FLORISTIC AFFINITIES OF THE FLORA OF THE LAND BETWEEN THE LAKES, KENTUCKY - TENNESSEE

NITA RAE HEILMAN

FLORISTIC AFFINITIES OF THE FLORA

OF

THE LAND BETWEEN THE LAKES, KENTUCKY-TENNESSEE

An Abstract

Presented to

the Graduate Council of

Austin Peay State University

In Partial fulfillment

of the Requirements for the Degree

Master of Science

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by

Nita Rae Heilman

March 1972

ABSTRACT

A survey of the flora of the Land Between the Lakes recreation area was conducted to determine the floristic affinities of that area. Individual range maps were drawn for each of the 809 species and varieties found in the study area. The plant distributions were based primarily on the descriptions of Fernald (1950) and Gleason and Cronquist (1963).

A total of twenty-one geo-floristic elements were identified for the Land Between the Lakes. There were nine intraneous elements representing 71.82 per cent of the total flora as compared with eleven extraneous elements for 11.62 per cent of the flora. The remaining 16.56 per cent was composed of introduced and hybrid species.

The largest single element, the intraneous Central United States and Canadian, contained 21.26 per cent of the flora. The three largest elements were both intraneous and wide ranging. The largest extraneous elements were the southeastern with 2.72 per cent and the northeastern with 2.22 per cent of the total flora. In terms of per cent of the respective flora, the southeastern element represented 23.4 per cent of the extraneous flora as compared with 5.16 per cent of the intraneous flora. Likewise, the northeastern element represented 19.15 per cent of the extraneous flora as compared with 2.75 per cent of the intraneous flora.

Six families, the Gramineae, Cruciferae, Leguminosae, Labiatae, Rosaceae, and Compositae, contained 50 per cent of the introduced species. The ten largest families, the Compositae, Cruciferae, Cyperaceae, Fagaceae, Gramineae, Labiatae, Leguminosae, Liliaceae, Rosaceae, and Scrophulariaceae, contained 400 species for 49.44 per cent of the total

flora. The Compositae, with thirteen extraneous and seventy-two intraneous species, was the largest family. In addition, the Compositae was the most widespread family with species occuring in eighteen of the twenty-one geo-floristic elements.

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To the Graduate Council:

I am submitting herewith a Thesis written by Nita Rae Heilman entitled "Floristic Affinities of the Flora of the Land Between the Lakes, Kentucky-Tennessee." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Biology.

Edward W. Chester
Major Professor

We have read this thesis and
recommend its acceptance:

Floyd L. Brown
Second Committee Member

Floyd M. Ford
Third Committee Member

Accepted for the Council:

Wayne E. Stamps
Dean of the Graduate School

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CHAPTER I

INTRODUCTION

Differences in physiographic, edaphic, and climatic factors determine the plants which will grow in a given area. The ranges of some plants are restricted by a specific set of conditions found only in one locality. Some may be widespread in a geographical region such as the southwestern United States while other plants are found in a variety of habitats throughout the North American continent.

By plotting the individual ranges and examining the number of plants occurring in certain geographic areas, it is possible to determine the floristic affinities of a given study area. The purpose of this research is to determine the floristic affinities of the flowering plants found in the Land Between the Lakes recreation area of Kentucky and Tennessee. The relative significance of the floristic elements, the number of intraneous, extraneous and introduced species, and certain statistical observations are also included in this paper.

The Land Between the Lakes recreation area is a 170,000-acre tract located between Kentucky Lake on the Tennessee River and Lake Barkley on the Cumberland River. The Tennessee Valley Authority developed recreation area, which is approximately 40 miles long and 6-8 miles wide, includes portions of Trigg and Lyon Counties, Kentucky and Stewart County, Tennessee (Figure 1). Prior to establishment as a recreational site, the area was composed of several small communities, a number of small farms, and a 60,000-acre wildlife refuge. All of the land has been purchased by Tennessee Valley Authority and most of the former buildings, utility

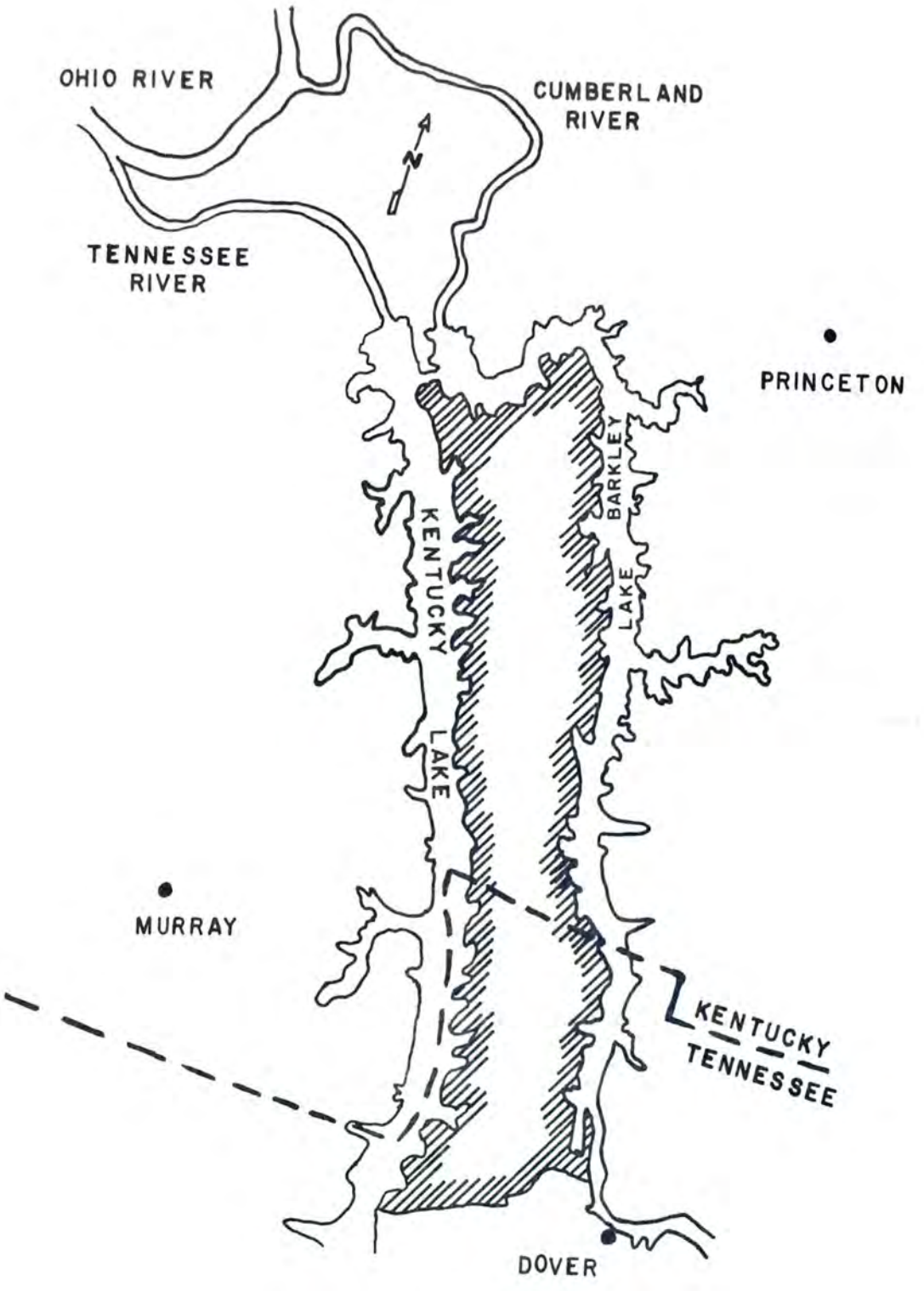

Figure 1. Location of the Land Between the Lakes recreation area, Kentucky-Tennessee.

lines, and advertising signboards have been removed (Ellis, Wofford, and Chester, 1971).

Fenneman (1938) includes the area in the western Highland Rim Section of the Interior Low Plateau Province. Typically, the area consists of open hills with 20-50 per cent of the area gently sloping. The elevation varies from 300 to 500 feet (United States Department of Interior, 1970).

Braun (1950) places the Land Between the Lakes area in the Mississippi Plateau portion of the Western Mesophytic Forest Region in the Deciduous Forest Formation. The vegetation of the Mississippi Plateau is a transition between the Mixed Mesophytic Region to the east and the Oak-Hickory Region to the west. The vegetation of this area is a mosaic of unlike communities and supports a relatively rich flora.

Rocks from two geologic periods, the Tertiary-Cretaceous and the Mississippian, are represented in the Land Between the Lakes. Generally speaking the shorelines of both Lake Barkley and Kentucky Lake are bounded by rocks of the Mississippian period while Tertiary-Cretaceous rocks are found on the higher ridges in the center of the area (Wharton and Barbour, 1971).

In Stewart County, the southern portion of the Land Between the Lakes, Fort Payne Chert is exposed in the bluffs along the eastern shore of Kentucky Lake. This Lower Mississippian chert ranges from about 240 feet to as much as 500 feet deep near the Kentucky-Tennessee boundary. Warsaw and St. Louis limestone from the Upper Mississippian era dominate the eastern two-thirds of the Stewart County portion. The slightly finer grained St. Louis limestone is at least 250 feet thick in Stewart County while the Warsaw limestone is approximately 200 feet thick in the central portion of the county. Rocks of the Tertiary-Cretaceous period are restricted to the higher ridges in northwestern Stewart County (Marcher, 1962).

According to Braun (1950), the Land Between the Lakes lies within the region of red and yellow podzolic soils. Three variations of the red and yellow podzols exist in this area. One of the red-yellow podzols has a relatively thick clay horizon without appreciable weatherable minerals. A second variety includes red-yellow podzols and some gray-brown podzols which either have a relatively thin subsurface clay horizon, a subsurface horizon containing appreciable weatherable minerals or both. The third red-yellow variety contains a clay hardpan horizon (United States Department of Interior, 1970).

The following climatic data for the Land Between the Lakes is based on records from the United States Weather Bureau stations in Dover, Tennessee and Hopkinsville and Princeton, Kentucky. Over a span of forty years, the average temperature in January was 38.1 degree F. while the average for July was 78.8 degree F. The average growing season lasted 193 days with the last spring frost on April 11 and the first killing frost in the fall on October 18. The average annual precipitation for the area was 48.33 inches with a January average of 5.42 inches and a July average of 3.67 inches (United States Department of Agriculture, 1941).

CHAPTER II

LITERATURE REVIEW

Braun (1955) points out that the terms element and floristic affinities are used in a variety of ways. These terms may refer to a geographic area, as the Appalachian element, or to a geologic time period, such as a Tertiary element. As early as 1819, N. J. Winch compiled the first plant geographical study in England (Cain, 1947). This study classified 2,176 species on the basis of northern and southern range limits, rare plants native to either Switzerland or Lapland, and location of maritime plants. According to Cain (1947), the term floral element was first introduced in plant geography by H. Christ in 1867. Originally a floristic element had only a geographic significance but Engler modified the term to indicate centers of origins and migration paths (Cain, 1947). Cowles (1929) proposes that the flora of a region should be divided as either intraneous, extraneous, disjunct distribution, or endemic.

Most of the literature concerning floristic elements or affinities may be placed in one of two categories. One category relates to the geographic affinities of the present flora in a specific locality. The second group involves the relation of the present flora to ancient floras and the factors which brought about changes in the flora of an area. Studies by Rudd (1951) for North Dakota, Little (1938) and Waterfall (1963) for Oklahoma, Cain (1930) for the Great Smoky Mountains, Parker (1936) for Indiana, Thompson (1939) for Ohio, and Rensing (1957) and Mohlenbrock (1959) for southern Illinois follow in general the

outline proposed by Cowles in 1929. Rensing (1957) and Ramseur (1960) added a separate category for introduced and hybrid plants.

Many botanists consider the southern Appalachians as a center of distribution for the emerging Coastal Plain in the southeastern United States. Thus the origin of the southern Appalachian flora is the subject of numerous articles. Asa Gray first proposed the possible relation of the eastern Asia and southern Appalachian flora in the early 1840's (Sharp, 1970). Li (1952) has written a broad summary of the families and genera shared by eastern Asia and eastern North America. The Klamath Mountains of northern California and southern Oregon are considered by Whittaker (1960, 1961) as a western center of origin comparable to the position of the southern Appalachians. Wood (1970) points out that 65 per cent of the Appalachian flora is located disjunctly on the west coast with a concentration in the Klamath Mountains. Miranda and Sharp (1950) indicate that bonds exist between the flora of the eastern United States and Mexico and Mexico and the southwestern United States. Steyermark (1950) suggest similar bonds in the flora of Guatemala. Apparent migrations from Asia to North America prior to the Late Tertiary have resulted in some genera which occur in both eastern Asia and Mexico. Ilex montana and Cladonia formosana are two representative species of this bicentric distribution (Sharp, 1961). Sharp (1970) expanded the idea of bicentric distributions between Asia and eastern North America, Mexico and eastern North America, and Mexico and eastern Asia to include a tricentric distributional pattern. These tricentric genera, exemplified by Mitchella repens and Liquidambar spp., occur in eastern Asia, northern Latin America and eastern North America.

CHAPTER III

METHODS AND MATERIALS

A list of the flowering plants for the Land Between the Lakes was prepared by the Biology Department at Austin Peay State University under contract with the Tennessee Valley Authority (Ellis et al., 1971). This list and several recent additions represented the 809 species and varieties and 116 families considered in this study.

The first step in determining the affinities of the plants in the Land Between the Lakes was to record the range of each species on individual pages in a notebook. The arrangement of the plants was according to Fernald (1950) for families with the respective genera and species listed alphabetically under each family. Four manuals, Fernald (1950), Small (1933), Britton and Brown (1970), and Gleason and Cronquist (1963) were the source of ranges for all plants. In addition, two government publications, Fowells (1965) and Little (1953), were used for shrubs and trees. The ranges from each manual were recorded along with the page numbers and titles on the individual species data pages. The recording of all data on individual pages arranged in phylogenetic order proved to be valuable in verifying range data. No attempt was made initially to sort out the different range types, however introduced and hybrid species were removed and arranged similarly in a separate notebook.

Although more than one manual was consulted, the primary reference for most of the plant ranges was Fernald (1950). These descriptions and to a lesser degree, those of Gleason and Cronquist (1963), were more valuable because of the specific locations cited. In most instances,

the range for an individual plant was basically identical for each manual checked. If a large range discrepancy occurred, the more widespread range was used to draw the distribution map.

After recording all range data, individual range maps were drawn for each native species. The maps were drawn as accurately and objectively as possible according to manual descriptions. As pointed out by Wood (1970), the drawing of a range map to show a continuous distribution should not be interpreted literally. Since there is no true continuous distribution pattern, this type of illustration is used as opposed to a disjunct range illustration. This study utilized two maps, one of the eastern United States and southern Canada and a second of continental North America. Both maps showed the boundaries of states, provinces, and the Land Between the Lakes recreation area. When all the maps were completed, the plants were grouped as either intraneous or extraneous species for the Land Between the Lakes area. Intraneous species were considered as those plants not near the limits of their distribution in the Land Between the Lakes area. Extraneous species were those plants at or near the limits of their distribution in the Land Between the Lakes area. Voigt and Mohlenbrock (1964) arbitrarily set one hundred miles as a dividing standard and this value was used here. Most of the ranges were separated by visual examination. A scaled radius of one hundred miles was marked on the remaining maps with the Kentucky-Tennessee boundary in the Land Between the Lakes area as the center point for the radius. After dividing the plants into intraneous and extraneous ranges, these major groups were further subdivided on the basis of geographic distribution.

Heimans (1939) in Cain (1947) stated that the only practical method of determining floristic elements was to define the elements of the native

flora of an area in relation to the area being studied and not to a universal system of floristic regions. Following the view expressed by Heimans, the geographic elements of the Land Between the Lakes recreation area were defined in relation to the Land Between the Lakes area. Although political boundaries are not the most desirable means of describing plant ranges, this was the method employed by all the manuals used. In assigning a species to a geographic area, political boundaries were the primary criterion. A species was considered transcontinental if at any latitude in its distribution the range extended from coast to coast. Plants placed in the grouping Central United States and Canada were basically eastern in distribution and extended west of the Mississippi River into the plains or Rocky Mountains. If a range occurred primarily from the east coast of North America west to the line of states including Minnesota, Iowa, Missouri, Arkansas, and Louisiana, the species was classified as Eastern. The distinction between Northern and Southern species was often based on where the major portion of the range occurred. The states of Kentucky, Tennessee, Virginia, and North Carolina were considered a buffer zone and were placed according to the major portion of the distribution. The same method was employed in subdividing Northern and Southern species into Northeast or Northwest and Southeast, Southwest, or Coastal Plain and Mississippi Embayment elements. The classification of Eastern and Northern or Southern species follows the method outlined by Little (1970).

After grouping all species into the various geographic elements, percentages of the total flora were calculated for each element. In addition, the data accumulated were plotted on a chart comparing plant families in the Land Between the Lakes area with the geo-floristic elements present.

CHAPTER IV

RESULTS

A total of twenty-one geo-floristic elements occur in the Land Between the Lakes recreation area. There are nine elements for the intraneous species, eleven for the extraneous species, and one element composed of introduced and hybrid species. Table I contains an outline of the geographic elements and a summary of the data for each element.

Of the three major groups considered, the intraneous group is the dominant element. There are 581 intraneous species which represent 71.82 per cent of the total flora. One hundred and thirty-four species composing 16.56 per cent of the total flora are either introduced or hybrid while the 94 extraneous species make up the remaining 11.62 per cent.

The largest individual geographic element is the Central United States and Canada group. This wide-ranging group contains 172 species or 21.26 per cent of the total flora. Another wide-ranging element, the Eastern group, contains the second highest number of species. The 17.8 per cent and 144 species for this group is slightly higher than the 16.56 per cent for introduced and hybrid species. Three additional elements each contain five per cent or more of the flora. The southern widespread group contains 92 species for 11.37 per cent, the northern widespread group contains 65 species for 8.03 per cent, and the transcontinental group contains 55 species for 6.8 per cent of the total flora. Not including the introduced and hybrid element which has no true range, the five largest geographic elements are intraneous species covering wide geographic areas.

TABLE I. GEOGRAPHIC AFFINITIES OF THE FLORA OF THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Geographic Areas	No. Species	Percentages
I. Intraneous		
A. Transcontinental	55	6.80
B. Central United States and Canada	172	21.26
C. Eastern North America		
1. Eastern	144	17.80
2. Southern		
a. southern widespread	92	11.37
b. southeastern	30	3.71
c. southwestern	5	0.62
3. Northern		
a. northern widespread	65	8.03
b. northeastern	16	1.98
c. northwestern	2	0.25
Total	581	71.82
II. Extraneous		
A. Transcontinental	3	0.37
B. Central United States and Canada		
1. central	1	0.12
2. central--east	9	1.11
3. central--west	4	0.49
C. Eastern North America		
1. Eastern	5	0.62
2. Southern		
a. southern widespread	7	0.87
b. southeastern	22	2.72
c. southwestern	4	0.49
d. coastal plain and Mississippi embayment	11	1.36
3. Northern		
a. northern widespread	10	1.24
b. northeastern	18	2.22
Total	94	11.62
III. Introduced and Hybrid	134	16.56
Total	134	16.56
Grand Total	809	100.00

With the exception of the southeastern intraneous group (30 species for 3.71 per cent), each of the remaining fifteen elements represent less than three per cent of the total flora. Individually, eight of these elements contain less than one per cent of the flora. All of the extraneous elements contain less than three per cent of the flora. The southeastern and northeastern elements are the major extraneous groups with 22 species for 2.72 per cent and 18 species for 2.22 per cent respectively. Figure 2 shows the relative ranking of the geographic elements based on the precentage of the total flora.

A comparison of similar elements for both intraneous and extraneous species reaffirms the dominance of the intraneous groups at almost every level (Figure 3). The transcontinental element is represented by 6.8 per cent for intraneous species and 0.37 per cent for the extraneous group. The combined total for extraneous central species is 1.73 per cent compared to 21.26 per cent for intraneous species. Eastern intraneous species outweigh the extraneous species 17.8 per cent to 0.62 per cent. A total of all southern elements indicates a ratio of three to one in favor of intraneous species. The southern widespread element is dominated by the intraneous group with 11.37 per cent as compared to 0.87 per cent extraneous. The Coastal Plain and Mississippi Embayment element is represented only by the extraneous value of 1.36 per cent. Two elements in the southern grouping are fairly similar with a slight edge for the intraneous species. Intraneous percentages for the southeastern and southwestern elements are 3.71 and 0.62 per cent respectively. The slightly lower extraneous values for the same two elements are 2.72 and 0.49 per cent. The total value for all northern elements is 10.26 per cent intraneous and 3.46 per cent extraneous. In the northern widespread element, the intraneous species

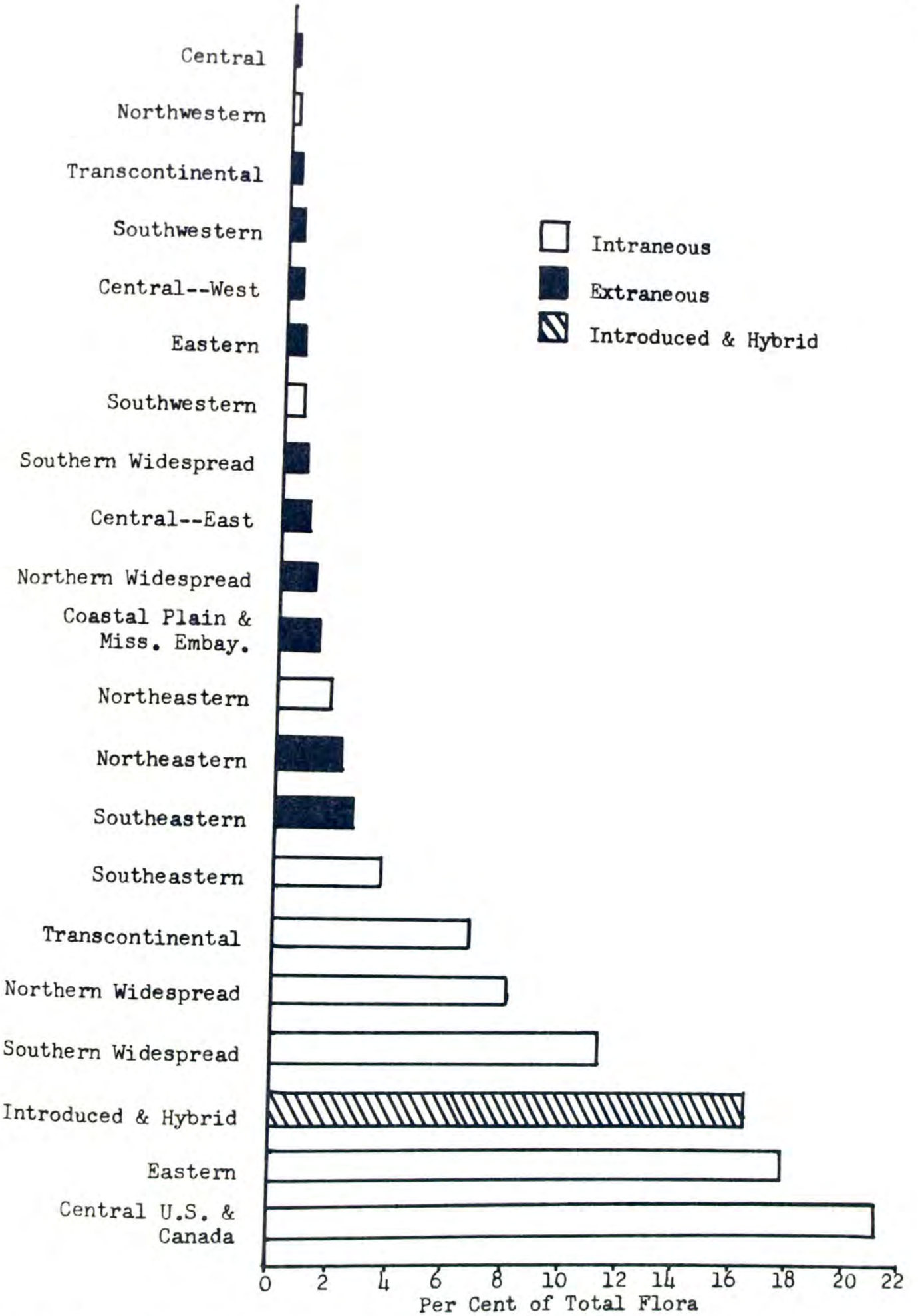

Figure 2. The relative position of each floristic element based on per cent of the total flora.

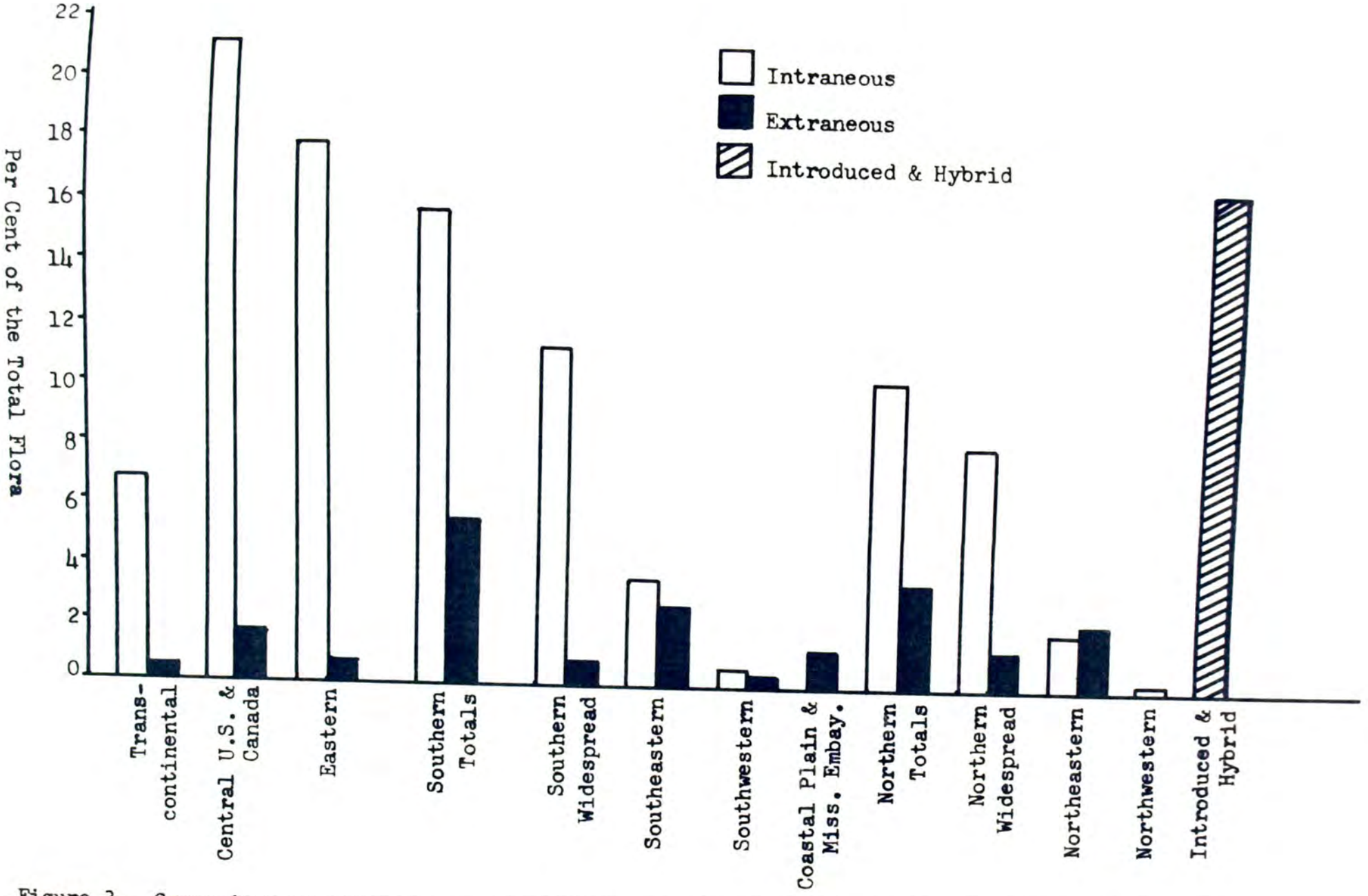

Figure 3. Comparison of Intraneous, Extraneous, and Introduced values based on per cent of the total flora.

rank 8.03 per cent of the total flora as compared to only 1.24 per cent for the extraneous species. The small northwestern element (0.25 per cent) is represented by the intraneous group alone. The northeastern element is the only geographic area with an extraneous value greater than the intraneous value. Although the extraneous value of 2.22 per cent is greater than the intraneous value of 1.98 per cent, neither value represents a major per cent of the total flora.

If the individual elements are examined as a percentage of the total intraneous flora or the total extraneous flora, certain data are more obvious (Figure 4). In terms of percentages of the total flora, the values for southern and northern intraneous species are greater than similar values for extraneous species. However, in terms of relative percentages of the respective flora, several extraneous elements play a more dominant role than similar intraneous elements. A total of all southern elements represents 46.81 per cent of the extraneous flora as compared to 21.86 per cent of the intraneous flora. The intraneous value for the southern widespread remains higher than the extraneous value. The southeastern element represents the largest single element of the extraneous flora while the intraneous value is a relatively small part of that flora. The southeastern species compose 23.4 per cent of the extraneous flora as compared to 5.16 per cent for intraneous species. The southwestern species also compose a greater per cent of the extraneous flora with 4.26 per cent as opposed to 0.86 per cent intraneous. Although there is not a comparable element in the intraneous flora, the Coastal plain element at 11.7 per cent is a major part of the southern extraneous flora.

The total northern elements represent 29.79 per cent of the extraneous flora as compared with 14.29 per cent of the intraneous flora. Just as

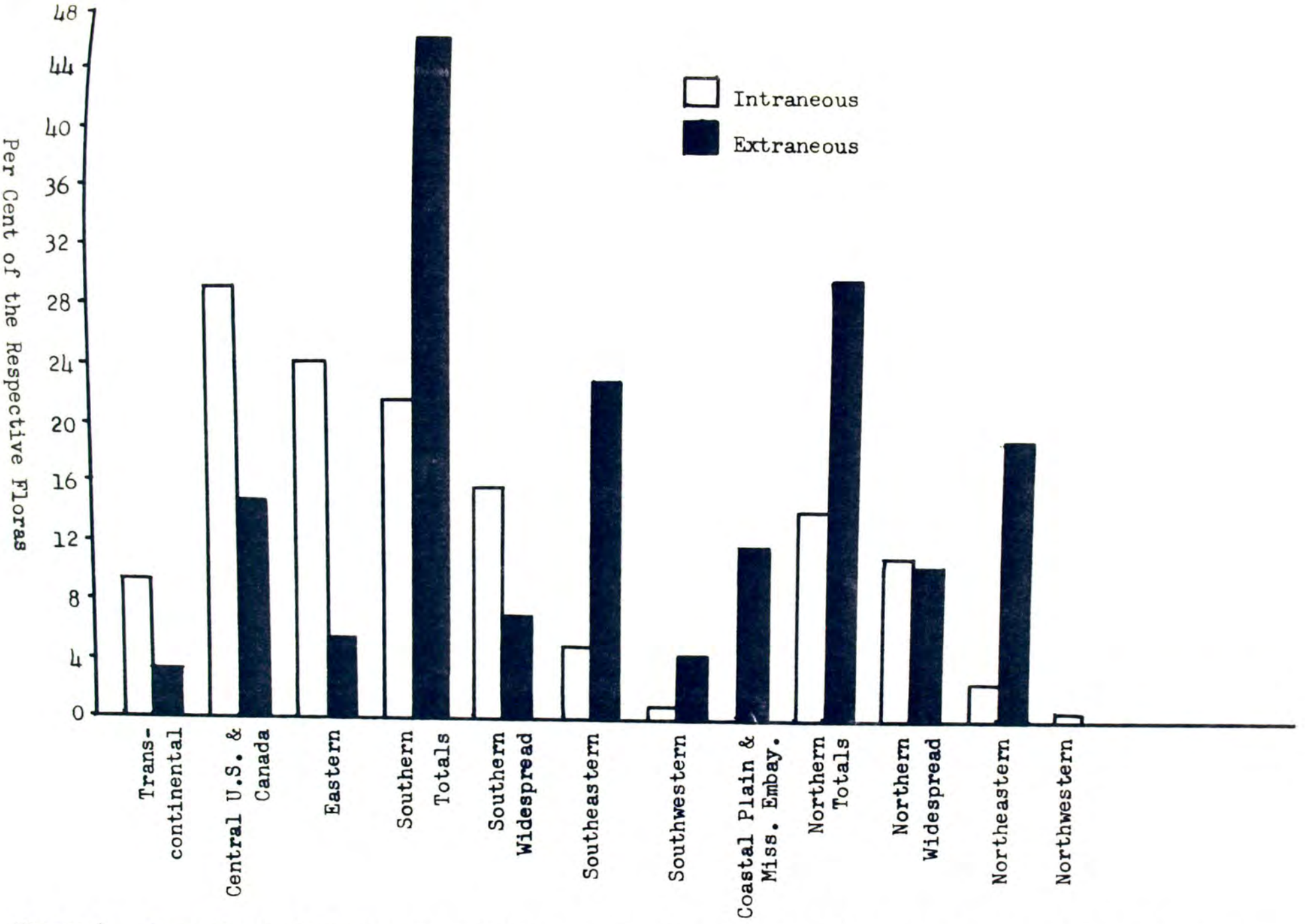

Figure 4. Comparison of Intraneous and Extraneous values based on per cent of the respective floras.

the southern widespread element maintained a higher percentage of the intraneous flora than the extraneous, the northern widespread intraneous element is slightly larger. The northeastern element is more evident in the extraneous flora. The extraneous value is 19.15 per cent as compared with 2.75 per cent for the intraneous flora.

There are nineteen species in the Land Between the Lakes with disjunct ranges. These species are grouped by the major portion of their range as opposed to a separate category for disjunct ranges. Three-fourths of the disjunct species are grouped with the intraneous central element. In general, these ranges include the central and eastern United States as the major portion of the range with a smaller portion along the west coast. One disjunct species occurs in the intraneous eastern and southern widespread elements and the extraneous southeastern, Coastal plain, and central-western elements. Although the disjunct species are not treated as a distinct percentage of the total flora, the individual species are listed with their respective element and also as disjunct species.

Each geo-floristic element is represented by a list of species arranged in alphabetical order and a typical range map (Figures 5-25). Elements which contain ten or more species are listed in Tables II-XIV.

The intraneous southwestern element includes Ampelamus albidus (Nutt.) Britt., Catalpa speciosa Ward., Eryngium prostratum Nutt., Jussiaea repens L. var glabrescens Ktze., and Scutellaria ovata Hill. (Figure 5). The intraneous northwestern element contains two species, Helianthus hirsutus Raf. and Pycnanthemum pilosum Nutt. (Figure 6).

Seven of the extraneous geo-floristic elements contain less than ten species each. The transcontinental element includes Ambrosia artemisiifolia L., Festuca rubra L., and Polygonum coccineum Muhl. (Figure 7). The central element contains one representative,

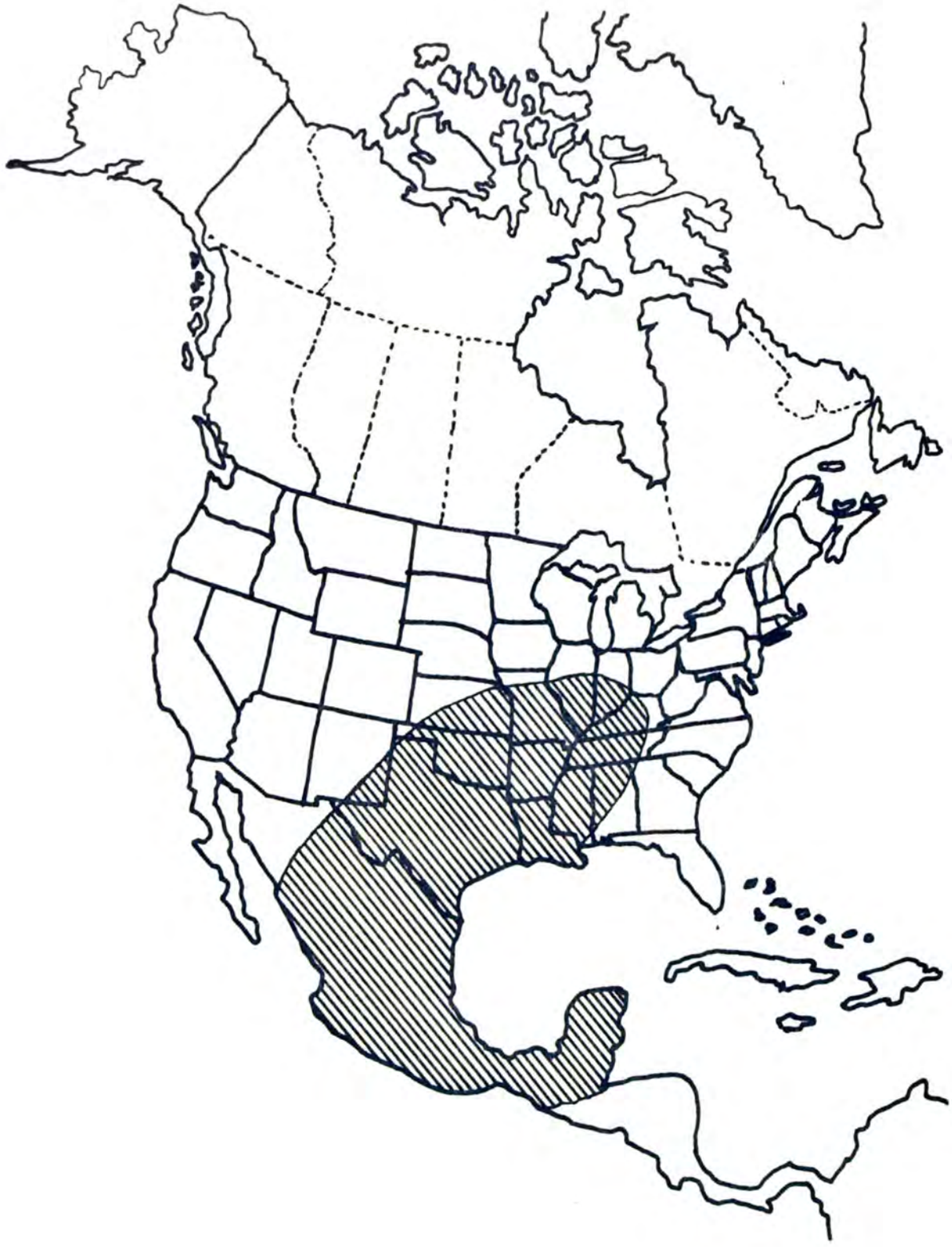

Figure 5. Distribution of Jussiaea repens L. var glabrescens Ktze., Intraneous southwestern.

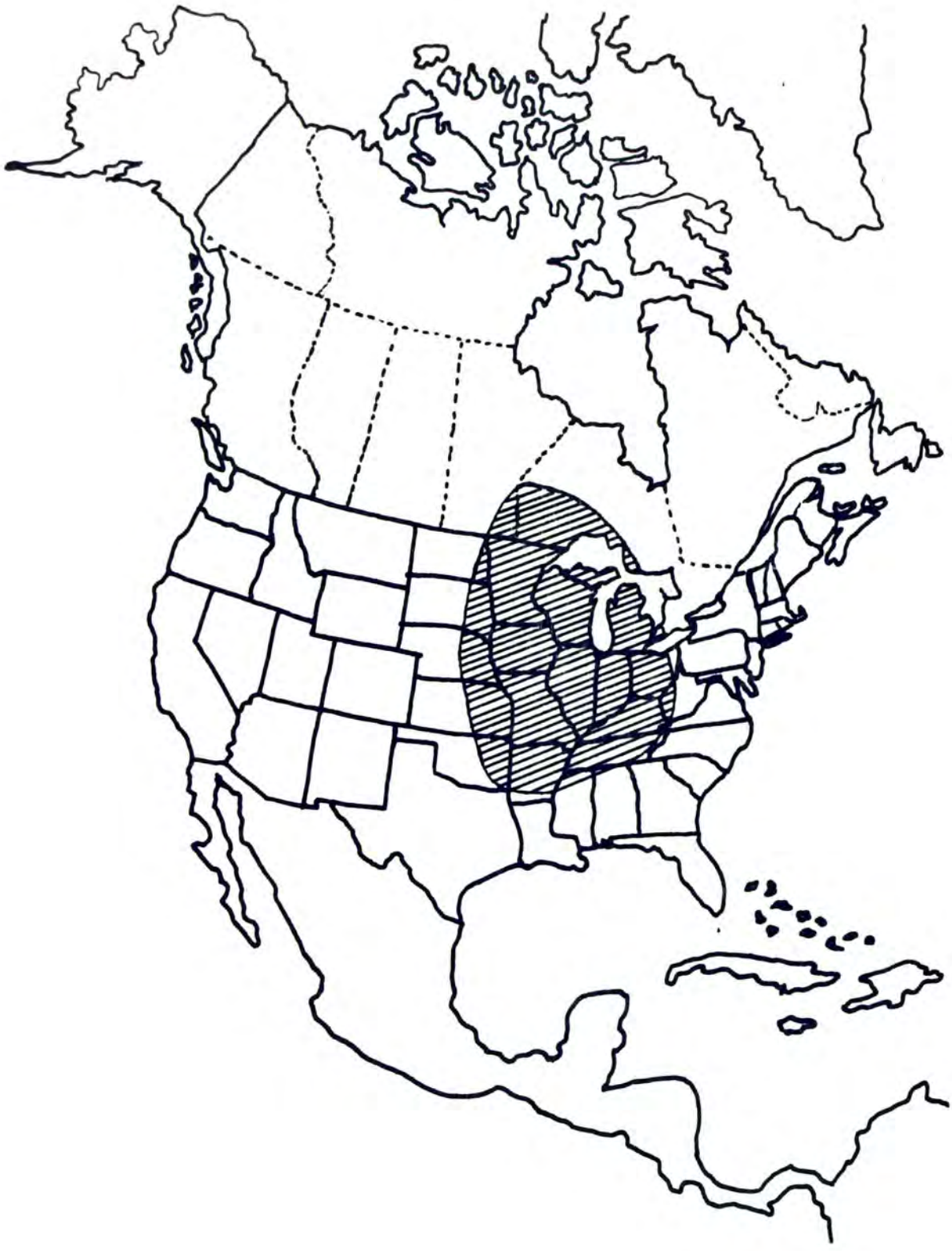

Figure 6. Distribution of Pycnanthemum pilosum Nutt., Intraneous northwestern.

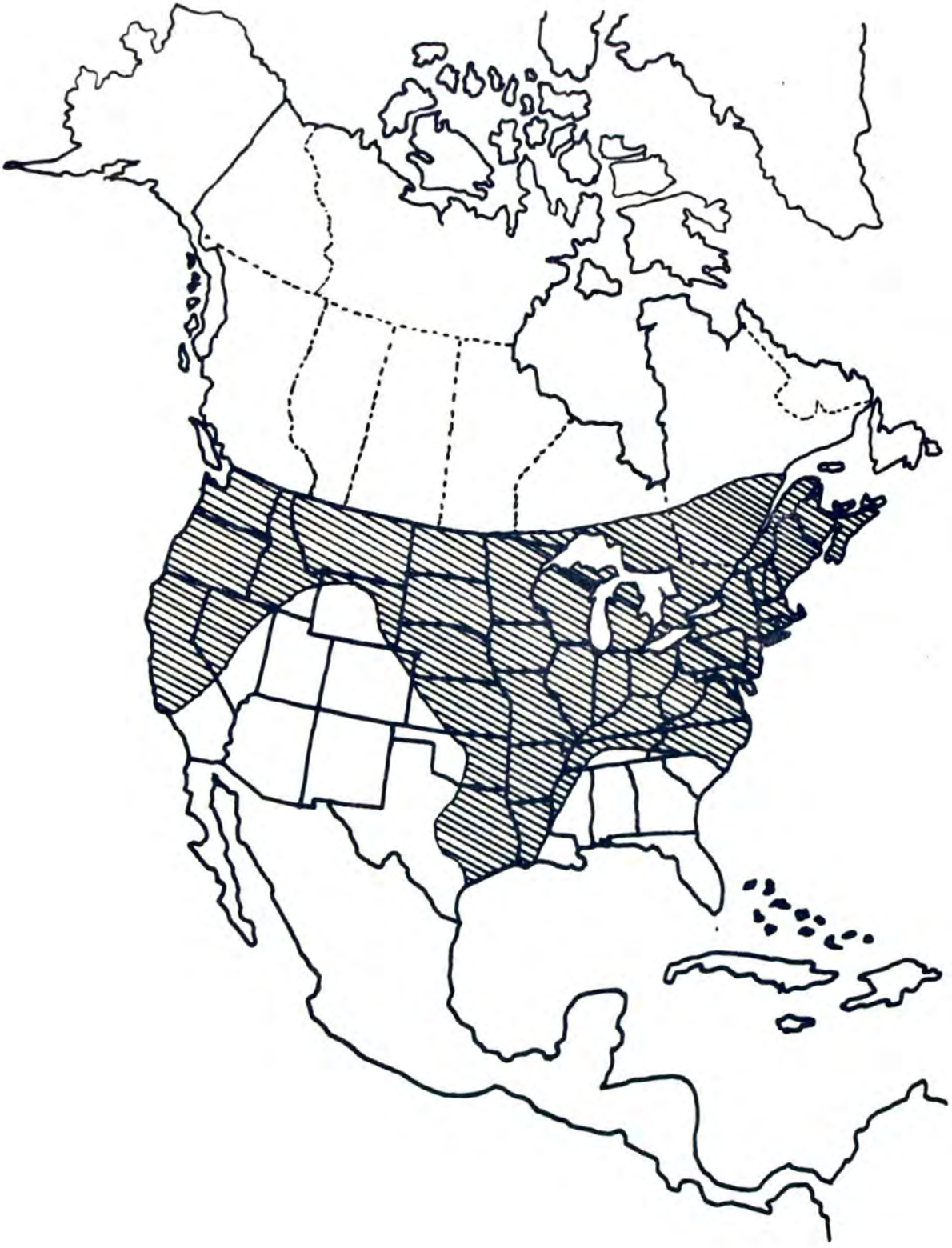

Figure 7. Distribution of Polygonum coccineum Muhl., Extraneous Transcontinental. (After Reed, 1971.)

Petalostemum candidum (Willd.) Michx. (Figure 8). The geo-floristic element which ranges eastward from the central United States and Canada includes Acer saccharum Marsh. var Schneckii Rehd., Baptisia leucophaea Nutt., Galium tinctorium L., Osmorhiza longistylis (Torr.) DC., Physalis heterophylla Nees., Plantago aristata Michx., Salix interior Rowlee., Silphium integrifolium Michx., and Solidago graminifolia (L.) Salisb. (Figure 9). Four species, Coreopsis tinctoria Nutt., Cuscuta cuspidata Engel., Elymus virginicus L. var submuticus Hook., and Polanisia trachysperma T. & G., represent the geo-floristic element which ranges westward from the central United States and Canada (Figure 10). The eastern element includes Acer rubrum L. var triloba Koch., Pycnanthemum muticum (Michx.) Pers., Rhus radicans L., Sericocarpus linifolius (L.) BSP., and Stellaria pubera Michx. (Figure 11). The southern widespread element is represented by Carex amphibola Steud., Carex oxylepis Torr. & Hook., Chrysopsis mariana (L.) Ell., Eupatorium hyssopifolium L., Nemophilia microcalyx (Nutt.) Fisch. & Mey., Panicum Ravenelii Scribn. & Merr., and Wisteria frutescens (L.) Poir. (Figure 12). Four species, Aster hemisphericus Alex., Carya illinoensis (Wang.) K. Koch., Quercus Nuttallii Pal., and Trepocarpus Aethusae Nutt., compose the south-western element (Figure 13).

An analysis of the flora of the Land Between the Lakes by families reveals several interesting statistics. Six families, the Gramineae, Cruciferae, Leguminosae, Labiatae, Compositae, and Rosaceae, contain 50 per cent of the 134 introduced or hybrid species. Three of these families, the Gramineae, Leguminosae, and Compositae, contain 32.8 per cent of the introduced species. The ten largest families, the Compositae, Cruciferae, Cyperaceae, Fagaceae, Gramineae, Labiatae, Leguminosae, Liliaceae,

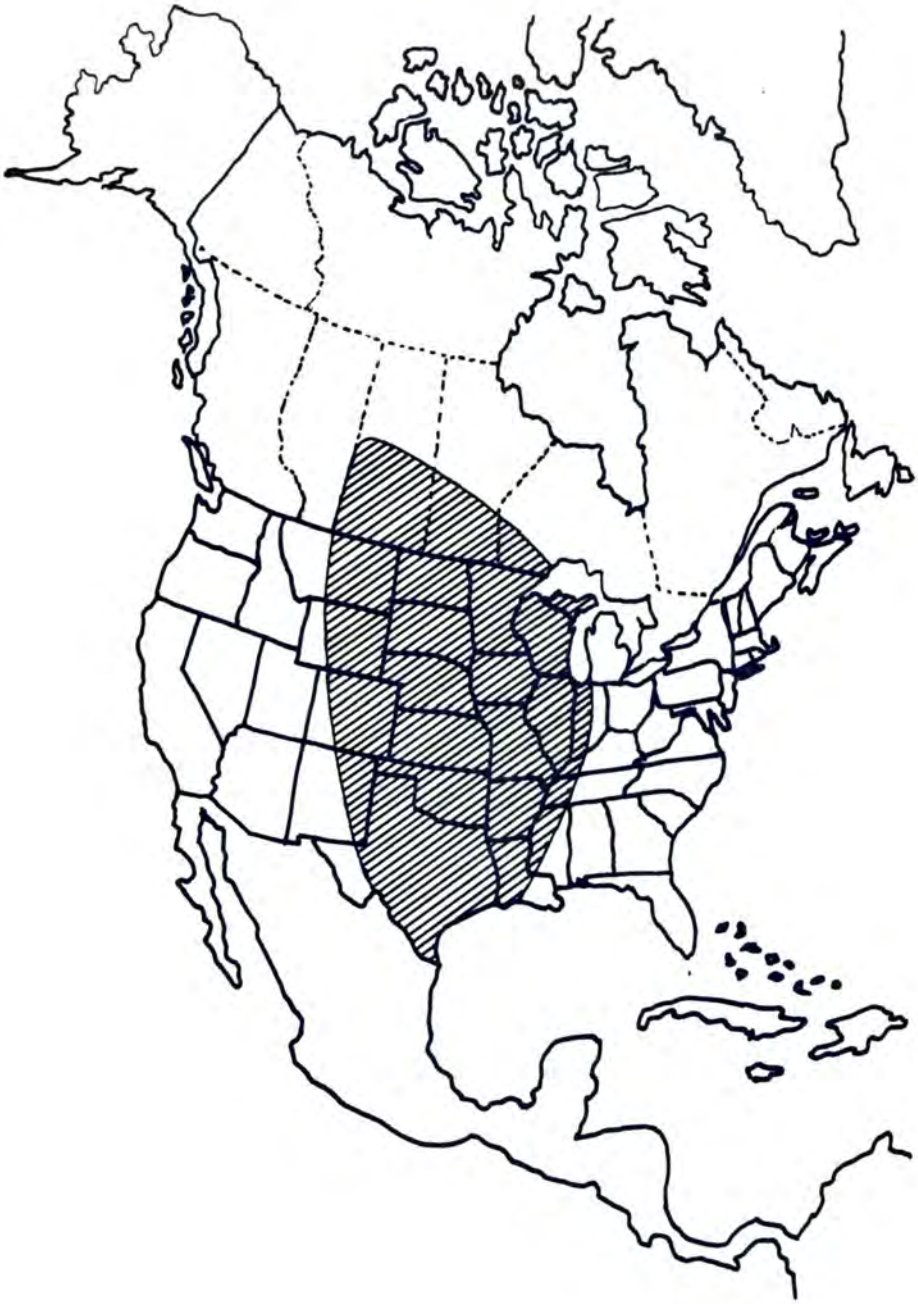

Figure 8. Distribution of Petalostemum candidum (Willd.) Michx., Extraneous central.

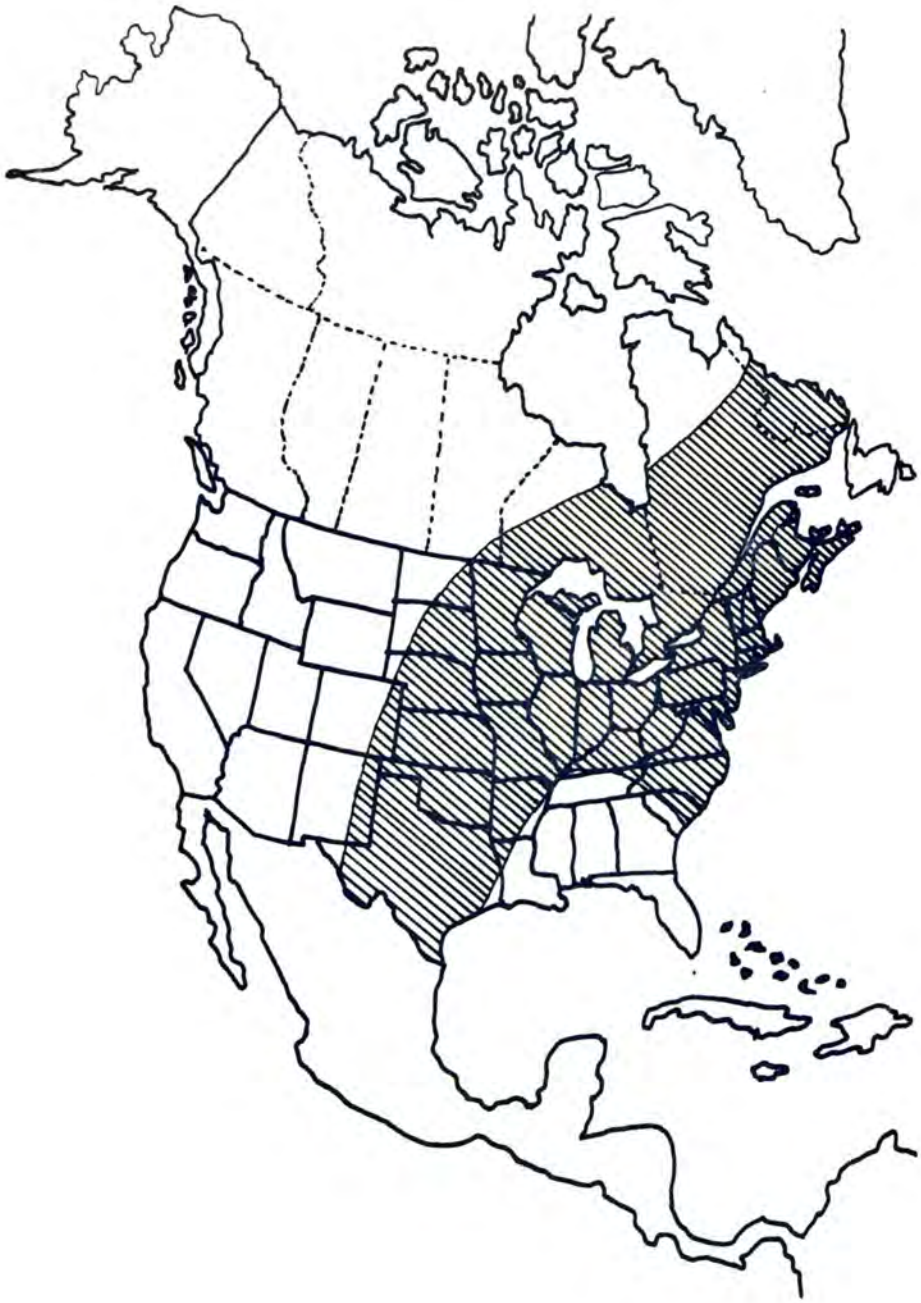

Figure 9. Distribution of Galium tinctorium L., Extraneous central United States-Canada and eastward.

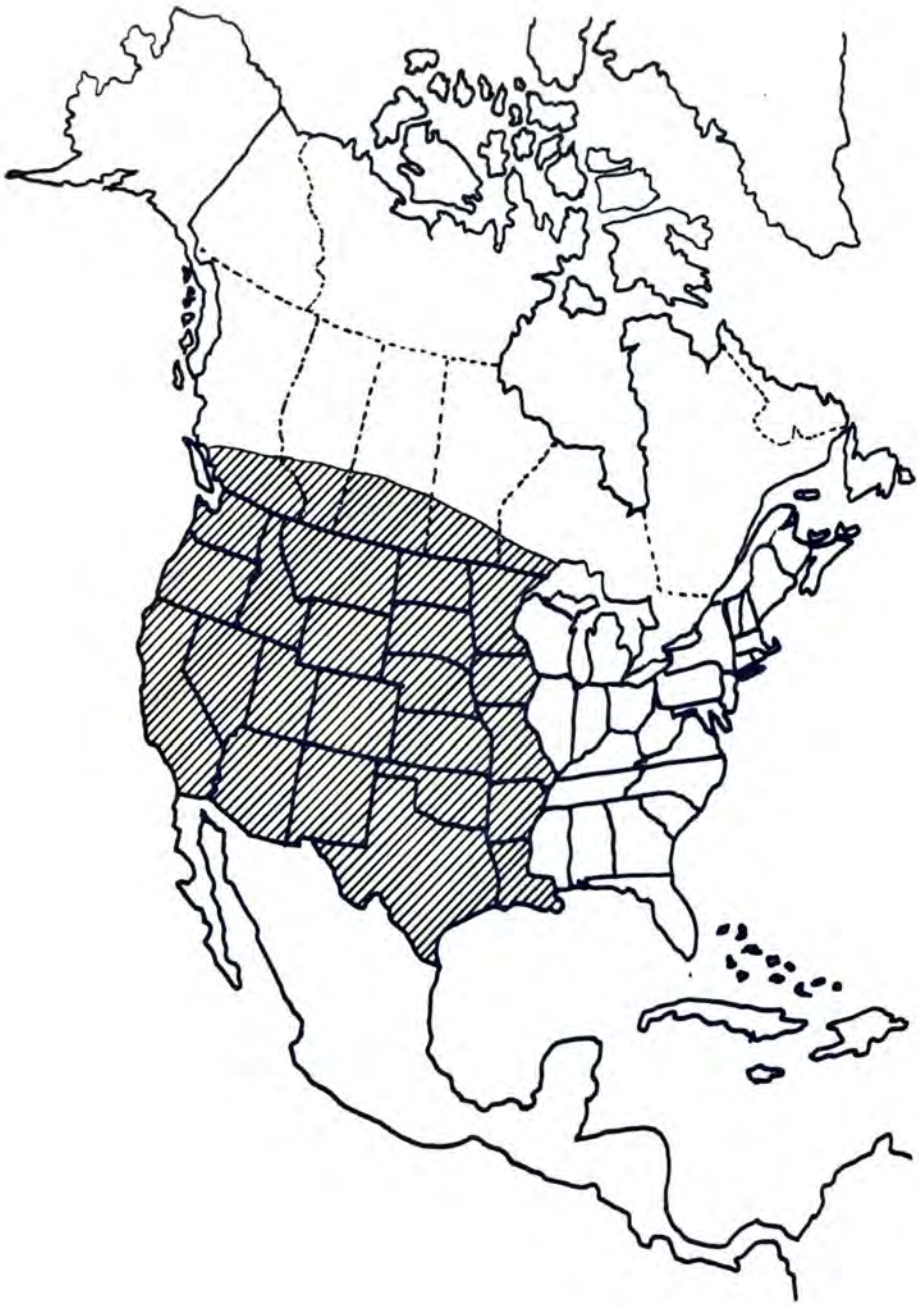

Figure 10. Distribution of Coreopsis tinctoria Nutt., Extraneous central United States-Canada and westward.

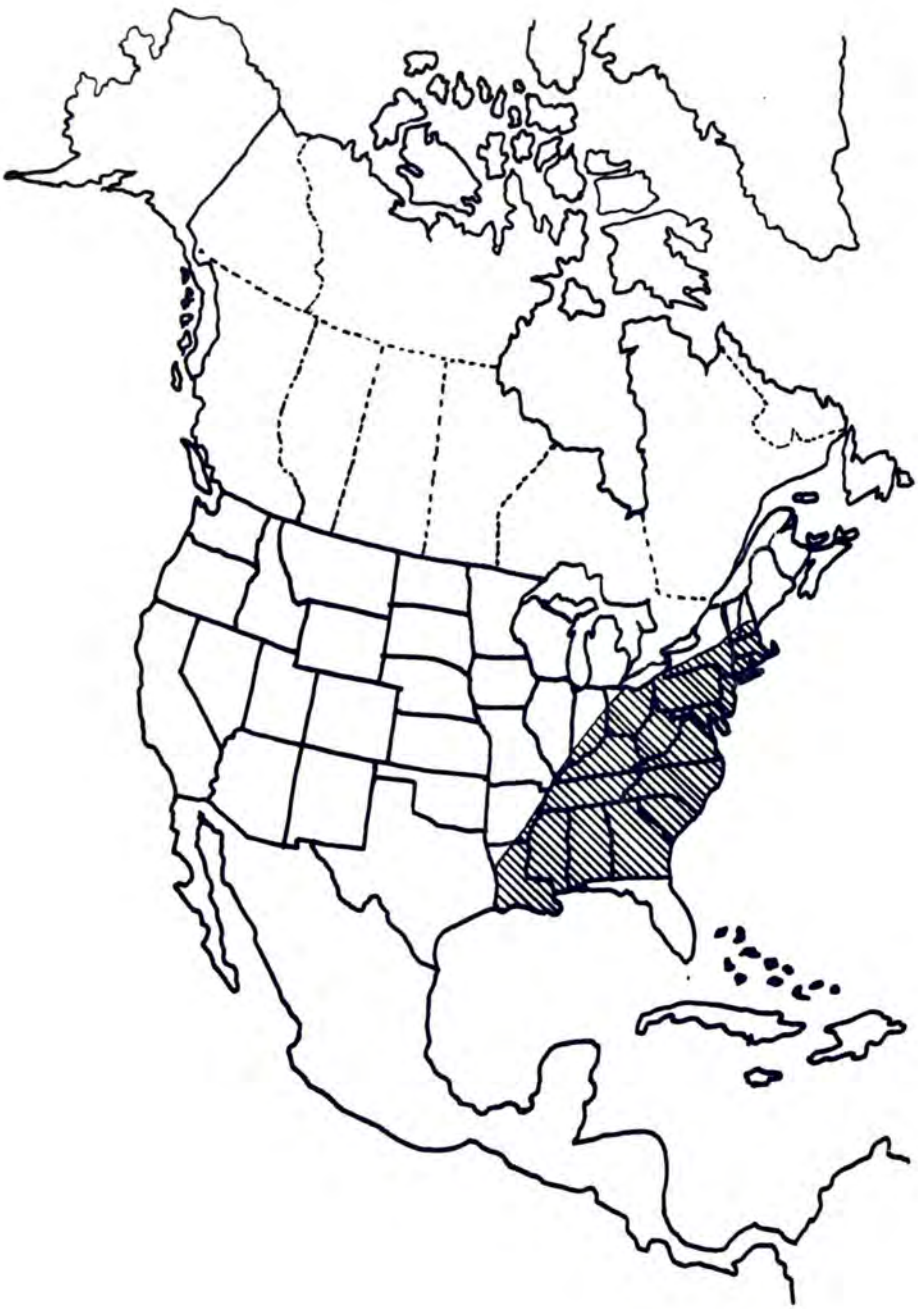

Figure 11. Distribution of Sericocarpus linifolius (L.) BSP., Extraneous Eastern.

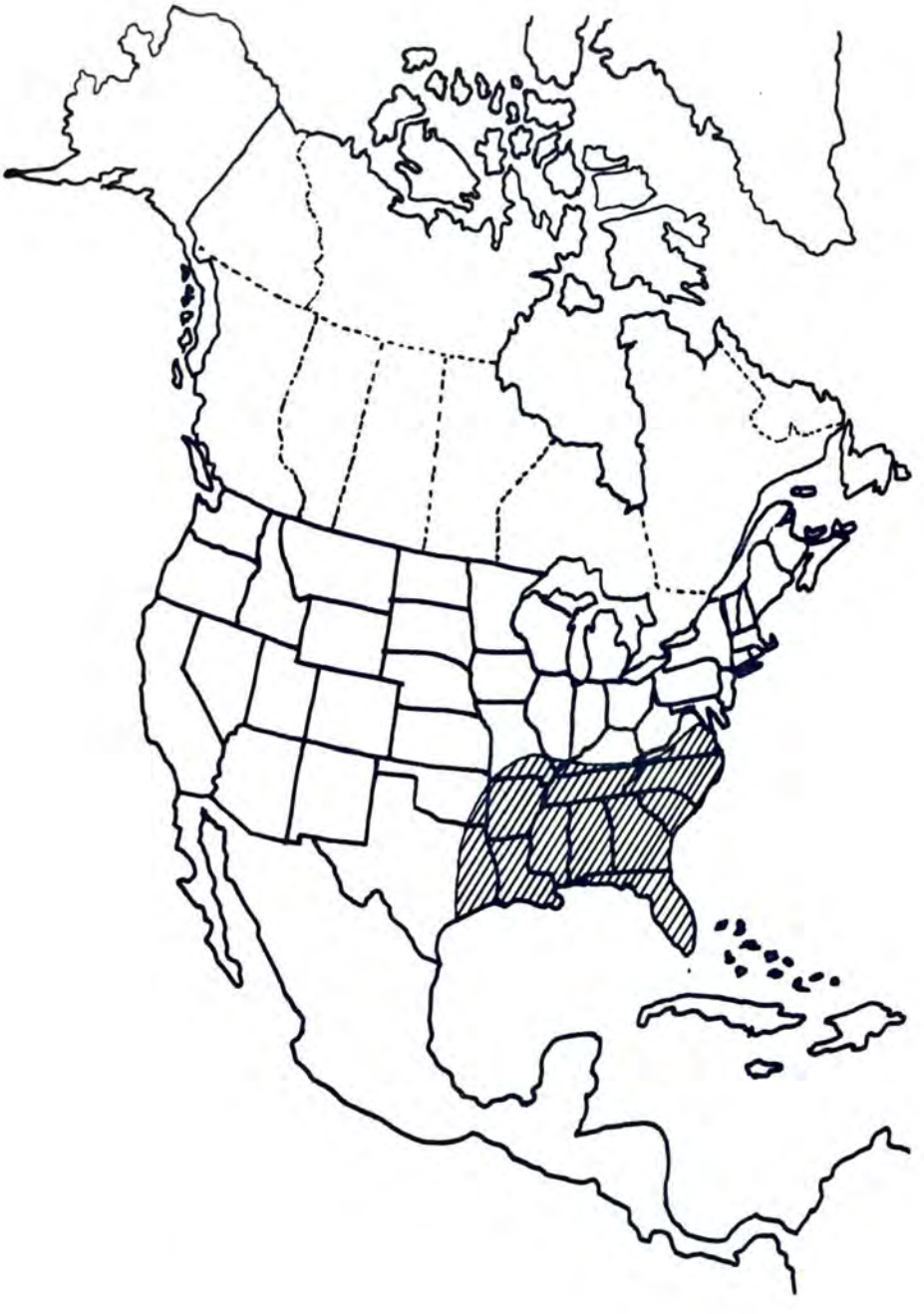

Figure 12. Distribution of Carex oxylepis Torr. & Hook., Extraneous southern widespread.

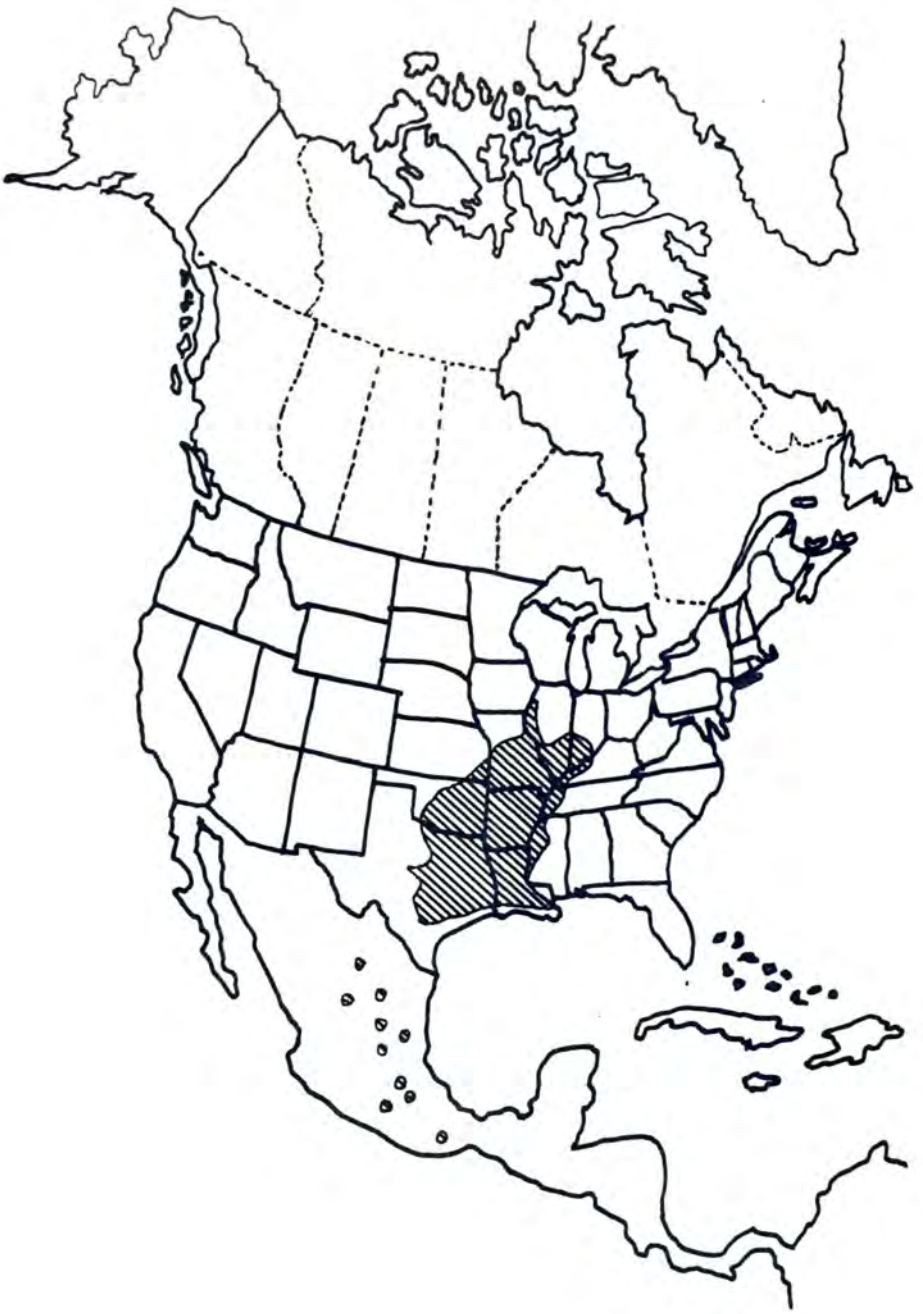

Figure 13. Distribution of Carya illinoensis (Wang.) K. Kock., Extraneous southwestern. (After Fowells, 1965.)

TABLE II. INTRANEOUS TRANSCONTINENTAL SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Acer Negundo L.
Ambrosia trifida L.
Ammannia coccinea Rothb.
Apocynum cannabium L.
Bidens frondosa L.
Callitriche heterophylla Pursh.
Cardamine pensylvanica Muhl.
Carex vulpinoidea Michx.
Cephalanthus occidentalis L.
Cerastium nutans Raf.
Ceratophyllum demersum L.
Convolvulus sepium L.
Cuscuta campestris Yunck.
Cuscuta pentagona Engel.
Cyperus odoratus L.
Eleocharis acicularis (L.) R. & S.
Eleocharis Engelmanni Steud.
Eragrostis hypnoides (Lam.) BSP.
Erigeron annus (L.) Pers.
Erigeron canadensis L.
Erigeron philadelphicus L.
Festuca octoflora Walt.
Galium Aparine L.
Galium triflorum Michx.
Geranium carolinianum L.
Gnaphalium purpureum L.
Gratiola neglecta Torr.
Hordeum pusillum Nutt.
Impatiens capensis Meerb.
Juncus tenuis Willd.
Lemna minor L.
Lepidium virginicum L.
Lindernia anagallidea (Michx.) Penn.
Lycopus americanus Muhl.
Lysimachia ciliata L.
Lythrum alatum Pursh.
Monotropa uniflora L.
Oxalis stricta L.
Panicum lanuginosum Ell. var Lindheimeri (Nash.) Fern.
Physalis pubescens L.
Plantago virginica L.
Polygonum lapathifolium L.
Polygonum punctatum Ell.
Potamogeton diversifolius Raf.
Potamogeton nodosus Poir.
Potentilla norvegica L.
Rhus glabra L.
Samolus parviflorus Raf.
Scutellaria lateriflora L.
Silene antirrhina L.
Smilacina racemosa (L.) Desf.
Specularia perfoliata (L.) DC.
Typha latifolia L.
Verbena bracteata Lag. & Rodr.
Verbena hastata L.

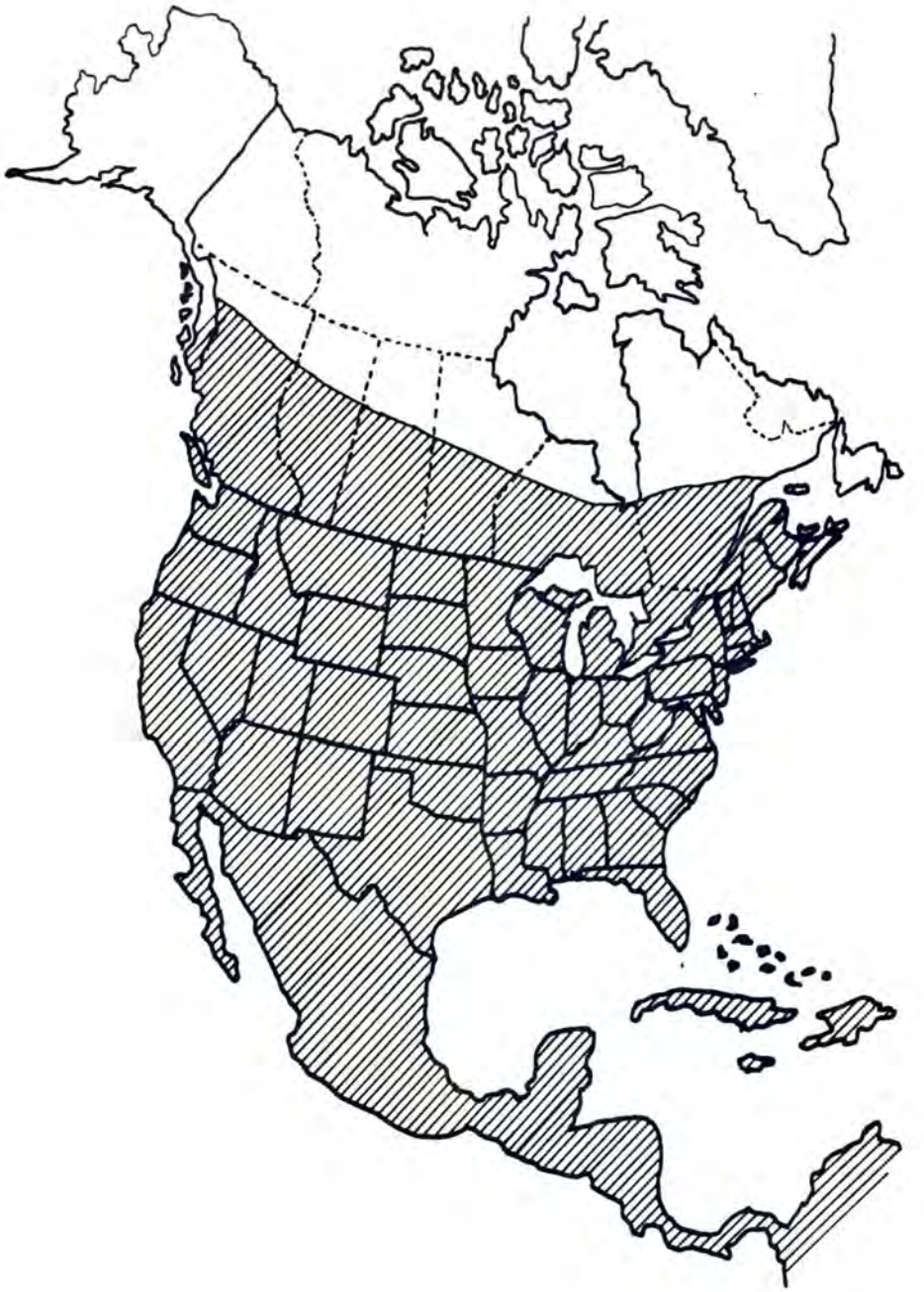

Figure 14. Distribution of Ceratophyllum demersum L., Intraneous Transcontinental. (After Reed, 1971.)

TABLE III. INTRANEOUS CENTRAL UNITED STATES AND CANADIAN SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Acalypha ostryaefolia Ridd.
Acalypha virginica L.
Agrimonia gryposepala Wallr.
Agrimonia parviflora Ait.
Alisma subcordatum Raf.
Ambrosia bidentata Michx.
Amphicarpa bracteata (L.) Fern.
Andropogon Gerardi Vitman.
Apios americana Medic.
Aplectrum hyemale (Muhl.) Torr.
Arabis canadensis L.
Arabis laevigata (Muhl.) Poir.
Aristida oligantha Michx.
Asclepias amplexicaulis Sm.
Asclepias incarnata L.
Asclepias syriaca L.
Asclepias tuberosa L.
Asclepias verticillata L.
Asimina triloba (L.) Dunal.
Astranthium integrifolium (Michx.) Nutt.
Baptisia leucantha T. & G.
Bidens bipinnata L.
Bidens comosa (Gray) Wieg.
Bidens polylepsis Blake
Boltonia asteroides (L.) L'Her.
Brasenia Schreberi Gmel.
Bromus purgans L.
Cardamine bulbosa (Schreb) BSP.
Carex cephalophora Muhl.
Carex comosa Boott.
Carex Frankii Kunth.
Carex lurida Wahlenb.
Cassia fasciculata Michx.
Cassia nictitans L.
Cassia obtusifolia L.
Celtis occidentalis L.
Cercis canadensis L.
Cicuta maculata L.
Circaea quadrisulcata (Max.) Fran. & Sav.
Cirsium altissimum (L.) Spreng.
Clitoria mariana L.
Commelina diffusa Burm.
Conobea multifida (Michx.) Benth.
Cornus obliqua Raf.
Corylus americana Walt.
Crotalaria sagittalis L.
Croton glandulosus L.
Cryptotaenia canadensis (L.) DC.
Cunila origanoides (L.) Britt.
Cyperus ovularis (Michx.) Torr.
Cyperus strigosus L.
Delphinium tricorne Michx.
Desmodium paniculatum (L.) DC.
Dicentra Cucullaria (L.) Bernh.
Draba brachycarpa Nutt.
Echinancea pallida Nutt.
Eclipta alba (L.) Hassk.
Eleocharis obtusa (Willd.) Schultes
Elephantopus carolinianus Willd.
Elymus villosus Muhl.
Elymus virginicus L. var virginicus
Elymus virginicus L. var glaberiflorus
Epilobium coloratum Bieh.
Erechitites hieracifolia (L.) Raf.
Euonymus atropurpureus Jacq.
Eupatorium perfoliatum L.
Eupatorium purpureum L.
Eupatorium rugosum Houtt.
Eupatorium serotinum Michx.
Euphorbia corollata L.
Euphorbia dentata Michx.
Euphorbia maculata L.
Euphorbia supina Raf.
Festuca obtusa Biehl.
Fragaria virginiana Duch.
Fraxinus pennsylvanica Marsh.
Fraxinus pennsylvanica Marsh. var subintegerrima (Vahl.) Fern.
Galium pilosum Ait.
Geranium maculatum L.
Gleditsia triacanthos L.
Glyceria striata (Lam.) Hitchc.
Gnaphalium obtusifolium L.
Hackelia virginiana (L.) Johnson
Helenium tenuifolium Nutt.
Helianthus divaricatus L.
Helianthus laetiflorus Pers.
Heteranthera reniformis R. & P.
Hieracium Gronovii L.
Houstonia longifolia Gaertn.

TABLE III. (continued)

Hypericum mutilum L.
Hypoxis hirsuta (L.) Coville
Impatiens pallida Nutt.
Iodanthus pinnatifidus (Michx.) Steud.
Ipomoea pandurata (L.) Mey.
Juglans nigra L.
Juncus acuminatus Michx.
Juniperus virginiana L.
Justicia americana (L.) Vahl
Krigia biflora (Walt.) Blake
Krigia virginica (L.) Willd.
Lactuca floridana (L.) Gaertn.
Liatris aspera Michx.
Lindernia dubia (L.) Penn.
Linum medium (Planch.) Britt.
Linum striatum Walt.
Lobelia inflata L.
Lonicera sempervirens L.
Lophotocarpus calycinus (Eng.) Sm.
Luzula campestris (L.) DC.
Menispermum canadense L.
Morus rubra L.
Myosotis verna L.
Nothoscordum bivalve (L.) Britt.
Nyssa sylvatica Marsh.
Oenothera biennis L.
Oenothera laciniata Hill.
Ostrya virginiana (Mill.) K. Koch.
Oxalis violacea L.
Panax quinquefolia L.
Panicum sphaerocarpon Ell.
Parietaria pensylvanica Muhl.
Parthenium integrifolium L.
Pedicularis canadensis L.
Penstemon Digitalis Nutt.
Penthorum sedoides L.
Phaseolus polystachios (L.) BSP.
Physalis virginiana Mill.
Polygonatum biflorum (Walt.) Ell.
Polygonum pensylvanicum L.
Polygonum scandens L.
Polymnia canadensis L.
Populus deltoides Bartr.
Prunus americana Marsh.
Prunus serotina Ehrh.
Ptelea trifoliata (L.) Raf.
Ranunculus abortivus L.
Ranunculus pusillus Poir.
Ranunculus recurvatus Poir.
Ratibida pinnata (Vent.) Barnh.
Rorippa sessiliflora (Nutt.) Hitchc.
Rotala ramosior (L.) Koehne.
Rudbeckia triloba L.
Salix nigra Marsh.
Salvia azurea Lam.
Sambucus canadensis L.
Sanguinaria canadensis L.
Scirpus americanus Pers.
Scirpus atrovirens Willd.
Scirpus lineatus Michx.
Seymeria macrophylla Nutt.
Sibara virginica (L.) Rollins.
Silphium perfoliatum L.
Smilacina racemosa (L.) Desf. var cylindrata Fern.
Solanum americanum Mill.
Solanum carolinense L.
Solidago caesia L.
Solidago juncea Ait.
Solidago nemoralis Ait.
Solidago odora Ait.
Spirodela polyrhiza (L.) Schleid.
Strophostyles helvola (L.) Ell.
Symphoricarpos orbiculatus Moench.
Tephrosia virginianum (L.) Pers.
Teucrium canadense L.
Ulmus americana L.
Ulmus rubra Muhl.
Verbena urticifolia L.
Verbesina helianthoides Michx.
Vernonia missurica Raf.
Viburnum prunifolium L.
Viola papilionacea Pursh.
Zizia aurea (L.) Koch.

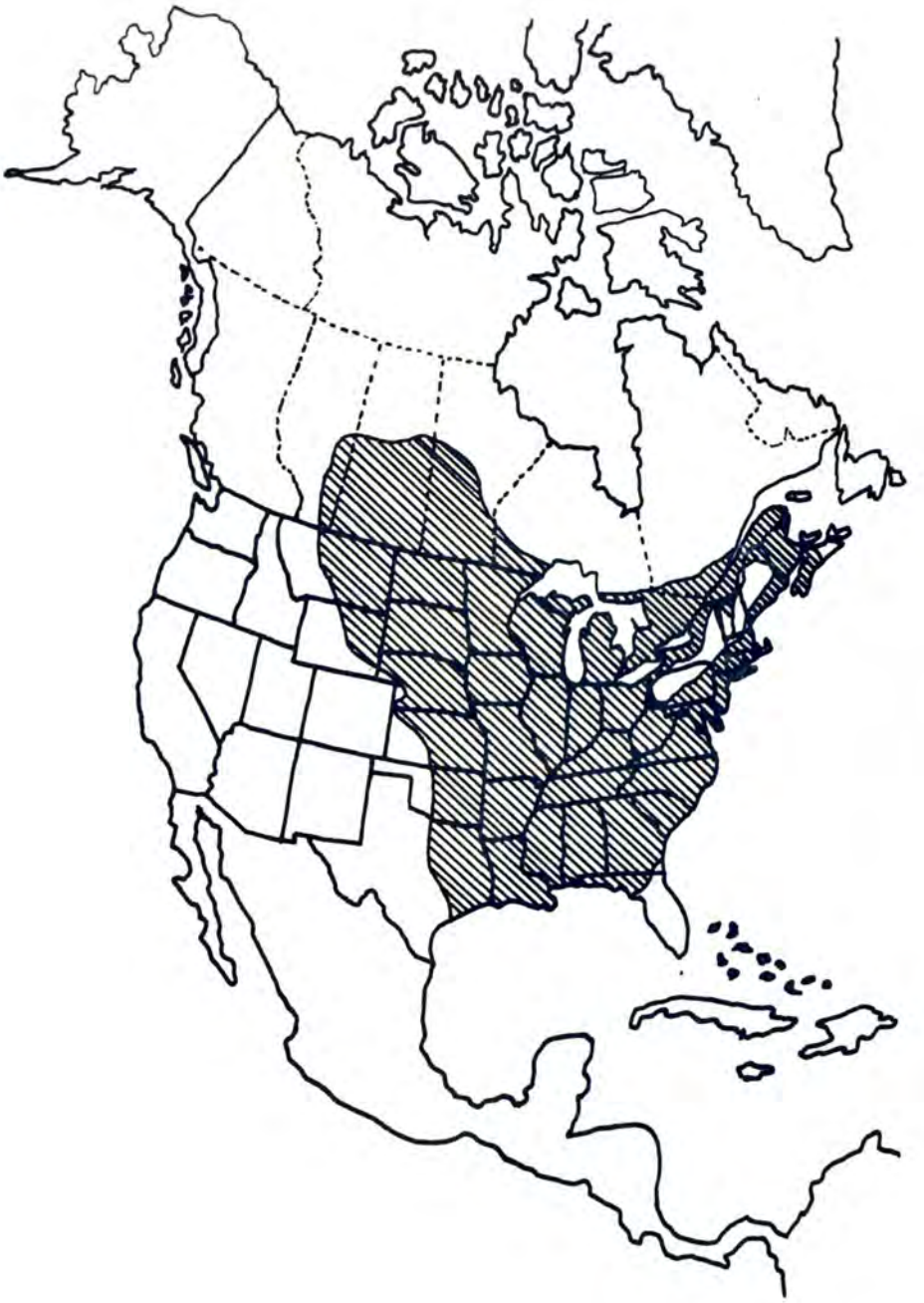

Figure 15. Distribution of Fraxinus pennsylvanica Marsh., Intraneous Central United States and Canada. (After Fowells, 1965.)

TABLE IV. INTRANEOUS EASTERN SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Acalypha rhomboidea Raf.
Acer rubrum L. var rubrum
Acer saccharinum L.
Acer saccharum Marsh. var saccharum
Actaea pachypoda Ell.
Actinomeris alternifolia (L.) DC.
Allium canadense L.
Alnus serrulata (Ait.) Willd.
Amelanchier arborea (Michx.) Fern.
Amorpha fruticosa L.
Anemonella thalictroides (L.) Spach.
Arisaema Dracontium (L.) Schott.
Arisaema triphyllum (L.) Schott.
Armoracia aquatica (Eat.) Wieg.
Asclepias quadrifolia Jacq.
Aster azureus Lindl.
Aster patens Ait.
Aster pilosus Willd.
Aureolaria virginica (L.) Penn.
Betula nigra L.
Bidens aristosa (Michx.) Britt.
Blephilia ciliata (L.) Benth.
Blephilia hirsuta (Pursh.) Benth.
Boehmeria cyclindrica (L.) Sw.
Brachyelytrum erectum (Sch.) Beauv.
Cacalia atriplicifolia L.
Cacalia Muhlenbergii (Sch. Bip.) Fern.
Campanula americana L.
Carex crus-corvi Shuttlw.
Carex festucacea Schkuhr.
Carex glaucodea Tuck.
Carex granularis Muhl.
Carex lupulina Muhl.
Carex Muhlenbergii Schkuhr.
Carex tribuloides Wahlenb.
Carex typhina Michx.
Carpinus caroliniana Walt.
Carya cordiformis (Wang.) K. Koch.
Carya glabra (Mill.) Sweet
Carya ovata (Mill.) K. Koch
Carya tomentosa Nutt.
Ceanothus americanus L.
Chamaelirium luteum (L.) Gray
Cinna arundinacea L.
Claytonia virginica L.
Clematis virginiana L.
Collinsonia canadensis L.
Coreopsis tripteris L.
Cornus florida L.
Cuphea petiolata (L.) Koehne
Danthonia spicata (L.) Beauv.
Dentaria laciniata Muhl.
Desmodium canescens (L.) DC.
Desmodium glutinosum (Muhl.) Wood.
Desmodium nudiflorum (L.) DC.
Desmodium pauciflorum (Nutt.) DC.
Desmodium rotundifolium DC.
Echinacea purpurea (L.) Moench.
Epifagus virginiana (L.) Bart.
Eragrostis capillaris (L.) Nees.
Eragrostis spectabilis (Pursh.) Steud.
Eryngium yuccifolium Michs.
Eupatorium fistulosum Barratt.
Euphorbia commutata Engelm.
Fagus grandifolia Ehrh.
Fraxinus americana L.
Galium circaezans Michx.
Gerardia purpurea L.
Hedeoma pulegiodes (L.) Pers.
Helenium flexosum Raf.
Hybanthus concolor (Forst.) Spreng.
Hydrangea arborescens L.
Hypericum prolificum L.
Hypericum punctatum L.
Juncus brachycarpus Engelm.
Juncus debilis Gray
Juncus effusus L. var solutus Fern. & Wieg.
Juncus marginatus Rostk.
Juncus scirpoides Lam.
Laportea canadensis (L.) Wedd.
Lechea tenuifolia Michx.
Lechea villosa Ell.
Lespedeza procumbens Michx.
Lespedeza violacea (L.) Pers.
Lobelia Cardinalis L.

TABLE IV. (continued)

Ludwigia alternifolia L.
Lycopus virginicus L.
Lysimachia lanceolata Walt.
Mertensia virginica (L.) Pers.
Mimulus alatus Ait.
Monarda fistulosa L.
Nelumbo lutea (Willd.) Pers.
Nymphaea odorata Ait.
Opuntia humifusa Raf.
Panicum Boscii Poir.
Panicum clandestinum L.
Panicum commutatum Schultes
Panicum depauperatum Muhl.
Panicum dichotomum L.
Panicum microcarpon Muhl.
Parthenocissus quinquefolia (L.) Planch.
Paspalum setaceum Michx. var Muhlenbergii (Nash) Fern.
Phlox pilosa L.
Phytolacca americana L.
Phryma Leptostachya L.
Pilea pumila L.
Platanus occidentalis L.
Podophyllum peltatum L.
Polemonium reptans L.
Polygala incarnata L.
Polygala verticillata L. var ambigua (Nutt.) Wood.
Polygonum hydropiperoides Michx.
Pycnanthemum tenuifolium Schrad.
Quercus alba L.
Quercus Muehlenbergii Engelm.
Quercus velutina Lam.
Rhus copallina L.
Rosa carolina L.
Rubus occidentalis L.
Rumex verticillatus L.
Sabatia angularis (L.) Pursh.
Sassafras albidum (Nutt.) Nees.
Saururus cernuus L.
Scrophularia marilandica L.
Scutellaria incana Bieh.
Scutellaria parvula Michx.
Sicyos angulatus L.
Sisyrinchium albidum Michx.
Sisyrinchium angustifolium Mill.
Sphenopholis obtusata (Michx.) Scribn.
Solidago erecta Pursh.
Spiranthes gracilis (Bigel.) Beck.
Staphylea trifolia L.
Silene stellata (L.) Ait.
Swertia caroliniensis (Walt.) Ktze.
Thaspium barbinode (Michx.) Nutt.
Tovara virginiana (L.) Raf.
Triodia flava (L.) Smyth.
Vaccinium stamineum L.
Verbena simplex Lehm.
Veronicastrum virginicum (L.) Farw.
Viola pensylvanica Michx.
Viola sagittata Ait.
Vitis aestivalis Michx.

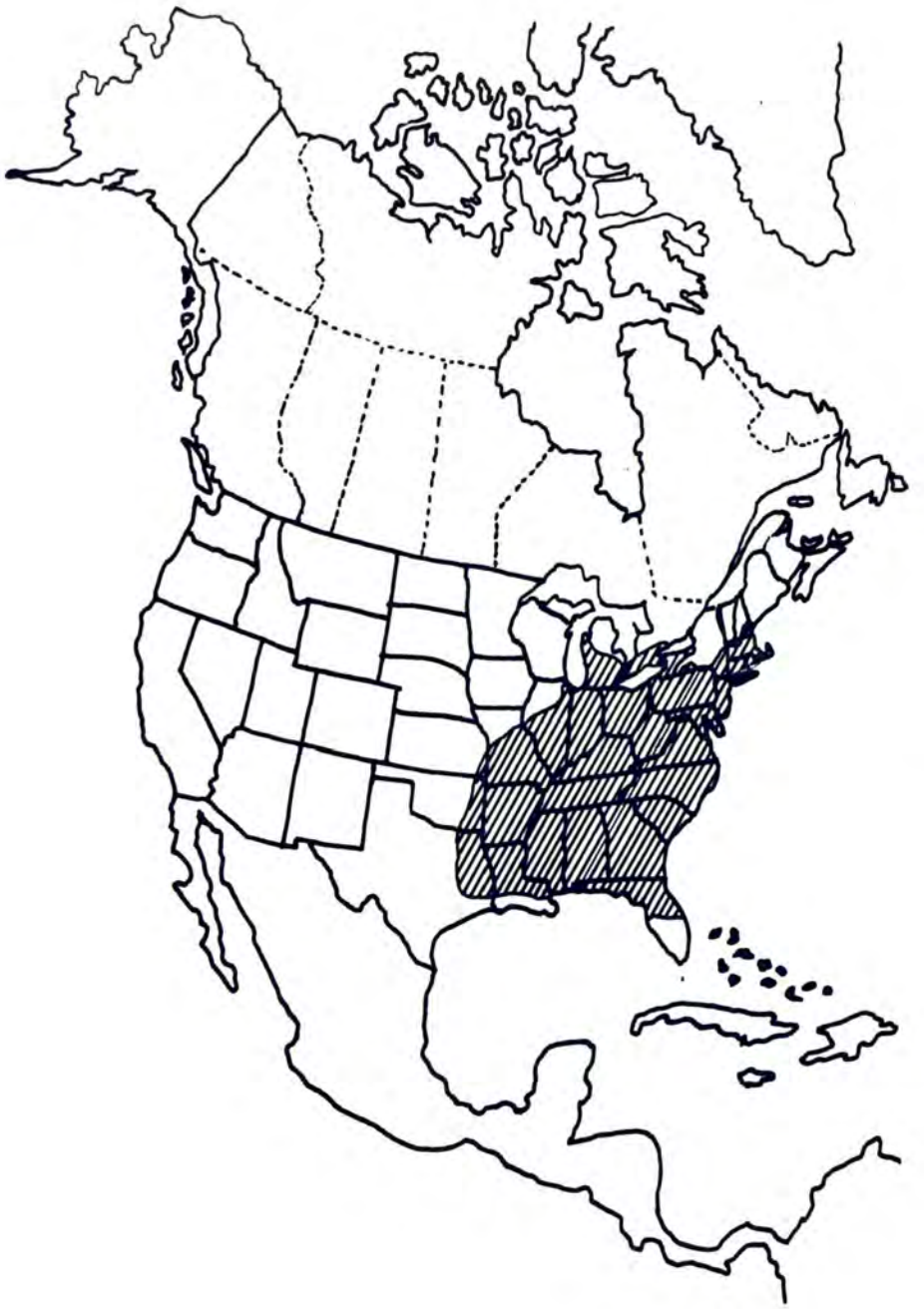

Figure 16. Distribution of Sassafras albidum (Nutt.) Nees., Intraneous Eastern. (After Fowells, 1965.)

TABLE V. INTRANEOUS SOUTHERN WIDESPREAD SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Aesculus Pavia L.
Agave virginica L.
Ampelopsus cordata Michx.
Amsonia Tabernaemontana Walt.
Andropogon Elliotti Chapm.
Andropogon virginicus L.
Aralia spinosa L.
Arundinaria gigantea (Walt.) Chapm.
Asclepias variegata L.
Ascyrum Hypericoides L.
Brunnichia cirrhosa Gaertn.
Campsis radicans (L.) Seem.
Cassia marilandica L.
Celtis laevigata Willd.
Chaerophyllum Tainturieri Hook.
Clematis Viorna L.
Cocculus carolinus (L.) DC.
Commelina virginica L.
Croton monanthogynus Michx.
Cynoglossum virginianum L.
Cyperus retrofractus (L.) Torr.
Cyperus virens Michx.
Diodia teres Walt.
Diodia virginiana L.
Diospyros virginiana L.
Echinodorus cordifolius (L.) Griseb.
Erianthus alopecuroides (L.) Ell.
Euonymus americanus L.
Eupatorium coelestinum L.
Galactia volubilis (L.) Britt.
Gillenia stipulata (Muhl.) Baill.
Gonolobus gonocarpos (Walt.) Perry.
Halesia carolina L.
Hibiscus militaris Cav.
Houstonia purpurea L.
Hypericum densiflorum Pursh.
Hypericum Drummondii (Grev. & Hook.) T. & G.
Ilex decidua Walt.
Ilex opaca Ait.
Ipomoea lacunosa L.
Iris cristata Ait.
Jussiaea decurrens (Walt.) DC.
Krigia Dandelion (L.) Nutt.
Liquidambar styraciflua L.
Lobelia puberula Michx.
Melica mutica Walt.
Myosotis macrosperma Engelm.
Obolaria virginica L.
Panicum anceps Michx.
Panicum laxiflorum Lam.
Panicum polyanthes Schultes
Paspalum circulare Nash.
Paspalum laeve Michx.
Paspalum pubiflorum Rupt. var glabrum Vasey
Passiflora incarnata L.
Phorandendron flavescens (Pursh.) Nutt.
Psoralea psoralioides (Walt.) Cory var eglandulosa (Ell.) Freem.
Ptilimnium capillaceum (Michx.) Raf.
Pyrrhopappus carolinianus (Walt.) DC.
Quercus falcata Michx.
Quercus marilandica Muench.
Quercus Phellos L.
Quercus Shumardii Buckl.
Quercus stellata Wang.
Rhamnus caroliniana Walt.
Robinia Pseudo-Acacia L.
Rosa setigera Michx.
Ruellia strepens L.
Salix caroliniana Michx.
Salvia lyrata L.
Sanicula canadensis L.
Scutellaria elliptica Muhl.
Sedum pulchellum Michx.
Senecio glabellus Poir.
Smilax Bona-nox L. var Hederaefolia (Beyrich) Fern.
Smilax glauca Walt.
Spigelia marilandica L.
Spiranthes vernalis Engel. & Gray
Strophostyles umbellata (Muhl.) Britt.
Stylosanthes biflora (L.) BSP.
Tipularia discolor (Pursh.) Nutt.

TABLE V. (continued)

Tragia cordata Michx.	Verbesina virginica L.
Triosteum angustifolium L.	Viburnum rufidulum Raf.
Ulmus alata Michx.	Viola pedata L.
Uniola latifolia Michx.	Viola triloba Sch. var dilatata (Ell.) Sch.
Vaccinium arboreum Marsh.	Vitis rotundifolia Michx.
Valerianella radiata (L.) Dufr.	

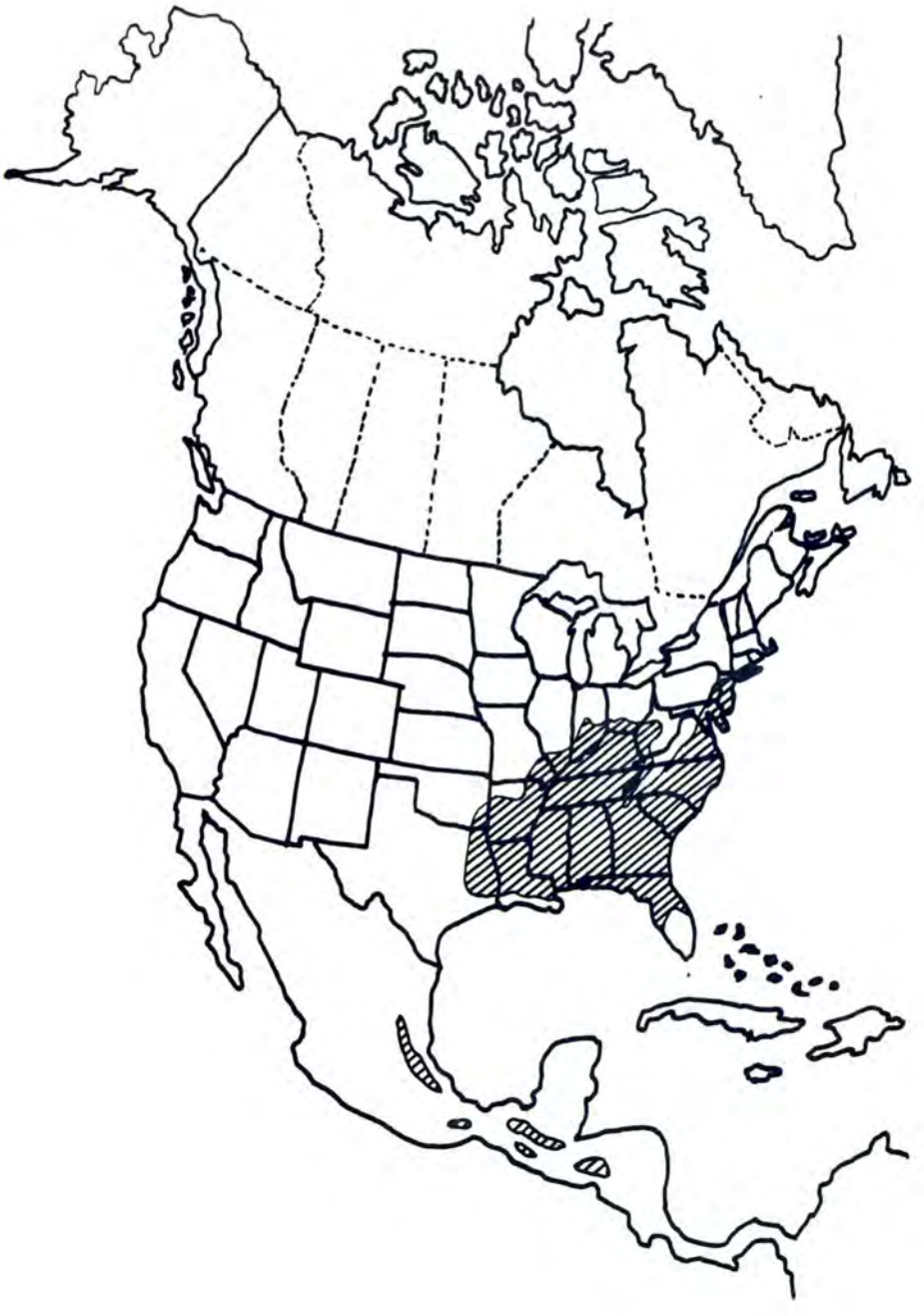

Figure 17. Distribution of Liquidambar styraciflua L., Intraneous southern widespread. (After Fowells, 1965.)

TABLE VI. INTRANEOUS SOUTHEASTERN SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Angelica venenosa (Greenw.) Fern.
Aureolaria pectinata (Nutt.) Benth.
Bignonia capreolata L.
Bumelia lycioides (L.) Gaertn. f.
Calycocarpum Lyoni (Pursh.) Gray
Celtis tenuifolia Nutt. var georgiana (Small) Fern. & Schub.
Crataegus Phaenopyrum (L. f.) Medic.
Cyperus lancastriensis Port.
Dicliptera brachiata (Pursh.) Spreng.
Dioscorea quaternata (Walt.) J. F. Gmel.
Fraxinus americana L. var biltmoreana (Beadle) J. Wright
Helianthus microcephalus T. & G.
Heuchera villosa Michx.
Hymenocallis occidentalis (LeConte) Kunth.
Hypericum tubulosum Walt.
Liatris squarrosa (L.) Michx.
Lippia lanceolata Michx.
Liriodendron tulipifera L.
Oenothera fruticosa L.
Phacelia bipinnatifida Michx.
Ptilimnium costatum (Ell.) Raf.
Pyrus angustifolia Ait.
Ranunculus hispidus Michx.
Ranunculus micranthus Nutt.
Rhynchospora corniculata (Lam.) Gray
Rubus argutus Link.
Sagittaria australis (Sm.) Small
Senecio aureus L.
Thaspium trifoliatum (L.) Gray
Tilia heterophylla Vent.

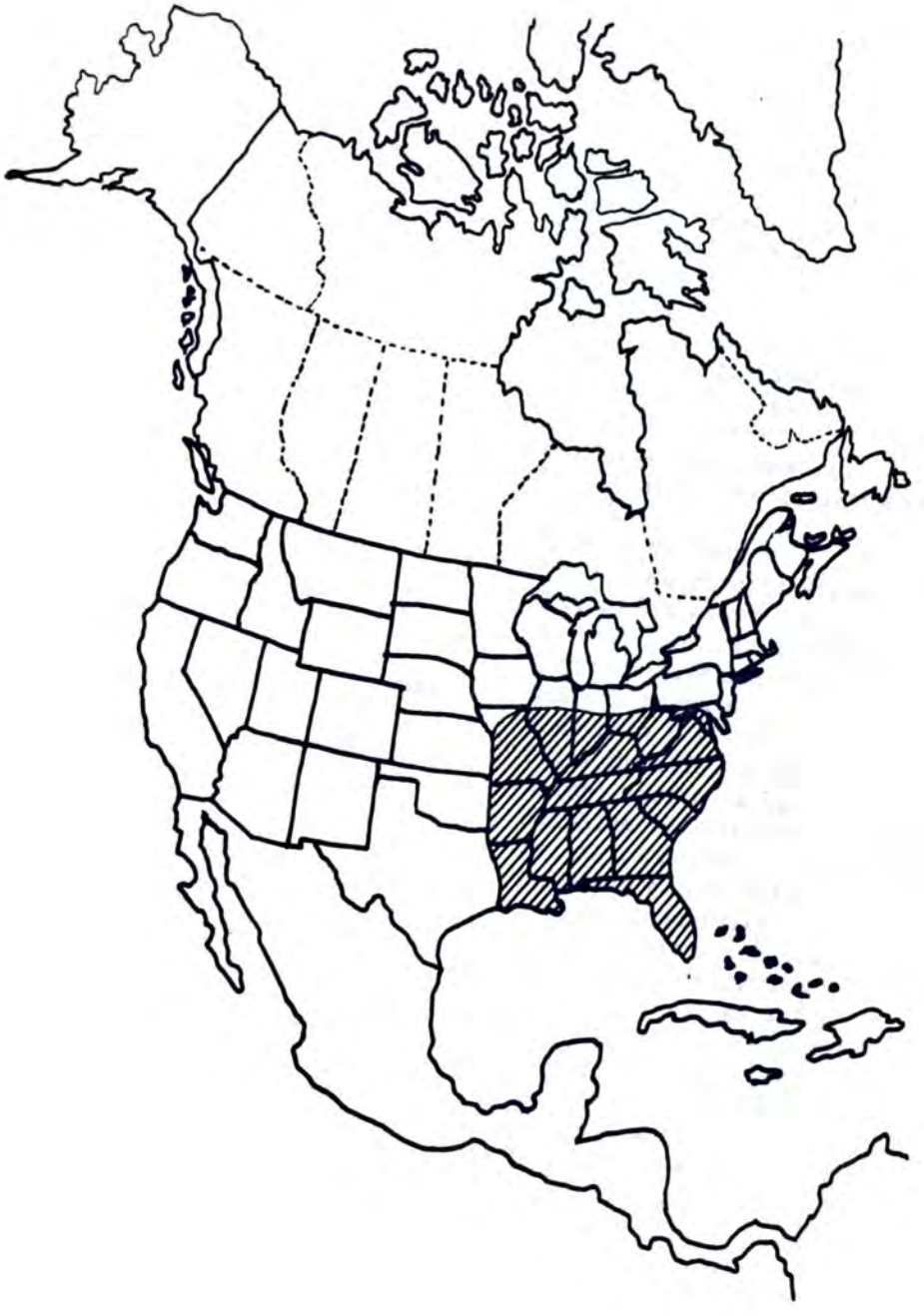

Figure 18. Distribution of Bignonia capreolata L., Intraneous southeastern.

TABLE VII. INTRANEOUS NORTHERN WIDESPREAD SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Aesculus glabra Willd.
Agastache nepetoides (L.) Ktze.
Agrimonia pubescens Wallr.
Anemone virginiana L.
Antennaria plantaginifolia (L.) Hook.
Aquilegia canadensis L.
Asarum canadense L.
Asclepias purpurascens L.
Aster lateriflorus (L.) Britt.
Aureolaria flava (L.) Farw.
Carex convoluta Mackenz.
Carex crinita Lam.
Carex squarrosa L.
Carex virescens Muhl.
Carya ovalis (Wang.) Sarg.
Castanea dentata (Marsh.) Borkh.
Caulophyllum thalictroides (L.) Michx.
Cirsium discolor (Muhl.) Spreng.
Comandra umbellata (L.) Nutt.
Corydalis flavula (Raf.) DC.
Crataegus Calpodendron (Ehrh.) Medic.
Cypripedium Calceolus L.
Dioscorea villosa L.
Dodecatheon Meadia L.
Echinichloa muricata (Beauv.) Fern.
Erigenia bulbosa (Michx.) Nutt.
Erigeron strigosus Muhl.
Erythronium albidum Nutt.
Erythronium americanum Ker.
Gaura biennis L.
Geum canadense Jacq.
Habenaria peramoena Gray
Hepatica acutiloba DC.
Heuchera americana L.
Houstonia caerulea L.
Hydrastis canadensis L.
Hystrix patula Moench.
Isopyrum biternatum (Raf.) T. & G.
Lactuca canadensis L.
Lobelia siphilitica L.
Lobelia spicata Lam.
Phlox paniculata L.
Polygala sanguinea L.
Polygonatum canaliculatum (Muhl.) Pursh.
Polygonum erectum L.
Potentilla simplex Michx.
Prenanthes altissima L.
Quercus imbricaria Michx.
Quercus palustris Muench.
Quercus rubra L.
Rudbeckia hirta L.
Salix humilis Marsh.
Silene virginica L.
Silphium terebinthinaceum Jacq.
Smilax tamnoides L. var hispida Muhl.
Solidago rugosa Ait.
Stachys tenuifolia Willd.
Tradescantia subaspera Ker.
Tradescantia virginiana L.
Trillium flexipes Raf.
Trillium recurvatum Beck.
Uvularia grandiflora Sm.
Vaccinium vacillans Torr.
Viburnum molle Michx.
Viola striata Ait.

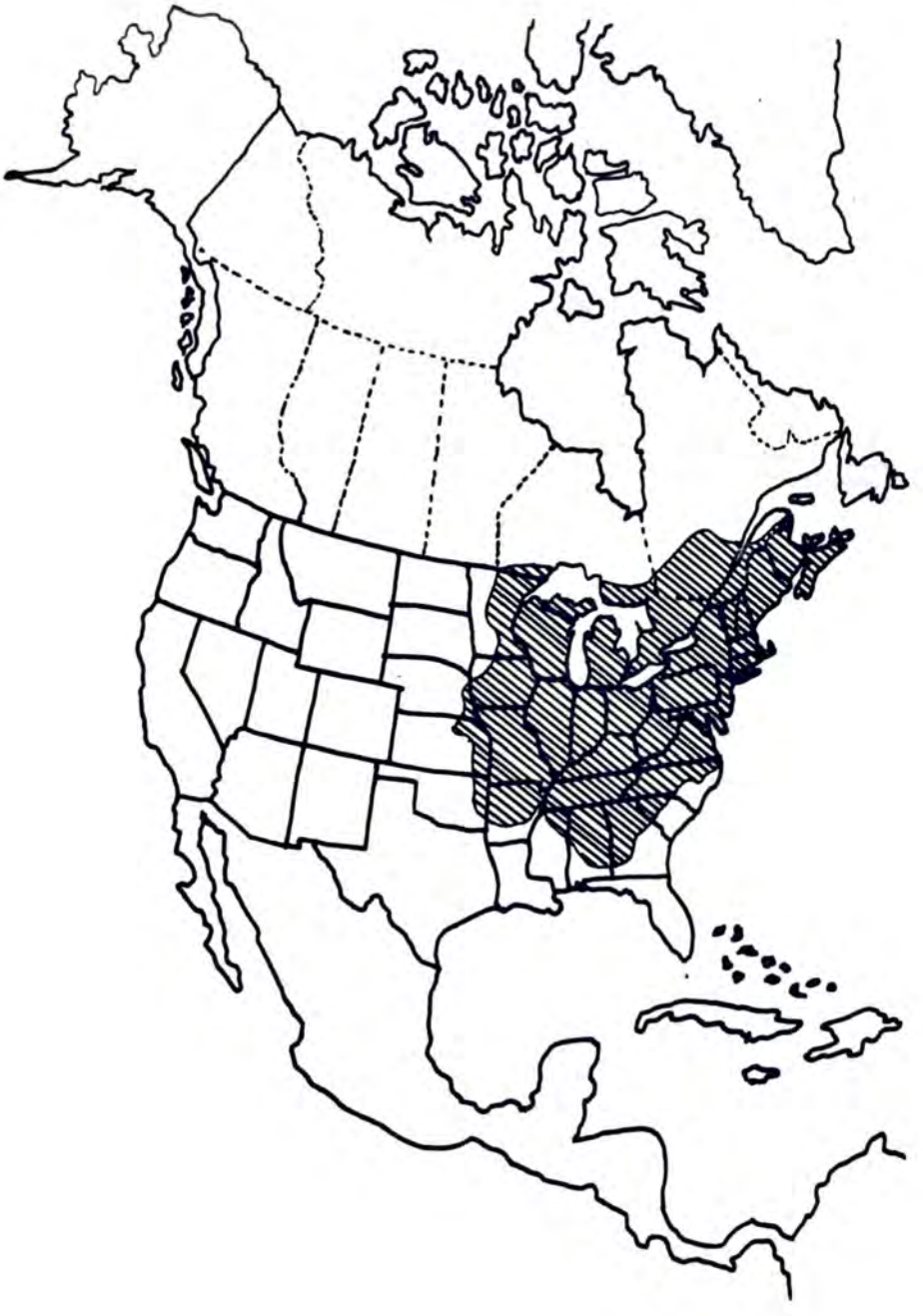

Figure 19. Distribution of Quercus rubra L., Intraneous northern widespread. (After Fowells, 1965.)

TABLE VIII. INTRANEOUS NORTHEASTERN SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Carex hirsutella Mackenz.	Polymnia Uvedalia L.
Cimicifuga racemosa (L.) Nutt.	Quercus bicolor Willd.
Eleocharis tenuis (Willd.) Schultes	Quercus coccinea Muench.
Gerardia tenuifolia Vahl.	Rhexia virginica L.
Geum vernum (Raf.) T. & G.	Sanicula gregaria Bickn.
Hydrophyllum canadense L.	Smilax pulverulenta Michx.
Juglans cinerea L.	Thalictrum revolutum DC.
Lespedeza hirta (L.) Hornem.	Viola triloba Sch. triloba

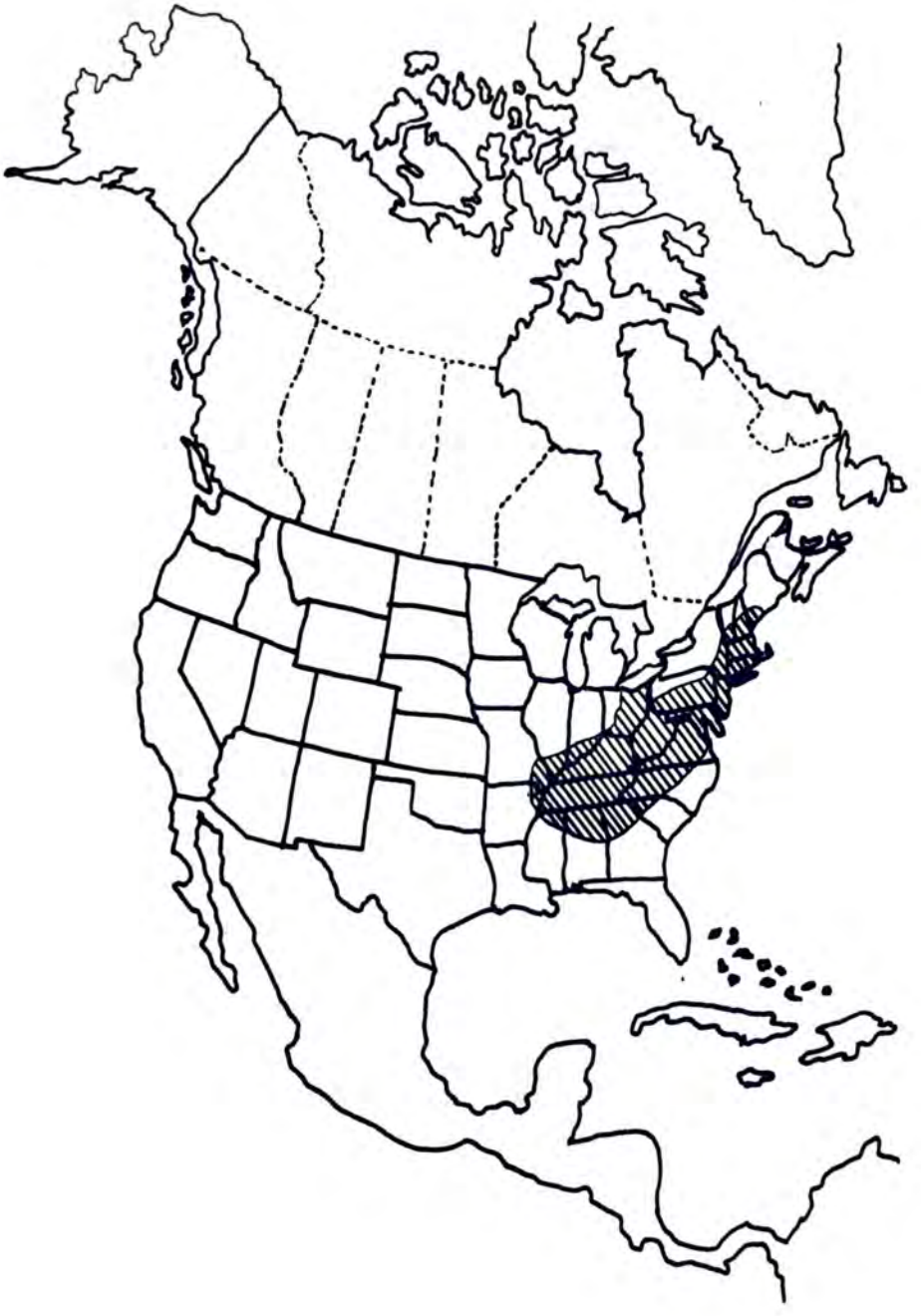

Figure 20. Distribution of Quercus coccinea Muench., Intraneous northeastern. (After Fowells, 1965.)

TABLE IX. EXTRANEOUS SOUTHEASTERN SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Amorpha glabra Desf.	Oxalis grandis Small
Apios Priceana Robins.	Oxydendrum arboreum (L.) DC.
Aruncus dioicus (Walt.) Fern.	Pachysandra procumbens Michx.
Aster dumosus L.	Passiflora lutea L.
Coreopsis major Walt.	Penstemon laevigatus Ait.
Dentaria heterophylla Nutt.	Penstemon tenuiflorus Penn.
Desmodium ochroleucum Curtis	Pycnanthemum pycnanthemoides (Leav.) Fern.
Gonolobus carolinensis (Jacq.) Sch.	Robinia Hispida L.
Gonolobus Shortii Gray	Ruellia caroliniensis (Walt.) Steud.
Hibiscus Moscheutos L.	Trillium cuneatum Raf.
Hydrophyllum macrophyllum Nutt.	Yucca Smalliana Fern.

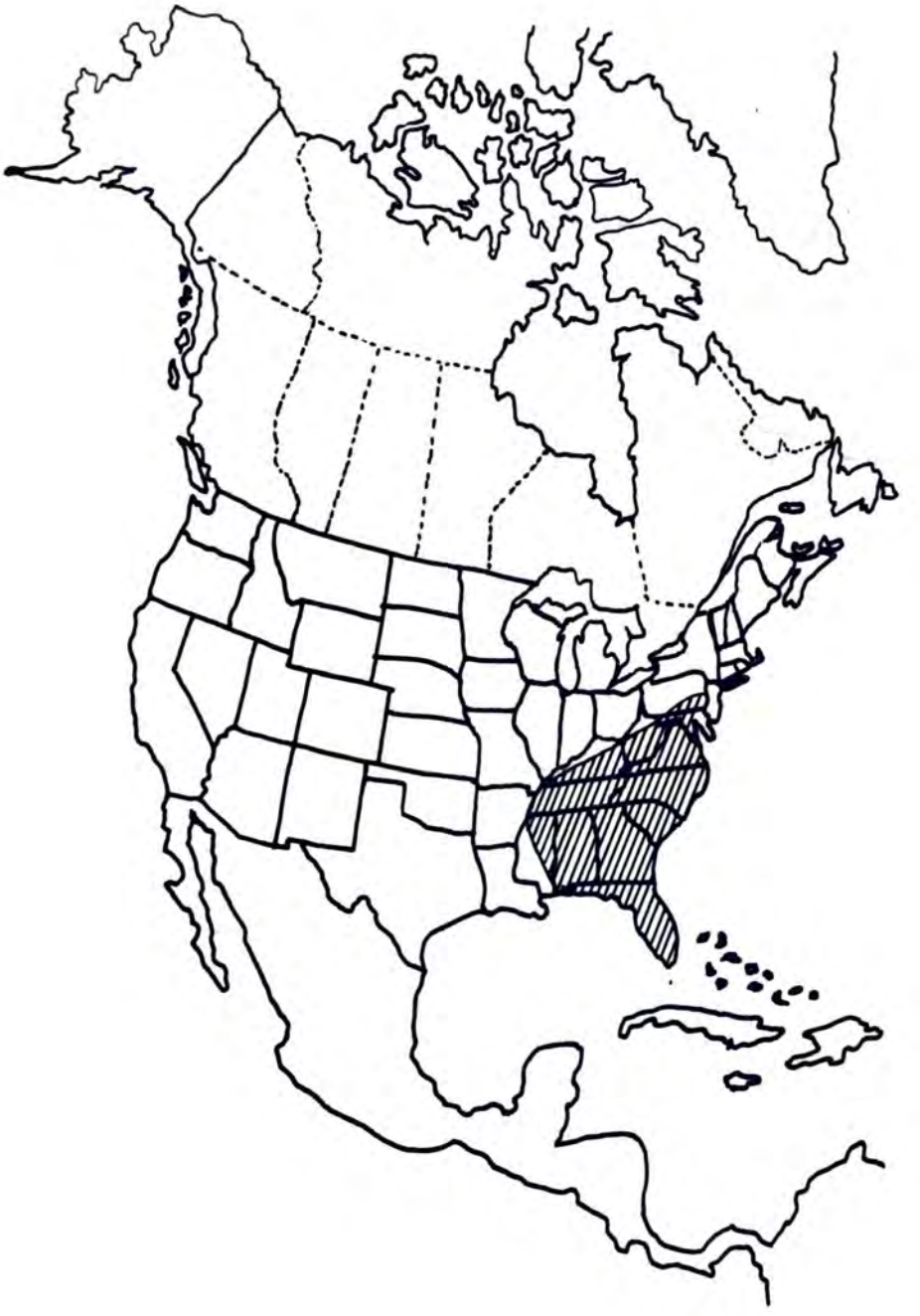

Figure 21. Distribution of Passiflora lutea L., Extraneous southeastern.

TABLE X. EXTRANEOUS COASTAL PLAIN AND MISSISSIPPI EMBAYMENT SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Dioclea multiflora (T. & G.) Mohr.	Quercus falcata Michx. var pagodaefolia Ell.
Hypericum denticulatum Walt.	Quercus lyrata Walt.
Micranthemum umbrosum (Walt.) Blake	Quercus Michauxii Nutt.
Panicum langinosum Ell.	Smilax Walteri Pursh.
Psoralea psoralioides (Walt.) Cory var psoralioides	Spiranthes tuberosa Raf. var Grayi (Ames.) Fern.
	Taxodium distichum (L.) Rich.

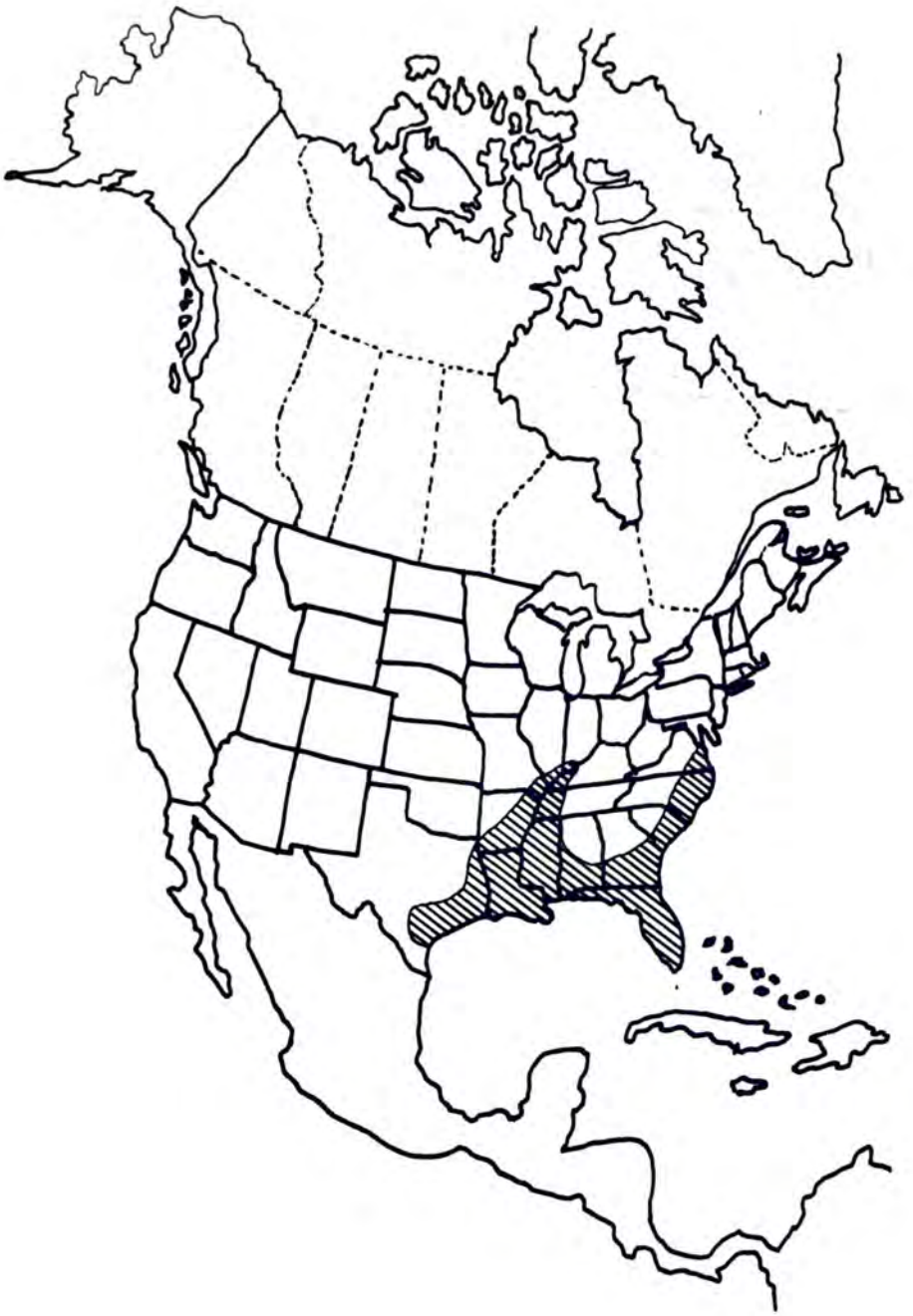

Figure 22. Distribution of Taxodium distichum (L.) Rich., Extraneous Coastal Plain and Mississippi Embayment. (After Fowells, 1965.)

TABLE XI. EXTRANEOUS NORTHERN WIDESPREAD SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Carex lupuliformis Sartw.	Linum virginianum L.
Carex normalis Mackenz.	Lysimachia terrestris (L.) BSP.
Carya laciniosa (Michx. f) Loud.	Oenothera tetragona Roth.
Heliopsis helianthoides (L.) Sweet.	Populus grandidentata Michx.
Lilium canadense L.	Sedum ternatum Michx.

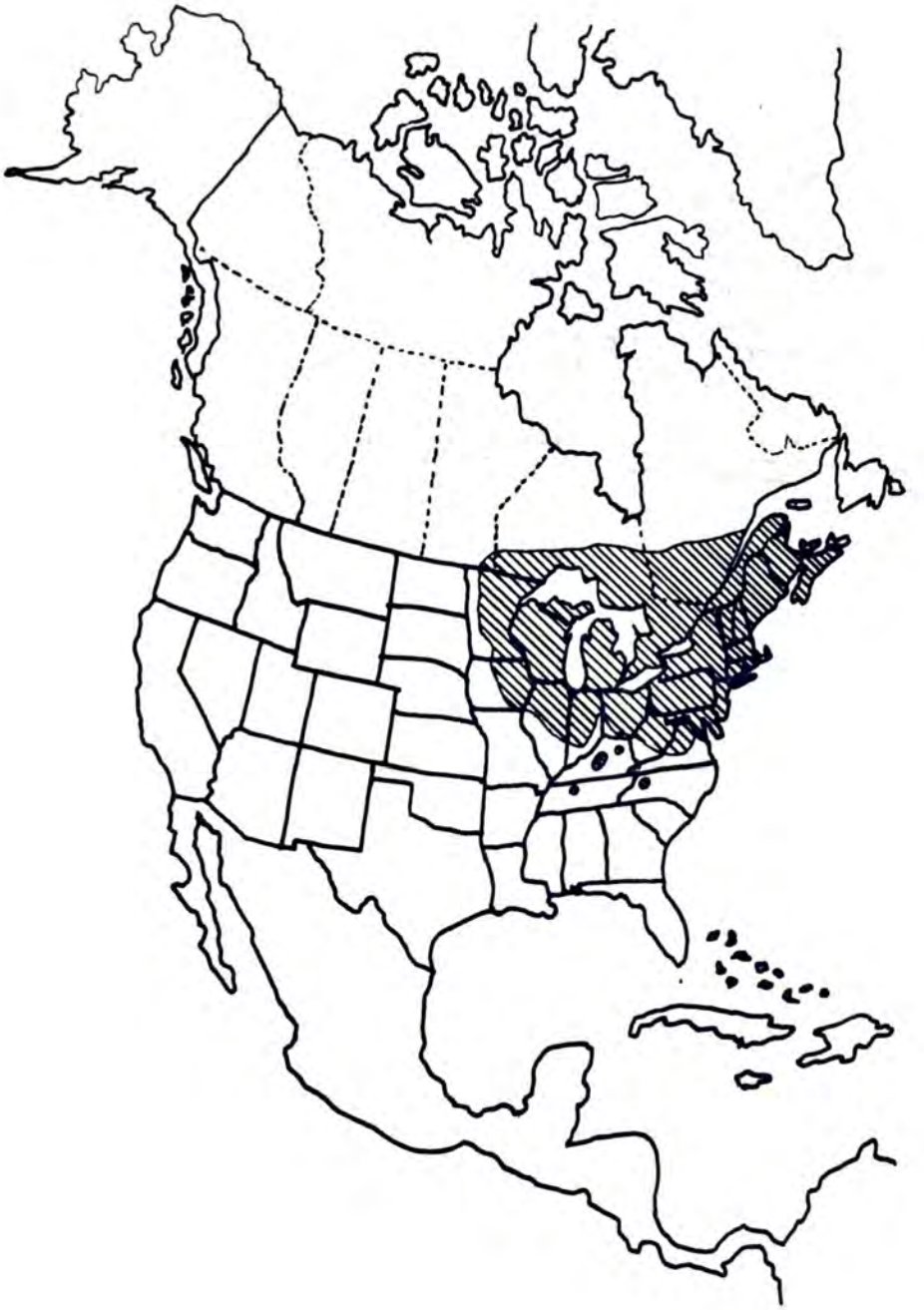

Figure 23. Distribution of Populus grandidentata Michx., Extraneous northern widespread. (After Fowells, 1965.)

TABLE XII. EXTRANEOUS NORTHEASTERN SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Carex Grayii Carey	Pinus virginiana Mill.
Cornus Amomum Mill.	Pycnanthemum incanum (L.) Michx.
Glyceria melicaria (Michx.) Hubb.	Quercus prinus L.
Kalmia latifolia L.	Rudbeckia fulgida Ait.
Lilium superbum L.	Scutellaria nervosa Pursh.
Lindera Benzoin (L.) Blume	Silphium trifoliatum L.
Panicum agrostoides Spreng.	Synandra hispidula (Michx.) Baill.
Penstemon hirsutus (L.) Willd.	Trichostema dichotomum L.
Phlox divaricata L.	Vitis Labrusca L.

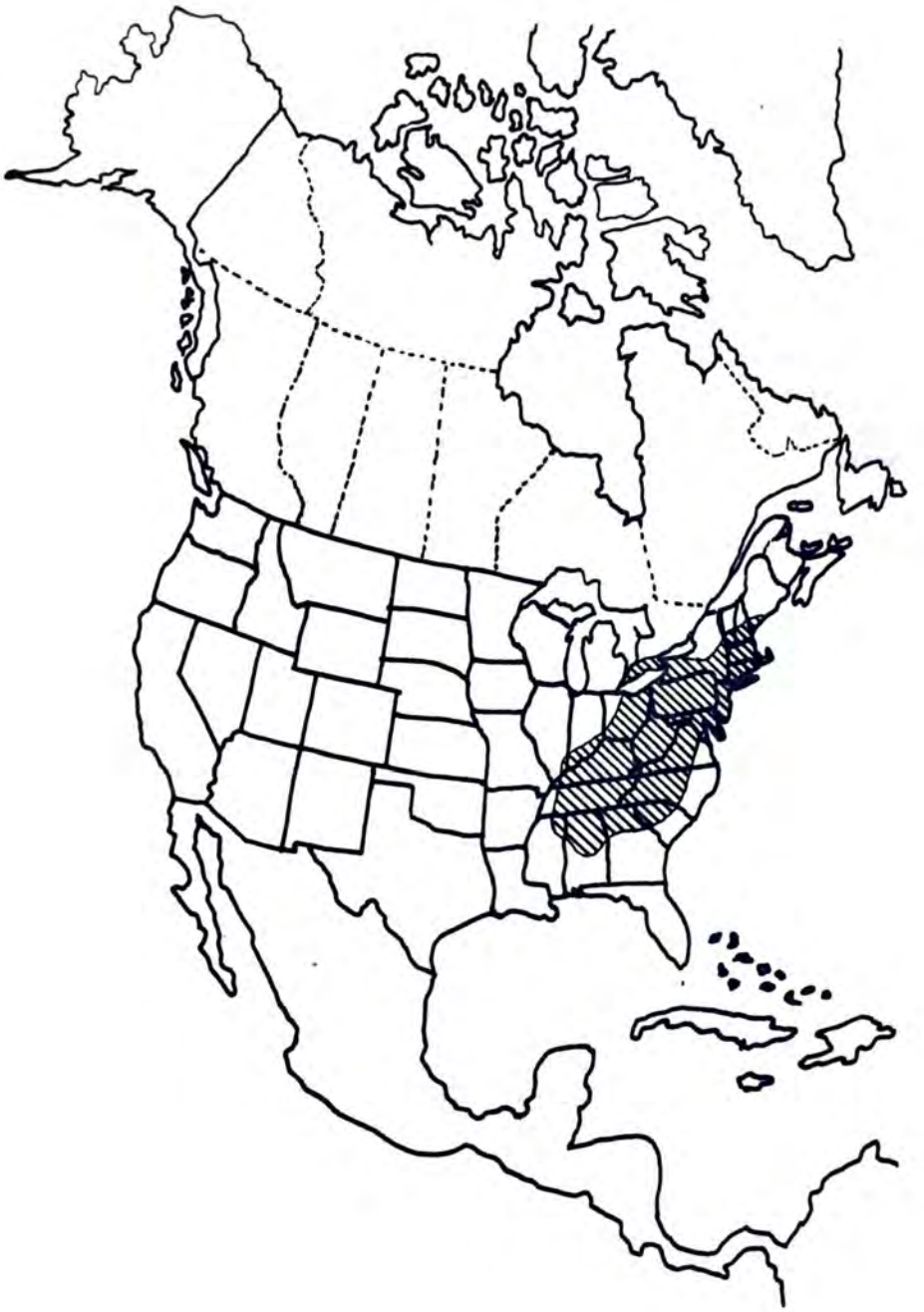

Figure 24. Distribution of Quercus prinus L., Extraneous northeastern. (After Fowells, 1965.)

TABLE XIII. SPECIES WITH DISJUNCT RANGES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Agrimonia gryposepala Wallr.	Elymus virginicus L. var submuticus Hook.
Aristida oligantha Michx.	Hypericum denticulatum Walt.
Aster dumosus L.	Lechea tenuifolia Michx.
Brasenia Schreberi Gmel.	Lindernia dubia (L.) Penn.
Carex comosa Boott.	Liquidambar styraciflua L.
Cyperus strigosus L.	Myosotis verna L.
Dicentra Cucullaria (L.) Bernh.	Scirpus lineatus Michx.
Draba brachycarpa Nutt.	Ranunculus pusillus Poir.
Eleocharis obtusa (Willd.) Schultes	Rorippa sessiliflora (Nutt.) Hitchc.
	Rotala ramosior (L.) Koehne.

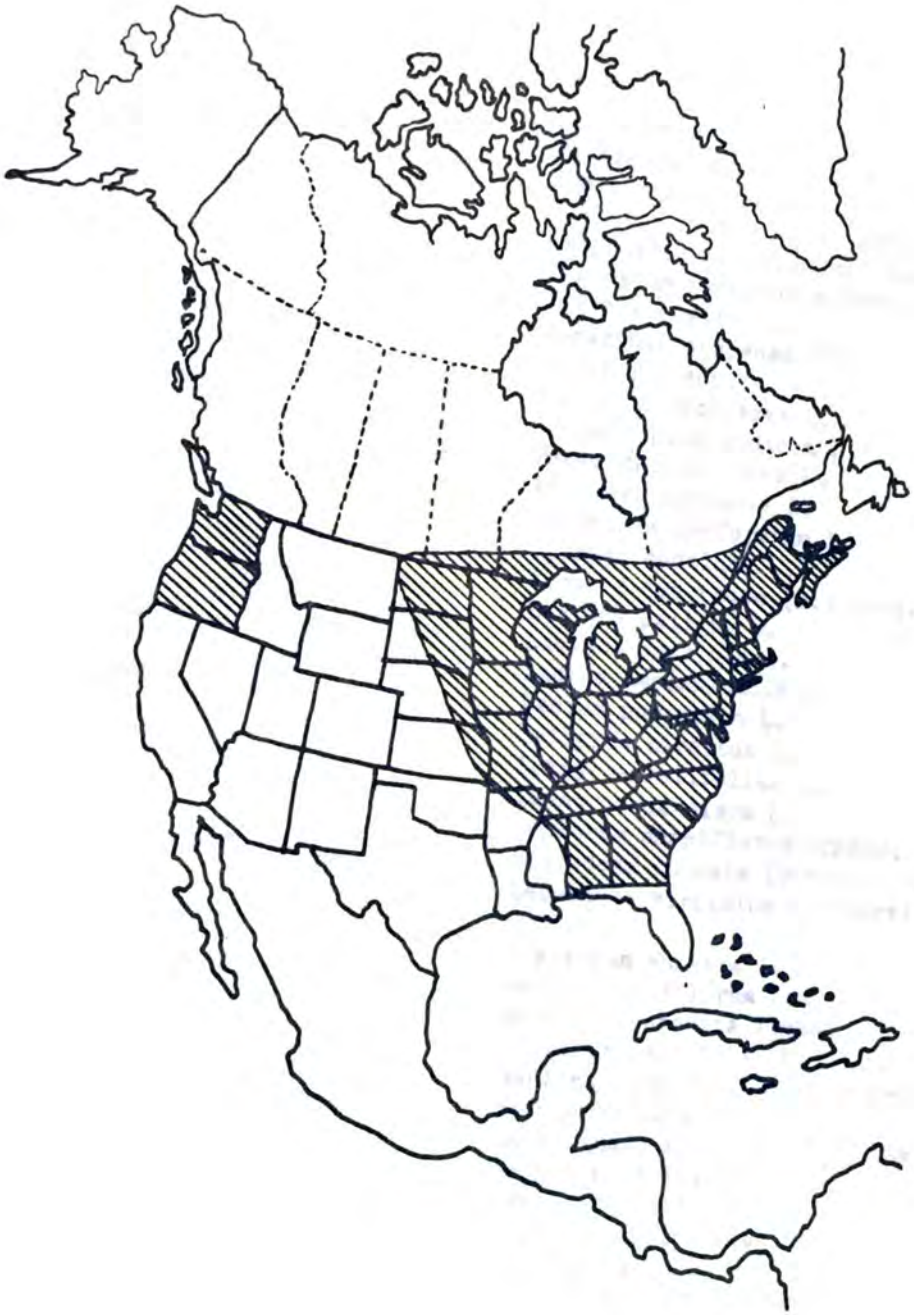

Figure 25. Distribution of Dicentra Cucullaria (L.) Bernh., Disjunct range.

TABLE XIV. INTRODUCED AND HYBRID SPECIES FOR THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Abutilon Theophrasti Medic.
Achillea Millefoium L.
Agrostis alba
Ailanthus altissima (Mill.) Swingle.
Albizzia julibrissin Duraz.
Allium vineale L.
Amaranthus hybridus L.
Amaranthus spinosa L.
Anagallis arvensis L.
Anthemis Cotula L.
Arabidopsis thaliana (L.) Heynh.
Arctium minus (Hill.) Bernh.
Artemesia annua L.
Asparagus officinalis L.
Barbarea vulgaris R. Br.
Belamcanda chinensis (L.) DC.
Brassica juncea (L.) Coss.
Bromus inermis Leyss.
Bromus japonicus Thunb.
Bromus racemosus L.
Bromus tectorum L.
Broussonetia papyrifera (L.) Vent.
Capsella bursa-pastoris (L.) Medic.
Cardamine hirsuta L.
Cardamine parviflora L.
Cardiospermum Halicacabum L.
Centaurea maculosa Lam.
Chenopodium album L.
Chenopodium ambrosioides L.
Chrysanthemum leucanthemum L.
Cichorium Intybus L.
Cirsium vulgare (Savi.) Ten.
Citrullus vulgaris Schrad.
Cleome spinosa Jacq.
Commelina communis L.
Coronilla varia L.
Dactylis glomerata L.
Datura Stramonium L.
Daucus Carota L.
Delphinium ajacis L.
Dianthus armeria L.
Digitaria sanguinalis (L.) Scop.
Dioscorea Batatus Dcne.
Dipsacus sylvestris Huds.
Draba verna L.
Duchesnea indica (Andr.) Focke.
Echinochloa crusgalli (L.) Beauv.
Eleusine indica (L.) Gaertn.
Eragrostis megastachya (Koel.) Link.
Fagopyrum esculentum Moench.
Festuca elatior L.
Forsythia suspensa (Thunb.) Vahl.
Gladiolus spp.
Glechoma hederacea L.
Heliotropium indicum L.
Hemerocallis fulva L.
Hibiscus syriacus L.
Hypericum perforatum L.
Ipomoea coccinea L.
Ipomoea hederacea (L.) Jacq.
Lactuca saligna L.
Lactuca Scariola L.
Lamium amplexicaule L.
Lamium purpureum L.
Lathyrus hirsutus L.
Lathyrus latifolius L.
Leonurus cardiaca L.
Lepidium densiflorum Schrad.
Lespedeza cuneata (Dumont.) G. Don.
Lespedeza virginica X Stuevei (L.) Britt.
Ligustrum vulgare L.
Lolium multiflorum Lam.
Lonicera japonica Thunb.
Ludwigia palustris (L.) Ell.
Maclura pomifera (Raf.) Schneid.
Melilotus alba Desr.
Melilotus officinalis (L.) Lam.
Mentha piperita L.
Mentha spicata L.
Mollugo verticillata L.
Morus alba L.
Myriophyllum brasiliense Camb.
Nasturtium officinale R. Br.
Nicandra physalodes (L.) Pers.
Ornithogalum umbellatum L.
Papaver Rhoeas L.
Paulownia tomentosa (Thunb.) Steud.
Perilla frutescens (L.) Britt.
Phleum pratense L.
Pinus Taeda L.

TABLE XIV. (continued)

Plantago lanceolata L.
Plantago major L.
Polygonum cuspidatum Sieb. & Zucc.
Polygonum orientale L.
Populus alba L.
Potentilla recta L.
Prunella vulgaris L.
Prunus Persica (L.) Batsch.
Pueraria lobata (Willd.) Ohwi.
Pyrus Malus L.
Ricinus communis L.
Rosa multiflora
Rubus phoenicolasius Maxim.
Rumex acetosella L.
Rumex crispus L.
Rumex obtusifolius L.
Salix babylonica L.
Saponaria officinalis L.
Sedum sarmentosum Bunge.
Setaria Faberii Herrm.
Setaria lutescens (Wiegel.) Hubb.
Setaria viridis (L.) Beauv.
Sida spinosa L.
Sonchus asper (L.) Hill.
Sorghum halepense (L.) Pers.
Stellaria aquatica (L.) Scop.
Stellaria media (L.) Cyrillo.
Syringa vulgaris L.
Taraxacum officinale Weber.
Torilis japonica (Houtt.) DC.
Trifolium arvense L.
Trifolium pratense L.
Trifolium procumbens L.
Trifolium repens L.
Ulmus pumila L.
Verbascum Blattaria L.
Verbascum Thapsus L.
Verbena X hybrida Voss.
Veronia arvensis L.
Vicia dasycarpa Ten.
Vinca minor L.
Viola rafinesquii (Green.) Fern.
Xanthium strumarium L.
Zebrina pendula Schnizl.

Rosaceae, and Scrophulariaceae, contain 400 species for 49.44 per cent of the total flora. The same ten families contain 325 native species for 48.15 per cent of the native flora.

Of the one hundred and sixteen families represented, seventeen contain ten or more species representing 498 plants for 61.56 per cent of the total flora. Thirty-four families contain only one species each for 29.31 per cent of the families. Eighteen families contain two species each for 15.51 per cent while thirteen families contain three species each for 11.21 per cent of the families. Fifty-six per cent of the families contain three or less species. With the exception of families which contain ten or more species, the percentage of the total number of families decreases with the increase in number of species per family.

The Compositae, with thirteen species, contains the largest number of extraneous plants. Although all five major geographic ranges are represented, the largest single number of plants occurs in the south. The Leguminosae family contains nine extraneous species which are concentrated in the south. Two families, the Gramineae and the Labiatae, each contain six extraneous species. Although the Gramineae are evenly distributed the Labiatae are primarily northern. Several families contain five extraneous species each. One of these, the Fagaceae, is almost entirely southern.

In examining the intraneous flora, the Compositae with seventy-two species is the dominant family. Although the intraneous Compositae species do occur in each major geographic area, almost half of these species represent the Central United States and Canada. The Gramineae contain forty-one intraneous species with half of this number divided almost equally between the east and the south. The Cyperaceae and Leguminosae contain thirty-two and twenty-nine intraneous species

respectively with emphasis on the Central United States and Canada and the east. Eleven families each contain ten to twenty species which are evenly distributed throughout most of the five major areas. In these eleven families, some trends are observed. The Labiatae occur primarily in the east while the Umbelliferae concentrate in the south. Although the Liliaceae and Ranunulaceae occur in most of the major areas, they demonstrate a strong northern distribution. The Cruciferae, Euphorbiaceae, and Asclepiadaceae seem to concentrate in the Central United States and Canada.

Of the seventeen largest families represented in the Land Between the Lakes, the Compositae is the most widespread. Eighteen of the twenty-one geographic elements represented in the Land Between the Lakes are found in the Compositae family. Only the extraneous central and coastal plain elements and the intraneous southwest are not represented in the Land Between the Lake Compositae species. Seven families occur in either ten or eleven of the geographic elements. Those families which are represented in eleven areas include the Gramineae, Liliaceae, and Labiatae. Ten geographic elements are found in the Cyperaceae, Leguminosae, Umbelliferae, and Scrophulariaceae. Table XV sumarizes the three largest families for each of the twenty-one geographic elements found in the Land Between the Lakes.

TABLE XV. SUMMARY OF THE THREE LARGEST FAMILIES FOR EACH GEOGRAPHIC ELEMENT IN THE LAND BETWEEN THE LAKES RECREATION AREA, KENTUCKY-TENNESSEE.

Geographic Element	Family and Number of Species					
I. Intraneous						
Trans-continental	Compositae	6	Gramineae	4	Cyperaceae	4
Central U.S. and Canada	Compositae	35	Leguminosae	14	Cyperaceae	10
Eastern	Gramineae	14	Compositae	12	Labiatae	9
Southern Widespread	Gramineae	12	Leguminosae	6	Fagaceae	5
South-eastern	Rosaceae	3	Umbelliferae	3	Compositae	3
South-western	Asclepiadaceae Onagraceae	1 1	Bignoniaceae Umbelliferae	1 1	Labiatae	1
Northern Widespread	Compositae	9	Liliaceae	7	Ranunculaceae	5
North-eastern	Cyperaceae	2	Fagaceae	2	Ranunculaceae	2
North-western	Labiatae	1	Compositae	1		
II. Extraneous						
Trans-continental	Compositae	1	Gramineae	1	Polygonaceae	1
Central	Leguminosae	1				
Central - east	Compositae	2				
Central - west	Capparidaceae Gramineae	1 1	Compositae	1	Convolvulaceae	1

TABLE XV. (continued)

	Eastern	Anacardiaceae	1	Caryophyllaceae	1	Compositae	1
		Labiatae	1				
	Southern Widespread	Compositae	2	Cyperaceae	2		
	South-eastern	Leguminosae	4	Asclepiadaceae	2	Compositae	2
		Liliaceae	2	Scrophulariaceae	2		
	South-western	Compositae	1	Fagaceae	1	Juglandaceae	1
		Umbelliferae	1				
	Coastal Plain	Fagaceae	3	Leguminosae	2		
	Northern Widespread	Cyperaceae	2				
	North-eastern	Labiatae	4	Compositae	2	Gramineae	2
III.	Introduced and Hybrid	Gramineae	17	Leguminosae	14	Compositae	13

CHAPTER V

DISCUSSION

As envisioned in this study, a total of twenty-one geo-floristic elements occur in the Land Between the Lakes recreation area. This total, because of the classification method utilized, is approximately twice the number of elements occuring in similar studies. Thompson (1939) recognizes sixteen elements in the flora of Ohio while Parker (1936) lists eleven elements in Indiana. The difference in the number of elements for these two similar areas lies in the generalized treatment of the intraneous flora. Rudd (1951) lists six broad categories for North Dakota. Little (1938) recognizes nine elements in the flora of Muskogee County, Oklahoma while Waterfall (1963) includes six elements in the Oklahoma Ozark flora. Little (1938) includes an outline of the Muskogee County, Oklahoma elements but refers to the intraneous-extraneous elements in general terms. Waterfall (1963) lists only the extraneous elements of the Oklahoma Ozarks.

The figure of 71.82 per cent intraneous flora for the Land Between the Lakes is very close to 78 per cent for a southern Illinois swamp study by Mohlenbrock (1959) and 69 per cent for the woody flora of the Great Smoky Mountains (Cain, 1930). Rensing (1957) indicates that the flora of southern Illinois is 63.5 per cent intraneous while Thompson (1939) and Parker (1936) estimate the intraneous element of the Ohio and Indiana floras respectively at 60 per cent.

A number of the various studies reviewed do not distinguish between

extraneous and intraneous elements. The values that are listed for extraneous elements run higher than the 11.62 per cent for the Land Between the Lakes. Rensing (1957) and Mohlenbrock (1959) both estimate the extraneous flora in southern Illinois to be approximately 22 per cent. According to Cain (1930), the woody flora of the Great Smoky Mountains contains an extraneous element of 31 per cent. Thompson (1939) and Parker (1936) both use a value of 40 per cent for Ohio and Indiana. Rudd (1951) records an extraneous value of 45 per cent for the North Dakota flora.

The introduced and hybrid value of 16.56 per cent might be considered high if one ignored the agricultural background of the Land Between the Lakes area. Rensing (1957) reports a similar value of 14 per cent while Ramseur (1960) indicates an introduced element of 12.5 per cent for the vascular flora of the southern Appalachians. Little (1938) shows an 8.9 per cent introduced species in the Muskogee County, Oklahoma flora. Smith and Noldeke (1960) published a revised statistical report on the California flora which indicates that 11 per cent of the flora is introduced. The flora of Oregon contains approximately 10 per cent introduced species (Baker, 1950).

According to Braun (1955), the Interior Low Plateau, which includes the Land Between the Lakes, is dominated by species of wide distribution in temperate latitudes. The two largest elements in the Land Between the Lakes are both wide ranging elements. The Central United States and Canadian intraneous element and Eastern intraneous element compose almost 40 per cent of the total flora. The combined Eastern and Central species represent 56 per cent of the Southern Illinois flora (Rensing, 1957). Forty-eight per cent of the Muskogee County, Oklahoma flora is either widespread Eastern or interior United States (Little, 1938).

The largest major extraneous value in the Land Between the Lakes is the Southern element. The Southern element represents 5.44 per cent of the total flora while it represents 46.86 per cent of the extraneous flora. Mohlenbrock (1959) indicates that 93 per cent of the extraneous flora in a southern Illinois swamp shows southern or southeastern affinities. Thirteen per cent of the total flora for southern Illinois representing 54.5 per cent of the extraneous flora is southern (Rensing, 1957). The extraneous Northern element in the Land Between the Lakes composes 29.79 per cent of the extraneous flora. In comparison, the Northern extraneous element in southern Illinois represents 38.6 per cent of the extraneous species for that area (Rensing, 1957).

If the species with disjunct ranges in the Land Between the Lakes were calculated as an element in the total flora, they would represent 2.35 per cent of the total flora. The majority of these disjunct species are distributed in eastern North America and on the west coast of the continent. According to Campbell and Wiggins (1947), 4.4 per cent of the California flora is distributed in both California and the Eastern United States. In contrast, the southern Appalachians share 65 per cent of their flora with western North America (Wood, 1970).

The three largest families represented in the introduced element of the Land Between the Lakes are, in order, the Gramineae, Leguminosae, and Compositae. According to Baker (1956), the Compositae and Cruciferae are the two largest families in the introduced element of the Iron Mountain, Oregon flora. The ten largest families represented in the Land Between the Lakes flora are similar to the ten largest families for the Muskogee County, Oklahoma flora. The five largest families in the same order for both areas are the Compositae, Gramineae, Leguminosae, Cyperaceae, and

Labiatae. Two of the remaining five families, the Rosaceae and Scrophulariaceae, are shared by both areas (Little, 1938). The three largest families for the California flora are identical to the top families for the Land Between the Lakes (Smith and Noldeke, 1960). The Compositae and Gramineae occupy the number one and two positions respectively in the flora of the Land Between the Lakes, California (Smith and Noldeke, 1960), Iron Mountain, Oregon (Baker, 1956), Muskogee County, Oklahoma (Little, 1938), and the southern Appalachians (Ramseur, 1960). Of the ten largest families in the Land Between the Lakes, only the Fagaceae does not occur in the larger families of the four areas discussed above. The ten largest families for the Land Between the Lakes and the southern Appalachians compose 49.44 per cent and 50 plus per cent of the total respective floras (Ramseur, 1960).

One hundred and sixteen families occur in the Land Between the Lakes with thirty-four of these families represented by a single species. This compares favorably with the flora of Muskogee County, Oklahoma which is represented by one hundred and four families. Twenty-seven of these families contain only one species (Little, 1938). Although the total number of families is smaller, there are thirty families in the southern Appalachians which contain only one species (Ramseur, 1960).

In considering the vegetation of the Land Between the Lakes, there are many factors to weigh. Sharp (1970) indicates that the southern Appalachians must have served as the cradle of vegetation for much of the adjacent area including the emerging Coastal Plain and the glaciated North. According to Sharp (1970), the flora of southern Appalachian must have been derived from a flora similar to the Wilcox during the late Cretaceous and early Tertiary periods. Studies of ancient and modern

floras suggest many of the angiosperm taxa occurring in the southern Appalachians originated in southeastern Asia, migrated through to North America via Alaska, and spread out over the continent (Sharp, 1970). Whittaker (1960) and Wood (1970) recognize the similarity of many species in the southern Appalachians and the Klamath region of northern California and southern Oregon. Research by Sharp and Miranda (1950) demonstrates a strong floral relation between northwestern Mexico and southwestern United States and between northwestern Mexico and eastern United States. Sharp (1970) further states that continental glaciation followed by xerothermic periods probably eliminated the more tropical species from the southern Appalachians and resulted in the disjunction of ranges in many Mexican-Appalachian species. Braun (1950) likewise attributes climatic changes with the reduction of the older Tertiary vegetation and the disappearance of certain species in the Western Mesophytic Forest.

According to Braun (1950), the Western Mesophytic Forest region is "a tension zone where the compensating effects of local environments permit unlike climaxes to exist close to one another." The presence of many unlike climaxes is a reflection of the past history of the area. The Tertiary oak-hickory forest expanded to occupy more area in the western portion of the Western Mesophytic Forest. On the drier ridges along the Tennessee River in the western portion of the Mississippian Plateau there are forest composed of chestnut oak, black oak, post oak, blackjack oak and various hickories. Today, these ridge top forest closely resemble the marginal forest of the Allegheny Plateau. Remnants of the prairies are still visible in isolated areas where drainage and precipitation patterns furnish a suitable habitat. Transeau (1935), as referred to by Shanks (1958), cites prairie areas along the Kentucky

state line in Stewart County, Tennessee. These prairie areas which are more extensive in Kentucky are floristically similar to the mid-west prairies.

Shanks (1958) noted that the Coastal Plain uplands in west Tennessee contain the drainage divide between the Mississippi River and the Tennessee River system. Many coastal plain species along with some Appalachian species occur on this Coastal Plain upland. Braun (1950) also refers to a migration of southern Mississippi embayment flora into the Western Mesophytic forest. Although Braun (1950) indicates that the forest vegetation of the Loess Hills belt is unlike other parts of the Mississippi embayment or the western Mississippian Plateau, there are species common to the Loess Hills and the Land Between the Lakes. The flora listed by Braun for the Loess Hills near Reelfoot Lake, Tennessee includes Fagus grandifolia, Liriodendron tulipifera, and Carya spp. in the canopy layer and Aralia spinosa, Asimina triloba, Carpinus caroliniana, and Ostrya virginiana in the undergrowth. Staphylea trifolia, Lindera Benzoin, and Euonymus americanus are listed for the shrub layer while woody climers include Parthenocissus quinquefolia, Rhus radicans, and Bignonia capreolata (Braun, 1950). Each of these species is likewise found in the Land Between the Lakes.

Braun (1950) indicates that the number of northern species which entered the Western Mesophytic Forest region during the period of Pleistocene glaciation represents a small portion of the flora. Carr (1965) considers the Mississippi drainage system as a means of plant migration from the Interior Low Plateau or the Coastal Plain to southwestern Virginia. If a plant can be transported in one direction it seems reasonable to assume that an equal number of species may move in the

opposite direction. Thus the Land Between the Lakes, by occupying an area on a major drainage system, is in a location which may receive species from many different geographic locations.

CHAPTER VI

SUMMARY

A study of the flora of the Land Between the Lakes recreation area was conducted to determine the geographic affinities of this area. The plants considered in this study included the list of taxa for the flowering plants of the Land Between the Lakes recreation area (Ellis et al., 1971) and several recent additions. The range for each individual plant was based primarily on the distributions outlined by Fernald (1950) and Gleason and Cronquist (1963). The plants were grouped according to the relative position of the major portion of the distribution pattern.

The important findings of this study are listed as follows:

(1) Based on the combined intraneous and extraneous values, the five major geo-floristic elements were the Central United States and Canadian (22.98 per cent), Southern (21.14 per cent), Eastern (18.42 per cent), Northern (13.72 per cent), and Transcontinental (7.17 per cent).

(2) The intraneous element represented 71.82 per cent of the total flora as compared to 11.62 per cent for the extraneous element and 16.56 per cent for the introduced and hybrid element.

(3) Twenty-one geo-floristic elements were represented in the Land Between the Lakes recreation area.

(4) The largest single element was the intraneous Central United States and Canadian which contained 21.26 per cent of the total flora.

(5) Excluding the introduced species, the three largest elements were both intraneous and wide ranging. These elements included the Central

United States and Canadian with 21.26 per cent, the Eastern with 17.8 per cent, and the southern widespread with 11.37 per cent of the total flora.

(6) The introduced and hybrid element represented the third largest element in the flora.

(7) The largest extraneous elements were the southeastern with 2.72 per cent and the northeastern with 2.22 per cent of the total flora.

(8) Based on per cent of the respective floras, the southeastern and northeastern elements played a dominant role in the extraneous flora as opposed to the intraneous flora.

(9) There were nineteen species which had disjunct ranges.

(10) Six families, the Gramineae, Cruciferae, Leguminosae, Labiatae, Rosaceae, and Compositae, represented 50 per cent of the introduced and hybrid species.

(11) Ten families contained 400 species for 49.44 per cent of the total flora. These families were the Compositae, Cruciferae, Cyperaceae, Fagaceae, Gramineae, Labiatae, Leguminosae, Liliaceae, Rosaceae, and Scrophulariaceae.

(12) The Compositae, which contained the largest number of intraneous and extraneous species, was represented in eighteen of the twenty-one geo-floristic elements.

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