Technical Report No. 193

HERBAGE DYNAMICS STUDIES AT THE PANTEX SITE, 1971

Richard E. Fagan and Russ D. Pettit

Department of Range and Wildlife Management

Texas Tech University

Lubbock, Texas

GRASSLAND BIOME

U.S. International Biological Program

December 1972

TABLE OF CONTENTS

ABSTRACT

Throughout the 1971 sampling season power shears were used to harvest vegetation at the Pantex Site. A stratified sampling procedure (blue grama and prickly pear strata) was used to increase precision and accuracy. At each sampling date 24 plots were clipped in both the ungrazed and grazed treatment.

On all sampling dates the prickly pear stratum had more standing crop than did the blue grama plots. Maximum standing crop in the pear stratum was 1099 g/m^2 on August 2, while least biomass in the grass stratum was 103 g/m^2 and 349 g/m^2 which corresponded to the May 14 and August 23 dates, respectively. On most sampling dates the grazed treatment had more standing crop in both strata.

Litter accumulations were greatest in both strata on May 14. Over 1100 g/m^2 of litter were harvested from prickly pear plots at this date, while 653 g/m^2 were found in the grass stratum. These values had decreased to 134 g/m^2 and 92 g/m^2 for the prickly pear and grass strata on September 28. Reasons for this great reduction are unclear.

Very little difference was found in crown biomass when comparing strata. Least crown biomass (112 g/m^2) was harvested in the grass stratum May 14. On this date prickly pear had 163 g/m^2 of crown material. On June 21 maximum crown weights were found, 400 and 397 g/m^2 in the grass and prickly pear strata, respectively.

Root biomass to a depth of 30 cm wa s determined at four sampling dates. Most biomass was found in the blue grama stratum on May 16 when 989 g/m^2 were present. At this date 654 g/m^2 were harvested in the prickly pear

stratum. After the first sampling date little variation was found in root biomass between treatments and strata.

We feel that refined techniques need to be used to obtain better root biomass data. In addition, the use of power shears harvests litter that has fallen into the tufts of grass. This erroneously places some of the litter component into the aboveground standing crop.

INTRODUCTION

The Pantex Site of the U.S. IBP Grassland Biome project is located on the Texas Tech University Center at Amarillo, Texas. This site is approximately 15 miles northeast of Amarillo on U.S. Highway 60. Technical Report No. 45 (Huddleston, 1970) gives a detailed summary of the facilities and environmental parameters.

The ungrazed site (treatment 1) is located within a 35-acre pasture owned by the Atomic Energy Commission. This particular pasture has been used occasionally by a few bulls from 1940 to 1966. The area has not been abused by large herbivores since 1940. The grazed site (treatment 3) is located 4 miles southeast of the ungrazed area. This treatment consists of a 40-acre pasture which has a moderate-grazing history.

Blue grama (*Bouteloua gracilis*) is the climax dominant on both areas. Subordinate grass species, each making up less than 5% of the biomass, include buffalo grass (*Buchloe dactyloides*), purple three-awn (*Aristida purpurea*), and sand dropseed (*Sporobolus cryptandrus*). The most abundant native perennial forb is scarlet globe mallow (*Spaeralcea coccinea*). Seasonal aspects of little barley (*Hordeum pusillum*), pigweeds (*Amaranthus* spp.), and kochia (*Kochia scoparia*) occur if late summer precipitation is above average. Appendix I lists the forage species found on both treatments in late July of 1971.

In 1970 a severe drought plagued the Texas high plains as less than 4 inches of precipitation were received. This reduced the vigor of, and killed some of, the forages on the site. The first 5 months of 1971 were also characterized by drought conditions; thus, little forage was produced. However, rains in late July and August promoted an unusually high blue grama production. Fig. 1 shows the bimonthly precipitation received at Pantex through October of 1971.

Keeping in mind the overall objectives of the Grassland Biome, our specific objectives for 1971 were:

1. to obtain aboveground and belowground biomass estimates of herbage production on a grazed and ungrazed site,
2. to document changes in the herbage components, and
3. to evaluate the differences in productivity of prickly pear colonies and pure blue grama stands.

METHODS AND PROCEDURES

After reviewing our 1970 data we found that our estimates of blue grama productivity at the Pantex Site were very poor. The objective sampling technique did not allow us to sample with enough accuracy and precision. Thus, our alternatives to correct this were (i) clip more plots in 1971, (ii) clip larger plots, (iii) stratify the area into a prickly pear and blue grama stratum, and (iv) use power shears. The most logical procedures, based on our personnel and resources, were to use power shears to eliminate hand clipper variability and to stratify the area into prickly pear and blue grama plots. Fig. 2 shows the typical strata variation in aboveground biomass. A randomized sampling technique could then be used within the strata.

The line-intercept technique was used to determine foliage cover of prickly pear in both treatments. Pear cover was found to be 11.5% in treatment 3 and approximately 3% in treatment 1.

Six 0.5-m^2 circular plots were sampled in each of two replicates per strata. This gave a total of 24 clipped plots per treatment. Samples were

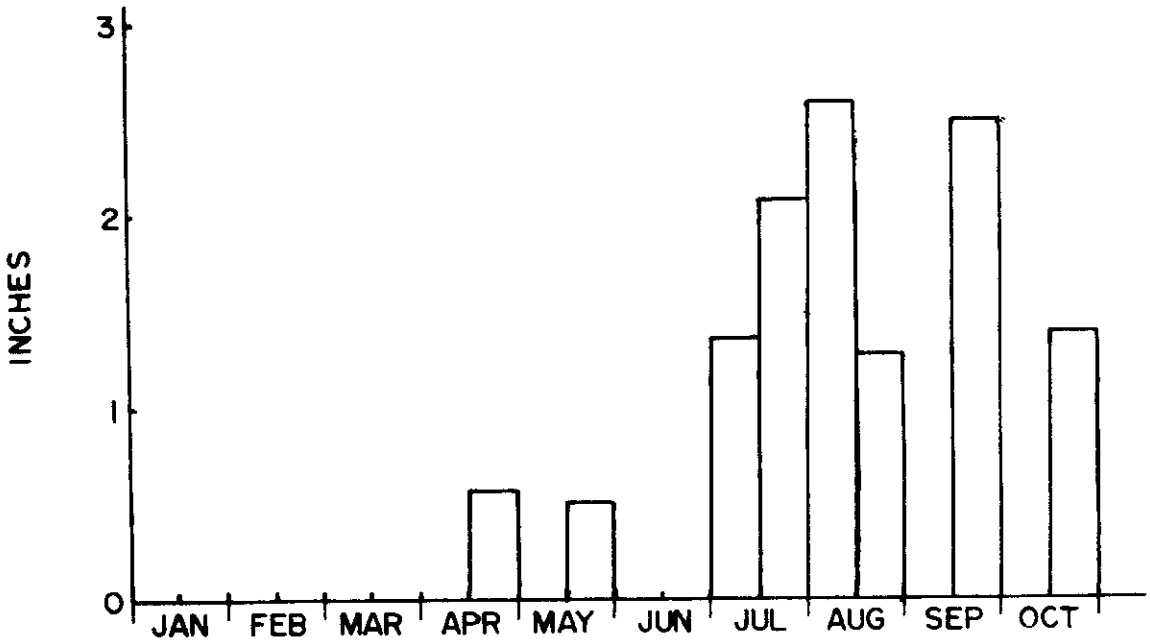

Fig. 1. Pantex precipitation for 1971. These values are averages of two gages near the site.

Fig. 2. Typical strata variability showing prickly pear on the right and blue grama on the left.

taken at 3-week intervals during the growing season and are currently being taken at 4- to 6-week intervals.

Aboveground herbage was clipped at the soil surface with Sunbeam Shearmaster shears. The D-vac was used to "suck" all aboveground materials from the clipper head. This prevented wind losses and did not allow aboveground material to become mixed with surface litter.

After removing the aboveground component, the D-vac was used to remove all litter (Fig. 3). This operation left the crowns of all plants exposed for clipping. The crowns were then removed in a second clipping (Fig. 4)., leaving a plot devoid of any aboveground vegetation (Fig. 5).

All aboveground material was placed on Berlese funnels for insect separations. After being on the funnels for 24 hours, samples were removed and placed in the oven to complete drying. Grass and most forbs required 24 hours of drying time, while prickly pear required 5 days. Since so much soil was present in these samples, they were thoroughly washed and then dried again.

Belowground biomass samples were taken with a "Bull" hydraulically-operated soil corer. A 7.62-cm soil tube placed over the denuded plots was inserted to a 30-cm depth. The undisturbed core was then cut into 10-cm segments. Each segment was placed in a 32-mesh nylon bag. A medium-pressure water stream was then directed on the samples to remove all soil. The remaining roots were oven-dried at 70°C for 24 hours, then weighed to the nearest .01 g.

After dry weights were recorded for all components (roots, litter, crowns, and aboveground), a composite from each replication and stratum was made.

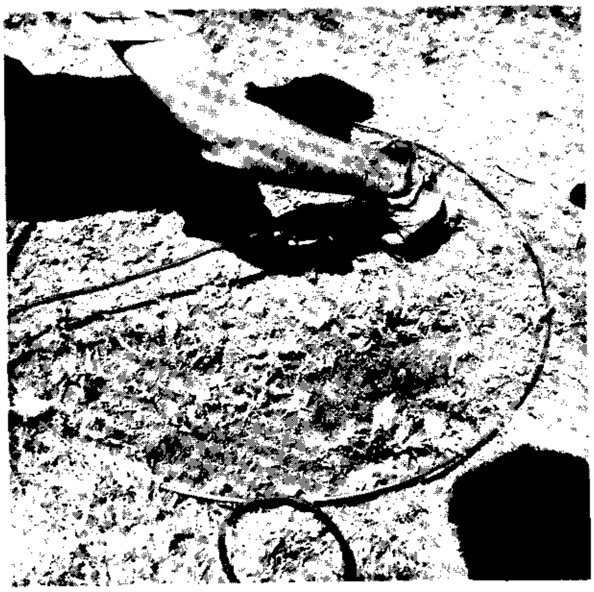

Fig. 3. Litter being removed from plot with a D-Vac. Note how all crowns are exposed for clipping.

Fig. 4. Removal of crowns from plots.

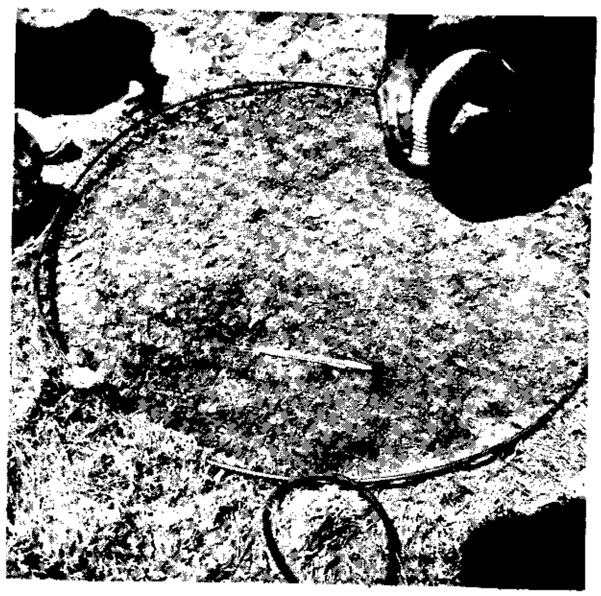

Fig. 5. A completely denuded blue grama plot.

The composite was ground through a Wiley Mill in order to get a homogenous subsample for ashing. All samples were then ashed to get appropriate correction factors.

RESULTS AND DISCUSSION

Results of this year's sampling are not comparable to the 1970 data. The efficiency and accuracy resulting from our revised sampling scheme has caused this.

Aboveground Standing Crop

On all sampling dates the prickly pear stratum had more standing crop than did the blue grama stratum (Fig. 6). As a result of the precipitation in late July and August, peak standing crop occurred abnormally late in the growing season. After moisture was received, an almost instantaneous vegetation response occurred.

Maximum standing crop (1100 g/m^2) was found in the prickly pear stratum on August 2. The peak in blue grama (350 g/m^2), however, lagged until August 23. Within the blue grama, treatment 3 had more standing crop than treatment 1 except on the August 2 sample. Our data reveal that this one exception was due to an unusually high weed production in the ungrazed treatment on this date. It is of considerable interest that until August 23 more blue grama biomass was found in the prickly pear stratum than in the blue grama plots. After this date blue grama had similar standing crop in both strata. Perhaps the reason for more blue grama in the prickly pear stratum than blue grama stratum is that these grass plants were of greater vigor. In addition, the prickly pear possibly provided a modified microclimate

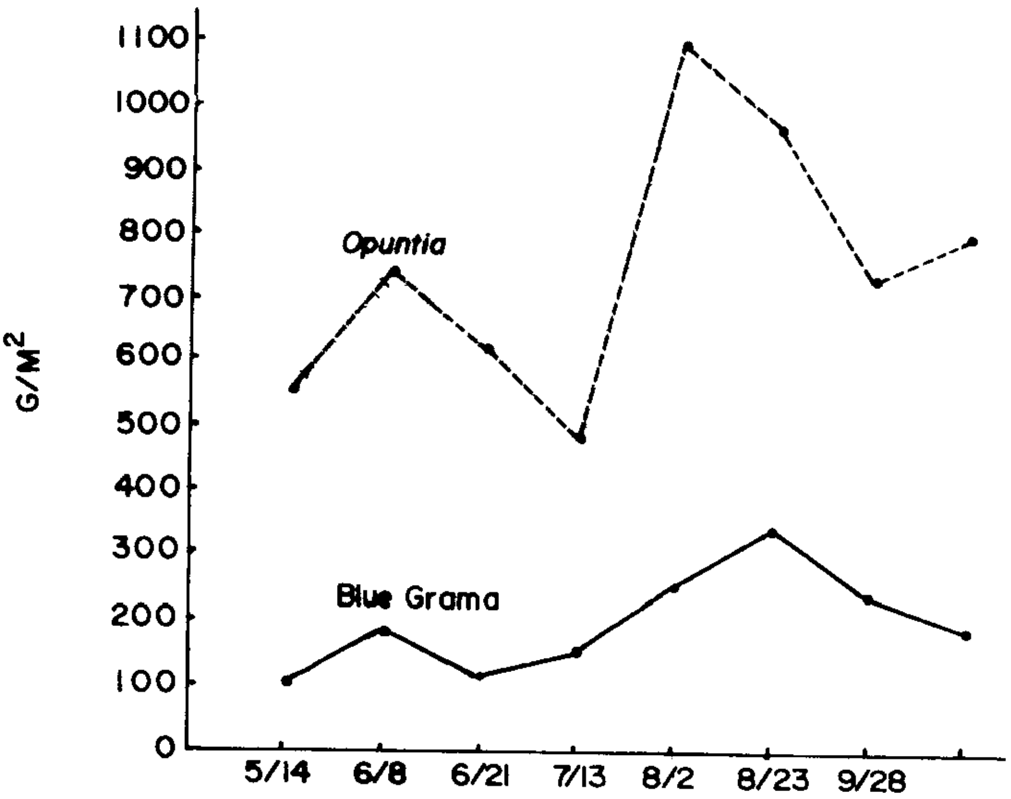

Fig. 6. Standing crop excluding crowns for both strata.

which protected the blue grama from full effects of the drought. It was very noticeable that, after the first showers were received this summer, those blue grama plants associated with the prickly pear began rapid growth before the plants away from the prickly pear.

Litter

The prickly pear litter component exceeded the blue grama litter crop at all sampling dates (Fig. 7). Maximum litter in both strata was found on May 14 and then steadily decreased until June 21. At this time there was a gradual increase in litter until a second maximum was reached on August 2.

Maximum litter crop in the prickly pear was 1101 g/m^2 while the maximum in the grama grass was 653 g/m^2. Litter decomposition progressed very rapidly in both strata after August 2. This probably resulted from a rapid microbial buildup because of moist, warm soil surface conditions.

Fig. 8 shows treatment differences of litter in the prickly pear stratum. The July 13 data show considerable variation from one treatment to the other. Surprisingly, however, the standard error of the mean on treatment 3 at this date was 45.63, while it was 70.75 for treatment 1. Thus, this difference was not due to sampling error.

Considerable variability in the litter crop of the blue grama stratum was found (Fig. 8). On all dates but June 8 most litter was found in treatment 1. The upper confidence limit for treatment 1 at this date was 418 g/m^2, while the lower confidence limit for treatment 3 was 542 g/m^2. Since these values do not overlap, we can assume that this difference did exist. No plausible explanation can be given for this early June difference. Again, blue grama litter decomposed rapidly after August 2.

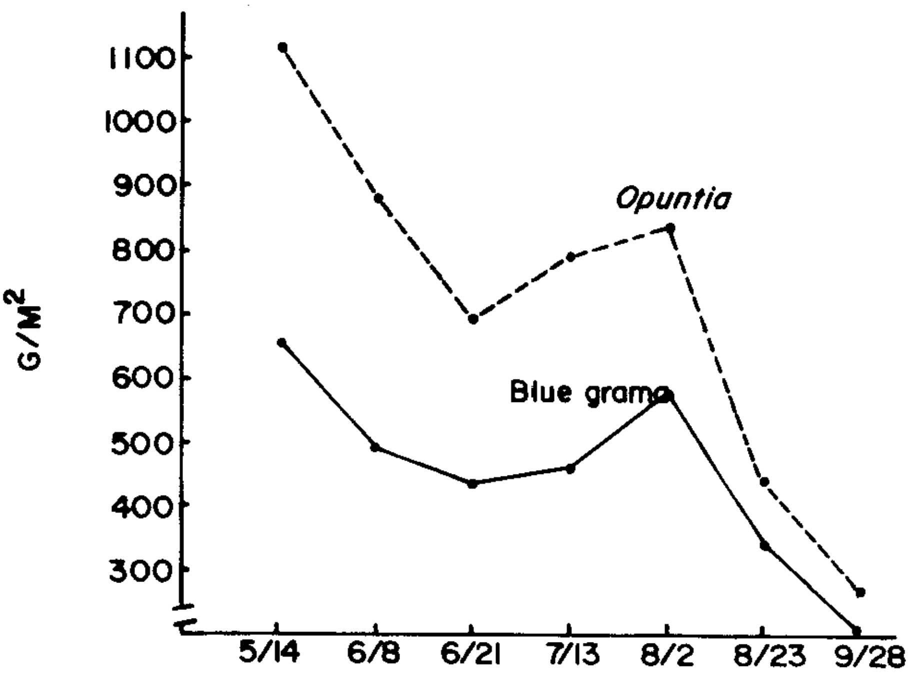

Fig. 7. Average litter biomass on *Opuntia* and blue grama strata.

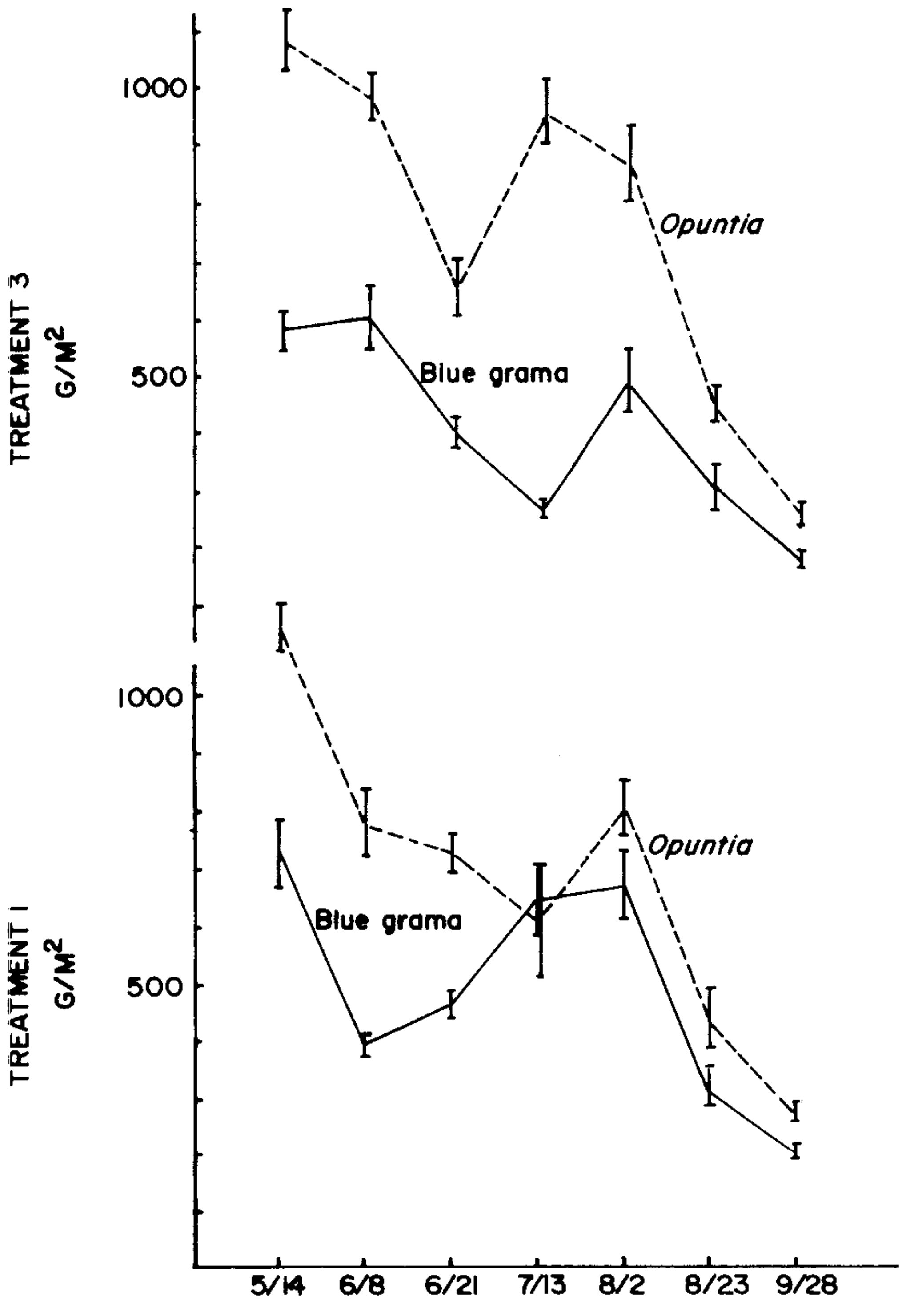

Fig. 8. Litter biomass for *Opuntia* and blue grama by treatment.

All data presented for the litter component are unashed weights. After ashing, however, we found from 25-40% of the total material to be ash. We have not found a satisfactory technique to separate plant ash from that contributed by soil materials in our sample.

Crowns

Crown weights in both strata as well as between treatments are shown in Fig. 9, 10, and 11. A consistent pattern of crown biomass was noted. In all cases least crown weights occurred at the May 14 sampling period when 100 to 200 g/m^2 of crowns were present. A gradual increase in crown weights was observed until June 21. After this date there was a slight reduction of crown weight until August 2. As the grasses became very vigorous, crown weights again increased for a short time. Data from September 28 again showed crown biomass to decrease.

In reference to Fig. 1 we note that approximately 1 inch of precipitation was received prior to May 31. By referring to Fig. 6 we can see that the precipitation was sufficient to slightly increase aboveground production. There, then, was a notable decline in standing crop. Now referring to Fig. 9 we can see that crown weights continue to increase for 3 more weeks before declining. Similarly, we see these same "lag" effects in August. It appears in all cases, nevertheless, that the first response to precipitation is to produce a flush of aboveground materials including crowns. However, when precipitation ceases, crown weights continue to increase for 3 more weeks. Further investigation of these results need to be done before concrete statements can be made.

All data in the preceding three figures are unashed weights. Again, we took subsamples of washed and dried crown material and found very near 50% ash on all sampling dates.

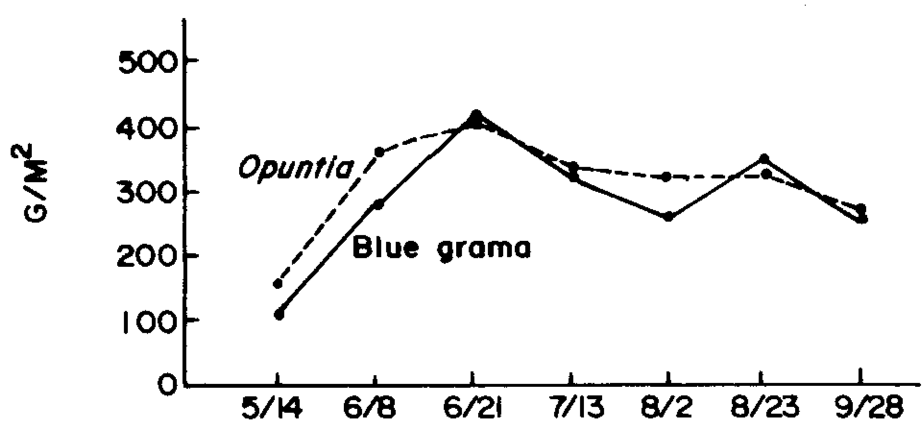

Fig. 9. Average crown weights (unashed) for *Opuntia* and blue grama strata.

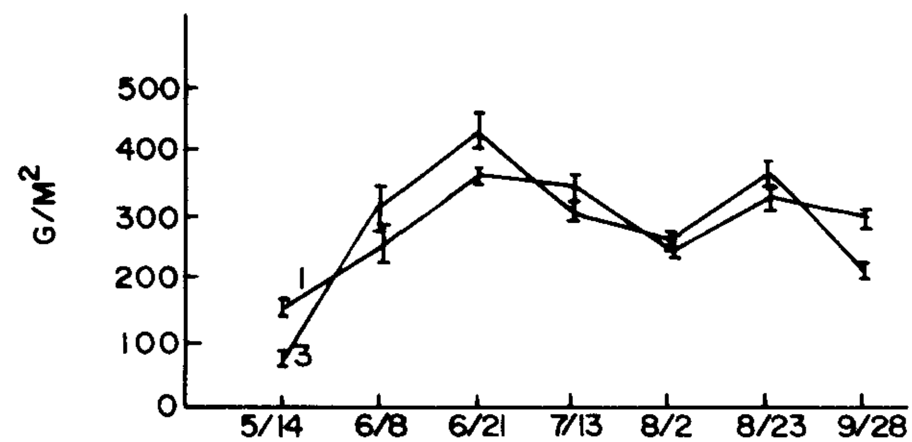

Fig. 10. Crown biomass (unashed) for blue grama stratum showing treatment differences.

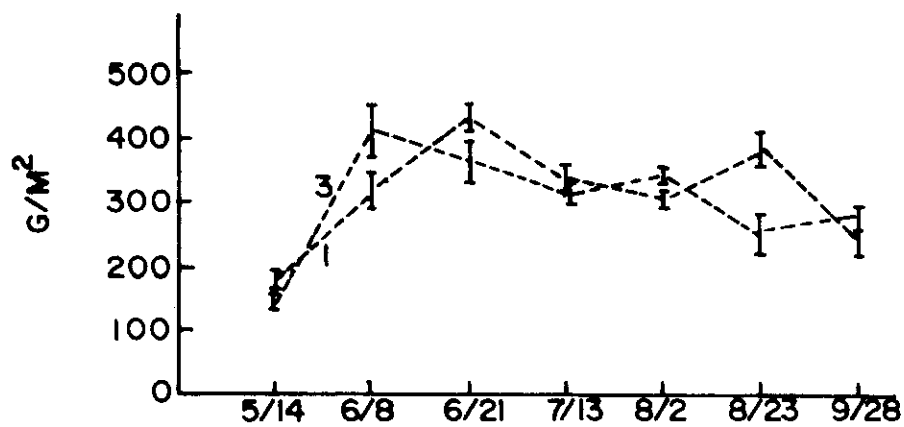

Fig. 11. Crown biomass (unashed) for *Opuntia* stratum showing treatment differences.

Roots

The root biomass, to a depth of 30 cm, was sampled four times in 1971 (Fig. 12). Except for a very high root biomass of 1169 g/m^2 in the grazed blue grama on May 16, very little difference was found the remainder of the year. It is very doubtful if any statistically significant difference exists between grazing treatments or between strata.

With the increase in vigor of aboveground biomass, we should expect root biomass to show subsequent increases in 1972. In the 30-month interval from October 6 to November 6 we can see a slight increase in root biomass in all samples. It will be particularly interesting to see if the differences between root biomass in both blue grama treatments will converge as in the prickly pear stratum.

Relationship of Aboveground Blue Grama Components

Litter biomass exceeded aboveground and crown weights until August 23 in the blue grama stratum (Fig. 13). After sufficient moisture was received to promote plant growth, the litter component in relation to crowns and aboveground material probably only reflects drought. As moisture is received the litter decomposes rapidly, and the other plant fractions gain in importance.

We feel that there are some subtle interactions occurring between the soil water, temperature, and vegetation. Providing our abiotic recording devices work next year, we hope to "tie down" some of these relationships.

Suggestions for Improvement in 1972

Although our biomass data for 1971 is more accurate and precise than in 1970, some problems still exist. Foremost among these is the root biomass

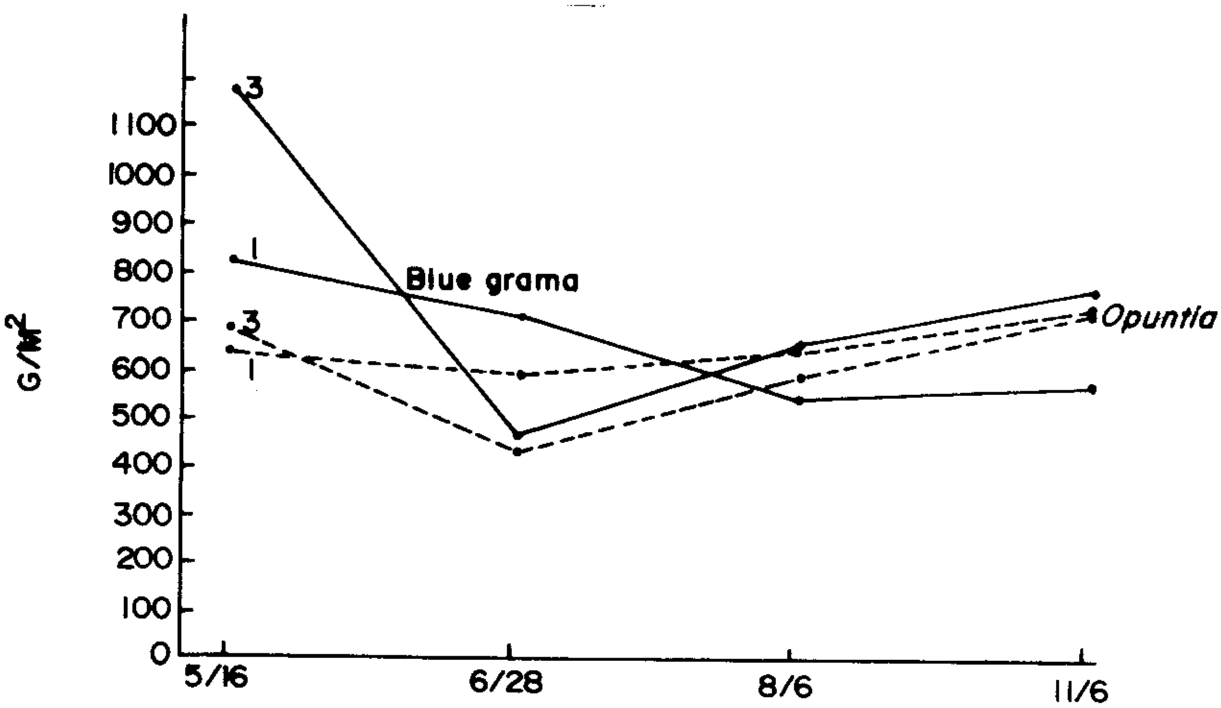

Fig. 12. Root biomass in top 30 cm of soil on Pantex Site for 1971. Blue grama and *Opuntia* strata are represented.

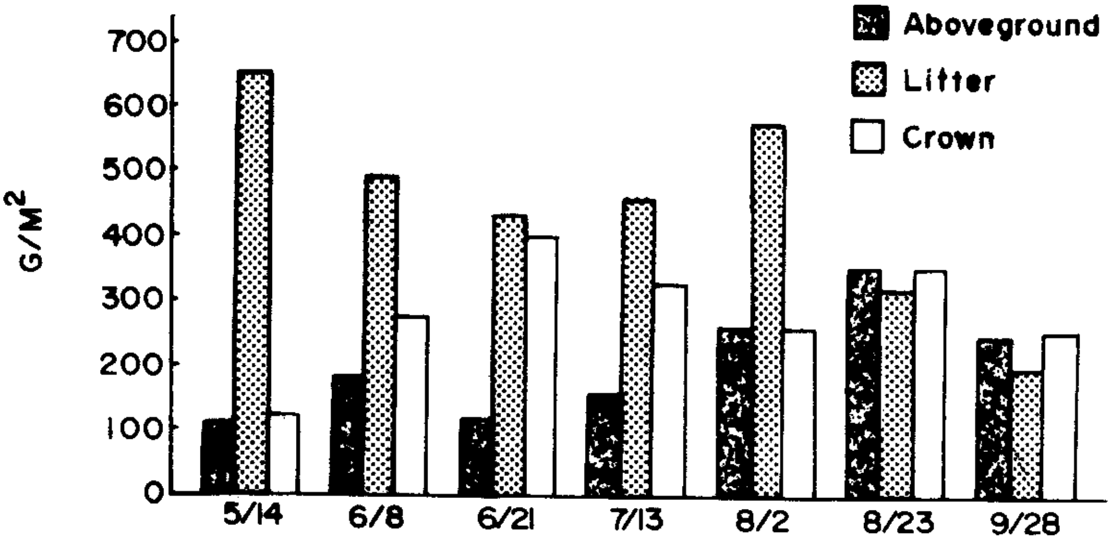

Fig. 13. Blue grama stratum showing relationship of aboveground, litter, and crown material.

sampling procedure. We feel that the 3-inch core is not adequate for this study. Apparently there exists tremendous variability in root biomass in the first 10 cm of soil. We know that more roots are present immediately below crown areas than there are between plants.

Another error in our data is the result of the aboveground harvest procedure. Litter material that is still in the grass tuft is being clipped and placed in the aboveground standing dead. If we modified the procedure and cleared the plot of litter first using the D-vac, substantial standing dead and green matter would be erroneously placed in the litter fraction. Perhaps we need an estimation technique to determine how much litter is actually included in the aboveground portion.

LITERATURE CITED

Huddleston, E. W. 1970. Comprehensive Network Site description, PANTEX. U.S. IBP Grassland Biome Tech. Rep. No. 45. Colorado State Univ., Fort Collins. 12 p.

APPENDIX I

APPENDIX TABLES

Appendix Table 1. List of plant species found on the Pantex Site determined in late July 1971.

Species	Treatment 1	Treatment 3
Bouteloua gracilis	X	X
Buchloe dactyloides	X	X
Hordeum pusillum	X	X
Aristida purpurea	X	X
Panicum capillare	X	X
Sporobolus cryptandrus	X	X
Eragrostis sp.	X	X
Shpaeralcea coccinea	X	X
Amaranthus retroflexus	X	
Lepidium densiflorum		X
Opuntia polyacantha	X	X
Chenopodium leptophyllum	X	X
Salsola kali	X	X
Euphorbia lata		X
Conyza canadensis		X
Vernonia sp.		X
Thelesperma sp.		X
Chenopodium album	X	X
Cirsium undulatum	X	X
Mirabilis linearis	X	X
Kochia scoparia	X	X
Solanum rostratum	X	X
Solanum elaeagnifolium		X
Asclepias latifolia	X	
Convolvulus sp.	X	
Psoralea tenuiflora		X
Mammalaria sp.		X
Gaura coccinea	X	
Portulaca sp.	X	X
Amaranthus sp.	X	

Appendix Table 2. The mean aboveground standing crop (less crowns) on the two strata and treatments at Pantex, 1971. Biomass in g/m^2.

Sampling Date	Blue Grama				Prickly-Pear Cactus				
	Other[a/]	Live[b/]	Old Dead[b/]	New Dead[b/]	Other[a/]	BOGR[c/]	Live	Old Dead	New Dead
Treatment 1									
05-14-71	3.42	0.02	59.92	--	2.16	164.80	44.74	276.32	--
06-08-71	9.58	0.28	160.24	--	3.62	216.26	77.50	187.88	--
06-21-71	5.14	1.68	100.26	--	4.30	135.74	79.06	260.41	--
07-13-71	6.10	11.08	120.66	--	2.28	149.56	117.86	105.58	--
08-02-71	57.12	61.06	171.74	--	20.26	237.48	359.18	240.16	--
08-23-71	23.20	148.36	81.50	61.12	85.06	306.78	93.08	246.26	--
09-28-71	26.92	47.58	11.80	166.38	77.36	167.72	58.92	150.06	--
11-06-71	15.48	17.26	--	153.64	51.88	198.06	392.76	213.80	--
Treatment 3									
05-14-71	2.36	0.38	140.68	--	3.22	162.70	370.02	91.02	--
06-08-71	4.64	4.40	191.08	--	2.52	412.88	482.94	101.64	--
06-21-71	3.99	34.60	78.41	--	1.92	149.28	490.36	126.90	--
07-13-71	6.08	58.84	99.96	--	5.60	187.96	683.26	66.42	--
08-02-71	18.00	100.06	112.78	--	21.76	219.12	1078.02	23.58	--
08-23-71	55.24	168.28	92.40	69.30	56.06	310.14	727.38	73.24	--
09-28-71	30.04	43.74	10.78	160.22	40.64	183.94	720.02	61.64	--
11-06-71	15.14	19.56	--	175.94	24.24	167.90	512.68	25.28	--

a/ Includes all species except blue grama and prickly pear.

b/ Pertains only to blue grama.

c/ All blue grama, irrespective of category.

Appendix Table 3. The mean belowground biomass and the upper and lower confidence limit at Pantex, 1971. Biomass in g/m^2.

Sampling Date	Blue Grama			Prickly Pear		
	High	Mean	Low	High	Mean	Low
			Treatment 1			
05-16-71	941.01	809.42	679.99	761.41	630.28	500.12
06-28-71	866.43	702.99	541.79	723.86	593.49	465.02
08-06-71	618.57	538.08	458.41	721.66	628.31	537.41
11-06-71	633.92	557.15	480.38	815.98	710.69	605.41
			Treatment 2			
05-16-71	1469.65	1169.46	873.44	813.79	678.90	546.18
06-28-71	526.44	457.71	390.44	570.31	422.67	278.14
08-06-71	745.79	634.22	526.44	607.60	579.91	552.76
11-06-71	993.66	756.76	519.86	791.85	708.50	625.15

APPENDIX II

FIELD DATA

Aboveground Biomass Data

The aboveground biomass data from the Pantex Site for 1971 is Grassland Biome data type number A2U00CA. The data are reported on form NREL-01. A sample data form and a listing of these data from one sampling date follow. The data from the blue grama-dominated stratum is always given first, followed by the data from the cactus-dominated stratum for that date.

IBP

GRASSLAND BIOME

U.S. INTERNATIONAL BIOLOGICAL PROGRAM

FIELD DATA SHEET - ABOVEGROUND BIOMASS

DATA TYPE	SITE	INITIALS	DATE DAY	DATE MO.	DATE YR.	TREATMENT	REPLICATE	PLOT SIZE	QUADRAT	CLIP-EST.	GROWTH FM.	GENUS	SPECIES	SUBSPECIES	CATEGORY	WEIGHT ESTIMATE	SACK NO.	DRY WEIGHT	CROWN PLOT SIZE	CROWN WEIGHT
1-2	3-4	5-7	8-9	10-11	12-13	14	15	16-19	21-23	25	27	29-30	31-32	34	35	36-40	42-45	47-52	54-57	59-64
01																				

DATA TYPE
- 01 Aboveground Biomass
- 02 Litter
- 03 Belowground Biomass
- 10 Vertebrate - Live Trapping
- 11 Vertebrate - Snap Trapping
- 12 Vertebrate - Collection
- 20 Avian Flush Census
- 21 Avian Road Count
- 22 Avian Road Count Summary
- 23 Avian Collection - Internal
- 24 Avian Collection - External
- 25 Avian Collection - Plumage
- 30 Invertebrate
- 40 Microbiology - Decomposition
- 41 Microbiology - Nitrogen
- 42 Microbiology - Biomass
- 43 Microbiology - Root Decomposition
- 44 Microbiology - Respiration

ITE
- 1 Ale
- 02 Bison
- 03 Bridger
- 04 Cottonwood
- 05 Dickinson
- 06 Hays
- 07 Hopland
- 08 Jornada
- 09 Osage
- 10 Pantex
- 11 Pawnee

TREATMENT
- 1 Ungrazed
- 2 Lightly grazed
- 3 Moderately grazed
- 4 Heavily grazed
- 5 Grazed 1969, ungrazed 1970
- 6 Grazed 1970, ungrazed 1971
- 7
- 8
- 9

CATEGORY
- 1 Live
- 2 Old dead
- 3 Recent dead

CLIP-ESTIMATE
- 1 Harvested
- 2 Harvest and Est.
- 3 Estimated
- 4 Est. for Insect
- 5 Est. for Reference
- 6 Est. for Future Clip

GROWTH FORM
- 1 Perennial grass
- 2 Annual grass
- 3 Sedge, rush, etc.
- 4 Annual forb
- 5 Biennial forb
- 6 Perennial forb
- 7 Half-shrub
- 8 Shrub
- 9 Tree
- 0 Miscellaneous

+++ EXAMPLE OF DATA +++

```
         1         2         3         4         5         6         7
1234567890123456789012345678901234567890123456789012345678901234567890

0110RF 08067111  .5  01 1 2 HOPU  1         1   0.58
0110RF 08067111  .5  01 1 2 HOPU  3         2  10.13
0110RF 08067111  .5  01 1 1 BOGR  2         3  74.13 0.71   97.72
0110RF 08067111  .5  01 1 4 LEP   2         4   2.00
0110RF 08067111  .5  02 1 1 BOGR  2         1 138.06 0.71  165.62
0110RF 08067111  .5  02 1 4 LEP   2         2   5.18
0110RF 08067111  .5  02 1 2 HOPU  3         3   0.38
0110RF 08067111  .5  03 1 1 BOGR  2         1  59.78 0.71   77.30
0110RF 08067111  .5  03 1 2 HOPU  3         2   2.38
0110RF 08067111  .5  03 1 4 LEP   2         3   3.56
0110RF 08067111  .5  04 1 1 BOGR  2         1  77.38 0.71  144.45
0110RF 08067111  .5  04 1 4 LEP   2         2   1.78
0110RF 08067111  .5  05 1 1 BOGR  2         1 131.68 0.71  113.89
0110RF 08067111  .5  05 1 4 LEP   2         2   1.63
0110RF 08067111  .5  06 1 1 BOGR  2         1  43.13 0.71  122.45
0110RF 08067111  .5  06 1 4 LEP   2         2   2.33
0110RF 08067112  .5  01 1 4 LEP   2         1   1.24
0110RF 08067112  .5  01 1 1 BOGR  2         2  91.14 0.71   80.76
0110RF 08067112  .5  01 1 1 BOGR  1         3   1.64
0110RF 08067112  .5  02 1 2 HOPU  3         1   2.56
0110RF 08067112  .5  02 1 4 LEP   2         2   3.92
0110RF 08067112  .5  02 1 1 BOGR  2         3  57.72 0.71   99.30
0110RF 08067112  .5  03 1 1 BOGR  2         1  47.12 0.71  126.02
0110RF 08067112  .5  03 1 2 HOPU  3         2   0.35
0110RF 08067112  .5  03 1 1 BOGR  1         3   0.01
0110RF 08067112  .5  03 1 4 LEP   2         4    .
0110RF 08067112  .5  04 1 4 LEP   2         1   4.84
0110RF 08067112  .5  04 1 2 HOPU  3         2   8.44
0110RF 08067112  .5  04 1 1 BOGR  2         3  86.01 0.71  309.52
0110RF 08067112  .5  05 1 4 LEP   2         1   2.71
0110RF 08067112  .5  05 1 1 BOGR  2         2  85.50 0.71   87.84
0110RF 08067112  .5  06 1 1 BOGR  2         1  69.75 0.71  120.87
0110RF 08067112  .5  06 1 2 HOPU  3         2   1.09
0110RF 08067112  .5  06 1 4 LEP   2         3   2.37
0110RF 08067131  .5  01 1 1 BOGR  1         1   0.10
0110RF 08067131  .5  01 1 1 BOGR  2         2  59.88 0.71  111.04
0110RF 08067131  .5  02 1 1 BOGR  2         1  89.04 0.71  176.46
0110RF 08067131  .5  02 1 2 HOPU  3         2   1.52
0110RF 08067131  .5  02 1 1 BOGR  1         3   2.77
0110RF 08067131  .5  03 1 1 BOGR  1         1   1.37
0110RF 08067131  .5  03 1 2 HOPU  3         2   0.92
0110RF 08067131  .5  03 1 1 BOGR  2         3 140.72 0.71  182.64
```

0110RF	08067131	.5	04	1	1	BOGR	2	1	69.18	0.71	170.73
0110RF	08067131	.5	04	1	1	BOGR	1	2	0.48		
0110RF	08067131	.5	05	1	1	BOGR	2	1	65.06	0.71	373.11
0110RF	08067131	.5	05	1	1	BOGR	1	2	3.04		
0110RF	08067131	.5	05	1	2	HOPU	3	3	1.42		
0110RF	08067131	.5	05	1	2	HOPU	1	4	3.01		
0110RF	08067131	.5	06	1	1	BOGR	2	1	75.37	0.71	223.00
0110RF	08067131	.5	06	1	1	BOGR	1	2	0.72		
0110RF	08067131	.5	06	1	2	HOPU	3	3	1.23		
0110RF	08067132	.5	01	1	1	BOGR	1	1	1.84		
0110RF	08067132	.5	01	1	1	BOGR	2	2	74.79	0.71	158.09
0110RF	08067132	.5	02	1	1	BOGR	2	1	109.04		
0110RF	08067132	.5	02	1	2	HOPU	3	2	2.93		
0110RF	08067132	.5	02	1	1	BOGR	1	3	2.87		
0110RF	08067132	.5	03	1	1	BOGR	2	1	95.17	0.71	78.17
0110RF	08067132	.5	03	1	1	BOGR	1	2	3.49		
0110RF	08067132	.5	03	1	2	HOPU	1	3	0.62		
0110RF	08067132	.5	03	1	2	HOPU	3	4	2.41		
0110RF	08067132	.5	04	1	1	BOGR	2	1	124.34	0.71	138.87
0110RF	08067132	.5	04	1	2	HOPU	3	2	3.68		
0110RF	08067132	.5	04	1	1	BOGR	1	3	1.75		
0110RF	08067132	.5	05	1	1	BOGR	2	1	140.10	0.71	130.02
0110RF	08067132	.5	05	1	1	BOGR	1	2	4.94		
0110RF	08067132	.5	05	1	2	HOPU	3	3	2.93		
0110RF	08067132	.5	05	1	2	HOPU	1	4	3.13		
0110RF	08067132	.5	05	1	6	SPCO	1	5	0.75		
0110RF	08067132	.5	06	1	4	LEP	2	1	0.10		
0110RF	08067132	.5	06	1	2	HOPU	1	2	1.33		
0110RF	08067132	.5	06	1	2	HOPU	3	3	1.90		
0110RF	08067132	.5	06	1	1	BOGR	2	4	103.61	0.71	95.77
0110RF	08067132	.5	06	1	1	BOGR	1	5	3.02		
0110RF	08067111	.5	01	1	1	BOGR	1	1	1.10		
0110RF	08067111	.5	01	1	1	BOGR	2	2	127.33	0.71	208.81
0110RF	08067111	.5	01	1	4	LEP	2	3	0.73		
0110RF	08067111	.5	01	1	6	OPU	2	4	92.83		
0110RF	08067111	.5	02	1	1	BOGR	2	1	99.61	0.71	278.41
0110RF	08067111	.5	02	1	4	LEP	2	2	1.41		
0110RF	08067111	.5	02	1	6	OPU	2	3	148.32		
0110RF	08067111	.5	03	1	4	LEP	2	1	2.91		
0110RF	08067111	.5	03	1	1	BOGR	2	2	118.06	0.71	156.77
0110RF	08067111	.5	03	1	1	BOGR	1	3	0.38		
0110RF	08067111	.5	03	1	6	OPU	2	4	167.57		
0110RF	08067111	.5	04	1	1	BOGR	2	1	81.90	0.71	267.27
0110RF	08067111	.5	04	1	4	LEP	2	2	0.63		
0110RF	08067111	.5	04	1	2	HOPU	3	3	0.13		
0110RF	08067111	.5	04	1	6	OPU	2	4	32.99		
0110RF	08067111	.5	05	1	1	BOGR	2	1	128.21	0.71	147.87
0110RF	08067111	.5	05	1	4	LEP	2	2	2.05		
0110RF	08067111	.5	05	1	2	HOPU	3	3	0.30		
0110RF	08067111	.5	05	1	6	OPU	2	4	77.12		
0110RF	08067111	.5	06	1	4	LEP	2	1	1.66		
0110RF	08067111	.5	06	1	1	BOGR	2	2	172.86	0.71	149.23
0110RF	08067111	.5	06	1	6	OPU	2	3	42.77		

0110RF	08067112	.5	01	1	6	OPU	1	1	63.80		
0110RF	08067112	.5	01	1	6	OPU	2	2	148.57		
0110RF	08067112	.5	01	1	4	LEP	2	3	3.07		
0110RF	08067112	.5	01	1	1	BOGR	2	4	108.02	0.71	150.74
0110RF	08067112	.5	02	1	6	OPU	1	1	21.10		
0110RF	08067112	.5	02	1	6	OPU	2	2	47.80		
0110RF	08067112	.5	02	1	1	BOGR	2	3	55.86	0.71	211.00
0110RF	08067112	.5	02	1	4	LEP	2	4	2.50		
0110RF	08067112	.5	03	1	6	OPU	1	1	309.10		
0110RF	08067112	.5	03	1	6	OPU	2	2	148.83		
0110RF	08067112	.5	03	1	2	HOPU	3	3	0.23		
0110RF	08067112	.5	03	1	1	BOGR	2	4	106.74	0.71	154.22
0110RF	08067112	.5	03	1	4	LEP	2	5	1.50		
0110RF	08067112	.5	04	1	6	OPU	1	1	16.35		
0110RF	08067112	.5	04	1	6	OPU	2	2	36.65		
0110RF	08067112	.5	04	1	4	LEP	2	3	2.29		
0110RF	08067112	.5	04	1	2	HOPU	2	4	0.12		
0110RF	08067112	.5	04	1	1	BOGR	2	5	76.21	0.71	118.72
0110RF	08067112	.5	05	1	6	OPU	1	1	54.68		
0110RF	08067112	.5	05	1	6	OPU	2	2	115.66		
0110RF	08067112	.5	05	1	4	LEP	2	3	1.17		
0110RF	08067112	.5	05	1	1	BOGR	2	4	143.84	0.71	111.80
0110RF	08067112	.5	06	1	6	OPU	2	1	68.14		
0110RF	08067112	.5	06	1	4	LEP	2	2	0.40		
0110RF	08067112	.5	06	1	2	HOPU	3	3	0.13		
0110RF	08067112	.5	06	1	1	BOGR	2	4	77.43	0.71	148.23
0110RF	08067131	.5	01	1	6	OPU	1	1	490.80		
0110RF	08067131	.5	01	1	6	OPU	2	2	70.05		
0110RF	08067131	.5	01	1	1	BOGR	2	3	240.10	0.71	88.22
0110RF	08067131	.5	01	1	2	HOPU	3	4	0.20		
0110RF	08067131	.5	01	1	1	BOGR	1	5	0.87		
0110RF	08067131	.5	02	1	6	OPU	1	1	536.51		
0110RF	08067131	.5	02	1	6	OPU	2	2	101.64		
0110RF	08067131	.5	02	1	1	BOGR	2	3	80.39	0.71	412.55
0110RF	08067131	.5	02	1	2	HOPU	3	4	0.10		
0110RF	08067131	.5	03	1	6	OPU	1	1	348.51		
0110RF	08067131	.5	03	1	6	OPU	2	2	72.28		
0110RF	08067131	.5	03	1	1	BOGR	2	3	252.36	0.71	259.84
0110RF	08067131	.5	03	1	1	BOGR	1	4	0.33		
0110RF	08067131	.5	04	1	6	OPU	1	1	231.52		
0110RF	08067131	.5	04	1	6	OPU	2	2	37.77		
0110RF	08067131	.5	04	1	1	BOGR	2	3	236.59	0.71	229.14
0110RF	08067131	.5	04	1	1	BOGR	1	4	0.93		
0110RF	08067131	.5	05	1	6	OPU	1	1	245.10		
0110RF	08067131	.5	05	1	6	OPU	2	2	43.44		
0110RF	08067131	.5	05	1	1	BOGR	2	3	221.34	0.71	194.13
0110RF	08067131	.5	05	1	1	BOGR	1	4	0.70		
0110RF	08067131	.5	06	1	6	OPU	1	1	12.30		
0110RF	08067131	.5	06	1	6	OPU	2	2	50.64		
0110RF	08067131	.5	06	1	1	BOGR	1	3	1.14		
0110RF	08067131	.5	06	1	1	BOGR	2	4	175.13	0.71	119.88
0110RF	08067131	.5	06	1	2	HOPU	3	5	1.21		
0110RF	08067132	.5	01	1	6	OPU	1	1	210.73		
0110RF	08067132	.5	01	1	2	HOPU	3	2	1.63		
0110RF	08067132	.5	01	1	1	BOGR	1	3	0.86		

0110RF	08067132	.5	01	1	1	BOGR	2	4	175.70	0.71	184.53
0110RF	08067132	.5	02	1	6	OPU	1	1	62.94		
0110RF	08067132	.5	02	1	1	BOGR	1	2	1.35		
0110RF	08067132	.5	02	1	1	BOGR	2	3	228.35	0.71	140.70
0110RF	08067132	.5	02	1	6	OPU	2	4	122.72		
0110RF	08067132	.5	03	1	1	OPU	1	1	158.97		
0110RF	08067132	.5	03	1	1	BOGR	2	2	148.68	0.71	272.37
0110RF	08067132	.5	03	1	2	HOPU	3	3	0.76		
0110RF	08067132	.5	03	1	1	BOGR	1	4	2.53		
0110RF	08067132	.5	04	1	6	OPU	1	1	60.92		
0110RF	08067132	.5	04	1	6	OPU	2	2	31.03		
0110RF	08067132	.5	04	1	2	HOPU	3	3	0.50		
0110RF	08067132	.5	04	1	1	BOGR	1	4	1.70		
0110RF	08067132	.5	04	1	1	BOGR	2	5	224.70	0.71	163.40
0110RF	08067132	.5	05	1	6	OPU	1	1	209.55		
0110RF	08067132	.5	05	1	6	OPU	2	2	36.63		
0110RF	08067132	.5	05	1	1	BOGR	1	3	1.00		
0110RF	08067132	.5	05	1	2	HOPU	2	4	0.26		
0110RF	08067132	.5	05	1	2	HOPU	1	5	0.83		
0110RF	08067132	.5	05	1	1	BOGR	2	6	266.20	0.71	
0110RF	08067132	.5	06	1	6	OPU	1	1	334.76		
0110RF	08067132	.5	06	1	6	OPU	2	2	43.57		
0110RF	08067132	.5	06	1	2	HOPU	1	3	0.98		
0110RF	08067132	.5	06	1	1	BOGR	1	4	3.78		
0110RF	08067132	.5	06	1	2	HOPU	3	5	8.68		
0110RF	08067132	.5	06	1	1	BOGR	2	6	213.58	0.71	214.10