THIRD AND FOURTH YEAR PLANT SUCCESSION ON ABANDONED FIELDS IN LAND-BETWEEN-THE-LAKES, STEWART COUNTY, TENNESSEE

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THIRD AND FOURTH YEAR PLANT SUCCESSION ON ABANDONED FIELDS IN 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

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by

David Arlie Chester

August, 1972

ABSTRACT

Plant succession studies on abandoned fields in the Land-Between-the-Lakes area of Stewart County, Tennessee, were made in 1970 and 1971. Prior to abandonment in 1967 or 1968, corn or tobacco was cultivated in the research fields.

The quadrat method of sampling was used with ten one-meter square quadrats taken per field. All species were identified and for each species the following values were determined: density, relative density, dominance, relative dominance, frequency, and relative frequency. A summation value, Importance Value Index (IVI), was determined for each species by taking a total of the relative values.

During the third and fourth year of succession, 61 herbaceous species, three woody vines, and 13 trees and shrubs were identified as being present. The results of the research show a decline in annuals and an increase in perennials from the first and second year.

All data were summarized and comparisons made with the results obtained by McReynolds (1969), who made a study of the same fields in the first and second years of abandonment. Comparisons were also made with similar studies in other geographic areas.

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To the Graduate Council:

I am submitting herewith a Thesis written by David Arlie Chester entitled "Third and Fourth Year Plant Succession on Abandoned Fields in 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.

Edward W. Chester
Major Professor

We have read this thesis and recommend its acceptance:

Lois Brusman -
Second Committee Member

Floyd M. Ford
Third Committee Member

Accepted for the Council:

Wayne C. Stamper
Dean of the Graduate School

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Appreciation is expressed to the Tennessee Valley Authority for their cooperation in allowing this and previous studies to be made in the Land-Between-the-Lakes area.

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CHAPTER I

INTRODUCTION

The orderly and progressive replacement of one plant community by another until a relatively stable community occupies the area is called ecological succession (Smith, 1966). Succession on abandoned farmland or other previously vegetated areas is termed secondary as opposed to primary succession which occurs on areas with no previous vegetation.

In today's society it is very difficult to locate areas on which extended studies of secondary succession may be made without disturbance by man or domesticated animals. A very desirable study area is available in the Land-Between-the-Lakes region of northwestern Tennessee and western Kentucky. Most of this land was closed to farming when purchased by the Tennessee Valley Authority and the ages of abandoned fields may be accurately determined. A study was undertaken and published by McReynolds (1969) to determine qualitative and quantitative characteristics of the vegetation of fields during their first and second year of abandonment.

The purpose of this research was to continue the work initiated by McReynolds and study fields in their third and fourth years of abandonment. The same fields utilized by McReynolds were used in this

study and many of the same techniques employed in order to facilitate comparisons. Specific objectives of this work were to determine the species and proportions of each present in fields abandoned for three and four years. Quantitative values were obtained and comparisons made with the findings of McReynolds and with other studies in various physiographic provinces. Similarities and differences were determined and the changing dominance of species determined.

CHAPTER II

LITERATURE SURVEY

A review of the literature relating to secondary plant succession revealed that numerous studies have been conducted throughout the United States. However, relatively few articles have been written concerning secondary succession during the third and fourth year of abandonment. Results of those available studies relating to third and fourth year of abandonment are cited throughout this study. McReynolds' (1969) study proved very beneficial for the purpose of comparisons since this study is a continuation of her work.

Oosting (1942) made an ecological analysis of the plant communities of the Piedmont region of North Carolina. Several references to this major work are made throughout this study. Oosting's research involved fields from initial abandonment until a climax vegetation had been reached. Other research in the Piedmont region of North Carolina was by Keever (1950) who discussed causes of succession on old fields. McQuilken (1940) studied the establishment of pine in abandoned fields and Crafton and Wells (1934) did research on how different soil types influenced species found in early stages of secondary succession.

Quarterman (1957) completed a study on abandoned cropland in the Central Basin of Tennessee. Since this work was conducted nearby

geographically, it was very interesting to observe how conclusions made in that study related to those of the present study.

Bazzaz (1968) studied succession on abandoned fields in the Shawnee Hills of Southern Illinois. His work offered interesting and informative reading relative to this study.

From the literature survey it was concluded that the present research is important because (1) it is only the second such work to be undertaken in the Northwestern Highland Rim region of Tennessee and (2) it is the only study known in which succession has been studied on the same fields in successive years. All other studies, including the classical work of Oosting (1942), involved selecting different fields and estimating their ages.

CHAPTER III

METHODS AND MATERIALS

The Study Area

The study area in which this research was conducted is located in the Land-Between-the-Lakes Region of Stewart County, Tennessee. Stewart County is located in the northwestern part of Middle Tennessee and lies within the Northwestern Highland Rim Section of the Interior Low Plateau Province (Fenneman, 1938). The Land-Between-the-Lakes is a 170,000 acre tract located in western Kentucky and Tennessee. Situated between TVA's Kentucky Lake (Tennessee River) and the U. S. Corp of Engineers' Lake Barkley (Cumberland River), the area is being developed by TVA as a major outdoor recreation and conservation education facility (Ellis, Wofford, and Chester, 1971). This area is approximately forty miles long and six to eight miles wide.

The topography of the area is rolling to hilly with some flood plains and swampy areas adjacent to the two rivers. The elevation varies from about 300 to 600 feet (Austin, et al., 1953). The variety of soil types, rock formations, drainage patterns, and past agricultural and mining endeavors provide a varied landscape with numerous habitat types. This results in a rather rich and varied flora, especially in the southern end.

The Highland Rim soils were referred to by Law (1962) 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).

Stewart County has a warm-temperate 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 crops and pasture plants (McReynolds, 1969). The mean annual rainfall is 48.61 inches. The record dry year was 1930 with only 32.88 inches of rainfall and the wettest year was 1923 with 70.67 inches of rain (Austin, et al., 1953).

Location and Description of Research Fields

All of the research fields were located in the Stewart County section of Land-Between-the-Lakes. Ten fields were selected for the research, all of which were either bottomland or upland but in no cases were alluvial. Most of the fields were relatively level with very few signs of erosion. All fields were cultivated in either corn or tobacco during the 1967 or 1968 growing season. Apparently, most of these fields had been used quite extensively for cultivation although the fertility seemed to be as great or greater than the majority of the

surrounding fields. The fields ranged in size from one to three acres.

All fields were located adjacent to wooded areas on at least one side. This had a definite influence upon succession in that particular area.

Sampling Methods

All fields sampled were observed periodically during the two year interval while the research was being conducted. Actual sampling was conducted between July 1 and August 31, 1970, and July 15 and August 31, 1971. At this time during the growing season most species were easily recognizable. Fernald (1950) was used as the primary reference for identification.

Sampling was done by the quadrat method as outlined by Phillips (1959). Ten, one-meter square plots were taken in each field. Within each plot all species present and the number of each was determined. According to Cain (1938) and as a result of a species-area curve, 10 quadrats proved to be adequate for sampling each field. The 10 quadrats were selected by first dividing the field into three sections by choosing two lines transversing the field at its longest axis. The 10, one-meter square sampling areas were selected along these two lines and were delimited by the use of a portable frame with four equal sides. This same sampling method was used by McReynolds

(1969) and was similar to the method used by Batson and Tulloch (1955).

For each species found the following parameters were determined: density (average number of individuals per unit area), relative density, dominance (estimated cover of the species), relative dominance, frequency (how often one would expect to find a certain species), and relative frequency. A summation figure, Importance Value Index (IVI), was determined by the addition of the three relative values obtained. An example of this can be shown by using the results of Ambrosia artemisiifolia in a three year old field. Its relative density was 3.9, relative dominance 5.7, and relative frequency 4.3; therefore, its Importance Value Index (IVI) would be 13.9.

Calculations were determined by use of the following formulas:

1. Density — average number of individual plants per quadrat (expressed in number of individuals per square meter)

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

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

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

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

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

The following classes for estimating dominance were used (Brann-Blanquet, 1932):

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

Cover as a percentage of the total area of the quadrat was estimated visually and placed in categories as listed above.

CHAPTER IV

RESULTS

Ten fields were studied in 1970 and 1971; five of these fields had been abandoned for three years and five for four years. Seventy-eight species of plants were identified in the ten fields. The 78 observed species were subdivided into 61 herbaceous species, three species of woody vines and 13 species of trees and shrubs. Of the total, this proved to be approximately 80 percent herbaceous species, 16 percent trees and shrubs and four percent woody vines. McReynolds (1969) found 71 herbaceous species in one and two year fields as compared to the 61 found in this study. Oosting (1942) found only 37 species present in three year old fields. This is a decline of 23 species in the same fields from the previous year.

Nine species, or approximately 12 percent of the total species were found to be present in all ten fields sampled. Those species include Ambrosia artemisiifolia, Andropogon virginicus, Aster spp., Cassia fasciculata, Diodia teres, Erigeron canadensis, Eupatorium serotinum, Lespedeza spp., and Solidago spp. Seven of these nine species were the top seven species in importance value (IVI). McReynolds (1969) found only two of these species, Ambrosia artemisiifolia and Lespedeza spp., present in all ten fields sampled

in one and two year old fields. Table I lists the composite collected data for three and four year old fields. Species are listed in alphabetical order; nomenclature follows Fernald (1950).

Table II lists the Importance Value Index (IVI) of all species found growing in three and four year old fields. Lespedeza was by far the dominant species found. Other important species, according to IVI values, were Aster spp., Cassia fasciculata, Solidago spp., and Andropogon virginicus. McReynolds (1969) found Lespedeza spp., Ambrosia artemisiifolia, Digitaria sanguinalis, Diodia teres, Plantago virginica, and Erigeron canadensis to be the dominant species in two year old fields. Lespedeza spp. remained the dominant species in two, three and four year old fields. McReynolds (1969) found Digitaria sanguinalis to be the dominant species in one year old fields with an IVI of 81.1. In the two year old fields the IVI had dropped to 22.7 and in the three and four year old fields the IVI had dropped to 7.2. In contrast to this, Andropogon virginicus had an IVI of 20.4 in the three and four year old fields; in the two year old fields the IVI was only 3.5 and it was not found in the one year old fields. Table III is a comparison of importance values of dominant species in three and four year fields with the findings of McReynolds (1969) in one and two year fields.

TABLE I

COMPOSITE DATA FOR THREE AND FOUR YEAR OLD FIELDS

Species	Number Fields	Number Plots	Number Plants	Percent Coverage
Acalypha virginica L.	1	1	2	0
Acer saccharum Marsh.	1	3	8	0
Achillea Millefolium L.	1	1	1	0
Allium spp.	4	8	18	0
Ambrosia artemisiifolia L.	10	41	364	32
Andropogon virginicus L.	10	51	192	73
Artemesia annua L.	1	2	3	0
Aster spp.	10	76	556	46
Bromus tectorum L.	3	20	170	20
Campsis radicans L.	3	27	96	29
Cassia fasciculata Michx.	10	60	724	38
Catalpa speciosa Warder	1	1	1	0
Chenopodium album L.	1	1	1	0
Cirsium vulgare (Savi) Tenore	1	1	1	0
Convolvulus arvensis L.	1	4	7	3
Cuscuta spp.	5	20	102	3
Cyperus strigosus L.	1	1	3	1
Daucus carota L.	3	3	3	0
Desmodium canescens L.	6	19	36	13
Desmodium paniculatum L.	6	11	14	3
Digitaria sanguinalis L.	4	12	485	4
Diodia teres Walt.	10	47	730	34
Diospyros virginiana L.	5	6	10	5
Erigeron canadenesis L.	10	49	153	7
Erigeron strigosus Muhl.	4	12	49	2
Eupatorium perfoliatum L.	1	1	3	1
Eupatorium serotinum Michx.	10	37	120	8
Euphorbia corollata L.	4	4	15	1
Festuca spp.	1	6	18	5
Geranium caroliniense L.	1	1	1	0
Gerardia purpurea L.	2	2	3	0
Geum canadense Rydb.	2	2	2	0
Gnaphalium obtusifolium L.	6	15	46	5
Hedeoma pulegioides L.	1	1	3	0
Hypericum denticulatum Walt.	4	6	10	1

TABLE I (continued)

Species	Number Fields	Number Plots	Number Plants	Percent Coverage
Hypericum Drummondii (Grev. and Hook.)	1	1	4	0
Ipomoea spp.	2	8	11	2
Juglans nigra L.	1	1	2	0
Juncus tenuis Willd.	3	18	230	1
Lactuca canadensis L.	2	3	3	1
Lespedeza cuneata (Dumont) G. Don	3	3	3	0
Lespedeza spp.	10	95	3,900	78
Liquidambar styraciflua L.	1	2	3	1
Liriodendron tulipifera L.	1	1	1	0
Lobelia inflata L.	2	2	4	0
Melilotus alba Desr.	1	1	2	0
Oenothera biennis L.	1	2	12	2
Oxalis stricta L.	4	7	43	1
Panicum spp.	6	26	129	12
Passiflora incarnata L.	4	12	21	6
Phytollaca americana L.	5	5	5	2
Pinus taeda L.	1	1	1	0
Plantago aristata Michx.	1	2	4	0
Plantago lancelata L.	3	5	22	1
Platanus occidentalis L.	2	2	7	0
Polygonum pensylvanicum L.	3	6	14	2
Potentilla simplex Michx.	2	3	20	3
Prunus serotina Ehrh.	1	1	1	0
Pyrrophappus carolinianus Walt.	1	1	1	0
Rhus copallina L.	2	2	4	4
Rubus argutus Link	7	20	78	29
Rumex crispus L.	3	7	10	3
Sabatia angularis L.	1	1	3	0
Sassafras albidum (Nutt.) Nees	2	2	7	5
Setaria spp.	3	2	7	1
Smilax spp.	6	23	62	21
Solanum carolinense L.	9	33	74	6
Solidago spp.	10	70	516	42
Teucrium canadensis L.	1	1	2	0
Trifolium repens L.	3	6	22	3
Ulmus alata Michx.	1	1	1	0

TABLE I (continued)

Species	Number Fields	Number Plots	Number Plants	Percent Coverage
Uniola latifolia Michx.	1	1	3	3
Unknowns	6	9	14	1
Verbascum thapsus L.	3	6	6	0
Verbena simplex Lehm.	1	5	6	0
Verbena urticifolia L.	1	3	4	1
Vicia dasycarpa Ten.	1	1	1	0
Vitis spp.	1	1	1	0

TABLE II

IMPORTANCE VALUE INDEX FOR ALL SPECIES FOUND IN THREE AND FOUR YEAR OLD FIELDS

Species	IVI
Lespedeza spp.	66.10
Aster spp.	22.14
Cassia fasciculata	20.88
Solidago spp.	20.37
Andropogon virginicus	20.35
Diodia teres	18.87
Ambrosia artemisiifolia	13.91
Campsis radicans	9.00
Rubus argutus	8.08
Erigeron canadensis	8.04
Bromus tectorum	7.49
Digitaria sanguinalis	7.23
Smilax spp.	6.80
Eupatorium serotinum	6.60
Panicum spp.	6.25
Solanum carolinense	5.32
Desmodium canescens	4.68
Juncus tenuis	4.57
Cuscuta spp.	3.74
Gnaphalium obtusifolium	2.95
Passiflora incarnata	2.55
Erigeron strigosus	2.14
Desmodium paniculatum	1.83
Festuca spp.	1.70
Diospyros virginiana	1.62
Trifolium repens	1.40
Oxalis stricta	1.38
Rumex crispus	1.37
Ipomoea spp.	1.31
Unknowns	1.27
Sassafras albidum	1.16
Polygonum pensylvanicum	1.13
Potentilla simplex	1.06
Allium spp.	1.03
Convolvulus arvensis	1.02
Rhus copallina	0.96

TABLE II (continued)

Species	IVI
Plantago lanceolata	0.94
Hypericum denticulatum	0.92
Phytollaca americana	0.92
Euphorbia corollata	0.76
Oenothera biennis	0.69
Verbascum thapsus	0.69
Uniola latifolia	0.66
Verbena simplex	0.58
Verbena urticifolia	0.53
Lactuca canadensis	0.52
Setaria spp.	0.47
Liquidambar styraciflua	0.42
Acer saccharum	0.40
Daucus carota	0.34
Lespedeza cuneata	0.34
Cyperus strigosus	0.31
Eupatorium perfoliatum	0.31
Platanus occidentalis	0.28
Lobelia inflata	0.25
Plantago aristata	0.25
Artemesia annua	0.24
Gerardia purpurea	0.24
Geum canadense	0.23
Hypericum Drumondii	0.14
Hedeoma pulagioides	0.13
Sabatia angularis	0.13
Acalypha virginica	0.12
Melilotus alba	0.12
Teucrium canadensis	0.12
Juglans nigra	0.12
Achillea Millefolium	0.11
Chenopodium album	0.11
Cirsium vulgare	0.11
Geranium caroliniense	0.11
Pyrrophappus carolinianus	0.11
Vicia dasycarpa	0.11
Catalpa speciosa	0.11
Liriodendron tulipifera	

TABLE II (continued)

Species	IVI
Pinus taeda	0.11
Prunus serotina	0.11
Ulmus alata	0.11
Vitis spp.	0.11

TABLE III

COMPARISON OF IMPORTANCE VALUES OF DOMINANT SPECIES IN ONE AND TWO YEAR FIELDS (McREYNOLDS, 1969) WITH THREE AND FOUR YEAR FIELDS

1 Year Fields	IVI	2 Year Fields	IVI	3 and 4 Year Fields	IVI
Digitaria sanguinalis	81.1	Lespedeza spp.	69.5	Lespedeza spp.	66.1
Lespedeza spp.	20.8	Ambrosia artemisiifolia	24.9	Aster spp.	22.1
Ambrosia artemisiifolia	17.9	Digitaria sanguinalis	22.7	Cassia faciculata	20.9
Erigeron canadensis	14.9	Aster pilosus	15.1	Solidago spp.	20.4
Diodia teres	14.2	Diodia teres	14.7	Andropogon virginicus	20.4
Xanthium strumarium	11.3	Plantago virginica	13.8	Diodia teres	18.4
Specularia perfoliata	08.9	Erigeron canadensis	12.7	Ambrosia artemisiifolia	13.9
Campsis radicans	08.3	Panicum lanuginosum	12.6	Campsis radicans	09.4
Oenothera laciniata	07.9	Eupatorium serotinum	09.5	Rubus argutus	08.1
Oxalis stricta	07.4	Gnaphalium obtusifolium	08.3	Erigeron canadensis	08.0
Plantago virginica	06.8	Erigeron strigosus	07.5	Bromus tectorum	07.5
Lepidium virginicum	05.4	Cassia fasciculata	07.4	Digitaria sanguinalis	07.2

Table IV lists the importance value of woody vines found in three and four year fields compared with the results of one and two year fields. Campsis radicans was found to be the major species of woody vines in all four years of succession. The decline in importance of this species in the second year is probably due more to sampling variations than to an actual decline. Vitis spp. was found in the three and four year old fields, although it was not very abundant. It was not found at all in the one and two year old fields. In similar studies by Quarterman (1957) and Bazzaz (1968), the only woody vine found was Campsis radicans.

Table V lists the importance values of trees and shrubs found during the third and fourth year of succession. Thirteen species of trees and shrubs were identified with Rubus argutus being the leading species. Other important species included Sassafras albidum, Diospyros virginiana and Rhus copallina. McReynolds (1969) found ten species of trees and shrubs in two year fields with Diospyros virginiana, Rubus spp., and Ulmus alata being the dominant species. Only four species were observed in fields abandoned for only one year. Bazzaz (1968) found six species of trees and shrubs in four year fields. Diospyros virginiana was the dominant species with Sassafras albidum, Ulmus alata and Juniperus virginiana also present.

TABLE IV

COMPARISON OF IMPORTANCE VALUES OF WOODY VINES IN THREE AND FOUR YEAR OLD FIELDS WITH ONE AND TWO YEAR OLD FIELDS

Species	1 Year Old Field	2 Year Old Field	3 and 4 Year Old Fields
Campsis radicans	8.3	4.3	9.0
Smilax spp.	0.9	3.3	6.8
Vitis spp.	Not Found	Not Found	0.1

TABLE V

IMPORTANCE VALUES OF TREES AND SHRUBS FOUND IN THREE AND FOUR YEAR FIELDS

Species	IVI
Acer saccharum	0.40
Catalpa speciosa	0.11
Diospyros virginiana	1.62
Juglans nigra	0.12
Liquidambar styraciflua	0.42
Liriodendron tulipifera	0.11
Pinus taeda	0.11
Platanus occidentalis	0.28
Prunus serotina	0.11
Rhus copallina	0.96
Rubus argutus	8.08
Sassafras albidum	1.16
Ulmus alata	0.11

Table VI contains a summary of all data collected on the ten fields abandoned for three and four years. Species are listed in alphabetical order rather than by importance values.

A major objective of this research was to determine which species increased in importance, decreased, or remained approximately the same from a one year field to a four year field. Table VII is a listing of species which increased from one to four years. The primary point emphasized here is the increase in woody species and in perennial herbs, especially Andropogon, Aster, Solidago, and Desmodium. Increases were also shown in the indigenous Cassia and introduced Lespedeza, both of which are annuals.

Bazzaz (1968) found results very similar to these in four year fields. Andropogon and Solidago became the dominant species with Lespedeza increasing in importance value over the past years. Quarterman (1957) found Andropogon, Aster and Solidago to be the dominant species in fields abandoned from four to eight years. Oosting (1942) also found Andropogon to be dominant species in three and four year fields. In all three studies there were constant increases in importance values of woody species.

Table VIII lists the species which decreased in IVI from one to four years. The most dramatic decreases were in the shade-tolerant annuals such as Ambrosia, Digitaria, Erigeron, and Plantago. Such

TABLE VI

SUMMARIZED COMPUTATIONS FOR THREE AND FOUR YEAR FIELDS

Taxa	Den-sity	Rel. Dens.	Dom.	Rel. Dom.	Freq.	Rel. Freq.	IVI
Acaypha virginica	0.02	0.02	0	0	0.01	0.10	0.12
Acer saccharum	0.08	0.09	0	0	0.03	0.31	0.40
Achillea Millefolium	0.01	0.01	0	0	0.01	0.10	0.11
Allium spp.	0.18	0.19	0	0	0.08	0.84	1.03
Ambrosia artemisiifolia	3.64	3.95	0.32	5.66	0.41	4.30	13.91
Andropogon virginicus	1.92	2.08	0.73	12.92	0.51	5.35	20.35
Artemesia annua	0.03	0.03	0	0	0.02	0.21	0.24
Aster spp.	5.56	6.03	0.46	8.14	0.76	7.97	22.14
Bromus japonicus	1.70	1.85	0.20	3.54	0.20	2.10	7.49
Campsis radicans	0.96	1.04	0.29	5.13	0.27	2.83	9.00
Cassia fasciculata	7.24	7.86	0.38	6.73	0.60	6.29	20.88
Catalpa speciosa	0.01	0.01	0	0	0.01	0.10	0.11
Chenopodium album	0.01	0.01	0	0	0.01	0.10	0.11
Cirsium vulgare	0.01	0.01	0	0	0.01	0.10	0.11
Convolvulus arvensis	0.07	0.07	0.03	0.53	0.04	0.42	1.02
Cuscuta spp.	1.02	1.11	0.03	0.53	0.20	2.10	3.74
Cyperus strigosus	0.03	0.03	0.01	0.18	0.01	0.10	0.31
Daucus carota	0.03	0.03	0	0	0.03	0.31	0.34
Desmodium canescens	0.36	0.39	0.13	2.30	0.19	1.99	4.68
Desmodium paniculatum	0.14	0.15	0.03	0.53	0.11	1.15	1.83
Digitaria sanguinalis	4.85	5.26	0.04	0.71	0.12	1.26	7.23

TABLE VI (continued)

Taxa	Den-sity	Rel. Dens.	Dom.	Rel. Dom.	Freq.	Rel. Freq.	IVI
Diodia teres	7.30	7.92	0.34	6.02	0.47	4.93	18.87
Diospyros virginiana	0.10	0.11	0.05	0.88	0.06	0.63	1.62
Erigeron canadensis	1.53	1.66	0.07	1.24	0.49	5.14	8.04
Erigeron strigosus	0.49	0.53	0.02	0.35	0.12	1.26	2.14
Eupatorium perfoliatum	0.03	0.03	0.01	0.18	0.01	0.10	0.31
Eupatorium serotinum	1.20	1.30	0.08	1.42	0.37	3.88	6.60
Euphorbia corollata	0.15	0.16	0.01	0.18	0.04	0.42	0.76
Festuca spp.	0.18	0.19	0.05	0.88	0.06	0.63	1.70
Geranium caroliniense	0.01	0.01	0	0	0.01	0.10	0.11
Gerardia purpurea	0.03	0.03	0	0	0.02	0.21	0.24
Geum canadense	0.02	0.02	0	0	0.02	0.21	0.23
Gnaphelium obtusifolium	0.46	0.50	0.05	0.88	0.15	1.57	2.95
Hedeoma pulegioides	0.03	0.03	0	0	0.01	0.10	0.13
Hypericum denticulatum	0.10	0.11	0.01	0.18	0.06	0.63	0.92
Hypericum Drumondii	0.04	0.04	0	0	0.01	0.10	0.14
Ipomoea spp.	0.11	0.12	0.02	0.35	0.08	0.84	1.31
Juglans nigra	0.02	0.02	0	0	0.01	0.10	0.12
Juncus tenuis	2.30	2.50	0.01	0.18	0.18	1.89	4.57
Lactuca canadensis	0.03	0.03	0.01	0.18	0.03	0.31	0.52
Lespedeza cuneata	0.03	0.03	0	0	0.03	0.31	0.34
Lespedeza spp.	39.00	42.33	0.78	13.81	0.95	9.96	66.10
Liquidambar styraciflua	0.03	0.03	0.01	0.18	0.02	0.21	0.42
Liriodendron tulipifera	0.01	0.01	0	0	0.01	0.10	0.11

TABLE VI (continued)

Taxa	Density	Rel. Dens.	Dom.	Rel. Dom.	Freq.	Rel. Freq.	IVI
Lobelia inflata	0.04	0.04	0	0	0.02	0.21	0.25
Melilotus alba	0.02	0.02	0	0	0.01	0.10	0.12
Oenothera biennis	0.12	0.13	0.02	0.35	0.02	0.21	0.69
Oxalis stricta	0.43	0.47	0.01	0.18	0.07	0.73	1.38
Panicum spp.	1.29	1.40	0.12	2.12	0.26	2.73	6.25
Passiflora incarnata	0.21	0.23	0.06	1.06	0.12	1.26	2.55
Phytollaca americana	0.05	0.05	0.02	0.35	0.05	0.52	0.92
Pinus taeda	0.01	0.01	0	0	0.01	0.10	0.11
Plantago aristata	0.04	0.04	0	0	0.02	0.21	0.25
Plantago lanceolata	0.22	0.24	0.01	0.18	0.05	0.52	0.94
Plantanus occidentalis	0.07	0.07	0	0	0.02	0.21	0.28
Polygonum pensylvanicum	0.14	0.15	0.02	0.35	0.06	0.63	1.13
Potentilla simplex	0.20	0.22	0.03	0.53	0.03	0.31	1.06
Prunus serotina	0.01	0.01	0	0	0.01	0.10	0.11
Pyrrophappus carolinianus	0.01	0.01	0	0	0.01	0.10	0.11
Rhus copallina	0.04	0.04	0.04	0.71	0.02	0.21	0.96
Rubus argutus	0.78	0.85	0.29	5.13	0.20	2.10	8.08
Rumex crispus	0.10	0.11	0.03	0.53	0.07	0.73	1.37
Sabatia angularis	0.03	0.03	0	0	0.01	0.10	0.13
Sassafras albidum	0.07	0.07	0.05	0.88	0.02	0.21	1.16
Setaria spp.	0.07	0.08	0.01	0.18	0.02	0.21	0.47
Smilax spp.	0.62	0.67	0.21	3.72	0.23	2.41	6.80
Solanum carolinense	0.74	0.80	0.06	1.06	0.33	3.46	5.32
Solidago spp.	5.16	5.60	0.42	7.43	0.70	7.34	20.37

TABLE VI (continued)

Taxa	Density	Rel. Dens.	Dom.	Rel. Dom.	Freq.	Rel. Freq.	IVI
Teucrium canadensis	0.02	0.02	0	0	0.01	0.10	0.12
Trifolium repens	0.22	0.24	0.03	0.53	0.06	0.63	1.40
Ulmus alata	0.01	0.01	0	0	0.01	0.10	0.11
Uniola latifolia	0.03	0.03	0.03	0.53	0.01	0.10	0.66
Unknowns	0.14	0.15	0.01	0.18	0.09	0.94	1.27
Verbaseum thapsus	0.06	0.06	0	0	0.06	0.63	0.69
Verbena simplex	0.06	0.06	0	0	0.05	0.52	0.58
Verbena urticifolia	0.04	0.04	0.01	0.18	0.03	0.31	0.53
Vicia dasycarpa	0.01	0.01	0	0	0.01	0.10	0.11
Vitis spp.	0.01	0.01	0	0	0.01	0.10	0.11

TABLE VII

SPECIES WHICH INCREASED IN IVI FROM ONE TO FOUR YEAR FIELDS

Species	IVI One Year	IVI Two Year	IVI Three-Four Year
Andropogon virginicus	x	3.48	20.35
Aster spp.	2.30	15.10	22.14
Cassia fasciculata	0.53	7.40	20.88
Desmodium canescens	0.72	0.23	6.51
Diospyros virginiana	0.72	1.80	1.62
Juncus tenuis	1.60	4.40	4.57
Lespedeza spp.	20.80	69.50	66.10
Liquidambar styraciflua	x	0.21	0.42
Rhus copallina	x	0.67	0.96
Rubus argutus	x	0.70	8.08
Sassafras albidum	x	0.24	1.16
Smilax spp.	0.89	3.20	6.80
Solidago spp.	2.90	7.40	20.37
Vitis spp.	x	x	0.11

x Species not found that year

TABLE VIII

SPECIES WHICH DECREASED IN IVI FROM ONE TO FOUR YEAR FIELDS

Species	IVI One Year	IVI Two Year	IVI Three-Four Year
Ambrosia artemisiifolia	18.25	29.36	13.91
Cyperus strigosus	2.10	1.50	0.31
Digitaria sanguinalis	81.10	22.70	7.23
Erigeron canadensis	14.9	12.70	8.04
Euphorbia corollata	3.60	1.60	0.76
Ipomoea spp.	5.40	2.10	1.31
Oenothera biennis	3.10	1.20	0.69
Oxalis stricta	7.40	6.30	1.38
Plantago aristata	1.80	0.62	0.25
Plantago lanceolata	6.80	0.26	0.94
Potentilla simplex	2.60	1.42	1.06
Trifolium repens	5.95	3.54	1.40

perennials as Cyperus strigosus and Trifolium repens are also shade-intolerant and dropped significantly in IVI.

Oosting (1942) also found drastic decreases in those species listed above with Digitaria decreasing at the greatest rate. Ambrosia showed a slight increase during the second year, as it did in the study made by McReynolds (1969), but made rapid declines during the third and fourth years. Bazzaz (1968) found a definite decrease in Erigeron and by the third year Digitaria had completely disappeared from the fields. There was also no mention of Trifolium after the third year. Many species remained relatively constant from one year old fields to four year old fields. Some of these species are listed on Table IX.

Some species played an important part in one and two year fields (McReynolds, 1969) but had disappeared in the three and four year fields. Table X is a listing of these species. Many of these are annuals (indicated by an asterisk) and are probably not present. Species such as Acer saccharum, Lobelia inflata and Uniola latifolia were prevalent in three and four year fields but were not found in one or two year fields. Table XI gives a listing of such species in three and four year fields but not found in one or two year fields.

TABLE IX

SPECIES WHICH REMAINED RELATIVELY CONSTANT FROM ONE TO FOUR YEAR FIELDS

Species	IVI One Year	IVI Two Year	IVI Three-Four Year
Campsis radicans	8.30	4.30	9.00
Chenopodium album	0.17	x	0.11
Convolvulus arvensis	0.53	0.55	1.02
Diodia teres	14.20	14.70	18.87
Frigeron strigosus	4.20	7.50	2.14
Eupatorium serotinum	5.30	9.50	6.60
Festuca spp.	1.40	x	1.70
Lactuca canadensis	0.80	1.60	0.52
Passiflora incarnata	1.23	2.20	2.55
Solanum carolinense	4.40	3.40	5.32
Verbascum thapsus	0.89	1.10	1.69

x Species not found that year

TABLE X

SPECIES FOUND IN ONE AND TWO YEAR FIELDS (McREYNOLDS, 1969) BUT NOT FOUND IN THREE AND FOUR YEAR FIELDS

Species	IVI
Agrostis hyemalis	2.00
Amaranthus hybridus *	0.72
Anthemis Cotula *	3.50
Asclepias tuberosa	0.17
Bidens polylepis *	2.00
Cardamina hirsuta *	1.30
Gerastium nutans *	0.53
Croton monanthogynus *	0.17
Dactylis glomerata	0.72
Datura Stramonium *	0.35
Eragrostis sp.	2.20
Fragaria virginiana	0.17
Helenium tenuifolium *	0.35
Hordeum pusillum *	0.51
Lepidium virginicum *	5.40
Mollugo verticillata *	0.35
Oxydendrum arboreum	0.21
Physalis virginiana *	0.35
Pycnanthemum pycnanthemoides	0.21
Rudbeckia hirta	0.55
Sida spinosa *	0.89
Sorgum halepense	0.54
Specularia perfoliata *	8.90
Trifolium dubium	0.35
Trifolium pratense	0.35
Veronica peregrina *	4.80
Xanthium strumarium *	11.30

TABLE XI

SPECIES FOUND IN THREE OR FOUR YEAR FIELDS BUT NOT FOUND IN ONE OR TWO YEAR FIELDS (McREYNOLDS, 1969)

Species	IVI
Acer saccharum	0.40
Catalpa speciosa	0.11
Cirsium vulgare	0.11
Gerardia purpurea	0.24
Geum canadense	0.23
Liriodendron tulipifera	0.11
Lobelia inflata	0.25
Melilotus alba	0.12
Platanus occidentalis	0.28
Teucrium canadensis	0.12
Uniola latifolia	0.66
Vicia dasycarpa	0.11
Vitis spp.	0.11

CHAPTER V

DISCUSSIONS OF RESULTS

As stated by McReynolds (1969), the abundance of Lespedeza (and also Trifolium) must be recognized as being influenced by the previous farming practices of the study area. Since Lespedeza will reseed itself for several years, and many times become even more abundant, it completely dominated the species occuring in three and four year fields. In other studies, such as Keever (1950), Bazzaz (1968), and Quarterman (1957), Lespedeza did not occupy nearly the role of importance as it did in this study. Digitaria sanguinalis, which was very abundant in one and two year fields, had decreased considerably in importance by the fourth year. Andropogon virginicus apparently was increasing year by year, probably replacing the position held by Crabgrass during the first and second years. One can foresee Andropogon or Broomsedge increasing in dominance during the next few years. Oosting (1942) found Andropogon to be the dominant species in three and four year fields. In this study, however, four species had an importance value greater than Andropogon. They were Lespedeza spp., Aster spp., Cassia fasciculata, and Solidago spp.

Woody vines appeared to be very noticeable in the three and four year fields with Campsis radicans being most common. Bazzaz (1968)

did not mention finding Campsis radicans in three and four year fields although Quarterman (1957) states that it was very abundant in fields four to eight years of age. McReynolds (1969) also found Campsis radicans to be common.

Perhaps too little attention has been paid to the presence of trees and shrubs in the three and four year fields. Thirteen species of trees and shrubs were identified. Although the IVI of most species was very small, one must realize the small coverage that these seedlings occupy. Some fields contained large stands of Rhus, which increased its importance value. Thickets of Rubus were found to be common in many of the fields. Rubus argutus ranked ninth in importance value in three and four year fields. Other studies do not show Rubus being this prevalent in early stages of secondary succession. Oosting (1942) found Rubus to be more common in fields eight to twelve years old and refers to it as being a part of the lesser stratum for many years but as strands matures it decreased in numbers and became more or less localized. If the presence of Rubus now is an indication of its abundance in later years, it will definitely become a dominant species. Pine seedlings also were relatively plentiful, especially in the one field adjoining a pine thicket. Hardwood seedlings also increased remarkably from two to four years and definitely will assume a greater role in the fields in later years.

TABLE XII

COMPARISON OF DOMINANT SPECIES IN THREE AND FOUR YEAR OLD FIELDS WITH SIMILAR STUDIES FROM THE PIEDMONT, NORTH CAROLINA (OOSTING, 1942), THE CENTRAL BASIN, TENNESSEE (QUARTERMAN, 1957) AND SOUTHERN ILLINOIS (BAZZAZ, 1968)

Land-Between-the-Lakes	Piedmont	Central Basin	Southern Illinois
Lespedeza spp.	Andropogon spp.	Bromus japonicus	Andropogon virginicus
Aster spp.	Digitaria singuinalis	Solidago altissima	Solidago nemoralis
Cassia fasciculata	Leptilon canadense	Aster pilosus	Panicum dichotomum
Solidago spp.	Campsis radicans	Chaerophyllum spp.	Aristida dichotoma
Andropogon virginicus	Aster ericoides	Lespedeza spp.	Lespedeza spp.
Diodia teres	Hypericum gentianoides	Andropogon virginicus	Bidens coronata

TABLE XII (continued)

Land-Between-the-Lakes	Piedmont	Central Basin	Southern Illinois
Ambrosia artemisiifolia	Gnaphalium purpureum	Oxalis stricta	Smilax glauca
Campsis radicans	Eupatorium capillifolium	Physalis heterophylla	Aster pilosus
Rubus argutus	Plantago aristata	Geranium sp.	Diodia teres
Erigeron canadensis	Juncus tenuis	Ambrosia artemisiifolia	Ambrosia artemisiifolia

A comparison of the dominants in three and four year old fields from the Piedmont (Oosting, 1942), the Central Basin of Tennessee (Quarterman, 1957), and Southern Illinois (Bazzaz, 1968) with this study is shown in Table XII. The ten dominant species found in each study are listed. Andropogon and Aster are the only two species listed in the top ten dominants of all four studies.

CHAPTER VI

SUMMARY

Plant succession studies on ten abandoned fields in the Land-Between-the-Lakes area of Stewart County, Tennessee, were made in 1970 and 1971. All fields used for study were abandoned in 1967 or 1968 after being last cultivated in corn or tobacco.

The quadrat method of sampling was used in each field with ten, one-meter square quadrats taken per field. All species were identified and for each species the following values were determined: density, relative density, dominance, relative dominance, frequency, and relative frequency. A summation value, Importance Value Index (IVI), was determined for each species by taking a total of the relative values.

During the third and fourth year of succession, 61 herbaceous species, three woody vines, and 13 trees and shrubs were identified. The results of the research show, by Importance Value Index (IVI), that the dominant species in three and four year fields are Lespedeza spp., Cassia fasciculata, Solidago spp., Andropogon virginicus, and Diodia teres. The most abundant species of trees and shrubs were Rubus argutus, Diospyros virginiana, Sassafras albidum, and Rhus copallina. Campsis radicans and Smilax spp. were the leading woody

vines present. The data indicate a sharp decline in IVI for most annuals and shade-intolerant perennial herbs. A significant increase in IVI of small trees, woody vines, and some perennial herbs was observed. If present trends continue, an Andropogon-Rubus community will soon dominate the late summer aspect of most of the fields.

All data were summarized and comparisons of the three and four year results were made with McReynolds (1969), who studied the same fields in the first and second years of succession. Similarities and differences between this study and similar studies in other areas were also made and are discussed.

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