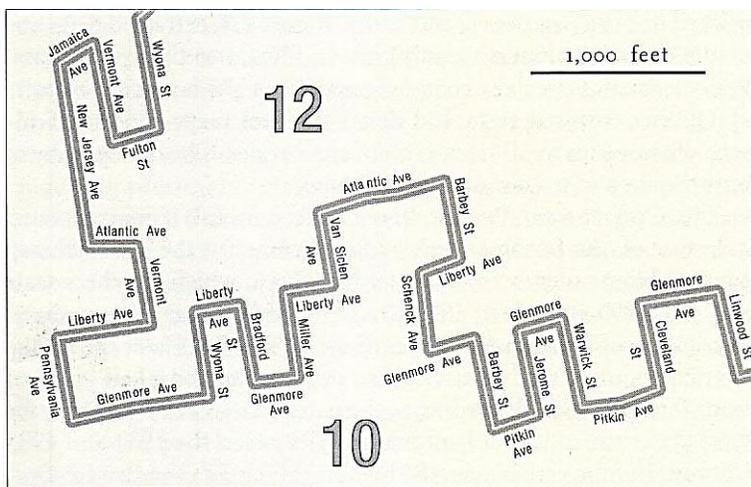


Figure 1.3. Excerpt from U.S. Bureau of the Census, *Congressional District Atlas: 103rd Congress of the United States* (Washington, D.C., 1993), NEW YORK-16.

Dr. Monmonier coined the word "insetuous" to describe the maps required to illustrate the details of these districts.

By the 1990's, the Republicans had figured out that by favoring African American and Latino candidates, almost certain to be Democrats, they could add white voters to formerly Democratic districts, which responded, as hoped, by electing Republicans. As a bonus, they could milk a widely shared resentment of minority-majority districts, perceived as "affirmative action" districts and scapegoated as the cause for middle class union jobs becoming harder to get. While the GOP did not openly advocate minority-majority districts, their candidates could rail against the bushmender's flagrantly contorted shapes. As might be expected, the "filler people" would file law suits that pro-civil rights Democrats would defend and, adding to the irony, federal judges appointed by Presidents Reagan and Bush won the public approval of white Republicans by condemning the racial gerrymanders that helped their party take the House in 1994.

¹ Joe Fodor, "Kings County Almanac: Reapportion This!" *Brooklyn Bridge 2* (July 1997): 20-21

Note: If you go to <http://nationalatlas.gov/printable/congress.html#ny> and look at district 12 today, you see this:

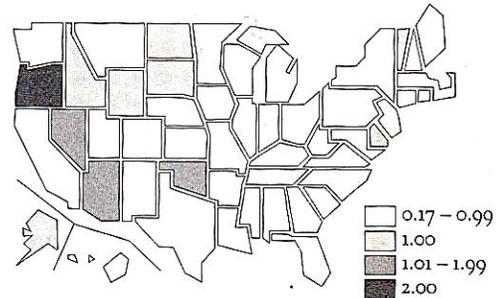


Measuring by Congressional District Atlas map pages to House members gives an indication of where the data hogs have been busy.

A pattern here: most states with high ratios for 1993 are in the South, most have high relatively large percentages of African American or Spanish-speaking residents and, as the figure below shows, most required clearance by the DOJ.

In the same way that Eldridge Gerry's Jeffersonian Republicans packed Federalist voters into Essex County's inner district, Bush Republicans packed white voters into formerly Democratic districts, which responded, as hoped, by electing Republicans.

1983 edition (98th Congress)



1993 edition (103rd Congress)

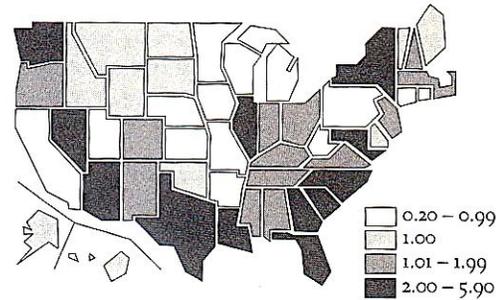


Figure 1.4. Ratio of map pages in the Congressional District Atlas to members of the House of Representatives.

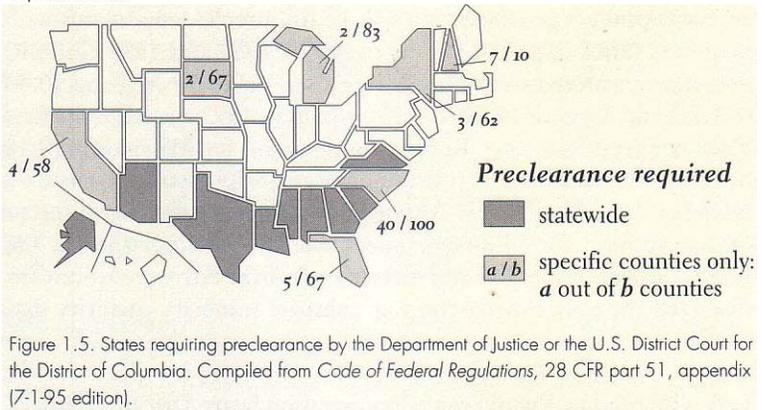


Figure 1.5. States requiring preclearance by the Department of Justice or the U.S. District Court for the District of Columbia. Compiled from Code of Federal Regulations, 28 CFR part 51, appendix (7-1-95 edition).

Here's a hypothetical example showing how racial gerrymandering works.

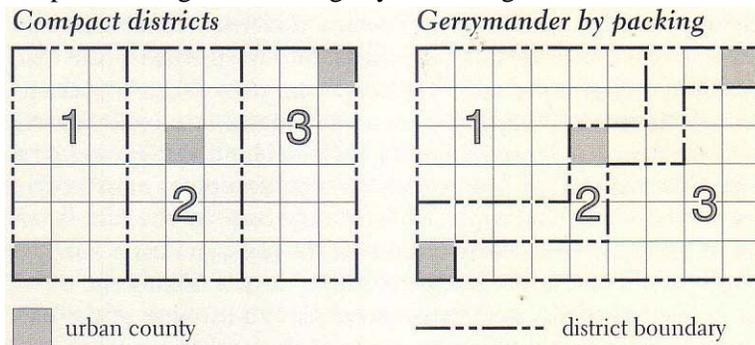


Figure 1.6. Packing opposition votes into a single, comparatively urban district (right) can yield two seats for a largely rural party likely to lose all three otherwise compact districts (left).

Suppose the 6by9 grids above represent an area allotted 3 congressional districts and competing for the voters in these districts are two parties, the Fidels and the Seekers. The Fidels believe in Borg and prefer the rural areas, in particular the 51 unshaded squares, where they outnumber Seekers by a small majority of 81,600 to 71,400. By contrast, the Seekers aren't so sure about Borg, and form a larger majority in the three (shaded) urban squares where they outnumber Fidels by 24,000 to 3000.

Altogether then there are more Seekers: $24,000 + 71,400 = 95,400 > 81,600 + 3000 = 84,600$ so, if votes were apportioned proportionally, as in the compact districts diagram on the left, Seekers would elect 3 representatives and the Fidels none. The Seekers get $71,400/51 = 1400$ votes per rural county and $24,000/3 = 8000$ from each urban county, for a total of $1400 \cdot 17 + 8000 = 31,800$ votes per compact district. Meanwhile, Fidels can muster only $1600 \cdot 17 + 1000 = 28,200$ votes per compact district. If Fidels value the righteous morality of compact districts and winner-take-all victories, then they may be satisfied with the results.

On the other hand, if Fidels in Washington were to redraw the district boundaries on behalf of an ethnic minority of Seekers concentrated in the three urban districts, as shown in the Gerrymander packing on the right, then the Fidels are trounced in that district by $1400 \cdot 11 + 8000 \cdot 3 = 39,400$ to $1600 \cdot 11 + 3000 = 20,600$, but they take the other two districts by $1600 \cdot 20 = 32,000$ to $1400 \cdot 20 = 28,000$. So Fidels go from 0 reps to a majority... while championing minority rights.

While the DOJ of the 90's supported packing, they discouraged "cracking," a gerrymander to break up a concentrated group of interest to dilute its voice. The hypothetical map below shows how a Seeker stronghold may be dismembered to yield three equally urban districts. This could benefit Seekers but it dilutes them.

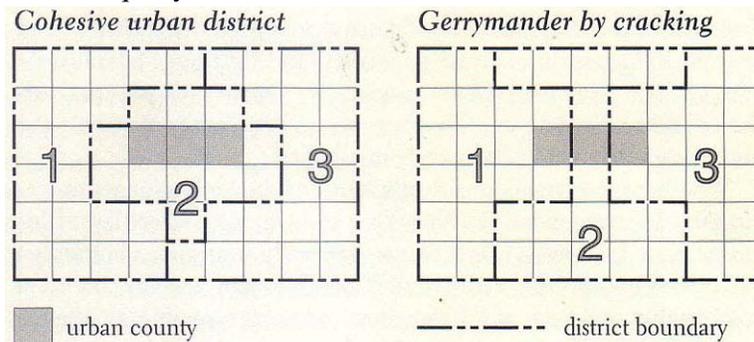
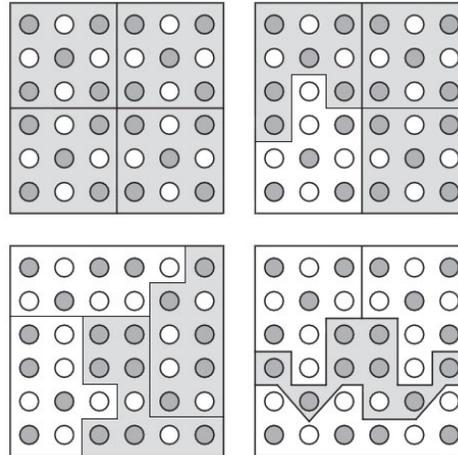


Figure 1.7. Cracking a strongly urban district (left) can dilute the strength of a largely urban party and help its more rural opponents capture all three rural-urban districts (right).

Of course, this is a two-way street. Renowned political cartographer and California congressman Phil Burton managed to crack and pack Republican votes in California so that the 1982 to win 28 of the states 45 districts with only 48% of the statewide vote. This was undone in 1984. By contrast, in 1994, Democrats had 52% of the statewide vote and captured only 27 of the 52 congressional seats.

Here’s another hypothetical situation. The Seekers (filled circles) and Fidels are nicely integrated, with Seekers outnumbering Fidels 25 to 16, as shown. In this situation, the most compact districts with winner-take-all give the Fidels no representatives. With a slight tinkering (upper right), the Fidels can finagle one representative. A Gerrymander like those at the bottom can give Fidels an equal number of representatives, or an actual majority!



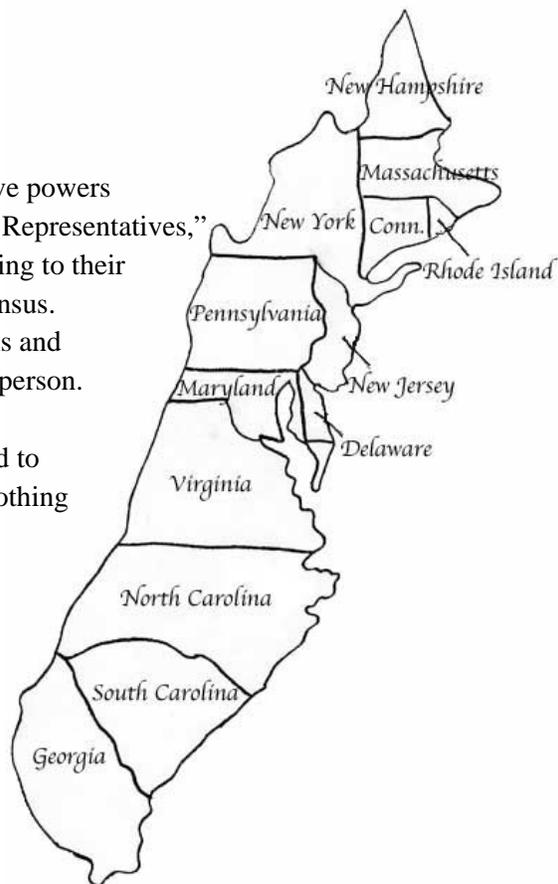
Apportionment

Section 1, Article 1 of the US Constitution assigned legislative powers to Congress “which shall consist of a Senate and a House of Representatives,” and Article 2 apportioned the House among the states according to their “respective Numbers,” as determined every ten years by a census. A formula specified not more than one rep per 30,000 persons and excluded “Indians not taxed” and counted a slave as 3/5 of a person.

Originally the number of reps ranged from 1 for Rhode Island to 10 for Virginia. In those days, the federal government had nothing to say about how a state chose its representatives.

The number of reps per state increased steadily with the population until 1910, when the total number was capped at 435.

Some difficulties arise.



State	Population	seats		
		Exact Quota	25	26
A	9061	8.713	9.061	9.410
B	7179	6.903	7.179	7.455
C	5259	5.057	5.259	5.461
D	3319	3.191	3.319	3.447
E	1182	1.137	1.182	1.227
	26000	25.000	25.000	25.000

Consider, for example, the five-state hypothetical country with populations as shown in the table above. The exact quotas are given for a house of 25, 26 and 27 seats.

For a house of 25 seats the as-near-as-can-be integer solution is 9,7,5,3,1, seats for A,B,C,D,E, respectively. But which state(s) should get the extra seat(s) if there are 26 or 27?

The apportionment act of 1850 fixed on the Hamilton method and, although in force through 1900, did not quash discussion. In 1881m C.W. Seaton, Chief Clerk of the Census Office, wrote that he had “complete various apportionments ... made upon assumptions as to the total number of Representatives ranging from 275 to 350... While making these calculations I met with the so-called ‘Alabama paradox’ where Alabama was allotted 8 Representatives out of 299, receiving but 7 where the total became 300.” Note that the Hamilton method applied to the above example gives $f(p, 26) = (9,7,5,4,1)$ while $f(p, 27) = (9,8,6,3,1)$, that is, state D loses a seat as the House gains a seat.

To see how this works, consider the following hypothetical apportionment.

Alabama Paradox

		seats			101		
		100			101		
Greatest Fractions method of apportionment							
State	Population	Exact Quota	Whole Number	greatest Fractions Apport.	Exact Quota	Whole Number	greatest Fractions Apport.
A	452170	45.217	45	45	45.66917	45	46
B	442260	44.226	44	44	44.66826	44	45
C	105570	10.557	10	11	10.66257	10	10
	1000000	100	99	100	101	99	101

“This atrocity which [mathematicians] have elected to call a ‘paradox’...this freak presents a mathematical impossibility,” said Representative John C. Bell of Colorado. The House majority opted for a 357 members: but every apportionment for 350 through 400 gave Colorado 3 seats save for one: 357, which gave her 2. Similarly, Maine’s rep, whose representation was reduced from 4 to 3, wrote “Not only is Maine subjected to the assaults of Chairman Hopkins, but it does seem as though mathematics and science has combined to make a shuttlecock and battle door of the State of Maine in connection with the scientific basis upon which this bill is presented...God help the State of Maine when mathematics reach for her.”

1910-1973: In 1911 the House chose to have 433 members because, “It is proper to say in this connection that a membership of 433 in the House is the lowest number that will prevent any State from losing a Representative.” The bill provided that if either Arizona or New Mexico were admitted as states before the next apportionment, each would be given 1 representative, bringing the total to 435. The method used was the Webster method.

Wood v. Broom started out as Broom v. Wood in 1932, when congressional wannabe Stewart Broom sued Mississippi Sec. of State Walker Wood over a remap. Broom charged that the new map violated the equality standard (that districts as near as practicable have an equal number of inhabitants) by having one district with 414,000 and another with only 184,000. Two out of three judges on the Federal District Court for Mississippi agreed, but a third judge considered the injunction “an encroachment by the court upon the legislative power of the state.” Encouraged, the state appealed to the SCOTUS who overturned the injunction by claiming there was no equality standard.

Range of District Sizes in Various States in 1930

State	min size	max size	ratio
Mississippi	184000	414000	2.3
Alabama	250000	450000	1.8
California	165000	350000	2.1
Michigan	225000	400000	1.8
Pennsylvania	125000	445000	3.6
South Dakota	200000	650000	3.3
Tennessee	195000	380000	1.9
Ohio	168000	634000	3.8

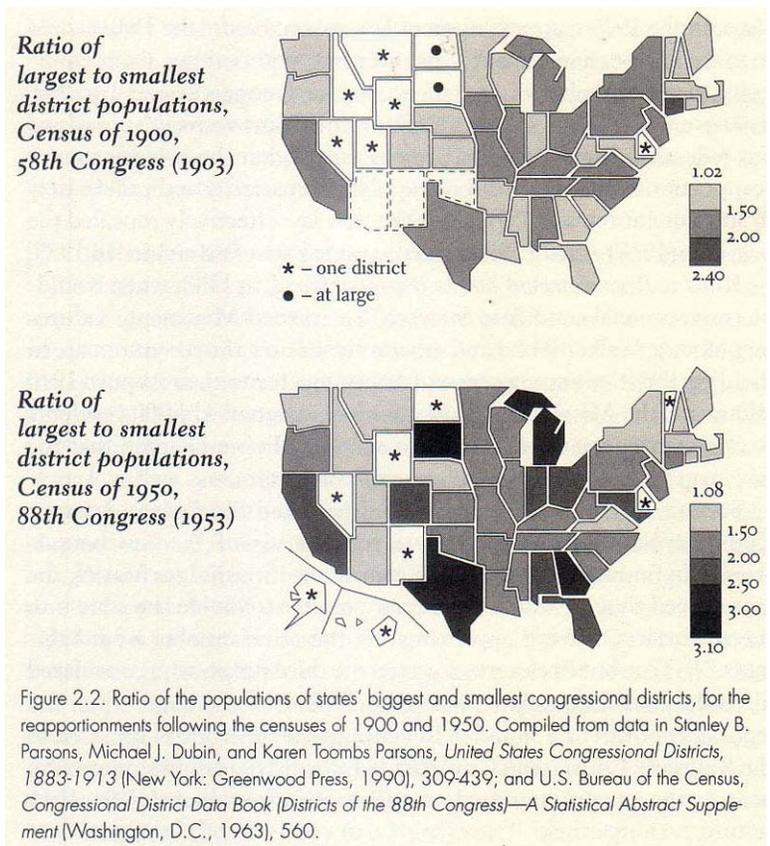


Figure 2.2. Ratio of the populations of states' biggest and smallest congressional districts, for the reapportionments following the censuses of 1900 and 1950. Compiled from data in Stanley B. Parsons, Michael J. Dubin, and Karen Toombs Parsons, *United States Congressional Districts, 1883-1913* (New York: Greenwood Press, 1990), 309-439; and U.S. Bureau of the Census, *Congressional District Data Book (Districts of the 88th Congress)—A Statistical Abstract Supplement* (Washington, D.C., 1963), 560.

Ratios in some states grew into the 100's – or even 1000 for New Hampshire. Finally, in a 1962 ruling, *Baker v. Carr*, the SCOTUS asserted its duty to exercise the equal protection clause of the 14th Amendment guaranteeing that, “no State shall...deny to any person within its jurisdiction the equal protection of the laws.” By the early 70's, numerical ratios fell below 1.1 across the country. With the Voting Rights Act, the registration among blacks in Mississippi grew from less than 7% in 1964 to 62% in 1971 and leading candidates no longer campaigned as segregationists.

Mississippi is the poster child for the VRA. In the maps shown below, thinner boundaries represent counties and thicker boundaries represent districts. The light gray shading indicates a county with a majority of African American citizens.

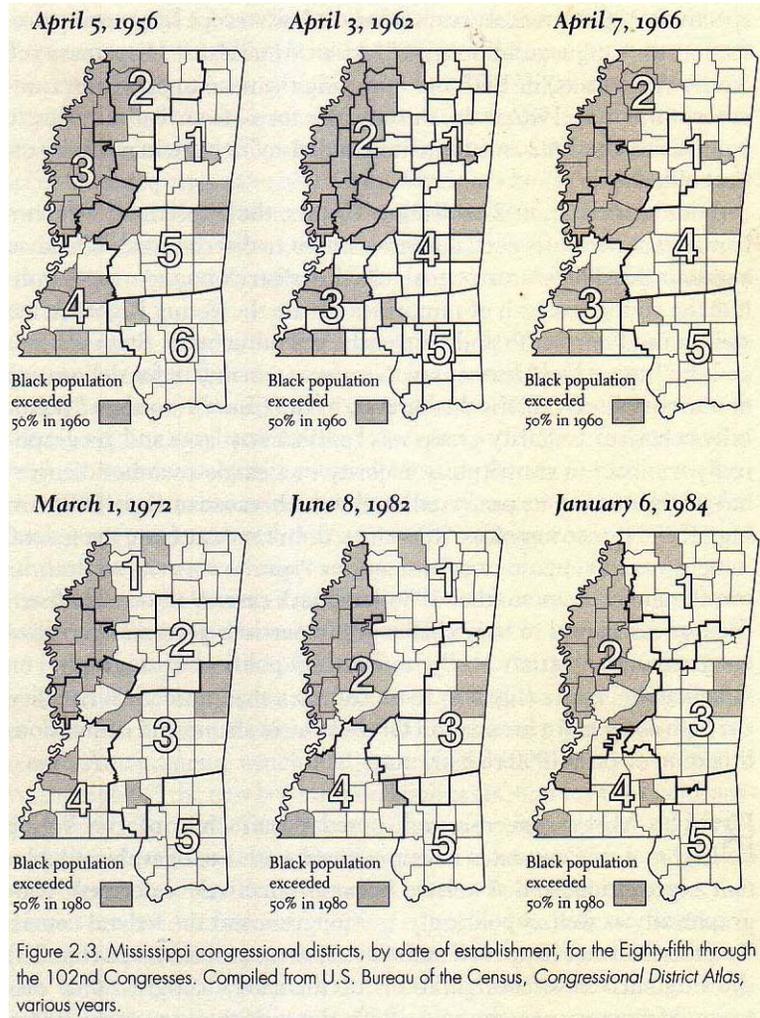
In the maps shown here, thinner boundaries represent counties and thicker boundaries represent districts. The light gray shading indicates a county with a majority of African American citizens.

Note the outmigration of African Americans northward decreased the number of minority-majority districts and cost the state a seat.

Segregationist Governor Barnett chose a consolidation that increased the disparity ratio from 1.93 to 2.06 and forced the moderated representative there into a runoff.

To avoid a court-ordered cartographer, the legislature drew 3 east-west districts, none with a minority majority and reduced the disparity ratio to 1.06 – so the Delta was diced and sliced.

Note how the 1982 map shows district boundaries cutting across counties...the need to blend minority empowerment with equity.



Hinds County officials argued in *Kirksey v. BoS of Hinds County* that their goal in cracking Jackson was equality in population and county highways, and, even though a judge agreed district 3 resembled a turkey and district 4 a baby elephant, he sided with the county and a panel of the 5th Circuit agreed. However, upon appeal to the entire 5th Circuit it was ruled cracking.

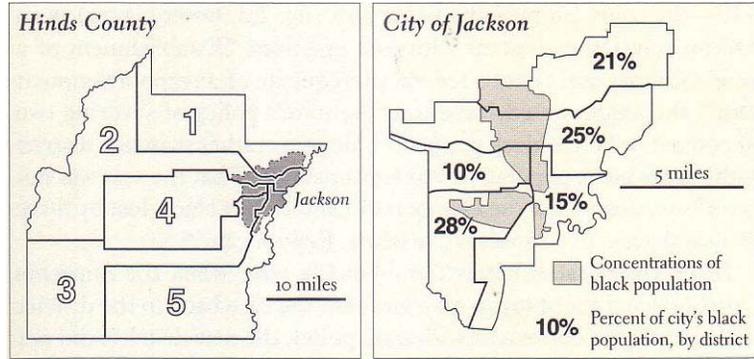


Figure 2.4. Boundaries adopted in 1973 by the Hinds County (Mississippi) Board of Supervisors divided Jackson's black population (right) among all five districts (right). Compiled from Frank R. Parker, *Black Votes Count: Political Empowerment in Mississippi after 1965* (Chapel Hill: University of North Carolina Press, 1990), 155-56.

An apparent weakness in the VRA was the need to prove racial intent. When the law came up for renewal in 1982, Congress shifted the issue of proof from intent to results: a plaintiff need only show that “based on a totality of circumstances...member [of a minority group] have less opportunity than other members of the electorate to participate in the political process and to elect the representatives of their choice.”

In the early 1990's Democrats controlled the MS legislature, the governorship and all house seats. They were confident they could do a remap. But, in an upset, Gov. Mabus lost to Republican Fordice, so they had to hurry it through. The problem was even more black outmigration made it harder to maintain a minority-majority status for district 2, which would likely lose Espy to higher office. This meant very careful boundaries that split 11 counties to maintain a supermajority minority (65%) in district 2.

In 1994, district 1 replaced its retiring 84-year old Democratic incumbent with a conservative republican, who beat his moderate opponent by 63-37%.

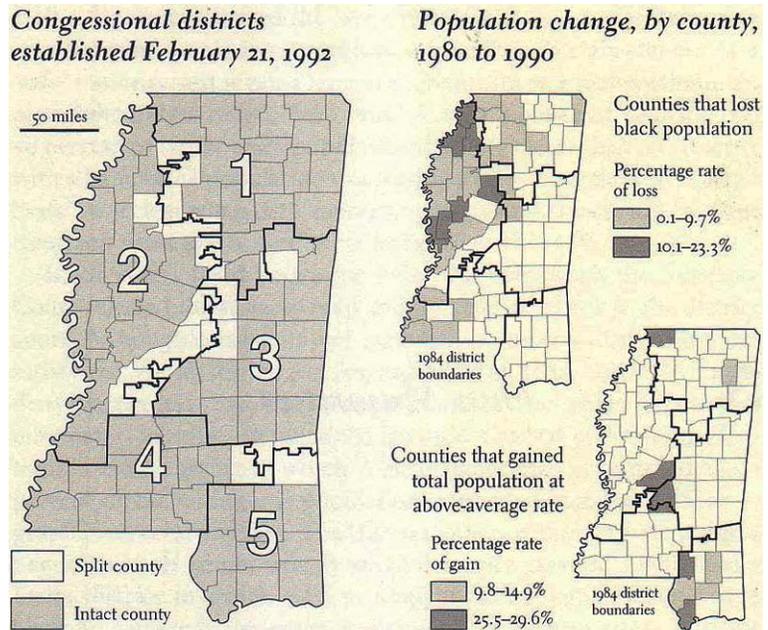


Figure 3.1. Mississippi's post-1990 congressional remap (left) compensated for black losses in the Delta (upper right) and slow growth or loss of total population throughout much of the state (lower right). Compiled from U.S. Bureau of the Census, *Congressional District Atlas: 103rd Congress of the United States* (Washington, D.C., 1993).

North Carolina and MS have similar histories of racial discrimination, but NC gained seats. Blacks in NC are more numerous but aren't as concentrated as they are in MS.

In the 1980's, NC Republicans, a rising force, would join black leaders in opposition to cracking, resulting in many white, Republican suburban districts and minority-majority urban districts.

Compactness was sacrificed to achieve two minority-majority districts and produced what the WaPo termed a "jellyfish tentacle" that followed I85 from Charlotte north to Salisbury, Lexington and Winston-Salem, consuming 30 pages in the Congressional District Atlas for the 103rd Congress.

<https://www.census.gov/geo/www/cob/cd103.html>

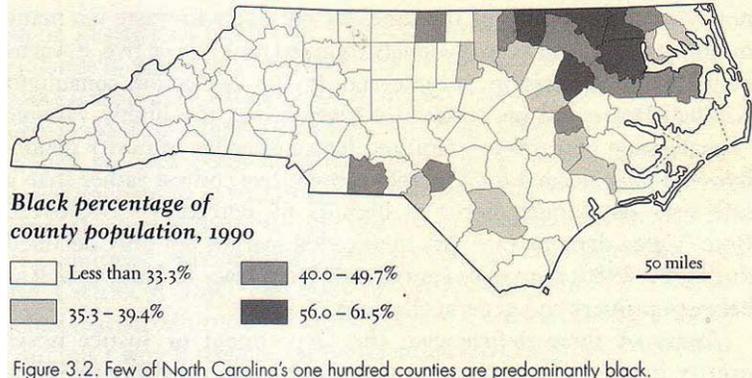


Figure 3.2. Few of North Carolina's one hundred counties are predominantly black.

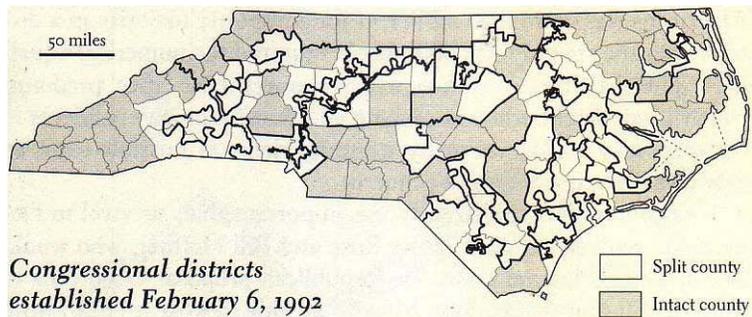


Figure 3.3. North Carolina's post-1990 congressional district boundaries. Compiled from U.S. Bureau of the Census, *Congressional District Atlas: 103rd Congress of the United States* (Washington, D.C., 1993).

Here's a detail of NC's district 12 showing a corridor less than 100 ft. wide.

Conservative columnist James J Kilpatrick described district 12 saying it

"rather resembles a lower intestine."

Candidate Mickey Michaux promised to hold

"campaign rallies at every exit along I85 from Vance County all the way to Mecklenburg County."

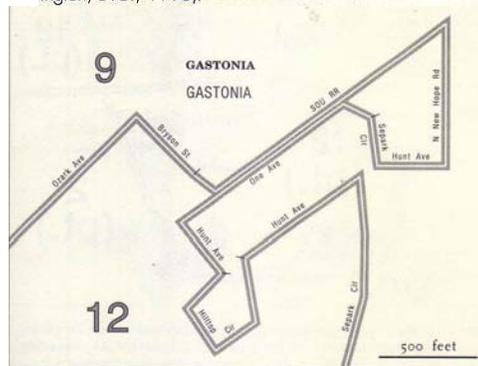


Figure 3.4. Bounded by District 9 along One Avenue and the Southern Railway, District 12 occupies a corridor less than one hundred feet wide. Excerpt from U.S. Bureau of the Census, *Congressional District Atlas: 103rd Congress of the United States* (Washington, D.C., 1993), North Carolina section, 25, inset D.

There are many instances of what geographers call point contiguity: boundary lines that converge to a point and then diverge, as shown below to the right. Here a black enclave in the city of Durham in turn encloses a largely nonblack portion of District 2 bounded by Shropshire Place, Stonehenge Avenue and a stream.

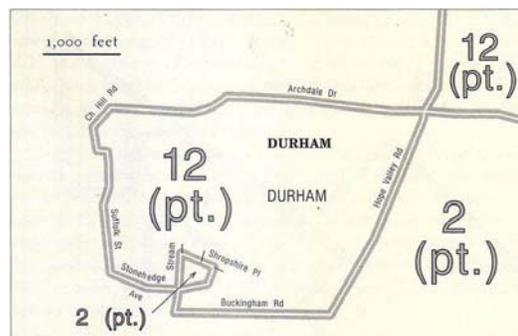


Figure 3.5. Districts 2 and 12 converge to a point twice, so that a part of District 2 is nested within a part of District 12, nested in turn in a part of District 2. Excerpt from U.S. Bureau of the Census, *Congressional District Atlas: 103rd Congress of the United States* (Washington, D.C., 1993), North Carolina section, 18, inset B.

At right are the NC districts drawn as silhouettes. This illustrates a principle that graphics guru [Edward Tufte](#) dubbed “small multiples” (see the next page for another illustration of this principle with knight’s tours.)

The two minority-majority districts are in the upper left and differ markedly in size and shape. District 1 shows the dispersal of rural blacks in the Carolina coastal plain, while district 12 shows the concentration of urban blacks in industrial cities.

Monmonier points out that, while district 12 may look peculiar, it is “more uniform economically & demographically than many of its more geographically compact counterparts.”

Thanks to the GHW Bush DOJ, NC had its first and second African American representatives in the 20th century. What followed was an unbelievable back and forth between SCOTUS, DOJ and lower circuit judges with myriad suits and countersuits and 5-4 decisions reversing other 5-4 decisions that ultimately ruled, as Chief Justice Rhenquist put it, “...the NC plan does violate the Equal Protection Clause because the State’s reapportionment scheme is not narrowly tailored to serve a compelling state interest,” and the I85 District “could not remedy any potential §2 violation because a plaintiff must show that the minority group is geographically compact to establish §2 liability.” Justice John Paul Stevens vehemently dissented.

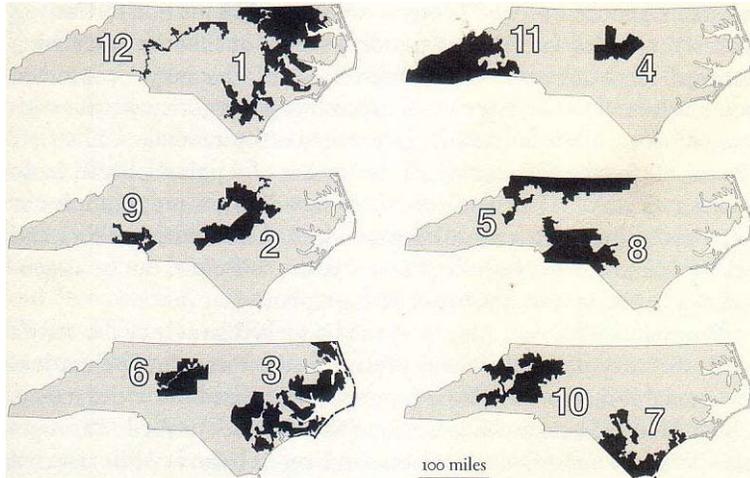


Figure 3.6. Silhouettes of North Carolina’s post-1990 congressional districts. Compiled from U.S. Bureau of the Census, *Congressional District Atlas: 103rd Congress of the United States* (Washington, D.C., 1993).

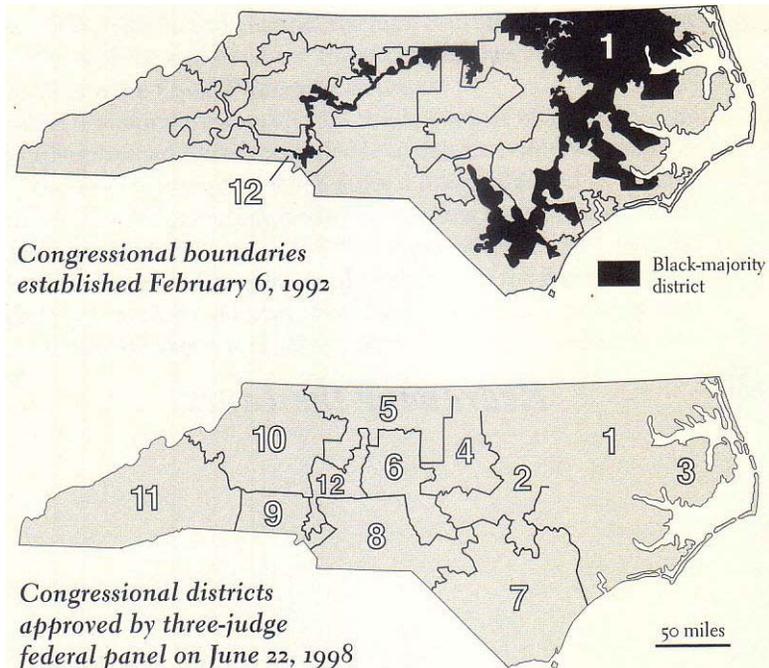
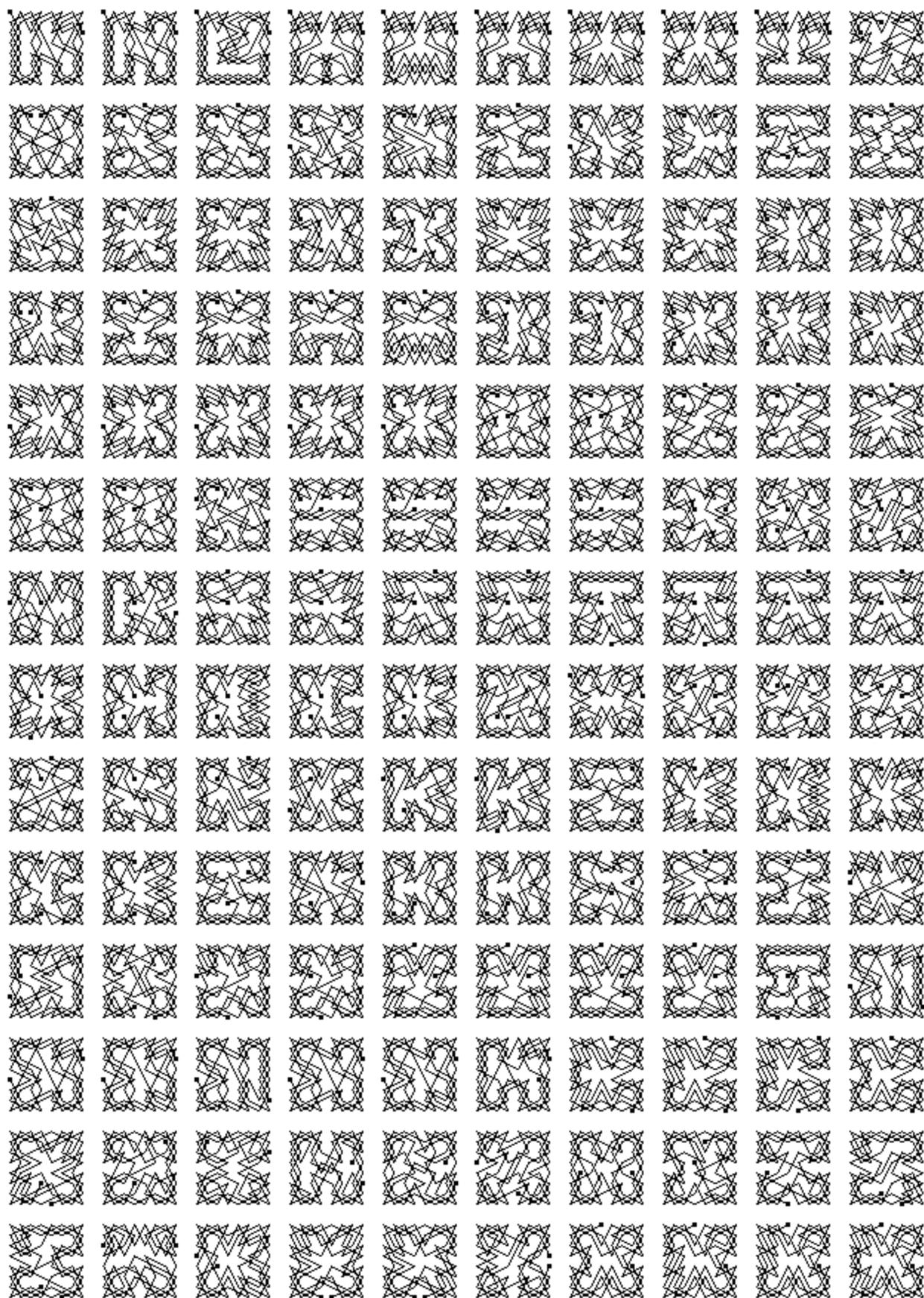


Figure 4.1. North Carolina congressional districts for the 1992 and 1998 elections. Compiled from the *Congressional District Atlas* and an updated map from the North Carolina General Assembly. Because a 1999 Supreme Court decision overturned the lower-court ruling the lower map was designed to address, these boundaries were used in 1998 but not in 2000.



NC might justifiably feel abused—an innocent victim of competing forces in government. Consider, by contrast, NY’s 12th district (Bullwinkle) and Illinois 4th district, escaped the fate of NC’s 12th district. It was challenged, and a 3-judge panel in Chicago decided it “passes constitutional muster.” SCOTUS declined to hear the appeal.

To give the black representatives from NC some hope, there was the case of Georgia, where a court-imposed remap cut the number of minority-majority districts from 3 down to 1. District 5 (Atlanta) was not much affected but district 2’s restructuring reduced its black majority from 52 to 35% of voting age citizens. District 11 was vaulted over district 10, reducing its black voters from 60 to 11%, though district 10 saw its share of black voters increase from 16 to 34%. In spite of the geographic reshuffling, all three black representatives won reelection. Most prominent was Cynthia McKinney, who jumped from District 11 to District 4. Only 33% of her district was black, but she got 58% of the vote in her election.

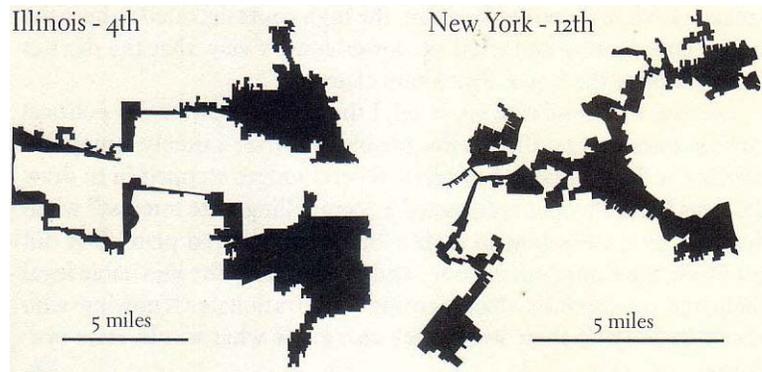


Figure 3.9. Illinois’s Fourth District and New York’s Twelfth District have Hispanic majorities, but only the New York district was judged unconstitutional. Compiled from the *Congressional District Atlas: 103rd Congress of the United States* (Washington, D.C., 1993).

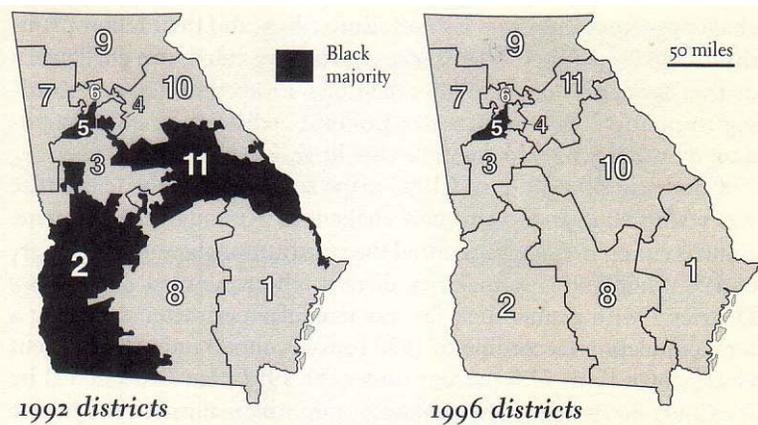


Figure 4.2. Georgia congressional districts for the 1992 and 1996 elections. Compiled from the *Congressional District Atlas* and the updated *Congressional Districts State Map Data Sets, 105th Congress*, from the Geography Division, Bureau of the Census.

However, the bushmunder strategy eventually held sway. Before the 1992 election Georgia had 10 delegates including 1 black and 1 Republican, but by 1996 there were 8 white Republicans and 3 black Democrats.

Louisiana had a brush with bushmaderism similar to Georgia's. Demographic patterns supported a single minority-majority district within New Orleans, but DOJ inststed on a second minority-majority district which cut across the map, as pundits gloated, like the mark of Zorro. Lawsuits were filed with impassioned pleas to federal judges, a decisive finding of unconstitutional racial bias, and a court-drawn 1996 map that was much simpler was fashioned. But the irradiation of the 1992 map involved an intermediate 1994 map which also had two minority-majority districts, and was also condemned by the courts. Unlike Georgia, the black incumbent from district 4 did not survive. In the final SCOTUS ruling, Justice Anthony Kennedy wrote, "Shape is relevant not because bizarreness is a necessary element of the constitutional wrong or a threshold requirement of proof, but because it may be persuasive evidence that race of its own sake...was the legislature's dominant and controlling rationale in drawing its district lines."

Also, by a 5-4 majority, SCOTUS ruled three minority-majority districts in Texas were based predominantly on race and hence unconstitutional. The argument that communities of interest were united by transportation lines was rejected by Justice Sandra Day O'Connor. Ironically, GW Bush appealed the lower court ruling that struck down these bushmanders...but truly remarkable is that, as if to reinforce the notion that race, not shape, was at the heart of the matter, the courts did not condemn the equally contorted white-majority districts. Justice John Paul Stevens wrote an especially biting dissent.

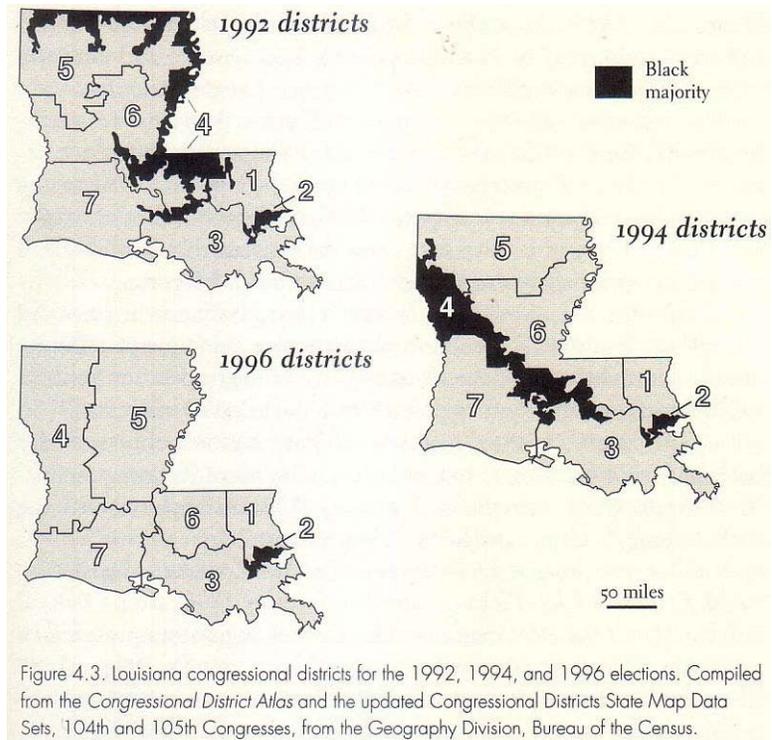


Figure 4.3. Louisiana congressional districts for the 1992, 1994, and 1996 elections. Compiled from the *Congressional District Atlas* and the updated *Congressional Districts State Map Data Sets*, 104th and 105th Congresses, from the Geography Division, Bureau of the Census.

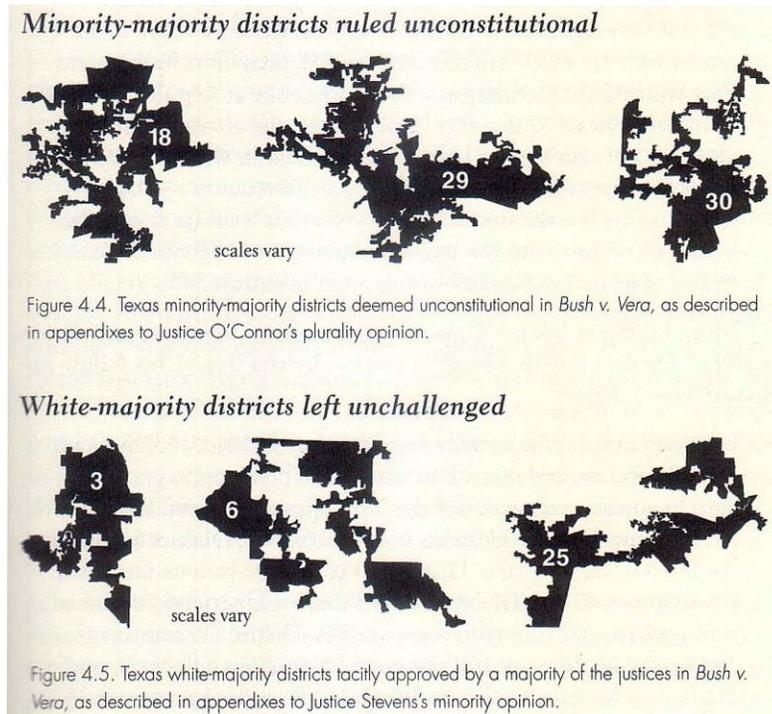


Figure 4.4. Texas minority-majority districts deemed unconstitutional in *Bush v. Vera*, as described in appendixes to Justice O'Connor's plurality opinion.

Figure 4.5. Texas white-majority districts tacitly approved by a majority of the justices in *Bush v. Vera*, as described in appendixes to Justice Stevens's minority opinion.

Measuring Compactness.

Rivers, shorelines, highways, mountains and other highly functional political borders tend to meander, and tend to make political boundaries more contorted – so contortion is not inherently reprehensible. Also, severe variations in population density undercut the significance of silhouette maps. In the age of the internet and the interstate highway, geometric distance becomes less significant.

Here are two common geometric measures for compactness which range from 1 for the perfectly compact, to 0 for the maximally bizarre.

The *dispersion score* is computed by dividing the area of the district by the area of the smallest circle that contains the district. As the diagram shows, this does pretty well, but is not particularly sensitive to incisions or appendages that appear within the district's circumscribed circle. Note the variation of the three districts with dispersion score = 0.5.

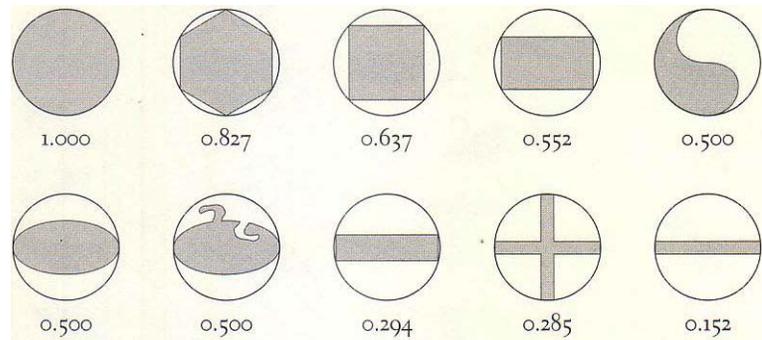


Figure 5.1. Dispersion scores for a variety of shapes illustrate the measurement of circular fullness.

To account for this perimeter variance, we can use the *perimeter score*, which is computed by dividing the district's area by the area of a circle with the circumference equal in length to the district's perimeter. Think of it as the relative expense of buying fence by the mile or paying cartographic drafters by the inch. These examples at the right all have the same perimeter, but as their scores indicate, their areas are quite different.

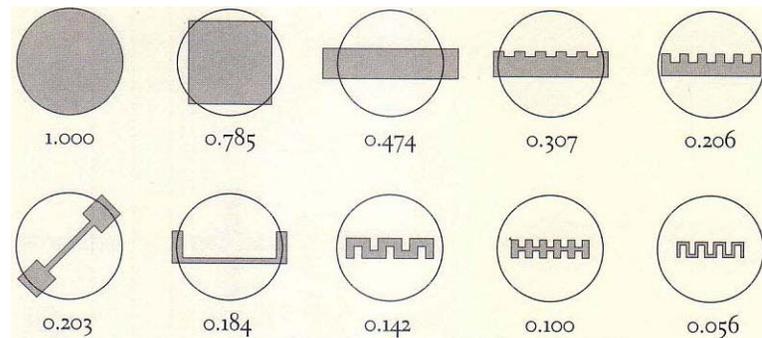


Figure 5.2. Perimeter scores for a variety of shapes illustrate the measurement of boundary efficiency.

To gauge how well these indices measure compactness of real congressional districts, Monmonier arranged the generalize silhouettes of NC's districts along separate dispersion and perimeter scales.

Not too surprisingly, NC's 12th district measures poorly on both scales, but NC's other minority-majority District 1 has a markedly higher dispersion score.

Compare District 4 and District 6.

While the two compactness measures appear mildly correlated, very low perimeter scores are more likely to be unconstitutional than very low dispersion scores. This can be explained in two ways:

1. The courts struck down all five districts with perimeter scores of 0.01, but as you can see, a highly inefficient boundary can enclose comparatively circular regions like Texas' District 18, as well as NC's flagrantly elongated 12th district. That all 5 are minority-majority districts shows the DOJ's insistence on uniting dispersed minority populations.
2. By contrast, look at the two districts of perimeter score 0.02 which survived court scrutiny as compared to the two minority-majority districts that didn't. This shows that, when race is not a factor, bizarre borders are fine. While the two districts with a perimeter score of 0.03 satisfied "constitutional muster," they did attract much scrutiny. So an inefficient border makes a racial gerrymander more vulnerable to judicial intervention.

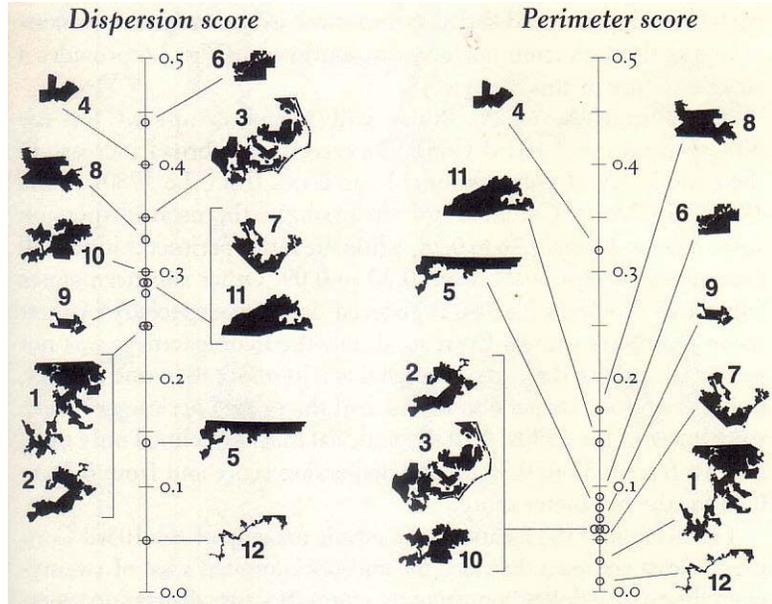


Figure 5.3. Compactness indexes for North Carolina's 1992 congressional districts. Based on dispersion and perimeter scores reported in Richard H. Pildes and Richard G. Niemi, "Expressive Harms, 'Bizarre Districts,' and Voting Rights: Evaluating Election-District Appearances after *Shaw v. Reno*," *Michigan Law Review* 92 (1993): 562, table 2.

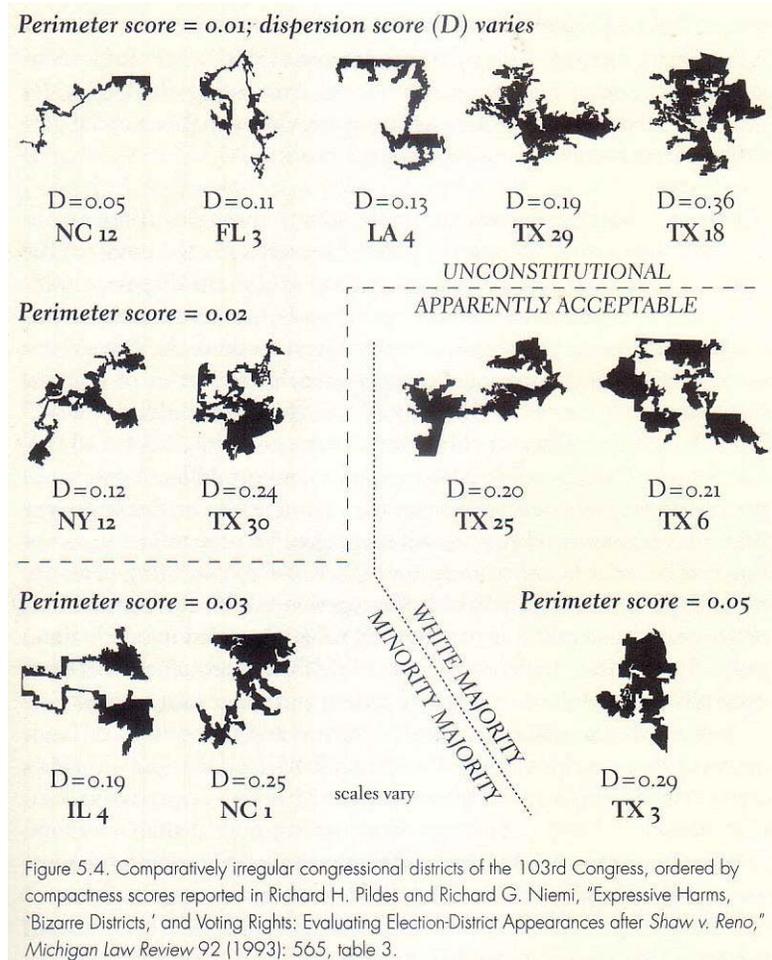


Figure 5.4. Comparatively irregular congressional districts of the 103rd Congress, ordered by compactness scores reported in Richard H. Pildes and Richard G. Niemi, "Expressive Harms, 'Bizarre Districts,' and Voting Rights: Evaluating Election-District Appearances after *Shaw v. Reno*," *Michigan Law Review* 92 (1993): 565, table 3.

Consider the plight of cartographers vis-à-vis coastlines and rivers such as the Mississippi. Redistricting committees can't control the perimeter score for districts with these boundaries. Louisiana's 1992 4th district boundary, for instance.

Mathematicians might estimate the length of smooth curves that reflect the general trend of natural boundaries, such as those shown here, but these are hard to codify in redistricting regulations. But what about mountains with penetrating tunnels, etc?

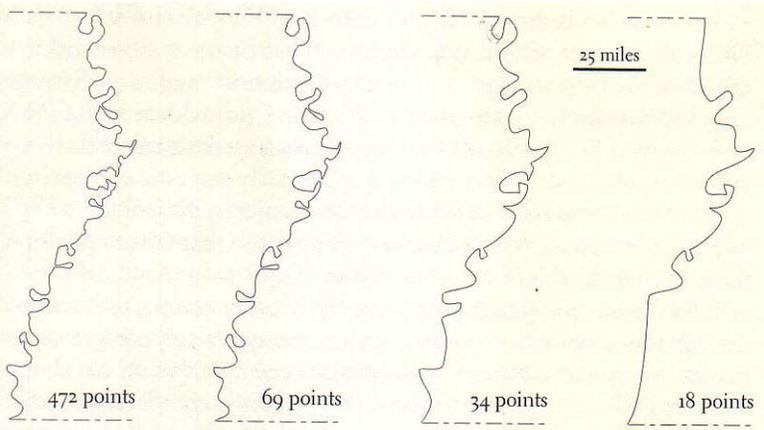


Figure 5.5. Small-scale renderings of Louisiana's riverine boundary with Mississippi demonstrate the varying degrees to which generalization algorithms can simplify, smooth, and shorten cartographic lines.

Another concern is population density. In much the way that a perimeter score is skewed by natural boundaries, a dispersion score fails to consider uneven population densities.

There are several remedies proposed.

1. The minimum circumscribed circle (the one used for the dispersion score) and
2. The convex hull formed by stretch a giant rubber band around the district. Dividing the district population by the population residing within the reference figure yield a population score ranging from 1 for perfect population compactness to nearly zero for a district that includes relatively few residents of the surrounding region.

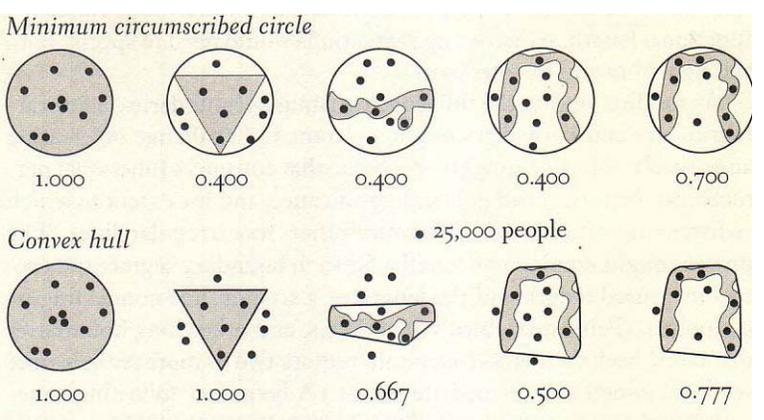


Figure 5.6. Population scores for a variety of shapes illustrate the measurement of population dispersion relative to two reference figures, the minimum circumscribed circle and the convex hull.

For further amusing research, watch the movie *Gerrymandering* (2010) on Hulu <http://www.hulu.com/watch/255611> and/or play the Redistricting Game: <http://www.redistrictinggame.org/>