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Adding species diversity to a reconstructed prairie using an incremental approach

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ADDING SPECIES DIVERSITY TO A RECONSTUCTED PRAIRIE USING AN INCREMENTAL APPROACH

An Abstract of a Thesis

Submitted

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

Amy L. Carolan

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ABSTRACT

Plant species diversity in reconstructed prairies is extremely low when compared to that of prairie remnants. In this experiment I am testing the feasibility of increasing the abundance of native forbs in a reconstructed prairie using an incremental approach. The site chosen for this experiment is one that consists of five species of thirty-year old prairie grasses along with 23 species of native prairie forbs that were overseeded in 1999.

I hypothesized that forb diversity could be increased in an established grassland using an incremental approach, and that mowing would amplify the success of the planting. To test these ideas I overseeded 10 species of native forbs into 18, 12m x 15m experimental plots at a rate of 250 seeds/m^2. Each plot was then randomly assigned one of three mowing treatments: control, infrequently mowed, and frequently mowed, which were carried out for two consecutive growing seasons. I assessed the effects of the different mowing treatments on both the new species I seeded in 2003, the adult forbs that were seeded in 1999, as well as, the effects on the overall plant community.

While mowing did significantly increase the amount of light reaching the soil surface ($p=0.02$), and reduce the amount of accumulated leaf litter ($p<0.01$) improving the environment for young seedlings, mowing did not affect the number of new seedlings that emerged during any year of the study. Mowing also had no effect on seedling mortality over the 2003-2004 winter, or over the 2004 growing season. Mowing did, however, increase the size of two out of the four species selected for

study, *Parthenium integrifolium* ($p<0.01$), and *Dalea candidum* ($p=0.02$). *Aster laevis* and *Amorpha canescens* showed no difference in size due to mowing.

Mowing also had significant effects on the established plant community. Mowing significantly ($p<0.01$) increased the number of flowering stalks of cool season grasses (mainly *Poa pratensis*), but did not affect the number of warm season grass flowering stalks. Mowing significantly reduced the size of five-year-old adult plants of *Ratibida pinnata* ($p=0.01$), and *Solidago rigida* ($p<0.01$) however by 2005 there was no significant difference in the individual number of forbs found per m^2 when comparing mowing treatments. Infrequent mowing significantly ($p=0.02$) increased the amount of below ground root biomass as compared to controls, but no difference was found between control and frequently mowed treatments.

The overall plant community changed greatly during the experimental period, but the changes were not due to the mowing treatments. Species richness increased in all the plots from approximately 0.5 species/m^2 in 2003 to nearly one species/m^2 by 2005. The Shannon diversity index also increased from 1.8 in 2003 to 2.15 in 2005.

Based on the results of this study, I have concluded that it is possible to add forb diversity to a reconstructed prairie using an incremental approach (seven new forb species became established at the site during this experiment), but mowing may not be necessary during the second incremental seeding. The increase in species richness achieved here proves this method is effective for making prairie reconstructions more similar to the actual tallgrass prairie.

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This Study by: Amy L. Carolan

Entitled: Adding Species Diversity to a Reconstructed Prairie Using an Incremental Approach

has been approved as meeting the thesis requirement for the

Degree of Master of Science

5/15/06 Date	Dr. Laura L. Jackson, Chair, Thesis Committee
May 1, 2006 Date	Dr. Jean M. Gerrath, Thesis Committee Member
5/17/06 Date	Dr. Daryl D. Smith, Thesis Committee Member
7-18-06 Date	Dr. Susan J. Koch, Dean, Graduate College

DEDICATION

For Steve, Sherri, Bethany and Allison

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The retreat of the glaciers in North America nearly 10,000-12,000 years ago yielded a warm, dry climate, which eventually gave rise to the great prairie grasslands. The grasslands expanded over much of central North America, as far north as Canada as far south as Texas, as far west as Montana, Wyoming, Colorado and New Mexico, and as far east as Indiana. At the heart of this region was a type of grassland known as the tallgrass prairie (Clements 1920). The tallgrass prairie was comprised of many different species of grasses (most growing more than three feet tall) as well as a highly diversified assortment of prairie forbs. This diverse plant community, and the recent glacial till helped to form the most fertile soils in North America, a valuable resource that ultimately led to the prairies demise.

Upon European settlement in the tallgrass prairie region in the early 1800s, cultivation of the fertile soil beneath the prairie quickly occurred for agricultural purposes. In a span of approximately 100 years, 68 million hectares of tallgrass prairie were reduced to less than 5% of their original extent. (Samson and Knopf 1994, Smith 1998).

Recently, attempts have been made to begin reconstructing the tallgrass prairie. Unfortunately these sites often lack the species diversity, especially the forb diversity, which the original tallgrass prairie contained. The lack of species diversity in these plantings is the result of many factors, including but not limited to, the lack of forb seed availability at the time of planting, competition by exotic weeds, and a lack of disturbances by fire or grazing (Williams *et al.* in press). As a result, there are many tallgrass prairie reconstructions that lack species diversity. This fact has caused some researchers (Williams *et al.* in press) to focus on developing a method to enhance existing prairie plantings without plowing the up established vegetation, which can be detrimental to a site, because it can permit invasions by exotics, as well as increase chances of erosion.

Adding new species to an established plant community can be extremely difficult because many of the resources (i.e. light, water, and nitrogen) that a newly introduced small seedling needs to successfully become established in a mature plant community are already tied up in the surrounding large adult plants (Davis *et al.* 2000). Studies have shown that by creating disturbance-generated gaps in an established plant community, limited resources can be released, making the existing community more susceptible to invasion by new species (Williams *et al.* in press). Disturbance-generated gaps can be created through processes such as mowing, grazing or digging.

The use of mowing to increase species diversity by creating and maintaining gaps is the focus and method used in this study. Mowing was chosen as the method for gap creation as it is the most efficient method available at this time. Since mowing is an incomplete proxy for natural gap creation (mainly grazing) it does have some biological limitations, but overall mowing in an established plant community is an economically practical way to increase species diversity. Compared to grazing, mowing is relatively inexpensive, requires little management (no fences, water systems, or herd managers required), and is suitable for small reconstruction sites. However, mowing cannot duplicate the substantial physical disturbance of animal hooves, or the rich inputs of dung and urine. Furthermore, unlike grazing, mowing does not selectively defoliate certain plants and leave others alone. Mowing does, however, create a gap in existing vegetation, which should in theory increase plant diversity by weakening existing plants and releasing resources to newly establishing species. Light availability at the soil surface, where seedlings are beginning to establish themselves can be limited if a gap in the established plant canopy is not created and maintained. Tilman (1993) and Williams *et al.* (in press) found that mowing significantly increased light availability at the soil surface, which could in theory increase seedling germination and survival. Not only would canopy removal through mowing increase light availability, but it would also increase physical space above ground, therefore decreasing competition for new seedlings. By removing the above ground biomass, below ground competition for rooting space is also reduced as plants are putting most of their energy into creating above ground biomass therefore reducing below ground root density (Johnson and Matchett 2001).

Another factor that can impede seedling recruitment is litter accumulation, which is often significant in undisturbed grasslands. Carson and Peterson (1990) found that by removing litter seedling densities could be significantly increased. Weaver and Rowland (1952) reported that mowed prairies had significantly less litter accumulation than prairies that were protected from mowing.

Frequent mowing has been proven to be an effective method for increasing species diversity in an existing plant community (e.g. Williams *et al.* in press, Maron and Jefferies 2001, and Kurtz 1994). Developing a method for adding species diversity incrementally to a reconstructed grassland would be beneficial for several reasons. First of all, adding species diversity to a site can be extremely costly (some forb seed such as *Phlox pilosa* can cost $1,200 per pound). Incremental forb addition would allow land managers to spread out the cost of a reconstruction project, which would make the endeavor more feasible. Another reason it is important to be able to add forb species incrementally is that forb seed availability can be variable. Each year new species are added into seed production systems making new species available each year. Having the ability to add forb diversity in different years will allow conservationists to add forb seed whenever it is available. A final reason for determining a method for adding species diversity incrementally is that often times prairie reconstructions are only partially successful; being able to go back in and add species that failed to establish previously would be beneficial to reconstruction efforts.

The study site was a suitable location to test a method for adding forb species diversity incrementally, because it had been enhanced one time with forb diversity. By 2003,when this study commenced, the forb species added by Williams *et al.* (in press) were five-year-old adult plants that had reached reproductive maturity. Thus it was my intent to complete a second seeding of native forbs (ten species) into the same experimental site used by Williams *et al.* (in press) and determine a method for increasing species diversity incrementally.

Increasing forb diversity incrementally using mowing is especially difficult, as previously established forbs must be considered. Adding forb diversity to a plant community that consists solely of grasses is less difficult because grasses have evolved under pressures such as grazing and have basal meristems therefore making them more resilient in their response to frequent defoliation compared to forbs (Knapp *et al.* 1999). A method for incrementally increasing forb diversity must include a mowing regime that is frequent enough to reduce the dominant vegetation, but not kill previously added forb species. If frequent mowing kills previously established forb species the method would negatively affect species diversity rather then improve it, meaning incremental species addition is not possible.

The objective of this experiment was to increase forb diversity through the use of mowing, at a site that was previously enhanced with forb diversity during a 1999 study (Williams *et al.* in press). I hypothesized that forb diversity can be increased in an established grassland using an incremental approach, and that mowing would amplify the success of the planting. Mowing would increase success by weakening the existing vegetation (grasses and five-year-old forbs) allowing newly seeded species of native forbs to establish themselves in higher densities than in unmowed controls. Additionally, I hypothesized that mowing frequently (weekly) would be more effective at increasing species diversity than mowing infrequently (every three weeks).

To truly understand some of the factors that contribute to the incremental increase of forb diversity, many biotic and abiotic factors were assessed. Over a three year study period I looked at the effects of mowing on the following: seedling emergence and mortality; newly introduced seedling size; the established plant community (grasses and forbs); overall species diversity (including richness and evenness); and environmental factors (weather, leaf litter, light availability, and root growth).

It is imperative that a method for incrementally increasing forb diversity be developed and added to the knowledge currently available to prairie conservationists. A solid method that makes prairie reconstruction more economically feasible may eventually lead to increased participation, especially by private landowners, in reconstruction projects. The more people and land that can be involved in tallgrass prairie reconstruction, the closer we will be to returning our highly modified landscape to the grasslands found in the region prior to European settlement.

CHAPTER 2

LITERATURE REVIEW

The creation of the grassland biome began during the Miocene-Pliocene transition, which occurred about 7-5 million years ago. During this period dryness increased, which favored the development of grasses and forbs and forced a restriction on the range of woody species. The remaining grasses and forbs were burned sporadically, and were subject to grazing both of which kept the rangeland open, free of trees and other woody vegetation (Axelrod 1985).

The grassland biome is the largest of the four land biomes. In North America alone there are roughly 3.5 million square kilometers of grassland (Savage 2004). In the North American grassland there are several 'types' of grasslands including; desert plains, short-grass prairie, mixed-grass prairie, and the tallgrass prairie (Clements 1920).

The focus of this study is the tallgrass prairie, which once dominated approximately 68 million hectares in North America. However it is now rapidly declining and has been reduced to less than five percent of its original range (Samson and Knopf 1994). The state of Iowa, where this study takes place, is located in the heart of the tallgrass prairie region. Preceding European settlement General Land Office surveys estimated that 79.5% of Iowa, or nearly 28.6 million acres, was dominated by the tallgrass prairie ecosystem (Smith 1998). Beginning in the 1830's European settlement and its accompanying agricultural practices began to destroy the tallgrass prairie in Iowa. Currently it is believed that less than 0.1% of the original ecosystem is still exists in Iowa and these remnants are confined to small areas that are not suitable for agriculture, such as right of ways, cemeteries, steep slopes or rocky areas (Smith 1998).

Currently, attempts are being made to restore the tallgrass prairie. Government programs such as the Federal Conservation Reserve Program as well as county roadside plantings have promoted the planting of tallgrass prairie grasses. Recently there have been attempts to add forb species to these planting mixes (CRP-CP25 mixture) but often the area becomes dominated by a few aggressive forb species and many of the planted forb species fail to establish themselves (Personal observation; and Williams unpublished data). Instead of replanting these areas and including more forb species in the seed mix, research studies have tried to determine how forb diversity could be increased in these grassland plantings without destroying the existing vegetation.

This literature review will assess a number of studies that have attempted to increase species diversity in grass-dominated plantings. I will first look at the difficulties of adding species diversity to plantings. Next, I will summarize current techniques for enhancing species poor communities including gap creation, grazing, and mowing. Furthermore, I will discuss the importance of having species diversity in restoration plantings. Finally, this synthesis will conclude with my assessment of what research is still needed in the field of prairie restoration, and will explain how my study will contribute to the body of knowledge that already exists.

Increasing diversity in grassland plantings can be very difficult because established plant communities are often resistant to invasions by new species (Davies *et al.* 1996). Davis *et al.* (2000) have proposed that invasions by new species are dependent on the amount of available resources, especially those that are limiting; light, nutrients and water. Crawley (1986) believed that the major factor that made grasslands resistant to invasions is the dense, closed canopy that is produced by mid-summer, which significantly reduces light availability at the soil surface. If these ideas are correct, more productive grasslands should be highly resistant to invasions as there will be less light, water, and physical space available, as well as fewer nutrients. These combined factors in a highly productive grassland will most likely lead to a decline in diversity over time.

A study by Tilman (1993) found grassland productivity had no effect on species diversity. However, the study did conclude that species diversity was lower in productive grasslands. Results of this study indicate that accumulated litter and lower light availability, rather than high productivity, suppressed the growth of invading seedlings, therefore decreasing species diversity. Burke and Grime (1996) had similar results and reported that more productive vegetation closes gaps quickly and densely, making unfavorable conditions for invading seedlings.

In order to make an established plant community more susceptible to invasions by new species, the amount of limiting resources must be increased. One way to increase the availability of these resources is to decrease uptake by established plants. In theory, disturbance-generated gaps in vegetation created through forces such as grazing, animal digging, or mowing could damage existing vegetation enough to decrease their nutrient uptake, therefore making a plant community more susceptible to invasion (Davis *et al.* 2000).

Many studies have focused on the use of large and small scale disturbances to increase diversity in grasslands. Small scale, disturbance-generated gaps similar to those produced naturally by ants, crayfish, and small mammals (5.8-cm in diameter and 12-cm deep) were studied by Rapp and Rabinowitz (1985). The results of this study indicate that although many seedlings germinated in these small disturbance areas, most died out and did not establish in numbers significantly different than undisturbed controls.

McConnaughay and Bazzaz (1987) looked at the effect of size of small disturbances on colonizing annual plants in an old field. Gap sizes were 5, 10, 20, and 40-cm in diameter. Results of this study show that many species respond positively to an increase in gap size. For the majority of the species studied, plants found within the gap tended to produce more seed and increase their height and reproductive biomass in larger gaps. The results of studies involving small scale disturbances seem to suggest that larger scale disturbances may be necessary to increase the invasibility of grasslands.

According to a hypothesis by Knapp *et al.* (1999) large scale disturbances, historically created through processes such as fire and grazing, created necessary disturbance-generated gaps allowing forb species to invade and persist in highly productive prairie grasslands. Grazing helped maintain high levels of diversity in the tallgrass prairie by keeping the dominant grasses in check. A study by Collins *et al.* (1998) found that *B. bison* are selective grazers that consume mainly grasses. This selectivity may have allowed forb species to survive and compete in a community that would otherwise be dominated by grasses. Towne *et al.* (2005) also found grazing aided in survival of forbs and concluded that grazing by either bison or cattle increased the cover of annual forbs, perennial forbs, and cool season grasses as compared to areas that were not grazed. A study by Collins (1987) also found that burning and grazing by cattle together increased species richness primarily by increasing the number of forb species. Collins (1987) also concluded that species richness increased with grazing alone. Fuhlendorf and Engle (2004) found that burning and grazing in small patches, as opposed to burning and grazing an entire area at once, helped to recreate the heterogeneous grassland that once existed. Heterogeneous grasslands have greater species evenness and sometimes increased species richness both of which contribute to increased biodiversity.

Grazing not only reduces above ground competition, it also affects root growth. Johnson and Matchett (2001) found that grazing heavily reduced root mass by about 30% as compared to areas excluded from grazing and annually burned. This study also found that although the root mass was lower, the root tissue quality was higher (higher N concentrations) than roots found in ungrazed, annually burned areas.

While these studies indicate that grazing does help to increase the tallgrass prairie's susceptibility to invasion, it is not always a feasible option due to the size of restoration sites, lack of fencing, and management issues. A large amount of research in prairie restoration has focused on the use of mowing to create large scale disturbances as an alternative to grazing.

A study by Collins *et al.* (1998) determined that mowing significantly increased light availability as compared to unmowed plots. This study also concluded that mowing helped maintain some species of C_3 grasses and forbs, therefore preventing the loss of species richness. Howe (1999) found that *Zizea aurea* responded positively to mowing by doubling in abundance and increasing flowering percentage from 6 to 20% when mowed in August compared to May.

Maron and Jefferies (2001) conducted a study on the effects of mowing on species richness in a grassland that had been enriched with nitrogen by the plant *Lupinus arboreus* (Bush lupine). By mowing plots one time in mid-May, species richness was significantly increased compared to unmowed controls. Most of the increase in species richness was due to the increased growth of perennial forbs (44% of forb biomass being from natives). This study suggests that even with high levels of nitrogen, mowing can still help promote forb diversity. This is an important finding, as nitrogen enrichment of natural communities is becoming a significant concern in conservation (Bakker and Berendse 1999).

Tix and Charvat (2005) attempted to use mowing and raking as an alternative to burning to increase plant diversity in a reconstructed tallgrass prairie in Minnesota. Plots were mowed or burned once per year for two consecutive years. Half of the mowed plots were also raked. Results from this study indicated that mowing alone did not increase diversity. However, mowing followed by raking was found to be a good alternative to burning because it offered the same benefits without stimulating already dominate warm season grasses.

Van Dyke *et al.* (2004) looked at the effects of burning and mowing on species richness in a reconstructed prairie planting at the DeSoto National Wildlife Refuge in an effort to increase the diversity of plants and birds in the area. All sites in the study were burned or mowed in April or May. Sampling of the sites following treatment indicated that neither burning nor mowing significantly increased species richness or diversity at the site.

Hayes and Holl (2003) found that frequent clipping of dominant grasses in the California coastal prairie favored the growth of exotic forbs over exotic grasses, but did not help to increase the presence of native species. From these results it was determined that grassland restoration will most likely require the reintroduction of native species from plant or seed along with appropriate disturbance regimes to achieve desired results.

While the studies cited here indicate that disturbances created through grazing increased native species diversity, the mowing studies were not as conclusive. This is most likely due to the fact that the grazing studies took place on large tracts of remnant prairie (Kansas and Oklahoma) where the native species are still abundant. The mowing studies however, took place mostly on reconstructed sites where the native species are absent. Natural colonization of these sites with native species can be slow and unreliable considering that the seed of these plants is absent in the seed bank (Berendse *et al.* 1992). As Hayes and Holl (2003) suggested, the reintroduction of native species along with mowing will be necessary to increase forb diversity in established grasslands.

Kurtz (1994) attempted to reconstruct the tallgrass prairie, including forb diversity, by seeding an area with native species followed by frequent mowing in the first growing season. This study concluding that mowing helps increase the success of prairie reconstructions. Zajicke (1986) attempted to diversify an established stand of grasses by overseeding the area with five species of native forbs followed by one of three treatments; burning, mowing, and herbicide followed by mowing. There was also an untreated control used for comparisons. The results of this study concluded that seedling establishment was not affected by different treatments.

Williams *et al.* (in press) attempted to add 23 species of native forbs to an established grass community composed of primarily C_4 grasses by overseeding and mowing. A frequent mowing regime was used in an attempt to reduce the dominance of the grasses and increase seedling establishment. Frequent mowing significantly reduced over-winter seedling mortality as compared to unmowed controls. This study also concluded that forbs found in mowed plots had a significantly higher root and shoot biomass compared to controls. While the researchers did not find that mowing increased seedling abundance initially, by the fourth growing season forbs were twice as abundant in mowed treatments as in controls.

Whatever the method for achieving it, increasing the diversity of grassland plantings is important. Tracy *et al.* (2004) studied how species diversity affected the abundance of weeds in a pasture community. The researchers seeded pastures with 1, 2, 3, 6, or 8 forage species (including *Andropogon gerardii*) and found that as the evenness of different forage species increased weed abundance declined.

Zavaleta and Hulvey (2004) looked at the effects of biodiversity loss on grasslands' ability to resist invasions by weedy exotics, in this case *Centaurea solstitialis* (yellow starthistle). The results of this study show starthistle biomass increased greatly with progressive loss of species. The researchers also concluded that starthistle reproduction was greater in areas with declining species richness.

Tilman *et al.* (1996) determined that more diverse plant communities were more productive than less diverse communities. This study compared plantings containing 1, 2, 4, 6, 8, 12, or 24 species. The results of this study indicated that more diverse plant communities utilize nitrogen more efficiently than less diverse communities, which led to less nitrate leaching in the environment. The central idea behind these results is that a more diverse plant community can utilize nitrogen more efficiently because different plant species use nutrients at different times and in different spatial areas.

Another study by Tilman and Downing (1994) found that more diverse plant communities can resist and be more resilient to drought events than communities with less diversity. The study period included the severe 1987-1988 drought that occurred in the Midwest. This study found that the most species rich plots produced about a half of their pre-drought biomass during the drought, while only one-eighth of the pre-drought biomass was produced in plots with low species richness. From this study it was concluded that higher species richness led to better drought resistance, most likely because the community was more likely to contain some drought resistant species if it were more diverse. This study also determined that more species rich plots began producing their pre-drought biomass much more quickly following a drought than less diverse areas. By 1992, species rich plots were already producing their pre-drought biomass, but the less diverse plots were significantly below their pre-drought biomass.

The study presented here is a continuation of the research conducted by Williams *et al.* (in press). After it was determined that frequent mowing could indeed increase the establishment of native forbs in an established grassland, I wanted to determine if species diversity could be added to a grassland incrementally. Reconstruction projects that involve just a few select species of forbs are expensive. Seed mixes containing only 25 species of forbs and five species of grasses can cost over $1,300 per acre (Prairie Moon Nursery 2006). Finding methods in which species diversity could be increased incrementally would make an excellent addition to the restoration knowledge already available.

From this literature synthesis I conclude that it is possible to diversify an established plant community without plowing the area up and starting over. The main method by which this is achieved is by making a grassland more subject to invasion through some type of disturbance regime. The studies in the above discussion have used grazing, mowing and soil coring to create disturbances that have lead to increased species diversity in plant communities. Now that the mechanism for increasing diversity is somewhat better understood, the next step is to determine if species diversity can be added incrementally by repeatedly seeding and disturbing the same area. Should this study yield the desired results, land managers may have the opportunity to increase species diversity incrementally, a more economically feasible method that is currently in use.

CHAPTER 3

METHODS

Site Description

This study was conducted on the University of Northern Iowa campus tallgrass prairie preserve (42° 30' 30" N; 92° 27' 00"W). The average precipitation per month for each year during the experiment was 59.71 mm, 2003; 73.76 mm, 2004; and 65.27 mm, 2005. The average monthly temperatures over the three-year period were 47.9 °F, 2003; 48.0 °F, 2004; and 47.2 °F, 2005 (Fig. 1 NOAA 2005).

The study site was located on an alluvial terrace. Soil type for the area was classified as a Saude loam with zero to two percent slopes; it is characteristic of stream benches and is often droughty. The native vegetation of this soil type was classified as prairie (Fouts and Highland 1978).

In the years before 1973 the area of study had been kept as a hayfield dominated by three cool season species. Then, in 1973 the area was plowed and converted to a tallgrass prairie planting, consisting of five cultivated varieties of warm season grasses, as part of the University of Northern Iowa's campus preserve system. The next addition of species came in 1999 when 23 species of native forbs were broadcast seeded into the area as part of a Master of Science project (Williams 2002; Table 1).

When this particular study began in 2003, the area consisted of the five warm season grass species seeded in 1973, and 23 species, then five-years-old, of forbs that germinated in 1999. The most abundant forbs existing from the previous study were

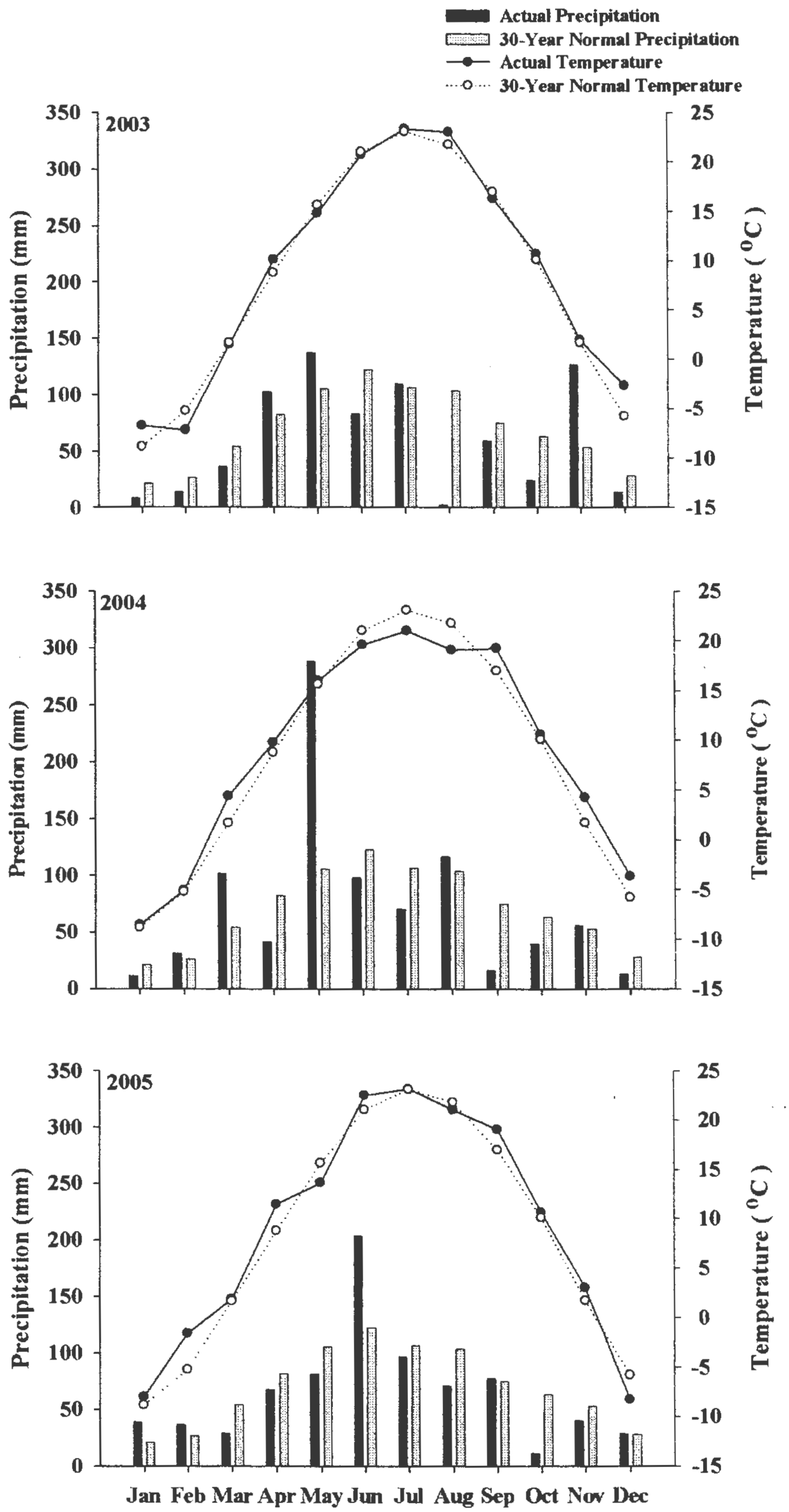

Figure 1. Mean monthly temperature and precipitation values for three years of study (NOAA 2005).

Table 1. Past species composition of the study site.

Year	Species Added
Prior to 1973 – Hayfield	*Agropyron repens* *Bromus inermis* *Trifolium pratense* *Poa pratensis*
1973 – Hayfield converted to prairie planting.	*Andropogon gerardii* *Bouteloua curtipendula* *Panicum virgatum* *Schizachyrium scoparium* *Sorghastrum nutans*
1999 – Addition of 23 species of native forbs for master's thesis by Dave Williams.	*Amorpha canescens* *Anemone canadensis* *Anemone cylindrica* *Asclepias tuberosa* *Aster novae-angliae* *Coreopsis palmata* *Dalea purpurea* *Desmanthus illinoensis* *Desmodium canadense* *Echinacea pallida* *Euphorbia corollata* *Heliopsis helianthoides* *Lespedeza capitata* *Liatris aspera* *Liatris pychnostachya* *Monarda fistulosa* *Ratibida pinnata* *Rudbeckia hirta* *Rudbeckia subtomentosa* *Silphium laciniatum* *Solidago rigida* *Tradescantia ohiensis* *Zizia aurea*

Rudbeckia hirta (Black-eyed susan), *Solidago rigida* (Stiff goldenrod) and *Ratibida pinnata* (Grey-headed coneflower).

Experimental Design and Treatments

The experiment was a randomized block design consisting of two, 60 x 60-m blocks, each containing twelve, 15 x 20-m plots. Three different mowing treatments were randomly assigned to 18 of the 24 plots. The mowing treatments consisted of unmowed (control), mowed infrequently (every three weeks) and mowed frequently (weekly). Six of the twenty-four plots were unused due to the fact that they were previously part of an unmowed treatment during the Williams *et al.* (in press) study; and lacked a forb component of suitable abundance to facilitate a study on incremental forb addition.

Within each replicate plot 12, 0.25-m^2 circular quadrats were permanently affixed to the ground to facilitate repeated sampling. Quadrats were constructed of flexible plastic tubing and stapled flush with the ground using nine-gauge wire, which allowed mowing above them without disturbance.

Addition of Seeds

Ten species of native forbs were selected for this experiment (Table 2) based on cost and availability. Seven out of the ten species were obtained from Ion Exchange Native Seed and Plant Nursery located in Harpers Ferry, IA. The remaining three species were acquired from the Tallgrass Prairie Center (at that time called the Native Roadside Vegetation Center) in Cedar Falls, Iowa.

All species selected for this experiment were greenhouse grown prior to any data collection to ensure proper identification of species once germinating began in the field.

In the fall of 2002 the experimental plots were burned in preparation for broadcast seeding. Seeds of each of the ten species were hand sown into the plots at a rate of 25 seeds/m^2/species, a resulting total of 250 seeds/m^2.

Table 2. Forb species selected for this study.

Scientific Name	Common Name
Amorpha canescens	Leadplant *
Aster laevis	Smooth blue aster
Astragalus canadensis	Canadian milkvetch
Dalea candidum	White prairie clover
Liatris pychnostachya	Prairie blazingstar *
Parthenium integrifolium	Wild quinine
Pycnanthemum virginianum	Virginia mountain mint
Solidago speciosa	Showy goldenrod
Veronicastrum virginicum	Culver's root
Zizea aptera	Heart-leaved golden alexanders

* Denotes species that were also seeded in 1999 during the Williams et al (*in press*) study, but were either completely absent or present at extremely low densities at the start of this study.

Mowing

Mowing treatments were applied for two consecutive growing seasons, 2003 and 2004. Mowing began on 26 May 2003 and continued through 25 August 2004. During the 2003 growing season plots were mowed using a Toro riding mower. The starting height was 5-cm, which was increased to 15-cm by the end of the growing season to avoid clipping newly established seedlings. During the second growing season a John Deere tractor and rotary mower were used. The starting height for the mower in the second growing season was 15-cm increased to 20-cm by the end of 2004.

Data Analysis

All data collected for this experiment were analyzed using SAS (SAS Institute Inc., 2000). Normality of each data set was assessed to meet the assumptions of ANOVA using the Shapiro-Wilk (source) test for normality. Data sets with a W-statistic (calculated by SAS) greater than 0.05 were considered normally distributed. Residual versus predicted value plots were inspected for homoscedasticity by looking for a random distribution of the data. Data sets that were not judged normal were natural log transformed to create a more normal distribution. All transformed data were back-transformed for reporting.

For most data sets, differences in means by each treatment were determined using two-way analysis of variance with three factors: block, mowing treatment and their interaction. There were two blocks, northeast and southwest. There were three mowing treatments: control, infrequently mowed (every three weeks), and frequently mowed (weekly). All two-way ANOVAs were inspected to be certain there were no block by mowing treatment interactions before making means comparisons. All treatment means generated by the two-way ANOVA were compared using Tukey's protected test for pairwise comparisons.

To look for differences in data over time a repeated measures analysis of variance was used. Analysis of covariance was also used to analyze data from this experiment. All analysis procedures are part of the GLM procedure in SAS.

Emergence and Establishment of Ten New Forb Species Added in 2003

Seedling Emergence and Establishment

Seedling emergence and establishment of the 10 new species seeded in 2002 was quantified using the 12 permanently fixed 0.25-m^2 circular quadrats randomly placed in each plot. These quadrats were used to sample only the seedlings of the ten new species added at the beginning of this part of the study. Each of these seedlings found growing within the quadrats was counted and identified to species once on 21 July 2003, bimonthly in 2004 from June until September, and once on 11 July 2005.

To determine if mowing treatments had an effect on seedling emergence at any time during this study, a two-way analysis of variance was completed for each of the seedling censuses separately.

Changes in seedling number over time were analyzed using repeated measures ANOVA. This analysis was used to determine if changes in seedling number over time were due to different mowing treatments. This analysis was only used on the 2004 seedling count data.

Seedling Mortality

Using the permanently fixed 0.25-m^2 subplots it was possible to calculate seedling mortality over the winter of 2003-2004, as well as seedling mortality over the 2004-growing season. To determine seedling mortality over the winter of 2003-2004, the

Williams *et al* (in press) method was used keep the two studies comparable. His method was as follows:

First, the total number of seedlings (of all ten species) was determined for the last seedling census in the summer of 2003 (21 July) and for the first census in 2004 (3 June). The difference between the two was found by subtracting the 3 June 2004 count from the 21 July 2003 count. This difference was divided by the 21 July 2003 count and multiplied by one hundred to determine a percent mortality over the winter of 2003-2004 for each of the plots.

The percent mortality over the 2004-growing season was also calculated using Williams' (2002) method. First, a plot maximum was determined for each of the plots for the summer of 2004. This was done by summing the maximum number of each of the ten species found in the plot during the summer of 2004. This calculated maximum was then compared to the number of seedlings of each of the ten species found in each plot during the last seedling census of the summer, 7 September 2004. A percent mortality was determined from these numbers by subtracting the 7 September 2004 count from the calculated maximum for each plot. The difference was then divided by the plot maximum and multiplied by one hundred. The resulting percentage was determined for each plot as the mortality over the summer of 2004.

The percentages determined for each plot were then analyzed using two-way analysis of variance using the block by treatment model used throughout this study.

Environmental Measures

Light Intensity

To determine if mowing increased the amount of available light at the soil surface, data were collected in all treatments at approximately solar noon on a clear day, 8 July 2004. A Licor quantum light sensor was used to measure light in the 400-700-nm range (LI-COR Inc. 1999). Three measurements were taken at each of two randomly located sites within replicate plots. Readings were collected above the plant canopy, at 20-cm, and at 2.5-cm above ground level. The amount of available light at the soil surface was determined by calculating a percent of maximum. The maximum amount of light available above the plant canopy was divided by the amount of light reaching the soil surface (2.5-cm above ground level) to calculate the percentage.

Leaf Litter

To determine how mowing affects the amount of leaf litter at the soil surface, litter samples were collected from 26 May through 2 June 2004. Amount of leaf litter in each plot was quantified by collecting all leaf debris on the surface within a 0.1-m^2 circular quadrat, in each of the 18 plots. Collected leaf litter samples were bagged and placed in a drying oven at 60°C. The constant mass was then determined.

Plant Responses to Mowing

Warm and Cool Season Grasses (Seeded in 1973 and Prior)

To determine the effects of mowing on cool season grass abundance (Kentucky bluegrass and smooth brome), we counted grass panicles on 16 June 2005 when cool season grasses were at their peak of flowering. The panicles of all cool season grasses found within five, randomly located 0.25-m^2 quadrats were counted in each of the plots. The same method was used to determine the effects of mowing on warm season grasses. Flowering stalks of warm season grasses were counted on 12 September of 2005 when warm season prairie grasses had reached full maturity.

Adult Forbs: Seeded in 1999

To determine how mowing affected five-year-old adult forbs previously added to the site, samples were obtained to conclude if forbs were hardy enough survive mowing treatments. On 4 June 2003 crowns of two of the most abundant previously (from Williams *et al.* experiment) established forbs, *Solidago rigida* (Stiff goldenrod) and *Ratibida pinnata* (Grey-headed coneflower), were extracted along with crowns of bulk warm season grasses (any species of warm season grass). Random coordinates were used to select three individual plants of *S. rigida*, *R. pinnata*, and unidentified warm season grasses in each plot. Samples were extracted using a 5-cm diameter x 15-cm depth bulb planter and cleaned to remove mineral soil and fine roots. Shoots were counted and each sample was trimmed to 5-cm above and below ground; this was identified as the "crown". The crowns were then dried to a constant mass in a 60°C oven and weighed. Analysis of covariance was used to analyze these data with biomass being dependent on shoot number and treatment.

Forbs Seeded in 2003

Destructive Sampling

On 19 October 2004 the most abundant of the ten new species seeded in 2003, *Parthenium integrifolium* (wild quinine), was destructively sampled to determine if mowing increased the size of new seedlings (then one-year-old plants) in terms of above and below ground biomass. In each plot, four individuals were randomly selected and extracted using a 5-cm diameter bulb planter. Each sample was washed to remove mineral soil and fine roots. The cleaned samples were dried to a constant mass in a 60°C-drying oven and weighed. These data were analyzed using two-way analysis of variance.

Non-Destructive Sampling

During the third growing season, 2005, the newly added seedlings that had emerged in 2003 were beginning to reach maturity (three year old plants). To determine if mowing increased the above ground size of the ten new species added to the prairie reconstruction, non-destructive measures of plant size were collected from 20 June to 30 June 2005. Four of the ten species, *Dalea candidum* (White prairie clover), *Astragalus canadensis* (Canada milkvetch), *Aster laevis* (Smooth blue aster), and *P. integrifolium* were selected for measurement, as they were most abundant throughout the plots. Maximum height and stem number were recorded for up to fifteen individual plants per plot for each of the four species. To ensure random sampling of individuals, all 20 x 1-m transects were established at a random point within each plot and sampling began at a random point within that transect. At the completion of each transect the tape was moved north or south (based on a random number) of the original transect and sampling continued until fifteen individuals per species had been sampled or until the entire plot was sampled.

Below Ground Biomass

The effects of mowing on belowground competition (physical rooting space) were studied by looking at how actively roots were growing after mowing treatments had been imposed for two growing seasons. After random samples of *P. integrifolium* were extracted using the 5-cm diameter bulb planter on 19 October 2004, (see above, destructive plant size) the remaining hollow space, 5-cm in diameter and 15-cm deep, was filled with commercially available top soil and permanently marked.

On 15 July 2005, the same 5 x 15-cm bulb planter was used to extract each permanently marked core of fallow soil; four cores were removed from each plot. The roots were then extracted from the soil core by rinsing over a fine mesh screen until all mineral soil had been removed. The roots obtained from each core were dried to a constant mass and weighed. The method for this data collection was derived from methods used by Johnson and Matchett (2001), and Neill (1992).

Species Diversity, Richness, and Evenness

To gain an understanding of how long-term mowing and incremental seeding affects species diversity, species richness and Shannon-Wiener indices were calculated for each plot. I established 20 x 1-m transects in each of the plots. Transect data were collected on 20 May 2003, 18 May 2004, 12 July 2004, and 3 August 2005. All native forbs (including 23 species added in 1999 and 10 species added in 2003) above 3 cm in height found within these transects were counted and recorded by species. To determine if mowing affected species richness, the number of species found in each transect was determined. Data on species richness were analyzed using analysis of covariance (ANCOVA) where the number of species found in August of 2005 was dependent on both treatment and the number of species found in May of 2003.

The diversity of each plot was determined by calculating a Shannon-Wiener Index. The Shannon-Wiener index is a calculation of a degree of uncertainty that the species of next individual selected at random will be correctly predicted (Smith and Smith 2003). The more diverse and even the abundance of the plot, the higher the index will be. Shannon-Wiener indices were calculated for each plot.

The data were analyzed using two-way analysis of variance to look for differences in diversity at each of the sampling times. Analysis of covariance was also completed on these data where the Shannon-Wiener indices determined for the 3 August 2005 data set were dependent on both the 20 May 2003 indices and treatment.

CHAPTER 4

RESULTS

Emergence and Establishment of Ten New Forb Species Added in 2003

Seedling Emergence and Establishment

A two-way analysis of variance on 21 July 2003 seedling counts revealed that mowing at any interval did not have an effect on the number of seedlings that emerged per m^2 from the ten new species seeded at the beginning of this study. There were no significant differences ($p=0.197$) between any of the mowing treatment means (Table 3).

In 2004 seedling censuses were conducted five times throughout the growing season. Separate analysis on each count time using two-way ANOVA indicated that there were no significant differences in the average number of seedlings that emerged throughout the plots due to mowing treatments at any time during the 2004 growing season. However, for each of the five seedling censuses in 2004, with the exception of the first count of the summer (3 June), the data show a trend of absolute seedling numbers being slightly greater in plots receiving either of the mowing treatments compared to controls (Table 3).

The results of the separate two-way ANOVAs on the 2004 seedling count data also indicated that seedling numbers were changing during the growing season. To determine if these numbers were changing due to different mowing treatments a repeated measures ANOVA was conducted on the 2004 seedling count data. Results of this repeated measures analysis revealed that seedling numbers were changing over time, but these changes were not due to the different mowing treatments, $p=0.090$.

Two-way ANOVA on treatment means for the final seedling census in 2005 yielded the same results as the two previous growing seasons. While the absolute value of the mean of seedling numbers was usually greater in mowed treatments than control treatments, the differences were not significant, p=0.4776 (Table 3).

Table 3. Mean number of seedlings/m² (standard error; upper and lower limits presented for back-transformed data) by treatment for each date seedling counts were conducted during the study. Letters that differ following means represent statistical significance.

Date	Treatment	Mean (S.E.)	p-value
21 July 2003	Control	10.33 (1.00) A	0.197
	Infrequent	13.22 (1.94) A	
	Frequent	9.44 (1.23) A	
3 June 2004	Control	3.59 (4.13) (3.12) A	0.580
	Infrequent	2.16 (4.29) (2.33) A	
	Frequent	4.37 (5.09) (3.75) A	
23 June 2004	Control	3.58 (4.29) (2.99) A	0.279
	Infrequent	5.21 (6.54) (4.14) A	
	Frequent	5.29 (6.60) (4.24) A	
7 July 2004	Control	3.76 (4.31) (3.27) A	0.167
	Infrequent	5.31 (6.46) (4.37) A	
	Frequent	5.77 (6.50) (5.13) A	
24 July 2004	Control	3.40 (3.89) (2.98) A	0.075
	Infrequent	5.27 (6.45) (4.32) A	
	Frequent	4.78 (5.86) (3.91) A	
7 Sept 2004	Control	3.31 (3.77) (2.92) A	0.617
	Infrequent	4.21 (5.41) (3.28) A	
	Frequent	3.83 (4.54) (3.22) A	
11 July 2005	Control	4.17 (0.46) A	0.478
	Infrequent	4.67 (1.49) A	
	Frequent	5.55 (1.01) A	

While there were no significant differences in the number of established seedlings per m² between different mowing treatments, new species were successfully added to the research plots. Figure 2 depicts the number of seedlings/m² that germinated by species throughout the study site. In all three years of this study *P. integrifolium* was present throughout the plots at the highest density, 6.46/ m^2, 2003; 3.20/ m^2, 2004; and 3.28/ m^2, 2005. In 2003 the second most abundant species was *D. candidum* at 2.28-seedlings/ m^2, but it was reduced to 0.33/ m^2 in 2004 and 0.17/ m^2 in 2005. During the second growing season (2004) *A. laevis* became the second most abundant species throughout the plots at 0.93/ m^2 and remained slightly below this level during the 2005-growing season. *A. canescens* was found at a rate of 0.74/ m^2 in 2003, but leveled off to 0.20/ m^2, 2004 and 0.37/ m^2, 2005. *A. canadensis,* and *S. speciosa* were found at low densities, approximately 0.50/ m^2, throughout the study. *L. pychnostachya* germinated in 2003, but did not reappear in 2004 or 2005. *Z. aptera* was present at low densities in 2003 and 2005, but not in 2004. *P. virginianum* and *V. virginicum* were not found at any time during the study.

Overall, eight out of the ten species of forbs added to the study site were present in 2003, six out of ten were present in 2004, and seven out of ten were present in 2005.

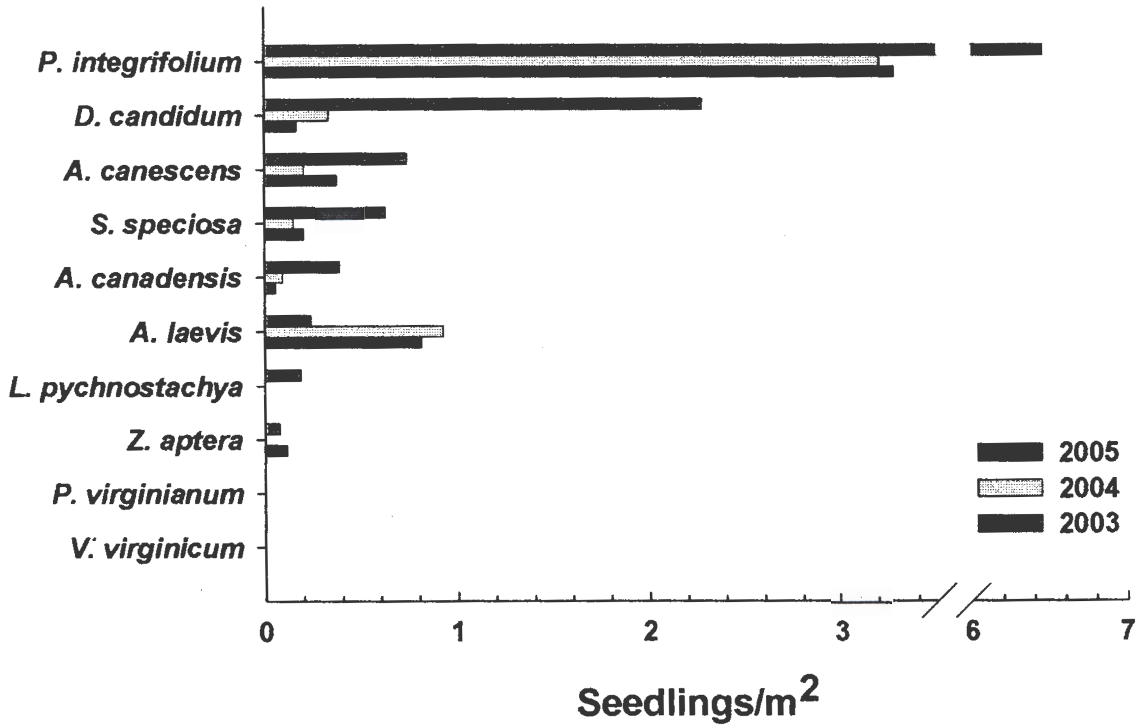

Figure 2. Seedlings/m² by species throughout the study area. Numbers are out of a possible 25 seeds/m² per species. Numbers are derived from 21 July 2003, 22 July 2004, and 11 July 2005 seedling counts.

Seedling Mortality

Seedling mortality was determined for the winter between the 2003-2004 growing season and for the period over the growing season of 2004. Results of a two-way ANOVA on treatment means showed mowing at any frequency did not affect the mortality of seedlings over the winter, (p=0.637; Table 4).

Conducting five seedling counts over the summer of 2004 allowed for the determination of seedling mortality over the growing season. A two-way ANOVA on calculated mortality values revealed that mowing at any interval did not have a significant effect on the percent mortality that occurred over the 2004 growing season, p=0.53 (Table 4).

Table 4. Mean (standard error) percent mortality of seedlings by treatment over the 2003-2004 winter and over the 2004 growing season

	Control	**Infrequent**	**Frequent**	**p-value**
2003-2004 Winter Mortality	62.85% (4.88)	64.45% (9.23)	53.99% (7.53)	0.637
2004 Growing Season Mortality	34.24% (6.98)	37.03% (8.20)	45.03% (4.62)	0.532

Environmental Measures

Light Availability

As mowing frequency increased the percentage of available light at 2.5-cm above the surface also increased. A two-way ANOVA revealed that frequently and infrequently mowed plots received 55% and 49% of available light respectively, while control plots received 22% of available light ($p=0.024$). Mowing frequently or infrequently significantly increased the percent of available light as compared to unmowed controls.

Leaf Litter

Two-way ANOVA on treatment means of leaf litter biomass indicated that mowing significantly reduced the amount of leaf litter on the surface as compared to unmowed controls ($p<0.001$). While 282 g/m^2 of non-living leaf debris were found in control plots, only 96.9 g/m² and 85.9 g/m² were found in infrequently mowed plots and frequently mowed plots, respectively.

Plant Responses to Mowing

Warm and Cool Season Grasses Seeded in 1973 and Prior

Mowing either frequently or infrequently significantly ($p<0.001$) increased the number of seed panicles produced by the cool season grasses. However, the number of seed stalks produced by the warm season grasses was not affected by mowing, ($p=0.967$; Table 5).

Table 5. Mean (S.E.) number of flowering seed stalks for cool and warm season grasses by treatment.

	Control	**Infrequent**	**Frequent**	**p-value**
Cool Season Flowering Stalks per m²	13.20 (3.58) B	135.87 (23.81) A	150.13 (24.05) A	<0.001
Warm Season Flowering Stalks per m²	19.47 (2.72) A	19.73 (3.45) A	18.53 (3.41) A	0.967

Forbs Seeded in 1999

An analysis of covariance with crown biomass being dependent on covariates; shoot number and mowing treatment showed that mowing had a significant effect on the size of adult forbs added in 1999. Mowing significantly reduced the biomass of the crowns of *Ratibida pinnata* (p=0.011) and *Solidago rigida* (p<0.001). Mowing did not have an effect on the crown size of the warm season grasses (p=0.236; Figure 3).

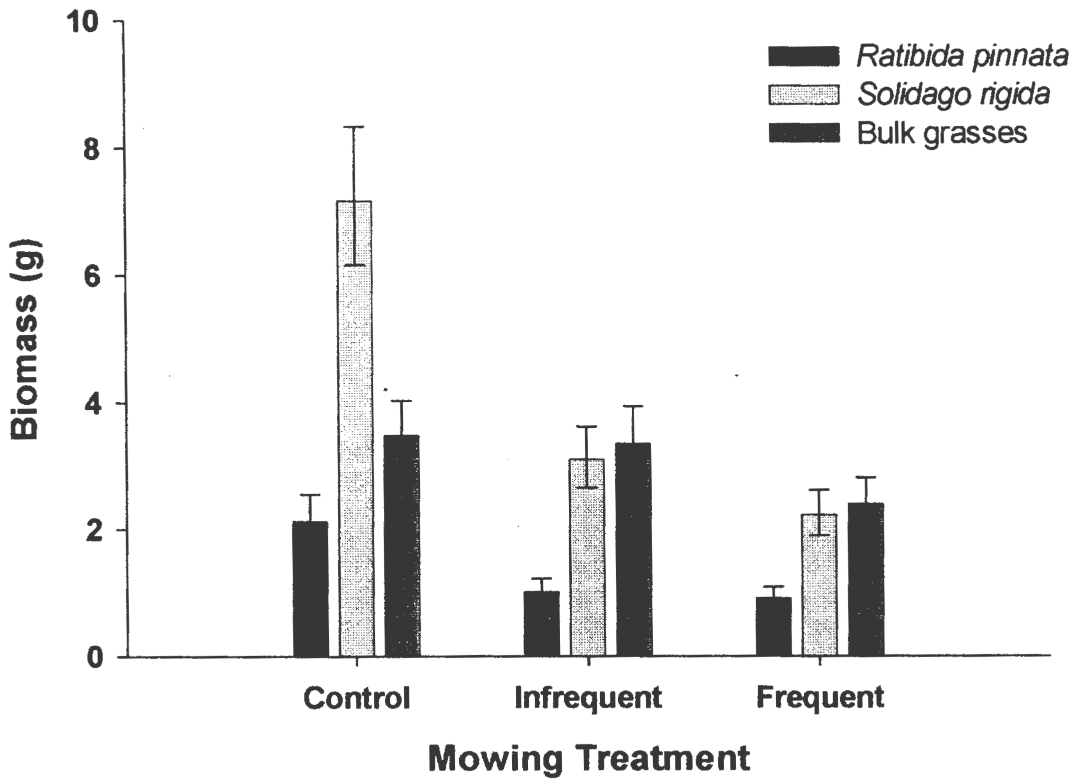

Figure 3. L.S. means +/- 1 S.E. of established forb crowns. Mowing frequently or infrequently significantly reduced the crown size of *R. pinnata* and *S. rigida*, p=0.011 and p<0.001 respectively. Mowing at any interval did not affect crown sizes of bulk warm season grasses.

<u>Forbs Seeded in 2003</u>

<u>Destructive Sampling</u>

Two-way ANOVA on biomass treatment means revealed that mowing does have a significant impact on the size of certain species after two consecutive seasons of mowing. When destructively sampled, including roots to 15-cm in the total biomass, results indicate that mowing significantly (p=0.005) increased the size of *P. integrifolium* two-year-old seedlings (Fig. 4).

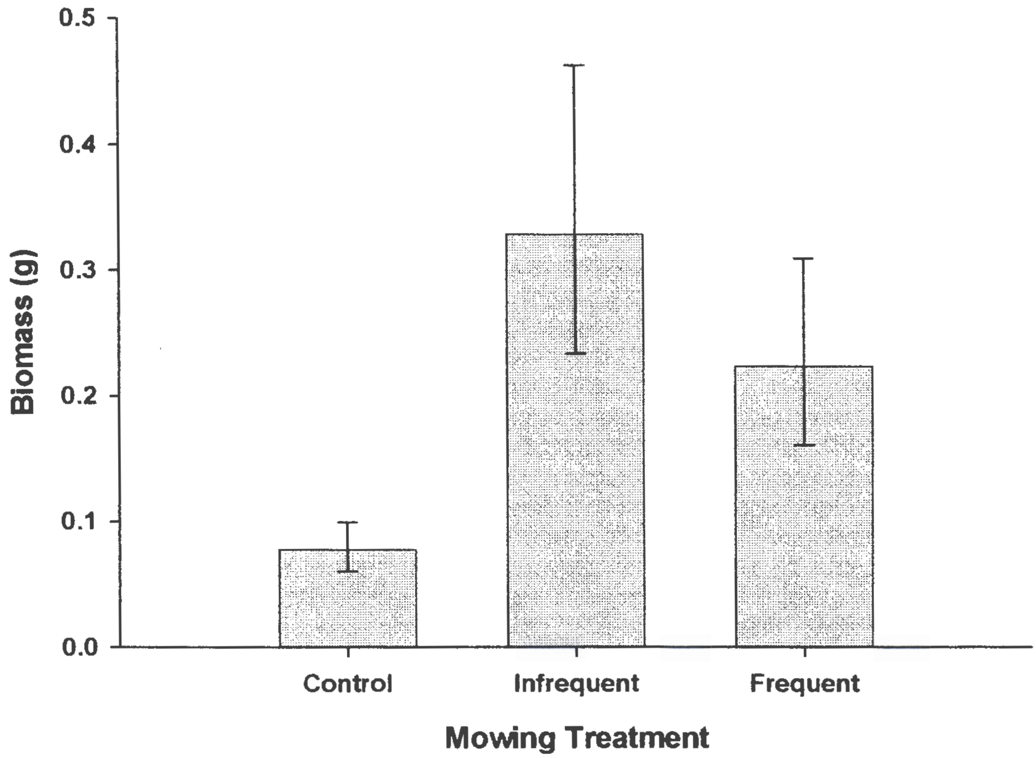

Figure 4. Mean biomass of *P. integrifolium* seedlings by treatment. Mowing significantly increased the size of seedlings p=0.005

Non-Destructive Sampling

When plants were non-destructively sampled for plant size (using stem number by maximum height as measurement) two-way ANOVA on treatment means for each species revealed a significant treatment effect in one out of the four species included in this part of the study. When mowed infrequently, *Dalea candidum* was significantly (p=0.023) larger than plants in control plots. However, there was no difference between *D. candidum* individuals found in control plots or frequently mowed plots, and likewise there was no difference in *D. candidum* size between frequently mowed plots and infrequently mowed plots. Mowing did not affect the size of the other three species included in the non-destructive plant size study (*Astragalus canadensis*, p=0.8101; *Aster laevis*, p=0.0681; *Parthenium integrifolium*, p=0.853; Fig 5).

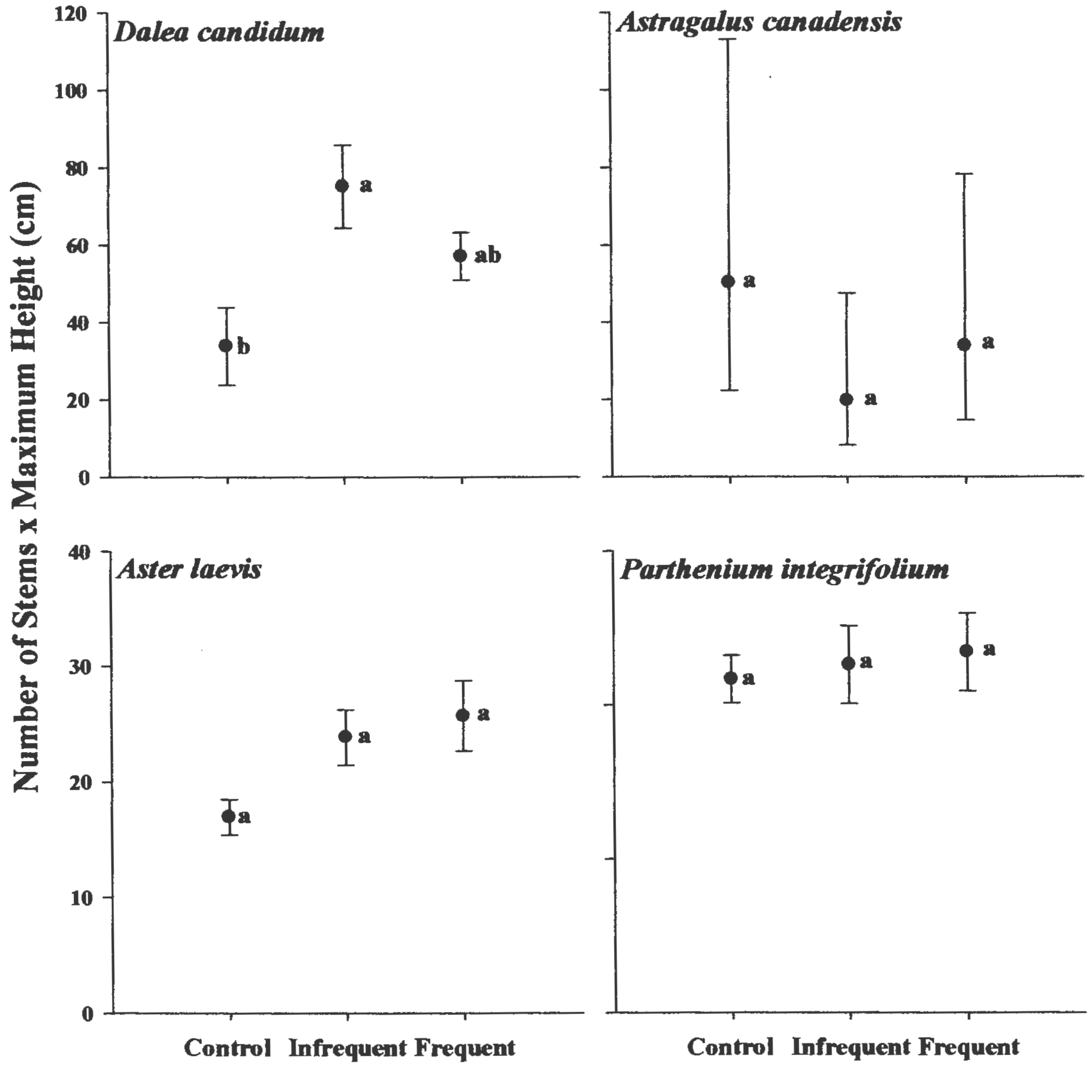

Figure 5. *D. candidum* was the only one of four species to be found significantly larger when infrequently mowed p=0.023.

Below Ground Biomass

Mowing had a significant effect on the biomass of root regrowth. Two-way ANOVA on treatment means showed significantly more fine roots grew into areas of fallow soil in plots that were receiving the infrequent mowing treatment as compared to unmowed controls, p=0.024. No statistical difference was found between the infrequently mowed treatment and the frequently mowed treatment or between the frequently mowed treatment and the control treatment (Fig. 6).

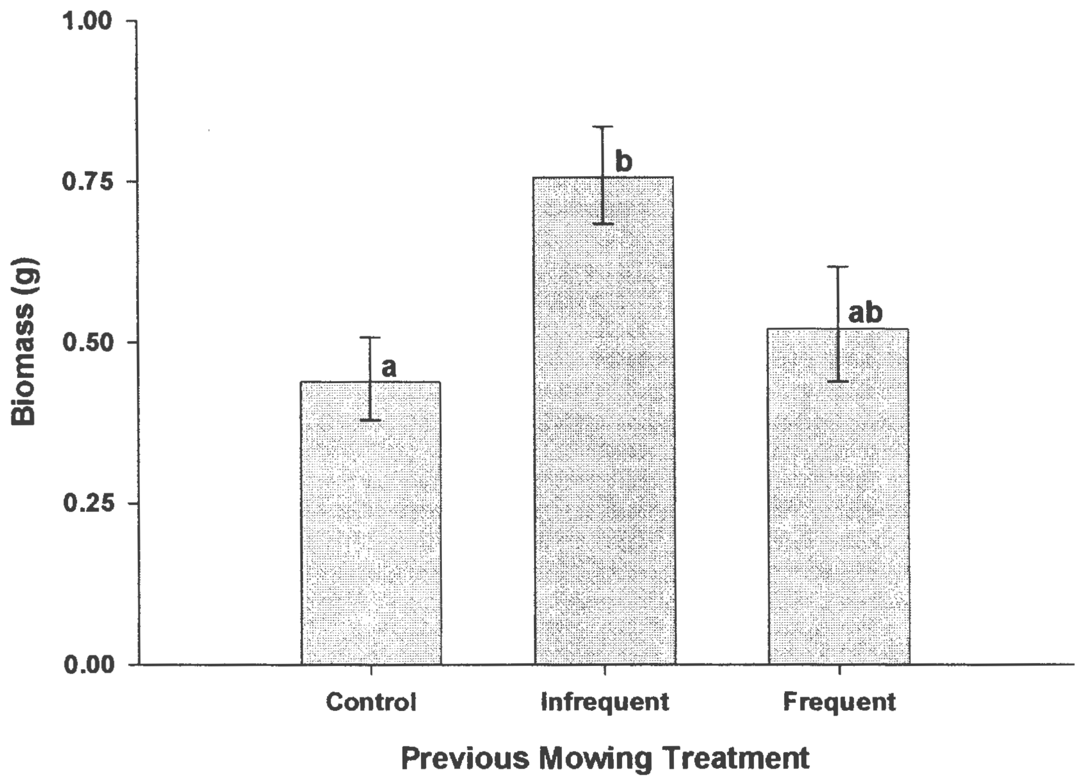

Figure 6. Mowing infrequently significantly increased the amount of root biomass that was produced in areas filled with fallow soil, p=0.024. There were no significant differences found in root biomass amounts between infrequently and frequently mowed plots or between frequently mowed and control plots.

Species Diversity: Richness and Evenness

I used two-way analysis of covariance where species richness was dependent on the initial species richness and treatment to analyze this data set. Mowing at any interval did not have a significant effect on species richness, (p=0.649; Fig.7). Most of the increase in species diversity between May 2003 and May 2004 can be attributed to the addition of new species seeded at the beginning of the study.

Two way ANCOVA on mean Shannon index values by treatment, where values were dependent on the index value at the beginning of the study and treatment, showed mowing also had no effect on the distribution of species throughout the plots, p=0.927. The increase in the Shannon diversity index between July 2004 and August 2005 may be due to the decrease in abundance of the most dominant species, especially *Rudbeckia hirta*. *R. hirta* was present at an abundance of approximately 8.06 seedlings/m^2 in July of 2004, but decreased to 1.63 seedlings/m^2 by August of 2005. A decrease in the dominance of certain species can lead to an increase in Shannon diversity index values because it becomes more difficult to predict the identity of an individual picked at random. A decrease in dominance would not have a major affect on species richness, but increasing species number would contribute to the higher Shannon Index values.

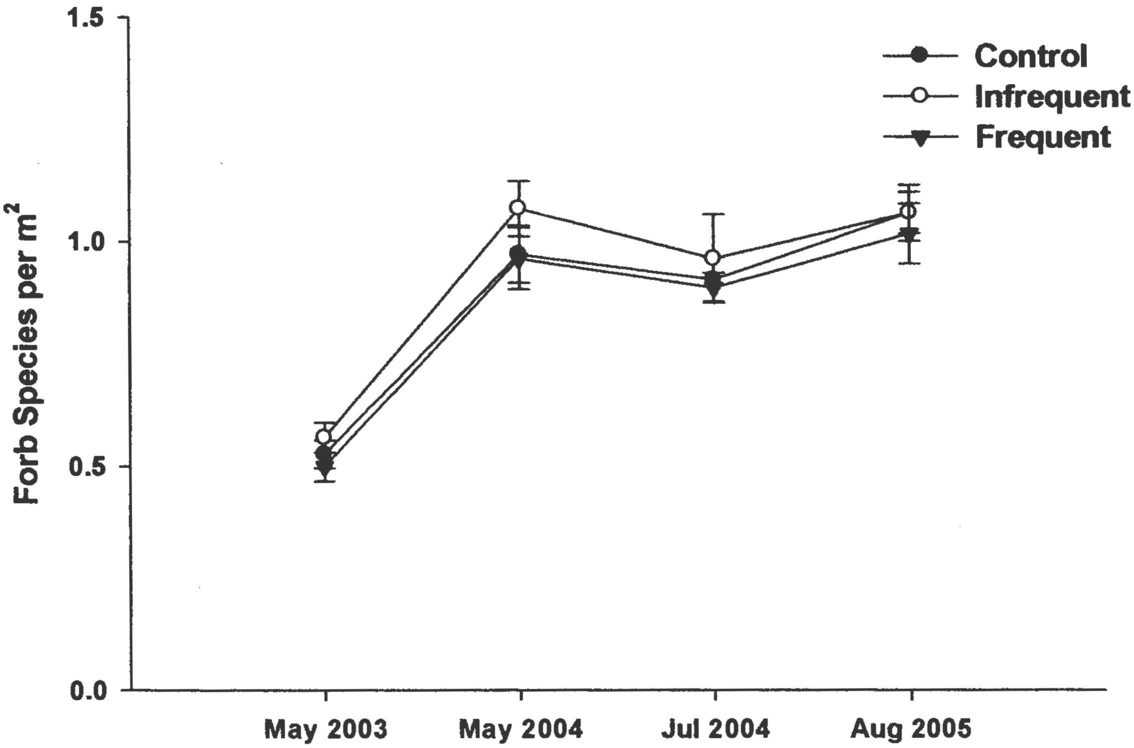

Figure 7. Mowing at any interval did not have an affect on species richness, p=0.649.

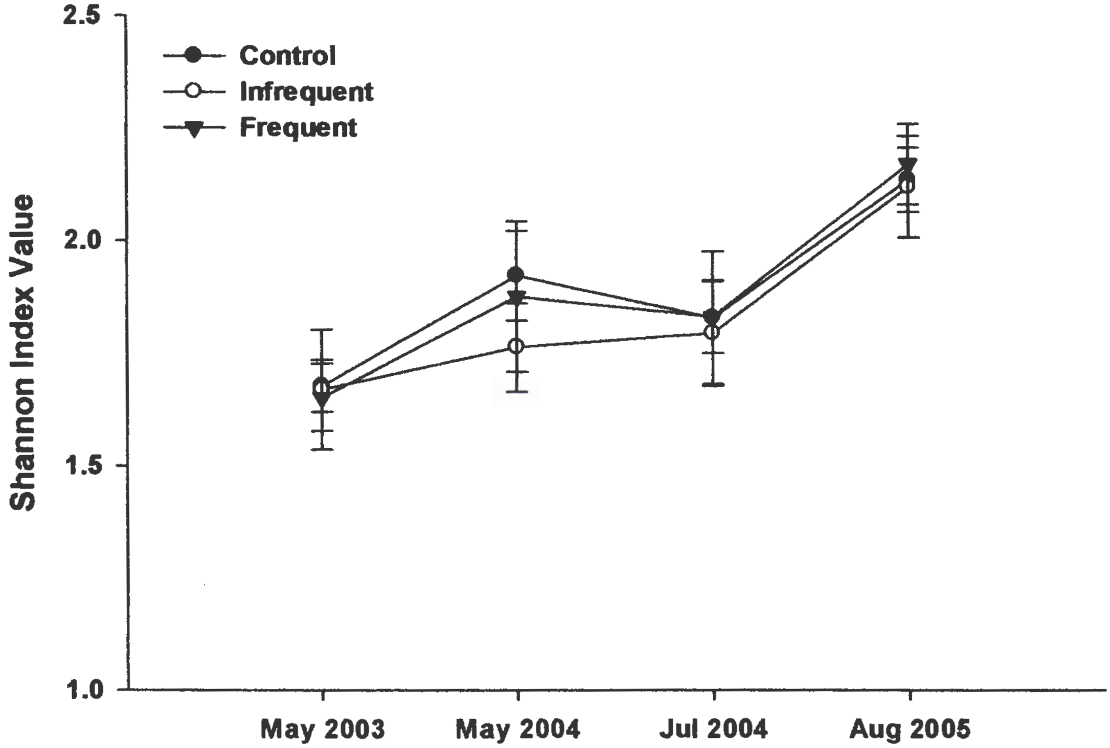

Figure 8. Mowing at any interval did not significantly affect the Shannon index value for each treatment, p=0.913.

CHAPTER 5

DISCUSSION

The results of this study support the hypothesis that it is possible to increase forb diversity in an established grassland using an incremental approach. Furthermore, I have determined that following the initial addition of forbs to a site, mowing may not be necessary to achieve establishment of new forb species in subsequent forb additions to the same site. However even if mowing is used in subsequent projects to obtain the limited benefits it provides, it is still possible to incrementally increase forb diversity without decreasing the population size of previously established forbs.

Incremental Addition of Native Forb Species

With or without mowing, new species were successfully added to the experimental site without harming the existing forb population. At the conclusion of this study in 2005, seven out of the ten species that were broadcast seeded into the study site in spring of 2003 were present alongside the twenty-three species of native forbs that were added by Williams *et al.* (in press) in 1999. These results make it possible to accept my hypothesis that forb species can be added to an established grassland by incremental seeding.

The species that did become established in the experimental plots varied in abundance throughout the three years of this study. *P. integrifolium* established at the highest abundance at a rate of 3.28 seedlings/m^2 by the end of the study period in 2005, which is approximately 13.1% establishment of the 25 seeds/m^2 that were planted. *D.*

candidum and *A. laevis* were also fairly abundant with rates of 0.17 and 0.93 seedlings/m^2 respectively. The emergence of *A. laevis* was interesting because it occurred at very low densities in 2003, but became the second most abundant of the newly added forb species in 2004. The low germination levels seen in *A. laevis* in 2003 may be related to the fact that the growing season was very dry with almost no precipitation falling in August. Baskin and Baskin (1998) have suggested that seeds of some plant species can undergo a secondary dormancy period inhibiting germination until the following growing season, if germination conditions are unfavorable at time of seeding. The remaining four out of the ten new species that were added during this experiment were present at low levels throughout the experimental period. The two species that were not found in any year of this project were *V. virginicum* and *P. virginianum*. Both of these species have an extremely small seed size (*V. virginicum* 0.000038g and *P. virginianum* 0.000128g), which may have reduced their ability to compete with large, established plants (Moles and Westoby 2004). It is also possible that the two species did germinate, but were too rare to be detected even with the extensive sampling methods used. Overall, I was able to successfully add seven new species of Iowa's native forbs to the study site. The use of infrequent or frequent mowing did not significantly increase the emergence, survival or, abundance of any of these species compared to controls.

Not only was forb diversity increased at the experimental site, it was accomplished without decreasing the population of previously added forbs (from Williams *et al.* in press study). The results of my research show that even under frequent or infrequent mowing regimes, established, adult prairie forbs will survive and persist in an area once they are introduced. The crowns of *Solidago rigida* and *Ratibida pinnata* collected in 2003 showed that mowing had significantly reduced the size of these five-year-old forbs ($p<0.001$ and $p=0.011$). However, at the conclusion of this study there was no significant difference in the individual number of forbs found in frequently and infrequently mowed plots compared to controls. The mean number of forbs found per m^2 in frequently mowed, infrequently mowed, and control plots were 12.75, 13.14 and 15.42 respectively.

The addition of new forb species did not affect the warm season grasses either. Contrary to my expectations there was no difference in the size of the crowns of the warm season grasses collected in June of 2003, $p=0.237$. Additional analysis of warm season grass abundance was performed in September of 2005. The data showed that mowing at any interval did not affect the abundance of warm season grass flowering stalks compared to controls. Although biomass measures were not collected, it is likely that the mass of grasses receiving the mowed treatment is smaller compared to controls. However, based on visual observations, it appears the grasses will recover quickly.

Overall, increasing forb diversity to an established grassland can be done incrementally. This research has shown that new forb species can be successfully introduced into an area containing both grasses and forbs with or without mowing. It was also shown that increasing species diversity through incremental seed additions does not cause irreversible damage to previously established grasses and forbs. This is true even when a high intensity mowing treatment is used.

Effects of Mowing

The results obtained from this experiment do not support my hypothesis that frequent mowing helps increase the establishment and survival of newly seeded forb species. While there is mixed evidence suggesting that mowing may offer a limited number of benefits, it is possible to conclude that mowing during the second incremental addition of forb species is not necessary. Based on my own visual observations I have concluded that once the initial forb component has been added using mowing (Williams *et al.* in press) to a warm season grass stand, the presence of natural gaps increases greatly. It is quite possible that the established grasses were still recovering from the intense mowing treatment they received previously during the Williams *et al.* (in press) study making all plots susceptible to invasion by the newly seeded species, whether they received an additional mowing treatment or not.

Mowing did succeed in altering the established plant community in a way that should in theory, (Davis et al 2000 and Crawley 1986), make invasions by newly seeded forb species more successful. Mowing removed the majority of above ground biomass, increasing the amount of physical space for new seedling recruits. Mowing also increased light availability; frequently and infrequently mowed plots received 49-55% of available light at the soil surface compared to 22% of light that was available at the surface in control plots. Mowing also successfully reduced the amount of leaf litter that accumulated on the surface from 282 g/m^2 in control plots to 96.9-85.9 g/m^2 in infrequently and frequently mowed plots. By increasing the amount of physical space, available light at the soil surface, and reducing the amount of accumulated leaf litter conditions for new seedling recruitment and establishment should have been improved (Tilman 1993, Williams *et al.* in press, and Carson and Peterson 1990).

However, as discussed earlier in this chapter, mowing did not increase the emergence or establishment of the newly seeded forb species in any year of this study. While the absolute treatment mean of seedlings/m² was about 1 to 3 seedlings greater in mowed plots compared to controls there were no significant difference from unmowed plots. From these results it can be concluded that mowing during the second incremental seeding is not necessary to achieve germination and establishment of newly seeded species.

Williams et al (in press) found that mowing significantly decreased the amount of over winter mortality of newly added species. The Williams study also found that mowing lessened the growing season mortality of new forb seedlings. However, I did not find similar results for seedling mortality in my study. Seedling mortality both over the winter and over the 2004-growing season did not differ significantly with any mowing treatment compared to controls. The 2003-2004-winter mortality of newly emerged seedlings was greater than fifty percent in all mowing treatments. The cause of this high mortality cannot be known with certainty, but part may be attributed to lack of precipitation during the 2003 growing season. As mentioned earlier, almost no precipitation fell in August of 2003, which may have resulted in smaller, less vigorous seedlings than what might be expected in a normal year. Small seedlings may have difficulty surviving a winter if they have not reached a minimum size and have not built up efficient reserves.

The 2004 growing season mortality also did not differ significantly due to different mowing treatments. Mortality rates were between 34.2-45.0 percent in all treatments. These results show that the number of seedlings present at different times during the growing season is not static. Throughout the growing season, mortality of seedlings occurs, although seedling numbers changed over time during the growing season. Thus during early summer the number of seedlings increased; but seedling mortality was most pronounced from mid-July on, as seedling numbers declined.

Although there was a high percentage of seedling mortality both over the winter and during the 2004-growing season, mowing did not help decrease mortality. From these results I have concluded that mowing during the second incremental addition of forbs does not help to decrease seedling mortality.

Studies by Johnson and Matchett (2001) and Biswell and Weaver (1933) have shown that grazing or mowing of established vegetation significantly reduces the amount of root biomass produced by the plants. For a study such as this one, reduced production of root biomass by established plants due to mowing could help increase seedling emergence and establishment by reducing below ground competition. I used a proxy measure of root ingrowth cores to determine how root density compared between mowed and unmowed treatments. My results were not in agreement with the previous studies on root biomass production following mowing treatments (Johnson and Matchett 2001). My data suggested that infrequent mowing significantly increases below ground root density compared to controls, and therefore will not aid in the establishment of newly introduced forb species. Based on my personal observations and comments by Clements and

Weaver (1924) it is possible that due to the difficulty involved in quantifying root densities, my results for this part of the experiment may not be reliable. However, my results seem to suggest that mowing during the second incremental forb seed addition does not decrease competition for seedlings by reducing root densities. In actuality, mowing infrequently may make the competition more intense.

Another way mowing may have actually increased the competition for the newly added forbs is it significantly increased the abundance of cool season grasses (mainly Kentucky bluegrass). In the frequently mowed treatment 150.13/m^2 flowering stalks of Kentucky bluegrass were recorded compared to 13.20 flowering stalks/m^2 in controls. Because mowing did not affect the warm season grasses it is likely that within a few growing seasons the abundance of cool season grasses will decline to normal levels as the grasses and forbs become more competitive and prescribed fire is returned to the area.

Mowing had no significant effect on species richness or Shannon Index values compared to controls. Species richness did increase in all treatments from approximately 0.5 to 1.0 species/m^2 from the first sampling in May 2003 to the second sampling in May 2004. This increase in species richness can be attributed to the additional seeding of ten new species in which a maximum of eight out of ten species were present. From May 2004 to the end of the study in August 2005, species richness remained relatively constant.

The Shannon Index, which takes into account species richness and evenness, was not significantly different due to different mowing treatments at any time during this experiment. However, all plots showed an increase in Shannon diversity from July 2004 to August 2005 from approximately 1.8 to 2.15. This increase is most like due to a decrease in the most dominant species from the Williams *et al.* (in press) previous forb addition experiment. *Ratibida pinnata* and *Solidago rigida* both showed decreases in all plots, but the biennial *Rudbeckia hirta* decreased most drastically from 8.06 plants/m² in July 2004 to 1.63 plants/m². A decrease in dominant species often causes an increase in the Shannon Index because it becomes more difficult to predict the identity of an individual picked at random meaning the planting is more diverse. Increasing the number of species would also contribute to a higher Shannon Index value, however that was not the cause of the increase during that time interval as species richness only increased by approximately one species/m² between the two dates.

While the majority of the data presented here suggest that mowing during the second incremental seeding of forb species is not necessary, there is one significant piece of evidence that indicated that mowing may offer some benefit to new seedlings. By destructively sampling *P. integrifolium* (digging up the seedlings with roots intact and obtaining whole plant biomass measures) it was determined that mowing at any interval significantly increased the size of newly established seedlings. Non-destructive sampling, using leaf or stem number and maximum height as measures, was used to look at trends in plant size for four of the ten new species seeded at the beginning of this study. Typically (with the exception of *Astragalus canadensis*), mowing increased the stem number and height of the newly added forb species, but only *D. candidum* was found to be significantly larger when mowed infrequently compared to controls. *P. integrifolium* proved larger when sampled destructively. However when sampled non-destructively the species was not found to be significantly larger due to mowing. This result may indicate that destructive sampling may be a more accurate method for determining plant size because biomass (including roots) measurements are used for comparison and much of a young forb's growth takes place below ground. Due to the fact that many of the ten seeded species were present in such low abundances it was not feasible to destructively sample all species, although it may have been a more accurate measure of plant size.

The creation of larger plants due to mowing will eventually lead to long-term success, as it will most likely increase the plants' survival rate and subsequent reproductive ability. Studies suggest that larger plants with more extensive root systems and food storage capabilities are more resistant to stressful situations and over-winter mortality (Weaver 1930). The increase in plant size in some species is evidence that supports the importance of mowing, but this one benefit may not be enough to conclude that mowing is still necessary during the second incremental forb seeding.

Conclusion

From this study I have concluded that it is entirely possible to increase forb species diversity in an incremental manner. Perhaps the most interesting finding derived from this research is that mowing offers only limited benefits once the initial forb addition project has been completed on a site. This might be due to the fact that a prairie restoration that consists of both warm season grasses and forbs consists of a much patchier environment with more naturally occurring available gaps than a planting that contains solely grasses. For this reason, it is possible for incremental forb addition to be accomplished in a reconstruction without management via intensive mowing. With every successful seed addition project, species richness will increase. In this study, just by adding the seeds of ten forb species to a grassland with twenty-three previously established forbs, species richness increased from 0.5 to 1.0 species/m^2. Studies have shown that true remnant prairies have about twice the species richness and Shannon Index values of restoration sites (Martin *et al.* 2005). By continually adding species using this incremental seed addition approach, we will be closer to restoring a grassland community that is much more reminiscent of the original tallgrass prairie.

Future Studies

The findings of this study may be very useful in future restoration projects by offering a method for increasing species diversity in a manner that is not management intensive. However, there are many unanswered questions about how this system actually works. Low germination rates in the first year of this study and the complete failure of some species (with or without mowing) suggest that there are many other factors affecting seedling emergence and establishment besides competition from established plants. It is likely that some species are more suitable for seeding in an incremental forb addition project than others.

To look at what species are best suited for this type of project, I have begun a pilot study (which is not discussed in this thesis) to test how well showy and expensive forbs (*Dodecatheon meadia* and *Phlox pilosa*) establish in a situation where they are seeded into an established grassland. Often showy, expensive forb species included in restoration projects fail to germinate. This study is being completed on a much smaller spatial scale so details of the seedling life cycle can be observed more readily. Already I have encountered some new findings that have led me to believe low seedling germination and high mortality may be due to factors other than competition by established plants. Most likely these factors include planting time, pre-seeding seed treatments, seed death and seed loss through predation by birds, small mammals, and insects. By determining a method for eliminating these factors, forb addition projects can be even more successful.

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APPENDIX 1

SEEDLING DATA

2003 Seedling Data												
Block	**Plot**	**Quadrat**	**Amca**	**Asla**	**Asca**	**Daca**	**Lipy**	**Pain**	**Pyvi**	**Sosp**	**Vevi**	**Ziap**
1	3	1						1				
1	3	2	1					3				
1	3	3				2						
1	3	4				2						
1	3	5						1		5		
1	3	6										
1	3	7	2									
1	3	8	1			2						
1	3	9	1			2				1		
1	3	10				1		3				
1	3	11										
1	3	12										
1	4	1				3						
1	4	2	1		3	1		1				
1	4	3						1				
1	4	4										
1	4	5										
1	4	6			1	1						
1	4	7			1	1		3				
1	4	8	1		3	1		1				
1	4	9	2		1			6				
1	4	10				1	1					
1	4	11										
1	4	12						2				
1	6	1										
1	6	2		1								
1	6	3						3		1		
1	6	4	3			4		5				
1	6	5						2				
1	6	6						2				
1	6	7						2		7		
1	6	8	1					4				
1	6	9										
1	6	10										
1	6	11						2				
1	6	12		2				3				
1	7	1						1				
1	7	2										
1	7	3										
1	7	4						5				
1	7	5										
1	7	6						1				
1	7	7	1					4				
1	7	8						5				
1	7	9						6				
1	7	10				2		1		1		

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	7	11				1		5				
1	7	12						4				
1	8	1			1							
1	8	2	1					3				
1	8	3										
1	8	4				1		4				
1	8	5	1				1					
1	8	6	1					1				
1	8	7						3				
1	8	8				1		1				
1	8	9				1		3		2		
1	8	10			1			1				
1	8	11										
1	8	12	1			1						
1	9	1										
1	9	2										
1	9	3						1				
1	9	4										
1	9	5						1				
1	9	6						1				
1	9	7						1				
1	9	8				1						
1	9	9						1		1		
1	9	10						4				
1	9	11			1			6				
1	9	12										
1	10	1	1									
1	10	2				2		3				
1	10	3				1						
1	10	4										
1	10	5										
1	10	6										
1	10	7	1			1		6				
1	10	8						3				
1	10	9										
1	10	10										
1	10	11						2				
1	10	12			1			4				
1	11	1	1									
1	11	2										
1	11	3	1					2				
1	11	4						1				
1	11	5					1	1				
1	11	6						5				
1	11	7										
1	11	8						3				
1	11	9										

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	11	10				2		1				
1	11	11				2		3				
1	11	12				1		2				
1	12	1				1		4				
1	12	2	1			2	1	5				
1	12	3				3		3				
1	12	4										
1	12	5						2				
1	12	6										
1	12	7						4				
1	12	8				1		5				
1	12	9				3		1				
1	12	10						2				
1	12	11										
1	12	12						1				
2	1	1			1							
2	1	2										
2	1	3	1				1					
2	1	4				4		2				
2	1	5						3				
2	1	6						2				
2	1	7						2				
2	1	8						1				
2	1	9						1				
2	1	10						1				
2	1	11	1					1		1		
2	1	12										
2	4	1										
2	4	2										
2	4	3				1		2				
2	4	4						1				
2	4	5			1			4		1		
2	4	6						2				
2	4	7						1				
2	4	8										
2	4	9						1				
2	4	10										
2	4	11			1			4				
2	4	12			2			4				
2	5	1						3				
2	5	2						4		1		
2	5	3						2				
2	5	4										
2	5	5			1	2		2				
2	5	6				1	1	6				
2	5	7	1					1				
2	5	8						2				

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	5	9				1	1	1				
2	5	10	2					1				
2	5	11	1									
2	5	12										
2	7	1						1		1		
2	7	2					1					
2	7	3										
2	7	4	1									
2	7	5								1		
2	7	6						4				
2	7	7						4				
2	7	8		1								
2	7	9						1				
2	7	10				1						
2	7	11						2				
2	7	12										
2	8	1						2				1
2	8	2	1					3				
2	8	3	1			1	1	6				
2	8	4						5		2		
2	8	5				1		4		1		
2	8	6				1						
2	8	7		1				9		2		
2	8	8			1							1
2	8	9	1					3				
2	8	10						1		1		
2	8	11			1	1		3				
2	8	12						2				
2	9	1	1			1						
2	9	2						1				
2	9	3		1		1		3				
2	9	4										
2	9	5		1								
2	9	6	1	2		4		1				
2	9	7				1						
2	9	8		1		4		1				
2	9	9				1		3				
2	9	10						6				
2	9	11		1		2		4				
2	9	12		1				3				
2	10	1						1				
2	10	2										
2	10	3						3				
2	10	4						1				
2	10	5				2		1				
2	10	6						1				
2	10	7										

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	10	8						2				
2	10	9						2				1
2	10	10	1					4				
2	10	11				1		4				
2	10	12	1			1		2				1
2	11	1				1		1				
2	11	2				2		2				
2	11	3										
2	11	4						1				
2	11	5						5				
2	11	6	1									
2	11	7	1			1		1				
2	11	8				1	1	1		4		
2	11	9				2		1				
2	11	10	1			21						
2	11	11		1								
2	11	12								1		
2	12	1						4				
2	12	2				1		1				
2	12	3				5						
2	12	4				4		2				
2	12	5				4						
2	12	6						3				
2	12	7						1				
2	12	8						1				
2	12	9				1		1				
2	12	10										
2	12	11						1				
2	12	12						1				

June 3rd 2004 Seedling Data												
Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	3	1	0	0	0	0	0	1	0	0	0	0
1	3	2	0	0	0	0	0	3	0	0	0	0
1	3	3	0	0	0	0	0	0	0	0	0	0
1	3	4	0	0	0	0	0	0	0	0	0	0
1	3	5	0	0	0	0	0	0	0	0	0	0
1	3	6	0	0	0	0	0	0	0	0	0	0
1	3	7	0	0	0	0	0	0	0	0	0	0
1	3	8	0	0	0	0	0	1	0	0	0	0
1	3	9	0	0	0	1	0	0	0	0	0	0
1	3	10	0	0	0	0	0	1	0	0	0	0
1	3	11	0	0	0	0	0	0	0	0	0	0
1	3	12	0	0	0	0	0	0	0	0	0	0
1	4	1	0	0	0	1	0	0	0	0	0	0
1	4	2	0	0	0	0	0	0	0	0	0	0
1	4	3	0	0	0	0	0	1	0	0	0	0
1	4	4	0	0	0	0	0	0	0	0	0	0
1	4	5	1	0	0	0	0	0	0	0	0	0
1	4	6	0	0	0	0	0	1	0	0	0	0
1	4	7	1	1	0	0	0	3	0	0	0	0
1	4	8	0	0	0	1	0	0	0	1	0	0
1	4	9	0	1	0	0	0	2	0	0	0	0
1	4	10	0	0	0	0	0	0	0	0	0	0
1	4	11	0	0	0	0	0	1	0	0	0	0
1	4	12	0	0	0	0	0	1	0	0	0	0
1	6	1	0	0	0	0	0	0	0	0	0	0
1	6	2	0	0	0	0	0	0	0	0	0	0
1	6	3	0	0	0	0	0	0	0	0	0	0
1	6	4	0	0	1	0	0	3	0	0	0	0
1	6	5	0	0	0	0	0	0	0	0	0	0
1	6	6	0	0	0	0	0	0	0	0	0	0
1	6	7	0	0	0	0	0	0	0	0	0	0
1	6	8	0	0	0	0	0	0	0	0	0	0
1	6	9	0	0	0	0	0	1	0	0	0	0
1	6	10	0	0	0	0	0	0	0	0	0	0
1	6	11	0	0	0	0	0	1	0	0	0	0
1	6	12	0	1	0	0	0	0	0	0	0	0
1	7	1	0	0	0	0	0	0	0	0	0	0
1	7	2	0	0	0	0	0	0	0	0	0	0
1	7	3	0	0	0	0	0	0	0	0	0	0
1	7	4	0	0	0	0	0	0	0	0	0	0
1	7	5	0	0	0	0	0	0	0	0	0	0
1	7	6	0	0	0	0	0	0	0	0	0	0
1	7	7	0	0	0	0	0	0	0	0	0	0
1	7	8	0	0	0	0	0	1	0	0	0	0
1	7	9	0	0	0	0	0	0	0	0	0	0
1	7	10	0	0	0	2	0	1	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	7	11	0	0	0	0	0	0	0	0	0	0
1	7	12	0	0	0	0	0	0	0	0	0	0
1	8	1	0	0	0	0	0	0	0	0	0	0
1	8	2	0	0	0	0	0	0	0	0	0	0
1	8	3	0	0	0	0	0	0	0	0	0	0
1	8	4	1	0	0	0	0	3	0	0	0	0
1	8	5	0	0	0	0	0	0	0	0	0	0
1	8	6	0	0	0	0	0	1	0	0	0	0
1	8	7	0	0	0	0	0	1	0	0	0	0
1	8	8	0	0	0	0	0	1	0	0	0	0
1	8	9	1	1	1	1	0	1	0	0	0	0
1	8	10	0	0	0	1	0	0	0	0	0	0
1	8	11	2	0	0	0	0	0	0	0	0	0
1	8	12	1	0	0	0	0	0	0	0	0	0
1	9	1	0	0	0	1	0	0	0	0	0	0
1	9	2	0	0	0	0	0	0	0	0	0	0
1	9	3	0	0	0	0	0	0	0	0	0	0
1	9	4	0	0	0	0	0	0	0	0	0	0
1	9	5	0	0	0	0	0	0	0	0	0	0
1	9	6	0	0	0	0	0	1	0	0	0	0
1	9	7	0	0	0	0	0	0	0	0	0	0
1	9	8	0	0	0	2	0	0	0	0	0	0
1	9	9	0	0	0	0	0	1	0	0	0	0
1	9	10	0	0	0	1	0	4	0	0	0	0
1	9	11	0	1	0	0	0	3	0	0	0	0
1	9	12	0	0	0	0	0	0	0	0	0	0
1	10	1	0	0	0	0	0	0	0	0	0	0
1	10	2	0	1	0	0	0	3	0	0	0	0
1	10	3	0	0	0	0	0	0	0	0	0	0
1	10	4	0	0	0	0	0	0	0	0	0	0
1	10	5	0	0	0	0	0	0	0	0	0	0
1	10	6	0	0	0	0	0	0	0	1	0	0
1	10	7	0	1	0	0	0	0	0	0	0	0
1	10	8	0	0	1	0	0	1	0	0	0	0
1	10	9	0	0	0	0	0	0	0	0	0	0
1	10	10	0	0	0	0	0	0	0	0	0	0
1	10	11	0	0	0	0	0	1	0	0	0	0
1	10	12	0	0	0	0	0	2	0	0	0	0
1	11	1	0	0	0	0	0	0	0	0	0	0
1	11	2	0	0	0	0	0	0	0	0	0	0
1	11	3	0	1	0	0	0	1	0	0	0	0
1	11	4	0	0	0	0	0	0	0	0	0	0
1	11	5	0	0	0	0	0	0	0	0	0	0
1	11	6	0	0	0	0	0	3	0	0	0	0
1	11	7	0	0	0	0	0	0	0	0	0	0
1	11	8	0	0	0	0	0	3	0	0	0	0
1	11	9	0	0	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	11	10	0	0	0	2	0	0	0	0	0	0
1	11	11	1	2	0	0	0	2	0	0	0	0
1	11	12	0	2	0	0	0	1	0	0	0	0
1	12	1	0	0	0	0	0	0	0	0	0	0
1	12	2	1	0	0	0	0	2	0	0	0	0
1	12	3	0	0	0	0	0	0	0	0	0	0
1	12	4	0	0	0	0	0	0	0	0	0	0
1	12	5	0	0	0	0	0	0	0	0	0	0
1	12	6	0	0	0	0	0	0	0	0	0	0
1	12	7	0	0	0	0	0	0	0	0	0	0
1	12	8	0	0	0	0	0	4	0	0	0	0
1	12	9	0	1	0	0	0	0	0	0	0	0
1	12	10	0	0	0	0	0	0	0	0	0	0
1	12	11	0	0	0	0	0	0	0	0	0	0
1	12	12	0	0	0	0	0	0	0	0	0	0
2	1	1	0	0	0	0	0	0	0	0	0	0
2	1	2	0	0	0	0	0	0	0	0	0	0
2	1	3	0	0	0	0	0	0	0	0	0	0
2	1	4	0	1	0	0	0	0	0	0	0	0
2	1	5	0	0	0	0	0	1	0	0	0	0
2	1	6	0	0	0	0	0	0	0	0	0	0
2	1	7	0	1	0	0	0	2	0	0	0	0
2	1	8	0	0	0	0	0	0	0	0	0	0
2	1	9	0	0	0	0	0	0	0	0	0	0
2	1	10	0	0	0	0	0	0	0	0	0	0
2	1	11	0	1	0	0	0	0	0	0	0	0
2	1	12	0	0	0	0	0	0	0	0	0	0
2	4	1	0	0	0	0	0	0	0	0	0	0
2	4	2	0	0	0	0	0	0	0	0	0	0
2	4	3	0	0	0	0	0	1	0	0	0	0
2	4	4	0	0	0	0	0	0	0	0	0	0
2	4	5	0	2	0	0	0	1	0	0	0	0
2	4	6	0	1	0	0	0	1	0	0	0	0
2	4	7	0	0	0	0	0	0	0	1	0	0
2	4	8	0	0	0	0	0	0	0	0	0	0
2	4	9	0	0	0	0	0	1	0	0	0	0
2	4	10	0	0	0	0	0	0	0	0	0	0
2	4	11	0	0	0	0	0	3	0	0	0	0
2	4	12	1	0	0	1	0	3	0	0	0	0
2	5	1	0	0	0	0	0	2	0	0	0	0
2	5	2	0	1	0	0	0	0	0	0	0	0
2	5	3	0	0	0	0	0	0	0	0	0	0
2	5	4	0	0	0	0	0	0	0	0	0	0
2	5	5	0	0	0	0	0	0	0	0	0	0
2	5	6	0	0	0	0	0	2	0	0	0	0
2	5	7	0	1	0	0	0	0	0	0	0	0
2	5	8	0	0	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	5	9	0	1	0	0	0	1	0	0	0	0
2	5	10	0	0	0	0	0	0	0	0	0	0
2	5	11	0	0	0	0	0	0	0	0	0	0
2	5	12	0	0	0	0	0	0	0	1	0	0
2	7	1	0	0	0	0	0	0	0	0	0	0
2	7	2	0	0	0	0	0	0	0	0	0	0
2	7	3	0	0	0	0	0	1	0	0	0	0
2	7	4	0	0	0	0	0	0	0	0	0	0
2	7	5	0	0	0	0	0	0	0	0	0	0
2	7	6	0	0	0	0	0	1	0	0	0	0
2	7	7	0	0	0	0	0	2	0	0	0	0
2	7	8	0	1	0	0	0	0	0	0	0	0
2	7	9	0	0	0	0	0	0	0	0	0	0
2	7	10	0	0	0	0	0	1	0	0	0	0
2	7	11	0	0	0	0	0	1	0	0	0	0
2	7	12	0	0	0	0	0	0	0	0	0	0
2	8	1	0	0	0	0	0	1	0	0	0	0
2	8	2	1	0	0	0	0	1	0	1	0	0
2	8	3	0	1	0	0	0	6	0	0	0	0
2	8	4	0	0	0	0	0	1	0	0	0	0
2	8	5	0	1	0	0	0	2	0	0	0	0
2	8	6	0	0	0	0	0	0	0	0	0	0
2	8	7	0	0	0	0	0	0	0	0	0	0
2	8	8	0	0	0	0	0	1	0	0	0	0
2	8	9	0	3	0	0	0	3	0	0	0	0
2	8	10	0	1	0	0	0	1	0	0	0	0
2	8	11	0	1	0	0	0	2	0	0	0	0
2	8	12	0	1	0	0	0	2	0	0	0	0
2	9	1	0	0	0	0	0	0	0	0	0	0
2	9	2	0	0	0	0	0	3	0	0	0	0
2	9	3	0	1	0	0	0	0	0	0	0	0
2	9	4	0	0	0	0	0	0	0	0	0	0
2	9	5	0	1	0	0	0	0	0	0	0	0
2	9	6	1	1	0	0	0	0	0	0	0	0
2	9	7	0	0	0	0	0	0	0	0	0	0
2	9	8	0	0	0	0	0	0	0	0	0	0
2	9	9	0	0	0	0	0	2	0	0	0	0
2	9	10	0	0	0	0	0	3	0	0	0	0
2	9	11	0	0	0	0	0	2	0	0	0	0
2	9	12	0	0	0	0	0	0	0	0	0	0
2	10	1	1	0	0	0	0	1	0	0	0	0
2	10	2	0	0	0	0	0	0	0	0	0	0
2	10	3	0	0	0	0	0	2	0	0	0	0
2	10	4	0	0	0	0	0	1	0	0	0	0
2	10	5	0	0	0	0	0	3	0	0	0	0
2	10	6	0	1	0	0	0	0	0	0	0	0
2	10	7	1	0	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	10	8	0	0	0	0	0	1	0	0	0	0
2	10	9	0	0	0	0	0	2	0	0	0	0
2	10	10	0	0	0	0	0	4	0	0	0	0
2	10	11	0	0	0	0	0	2	0	0	0	0
2	10	12	1	0	0	0	0	1	0	0	0	0
2	11	1	0	0	0	0	0	0	0	0	0	0
2	11	2	0	0	0	0	0	0	0	0	0	0
2	11	3	0	0	0	0	0	0	0	0	0	0
2	11	4	0	0	1	0	0	1	0	0	0	0
2	11	5	0	0	0	0	0	2	0	0	0	0
2	11	6	0	0	0	0	0	0	0	0	0	0
2	11	7	1	0	0	0	0	0	0	0	0	0
2	11	8	0	0	0	0	0	0	0	1	0	0
2	11	9	0	0	0	0	0	0	0	0	0	0
2	11	10	0	0	0	0	0	0	0	0	0	0
2	11	11	0	1	0	0	0	0	0	0	0	0
2	11	12	0	0	0	0	0	1	0	0	0	0
2	12	1	0	0	0	0	0	4	0	0	0	0
2	12	2	0	0	0	0	0	0	0	0	0	0
2	12	3	0	0	0	0	0	0	0	0	0	0
2	12	4	0	0	0	0	0	0	0	0	0	0
2	12	5	0	0	0	0	0	0	0	0	0	0
2	12	6	0	1	0	1	0	2	0	0	0	0
2	12	7	0	0	0	0	0	1	0	0	0	0
2	12	8	0	0	0	0	0	1	0	0	0	0
2	12	9	0	0	0	0	0	0	0	0	0	0
2	12	10	0	0	0	0	0	0	0	0	0	0
2	12	11	0	0	0	0	0	0	0	0	0	0
2	12	12	0	0	0	0	0	0	0	0	0	0

6/23/04												
Block	**Plot**	**Quadrat**	**Amca**	**Asla**	**Asca**	**Daca**	**Lipy**	**Pain**	**Pyvi**	**Sosp**	**Vevi**	**Ziap**
1	3	1	0	0	0	0	0	2	0	0	0	0
1	3	2	0	0	0	0	0	3	0	0	0	0
1	3	3	0	0	0	0	0	0	0	0	0	0
1	3	4	0	0	0	0	0	0	0	0	0	0
1	3	5	0	0	0	0	0	0	0	0	0	0
1	3	6	0	0	0	0	0	0	0	0	0	0
1	3	7	0	0	0	0	0	0	0	0	0	0
1	3	8	0	0	0	0	0	1	0	0	0	0
1	3	9	0	0	0	1	0	0	0	0	0	0
1	3	10	0	0	0	1	0	0	0	0	0	0
1	3	11	0	0	0	0	0	0	0	0	0	0
1	3	12	0	0	0	0	0	0	0	0	0	0
1	4	1	0	0	0	1	0	0	0	0	0	0
1	4	2	0	0	0	0	0	0	0	0	0	0
1	4	3	0	0	0	0	0	0	0	0	0	0
1	4	4	0	0	0	0	0	0	0	0	0	0
1	4	5	0	0	0	0	0	0	0	0	0	0
1	4	6	0	0	0	0	0	0	0	0	0	0
1	4	7	1	0	0	0	0	0	0	0	0	0
1	4	8	0	0	0	1	0	0	0	0	0	0
1	4	9	0	1	0	0	0	1	0	0	0	0
1	4	10	0	0	0	0	0	0	0	0	0	0
1	4	11	0	0	0	0	0	0	0	0	0	0
1	4	12	0	0	0	0	0	1	0	0	0	0
1	6	1	0	0	0	0	0	0	0	0	0	0
1	6	2	0	0	0	0	0	0	0	0	0	0
1	6	3	0	0	0	0	0	2	0	0	0	0
1	6	4	0	0	1	1	0	3	0	0	0	0
1	6	5	0	0	0	0	0	1	0	0	0	0
1	6	6	0	0	0	0	0	6	0	0	0	0
1	6	7	0	0	0	0	0	0	0	0	0	0
1	6	8	0	0	0	0	0	0	0	0	0	0
1	6	9	0	0	0	0	0	1	0	0	0	0
1	6	10	0	0	0	0	0	0	0	0	0	0
1	6	11	0	0	0	0	0	1	0	0	0	0
1	6	12	0	0	0	0	0	1	0	0	0	0
1	7	1	0	0	0	0	0	0	0	0	0	0
1	7	2	0	0	0	0	0	0	0	0	0	0
1	7	3	0	1	0	0	0	0	0	1	0	0
1	7	4	0	0	0	0	0	1	0	1	0	0
1	7	5	0	0	0	0	0	0	0	0	0	0
1	7	6	0	0	0	0	0	0	0	0	0	0
1	7	7	0	0	0	0	0	0	0	0	0	0
1	7	8	0	0	0	0	0	0	0	1	0	0
1	7	9	0	0	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	7	10	0	0	0	1	0	1	0	0	0	0
1	7	11	0	0	0	0	0	1	0	0	0	0
1	7	12	0	0	0	0	0	0	0	0	0	0
1	8	1	0	0	0	0	0	0	0	0	0	0
1	8	2	0	0	0	0	0	1	0	0	0	0
1	8	3	0	0	0	0	0	0	0	0	0	0
1	8	4	1	0	0	0	0	3	0	0	0	0
1	8	5	0	0	0	1	0	0	0	0	0	0
1	8	6	1	0	0	0	0	1	0	0	0	0
1	8	7	0	0	0	0	0	2	0	0	0	0
1	8	8	0	0	0	0	0	1	0	0	0	0
1	8	9	0	1	0	1	0	1	0	0	0	0
1	8	10	0	0	0	1	0	0	0	0	0	0
1	8	11	0	0	0	0	0	0	0	0	0	0
1	8	12	0	0	0	0	0	0	0	0	0	0
1	9	1	0	0	0	1	0	0	0	0	0	0
1	9	2	0	0	0	0	0	0	0	0	0	0
1	9	3	0	0	1	0	0	0	0	0	0	0
1	9	4	0	0	0	0	0	0	0	0	0	0
1	9	5	0	0	0	0	0	0	0	0	0	0
1	9	6	0	0	0	0	0	1	0	0	0	0
1	9	7	0	0	0	0	0	0	0	0	0	0
1	9	8	0	0	0	2	0	0	0	0	0	0
1	9	9	0	0	0	0	0	0	0	0	0	0
1	9	10	0	0	0	1	0	3	0	0	0	0
1	9	11	0	1	0	2	0	3	0	0	0	0
1	9	12	0	0	0	0	0	0	0	0	0	0
1	10	1	0	0	0	0	0	0	0	0	0	0
1	10	2	0	1	0	0	0	3	0	0	0	0
1	10	3	0	0	0	0	0	0	0	0	0	0
1	10	4	0	0	0	0	0	0	0	0	0	0
1	10	5	0	0	0	0	0	0	0	0	0	0
1	10	6	0	0	0	0	0	0	0	0	0	0
1	10	7	0	1	0	0	0	0	0	0	0	0
1	10	8	0	0	0	0	0	1	0	0	0	0
1	10	9	0	0	0	0	0	0	0	0	0	0
1	10	10	0	0	0	0	0	0	0	0	0	0
1	10	11	0	0	0	0	0	1	0	0	0	0
1	10	12	0	0	0	0	0	2	0	0	0	0
1	11	1	0	0	0	0	0	0	0	0	0	0
1	11	2	0	0	0	0	0	0	0	0	0	0
1	11	3	0	0	0	0	0	1	0	0	0	0
1	11	4	0	0	0	0	0	0	0	0	0	0
1	11	5	0	0	0	0	0	0	0	0	0	0
1	11	6	0	0	0	0	0	4	0	0	0	0
1	11	7	0	0	0	0	0	0	0	0	0	0
1	11	8	0	0	0	0	0	1	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	11	9	0	0	0	0	0	0	0	0	0	0
1	11	10	0	0	0	2	0	0	0	0	0	0
1	11	11	0	2	1	0	0	1	0	0	0	0
1	11	12	1	1	0	0	0	0	0	1	0	0
1	12	1	0	0	0	0	0	0	0	0	0	0
1	12	2	1	0	0	0	0	1	0	0	0	0
1	12	3	0	0	0	0	0	1	0	0	0	0
1	12	4	0	0	0	0	0	0	0	0	0	0
1	12	5	0	0	0	0	0	0	0	0	0	0
1	12	6	0	0	0	0	0	0	0	0	0	0
1	12	7	0	0	0	0	0	0	0	0	0	0
1	12	8	0	0	0	0	0	5	0	0	0	0
1	12	9	0	1	0	0	0	0	0	0	0	0
1	12	10	0	0	0	0	0	0	0	0	0	0
1	12	11	0	0	0	0	0	0	0	0	0	0
1	12	12	0	0	0	0	0	0	0	0	0	0
2	1	1	0	0	0	0	0	0	0	0	0	0
2	1	2	0	0	0	0	0	0	0	0	0	0
2	1	3	0	0	0	0	0	0	0	0	0	0
2	1	4	0	1	0	0	0	2	0	0	0	0
2	1	5	0	0	0	0	0	3	0	0	0	0
2	1	6	0	0	0	0	0	0	0	0	0	0
2	1	7	0	1	0	0	0	2	0	0	0	0
2	1	8	0	0	0	0	0	0	0	0	0	0
2	1	9	0	0	0	0	0	0	0	0	0	0
2	1	10	0	0	0	0	0	0	0	0	0	0
2	1	11	0	1	0	0	0	0	0	0	0	0
2	1	12	0	0	0	0	0	0	0	0	0	0
2	4	1	0	0	0	0	0	2	0	0	0	0
2	4	2	0	0	1	0	0	1	0	0	0	0
2	4	3	0	0	0	0	0	3	0	0	0	0
2	4	4	0	0	0	0	0	0	0	0	0	0
2	4	5	0	2	1	0	0	4	0	1	0	0
2	4	6	0	1	0	1	0	1	0	0	0	0
2	4	7	1	1	0	0	0	0	0	0	0	0
2	4	8	0	0	0	0	0	0	0	0	0	0
2	4	9	0	0	0	0	0	1	0	0	0	0
2	4	10	0	0	0	0	0	0	0	0	0	0
2	4	11	0	0	0	0	0	3	0	0	0	0
2	4	12	1	1	0	2	0	2	0	0	0	0
2	5	1	0	0	0	0	0	3	0	0	0	0
2	5	2	0	1	0	0	0	3	0	0	0	0
2	5	3	0	0	0	0	0	1	0	0	0	0
2	5	4	1	0	0	0	0	0	0	0	0	0
2	5	5	0	0	0	0	0	1	0	0	0	0
2	5	6	0	0	0	0	0	4	0	0	0	0
2	5	7	1	1	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	5	8	0	0	0	0	0	1	0	0	0	0
2	5	9	0	1	0	0	0	2	0	0	0	0
2	5	10	0	2	0	0	0	0	0	0	0	0
2	5	11	0	0	0	0	0	0	0	0	0	0
2	5	12	0	0	0	0	0	0	0	0	0	0
2	7	1	0	1	0	0	0	0	0	0	0	0
2	7	2	0	0	0	0	0	0	0	0	0	0
2	7	3	0	0	0	0	0	0	0	0	0	0
2	7	4	0	0	0	0	0	0	0	0	0	0
2	7	5	0	0	0	0	0	0	0	0	0	0
2	7	6	0	0	0	0	0	3	0	0	0	0
2	7	7	0	0	0	0	0	2	0	0	0	0
2	7	8	0	1	0	0	0	0	0	0	0	0
2	7	9	0	0	0	1	0	1	0	0	0	0
2	7	10	0	0	0	0	0	0	0	0	0	0
2	7	11	0	0	0	0	0	1	0	0	0	0
2	7	12	0	0	0	0	0	0	0	0	0	0
2	8	1	0	0	0	0	0	2	0	0	0	0
2	8	2	1	1	0	0	0	1	0	0	0	0
2	8	3	0	3	0	0	0	5	0	0	0	0
2	8	4	0	0	0	0	0	1	0	0	0	0
2	8	5	0	2	0	0	0	4	0	0	0	0
2	8	6	0	0	0	0	0	0	0	0	0	0
2	8	7	0	2	0	0	0	1	0	0	0	0
2	8	8	0	0	0	0	0	1	0	0	0	0
2	8	9	0	4	0	0	0	3	0	0	0	0
2	8	10	0	1	0	0	0	1	0	0	0	0
2	8	11	0	2	0	0	0	2	0	0	0	0
2	8	12	0	1	0	0	0	2	0	0	0	0
2	9	1	0	0	0	0	0	0	0	0	0	0
2	9	2	0	0	0	0	0	1	0	2	0	0
2	9	3	0	1	0	0	0	0	0	0	0	0
2	9	4	0	0	0	0	0	0	0	0	0	0
2	9	5	0	1	0	0	0	0	0	0	0	0
2	9	6	2	1	0	0	0	1	0	1	0	0
2	9	7	0	0	0	0	0	0	0	0	0	0
2	9	8	0	0	0	0	0	0	0	0	0	0
2	9	9	0	0	0	0	0	2	0	0	0	0
2	9	10	0	0	0	0	0	3	0	0	0	0
2	9	11	0	0	0	0	0	3	0	0	0	0
2	9	12	0	0	0	0	0	1	0	0	0	0
2	10	1	0	0	1	0	0	2	0	1	0	0
2	10	2	0	0	0	0	0	0	0	0	0	0
2	10	3	0	0	0	0	0	2	0	0	0	0
2	10	4	0	0	0	0	0	1	0	0	0	0
2	10	5	0	1	0	0	0	2	0	1	0	0
2	10	6	0	1	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	10	7	1	0	0	0	0	0	0	0	0	0
2	10	8	0	0	0	0	0	1	0	0	0	0
2	10	9	0	0	1	0	0	1	0	0	0	0
2	10	10	0	0	0	0	0	4	0	0	0	0
2	10	11	0	0	1	0	0	3	0	0	0	0
2	10	12	0	1	0	0	0	1	0	0	0	0
2	11	1	0	0	0	0	0	2	0	0	0	0
2	11	2	0	0	0	0	0	2	0	0	0	0
2	11	3	0	0	0	0	0	0	0	0	0	0
2	11	4	0	0	1	0	0	3	0	0	0	0
2	11	5	0	0	0	0	0	4	0	0	0	0
2	11	6	0	0	0	0	0	0	0	0	0	0
2	11	7	0	0	0	0	0	2	0	0	0	0
2	11	8	0	0	0	0	0	1	0	0	0	0
2	11	9	0	0	0	0	0	1	0	0	0	0
2	11	10	0	0	0	0	0	0	0	0	0	0
2	11	11	0	1	0	0	0	1	0	0	0	0
2	11	12	0	0	0	0	0	0	0	0	0	0
2	12	1	0	0	0	1	0	3	0	0	0	0
2	12	2	0	0	0	0	0	0	0	0	0	0
2	12	3	0	0	0	0	0	0	0	0	0	0
2	12	4	0	0	0	0	0	0	0	0	0	0
2	12	5	0	0	0	0	0	0	0	0	0	0
2	12	6	0	1	0	1	0	0	0	1	0	0
2	12	7	0	0	0	0	0	0	0	0	0	0
2	12	8	0	0	0	0	0	1	0	0	0	0
2	12	9	0	0	0	1	0	0	0	0	0	0
2	12	10	0	0	0	0	0	0	0	0	0	0
2	12	11	0	0	0	0	0	0	0	0	0	0
2	12	12	0	0	0	0	0	0	0	0	0	0
						23						

July 7 2004											
Block	**Plot**	**Quadrat**	**Amca**	**Asla**	**Asca**	**Daca**	**Lipy**	**Pain**	**Pyvi**	**Sosp**	**Vevi**	**Ziap**
1	3	1	0	0	0	0	0	0	0	0	0	0
1	3	2	0	0	0	0	0	2	0	0	0	0
1	3	3	0	0	0	0	0	0	0	0	0	0
1	3	4	0	0	0	1	0	0	0	0	0	0
1	3	5	0	0	0	0	0	0	0	0	0	0
1	3	6	0	0	0	0	0	0	0	0	0	0
1	3	7	0	0	0	0	0	0	0	0	0	0
1	3	8	0	0	0	1	0	1	0	0	0	0
1	3	9	0	0	0	2	0	0	0	0	0	0
1	3	10	1	0	0	1	0	2	0	0	0	0
1	3	11	0	0	0	0	0	0	0	0	0	0
1	3	12	0	0	0	1	0	0	0	0	0	0
1	4	1	0	0	0	1	0	0	0	0	0	0
1	4	2	0	0	0	0	0	0	0	0	0	0
1	4	3	0	0	0	0	0	0	0	0	0	0
1	4	4	0	0	0	0	0	0	0	0	0	0
1	4	5	0	0	0	0	0	0	0	0	0	0
1	4	6	0	0	0	0	0	0	0	0	0	0
1	4	7	1	0	0	0	0	1	0	0	0	0
1	4	8	0	0	0	1	0	0	0	0	0	0
1	4	9	0	1	0	0	0	2	0	0	0	0
1	4	10	0	0	0	0	0	0	0	0	0	0
1	4	11	0	0	0	0	0	1	0	0	0	0
1	4	12	0	0	0	0	0	1	0	0	0	0
1	6	1	0	0	0	0	0	0	0	0	0	0
1	6	2	0	0	0	0	0	0	0	0	0	0
1	6	3	0	0	0	0	0	3	0	0	0	0
1	6	4	0	0	1	0	0	3	0	0	0	0
1	6	5	0	0	0	0	0	0	0	0	0	0
1	6	6	0	0	0	0	0	1	0	0	0	0
1	6	7	0	0	0	0	0	0	0	0	0	0
1	6	8	0	0	0	1	0	1	0	0	0	0
1	6	9	0	0	0	0	0	1	0	0	0	0
1	6	10	0	0	0	0	0	0	0	0	0	0
1	6	11	0	0	0	0	0	2	0	0	0	0
1	6	12	0	0	0	0	0	1	0	0	0	0
1	7	1	0	0	0	0	0	0	0	0	0	0
1	7	2	0	0	0	0	0	0	0	0	0	0
1	7	3	0	0	0	0	0	0	0	0	0	0
1	7	4	0	0	0	0	0	2	0	0	0	0
1	7	5	0	2	0	0	0	0	0	1	0	0
1	7	6	0	0	0	0	0	0	0	1	0	0
1	7	7	0	0	0	0	0	0	0	0	0	0
1	7	8	0	0	0	0	0	0	0	1	0	0
1	7	9	0	0	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	7	10	0	0	0	1	0	1	0	1	0	0
1	7	11	0	0	0	0	0	2	0	0	0	0
1	7	12	0	0	0	0	0	0	0	0	0	0
1	8	1	0	0	0	0	0	0	0	0	0	0
1	8	2	0	0	0	0	0	1	0	0	0	0
1	8	3	0	0	0	0	0	0	0	0	0	0
1	8	4	0	0	0	0	0	3	0	0	0	0
1	8	5	0	0	0	2	0	0	0	0	0	0
1	8	6	1	0	0	0	0	1	0	0	0	0
1	8	7	0	0	0	0	0	2	0	0	0	0
1	8	8	0	0	0	0	0	1	0	0	0	0
1	8	9	0	1	0	2	0	1	0	0	0	0
1	8	10	0	0	0	0	0	0	0	0	0	0
1	8	11	0	0	0	0	0	0	0	0	0	0
1	8	12	0	0	0	0	0	0	0	0	0	0
1	9	1	0	0	0	1	0	0	0	0	0	0
1	9	2	0	1	0	0	0	0	0	0	0	0
1	9	3	0	0	1	1	0	0	0	0	0	0
1	9	4	0	0	0	0	0	0	0	0	0	0
1	9	5	0	0	0	0	0	0	0	0	0	0
1	9	6	0	0	0	0	0	1	0	0	0	0
1	9	7	0	0	0	0	0	0	0	0	0	0
1	9	8	0	0	0	2	0	0	0	0	0	0
1	9	9	0	0	0	0	0	1	0	0	0	0
1	9	10	0	0	0	1	0	7	0	0	0	0
1	9	11	0	1	0	0	0	3	0	0	0	0
1	9	12	0	0	0	0	0	0	0	0	0	0
1	10	1	0	0	0	0	0	0	0	0	0	0
1	10	2	0	1	0	0	0	5	0	0	0	0
1	10	3	0	0	0	0	0	0	0	0	0	0
1	10	4	0	0	0	0	0	0	0	0	0	0
1	10	5	0	0	0	0	0	0	0	0	0	0
1	10	6	0	0	0	0	0	0	0	0	0	0
1	10	7	0	1	0	0	0	1	0	0	0	0
1	10	8	0	0	0	0	0	1	0	0	0	0
1	10	9	0	0	0	0	0	0	0	0	0	0
1	10	10	0	0	0	0	0	0	0	0	0	0
1	10	11	0	0	0	0	0	1	0	0	0	0
1	10	12	0	0	0	0	0	2	0	0	0	0
1	11	1	0	0	0	0	0	0	0	1	0	0
1	11	2	0	0	0	0	0	1	0	0	0	0
1	11	3	0	0	0	0	0	0	0	0	0	0
1	11	4	0	0	0	0	0	0	0	0	0	0
1	11	5	0	0	0	0	0	0	0	0	0	0
1	11	6	0	0	0	0	0	4	0	0	0	0
1	11	7	0	0	0	0	0	0	0	1	0	0
1	11	8	0	0	0	0	0	2	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	11	9	0	0	0	0	0	0	0	0	0	0
1	11	10	0	0	0	2	0	0	0	0	0	0
1	11	11	0	3	1	0	0	1	0	0	0	0
1	11	12	0	1	0	0	0	1	0	0	0	0
1	12	1	0	0	0	0	0	0	0	0	0	0
1	12	2	1	0	0	0	0	2	0	0	0	0
1	12	3	0	0	1	0	0	0	0	0	0	0
1	12	4	0	0	0	0	0	0	0	0	0	0
1	12	5	0	0	0	0	0	0	0	0	0	0
1	12	6	0	0	0	0	0	0	0	0	0	0
1	12	7	0	0	0	0	0	0	0	0	0	0
1	12	8	0	0	0	0	0	2	0	1	0	0
1	12	9	0	1	0	0	0	0	0	0	0	0
1	12	10	0	0	0	0	0	0	0	0	0	0
1	12	11	0	0	0	0	0	0	0	0	0	0
1	12	12	0	0	0	0	0	0	0	0	0	0
2	1	1	0	0	0	0	0	0	0	0	0	0
2	1	2	0	0	0	0	0	0	0	0	0	0
2	1	3	0	0	0	0	0	0	0	0	0	0
2	1	4	0	2	0	0	0	3	0	0	0	0
2	1	5	0	0	0	0	0	4	0	1	0	0
2	1	6	0	0	0	0	0	0	0	0	0	0
2	1	7	0	1	0	0	0	1	0	0	0	0
2	1	8	0	0	0	0	0	0	0	0	0	0
2	1	9	0	0	0	0	0	0	0	0	0	0
2	1	10	0	0	0	0	0	0	0	1	0	0
2	1	11	0	1	0	0	0	0	0	0	0	0
2	1	12	0	0	0	0	0	0	0	0	0	0
2	4	1	0	0	0	0	0	0	0	0	0	0
2	4	2	0	0	0	0	0	0	0	0	0	0
2	4	3	0	0	0	0	0	1	0	0	0	0
2	4	4	0	0	0	0	0	0	0	0	0	0
2	4	5	0	2	1	0	0	5	0	0	0	0
2	4	6	0	1	0	0	0	1	0	0	0	0
2	4	7	1	1	0	0	0	0	0	1	0	0
2	4	8	0	0	0	0	0	0	0	0	0	0
2	4	9	0	0	0	0	0	0	0	0	0	0
2	4	10	0	0	0	0	0	0	0	0	0	0
2	4	11	0	0	0	0	0	3	0	0	0	0
2	4	12	1	1	0	1	0	1	0	0	0	0
2	5	1	0	0	0	0	0	3	0	0	0	0
2	5	2	0	1	0	0	0	3	0	0	0	0
2	5	3	0	0	0	0	0	1	0	0	0	0
2	5	4	0	0	0	0	0	0	0	0	0	0
2	5	5	0	0	0	0	0	1	0	0	0	0
2	5	6	0	1	0	0	0	2	0	0	0	0
2	5	7	1	0	0	0	0	1	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	5	8	0	0	0	0	0	1	0	0	0	0
2	5	9	0	1	0	0	0	1	0	0	0	0
2	5	10	1	1	0	0	0	0	0	0	0	0
2	5	11	0	0	0	0	0	0	0	0	0	0
2	5	12	0	0	0	0	0	0	0	0	0	0
2	7	1	0	1	0	0	0	0	0	0	0	0
2	7	2	0	0	0	0	0	1	0	0	0	0
2	7	3	0	0	0	0	0	1	0	0	0	0
2	7	4	0	0	0	0	0	1	0	0	0	0
2	7	5	0	0	0	0	0	0	0	0	0	0
2	7	6	0	0	0	0	0	2	0	0	0	0
2	7	7	0	0	0	0	0	2	0	0	0	0
2	7	8	0	0	0	0	0	0	0	0	0	0
2	7	9	0	0	0	0	0	0	0	0	0	0
2	7	10	0	0	0	0	0	0	0	0	0	0
2	7	11	0	0	0	0	0	1	0	0	0	0
2	7	12	0	0	0	0	0	0	0	0	0	0
2	8	1	0	0	0	0	0	1	0	0	0	0
2	8	2	1	1	0	0	0	2	0	1	0	0
2	8	3	0	4	0	0	0	4	0	0	0	0
2	8	4	0	0	0	0	0	2	0	0	0	0
2	8	5	0	2	0	0	0	3	0	0	0	0
2	8	6	0	0	0	0	0	0	0	0	0	0
2	8	7	0	2	0	0	0	0	0	0	0	0
2	8	8	0	0	0	0	0	1	0	0	0	0
2	8	9	0	4	0	0	0	3	0	0	0	0
2	8	10	0	1	0	0	0	1	0	0	0	0
2	8	11	0	1	0	0	0	1	0	0	0	0
2	8	12	0	1	0	0	0	2	0	1	0	0
2	9	1	0	0	0	0	0	0	0	0	0	0
2	9	2	0	0	0	0	0	0	0	1	0	0
2	9	3	0	1	0	0	0	0	0	0	0	0
2	9	4	0	0	0	0	0	0	0	0	0	0
2	9	5	0	1	0	0	0	0	0	0	0	0
2	9	6	2	1	0	0	0	2	0	0	0	0
2	9	7	0	0	0	0	0	0	0	0	0	0
2	9	8	0	0	0	0	0	0	0	0	0	0
2	9	9	0	0	0	0	0	2	0	2	0	0
2	9	10	0	0	0	0	0	4	0	0	0	0
2	9	11	0	0	0	0	0	2	0	0	0	0
2	9	12	0	0	0	0	0	1	0	0	0	0
2	10	1	0	0	1	0	0	1	0	1	0	0
2	10	2	0	0	0	0	0	0	0	0	0	0
2	10	3	0	0	0	0	0	2	0	0	0	0
2	10	4	0	0	0	0	0	1	0	0	0	0
2	10	5	0	1	0	0	0	2	0	0	0	0
2	10	6	0	1	0	0	0	1	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	10	7	0	0	1	0	0	0	0	0	0	0
2	10	8	0	0	0	0	0	1	0	0	0	0
2	10	9	0	0	0	0	0	2	0	0	0	0
2	10	10	0	0	0	0	0	3	0	0	0	0
2	10	11	0	0	0	0	0	2	0	0	0	0
2	10	12	0	1	0	0	0	2	0	0	0	0
2	11	1	0	0	0	0	0	1	0	0	0	0
2	11	2	0	0	0	0	0	1	0	0	0	0
2	11	3	0	0	0	0	0	0	0	0	0	0
2	11	4	0	0	1	0	0	2	0	0	0	0
2	11	5	0	0	0	0	0	1	0	0	0	0
2	11	6	0	0	0	0	0	0	0	0	0	0
2	11	7	0	0	0	0	0	0	0	0	0	0
2	11	8	0	1	0	0	0	1	0	0	0	0
2	11	9	0	0	0	0	0	0	0	0	0	0
2	11	10	0	0	0	0	0	0	0	1	0	0
2	11	11	0	1	0	0	0	0	0	0	0	0
2	11	12	0	0	0	0	0	0	0	0	0	0
2	12	1	0	0	0	0	0	4	0	0	0	0
2	12	2	0	0	0	0	0	0	0	0	0	0
2	12	3	0	1	0	0	0	0	0	0	0	0
2	12	4	0	0	0	0	0	1	0	0	0	0
2	12	5	0	0	0	0	0	0	0	0	0	0
2	12	6	0	1	0	1	0	0	0	0	0	0
2	12	7	0	0	0	0	0	1	0	0	0	0
2	12	8	0	0	0	0	0	1	0	0	0	0
2	12	9	0	0	0	0	0	1	0	0	0	0
2	12	10	0	0	0	0	0	0	0	0	0	0
2	12	11	0	0	0	0	0	0	0	0	0	0
2	12	12	0	0	0	0	0	0	0	0	0	0

7/22/04												
Block	**Plot**	**Quadrat**	**Amca**	**Asla**	**Asca**	**Daca**	**Lipy**	**Pain**	**Pyvi**	**Sosp**	**Vevi**	**Ziap**
1	3	1	0	0	0	0	0	0	0	0	0	0
1	3	2	0	0	0	0	0	3	0	0	0	0
1	3	3	0	0	0	0	0	0	0	0	0	0
1	3	4	0	0	0	0	0	0	0	0	0	0
1	3	5	0	0	0	0	0	0	0	0	0	0
1	3	6	0	0	0	0	0	0	0	0	0	0
1	3	7	0	0	0	0	0	0	0	0	0	0
1	3	8	0	0	0	1	0	1	0	0	0	0
1	3	9	0	0	0	2	0	0	0	0	0	0
1	3	10	0	0	0	0	0	2	0	0	0	0
1	3	11	0	0	0	0	0	0	0	0	0	0
1	3	12	0	0	0	0	0	0	0	0	0	0
1	4	1	0	0	0	0	0	0	0	0	0	0
1	4	2	0	0	0	0	0	0	0	0	0	0
1	4	3	0	0	0	0	0	0	0	0	0	0
1	4	4	0	0	0	0	0	0	0	0	0	0
1	4	5	0	0	0	0	0	0	0	0	0	0
1	4	6	0	0	0	1	0	0	0	0	0	0
1	4	7	1	0	0	0	0	0	0	0	0	0
1	4	8	0	0	0	0	0	0	0	0	0	0
1	4	9	0	1	0	0	0	1	0	1	0	0
1	4	10	0	0	0	0	0	0	0	0	0	0
1	4	11	0	0	0	0	0	1	0	0	0	0
1	4	12	0	0	0	0	0	0	0	0	0	0
1	6	1	0	0	0	0	0	0	0	0	0	0
1	6	2	0	0	0	0	0	0	0	0	0	0
1	6	3	0	0	0	0	0	3	0	0	0	0
1	6	4	0	0	0	1	0	2	0	0	0	0
1	6	5	0	0	0	0	0	1	0	0	0	0
1	6	6	0	0	0	0	0	0	0	0	0	0
1	6	7	0	1	0	0	0	0	0	0	0	0
1	6	8	0	0	0	2	0	0	0	0	0	0
1	6	9	0	0	0	0	0	1	0	0	0	0
1	6	10	0	0	0	0	0	0	0	0	0	0
1	6	11	0	0	0	0	0	1	0	0	0	0
1	6	12	0	1	0	0	0	1	0	0	0	0
1	7	1	0	0	0	0	0	0	0	0	0	0
1	7	2	0	0	0	0	0	0	0	0	0	0
1	7	3	0	1	0	0	0	0	0	0	0	0
1	7	4	0	0	0	0	0	1	0	0	0	0
1	7	5	0	1	0	0	0	0	0	1	0	0
1	7	6	0	0	0	0	0	0	0	0	0	0
1	7	7	0	0	0	0	0	0	0	0	0	0
1	7	8	0	0	0	0	0	0	0	0	0	0
1	7	9	0	0	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	7	10	0	0	0	1	0	1	0	0	0	0
1	7	11	0	0	0	0	0	2	0	0	0	0
1	7	12	0	0	0	0	0	0	0	0	0	0
1	8	1	0	0	0	0	0	0	0	0	0	0
1	8	2	0	0	0	0	0	2	0	0	0	0
1	8	3	0	0	0	0	0	0	0	0	0	0
1	8	4	0	0	0	0	0	2	0	0	0	0
1	8	5	0	0	0	2	0	0	0	0	0	0
1	8	6	1	0	0	0	0	1	0	0	0	0
1	8	7	0	0	0	0	0	1	0	0	0	0
1	8	8	0	0	0	0	0	1	0	0	0	0
1	8	9	0	0	0	1	0	0	0	0	0	0
1	8	10	0	0	0	0	0	0	0	0	0	0
1	8	11	0	0	0	0	0	0	0	0	0	0
1	8	12	0	0	0	0	0	0	0	0	0	0
1	9	1	0	0	0	0	0	0	0	0	0	0
1	9	2	0	0	0	0	0	0	0	0	0	0
1	9	3	0	0	1	0	0	0	0	0	0	0
1	9	4	0	0	0	0	0	0	0	0	0	0
1	9	5	0	0	0	0	0	0	0	0	0	0
1	9	6	0	0	0	0	0	1	0	0	0	0
1	9	7	0	0	0	0	0	0	0	0	0	0
1	9	8	0	0	0	1	0	0	0	0	0	0
1	9	9	0	0	0	0	0	0	0	0	0	0
1	9	10	0	0	0	1	0	5	0	0	0	0
1	9	11	0	1	0	0	0	1	0	0	0	0
1	9	12	0	0	0	0	0	0	0	0	0	0
1	10	1	0	0	0	0	0	0	0	0	0	0
1	10	2	0	0	0	0	0	3	0	0	0	0
1	10	3	0	0	0	0	0	0	0	0	0	0
1	10	4	0	0	0	0	0	0	0	0	0	0
1	10	5	0	0	0	0	0	0	0	0	0	0
1	10	6	0	0	0	0	0	0	0	0	0	0
1	10	7	0	1	0	0	0	1	0	0	0	0
1	10	8	0	0	0	0	0	1	0	0	0	0
1	10	9	0	0	0	0	0	0	0	0	0	0
1	10	10	0	0	0	0	0	0	0	0	0	0
1	10	11	0	0	0	0	0	1	0	0	0	0
1	10	12	0	0	0	0	0	1	0	0	0	0
1	11	1	0	0	0	0	0	0	0	0	0	0
1	11	2	0	0	0	0	0	0	0	0	0	0
1	11	3	0	0	0	0	0	1	0	0	0	0
1	11	4	0	0	0	0	0	0	0	0	0	0
1	11	5	0	0	0	0	0	0	0	0	0	0
1	11	6	0	0	0	0	0	3	0	0	0	0
1	11	7	0	0	0	0	0	0	0	0	0	0
1	11	8	0	0	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	11	9	0	0	0	0	0	0	0	0	0	0
1	11	10	0	0	0	2	0	0	0	0	0	0
1	11	11	0	3	0	0	0	3	0	0	0	0
1	11	12	0	2	0	0	0	1	0	0	0	0
1	12	1	0	0	0	0	0	0	0	0	0	0
1	12	2	1	0	0	0	0	2	0	0	0	0
1	12	3	0	0	1	0	0	0	0	0	0	0
1	12	4	0	0	0	0	0	0	0	0	0	0
1	12	5	0	0	0	0	0	0	0	0	0	0
1	12	6	0	0	0	0	0	0	0	0	0	0
1	12	7	0	0	0	0	0	0	0	0	0	0
1	12	8	0	0	0	0	0	3	0	0	0	0
1	12	9	0	1	0	0	0	0	0	0	0	0
1	12	10	0	0	0	0	0	1	0	0	0	0
1	12	11	0	0	0	1	0	0	0	0	0	0
1	12	12	0	0	0	0	0	0	0	0	0	0
2	1	1	0	0	0	0	0	0	0	0	0	0
2	1	2	0	0	0	0	0	0	0	0	0	0
2	1	3	0	0	0	0	0	0	0	0	0	0
2	1	4	0	2	0	0	0	2	0	0	0	0
2	1	5	0	0	0	0	0	5	0	1	0	0
2	1	6	0	0	0	0	0	1	0	0	0	0
2	1	7	0	2	0	0	0	2	0	0	0	0
2	1	8	0	0	0	0	0	0	0	0	0	0
2	1	9	0	0	0	0	0	0	0	0	0	0
2	1	10	0	0	0	0	0	0	0	0	0	0
2	1	11	0	1	0	0	0	0	0	0	0	0
2	1	12	0	0	0	0	0	0	0	0	0	0
2	4	1	0	0	0	0	0	0	0	0	0	0
2	4	2	0	0	0	0	0	0	0	0	0	0
2	4	3	0	0	0	0	0	2	0	0	0	0
2	4	4	0	0	0	0	0	0	0	0	0	0
2	4	5	0	2	0	0	0	6	0	0	0	0
2	4	6	0	1	0	0	0	1	0	0	0	0
2	4	7	0	1	0	0	0	0	0	0	0	0
2	4	8	0	0	0	0	0	0	0	0	0	0
2	4	9	0	0	0	0	0	1	0	0	0	0
2	4	10	0	0	0	0	0	0	0	0	0	0
2	4	11	0	0	0	0	0	2	0	0	0	0
2	4	12	1	0	0	1	0	1	0	0	0	0
2	5	1	0	0	0	0	0	3	0	0	0	0
2	5	2	0	1	0	0	0	3	0	0	0	0
2	5	3	0	0	0	0	0	1	0	0	0	0
2	5	4	0	0	0	0	0	0	0	0	0	0
2	5	5	0	0	0	0	0	1	0	0	0	0
2	5	6	0	1	0	0	0	1	0	0	0	0
2	5	7	1	0	0	0	0	1	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	5	8	0	0	0	0	0	0	0	0	0	0
2	5	9	0	1	0	0	0	0	0	0	0	0
2	5	10	1	1	0	0	0	0	0	0	0	0
2	5	11	0	0	0	0	0	0	0	0	0	0
2	5	12	0	0	0	0	0	0	0	0	0	0
2	7	1	0	1	0	0	0	0	0	0	0	0
2	7	2	0	0	0	0	0	1	0	0	0	0
2	7	3	0	0	0	0	0	1	0	0	0	0
2	7	4	0	0	0	0	0	1	0	0	0	0
2	7	5	0	0	0	0	0	0	0	0	0	0
2	7	6	0	0	0	0	0	2	0	0	0	0
2	7	7	0	0	0	0	0	2	0	0	0	0
2	7	8	0	0	0	0	0	0	0	0	0	0
2	7	9	0	0	0	0	0	0	0	0	0	0
2	7	10	0	0	0	0	0	0	0	0	0	0
2	7	11	0	0	0	0	0	1	0	0	0	0
2	7	12	0	0	0	0	0	0	0	0	0	0
2	8	1	0	0	0	0	0	2	0	0	0	0
2	8	2	1	0	0	0	0	1	0	0	0	0
2	8	3	0	3	0	0	0	5	0	0	0	0
2	8	4	0	0	0	0	0	2	0	1	0	0
2	8	5	0	2	0	0	0	3	0	0	0	0
2	8	6	0	0	0	0	0	0	0	0	0	0
2	8	7	0	3	0	0	0	0	0	0	0	0
2	8	8	0	0	0	0	0	1	0	0	0	0
2	8	9	0	4	0	0	0	2	0	0	0	0
2	8	10	0	1	0	0	0	1	0	0	0	0
2	8	11	0	1	0	0	0	1	0	0	0	0
2	8	12	0	1	0	0	0	2	0	0	0	0
2	9	1	0	0	0	0	0	0	0	0	0	0
2	9	2	0	0	0	0	0	3	0	1	0	0
2	9	3	0	1	0	0	0	0	0	0	0	0
2	9	4	0	0	0	0	0	0	0	0	0	0
2	9	5	0	1	0	0	0	0	0	0	0	0
2	9	6	3	1	0	0	0	1	0	0	0	0
2	9	7	0	0	0	0	0	0	0	0	0	0
2	9	8	0	0	0	0	0	0	0	0	0	0
2	9	9	0	0	0	0	0	4	0	1	0	0
2	9	10	0	0	0	0	0	4	0	0	0	0
2	9	11	0	0	0	0	0	2	0	0	0	0
2	9	12	0	0	0	0	0	3	0	0	0	0
2	10	1	0	0	1	0	0	1	0	1	0	0
2	10	2	0	0	0	0	0	0	0	0	0	0
2	10	3	0	0	0	0	0	2	0	0	0	0
2	10	4	0	0	0	0	0	1	0	0	0	0
2	10	5	0	1	0	0	0	3	0	0	0	0
2	10	6	1	1	0	0	0	1	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	10	7	0	0	1	0	0	0	0	0	0	0
2	10	8	0	0	0	0	0	1	0	0	0	0
2	10	9	0	0	0	0	0	1	0	0	0	0
2	10	10	0	0	0	0	0	4	0	0	0	0
2	10	11	0	0	0	0	0	1	0	0	0	0
2	10	12	0	0	0	0	0	2	0	0	0	0
2	11	1	0	0	0	0	0	1	0	0	0	0
2	11	2	0	0	0	0	0	1	0	0	0	0
2	11	3	0	0	0	0	0	0	0	0	0	0
2	11	4	0	0	1	0	0	3	0	0	0	0
2	11	5	0	0	0	0	0	3	0	0	0	0
2	11	6	0	0	0	0	0	0	0	0	0	0
2	11	7	0	0	0	0	0	1	0	0	0	0
2	11	8	0	0	0	0	0	1	0	0	0	0
2	11	9	0	0	0	0	0	0	0	0	0	0
2	11	10	0	0	0	0	0	1	0	1	0	0
2	11	11	0	1	0	0	0	1	0	0	0	0
2	11	12	0	0	0	0	0	1	0	0	0	0
2	12	1	0	0	0	0	0	5	0	0	0	0
2	12	2	0	0	0	0	0	0	0	0	0	0
2	12	3	0	1	0	0	0	0	0	0	0	0
2	12	4	0	0	0	0	0	1	0	0	0	0
2	12	5	0	0	0	0	0	0	0	0	0	0
2	12	6	0	1	0	1	0	0	0	0	0	0
2	12	7	0	0	0	0	0	1	0	0	0	0
2	12	8	0	0	0	0	0	1	0	0	0	0
2	12	9	0	0	0	0	0	1	0	0	0	0
2	12	10	0	0	0	0	0	0	0	0	0	0
2	12	11	0	0	0	0	0	0	0	0	0	0
2	12	12	0	0	0	0	0	0	0	0	0	0

9/7/04												
Block	**Plot**	**Quadrat**	**Amca**	**Asla**	**Asca**	**Daca**	**Lipy**	**Pain**	**Pyvi**	**Sosp**	**Vevi**	**Ziap**
1	3	1	0	0	0	0	0	0	0	0	0	0
1	3	2	0	0	0	0	0	3	0	0	0	0
1	3	3	0	0	0	0	0	0	0	0	0	0
1	3	4	0	0	0	0	0	0	0	0	0	0
1	3	5	0	0	0	0	0	0	0	0	0	0
1	3	6	0	0	0	0	0	0	0	0	0	0
1	3	7	0	0	0	0	0	0	0	0	0	0
1	3	8	0	0	0	1	0	1	0	0	0	0
1	3	9	0	0	0	2	0	0	0	0	0	0
1	3	10	0	0	0	0	0	2	0	0	0	0
1	3	11	0	0	0	0	0	0	0	0	0	0
1	3	12	0	0	0	0	0	0	0	0	0	0
1	4	1	0	0	0	0	0	0	0	0	0	0
1	4	2	0	0	0	0	0	0	0	0	0	0
1	4	3	0	0	0	0	0	0	0	0	0	0
1	4	4	0	0	0	0	0	0	0	0	0	0
1	4	5	0	0	0	0	0	0	0	0	0	0
1	4	6	0	0	0	1	0	0	0	0	0	0
1	4	7	1	0	0	0	0	0	0	0	0	0
1	4	8	0	0	0	0	0	0	0	0	0	0
1	4	9	0	1	0	0	0	1	0	1	0	0
1	4	10	0	0	0	0	0	0	0	0	0	0
1	4	11	0	0	0	0	0	1	0	0	0	0
1	4	12	0	0	0	0	0	0	0	0	0	0
1	6	1	0	0	0	0	0	0	0	0	0	0
1	6	2	0	0	0	0	0	0	0	0	0	0
1	6	3	0	0	0	0	0	3	0	0	0	0
1	6	4	0	0	0	1	0	2	0	0	0	0
1	6	5	0	0	0	0	0	1	0	0	0	0
1	6	6	0	0	0	0	0	0	0	0	0	0
1	6	7	0	1	0	0	0	0	0	0	0	0
1	6	8	0	0	0	2	0	0	0	0	0	0
1	6	9	0	0	0	0	0	1	0	0	0	0
1	6	10	0	0	0	0	0	0	0	0	0	0
1	6	11	0	0	0	0	0	1	0	0	0	0
1	6	12	0	1	0	0	0	1	0	0	0	0
1	7	1	0	0	0	0	0	0	0	0	0	0
1	7	2	0	0	0	0	0	0	0	0	0	0
1	7	3	0	1	0	0	0	1	0	0	0	0
1	7	4	0	0	0	0	0	0	0	0	0	0
1	7	5	0	0	0	0	0	0	0	1	0	0
1	7	6	0	0	0	0	0	0	0	0	0	0
1	7	7	0	0	0	0	0	0	0	0	0	0
1	7	8	0	0	0	0	0	0	0	0	0	0
1	7	9	0	0	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	7	10	0	1	0	1	0	1	0	0	0	0
1	7	11	0	0	0	0	0	0	0	0	0	0
1	7	12	0	0	0	0	0	0	0	0	0	0
1	8	1	0	0	0	0	0	0	0	0	0	0
1	8	2	0	0	0	0	0	2	0	0	0	0
1	8	3	0	0	0	0	0	0	0	0	0	0
1	8	4	0	0	0	0	0	2	0	0	0	0
1	8	5	0	0	0	2	0	0	0	0	0	0
1	8	6	1	0	0	0	0	1	0	0	0	0
1	8	7	0	0	0	0	0	1	0	0	0	0
1	8	8	0	0	0	0	0	1	0	0	0	0
1	8	9	0	0	0	1	0	0	0	0	0	0
1	8	10	0	0	0	0	0	0	0	0	0	0
1	8	11	0	0	0	0	0	0	0	0	0	0
1	8	12	0	0	0	0	0	0	0	0	0	0
1	9	1	0	0	0	0	0	0	0	0	0	0
1	9	2	0	0	0	0	0	0	0	0	0	0
1	9	3	0	0	1	0	0	0	0	0	0	0
1	9	4	0	0	0	0	0	0	0	0	0	0
1	9	5	0	0	0	0	0	0	0	0	0	0
1	9	6	0	0	0	0	0	1	0	0	0	0
1	9	7	0	0	0	0	0	0	0	0	0	0
1	9	8	0	0	0	1	0	0	0	0	0	0
1	9	9	0	0	0	0	0	0	0	0	0	0
1	9	10	0	0	0	1	0	2	0	0	0	0
1	9	11	0	1	0	0	0	1	0	0	0	0
1	9	12	0	0	0	0	0	0	0	0	0	0
1	10	1	0	0	0	0	0	0	0	0	0	0
1	10	2	0	0	0	0	0	2	0	0	0	0
1	10	3	0	0	0	0	0	0	0	0	0	0
1	10	4	0	0	0	0	0	0	0	0	0	0
1	10	5	0	0	0	0	0	0	0	0	0	0
1	10	6	0	0	0	0	0	0	0	0	0	0
1	10	7	0	3	0	0	0	1	0	0	0	0
1	10	8	0	0	0	0	0	1	0	0	0	0
1	10	9	0	0	0	0	0	0	0	0	0	0
1	10	10	0	0	0	0	0	0	0	0	0	0
1	10	11	0	0	0	0	0	0	0	0	0	0
1	10	12	0	0	0	0	0	0	0	0	0	0
1	11	1	0	0	0	0	0	0	0	0	0	0
1	11	2	0	0	0	0	0	0	0	0	0	0
1	11	3	0	0	0	0	0	1	0	0	0	0
1	11	4	0	0	0	0	0	0	0	0	0	0
1	11	5	0	0	0	0	0	0	0	0	0	0
1	11	6	0	0	0	0	0	4	0	0	0	0
1	11	7	0	0	0	0	0	0	0	0	0	0
1	11	8	0	0	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
1	11	9	0	0	0	0	0	0	0	0	0	0
1	11	10	0	0	0	2	0	0	0	0	0	0
1	11	11	0	3	0	0	0	1	0	0	0	0
1	11	12	0	2	0	0	0	1	0	0	0	0
1	12	1	0	0	0	0	0	0	0	0	0	0
1	12	2	0	0	0	0	0	2	0	0	0	0
1	12	3	0	0	1	0	0	0	0	0	0	0
1	12	4	0	0	0	0	0	0	0	0	0	0
1	12	5	0	0	0	0	0	0	0	0	0	0
1	12	6	0	0	0	0	0	0	0	0	0	0
1	12	7	0	0	0	0	0	0	0	0	0	0
1	12	8	0	0	0	0	0	3	0	0	0	0
1	12	9	0	1	0	0	0	0	0	0	0	0
1	12	10	0	0	0	0	0	1	0	0	0	0
1	12	11	0	0	0	1	0	0	0	0	0	0
1	12	12	0	0	0	0	0	0	0	0	0	0
2	1	1	0	0	0	0	0	0	0	0	0	0
2	1	2	0	0	0	0	0	0	0	0	0	0
2	1	3	0	0	0	0	0	0	0	0	0	0
2	1	4	0	2	0	0	0	3	0	0	0	0
2	1	5	0	0	0	0	0	4	0	1	0	0
2	1	6	0	0	0	0	0	1	0	0	0	0
2	1	7	0	1	0	0	0	2	0	0	0	0
2	1	8	0	0	0	0	0	0	0	0	0	0
2	1	9	0	0	0	0	0	0	0	0	0	0
2	1	10	0	0	0	0	0	0	0	0	0	0
2	1	11	0	1	0	0	0	0	0	0	0	0
2	1	12	0	0	0	0	0	0	0	0	0	0
2	4	1	0	0	0	0	0	0	0	0	0	0
2	4	2	0	0	0	0	0	0	0	1	0	0
2	4	3	0	0	0	0	0	2	0	0	0	0
2	4	4	0	0	0	0	0	0	0	0	0	0
2	4	5	0	2	0	0	0	3	0	0	0	0
2	4	6	0	1	0	0	0	1	0	0	0	0
2	4	7	0	1	0	0	0	0	0	0	0	0
2	4	8	0	0	0	0	0	0	0	0	0	0
2	4	9	0	0	0	0	0	1	0	0	0	0
2	4	10	0	0	0	0	0	0	0	0	0	0
2	4	11	0	0	0	0	0	3	0	0	0	0
2	4	12	0	1	0	2	0	1	0	0	0	0
2	5	1	0	0	0	0	0	3	0	0	0	0
2	5	2	0	1	0	0	0	3	0	0	0	0
2	5	3	0	0	0	0	0	1	0	0	0	0
2	5	4	0	0	0	0	0	0	0	0	0	0
2	5	5	0	0	0	0	0	1	0	0	0	0
2	5	6	0	1	0	0	0	1	0	0	0	0
2	5	7	1	0	0	0	0	1	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	5	8	0	0	0	0	0	0	0	0	0	0
2	5	9	0	1	0	0	0	0	0	0	0	0
2	5	10	1	1	0	0	0	0	0	0	0	0
2	5	11	0	0	0	0	0	0	0	0	0	0
2	5	12	0	0	0	0	0	0	0	0	0	0
2	7	1	0	1	0	0	0	0	0	0	0	0
2	7	2	0	0	0	0	0	1	0	0	0	0
2	7	3	0	0	0	0	0	1	0	0	0	0
2	7	4	0	0	0	0	0	1	0	0	0	0
2	7	5	0	0	0	0	0	0	0	0	0	0
2	7	6	0	0	0	0	0	2	0	0	0	0
2	7	7	0	0	0	0	0	2	0	0	0	0
2	7	8	0	0	0	0	0	0	0	0	0	0
2	7	9	0	0	0	0	0	0	0	0	0	0
2	7	10	0	0	0	0	0	0	0	0	0	0
2	7	11	0	0	0	0	0	1	0	0	0	0
2	7	12	0	0	0	0	0	0	0	0	0	0
2	8	1	0	0	0	0	0	0	0	0	0	0
2	8	2	1	1	0	0	0	1	0	0	0	0
2	8	3	1	4	0	0	0	5	0	0	0	0
2	8	4	0	0	0	0	0	0	0	0	0	0
2	8	5	0	2	0	0	0	2	0	0	0	0
2	8	6	0	0	0	0	0	0	0	0	0	0
2	8	7	0	1	0	0	0	0	0	0	0	0
2	8	8	0	0	0	0	0	0	0	0	0	0
2	8	9	0	4	0	0	0	3	0	0	0	0
2	8	10	0	1	0	0	0	1	0	1	0	0
2	8	11	0	1	0	0	0	1	0	0	0	0
2	8	12	0	1	0	0	0	2	0	0	0	0
2	9	1	0	0	0	0	0	0	0	0	0	0
2	9	2	0	0	0	0	0	1	0	1	0	0
2	9	3	0	1	0	0	0	0	0	0	0	0
2	9	4	0	0	0	0	0	0	0	0	0	0
2	9	5	0	1	0	0	0	0	0	0	0	0
2	9	6	1	0	0	0	0	1	0	0	0	0
2	9	7	0	0	0	0	0	0	0	0	0	0
2	9	8	0	0	0	0	0	0	0	0	0	0
2	9	9	0	0	0	0	0	0	0	0	0	0
2	9	10	0	0	0	0	0	3	0	2	0	0
2	9	11	0	0	0	0	0	1	0	0	0	0
2	9	12	0	0	0	0	0	2	0	0	0	0
2	10	1	0	0	1	0	0	0	0	1	0	0
2	10	2	0	0	0	0	0	0	0	0	0	0
2	10	3	0	0	0	0	0	2	0	0	0	0
2	10	4	0	0	0	0	0	1	0	0	0	0
2	10	5	0	1	0	0	0	1	0	0	0	0
2	10	6	0	1	0	0	0	0	0	0	0	0

Block	Plot	Quadrat	Amca	Asla	Asca	Daca	Lipy	Pain	Pyvi	Sosp	Vevi	Ziap
2	10	7	0	1	0	0	0	0	0	0	0	0
2	10	8	0	0	0	0	0	0	0	0	0	0
2	10	9	0	0	0	0	0	0	0	1	0	0
2	10	10	0	0	0	0	0	4	0	1	0	0
2	10	11	0	0	0	0	0	2	0	0	0	0
2	10	12	0	0	0	0	0	0	0	0	0	0
2	11	1	0	0	0	0	0	1	0	0	0	0
2	11	2	0	0	0	0	0	0	0	0	0	0
2	11	3	0	0	0	0	0	0	0	0	0	0
2	11	4	0	0	1	0	0	3	0	0	0	0
2	11	5	0	0	0	0	0	1	0	0	0	0
2	11	6	0	0	0	0	0	0	0	0	0	0
2	11	7	0	0	0	0	0	0	0	0	0	0
2	11	8	0	0	0	0	0	0	0	0	0	0
2	11	9	0	0	0	0	0	0	0	0	0	0
2	11	10	0	0	0	0	0	0	0	0	0	0
2	11	11	0	1	0	0	0	0	0	0	0	0
2	11	12	0	0	0	0	0	0	0	0	0	0
2	12	1	0	0	0	0	0	5	0	0	0	0
2	12	2	0	0	0	0	0	0	0	0	0	0
2	12	3	0	1	0	0	0	0	0	0	0	0
2	12	4	0	0	0	0	0	1	0	0	0	0
2	12	5	0	0	0	0	0	0	0	0	0	0
2	12	6	0	1	0	1	0	0	0	0	0	0
2	12	7	0	0	0	0	0	1	0	0	0	0
2	12	8	0	0	0	0	0	1	0	0	0	0
2	12	9	0	0	0	0	0	1	0	0	0	0
2	12	10	0	0	0	0	0	0	0	0	0	0
2	12	11	0	0	0	0	0	0	0	0	0	0
2	12	12	0	0	0	0	0	0	0	0	0	0

APPENDIX 2

COOL SEASON GRASSES

Block	Plot	Trt	# of Panicles
1	4	1	11
1	4	1	0
1	4	1	0
1	4	1	12
1	4	1	4
1	8	1	0
1	8	1	3
1	8	1	2
1	8	1	1
1	8	1	1
1	12	1	7
1	12	1	16
1	12	1	1
1	12	1	0
1	12	1	5
1	3	2	31
1	3	2	40
1	3	2	47
1	3	2	46
1	3	2	81
1	9	2	87
1	9	2	67
1	9	2	26
1	9	2	36
1	9	2	74
1	10	2	7
1	10	2	20
1	10	2	27
1	10	2	30
1	10	2	66
1	6	3	32
1	6	3	52
1	6	3	25
1	6	3	49
1	6	3	51
1	7	3	20
1	7	3	33
1	7	3	39
1	7	3	54
1	7	3	59
1	11	3	27
1	11	3	81
1	11	3	41
1	11	3	23
1	11	3	27
1	1	4	1
1	1	4	11

Block	Plot	Trt	# of Panicles
1	1	4	5
1	1	4	3
1	1	4	1
1	2	4	4
1	2	4	2
1	2	4	10
1	2	4	5
1	2	4	8
1	5	4	2
1	5	4	12
1	5	4	1
1	5	4	1
1	5	4	1
2	5	1	0
2	5	1	1
2	5	1	7
2	5	1	6
2	5	1	8
2	7	1	2
2	7	1	4
2	7	1	1
2	7	1	2
2	7	1	2
2	12	1	0
2	12	1	0
2	12	1	0
2	12	1	2
2	12	1	1
2	4	2	10
2	4	2	71
2	4	2	29
2	4	2	20
2	4	2	35
2	9	2	50
2	9	2	48
2	9	2	28
2	9	2	25
2	9	2	44
2	10	2	5
2	10	2	10
2	10	2	28
2	10	2	8
2	10	2	30
2	1	3	34
2	1	3	4
2	1	3	27
2	1	3	18

Block	Plot	Trt	# of Panicles
2	1	3	30
2	8	3	25
2	8	3	67
2	8	3	23
2	8	3	59
2	8	3	69
2	11	3	16
2	11	3	9
2	11	3	3
2	11	3	20
2	11	3	2
2	2	4	0
2	2	4	0
2	2	4	0
2	2	4	15
2	2	4	8
2	3	4	2
2	3	4	1
2	3	4	3
2	3	4	1
2	3	4	1
2	6	4	2
2	6	4	2
2	6	4	1
2	6	4	6
2	6	4	0

APPENDIX 3

WARM SEASON GRASSES

Block	Plot	Trt	# Flowering Stalks
1	1	4	0
1	1	4	16
1	1	4	1
1	1	4	2
1	1	4	2
1	2	4	2
1	2	4	2
1	2	4	0
1	2	4	3
1	2	4	0
1	3	2	0
1	3	2	8
1	3	2	8
1	3	2	5
1	3	2	2
1	4	1	4
1	4	1	7
1	4	1	11
1	4	1	9
1	4	1	3
1	5	4	1
1	5	4	6
1	5	4	12
1	5	4	0
1	5	4	1
1	6	3	9
1	6	3	5
1	6	3	2
1	6	3	4
1	6	3	3
1	7	3	1
1	7	3	6
1	7	3	6
1	7	3	4
1	7	3	1
1	8	1	13
1	8	1	0
1	8	1	3
1	8	1	3
1	8	1	2
1	9	2	4
1	9	2	1
1	9	2	0
1	9	2	4
1	9	2	0
1	10	2	21
1	10	2	1

Block	Plot	Trt	# Flowering Stalks
1	10	2	3
1	10	2	2
1	10	2	0
1	11	3	2
1	11	3	11
1	11	3	1
1	11	3	6
1	11	3	5
1	12	1	9
1	12	1	0
1	12	1	2
1	12	1	5
1	12	1	1
2	1	3	7
2	1	3	6
2	1	3	9
2	1	3	8
2	1	3	14
2	2	4	2
2	2	4	1
2	2	4	2
2	2	4	2
2	2	4	2
2	3	4	5
2	3	4	1
2	3	4	7
2	3	4	2
2	3	4	6
2	4	2	3
2	4	2	0
2	4	2	2
2	4	2	12
2	4	2	14
2	5	1	5
2	5	1	0
2	5	1	0
2	5	1	6
2	5	1	3
2	6	4	10
2	6	4	7
2	6	4	3
2	6	4	8
2	6	4	4
2	7	1	1
2	7	1	16
2	7	1	4
2	7	1	10

Block	Plot	Trt	# Flowering Stalks
2	7	1	2
2	8	3	5
2	8	3	0
2	8	3	2
2	8	3	1
2	8	3	5
2	9	2	4
2	9	2	1
2	9	2	4
2	9	2	0
2	9	2	4
2	10	2	8
2	10	2	14
2	10	2	4
2	10	2	3
2	10	2	7
2	11	3	1
2	11	3	9
2	11	3	3
2	11	3	2
2	11	3	10
2	12	1	6
2	12	1	11
2	12	1	6
2	12	1	2
2	12	1	2

APPENDIX 4

ADULT FORB CROWN BIOMASS

			Ratibida pinnata		*Solidago rigida*		GRASS	
Block	**Plot**	**Trt**	**Shoot Number**	**Weight**	**Shoot Number**	**Weight**	**Shoot Number**	**Weight**
1	3	2	4	0.3	1	1.8	6	1.1
1	3	2	8	1.4	5	2.3	11	3.5
1	3	2	6	2.2	4	2.7	6	1.5
1	4	1	7	2.8	1	1.7	8	3.9
1	4	1	8	6	5	6.8	9	6
1	4	1	3	1	2	2.7	3	1.9
1	6	3	2	0.5	5	7	18	8.9
1	6	3	1	0.8	7	10.2	10	4.3
1	6	3	4	0.4	6	8.8	5	1.3
1	7	3	4	1.8	3	5.9	11	2.9
1	7	3	7	4.6	1	0.3	4	0.7
1	7	3	4	0.6	4	6	6	2.3
1	8	1	6	3.1	2	7.4	7	1.8
1	8	1	2	1.6	1	2.1	13	2.1
1	8	1	5	4.8	5	12.5	11	2.9
1	9	2	5	1.4	10	5.2	5	1.8
1	9	2	6	1.1	4	3	8	2.3
1	9	2	1	1.2	4	3.7	6	1.7
1	10	2	1	0.1	6	3.5	5	3.4
1	10	2	6	4.1	9	10.6	4	1.6
1	10	2	2	0.6	5	3.1	5	1.1
1	11	3	4	1.9	3	2.3	6	1.4
1	11	3	2	0.3	2	1.4	12	8.2
1	11	3	5	2.1	4	4.4	5	1
1	12	1	3	2.5	3	8	7	3.4
1	12	1	10	9.1	3	4	4	2.5
1	12	1	4	2.9	3	10.7	10	1.4
2	1	3	2	0.3	3	1.4	12	3.2
2	1	3	2	0.8	3	2.1	6	3.8
2	1	3	1	0.1	3	1.2	9	2.2
2	4	2	2	0.6	3	2.1	4	2.8
2	4	2	1	0.1	1	0.7	8	3.1
2	4	2	2	0.8	2	0.5	6	3.3
2	5	1	6	4.1	3	6.9	5	1.5
2	5	1	1	0.9	5	19.1	6	4.3
2	5	1	1	0.7	3	4.6	6	2
2	7	1	2	0.8	3	3.4	6	1.9
2	7	1	5	1.9	4	3.8	12	5.3
2	7	1	4	0.8	3	3.3	11	12.9
2	8	3	1	0.2	4	3.2	10	2.3
2	8	3	3	0.4	2	2.5	5	1.8
2	8	3	3	1.7	2	1.5	8	6.7
2	9	2	3	0.5	5	7.4	3	0.6
2	9	2	2	0.2	3	2.6	8	7.6
2	9	2	1	0.1	3	0.2	6	2.3

			Ratibida pinnata		*Solidago rigida*		GRASS	
Block	**Plot**	**Trt**	**Shoot Number**	**Weight**	**Shoot Number**	**Weight**	**Shoot Number**	**Weight**
2	10	2	5	2.6	2	2	4	0.8
2	10	2	2	0.1	7	4.9	10	2.1
2	10	2	3	1.6	3	1.7	9	2.6
2	11	3	2	0.2	2	0.4	13	4.3
2	11	3	1	0.3	2	1.5	7	2
2	11	3	4	1.8	1	0.1	8	7.5
2	12	1	1	0.8	3	5.3	6	4.5
2	12	1	1	3.3	8	33.3	6	7.4
2	12	1	3	2.6	4	6.3	4	2.1

APPENDIX 5

DESTRUCTIVE PLANT SIZE

Block	Plot	Trt	Shoot #	Height Above (cm)	Length Below (cm)	Weight (g)
1	3	2	1	5	7.5	0.061
1	3	2	2	7.2	10.2	0.077
1	3	2	2	11.5	15.6	0.548
1	3	2	1	6.7	10.7	0.167
1	4	1	1	8.6	7.8	0.08
1	4	1	1	4.8	7.6	0.03
1	4	1	3	9.9	7.5	0.14
1	4	1	2	5.7	7.7	0.06
1	6	3	3	9.6	15.6	0.629
1	6	3	5	13.4	15	0.906
1	6	3	4	9.2	17	0.785
1	6	3	3	8	8.2	0.407
1	7	3	1	10.5	12	0.394
1	7	3	3	11.7	10.2	0.711
1	7	3	4	16.5	8.1	2.538
1	7	3	1	7.6	5.9	0.113
1	8	1	1	6.6	6.1	0.037
1	8	1	1	3.8	12.6	0.076
1	8	1	2	8.2	6.4	0.154
1	8	1	2	6.7	9.8	0.077
1	9	2	8	9.8	9	2.635
1	9	2	3	10.2	14.4	1.149
1	9	2	7	12.4	16.5	1.44
1	9	2	3	5.2	14	0.218
1	10	2	2	4.5	7	0.08
1	10	2	2	7.1	13.3	0.258
1	10	2	3	8.6	10.7	0.351
1	10	2	3	7.7	10.7	0.187
1	11	3	6	14.3	11.2	2.241
1	11	3	5	11.9	11.3	0.778
1	11	3	3	8.7	13.7	0.412
1	11	3	3	12.5	11.5	1.038
1	12	1	2	6.5	9.5	0.084
1	12	1	2	6.5	5.9	0.058
1	12	1	2	7.2	13	0.172
1	12	1	1	9.5	8.5	0.148
2	1	3	1	7.2	7.5	0.075
2	1	3	3	6.8	6.8	0.177
2	1	3	2	6.9	7.5	0.215
2	1	3	5	9.3	9.2	0.385
2	4	2	3	7	9.7	0.206
2	4	2	4	8.5	8	0.378
2	4	2	2	6.2	8.2	0.156
2	4	2	2	9.4	7.8	0.296
2	5	1	2	4.6	5.3	0.029
2	5	1	2	4.1	8.3	0.039

Block	Plot	Trt	Shoot #	Height Above (cm)	Length Below (cm)	Weight (g)
2	5	1	1	5.2	5.5	0.019
2	5	1	1	2.8	6.4	0.031
2	7	1	3	10.5	10.9	0.999
2	7	1	2	7.5	7.6	0.093
2	7	1	2	9.2	6.9	0.156
2	7	1	3	7.6	6.8	0.081
2	8	3	2	8	11.5	0.137
2	8	3	2	10.5	12	0.179
2	8	3	1	3.7	9	0.044
2	8	3	4	10.7	12.5	0.827
2	9	2	1	3.8	10	0.032
2	9	2	3	14	13	0.711
2	9	2	2	8.4	10.5	0.128
2	9	2	1	4.3	4.8	0.027
2	10	2	1	5.3	11.2	0.382
2	10	2	3	10.5	8.1	0.274
2	10	2	3	7.5	7.4	0.121
2	10	2	2	5	8.3	0.119
2	11	3	2	7.8	10.9	0.102
2	11	3	3	12.3	9.1	0.267
2	11	3	1	6.2	8.4	0.134
2	11	3	1	7.8	6.6	0.064
2	12	1	2	6	4.6	0.073
2	12	1	2	10.2	10.7	0.205
2	12	1	1	8	5.5	0.03
2	12	1	1	9	7.1	0.075

APPENDIX 6

NON-DESTRUCTIVE PLANT SIZE

Astragalus canadensis				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	3	2	1	35.3
1	3	2	2	48.5
1	3	2	2	62.8
1	3	2	1	22.6
1	3	2	2	60.5
1	3	2	2	59.9
1	3	2	4	69.4
1	3	2	2	28.2
1	3	2	4	56.9
1	3	2	1	42.0
1	3	2	2	51.6
1	3	2		
1	3	2		
1	3	2		
1	3	2		
1	4	1	11	89.1
1	4	1	1	46.1
1	4	1	11	83.6
1	4	1	1	39.5
1	4	1		
1	4	1		
1	4	1		
1	4	1		
1	4	1		
1	4	1		
1	4	1		
1	4	1		
1	4	1		
1	4	1		
1	4	1		
1	6	3	2	55.5
1	6	3	2	61.0
1	6	3	1	20.0
1	6	3	2	46.7
1	6	3	1	55.0
1	6	3	1	37.0
1	6	3		
1	6	3		
1	6	3		
1	6	3		
1	6	3		
1	6	3		
1	6	3		
1	6	3		
1	6	3		
1	7	3	4	85.5

Block	Plot	Trt	Leaf/Stem #	Height (cm)
1	7	3	2	70.0
1	7	3	2	58.3
1	7	3	6	63.0
1	7	3	6	77.1
1	7	3	1	55.6
1	7	3	1	41.1
1	7	3	3	54.5
1	7	3	1	16.5
1	7	3	4	72.6
1	7	3	2	66.7
1	7	3	1	65.1
1	7	3	1	45.1
1	7	3	1	43.7
1	7	3	5	110.0
1	8	1	1	55.5
1	8	1	6	80.1
1	8	1	1	31.6
1	8	1	2	58.0
1	8	1	1	42.5
1	8	1	1	49.4
1	8	1	1	65.2
1	8	1	1	49.1
1	8	1	1	42.6
1	8	1	1	43.5
1	8	1	5	83.8
1	8	1	3	58.4
1	8	1	1	44.6
1	8	1	1	25.6
1	8	1	1	42.4
1	9	2	1	52.2
1	9	2	1	51.9
1	9	2	5	59.2
1	9	2	1	78.4
1	9	2	3	70.9
1	9	2	1	59.9
1	9	2	5	90.0
1	9	2	1	73.6
1	9	2	1	44.6
1	9	2	3	61.9
1	9	2	4	58.5
1	9	2	1	56.8
1	9	2	1	38.0
1	9	2	3	66.0
1	9	2	5	60.0
1	10	2	1	42.6
1	10	2	1	56.3
1	10	2	2	48.2

Block	Plot	Trt	Leaf/Stem #	Height (cm)
1	10	2	2	54.4
1	10	2	1	45.2
1	10	2	1	25.9
1	10	2	1	47.8
1	10	2	1	53.0
1	10	2	1	77.1
1	10	2	1	44.0
1	10	2	2	61.5
1	10	2	2	69.0
1	10	2	2	78.0
1	10	2	1	31.9
1	10	2	2	58.5
1	11	3	1	73.5
1	11	3	1	13.0
1	11	3	1	16.3
1	11	3	1	45.0
1	11	3	1	25.3
1	11	3	1	58.7
1	11	3	1	40.1
1	11	3	2	69.9
1	11	3	1	62.4
1	11	3	1	45.1
1	11	3	2	75.5
1	11	3	1	36.1
1	11	3	1	59.6
1	11	3	1	55.0
1	11	3	4	85.0
1	12	1	1	28.2
1	12	1	1	26.2
1	12	1	1	35.6
1	12	1	3	71.3
1	12	1	10	98.7
1	12	1	1	80.5
1	12	1		
1	12	1		
1	12	1		
1	12	1		
1	12	1		
1	12	1		
1	12	1		
1	12	1		
1	12	1		
2	1	3	1	15.0
2	1	3	1	61.5
2	1	3	7	75.2
2	1	3	1	45.7
2	1	3	1	31.2

Block	Plot	Trt	Leaf/Stem #	Height (cm)
2	1	3	1	40.8
2	1	3	2	59.3
2	1	3	2	48.6
2	1	3	1	18.5
2	1	3	4	73.1
2	1	3	1	33.6
2	1	3	3	73.0
2	1	3	1	54.8
2	1	3	2	49.0
2	1	3		
2	4	2	2	74.6
2	4	2	1	69.2
2	4	2	1	25.6
2	4	2	1	14.6
2	4	2	1	33.3
2	4	2	1	51.5
2	4	2	2	46.8
2	4	2		
2	4	2		
2	4	2		
2	4	2		
2	4	2		
2	4	2		
2	4	2		
2	4	2		
2	5	1	2	31.5
2	5	1	2	49.9
2	5	1	2	58.5
2	5	1	2	25
2	5	1	1	34.4
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	7	1	1	39.8
2	7	1	1	26.9
2	7	1	1	18.5
2	7	1	1	31.7
2	7	1	3	56.4
2	7	1	1	39.9
2	7	1	1	34.3

Block	Plot	Trt	Leaf/Stem #	Height (cm)
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	8	3	1	11.2
2	8	3	1	65.3
2	8	3	1	24.2
2	8	3	2	60.0
2	8	3	1	59.0
2	8	3	2	67.9
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	9	2	3	68.3
2	9	2	1	32.4
2	9	2	4	59.2
2	9	2	2	65.8
2	9	2	1	53.5
2	9	2	1	31.2
2	9	2	1	30.2
2	9	2	1	29.1
2	9	2	4	75.0
2	9	2	1	26.1
2	9	2	1	21.2
2	9	2		
2	9	2		
2	9	2		
2	9	2		
2	10	2	3	54.5
2	10	2	1	23.5
2	10	2	1	37.1
2	10	2	1	63.5
2	10	2	2	57.5
2	10	2	2	84.1
2	10	2	1	31.8
2	10	2	1	28.7
2	10	2	3	75.8

Block	Plot	Trt	Leaf/Stem #	Height (cm)
2	10	2	3	53.3
2	10	2	3	42.1
2	10	2	1	47.7
2	10	2	1	26.9
2	10	2	1	32.7
2	10	2	2	29.1
2	11	3	1	10.0
2	11	3	4	56.3
2	11	3	1	56.2
2	11	3	1	72.0
2	11	3	2	49.5
2	11	3	1	47.5
2	11	3	3	63.9
2	11	3	4	48.6
2	11	3	2	49.6
2	11	3	2	67.3
2	11	3		
2	11	3		
2	11	3		
2	11	3		
2	11	3		
2	12	1	1	40.2
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		
2	12	1		

Non-Destructive Plant Size: *Aster laevis*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	3	2	1	12.4
1	3	2	1	11.5
1	3	2	1	9.0
1	3	2	1	7.4
1	3	2	1	19.5
1	3	2	1	21.8
1	3	2	1	25.5
1	3	2	1	27.1
1	3	2	1	41.5
1	3	2	1	23.3
1	3	2	1	25.5
1	3	2	1	23.4
1	3	2	1	21.1
1	3	2	1	29.5
1	3	2	2	35.1
1	4	1	1	18.6
1	4	1	1	12.9
1	4	1	1	18.2
1	4	1	1	14.5
1	4	1	1	9.8
1	4	1	1	8.9
1	4	1	1	24.9
1	4	1	1	15.1
1	4	1	1	10.4
1	4	1	1	10.2
1	4	1	1	11.0
1	4	1	1	14.4
1	4	1	1	13.5
1	4	1	1	20.1
1	4	1	1	23.9
1	6	3	1	23.4
1	6	3	1	10.9
1	6	3	1	13.0
1	6	3	1	13.5
1	6	3	1	11.0
1	6	3	1	19.5
1	6	3	1	19.9
1	6	3	1	21.6
1	6	3	1	16.0
1	6	3	3	31.0
1	6	3	1	15.3
1	6	3	1	19.7
1	6	3	1	13.9
1	6	3	1	24.9
1	6	3	1	37.6

Non-Destructive Plant Size: *Aster laevis*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	7	3	1	14.1
1	7	3	1	24.1
1	7	3	1	13.0
1	7	3	2	21.6
1	7	3	1	23.1
1	7	3	1	9.5
1	7	3	1	32.4
1	7	3	2	25.4
1	7	3	1	16.6
1	7	3	1	15.5
1	7	3	1	13.2
1	7	3	1	27.0
1	7	3	1	21.3
1	7	3	1	36.5
1	7	3	2	22.6
1	8	1	2	16.5
1	8	1	1	29.0
1	8	1	1	6.9
1	8	1	1	10.4
1	8	1	1	14.5
1	8	1	1	10.1
1	8	1	1	15.1
1	8	1	1	34.1
1	8	1	1	27.6
1	8	1	1	19.3
1	8	1	1	10.6
1	8	1	1	15.1
1	8	1	1	12.6
1	8	1	1	15.4
1	8	1	1	13.0
1	9	2	1	23.7
1	9	2	1	20.4
1	9	2	1	63.0
1	9	2	1	25.5
1	9	2	1	13.9
1	9	2	1	13.4
1	9	2	1	29.5
1	9	2	3	38.5
1	9	2	1	24.8
1	9	2	2	50.2
1	9	2	1	23.3
1	9	2	1	39.0
1	9	2	3	42.9
1	9	2	1	12.3
1	9	2	1	23.5

Non-Destructive Plant Size: *Aster laevis*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	10	2	1	9.8
1	10	2	1	18.7
1	10	2	2	14.3
1	10	2	1	17.9
1	10	2	2	19.3
1	10	2	1	41.4
1	10	2	1	17.0
1	10	2	1	10.4
1	10	2	1	12.5
1	10	2	1	18.0
1	10	2	1	35.1
1	10	2	1	15.1
1	10	2	1	13.3
1	10	2	1	20.4
1	10	2	1	13.5
1	11	3	1	13.5
1	11	3	1	7.4
1	11	3	1	16.2
1	11	3	1	5.0
1	11	3	1	14.7
1	11	3	1	15.1
1	11	3	1	15.3
1	11	3	1	6.6
1	11	3	1	24.8
1	11	3	1	31.5
1	11	3	1	33.9
1	11	3	1	28.7
1	11	3	1	29.0
1	11	3	1	26.7
1	11	3		
1	12	1	1	7.2
1	12	1	1	19.7
1	12	1	1	13.1
1	12	1	1	69.0
1	12	1	1	17.3
1	12	1	1	16.4
1	12	1	1	24.1
1	12	1	1	26.7
1	12	1	1	34.4
1	12	1	1	25.0
1	12	1	1	19.0
1	12	1	1	17.8
1	12	1	1	31.3
1	12	1	1	23.1
1	12	1	1	9.0

Non-Destructive Plant Size: *Aster laevis*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
2	1	3	1	26.5
2	1	3	1	21.5
2	1	3	1	18.4
2	1	3	1	12.7
2	1	3	1	12.6
2	1	3	1	25.6
2	1	3	1	10.9
2	1	3	1	5.4
2	1	3	1	20.0
2	1	3	1	17.0
2	1	3	1	16.3
2	1	3	1	14.6
2	1	3	1	18.0
2	1	3	1	12.0
2	1	3	1	19.4
2	4	2	1	17.0
2	4	2	1	13.2
2	4	2	1	5.7
2	4	2	1	16.2
2	4	2	2	31.0
2	4	2	2	32.9
2	4	2	1	15.8
2	4	2	1	19.7
2	4	2	1	24.8
2	4	2	1	16.0
2	4	2	1	8.1
2	4	2	1	15.4
2	4	2	3	30.0
2	4	2	1	21.5
2	4	2	2	12.5
2	5	1	1	12.7
2	5	1	1	20.1
2	5	1	1	9.6
2	5	1	1	16.4
2	5	1	2	16.9
2	5	1	1	13.6
2	5	1	1	10.3
2	5	1	1	28.6
2	5	1	1	19.5
2	5	1	1	20.5
2	5	1	1	22.1
2	5	1	1	7.5
2	5	1	1	23.0
2	5	1	1	17.0
2	5	1	1	19.1

Non-Destructive Plant Size: *Aster laevis*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
2	7	1	1	7.8
2	7	1	1	13.6
2	7	1	1	4.3
2	7	1	1	10.2
2	7	1	1	5.6
2	7	1	1	11.4
2	7	1	1	7.0
2	7	1	1	5.4
2	7	1	1	16.8
2	7	1	1	21.9
2	7	1	1	16.0
2	7	1	1	15.9
2	7	1	1	29.5
2	7	1	1	26.0
2	7	1	1	10.8
2	8	3	1	12.0
2	8	3	1	21.7
2	8	3	2	58.8
2	8	3	2	26.7
2	8	3	1	17.1
2	8	3	2	32.7
2	8	3	1	15.4
2	8	3	1	26.0
2	8	3	1	15.5
2	8	3	2	47.7
2	8	3	1	15.6
2	8	3	1	17.6
2	8	3	1	16.0
2	8	3	1	26.5
2	8	3	1	41.0
2	9	2	1	19.4
2	9	2	1	17.4
2	9	2	1	22.5
2	9	2	2	38.1
2	9	2	2	23.9
2	9	2	1	22.9
2	9	2	1	11.8
2	9	2	1	11.8
2	9	2	1	22.0
2	9	2	1	26.3
2	9	2	1	25.5
2	9	2	1	14.3
2	9	2	1	14.3
2	9	2	1	25.3
2	9	2	3	29.5

Non-Destructive Plant Size: *Aster laevis*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
2	10	2	1	14.7
2	10	2	1	15.4
2	10	2	1	28.7
2	10	2	1	12.2
2	10	2	3	17.5
2	10	2	1	16.7
2	10	2	1	20.0
2	10	2	1	33.0
2	10	2	1	16.1
2	10	2	1	6.8
2	10	2	1	9.7
2	10	2	1	19.5
2	10	2	1	14.9
2	10	2	1	5.6
2	10	2	1	7.5
2	11	3	1	36.0
2	11	3	1	15.7
2	11	3	1	22.7
2	11	3	3	40.5
2	11	3	1	29.2
2	11	3	1	24.5
2	11	3	1	21.4
2	11	3	1	17.7
2	11	3	2	28.9
2	11	3	1	24.5
2	11	3	1	6.7
2	11	3	1	8.7
2	11	3	1	11.5
2	11	3	1	22.5
2	11	3	1	29.2
2	12	1	1	10.1
2	12	1	1	6.1
2	12	1	1	18.5
2	12	1	1	8.9
2	12	1	1	18.3
2	12	1	1	5.4
2	12	1	1	3.9
2	12	1	1	17.7
2	12	1	1	15.0
2	12	1	1	9.8
2	12	1	1	3.9
2	12	1	1	27.7
2	12	1	1	18.4
2	12	1	1	15.3
2	12	1	1	25.6

Non-Destructive Plant Size: *Dalea candidum*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	3	2	2	32.4
1	3	2	1	29.6
1	3	2	1	24.7
1	3	2	1	39.8
1	3	2	1	24.1
1	3	2	1	26.2
1	3	2	1	52.7
1	3	2	2	32.2
1	3	2	1	28.1
1	3	2	2	32.0
1	3	2	1	41.8
1	3	2	1	34.5
1	3	2	1	31.0
1	3	2	1	20.7
1	3	2	2	43.5
1	4	1	1	20.0
1	4	1	1	13.8
1	4	1	2	27.9
1	4	1	2	34.1
1	4	1	1	34.0
1	4	1	2	36.0
1	4	1	1	20.5
1	4	1	1	24.5
1	4	1	2	64.7
1	4	1	1	58.7
1	4	1	1	64.5
1	4	1	2	24.0
1	4	1	1	21.0
1	4	1	1	31.5
1	4	1	3	61.5
1	6	3	2	40.0
1	6	3	3	45.5
1	6	3	3	61.0
1	6	3	3	27.5
1	6	3	5	63.0
1	6	3	3	54.4
1	6	3	1	39.0
1	6	3	3	39.5
1	6	3	1	44.3
1	6	3	1	34.5
1	6	3	1	17.0
1	6	3	2	31.0
1	6	3	1	37.0
1	6	3	1	36.5
1	6	3	2	45.0

Non-Destructive Plant Size: *Dalea candidum*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	7	3	1	40.7
1	7	3	2	25.5
1	7	3	1	22.1
1	7	3	2	26.7
1	7	3	4	47.7
1	7	3	1	71.0
1	7	3	1	59.3
1	7	3	1	16.9
1	7	3	1	33.5
1	7	3	7	47.3
1	7	3	1	16.4
1	7	3	1	53.5
1	7	3	2	30.9
1	7	3	1	39.4
1	7	3	1	15.9
1	8	1	1	37.8
1	8	1	1	27.0
1	8	1	3	39.6
1	8	1	1	28.0
1	8	1	1	24.3
1	8	1	1	42.6
1	8	1	2	33.3
1	8	1	1	66.8
1	8	1	1	28.7
1	8	1	2	23.5
1	8	1	1	38.2
1	8	1	2	32.5
1	8	1	1	29.9
1	8	1	3	50.0
1	8	1	1	46.1
1	9	2	2	37.7
1	9	2	1	28.4
1	9	2	1	18.0
1	9	2	1	57.4
1	9	2	1	45.9
1	9	2	2	42.6
1	9	2	1	36.4
1	9	2	2	73.0
1	9	2	1	62.5
1	9	2	2	44.5
1	9	2	3	31.6
1	9	2	3	46.5
1	9	2	1	52.4
1	9	2	1	39.0
1	9	2	1	28.3

Non-Destructive Plant Size: *Dalea candidum*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	10	2	2	55.6
1	10	2	1	28.0
1	10	2	1	30.2
1	10	2	2	29.0
1	10	2	2	31.0
1	10	2	1	15.1
1	10	2	1	34.4
1	10	2	1	64.1
1	10	2	2	19.0
1	10	2		
1	10	2		
1	10	2		
1	10	2		
1	10	2		
1	10	2		
1	11	3	3	40.4
1	11	3	2	20.2
1	11	3	1	66.1
1	11	3	3	33.1
1	11	3	2	18
1	11	3	1	31.4
1	11	3	1	37.1
1	11	3	1	39.1
1	11	3	1	49.5
1	11	3	2	65.6
1	11	3	1	33.6
1	11	3	1	35.8
1	11	3	2	70
1	11	3	2	24.9
1	11	3	2	55.2
1	12	1	2	21.8
1	12	1	2	55.5
1	12	1	1	10.6
1	12	1	2	36.2
1	12	1	1	31.4
1	12	1	1	42.1
1	12	1	1	27.4
1	12	1	1	25.4
1	12	1	1	24.8
1	12	1	1	30.7
1	12	1	1	33.5
1	12	1	1	55.5
1	12	1	1	57.7
1	12	1	1	39.5
1	12	1	1	52.5

Non-Destructive Plant Size: *Dalea candidum*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
2	1	3	2	29.4
2	1	3	1	19.3
2	1	3	1	28.6
2	1	3	1	25.5
2	1	3		
2	1	3		
2	1	3		
2	1	3		
2	1	3		
2	1	3		
2	1	3		
2	1	3		
2	1	3		
2	1	3		
2	1	3		
2	4	2	2	40.1
2	4	2	1	24.6
2	4	2	1	21.8
2	4	2	2	31.5
2	4	2	1	35.7
2	4	2	1	28.1
2	4	2	2	19.9
2	4	2	1	19.4
2	4	2	1	26.2
2	4	2	1	52.8
2	4	2	1	38.0
2	4	2	1	72.4
2	4	2	1	29.9
2	4	2	1	33.0
2	4	2		
2	5	1	1	5.1
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		
2	5	1		

Non-Destructive Plant Size: *Dalea candidum*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	7	1		
2	8	3	1	40
2	8	3	3	52.9
2	8	3	3	20.9
2	8	3	3	60.2
2	8	3	1	47.6
2	8	3	2	40.5
2	8	3	1	61.6
2	8	3	1	49.3
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	8	3		
2	9	2	1	38.7
2	9	2	5	27.4
2	9	2	2	41.6
2	9	2	2	20.0
2	9	2	1	26.1
2	9	2	3	37.6
2	9	2	4	24.4
2	9	2	1	26.0
2	9	2	2	26.3
2	9	2	1	31.7
2	9	2	4	40.3
2	9	2	2	67.9
2	9	2	1	33.7
2	9	2	1	24.5
2	9	2	1	25.7

Non-Destructive Plant Size: *Dalea candidum*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
2	10	2	1	61.0
2	10	2	1	21.1
2	10	2	3	40.9
2	10	2	1	19.9
2	10	2	4	49.1
2	10	2		
2	10	2		
2	10	2		
2	10	2		
2	10	2		
2	10	2		
2	10	2		
2	10	2		
2	10	2		
2	10	2		
2	11	3	3	42.6
2	11	3	6	58.2
2	11	3	2	43.4
2	11	3	3	64.5
2	11	3	1	23.4
2	11	3	2	63.5
2	11	3	1	30.1
2	11	3	3	54.8
2	11	3	1	56.9
2	11	3	2	32.5
2	11	3	2	43.0
2	11	3	4	58.0
2	11	3	1	69.5
2	11	3	1	52.5
2	11	3	1	57.2
2	12	1	1	27.0
2	12	1	1	62.5
2	12	1	2	31.5
2	12	1	1	40.9
2	12	1	1	27.9
2	12	1	1	36.5
2	12	1	1	12.6
2	12	1	1	44.0
2	12	1	2	19.4
2	12	1	1	36.5
2	12	1	1	43.3
2	12	1	1	33.3
2	12	1	1	34.2
2	12	1	2	52.0
2	12	1	2	68.3

Non-Destructive Plant Size: *Parthenium integrifolium*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	3	2	3	19.1
1	3	2	2	12.8
1	3	2	2	17.2
1	3	2	2	15.6
1	3	2	1	6.2
1	3	2	2	21.7
1	3	2	1	12.0
1	3	2	2	22.7
1	3	2	2	14.4
1	3	2	1	13.4
1	3	2	2	15.4
1	3	2	3	6.3
1	3	2	2	17.4
1	3	2	2	14.4
1	3	2	3	15.2
1	4	1	2	14.6
1	4	1	2	9.9
1	4	1	1	16.1
1	4	1	3	17.0
1	4	1	2	8.2
1	4	1	3	6.4
1	4	1	1	9.5
1	4	1	2	11.8
1	4	1	2	5.9
1	4	1	2	15.0
1	4	1	3	18.6
1	4	1	4	17.2
1	4	1	3	9.2
1	4	1	2	4.5
1	4	1	2	10.3
1	6	3	2	10.4
1	6	3	2	10.4
1	6	3	2	9.1
1	6	3	1	12.3
1	6	3	1	7.0
1	6	3	3	17.2
1	6	3	3	23.5
1	6	3	2	11.4
1	6	3	1	7.5
1	6	3	1	7.1
1	6	3	4	16.0
1	6	3	2	10.5
1	6	3	2	8.0
1	6	3	3	16.5
1	6	3	2	5.5

Non-Destructive Plant Size: *Parthenium integrifolium*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	7	3	1	5.0
1	7	3	3	21.4
1	7	3	3	10.5
1	7	3	2	19.7
1	7	3	2	15.9
1	7	3	2	17.5
1	7	3	2	19.5
1	7	3	3	15.4
1	7	3	6	32.2
1	7	3	2	11.1
1	7	3	1	7.1
1	7	3	3	19.9
1	7	3	2	12.5
1	7	3	2	25.0
1	7	3	2	12.5
1	8	1	2	9.5
1	8	1	3	7.0
1	8	1	2	14.0
1	8	1	1	7.4
1	8	1	2	16.6
1	8	1	2	11.7
1	8	1	4	10.9
1	8	1	1	14.6
1	8	1	2	6.0
1	8	1	2	13.1
1	8	1	4	17.6
1	8	1	2	10.0
1	8	1	2	15.0
1	8	1	3	11.8
1	8	1	3	11.4
1	9	2	3	14.2
1	9	2	1	11.1
1	9	2	2	9.8
1	9	2	3	11.8
1	9	2	2	13.5
1	9	2	2	12.4
1	9	2	1	22.2
1	9	2	2	8.5
1	9	2	2	12.5
1	9	2	6	39.3
1	9	2	11	25.2
1	9	2	1	10.5
1	9	2	2	13.0
1	9	2	2	22.6
1	9	2	2	16.0

Non-Destructive Plant Size: *Parthenium integrifolium*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
1	10	2	3	15.4
1	10	2	3	18.5
1	10	2	2	16.3
1	10	2	2	13.3
1	10	2	3	7.6
1	10	2	2	13.0
1	10	2	2	13.5
1	10	2	2	16.0
1	10	2	3	13.4
1	10	2	2	7.6
1	10	2	2	9.5
1	10	2	3	12.0
1	10	2	2	15.2
1	10	2	3	18.4
1	10	2	3	14.2
1	11	3	1	8.0
1	11	3	2	8.6
1	11	3	2	19.2
1	11	3	3	7.2
1	11	3	2	11.4
1	11	3	2	12.8
1	11	3	3	9.8
1	11	3	5	10.5
1	11	3	3	17.0
1	11	3	3	10.0
1	11	3	3	16.2
1	11	3	1	14.3
1	11	3	2	10.4
1	11	3	2	10.7
1	11	3	2	13.3
1	12	1	3	19.7
1	12	1	3	12.4
1	12	1	6	22.9
1	12	1	2	12.6
1	12	1	1	10.3
1	12	1	2	10.9
1	12	1	3	10.5
1	12	1	1	10.8
1	12	1	3	9.9
1	12	1	2	16.0
1	12	1	2	14.0
1	12	1	3	17.0
1	12	1	2	16.8
1	12	1	3	13.5
1	12	1	1	13.5

Non-Destructive Plant Size: *Parthenium integrifolium*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
2	1	3	3	11.3
2	1	3	2	9.0
2	1	3	3	15.1
2	1	3	3	23.5
2	1	3	3	23.6
2	1	3	1	7.3
2	1	3	2	7.0
2	1	3	3	13
2	1	3	2	18.8
2	1	3	2	10.9
2	1	3	1	7.9
2	1	3	4	10.0
2	1	3	2	11.2
2	1	3	2	11.2
2	1	3	3	11.0
2	4	2	2	20.0
2	4	2	4	18.6
2	4	2	2	14.3
2	4	2	3	13.2
2	4	2	3	18.5
2	4	2	2	5.0
2	4	2	2	17.4
2	4	2	4	24.7
2	4	2	2	13.0
2	4	2	2	8.5
2	4	2	3	10.0
2	4	2	1	5.0
2	4	2	2	16.5
2	4	2	2	12.8
2	4	2	2	9.6
2	5	1	2	10.2
2	5	1	2	8.2
2	5	1	2	9.3
2	5	1	3	8.4
2	5	1	2	6.1
2	5	1	3	7.4
2	5	1	2	12.7
2	5	1	2	12.4
2	5	1	2	12.0
2	5	1	2	12.6
2	5	1	2	8.8
2	5	1	3	19.6
2	5	1	5	19.0
2	5	1	6	22.9
2	5	1	4	19.2

Non-Destructive Plant Size: *Parthenium integrifolium*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
2	7	1	4	17.0
2	7	1	2	13.0
2	7	1	2	14.0
2	7	1	2	6.9
2	7	1	1	14.4
2	7	1	3	11.0
2	7	1	1	8.3
2	7	1	4	22.7
2	7	1	2	11.1
2	7	1	4	17.5
2	7	1	2	12.8
2	7	1	2	12.5
2	7	1	3	24.3
2	7	1	2	12.7
2	7	1	2	13.5
2	8	3	2	10.1
2	8	3	3	5.4
2	8	3	3	13.0
2	8	3	2	16.2
2	8	3	2	10.0
2	8	3	2	16.0
2	8	3	2	14.5
2	8	3	2	10.2
2	8	3	2	13.2
2	8	3	2	10.7
2	8	3	6	24.5
2	8	3	4	21.5
2	8	3	2	7.4
2	8	3	3	13.0
2	8	3	2	8.5
2	9	2	2	10.5
2	9	2	4	21.0
2	9	2	3	20.0
2	9	2	1	13.0
2	9	2	2	14.0
2	9	2	2	21.9
2	9	2	1	5.7
2	9	2	2	12.2
2	9	2	2	12.5
2	9	2	2	7.6
2	9	2	2	9.4
2	9	2	5	19.3
2	9	2	3	11.8
2	9	2	3	7.6
2	9	2	1	9.2

Non-Destructive Plant Size: *Parthenium integrifolium*				
Block	**Plot**	**Trt**	**Leaf/Stem #**	**Height (cm)**
2	10	2	2	11.2
2	10	2	2	13.1
2	10	2	3	11.7
2	10	2	2	13.0
2	10	2	2	9.2
2	10	2	3	15.1
2	10	2	3	8.0
2	10	2	2	18.7
2	10	2	2	20.3
2	10	2	2	14.3
2	10	2	2	6.2
2	10	2	3	9.6
2	10	2	3	15.0
2	10	2	1	3.0
2	10	2	3	13.3
2	11	3	3	14.3
2	11	3	3	16.3
2	11	3	4	13.2
2	11	3	2	12.5
2	11	3	2	10.7
2	11	3	5	23.7
2	11	3	3	20.6
2	11	3	2	7.0
2	11	3	3	14.1
2	11	3	3	8.6
2	11	3	3	9.5
2	11	3	4	14.0
2	11	3	3	18.4
2	11	3	1	10.1
2	11	3	2	14.6
2	12	1	2	14.9
2	12	1	2	12.5
2	12	1	2	8.0
2	12	1	2	13.6
2	12	1	2	10.2
2	12	1	2	14.7
2	12	1	3	24.3
2	12	1	2	32.9
2	12	1	3	13.2
2	12	1	3	7.0
2	12	1	2	12.5
2	12	1	4	15.0
2	12	1	2	20.0
2	12	1	1	7.6
2	12	1	1	13.5

APPENDIX 7

BELOW GROUND BIOMASS

Block	Trt	Plot	Coordinates		Biomass (g)
			W	L	
1	2	3	6	3	0.570
1	2	3	11	6	0.258
1	2	3	9	17	0.481
1	2	3	9	17	0.431
1	1	4	12	6	0.885
1	1	4	3	5	0.478
1	1	4	3	15	0.567
1	1	4	3	15	0.475
1	3	6	8	8	0.761
1	3	6	8	8	0.789
1	3	6	8	8	0.801
1	3	6	8	14	0.327
1	3	7	2	16	3.075
1	3	7	11	16	0.787
1	3	7	11	1	0.723
1	3	7	2	16	0.344
1	1	8	10	3	0.416
1	1	8	10	3	0.599
1	1	8	4	18	1.162
1	1	8	10	3	0.434
1	2	9	11	10	0.350
1	2	9	11	10	0.200
1	2	9	11	10	0.503
1	2	9	11	10	0.258
1	2	10	10	4	0.352
1	2	10	4	9	0.209
1	2	10	7	7	0.627
1	2	10	9	7	0.273
1	3	11	8	18	0.776
1	3	11	7	15	0.785
1	3	11	12	10	0.787
1	3	11	4	9	0.481
1	1	12	9	8	0.154
1	1	12	6	15	0.418
1	1	12	13	7	0.219
1	1	12	13	7	0.182
2	3	1	8	13	0.879
2	3	1	13	8	0.528
2	3	1	3	9	0.476
2	3	1	9	16	0.662
2	2	4	11	10	0.580
2	2	4	11	10	0.570
2	2	4	11	10	0.665
2	2	4	14	11	1.291
2	1	5	5	5	0.584
2	1	5	5	5	0.146

Block	Trt	Plot	Coordinates		Biomass (g)
			W	L	
2	1	5	5	2	0.529
2	1	5	5	7	0.276
2	1	7	2	16	0.188
2	1	7	12	10	0.104
2	1	7	12	10	0.896
2	1	7	12	10	0.449
2	3	8	10	17	0.652
2	3	8	10	17	0.365
2	3	8	3	15	1.070
2	3	8	11	7	0.657
2	2	9	14	7	0.380
2	2	9	12	13	0.665
2	2	9	14	7	0.480
2	2	9	14	7	0.589
2	2	10	5	12	1.464
2	2	10	9	14	0.905
2	2	10	5	12	0.337
2	2	10	5	12	1.030
2	3	11	9	16	1.611
2	3	11	12	9	0.365
2	3	11	10	13	0.431
2	3	11	10	13	0.535
2	1	12	7	3	0.536
2	1	12	5	16	0.365
2	1	12	6	14	0.628
2	1	12	6	14	0.377

APPENDIX 8

TRANSECT DATA

May 2003 Transect Data								
Block	Plot	Trt	Asno	Ruhi	Sori	Rapi	Dapu	Mofi
1	1	4	0	6	0	7	0	1
1	2	4	0	3	4	14	0	0
1	3	2	6	30	47	39	1	0
1	4	1	7	7	20	51	1	0
1	5	4	1	18	2	17	0	0
1	6	3	12	1	55	51	0	7
1	7	3	10	3	26	44	1	1
1	8	1	8	14	16	49	0	0
1	9	2	3	42	8	22	0	0
1	10	2	12	7	17	40	0	5
1	11	3	5	25	4	20	3	10
1	12	1	1	13	18	26	1	1
2	1	3	2	2	30	50	0	7
2	2	4	8	2	12	16	0	6
2	3	4	4	6	4	25	0	6
2	4	2	8	17	16	60	0	17
2	5	1	4	19	18	33	0	8
2	6	4	5	2	5	7	0	9
2	7	1	2	2	19	31	0	9
2	8	3	2	11	24	33	0	3
2	9	2	24	0	24	39	2	18
2	10	2	4	25	21	27	0	6
2	11	3	17	6	22	48	1	11
2	12	1	24	30	20	30	0	19

Block	Plot	Trt	Copa	Ancy	Lipy	Rusu	Leca	Euco
1	1	4	2	1	1	0	0	3
1	2	4	5	1	0	0	0	1
1	3	2	5	0	0	0	0	1
1	4	1	0	3	0	0	0	0
1	5	4	1	0	0	0	0	0
1	6	3	0	1	1	0	0	0
1	7	3	2	0	1	0	0	0
1	8	1	5	2	2	0	0	0
1	9	2	0	0	0	0	0	0
1	10	2	2	4	0	0	0	0
1	11	3	0	1	0	0	0	0
1	12	1	2	1	0	0	0	0
2	1	3	1	0	2	0	0	0
2	2	4	2	0	0	0	0	0
2	3	4	1	0	1	0	0	0
2	4	2	1	4	0	0	0	0
2	5	1	2	0	1	0	0	0
2	6	4	0	0	0	0	0	0
2	7	1	2	1	0	0	0	0
2	8	3	3	1	0	0	0	0
2	9	2	4	2	0	0	0	0
2	10	2	0	0	0	0	0	0
2	11	3	5	5	0	0	0	0
2	12	1	0	4	0	0	0	0

Block	Plot	Trt	Lias	Ecpa	Troh	Deca	Amca	Anca
1	1	4	0	9	0	0	0	0
1	2	4	0	14	0	0	0	1
1	3	2	0		0	0	0	0
1	4	1	0	1	0	3	0	0
1	5	4	0	9	0	0	0	1
1	6	3	0		0	1	0	0
1	7	3	0	6	0	4	0	0
1	8	1	0	2	0	0	0	0
1	9	2	0	4	0	3	0	0
1	10	2	0	5	0	1	0	0
1	11	3	0	2	0	3	0	0
1	12	1	0	3	0	0	0	0
2	1	3	0	1	0	0	0	0
2	2	4	0	10	0	2	0	0
2	3	4	0	3	0	1	0	0
2	4	2	0	5	0	2	0	0
2	5	1	0	4	0	1	0	0
2	6	4	0	1	0	0	0	0
2	7	1	0	1	0	0	0	0
2	8	3	0	3	0	2	0	0
2	9	2	0	1	0	1	0	0
2	10	2	0	9	0	2	0	0
2	11	3	0	7	0	11	0	0
2	12	1	0	2	0	2	0	0
Block	Plot	Trt	Astu	Ziau	Sila	Soca	Hehe	
1	1	4	0	0	3	0	0	
1	2	4	0	0	2	0	0	
1	3	2	0	0	0	0	0	
1	4	1	0	0	0	2	6	
1	5	4	0	0	0	1	1	
1	6	3	0	0	0	2	0	
1	7	3	0	0	0	3	6	
1	8	1	0	0	0	0	2	
1	9	2	0	0	0	1	2	
1	10	2	0	0	0	1	1	
1	11	3	0	0	0	9	6	
1	12	1	0	0	0	14	13	
2	1	3	0	0	0	0	0	
2	2	4	0	0	0	2	2	
2	3	4	0	0	1	0	1	
2	4	2	0	0	0	0	0	
2	5	1	0	0	0	4	0	
2	6	4	0	0	2	1	0	
2	7	1	0	0	0	3	0	
2	8	3	0	0	0	4	0	
2	9	2	0	0	0	18	0	
2	10	2	0	0	1	3	0	
2	11	3	0	0	0	1	0	
2	12	1	0	0	0	0	0	

May 2004 Transect Data								
Block	**Plot**	**Trt**	**Sori**	**Rapi**	**Ruhi**	**Ecpa**	**Asno**	**Copa**
1	3	2	155	60	172	0	9	0
1	4	1	115	106	191	9	36	4
1	6	3	99	62	8	0	15	0
1	7	3	157	79	213	6	25	7
1	8	1	57	70	121	6	24	0
1	9	2	23	85	141	21	5	1
1	10	2	18	73	133	3	11	0
1	11	3	44	55	304	8	56	4
1	12	1	83	55	40	3	30	0
2	1	2	21	71	191	6	16	0
2	4	2	21	94	494	7	28	0
2	5	1	150	41	185	6	17	15
2	7	1	48	5	41	7	7	0
2	8	3	135	45	298	2	18	15
2	9	2	80	70	53	19	42	1
2	10	2	87	53	246	5	13	1
2	11	3	108	30	590	12	20	4
2	12	1	33	26	344	4	13	1
Block	**Plot**	**Trt**	**Mofi**	**Daca**	**Dapu**	**Deca**	**Lias**	**Lipy**
1	3	2	3	2	0	0	0	3
1	4	1	51	1	8	0	0	0
1	6	3	2	5	0	0	0	0
1	7	3	0	0	12	0	0	0
1	8	1	1	16	1	0	0	0
1	9	2	12	6	0	0	1	3
1	10	2	12	0	0	0	0	0
1	11	3	35	10	6	1	0	1
1	12	1	10	0	0	0	0	1
2	1	2	0	1	1	0	0	0
2	4	2	7	3	1	0	0	3
2	5	1	10	0	0	0	0	6
2	7	1	4	0	0	0	0	0
2	8	3	11	2	0	0	0	6
2	9	2	31	2	4	0	0	0
2	10	2	14	1	2	0	0	0
2	11	3	24	0	2	0	0	0
2	12	1	21	1	6	0	0	0

Block	Plot	Trt	Sila	Leca	Ziau	Pain	Amca	Anca
1	3	2	0	0	1	11	0	5
1	4	1	1	10	3	4	0	12
1	6	3	1	0	2	2	0	2
1	7	3	0	1	4	2	1	11
1	8	1	0	0	3	20	2	9
1	9	2	3	4	4	26	0	3
1	10	2	0	1	4	18	0	3
1	11	3	1	18	3	22	1	4
1	12	1	0	0	0	3	0	2
2	1	2	0	0	3	30	0	3
2	4	2	0	1	4	15	0	4
2	5	1	1	3	4	32	0	7
2	7	1	0	0	2	10	0	2
2	8	3	1	0	3	36	0	13
2	9	2	0	3	1	19	1	10
2	10	2	0	1	6	21	0	2
2	11	3	1	3	7	21	6	7
2	12	1	0	15	3	12	0	5
Block	Plot	Trt	Asla	Asca	Euco	Sosp	Soca	Bala
1	3	2	4	1	1	2	0	0
1	4	1	1	1	0	8	16	0
1	6	3	0	0	2	5	16	0
1	7	3	1	1	0	6	10	0
1	8	1	5	2	1	7	12	0
1	9	2	2	0	1	0	1	1
1	10	2	2	0	0	12	29	0
1	11	3	7	2	0	8	8	0
1	12	1	1	0	1	4	45	0
2	1	2	17	0	0	12	10	0
2	4	2	5	0	3	4	0	0
2	5	1	8	1	0	2	8	0
2	7	1	0	0	1	1	6	0
2	8	3	12	1	2	7	9	0
2	9	2	6	0	1	7	24	0
2	10	2	10	3	1	5	5	0
2	11	3	5	0	2	2	1	0
2	12	1	1	0	0	3	13	0

Block	Plot	Trt	Hehe
1	3	2	8
1	4	1	7
1	6	3	12
1	7	3	61
1	8	1	43
1	9	2	25
1	10	2	6
1	11	3	9
1	12	1	17
2	1	2	27
2	4	2	12
2	5	1	4
2	7	1	20
2	8	3	11
2	9	2	16
2	10	2	19
2	11	3	4
2	12	1	6

July 2004 Transect Data									
Block	**Plot**	**Trt**	**Sori**	**Rapi**	**Ruhi**	**Ecpa**	**Asno**	**Copa**	**Mofi**
1	3	2	79	46	62	0	8	4	2
1	4	1	67	150	91	2	25	4	36
1	6	3	65	48	9	0	11	0	1
1	7	3	149	60	109	9	9	8	12
1	8	1	69	85	75	7	20	0	4
1	9	2	12	60	57	6	2	0	5
1	10	2	17	46	97	4	0	0	7
1	11	3	51	53	214	8	27	4	11
1	12	1	36	41	13	2	5	1	6
2	1	3	57	61	170	4	36	1	2
2	4	2	27	67	414	4	20	3	13
2	5	1	73	36	192	8	10	0	3
2	7	1	34	35	33	1	9	0	2
2	8	3	99	42	85	5	8	3	2
2	9	2	27	55	83	3	24	1	15
2	10	2	86	30	167	4	17	0	7
2	11	3	78	22	434	16	24	3	33
2	12	1	26	10	306	3	10	0	12

Block	Plot	Trt	Daca	Dapu	Deca	Lias	Lipy	Sila	Leca
1	3	2	0	0	1	0	0	0	0
1	4	1	5	1	10	0	0	0	0
1	6	3	2	0	0	0	0	0	0
1	7	3	9	5	5	0	0	0	0
1	8	1	15	2	0	0	0	0	0
1	9	2	2	0	4	0	0	1	0
1	10	2	3	0	0	0	0	0	0
1	11	3	7	3	11	0	0	1	5
1	12	1	0	1	0	0	0	0	0
2	1	3	3	2	1	0	0	0	0
2	4	2	0	0	6	0	0	0	2
2	5	1	0	0	1	0	0	1	4
2	7	1	0	0	0	0	0	0	0
2	8	3	0	0	0	0	0	0	1
2	9	2	0	1	1	0	1	2	0
2	10	2	1	0	1	0	0	0	0
2	11	3	1	1	4	0	0	0	2
2	12	1	7	1	7	0	0	0	0

Block	Plot	Trt	Ziau	Pain	Amca	Ancy	Asla	Astu	Asca
1	3	2	2	7	1	7	2	0	0
1	4	1	4	12	0	9	3	1	0
1	6	3	0	0	0	1	0	0	0
1	7	3	1	5	1	4	3	0	1
1	8	1	2	33	3	2	4	0	2
1	9	2	1	21	0	2	5	0	0
1	10	2	4	19	2	2	2	0	0
1	11	3	1	19	0	3	6	3	3
1	12	1	2	2	0	2	1	0	0
2	1	3	5	63	2	3	30	0	3
2	4	2	7	30	0	10	27	0	0
2	5	1	0	30	0	3	13	0	2
2	7	1	0	59	1	1	3	0	1
2	8	3	0	28	1	4	11	0	1
2	9	2	2	17	0	4	2	0	2
2	10	2	2	20	0	7	11	0	0
2	11	3	0	31	1	10	12	0	0
2	12	1	1	17	2	3	5	0	0

Block	Plot	Trt	Sosp	Soca	Bale	Hehe
1	3	2	3	1	0	8
1	4	1	1	13	3	7
1	6	3	0	2	0	10
1	7	3	1	7	0	33
1	8	1	1	7	0	33
1	9	2	0	1	1	9
1	10	2	2	6	0	7
1	11	3	0	2	0	8
1	12	1	0	36	2	18
2	1	3	2	8	0	66
2	4	2	4	3	0	14
2	5	1	0	1	0	4
2	7	1	0	2	0	6
2	8	3	1	5	0	9
2	9	2	1	3	0	12
2	10	2	2	2	0	18
2	11	3	0	1	0	8
2	12	1	0	4	0	3

2005 Transect Data									
Block	Plot	Trt	Amca	Anca	Asca	Asla	Asno	Astu	Bale
1	3	2	0	6	1	2	5	0	0
1	4	1	3	13	1	6	26	2	3
1	6	3	0	2	0	2	10	1	0
1	7	3	0	3	3	0	13	0	0
1	8	1	4	2	4	7	12	1	0
1	9	2	0	2	0	6	9	0	0
1	10	2	0	0	0	2	13	0	0
1	11	3	0	1	2	5	16	0	0
1	12	1	0	1	0	5	13	1	0
2	1	3	0	0	0	23	8	0	0
2	4	2	0	0	1	8	10	0	0
2	5	1	0	0	0	4	10	0	0
2	7	1	0	0	0	3	4	0	0
2	8	3	2	0	1	5	10	0	0
2	9	2	5	0	2	11	18	0	0
2	10	2	2	0	5	25	6	2	0
2	11	3	2	1	0	17	6	1	0
2	12	1	1	0	0	2	38	0	0
Block	Plot	Trt	Copa	Daca	Dapu	Deca	Ecpa	Euco	Hehe
1	3	2	1	2	1	1	0	0	5
1	4	1	6	6	0	23	14	0	6
1	6	3	1	5	1	0	0	1	2
1	7	3	2	4	6	1	7	1	40
1	8	1	1	12	3	1	3	1	26
1	9	2	1	1	0	4	18	1	12
1	10	2	1	0	0	0	5	0	5
1	11	3	4	4	5	5	7	0	15
1	12	1	3	0	0	0	0	2	19
2	1	3	0	0	0	1	5	0	9
2	4	2	0	0	0	4	3	0	8
2	5	1	7	0	0	0	7	0	5
2	7	1	1	0	0	0	6	0	3
2	8	3	3	0	0	0	3	0	4
2	9	2	1	3	8	2	9	0	11
2	10	2	0	0	0	0	8	0	8
2	11	3	0	1	1	5	3	1	14
2	12	1	6	4	1	6	9	1	2

Block	Plot	Trt	Lipy	Leca	Lias	Mofi	Pain	Pyvi	Rapi
1	3	2	0	0	1	6	5	0	42
1	4	1	0	1	0	45	22	0	72
1	6	3	2	0	1	9	5	0	51
1	7	3	0	1	0	8	1	0	60
1	8	1	0	0	0	6	21	0	116
1	9	2	0	1	0	5	23	0	64
1	10	2	0	0	0	8	10	0	44
1	11	3	0	2	0	12	26	0	30
1	12	1	5	0	0	11	9	0	44
2	1	3	0	4	0	1	50	0	24
2	4	2	1	0	1	7	24	0	44
2	5	1	1	1	0	5	20	0	22
2	7	1	1	0	0	7	44	0	44
2	8	3	2	0	0	10	35	0	37
2	9	2	1	0	0	14	22	0	43
2	10	2	0	4	0	6	56	0	25
2	11	3	0	2	0	10	27	0	20
2	12	1	2	2	0	36	2	0	39

Block	Plot	Trt	Ruhi	Rusu	Sila	Soca	Sori	Sosp	Vevi
1	3	2	29	5	1	2	97	1	0
1	4	1	16	8	1	0	92	0	0
1	6	3	11	3	0	6	70	2	0
1	7	3	5	1	0	4	150	0	0
1	8	1	10	2	0	10	60	4	0
1	9	2	14	0	1	1	33	1	0
1	10	2	72	8	0	7	41	0	0
1	11	3	33	0	0	4	32	1	0
1	12	1	18	13	1	42	66	0	0
2	1	3	27	3	0	9	38	12	0
2	4	2	28	4	0	2	21	7	0
2	5	1	56	12	0	2	113	1	0
2	7	1	21	1	1	6	63	4	0
2	8	3	40	2	0	17	123	2	0
2	9	2	46	5	0	11	81	3	0
2	10	2	51	8	1	8	65	12	0
2	11	3	10	1	0	3	84	6	0
2	12	1	44	15	1	2	67	0	0

Block	Plot	Trt	Ziap	Ziau
1	3	2	0	3
1	4	1	1	1
1	6	3	0	1
1	7	3	0	3
1	8	1	1	0
1	9	2	1	1
1	10	2	0	2
1	11	3	4	1
1	12	1	0	2
2	1	3	5	2
2	4	2	1	0
2	5	1	1	0
2	7	1	1	1
2	8	3	1	1
2	9	2	3	3
2	10	2	4	1
2	11	3	2	2
2	12	1	0	3