



Invasion and Range Expansion of Imported Fire Ants (Hymenoptera: Formicidae) in North America from 1918-1995

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Key Words: Imported fire ant, *Solenopsis invicta*, *Solenopsis richteri*, distribution.

RESUMEN

Nativas de América del Sur, las hormigas importadas del fuego fueron detectadas en los Estados Unidos en Mobile, Alabama, alrededor de 1918. En 1958 las hormigas importadas del fuego se habían expandido a todos o parte de los 141 condados/parroquias en 8 estados, cubriendo 25,272,706 ha. En 1995, esta plaga incrementó su rango al incluir un total de 114,098,722 ha en todos o parte de los 670 condados/parroquias en 11 estados y en Puerto Rico.

The first imported fire ant identified in the United States was the black imported fire ant, *Solenopsis richteri* Forel (Loding 1929). Creighton (1930) estimated the arrival of *S. richteri* from South America to be around 1918 through the port of Mobile, AL. A second species, the red imported fire ant, *S. invicta* Buren, also arrived through the port of Mobile, AL, sometime between 1933 and 1945 (Lennartz 1973). The fact that there were two species present in the United States was not fully recognized until Buren (1972) revised the taxonomy for the imported fire ants. More recently, it was discovered that a hybrid form of the two species also exists (Vander Meer et al. 1985, Diffie et al. 1988).

Information and data relative to the range expansion of the imported fire ants, *S. richteri* and *S. invicta*, is scattered throughout the literature. Several authors have examined range expansion through 1953 to 1974 (Culpepper 1953, Wilson & Brown 1957, George 1958, Adkins 1970, Buren et al. 1974). More recent authors have briefly reviewed range expansion before discussing the history of imported fire ant control (Lofgren 1986) or quarantine (Lockley & Collins 1990). The minimal historical data that are available on the specific ranges of *S. richteri* and the hybrid suggest that *S. invicta* has displaced *S. richteri*, pushing it to the northern edges of the range. Diffie et al. (1988) found *S. richteri* in a band from northeastern Mississippi to northwestern Alabama, and the hybrid in a slightly larger area from eastern Mississippi through Alabama into northwestern Georgia, thus separating the two *Solenopsis* species in this area. A 1993 survey in Tennessee found *S. richteri* in 8 southern counties and the hybrid in 4 southern counties (R. G. Milam, USDA, APHIS, PPQ, Nashville, TN, personal communication).

This document is not intended to speculate on possible future range expansion, but to simply compile all known information on range expansion of imported fire ants into a single source.

MATERIALS AND METHODS

Objective Criteria

In order to accomplish our objective, the following criteria were used.

1. The overall expansion of all imported fire ants was established; expansion of individual species or their hybrid was not differentiated due to lack of historical data on *S. richteri* and the hybrid.
2. Over the years, the Federal imported fire ant quarantine document (Code of Federal Regulations, Title 7, Section 301.81 - hereafter cited as CFR) has listed the affected areas in a variety of ways: regulated areas,

generally infested areas, eradication areas, suppressive areas, and quarantined areas. For our purposes, we consider any county/parish listed in the CFR as an infested area. Information listed in the CFR is submitted annually by the United States Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine, and is based on physical surveys conducted by Federal or State quarantine officials.

3. Pockets of infestations may be present in any given year outside the area listed in the CFR for that year. Since these areas are not cited in any consistent manner, they were not included.
4. In order to determine the total number of hectares infested per year, total area infested per county/parish was extrapolated from the literature for 1918-1953 (see Extrapolation methods below). From 1958-1995, all data came from the annual CFR. Counties are listed in the CFR as partially or fully infested, but partial boundaries would have been difficult to accurately determine for all counties over the 35 year period. Therefore, total county area was used regardless of amount of county infested. County/parish area was obtained from Rand McNally (1993).

Extrapolation Methods

- 1918: In a personal communication from H.P. Loding, Creighton (1930) reported that the ant appeared in Mobile, AL about 1918. We estimated at arrival, the ant infested about 1 acre (0.4047 ha) around the port of Mobile.
- 1930: Creighton (1930) reported that the infestation extended 6-7 miles from Mobile. We assumed the infestation radiated out from the port of Mobile, making a circular pattern around the port with a diam of 7 miles (area = πr^2 = 38.48 square miles or about 9968 ha).
- 1939: Adkins (1970) reported that prior to 1940 there were 12 counties infested: 2 in Florida, 3 in Mississippi, and 7 in Alabama. His map indicated the specific counties. We assumed only the counties completely surrounded by other infested counties were fully infested and all others were partially infested. For our calculations, total county area was used for fully infested counties, and 0.5 county area was used for partially infested counties. All county area was obtained from Rand McNally (1993).
- 1953: Culpepper (1953) reported the results of several years of surveys by listing the counties infested and describing the area infested within each county. From these descriptions, we made the following assumptions for our calculations:
- entire county = total county area
 - corner or portion (ex. SE corner) = 0.25 county area
 - corner or portion (ex. southern corner) = 0.5 county area
 - nursery = average size of nursery in that state in 1950 as documented by Hurley (1952); average ha in field grown stock, does not include material grown under glass or in houses
 - area around a cited town = sq. miles of township in 1960 as documented by Area Measurement Reports (1960); towns of <1000 people not listed and therefore arbitrarily assigned 0.5 sq. miles or 130 ha (smallest town listed in reference = 0.6 sq. miles or 155 ha)

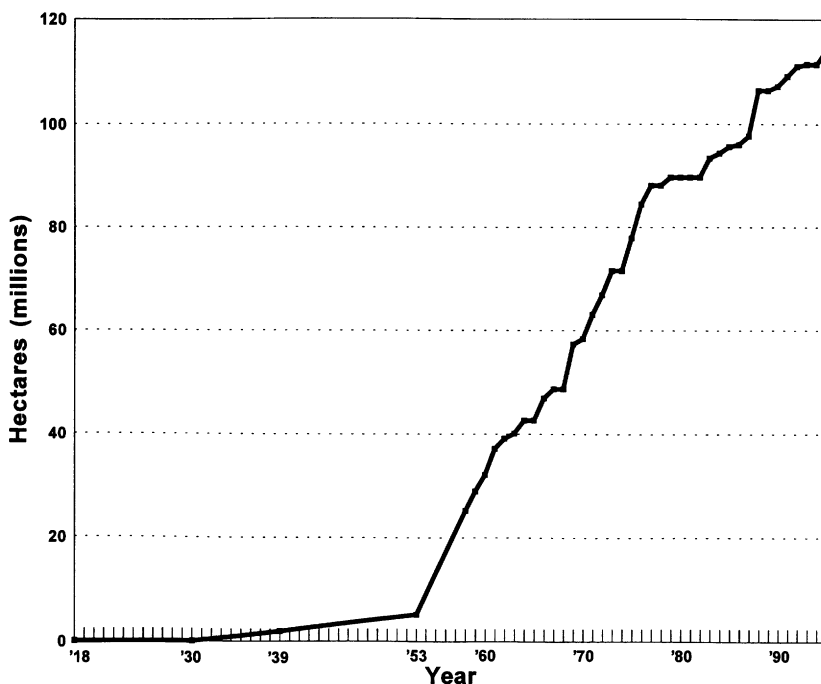


Figure 1. Number of hectares in North America infested by imported fire ants from 1918 - 1995.

RESULTS

Date of Infestation

A list of counties/parishes by state which are all or partially infested/quarantined and the year they became infested/quarantined is provided in Appendix I.

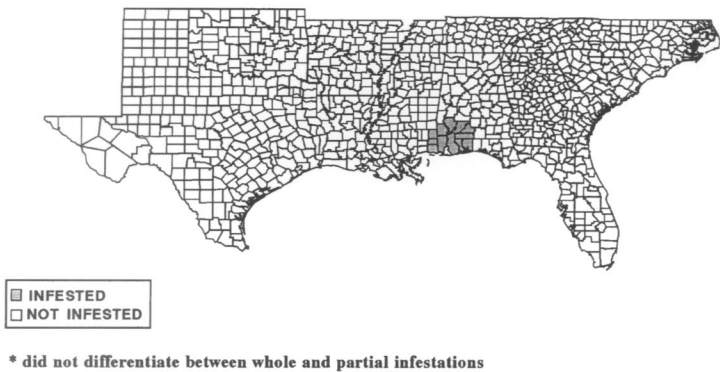
Range Expansion

The average yearly increase in range for the imported fire ants was 147,642 ha between 1918 and 1953 (Fig. 1). During this time, most surveys were conducted by individual states, since there was no Federal quarantine to coordinate the efforts. Since the inception of the Federal quarantine in 1958, the average range expansion has been 2,400,703 ha per year. However, in some years, no additions were made to the Federal quarantine. In those years, it is unknown if new areas meeting the criteria necessary for inclusion in the Federal quarantine were not found, or if no surveys were conducted due to lack of manpower or funds.

Through 1958, imported fire ants expanded their range fairly consistently in all directions from Mobile, AL; north, east and west (Figs. 2 and 3). From 1958 until 1975, the expansion progressed rapidly eastward and westward, while there was little expansion into areas further north (Figs. 3, 4, and 5). Since 1975, movement has slowed (Figs. 5, 6, and 7), probably due to climatic limitations. During this time, the ants were

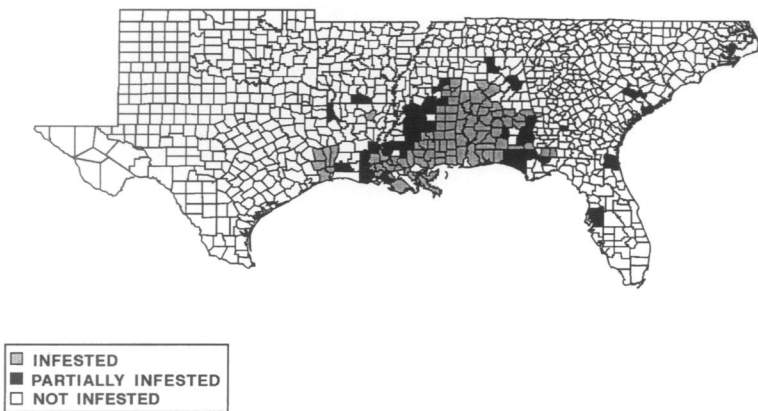
2

INFESTED COUNTIES - ca 1939
Adkins 1970*

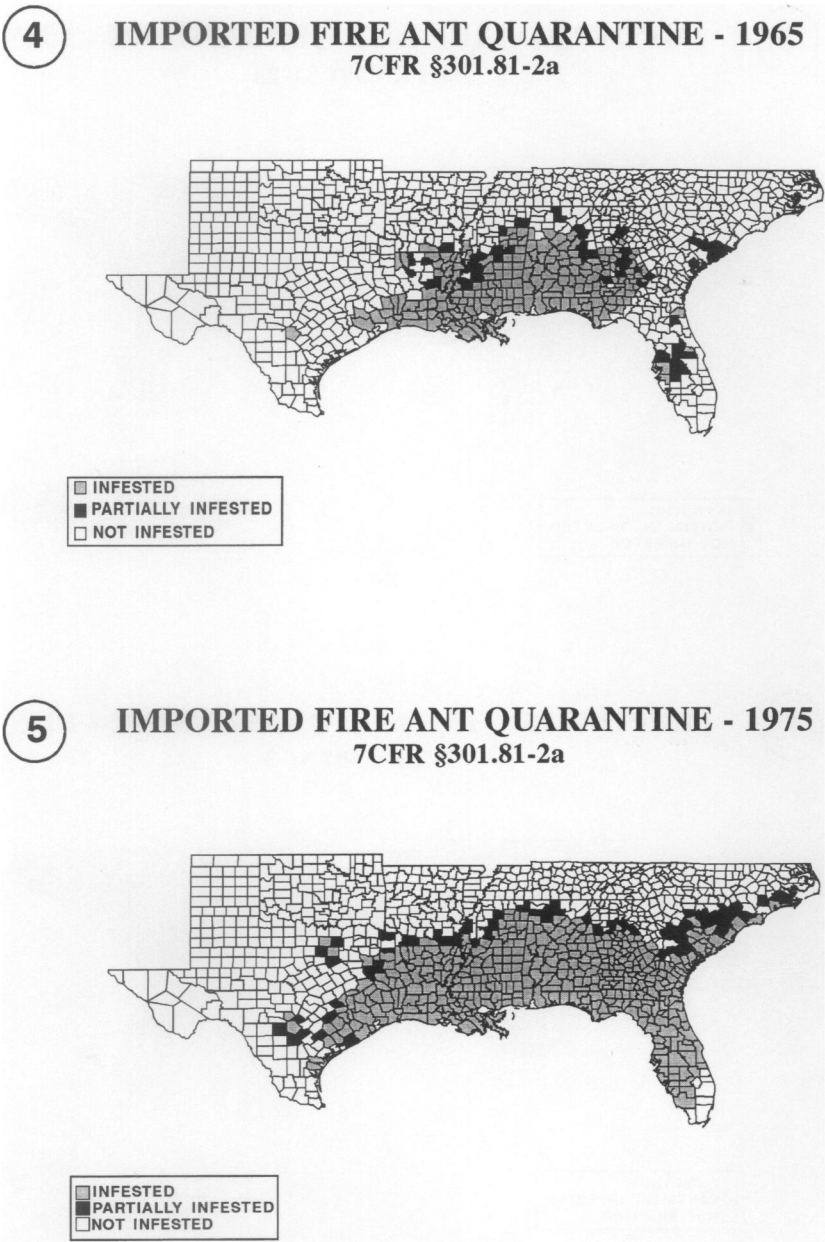


3

IMPORTED FIRE ANT QUARANTINE - 1958
7CFR §301.81-2a effective May 6, 1958



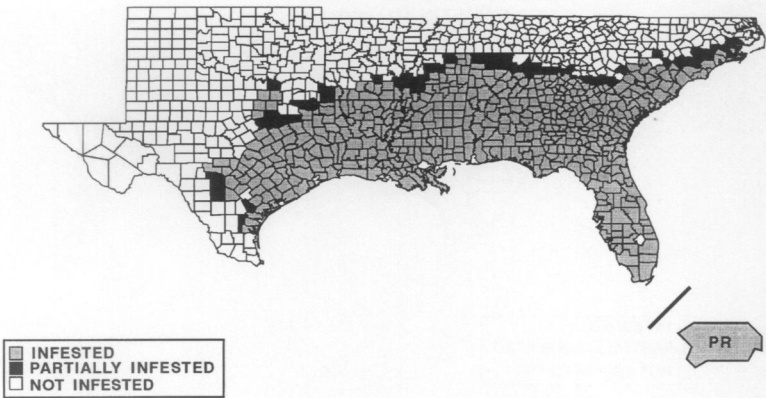
Figures 2-3. Counties infested by imported fire ants. 2.) about 1939; 3.) 1958.



Figures 4-5. Counties infested by imported fire ants. 4.) 1965; 5.) 1975.

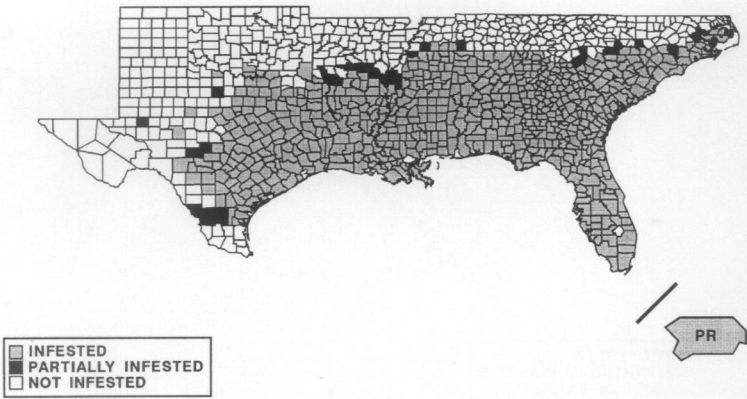
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IMPORTED FIRE ANT QUARANTINE - 1985
7CFR §301.81-2a



7

IMPORTED FIRE ANT QUARANTINE - 1995
7CFR §301.81-3



Figures 6-7. Counties infested by imported fire ants. 6.) 1985; 7.) 1995.

introduced into Puerto Rico, possibly on oil field equipment shipped from the U.S., and there was also expansion west into central Texas. Other movement during the past 20 years has been a slow "filling in" of the northern ranges of the ant.

DISCUSSION

From their invasion into Mobile, AL in 1918, imported fire ants rapidly spread over 25,272,706 ha (62,448,000 acres) into all or part of 141 counties/parishes in eight states by 1958. By 1995, the pest had expanded its range to include a total of 114,098,722 ha (281,934,080 acres) in all or part of 670 counties/parishes in 11 states and Puerto Rico.

While range expansion has slowed in the last 20 years, and the range of the ant is limited by temperature and moisture, future expansion is expected and should continue to be monitored.

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APPENDIX I

Alabama: Autauga (1953), Baldwin (1931), Barbour (1958), Bibb (1958), Blount (1966), Bullock (1958), Butler (1958), Calhoun (1958), Chambers (1961), Cherokee (1975), Chilton (1953), Choctaw (1953), Clarke (1939), Clay (1961), Cleburne (1966), Coffee (1962), Colbert (1977), Conecuh (1939), Coosa (1961), Covington (1958), Crenshaw (1958), Cullman (1969), Dale (1958), Dallas (1953), DeKalb (1984), Elmore (1958), Escambia (1939), Etowah (1958), Fayette (1966), Franklin (1975), Geneva (1958), Greene (1958), Hale (1958), Henry (1958), Houston (1958), Jackson (1988), Jefferson (1958), Lamar (1960), Lauderdale (1977), Lawrence (1975), Lee (1958), Limestone (1958), Lowndes (1953), Macon (1958), Madison (1984), Marengo (1953), Marion (1966), Marshall (1976), Mobile (1918), Monroe (1939), Montgomery (1953), Morgan (1958), Perry (1953), Pickens (1958), Pike (1960), Randolph (1969), Russell (1958), St. Clair (1960), Shelby (1959), Sumter (1953), Talladega (1959), Tallapoosa (1961), Tuscaloosa (1958), Walker (1958), Washington (1939), Wilcox (1953), Winston (1975)

Arkansas: Ashley (1963), Bradley (1972), Calhoun (1977), Chicot (1973), Cleveland (1983), Columbia (1975), Dallas (1987), Desha (1983), Drew (1976), Grant (1991), Hempstead (1987), Hot Spring (1995), Howard (1988), Jefferson (1987), Lafayette (1972), Lincoln (1987), Little River (1987), Miller (1977), Nevada (1987), Ouachita (1983), Union (1958)

Florida: Alachua (1969), Baker (1966), Bay (1953), Bradford (1969), Brevard (1969), Broward (1976), Calhoun (1959), Charlotte (1969), Citrus (1969), Clay (1963), Collier (1972), Columbia (1969), Dade (1976), DeSoto (1969), Dixie (1969), Duval (1958), Escambia (1939), Flagler (1971), Franklin (1966), Gadsden (1958), Gilchrist (1973), Glades (1973), Gulf (1959), Hamilton (1969), Hardee (1964), Hendry (1975), Hernando (1963), Highlands (1969), Hillsborough (1958), Holmes (1958), Indian River (1975), Jackson (1958), Jefferson (1967), Lafayette (1973), Lake (1961), Lee (1973), Leon (1961), Levy (1973), Liberty (1961), Madison (1969), Manatee (1961), Marion (1969), Martin (1976), Monroe (1976), Nassau (1958), Okaloosa (1953), Okeechobee (1975), Orange (1961), Osceola (1969), Palm Beach (1976), Pasco (1958), Pinellas (1962), Polk (1962), Putnam (1973), St. Johns (1966), St. Lucie (1976), Santa Rosa (1939), Sarasota (1966), Seminole (1961), Sumter (1966), Suwannee (1969), Taylor (1969), Union (1969), Volusia (1966), Wakulla (1966), Walton (1958), Washington (1958)

Georgia: Appling (1971), Atkinson (1971), Bacon (1971), Baker (1961), Baldwin (1966), Banks (1988), Barrow (1977), Bartow (1985), Ben Hill (1961), Berrien (1971), Bibb (1960), Bleckley (1959), Brantley (1966), Brooks (1969), Bryan (1966), Bulloch (1966), Burke (1977), Butts (1966), Calhoun (1966), Camden (1971), Candler (1976), Carroll (1973), Catoosa (1993), Charlton (1971), Chatham (1966), Chattahoochee (1961), Chattooga (1985), Cherokee (1983), Clarke (1977), Clay (1964), Clayton (1959), Clinch (1971), Cobb (1975), Coffee (1966), Colquitt (1961), Columbia (1971), Cook (1969), Coweta (1971), Crawford (1964), Crisp (1958), Dade (1993), Dawson (1993), Decatur (1958), DeKalb (1964), Dodge (1961), Dooly (1959), Dougherty (1959), Douglas (1976), Early (1960), Echols (1973), Effingham (1966), Elbert (1988), Emanuel (1973), Evans (1967), Fannin (1995), Fayette (1966), Floyd (1983), Forsyth (1977), Franklin (1995), Fulton (1964), Gilmer (1995), Glascock (1983), Glynn (1971), Gordon (1988), Grady (1958), Greene (1977), Gwinnett (1964), Habersham (NI, not infested), Hall (1984), Hancock (1976), Haralson (1973), Harris (1959), Hart (1993), Heard (1969), Henry (1964), Houston (1961), Irwin (1964), Jackson (1988), Jasper (1971), Jeff Davis (1966), Jefferson (1976), Jenkins (1973), Johnson (1971), Jones (1961), Lamar (1964), Lanier (1971), Laurens (1966), Lee (1961), Liberty (1966), Lincoln (1984), Long (1972), Lowndes (1969), Lumpkin (1995), McDuffie (1977), McIntosh (1971), Macon (1964), Madison (1988), Marion (1961), Meriwether (1959), Miller (1960), Mitchell

(1960), Monroe (1964), Montgomery (1971), Morgan (1975), Murray (1993), Muscogee (1958), Newton (1971), Oconee (1983), Oglethorpe (1985), Paulding (1983), Peach (1960), Pickens (1995), Pierce (1961), Pike (1964), Polk (1976), Pulaski (1964), Putnam (1971), Quitman (1961), Rabun (NI), Randolph (1964), Richmond (1966), Rockdale (1967), Schley (1960), Screven (1971), Seminole (1960), Spaulding (1966), Stephens (1995), Stewart (1961), Sumter (1960), Talbot (1961), Taliaferro (1983), Tatnall (1971), Taylor (1964), Telfair (1964), Terrell (1961), Thomas (1961), Tift (1964), Toombs (1971), Towns (NI), Treutlen (1971), Troup (1959), Turner (1961), Twiggs (1966), Union (NI), Upson (1964), Walker (1993), Walton (1971), Ware (1966), Warren (1983), Washington (1972), Wayne (1971), Webster (1966), Wheeler (1966), White (NI), Whitfield (1988), Wilcox (1961), Wilkes (1984), Wilkinson (1969), Worth (1961)

Louisiana: Acadia (1958), Allen (1961), Ascension (1958), Assumption (1959), Avoyelles (1958), Beauregard (1959), Bienville (1967), Bossier (1960), Caddo (1958), Calcasieu (1958), Caldwell (1962), Cameron (1962), Catahoula (1962), Claiborne (1973), Concordia (1959), De Soto (1967), East Baton Rouge (1953), East Carroll (1960), East Feliciana (1962), Evangeline (1958), Franklin (1960), Grant (1964), Iberia (1953), Iberville (1958), Jackson (1967), Jefferson (1953), Jeff Davis (1961), Lafayette (1953), Lafourche (1959), La Salle (1962), Lincoln (1962), Livingston (1958), Madison (1959), Morehouse (1960), Natchitoches (1969), Orleans (1953), Ouachita (1958), Plaquamines (1953), Pointe Coupee (1958), Rapides (1959), Red River (1961), Richland (1959), Sabine (1967), St. Bernard (1953), St. Charles (1958), St. Helena (1958), St. James (1961), St. John the Baptist (1958), St. Landry (1953), St. Martin (1953), St. Mary (1958), St. Tammany (1953), Tangipahoa (1958), Tensas (1960), Terrebonne (1958), Union (1960), Vermilion (1953), Vernon (1967), Washington (1953), Webster (1962), West Baton Rouge (1958), West Carroll (1960), West Feliciana (1958), Winn (1969)

Mississippi: Adams (1960), Alcorn (1983), Amite (1958), Attala (1958), Benton (1984), Bolivar (1972), Calhoun (1960), Carroll (1960), Chickasaw (1958), Choctaw (1960), Caliborne (1966), Clarke (1953), Clay (1953), Coahoma (NI), Copiah (1958), Covington (1958), DeSoto (1995), Forrest (1953), Franklin (1960), George (1939), Greene (1939), Grenada (1967), Hancock (1953), Harrison (1953), Hinds (1958), Holmes (1970), Humphreys (1973), Issaquena (1966), Itawamba (1964), Jackson (1939), Jasper (1958), Jefferson (1964), Jeff Davis (1958), Jones (1953), Kemper (1953), Lafayette (1973), Lamar (1953), Lauderdale (1953), Lawrence (1958), Leake (1958), Lee (1963), Leflore (1976), Lincoln (1958), Lowndes (1953), Madison (1958), Marion (1953), Marshall (1988), Monroe (1958), Montgomery (1971), Neshoba (1958), Newton (1953), Noxubee (1953), Oktibbeha (1953), Panola (1984), Pearl River (1953), Perry (1953), Pike (1958), Pontotoc (1966), Prentiss (1971), Quitman (1995), Rankin (1958), Scott (1960), Sharkey (1959), Simpson (1958), Smith (1958), Stone (1953), Sunflower (1976), Tallahatchie (1985), Tate (1990), Tippah (1976), Tishomingo (1973), Tunica (NI), Union (1969), Walthall (1953), Warren (1961), Washington (1963), Wayne (1953), Webster (1958), Wilkinson (1958), Winston (1953), Yalobusha (1971), Yazoo (1958)

North Carolina: Anson (1985), Beaufort (1983), Bladen (1983), Brunswick (1971), Carteret (1971), Columbus (1971), Craven (1971), Cumberland (1992), Dare (1995), Duplin (1975), Hoke (1992), Hyde (1988), Jones (1971), Lenoir (1977), Martin (1992), Mecklenburg (1995), Montgomery (1995), New Hanover (1976), Onslow (1971), Pamlico (1973), Pender (1983), Pitt (1992), Richmond (1985), Robeson (1973), Sampson (1985), Scotland (1985), Tyrell (1992), Union (1985), Washington (1992)

Oklahoma: Bryan (1988), Carter (1995), Love (1992), McCurtain (1988), Marshall (1988)

Puerto Rico: (1983)

South Carolina: Abbeville (1992), Aiken (1972), Allendale (1975), Anderson (1995), Bamberg (1971), Barnwell (1973), Beaufort (1970), Berkeley (1964), Calhoun (1970), Charleston (1958), Cherokee (NI), Chester (1987), Chesterfield (1987), Clarendon (1971), Colleton (1970), Darlington (1975), Dillon (1975), Dorchester (1964), Edgefield (1972), Fairfield (1975), Florence (1971), Georgetown (1972), Greenville (1995), Greenwood (1991), Hampton (1970), Horry (1967), Jasper (1963), Kershaw (1972), Lancaster (1986), Laurens (1995), Lee (1975), Lexington (1971), McCormick (1977), Marion (1975), Marlboro (1972), Newberry (1977), Oconee (NI), Orangeburg (1958), Pickens (NI), Richland (1970), Saluda (1987), Spartanburg (NI), Sumter (1972), Union (1987), Williamsburg (1972), York (1995)

Tennessee: Fayette (1995), Hardeman (1991), Hardin (1990), McNairy (1990), Wayne (1995)

Texas: Anderson (1976), Angelina (1969), Aransas (1983), Atacosa (1975), Austin (1969), Bandera (1976), Bastrop (1979), Bee (1977), Bell (1977), Bexar (1959), Blanco (1977), Bosque (1988), Bowie (1975), Brazoria (1969), Brazos (1975), Burleson (1975), Brunet (1988), Caldwell (1976), Calhoun (1976), Camp (1977), Cass (1979), Chambers (1969), Cherokee (1975), Collin (1972), Colorado (1969), Comal (1975), Comanche (1988), Cooke (1988), Coryell (1988), Dallas (1969), Denton (1969), DeWitt (1975), Duval (1988), Eastland (1988), Edwards (1991), Ellis (1975), Erath (1988), Falls (1977), Fannin (1988), Fayette (1973), Fort Bend (1969), Franklin (1988), Freestone (1977), Frio (1976), Galveston (1969), Gillespie (1977), Goliad (1979), Gonzales (1976), Grayson (1976), Gregg (1969), Grimes (1969), Guadalupe (1976), Hamilton (1991), Hardin (1958), Harris (1959), Harrison (1972), Hays (1979), Henderson (1983), Hill (1983), Hood (1988), Hopkins (1990), Houston (1973), Hunt (1988), Jackson (1975), Jasper (1958), Jefferson (1958), Jim Wells (1977), Johnson (1985), Karnes (1988), Kaufman (1988), Kendall (1975), Kerr (1976), Kimble (1988), Kleberg (1985), Lampasas (1988), Lavaca (1975), Lee (1979), Leon (1976), Liberty (1961), Limestone (1976), Live Oak (1986), Llano (1988), McLennan (1983), McMullen (1991), Madison (1975), Marion (1975), Mason (1990), Matagorda (1975), Medina (1975), Midland (1991), Milam (1977), Montgomery (1961), Morris (1988), Nacogdoches (1969), Navarro (1976), Newton (1958), Nueces (1973), Orange (1958), Panola (1972), Parker (1988), Polk (1969), Rains (1983), Real (1991), Refugio (1977), Robertson (1976), Rockwall (1983), Rusk (1972), Sabine (1969), San Augustine (1969), San Jacinto (1969), San Patricio (1975), Shelby (1972), Smith (1973), Somervell (1988), Tarrant (1969), Taylor (1988), Titus (1988), Tom Green (1988), Travis (1979), Trinity (1973), Tyler (1958), Upshur (1976), Uvalde (1988), Van Zandt (1988), Victoria (1973), Walker (1973), Waller (1969), Washington (1973), Webb (1992), Wharton (1969), Wichita (1988), Williamson (1979), Wilson (1975), Wise (1988), Wood (1976), Young (1988)