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Local Ecology Research Papers

An Ecological Analysis of a Prairie Restoration Project on the St. Olaf College Campus, Northfield, MN

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Biology 62: Field Ecology
Dr. Kathy Shea

To make a prairie it takes a clover
and one bee, -
And revery.
The revery alone will do
If bees are few.

- Emily Dickinson

(Found in John Madson's Where the Sky Began)

Abstract

In this study, the species composition of a prairie restoration area was compared to that of a nearby field undergoing secondary succession. Only one species was found to be common to both areas. Seven species were unique to the prairie and ten were unique to the field. It is likely that the species present in the prairie are due to the reintroduction of prairie species. The absence of field species from the prairie may be due to the prairie's spatial separation from other successional fields. In order to maintain native prairie community species, it was recommended that the prairie be burned every 2 to 3 years.

Introduction

One characteristic of prairie ecosystems is that they are dominated by grasses. The question of why one area is dominated by a particular class of organisms is an old one, but in the case of prairies, the answer is likely older still. Prairies have their origin 25 million years ago in Tertiary times (Weaver, 1954). They are a product of the uplift of the Rocky Mountains. In the shaping of the landscape of the North American continent this event was a very significant one. Rising to over 14,000 feet in places, the Rockies pose a foreboding barrier to moisture moving east from the Pacific in the prevailing Westerly winds. Unable to make the climb over the mountains without freezing and precipitating, moisture is left on the west side of the Rockies while the wind continues its eastward journey. The climate produced by the dry wind that blows down on the east side of the Rockies made tree growth on the plains impossible and led to the ultimate recession of forests in this region. Thus, the contemporary prairies are pre-glacial in origin. Figure 1 shows the geographical location of the major grasslands, or prairies, in the United States.

As figure 2 indicates more clearly, the Mid-continental Prairie is by no means inferior to the Rockies in magnitude. In fact, not long ago, there were approximately 700 million acres of prairie in the United States (Lemon, 1970). Despite their late arrival on the plains (Dix, 1975), native tribes quickly acculturated and learned to make use of the diversity of organisms such a large area provided (Shay, 1986; Anfinson,

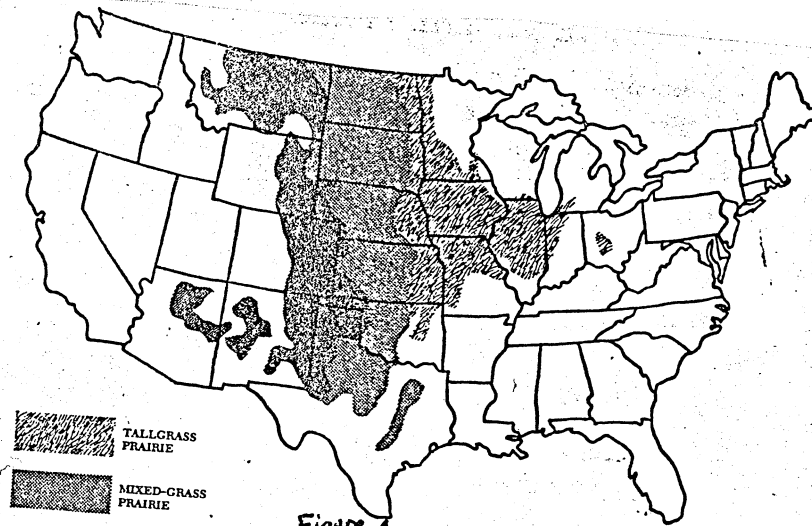


Figure 1
MAJOR GRASSLANDS
OF THE UNITED STATES

(from Madson, 1982)

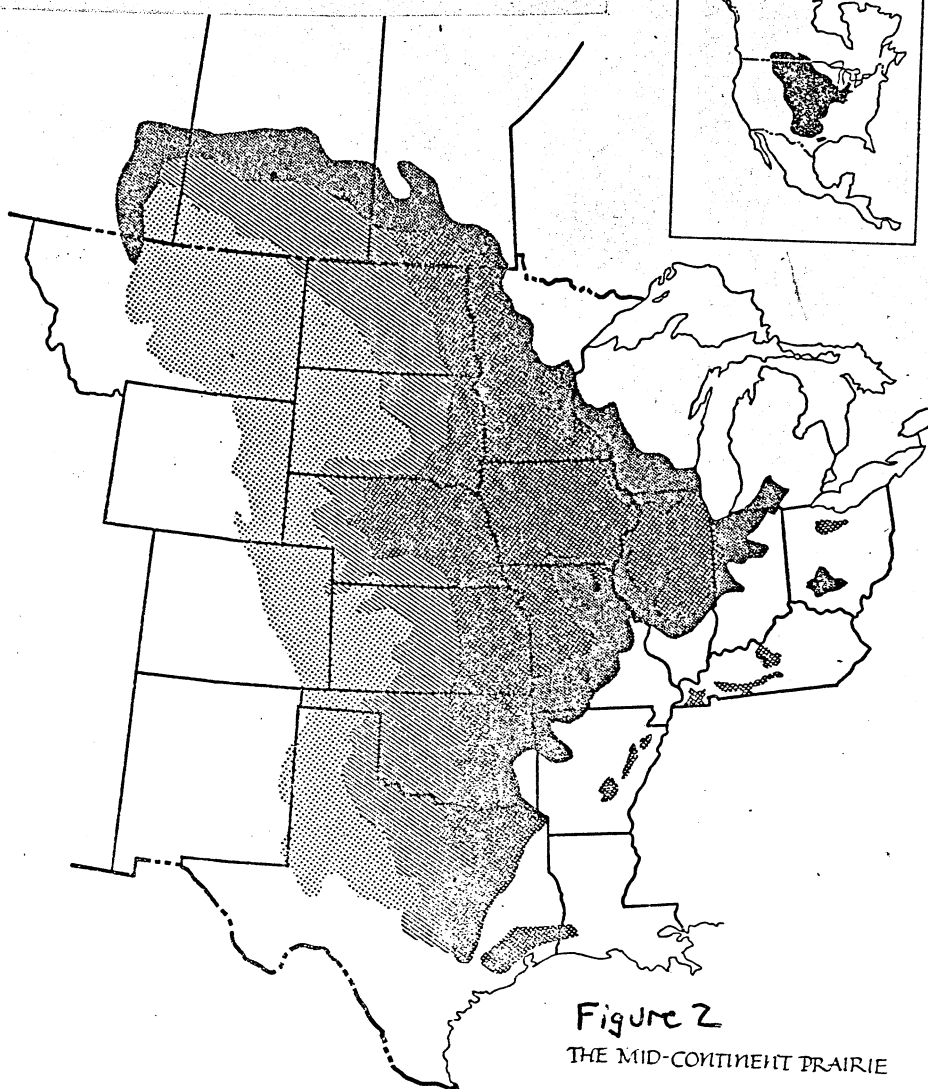





Figure 2
THE MID-CONTINENT PRAIRIE

-  Mixed-Grass Prairie
-  Transition Prairie
-  Tallgrass Prairie

(from Castello, 1969)

1986). Likewise, European colonists awed by such seemingly infinite grassland (Madson, 1982), were quick to settle the plains. Most of the prairies shown in Figures 1 and 2 have been turned into agricultural regions within the last 120 years (Wagner, 1975).

Michael Soule refers to "conservation biology" as a crisis discipline (Soule, 1985), and it seems that few areas are in need of its application more than the prairie. Despite the vastness of the one time prairie, there now remain only remnants, and every day these are threatened by further development. Schwarzmeier (1973) has suggested that a new regulatory agency be formed in order to protect prairie areas from ultimate destruction. He notes that alongside development, competition from introduced species is a significant threat to remaining prairies. Wagner (1975) points out that it is not merely the nostalgia of the prairie that needs to be preserved, but a wealth of evolutionary history. He notes that in prairies many species of grass, forbs, insects, and animals have evolved together over thousands of years and are well adapted to the prairie environment.

One attempt to preserve prairies and their inhabitant species is found in restoration projects. In many areas prairie restoration efforts have resulted in acres of land being set aside as preserves and prairie species being re-introduced. One such project was started on one third of an acre of land on the St. Olaf College Campus in Northfield, Minnesota (Wedin, unpublished).

This study set out to evaluate the effectiveness of St. Olaf's restoration project. In order to do this, the current species composition of the "prairie" was compared to that of a nearby field. The field was undergoing secondary succession and contained a number of "weed" species. It was therefore a good control area with which to compare the prairie. Due to the lack of management of the St. Olaf Prairie, it was expected that a fair number of species would be found in common to the two areas. The null hypothesis being tested was:

Ho: Species composition of the "prairie" is the same as that of a neighboring field.

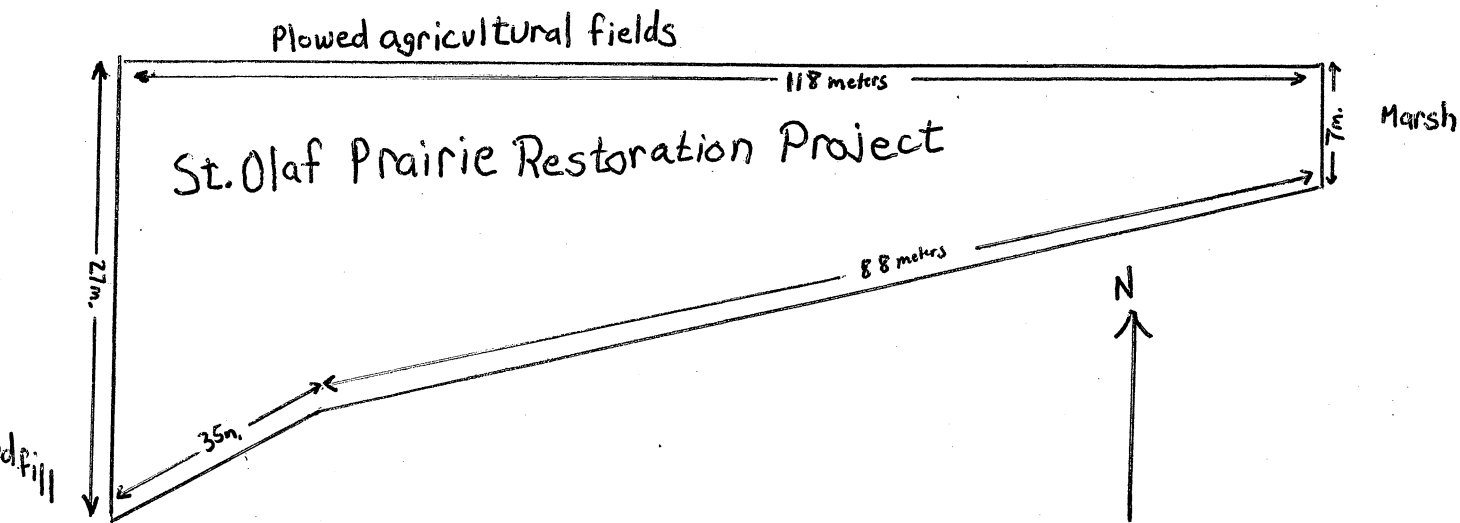
By examining this hypothesis, a determination could be made as to whether the restoration area had truly unique species and could be rightfully be termed a prairie.

Methods

Figures 3 and 4 show the two areas sampled. Data on species composition were collected using the line-intercept sampling technique described in Brower and Zar (1984). In the prairie restoration area, four random transects of 50cm each were sampled. In the successional field, three randomly chosen transects were sampled. Two of these transects were five meters in length, but a shorter one of only two meters was also sampled. From the data obtained, importance values for each species were calculated according to the formulas in Brower and Zar (1984).

A sample of each species present was taken and brought back to the lab for identification. Identification was attempted using a number of taxonomic keys and field guides, but due to the

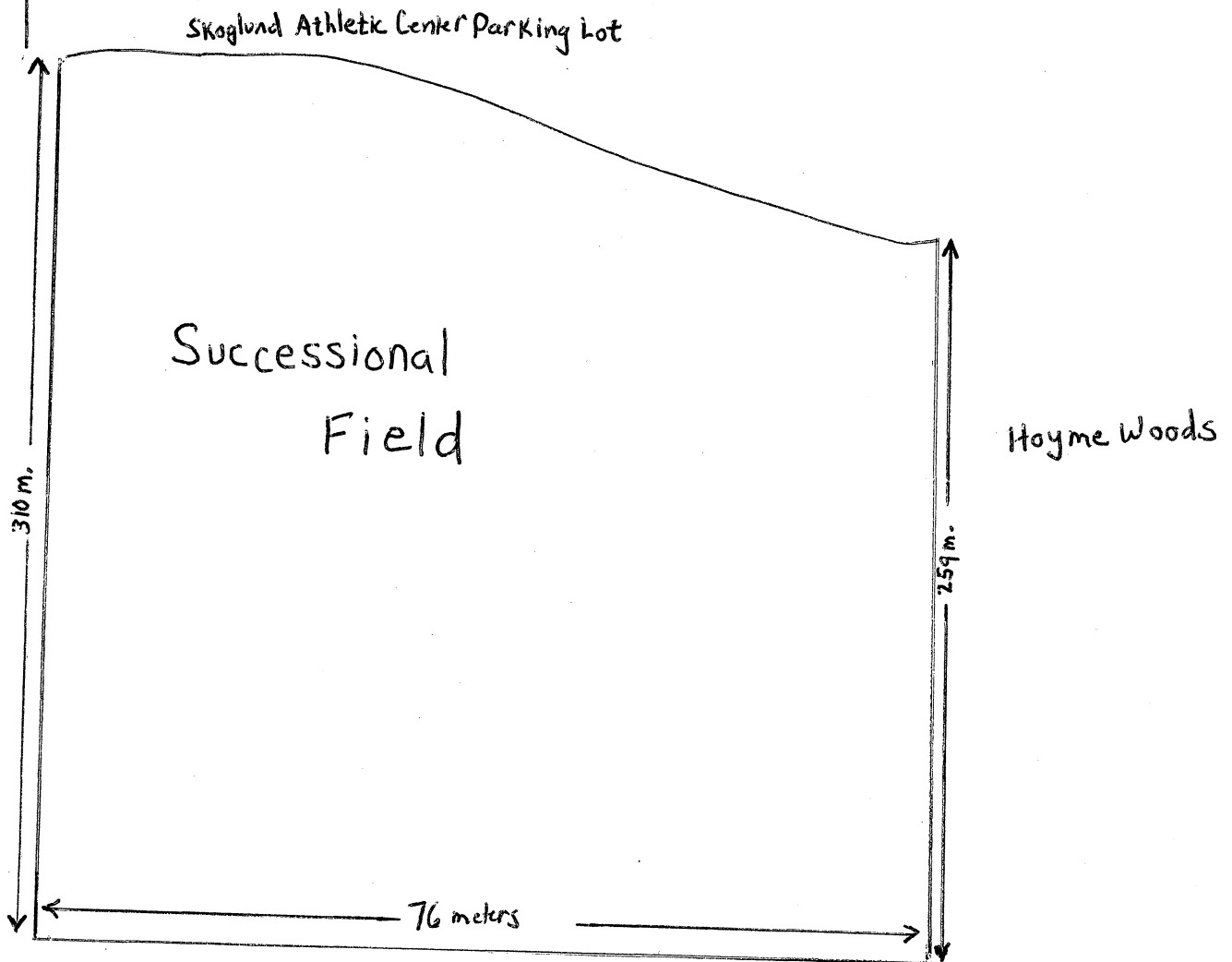
Figure 3 Map of the St. Olaf Prairie Restoration Project Area



Road to Skoglund
↓

Soccer Fields

Figure 4 Map of the Control Field Area



late season in which the plants were sampled, identification with any degree of certainty proved impossible.

Results

Table 1 summarizes the characteristics of each of the species collected and assigns each a label. Species will be referred to by their label throughout the remainder of this paper. Table 2 summarizes the importance values for the eight species found in the prairie. Likewise Table 3 lists the importance values for the 11 species found in the field.

Assuming that species B and Species L were both correctly assumed to be Aster spp., this was the only species found in common to the prairie restoration area and the field. The null hypothesis that there is no difference in the species composition of the two areas could therefore be safely rejected. A definite difference was found in which the prairie restoration area contained at least seven species not found in the field and the field contained at least ten species not found in the restoration area.

Although the importance values are not necessary to disprove the null hypothesis, it is interesting to note that both areas are dominated by one species of grass. In the prairie, species A was dominant and was assumed to be big bluestem (Andropogon gerardi), little bluestem (A. scoparius), or Indian grass (Sorghastrum nutans) for reasons which will be discussed later in this paper. In the field, species J was dominant and as Table 1 indicates, was assumed to be a species of foxtail.

Table 1 Some Characteristics of Species Found in the St. Olaf
Prairie Restoration Area and a Nearby Field

Species (Label)	Possible Taxonomic Group	Characteristics
A	<u>Andropogon gerardi</u> <u>Andropogon scoparius</u> <u>Sorghastrum nutans</u>	Grass. Tall, round stem, wide leaves.
B	<u>Aster spp.</u>	Composite flower. Round stem, whorled branching pattern.
C	<u>Hystrix spp.</u>	Grass. Thin fine hairs of spikelet, originating in clumps. Slender stalk.
D	<u>Labiatae fam.</u>	Square stem. Opposite branching. Seeds in seed pods which circle around stem in clusters.
E		Runner. Reddish color. Alternate leaves.
F	<u>Solidago spp.</u>	Thick, round stem. Whorled leaf arrangement.
G		Small runner. 11 lobes on leaves.
H		Tall. Round, hollow stem. Opposite branching. Seed clusters with elongated seeds-widest at middle.
J	<u>Setaria spp.</u>	Tall, slender stem. Fine, short hairs on spikelet.
K		Medium height. May have 2 types of seeds - small, cone shaped seeds on terminal raceme. diamond shaped seeds in clusters on stem.
L	<u>Aster spp.</u>	Composite flower. Low branching. Thin leaves.
M		Grass. Clumped. Terminal raceme.
N		Grass. Round stem. Hay scented. Terminal raceme.
O		Grass. Short. Reddish color. Condensed terminal raceme. No apparent leaves.
P	<u>Oxalis spp.</u>	Runner. 3 heart shaped leaves. Small.
Q		Very small runner.
R	<u>Plantago spp.</u>	Basal rosette. Longish leaves.
S.	<u>Cirsium spp.</u>	Wide, lobed leaf. Pointed spires at ends.
T		Black seeds at end of terminal raceme. Grass. Slender stalk, reddish in color. Elongated, oval shaped leaves.

Table 2 Importance Values for Species in Prairie

<u>Species</u>	<u>Importance Value</u>
A	1.7471
B	0.1126
C	0.3544
D	0.3696
E	0.1255
F	0.0811
G	0.1023
H	0.1071

Table 3 Importance Values for Species in Field

<u>Species</u>	<u>Importance Value</u>
J	1.8291
K	0.2147
L	0.1417
M	0.1531
N	0.2198
O	0.0617
P	0.0867
Q	0.0654
R	0.0708
S	0.0847
T	0.0619

Discussion

Since the null hypothesis was rejected, it is tempting to conclude that the restoration area, having only one species in common with the field, is a prairie. This conclusion, however, can not be made since no comparison of the restoration area to a known prairie was made. This may not be necessary if the species in the prairie restoration area could be identified as common prairie species. In order to make this identification, it would be best to sample the area during the summer when most species are in bloom and can easily be identified. For convenience, however, I will continue to refer to the area as the prairie.

One might ask why there are so few species common to the two areas. The different species compositions are most likely due to two factors. First, the prairie is after all a restoration project and prairie species have been reintroduced there (Wedin, unpublished). Prior to reintroduction, the area was part of the plowed field which now lies to the north of the prairie (Eugene Bakko, personal communication), and would therefore not have contained any of the field species. Second, the prairie is nestled between plowed farmland, a marsh, manicured athletic fields, and a landfill. It is not adjacent to any successional fields and therefore is less likely to receive many seeds from dispersal efforts of species in nearby fields.

It is likely that the reintroduction of prairie species in 1981 is directly responsible for the species composition in the prairie today. Since big bluestem, little bluestem, and Indian grass were the three grasses reintroduced (Wedin, unpublished),

species A is likely one of these. Why only one grass species was observed in the prairie is unclear, but may be attributable to error in sampling.

It is also possible that species A is not one of the three grasses mentioned above. Weaver (1954) discusses the competition between cool season and warm season grasses in prairie ecosystems. Native prairie species are generally warm season grasses which do not start to grow until later in the spring. Their largest increase in foliage is in midsummer and they flower and engage in seed production from midsummer through late autumn. Cold season grasses, such as the introduced Kentucky bluegrass (Poa pratensis), grow much earlier in the spring and show the greatest increase in foliage from late March to early June. Cold season grasses are therefore a competitive threat to warm season prairie species as they control space earlier. Often, if left to grow unchecked, they will replace prairie species.

Fortunately, the growth of cold season grass can be effectively halted. Fire has often been used for this purpose. Olson (1986) notes that burning in the late spring prevents cold species from flowering while leaving the still dormant warm season grasses unharmed. Svedarsky and Buckley (1975) support this point while noting that late spring burning can also be effectively used to control Aspen (Populus tremuloides) growth.

In order to effectively manage the St. Olaf prairie, late spring burnings should be scheduled every two to three years. This would not only discourage possible invasion by cold season grasses and neighboring (Garrigan, personal observation) Aspen

(P. grandidentata) seedlings, but would also increase the density of prairie grasses (Kucera, 1970). Kucera (1970) found that in the absence of fire, greater populations of Solidago spp., Aster spp. and Helianthus spp. develop. He attributes this to a build-up of litter which stagnates grass growth. He also found that burning at intervals of five or more years proved ineffectual in preventing litter accumulation. He suggests a three year interval is effective in maintaining grass dominance as well as maintaining species that are typical of native prairie communities. Lemon (1970) also suggests a two to five year interval.

Conclusion

It is clear that the two areas sampled have two distinctly different species compositions. This does not guarantee that those species found in the prairie restoration area are native prairie species and we can not therefore conclude that this area is a "prairie" without further sampling and comparison with species composition of a known prairie. It is likely, however, that the species present are due to the reintroduction of prairie species. In order to maintain these species, burning the prairie every two to three years in late spring is recommended.

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Prairie - 4^k transects (@ 50 cm each) = 2 meters

Species	n_i	SD_i	RD_i	j_i	f_i	RF_i	l_i	IC_i	$RC_i = \frac{l_i / \sum l_i}{\sum f_i / \sum f_i}$	IV_i
1 (A)	208	104	0.7591	3	0.75	.2308	238.3	1.1915	0.7572	1.7471
2 * (B)	3	1.5	0.0109	1	.25	.0769	7.8	0.0390	0.0248	0.1126
3 (C)	23	11.5	0.0839	3	.75	.2308	12.5	0.0625	0.0397	0.3544
4 (D)	23	11.5	0.0839	2	.50	.1538	41.5	0.2015	0.1319	0.3696
5 (E)	6	3	0.0219	1	.25	.0769	8.4	0.0420	0.0267	0.1255
6 (F)	1	0.5	0.0004 0.0036	1	.25	.0769	0.2	0.0010	0.0006	0.0811
7 (G)	4	2	0.0146	1	.25	.0769	3.4	0.0170	0.0108	0.1023
8 (H)	6	3	0.0219	1	.25	.0769	2.6	0.0130	0.0083	0.1071
	$\sum n_i = 274$	$\sum SD_i = 137$	$\sum RD_i = 0.9998$		$\sum f_i = 3.25$	$\sum RF_i = .999$	$\sum l_i = 314.7$	$\sum IC_i = 1.5735$	$\sum RC_i = 1.0$	$\sum IV_i = 2.9977$

Data Sheet 3B.3. Class Summary of Data from Line-Intercept Plant Sampling

Date _____ Observers _____

Habitat and stratum _____

 Locality Field West of Hoyne Woods

 Total transect length (L) 12 meters

 Total number of transect intervals 3

Species (i)	Number of individuals (n _i)	Linear density index (ID _i)	Relative density (RD _i)	Present in how many transect intervals? (j _i)*	$f_i = j_i / K$ K=3 Frequency (f _i)	Relative frequency (Rf _i)	Intercept length (l _i)*	Linear coverage index (IC _i)	Relative coverage (RC _i)	Importance value (IV _i)
1 (J)	319	26.5833	0.8668	3	1.0	0.1765	780.5 cm	0.6504	0.7858	1.8291
2 (K)	11	0.9167	0.0299	2	0.6667	0.1177	66.7	0.0556	0.0671	0.2147
3 (L)	4	0.3333	0.0109	2	0.6667	0.1177	13.0	0.0108	0.0131	0.1417
4 (M)	3	0.25	0.0082	2	0.6667	0.1177	27.0	0.0225	0.0272	0.1531
5 (N)	13	1.0833	0.0353	2	0.6667	0.1177	66.4	0.0553	0.0668	0.2198
7 (O)	1	0.0833	0.0027	1	0.3333	0.0588	0.2	0.0002	0.0002	0.0617
8 (P)	8	0.6667	0.0217	1	0.3333	0.0588	6.2	0.0052	0.0062	0.0867
9 (Q)	2	0.1667	0.0054	1	0.3333	0.0588	1.2	0.0010	0.0012	0.0654
10 (R)	4	0.3333	0.0109	1	0.3333	0.0588	11.3	0.0094	0.0011	0.0708
11 (S)	2	0.1667	0.0054	1	0.3333	0.0588	20.4	0.0170	0.0205	0.0847
12 (T)	1	0.0833	0.0027	1	0.3333	0.0588	0.4	0.0003	0.0004	0.0619
Totals	$\Sigma n = 368$	$\Sigma ID = 30.6666$	$\Sigma RD = 1.0$		$\Sigma f = 5.6666$	$\Sigma Rf = 1.0$	$\Sigma l = 993.3$	$\Sigma IC = 0.8277$	$\Sigma RC = 1.0$	