Effects of Interspecific Interaction on Habitat Utilization of *Sigmodon hispidus* and *Reithrodontomys fulvescens*.

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Effects of Interspecific Interaction on Habitat Utilization of Sigmodon hispidus and Reithrodontomys fulvescens.

This study was conducted in order to determine whether Sigmodon hispidus and Reithrodontomys fulvescens have preferred habitats determined by attributes of vegetation structure. The role of interspecific interaction was investigated by observing habitat utilization in areas where one of the codominant rodent species was removed.

Vegetation in the mammal plots was quantified by a line intercept method. Raw vegetation measures were converted to relative dominance values which were then entered into a principal components program to categorize and therfore simplify the vegetation data. Those plant species which were consistently located in the same category during all seasons were used to test rodent distribution. The mammal plots were divided on the basis of above and below average abundances of the plant species selected from the principal components analysis. The distributions of Sigmodon hispidus and Reithrodontomys fulvescens in these areas were tested by chi square analyses. Both species were found to prefer areas containing above average amounts of Schizachyrium scoparium and Baccharis hamilifolia. The interspecific interactions between these codominant rodents were determined by observing the habitat utilization in areas were one of the species was removed. It was found that these rodents partition the habitat by different seasonal utilization of these plant species. In areas of

species removal, the remaining species tended to expand its habitat utilization to include the plant species normally utilized by the removed species thereby exhibiting competitive release. It is postulated that these plant species are important as cover and food based on the insect faunas associated with these plant species. A facilitative relationship based on decreased densities, survivorship, and reproduction in areas of species removal suggest that neither positive or negative interactions are independently important, but that a combination of both is essential for stability in this rodent system.

LIST OF TABLES

LIST OF APPENDICES

LIST OF FIGURES

TABLE OF CONTENTS

Effects of Interspecific Interaction on Habitat Utilization of *Sigmodon hispidus* and *Reithrodontomys fulvescens*.

INTRODUCTION

A large body of literature dealing with various aspects of interspecific interactions among rodents exists. Many of these studies have inferred that competition may exist between rodent species by observing that when one of two contiguously allopatric species is removed, the remaining species tends to expand into the vacated habitat space. Such a result, termed competitive release, has been demonstrated by Koplin and Hoffmann (1968) where *Microtus montanus* (mountain vole) was restricted to one habitat when *Microtus pennsylvanicus* (meadow vole) was present and expanded into both habitats upon removal of *Microtus pennsylvanicus*. Petersen (1973) demonstrated that *Sigmodon hispidus* (hispid cotton rat) expanded its population size and distances moved when the numerically dominant *Sigmodon fulviventer* (cotton rat) was removed.

Competitive release has also been noted by observing habitat utilization of species in areas where they occur alone as compared to areas of sympatry. Riewe (1971) demonstrated that the grassland rodent, *Microtus pennsylvanicus*, occured in both grassland and woodland on islands where the woodland species *Peromyscus maniculatus* (deer mouse) and *Clethrionomys gapperi* (boreal redback vole) were absent.

Peromyscus maniculatus, a typical brush rodent, has been captured in island grasslands when *Microtus pennsylvanicus* was absent (Cameron, 1958). Interspecific competition for space appears to be widespread among rodents. Grant (1972) suggests this is because they are more or less restricted to a single horizontal plane of the environment.

If space is important, then it is reasonable to expect rodent species to exhibit differential habitat selection according to their individual requirements. Rodents thus should not be distributed randomly in habitat space, but rather would be found in greater densities in preferred habitats or in habitats determined by interaction with a dominant sympatric species. In the latter case, the habitat occupied may in fact not be in preferred habitat. Harris (1952) emphasized the importance of behavioral differences in habitat selection, suggesting that objects in the environment present cues by which *Peromyscus maniculatus* select preferred habitats. Brown (1964) found no physiological determinants for habitat selection in *Peromyscus* and also concluded these rodents were distributed in preferred habitats on the basis of behavioral selection. Consequently, Wecker (1963) concluded that the behavioral basis to habitat selection in *Peromyscus* was genetically fixed and, hence, innate rather than learned.

Numerous studies suggest that vegetation structure provides a cue by which rodents are able to select preferred habitats. Density of vegetation as a measure of cover and, hence, protection from predators, may provide the most important cue for small rodents and has been indicated as a determinant of rodent distribution in a wide variety of studies involving herbivorous rodents. Goertz (1964, 1971) studying habitat utilization by *Sigmodon hispidus*, *Reithrodontomys fulvescens* (fulvous harvest mouse), and *Microtus pinetorum* (pine mouse) concluded that grass height and density were the important components of their habitat. Fleharty and Mares (1973) found that *Sigmodon hispidus* avoided habitats that lacked dense vegetation and tall overstory. Myton (1974) reported that trapping success of *Peromyscus leucopus* (white-footed mouse) was substantially greater in areas of dense vegetation. Rosenzweig and Winakur (1969) felt that spatial variations in the densities of several species of desert heteromyid rodents were responses to plant growth form and foliage density. Shure (1970) found a definite correlation between rodent distribution and density of barrier beach vegetation in New Jersey. *Microtus maniculatus* introduced into woodland areas consistently moved to adjacent grasslands (Grant, 1971). Batzli (1974) showed that *Microtus californicus* (California vole) exhibited high densities in patches of perennial grass than in areas containing the dominant annual. Brown et. al. (1972) demonstrated that woodrat density was dependent on the density of cholla cacti. Rosenzweig (1973) concluded that foliage is at least one cue in the habitat selection of *Dipodomys merriami* (Merriam kangaroo rat) and *Perognathus penicillatus* (desert pocket mouse). Wirtz and Pearson (1960) indicated that *Microtus pennsylvanicus* perferentially selected a broomsedge habitat in the laboratory

Physiognomy of vegetation and not species composition is probably more important in determining rodent distribution in preferred habitats. Physiognomy, or vegetative structure, is closely related to vegetation density and hence cover. Brown and Lieberman (1973) determined that desert heteromyid rodents forage in different areas relative to the cover of perennial shrubs. Terman (1974) found that vegetation cover was essential for habitat co-ulitization by Sidmodon hispidus and Microtus ochrogaster (Prairie vole) in laboratory experiments. Whitaker (1967) found that the amount of herbaceous ground cover was important in determining the presence and abundance of Mus musculus (house mouse), Peromyscus maniculatus, Peromyscus leucopus, and Microtus ochrogaster. Similarly, Batzli (1968) demonstrated a positive correlation between density of Microtus californicus, Peromyscus maniculatus, and Reithrodontomys megalotis (western harvest mouse) and the percent cover of wild oats. Getz (1961) was unable to provide evidence that Microtus pennsylvanicus selected any particular species of grass, but showed a definite correlation between Microtus density and the amount of cover.

There is evidence that some rodents are able to partition the habitat vertically, especially in areas of mixed grass and shrub where above ground vegetation provides the most cover. Vertical habitat partitioning may be a result of interspecific interaction, and thus vertical use of the habitat may serve as a mechanism of avoiding interspecific interaction. Rosenzweig and Winakur (1969) suggested that

Reithrodontomys fulvescens utilized the vertical component of a semi-desert habitat which served to partition the habitat from the ground-dwelling seed-eating rodents. Barbehenn (1973) indicated that stratified trapping in tropical environments was necessary to obtain accurate estimates of population densities when studying species which spend a gread deal of time either above or below the surface of the ground. M'Closkey and Fieldwick's (1975) study using smoked tracking paper led them to the conclusion that arboreal habitats may be important in facilitating local sympatry of *Peromyscus* and *Microtus*. Vertical trapping at the University of Houston Coastal Center has been successfully used to capture large numbers of *Reithrodontomys fulvescens* in a shrub canopy (Kincaid, unpub.). In all of these studies, vertical use of the habitat offers protection (in the form of greater cover) and provides for habitat partitioning in situations of species packing.

Numerous studies have demonstrated that vegetation is also an important cue in other vertebrate populations. Cody (1968) was able to predict the number of species, feeding ecology differences, and relative habitat separation of birds in grassland communities by using vegetation height and its standard deviation. MacArthur and MacArthur (1961) determined that plant species diversity was a good predictor of bird species diversity because plant species diversity reflects foliage height diversity. MacArthur (1964) concluded that the number of layers in the vegetation is sufficient to account for bird species diversity. Yeaton (1974) stated that competitive release occurs in island bird communities where competition is reduced allowing them to expand their habitat utilization.

Lizards also rely upon vegetation cues to seek preferred habitats. Pianka (1966) determined that plant structure leads to spatial partitioning of the habitat which is instrumental in allowing coexistence of desert flatland lizards. Pianka (1967) stated that vegetative heterogeneity was the single most important factor in determining the number of lizards that will be present in an area.

Vegetation structure, therefore, is important as a cue for resource partitioning in a number of vastly different taxa. The conclusion that vegetation structure aids in habitat partitioning is not surprising since these organisms are herbivores depending upon the primary producers for food and shelter or insectivores depending upon plant associated insect faunas. These organisms appear to have evolved mechanisms to select habitats which maximize their fitness. Since various components of the vegetation structure provide such a function, different organisms rely upon different attributes of vegetation, e.g., cover, physiognomy, species composition, to insure their continued success.

STATEMENT OF THE PROBLEM

The role of vegetation structure in habitat selection may provide insight into the process of interspecific interaction and resource partitioning. In particular, it is hypothesized that two codominant rodents on the Texas coastal prairie, the cotton rat, *Sigmodon hispidus*, and the fulvous harvest mouse, Reithrodontomys fulvescens, have a preferred habitat determined by attributes of vegetational structure. A corollary hypothesis predicts that removal of one codominant rodent will allow habitat expansion by the remaining species. The results from this study will provide insight into the type and role of interspecific interactions between these codominant rodent species.

METHODS

A. STUDY AREA

The fieldwork for this study was conducted at the University of Houston Coastal Center near LaMarque, Texas. The Coastal Center was an Army National Guard base during World War II which was abandoned in 1946 and assigned to the University of Houston as an outdoor environmental labortory in 1960.

The Coastal Center is undergoing secondary succession with vegetation typical of the Texas coastal prairie. Baccharis hamilifolia (sea-myrtle) and Schizachyrium scoparium (little blue stem) dominate the area. Other less common plants include Andropogon glomeratus (bushy beardgrass), Spartina spp. (cordgrass), Ampelopsis arborea (pepper vine), Rubus trivialis (southern dewberry), and Solidago spp. (goldenrod). Sapium sebiferum (Chinese tallow tree) and Salix spp. (willow) can be found along the moist drainage ditches that parellel the roads.

Sigmondon hispidus (hispid cotton rat) and Reithrodontomys fulvescens (fulvous harvest mouse) are the most common rodents in the study area accounting for more than 90% of the captures. *Oryzomys palustris* (eastern rice rat), *Baiomys taylori* (pygmy mouse), *Mus musculus* (house mouse), *Cryptotis parva* (least shrew), *Rattus rattus* (black or roof rat), *Rattus norvegicus* (brown or Norway rat), and *Neotoma floridana* (Florida woodrat) are present but their abundance are highly erratic from year to year.

B. TRAPPING METHODS

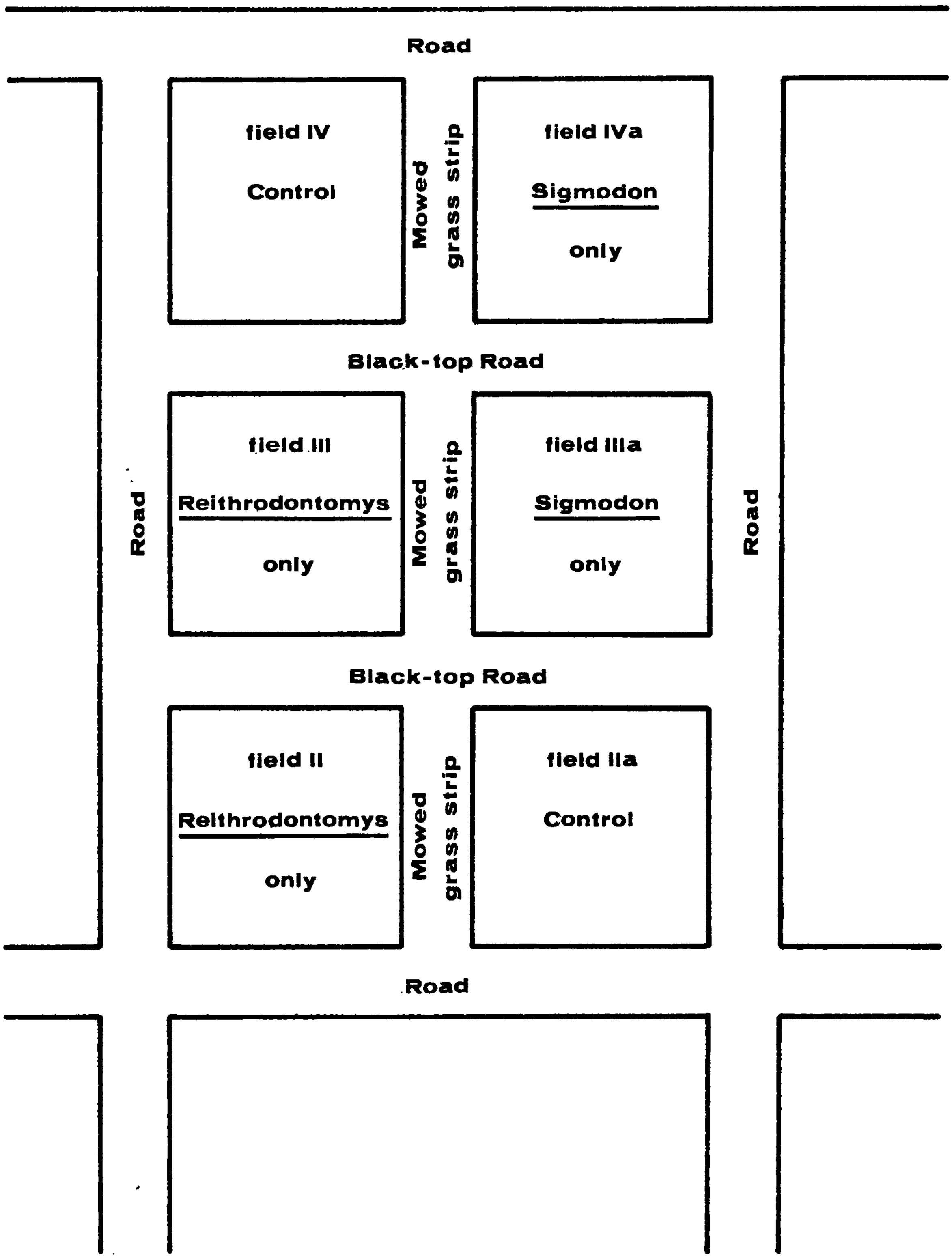
The experimental plots consist of six 1.6 ha fields each containing a 9 x 9 grid of Sherman live traps (7.5 x 7.5 x 25cm) at 15m intervals. The six fields include two controls (no animals removed), two *Sigmodon*-only fields (all *Reithrodontomys* removed), and two *Reithrodontomys*-only fields (all *Sigmodon* removed) (fig. 1).

These fields have been trapped at the beginning of each month for 36 months (Jan. 1972 to Jan. 1975)(Joule and Cameron, in prep.). Trapping data used in the study was collected during the last portion of the previous study (Sept. 1973 to Jan. 1975). The traps were opened and baited with sliced apples before sundown on the first day. During the cooler months cotton was added to the traps to reduce cold shock. The traps were then checked about one hour after sunrise for the next three days.

Traps with captured animals were replaced with clean, freshly baited traps. The traps containing animals were marked with field, trapline, and trapsite identification and returned to the adjacent laboratory to be processed.

FIGURE 1.

Mammal plot design. The species released in a plot are shown. All animals are returned in the controls.


Road
field IV
Control
Mowed grass strip
field IVa
Sigmodon
only
Black-top Road
field III
Reithrodontomys
only
Mowed grass strip
field IIIa
Sigmodon
only
Road
Road
Black-top Road
field II
Reithrodontomys
only
Mowed grass strip
field IIa
Control
Road

Processing consists of recording body weight, species, reproductive condition, presence of external parasites, and old marks. New animals were individually marked either by a Monel ear-tag (*Sigmodon*) or by means of a toe-clip system (*Reithrodontomys*). Each animal was placed in a separate cage containing food and nesting material; captured animals remained in the laboratory for the duration of the trapping period. All animals captured in the control fields, all *Sigmodon* from the *Sigmodon*-only fields, and all *Reithrodontomys* from the *Reithrodontomys*-only fields were returned on the last day of trapping to the exact site of their capture. All removed animals were released at an isolated spot on the Coastal Center. On the final trap run during each month the traps were closed to eliminate any possible capture and left at the trapsite until the next trapping period. This temporary removal trapping technique was employed to eliminate the bias created by the capture of heavier *Sigmodon* on the first trapnight and to ensure reliable monitoring of population parameters of both species (Joule and Cameron, 1974).

C. VEGETATION ANALYSIS

A line intercept vegetation technique (Phillips, 1959) was employed at each trapsite because it is an efficient method to employ in areas of mixed grass and shrub. The distance in cm that a plant intercepted the imaginary vertical plane of a 5m transect was recorded. These values were converted to relative dominance by taking the sum intercept for a plant species and dividing by the sum intercept of all plant species at that trapsite. Relative dominance was selected because it was the simplest descriptive value to measure and calculate; cover and density values required the additional measurement of the plant's width perpendicular to the transect. This is a difficult measure to make when bunchgrass and vines form a portion of the vegetation matrix and intersect the transect at numerous points. Futhermore, the large number of trapsites which had to be monitored made the extra time required to obtain these values not feasible in as much as relative dominance values approximate cover. The vegetation at all 486 trapsites in the six plots was monitored in this way at three months intervals for one year to allow observation of seasonal trends in vegetation structure. Samples were taken in April, July, and October of 1974, and January of 1975. Sample periods were selected to correspond to spring (Mar. 1974 to May 1974), summer (Jun. 1974 to Aug. 1974), fall (Sept. 1974 to Nov. 1974), and winter (Dec. 1974 to Feb. 1975).

A total of 108 plant species were recorded and identified during the year. Those plant species which were so rare as to not be recorded in all six fields during one season were eliminated, thereby reducing the number of plant species included to 56. To further reduce the plant data to manageable size, all those plant species accounting for less than 1% of the total vegetation in a season were eliminated. Many of the plants elimated were annuals and herbs which at least in combination may provide habitat structure, food, or shelter for the rodents. These plants were eliminated in favor of those plants that were abundant as live or standing dead throughout the year. The plants retained account for the vast majority of vegetative biomass in the study area, hence their overall structural importance may be greater than the seasonal plants.

Eleven plant species were retained for this analysis including Rubus trivialis (vine), Solidago spp. (annual), Baccharis hamilifolia (shrub), Ampelopsis arborea (vine), Eupatorium spp. (mist flower), Sapium sebiferum (tree), Schizachyrium scoparium (grass), Andropogon glomeratus (grass), Spartina spp. (grass), Ambrosia spp. (ragweed, annual), and a general graminoid category (grass and sedge). In addition, companion studies have shown these plants, together with their associated insect fauna, comprise the bulk of the rodent diet in this area (Kincaid, unpub.). These speices represent the array of vegetation types on the Texas Coastal Prairie, from woody annuals (Solidago, Ambrosia) to woody perennials (Baccharis); monocots (Andropogon, Schizachyrium) to dicots (Eupatorium, Solidago); shrubs (Baccharis) to trees (Sapium); herbs (Eupatorium) to vines (Rubus, Ampelopsis).

Bare ground was the twelfth category selected as a plant variable. Reports in the literature suggest that dense vegetation is an important component in the habitat of most rodents; it was postulated, therefore, that areas of bare ground may be avoided by rodents. Hence, the amount of bare ground intercepting the line transect was recorded and its relative dominance calculated. This computation of relative dominance indicated that bare ground was a major component of the habitat, and it was retained as one of the twelve plant variables as its influence upon rodent distribution may be great, especially in combination with the other plant species.

The mean relative dominace for each field was computed for each of the twelve plant variables and these values transformed by an arcsin for seasonal analysis by a principal components program. The arcsin transformation (often used on data expressed as proportions) was used in an effort to make the data homoscedastic. Principal components ascertain underlying relationships between the plant variables and further simplify the data by grouping similar plant species into categories based on these relationships.

The correlation matrix of relative dominance among plant species is given by a 12 x 12 matrix which expresses the relationships between the twelve plant species. The closer a correlation value approaches 1.0, the greater the relationship between the two variables. A negative correlation indicates that the two variables under consideration are inversely related. The principal diagonal of this matrix is composed of the correlation of each plant variable with itself. The number of axes to be used in the principal component analysis was increased until the associated eigenvalue dropped below 1.0. For this analysis, three axes accounting for approximately 90% of the variance were selected. The loadings of each species in the principal component axes are the columns in the unrotated factor matrix. They represent statistically independent patterns of relationships between the plant variables (Rummel, 1970). The twelve plant variables in this analysis can be classified into three categories. What these three common factors or categories actually represent were unknown in this study but presumably were related to biotic and abiotic factor determinants of plant distribution. Further elucidation of these factors was not required for this study.

Factor loadings for each plant species that constitute the three common factors indicate which plant variable is associated with which common factor. The loadings for each variable can be squared and multiplied by 100 to determine the percent variation that a plant species has in common with a particular common factor.

The initial factor matrix is rotated around the origin through some specified angle by linear transformations to produce the rotated factor matrix. The relation of the plant variables to each other is unchanged but the rotation maximizes the number of variables with high loadings for a specific factor and thus refines the delineation between factors. The individual variable loadings should be interpreted in the same fashion as the unrotated factor loadings.

The communality matrix from the principal component program represents the proportion of a plant species' total variance that is accounted for by the three factors (Appendix 3). The loadings for a plant species for each of the three common factors are squared and summed to determine its communality.

The relative dominance of the plant variables selected (based on factor consistency) for the rodent analysis were plotted on 9 x 9 grids for each season and field (Appendix 1). The grand mean of the seasonal relative dominance for the six fields pooled was then computed for each of these plant species and those trapsites above and below the grand mean for a particular plant species were identified. The grand mean was used to obtain two classes in each field for a chi square analysis. The six fields were pooled to demonstrate differences between the fields in the number of above and below average trapsites for a particular plant species. Using only the mean for each particular field would produce approximately the same number of trapsites above and below the mean which would not demonstrate differences between the fields in the abundance of a particular plant species.

The six plant species previously plotted were again plotted on 9 x 9 grids using their original intercept values in cm for one season in order to confirm that relative dominance was an appropriate measure. Those trapsites above and below the mean for a field were again identified and compared to the plots for relative dominance. The trapsite position and number of trapsites above and below the mean were similar enough to those values obtained from relative dominance measures to verify their use as a unit of measure. Therefore, relative dominance was used in the principal components program and the chi square tests employed in the rodent analysis.

D. MAMMAL ANALYSIS

The raw rodent capture data for three-month intervals were pooled to coincide with the sample periods for the vegtation analysis. The 1973 and 1974 capture data were pooled to increase the *Sigmodon* sample size. The *Reithrodontomys* trapping data was similarly pooled for consistency.

Rodent captures in each field for each season were superimposed over the previously prepared 9 x 9 vegetation grids (Appendix 1). The number of rodents captured in above and below average areas for each of the five plant species selected (see results) were tabulated. Above average trapsites for a plant species correspond to areas of greater abundance and density of this plant species. This in turn should be related to the amount of food and cover that this plant species can provide. It is assumed that trap response is an indicator of rodent density. The type of trapping technique used has provided accurate estimates of rodent density (Joule and Cameron, 1974). Furthermore, it is assumed that rodent density is an indicator of habitat quality, suggesting that greater rodent capture success is related to a preferred habitat. It may, however, be possible that rodent distribution is a reflection of interspecific interaction; this possibility will be tested in this study by comparing habitat utilization in control and experimental plots.

Chi square analyses were employed to determine whether rodent captures in areas of above or below average vegetation in each field deviated from expected. The expected number of captures in an area of above or below average vegetation was computed by multiplying the total number of captures in the entire field by the proportion of traps in that area. This resulted in chi square tests with two classes and one degree of freedom. Chi square tests were employed for Sigmodon in areas of above and below average Schizachyrium, Baccharis, Andropogon, Solidago, Sapium; above average Schizachyrium but below average Baccharis; above average Baccharis but below average Schizachyrium; and above average Schizachyrium and Baccharis. The same battery of chi square tests were employed for Reithrodontomys. The rationale for the selection of these plant species will be discussed in the results.

RESULTS

A. VEGETATION

The factor loadings for each plant variable were observed for the four seasons to determine which plant species were consistently and closely related to a particular common factor (Table 1 and 2). The plant variables selected to test the hypothesis that Sidmodon hispidus and Reithrodontomys fulvescens select a preferred habitat based on their consistency of postion and correlation in the rotated factor matrix were Baccharis hamilifolia, Schizachyrium scoparium, Solidago spp., Andropogon glomeratus, and Sapium sebiferum. Baccharis and Schizachyrium were selected because of their high negative loading on factor 1 for all seasons while Solidago was selected for its consistent high postive loading on factor 1 (Table 2). These plant species all have high loadings on factor 1 and are therefore highly correlated to each other as can be seen by observing the correlation matrices

TABLE 1.

Unrotated factor matrix for each season.

SUMMER

	1	2	3
Rubus	.55	.14	-.32
Solidago	.98	.07	.20
Baccharis	-.96	-.15	-.07
Ampelopsis	.89	-.12	-.20
Eupatorium	-.12	.97	-.05
Sapium	.66	-.04	.75
Schizachyrium	-.72	-.58	-.24
Andropogon	-.28	.79	-.54
Spartina	-.78	.23	-.42
Bare Ground	-.53	-.81	.11
Ambrosia	.71	.62	.30
Graminoid	-.14	-.07	.98

FALL

	1	2	3
Rubus	.85	-.07	-.14
Solidago	.80	.29	-.47
Baccharis	-.84	.07	.51
Ampelopsis	.92	.12	.12
Eupatorium	-.20	-.95	-.14
Sapium	.26	.10	-.94
Schizachyrium	-.84	.03	.51
Andropogon	.24	-.95	.16
Spartina	-.29	-.12	.79
Bare Ground	-.11	-.43	-.86
Ambrosia	.48	-.52	-.55
Graminoid	-.93	.29	.13

WINTER

	1	2	3
Rubus	.09	.85	.17
Solidago	.96	.24	.12
Baccharis	-.97	-.12	-.07
Ampelopsis	.90	.06	.06
Eupatorium	.70	.04	-.70
Sapium	.76	-.20	.59
Schizachyrium	-.98	-.13	-.04
Andropogon	.04	.91	-.27
Spartina	-.28	-.16	-.94
Bare Ground	.96	-.17	-.03
Ambrosia	.77	.33	.19
Graminoid	-.11	-.96	-.16

SPRING

	1	2	3
Rubus	.52	-.18	.33
Solidago	.86	-.47	.13
Baccharis	-.94	.32	-.02
Ampelopsis	.89	-.11	.32
Eupatorium	.08	-.24	.94
Sapium	.68	-.58	.34
Schizachyrium	-.99	.11	-.07
Andropogon	-.16	.96	-.22
Spartina	-.43	.88	-.18
Bare Ground	-.62	.19	-.68
Ambrosia	.67	-.04	.68
Graminoid	.04	-.66	.73

TABLE 2.

Rotated factor matrix for each season.

SUMMER

	1	2	3
Rubus	.47	.24	.39
Solidago	.98	-.15	.15
Baccharis	-.95	.01	-.20
Ampelopsis	.75	-.09	.53
Eupatorium	.13	.85	-.46
Sapium	.78	-.50	-.36
Schizachyrium	-.89	-.29	.22
Andropogon	-.18	.98	-.03
Spartina	-.77	.50	-.04
Bare Ground	-.69	-.69	.11
Ambrosia	.90	.29	-.29
Graminoid	.09	-.57	-.81

FALL

	1	2	3
Rubus	.79	.19	.32
Solidago	.89	.38	-.12
Baccharis	-.98	-.06	-.03
Ampelopsis	.67	.46	.46
Eupatorium	.03	-.96	.22
Sapium	.73	-.12	-.65
Schizachyrium	-.97	-.10	-.01
Andropogon	.22	-.71	.66
Spartina	-.66	.04	.52
Bare Ground	.44	-.69	-.52
Ambrosia	.77	-.47	.03
Graminoid	-.87	-.02	-.46

WINTER

	1	2	3
Rubus	.28	.82	.10
Solidago	.99	.04	-.02
Baccharis	-.98	.08	.06
Ampelopsis	.90	-.12	-.06
Eupatorium	.59	-.14	-.78
Sapium	.78	-.33	.50
Schizachyrium	-.98	.07	.10
Andropogon	.18	.87	-.34
Spartina	-.43	-.14	-.88
Bare Ground	.89	-.36	-.14
Ambrosia	.84	.17	.07
Graminoid	-.32	-.92	-.08

SPRING

	1	2	3
Rubus	.63	.08	.12
Solidago	.93	.25	-.22
Baccharis	-.86	-.44	.19
Ampelopsis	.86	.36	.16
Eupatorium	.60	-.57	.50
Sapium	.94	-.03	-.14
Schizachyrium	-.82	-.56	.01
Andropogon	-.69	.52	.51
Spartina	-.83	.28	.48
Bare Ground	-.86	.05	-.36
Ambrosia	.83	.06	.47
Graminoid	.68	-.71	.07

(Table 3). It should be sufficient to use only one of these plant species in the analysis because of their high correlation; however, they were all retained for the rodent analysis because factor 1 is the major factor (because of the consistency and number of plant variables located on this factor) and these plants are all major dominants in the study area. Andropogon was selected because it was consistently highly correlated to factor 2 (Table 2). There were no plant species consistently located on factor 3; however, Sapium sebiferum (Chinese tallow) was selected for its partial affinity to factor 3 and its correlation to bare ground (Table 3). Bare ground was considered an important variable, but its factor position was too inconsistent to warrant its selection for the analysis. The remaining plant variables were also too inconsistent in factor position to be selected.

The rotated factor loadings for the four seasons were analyzed by principal components to verify that the first common factor in one season was the same factor in the other seasons (Appendix 2). The first factor loading for each season was highly correlated to the first factor in the rotated factor matrix, suggesting that the first common factor for each season was equivalent. The remaining factors were not as consistent, which is not surprising in view of the fact that plant variable loadings on common factors 2 and 3 were not consistent in factor position when the seasons were run separately. This is another reason for placing the primary emphasis of this study on those plant variables located on factor 1.

TABLE 3.

Seasonal correlation matrices.

SUMMER

		1	2	3	4	5	6	7	8	9	10	11	12
1.	*Rubus*	1.00											
2.	*Solidago*	.46	1.00										
3.	*Baccharis*	-.42	-.96	1.00									
4.	*Ampelopsis*	.27	.84	-.85	1.00								
5.	*Eupatorium*	.24	-.07	-.01	-.30	1.00							
6.	*Sapium*	.10	.79	-.67	.46	-.16	1.00						
7.	*Schizachyrium*	-.20	-.80	.85	-.62	-.41	-.63	1.00					
8.	*Andropogon*	.04	-.32	.17	-.19	.80	-.61	-.17	1.00				
9.	*Spartina*	-.56	-.81	.70	-.49	.25	-.82	.43	.67	1.00			
10.	Bare ground	-.54	-.56	.57	-.38	-.74	-.24	.78	-.54	.22	1.00		
11.	*Ambrosia*	.29	.80	-.81	.55	.48	.67	-.98	.15	-.49	-.84	1.00	
12.	Graminoid	-.33	.05	.09	-.34	-.08	.65	-.06	-.56	-.36	.22	.14	1.00

FALL

		1	2	3	4	5	6	7	8	9	10	11	12
1.	*Rubus*	1.00											
2.	*Solidago*	.82	1.00										
3.	*Baccharis*	-.71	-.86	1.00									
4.	*Ampelopsis*	.58	.65	-.76	1.00								
5.	*Eupatorium*	.00	-.34	.05	-.38	1.00							
6.	*Sapium*	.27	.66	-.72	.19	-.04	1.00						
7.	*Schizachyrium*	-.71	-.85	.99	-.76	.09	-.71	1.00					
8.	*Andropogon*	.30	-.13	-.17	.09	.85	-.19	-.12	1.00				
9.	*Spartina*	-.61	-.73	.55	.00	-.04	-.75	.56	.11	1.00			
10.	Bare ground	-.04	.17	-.41	-.20	.53	.78	-.36	.24	-.50	1.00		
11.	*Ambrosia*	.38	.40	-.78	.42	.42	.63	-.79	.46	-.36	.65	1.00	
12.	Graminoid	-.85	-.75	.86	-.79	-.12	-.34	.82	-.50	.36	-.15	-.60	1.00

WINTER

		1	2	3	4	5	6	7	8	9	10	11	12
1.	*Rubus*	1.00											
2.	*Solidago*	.34	1.00										
3.	*Baccharis*	-.29	-.98	1.00									
4.	*Ampelopsis*	.34	.92	-.97	1.00								
5.	*Eupatorium*	-.08	.59	-.61	.53	1.00							
6.	*Sapium*	-.08	.74	-.73	.65	.13	1.00						
7.	*Schizachyrium*	-.26	-.98	.99	-.93	-.66	-.73	1.00					
8.	*Andropogon*	.57	.20	-.07	-.05	.29	-.27	-.11	1.00				
9.	*Spartina*	-.25	-.41	.33	-.27	.44	-.76	.31	.05	1.00			
10.	Bare gound	-.16	.87	-.88	.80	.70	.77	-.88	-.05	-.24	1.00		
11.	*Ambrosia*	.22	.79	-.72	.54	.48	.69	-.80	.39	-.50	.69	1.00	
12.	Graminoid	-.79	-.36	.22	-.14	-.01	.00	.22	-.87	.36	.02	-.43	1.00

SPRING

		1	2	3	4	5	6	7	8	9	10	11	12
1.	*Rubus*	1.00											
2.	*Solidago*	.47	1.00										
3.	*Baccharis*	-.66	-.94	1.00									
4.	*Ampelopsis*	.68	.82	-.89	1.00								
5.	*Eupatorium*	.53	.29	-.20	.38	1.00							
6.	*Sapium*	.36	.95	-.79	.72	.48	1.00						
7.	*Schizachyrium*	-.56	-.91	.96	-.89	-.19	-.76	1.00					
8.	*Andropogon*	-.33	-.62	.46	-.33	-.45	-.74	.28	1.00				
9.	*Spartina*	-.47	-.80	.69	-.53	-.43	-.85	.53	.96	1.00			
10.	Bare ground	-.35	-.75	.61	-.80	-.65	-.84	.67	.44	.54	1.00		
11.	*Ambrosia*	.39	.73	-.62	.74	.69	.80	-.72	-.30	-.44	-.93	1.00	
12.	Graminoid	.41	.42	-.26	.39	.83	.63	-.14	-.81	-.72	-.66	.52	1.00

Factor scores can be used to determine which plant species are important in a particular field and any seasonal difference within a field caused by alterations in vegetative structure. Factor scores, which give each field a score for each of the three common factors, are derived by weighting each field according to the loadings of its plant species into each factor (Table 4). *Baccharis* and *Schizachyrium* have high negative loadings on the first factor during all seasons (Table 2). They are responsible for the high negative loading of fields II and IV in the factor score matrix (Table 4). *Solidago*, *Ampelopsis*, and *Sapium* have high loadings on the first factor which is the reason field IIIa has a high positive loading in the factor score matrix. Therefore, fields II and IV have the greatest amount of *Baccharis* and *Schizachyrium* and the least amount of *Solidago*, *Ampelopsis* and *Sapium* while field IIIa is abundant in *Solidago*, *Ampelopsis*, and *Sapium* but has little *Baccharis* and *Schizachyrium*. This can be verified by observing the field relative dominance means for these plants (Table 5). The remaining fields are intermediate between these extremes, as can be seen in the diagram of the first factor score plotted for the six fields for the four seasons (Fig. 2). Another reason for placing the major emphasis of this analysis on factor 1 is the lack of consistent trends in the graphs of factor scores 2 and 3 (Fig. 3 and 4). The fact that the fields do differ in vegetative structure (and hence differ in phenology) is probably the primary reason for the different seasonal trends observed among the fields (Fig. 2).

TABLE 4.

Seasonal factor scores for the fields.

SUMMER

	1	2	3
Field II	-1.46	-.83	.76
Field IIa	.48	-.70	-1.08
Field III	-.06	.13	-1.37
Field IIIa	1.56	-.48	1.09
Field IV	-.44	-.02	.28
Field IVa	-.07	1.89	.31

FALL

	1	2	3
Field II	-1.57	.94	.24
Field IIa	.74	.96	.90
Field III	.65	-.73	1.25
Field IIIa	1.03	.69	-1.46
Field IV	-.69	-.43	-.47
Field IVa	-.16	-1.42	-.45

WINTER

	1	2	3
Field II	-1.06	-1.58	.13
Field IIa	-.33	.95	.67
Field III	.24	-.05	-1.90
Field IIIa	1.75	-.69	.74
Field IV	-.78	.38	.57
Field IVa	.17	.99	-.22

SPRING

	1	2	3
Field II	-1.45	.29	-.43
Field IIa	.20	-.12	-1.48
Field III	.36	1.30	-.21
Field IIIa	1.38	-.99	-.06
Field IV	-.84	-1.27	.76
Field IVa	.34	.79	1.41

Table 5.

Field relative dominance means transformed by an arcsin for each plant species.

SUMMER

	II	IIa	III	IIIa	IV	IVa
Rubus	13.84	20.76	17.60	18.54	20.76	18.36
Solidago	11.61	18.79	17.06	26.75	16.31	18.66
Baccharis	27.34	22.15	24.15	19.03	25.93	22.37
Ampelopsis	14.80	18.46	19.30	21.17	15.24	16.66
Eupatorium	3.09	3.63	4.21	3.03	4.83	7.31
Sapium	9.42	8.70	7.27	17.38	10.53	10.97
Schizachyrium	31.22	25.96	24.16	14.83	29.08	14.71
Andropogon	7.77	8.19	9.42	6.94	8.11	9.84
Spartina	16.85	12.07	17.65	7.84	12.22	14.90
Bare Ground	14.83	12.41	11.18	11.17	11.58	9.35
Ambrosia	2.98	6.07	7.15	13.16	6.34	13.32
Graminoid	5.32	2.87	2.50	5.26	4.87	4.37

FALL

	II	IIa	III	IIIa	IV	IVa
Rubus	16.79	23.63	21.30	23.03	21.75	21.15
Solidago	14.19	20.79	17.77	24.91	18.66	16.83
Baccharis	25.85	23.30	22.93	19.82	24.23	22.69
Ampelopsis	11.01	13.60	14.32	14.50	10.56	12.18
Eupatorium	4.25	3.53	7.20	4.29	9.04	10.56
Sapium	9.26	8.11	7.64	16.57	10.78	11.24
Schizachyruim	32.07	24.64	25.58	16.61	28.85	23.26
Andropogon	6.02	7.01	9.08	6.87	8.27	9.13
Spartina	18.28	13.85	19.52	9.94	11.17	14.38
Bare Ground	11.61	9.10	11.14	14.14	13.30	13.80
Ambrosia	7.31	8.72	10.74	14.49	8.84	15.77
Graminoid	9.63	7.80	7.22	7.06	8.13	7.90

WINTER

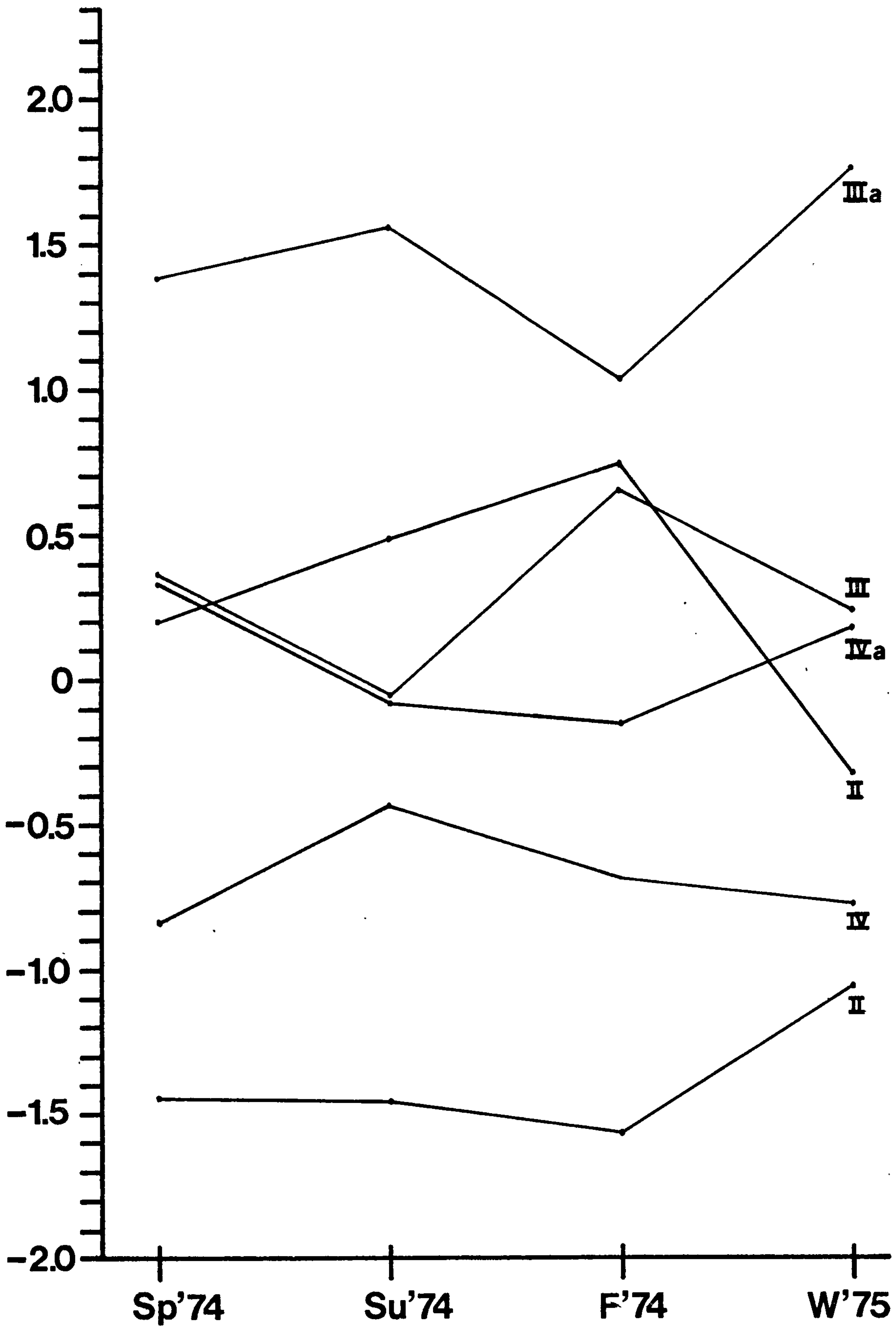
	II	IIa	III	IIIa	IV	IVa
Rubus	13.75	21.61	16.84	16.42	16.77	18.10
Solidago	2.36	7.06	7.08	11.93	5.20	7.45
Baccharis	22.35	18.43	18.26	13.95	21.06	18.76
Ampelopsis	5.62	7.99	7.84	9.80	6.05	6.72
Eupatorium	0.00	0.00	1.90	1.28	0.00	1.15
Sapium	4.66	4.90	3.34	9.86	5.13	5.53
Schizachyrium	37.14	30.24	29.34	20.59	35.67	28.42
Andropogon	6.34	10.47	11.00	8.25	11.29	13.32
Spartina	20.97	15.26	29.34	11.27	14.70	17.23
Bare Ground	23.47	23.65	29.87	37.99	25.84	28.23
Ambrosia	4.25	6.55	5.91	11.46	5.96	11.84
Graminoid	8.82	5.20	6.72	6.77	5.29	5.03

SPRING

	II	IIa	III	IIIa	IV	IVa
Rubus	15.83	20.68	20.62	20.13	21.69	21.11
Solidago	12.25	18.38	16.03	27.48	17.49	19.40
Baccharis	22.29	18.14	18.94	15.84	19.37	18.59
Ampelopsis	10.83	14.26	17.32	19.42	15.37	16.63
Eupatorium	0.57	0.00	1.15	3.14	6.05	7.01
Sapium	6.45	8.05	6.73	16.04	10.06	10.98
Schizachyrium	31.99	22.55	23.27	15.69	27.56	21.17
Andropogon	6.67	5.88	7.80	3.24	3.03	6.29
Spartina	18.27	14.23	18.54	8.80	10.71	15.28
Bare Ground	25.29	26.79	22.79	17.87	22.41	19.78
Ambrosia	0.00	0.00	2.43	8.35	2.43	9.19
Graminoid	3.09	1.90	2.75	6.05	7.94	5.32

FIGURE 2.

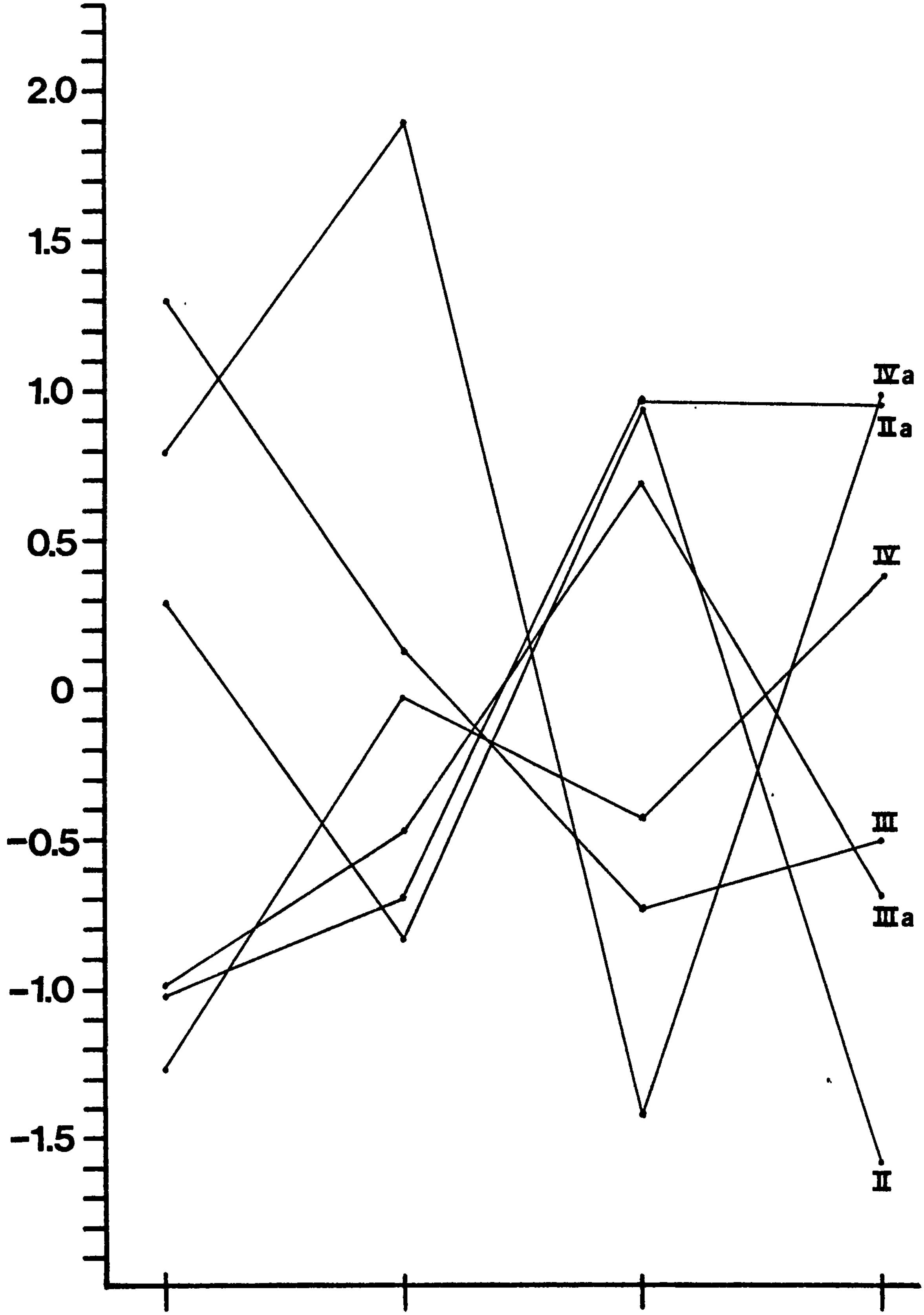
Graph of factor score 1.



2.0
1.5
1.0
0.5
0
−0.5
−1.0
−1.5
−2.0
Sp'74
Su'74
F'74
W'75
IIIa
III
IVa
II
IV
II

FIGURE 3.

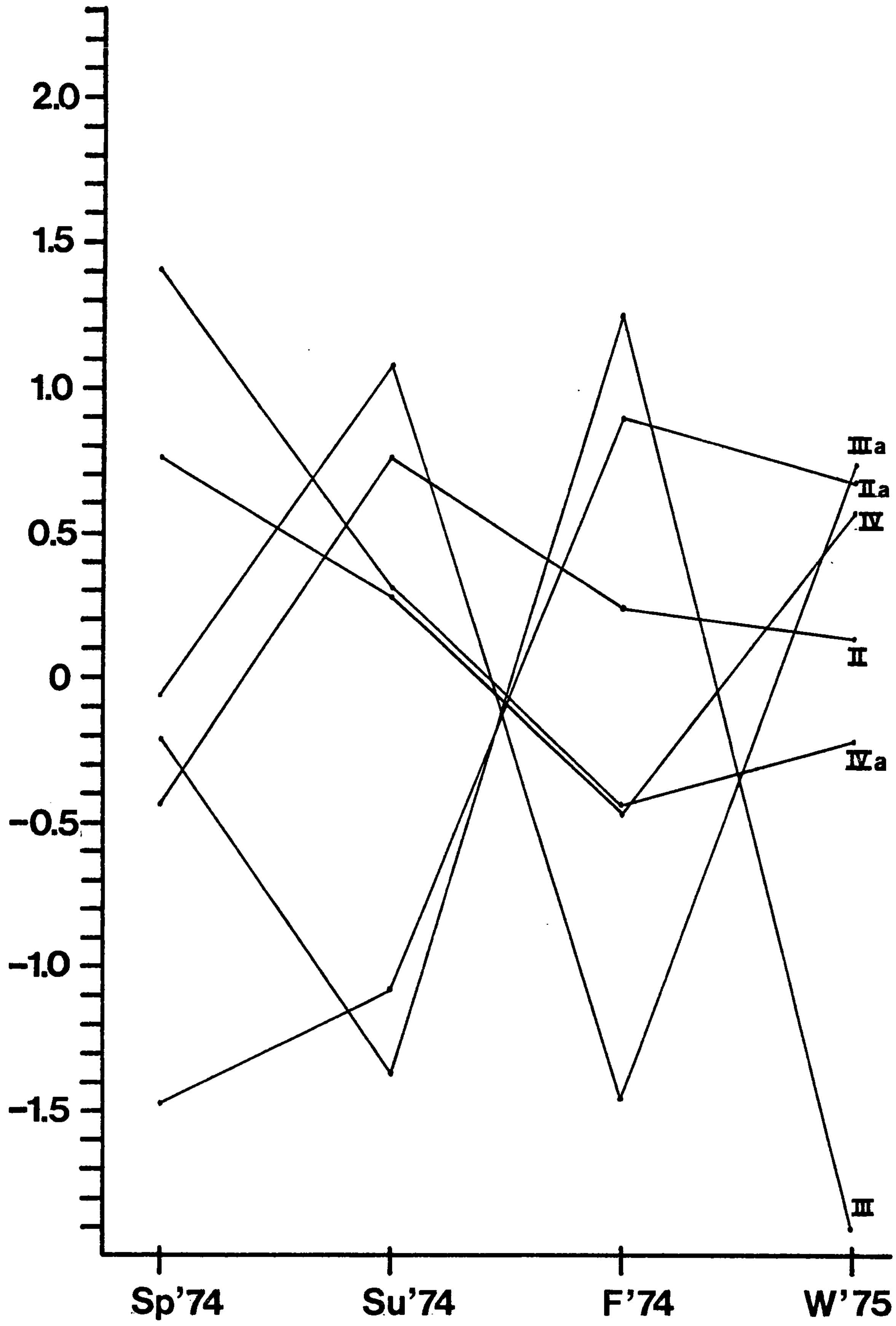
Graph of factor score 2.



2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
Sp'74
Su'74
F'74
W'75
IVa
IIa
IV
III
IIIa
II

FIGURE 4.

Graph of factor score 3.



2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
Sp'74
Su'74
F'74
W'75
IIIa
IIa
IV
II
IVa
III

B. SIGMODON

The captures of Sigmodon hispidus were tested for each plant species. The number of Sigmodon captured in above average Schizachyrium in field IIa (control) was greater than expected ($p < .005$) during the summer (June - August) (Table 6). The remaining fields did not deviate from the expected. During the fall (Sept. - Nov.) ($p < .05$) and winter (Dec. - Feb.) ($p < .025$) Sigmodon were captured in greater numbers than expected in areas of field IVa (Sigmodon-only) containing above average Schizachyrium. The remaining fields were nonsignificant. There were no significant deviations in the expected number of Sigmodon captures in any of the fields containing above average Schizachyrium during the spring (Mar. - May) (Table 6).

There were no deviations in the expected number of Sigmodon captures in areas of above average Baccharis in any field during fall and spring. There were more Sigmodon captured in above average Baccharis than expected in field IVa (Sigmodon-only) during the summer ($p < .05$) and fields IIa and IV (controls) during the winter ($p < .05$) (Table 7).

Sigmodon captures did not deviate from the expected in areas containing above average Schizachyrium but below average Baccharis during summer, fall, winter or spring (Table 8). Sigmodon were not captured in greater numbers than expected in areas containing above average Baccharis but below average Schizachyrium during any season (Table 9).

Those trapsites containing above average Schizachyrium and Baccharis did have significant deviations in the expected

TABLE 6.

Chi square values for *Sigmodon hispidus* captured in areas of above and below average *Schizachyrium scoparium*.

IIa - Control
IIIa - *Sigmodon*-only
IV - Control
IVa - *Sigmodon*-only

* - significant at the .05 level
** - significant at the .025 level
*** - significant at the .01 level
**** - significant at the .005 level

AAT - above average trapsites
EC - expected captures
OC - observed captures
BAT - below average trapsites
X^2 - chi square values

Field	AAT	EC	OC	BAT	EC	OC	X^2
			SUMMER				
IIa	41	14.86	23	39	14.14	6	9.145****
IIIa	13	3.69	4	68	19.31	19	0.031ns
IV	50	22.84	27	31	14.16	10	1.980ns
IVa	33	7.74	11	48	11.26	8	2.317ns
			FALL				
IIa	37	22.20	26	43	25.80	22	1.210ns
IIIa	14	3.11	5	67	14.89	13	1.388ns
IV	51	19.52	20	30	11.48	11	0.032ns
IVa	30	8.15	13	51	13.85	9	4.585*
			WINTER				
IIa	40	35.00	43	40	35.00	27	3.657ns
IIIa	18	8.00	11	63	28.00	25	1.446ns
IV	47	56.86	61	34	41.14	37	0.718ns
IVa	31	19.14	27	50	30.86	23	5.230**
			SPRING				
IIa	31	8.14	12	49	12.86	9	2.989ns
IIIa	13	1.28	3	68	6.72	5	2.752ns
IV	49	12.10	12	32	7.90	8	0.002ns
IVa	31	6.89	9	50	11.11	9	1.047ns

TABLE 7.

Chi square values for *Sigmodon hispidus* captured in areas of above and below average *Baccharis hamilifolia*. For identification of fields, abbreviations, and significance symbols refer to Table 6.

Field	AAT	EC	OC	BAT	EC	OC	X^2
			SUMMER				
IIa	34	12.32	14	46	16.68	15	0.398ns
IIIa	24	6.81	6	57	16.19	17	0.137ns
IV	46	21.01	26	35	15.99	11	2.742ns
IVa	35	8.21	13	46	10.79	6	4.921*
			FALL				
IIa	35	21.00	20	45	27.00	28	0.085ns
IIIa	25	5.55	8	56	12.45	10	1.564ns
IV	36	13.78	15	45	17.22	16	0.194ns
IVa	36	9.78	12	45	12.22	10	0.907ns
			WINTER				
IIa	34	29.75	38	46	40.25	32	3.979*
IIIa	14	6.22	2	67	29.78	34	3.461ns
IV	39	47.19	57	42	50.81	41	3.933*
IVa	31	19.14	24	50	30.86	26	1.999ns
			SPRING				
IIa	35	9.19	9	45	11.81	12	0.007ns
IIIa	21	2.07	2	60	5.93	6	0.003ns
IV	34	8.40	9	47	11.60	11	0.074ns
IVa	38	8.44	7	43	9.56	11	0.463ns

TABLE 8.

Chi square values for Sigmodon hispidus captured in areas of above average Schizachyrium scoparium but below average Baccharis hamilifolia. For identification of fields, abbreviations, and significance symbols refer to Table 6.

Field	AAT	EC	OC	BAT	EC	OC	x^2
			SUMMER				
IIa	24	8.70	11	56	20.30	18	0.869ns
IIIa	9	2.56	2	72	20.44	21	0.138ns
IV	16	7.31	7	65	29.69	30	0.016ns
IVa	10	2.35	1	71	16.65	18	0.885ns
			FALL				
IIa	19	11.40	13	61	36.60	35	0.294ns
IIIa	9	2.00	3	72	16.00	15	0.562ns
IV	20	7.65	8	61	23.35	23	0.021ns
IVa	12	3.26	5	69	18.74	17	1.090ns
			WINTER				
IIa	24	21.00	26	56	49.00	44	1.701ns
IIIa	15	6.67	11	66	29.33	25	3.766ns
IV	18	21.78	19	63	76.22	79	0.456ns
IVa	18	11.11	9	63	38.89	41	0.515ns
			SPRING				
IIa	14	3.68	4	66	17.32	17	0.034ns
IIIa	10	.99	2	71	7.01	6	1.176ns
IV	19	4.69	3	62	15.31	17	0.796ns
IVa	15	3.33	5	66	14.67	13	1.028ns

TABLE 9.

Chi square values for *Sigmodon hispidus* captured in areas of above average *Baccharis hamilifolia* but below average *Schizachyrium scoparium*. For identification of fields, abbreviations, and significance symbols refer to Table 6.

Field	AAT	EC	OC	BAT	EC	OC	X^2
			SUMMER				
IIa	17	6.16	2	63	22.84	27	3.567ns
IIIa	20	5.68	4	61	17.32	19	0.660ns
IV	12	5.48	6	69	31.52	31	0.058ns
IVa	12	2.81	3	69	16.19	16	0.015ns
			FALL				
IIa	17	10.20	7	63	37.80	41	1.275ns
IIIa	20	4.44	6	61	13.56	12	0.728ns
IV	8	3.06	3	73	27.94	28	0.001ns
IVa	18	4.89	4	63	17.11	18	0.208ns
			WINTER				
IIa	18	15.75	18	62	54.25	52	0.415ns
IIIa	11	4.89	2	70	31.11	34	1.976ns
IV	10	12.10	18	71	85.90	80	3.282ns
IVa	17	10.50	6	64	39.50	44	2.441ns
			SPRING				
IIa	18	4.72	2	62	16.28	19	2.022ns
IIIa	18	1.78	1	63	6.22	7	0.440ns
IV	4	.99	0	77	19.01	20	1.042ns
IVa	22	4.89	3	59	13.11	15	1.003ns

number of Sigmodon captured. Fields IIa (control) ($p < .01$) and IVa (Sigmodon-only) ($p < .025$) had more captures than expected during the summer; field IVa (Sigmodon-only) also had greater numbers than expected during the winter ($p < .005$). Sigmodon captures did not deviate from the expected in any field during fall and spring (Table 10).

Sigmodon distribution showed no correlation to Solidago during any season (Table 11). Areas containing above average Andropogon did not exhibit significant chi squares for Sigmodon captures during summer, winter, or spring. However, Sigmodon captures were greater than expected in areas containing above average Andropogon in fields IIa (control) ($p < .025$) and IVa (Sigmodon-only) ($p < .025$) during the fall (Table 12).

Sigmodon avoids Chinese tallow in field IIIa (Sigmodon-only) during summer, fall and winter ($p < .05$) (Table 13). These were the only significant departures from the expected number of captures in any field or season when considering Chinese tallow.

C. REITHRODONTOMYS

Reithrodontomys were also captured in greater numbers than expected in areas of above average Schizachyrium. Harvest mouse distribution in field II (Reithrodontomys-only) was significantly associated with Schizachyrium during the summer ($p < .05$). Greater numbers of Reithrodontomys than expected were captured during the fall in field II (Reithrodontomys-only) ($p < .05$), IIa (control) ($p < .05$), and III (Reithrodontomys-only) ($p < .025$). Reithrodontomys avoided areas of above

TABLE 10.

Chi square values for Sigmodon hispidus captured in areas of above average Baccharis hamilifolia and Schizachyrium scoparium. For identification of fields, abbreviations, and significance symbols refer to Table 6.

Field	AAT	EC	OC	BAT	EC	OC	x^2
			SUMMER				
IIa	17	6.16	12	63	22.84	17	7.030***
IIIa	4	1.14	2	77	21.86	21	0.683ns
IV	34	15.53	20	47	21.47	17	2.217ns
IVa	23	5.40	10	58	13.60	9	5.474**
			FALL				
IIa	18	10.80	13	62	37.20	35	0.578ns
IIIa	4	.89	2	77	17.11	16	1.456ns
IV	31	11.86	12	50	19.14	19	0.003ns
IVa	18	4.89	8	63	17.11	14	2.543ns
			WINTER				
IIa	16	14.00	20	64	56.00	50	3.214ns
IIIa	3	1.33	0	78	34.67	36	1.381ns
IV	28	33.88	42	53	64.12	56	2.974ns
IVa	14	8.64	19	67	41.36	31	15.885****
			SPRING				
IIa	17	4.46	8	63	16.54	13	3.568ns
IIIa	3	.30	1	78	7.70	7	1.697ns
IV	30	7.41	9	51	12.59	11	0.542ns
IVa	16	3.56	4	65	14.44	14	0.068ns

TABLE 11.

Chi square values for Sigmodon hispidus captured in areas of above and below average Solidago spp. For identification of fields, abbreviations, and significance symbols refer to Table 6.

Field	AAT	EC	OC	BAT	EC	OC	X^2
			SUMMER				
IIa	31	11.24	12	49	17.76	17	0.084ns
IIIa	47	13.34	16	34	9.66	7	1.263ns
IV	21	9.59	9	60	27.41	28	0.049ns
IVa	34	7.98	7	47	11.02	12	0.208ns
			FALL				
IIa	30	18.00	17	50	30.00	31	0.089ns
IIIa	45	10.00	12	36	8.00	6	0.900ns
IV	27	10.33	8	54	20.67	23	0.788ns
IVa	27	7.33	4	54	14.67	18	2.269ns
			WINTER				
IIa	25	21.88	19	55	48.12	51	0.552ns
IIIa	51	22.67	24	30	13.33	12	0.211ns
IV	15	18.15	18	66	79.85	80	0.002ns
IVa	29	17.90	18	52	32.10	32	0.001ns
			SPRING				
IIa	28	7.35	8	52	13.65	13	0.088ns
IIIa	53	5.23	6	28	2.77	2	0.327ns
IV	25	6.17	6	56	13.83	14	0.007ns
IVa	30	6.67	7	51	11.33	11	0.026ns

TABLE 12.

Chi square values for *Sigmodon hispidus* captured in areas of above and below average *Andropogon glomeratus*. For identification of fields, abbreviations, and significance symbols refer to Table 6.

Field	AAT	EC	OC	BAT	EC	OC	X^2
			SUMMER				
IIa	25	9.06	9	55	19.94	20	0.001ns
IIIa	15	4.26	6	66	18.74	17	0.872ns
IV	22	10.05	12	59	26.95	25	0.419ns
IVa	27	6.33	5	54	12.67	14	0.520ns
			FALL				
IIa	21	12.60	20	59	35.40	28	5.893**
IIIa	17	3.78	5	64	14.22	13	0.498ns
IV	23	8.80	8	58	22.20	23	0.102ns
IVa	34	9.24	15	47	12.76	7	6.191**
			WINTER				
IIa	40	35.00	33	40	35.00	37	0.229ns
IIIa	25	11.11	16	56	24.89	20	3.113ns
IV	36	43.55	48	45	54.45	50	1.092ns
IVa	48	29.63	26	33	20.37	24	0.818ns
			SPRING				
IIa	18	4.72	8	62	16.28	8	2.940ns
IIIa	7	.69	0	74	7.31	13	0.755ns
IV	3	.74	0	78	19.26	20	2.085ns
IVa	16	3.56	6	65	14.44	12	0.768ns

TABLE 13.

Chi square values for <u>Sigmodon hispidus</u> captured in areas of above and below average <u>Sapuim sebiferum</u>. For identification of fields, abbreviations, and significance symbols refer to Table 6.

Field	AAT	EC	OC	BAT	EC	OC	x^2
				SUMMER			
IIa	14	5.08	4	66	23.92	25	0.278ns
IIIa	23	6.53	2	58	16.47	21	4.389*
IV	9	4.11	1	72	32.89	36	2.647ns
IVa	15	3.52	0	66	15.48	19	3.747ns
				FALL			
IIa	9	5.40	3	71	42.60	45	1.202ns
IIIa	23	5.11	1	58	12.89	17	4.616*
IV	12	4.59	1	69	26.41	30	3.296ns
IVa	15	4.07	3	66	17.93	19	0.345ns
				WINTER			
IIa	4	3.50	3	76	66.50	67	0.075ns
IIIa	15	6.67	2	66	29.33	34	4.013*
IV	5	6.05	3	76	91.95	95	1.639ns
IVa	7	4.32	3	74	45.68	47	0.441ns
				SPRING			
IIa	11	2.89	0	69	18.11	21	3.351ns
IIIa	21	2.07	1	60	5.93	7	0.746ns
IV	10	2.47	0	71	17.53	20	2.818ns
IVa	15	3.33	3	66	14.67	15	0.040ns

average *Schizachyrium* in field IIa (control) during the winter ($p < .05$). Captures did not diviate from the expected during the spring (Table 14).

Reithrodontomys captures in areas of above average *Baccharis* were greater than expected during all seasons in *Reithrodontomys*-only plots and during the summer in field IV (control). The association between *Reithrodontomys* and *Baccharis* was significant during the summer in field II (*Reithrodontomys*-only) ($p < .005$) and IV (control) ($p < .05$). Field III (*Reithrodontomys*-only) was the only field showing greater numbers of *Reithrodontomys* than expected during the fall ($p < .005$). There were greater numbers of *Reithrodontomys* than expected in areas of above average *Baccharis* in fields II (*Reithrodontomys*-only) ($p < .005$) and III (*Reithrodontomys*-only) ($p < .005$) during winter. The only field having a significant chi square during the spring was field II (*Reithrodontomys*-only) ($p < .025$); the remaining fields had nonsignificant chi square values (Table 15).

There were no significant devations from the expected number of *Reithrodontomys* captured in areas containing above average *Schizachyrium* but below average *Baccharis* during any season (Table 16). There were significantly more *Reithrodontomys* captured in areas of above average *Baccharis* but below average *Schizachyrium* in field III (*Reithrodontomys*-only) during the winter ($p < .005$) and field II (*Reithrodontomys*-only) during spring ($p < .05$) (Table 17).

The number of *Reithrodontomys* captured in areas of above average *Baccharis* and *Schizachyrium* deviated from the expected

TABLE 14.

Chi square values for *Reithrodontomys fulvescens* captured in areas of above and below average *Schizachyrium scoparium*.

II - *Reithrodontomys*-only
IIa - Control
III - *Reithrodontomys*-only
IV - Control

* - significant at the .05 level
** - significant at the .025 level
*** - significant at the .01 level
**** - significant at the .005 level

AAT - above average trapsites
EC - expected captures
OC - observed captures
BAT - below average trapsites
X^2 - chi square values

Field	AAT	EC	OC	BAT	EC	OC	X^2
			SUMMER				
II	56	29.73	36	25	13.27	7	4.285*
IIa	41	23.58	24	39	22.42	22	0.015ns
III	41	20.75	25	40	20.25	16	1.762ns
IV	50	38.89	43	31	24.11	20	1.135ns
			FALL				
II	53	39.91	48	28	21.09	13	4.743*
IIa	37	20.35	27	43	23.65	17	4.043*
III	36	34.22	45	45	42.78	32	6.112**
IV	51	39.04	35	30	22.96	27	1.129ns
			WINTER				
II	51	86.26	97	30	50.74	40	3.610ns
IIa	40	75.50	62	40	75.50	89	4.828*
III	34	77.66	70	47	107.34	115	1.302ns
IV	47	89.93	93	34	65.07	62	0.250ns
			SPRING				
II	53	50.38	50	28	26.62	27	0.008ns
IIa	31	40.30	35	49	63.70	69	1.138ns
III	36	25.33	27	45	31.67	30	0.198ns
IV	49	57.47	58	32	37.53	37	0.012ns

TABLE 15.

Chi square values for <u>Reithrodontomys fulvescens</u> captured in areas of above or below average <u>Baccharis hamilifolia</u>. For identification of fields, abbreviations, and significance symbols refer to Table 14.

Field	AAT	EC	OC	BAT	EC	OC	x^2
SUMMER							
II	44	23.36	33	37	19.64	10	8.710****
IIa	34	19.55	23	46	26.45	23	1.059ns
III	40	20.25	26	41	20.75	15	3.226ns
IV	46	35.78	44	35	27.22	19	4.371*
FALL							
II	41	30.88	38	40	30.12	23	3.325ns
IIa	35	19.25	22	45	24.75	22	0.698ns
III	36	34.22	49	45	42.78	28	11.490****
IV	36	27.55	33	45	34.45	29	1.940ns
WINTER							
II	41	69.35	89	40	67.65	48	11.275****
IIa	34	64.18	59	46	86.82	92	0.727ns
III	29	66.23	88	52	118.77	97	11.146****
IV	39	74.63	79	42	80.37	76	0.494ns
SPRING							
II	42	39.92	51	38	37.08	26	6.386**
IIa	35	45.50	48	45	58.50	56	0.244ns
III	34	23.92	25	47	33.07	32	0.082ns
IV	34	39.88	42	47	55.12	53	0.194ns

TABLE 16.

Chi square values for Reithrodontomys fulvescens captured in areas of above average Schizachyrium scoparium but below average Baccharis hamilifolia. For identification of fields, abbreviations, and significance symbols refer to Table 14.

Field	AAT	EC	OC	BAT	EC	OC	x^2
			SUMMER				
II	21	11.15	9	60	31.85	34	0.560ns
IIa	24	13.80	11	56	32.20	35	0.812ns
III	17	8.61	8	64	32.39	33	0.055ns
IV	16	12.44	8	65	50.56	55	1.975ns
			FALL				
II	22	16.57	15	59	44.43	46	0.204ns
IIa	19	10.45	13	61	33.55	31	0.816ns
III	18	17.11	12	63	59.89	65	1.962ns
IV	20	15.31	9	61	46.59	53	3.454ns
			WINTER				
II	22	37.21	28	59	99.79	109	3.130ns
IIa	24	45.30	42	56	105.70	109	0.343ns
III	19	43.40	34	62	141.60	151	2.660ns
IV	18	34.44	40	63	120.56	115	1.154ns
			SPRING				
II	23	21.87	16	58	55.13	61	2.200ns
IIa	14	18.20	11	66	85.80	93	3.453ns
III	20	14.07	15	61	42.93	42	0.082ns
IV	19	22.29	22	62	72.71	73	0.005ns

TABLE 17.

Chi square values for *Reithrodontomys fulvescens* captured in areas of above average *Baccharis hamilifolia* but below average *Schizachyrium scoparium*. For identification of fields, abbreviations, and significance symbols refer to Table 14.

Field	AAT	EC	OC	BAT	EC	OB	X^2
SUMMER							
II	9	4.78	5	72	38.22	38	0.011ns
IIa	17	9.78	10	63	36.22	36	0.006ns
III	16	8.10	9	65	32.90	32	0.125ns
IV	12	9.33	10	69	53.67	53	0.056ns
FALL							
II	9	6.78	5	72	54.22	56	0.526ns
IIa	17	9.35	8	63	34.65	36	0.248ns
III	18	17.11	16	63	59.89	61	0.093ns
IV	8	6.13	7	73	55.87	55	0.137ns
WINTER							
II	12	20.29	18	69	116.71	119	0.303ns
IIa	18	33.98	38	62	117.02	113	0.614ns
III	14	31.97	52	67	153.03	133	15.171****
IV	10	19.14	26	71	135.86	129	2.805ns
SPRING							
II	11	10.46	17	70	66.54	60	4.732*
IIa	18	23.40	25	62	80.60	79	0.141ns
III	18	12.67	13	63	44.33	44	0.011ns
IV	4	4.69	8	77	90.31	87	2.457ns

in field II (*Reithrodontomys*-only) during the summer ($p < .01$), field II ($p < .025$) and field III (*Reithrodontomys*-only) ($p < .005$) during the fall, and field II ($p < .005$) during the winter. There were no significant deviations in any of the fields during the spring (Table 18).

Reithrodontomys were captured in greater numbers than expected in *Solidago* during the spring in field II (*Reithrodontomys*-only) ($p < .05$) (Table 19). *Reithrodontomys* were captured in number less than expected in areas of above average *Andropogon* in field III (*Reithrodontomys*-only) ($p < .005$) and in numbers greater than expected in field IV (control) ($p < .025$) during the winter. The remaining fields and seasons did not show significant deviations from the expected (Table 20). Tallow was avoided by *Reithrodontomys* in field IV (control) ($p < .05$) during the summer while the remaining seasons did not deviate from the expected number of captures (Table 21).

DISCUSSION

Sigmodon hispidus and *Reithrodontomys fulvescens* have similar habitat requirements. *Schizachyrium scoparium* and *Baccharis hamilifolia* are major components in the preferred habitat of both rodents, while *Solidago* and *Andropogon* form minor components and *Sapium* (Chinese tallow) is avoided. The chi square results from the control fields, however, demonstrate that each rodent's seasonal utilization of these plant species differ. *Sigmodon* utilizes *Schizachyrium* during the summer while *Reithrodontomys* utilizes *Schizachyrium* during the fall (Table 22). Dense stands of *Baccharis* are the

TABLE 18.

Chi square values for *Reithrodontomys fulvescens* captured in areas of above average *Baccharis hamilifolia* and *Schizachyrium scoparuim*. For identification of fields, abbreviations, and significance symbols refer to Table 14.

Field	AAT	EC	OC	BAT	EC	OC	X^2
				SUMMER			
II	36	19.11	28	45	23.89	15	7.444***
IIa	18	10.35	13	62	35.65	33	0.876ns
III	24	12.15	17	57	28.85	24	2.751ns
IV	34	26.45	34	47	36.55	29	3.715ns
				FALL			
II	31	23.34	33	50	37.66	28	6.476**
IIa	17	9.35	13	63	34.65	31	1.809ns
III	18	17.11	33	63	59.89	44	18.973****
IV	31	23.73	26	50	38.27	36	0.352ns
				WINTER			
II	29	49.05	71	52	87.95	66	15.301****
IIa	16	30.20	21	64	120.80	130	3.503ns
III	15	34.26	36	66	150.74	49	0.108ns
IV	29	55.49	53	52	99.51	102	0.174ns
				SPRING			
II	31	29.47	34	50	47.53	43	1.128ns
IIa	16	20.80	23	64	83.20	81	0.291ns
III	17	11.96	12	64	45.04	45	0.000ns
IV	30	35.19	34	51	59.81	61	0.064ns

TABLE 19.

Chi square values for *Reithrodontomys fulvescens* captured in areas of above and below average *Solidago* spp. For identification of fields, abbreviations, and significance symbols refer to Table 14.

Field	AAT	EC	OC	BAT	EC	OC	X^2
			SUMMER				
II	21	16.34	14	60	46.66	49	0.452ns
IIa	7	3.72	3	74	39.28	40	0.153ns
III	31	17.82	22	49	28.18	24	1.600ns
IV	30	15.19	16	51	25.81	25	0.069ns
			FALL				
II	14	10.54	15	67	50.46	46	2.281ns
IIa	30	16.50	15	50	27.50	29	0.218ns
III	28	26.62	29	53	50.38	48	0.325ns
IV	27	20.66	19	54	41.34	43	0.200ns
			WINTER				
II	4	6.77	8	77	130.23	129	0.235ns
IIa	25	47.19	48	55	103.81	103	0.020ns
III	26	59.38	63	55	125.62	122	0.325ns
IV	15	28.71	28	66	126.29	127	0.022ns
			SPRING				
II	13	12.36	19	68	64.64	58	4.249*
IIa	28	36.40	33	52	67.60	71	0.489ns
III	23	16.19	14	58	40.81	43	0.414ns
IV	25	29.32	31	56	65.68	64	0.139ns

TABLE 20.

Chi square values for *Reithrodontomys fulvescens* captured in areas of above and below average *Andropogon glomeratus*. For identification of fields, abbreviations, and significance symbols refer to Table 14.

Field	AAT	EC	OC	BAT	EC	OC	X^2
			SUMMER				
II	19	10.09	13	62	32.91	30	1.097ns
IIa	25	14.38	19	55	31.62	27	2.159ns
III	30	15.19	16	51	25.81	25	0.069ns
IV	22	17.11	13	59	45.89	50	1.355ns
			FALL				
II	14	10.54	10	67	50.46	51	0.034ns
IIa	21	11.55	11	59	32.45	33	0.036ns
III	29	27.57	20	52	49.43	57	3.238ns
IV	23	17.61	19	58	44.39	43	0.153ns
			WINTER				
II	21	35.52	29	60	101.48	108	1.616ns
IIa	40	75.50	84	40	75.50	67	1.914ns
III	39	89.08	70	42	95.92	115	7.882****
IV	36	68.88	83	45	86.12	72	5.210**
			SPRING				
II	16	15.21	14	65	61.79	63	0.120ns
IIa	18	23.40	22	62	80.60	82	0.108ns
III	16	11.26	9	65	45.74	48	0.565ns
IV	3	3.52	3	78	91.48	92	0.080ns

TABLE 21.

Chi square values for *Reithrodontomys fulvescens* captured in areas of above and below average *Sapium sebiferum*. For identification of fields, abbreviations, and significance symbols refer to Table 14.

Field	AAT	EC	OC	BAT	EC	OE	x^2
			SUMMER				
II	12	6.37	3	69	36.63	40	2.093ns
IIa	14	8.05	7	66	37.95	39	0.166ns
III	10	5.06	4	71	35.94	37	0.253ns
IV	9	7.00	2	72	56.00	61	4.018*
			FALL				
II	12	9.03	7	69	51.97	54	0.536ns
IIa	9	4.95	3	71	39.05	41	0.866ns
III	8	7.61	3	73	69.39	74	3.099ns
IV	12	9.18	4	69	52.82	58	3.431ns
			WINTER				
II	5	8.45	5	76	128.55	132	1.501ns
IIa	4	7.55	6	76	143.45	145	0.335ns
III	4	9.14	9	77	175.86	176	0.002ns
IV	5	9.56	9	76	145.44	146	0.035ns
			SPRING				
II	7	6.65	6	74	70.35	71	0.070ns
IIa	11	14.30	9	69	89.70	95	2.278ns
III	3	2.11	4	78	54.89	53	1.758ns
IV	10	11.73	13	71	83.27	82	0.157ns

TABLE 22.

Comparison of plant utilization in controls versus experimentals.

CONTROL

	SUMMER	FALL	WINTER	SPRING
Sigmodon	Schizachyrium above average Schizachyrium and Baccharis	Andropogon	Baccharis	------
Reithrodontomys	Baccharis Sapium avoided	Schizachyrium	Schizachyrium avoided Andropogon	

SIGMODON-ONLY

	SUMMER	FALL	WINTER	SPRING
Sigmodon	Baccharis, and above average Schizachyrium and Baccharis Sapium avoided	Schizachyrium Andropogon Sapium avoided	Schizachyrium above average Schizachyrium and Baccharis Sapium avoided	------

REITHRODONTOMYS-ONLY

	SUMMER	FALL	WINTER	SPRING
Reithrodontomys	Schizachyrium Baccharis above average Schizachyrium and Baccharis	Schizachyrium Baccharis above average Schizachyrium and Baccharis	Baccharis Andropogon avoided above average Schizachyrium and Baccharis above average Baccharis but below average Schizachyruim	Baccharis Solidago above average Baccharis but below average Schizachyrium

preferred habitat for *Sigmodon* during the winter while *Reithrodontomys* utilized these areas during the summer. Neither *Schizachyrium* or *Baccharis* is of overriding importance to either rodent but both are seasonally important. In addition, *Sigmodon* utilizes *Andropogon* during the fall while *Reithrodontomys* uses this plant during the winter. *Solidago* is not important to *Sigmodon* during any season but *Reithrodontomys* utilizes this plant during the spring (Table 22).

Baccharis is not utilized as a food source by either rodent (Kincaid, unpub.). *Sigmodon* cues on stands of *Baccharis* in the control plot during the winter when vegetational density is at a minimum and *Sigmodon* density is at a maximum; there is also an association of above average *Baccharis* and *Schizachyrium* during the summer in the controls. *Baccharis* is hypothesized to serve as overhead protection from avian predators during a time when ground cover is minimal (winter) and *Sigmodon* movement is intensified because of the late fall-early winter and late spring-early summer breeding season. *Baccharis* may offer nesting adults as well as dispersing juveniles overhead protection from avian predators during this time. Such protection is especially important in view of the fact that the major activity periods of *Sigmodon* are diurnal or crepuscular so that overhead protection during periods of low ground vegetation density and increased population movement would be critical.

Reithrodontomys utilize *Baccharis* in the control during the summer, coinciding with peak occurence of insect infestations in *Baccharis*. The arboreal *Reithrodontomys* is presumed to climb throughout the Baccharis shrubs to glean insects. This is supported by the facts that insects are an important component in the diet of Reithrodontomys during this season, and vertical trapping confirms that Reithrodontomys utilizes the above ground component of the vegetation (Kincaid, unpub.). Sigmodon is a poor climber but may also glean insects from the lower branches and trunk of Baccharis during summer. Baccharis, therefore, appears to be important in providing cover and food (insects) for both rodents although there is a differential seasonal use of the vegetation by each rodent. During the summer, both Reithrodontomys and Sigmodon utilize stands of Baccharis, however, they are spatially and temporally partitioning the habitat. Reithrodontomys utilizes the above ground portion of Baccharis while Sigmodon remains on the ground. In addition, their daily activity periods do not overlap; Sigmodon is a diurnal crepuscular rodent, while Reithrodontomys is strictly nocturnal (Kincaid, unpub.).

Schizachyrium scoparium probably serves multiple functions also. Sigmodon cues on Schizachyrium in the summer during the time of maximum herbaceous growth. Sigmodon utilizes this plant as its primary herbaceous food source during the summer. Schizachyrium sets seed clusters at the end of terminal branches during late summer and fall. Reithrodontomys utilize above average Schizachyrium areas in the control during fall and is probably able to harvest these seed clusters as a food source. Schizachyrium is abundant as live or standing dead throughout the year, making it a stable and predictable food and/or cover resource. The fact that numerous runways have been observed penetrating dense stands of *Schizachyrium*, coupled with a high amount of diurnal and crepuscular activity for *Sigmodon*, suggest that *Schizachyrium* is also valuable as cover from *Sigmodon's* major avian predators (owls and hawks). During the winter months when most *Schizachyrium* is standing dead, the coat color of *Sigmodon* blends almost perfectly with the color of the dead vegetation. This phenomenon compensates for the lessened vegetational density during the winter and serves to provide another source of predator protection for *Sigmodon*. Needless to say, predators are highly effective in cueing on movement, in which case vegetation density and protective coloration are critical to *Sigmodon's* survival. *Schizachyrium* probably serves the additional function of providing nesting material as well as being a food source for both rodents (Kincaid, unpub.).

No significant plant-rodent associations were observed in the controls during the spring months. This may be explained by the fact that most of the vegetation is just beginning to grow, and the rodents must move greater distances to forage and seek cover. Increased movement may result in non-associations with particular plant species and, hence, non-significant chi square tests which indicate that the rodent distribution during the spring approaches a random pattern.

The chi square analysis indicates there is a competitive interaction between *Sigmodon hispidus* and *Reithrodontomys fulvescens* because the rodents in the experimental plots expand their habitat associations to include plant species that are not used in the control (Table 22). This result suggests the rodents may not be occupying their preferred habitat in the control because of interspecific interactions. In the control fields Sigmodon utilizes Schizachyrium and Reithrodontomys utilizes Baccharis during the summer; whereas ir the Sigmodon-only fields, cotton rats are captured in areas of above average Baccharis and Schizachyrium and in the Reithrodontomys-only fields, harvest mice utilize Schizachyrium as well as Baccharis. Each rodent species therefore expands its habitat usage to include vegetation utilized by the codominant species in the control. During the fall, Sigmodon utilized Andropogon in the control and Schizachyrium and Andropogon in the Sigmodon-only plots. Reithrodontomys, on the other hand, utilized Schizachyrium in the control but expanded its habitat to include Baccharis in the experimental plots. The same trend is noticed during the winter where Sigmodon is associated with Baccharis in the control, but expands its utilization to include Schizachyrium in the experimental plots. Reithrodontomys utilizes Andropogon in the control while switching to Baccharis and above average Schizachyrium and Baccharis in the Reithrodontomys-only fields. The data indicates, therefore, that these rodents exhibit competitive release in the experimental plots when interspecific interactions are reduced by experimental species removal and their array of habitats utilized is enhanced in the absence of the codominant species. The plants which these rodents are restricted to seasonally in the control must be those essential to completion of their life history functions. Schizachyrium and Baccharis are used in different seasons. Schizachyrium seems to be most heavily utilized by

Reithrodontomys during its major breeding periods (late fall-early winter) while Sigmodon utilized several grass species (Schizachyrium and Andropogon). The exact function of these grass species is unknown at this time, but they could provide food, nest, cover, or a combination of these. Baccharis seems to be selected during times of low ground vegetation density (winter) for Sigmodon and during times of increased insect associations (summer) by Reithrodontomys. Thus in the absence of the codominant, habitat expansion occurs and each rodent species is now significantly associated with both major plant species (Baccharis and Schizachyrium).

If competition is the dominant interspecific interaction occuring, the number of Sigmodon and Reithrodontomys should increase in the experimental plots. Negative interspecific interaction should, when released, result in populations expansion. There are numerous examples in the literature of positive population responses after competitive release. One such example is Petersen's (1973) observation that Sigmodon hispidus populations increased when the dominant Sigmodon fulviventer was removed. Since species removal led to habitat expansion (a form of competitve release) for both Sigmodon and Reithrodontomys, it should be expected that a positive influence upon other population parameters would follow. This, however, was not the case. Concurrent studies on this system have demonstrated that both Reithrodontomys and Sigmodon in the experimental plots do not do as well as in the controls (Joule and Cameron, in preparation). That is, population density, age class survivorship, and percent reproduction decrease in the experimental plots suggesting a positive (facilitative) relationship between Sigmodon and Reithrodontomys which is overriding any effect of competitive release. Part of this response may be explained by the fact that field IIIa (Sigmodon-only) contains less Schizachyrium and Baccharis than any other field in any season. This field is deficient in Sigmodon's preferred habitat and can therefore not sustain a large population of Sigmodon. This, however, is not the case in field IVa (Sigmodon-only). The Sigmodon in field IVa also exhibit reduction in population parameters but the vegetation data suggest that this field contains adequate amounts of Schizachyrium and Baccharis. The antithesis to this argument suggest that in "good" habitat such as field II (Reithrodontomys-only) the population size of Reithrodontomys should be greater; this, however, is not supported by the data.

The vegetation analysis has demonstrated that the six fields in the mammal plots do differ in vegetation structure. In the experimental design for the rodent studies conducted at the University of Houston Coastal Center the six fields were intended to consist of three replicates (see Trapping Methods). In view of the findings from this study, however, the six fields must be considered separately and not as replicates.

The results from this study indicate that Sigmodon hispidus and Reithrodontomys fulvescens have a preferred habitat consisting of Baccharis hamilifolia and Schizachyrium scoparium. Andropogon is also utilized by both rodents but to a lesser extent. Competition between these rodents was inferred on the basis of the competitive release in habitat utilization observed in the experimental fields, however, the result of expanded population sizes expected from competitive release was not realized. The preferred habitats appear to be selected for food and/or cover from avian predators. These results, in combination with the results of other studies, suggest that neither positive or negative interactions are independently important, but that a combination of both is essential for stability in this rodent system.

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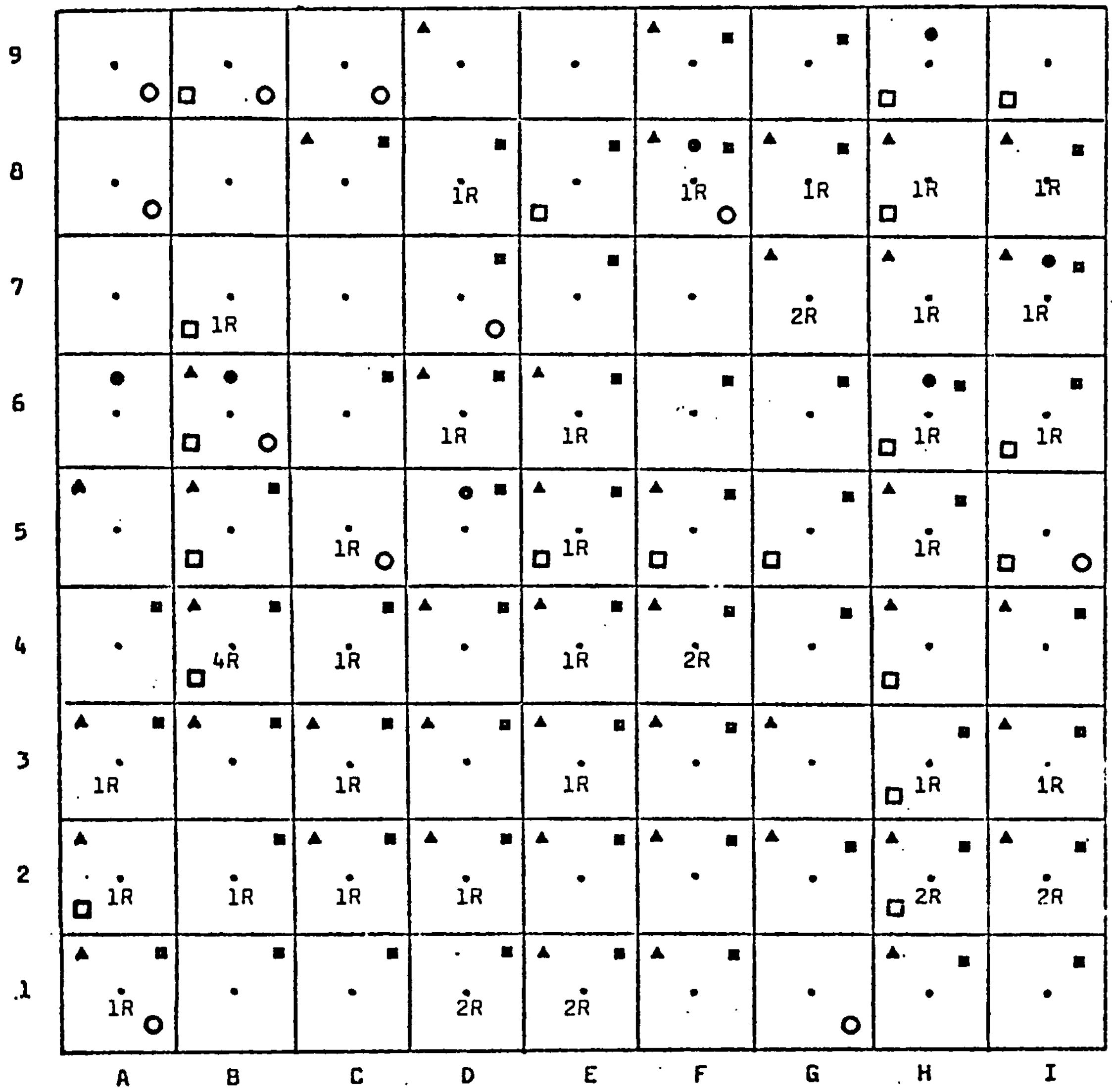
APPENDIX 1.

Seasonal vegetation grids with superimposed rodent captures.

SUMMER-FIELD II-REITHRODONTOMYS ONLY



▲ = Above average Baccharis hamilifolia

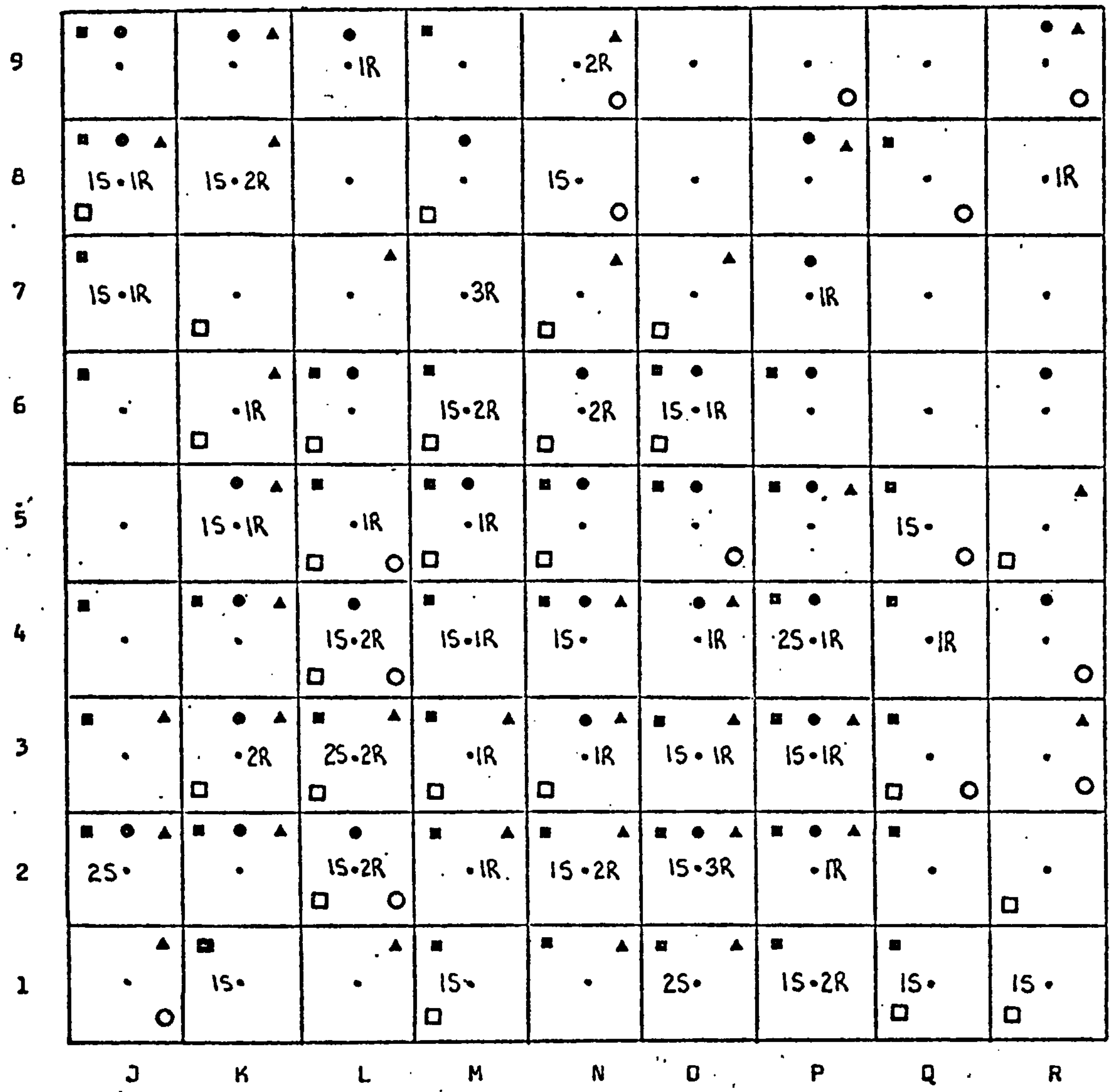
■ = Above average Schizachyrium scoparium

● = Above average Solidago spp.

□ = Above average Andropogon glomeratus

○ = Above average Sapium sebiferum

SUMMER-FIELD IIa-CONTROL



▲ = Above average <u>Baccharis hamilifolia</u>

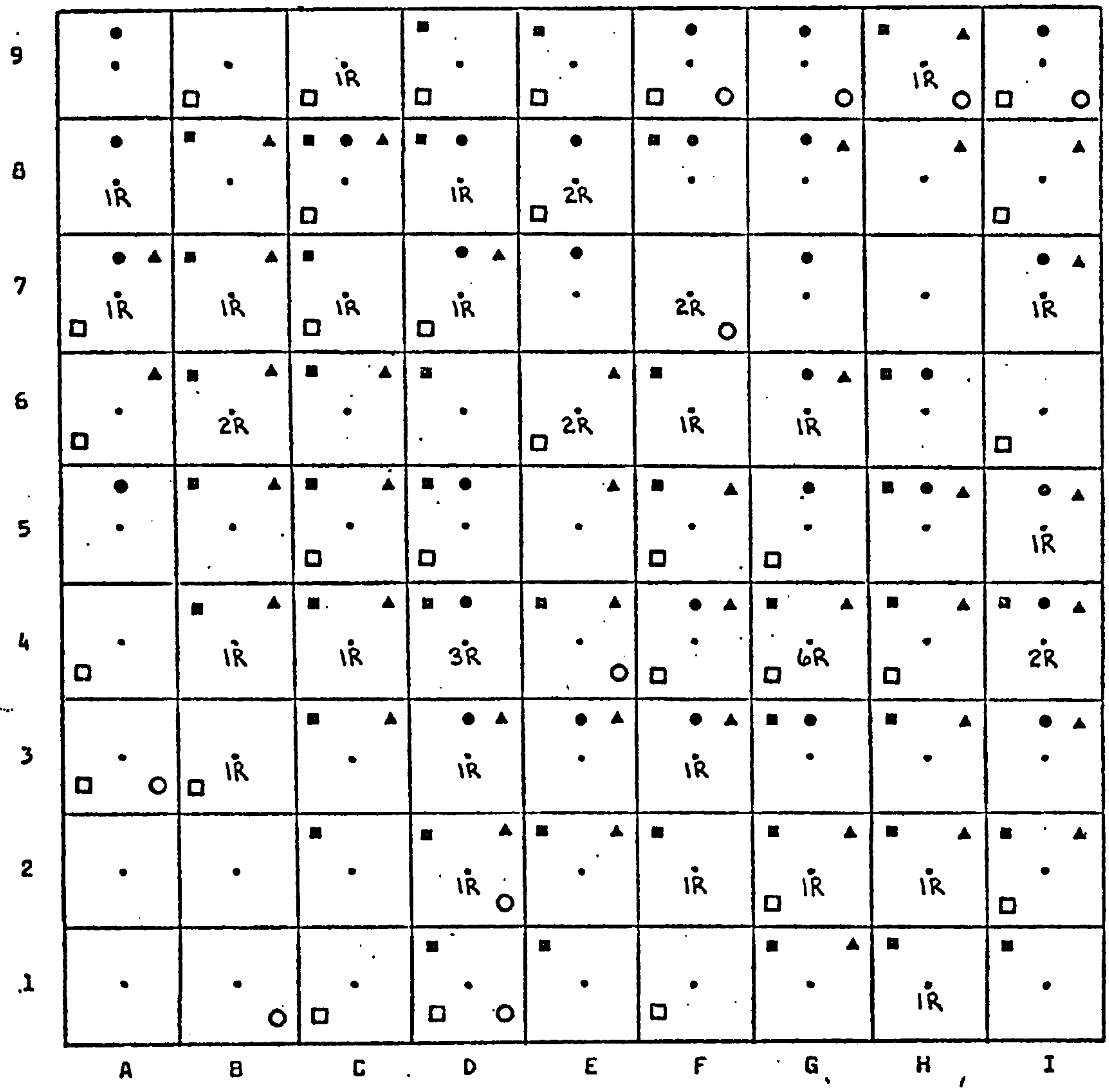
■ = Above average <u>Schizachyrium scoparium</u>

● = Above average <u>Solidago</u> spp.

□ = Above average <u>Andropogon glomeratus</u>

○ = Above average <u>Sapium sebiferum</u>

SUMMER-FIELD III-REITHRODONTOMYS ONLY



▲ = Above average Baccharis hamilifolia

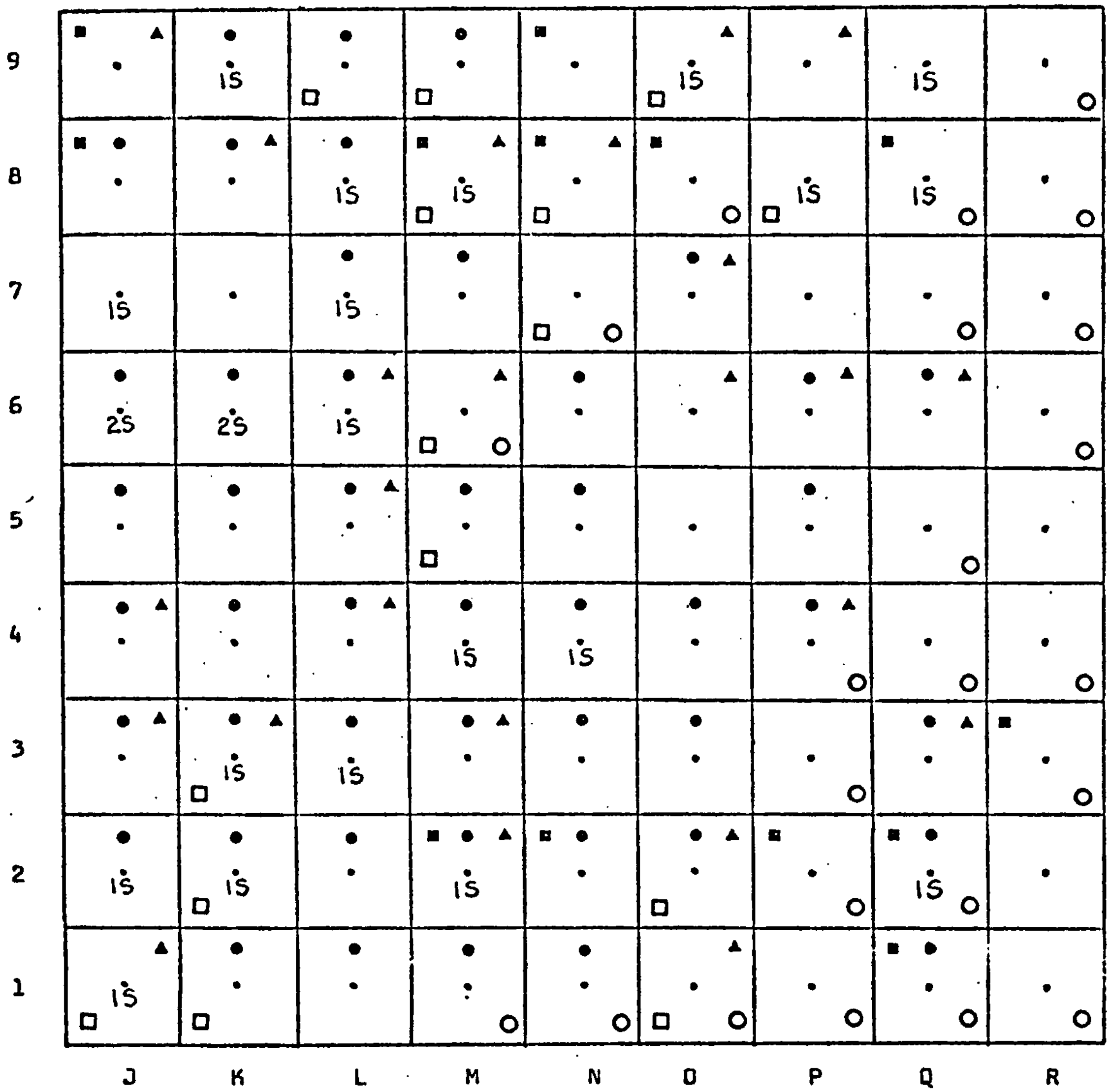
■ = Above average Schizachyrium scoparium

● = Above average Solidago spp.

□ = Above average Andropogon glomeratus

○ = Above average Sapium sebiferum

SUMMER-FIELD IIIa-*SIGMODON* ONLY



▲ = Above average *Baccharis hamilifolia*

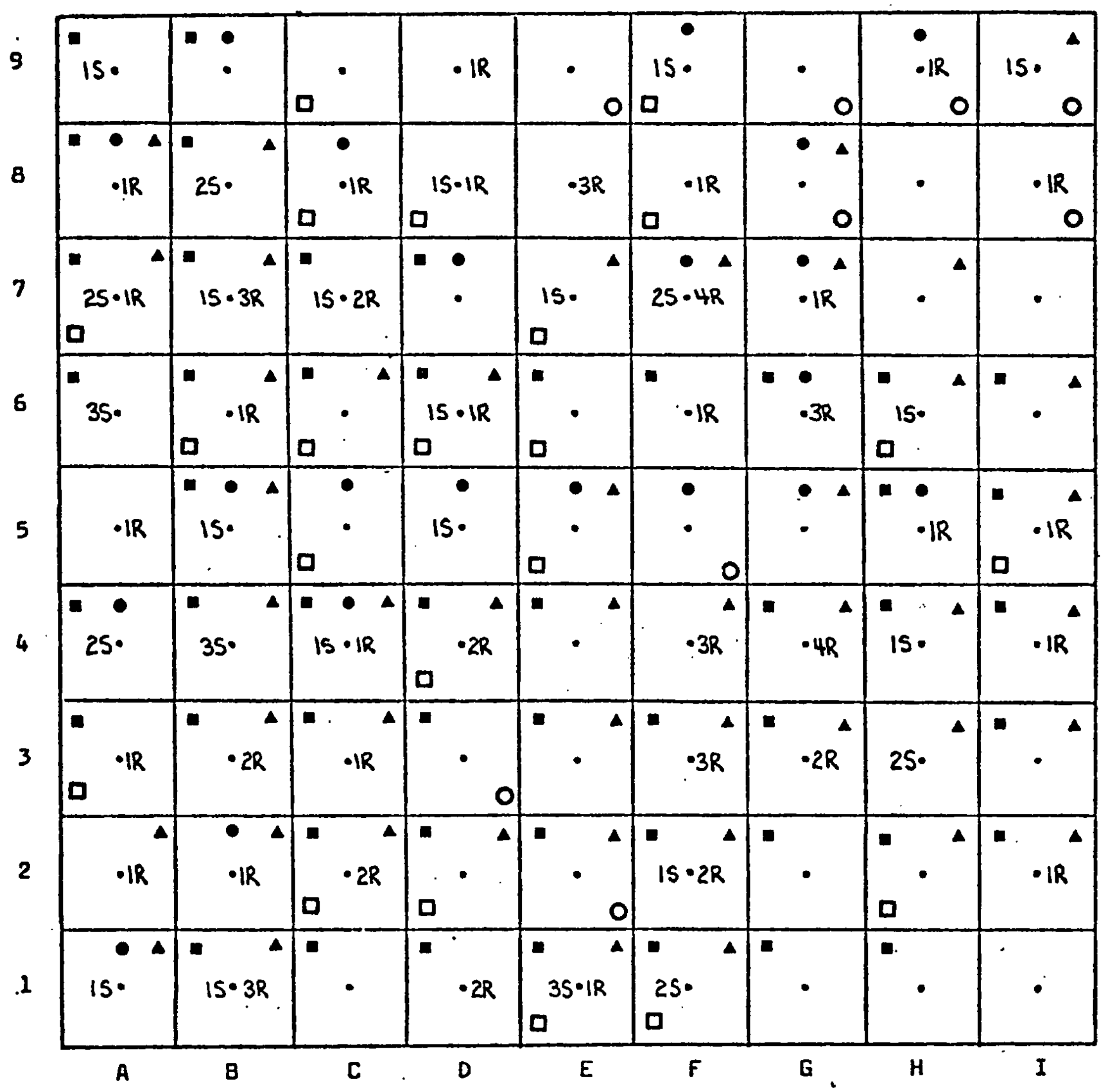
■ = Above average *Schizachyrium scoparium*

● = Above average *Solidago* spp.

□ = Above average *Andropogon glomeratus*

○ = Above average *Sapium sebiferum*

SUMMER-FIELD IV-CONTROL



▲ = Above average <u>Baccharis hamilifolia</u>

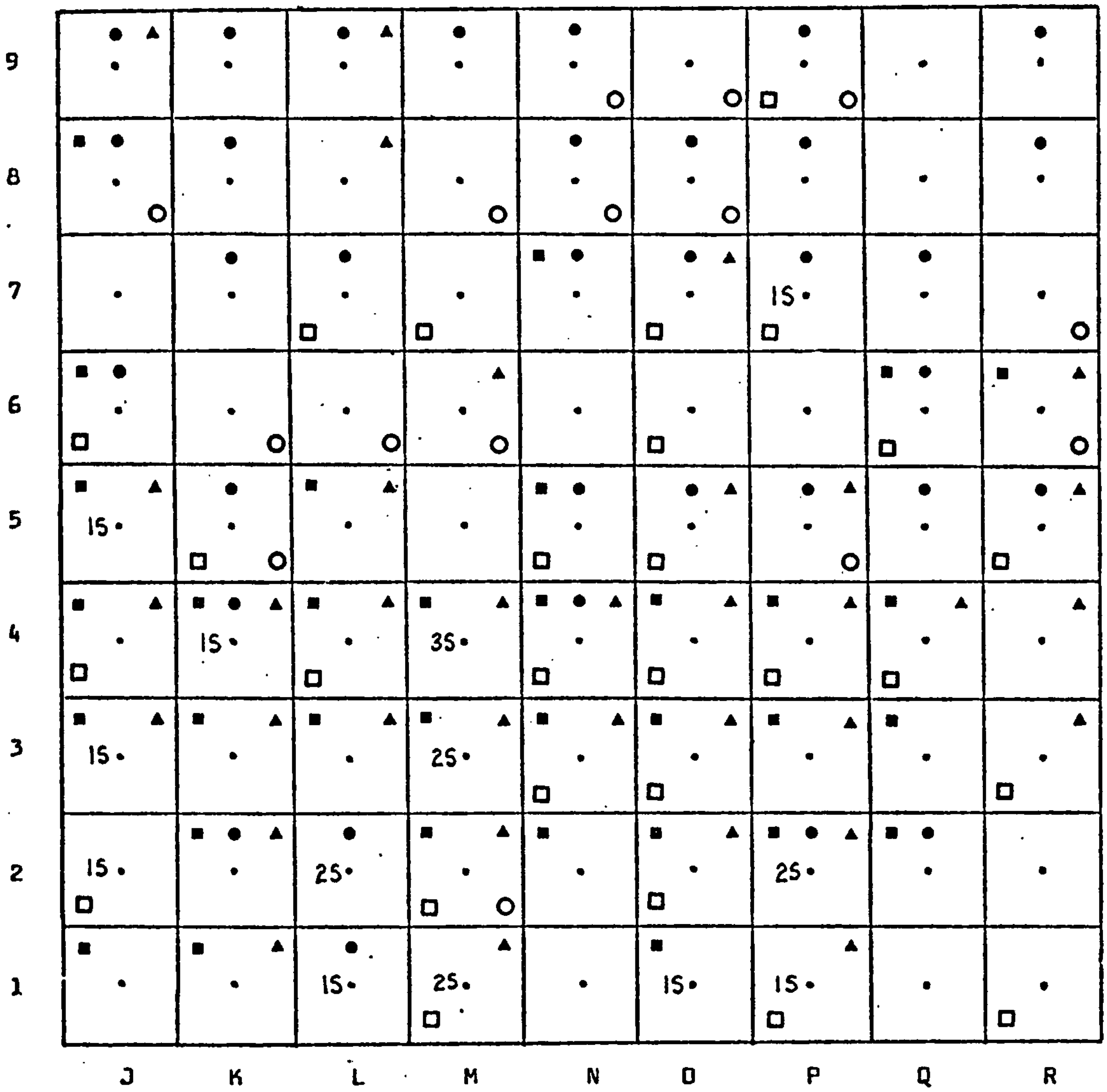
■ = Above average <u>Schizachyrium scoparium</u>

● = Above average <u>Solidago</u> spp.

□ = Above average <u>Andropogon glomeratus</u>

○ = Above average <u>Sapium sebiferum</u>

SUMMER-FIELD IVa-SIGMODON ONLY



▲ = Above average Baccharis hamilifolia

■ = Above average Schizachyrium scoparium

● = Above average Solidago spp.

□ = Above average Andropogon glomeratus

○ = Above average Sapium sebiferum

FALL-FIELD II-*REITHRODONTOMYS* ONLY

	A	B	C	D	E	F	G	H	I
9	•1R ○	•	•	•	•	■ •2R	•	■ ● •	•
8	• ○	•	■ ● ▲ •2R	■ •	■ •1R □	● ▲ •1R	•	▲ •	■ ▲ •1R
7	• □	•	■ •	■ • ○	■ •1R □	■ ▲ •2R	•3R	● ▲ •2R □	■ ● ▲ •1R
6	● • ○	● ▲ • ○	■ ▲ • □ ○	■ ▲ •1R	■ ▲ •	■ •	■ ▲ •1R	■ ▲ • □	•1R □
5	● ▲ •	● •1R □	■ • ○	■ •1R	■ ● ▲ •1R □	■ ● ▲ •2R	■ •1R □	■ • □	•2R ○
4	■ ● ▲ •2R	■ ● ▲ •1R	■ ▲ •2R ○	■ •1R	■ ▲ •	■ ▲ • □ ○	■ •2R □	■ ▲ •2R	■ ▲ •
3	■ ▲ •2R	■ ● ▲ •2R	■ ▲ •3R	▲ •2R	■ ▲ •	▲ •	▲ •	■ •	■ ▲ •1R
2	■ ▲ •1R	■ •2R	■ ▲ •3R	■ ▲ •1R	■ ▲ •	■ ▲ •	■ ▲ •2R	■ ▲ • □	▲ •
1	■ •	•	■ ▲ •	■ •1R	■ ▲ •	■ •1R ○	■ •1R ○	■ •1R	■ •

▲ = Above average *Baccharis hamilifolia*

■ = Above average *Schizachyrium scoparium*

● = Above average *Solidago* spp.

□ = Above average *Andropogon glomeratus*

○ = Above average *Sapium sebiferum*

FALL-FIELD IIa-CONTROL

	J	K	L	M	N	O	P	Q	R
9	▲ •	● 1S•	▲ •1R	● •1R ○	● •	2S•	•1R	•	1S• ○
8	■ ● ▲ 3S•1R □	1S•	▲ •	■ •1R	•1R ○	■ •1R	▲ •	■ •	•
7	■ 1S• □	1S•1R □	● 1S• □	1S•	■ ▲ •4R □	▲ 1S•1R	• □	• □	•
6	■ 2S• □	•	■ ▲ 1S•	■ ● •3R	● ▲ •2R	■ ● ▲ •	● 1S• □	•1R □	● •
5	2S•1R □	● 2S•2R	■ 1S•	● 1S•	■ ● •	● 1S• □	■ •1R	▲ •	● •
4	■ ▲ 1S•1R	■ ● ▲ •1R	● ▲ • □	■ ▲ 1S•4R	■ ● •1R	● ▲ 1S• □	■ ▲ 1S•2R	■ ▲ 1S• □	● • ○
3	■ ▲ 1S•	● ▲ 2S•	■ 1S•1R	● ▲ •	● ▲ •1R	● ▲ •1R	■ ● ▲ 1S• □	■ ▲ •1R □	▲ 1S• ○
2	■ ● ▲ •	● ▲ 1S•1R	■ ● •	■ 1S• □	■ 3S•	■ ● 2S•1R □	■ ▲ •	■ ▲ 1S•	▲ 1S•
1	■ ▲ 2S•	■ ● •	■ 1S• □ ○	■ 1S•1R □	■ ▲ •	▲ •1R	■ •3R	■ ▲ • ○	•1R ○

▲ = Above average Baccharis hamilifolia

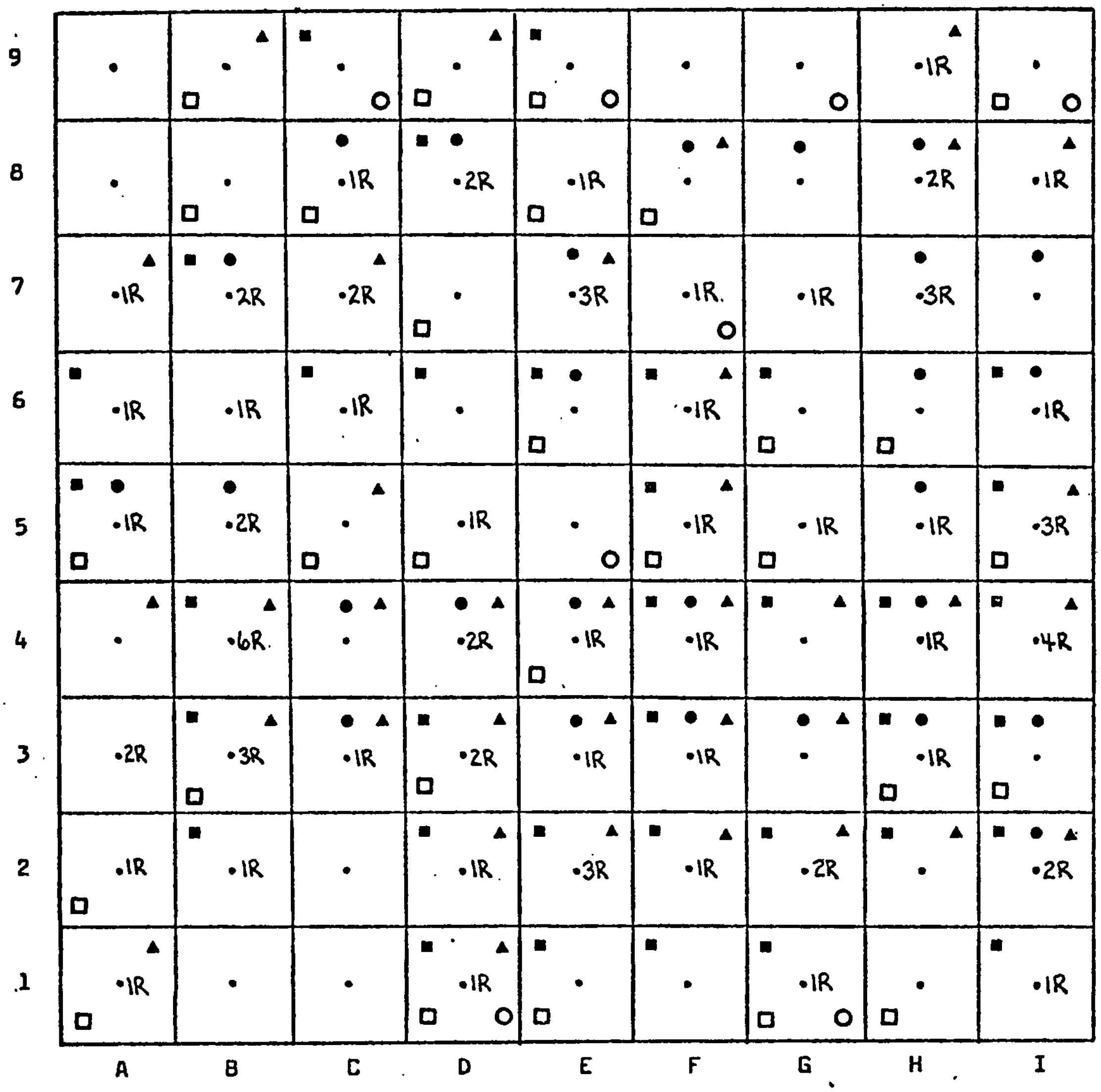
■ = Above average Schizachyrium scoparium

● = Above average Solidago spp.

□ = Above average Andropogon glomeratus

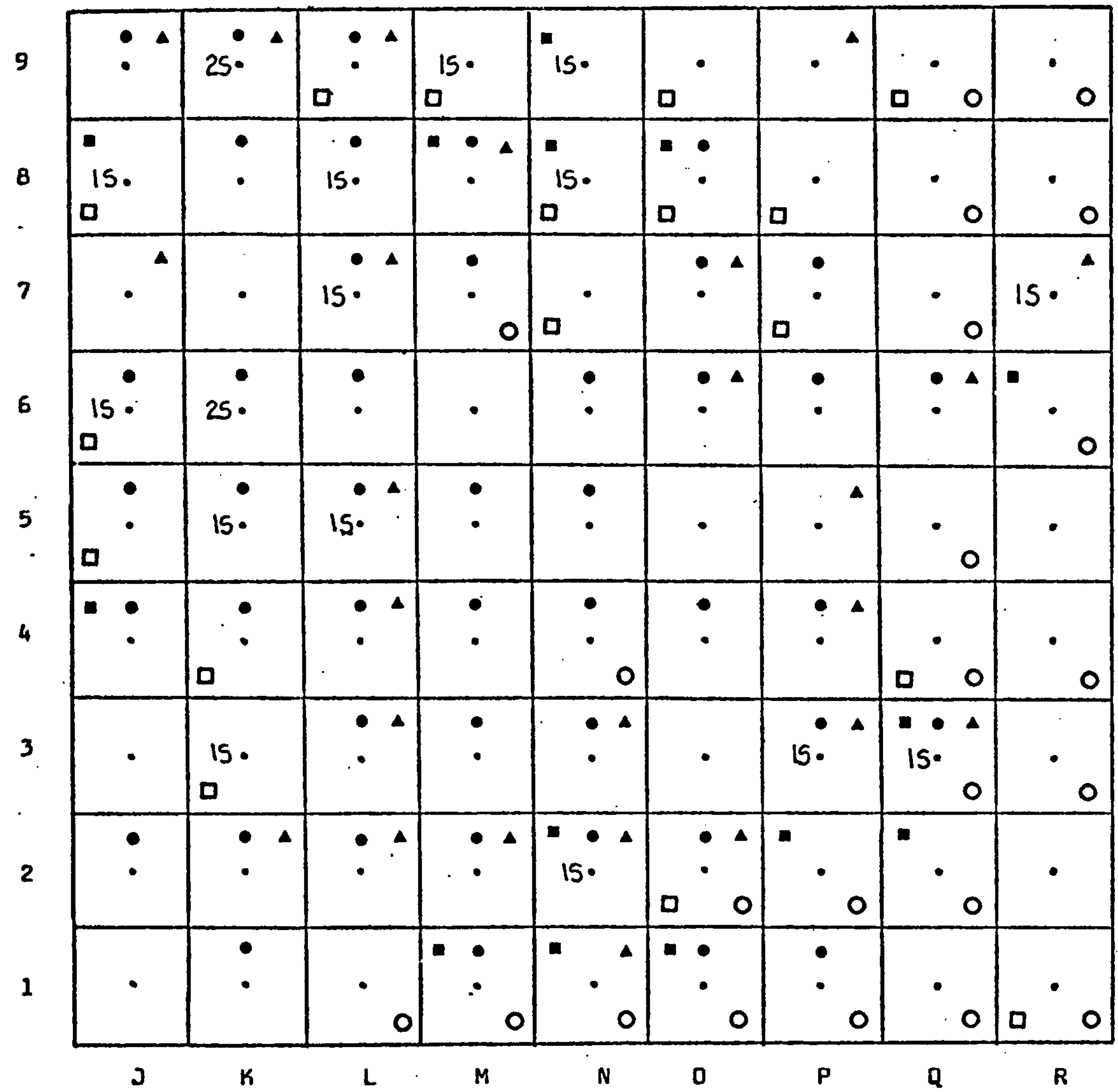
○ = Above average Sapium sebiferum

FALL-FIELD III-REITHRODONTOMYS ONLY



▲ = Above average Baccharis hamilifolia
■ = Above average Schizachyrium scoparium
● = Above average Solidago spp.
□ = Above average Andropogon glomeratus
○ = Above average Sapium sebiferum

FALL-FIELD IIIa-SIGMODON ONLY



▲ = Above average *Baccharis hamilifolia*

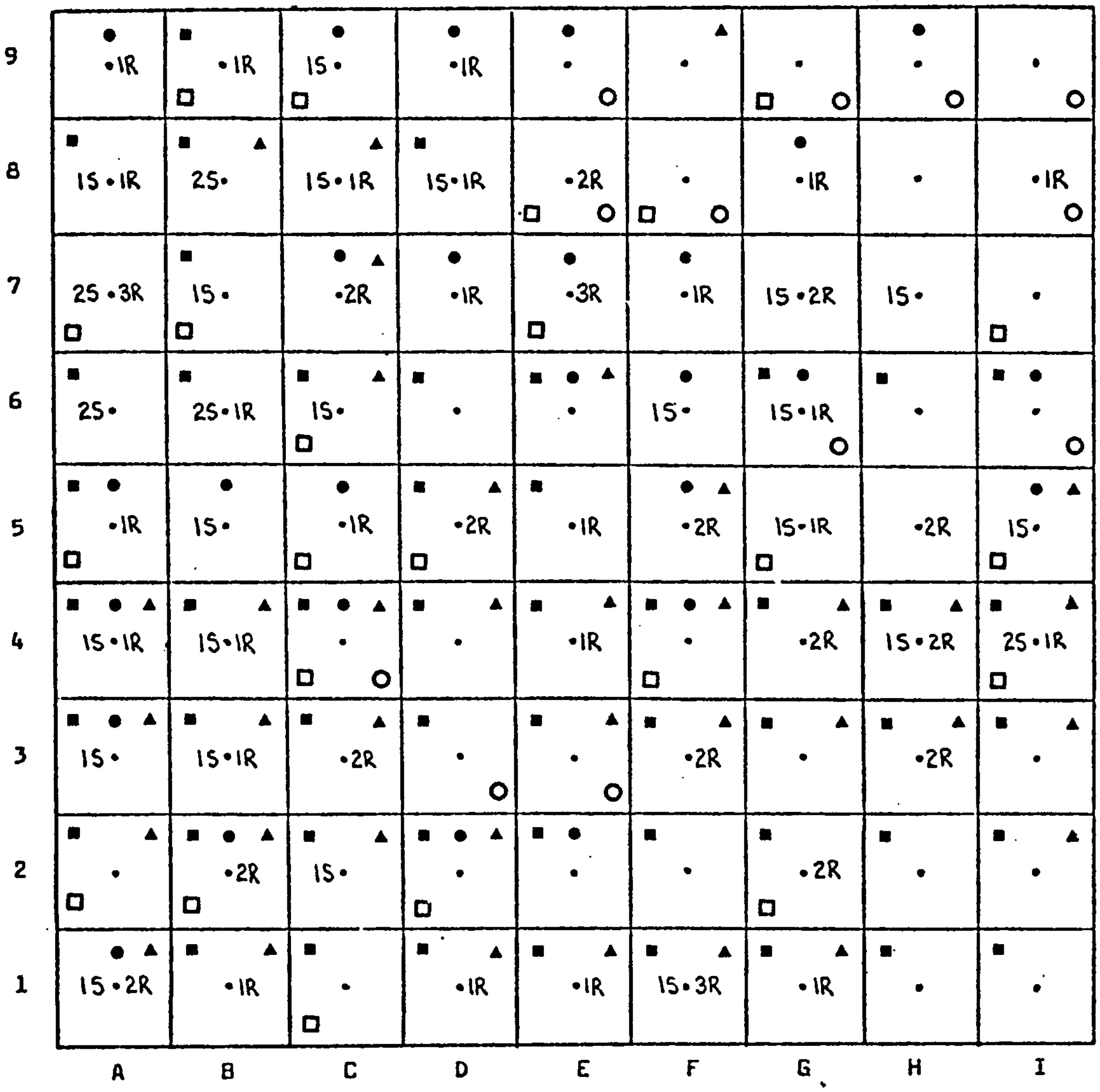
■ = Above average *Schizachyrium scoparium*

● = Above average *Solidago* spp.

□ = Above average *Andropogon glomeratus*

○ = Above average *Sapium sebiferum*

FALL-FIELD IV-CONTROL



▲ = Above average <u>Baccharis hamilifolia</u>

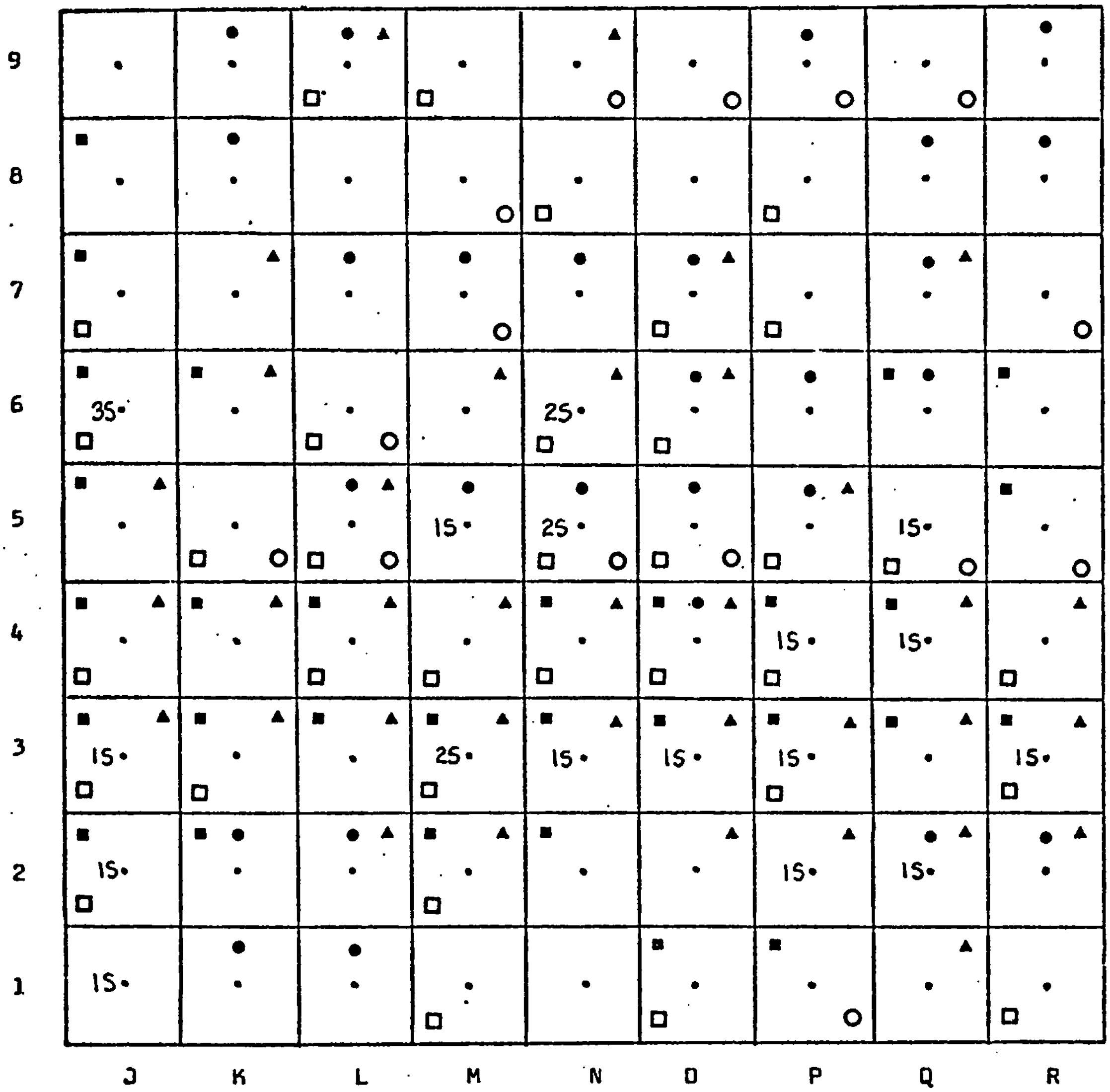
■ = Above average <u>Schizachyrium scoparium</u>

● = Above average <u>Solidago</u> spp.

□ = Above average <u>Andropogon glomeratus</u>

○ = Above average <u>Sapium sebiferum</u>

FALL-FIELD IVa-SIGMODON ONLY



▲ = Above average *Baccharis hamilifolia*
■ = Above average *Schizachyrium scoparium*
● = Above average *Solidago* spp.
□ = Above average *Andropogon glomeratus*
○ = Above average *Sapium sebiferum*

WINTER-FIELD II-REITHRODONTOMYS ONLY

	A	B	C	D	E	F	G	H	I
9	•	•1R	• □	• □	•	■ ▲ •4R	■ •1R □	● •1R □	•2R
8	• ○	•1R	▲ •2R	■ • □	■ •2R	■ ▲ •1R ○	■ •2R □	▲ •1R	■ ▲ •1R
7	•2R	▲ • □	•3R □	■ • ○	■ •	■ ▲ •1R □	▲ • □	▲ •5R	■ ● ▲ •2R
6	▲ •3R	▲ •	■ ▲ •	■ ▲ •4R	■ ▲ •1R	■ •	■ •2R	■ •2R □ ○	■ •3R □
5	▲ •	■ •3R □	•1R	■ ● •	■ ▲ •5R □	■ ▲ •1R □	■ •2R	■ •3R	•2R □ ○
4	•3R	■ ▲ •2R	■ ▲ •3R	■ ▲ •2R □	■ ▲ •1R	■ ▲ •2R	■ • □	■ ▲ •1R	■ ▲ •2R
3	■ ▲ •1R	■ ● ▲ •5R	■ ▲ •3R	■ ▲ •6R	▲ •2R	■ ▲ •1R	▲ •1R □	■ •	■ ▲ •4R
2	•2R	■ •1R	▲ •2R	■ ▲ •3R	■ ▲ •3R	■ ▲ •2R	■ ▲ •4R	■ ▲ •5R	•1R
1	▲ •2R □	• □	■ •1R	■ •1R	■ •1R	■ •1R	■ •4R	■ ▲ •1R	■ •

▲ = Above average *Baccharis hamilifolia*

■ = Above average *Schizachyrium scoparium*

● = Above average *Solidago* spp.

□ = Above average *Andropogon glomeratus*

○ = Above average *Sapium sebiferum*

WINTER-FIELD IIa-CONTROL

	J	K	L	M	N	O	P	Q	R
9	▲ 1S•1R □	■ ● ▲ • □	● •4R □	■ •3R	▲ 1S•2R	1S•3R	2S•	•	•1R □
8	■ 1S•3R □	•5R □	•	● 2S•3R □	■ 2S•4R	● • □	▲ •	■ •	•
7	■ 3S• □	•2R	▲ •1R	2S•5R □	▲ •2R □	▲ 1S•6R □	•6R □	•1R	•1R
6	■ 1S•2R □	▲ 2S•1R □	■ ▲ •4R □	■ ● 1S•3R	● •4R □	■ 1S•2R	● ▲ 1S•2R □	•2R □	● •2R
5	•2R □	▲ 3S•2R □	■ 1S• □	■ • □	■ ● ▲ • □	■ ● 1S• ○	● ▲ 4S•2R	■ 1S•2R □	▲ •4R □
4	■ ▲ 2S•1R	● 1S•2R □	■ ● ▲ • □	■ ● ▲ 2S•	■ •3R	● ▲ 2S• □	■ 3S•1R	■ •1R	1S•2R ○
3	■ ● ▲ • □	● ▲ •3R	■ ▲ 2S•1R	▲ 1S•4R	■ ● 1S•5R □	● •3R □	■ ▲ 3S•4R □	■ 1S•1R	▲ •2R ○
2	▲ 1S•3R	■ ● ▲ 1S•3R	■ ● •5R	■ •1R □	■ ▲ 3S•1R	■ ● ▲ •3R	■ ● ▲ 2S•2R	■ ● •1R	▲ •2R □
1	▲ 1S•1R	■ ▲ 3S•1R	■ ● ▲ 1S•1R □	■ 2S•1R □	■ ▲ 1S•	1S•2R	■ 1S•1R □	■ 2S•1R □	■ 1S•2R □ ○

▲ = Above average *Baccharis hamilifolia*

■ = Above average *Schizachyrium scoparium*

● = Above average *Solidago* spp.

□ = Above average *Andropogon glomeratus*

○ = Above average *Sapium sebiferum*

WINTER-FIELD III-<u>REITHRODONTOMYS</u> ONLY

	A	B	C	D	E	F	G	H	I
9	•2R □	■ •2R □	• □ ○	■ ● •1R	■ • □	● • ○	● • □	● • □	•
8	•7R	■ •2R □	▲ • □	■ ● ▲ •3R □	● • □	■ ● •3R □	▲ •3R	● •5R	▲ •3R
7	•2R	● •2R □	▲ •6R □	● •1R	● •6R	•2R	● •	•9R	● •
6	•1R □	■ ▲ •1R □	■ ● •1R □	■ •1R □	■ • □	■ •3R □	● ▲ •5R	■ •1R □	● •2R
5	•5R □ ○	● •2R	▲ •4R □	■ • □	▲ •4R	■ ● ▲ •1R □	● •2R □	■ ● •3R □	● •
4	•3R □	■ ▲ •4R	▲ •2R □	● •5R □	■ ▲ •1R	■ ▲ •1R	■ ▲ •3R	■ ▲ •1R □	■ ▲ •5R
3	•2R □	■ •2R □	● ▲ •9R	● ▲ •3R	▲ •2R	▲ •5R	■ ● •5R	■ ▲ •3R	■ ▲ •4R □
2	•	■ •1R	■ •	■ ● •4R ○	■ ▲ •4R	▲ •3R	■ ▲ •2R □	■ •3R	•1R
1	•2R	•	• □	■ ▲ •1R	•1R □	■ ▲ •2R □	■ •2R □	▲ •3R	•1R □

▲ = Above average *Baccharis hamilifolia*

■ = Above average *Schizachyrium scoparium*

● = Above average *Solidago* spp.

□ = Above average *Andropogon glomeratus*

○ = Above average *Sapium sebiferum*

WINTER-FIELD IIIa-SIGMODON ONLY

	J	K	L	M	N	O	P	Q	R
9	■ ● •	■ ● 3S•	● 1S• □	2S• □	• □	■ 1S• □	● ▲ • □	•	• ○
8	■ 3S• □	● ▲ •	● 1S•	■ 1S• □	■ 1S• □	■ •	1S• □	■ • ○	● • ○
7	● ▲ • □	•	•	• □	• □	● 1S• □	1S• □	• ○	• ○
6	● • □	● 1S•	● ▲ •	● • □	● 1S• □	● 1S•	● •	▲ •	■ ● • □ ○
5	● 1S• □	● 1S•	● ▲ 1S• □	● •	● 1S•	•	● •	● • ○	•
4	● 2S•	● • □	● ▲ •	● •	● 1S•	● 1S•	● ▲ • ○	• □	• ○
3	1S• □	● ▲ • □	● 1S•	● •	● 1S•	● •	● • ○	● ▲ 1S•	■ •
2	● 1S•	● • □	● •	■ ● •	■ ● •	● ▲ •	● 1S• ○	■ ● •	• ○
1	1S•	● •	● 1S•	■ ● ▲ •	● 1S• ○	■ ▲ •	■ ▲ •	■ ● • ○	• ○

▲ = Above average Baccharis hamilifolia

■ = Above average Schizachyrium scoparium

● = Above average Solidago spp.

□ = Above average Andropogon glomeratus

○ = Above average Sapium sebiferum

WINTER-FIELD IV-CONTROL

	A	B	C	D	E	F	G	H	I
9	● 1S•2R □	● 1S•1R □	2S•	•1R	•1R ○	▲ 2S•1R □	● 1S• □	● 2S•2R	•1R □
8	■ 2S•2R □	■ ▲ 5S•1R	•4R	■ 2S•2R □	• □	•4R □	● ▲ 4S•2R	•	•2R ○
7	■ ● ▲ 2S• □	■ ▲ 3S•1R □	■ ● •5R □	■ ▲ •1R	1S•1R □	▲ 3S•2R	▲ •1R	● ▲ •2R	1S•2R □
6	4S•1R □	■ ▲ 2S•2R □	■ 1S•2R	■ ▲ 1S•1R □	■ 3S•1R □	•2R	■ 2S•5R □	■ •	■ 1S•3R ○
5	■ ▲ 3S•6R □	● 3S• □	● •2R □	1S•1R □	● 2S•2R □	■ ● 1S•2R	1S•4R □	■ ● 1S•3R □	▲ •2R □
4	■ ● •3R □ ○	▲ 1S•8R □	■ ▲ •1R	■ ▲ 3S•4R	■ ▲ 1S•3R	▲ 2S•1R	■ ▲ 1S•5R □	■ ▲ •1R	■ ▲ 5S•2R
3	■ •3R □	■ ▲ 2S•3R	■ ▲ 2S•3R	■ ▲ 2S• ○	■ ▲ •2R	■ ▲ •3R	■ ▲ 1S•1R	▲ 2S•7R □	■ ▲ •2R
2	▲ 4S• □	■ ▲ 3S•5R	■ ▲ •1R	■ ▲ 3S•1R	■ ▲ 1S• □	■ 3S•2R	■ •	■ ▲ •	■ ▲ 1S•
1	■ •3R □	■ ▲ •2R	■ •2R	● •2R □	■ ▲ 1S•	■ ▲ •2R	■ 2S•2R	•1R	■ 1S•

▲ = Above average *Baccharis hamilifolia*

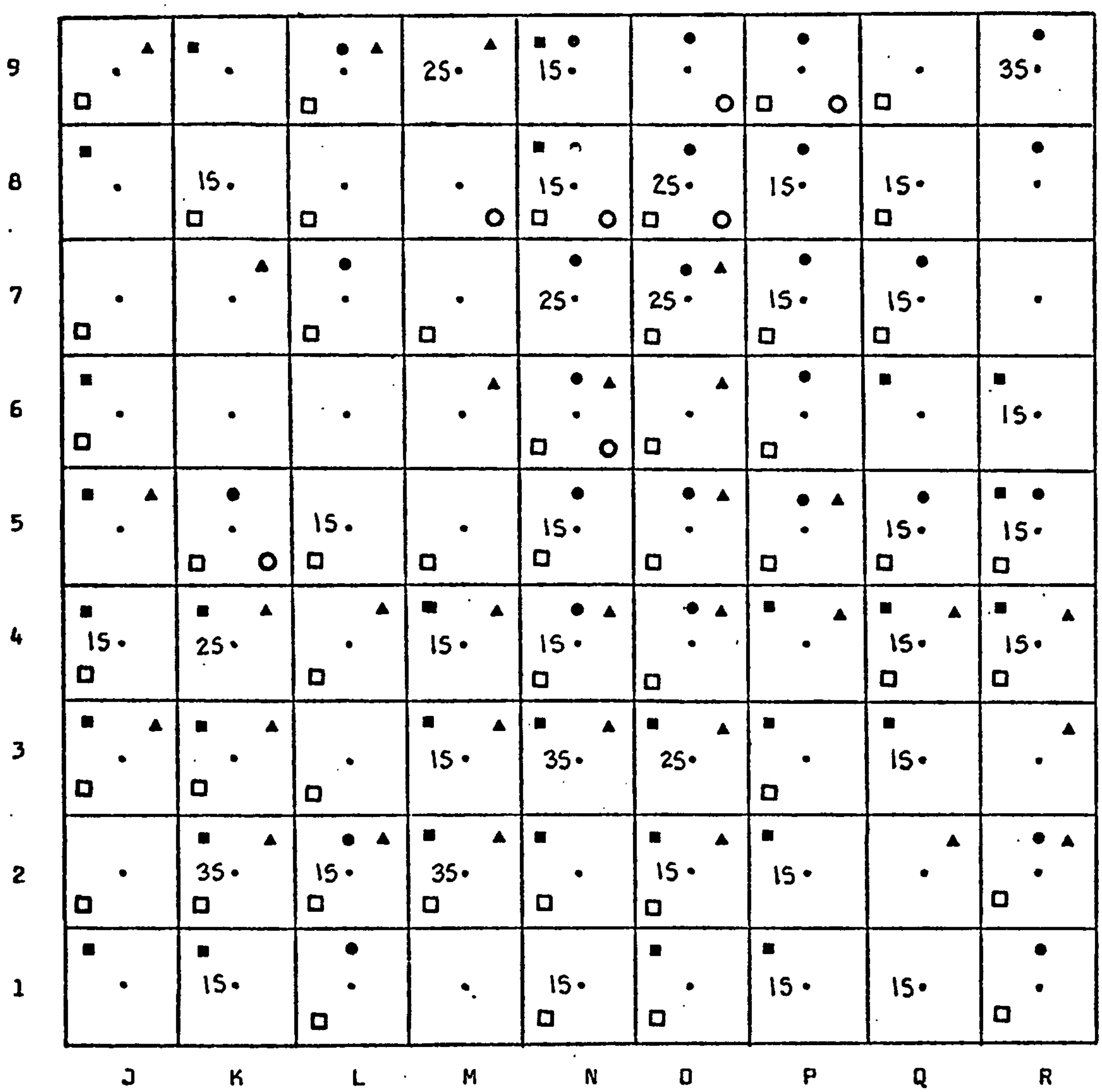
■ = Above average *Schizachyrium scoparium*

● = Above average *Solidago* spp.

□ = Above average *Andropogon glomeratus*

○ = Above average *Sapium sebiferum*

WINTER-FIELD IVa-SIGMODON ONLY



▲ = Above average Baccharis hamilifolia

■ = Above average Schizachyrium scoparium

● = Above average Solidago spp.

□ = Above average Andropogon glomeratus

○ = Above average Sapium sebiferum

SPRING-FIELD II-*REITHRODONTOMYS* ONLY

	A	B	C	D	E	F	G	H	I
9	•	•	•	•	•	▲ •1R □	▲ •2R □	■ ● ▲ •1R	■ ▲ •1R
8	• ○	■ •	● ▲ •2R	■ •2R	■ ▲ •	■ ▲ • □	■ ● •1R □	■ ▲ •2R □	■ ▲ • □
7	•	▲ •	•2R	■ •1R	■ •	▲ •2R	● •	● ▲ •4R	● •1R
6	● •3R	■ ● •1R ○	■ • □ ○	■ ▲ •2R	■ ▲ •	■ ▲ •	■ ▲ •3R	▲ • □	■ ● •1R
5	● ▲ •1R	■ ● ▲ •3R	•	• ○	■ ▲ •2R	■ ● •1R	■ ▲ •	■ •2R □	•2R □ ○
4	▲ •1R	■ ▲ •1R	■ ▲ •1R	■ ▲ •2R	▲ •2R ○	■ ▲ •2R	■ • □	■ ▲ •	■ ▲ •2R
3	■ ▲ •	▲ •3R	■ ▲ •3R	▲ •	■ ● •	■ ▲ •1R	•2R □	■ • □	■ ▲ • □
2	■ •2R	■ ▲ •1R	■ ▲ •1R	■ ▲ •2R □	■ ▲ •1R	■ ▲ •	■ ▲ •2R	■ ▲ •	• □
1	■ •	■ •	■ •1R	■ •	■ •1R	■ •	■ •1R ○	■ •2R	■ •

▲ = Above average *Baccharis hamilifolia*

■ = Above average *Schizachyrium scoparium*

● = Above average *Solidago* spp.

□ = Above average *Andropogon glomeratus*

○ = Above average *Sapium sebiferum*

SPRING-FIELD IIa-CONTROL

	J	K	L	M	N	O	P	Q	R
9	● ▲ •	● ▲ •2R	•1R	■ ● ▲ • ○	•1R	•1R	● •1R □	•	● ▲ • ○
8	● ▲ •2R	1S•1R	● ▲ •	■ ▲ •2R	■ ▲ •2R	● • ○	▲ • ○	■ ● • ○	•
7	■ ▲ •4R	•1R	•4R □	▲ •1R	▲ •1R	•5R	•	•	•3R
6	•1R	1S•	■ •1R	■ ● ▲ 2S• □	● •3R	■ ● ▲ 1S• □	● •1R □	▲ •1R ○	● ▲ •
5	■ • □	● 2S•1R	• □	1S•1R	● •2R	● • □	■ ▲ 1S•1R	▲ •1R	•1R ○
4	■ ▲ • □	■ ▲ •1R	■ ● • □	▲ •2R	● 1S•1R	● ▲ 1S•3R □	■ ▲ •2R	■ ▲ •2R	● •3R ○
3	■ ▲ 1S•1R □	● •	•2R	● ▲ •6R	● ▲ •1R	● ▲ 1S•2R	■ 1S• □	■ ▲ 1S•2R □	•1R □ ○
2	▲ •1R	● ▲ •1R	■ ● •2R	■ • □	■ •3R	■ ● ▲ •2R	■ ▲ •3R	■ •	1S•6R □
1	■ •1R	■ ▲ 1S•1R	■ •1R	■ 1S•1R	■ ▲ 1S•1R	•3R □	■ 2S•	■ •2R ○	•1R ○

▲ = Above average Baccharis hamilifolia

■ = Above average Schizachyrium scoparium

● = Above average Solidago spp.

□ = Above average Andropogon glomeratus

○ = Above average Sapium sebiferum

SPRING-FIELD III-*REITHRODONTOMYS* ONLY

	A	B	C	D	E	F	G	H	I
9	● •	•2R	▲ •	■ ▲ • □	■ •1R □	● • □	● • ○	● •1R	■ • □
8	•	•	•2R □	■ ● •	• □	● •	● •	▲ •2R	▲ •1R
7	▲ •	▲ •1R	•3R	■ ● •	● ▲ •1R	•	● •2R	● •	● •
6	■ •1R	■ •1R	■ • □	■ •2R	•1R	▲ •1R	■ •1R	● •1R □	● •2R
5	■ ▲ •1R	▲ •2R □	•	■ ● •1R	▲ •	■ ▲ • □	● •	•	● ▲ •2R
4	▲ •1R □	■ ▲ •	■ ▲ •	● ▲ •1R	▲ •1R	■ •1R	■ ▲ •2R	● ▲ •	■ ▲ •
3	• □	■ •2R □	■ •2R	■ ▲ •2R	● ▲ •1R	● ▲ • □	● ▲ •1R	■ ▲ •	■ ● ▲ •1R
2	•	■ •1R	▲ •	■ •2R ○	■ ▲ •	■ ▲ •	■ ▲ • □	■ ▲ •2R	■ ▲ • □
1	•	•1R	■ •	•2R ○	■ •	■ •	■ ▲ •2R	•	■ •

▲ = Above average *Baccharis hamilifolia*

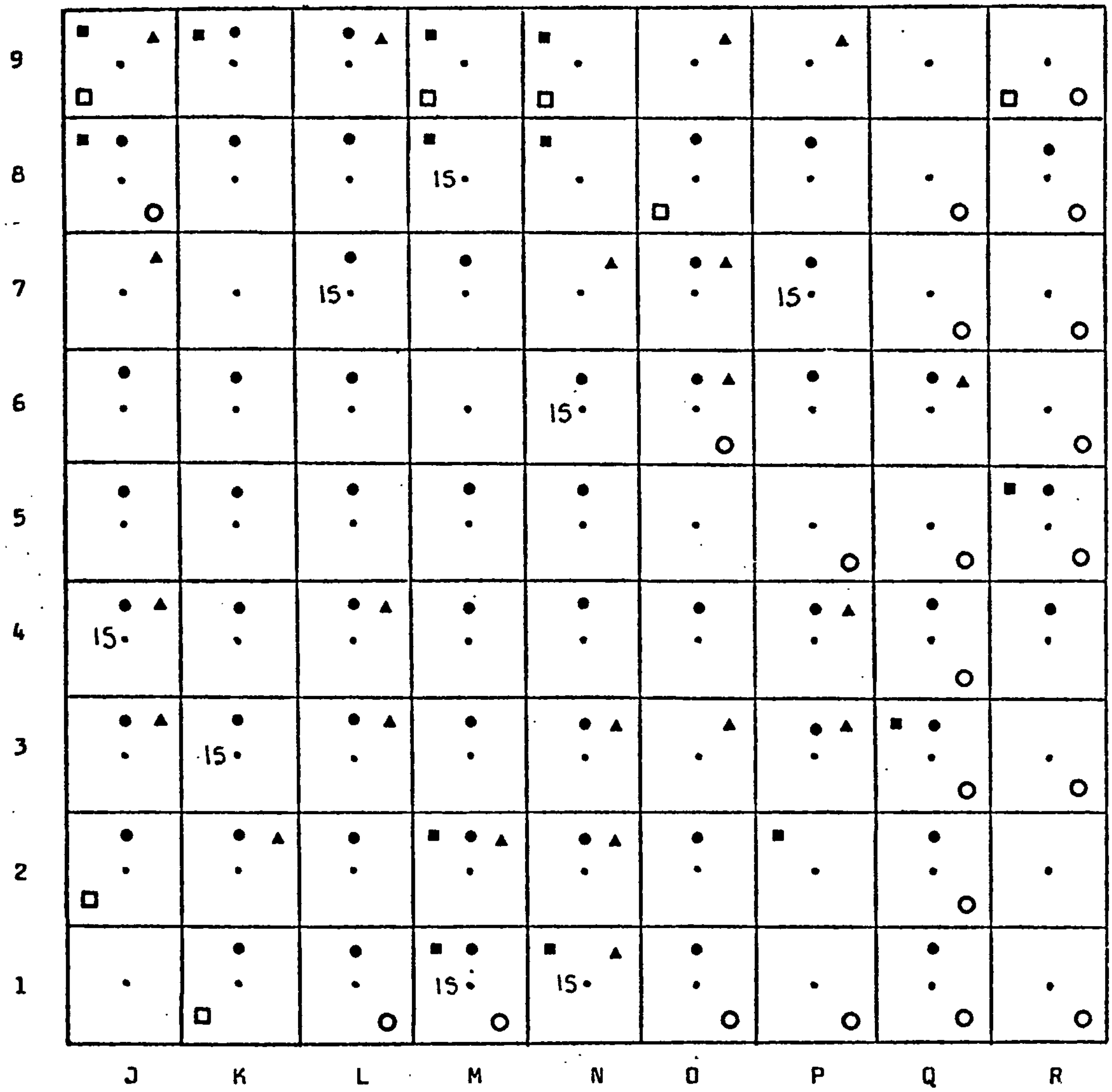
■ = Above average *Schizachyrium scoparium*

● = Above average *Solidago* spp.

□ = Above average *Andropogon glomeratus*

○ = Above average *Sapium sebiferum*

SPRING-FIELD IIIa-SIGMODON ONLY



▲ = Above average *Baccharis hamilifolia*
■ = Above average *Schizachyrium scoparium*
● = Above average *Solidago* spp.
□ = Above average *Andropogon glomeratus*
○ = Above average *Sapium sebiferum*

SPRING-FIELD IV-CONTROL

9	● 1S •1R	■ •1R	■ •2R	● •1R	■ ▲ • ○	● •1R	● 1S•2R	• ○	•
8	■ 1S•	■ ▲ 1S•	● ▲ •3R	▲ •2R	•1R	•	● 1S•	•	• ○
7	■ ● •1R	■ 1S•	● •2R	■ ● •	● •2R	● •4R	● •2R	● 1S•	1S •1R
6	2S •3R	■ ▲ •	■ ▲ 1S •2R	■ 1S •2R	■ ● ▲ 1S•	● 1S •1R	■ ● • □ ○	•	● ▲ •1R
5	■ ▲ •3R	● •4R ○	● •	■ ▲ •2R	■ ▲ •1R	● •	•	● •	•3R □
4	■ ● •1R	■ •1R ○	■ ● ▲ •4R	■ ▲ •	▲ •2R	■ ▲ •2R	■ ▲ •	■ ▲ 2S•2R	■ ▲ •1R
3	■ •	■ ▲ •1R	■ •3R	■ •1R ○	■ ▲ 1S•1R	■ ▲ •1R	■ ▲ 1S •1R	■ ▲ •1R	■ ▲ 1S •1R
2	■ •4R	■ •2R ○	■ ● ▲ •1R	■ ▲ •2R ○	■ ▲ •	■ ▲ •1R	■ ▲ •	■ •	■ ▲ •3R
1	● •	■ ▲ 1S •2R	■ ▲ •1R	■ ▲ •1R	•3R ○	■ •3R	■ ▲ • □	■ •	■ •1R
	A	B	C	D	E	F	G	H	I

▲ = Above average Baccharis hamilifolia

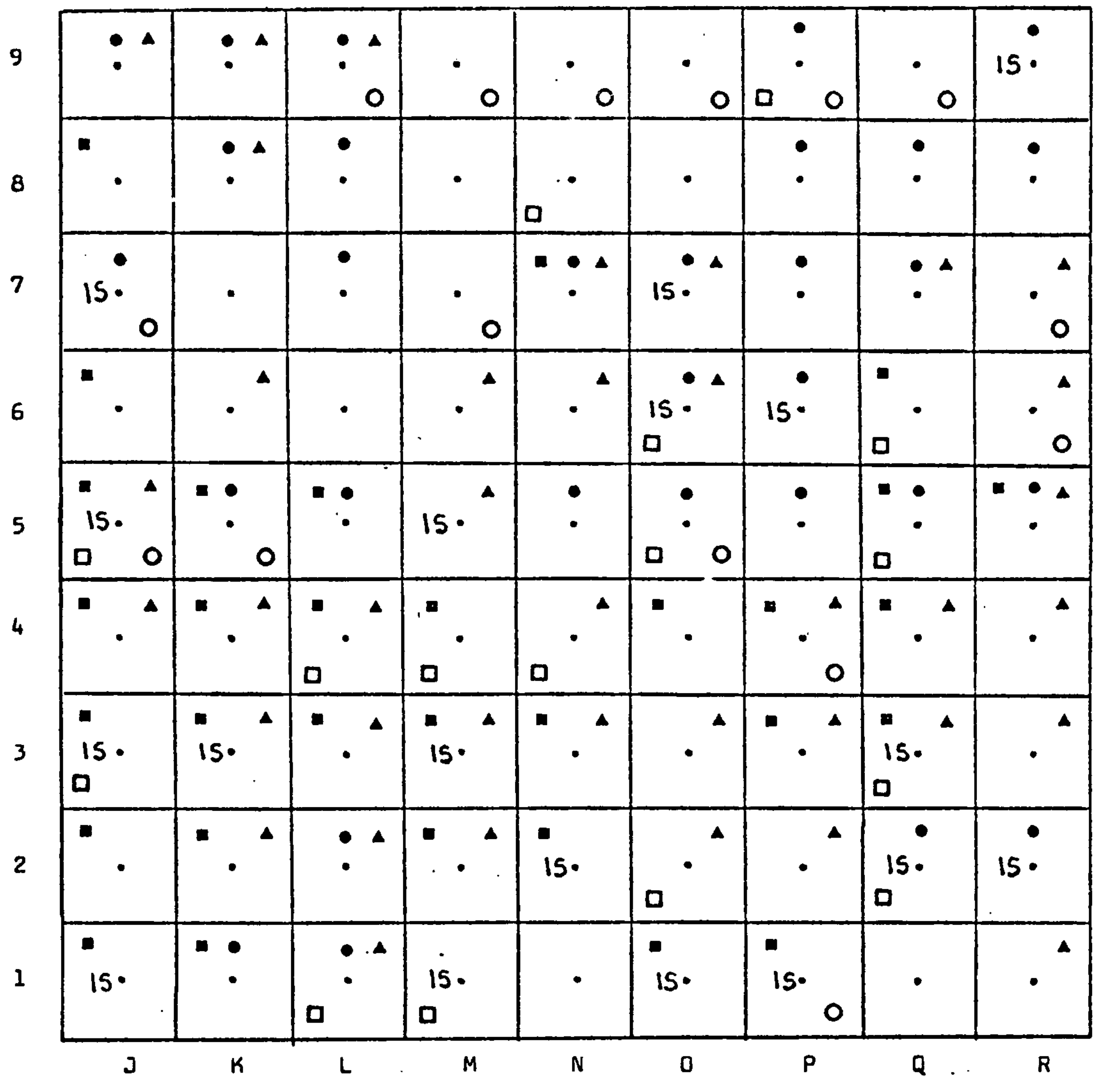
■ = Above average Schizachyrium scoparium

● = Above average Solidago spp.

□ = Above average Andropogon glomeratus

○ = Above average Sapium sebiferum

SPRING-FIELD IVa-SIGMODON ONLY



▲ = Above average Baccharis hamilifolia

■ = Above average Schizachyrium scoparium

● = Above average Solidago spp.

□ = Above average Andropogon glomeratus

○ = Above average Sapium sebiferum

APPENDIX 2

Principal Components using Rotated Factor Loadings from the Principal Components Analysis run on each season separately.

ROTATED FACTOR LOADINGS

ENTERED INTO PRINCIPAL COMPONENTS PROGRAM

	Summer			Fall			Winter			Spring		
	1	2	3	1	2	3	1	2	3	1	2	3
Rubus	.55	.14	-.32	.85	-.07	-.14	.09	.85	.17	.52	-.18	.33
Solidago	.98	.07	.20	.80	.29	-.47	.96	.24	.12	.86	-.47	.13
Baccharis	-.96	-.15	-.07	-.84	.07	.51	-.97	-.12	-.07	-.94	.32	-.02
Ampelopsis	.89	-.12	-.20	.92	.12	.12	.90	.06	.06	.89	-.11	.32
Eupatorium	-.12	.97	-.05	-.20	-.95	-.14	.70	.04	-.70	.08	-.24	.94
Sapium	.66	-.04	.75	.26	.10	-.94	.76	-.20	.53	.68	-.58	.34
Schizachyrium	-.72	-.58	-.24	-.84	.03	.51	-.98	-.13	-.04	-.99	.11	-.07
Andropogon	-.28	.79	-.54	.24	-.95	.16	.04	.91	-.27	-.16	.96	-.22
Spartina	-.78	.23	-.42	-.29	-.12	.79	-.28	-.16	-.94	-.43	.88	-.18
Bare Ground	-.53	-.81	.11	-.11	-.43	-.86	.96	-.17	-.03	-.62	.[illegible]9	-.68
Ambrosia	.71	.62	.30	.48	-.52	-.55	.77	.33	.19	.67	-.04	.68
Graminoid	-.14	-.07	.98	-.93	.29	.13	-.11	-.96	-.16	.04	-.66	.73

CORRELATION MATRIX

		1	2	3	4	5	6	7	8	9	10	11	12
1.	*Rubus*	1.00											
2.	*Solidago*	.23	1.00										
3.	*Baccharia*	.30	-.18	1.00									
4.	*Ampelopsis*	.84	.26	-.19	1.00								
5.	*Eupatorium*	.19	-.62	.40	-.06	1.00							
6.	*Sapium*	-.58	.06	-.52	-.47	.10	1.00						
7.	*Schizachyrium*	.73	.18	.28	.71	-.19	-.79	1.00					
8.	*Andropogon*	.30	.46	-.66	.66	-.48	-.08	.15	1.00				
9.	*Spartina*	.59	-.35	.45	.39	.41	-.63	.28	.10	1.00			
10.	Bare Ground	.97	.36	.30	.82	.14	-.52	.75	.26	.44	1.00		
11.	*Ambrosia*	-.60	.15	-.77	-.14	-.47	.53	-.40	.38	-.55	-.55	1.00	
12.	Graminoid	.47	.55	.45	.09	.00	-.10	.20	-.14	.06	.54	-.63	1.00

UNROTATED FACTOR MATRIX

Factor		1	2	3
Summer	1	.95	.16	-.04
	2	.16	.68	.67
	3	.52	-.72	.27
Fall	1	.72	.56	-.32
	2	.17	-.72	-.26
	3	-.76	.05	.24
Winter	1	.80	.24	-.06
	2	.14	.87	-.29
	3	.65	-.30	-.48
Spring	1	.92	.22	.10
	2	-.73	.56	-.21
	3	.50	-.07	.80

ROTATED FACTOR MATRIX

Factor		1	2	3
Summer	1	.94	-.18	.13
	2	.15	.18	.94
	3	.22	-.90	-.11
Fall	1	.90	.35	.09
	2	.04	-.52	-.59
	3	-.76	.20	.16
Winter	1	.82	-.06	.14
	2	.43	.79	.22
	3	.65	-.25	-.51
Spring	1	.89	-.20	.28
	2	-.48	.81	.05
	3	.25	-.61	.68

FACTOR SCORES

Plant Variable	1	2	3
Rubus	.87	.68	-.05
Solidago	1.23	-.16	-.40
Baccharis	-1.35	-.03	-.58
Ampelopsis	.94	.14	-.19
Eupatorium	-.28	-.35	2.23
Sapium	1.08	-1.03	-.61
Schizachyrium	-1.25	.01	-.99
Andropogon	-.13	1.85	.74
Spartina	-1.32	.73	.37
Bare Ground	.06	.53	-1.62
Ambrosia	.93	-.13	.88
Graminoid	-.78	-2.24	.23

APPENDIX 3.

Seasonal communalities for the twelve plant variables.

SUMMER

	ORIGINAL	FINAL	DIFFERENCE
Rubus	.430	.430	.000
Solidago	.997	.997	.000
Baccharis	.947	.947	.000
Ampelopsis	.855	.855	.000
Eupatorium	.951	.951	.000
Sapium	.996	.996	.000
Schizachyrium	9.17	.917	.000
Androgopgon	.985	.985	.000
Spartina	.839	.839	.000
Bare Ground	.955	.955	.000
Ambrosia	.986	.986	.000
Graminoid	.988	.988	.000

FALL

	ORIGINAL	FINAL	DIFFERENCE
Rubus	.753	.753	.000
Solidago	.949	.949	.000
Baccharis	.972	.972	.000
Ampelopsis	.875	.875	.000
Eupatorium	.970	.970	.000
Sapium	.974	.974	.000
Schizachyrium	.956	.956	.000
Andropogon	.981	.981	.000
Spartina	.718	.718	.000
Bare Ground	.943	.943	.000
Ambrosia	.809	.809	.000
Graminoid	.964	.964	.000

WINTER

	ORIGINAL	FINAL	DIFFERENCE
Rubus	.758	.758	.000
Solidago	.989	.989	.000
Baccharis	.966	.966	.000
Ampelopsis	.828	.828	.000
Eupatorium	.981	.981	.000
Sapium	.976	.976	.000
Schizachyrium	.982	.982	.000
Andropogon	.899	.899	.000
Spartina	.979	.979	.000
Bare Ground	.943	.943	.000
Ambrosia	.740	.740	.000
Graminoid	.964	.964	.000

SPRING

	ORIGINAL	FINAL	DIFFERENCE
Rubus	.415	.415	.000
Solidago	.975	.975	.000
Baccharis	.980	.980	.000
Ampelopsis	.907	.907	.000
Eupatorium	.942	.942	.000
Sapium	.913	.913	.000
Schizachyrium	.992	.992	.000
Andropogon	.999	.999	.000
Spartina	.996	.996	.000
Bare Ground	.880	.880	.000
Ambrosia	.910	.910	.000
Graminoid	.976	.976	.000