United States
Department of
Agriculture

Forest Service

**Northeastern Forest
Experiment Station**

Research
Paper NE-516

1983

Classification
of American Metropolitan Areas by Ecoregion and Potential Natural Vegetation

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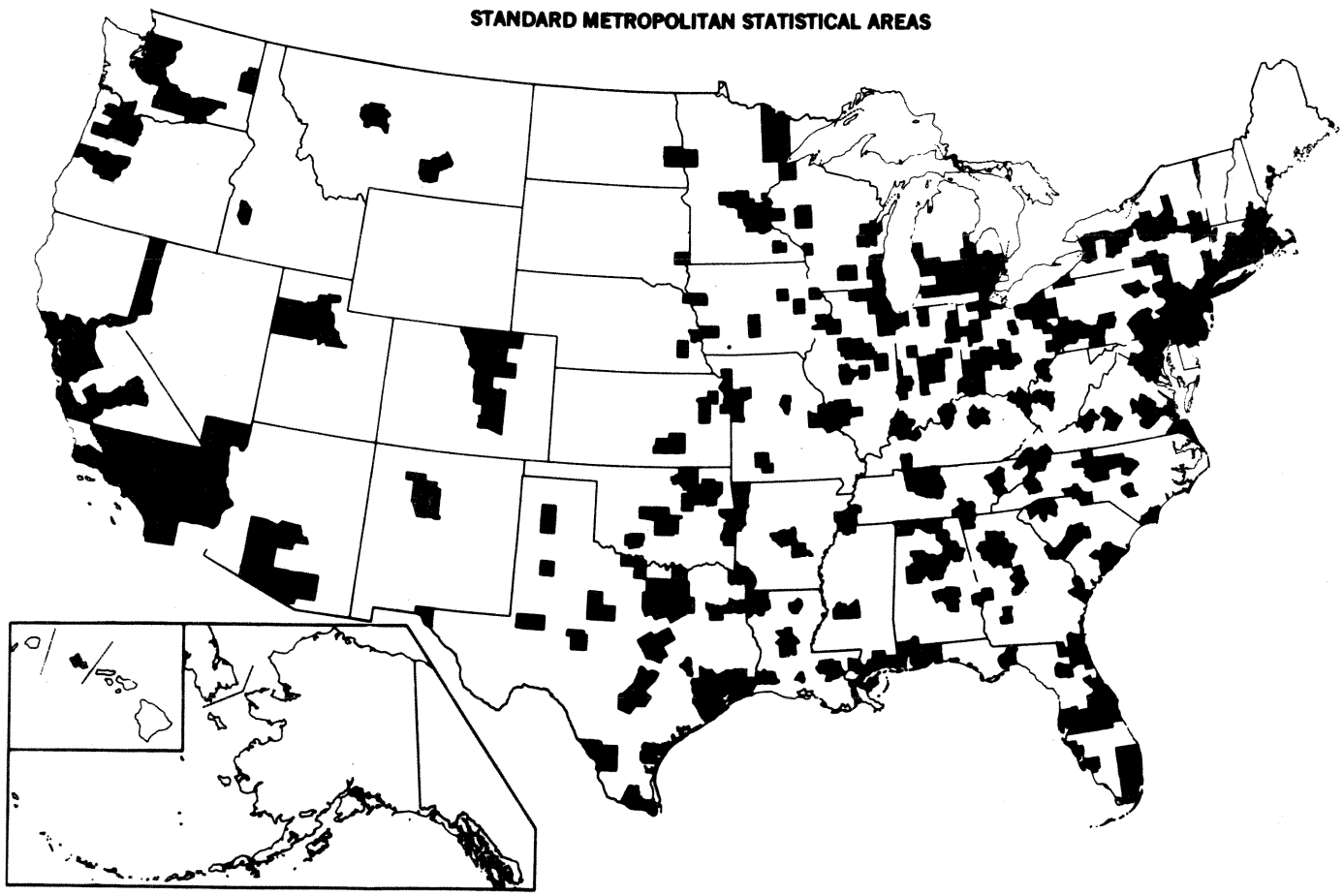

The Authors

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Manuscript received for publication 25 November 1981

Abstract

This publication classifies 279 American metropolitan areas by ecoregion and potential natural vegetation. The classification forms a baseline of expected vegetation structure and composition that can assist scientists and policy makers in making urban forestry generalizations about classes of cities.

Contents

Introduction

Urban forestry researchers and planners ask: How similar or different are the urban forests of American cities? Specifically, for example, to what degree does the vegetation pattern of Richmond, Virginia resemble that of Wheeling, West Virginia, or Peoria, Illinois? How dissimilar are Phoenix and Spokane? If we were to complete an intensive vegetation survey of Omaha, could we extrapolate results to a class of similar cities?

Every city is a unique entity that shares some of its characteristics with others, and is able to be examined for its unique properties or for its general character. The similarity of cities has led to the idea of developing classifications.[1] Many early attempts at classification focused in the functional or economic character of cities and gave rise to single-level groups such as industrial cities, retailing cities, government cities, transportation cities, and so on. Later classification attempts were based on the morphology of the built environment (especially spatial arrangements), population growth histories, and positions with a hierarchy of city sizes. Recently an attempt was made to reflect the character of the population in urban typologies, and one classification for a limited set of American cities reflecting the physical environment was written.[2]

Similarly, a taxonomy of cities based on the composition and distribution of urban vegetation is desired. The classification would suggest: what the normal, average, or usual conditions are, how great the contrasts within and between cities are, and what regional or other patterns of similarity and dissimilarity exist. This information implies what may be true in one city from what is known by observation in another. It also would suggest how widespread one class of vegetation problems is and inform local policy makers which cities might have useful information. In general, this classification for urban forestry provides a basis for reliable inferences where knowledge is limited or unavailable, and lays a foundation for establishing scientific generalities and public policy guidelines with an economy of effort.

Generally, the composition and distribution of urban vegetation are determined by three broad categories of influence: the natural environment; the growing space available; and the human influences on selection, planting, removal, and maintenance. Cities may be classified by the pattern of aboveground growing space made available by the physical morphology of artificial surfaces. Also, cities may be classified by the aggregate impact of human choices and actions. We selected the simplest factor: natural environment, which is a logical point of departure for generalizing about urban vegetation in different parts of the United States, because of recent work in mapping ecological regions.

Our classification system is based on the assumption that attributes of the natural environment—climate, soils, gemorphology, and the regional vegetation itself—offer constraints and opportunities for molding the vegetation within the urban area. Of course, this premise acknowledges the importance of the other two factors, the distribution of available growing space and human influences that work in conjunction with the natural environment.

Reliable inventories of urban vegetation in the United States, obtained either from on-ground surveys or from remote sensing imagery, do not exist. Existing inventories are confined to specific subsets of urban vegetation, usually street tree populations and urban public parks. These inventories are few and vary in information content (Sacksteder and Gerhold 1979). A systematic survey of urban vegetation characteristics for a large set of American cities, therefore, seems a distant hope, particularly because it is difficult to determine detailed vegetation characteristics from remote sensing. Satellite technology (using increased spatial resolution of the sensor apparatus and computer-aided interpretation of radiance values associated with vegetation characteristics) may offer long term promise because of its breadth and continuity of coverage and the alternative high cost of obtaining on-ground surveys or reliable manual interpretations of variable quality, low-altitude photography.

An alternative is to classify cities according to characteristics of potential vegetation. We suggest that knowledge of the regional natural environment in which the city is located provides a basis for predicting certain attributes of urban vegetation—all tree, shrub, and herbaceous vegetation in the urban area. Cities in hot, arid regions will tend to have vegetation reflecting those facts, and the vegetation of these cities usually would differ substantially from that in cool, moist regions. We believe that much urban vegetation, especially in less developed and exurban portions, tends to resemble the vegetation, at least in general terms, of the surrounding ecoregion. Whether this is true ultimately depends on the unique combination of natural and human-urban histories that have produced the current urban vegetation configuration. When such histories are available, we will know how and why the extant vegetation pattern differs from the expected regional "baseline" (of

[1] The most complete summary of urban classification systems is in Berry and Horton (1970), Chapter 5 (p. 106-149) and Chapter 6 (p. 150-168).

[2] Berry and coworkers (1974) applied Q-mode factor analysis to a matrix containing measures of air, water, solid waste, pesticide, radiation, and noise pollution for 76 metropolitan areas to develop a taxonomy that describes how city characteristics and pollution covary for these cities.

potential natural vegetation). Two categories of influence that explain variations from the regional baseline are the unique distribution of growing spaces in the city, and the set of human preferences for species, ages, and conditions of plants.

There are at least three reasons why urban vegetation may resemble the surrounding regional vegetation complex. First, every city contains sizable portions of residual or relict vegetation, particularly in the newer suburban fringes of the urbanized area. This vegetation tends to resemble that in the non-urbanized portions of the larger urban region, having fallen into the urban category during recent stages of urban growth. Second, residual urban vegetation and that at the urban periphery act as seed sources for natural or seminatural propagation processes. Third, the potentials for and limits on vegetation types and densities as defined by the regimes of temperatures, precipitation, and soil types probably do not differ appreciably from urban to rural locations within broad regional limits, except perhaps where intensive urban development at the city center and the effects of local topography create distinctive sites. Thus, we need a measure of the regional natural environment for plant growth and development that will serve as a baseline for predicting what the urban vegetation configuration might be in the absence of direct human interference.

This natural region approach to urban classification lacks the vastly important anthropogenic or cultural component or urban vegetation. The myriad decisions to breed, plant, maintain, and remove vegetation by home and business owners and by representatives of both private and public institutions collectively establish a controlling environment for plants, the particular results of which have never been determined. A central question of urban forest science today is in what ways and to what degree, do anthropogenic influences on urban vegetation determine its final configuration. We conclude, however, that a classification of urban places according to the natural properties of the regions of which they are a part provides a useful guide to the similarities and differences in urban vegetation.

Method of Classification

For this classification, the population of American cities is taken as the complete set of Standard Metropolitan Statistical Areas (SMSA's) as of 1979. According to U.S. Bureau of the Census definitions, there are 279 SMSA's in the 50 states covering about 20 percent of the nation's land area. As a set, these SMSA's represent all urban places which contain at least one central city (a political entity) with a population of at least 50,000 and the counties in which the surrounding economically integrated populations are contained. The county basis for defining SMSA's, therefore, incorporates into the urban definition substantial tracts of what might be thought of as nonurban land, land which in the eyes of some researchers, however, can be regarded largely as "preurban," assuming a continuation of metropolitan decentralization trends. The 279 SMSA's examined in this study represent all the large urban areas in the United States.

To delimit the natural environment of the urban places to project likely characteristics of urban vegetation or sizable portions of it, two variables are used: (1) the "ecoregion" in which the city is located, and (2) the Potential Natural Vegetation (PNV) of that location. Each of these has been succinctly described and mapped (Bailey 1980, USDA Forest Service 1978).

The ecoregions devised by Bailey reflect the distinctive flora, fauna, climate, landform, soil, vegetation, and ecological climax of a continuous geographical area. These regions differ from surrounding regions in one or more important ecological associations or in the proportions of the area covered by distinctive associations. The ecoregion system is organized into a four-tiered hierarchy, each level representing a subdivision of the area encompassed by the preceding hierarchical level. These levels, from upper to lower, are domain, division, province, and section. For the purpose of this classification, urban places were located at the division level, which differentiates regions primarily according to vegetation and climate, but allows the classification to remain relatively simple. The metropolitan areas of the United States are located in 11 of the 12 ecoregion divisions. The ecoregion division reflects the general availability of heat and moisture, both determinants of the limitations on and potentials for regional associations of vegetation, and the PNV is simply a more specific variable describing the natural environment.

The PNV of an area is the vegetation that would exist today if man were (now) removed from the scene and if the plant succession after his removal were telescoped into a single moment (Küchler 1964). It reflects both the life-forms (physiognomy and structure) and the taxa (dominant genera for the regions of PNV). PNV is contrasted with actual or real vegetation, which is normally expressed or mapped as a statistic depiction of the regional vegetation at a point in time, independent of any impetus or direction of change. We chose PNV over existing vegetation for this classification because of the rapid change in land use in urban areas, particularly in inner city areas where population densities are falling and open spaces emerging, in suburban areas where land development processes are most active, and in exurban areas where the economic bases of farm and forest practices are increasingly challenged by the prospect of continuing metropolitan decentralization. The existing vegetation in these places (even if

this were now classified) probably would be a poor predictor of developing urban vegetation configurations. PNV suggests what kinds of vegetation are possible in these areas.

Using Bailey's recent map, we recorded the ecoregion division and PNV for each of the 279 SMSA's. These were determined by finding the exact locations of SMSA's on the Bailey map, and determining the correct classifications at the visual center of the SMSA. Where natural boundaries of ecoregions or PNV appeared to bisect the metropolitan area, only that zone which was judged to cover the greatest portion of the SMSA was recorded. This preserved simplicity in the classification system. The literal interpretation of natural boundaries on maps can be a misleading exercise, because most of these represent gradual transitions of natural characteristics from one region to another, and many boundaries merely reflect only the change in proportions of several of the dominant natural characteristics. This means that any attempt of a natural urban classification for any large set of metropolitan areeas is imprecise, and needs substantial improvements in the quality of natural environmental data derived for local sources.

Results

The lack of high-quality local data and the forced reliance on generalized natural maps prohibit highly literal interpretations of the classification outlined here. The classification merely suggests the likely similarity and dissimilarity of the wild component of urban vegetation between metropolitan areas. In this sense, the classification refers less to the specific character of vegetation in an urban place than to the likelihood of resemblance with like places.

A summary of the natural-urban classification resulting from this process is given in Table 1. More than half of the American metropolitan areas are in the Hot Continental and Subtropical ecoregion divisions. From the perspective of vegetation, roughly two-thirds of the SMSA's are located within the Eastern Broadleaf and the Eastern Needleleaf and Broadleaf Forests (PNV). This implies that a large number of these urban places share similar vegetation characteristics, and identification of and solutions to both scientific and public policy problems in any one place may be applied in others. In contrast, seven metropolitan areas occupy unique positions in this classification system, and many others represent a typical or special cases in the classification, sharing their natural characteristics with only one or two urban places. Scientific or public policy solutions learned in these cities may not be applied easily to other cities.

The detailed results of the classification are given in three cross-indexed lists. Appendix II lists the SMSA's alphabetically by the name of the city (or principal city) in the metropolitan area, so individual cities may be located easily in the classification. In Appendix II, the ecoregion division and PNV are given for each place. Appendix III classifies SMSA's by Ecoregion Division (alphabetically by states) and theses are cross-referenced for PNV. Appendix IV lists cities by zones of PNV, organizing these broadly into life-form zones. By listing metropolitan areas in each of these ways, the classification system provides a convenient description of urban natural classes, the internal composition of any class, and the particular classification of any one urban place.

Table 1.—Summary classification of SMSA's by ecoregion and by potential natural vegetation

Potential Natural Vegetation by Ecosystem Regions	Ecoregion division											Total
	Sub-arctic	Warm Contin-ental	Hot Contin-ental	Sub-trop-ical	Marine	Prairie	Medi-terran-ean	Steppe	Desert	Savanna	Rain-forest	
West Needle leaf forest	—	1	—	—	3	—	—	—	—	—	—	4(1.4)[a]
West Needle leaf and Broadleaf forest	—	—	—	—	3	—	3	—	—	—	—	6(2.2)
West Shrub	—	—	—	—	—	1	3	2	3	—	—	9(3.2)
West Grass-land	—	—	—	—	2	—	8	1	—	—	—	11(3.9)
West Shrub and Grass-land	—	—	—	—	—	2	—	4	1	—	—	7(2.5)
Central and East Grass-land	—	—	—	2	—	11	—	10	—	—	—	23(8.2)
Central and East Grass-land and forest	—	—	8	—	—	14	—	—	—	—	—	22(7.9)
East Needle leaf forest	—	2	—	—	—	—	—	—	—	—	—	2(0.7)
East Broad-leaf forest	—	6	90	1	—	15	—	2	—	—	—	114(40.9)
East Needle leaf and Broadleaf	—	14	4	58	—	—	—	—	—	3	—	79(28.3)
Alaskan Types	1	—	—	—	—	—	—	—	—	—	—	1(0.4)
Hawaiian type	—	—	—	—	—	—	—	—	—	—	1	1(0.4)
Total	1 (0.4)	23 (8.2)	102 (36.6)	61 (21.9)	8 (2.9)	43 (15.4)	14 (5.0)	19 (6.8)	4 (1.4)	3 (1.0)	1 (0.4)	279(100.0)

[a] Number in parentheses is the percentage of total SMSA's in given category.

Appendix I

Code Numbers

Code numbers for ecoregion divisions and for potential natural vegetation used in subsequent appendixes.[3]

Code	*Ecoregion division*
1300	Subartic
2100	Warm Continental
2200	Hot Continental
2300	Subtropical
2400	Marine
2500	Prairie
2600	Mediterranean
3100	Steppe
3200	Desert
4100	Savanna
4200	Rainforest

Code	*Potential natural vegetation, by ecosystem regions*
1-21	Western Needleleaf Forest
22-23	Western Broadleaf Forest
24-28	Western Needleleaf and Broadleaf Forest
29-39	Western Shrub
40-48	Western Grassland
49-55	Western Shrub and Grassland
56-71	Central and Eastern Grassland
72-83	Central and Eastern Grassland and Forest Combination
84-88	Eastern Needleleaf Forest
89-96	Eastern Broadleaf Forest
97-106	Eastern Needleleaf and Broadleaf Forest
111-120	Ecosystems of Alaska
121-127	Ecosystems of Hawaii

[3] Code numbers are listed and mapped by Bailey (1978)

Appendix II

Alphabetical list of SMSA's by ED and PNV.

SMSA	*ED*	*PNV*
Abilene, TX	2500	76
Akron, OH	2200	93
Albany, GA	2300	102
Albany-Schenectady-Troy, NY	2100	97
Albuquerque, NM	3100	47
Alexandria, LA	2300	101
Allentown-Bethlehem-Easton, PA	2200	95
Altoona, PA	2200	95
Amarillo, TX	3100	58
Anaheim-Santa Ana-Garden Grove, CA	2600	41
Anchorage, AK	1300	113
Anderson, IN	2200	93
Ann Arbor, MI	2200	91
Anniston, Al	2300	101
Appleton-Oshkosh, WI	2200	90
Asheville, NC	2200	95
Atlanta, GA	2300	101
Atlantic City, NJ	2300	65
Augusta, GA-SC	2300	101
Austin, TX	2500	68
Bakersfield, CA	2600	34
Baltimore, MD	2300	101
Baton Rouge, LA	2300	91
Battle Creek, MI	2200	91
Bay City, MI	2100	92
Beaumont-Port Arthur-Orange, TX	2300	69
Billings, MT	3100	89
Biloxi-Gulfport, MS	2300	102
Binghamton, NY-PA	2100	97
Birmingham, AL	2300	101
Bismarck, ND	3100	89
Bloomington, IN	2200	93
Bloomington-Normal, IL	2500	73
Boise City, ID	3100	49
Boston, MA	2200	95
Bradenton, FL	2300	102
Bridgeport, CT	2200	95
Bristol, CT	2200	95
Brockton, MA	2100	97
Brownsville-Harlingen-San Benito, TX	2500	54
Bryan-College Station, TX	2500	91
Buffalo, NY	2200	93
Burlington, NC	2300	101
Canton, OH	2200	95
Cedar Rapids, IA	2500	91
Champaign-Urbana-Rantoul, IL	2300	101
Charleston, WV	2200	94
Charlotte-Gastonia, NC	2300	101
Chattanooga, TN-GA	2200	101
Chicago, IL	2500	73
Cincinnati, OH-KY-IN	2200	91
Clarksville-Hopkinsville, TN-KY	2200	91
Cleveland, OH	2200	93
Colorado Springs, CO	3100	58
Columbia, MO	2200	91
Columbia, SC	2300	101
Columbus, GA-AL	2300	101
Columbus, OH	2200	93
Corpus Christi, TX	2500	69
Dallas-Fort Worth, TX	2500	68

Appendix II (Cont.)

SMSA	ED	PNV
Danbury, CT	2200	95
Davenport-Rock Island-Moline, IA-IL	2500	91
Dayton, OH	2200	91
Daytona Beach, FL	2300	102
Decatur, IL	2500	91
Denver-Boulder, CO	3100	58
Des Moines, IA	2500	91
Detroit, MI	2200	92
Dubuque, IA	2200	90
Duluth-Superior, MN-WI	2100	86
Eau Claire, WI	2200	72
Elkhart, IN	2200	91
El Paso, TX	3200	52
Elmira, NY	2100	95
Erie, PA	2200	93
Eugene-Springfield, OR	2400	24
Evansville, IN-KY	2200	103
Fall River, MA-RI	2200	95
Fargo-Moorhead, ND-MN	2500	89
Fayetteville, NC	2300	101
Fayetteville-Springdale, AR	2200	91
Fitchburg-Leominster, MA	2100	97
Flint, MI	2200	91
Florence, AL	2200	91
Fort Collins, CO	3100	58
Fort Lauderdale-Hollywood, FL	4100	102
Fort Myers, FL	2300	102
Fort Smith, AR-OK	2200	103
Fort Wayne, IN	2200	91
Fresno, CA	2600	41
Gadsden, AL	2300	101
Gainesville, FL	2300	102
Galveston-Texas City, TX	2500	70
Gary-Hammond-East Chicago, IN	2200	91
Grand Forks, ND-MN	2500	89
Grand Rapids, MI	2200	93
Great Falls, MT	3100	56
Greeley, CO	3100	58
Green Bay, WI	2100	97
Greensboro-Winston-Salem-High Point, NC	2300	101
Greenville-Spartansburg, SC	2300	101
Hamilton-Middletown, OH	2200	93
Harrisburg, PA	2200	95
Hartford, CT	2200	95
Honolulu, HI	4200	121
Houston, TX	2500	69
Huntington-Ashland, WV-KY-OH	2200	94
Huntsville, AL	2200	74
Indianapolis, IN	2200	93
Jackson, MI	2200	92
Jackson, MS	2300	101
Jacksonville, FL	2300	102
Jersey City, NJ	2200	95
Johnson City-Kingsport-Bristol, TN-VA	2200	95
Johnstown, PA	2200	95
Kalamazoo-Portage, MI	2200	91
Kankakee, IL	2500	73
Kansas City, MO-KS	2500	91
Kenosha, WI	2200	72
Killeen-Temple, TX	2500	68
Knoxville, TN	2200	95
Kokomo, IN	2200	93
La Crosse, WI	2200	90
Lafayette, LA	2300	103
Lafayette-West Lafayette, IN	2200	91
Lake Charles, LA	2300	102
Lakeland-Winter Haven, FL	2300	102
Lancaster, PA	2200	95
Lansing-East Lansing, MI	2200	93
Laredo, TX	2500	38
Las Vegas, NV	3200	35
Lawrence, KS	2500	73
Lawrence-Haverhill, MA-NH	2200	95
Lawton, OK	2500	62
Lewiston-Auburn, ME	2100	97
Lexington-Fayette, KY	2200	91
Lima, OH	2200	93
Lincoln, NE	2500	89
Little Rock-North Little Rock, AR	2300	101
Long Branch-Asbury Park, NJ	2200	95
Longview, TX	2300	101
Lorain-Elyria, OH	2200	92
Los Angeles-Long Beach, CA	2600	41
Louisville, KY-IN	2200	91
Lowell, MA-NH	2100	97
Lubbock, TX	3100	58
Lynchburg, VA	2300	101
Macon, GA	2300	101
Madison, WI	2200	72
Manchester, NH	2100	97

Appendix II (Cont.)

SMSA	ED	PNV
Mansfield, OH	2200	93
McAllen-Pharr-Edinburg, TX	2500	54
Melbourne-Titusville-Cocoa, Fl	2300	102
Memphis, TN-AR-MS	2300	103
Meriden, CT	2200	95
Miami, FL	4100	106
Midland, TX	3100	58
Milwaukee, WI	2200	90
Minneapolis-St. Paul, MN-WI	2200	72
Mobile, AL	2300	102
Modesto, CA	2600	42
Monroe, LA	2300	103
Montgomery, AL	2300	103
Muncie, IN	2200	93
Muskegon-North Shores-Muskegon Heights, MI	2100	86
Nashua, NH	2100	97
Nashville-Davidson, TN	2200	91
Nassau-Suffolk, NY	2200	100
New Bedford, MA	2200	95
New Britain, CT	2200	95
New Brunswick-Perth Amboy-Sayreville, NJ	2200	95
New Haven-West Haven, CT	2200	95
New London-Norwich, CT	2200	95
New Orleans, LA	2300	103
New York, NY-NJ	2200	95
Newark, NJ	2200	95
Newport News-Hampton, VA	2300	101
Norfolk-Virginia Beach-Portsmouth, VA-NC	2300	101
Norwalk, CT	2200	95
Odessa, TX	3100	58
Oklahoma City, OK	2500	62
Omaha, NE-IA	2500	91
Orlando, FL	2300	102
Owensboro, KY	2200	91
Oxnard-Simi Valley-Ventura, CA	2600	26
Panama City, FL	2300	102
Parkersburg-Marietta, WV-OH	2200	95
Pascagoula-Moss Point, MS	2300	102
Paterson-Clifton-Passaic, NJ	2200	95
Pensacola, FL	2300	102
Peoria, IL	2500	91
Petersburg-Colonial Heights-Hopewell, VA	2300	101
Philadelphia, PA-NJ	2200	95
Phoenix, AZ	3200	36
Pine Bluff, AR	2300	101
Pittsburgh, PA	2200	95
Pittsfield, MA	2100	97
Portland, ME	2100	97
Portland, OR-WA	2400	2
Poughkeepsie, NY	2100	95
Providence-Warwick-Pawtucket, RI	2200	95
Provo-Orem, UT	3100	31
Pueblo, CO	3100	58
Racine, WI	2200	90
Raleigh-Durham, NC	2300	101
Reading, PA	2200	95
Reno, NV	3100	49
Richland-Kennewick, WA	3100	49
Richmond, VA	2300	101
Riverside-San Bernardino-Ontario, CA	2600	30
Roanoke, VA	2300	101
Rochester, MN	2200	90
Rochester, NY	2100	97
Rockford, IL	2500	73
Sacramento, CA	2600	42
Saginaw, MI	2100	92
St. Cloud, MN	2200	72
St. Joseph, MO	2500	73
St. Louis, MO-IL	2200	91
Salem, OR	2400	42
Salinas-Seaside-Monterey, CA	2600	41
Salt Lake City-Ogden, UT	3100	32
San Angelo, TX	2500	76
San Antonio, TX	2500	78
San Diego, CA	2600	30
San Francisco-Oakland, CA	2400	40
San Jose, CA	2600	40
Santa Barbara-Santa Maria-Lompoc, CA	2600	26
Santa Cruz, CA	2600	26
Santa Rosa, CA	2400	25
Sarasota, FL	2300	102
Savannah, GA	2300	102
Scranton-Wilkes-Barre-Hazleton, PA	2100	95
Seattle-Everett, WA	2400	2
Sherman-Denison, TX	2500	75
Shreveport, LA	2300	103
Sioux City, IA-NE	2500	66
Sioux Falls, SD	2500	66
South Bend, IN	2200	91
Spokane, WA	2100	11

Appendix II (Cont.)

SMSA	ED	PNV
Springfield, IL	2500	91
Springfield-Chicopee-Holyoke, MA-CT	2200	95
Springfield, MO	2200	73
Springfield, OH	2200	73
Stamford, CT	2200	95
Steubenville-Weirton, OH-WV	2200	95
Stockton, CA	2600	42
Syracuse, NY	2100	97
Tacoma, WA	2400	2
Tallahassee, FL	2300	102
Tampa-St. Petersburg, FL	2300	102
Terre Haute, IN	2500	91
Texarkana, TX-Texarkana, AR	2300	101
Toledo, OH-MI	2200	92
Topeka, KS	2500	73
Trenton, NJ	2200	95
Tuscon, AZ	3200	36
Tulsa, OK	2500	75
Tuscaloosa, AL	2300	101
Tyler, TX	2300	101
Utica-Rome, NY	2100	93
Vallejo-Fairfield-Napa, CA	2400	40
Vineland-Millville-Bridgeton, NJ	2300	100
Waco, TX	2500	68
Washington, DC-MD-VA	2300	101
Waterbury, CT	2200	95
Waterloo-Cedar Falls, IA	2500	91
West Palm Beach-Boca Raton, FL	4100	102
Wheeling, WV-OH	2200	95
Wichita, KS	2500	89
Wichita Falls, TX	2500	76
Williamsport, PA	2200	95
Wilmington, DE-NJ-MD	2200	95
Wilmington, NC	2300	102
Worcester, MA	2100	97
Yakima, WA	3100	49
York, PA	2200	95
Youngstown-Warren, OH	2200	93

Appendix III

SMSA Classification by ED[4]

		PNV
1300	*SUBARCTIC DIVISION*	
	Alaska	
	Anchorage	113
2100	*WARM CONTINENTAL DIVISION*	
	Maine	
	Lewiston-Auburn	97
	Portland	97
	Massachusetts	
	Brockton	97
	Fitchburg-Leominster	97
	Lowell	97
	Worcester	97
	Michigan	
	Bay City	92
	Muskegon-North Shores-Muskegon Heights	86
	Saginaw	92
	Minnesota	
	Duluth-Superior	86
	New Hampshire	
	Manchester	97
	Nashua	97
	New York	
	Albany-Schenectady-Troy	97
	Binghamton	97
	Elmira	95
	Poughkeepsie	95
	Rochester	97
	Syracuse	97
	Utica-Rome	97
	Pennsylvania	
	Scranton-Wilkes-Barre-Hazelton	95
	Washington	
	Spokane	11
	Wisconsin	
	Green Bay	97

[4] The list of SMSA's within ecoregion divisions is arranged alphabetically by state. Note that for SMSA's with compound names the state of the first-named urban place is given and the state of the second or third-named urban place is not given.

Appendix III (Cont.)

2200	*HOT CONTINENTAL DIVISION*	*PNV*
	Alabama	
	Florence	91
	Huntsville	74
	Arkansas	
	Fayetteville-Springdale	91
	Fort Smith	103
	Connecticut	
	Bridgeport	95
	Bristol	95
	Danbury	95
	Hartford	95
	Meriden	95
	New Britain	95
	New Haven-West Haven	95
	New London-Norwich	95
	Norwalk	95
	Stamford	95
	Waterbury	95
	Delaware	
	Wilmington	95
	Indiana	
	Anderson	93
	Bloomington	93
	Elkhart	91
	Evansville	103
	Fort Wayne	91
	Gary-Hammond-East Chicago	91
	Indianapolis	93
	Kokomo	93
	Lafayette-West Lafayette	91
	Muncie	93
	South Bend	91
	Iowa	
	Dubuque	90
	Kentucky	
	Lexington-Fayette	91
	Louisville	91
	Owensboro	91
	Massachusetts	
	Boston	95
	Fall River	95
	Lawrence-Haverhill	95
	New Bedford	95
	Springfield-Chicopee-Holyoke	95
	Michigan	
	Ann Arbor	91
	Battle Creek	91
	Detroit	92
	Flint	91
	Grand Rapids	93
	Jackson	92
	Kalamazoo-Portage	91
	Lansing-East Lansing	93
	Minnesota	
	Minneapolis-St. Paul	72
	Rochester	90
	St. Cloud	72
	Missouri	
	Columbia	91
	St. Louis	91
	Springfield	73
	New Jersey	
	Jersey City	95
	Long Branch-Asbury Park	95
	New Brunswick-Perth Amboy-Sayreville	95
	Newark	95
	Paterson-Clifton-Passaic	95
	Trenton	95
	New York	
	Buffalo	93
	Nassau-Suffolk	100
	New York	95
	North Carolina	
	Asheville	95
	Ohio	
	Akron	93
	Canton	95
	Cincinnati	91
	Cleveland	93
	Columbus	93
	Dayton	91
	Hamilton-Middletown	93
	Lima	93
	Lorain-Elyria	92
	Mansfield	93
	Springfield	73
	Steubenville-Weirton	95
	Toledo	92
	Youngstown-Warren	93
	Pennsylvania	
	Allentown-Bethlehem-Easton	95
	Altoona	95
	Erie	93
	Harrisburg	95
	Johnstown	95
	Lancaster	95
	Philadelphia	95
	Pittsburgh	95
	Reading	95
	Williamsport	95
	York	95
	Rhode Island	
	Providence-Warwick-Pawtucket	95
	Tennessee	
	Chattanooga	101
	Clarksville-Hopkinsville	91
	Johnson City-Kingsport-Bristol	95
	Knoxville	95
	Nashville-Davidson	91
	West Virginia	
	Charleston	94
	Huntington-Ashland	94
	Parkersburg-Marietta	95
	Wheeling	95

Appendix III (Cont.)

		PNV
	Wisconsin	
	Appleton-Oshkosh	90
	Eau Claire	72
	Kenosha	72
	La Crosse	90
	Madison	72
	Milwaukee	90
	Racine	90
2300	*SUBTROPICAL DIVISION*	
	Alabama	
	Anniston	101
	Birmingham	101
	Gadsden	101
	Mobile	102
	Montgomery	103
	Tuscaloosa	101
	Arkansas	
	Little Rock-North Little Rock	101
	Pine Bluff	101
	District of Columbia	
	Washington	101
	Florida	
	Bradenton	102
	Daytona Beach	102
	Fort Myers	102
	Gainesville	102
	Jacksonville	102
	Lakeland-Winter Haven	102
	Melbourne-Titusville-Cocoa	102
	Orlando	102
	Panama City	102
	Pensacola	102
	Sarasota	102
	Tallahassee	102
	Tampa-St. Petersburg	102
	Georgia	
	Albany	102
	Atlanta	101
	Augusta	101
	Columbus	101
	Macon	101
	Savannah	102
	Louisiana	
	Alexandria	101
	Baton Rouge	91
	Lafayette	103
	Lake Charles	102
	Monroe	103
	New Orleans	103
	Shreveport	103
	Maryland	
	Baltimore	101
	Mississippi	
	Biloxi-Gulfport	102
	Jackson	101
	Pascagoula-Moss Point	102
	New Jersey	
	Atlantic City	65
	Vineland-Millville-Bridgeton	100
	North Carolina	
	Burlington	101
	Charlotte-Gastonia	101
	Fayetteville	101
	Greensboro-Winston-Salem-High Point	101
	Raleigh-Durham	101
	Wilmington	102
	South Carolina	
	Charleston-North Charleston	101
	Columbia	101
	Greenville-Spartansburg	101
	Tennessee	
	Memphis	103
	Texas	
	Beaumont-Port Arthur-Orange	69
	Longview	101
	Texarkana	101
	Tyler	101
	Virginia	
	Lynchburg	101
	Newport News-Hampton	101
	Norfolk-Virginia Beach-Portsmouth	101
	Petersburg-Colonial Heights-Hopewell	101
	Richmond	101
	Roanoke	101
2400	*MARINE DIVISION*	
	California	
	San Francisco-Oakland	40
	Santa Rosa	25
	Vallejo-Fairfield-Napa	40
	Oregon	
	Eugene-Springfield	24
	Portland	2
	Salem	24
	Washington	
	Seattle-Everett	2
	Tacoma	2
2500	*PRAIRIE DIVISION*	
	Illinois	
	Bloomington-Normal	73
	Champaign-Urbana-Rantoul	73
	Chicago	73
	Decatur	91
	Kankakee	73
	Peoria	91
	Rockford	73
	Springfield	91
	Indiana	
	Terre Haute	91

Appendix III (Cont.)

		PNV
	Iowa	
	Cedar Rapids	91
	Davenport-Rock Island-Moline	91
	Des Moines	91
	Sioux City	66
	Waterloo-Cedar Falls	91
	Kansas	
	Lawrence	73
	Topeka	73
	Wichita	89
	Missouri	
	Kansas City	91
	St. Joseph	73
	Nebraska	
	Lincoln	89
	Omaha	91
	North Dakota	
	Fargo-Moorhead	89
	Grand Forks	89
	Oklahoma	
	Lawton	62
	Oklahoma City	62
	Tulsa	75
	South Dakota	
	Sioux Falls	66
	Texas	
	Abilene	76
	Austin	68
	Brownsville-Harlingen-San Benito	54
	Bryan-College Station	91
	Corpus Christi	69
	Dallas-Fort Worth	68
	Galveston-Texas City	70
	Houston	69
	Killeen-Temple	68
	Laredo	38
	McAllen-Pharr-Edinburg	54
	San Angelo	76
	San Antonio	78
	Sherman-Denison	75
	Waco	68
	Wichita Falls	76
2600	*MEDITERRANEAN DIVISION*	
	California	
	Anaheim-Santa Ana-Garden Grove	41
	Bakersfield	34
	Fresno	41
	Los Angeles-Long Beach	41
	Modesto	42
	Oxnard-Simi Valley-Ventura	26
	Riverside-San Bernardino-Ontario	30
	Sacramento	42
	Salinas-Seaside-Monterey	41
	San Diego	30
	San Jose	40
	Santa Barbara-Santa Maria-Lompoc	26
	Santa Cruz	26
	Stockton	42
3100	*STEPPE DIVISION*	PNV
	Colorado	
	Colorado Springs	58
	Denver-Boulder	58
	Fort Collins	58
	Greeley	58
	Pueblo	58
	Idaho	
	Boise City	49
	Montana	
	Billings	89
	Great Falls	56
	Nevada	
	Reno	49
	New Mexico	
	Albuquerque	47
	North Dakota	
	Bismarck	89
	Texas	
	Amarillo	58
	Lubbock	58
	Midland	58
	Odessa	58
	Utah	
	Provo-Orem	31
	Salt Lake City-Ogden	32
	Washington	
	Richland-Kennewick	49
	Yakima	49
3200	*DESERT DIVISION*	
	Arizona	
	Phoenix	36
	Tucson	36
	Nevada	
	Las Vegas	35
	Texas	
	El Paso	52
4100	*SAVANNA DIVISION*	
	Florida	
	Fort Lauderdale-Hollywood	102
	Miami	106
	West Palm Beach-Boca Raton	102
4200	*RAINFOREST DIVISION*	
	Hawaii	
	Honolulu	121

Appendix IV

SMSA Classification by Zones of PNV[5]

		ED
WESTERN NEEDLELEAF FOREST		
2	*Cedar—hemlock—Douglas-fir forest*	
	Portland, OR-WA	2400
	Seattle-Everett, WA	2400
	Tacoma, WA	2400
11	*Douglas-fir forest*	
	Spokane, WA	2100
WESTERN NEEDLELEAF AND BROADLEAF FOREST		
24	*Cedar—hemlock—Douglas-fir forest and Oregon oakwoods*	
	Eugene-Springfield, OR	2400
	Salem, OR	2400
25	*California mixed evergreen forest*	
	Santa Rosa, CA	2400
26	*California oakwoods*	
	Oxnard-Simi Valley-Ventura, CA	2600
	Santa Barbara-Santa Maria-Lompoc, CA	2600
	Santa Cruz, CA	2600
WESTERN SHRUB		
30	*Coastal sagebrush*	
	Riverside-San Bernardino-Ontario, CA	2600
	San Diego, CA	2600
31	*Mountain mahogany--oak scrub*	
	Provo-Orem, UT	3100
32	*Great Basin sagebrush*	
	Salt Lake City-Ogden, UT	3100
34	*Saltbrush-greasewood*	
	Bakersfield, CA	2600
35	*Creosote bush*	
	Las Vegas, NV	3200
36	*Creosote bush-bur sage*	
	Phoenix, AZ	3200
	Tucson, AZ	3200
38	*Ceniza shrub*	
	Laredo, TX	2500
WESTERN GRASSLAND		
40	*Fescue-oatgrass*	
	San Francisco-Oakland, CA	2400
	San Jose, CA	2600
	Vallejo-Fairfield-Napa, CA	2400
41	*California steppe*	
	Anaheim-Santa Ana-Garden Grove, CA	2600
	Fresno, CA	2600
	Los Angeles-Long Branch, CA	2600
	Salinas-Seaside-Monterey, CA	2600
42	*Tule marshes*	
	Modesto, CA	2600
	Sacramento, CA	2600
	Stockton, CA	2600
47	*Grama-galleta steppe*	
	Albuquerque, NM	3100
WESTERN SHRUB AND GRASSLAND		
49	*Sagebrush steppe*	
	Boise City, ID	3100
	Reno, NV	3100
	Richland-Kennewick, WA	3100
	Yakima, WA	3100
52	*Grama-tobosa shrubsteppe*	
	El Paso, TX	3200
54	*Mesquite-acacia-savanna*	
	Brownsville-Harlingen-San Benito, TX	2500
	McAllen-Pharr-Edinburg, TX	2500
CENTRAL AND EASTERN GRASSLANDS		
56	*Foothills prairie*	
	Great Falls, MT	3100
58	*Grama-buffalograss*	
	Amarillo, TX	3100
	Colorado Springs, CO	3100
	Denver-Boulder, CO	3100
	Fort Collins, CO	3100
	Greeley, CO	3100
	Lubbock, TX	3100
	Midland, TX	3100
	Odessa, TX	3100
	Pueblo, CO	3100
62	*Bluestem-grama prairie*	
	Lawton, OK	2500
	Oklahoma City, OK	2500
65	*Northern cordgrass prairie*	
	Atlantic City, NJ	2300
66	*Bluestem prairie*	
	Sioux City, IA-NE	2500
	Sioux City, SD	2500
68	*Blackland prairie*	
	Austin, TX	2500
	Dallas-Fort Worth, TX	2500
	Killeen-Temple, TX	2500
	Waco, TX	2500
69	*Bluestem-sacahuista prairie*	
	Beaumont-Port Arthur-Orange, TX	2300
	Corpus Christi, TX	2500
	Houston, TX	2500
70	*Southern cordgrass prairie*	
	Galveston-Texas City, TX	2500

[5] Based on Kuchler (1964). The numerical prefix to the PNV class corresponds to that given by Bailey (1978). The numerical suffix to the SMSA refers to the ecoregion division.

Appendix IV (Cont.)

CENTRAL AND EASTERN GRASSLAND AND FOREST COMBINATION

		ED
72	*Oak savanna*	
	Eau Claire, WI	2200
	Kenosha, WI	2200
	Madison, WI	2200
	Minneapolis-St. Paul, MN-WI	2200
	St. Cloud, MN	2200
73	*Bluestem prairie and oak-hickory forest*	
	Bloomington-Normal, IL	2500
	Champaign-Urbana-Rantoul, IL	2500
	Chicago, IL	2500
	Kankakee, IL	2500
	Lawrence, KS	2500
	Rockford, IL	2500
	St. Joseph, MO	2500
	Springfield, OH	2200
	Springfield, MO	2200
	Topeka, KS	2500
74	*Cedar glades*	
	Huntsville, AL	2200
75	*Cross timbers*	
	Sherman-Denison, TX	2500
	Tulsa, OK	2500
76	*Mesquite-buffalo grass*	
	Abilene, TX	2500
	San Angelo, TX	2500
	Wichita Falls, TX	2500
78	*Mesquite-oak savanna*	
	San Antonio, TX	2500

EASTERN NEEDLELEAF FOREST

86	*Great Lakes pine forest*	
	Muskegon-North Shores-Muskegon Heights, MI	2100
	Duluth-Superior, MN-WI	2100

EASTERN BROADLEAF FOREST

89	*Northern floodplain forest*	
	Billings, MT	3100
	Bismarck, ND	3100
	Fargo-Moorhead, ND-MN	2500
	Grand Forks, ND-MN	2500
	Lincoln, NE	2500
	Wichita, KS	2500
90	*Maple—basswood forest*	
	Appleton-Oshkosh, WI	2200
	Dubuque, IA	2200
	La Crosse, WI	2200
	Milwaukee, WI	2200
	Racine, WI	2200
	Rochester, MN	2200
91	*Oak—hickory forest*	
	Ann Arbor, MI	2200
	Baton Rouge, LA	2300
	Battle Creek, MI	2200
	Bryan-College Station, TX	2500
	Cedar Rapids, IA	2500
	Cincinnati, OH-KY-IN	2200
	Clarksville-Hopkinsville, TN-KY	2200
	Columbia, MO	2200
	Davenport-Rock Island-Moline, IA-IL	2500
	Dayton, OH	2200
	Decatur, IL	2500
	Des Moines, IA	2500
	Elkhart, IN	2200
	Fayetteville-Springdale, AR	2200
	Flint, MI	2200
	Florence, AL	2200
	Fort Wayne, IN	2200
	Gary-Hammond-East Chicago, IN	2200
	Kalamazoo-Portage, MI	2200
	Kansas City, MO-KS	2500
	Lafayette-West Lafayette, IN	2200
	Lexington-Fayette, KY	2200
	Louisville, KY-IN	2200
	Nashville-Davidson, TN	2200
	Omaha, NE-IA	2500
	Owensboro, KY	2200
	Peoria, IL	2500
	St. Louis, MO-IL	2200
	South Bend, IN	2200
	Springfield, IL	2500
	Terre Haute, IN	2500
	Waterloo-Cedar Falls, IA	2500
92	*Elm-ash forest*	
	Bay City, MI	2100
	Detroit, MI	2200
	Jackson, MI	2200
	Lorain-Elyria, OH	2200
	Saginaw, MI	2100
	Toledo, OH-MI	2200
93	*Beech-maple forest*	
	Akron, OH	2200
	Anderson, IN	2200
	Bloomington, IN	2200
	Buffalo, NY	2200
	Cleveland, OH	2200
	Columbus, OH	2200
	Erie, PA	2200
	Grand Rapids, MI	2200
	Hamilton-Middletown, OH	2200
	Indianapolis, IN	2200
	Kokomo, IN	2200
	Lansing-East Lansing, MI	2200
	Lima, OH	2200
	Mansfield, OH	2200
	Muncie, IN	2200
	Utica-Rome, NY	2100
	Youngstown-Warren, OH	2200
94	*Mixed mesophytic forest*	
	Charleston, WV	2200
	Huntington-Ashland, WV-KY-OH	2200
95	*Appalachian oak forest*	
	Allentown-Bethlehem-Easton, PA	2200
	Altoona, PA	2200
	Asheville, NC	2200
	Boston, MA	2200
	Bridgeport, CT	2200

Appendix IV (Cont.)

	ED
Bristol, CT	2200
Canton, OH	2200
Danbury, CT	2200
Elmira, NY	2200
Fall River, MA-RI	2200
Harrisburg, PA	2200
Hartford, CT	2200
Jersey City, NJ	2200
Johnson City-Kingsport-Bristol, TN-VA	2200
Johnstown, PA	2200
Knoxville, TN	2200
Lancaster, PA	2200
Lawrence-Haverhill, MA-NH	2200
Long Branch-Asbury Park, NJ	2200
Meriden, CT	2200
New Bedford, MA	2200
New Britain, CT	2200
New Brunswick-Perth Amboy-Sayreville, NJ	2200
New Haven-West Haven, CT	2200
New London-Norwich, CT	2200
New York, NY-NJ	2200
Newark, NJ	2200
Norwalk, CT	2200
Parkersburg-Marietta, WV-OH	2200
Paterson-Clifton-Passaic, NJ	2200
Philadelphia, PA-NJ	2200
Pittsburgh, PA	2200
Poughkeepsie, NY	2100
Providence-Warwick-Pawtucket, RI	2200
Reading, PA	2200
Scranton-Wilkes-Barre-Hazelton, PA	2100
Springfield-Chicopee-Holyoke, MA-CT	2200
Stamford, CT	2200
Steubenville-Weirton, OH-WV	2200
Trenton, NJ	2200
Waterbury, CT	2200
Wheeling, WV-OH	2200
Williamsport, PA	2200
Wilmington, DE-NJ-MD	2200
York, PA	2200

EASTERN NEEDLELEAF AND BROADLEAF FOREST

		ED
97	*Northern hardwoods*	
	Albany-Schenectady-Troy, NY	2100
	Binghamton, NY-PA	2100
	Brockton, MA	2100
	Fitchburg-Leominster, MA	2100
	Green Bay, WI	2100
	Lewiston-Auburn, ME	2100
	Lowell, MA-NH	2100
	Manchester, NH	2100
	Nashua, NH	2100
	Pittsfield, MA	2100
	Portland, ME	2100
	Rochester, NY	2100
	Syracuse, NY	2100
	Worcester, MA	2100
100	*Northeastern oak—pine forest*	
	Nassau-Suffolk, NY	2200
	Vineland-Millville-Bridgeton, NJ	2300
101	*Oak—hickory—pine forest*	
	Alexandria, LA	2300
	Anniston, AL	2300
	Atlanta, GA	2300
	Augusta, GA-SC	2300
	Baltimore, MD	2300
	Birmingham, AL	2300
	Burlington, NC	2300
	Chattanooga, TN-GA	2200
	Charleston-North Carolina, SC	2300
	Charlotte-Gastonia, NC	2300
	Columbia, SC	2300
	Columbus, GA-AL	2300
	Fayetteville, NC	2300
	Gadsden, AL	2300
	Greensboro-Winston-Salem-High Point, NC	2300
	Greenville-Spartansburg, SC	2300
	Jackson, MS	2300
	Little Rock-North Little Rock, AR	2300
	Longview, TX	2300
	Lynchburg, VA	2300
	Macon, GA	2300
	Newport News-Hampton, VA	2300
	Norfolk-Virginia Beach-Portsmouth, VA-NC	2300
	Petersburg-Colonial Heights-Hopewell, VA	2300
	Pine Bluff, AR	2300
	Raleigh-Durham, NC	2300
	Richmond, VA	2300
	Roanoke, VA	2300
	Texarkana, TX-Texarkana, AR	2300
	Tuscaloosa, AL	2300
	Tyler, TX	2300
	Washington, DC-MD-VA	2300
102	*Southern mixed forest*	
	Albany, GA	2300
	Biloxi-Gulfport, MS	2300
	Bradenton, FL	2300
	Daytona Beach, FL	2300
	Fort Lauderdale-Hollywood, FL	4100
	Fort Myers, FL	2300
	Gainesville, FL	2300
	Jacksonville, FL	2300
	Lake Charles, LA	2300
	Lakeland-Winter Haven, FL	2300
	Melbourne-Titusville-Cocoa, FL	2300
	Mobile, AL	2300
	Orlando, FL	2300
	Panama City, FL	2300
	Pascagoula-Moss Point, MS	2300
	Pensacola, FL	2300
	Sarasota, FL	2300
	Savannah, GA	2300
	Tallahassee, FL	2300
	Tampa-St. Petersburg, FL	2300
	West Palm Beach-Boca Raton, FL	4100
	Wilmington, NC	2300

Appendix IV (Cont.)

		ED
103	*Southern floodplain forest*	
	Evansville, IN-KY	2200
	Fort Smith, AR-OK	2200
	Lafayette, LA	2300
	Memphis, TN-AR-MS	2300
	Monroe, LA	2300
	Montgomery, AL	2300
	New Orleans, LA	2300
	Shreveport, LA	2300
106	*Subtropical pine forest*	
	Miami, FL	4100
ALASKAN VEGETATION		
113	*Black spruce forest*	
	Anchorage, AK	1300
HAWAIIAN VEGETATION		
121	*Schlerophyllous forest-shrubland-grassland*	
	Honolulu, HI	4200

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This publication classifies 279 American metropolitan areas by ecoregion and potential natural vegetation. The classification forms a baseline of expected vegetation structure and composition that can assist scientists and policymakers in making urban forestry generalizations about classes of cities.

Keywords: urban forestry; regional ecology

☆ U.S. GOVERNMENT PRINTING OFFICE: 1983-605-024:57

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