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FLORISTIC REGIONS OF TENNESSEE[1, 2]

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Distribution records of the woody plants in Tennessee, systematically compiled since 1947 (Shanks, 1952, 1953, 1954a), are now sufficiently complete that floristic generalizations may safely be based on them. Woody plants are particularly useful for this purpose, since they are the most conspicuous element in the natural vegetation of the region at all seasons, and are for the most part identifiable in the field in vegetative condition. For these reasons their distribution patterns are better known than those of herbaceous species, and they are used in the present analysis. Confused and controversial taxonomic groups are excluded, as well as species whose native ranges are obscured by secondary spread, such as catalpa and black locust.

A floristic region is characterized by a distinctive flora from which a characteristic vegetation has developed. It is based on coincidence of concentration of a number of species and general agreement in their range limits. Floristic regions may therefore be established by plotting mass ranges and drawing boundaries where the maximum number of species limits coincide (Figures 2, 3, 5, 6, 8, 10, 12). They may then be checked by the concentration and limits of vegetation types made up of some of their characteristic species (Figures 4, 7, 9, 11, based on data from Cowan, 1946).

Physiographic regions (Fenneman, 1938; Safford, 1869) and county boundaries are shown in Fig. 1, and frequent reference will be made to such geographic divisions of the state in the following discussions of species distribution patterns. Additional sub-regions not commonly shown on physiographic maps are designated by shading and their approximate boundaries indicated by broken lines. While admitted on floristic evidence their differentiation is primarily physiographic. Further specific reference to these sub-regions will be made in the concluding portion of this paper.

Species Distribution Patterns

The known county distribution of a group of woody species characteristic of the high mountain counties of east Tennessee is plotted in Fig. 2. In this and the following maps each dot represents a county record of a species. Outlying stations in the

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Appalachian valley region and Cumberlands are shown, but it will be noted that no more than two of the high mountain species occur in any outlying county. These are disjunct occurrences of species in local habitats due to the varied topography, rather than outlying floristic islands. The following forty species were used. The twenty marked with an asterisk are entirely restricted to the high mountains (in the ten counties touching North Carolina plus Sullivan which is adjacent to them).

* Abies fraseri (Pursh) Poir. ---------- Fraser fir
* Acer spicatum Lam. ---------- Mountain maple
* Alnus crispa (Ait.) Pursh ---------- Green alder
Buckleya distichophylla Torr. ---------- Sapsuck
* Diervilla sessilifolia Buckl. ---------- Bush honeysuckle
Fothergilla gardeni Murr. ---------- Witch alder
* Gaylussacia ursina (Curtis) T. & G. ---------- Bear huckleberry
Hydrangea radiata Walt.
* Kalmia angustifolia var. caroliniana (Small) Fern. ---------- Lambkill
* Leiophyllum buxifolium var. hugeri (Small) Schneid. ---------- Sand myrtle
Leucothoe editorum Fern. & Schub. ---------- Dog hobble
Leucothoe recurva (Buckl.) Gray ---------- Fetter-bush
* Lonicera canadensis Bartr. ---------- Fly honeysuckle
Lonicera dioica L. ---------- Mountain honeysuckle
* Magnolia fraseri Walt. ---------- Fraser magnolia
* Menziesia pilosa (Michx.) Juss. ---------- Minnie-bush
* Picea rubens Sarg. ---------- Red spruce
* Pieris floribunda (Pursh) B. & H. ---------- Mountain fetter-bush
Pinus pungens Lamb ---------- Table mountain pine
* Potentilla tridentata Ait. ---------- Three-toothed cinquefoil
Prunus pensylvanica L.f. ---------- Fire cherry
Prunus virginiana L. ---------- Choke cherry
* Pyrus (Sorbus) americana (Marsh.) D.C. ---------- Mountain ash
* Rhododendron carolinianum Rehd. ---------- Carolina rhododendron
Rhododendron catawbiense Michx. ---------- Catawba rhododendron
* Ribes glandulosum Grauer ---------- Skunk currant
* Ribes rotundifolium Michx. ---------- Round-leaf gooseberry
* Rubus canadensis L. ---------- Canada blackberry
* Rubus idaeus var. canadensis Richards ---------- Red raspberry
Rubus odoratus L. ---------- Flowering raspberry
Sambucus pubens Michx. ---------- Red-berried elder
Spiraea alba DuRoi ---------- Meadowsweet
Tsuga caroliniana Engelm. ---------- Carolina hemlock
Vaccinium constablaei Gray ---------- High-bush blueberry
Vaccinium erythrocarpum Michx. ---------- Mountain cranberry
Vaccinium hirsutum Buckl. ---------- Hairy blueberry
Vaccinium macrocarpon Ait. ---------- Cranberry
* Viburnum alnifolium Marsh. ---------- Witch-hobble
Viburnum rafinesquianum Schultes ---------- Downy arrowood

Twenty species of more general Appalachian distribution form the basis of Fig. 3. These species are widespread and rather uniformly distributed in both the Appalachian mountains and Appalachian Plateaus. Most of their continuous ranges terminate abruptly at or near the western escarpment of the Cumberland Plateau, the most distinct floristic boundary in the area, and only a few have disjunct stations further west. The following twenty species were used.

Acer pensylvanicum L. ---------- Striped maple
Betula alleghaniensis Britton ---------- Yellow birch
Betula lenta L. ---------- Sweet birch
Calycanthus fertilis Walt. ---------- Sweet-shrub
Clethra acuminata Michx. ---------- Pepper-bush
Conradina verticillata Jennison ---------- Rosemary
Dirca palustris L. ---------- Leatherwood
Epigaea repens L. ---------- Trailing arbutus
Gaultheria procumbens L. ---------- Wintergreen
Gaylussacia baccata (Wang.) K. Koch ---------- Huckleberry
Gaylussacia brachycera (Michx.) Gray ---------- Box huckleberry
Lyonia ligustrina (L.) DC. ---------- Male-berry
Magnolia macrophylla Michx. ---------- Big-leaf magnolia
Magnolia tripetala L. ---------- Umbrella magnolia
Pinus strobus L. ---------- White pine
Stewartia ovata (Cav.) Weath. ---------- Mountain camellia
Tsuga canadensis (L.) Carr. ---------- Canada hemlock
Viburnum acerifolium L. ---------- Maple-leaf viburnum
Viburnum cassinoides L. ---------- Withe-rod
Viburnum dentatum L. ---------- Toothed arrowwood

Those species with restricted ranges centering in the Cumberland Plateau (Fig. 5) appear to owe their persistence in the area to the remarkable stability of the upland erosion surface and consequent persistence of habitats since Tertiary time (Braun 1937, 1950). The following eight species were used, of which the *Conradina* is a notably restricted Cumberland Plateau endemic, known only from four counties.

Ascyrum stans Michx. ---------- St. Peter's-wort
Conradina verticillata Jennison ---------- Rosemary
Cornus stolonifera Michx. ---------- Red-osier dogwood
Gaylussacia brachycera (Michx.) Gray ---------- Box huckleberry
Magnolia macrophylla Michx. ---------- Big-leaf magnolia
Pryus (Aronia) arbutifolia (L.) L.f. ---------- Purple chokeberry
Ribes curvatum Small
Spiraea tomentosa var. rosea (Raf.) Fern. ---------- Hardhack

Not all ranges of Appalacian species terminate at the western edge of the Cumberland Plateau, however. Their extension into the Highland Rim and the drier upland area of West Tennessee as a sort of floristic peninsula is illustrated in Fig. 6, which is based on the combined ranges of the seven species in the following list. The *Pinus* and *Kalmia* are characteristic of dry habitats, *Itea* of swampy habitats, and *Magnolia* and *Dirca* of mesic habitats.

Dirca palustris L. ---------- Leatherwood
Itea virginica L. ---------- Virginia-willow
Kalmia latifolia L. ---------- Mountain laurel
Magnolia acuminata L. ---------- Cucumber tree
Magnolia macrophylla Michx. ---------- Big-leaf bagnolia
Magnolia tripetala L. ---------- Umbrella magnolia
Pinus virginiana Mill. ---------- Virginia pine

The cedar glades developed over the Ordovician limestone floor of the Central Basin of Tennessee have received much botanical attention (Gattinger, 1901, Harper, 1926, Freeman,

1932, Quarterman, 1950a, 1950b) because of their vegetational uniqueness as well as their interesting plants. However, a map of the combined distribution of selected species which represent this "limestone flora" (Fig. 8) shows considerable scatter, representing local stations mostly on limestone exposures and on the loess bluffs of West Tennessee. Secondary centers are also shown in White County on the eastern Highland Rim, in Knox and Anderson Counties in the Valley of East Tennessee, and on the bluffs above the Mississippi Alluvial Plain in northwestern Tennessee. The following species were used.

Aristolochia tomentosa Sims ---------- Wooly Dutchman's pipe
Bumelia lycioides (L.) Gaertn. ---------- Buckthorn
Cladrastis lutea (Michx. f.) K. Koch ---------- Yellow-wood
Forestiera ligustrina Poir.
Fraxinus quadrangulata Michx. ---------- Blue ash
Gymnocladus dioica (L.) K. Koch ---------- Kentucky coffee tree
Philadelphus pubescens Loisel. ---------- Mock orange
Ptelea trifoliata L. ---------- Hop-tree
Quercus macrocarpa Michx. ---------- Bur oak
Quercus prinoides Willd. ---------- Dwarf chinquapin oak
Rhamnus lanceolata var. glabrata Gleason ---------- Lance-leaf buckthorn
Ulmus serotina Sarg. ---------- September elm

Characteristic species of the bottomlands of the southern United States were used as the basis for Fig. 10, which is therefore an expression of the distribution and development of the "bottomland" habitat. These species increase in number and abundance both westward and southward, with extensions of range up the Cumberland Valley into Middle Tennessee, up the Tennessee Valley into East Tennessee and into the wet portions of the barrens of the southeastern Highland Rim as far north as Coffee and Grundy Counties.

Although characteristic of bottomlands, not all of the species are restricted to them, and outlying dots may represent upland stations. In the following list of the 30 species used in Fig. 10, those restricted to the Mississippi Alluvial Plain, the Mississippi Embayment and the counties immediately adjacent along the Tennessee River are indicated by an asterisk.

Acer rubrum var. drummondii (H. & A.) Sarg. ---------- Drummond red maple
* Ampelopsis arborea (L.) Koehne ---------- Pepper-vine
Brunnichia cirrhosa Gaertn. ---------- Buckwheat-vine
* Carya aquatica (Michx. f.) Nutt. ---------- Bitter pecan
Carya illinoensis (Wang.) K. Koch ---------- Pecan
Crataegus ashei Beadle ---------- Ashe hawthorn
Crataegus marshallii Eggl. ---------- Parsley hawthorn
Crataegus viridis L. ---------- Green hawthorn
* Diospyros virginiana var. pubescens (Pursh) Dippel ---------- Hairy persimmon
Fraxinus profunda (Bush) Bush ---------- Pumpkin ash
* Gleditsia aquatica Marsh. ---------- Water locust
Ilex decidua Walt. ---------- Possumhaw
* Nyssa aquatica Marsh. ---------- Water tupelo
Nyssa sylvatica var. biflora (Walt.) Sarg. ---------- Swamp black gum
* Planera aquatica (Walt.) Gmelin ---------- Water elm
Populus heterophylla L. ---------- Swamp cottonwood

* Prunus mexicana Wats. ---------- Big-tree plum
Quercus falcata var. pagodaefolia Ell. ---------- Cherry-bark oak
Quercus lyrata Walt. ---------- Overcup oak
Quercus michauxii Nutt. ---------- Swamp chestnut oak
Quercus nigra L. ---------- Water oak
* Schisandra glabra (Brickell) Rehd. ---------- Star-anise
Smilax laurifolia L. ---------- Laurel-leaf greenbrier
* Styrax americana Lam. ---------- Storax
* Taxodium distichum (L.) Rich. ---------- Bald cypress
* Trachelosperum difforme (Walt.) Gray ---------- Climbing dogbane
* Ulmus crassifolia Nutt. ---------- Cedar elm
Viburnum nudum L. ---------- Possumhaw viburnum
* Vitis cinerea var. canescens Bailey ---------- Graybark grape
* Vitis palmata Vahl. ---------- Red grape

While most of the southern bottomland species mapped in Fig. 10 extend considerably further north than Tennessee along the Mississippi River and its tributaries, another southern floristic element may be identified which reaches its northward limit in the state (Fig. 12). The following species, used to illustrate this type of distribution, occur principally in dry to moist upland habitats, or along smaller streams.

Acer barbatum Michx. ---------- Florida sugar maple
Acer leucoderme Small ---------- White-bark maple
Berchemia scandens (Hill) K. Koch ---------- Rattan-vine
Cotinus obovatus Raf. ---------- Smoke-tree
Decumaria barbara L. ---------- Climbing hydrangea
Gelsemium sempervirens (L.) Ait. f. ---------- Yellow jessamine
Hydrangea quercifolia Bartr. ---------- Oak-leaf hydrangea
Ilex longpipes Chapm. ---------- Long-stalked holly
Lonicera flava Sims ---------- Yellow honeysuckle
Magnolia virginiana L. ---------- Sweet bay
Pinus taeda L. ---------- Loblolly pine
Quercus laurifolia Michx. ---------- Laurel oak
Symplocos tinctoria (L.) L'Her. ---------- Horse-sugar

Legend:

1. Mississippi Alluvial Plain
2. Mississippi Embayment (West Gulf Coastal Plain)
   2a. Mississippi River Bluffs
   2b. Coastal Plain Upland
3. Highland Rim (Interior Lower Plateaus)
   3a. Kentucky Prairie Barrens
   3b. Barrens of the Southwestern Rim
   3c. Barrens of the Southeastern Rim
4. Central Basin
   4a. Cedar Barrens
5. Cumberland Plateau (Appalachian Plateaus)
6. Appalachian Valley (Ridge and Valley Province)
   6a. Oak-Pine Region
7. Unakas (Blue Ridge Province)

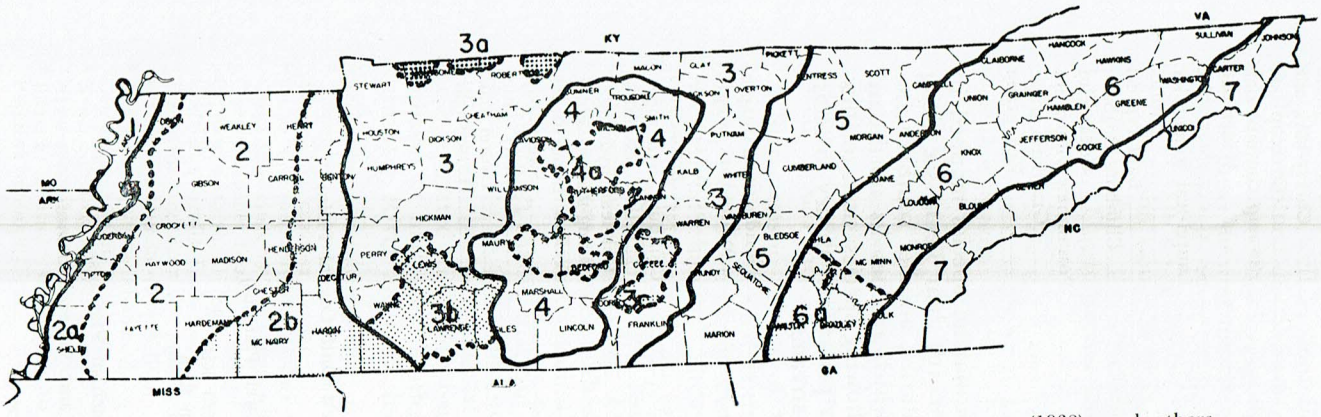

Figure 1. Physiographic-floristic map of Tennessee, after Safford (1869), Fenneman (1938), and others.

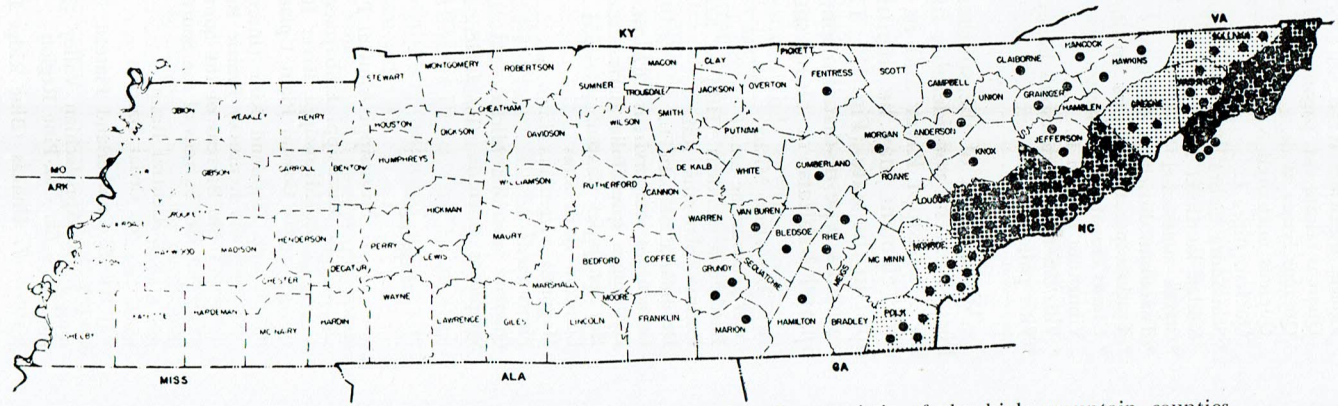

Figure 2. Known county distribution of 40 woody species characteristic of the high mountain counties.

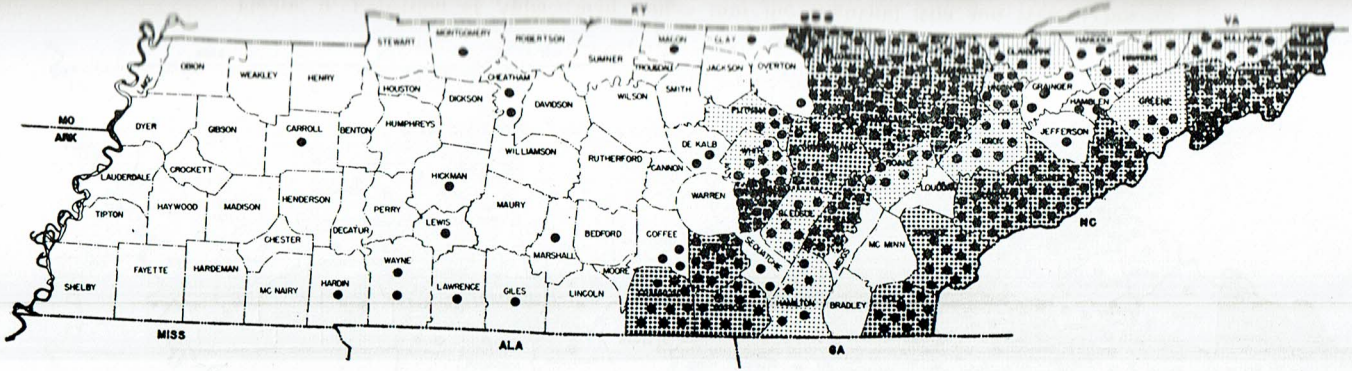

Figure 3. Known county records of 20 woody species of Appalachian distribution.

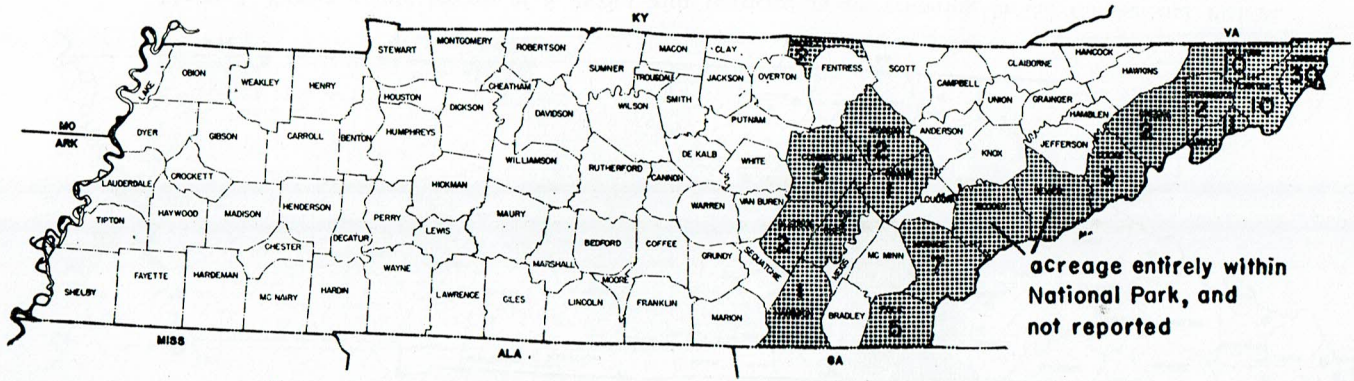

Figure 4. County distribution of White Pine-Hardwoods Forest Type, 1946.

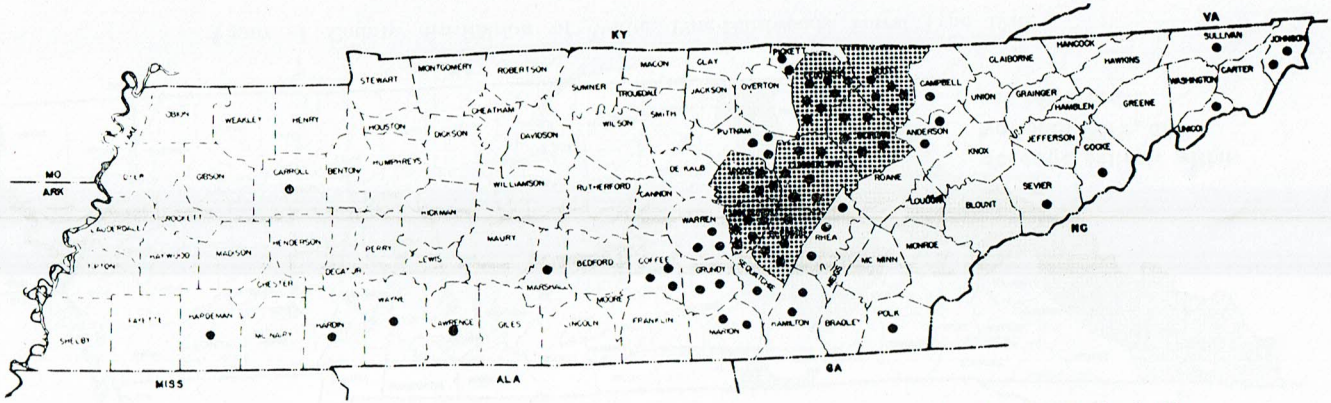

Figure 5. Known county records of 8 species with restricted ranges centering in the Cumberland Plateau.

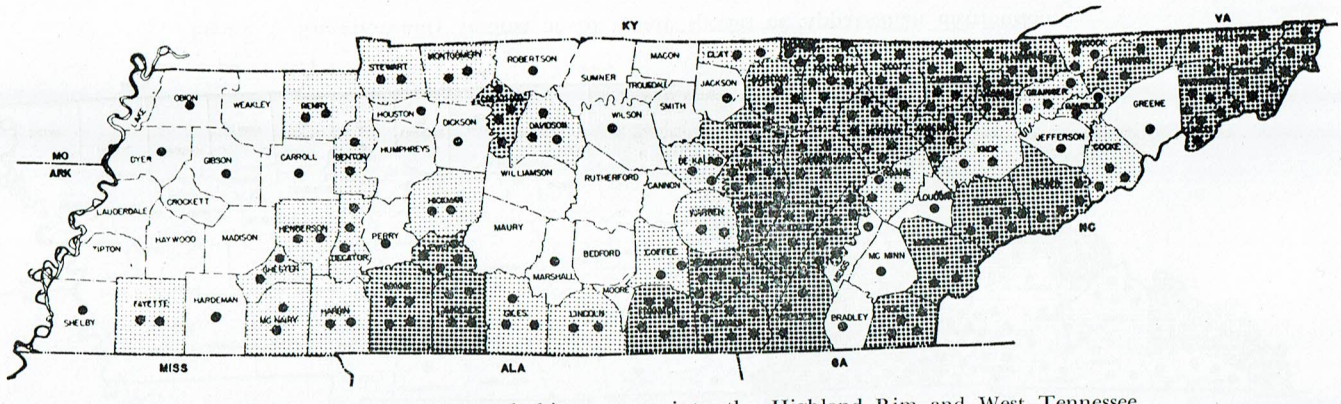

Figure 6. Extension of Appalachian ranges into the Highland Rim and West Tennessee.

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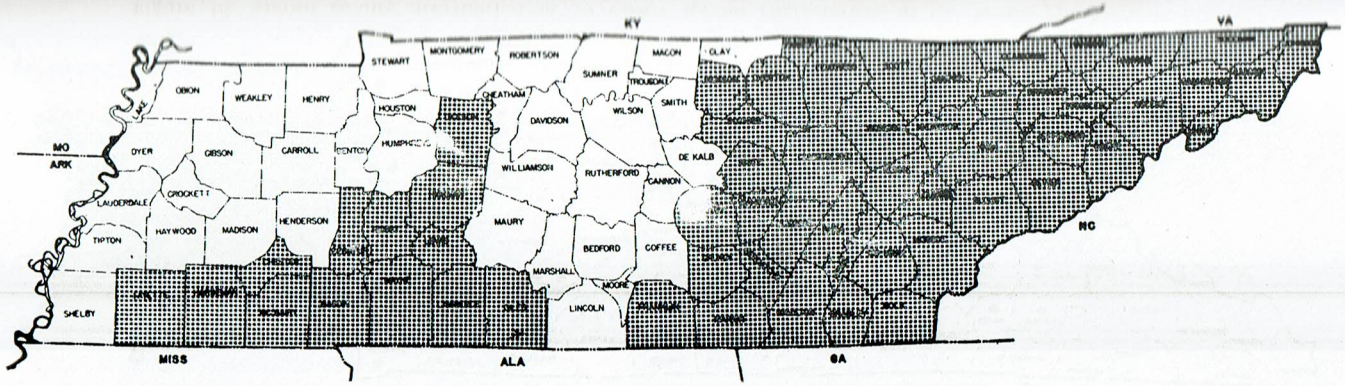

Figure 7. County distribution of Yellow Pine and Yellow Pine-Hardwoods forest types, 1946.

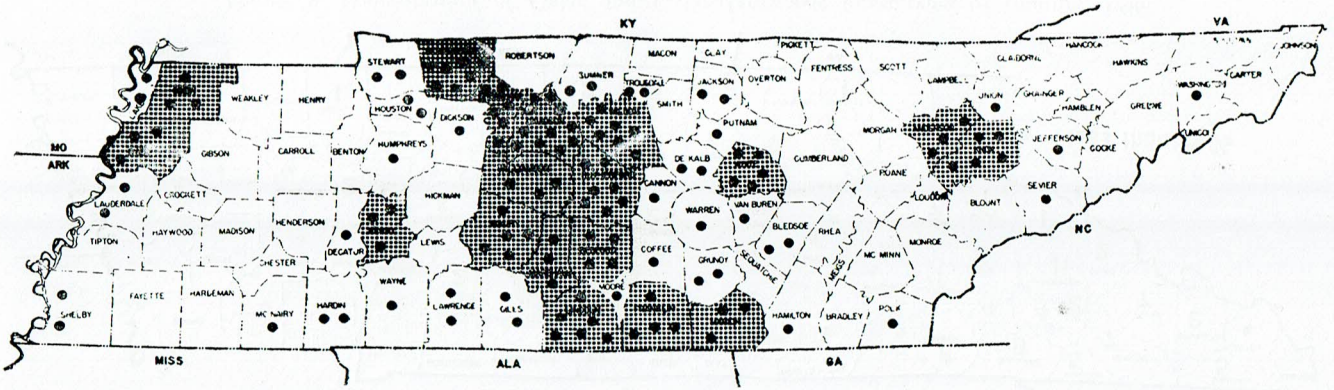

Figure 8. Combined ranges of 12 woody species with ranges centering in the Central Basin of Tennessee.

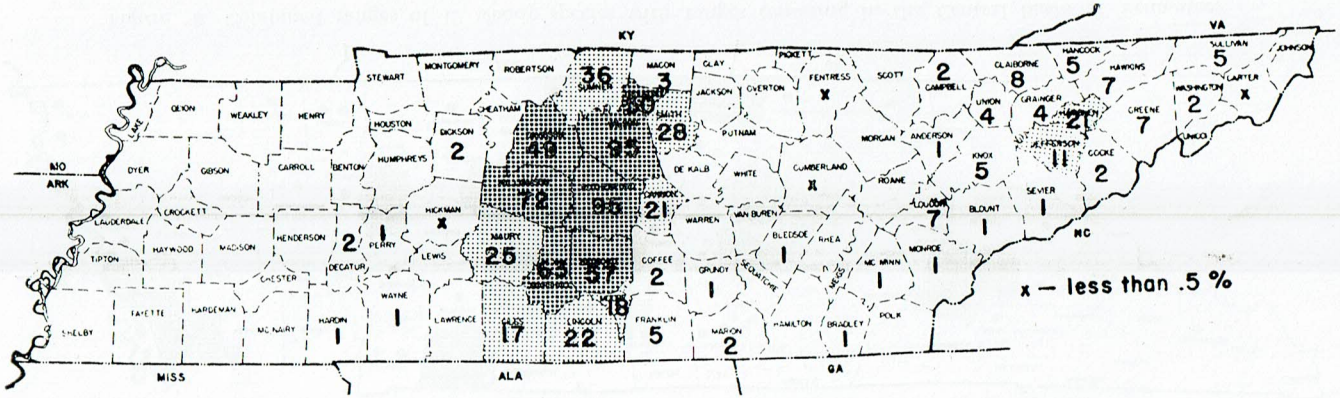

Figure 9. Concentration of Cedar and Cedar-Hardwoods forest types by counties, 1946.

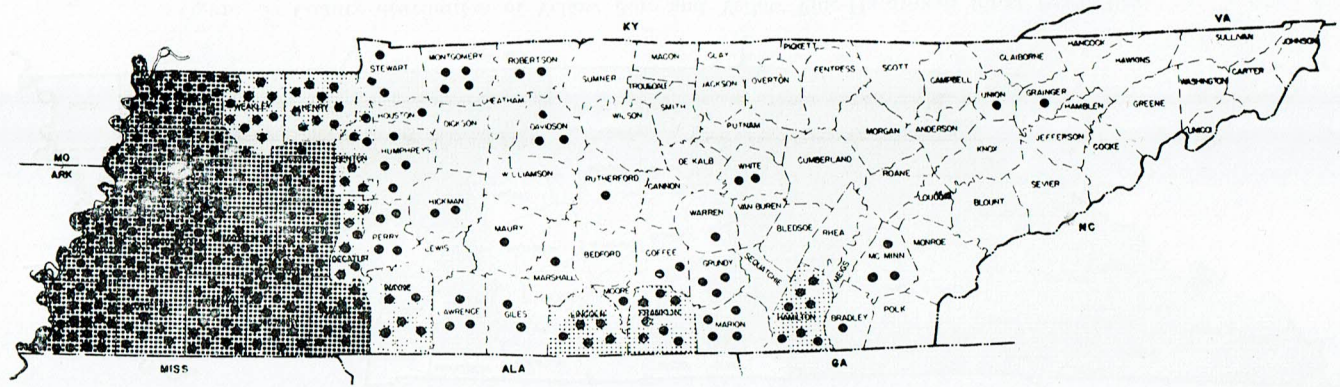

Figure 10. Known county distribution of 30 woody species characteristic of the Mississippi Embayment.

Figure 10. Known county distribution of 50 woody species characteristic of the Mississippi Embayment.

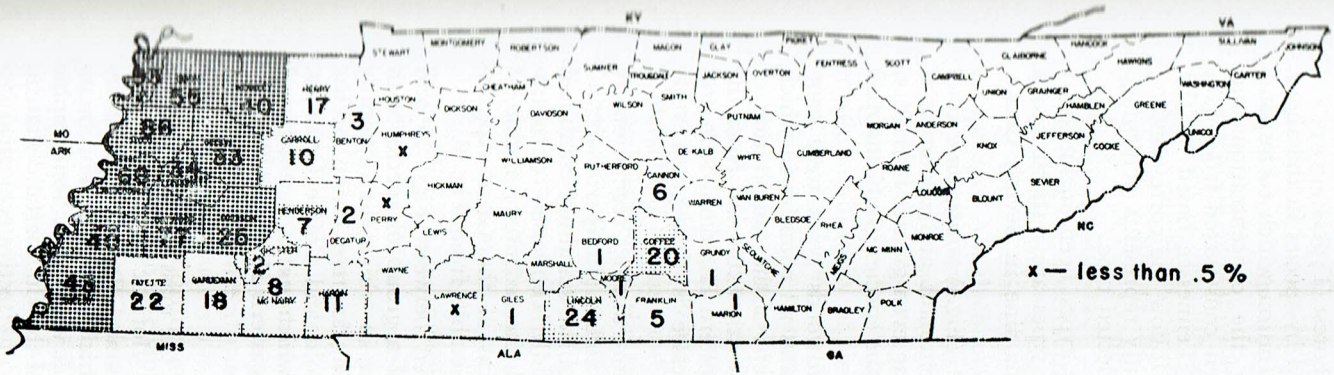

Figure 11. County distribution of Bottomland Hardwoods Forest Type, 1946.

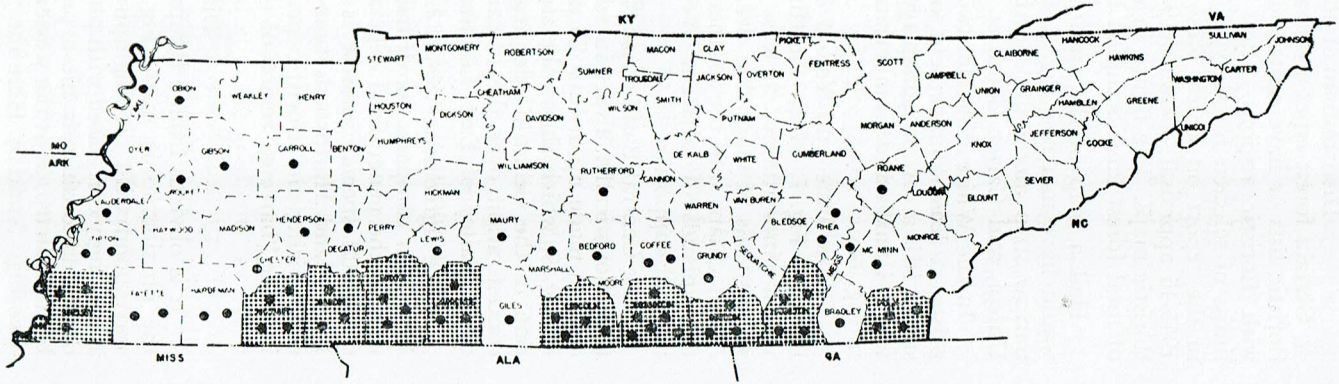

Figure 12. Known county records for 13 species which reach their northward inland limit within Tennessee.

Distribution of Regional Forest Types

Certain forest types are characterized by species in the above floristic lists or have centers of concentration which correspond with floristic regions. Maps showing the concentration and limits of selected forest types have been constructed from data in the report on Forest Resources in Tennessee based on the 1945-46 appraisal (Cowan, 1946), and follow the corresponding floristic maps. The figure in each county represents percentage of total forest land occupied by the selected type.

Had a map of the spruce and fir types been included, it would have matched Fig. 2, for these types are restricted to a narrow strip along the North Carolina line in Sevier, Cocke, Unicoi, and Carter Counties.

In the White Pine-Hardwoods type (Fig.4) white pine comprises at least 25 per cent of the dominant and codominant stems. It is an Appalachian type showing even greater restriction to the Unakas and Cumberlands than the species group mapped in Fig. 3.

Yellow Pine and Yellow Pine-Hardwoods types were combined in Fig. 7, which therefore indicates all counties in which yellow pines attained at least 25 per cent of the composition of some stands of mappable size. The floristic extension from the Appalachians into the southern and western Highland Rim and the uplands of adjacent West Tennessee is thus given vegetational support.

The Central Basin appears to be more distinct vegetationally than floristically. Types in which red cedar (*Juniperus virginiana* L.) made up at least 25 per cent of the stand are combined in Fig. 9, which shows the strong Middle Tennessee concentration in the Cedar Glades region, and the secondary region of concentration over the calcareous rocks of the Great Appalachian Valley of East Tennessee predictable from Fig. 8.

Close agreement would be expected between Figs. 10 and 11, which compare the distribution of a group of species with that of the generalized vegetation type in which they typically occur. Of special interest is the strong representation of the Bottomland Hardwoods type in Lincoln and Coffee Counties, emphasizing the floristic peninsula which extends northward into the "barrens" region of the southeastern Highland Rim.

Discussion

It is obvious from a comparison of the mass range maps and the physiographic map (Fig. 1) that floristic regions tend to correspond with physiographic regions and floristic boundaries are strongly correlated with physiographic boundaries. This boundary relationship is most pronounced where the topographic break is sharp, as at the western edge of the Cumberland Plateau (see Figs. 3 and 5). Here the gradients of effective ecological fac-

tors are markedly steepened, and the tolerances of a whole series of species are exceeded in short span, even though the limits of their tolerances may not be exactly the same.

When physiographic boundaries are examined critically they often prove to be more effective vegetational boundaries than floristic boundaries, as illustrated in Figs. 8 and 9, for outlying stations of a species are often distributed far within an area in which it is at a strong competitive disadvantage, and is vegetationally unimportant.

Often more species transgress a physiographic boundary in one direction than in the other. Such would appear to be the case at the western edge of the Cumberland Plateau, where a conspicuous Appalachian element spills over onto the Highland Rim and adjacent sandy uplands of West Tennessee as illustrated in Fig. 6, while relatively few of the characteristic species of Middle Tennessee extend past the escarpment into the Cumberland Plateau. The explanation lies in the high degree of edaphic uniformity of the plateau, with its heavy cap of Pennsylvanian sandstone and few inlying habitats favorable to the calciphytes of the Central Basin. In the other direction even beyond the outliers of plateau sandstones which dot the eastern Rim, the cherty residuum of the Mississippian bedrock, as well as the Cretaceous and Tertiary gravels and sands of the old coastal plain, provide local habitats edaphically favorable to Appalachian plants, and unfavorable to their elimination by the competition of the regional mesophytes.

While strong edaphic differentiation typically exists across the most distinct physiographic boundaries and is largely responsible for the floristic differences across them, climatic differentiation of floristic assemblages may also be noted. The general latitudinal limit illustrated in Fig. 12 is presumably climatic in nature, related in some way to temperature, dormancy, length of available growing season, or photoperiod.

Climatic differentiation is most pronounced in the high mountain area of extreme eastern Tennessee, where the altitude is great enough to produce gross climatic differences (Shanks, 1954b). Most of the woody plants present in the Great Smoky Mountains reach either their upper or lower altitudal limits in the region, and while few of their limits actually coincide, the altitudinal and climatic gradients are steep enough to pass many range limits in a short distance. This is the nature of a floristic boundary where the control is basically climatic rather than edaphic.

The "Canadian" element best represented above 5000 feet makes up the bulk of the distribution illustrated in Fig. 2. Here, again, there is more "spilling over" of the mountain flora into favorable habitat niches in the Ridge and Valley Province and even in the more remote Cumberland Plateau than transgres-

sion of the lowland flora across the mountain climatic boundaries. It would seem that most of the outlying stations for the mountain species are microclimatically protected against high maximum temperatures and pronounced or prolonged deficiencies of soil moisture. On the other hand, microclimatic differences within the mountain area are not sufficient to permit many lowland species to invade and survive.

Conclusion

From an examination of the available distribution data on woody plants it appears that all of the physiographic boundaries usually recognized in the state are also floristic boundaries. Range limits of plants often correspond with them rather consistently. However in certain cases smaller floristic regions may also be distinguished within these major physiographic provinces. When the boundaries of these smaller floristic regions are sought, they appear also to be minor physiographic-edaphic boundaries, the sort which show up in soil association maps or type of farming maps. The following included floristic areas appear to warrant recognition as well as the larger physiographic-floristic provinces which include them:

(1) *Mississippi River bluffs,* including the dissected zone behind them; rich in mesophytes, including some with Appalachian and Central Basin affinities (see Figs. 6 and 8); deep loessial soils with favorable combination of moisture and aeration due to topographic position, and with associated microclimatic differentiation;

(2) *Coastal Plain uplands* along the eastern margin of the "Mississippi embayment" of the West Gulf Coastal Plain, as here mapped corresponding rather closely with the area in which the undissected uplands are capped with Cretaceous gravels and sands; habitats include upland remnants which are dry both by virtue of topographic position and nature of soil parent material, and on which Appalachian floristic outliers occur as shown in Figs. 5 and 6; they also include the headwater swamps of the flat drainage divide between the Tennessee River system and the Mississippi River in which many of the "coastal plain species" of Fig. 10 occur; it will be noted from Fig. 11 that the heavy concentration of bottomland forest types does not extend as far eastward as the concentration of species shown in Fig. 10;

(3) *Kentucky prairie barrens,* on the karst topography along the Kentucky state line in Stewart, Montgomery, and Robertson Counties, as mapped by Transeau (1935); these prairie areas were more extensive in Kentucky and were floristically similar to the prairies of the middle west, with relatively few plants of

southern coastal plain affinities, and very infrequent occurrence of woody mesophytes;

(4) *barrens of the southwestern Highland Rim,* on the undissected upland erosion surface of the southwestern Rim, often characterized by a capping of Cretaceous gravel or by cherty residuum, elsewhere characterized by planosols with impeded internal drainage; because of these habitat extremes typically occupied by inferior, open forest stands generalized by TVA forest survey as blackjack-hardwoods (Tennessee Valley Authority, 1941) from which woody mesophytes are notably absent; prairie species frequent but not in extensive, continuous stands;

(5) *barrens of the southeastern Highland Rim,* long well known as a rich collecting ground for plants of coastal plain affinities (Gattinger, 1901, Svenson, 1941) but also including many prairie species; the swampy flatwoods associated with these barrens containing such species as *Quercus nigra* and *Liquidambar styraciflua* and classified as "bottomland hardwoods" in the TVA forest survey (Tennessee Valley Authority, 1941) and the later state-wide forest inventory (Cowan, 1946), see Fig. 11; this is the area designated "Barrens" on the physiographic map drawn by Raisz (Amick and Rollins, 1937);

(6) *cedar glades of the Central Basin,* on the exposed flat-lying limestone and associated shallow soils of the "inner basin," as here mapped corresponding with the Talbott-Hagerstown-Stony Land soil association area (Tennessee Agricultural Experiment Station, 1952); characterized by absence of both woody mesophytes and the Appalachian element of areas underlain by siliceous rocks; endemism the highest of any region in the state but largely in the herbaceous groups (Quarterman, 1950a);

(7) *oak-pine region of the Appalachian valley,* south of a floristic boundary corresponding with the vegetational boundary mapped by Braun (1950), where pines become more important on the landscape and *Pinus taeda* appears, along with associated southern species such as those shown in Figs. 10 and 12.

Summary

Mass ranges of groups of woody species provide a basis for establishing floristic regions for the state of Tennessee. The boundaries of these regions generally correspond with physiographic boundaries, but a good many species occur in more than one province. Recognition is floristically warranted for sub-regions not shown on ordinary physiographic maps: the bluffs above the Mississippi Alluvial Plain, the coastal plain uplands at the eastern edge of the Mississippi Embayment, the barrens of various parts of the Highland Rim, the cedar glades of the Central Basin, and the oak-pine region at the southern end of the Appalachian Valley.

References Cited

Amick, H. C. and L. H. Rollins 1937. *The geography of Tennessee.* Ginn and Company, Boston.

Braun, E. L. 1937. Some relationships of the flora of the Cumberland Plateau and Cumberland Mountains in Kentucky. *Rhodora* 39:193-208.

_____ 1950. *Deciduous forests of eastern North America.* Blakiston, Philadelphia.

Cowan, W. F. 1946. *The forest resources of Tennessee.* Processed report, Tennessee Conservation Department, Forestry Division, Nashville, and the American Forestry Association.

Fenneman, N. M. 1938. *Physiography of eastern United States.* McGraw-Hill, New York.

Freeman, C. P. 1932. Ecology of the cedar glade vegetation near Nashville, Tennessee. *Jour. Tenn. Acad. Sci.* 8:143-228.

Gattinger, A. 1901. *The flora of Tennessee.* State of Tennessee, Nashville.

Harper, R. M. 1926. The cedar glades of Middle Tennessee. *Ecology* 7:48-54.

Ligon, W. S. 1952. Soil associations of Tennessee (map). Offset, *Tenn. Agr. Exp. Sta.*

Luebke, B. H., S. W. Atkins, C. E. Allred, and W. J. Roth 1939. Types of farming in Tennessee. *Univ. Tenn. Agr. Exp. Sta. Bull.* 169: 1-94.

Quarterman, E. 1950a. Ecology of cedar glades. I. Distribution of glade flora in Tennessee. *Bull. Torr. Bot. Club* 77:1-9.

_____ 1950b. Major plant communities of Tennessee cedar glades. *Ecology* 31: 234-254.

Safford, J. M. 1869. *Geology of Tennessee.* State of Tennessee, Nashville.

Shanks, R. E. 1952 Checklist of the woody plants of Tennessee. *Jour. Tenn. Acad. Sci.* 27:27-50.

_____ 1953. Woody plants of Tennessee: first supplement. *Jour. Tenn. Acad. Sci.* 28: 158-159.

_____ 1954a. Woody plants of Tennessee: second supplement. *Jour. Tenn. Acad. Sci.* 29:234-237.

_____ 1954b. Climates of the Great Smoky Mountains. *Ecology* 35:354-361.

Svenson, H. K. 1941. Notes on the Tennessee flora. *Jour. Tenn. Acad. Sci.* 16:111-160.

Transeau, E. N. 1935. The prairie peninsula. *Ecology* 16:423-437.

News of Tennessee Science

Dr. Stanfield Rogers, director of research program at the U-T Memorial Research Center and Hospital, Knoxville, is conducting a project on the use of radioactive isotopes to study biological mechanisms of tumor cells. This study is being aided by a $69,100 grant from the U. S. Department of Health, Education and Welfare, National Institute of Health.

Dr. Rogers is taking part in the seventh International Cancer Congress, July 6-12, in London, England. Recently Dr. Rogers was elected an affiliate of England's Royal Society of Medicine. The designation "affiliate" is used to include Fellows who are not natives of England.

Dr. A. C. Cole, U-T Detpartment of Zoology and Entomology, is spending the summer in Mexico studying the "harvesting" ant. This work is being supported by a National Science Foundation grant. Dr. Cole's work includes collecting specimens and accumulating field data on distrubution, habitats, populations, and life histories.

Four members of the U-T Botany Department are studying plant life

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