Methodology of Transect Netting versus Use of Sugar Bait for Surveying Butterfly Assemblages in Tall Grass Prairie

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Abstract.- Butterfly netting was applied along one 80 meter transect each, though three separate restored prairies at Litzsinger Road Ecology center. Sampling was also performed at points along the transects set back by approximately 10 meters, through use of “sugar bait” stands. Comparisons of the stands and transects showed a marked difference in the diversity of butterfly assemblages collected. Put most simply, a single species found only feeding at the sugar bait stands was also the only species to make use of the stands. Results indicate the difference in collections to be statistically significant in number of individuals and very nearly so in number of species collected. It is thus recommended that though sugar bait stands are indicated to be significantly inefficient, other methods of collection not be ignored in favor of simple prairie netting. Despite the inefficiency of the stands, a wider variety of methods could easily produce a more accurate understanding of the sites true butterfly diversity. Essentially, relying on any single method of collection would also limit the number of species able to be easily collected.

Introduction

Among the various natural systems upon which human beings rely, Pollination of flowering plants ranks just below the cycling of carbon, nitrogen and oxygen. Without pollination by animals the vast majority of angio sperms as well as a few gymnosperms would not be able to reproduce sexually. Such species of plants include many of those used by humans for food and other products. In the United states alone, the value of services provided by animal pollinators are estimated to lie between 20 and 40 billion dollars per year. Excluding honeybees it remains as high as 6.7 billion per year (Keams 1998). Some species of plant even require a particular species of pollinator to effectively propagate. The Tumpet creeper(Campsis radicans) is one such example, as visitation by humming birds has been shown to increase deposition ten times that of honeybees (Bertin 1982). There remains however, little talk of pollinator conservation.

While guidelines have recently appeared for the management of native butterfly populations, the research accumulated in this field is still far behind others. This situation is exacerbated by the fact that more precise knowledge of how species make use of certain local sites is crucial to the development of greater long-term management (Royer 1998). In order to gain this knowledge it is therefore necessary to develop methods for assessing the species present at such sites, and, if possible, how said species make use of the site. Currently there are two old standbys in regular use, Checklist surveys and Pollard walk surveys (Royer 1998). Checklist surveys are notoriously unscientific in practice, used primarily to confirm the simple presence of different species and occasionally the number of individuals of each. Aside from the meteorology and raw numbers, few other

factors are accounted for. Spatially, the checklist survey is hap-hazard in that the surveyor samples wherever the butterflies can be found. Though it is highly adaptable,

allowing for inconveniences is timing, weather, changes in plant distribution, et cetera, it does so simply by collecting whatever is available whenever is convenient. Scientifically, this method is anything but a controlled lab setup. Pollard walk, by contrast, is essentially a standardized form of transect with uniform parameters. The drawback is that it does not follow the butterflies or even search them out, therefore species present in the area may never be counted, particularly if their particular movements keep them out of the transect. Many other forms of direct netting exist more or less resembling either pollard walk or checklist surveying rather closely. However other methods of collection such as screen traps, baiting, etc. exist and are used to a lesser extent. It is perhaps possible that these methods would display a much different representation of the butterflies present in a given area than would forms of direct netting. Litzsinger Road Ecology center (LREC) lies in between McKnight and Lindbergh Boulevard on Litzsinger Road in the City of Ladue, St. Louis county, Missouri. it is composed of a 34 acre ecology study area managed by the Missouri Botanical Garden. It encompasses a variety of habitats including bottomland forest, restored prairie, and an urban creek. The LREC was established as a research/education facility, and is closed to the public. The prairies of the site are used by a large number of species, including Brush-footed species, blues, sulfurs and whites, and skippers. A recent and detailed study of the exact species occupying the prairies remained absent, however, until the application of this study. Several major goals were established in the process of this lab, first and foremost was to provide proof of the hypothesis that sugar bait stands will allow for collection of a different assemblage of butterflies than ordinary transects. From this data recommendations can be made as to how to go about further sampling and assembling a proposed butterfly garden. Both the sampling and the garden have the unspoken objective of accurately portraying the community of butterflies at Litzsinger.

Materials and methods

For the purposes of this study one transect was made through each of three restored prairies at Litzsinger Rd Ecology center. Each prairie was approximately eighty meters long, the greatest length which could be made to fit in the smallest prairie with no edge effects confounding the study. Three sugar bait stands were placed along the transects on alternating sides (two near the ends on one side, one near the middle on the other side). Each of these stands was set back approximately ten meters from the transect and the total width of the area netted by transect was no greater than the length of the researchers arm and butterfly net together on either side (i.e. as far as one could reach from the "path"). Sugar bait stands were essentially of a one legged table design. The construction was composed of a plastic dish six inches in diameter glued to a "7.5"x "10" board which was attached by screws to a floor flange. This top was then screwed onto a metal pole pounded two feet into the ground with a remaining five feet standing up in the prairie. "Sugar bait" a recipe composed of two pounds brown sugar, two pounds of overripe peaches, two cups maple syrup, and 12 fluid ounces of beer was prepared through blending followed by one day of fermenting in the sun (Heitzman 1987). This concoction was then placed in the dish of the nine stands beginning two weeks before and concluding with the end of the study. This was done to habituate any butterflies to its presence which might make regular use of it. Individuals on the stand were either netted

on the stand in a “tipsy” state or found stuck in the bait itself. Collections along the transect were done purely by netting. All specimens were placed in a glad ware container until their species could be identified and the specimen(s) in the best physical condition mounted. Complication of recapture was avoided through this method. Collection from the stands occurred before and after transect netting taking under ten minutes total in each field. Transect netting took place over a forty-five minute period in each field. The clock was not stopped during netting as identification of unknown species took place later on and in most cases it took no longer than 10 seconds to get each specimen from the net to the container. Collection took place over three days; during this period the order in which the prairies were visited was rotated. Each day the total collection time took place from 10:00 am to 1:00 pm. Each prairie was completed within an hours time so that essentially the three days provide a uniform sampling period for each field. Weather conditions were recorded for each block, but in this case found to be curiously uniform for St. Louis.

Results

Within the three prairie transects a total of seventy-nine individuals were collected representing seventeen species. In the center bait stand of the South and Pasture prairies, one specimen each was collected of the Hackberry butterfly, Asterocampa celtis celtis. These specimens represent the only species to make use of the sugar bait within the time frame of the formal study, a species also completely unaccounted for in the transects. A breakdown of the total distribution of the butterfly population can be viewed in Figure 1, and divided by prairie in Figures 2 through 4. In each table, the hackberry butterfly is shown in red. Along with the eighteen species captured during the study, three other species were noticed outside of the formal time frame of the experiment. These specimens are listed separately at the bottom of Table 1; all of the species are listed along with their Latin name, number of specimens collected, and food source observed. A Ttest regarding differences in the assemblages between each form of collection showed that one collects significantly less individual specimens through the use of sugar bait (Table 2). The different forms of collection do not show a statistically significant difference in the number of species collected through each method but do indicate a trend with a P-value of .051878 (Table 3). ANOVA shows that there is no significant difference in the number of species one can collect in a given day among prairies (Table 5-1). Further T-tests serve to further confirm this (Tables *5-2* through 5-4). ANOVA analysis shows that there is only a trend in the number of individuals one can collect through each field (Table 4-1).

Further T-tests may indicate that the pasture prairie differs the most (Tables 4-2 through 4-4).

Table 1: Distribution of butterfly species in Combined Prairies

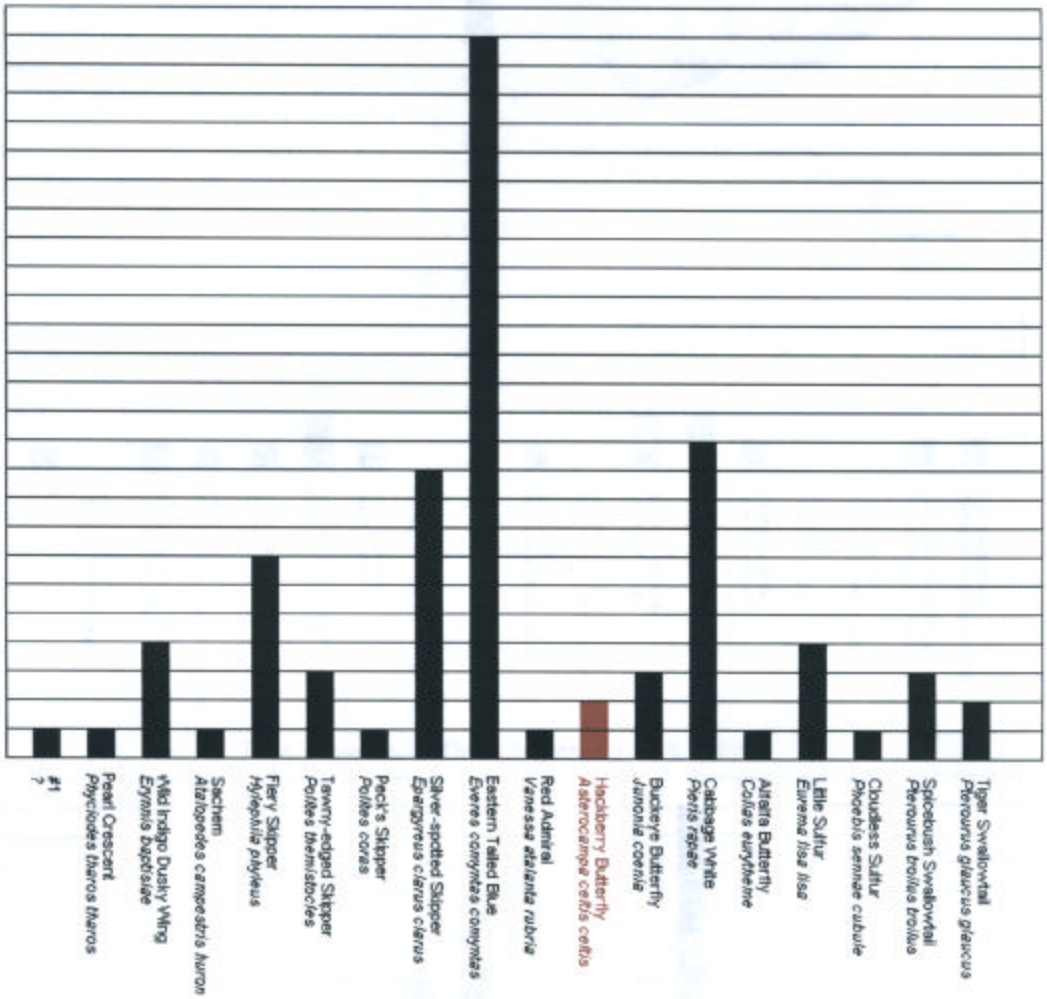


Table 2: Distribution of butterfly species in North Prairie

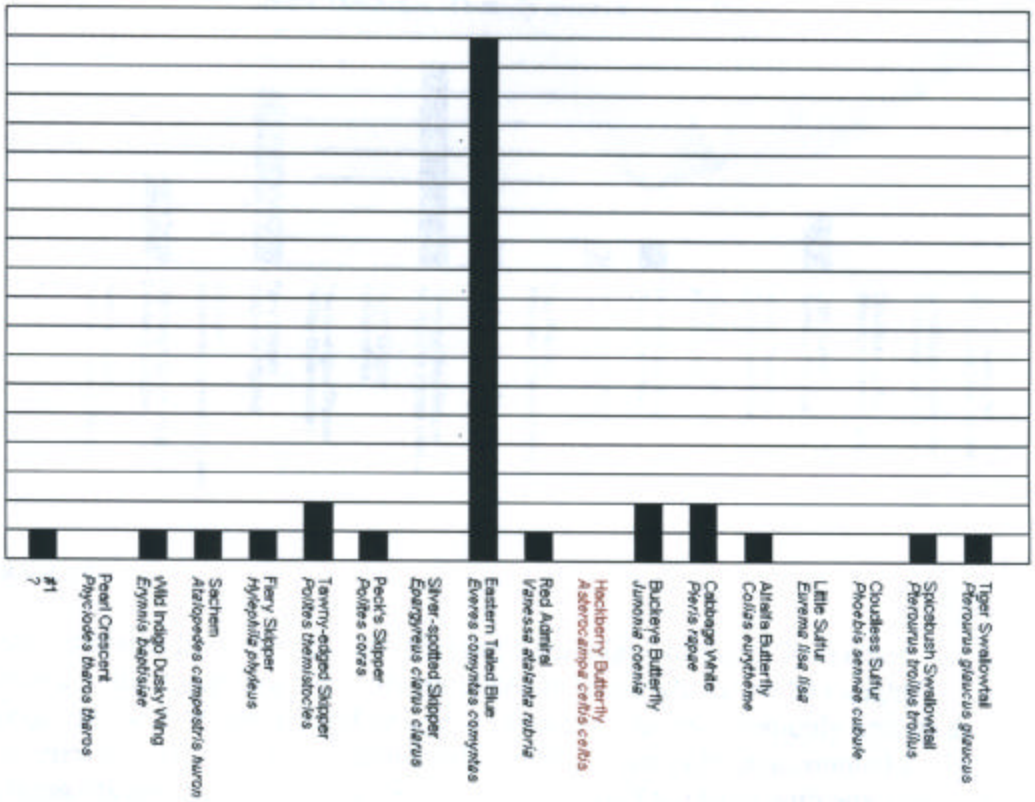


Table 3: Distribution of butterfly species in South Prairie

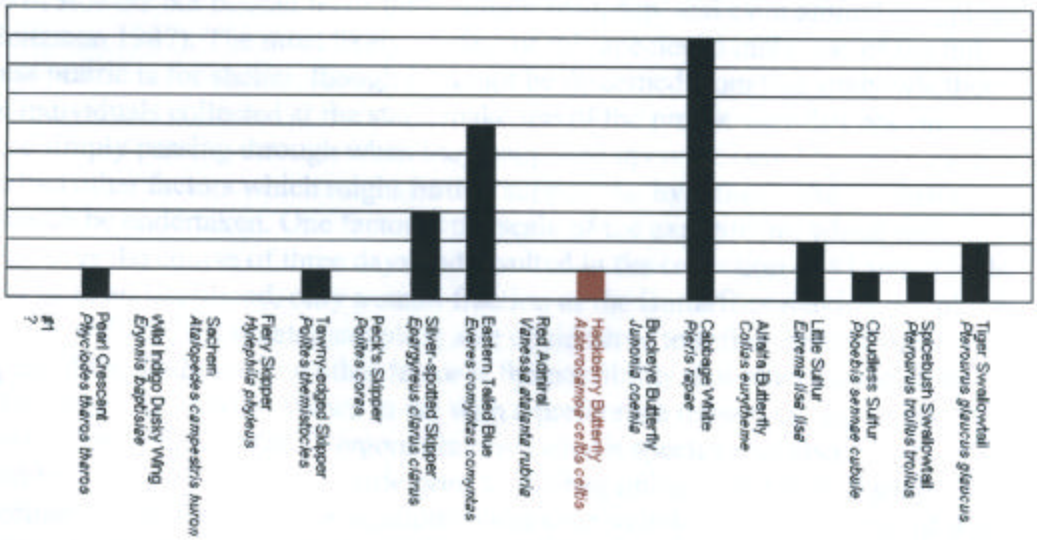
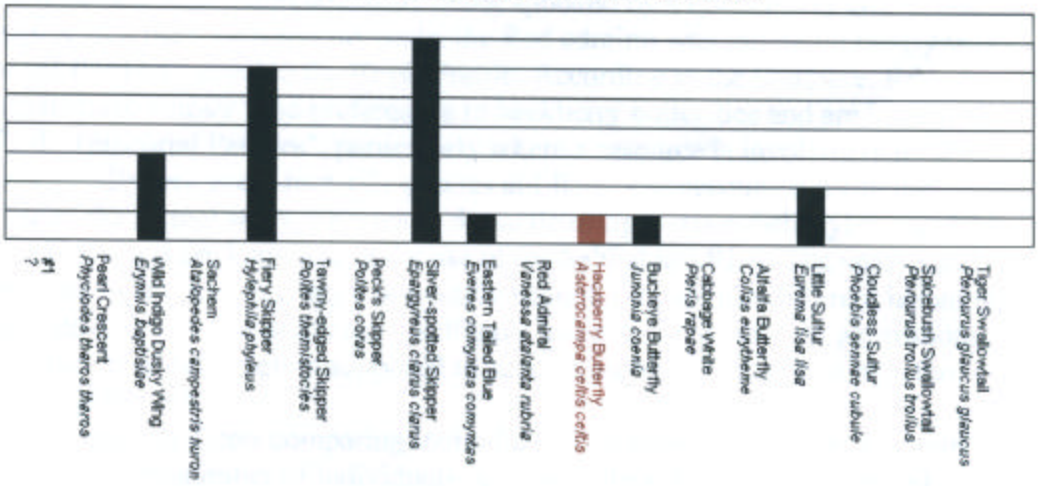


Table 4: Distribution of butterfly species in Pasture Prairie



Discussion

Clearly it seems from the raw data that the assemblage of butterfly species attracted to the sugar bait is strictly unrelated to those which can be caught through transects in the general prairie. The single species commonly known as hackberry butterfly or, Asterocampa celtis celtis, is not only unaccounted for in the transects but is also the only species found to visit the baits with any certainty. This species is referred to in most texts as a woodland species that rarely makes use of flowers but instead feeds upon rotting fruit, sap, and even animal droppings (Heitzman 1987). The most likely reason for this species to make use of the tall grass prairie is for shelter, though it cannot be discerned from this study whether the individuals collected at the stand make use of the prairie for other reasons or were simply passing through when they happened upon the bait. Currently there are two other factors which might further support the hypothesis should further research be undertaken. One factor is the scale of the experiment, which took place over the course of three days and resulted in the collection of 81 individuals. This is, in all likelihood, only a small fraction of the Butterflies making use of the prairies at LREC. A greater sampling size could serve to refine the statistical aspect of the findings. The other factor is the possibility that other species may, over a period of time be shown to act with a preference toward the sugar bait. A deceased specimen of the Polygonia Interrogationis species Was also found in the third bait stand of the north prairie prior to the beginning of the formal study. No specimens of Polygoma Interrogatioms were ever found using the interior of the prairie proper either through the transect collections or general observation. A single question mark (Polygonia Interrogationis), however, was captured on the fly after the course of the formal study in the firebreak. This would seem to lend credence to the possibility that members of polygonia, A genus noted for being attracted to rotting fruit and sap, might show the same preference to sugar bait as do hackberry butterflies. However, because neither specimen was found during the proper time frame, this possibility remains mere conjecture. Similarly, the single specimen of Red admiral, A territorial species, was caught under suspicious circumstances. After

simultaneously being spooked by a lawnmower and engaging in a fight with another male, the Red admiral was caught on the fly very near the third bait stand in the North Prairie. According to the literature, Red admirals have similar food preferences to hackberry butterflies and are known to defend “Territorial Perches”, particularly where a resource is involved (Knopf 1990). Finally, not every butterfly species at LREC was accounted for in the course of the formal study. Species as dramatic as Speyeria cybele cybele, and Danaus plexipus are known to make use of the habitat at LREC. The study itself took place over only three days, not nearly enough time to take different hatching times into account. The study may well have taken place in between generations. Lastly the sugar bait itself is supposed to accumulate more butterfly diners the longer it is left out.

The raw data and T-test comparing individuals both show that there is a serious difference in the number of individuals one can collect through each method. While the transects covered a very large area, the baits were little more than simple checkpoints. As is, only 2 out of 81 specimens came from the bait stands, and the T-test assigns a P-value of .0209 14 to this difference. The statistical T-test performed on the difference in number of species collected through each method shows that the odds of having such a difference through by chance are fairly low. The P-value of this test comparing species collected through each method is .051878 indicating a strong trend in the data. While this value is not low enough to statistically prove that there exists a significant difference in the number of species collected through each method, it would be prudent to remain suspicious of the possibility. Only one out of the eighteen species captured during the study was found lingering on the sugar bait. Furthermore, this second test does not actually prove or disprove the actual hypothesis of this study, but comments only on the likelihood of getting a difference in the number of species, not the assemblages themselves. According to this test there is not a statistically significant difference in number of species one can acquire through each method. Under this reasoning one should get roughly an equal number of species through each method, but whether the assemblages themselves will be different, one cannot say. ANOVA analysis shows no statistical difference in the number of species one can collect between prairies. However, this is not a true indication of the diversity or richness of each prairie as the pasture prairie often showed the same 3 species repeatedly while the collections in the North and South prairie varied more from day to day. The related T-tests indicate the same thing, though in reality the Pasture prairie consistently seemed to contain a lower number of species. ANOVA analysis of the number of individuals collected from each prairie showed a P-value of .055084 with the most significant difference being between the south and pasture prairies. Once again general observation seemed to indicate a lower degree of individuals in the Pasture prairie. None of these statistical tests were able to prove or disprove the hypothesis of this study, that sugar baits attract a different assemblage of species than do transects. They do however serve to asses the differences between the three prairies, indicate that sugar baits allow for the collection of a smaller variety of species, and point out the deficiency of sugar bait when it comes to collecting large numbers of specimens. For purposes of general collection, sugar bait stands are simply inefficient when it comes to collecting in large numbers. In this experiment the focus was on the sugar bait itself because of its significance to the ERC planned butterfly garden. An alternative for future study is the use of screen traps, which make use of sugar

bait, but take advantage of a butterfly's natural tendency to take off vertically. By placing a conical or cylindrical net above the bait, butterflies can be caught in larger numbers (Pyle 1984). This would yield a greater amount of data and perhaps serve to better refine estimates of the butterfly community at local sites such as Litzsinger. All findings indicate that while sugar bait can attract at least one unique species at LREC it is not a preferable substitute for real food plants when it comes to most species. Therefore sugar bait should be considered secondary to these plants when constructing a garden, but not to be overlooked when determining or attempting to showcase all of the species which make use of a given area.

Conclusions

The use of sugar bait does in fact create a difference in the assemblage of butterfly species collected through its use. For the purposes of gaining any accurate depiction of the butterfly species occupying a given habitat, it is generally advisable that sugar bait not be overlooked as it has been shown to attract a unique assemblage beyond that of general food plants. However, for the majority of these species it is no substitute for sources of true nectar. In addition these plants may provide shade, shelter, and sources of water. It is therefore recommended that sugar bait be used in tandem with the natural resources utilized by butterflies, in any venture which seeks to accurately portray the species richness and diversity found within the local habitat. In regards to researching the Butterfly community at LREC I believe it would be useful to adopt the Checklist survey method in tandem with screen traps serving to capture those species not easily captured through simple netting. For the purposes of a butterfly garden, sugar bait may well serve to attract otherwise uninterested species, and a bait stand or rotting fruit are often included in many such gardens already. For the purposes of continued scientific study, the usefulness of screen traps as well as any other fringe collection methods can not be overlooked or understated. To see the greatest number of species one should generally employ the greatest number of methods, be it for collecting or simple observation.

Works cited

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Table 4-1 ANOVA among prairies for individuals

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	33	11	7
Column 2	3	26	8.666667	1.33333333
Column 3	3	20	6.666667	0.33333333

ANOVA

ource of Variatic	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Group	28.22222	2	14.11111	4.88461538	0.055084	5.14324938
Within Groups	17.33333	6	2.888889			
Total	45.55556	8				

Table 4-2 T-test of prairies for individuals

t-Test: Two-Sample Assuming Unequal Variances

	Tran 1	*Tran 2*
Mean	11	8.666667
Variance	7	1.333333
Observations	3	3
Hypothesized M	0	
df	3	
t Stat	1.4	
P(T<=t) one-tail	0.128004	
t Critical one-tai	2.353363	
P(T<=t) two-tail	0.256007	
t Critical two-tail	3.182449	

no significant difference between 1 and 2

Table 4-3 T-test of prairies for individuals

t-Test: Two-Sample Assuming Unequal

	Tran 2	*Tran 3*
Mean	8.666667	6.66666667
Variance	1.333333	0.33333333
Observations	3	3
Hypothesize	0	
df	3	
t Stat	2.683282	
P(T<=t) one-	0.03742	
t Critical one	2.353363	
P(T<=t) two-	0.07484	
t Critical two-	3.182449	

Table 4-4 T-test of prairies for individuals

t-Test: Two-Sample Assuming Unequal Variances

	Tran 1	*Tran 3*
Mean	11	6.666667
Variance	7	0.333333
Observations	3	3
Hypothesized M	0	
df	2	
t Stat	2.771609	
P(T<=t) one-tail	0.054627	
t Critical one-tai	2.919987	
P(T<=t) two-tail	0.109255	
t Critical two-tail	4.302656	

individual anova

	Tran 1	Tran 2	Tran 3
1	8	8	7
2	13	10	6
3	12	8	7

Table 5-1 ANOVA among prairies for species

Anova: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average*	*Variance*
Column 1	3	17	5.666667	0.333333
Column 2	3	15	5	4
Column 3	3	12	4	4

ANOVA

rce of Varia	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between G	4.222222	2	2.111111	0.76	0.507926	5.143249
Within Gro	16.66667	6	2.777778			
Total	20.88889	8				

Table 5-2 T-test of prairies for species

t-Test: Two-Sample Assuming Unequal Variances

	Tran 1	*Tran 2*
Mean	5.666667	5
Variance	0.333333	4
Observatio	3	3
Hypothesiz	0	
df	2	
t Stat	0.5547	
P(T<=t) on	0.317426	
t Critical or	2.919987	
P(T<=t) tw	0.634852	
t Critical tw	4.302656	

no significant difference between 1 and 2

Table 5-3 T-test of prairies for species

t-Test: Two-Sample Assuming Unequal

	Tran 2	*Tran 3*
Mean	5	4
Variance	4	4
Observatio	3	3
Hypothesiz	0	
df	4	
t Stat	0.612372	
P(T<=t) on	0.286696	
t Critical or	2.131846	
P(T<=t) tw	0.573392	
t Critical tw	2.776451	

no significant difference between 2 and 3

Table 5-4 T-test of prairies for species

t-Test: Two-Sample Assuming Unequal Variances

	Tran 1	*Tran 3*
Mean	5.666667	4
Variance	0.333333	4
Observatio	3	3
Hypothesiz	0	
df	2	
t Stat	1.38675	
P(T<=t) on	0.14993	
t Critical or	2.919987	
P(T<=t) tw	0.29986	
t Critical tw	4.302656	

no significant difference between 1 and 3

species anova

	Tran 1	Tran 2	Tran 3
1	6	7	2
2	6	5	6
3	5	3	4

Table 2 Difference Between methodology for individuals
t-Test: Two-Sample Assuming Unequal Variances

	Transect	*bait*
Mean	26.33333	0.666667
Variance	42.33333	0.333333
Observatio	3	3
Hypothesiz	0	
df	2	
t Stat	6.805903	
P(T<=t) on	0.010457	
t Critical or	2.919987	
P(T<=t) tw	0.020914	
t Critical tw	4.302656	

	individuals	
	Transect	bait
Field 1	33	0
Field 2	26	1
Field 3	20	1

Table 3 Difference Between methodology for species
t-Test: Two-Sample Assuming Unequal Variances

	Transect	*bait*
Mean	9.333333	0.666667
Variance	12.33333	0.333333
Observatio	3	3
Hypothesiz	0	
df	2	
t Stat	4.217757	
P(T<=t) on	0.025939	
t Critical or	2.919987	
P(T<=t) tw	0.051878	
t Critical tw	4.302656	

	species	
	Transect	bait
Field 1	13	0
Field 2	9	1
Field 3	6	1

Table 1 Summary of raw data for all prairies and out of study sightings

Butterfly	latin name	seen feeding	number counted
Tiger swallowtail	*Pterourus glaucus glaucus*	Joe Pye weed,Bergamot	3
Spicebush swallowtail	*Pterourus troilus troilus*	Bergamot	2
Cloudless sulfur	*Phoebis sennae cubule*	?	1
Little sulfur	*Eurema lisa lisa*	Sweet coneflower	4
Alfalfa butterfly	*Colias eurytheme*	?	1
Cabbage White	*Pieris rapae*	Showy tick trefoil	11
Buckeye butterfly	*Junonia coenia*	Hairy mountain mint	3
Hackberry butterfly	*Asterocampa celtis celtis*	bait	2
Red admiral	*Vanessa atalanta rubria*	?, possibly bait?	1
Eastern tailed blue	*Everes comyntas comyntas*	?	25
Silver spotted skipper	*Epargyreus clarus clarus*	Bergamot, Showy tick trefoil	10
Peck's skipper	*Polites coras*	?	1
Tawny-edged skipper	*Polites themistocles*	Hairy mountain mint	3
Fiery skipper	*Hylephila phyleus* (Drury)	Sweet coneflower, Both mountain mints	7
sachem	*Atalopedes campestris huron*	?	1
Wild Indigo dusky wing	*Erynnis baptisiae* (Forbes)	Bergamot,Showy tick trefoil,Sweet coneflower	4
Pearl crescent	*Phyciodes tharos tharos*	Showy tick trefoil	1
# 1	?	Hairy mountain mint	1

Painted lady?	*Vanessa cardui/virginiensis*	Purple Coneflower	1
Question Mark	*Polygonia interrogationis*	bait	2
Great spangled fritillary	*Speyeria cybele cybele*	Purple Coneflower	1

Table 1 Distribution of butterfly species in Combined Prairies