EARLY SECONDARY SUCCESSION ON ABANDONED FARMLAND IN THE LAND-BETWEEN-THE-LAKES, STEWART COUNTY, TENNESSEE

MARY LOU MCREYNOLDS

To the Graduate Council:

I am submitting herewith a Thesis written by Mary Lou McReynolds entitled "Early Secondary Succession on Abandoned Farmland in the Land-Between-the-Lakes, Stewart County, 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.

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EARLY SECONDARY SUCCESSION ON ABANDONED FARMLAND IN THE LAND-BETWEEN-THE-LAKES, STEWART COUNTY, 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

---

by

Mary Lou McReynolds

November, 1969

ABSTRACT

Early secondary succession was studied on ten abandoned fields in the Land-Between-the-Lakes area of the Northwestern Highland Rim, Stewart County, Tennessee. Five of these fields had been abandoned in 1967 and five in 1968. All had been previously cultivated in corn or tobacco.

Ten one-meter square quadrats were taken in each field, and for each species the following values were determined: frequency, relative frequency, density, relative density, dominance, and relative dominance. A summation value, Importance Value Index (IVI), which is the sum of the relative values, was determined for each species. Species-area curves indicated adequate sampling.

The results obtained indicate a first-year dominance, in order of IVI values, of Digitaria sanguinalis, Lespedeza spp., Ambrosia artemisiifolia var. elatior, and Erigeron canadensis. The second year, Lespedeza spp. became even more important as a dominant, Ambrosia artemisiifolia var. elatior gained a slight edge on Digitaria sanguinalis, and Diodia teres moved up to fourth place in dominance.

All data were summarized and comparisons were made with the work of Quarterman (1957) in the Central Basin and other research in nearby areas. Similarities and differences are discussed.

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INTRODUCTION

It is common knowledge that the herbaceous species which first appear in an abandoned field are largely determined by past land usage and the vegetational composition of the surrounding areas. The woody seedlings first observed may arise from underground roots as in the case of all Diospyros virginiana individuals in certain one-year fields (Bazzaz, 1968), but for the most part, these seedlings are determined by those trees bounding the area. However, the species which will achieve dominance or be eliminated will be determined by various factors for any given locality. Herein lies the fascinating study of plant succession.

It is very difficult to obtain an area which can be studied for a long period of time with any guarantee that the land will not be disturbed. The Land-Between-the-Lakes affords such an area. This is the land that is now being developed by the Tennessee Valley Authority to show how an area drained of many of its natural resources by previous generations can be restored to serve the recreational needs of our rapidly urbanizing society. At the same time this development is designed to give impetus to the economic growth of the surrounding region.

In 1944 the Tennessee Valley Authority completed Kentucky Dam on the Tennessee River. Then in 1965, the

Corps of Engineers closed the gates of Barkley Dam on the other side of the ridge, filling the Cumberland River Valley with the waters of Lake Barkley. Today, the two lakes run parallel for some 40 miles with only this ridge, Land-Between-the-Lakes, to separate them.

This thesis was conceived to take advantage of this opportunity to study trends and rates of secondary succession on abandoned fields left undisturbed for a period of several years and to study some of the factors that influence the rate of succession of the area.

The objectives of this study were to determine what plants are characteristic of and dominant in one-year and two-year old abandoned fields and to compare these findings with those of other ecological workers in nearby areas. Specifically, a comparison was made with data published by Quarterman (1957), who did a comparable study in the Central Basin of Tennessee.

II. LITERATURE SURVEY

An extensive literature survey of work relating to secondary succession in the southeastern United States revealed that numerous studies have been conducted. However, no research has been done on secondary succession on abandoned farmland on the Western Highland Rim. Several studies carried out in nearby physiographic provinces will be cited and results compared throughout this study.

Clements (1916) did a classic work on plant succession, which made excellent background reading to this research. A comparative study by Bazzaz (1968) in Southern Illinois indicated a very similar general trend of succession in one and two-year fields. Oosting (1942) did an extensive ecological analysis of plant communities of the Piedmont region of North Carolina. Certain parallels in his study are noted in this paper. Keever (1950) discusses succession in terms of its causes in old fields of the Piedmont, North Carolina. Another study in the Piedmont area was done by Crafton and Wells (1934), who discuss the early stages of succession based on general observations, quadrat studies of several communities on different types of soil, and the invasion of plants into spaded quadrats. McQuilken (1940) did a study in the Piedmont region and Wells (1928) studied the plant communities of the Coastal Plain of North Carolina.

Obviously, from the literature survey, much more research has been done in the Piedmont region of North Carolina than has been done in the Northwestern Highland Rim of Tennessee. It is the hope of the writer that research done in this study will inspire future work in this area.

III. THE STUDY AREA

The entire study area lies in Stewart County, in the northcentral part of Tennessee. Fenneman (1938) termed this physiographic province the Northwestern Highland Rim of the Interior Low Plateau, and Braun (1950) has used this terminology extensively in writing of the region. The continuity of the Highland Rim may be regarded as nearly complete since there are no wide or important valleys dissecting it. Its topography ranges from rolling to hilly. The general level of the northwestern side of the Rim including Montgomery, Dickson, Robertson, and Stewart counties, through which the Cumberland River flows, is considerably lower than the part on the opposite side in Franklin, Coffee and Warren Counties (Safford, 1869).

The study area lies within the "Dover Area" of Marcher (1962). This area includes about 300 square miles of the western two-thirds of Stewart County. The Dover area is in the northwestern corner of the Highland Rim with relief ranging from 250 feet to 450 feet (Marcher, 1962).

Most of the Western Highland Rim is underlain by dominantly calcareous rocks of Mississippian age, where the stratigraphy and structure play a major role in the occurrence of ground water and the location of other mineral resources of the area (Marcher, 1962).

Nearly all of the study area is underlain by St.

Louis Limestone (Safford, 1869). Other formations include the Lafayette Gravel of the Tertiary System and Fort Payne Chert of the Mississippian System as described by Marcher (1962).

Soils

Law (1962) refers to the Highland Rim soils as being in the Dickson-Baxter Area. However, the predominant soil type of fields in the study area was Bodine cherty silt loam, as revealed by the United States Department of Agriculture Soil Survey Bulletin (Austin, et al, 1953). With few exceptions, fields were all cherty and on the average all were moderately low in productivity and fairly high in both conservability and workability. A few were Lax silty clay loam soil which absorbs and retains moisture poorly. Soil conditions, though somewhat different in the ten fields, seemed to have little effect upon the species present. It must be noted, however, that research concerning the effect of soil conditions on plant species was not a part of this study.

Grouped on the basis of use suitability, 41 percent of Stewart County soils make fair to excellent cropland, 14 percent poor to very poor cropland but fair to good pasture land, and 45 percent poor to very poor cropland or pasture land but at least fair forest land (Austin, et al, 1953).

Climate

Stewart County has a warm-temperate continental climate. Summers are long and warm and winters are classified as short and open. Extreme weather conditions are uncommon and temperature and moisture conditions are generally thought favorable for a wide variety of crop and pasture plants.

The average frost free period of 191 days extends from April 12 to October 20, but killing frosts have been recorded as late as May 2 and as early as September 24.

The mean annual rainfall as recorded by the United States Weather Bureau at Dover, Tennessee is 48.61 inches. The record dry year is 1930 with only 32.88 inches of rainfall, and 1923 is the wettest year on record, having 70.67 inches (Austin, et al, 1953).

Location and Description of Fields

All fields used in this study range from one to three acres in size, an acreage typical for the area as reflected by past land usage. From data collected in Stewart County's last soil survey (early 1940's), farms were predominantly small, about 50 percent consisting of less than 100 acres, with 69 farms having an acreage under ten acres (Austin, et al, 1953).

Originally, fourteen fields were selected, of which ten were actually used in this study. Four of these fields were later cultivated and hence discarded for

present use. Since the original number ascribed to each field was retained for convenience, the reader will observe a sequential disparity of numeration.

Field 0 is located 3.6 miles southwest of Tennessee Highway 49 on Byrd Cemetery road. It is a one acre bottomland bordered on one side by a road and the other three sides by wooded slopes. This field was cultivated in corn in 1967.

Field 5 is located .1 mile east of Tennessee Highway 49 near the Brandon Springs Branch. It is a three acre bottomland last cultivated in 1968. The field is surrounded by thickets and upland woods on three sides and has a fescue field on the fourth side.

Field 6 is located 2 miles southwest of Tennessee Highway 49 on the Brandon Springs Branch road. It is a three acre bottomland field, bordered on one side by a branch and the others by upland woods. It was last cultivated in 1968.

Field 7 is located .6 mile southwest of Tennessee Highway 49 on the Brandon Springs Branch road. This field is a one acre bottomland last cultivated in 1967. It is bordered by a road on one side, a branch on one side, and upland woods on the other two sides.

Field 8 is located .6 mile northwest of Tennessee Highway 49 on Tharpe road. This bottomland field is about one and one-half acres and is bordered by a branch on one side, a cultivated field on one side, and upland woods on

the other two sides. It was last cultivated in 1967.

Field 9 is located 2 miles northwest of Tennessee Highway 49 on the Jackson Hollow road. This bottomland of about an acre was last cultivated in 1968. A cultivated field bounds one side, a branch one side, and upland woods are on the other sides.

Field 10 is located 4.3 miles southwest of Tennessee Highway 49 in the Byrd Creek area. This bottomland of two and one-half acres was last cultivated in 1968. It is surrounded by woods on all sides.

Field 11 is located 3.7 miles southwest of Tennessee Highway 49 on the Byrd Cemetery road. This bottomland field of about an acre was last cultivated in 1967. It has an intermittent creek bordering one side and upland woods on the other sides.

Field 12 is located .5 mile west of Tennessee Highway 49 on the Relay Tower road. This is an upland field of about one and one-half acres and was last cultivated in 1967. It is bordered on one side by a road and has woods on the other sides.

Field 13 is located .5 mile east of Tennessee Highway 49 in the Fox Hollow area. This upland field of about one and one-half acres was last cultivated in 1968. It is a sloping field bordered by a road on one side and woods on the other sides.

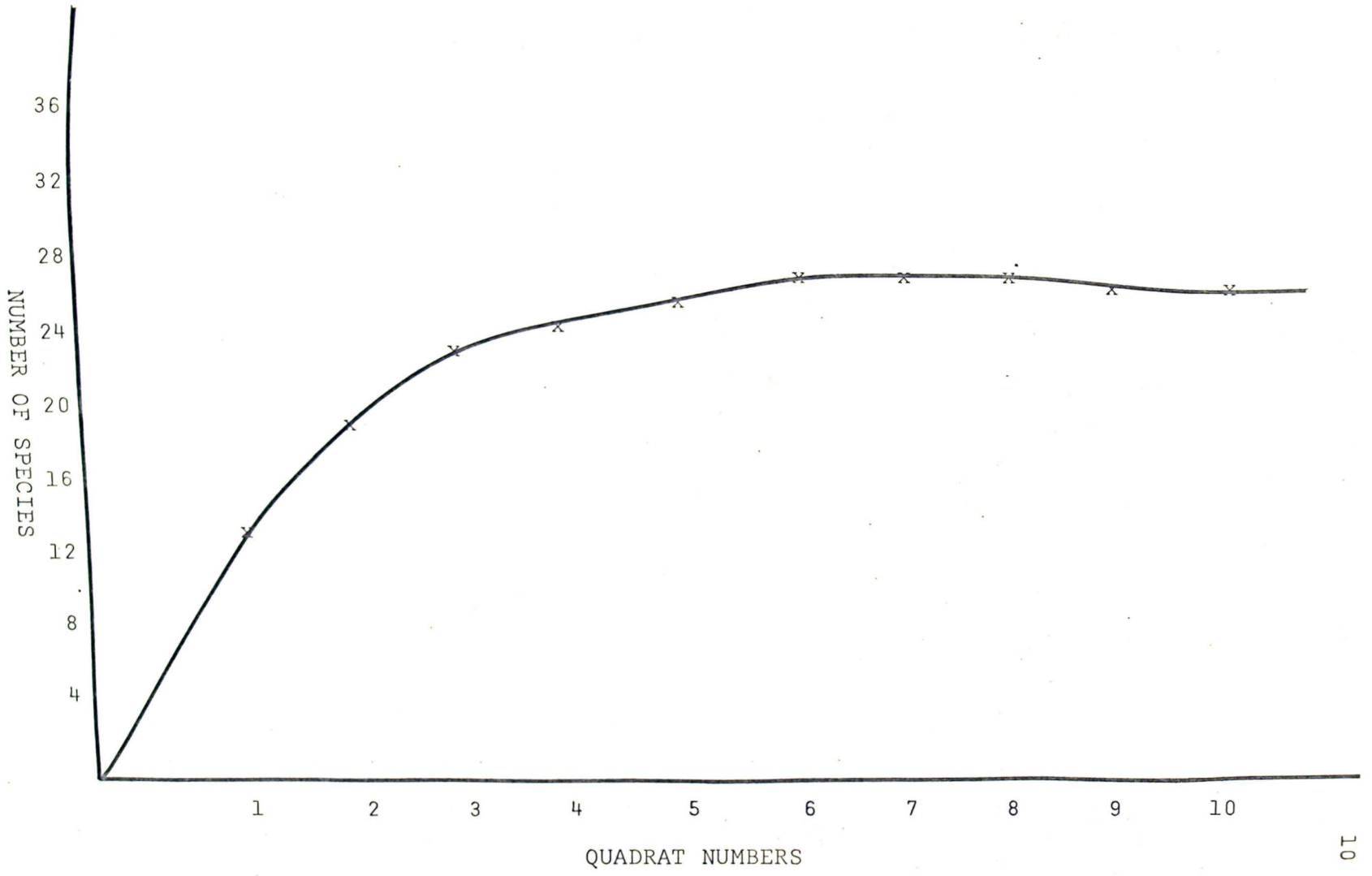

Figure 1. Species-Area Curve

IV. METHODS AND MATERIALS

Ten fields, all of which had been cultivated in corn or tobacco in 1967 or 1968, were studied. Although several of the fields were bottomland, no fields selected were flood-plain or hilltop. All fields were more or less rolling to hilly in relief. None was severely eroded.

Sampling was done by the quadrat method, using plots one meter square. Woody species under one inch diameter breast height (dbh) were counted with the herbaceous species. No woody species exceeding this measurement were observed in any of the ten fields. Ten quadrats were taken in each field, as species-area curves indicated a suitable margin of safety. Figure 1 is the species-area curve of field 8, selected because it illustrates a typical curve of a field adequately sampled. According to Cain (1938) sampling is adequate when a ten percent increase in area sampled results in no more than a ten percent increase in total species present. Phillips (1959) quotes Braun-Blanquet (1932) who considers the sample adequate when the curve becomes horizontal. Sampling was done by placing the quadrat at regularly spaced intervals along two lines traversing the fields at their longest axis.

For each species, frequency, relative frequency, density (average number of individuals per unit area),

relative density, dominance (estimated cover after Braun-Blanquet (1932), and relative dominance were determined. A summary figure, Importance Value Index (IVI), which is the summation of the three relative values obtained, was determined. The IVI as used by the author is apparently equivalent to the DFD index of Quarterman (1957).

The following formulas were used in calculations:

1. Frequency — $\frac{\text{number of plots in which a species occurs}}{\text{total number of plots sampled}}$

2. Relative Frequency — $\frac{\text{frequency value for a species}}{\text{total of frequency values for all species}} \times 100$

3. Density — average number of individuals per quadrat (expressed in number of individuals per square meter)

4. Relative Density — $\frac{\text{density for a species}}{\text{total density for all species}} \times 100$

5. Dominance (Cover) — $\frac{\text{areal coverage values}}{\text{area sampled}}$

6. Relative Dominance — $\frac{\text{dominance for a species}}{\text{total dominance for all species}} \times 100$

7. Coverage Classes for estimating dominance (Braun-Blanquet, 1932)

x	less than 1% coverage
1	1-5
2	6-25
3	26-50
4	51-75
5	76-100

All scientific nomenclature follows that of Fernald (1950) except where references are made to data collected by other researchers. The nomenclature used by those authors was left unchanged.

V. RESULTS

Five fields, all of which had been planted in corn or tobacco the preceding year, were studied. Seventy-one herbaceous species occurred in these fields with nine having a constancy of 100 percent. This was approximately 13 percent of the total number of species.

As used in this study, the word, "constant," refers to a species having a frequency of 100 percent in all fields of that age. The constants in this study were Ambrosia artemisiifolia var. elatior, Digitaria sanguinalis, Lespedeza spp., Oenothera laciniata, Oxalis stricta, Plantago virginica, Solanum carolinense, Specularia perfoliata, and Xanthium strumarium. With the exception of Erigeron canadensis, which was not a constant species, the top five plant species by IVI were also constant. Quarterman (1957) found a total of 64 herbaceous species with three constants, all of which were in her top five species by DFD index. Her three constants were Erigeron strigosus, Erigeron canadensis, and Ambrosia artemisiifolia var. elatior. Table I is a comparison of the importance values obtained in one-year fields in this study with those of Quarterman (1957). Bazzaz (1968) found 33 species of which Ambrosia artemisiifolia and Digitaria sanguinalis were dominant.

TABLE I

COMPARISON OF IMPORTANCE VALUES
OF THE CENTRAL BASIN (Quarterman, 1957) AND NORTHWESTERN HIGHLAND RIM
ONE-YEAR FIELDS

CENTRAL BASIN	DFD INDEX	NORTHWESTERN HIGHLAND RIM	IVI
Erigeron strigosus	50.0	Digitaria sanguinalis	81.1
Ambrosia artemisiifolia var. elatior	36.0	Lespedeza spp.	20.8
grass seedlings	33.0	Ambrosia artemisiifolia var. elatior	17.9
Lespedeza spp.	29.0	Erigeron canadensis	14.9
Erigeron canadensis	22.0	Diodia teres	14.2
Digitaria sanguinalis	20.0	Xanthium strumarium	11.3
Aster pilosus	19.0	Specularia perfoliata	8.9
Sida spinosa	13.0	Campsis radicans	8.3
Oxalis stricta	8.0	Oenothera laciniata	7.9
Cynodon dactylon	7.0	Oxalis stricta	7.4
Acalypha virginica	4.0	Plantago virginica	6.8
Physalis heterophylla	4.0	Lepidium virginicum	5.4
Polygonum pensylvanicum	4.0	Eupatorium serotinum	5.3
Gnaphalium obtusifolium	3.9	Veronica peregrina	4.8
Solidago altissima	3.7	Solanum carolinense	4.4

One major difference in the findings of the writer and those of Quarterman (1957) is the importance of Erigeron strigosus. Only 33 specimens were found in the fifty samples taken in this study. This represents an IVI of 4.2 compared to a DFD index of 50 in the Quarterman (1957) study. Erigeron strigosus was one of the chief dominants in her one-year fields. Bazzaz (1968) does not mention the presence of Erigeron strigosus in one-year old fields.

Table II is a comparison of importance values obtained in this study with those of Quarterman (1957) in fields abandoned for two years. In the second year fields, 65 species of herbaceous plants were found. Four, or seven percent of the total number, were constant. The constant species were Aster pilosus, Diodia teres, Eupatorium serotinum, and Lespedeza spp. Of these, only Diodia teres and Lespedeza spp. were among the top five in importance.

Dominant species, according to IVI values, were Lespedeza spp., Ambrosia artemisiifolia var. elatior, Digitaria sanguinalis, and Diodia teres. These same four species were listed by Quarterman (1957) in the following order: Digitaria sanguinalis, Diodia teres, Lespedeza spp., and Ambrosia artemisiifolia var. elatior. Bazzaz (1968) listed Aster pilosus, Ambrosia artemisiifolia, and Erigeron annuus as being dominant in two-year fields.

TABLE II

COMPARISON OF IMPORTANCE VALUES
OF THE CENTRAL BASIN (Quarterman, 1957) AND NORTHWESTERN HIGHLAND RIM
TWO-YEAR FIELDS

CENTRAL BASIN	DFD INDEX	NORTHWESTERN HIGHLAND RIM	IVI
Digitaria sanguinalis	138.0	Lespedeza spp.	69.5
Diodia teres	40.0	Ambrosia artemisiifolia var. elatior	24.9
Lespedeza spp.	37.0	Digitaria sanguinalis	22.7
Ambrosia artemisiifolia var. elatior	34.0	Diodia teres	14.7
Erigeron strigosus	27.0	Plantago virginica	13.8
Erigeron canadensis	24.0	Erigeron canadensis	12.7
Oxalis stricta	23.0	Eupatorium serotinum	09.5
Torilis japonicus	21.0	Oxalis stricta	06.3
Allium sp.	20.0	Campsis radicans	04.3
Andropogon virginicus	18.0	Solanum carolinense	03.4
Cynodon dactylon	16.0	Specularia perfoliata	01.2

Table III is a comparison of densities in the fields abandoned for one year and Table IV is this same comparison in fields abandoned for two years. In the fields abandoned one year, Digitaria sanguinalis has the greatest density by far. Oosting (1942) found that Digitaria sanguinalis was the most conspicuous species in one-year fields, making up 63 percent of all individuals present. He found it to be uniformly distributed, appearing in 50 quadrats in five fields. In this author's study, Digitaria sanguinalis made up 60.4 percent of all individuals in one-year fields. After Digitaria sanguinalis, Lespedeza spp., Ambrosia artemisiifolia var. elatior, and Erigeron canadensis had the next greatest densities in the fields abandoned for one year.

In the fields abandoned for two years, Lespedeza spp. had the greatest density. Others in order are as follows: Ambrosia artemisiifolia var. elatior, Digitaria sanguinalis, and Aster pilosus (Table IV).

Table V contains a summary of all data collected on the five fields abandoned for two years. For convenience, all species are listed in alphabetical order. Twelve woody species appeared in the two-year fields, with the most important one being Campsis radicans. It occurred 27 times in the fifty plots taken. Smilax rotundifolia, with 25 individuals, was also a rather significant woody species. Other woody species encountered were Diospyros virginiana, Liquidambar styraciflua, Oxydendrum arboreum, Pinus taeda,

TABLE III

A COMPARISON OF DENSITIES
IN ONE-YEAR FIELDS

SPECIES	IVI	FIELD NUMBERS				
		5	6	9	10	13
Digitaria sanguinalis	81.1	10.5	16.5	680.0	145.1	89.0
Lespedeza spp.	20.8	00.9	38.4	024.3	069.6	02.1
Ambrosia artemisiifolia var. elatior	17.9	03.6	04.9	016.6	010.6	17.4
Erigeron canadensis	14.9	23.5	22.0	000.7	002.2	00.4
Diodia teres	14.2	--	33.4	075.0	006.3	01.5
Xanthium strumarium	11.3	06.7	50.5	--	000.1	--
Specularia perfoliata	08.9	04.1	05.1	000.4	010.6	01.8
Campsis radicans	08.3	03.2	--	--	004.5	--
Oenothera laciniata	07.9	01.0	00.8	001.5	002.4	00.2
Oxalis stricta	07.4	06.5	00.6	000.9	001.6	01.5
Plantago virginica	06.8	01.6	00.8	001.6	001.6	01.9
Eupatorium serotinum	05.3	--	02.4	000.1	000.5	11.0
Trifolium procumbens	04.9	--	14.1	--	--	--
Veronica peregrina	04.8	05.9	00.1	000.3	000.9	00.8
Solanum carolinense	04.4	00.7	01.3	001.1	001.5	00.5
Ipomoea hederacea	04.3	04.7	--	000.2	000.2	--
Verbena hastata	04.0	--	00.1	013.8	--	00.2
Anthemis Cotula	03.5	00.2	00.6	001.8	--	02.6
Oenothera biennis	03.1	08.5	00.1	--	--	00.2
Solidago spp.	02.9	--	--	--	006.6	--
Cyperus strigosus	02.1	--	--	022.4	--	--

TABLE IV

A COMPARISON OF DENSITIES
IN TWO-YEAR FIELDS

SPECIES	IVI	FIELD NUMBERS				
		0	7	8	11	12
Lespedeza spp.	69.5	91.9	41.2	67.1	30.9	04.7
Ambrosia artemisiifolia var. elatior	24.9	07.7	02.1	24.3	19.1	--
Digitaria sanguinalis	22.7	--	02.5	--	21.2	88.6
Aster pilosus	15.1	03.4	02.3	05.0	04.9	18.3
Diodia teres	14.7	07.1	24.5	20.7	05.4	01.5
Plantago virginica	13.8	04.9	09.1	18.9	--	--
Erigeron canadensis	12.7	07.2	05.7	10.2	--	00.9
Panicum lanuginosum var. fasciculatum	12.5	03.9	01.4	--	22.1	--
Eupatorium serotinum	09.5	00.2	00.7	00.1	03.2	07.3
Gnaphalium obtusifolium	08.3	02.7	11.0	01.1	--	--
Erigeron strigosus	07.5	--	02.4	03.1	01.5	00.8
Cassia fasciculata	07.4	01.3	00.1	05.7	01.7	--
Solidago spp.	07.4	00.8	--	00.2	02.4	02.9
Oxalis stricta	06.3	--	02.6	01.8	00.4	00.9
Juncus tenuis	04.4	00.1	03.9	--	00.2	04.6
Cuscuta spp.	04.1	05.4	00.3	--	01.7	--
Trifolium repens	03.1	--	--	07.5	--	--

TABLE V

SUMMARIZED COMPUTATIONS FOR TWO-YEAR FIELDS

TAXA	No. Plots Occ.	Freq.	Rel. Freq.	Den- sity	Rel. Dens.	Dom.	Rel. Dom.	IVI
Acalypha virginica	6	0.12	1.2	00.62	00.43	0.04	00.68	02.31
Allium vineale	3	0.06	0.6	00.06	00.04	0.00	00.00	00.64
Andropogon virginicus	9	0.18	1.8	00.94	00.66	0.06	01.02	03.48
Ambrosia artemisiifolia var. elatior	31	0.62	6.2	10.64	07.47	0.66	11.20	24.90
Ambrosia bidentata	2	0.04	0.4	00.08	00.06	0.00	00.00	00.46
Artemisia annua	1	0.02	0.2	00.02	00.01	0.00	00.00	00.21
Aster pilosus	43	0.86	8.6	07.78	05.46	0.06	01.02	15.10
Bidens polylepis	6	0.12	1.2	00.66	00.46	0.02	00.34	02.00
Campsis radicans	11	0.22	2.2	00.54	00.38	0.10	01.70	04.30
Cassia fasciculata	16	0.32	3.2	01.76	01.23	0.18	03.00	07.40
Convolvulus sepium	1	0.02	0.2	00.02	00.01	0.02	00.34	00.55
Cuscuta spp.	9	0.18	1.8	01.48	01.04	0.08	01.30	04.10
Cyperus strigosus	4	0.08	0.8	00.58	00.41	0.02	00.34	01.50
Daucus Carota	2	0.04	0.4	00.04	00.03	0.06	01.02	01.40
Desmodium paniculatum	1	0.02	0.2	00.04	00.03	0.00	00.00	00.23
Digitaria sanguinalis	16	0.32	3.2	22.46	15.76	0.22	03.70	22.70
Diodia teres	27	0.54	5.4	11.84	08.31	0.06	01.02	14.70
Diospyros virginiana	2	0.04	0.4	00.14	00.10	0.00	00.00	01.80
Erigeron canadensis	21	0.42	4.2	04.80	03.37	0.30	05.10	12.70
Erigeron strigosus	17	0.34	3.4	01.56	01.09	0.18	03.00	07.50
Eupatorium serotinum	21	0.42	4.2	02.30	01.61	0.22	03.70	09.50
Euphorbia corollata	3	0.06	0.6	00.50	00.35	0.04	00.68	01.60
Euphorbia maculata	3	0.06	0.6	00.08	00.06	0.00	00.00	00.66
Gnaphalium obtusifolium	16	0.32	3.2	02.96	02.08	0.18	03.00	08.30
Hedeoma pulegioides	1	0.02	0.2	00.02	00.01	0.00	00.00	00.21

TABLE V (continued)

TAXA	No. Plots Occ.	Freq.	Rel. Freq.	Den-sity	Rel. Dens.	Dom.	Rel. Dom.	IVI
Hypericum perforatum	4	0.08	0.8	00.24	00.17	0.04	00.68	01.60
Ipomoea pandurata	5	0.10	1.0	00.18	00.13	0.06	01.02	02.10
Juncus tenuis	11	0.22	2.2	01.76	01.23	0.06	01.02	04.40
Lactuca canadensis	4	0.08	0.8	00.12	00.08	0.04	00.68	01.60
Lepidium virginicum	1	0.02	0.2	00.02	00.01	0.00	00.00	00.21
Lespedeza spp.	38	0.76	7.6	47.16	33.10	1.70	28.80	69.50
Liquidambar styraciflua	1	0.02	0.2	00.02	00.01	0.00	00.00	00.21
Oenothera biennis	4	0.08	0.8	00.12	00.08	0.02	00.34	01.20
Oxalis stricta	21	0.42	4.2	01.14	00.80	0.08	01.30	06.30
Oxydendrum arboreum	1	0.02	0.2	00.02	00.01	0.00	00.00	00.21
Panicum lanuginosum var. fasciculatum	20	0.40	4.0	05.48	03.85	0.28	04.70	12.55
Panicum polyanthes	1	0.02	0.2	00.06	00.04	0.00	00.00	00.24
Passiflora incarnata	4	0.08	0.8	00.14	00.10	0.08	01.30	02.20
Phytolacca americana	2	0.04	0.4	00.06	00.04	0.04	00.68	01.10
Pinus taeda	1	0.02	0.2	00.02	00.01	0.00	00.00	00.21
Plantago aristata	1	0.02	0.2	00.12	00.08	0.02	00.34	00.62
Plantago lanceolata	1	0.02	0.2	00.08	00.06	0.00	00.00	00.26
Plantago virginica	19	0.38	3.8	06.58	04.62	0.32	05.40	13.80
Polygonum pensylvanicum	1	0.02	0.2	00.04	00.03	0.00	00.00	00.23
Potentilla recta	5	0.10	1.0	00.12	00.08	0.02	00.34	01.42
Pycnanthemum pycnanthemoides	1	0.02	0.2	00.02	00.01	0.00	00.00	00.21
Rhus copallina	3	0.06	0.6	00.10	00.07	0.02	00.00	00.67
Rudbeckia hirta	1	0.02	0.2	00.06	00.04	0.00	00.00	00.55
Rubus allegheniensis	2	0.04	0.4	00.08	00.06	0.00	00.00	00.46
Rubus triviales	1	0.02	0.2	00.06	00.04	0.00	00.00	00.24

TABLE V (continued)

TAXA	No. Plots Occ.	Freq.	Rel. Freq.	Den-sity	Rel. Dens.	Dom.	Rel. Dom.	IVI
Rumex crispus	1	0.02	0.2	00.02	00.01	0.02	00.34	00.55
Sabatia angularis	2	0.04	0.4	00.04	00.03	0.00	00.00	00.43
Sassafras albidum	1	0.02	0.2	0.06	0.04	0.00	0.00	0.24
Setaria faberii	7	0.14	1.4	0.42	0.29	0.04	0.68	2.40
Smilax glauca	3	0.06	0.6	0.28	0.20	0.06	1.02	1.80
Smilax rotundifolia	6	0.12	1.2	0.50	0.35	0.00	0.00	1.50
Solanum carolinense	7	0.14	1.4	0.38	0.27	0.10	1.70	3.40
Solidago spp.	19	0.38	3.8	1.26	0.88	0.16	2.70	7.40
Specularia perfoliata	4	0.08	0.8	0.62	0.43	0.00	0.00	1.20
Trifolium pratense	2	0.04	0.4	0.06	0.04	0.00	0.00	0.44
Trifolium repens	4	0.08	0.8	1.50	1.05	0.08	1.30	3.10
Verbascum Thapsus	2	0.04	0.4	0.06	0.04	0.04	0.68	1.10
Verbena hastata	7	0.14	1.4	0.54	0.38	0.04	0.68	2.50
Ulmus alata	1	0.02	0.2	0.04	0.03	0.00	0.00	2.53
Unknowns	7	0.14	1.4	1.00	0.70	0.00	0.00	2.10

and Sassafras albidum.

Table VI is a summary of all data collected on the five fields abandoned for one year. Six woody species were found with Campsis radicans occurring 77 times in the fifty plots taken. The other five species were Diospyros virginiana, Juglans nigra, Prunus serotina, Smilax glauca, and Smilax rotundifolia, but their occurrence was insignificant.

TABLE VI

SUMMARIZED COMPUTATIONS FOR ONE-YEAR FIELDS

TAXA	No. Plots Occ.	Freq.	Rel. Freq.	Den-sity	Rel. Dens.	Dom.	Rel. Dom.	IVI
Achillea Millefolium	2	.04	0.35	0.06	0.00	0.04	00.38	0.72
Agrostis hyemalis	4	.08	0.70	0.50	0.16	0.12	01.11	2.00
Allium vineale	8	.16	1.40	0.32	0.00	0.12	01.11	2.50
Amaranthus hybridus	2	.04	0.35	0.06	0.00	0.04	00.37	0.72
Ambrosia artemisiifolia var. elatior	37	.74	6.50	10.62	3.41	0.86	07.98	17.90
Ambrosia bidentata	1	.02	0.17	00.02	0.00	0.02	00.18	0.35
Anthemis Cotula	16	.32	2.80	01.04	0.33	0.04	00.37	3.50
Artemisia annua	4	.08	0.70	00.24	0.00	0.08	00.74	1.40
Asclepias tuberosa	1	.02	0.17	00.02	0.00	0.00	00.00	0.17
Aster pilosus	7	.14	1.22	00.26	0.00	0.12	01.11	2.30
Bromus secalinus	1	.02	0.17	00.02	0.00	0.02	00.18	0.35
Bromus tectorum	3	.06	0.52	00.06	0.00	0.04	00.37	0.89
Campsis radicans	20	.40	3.50	01.54	0.49	0.46	04.27	8.30
Cardamine hirsuta	3	.06	0.52	00.10	0.00	0.08	00.74	1.30
Cassia fasciculata	2	.04	0.35	00.06	0.00	0.02	00.18	0.53
Cerastium nutans	2	.04	0.35	00.14	0.00	0.02	00.18	0.53
Chenopodium album	1	.02	0.17	00.02	0.00	0.00	00.00	0.17
Convolvulus sepium	2	.04	0.35	00.08	0.00	0.02	00.18	0.53
Croton monanthogynus	1	.02	0.17	00.02	0.00	0.00	00.00	0.17
Cyperus strigosus	1	.02	0.17	04.48	1.40	0.06	00.56	2.10
Dactylis glomerata	2	.04	0.35	00.04	0.00	0.04	00.37	0.72
Datura Stramonium	1	.02	0.17	00.04	0.00	0.02	00.18	0.35
Desmodium paniculatum	2	.04	0.35	00.06	0.00	0.04	00.37	0.72
Digitaria sanguinalis	34	.68	5.95	188.20	60.50	1.58	14.66	81.10
Diodia teres	17	.34	2.98	23.24	7.47	0.40	03.71	14.20

TABLE VI (continued)

TAXA	No. Plots Occ.	Freq.	Rel. Freq.	Den-sity	Rel. Dens.	Dom.	Rel. Dom.	IVI
Diospyros virginiana	2	.04	0.35	0.04	0.00	0.04	0.37	00.72
Eragrostis sp.	5	.10	0.88	0.66	0.21	0.12	1.11	02.20
Erigeron canadensis	32	.64	5.60	9.76	3.14	0.66	6.12	14.90
Erigeron strigosus	11	.22	1.93	0.66	0.21	0.22	2.04	04.20
Eupatorium serotinum	11	.22	1.93	2.32	0.75	0.28	2.60	05.30
Euphorbia maculata	12	.24	2.10	0.64	0.20	0.14	1.30	03.60
Festuca elatior	5	.10	0.88	0.18	0.00	0.06	0.56	01.40
Fragaria virginiana	1	.02	0.17	0.02	0.00	0.00	0.00	00.17
Geranium carolinianum	14	.28	2.45	0.50	0.16	0.14	1.30	03.90
Gnaphalium obtusifolium	3	.06	0.52	0.20	0.00	0.00	0.00	00.52
Helenium tenuifolium	2	.04	0.35	0.04	0.00	0.00	0.00	00.35
Hordeum pusillum	1	.02	0.17	0.50	0.16	0.02	0.18	00.51
Hypericum Drummondii	4	.08	0.70	0.20	0.00	0.04	0.37	01.10
Hypericum perforatum	1	.02	0.17	0.02	0.00	0.02	0.18	00.35
Ipomoea hederacea	13	.26	2.28	1.02	0.33	0.18	1.67	04.30
Ipomoea pandurata	4	.08	0.70	0.12	0.00	0.04	0.37	01.10
Juglans nigra	1	.02	0.17	0.02	0.00	0.00	0.00	00.17
Juncus tenuis	5	.10	0.88	0.38	0.12	0.06	0.56	01.60
Lactuca canadensis	3	.06	0.52	0.06	0.00	0.04	0.37	00.80
Lepidium virginicum	15	.30	2.63	0.46	0.15	0.28	2.60	05.40
Lespedeza spp.	30	.60	5.25	27.06	8.70	0.74	6.86	20.80
Mollugo verticillata	1	.02	0.17	0.12	0.00	0.02	0.18	00.35
Oenothera biennis	6	.12	1.05	1.76	0.57	0.16	1.48	03.10
Oenothera laciniata	24	.48	4.20	1.18	0.38	0.36	3.34	07.90
Oxalis stricta	21	.42	3.68	2.22	0.71	0.32	2.97	07.40
Panicum lanuginosum var. fasciculatum	1	.02	0.17	0.04	0.00	0.02	0.18	00.35

TABLE VI (continued)

TAXA	No. Plots Occ.	Freq.	Rel. Freq.	Den-sity	Rel. Dens.	Dom.	Rel. Dom.	IVI
Panicum polyanthes	1	.02	0.17	0.02	0.00	0.00	0.00	0.17
Passiflora incarnata	6	.12	1.05	0.12	0.00	0.02	0.18	1.23
Physalis virginiana	1	.02	0.17	0.02	0.00	0.02	0.18	0.35
Plantago aristata	4	.08	0.70	0.56	0.18	0.10	0.93	1.80
Plantago virginica	21	.42	3.68	1.40	0.00	0.34	3.15	6.80
Polygonum pensylvanicum	4	.08	0.70	0.32	0.00	0.02	0.18	0.88
Potentilla recta	6	.12	1.05	0.84	0.27	0.14	1.30	2.60
Prunus serotina	1	.02	0.17	0.02	0.00	0.00	0.00	0.17
Pyrrhopappus carolinianus	2	.04	0.35	0.04	0.00	0.04	0.37	0.72
Rumex crispus	3	.06	0.52	0.08	0.00	0.06	0.56	1.10
Sida spinosa	3	.06	0.52	0.08	0.00	0.04	0.37	0.89
Smilax glauca	1	.02	0.17	0.02	0.00	0.00	0.00	0.17
Smilax rotundifolia	2	.04	0.35	0.04	0.00	0.04	0.37	0.72
Solanum carolinense	16	.32	2.80	1.02	0.33	0.14	1.30	4.40
Solidago spp.	6	.12	1.05	1.32	0.42	0.16	1.48	2.90
Sorgum halepense	1	.02	0.17	0.16	0.00	0.04	0.37	0.54
Specularia perfoliata	30	.60	5.25	4.40	1.41	0.24	2.23	8.90
Trifolium procumbens	9	.18	1.58	2.82	0.91	0.26	2.40	4.90
Trifolium dubium	1	.02	0.17	0.06	0.00	0.02	0.18	0.35
Trifolium pratense	1	.02	0.17	0.02	0.00	0.02	0.18	0.35
Trifolium repens	1	.02	0.17	0.02	0.00	0.02	0.18	0.35
Verbascum blattaria	1	.02	0.17	0.06	0.00	0.02	0.18	0.35
Verbascum Thapsus	1	.02	0.17	0.14	0.00	0.04	0.37	0.54
Verbena hastata	10	.20	1.75	2.82	0.91	0.14	1.30	4.00
Veronica peregrina	17	.34	2.98	1.60	0.51	0.14	1.30	4.80
Xanthium strumarium	18	.36	3.15	11.46	3.69	0.48	4.45	11.30
Unknowns	2	.04	0.35	0.04	0.00	0.04	0.37	0.72

VI. DISCUSSION OF RESULTS

The abundance of Lespedeza must be recognized as being influenced by the farming practices of the study area. Keever (1950) made no mention of Lespedeza in her study, but crabgrass was found to be dominant in fields in late summer and fall following cultivation. This author also noted the abundance of crabgrass in late summer and fall in cultivated fields in the Land-Between-the-Lakes area. Due to farming practices in the study area, all of the first-year fields studied had been abandoned after corn cultivation. Perhaps this accounts for Digitaria sanguinalis being a first-year dominant. Keever (1950) found that the time of year which the last cultivation takes place greatly influences the trend of succession in first-year fields.

Andropogon virginicus, with 47 representatives appearing in the two-year fields, is perhaps an indication of its future dominance in this area (Table V). Frequently broomsedge assumes dominance in the third year in the Piedmont region (Keever, 1950). Crafton and Wells (1934) indicate that crabgrass precedes broomsedge because crabgrass seedlings are more drought-resistant than those of broomsedge. Their studies further indicate that only after tall weeds form a protective covering for the broomsedge seedlings, can they assume dominance.

Dates of collection of data in first-year fields ranged from June 20 to July 5, but no appreciable changes were observed in dominants. Seedlings of Digitaria sanguinalis were both recognizable and abundant, and though the general appearance of the field changed greatly seasonally, the same numbers of individuals and dominance were noted at any given time. In the case of Erigeron strigosus and other early blooming species, care had to be taken in counting all dead stems if data were collected late in the season.

In the two-year fields data were collected between late June and August 9. Observed earlier, these fields showed an entirely different visible aspect, but stem count and data computation revealed a consistency of species at any given time during the study period. One would definitely, however, have to take their stage of development into consideration.

Certain species were observed in the fields which did not appear in the ten quadrats taken. In all cases, no more than one or two individuals could be found by searching throughout the field for them, so it is felt that their omission has little, if any, effect upon the validity of the data.

In the one-year fields, Antennaria plantaginifolia, Chaerophyllum procumbens, Daucus Carota, Eleocharis sp., Heliotropium indicum, Rumex Acetosella, and Salvia lyrata were found but did not occur in the sampling plots.

In the two-year fields only five species were observed which did no appear in the ten quadrats taken in each field. These included Cirsium vulgare, Liriodendron tulipifera, Prunella vulgaris, Uniola latifolia, and Vernonia noveboracensis.

VII. SUMMARY

Early secondary succession was studied on ten abandoned fields in the Land-Between-the-Lakes area of the Northwestern Highland Rim, Stewart County, Tennessee. Five of these fields had been abandoned in 1967 and five in 1968. All had been previously cultivated in corn or tobacco.

Ten one-meter square quadrats were taken in each field, and for each species the following values were determined: frequency, relative frequency, density, relative density, dominance, and relative dominance. A summation value, Importance Value Index (IVI), which is the sum of the relative values, was determined for each species. Species-area curves indicated adequate sampling.

The results obtained indicate a first-year dominance in order of IVI values of Digitaria sanguinalis, Lespedeza spp., Ambrosia artemisiifolia var. elatior, and Erigeron canadensis. The second year, Lespedeza spp. became even more important as a dominant as Ambrosia artemisiifolia var. elatior gained a slight edge on Digitaria sanguinalis and Diodia teres moved up to fourth place in dominance.

All data were summarized and comparisons were made with the work of Quarterman (1957) in the Central Basin and other research in nearby areas. Similarities and differences are discussed.

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