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ABIOTIC AND HERBAGE DYNAMICS STUDIES ON THE COTTONWOOD SITE, 1970

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GRASSLAND BIOME

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ABSTRACT

Above- and below-ground herbage biomass, mulch, and abiotic factors were studied in a permanent exclosure in high range condition and in a temporary exclosure in low range condition at the Cottonwood Range Field Station, 75 miles east of Rapid City. The permanent exclosure was fenced from a pasture with a history of light grazing in 1963. This area appears to be approaching stability. The temporary exclosure was fenced from a pasture with a history of heavy grazing in the spring of 1970. Both exclosures are located on gentle, northeasterly slopes with silty clay soils. Mean annual precipitation is 15.1 inches of which about 75% is received from April through September.

Precipitation, evaporation, evaporation pan wind movement, and soil temperatures at 10, 20, 50, 100, and 150 cm were measured daily in exclosures near to and very similar to the study areas. Total solar radiation, wind movement and wind direction at 2 m, air temperature and relative humidity in a standard weather bureau instrument shelter were measured daily near the study areas. Soil moisture was determined gravimetrically on the clip plots at each sample date by 10 cm increments to 60 cm. Heavy snow in April resulted in total soil water to 60 cm of about 21 cm in both exclosures in early May, decreasing steadily to about 11 cm on September 2 with brief recharge in early July and early August with a significant increase in the fall. Precipitation for the year was 2.92 inches below normal.

Above-ground herbage biomass was estimated at approximately 2-weekly intervals from May 8 through September 4 and at about monthly intervals from September 4 through December 4 by clipping 10 0.5 m^2 plots in each of two replications in each of the two exclosures. Botanical composition by species separated as live, this year's (recent) dead, standing (old) dead, and live and dead crowns and stolons was estimated in the laboratory. The dominant species was Agropyron smithii in high range condition and Buchloe dactyloides in low range condition. In the high range condition exclosure, the standing crop of live plus this year's dead of all species increased to a peak of 199 g/m^2 in late July and to a second peak of 210 in early September while the low range condition exclosure increased to a peak of 137 g/m^2 in late July, declined in early August, increased to 139 g/m^2 in late August and then declined. Mulch was vacuumed from the plots and estimated as fresh and humic. Fresh mulch increased from 155 g/m^2 oven dry, ash-free weight in early May to 1361 in late July and then declined in the high range condition exclosure, while in low range condition it increased from 58 to 168 g/m^2 in late June, declined, increased to 160 in early August and then steadily declined. In high range condition, humic mulch increased from 63 to 111 g/m^2 in late May, behaved erratically and then declined. In low range condition it increased from 37 to 85 g/m^2 in early July and then declined erratically.

Below-ground plant weight was measured by taking 10 4.2 cm cores to a depth of 60 cm in each clipped plot at monthly intervals. Cores were cut into 0-5, 5-10 and then into 10 cm segments to 60 cm. Below-ground plant weight was predominantly roots, although below-ground

crowns and rhizomes were present. In the high range condition exclosure, total roots, live plus dead to 60 cm, increased from 934 g/m^2 oven dry, ash-free weight in early May to a peak of 1193 g/m^2 in early July. In the temporary exclosure, root weight increased from 1842 g/m^2 in early May to a peak value of 2227 in early July. In both exclosures, values declined after the peak and increased until early November. Forty-six and 44% of the total root weight was in the top 10 cm in the high and low range condition exclosures, respectively. Root turnover calculated from the biomass values was .16 and .25 for the high and low range condition exclosures, respectively. During the year below-:above-ground plant standing crop ratios ranged from 1:1 to 3:1 and from 4:1 to 7:1 in high and the low range condition exclosures, respectively.

INTRODUCTION

The Cottonwood Comprehensive Network site is located at the Cottonwood Range Field Station operated by the South Dakota Agricultural Experiment Station, 75 miles east of Rapid City in west central South Dakota. A contributing project to the Grassland Biome subprogram was initiated in 1970 comparing the herbage dynamics above- and below-ground, numbers of above-ground invertebrates, and decomposer activity in a permanent exclosure in high range condition and in a temporary exclosure in low range condition. Each exclosure was subdivided into two replications. The exclosures were located in the pastures of a summer grazing study with cattle initiated in 1942. The current phase of this study is South Dakota Agricultural Experiment Station project 539 directed by James K. Lewis. The climate, vegetation, pasture locations, stocking rates, and bibliography from 1942 through 1969 were reported by Lewis (1970[a]).

The permanent exclosure in high range condition containing about 5 acres was fenced in 1963 from pasture three which has been lightly grazed and is now in good+ range condition (Fig. 1). The exclosure is located on a gentle northeasterly slope with silty clay soils typical of the area. This exclosure was slightly enlarged and gravel placed along the west and north sides in 1970. The vegetation and mulch appear to have reached approximate stability following exclusion from grazing. Vegetation pattern appears to be due primarily to succession following pocket gopher activity. The temporary exclosure containing about 2 acres was fenced in 1970 from similar soils and slope in pasture one

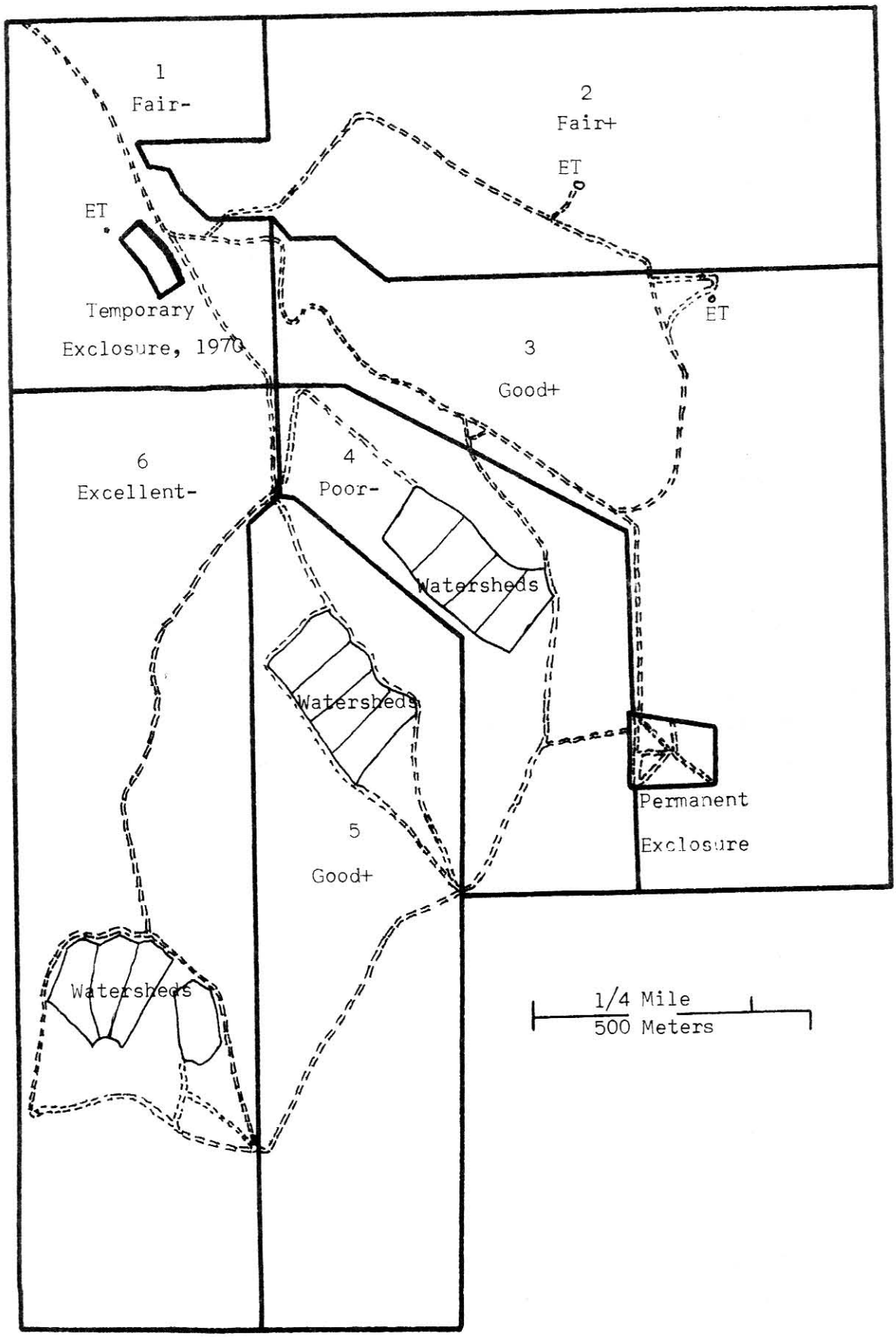

Fig. 1. Map of the summer grazing study pastures showing pasture number, range condition, location of Grassland Biome temporary and permanent exclosures, evapotranspiration plots, experimental watersheds, and trails. Cottonwood, 1970.

which has been heavily grazed and is now in fair range condition. Special care was taken to collect as much data on the same plots at the same time as possible.

Small mammal studies were conducted in pasture three outside the permanent exclosure on a grazed area with similar vegetation and soils but with more variation in topography. Bird studies were conducted on larger grazed areas in both pastures one and three.

A portion of the abiotic data was collected by Clayton Hanson, Agricultural Research Service, in connection with line project S. Dak. C-69-1 entitled "Evapotranspiration from native rangeland" and line project S. Dak. C-62-1 entitled "Determination of the relationship between intensity of grazing and runoff from rangeland on fine-textured soils." Locations of these study areas are shown in Fig. 1.

ABIOTIC STUDIES

Climatic and Microclimatic Studies (Clayton L. Hanson and Jerrold L. Dodd)

The data for this section of the report were obtained from the following instrumentation:

A. Evapotranspiration plot, pasture two

Air temperature and relative humidity data were obtained from a recording hygrothermograph that was in a standard U. S. Weather Bureau instrument shelter.

The two meter wind data were obtained from a direction and velocity recording anemometer. The one meter wind data were obtained from a totalizing anemometer.

Incoming radiation was recorded with an Eppley pyrheliograph at the evapotranspiration plot in pasture two.

B. Evapotranspiration plots, pastures one and three

Class "A" pan evaporation, pan wind, precipitation and soil temperatures were obtained daily at about 0800. Thermocouples located in the center of the evapotranspiration plots were used to obtain the soil temperatures.

C. Watersheds

Precipitation for the ungrazed area was obtained from recording rain gages RH-3 and RH-4 in pasture four. Other data collected from the watersheds are not included.

Precipitation was above normal in April, July, and September and below normal precipitation in May and June (Table 1). The April precipitation recorded by gages RH-3 and RH-4 was about 0.7 inch below the amount recorded by the two shielded gages RH-2 and RM-4, probably because the unshielded gages did not catch as much snow. Total precipitation was about 2 inches below normal during the growing season (April-September). The precipitation from October 1969 through March 1970 was 0.80 inches below normal.

Cumulative precipitation and Class A pan evaporation from April 1 through November 7 are shown in Fig. 2. Daily precipitation and evaporation from April 1 through November 7 is in Table 1 and Appendix Table 1. These data show that the annual evaporation was 61.35 inches. This is about 6 inches above the average evaporation at the field station headquarters (Spuhler et al. 1969).

Daily air and soil temperatures, relative humidity, incoming radiation, wind, precipitation, and Class A pan evaporation are listed in Appendix Table 1. These same data are summarized by sampling dates in Table 2. These data show that the average daily maximum temperature was above 90° for the periods prior to three sampling dates. Between June 24 and July 11 the daily maximum temperature averaged 94° which is about 5° above the mean. A thunderstorm on July 8 also gave this period the most precipitation between any of the sampling dates. This 1.8 inch rain occurred during the early July sampling. The other very hot period was between August 22 and September 4 when the average daily maximum temperature was 95°. During both of these periods, the pan evaporation was almost 1/2 inch per day.

Table 1 **YEARLY SUMMARY OF DAILY** Precipitation (Precipitation or Runoff) **(INCHES)** a/

Location Pasture 4, Cottonwood, South Dakota **Period, 19** 70 to 19 7 **Station** Average of rain gages RI-3 and PH-4 (Name or number)

Type of measuring equipment Weighing-recording rain and snow gages.

Day	January	February	March	April	May	June	July	August	September	October	November	December
1	.01					.02			.02		.05	
2	.01		.03						.08			
3	.01	.02										
4							.06					
5						.02		.31	.50	.17		
6					.05		.05		.57	.07	.15	
7			.05		.01						.23	
8			.12				1.69	.81			.03	.02
9					.15	.06					.02	.10
10				.30	.02	.33						.01
11				.20		.48				.06		.01
12		.03			.24				.55	.02	.02	
13				.22	.06			.19	.04			
14				.35		.02		.07				
15												
16												
17	.03	.06	.04	.27			.64			.01	.04	T
18	.02	.05	.02	.29						.02		.02
19			.05	.03								
20												
21				.01	.04							
22				.09	.03							
23							.62					
24	.23				.08	.21				.01	.11	
25			.01							.01	.01	
26			.01					.03		.02	.02	
27										.02		
28			.04	.04						.02		
29			.03		.01							
30					.20							
31					.01							
Monthly Totals	.31	.16	.40	1.80	.99	1.14	3.06	1.41	1.76	.43	.68	.16	= 12.30
1969 b/ Mo. Totals	.23	.85	.31	1.59	2.54	2.10	4.63	.63	1.23	1.13	.10	.29	= 15.63
Annual c/ Average	.42	.38	.75	1.76	2.78	2.99	1.81	1.56	1.13	.89	.40	.35	= 15.22

REMARKS

a/ Midnight to midnight readings.

b/ Average of 4 gages in Pasture 4.

c/ Average precipitation at Cottonwood Range Field Station, 1910-1967.

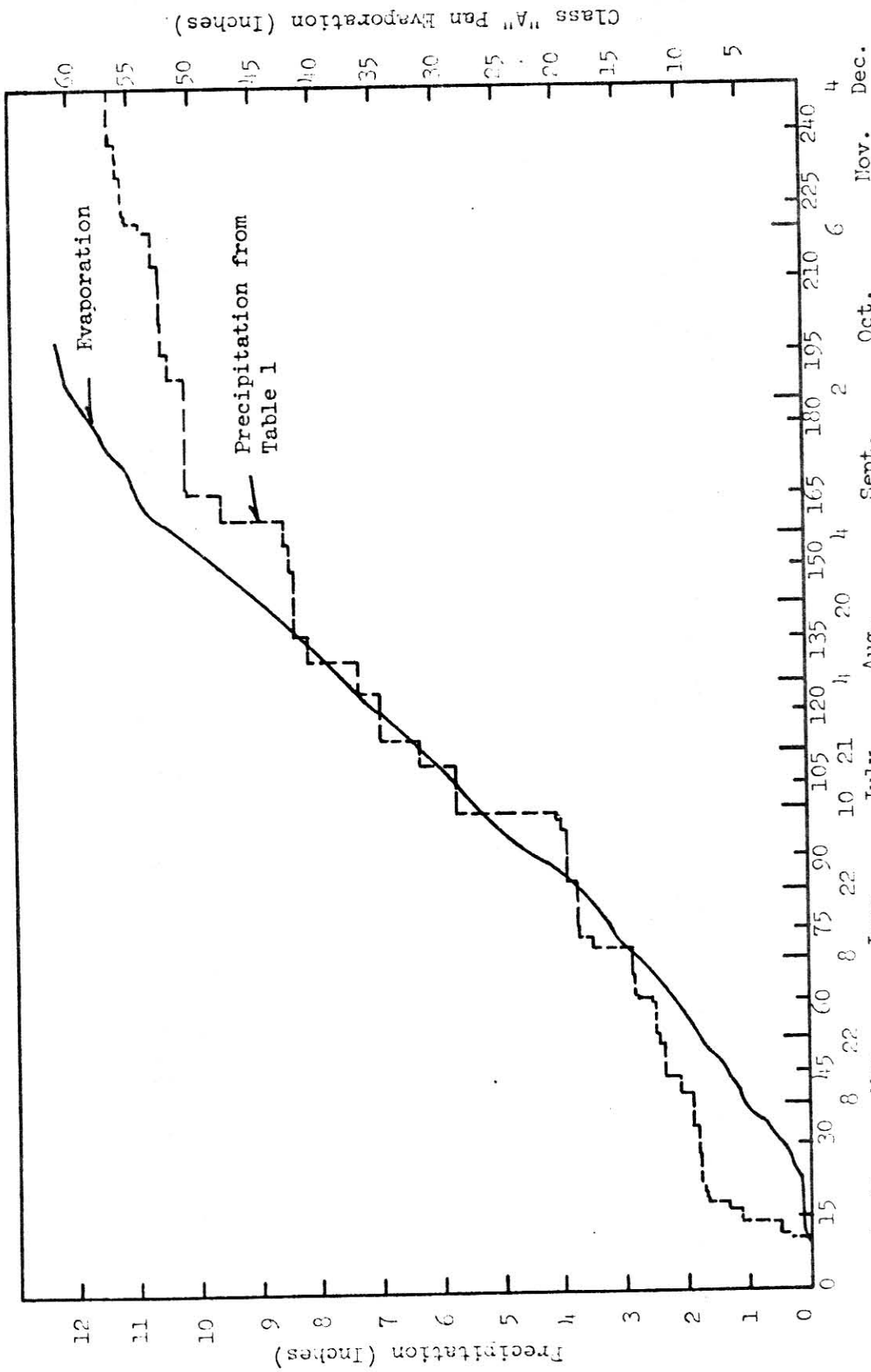

Figure 2. Cumulative daily precipitation and Class "A" pan evaporation, Cottonwood 1970.

Table 2. Summary of Air and Soil Temperatures, Relative Humidity, Solar Radiation, Wind, Precipitation and Class "A" Pan Evaporation by Sampling Periods - Cottonwood, South Dakota - 1970.

	Pasture 2 Data Common to Pastures 1 and 3							Pasture 1					Pasture 3				
	Air Temperature[a]			Relative Humidity[a]		Radiation[a]	2 meter wind	Evaporation	Precip.[b]	Pan Wind	Soil Temps.		Evaporation	Precip.[b]	Pan Wind	Soil Temps.	
Date	Max	Min	Av	Av	11 AM	Langleys	MPH	Inches	Inches	MPH	10 cm	20 cm	Inches	Inches	MPH	10 cm	20 cm
4/30-5/9	68	39	53	56	37	552.2	10.35	.33	.08	7.34	49	50	.33	.09	6.98	47	47
5/10-5/23	68	45	56	63	49	491.16	7.60	.26	.59	5.16	55	55	.26	.70	5.01	51	52
5/24-6/9	77	48	62	59	40	600.15	6.24	.32	.33	4.19	61	62	.31	.42	3.77	58	59
6/10-6/23	79	53	66	65	48	587.89	7.21	.31	.86	4.63	67	68	.30	.97	4.22	64	64
6/24-7/11	94	61	77	54	39	661.77	6.68	.49	2.15	4.39	74	75	.47	2.00	3.82	73	73
7/12-7/22	89	61	75	57	42	596.43	7.01	.40	.64	4.75	73	75	.39	.65	4.17	73	75
7/23-8/5	91	61	76	57	45	567.23	6.94	.41	.58	4.58	76	76	.40	.65	4.16	75	76
8/6-8/21	92	61	76	56	38	553.02	6.54	.41	1.47	4.24	74	75	.41	1.33	3.83	72	74
8/22-9/4	95	60	77	42	33	526.63	6.91	.48	.12	4.62	73	74	.46	.09	4.14	73	73
9/5-10/3	75	45	59	56	42	408.03	7.74	.29	1.62	5.31	58	62	.28	1.70	4.85	62	65
10/4-11/7	56	32	44	67	48	283.99	7.80	.13[c]	.37				.13[c]	.34			
11/8-12/6[d]	62	6	32	77	62	159.59	7.18		.20		34[e]	36[e]		.20		38[f]	40[f]

[a] Daily Average

[b] Total for period

[c] First 12 days only

[d] Air temperature, relative humidity, radiation, and wind measured in pasture one only. Precipitation recorded at headquarters.

[e] Average of three dates, 11/20, 11/30, 12/7.

[f] Average of two dates, 11/30, 12/7.

Maximum and minimum temperatures and 11:00 a.m. relative humidity are shown in Fig. 3. The plotting points are three-day means. The small circles give an indication of the 11:00 a.m. relative humidity immediately preceding the sampling dates. There were 15 days when the temperature was 100° or over but only one three-day period in August shows on the graph. There was another three-day period in late June when the temperature was 100° or over for three consecutive days.

The soil temperatures at the 20 and 50 cm depths in pastures one and three from April 30 through October 15 are shown in Fig. 4a and 4b. The plotting points are three-day means. A summary of the soil temperatures by weeks at the 10, 20, 50, 100, and 150 cm depths is presented in Table 3. The temperature of the 20 cm depth in pasture one varied from 45° at the beginning of the season to 79° in late July. The 50 cm depths vary from 42° F in early May to a high of 77° about the first of August. The 20 and 50 cm depths in pasture three were 1 to 2° cooler than those in pasture one. In both pastures, the 20 cm temperature was warmer than the 50 cm temperature until early September when the 20 cm temperature became cooler than the 50 cm temperature.

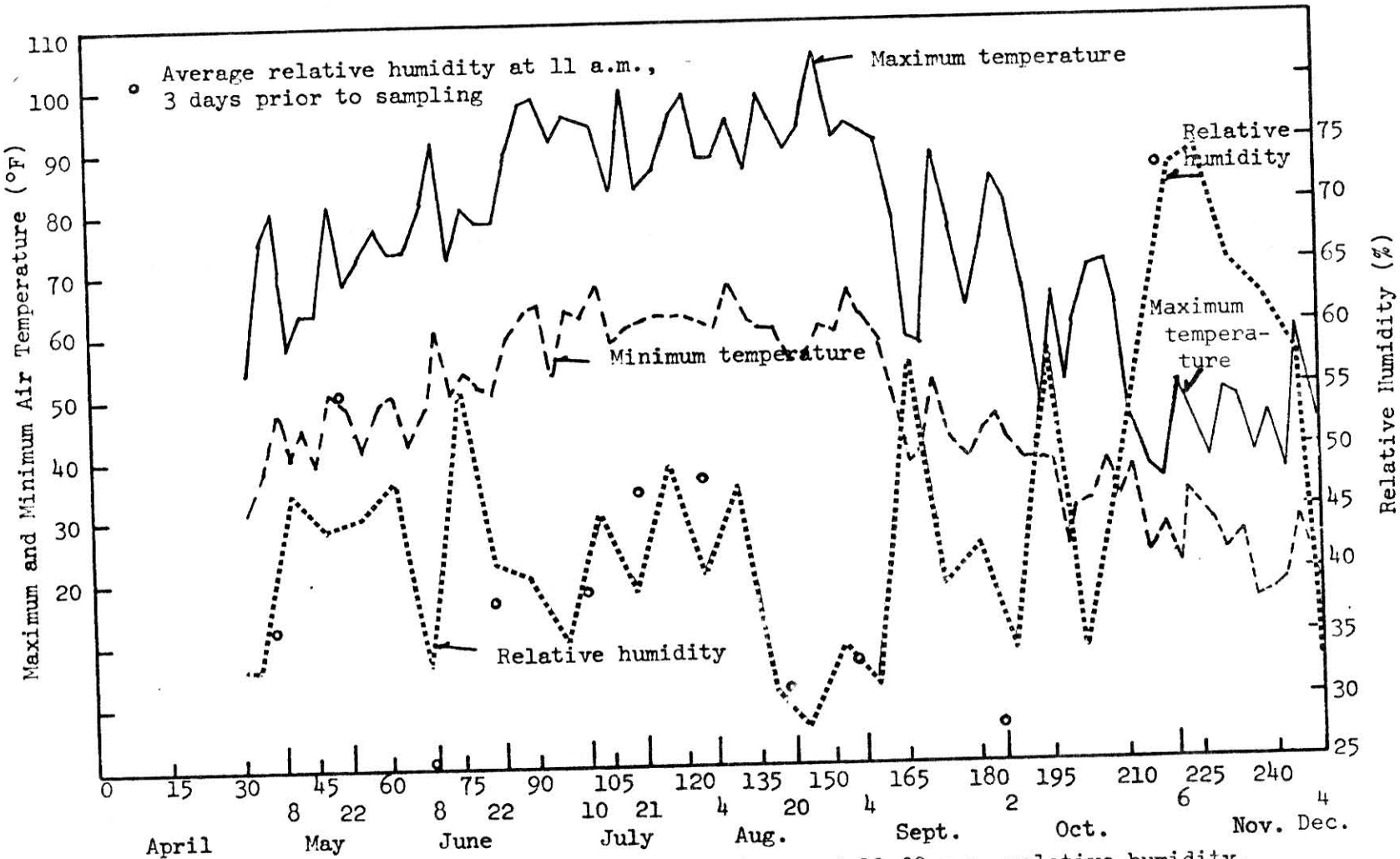

Figure 3. Maximum temperature, minimum temperature and 11:00 a.m. relative humidity. Each point is an average of three days.

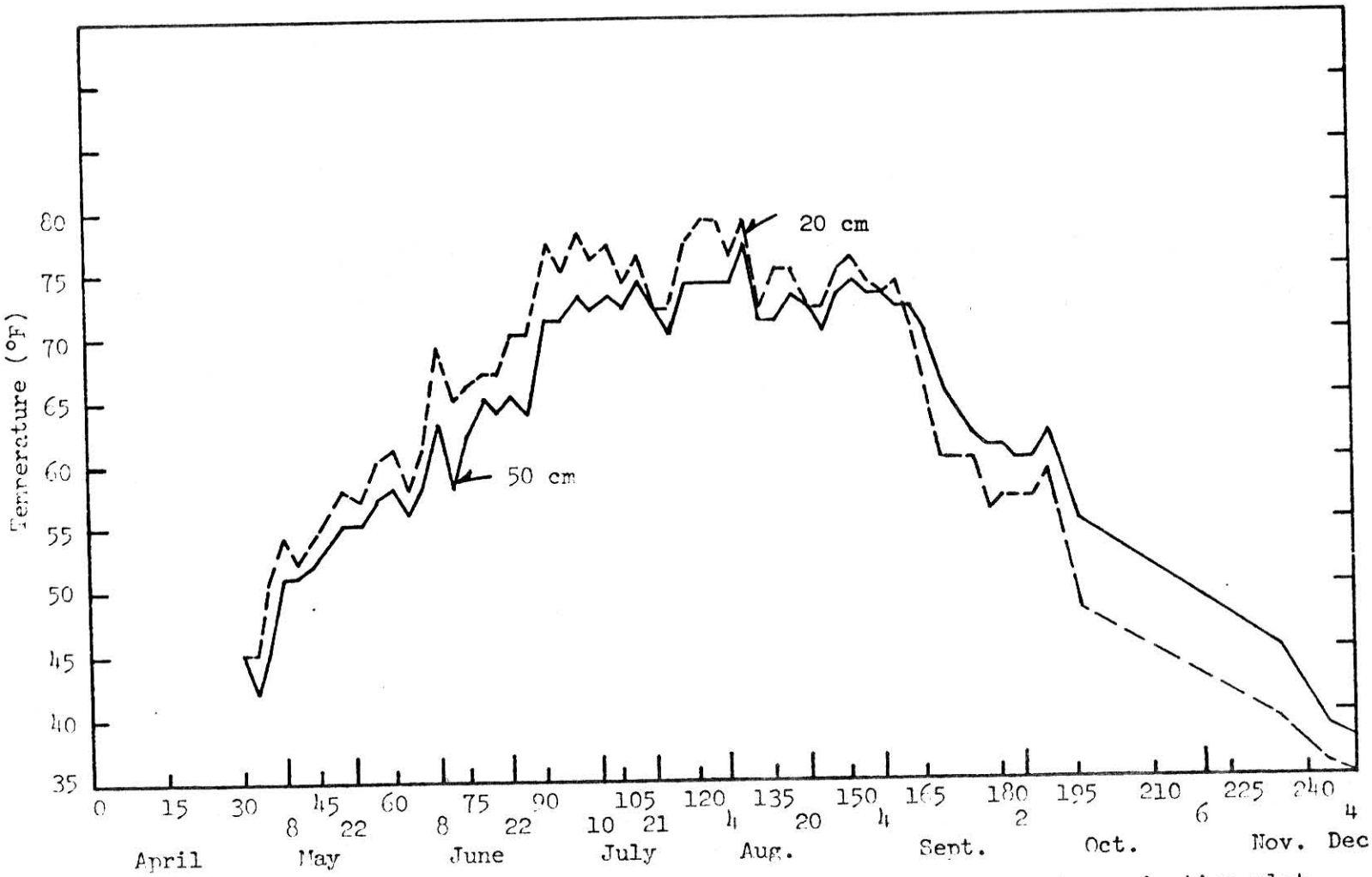

Figure 4a. 20 and 50 centimeter soil temperatures from Pasture 1 evapotranspiration plot. Each point is an average of three days.

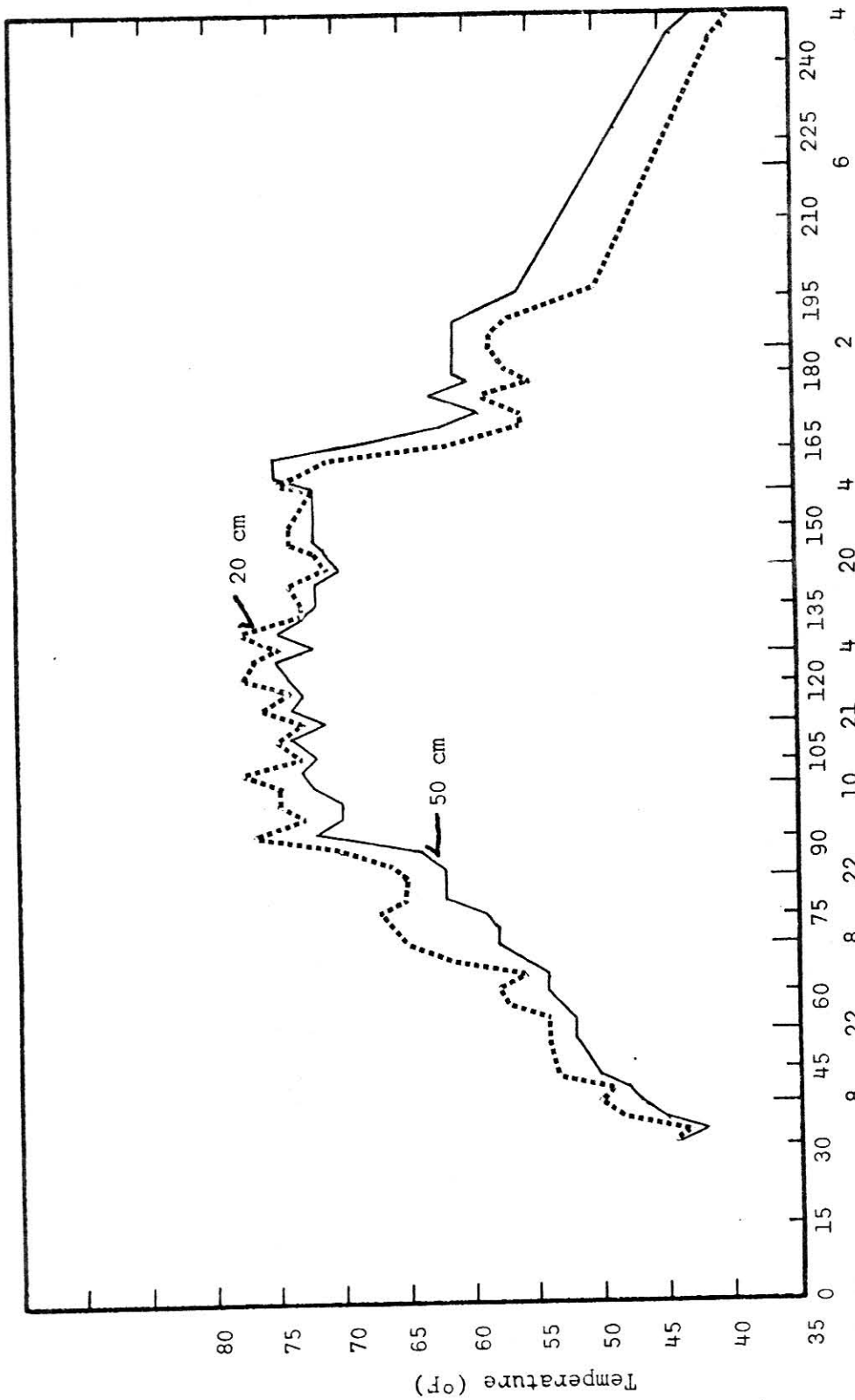

Fig. 4b. 20 and 50 centimeter soil temperatures from Pasture 3 evapotranspiration plot. Each point is an average of three days during the interval April 30-October 14. The November and December points are single day measurements.

Table 3. Weekly Soil Temperature (°F) in Pastures 1 and 3 for the 10, 20, 50, 100 and 150 Centimeter Depths - Cottonwood, South Dakota - 1970

	Pasture 1 Depth (cm)					Pasture 3 Depth (cm)				
Date	10	20	50	100	150	10	20	50	100	150
4/30-5/6	46	47	45	43	42	44	45	44	41	41
5/7-5/13	53	53	51	46	44	50	50	48	44	41
5/14-5/20	55	55	52	48	45	52	53	49	46	43
5/21-5/27	58	58	56	52	47	53	54	52	48	45
5/28-6/3	59	59	57	52	48	56	57	55	51	47
6/4-6/10	65	65	60	54	50	62	62	57	52	49
6/11-6/17	65	65	62	57	53	62	62	60	55	51
6/18-6/24	68	69	65	59	54	66	65	62	57	54
6/25-7/1	73	73	67	61	56	73	73	68	61	56
7/2-7/8	75	76	72	64	58	73	73	70	63	58
7/9-7/15	74	75	72	65	59	74	76	73	66	61
7/16-7/22	72	74	72	67	61	71	73	72	66	62
7/23-7/29	75	75	72	67	62	73	74	72	68	63
7/30-8/5	76	76	74	68	62	76	77	74	68	64
8/6-8/12	74	76	73	67	63	74	75	73	68	64
8/13-8/19	73	75	72	67	63	71	73	73	69	65
8/20-8/26	71	72	71	67	63	70	72	71	67	63
8/27-9/2	74	75	73	69	64	74	73	72	69	65
9/3-9/9	70	72	73	70	65	70	72	73	70	66
9/10-9/16	58	64	70	69	67	56	61	67	69	68
9/17-9/23	54	57	61	63	63	54	57	61	62	63
9/24-9/30	52	56	60	62	62	53	56	60	61	62
10/1-10/7	55	58	61	62	61	55	58	61	61	62
10/8-10/14	46	51	56	60	60	47	51	57	61	61
11/20[a]	37	39	45	50	55	M	M	M	M	M
11/30[a]	33	36	39	47	50	40	41	44	49	52
12/7[a]	32	33	38	44	48	35	39	42	47	50

[a] Single day estimates.

Soil Moisture Studies (Jerrold L. Dodd)

Soil moisture was determined gravimetrically at 10 cm increments to a depth of 60 cm. Determinations were made on five samples per replication per treatment for each depth at each sampling date. Total soil water was calculated using average bulk density data for each depth in each replication. The bulk densities were determined from samples taken with a 4.3 cm diameter hydraulic probe on October 2, 1970. Soil bulk density for each depth increment within each of 10 plots/replicate are presented in Appendix Table 2. Bulk density increased with depth from an average of about 1.00 g/cm^3 at the 0-5 cm depth to an average of about 1.50 g/cm^3 at the 50-60 cm depth. Little or no difference was evident between the grazed and ungrazed treatments.

Fig. 5 shows the change in total soil water to a depth of 60 cm between sampling periods for the exclosures in high and low range condition. Total soil water was consistently but slightly (<1.6 cm) less in the exclosure in low range condition than in high range condition for all dates before November 6. Fig. 5 also shows rapid depletion of soil moisture from May 8 to June 22 with a slower and more irregular pattern of depletion from July 10 to the seasonal low of less than 11 cm on October 2.

Total soil water by depth increments to 60 cm is summarized in Table 4. A more detailed tabular presentation of the total soil water and soil moisture data is in Appendix Table 3.

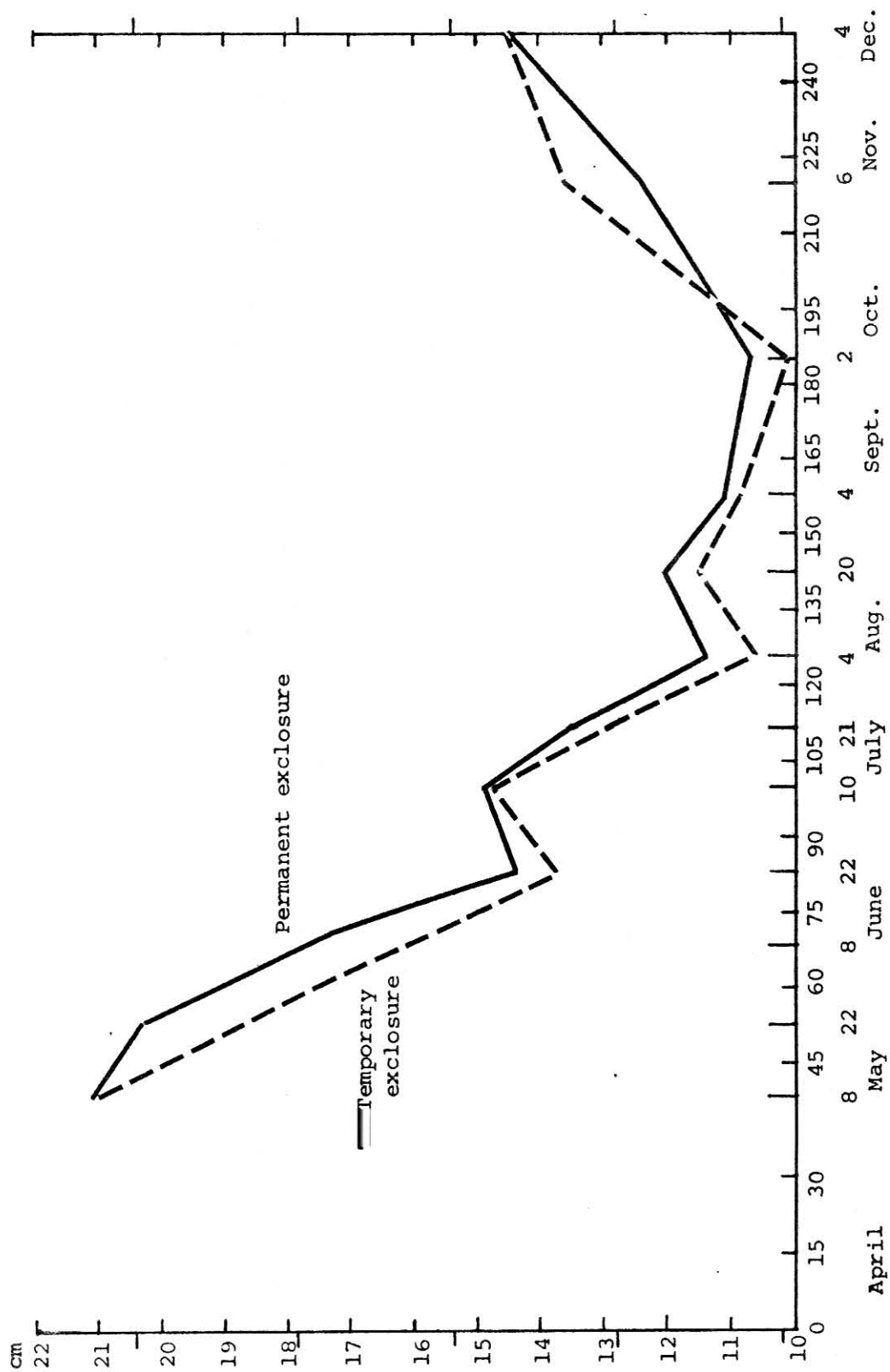

Fig. 5. Total soil water, 0-60 cm, Cottonwood, 1970.

Table 4. Total Soil Water (cm) by Depth, Treatment, and Sampling Date, Cottonwood, 1970[a/]

Month	May		June		July			August		Sept.	Oct.	Nov.	Dec.
Day	8	22	8	22	7	10	21	4	20	4	2[b/]	6	4
Depth cm													
Permanent Exclosure High Range Condition													
0-5	1.15	--	0.57	--	0.38[c/]	1.37	--	0.39	--	0.40	0.52	--	--
5-10	1.54	--	1.04	--	0.89[c/]	1.75	--	0.77	--	0.69	1.00	--	--
0-10	2.69	2.25	1.61	1.52	1.27[c/]	3.12	2.34	1.16	1.46	1.09	1.52	2.77	3.31
10-20	3.74	3.45	2.64	2.30	1.87[c/]	3.21	2.36	1.95	2.00	1.81	1.98	2.28	2.82
20-30	3.72	3.51	2.86	2.44	1.90[c/]	2.02	2.14	2.02	2.03	1.99	1.74	1.75	2.05
30-40	3.89	3.78	3.36	2.69	2.07[c/]	2.22	2.24	2.12	2.21	2.10	1.86	1.88	2.17
40-50	3.60	3.53	3.22	2.63	2.07[c/]	2.08	2.15	2.01	2.11	2.02	1.74	1.79	2.03
50-60	3.46	3.80	3.58	2.84	2.24[c/]	2.26	2.27	2.15	2.23	2.08	1.85	1.88	2.16
0-60	21.10	20.32	17.27	14.42	11.42[c/]	14.91	13.50	11.41	12.04	11.09	10.69	12.35	14.54
Temporary Exclosure Low Range Condition													
0-5	1.51	--	0.70	--	--	1.37	--	0.42	--	0.52	0.61	--	--
5-10	1.77	--	1.09	--	--	1.63	--	0.79	--	0.77	1.15	--	--
0-10	3.28	2.25	1.79	1.70	--	3.00	2.16	1.21	1.43	1.29	1.76	3.39	3.62
10-20	3.58	3.05	2.24	2.07	--	3.08	2.11	1.70	1.87	1.75	1.39	2.17	2.84
20-30	3.84	3.51	2.73	2.38	--	2.51	2.18	1.93	2.02	1.96	1.81	2.05	2.07
30-40	3.58	3.43	2.92	2.38	--	2.11	2.06	1.85	1.93	1.87	1.68	1.85	1.94
40-50	3.57	3.35	3.11	2.62	--	1.97	2.18	1.97	2.09	2.01	1.75	1.98	2.05
50-60	3.14	3.15	3.33	2.53	--	2.10	2.26	1.94	2.13	2.02	1.73	2.17	2.04
0-60	20.99	18.74	16.12	13.68	--	14.77	12.95	10.60	11.47	10.90	10.12	13.61	14.56

a/ Values are means of 5 cores per replicate, 2 replicates per treatment.
b/ Values are means of 10 cores per replicate, 2 replicates per treatment.
c/ Values are means of 4 cores taken prior to thunderstorm July 9.

Within the 0-10 cm depth of the soil profile, the low range condition exclosure contained more soil water than did the high range condition exclosure on 8 of the 12 dates of measurement (Table 4). However, soil water means for nearly all other 10 cm increments within the 0-60 cm segment of the low condition exclosure were less than those of the high condition exclosure. The only exceptions to this trend were in November when all depth increments of the temporary exclosure had more soil water than did increments of the same depth in the permanent exclosure.

HERBAGE DYNAMICS

Methods and Procedures (James K. Lewis, Jerrold L. Dodd, and H. L. Hutcheson)

Field procedures

1. Exclosure layout. Because of the small size of the permanent exclosure and the need to use wheeled vehicles, access trails were made and plots were located within each replication by restricted randomization along access trails (Fig. 6). No plot was allowed adjacent to an existing plot. All plot locations were permanently marked with 3/8 x 12 inch rods and labeled with metal eartags. Plot locations were mapped and a permanent record is kept. Plot locations more than one plot width off of the access trails are available for selection after the first row has been used. In this way a minimum area is damaged by trampling and vehicle use. In the temporary exclosure in low range condition alleyways were provided for travel and the plots were marked for one year only (Fig. 7).

2. Sampling dates. Ten plots were sampled in each replication at each sample date except in late June and early July. Two days were allotted for field sampling. One replicate of each treatment was sampled one day and the other replicate the following day. Rain and subsequent snow prevented completion of sampling on April 11. Above-ground herbage and mulch samples were taken approximately biweekly May 8, 9; May 22, 23; June 8, 9; June 22, 23, 25; July 7, 10, 11; July 21, 22; August 4, 5; August 20, 21; and approximately monthly September 4, 5; October 2, 3; November 6, 7; and December 4, 5 for a total of 12 sample dates. Below-ground plant biomass samples were taken seven times; at the first sample date of each month except that no samples were taken in December. The early July sample was started

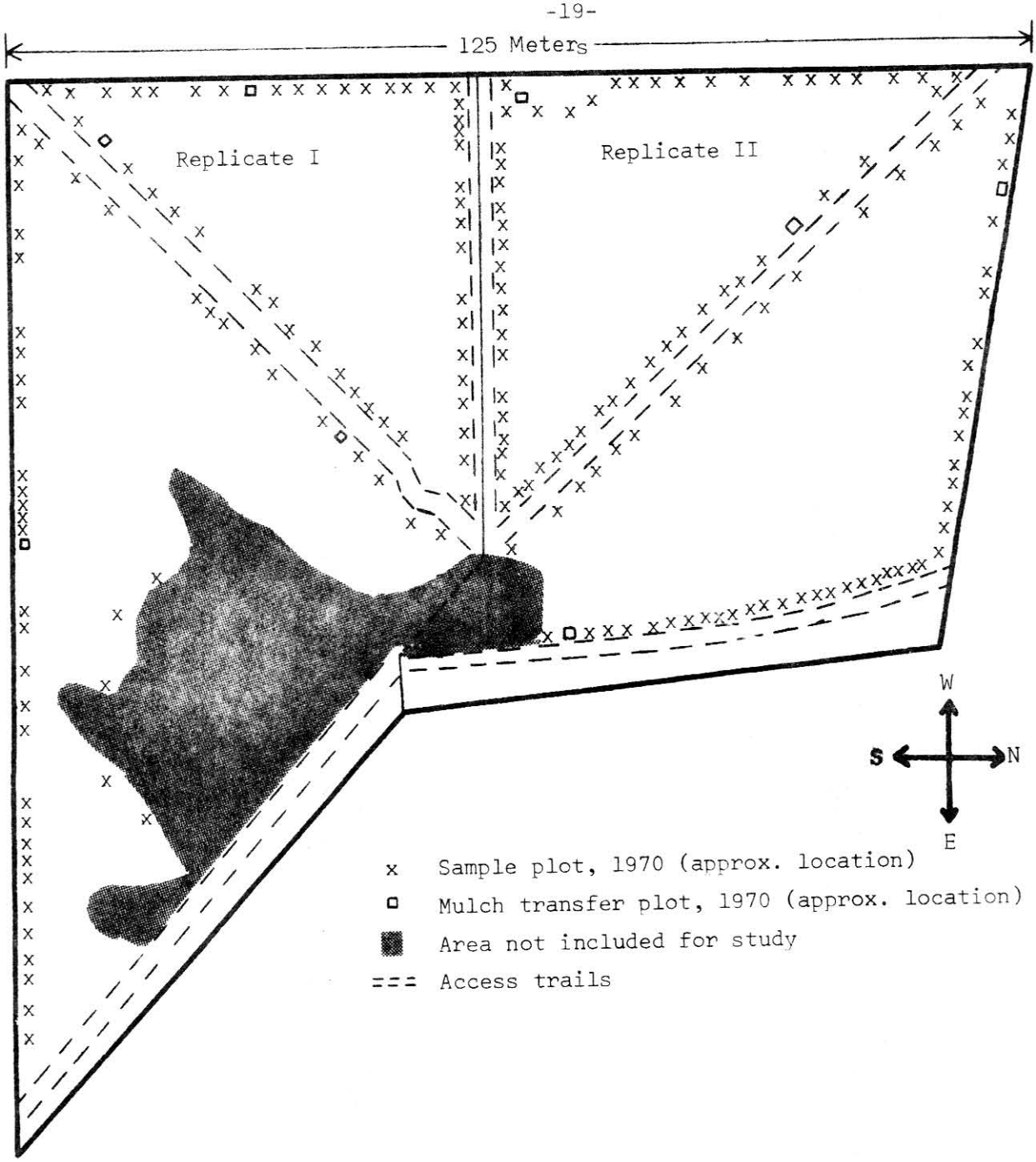

Fig. 6. Map of the portion of the permanent exclosure in high range condition used for sampling showing replicates, access trails, and typical plot locations along access trails. Cottonwood, 1970.

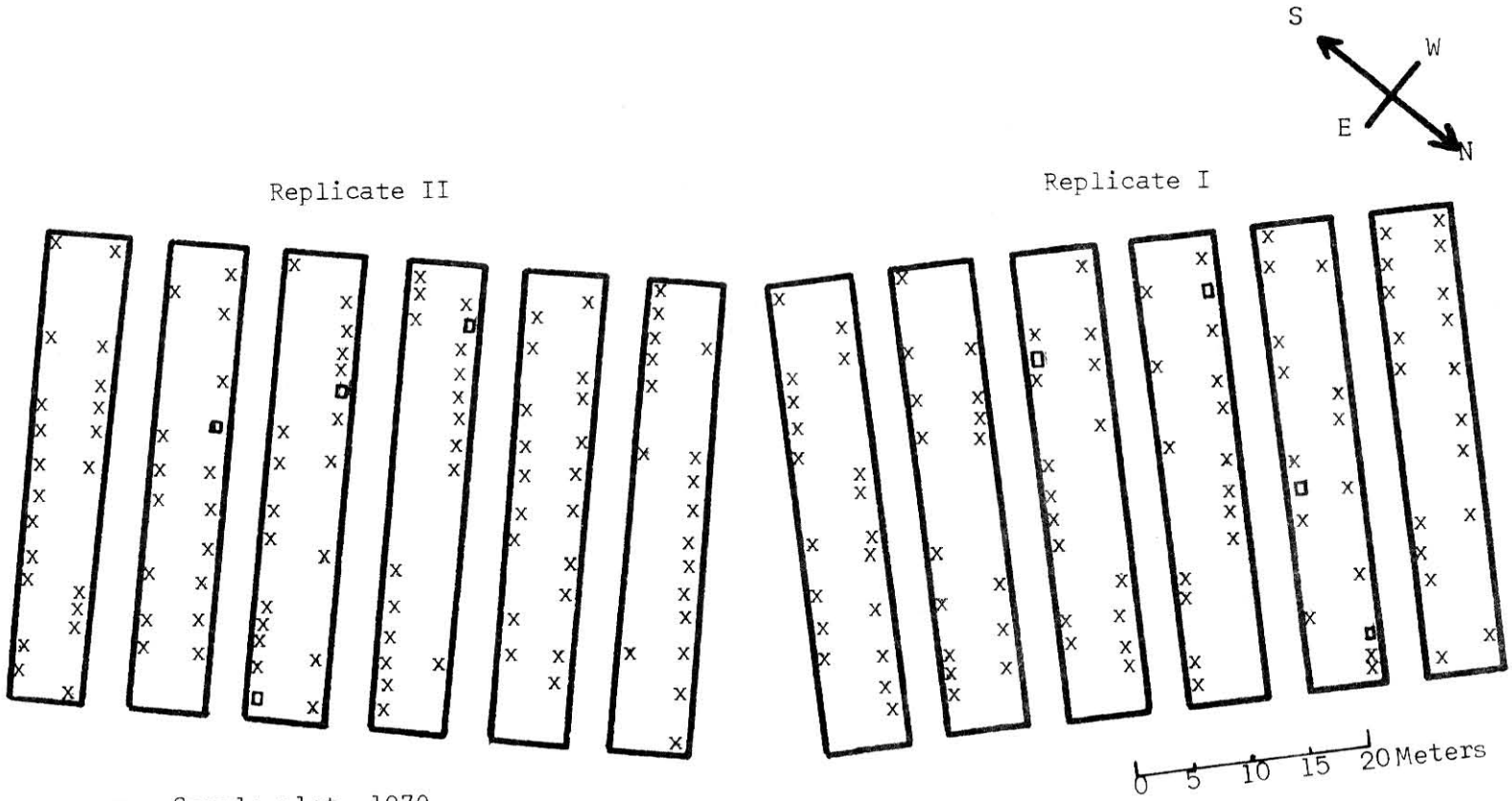

Fig. 7. Map of the temporary exclosure in low range condition showing alleways, sampling areas, and typical plot locations. Cottonwood, 1970.

on July 7 but stopped by equipment breakdown and further delayed by rain. A complete set of samples was taken on July 10, 11. An extra set of samples was taken in late June in replicate one of the permanent exclosure, because weight ranking was inadvertently omitted on the clipped plots.

3. Routine. Sampling procedures were identical from early May through late July and from early August through the remainder of the year. A flow chart of the later field operations is shown in Fig. 8. Plots were located prior to the sampling date and the Quick Traps were hung on their tripods by 4 p.m. M.D.T. of the day before sampling. Plots beneath the Quick Traps were then weight-ranked. Other plots were weight-ranked immediately before or after the two-day sampling period. Quick Traps were dropped at 10 a.m. (traps were not used in November and December). Herbage inside the trap was clipped to ground level with electric shears and placed in a paper bag inside the trap. The mulch was vacuumed with the De-Vac. The bag of herbage and the De-Vac bag of mulch were taken to the laboratory for arthropod extraction in Berlese funnels. If below-ground biomass was to be sampled, a tractor-mounted hydraulic core sampler was positioned over the plot and one or more 2-inch cores were removed, sectioned, and placed in polyethylene bags. If CO_2 evaluation was measured, a small canopy was placed over a portion of the denuded plot and left in place for 1 hour. Then the holes from which the cores were removed were filled with soil from a similar site and the plots were marked. Litter bags located on transects within each replicate were removed on sample dates for convenience. Transfer plots were read between sample dates.

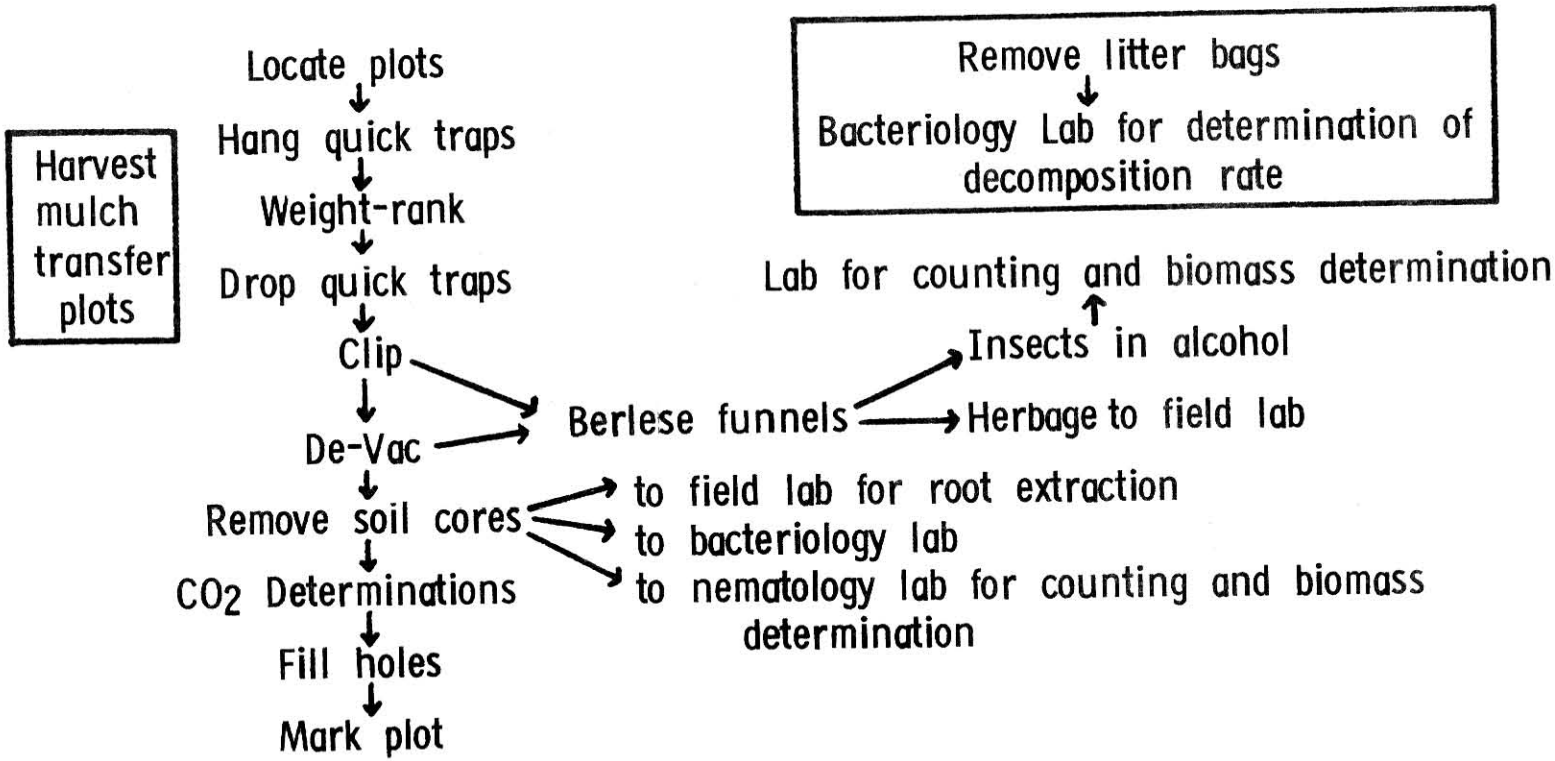

Fig. 8. Flow chart of field sampling operations. Cottonwood, 1970.

From May through July the routine was slightly different. The plots were vacuumed with the De-Vac for arthropods, then clipped, then vacuumed for mulch. Better separation of mulch and herbage was obtained as well as more complete removal of arthropods by clipping first, then vacuuming with the De-Vac. Early in the year an open-ended square plot frame, 0.5 m^2, was used for weight-ranking and clipping. More precise plot alignment was possible by using a circular plot frame and clipping inside the circular Quick Trap. High winds drifted the Quick Traps and prevented exact register of the plots weight-ranked and the plots clipped. Accordingly, from early August on a nylon cord was stretched from a pin in the center of the plot to the tripod and when released the trap slipped down the cord to provide almost perfect alignment.

4. Above-ground herbage biomass. Ten 0.5 m^2 plots were weight-ranked and clipped in each replication in each treatment for a total of 40 plots at each of 12 sampling dates. Ten times as many plots were weight-ranked as were clipped, making a total of 360 that were weight-ranked only and 40 that were weight-ranked and clipped at each sample date. Weight ranking was discontinued after the October data were taken. Samples were clipped with electric sheep shears and bagged in paper bags.

5. Mulch. After clipping the mulch was thoroughly removed by vacuuming on each of the 10 plots per replicate and bagged in pre-labeled paper bags.

6. Below-ground plant biomass. Ten 2-inch cores were taken at the first sampling period each month from May through November to a depth of 60 cm using a hydraulic coring machine mounted on a tractor.

A few samples were taken to 90 cm in order to secure a better estimate of the proportion of roots sampled. The 3-inch tube could not be used because the ground was too hard during most of the year. The cores were removed from the tube, sectioned into 0-5, 5-10, 10-20, 20-30, 30-40, 40-50, and 50-60 cm increments, bagged in polyethylene bags, labeled, and then frozen until the below-ground plant parts were washed from the soil cores in the laboratory.

Laboratory procedures

1. Routine. A flow chart of laboratory operations is presented in Fig. 9. Detailed procedures as well as departures from these operations from May through July are described below.

2. Above-ground herbage biomass. From May through July the plots were vacuumed with a De-Vac before clipping. The De-Vac picked up large amounts of green vegetation, standing dead, mulch and soil. Arthropods were extracted from these samples with Berlese funnels and the samples combined with the clipped samples for estimation of botanical composition. Estimation was unsuccessful until the samples were screened and much of the soil and mulch removed. From August through the remainder of the year plots were clipped with care to minimize disturbance of the mulch. After the herbage was removed the plots were vacuumed with the De-Vac, the arthropods were extracted in Berlese funnels from the herbage and the mulch separately.

After removal of the herbage from the Berlese funnels (or from May through July, after the composited fractions were cleaned) the samples were left in the laboratory to come to moisture equilibrium

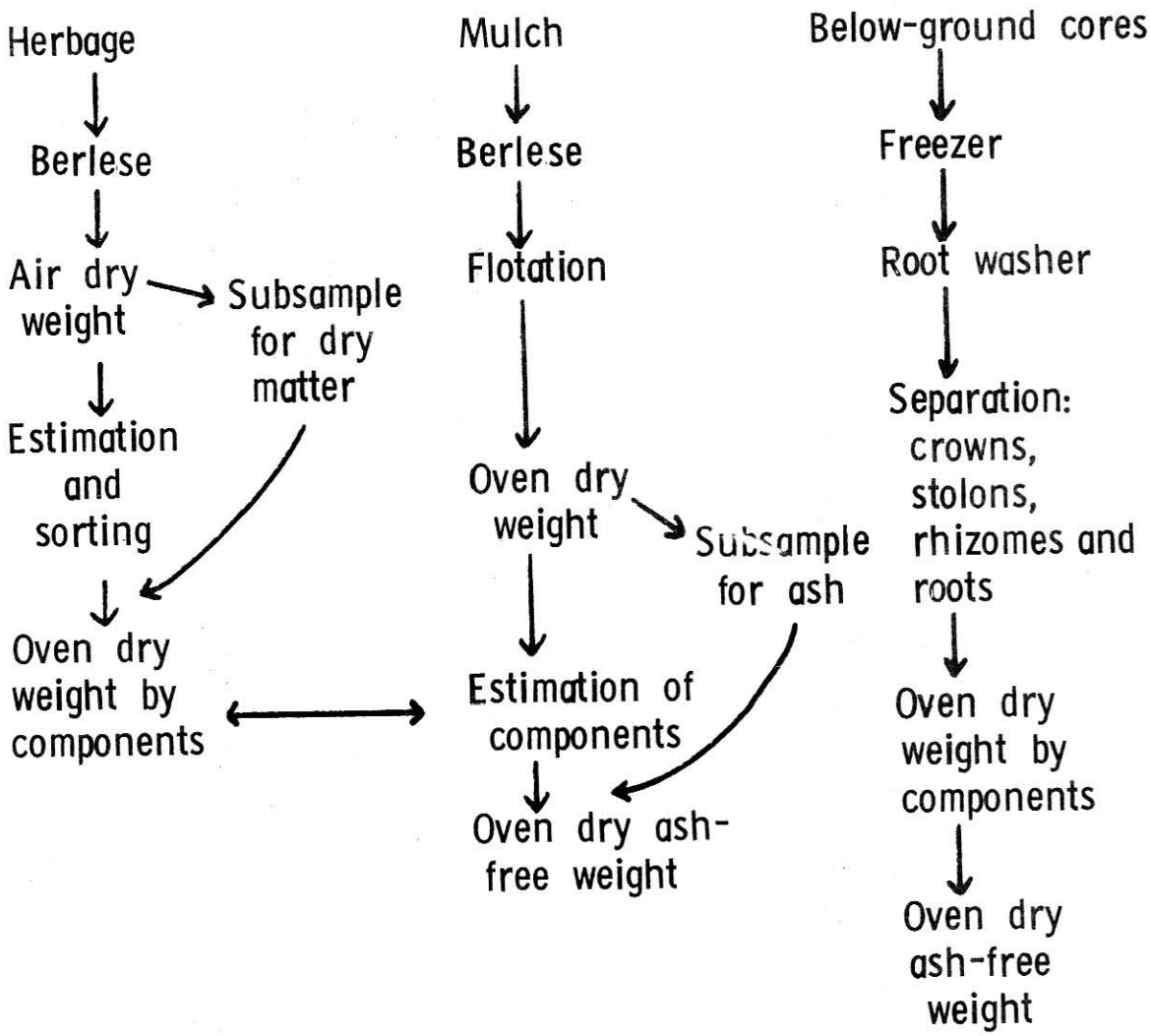

Fig. 9. Flow chart of laboratory operations in herbage dynamics. Cottonwood, 1970.

and then were weighed air dry as they were processed. Composition of various components was determined as indicated below.

Laboratory estimation procedure. The samples were grouped into data sets which were fairly uniform botanically as indicated in Table 5. The workers trained themselves in estimating the percentage air dry weight of different components in samples similar to a given data set. Their competence was further tested by estimation of synthetic mixtures of known composition. When the workers were trained so that the mean of their estimates for major components was within 10 to 15% of the actual sample mean (for example, 20 ± 2 or 3%), sample processing was begun. The samples from the permanent exclosure in high range condition were spread over a large cardboard ruled in 17 x 17 cm squares. Samples from the temporary exclosure in low range condition were spread over 12.7 x 12.7 cm squares. Each sample was spread uniformly over an area large enough to give uniform density from sample to sample. Density was chosen for the convenience of the worker.

For each plot in the data set (N_{Li}) the workers estimated the percent of each component in each plot (X_{Li}). The components which were estimated were (1) each plant species as live, this year's (recent) dead, and standing (old) dead; (2) fresh mulch; (3) humic mulch; (4) live crowns and stolons; (5) dead crowns and stolons; (6) lichens and (7) soils. Live, this year's dead, standing dead, fresh mulch and humic mulch formed a continuum at all sample dates. This year's dead was the light, unweathered material often still attached to a leaf or to a tiller. The standing dead or old dead was darker, more weathered

Table 5. Description of Data Sets Into Which Herbage Samples Were Grouped For Estimation of Component Weights Cottonwood, 1970

Data Set	Treatment	Sampling Dates	Number Plots Estimated	Number Subsamples Processed	Worker
01	Permanent, High	Early and late July and Aug., early Sept.	108[a]	12	Herndon
02	Temporary, Low	Early and late July and Aug., early Sept.	100	12	Weber
03	Permanent, High	Early and late May	40	8	Talsma
04	Temporary, Low	Early and late May	40	9	Jacobs
05	Permanent, High	Early and late June	50[b]	11	Herndon
06	Temporary, Low	Early and late June	50[b]	10	Weber
07	Permanent, High	Oct., Nov., Dec.	60	9	Herndon
08	Temporary, Low	Oct., Nov., Dec.	60	10	Weber

[a] Includes 8 plots which were clipped on July 7 before rain in Replicate I. Other plots were clipped July 10 and 11.

[b] Includes 10 plots which were clipped but which were not weight-ranked.

and usually not attached. Fresh mulch was more weathered than the standing dead but was not as dark or as fragmented as the humic mulch. As the season advanced each of these components changed in appearance. Consequently, it was necessary to prepare mounts of typical material at intervals during the season to aid in delineation. Some plants such as Lomatium and Allium progressed through all stages of decomposition in one season. Standing dead blue grama was especially difficult to distinguish from standing dead buffalograss. Dead crowns and stolons were distinguished from live crowns and stolons on the basis of color, texture and the presence of live shoot material. Total sample estimates required about 20 to 30 minutes per plot, including spreading, sacking and weighing.

A subsample of plots in each data set (N_{Si}) was selected at random by drawing white or colored disks without replacement from a container with as many total disks as plots in each replicate in the data set and with as many colored disks as plots in each replicate to be included in the subsample. The disk was drawn immediately after estimating. If only one plot per replicate was to be included in the subsample, all plots were estimated before the one to be separated was drawn. The process was repeated for each replicate in the data set. If the plot was included in the subsample, (1) the total plot estimate for each component was designated as X_{LSi}; (2) the percentage of each component in each square on the board was estimated and the mean calculated (X_{Si}); (3) a single square was chosen at random by drawing a disk from a dish containing numbers corresponding to the squares

over which the sample was spread; (4) the estimated percentage of each component in the selected square was designated as X_{Qi}; (5) the square was hand-separated by components, the components weighed and the percentage calculated (Y_{Qi}). Individual square estimations and the separation of one square, including drawing samples, weighing and calculating percentages, required 5 to 10 hours depending on the worker and the nature of the sample.

Using the data from the estimated and separated squares for each data set, the regression coefficient of the estimated (X_{Qi}) on the separated (Y_{Qi}) percentage of each component in each square and the intercept $a_Q = \bar{y}_Q - b_Q\bar{x}_Q$ were calculated. The separated percentage of each component in each plot in the subsample was predicted from the equation:

$$\hat{Y}_{Si} = a_Q + b_Q X_{Si}$$

This equation assumes that the separated percentage of each component of the total sample is equal to the mean of the separated percentages of that component in all squares over which the sample was spread. This assumption was valid in other data in which each square of several samples was individually separated. If the coefficient of determination (R^2) for the first regression was less than 0.25, estimates were used without prediction.

Using the data from each plot in the subsample of each data set, the regression coefficient of the estimated percentage of each component in the entire plot (X_{LSi}) on the separated percentage of each component in the entire plot ($\hat{Y}_{Si}$) and intercept $a_S = \bar{\hat{y}}_S - b_S\bar{x}_{LS}$ were

calculated. The separated percentage of each component in each plot of each entire data set was predicted from the equation:

$$\hat{Y}_{Li} = a_S + b_S X_{Li}$$

Inspection of the data suggests that for some components higher r values might have been obtained by using curvilinear regression forced through the origin rather than linear regression.

Oven dry weights for each component in each plot were calculated by multiplying the air dry plot weight times the dry matter percentage of samples estimated the same day times the separated percentage of that component.

All species present were recorded separately. If a component was estimated to make up less than 0.5% of the plot weight, the component was listed, but the percentage was recorded as zero. These trace species were not grouped. If the weight-ranker recorded species which the estimator did not find, these were listed, but the percentage was left blank.

3. Mulch. Some mulch was contained in the above-ground herbage biomass samples; however, the major part was removed from the plots by vacuuming. After this material was removed from the berlease funnels, it was stirred vigorously in a 12 liter vessel. The floating material was removed, oven-dried and weighed. The dried material was spread in a thin layer on a white surface and the percentage of fresh mulch, humic mulch, live crowns and stolons, and dead crowns and stolons was estimated (X_{Li}) by a trained worker. One plot per replicate was chosen for calibration and ash determination and the component percentage designated X_{Si}. The material from the selected plot was thoroughly mixed and spread uniformly over a white surface. Density was chosen for the convenience of the worker. A subsample was chosen randomly by placing a 10 x 10 cm frame over the material. The subsample which amounted to about 5 to 10% of the plot material was then hand-sorted by component (Y_i), weighed oven dry and ashed (800 C for 1 hour). Oven-dry weight of hand-sorted components of each total plot was predicted by the equation:

$$\hat{Y}_{Li} = a_S + b_S X_{Li}$$

where $a_S = \bar{y}_S - b_S \bar{x}_S$, $b_S = \dfrac{\Sigma x_S y_S}{\Sigma x_S^2}$

$\bar{y}_S$ was the mean of the separated component of the subsample, and $\bar{x}_S$ was the mean of the estimated component of the subsample. This procedure assumed that the subsample was thoroughly mixed and consequently that the percentage of each component in the subsample was the same as in the total plot. Ash-free weight of mulch components in the mulch

fraction was calculated by multiplying the oven dry weight times the ash percentage times the separated component percentage. Total mulch weight was obtained by adding the ash-free weights of the fresh and humic mulch in the above-ground herbage fraction to the fresh and humic mulch in the mulch fraction.

4. Below-ground plant biomass. Soil core segments were removed from the freezer and allowed to thaw. They were partially crushed and placed into individual cylinders of a root washer designed and constructed at South Dakota State University. Each root washer has seven cylinders mounted on a bar. Each cylinder has removable 32 mesh brass screen caps on each end and is large enough to hold a fragmented 4.2 x 10 cm core segment easily. An electric motor delivers power through a washing machine transmission to raise and lower the cylinders into a water bath with a stroke of about 10 cm and a cadence of about 75 strokes per minute. Plastic wastebaskets were filled with about 12 liters of warm (about 38 C) water containing commercial Calgon (sodium hexametaphosphate). One hundred g Calgon were added to the wash water of the 0-5, 5-10, and 10-20 cm segments, 80 g to the 20-30 cm segment, 60 g to the 30-40 cm segment and 40 g to the 40-50 and 50-60 cm segments. Approximately 75 to 90 minutes washing was required to remove all but the most stubborn soil peds. Sand and very resistant small peds in some cores did not pass the 32 mesh screen during this time. The lower cap on the cylinder was removed under water so that the plant material in the cylinder would float and not fall into the wash water. The cap was set aside until the cylinder was emptied. The cylinder was brought to the surface and the plant material transferred to a piece of 32 mesh brass

screen on a window screen over a sink. Peds were crushed and roots washed carefully and removed by hand. Some small roots did pass through the 32 mesh screen and were floating in the wash water. Accordingly, the wash water was carefully poured through the screen, thus collecting all of the material on one screen. The label was transferred and the washed sample was dried at 65 C for a minimum of 4 hours. A very few samples were dried at 100 C for not more than 3 hours.

After drying, the samples were removed from the screen, weighed and sent to South Dakota State University for sorting and ashing. Students were trained to separate crowns, rhizomes, and roots. No distinction was made between live and dead crowns. The entire separated material from each increment of each core was placed into pre-weighed crucibles, oven-dried overnight, weighed to the nearest .01 g and ashed at 800 C for 1 hour and weighed again. Weight loss of 34 samples which had been ashed at 600 C for 4 hours was negligible when ashed for an additional 1 hour at 800 C.

Above-ground Plant Biomass (Jerrold L. Dodd and James K. Lewis)

Evaluation of estimation. Linear regression coefficients (b) and coefficients of determination (R^2) for the individual square and entire plot regressions of major components for each data set are shown in Table 6. Data for each component are presented by data sets in Appendix Table 4. The data suggest that generally estimations were fairly precise where the component was an appreciable part of the vegetation. R^2 values for data set 2 were generally low. This data

Table 6. Linear Regression Coefficients and Coefficients of Determination for the Individual Square and Entire Plot Regressions of the Estimation Procedure, by Major Components and Data Sets Cottonwood, 1970.

Treatment			Permanent Exclosure High Range Condition							
Date			May		June		July, Aug., Sept.		Oct., Nov., Dec.	
Worker			R.T.		R.H.		R.H.		R.H.	
Data Set			03		05		01		07	
Regression Data[a]			Single Square	Entire Plot	Single Square	Entire Plot	Single Square	Entire Plot	Single Square	Entire Plot
Component	Phenology	Statistic								
Agropyron	Live	b_2	.87	.65	.87	1.05	.90	.00	.90	.90
		R^2	.49	.87	.84	.94	.81	.23	.95	1.00
smithii	TYD	b_2	None	None	.46	.26	.97	.76	1.01	.96
		R^2	None	None	.40	.71	.91	.84	.90	.98
	SD	b_2	.50	.46	.84	.88	.80	.84	.93	.91
		R^2	.55[b]	.81	.90	.97	.77	.64	.95[b]	.94
Bouteloua	Live	b_2	.58[b]	NP	.94	.99	.94	.00	1.00[b]	.80
		R^2	.24[b]	NP	.94	.96	.89	.24	1.00[b]	1.00
gracilis	TYD	b_2	None	None	NP	NP	.93	.00	.29	NP
		R^2	None	None	NP	NP	.96	.10	.11	NP
	SD	b_2	.50	.34	.97[b]	.92	.57	NP	.50[b]	.36
		R^2	.81	.61	.95[b]	.90	.17	NP	.42[b]	.96
Buchloe	Live	b_2	1.00	.50	1.03	1.09	.97	1.24	.69	.69
		R^2	1.00	.70	.97	.95	.90	.74	.89	1.00
dacty-	TYD	b_2	None	None	.61	.51	.67	.39	1.00	.96
		R^2	None	None	.56	.88	.75	.54	.99	.85
loides	SD	b_2	.37	.36	.96	1.04	.73	.72	.96	.76
		R^2	.99	.96	.97	.98	.89	.68	.96	.91
Fresh		b_2	1.24	.58	.74	.95	.95	.62	1.04	.90
mulch		R^2	.58	.32	.73	.95	.37	.47	.99	.85
Humic		b_2	1.12	.00	1.00	.78	.53	.00	.13	NP
mulch		R^2	.63	.00	.79	.79	.33	.21	.02	NP

Table 6 Continued. Linear Regression Coefficients and Coefficients of Determination

Treatment			Temporary Exclosure Low Range Condition					
Date			May		June		July, Aug., Sept.		Oct., Nov. Dec.	
Worker			R.J.		J.W.		J.W.		J.W.	
Data Set			04		06		02		08	
Regression Data[a]			Single Square	Entire Plot	Single Square	Entire Plot	Single Square	Entire Plot	Single Square	Entire Plot
Component	Phenology	Statistic								
Agropyron	Live	b_2	1.13	.55	1.47	1.47	-.50[b]	NP	None	None
		R^2	.92	.65	.43	.64	.12[b]	NP	None	None
smithii	TYD	b_2	None	None	None	None	None	None	.98	.65
		R^2	None	None	None	None	None	None	.58	.93
	SD	b_2	1.00[b]	.00	None	None	None	None	None	None
		R^2	1.00[b]	.00	None	None	None	None	None	None
Bouteloua	Live	b_2	.98	.44	.43	.51	.19	NP	.70	.63
		R^2	.88	.52	.36	.91	.11	NP	.69	.90
gracilis	TYD	b_2	None	None	None	None	.17	NP	.85	.75
		R^2	None	None	None	None	.01	NP	.38	.82
	SD	b_2	.91	1.00	1.00[b]	NP	.55	NP	.85	1.11
		R^2	.98	.96	.00[b]	NP	.19	NP	.83	.98
Buchloe	Live	b_2	.68	.71	1.38	1.15	.52	.39	.86	.81
		R^2	.90	.96	.70	.69	.58	.65	.87	.99
dacty-	TYD	b_2	None	None	1.00[b]	NP	.78	.65	1.11	1.12
		R^2	None	None	.00[b]	NP	.63	.75	.81	.96
loides	SD	b_2	.98	1.05	.84	.83	.48	.29	.83	.93
		R^2	.96	.97	.64	.91	.47	.56	.66	.99
Fresh		b_2	.26[b]	.13	1.75	1.17	.43[b]	NP	None	None
mulch		R^2	.94[b]	.67	.64	.57	.06[b]	NP	None	None
Humic		b_2	1.17	1.03	.87	.50	.92	.67	1.18	1.01
mulch		R^2	.93	.72	.33	.57	.84	.51	.34	.88

a/ See text, Methods and Procedures section of Above-ground Herbage Biomass for methods of calculation. NP: if R^2 was less than 0.25, if weight in the separated square was less than .0001 g, or if the component occurred in only 1 separated square original estimates were used and no predictions were made. None: component was not present or the weight in the separated square was less than .0001 g.

b/ Weight in the separated square was equal to or less than .01 g.

set must be redone. This was the first data set done by this worker, who apparently was not trained sufficiently before beginning.

In all data sets identification problems were encountered in estimation. B. gracilis and B. dactyloides are difficult to distinguish, especially when very young or after weathering. Likewise, standing dead of those two species is difficult to distinguish from fresh mulch in estimation. In separation of the material on a square, each doubtful piece of herbage was picked up with tweezers and examined under a lighted magnifier and dead categories were compared with standard specimens. The separated categories were carefully checked. Much greater precision at less cost would have been obtained by combining these two species. Careful separation of these two species by hand clipping in the field may require as much as 4 hours per m^2 without separating live, this year's dead, and standing dead by species. Complete separation of these two species in the field may be impossible for many plots at Cottonwood.

The number of plots required to sample at various levels of precision in the two treatments is shown in Tables 7 and 8. The variances were calculated from the predicted separated plot values of each component. Treatment means for herbage biomass in this report are based on 20 plots, 10 per replicate. Thus, the mean weight of live herbage at peak community standing crop can be expected to be within approximately 10% of the true mean with 95% confidence in the permanent exclosure in high range condition but within 10% of the true mean with only 90% confidence in the temporary exclosure in

Table 7. Number of Plots Per Treatment Required to Detect Differences of 10 or 20% of the Mean Standing Crop of Live Weight of Important Plant Species Near the Beginning of Growth and at Peak Standing Crop With 95, 90 or 80% Confidence. Permanent Exclosure High Range Condition, Cottonwood, 1970[a]

Species		Agropyron smithii		Bouteloua gracilis		Buchloe dactyloides		All Species	
Stage		Early	Peak	Early[b]	Peak	Early[b]	Peak	Early	Peak
Date		May 8	July 21	May 22	August 4	May 22	July 21	May 8	July 21
Standing crop, g/m^2		18.4	66.9	6.6	19.2	1.3	42.8	21.6	154.8
Standing crop, % all species		85	43	12	17	2	28	100	100
S.E., g/m^2		2.4	2.8	1.7	2.2	.5	5.2	3.4	7.5
S.E., % $\bar{x}$[c]		13	4	26	11	37	12	16	5
Difference % $\bar{x}$	Confidence %								
10	95	155	16	580	115	1209	131	223	20
10	90	106	11	396	78	825	89	152	14
10	80	63	6	234	46	487	53	90	8
20	95	39	4	145	29	309	33	56	5
20	90	27	3	99	20	211	22	38	3
20	80	16	2	58	12	125	13	22	2

[a] Calculated from the 1970 data as $n = \frac{t^2 s^2}{d^2}$, using 19 d.f. for t. Predicted separated plot values were used.

[b] These species had made no appreciable growth by May 8.

Table 8. Number of Plots Per Treatment Required to Detect Differences of 10 or 20% of the Mean Standing Crop of Live Weight of Important Plant Species Near the Beginning of Growth and at Peak Standing Crop With 95, 90 or 80% Confidence. Temporary Exclosure Low Range Condition, Cottonwood, 1970[a]

Species		Agropyron smithii		Bouteloua gracilis		Buchloe dactyloides		All Species	
Stage		Early	Peak	Early	Peak	Early	Peak	Early	Peak
Date		May 22[a]	July 21	May 8	July 21	May 8	July 21	May 8	July 21
Standing crop, g/m^2		0.6	8.6	2.7	34.5	6.7	40.6	15.4	93.8
Standing crop, % all species		1	9	17	37	44	56	100	100
S.E., g/m^2		0.1	3.2	0.5	3.5	1.3	2.5	1.8	5.1
S.E., % $\bar{x}$[b]		22	37	20	10	19	6	12	5
Difference % $\bar{x}$	Confidence %								
10	95	382	1201	331	93	328	28	119	26
10	90	225	819	225	63	223	19	82	18
10	80	132	483	133	37	132	11	48	10
20	95	109	304	83	23	81	7	30	6
20	90	64	208	57	16	55	5	20	4
20	80	38	122	34	9	33	3	12	3

[a] Calculated from the 1970 data as $n = \frac{t^2 s^2}{d^2}$, using 19 d.f. for t. Predicted separated plot values were used as actual separated values.

[b] This species had made no appreciable growth by May 8.

low range condition. At the beginning of sampling a very large number of plots would have been required for acceptable precision especially with individual species. In the permanent exclosure, the peak standing crop of live A. smithii (July 21) was estimated within 10% of the mean with 95% confidence, while the peak standing crop of live B. gracilis and B. dactyloides (July 21) were estimated at approximately 20% of the mean with 90% confidence. In the temporary exclosure, the peak standing crop of B. dactyloides was estimated within 10% of the mean with 90% confidence and B. gracilis within less than 20% of the mean with 90% confidence.

One hundred eighty plots were weight-ranked in each treatment at each sampling date in addition to the 20 plots which were both clipped and weight-ranked. The effect of the weight-ranked data on increasing precision of estimating individual species standing crop is not shown.

Herbage. A list of plant species encountered in temporary and permanent exclosures in 1970 is presented in Appendix Table 5.

Seasonal change in the live, this year's dead and standing dead components by treatment and replication for different plant species is shown in Appendix Tables 6 through 11. These data are summarized in Table 9 and in Fig. 10 through 20. The major species in the high range condition exclosure in decreasing order of peak standing crop were A. smithii, B. dactyloides, and B. gracilis while only the latter two were major species in the low range condition exclosure. Carex eleocharis and Bromus japonicus were the most important minor species on both treatments.

Table 9. Seasonal Change in Live Plus This Year's Dead Above-ground Standing Crop of Major Species and Species Groups (Oven Dry, g/m^2; Mean of 10 Plots/Replicate, 2 Replicates/Treatment; Seasonal Peaks Are Underscored), Cottonwood, 1970

Date	Agropyron smithii	Buchloe dactyloides	Bouteloua gracilis	Carex eleocharis	Bromus japonicus	All Species
			Permanent Exclosure, High Range Condition			
May 8	18.6	0.3	0.2	.4	1.0	21.9
May 22	41.5	1.3	6.7	.0	5.1	57.3
June 8	67.7	18.7	16.6	9.7	29.6	155.4
June 22	74.3	46.0	23.3	10.6	17.7	183.8
July 10[a]	98.6	33.9	17.4	8.1	15.5	185.5
July 21	100.8	52.9	13.5	3.9	11.9	199.2
Aug. 4	78.1	35.1	26.1	3.2	9.1	159.2
Aug. 20	83.9	15.7	22.5	9.4	11.1	152.8
Sept. 4	127.1	32.9	22.5	7.4		209.6
Oct. 2	75.9	29.3	22.4	8.2	10.2	151.9
Nov. 6	64.1	48.3	6.1	1.4	21.8	143.6
Dec. 4	47.0	44.2	6.5	2.8	18.6	120.9
			Temporary Exclosure, Low Range Condition			
May 8	1.4	6.7	2.7	4.5	0.0	15.4
May 22	0.6	25.6	7.6	7.1	0.2	44.9
June 8	2.2	42.9	17.2	3.8	3.5	73.4
June 22	4.8	59.0	25.5	4.0	3.9	103.8
July 10	3.2	94.7	14.6	5.1	3.4	123.0
July 21	10.7	80.6	34.5	7.2	1.2	136.8
Aug. 4	2.4	61.1	19.2	4.3	1.1	88.6
Aug. 20	3.6	100.8	20.6	4.3	0.6	138.8
Sept. 4	1.9	83.2	12.6	3.8	0.5	102.5
Oct. 2	2.9	67.3	14.9	3.2	0.4	90.9
Nov. 6	2.3	51.8	7.3	1.6	0.2	64.9
Dec. 4	2.2	52.0	6.5	1.6	0.1	62.4

[a] Means based on 28 plots (Rep I = 18 plots, Rep II = 10 plots).

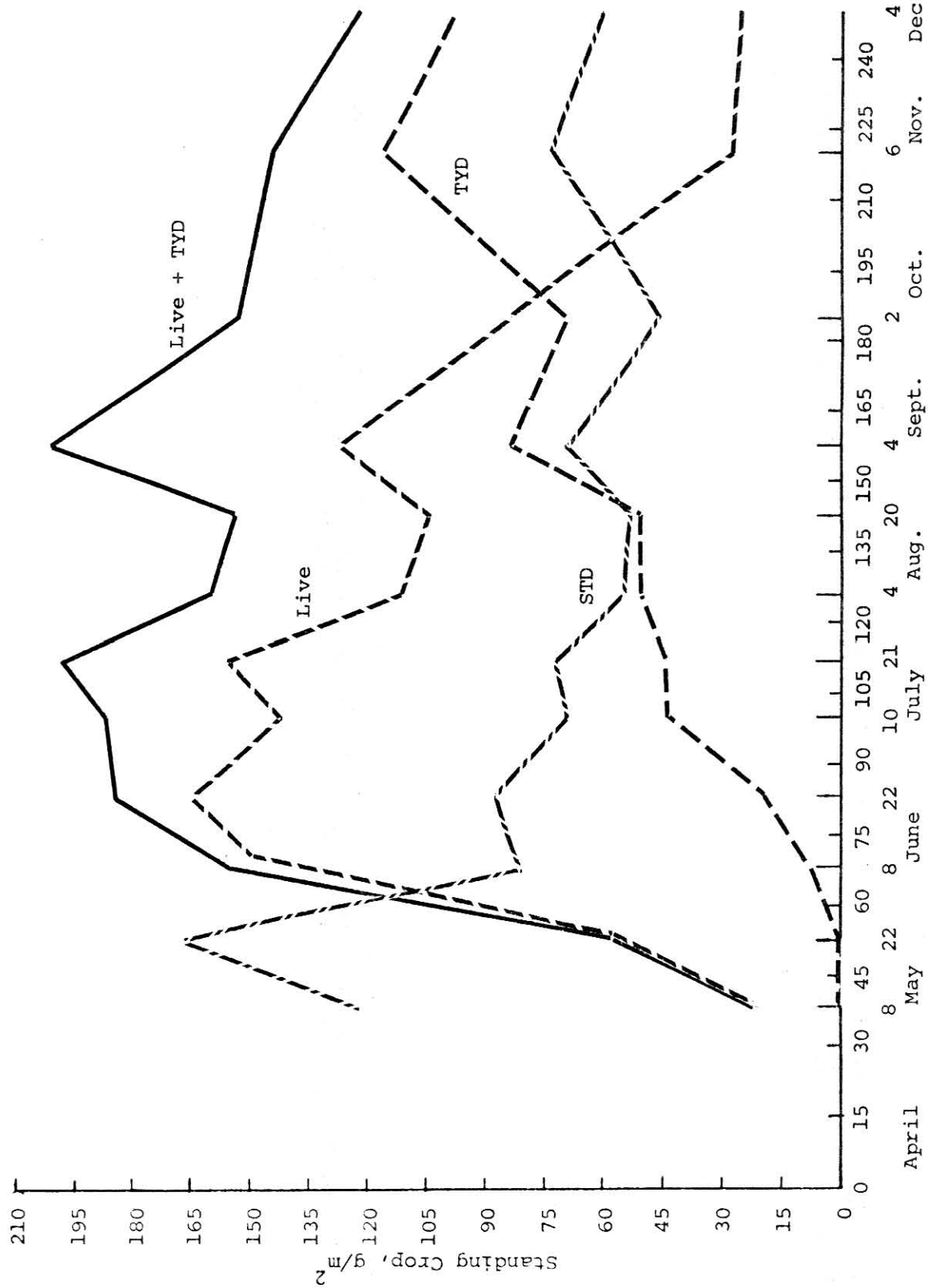

Fig. 10. Seasonal change in live, this year's dead (TYD), standing dead (STD), and live + TYD standing crop (oven-dry g/m^2) for all species--permanent exclosure, high range condition. Cottonwood, 1970.

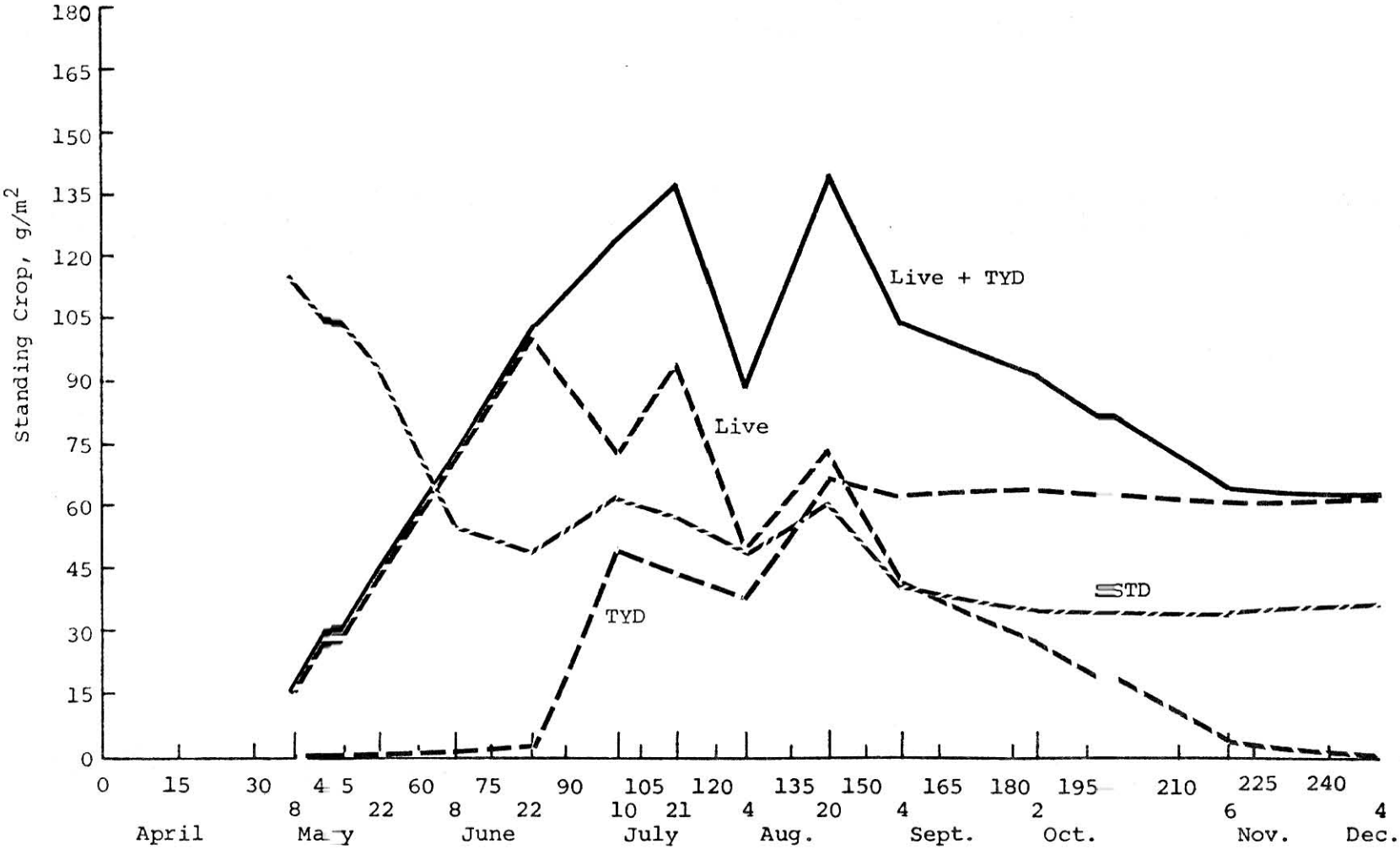

Fig. 11. Seasonal change in live, this year's dead (TYD), standing dead (STD), and live + TYD standing crop (oven-dry g/m^2) for all species--temporary exclosure, low range Condition. Cottonwood, 1970.

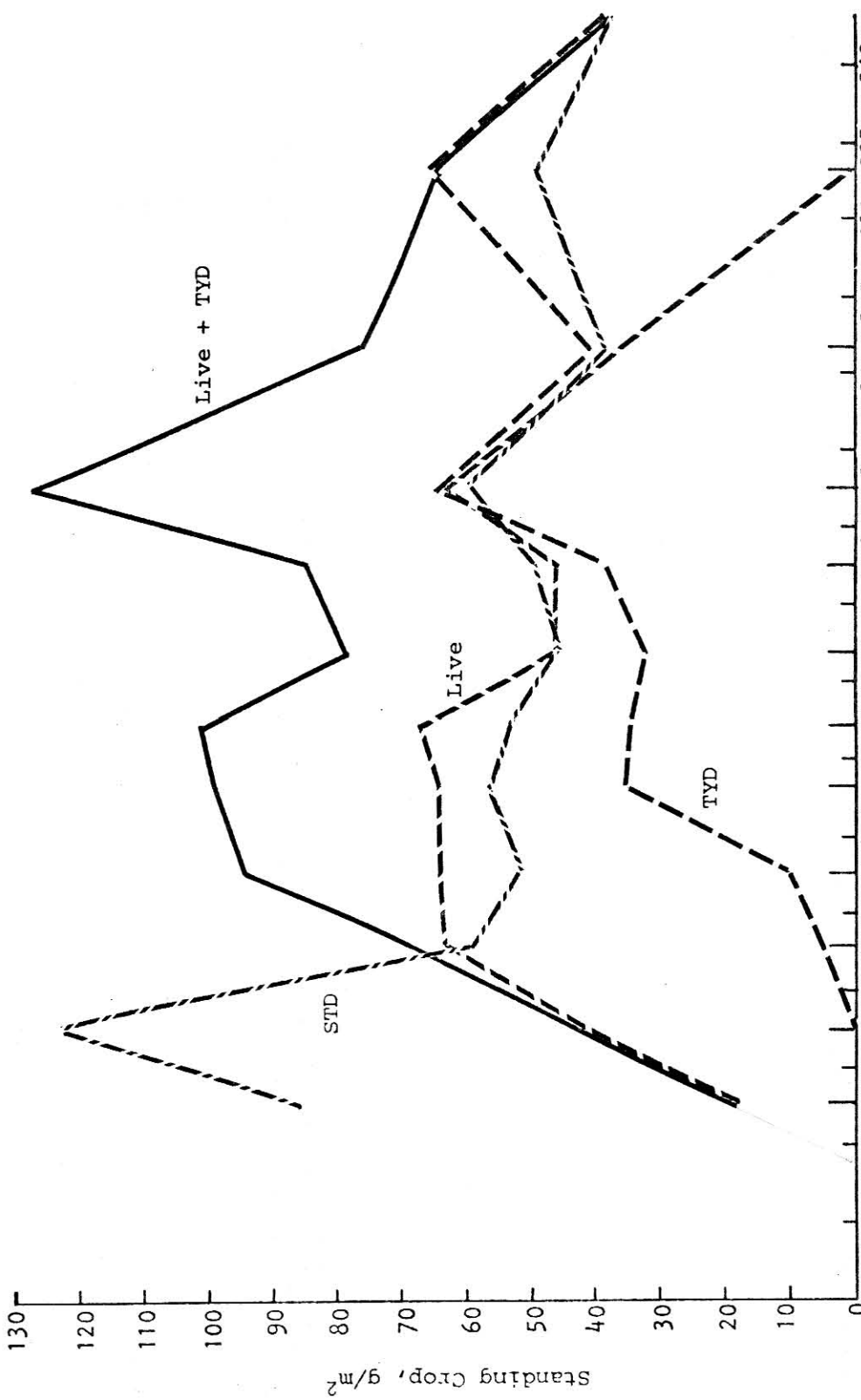

Fig. 12. Seasonal change in live, this year's dead (TYD), standing dead (STD), and live + TYD standing crop (oven-dry g/m^2) for Agropyron smithii--permanent exclosure, high range condition. Cottonwood, 1970.

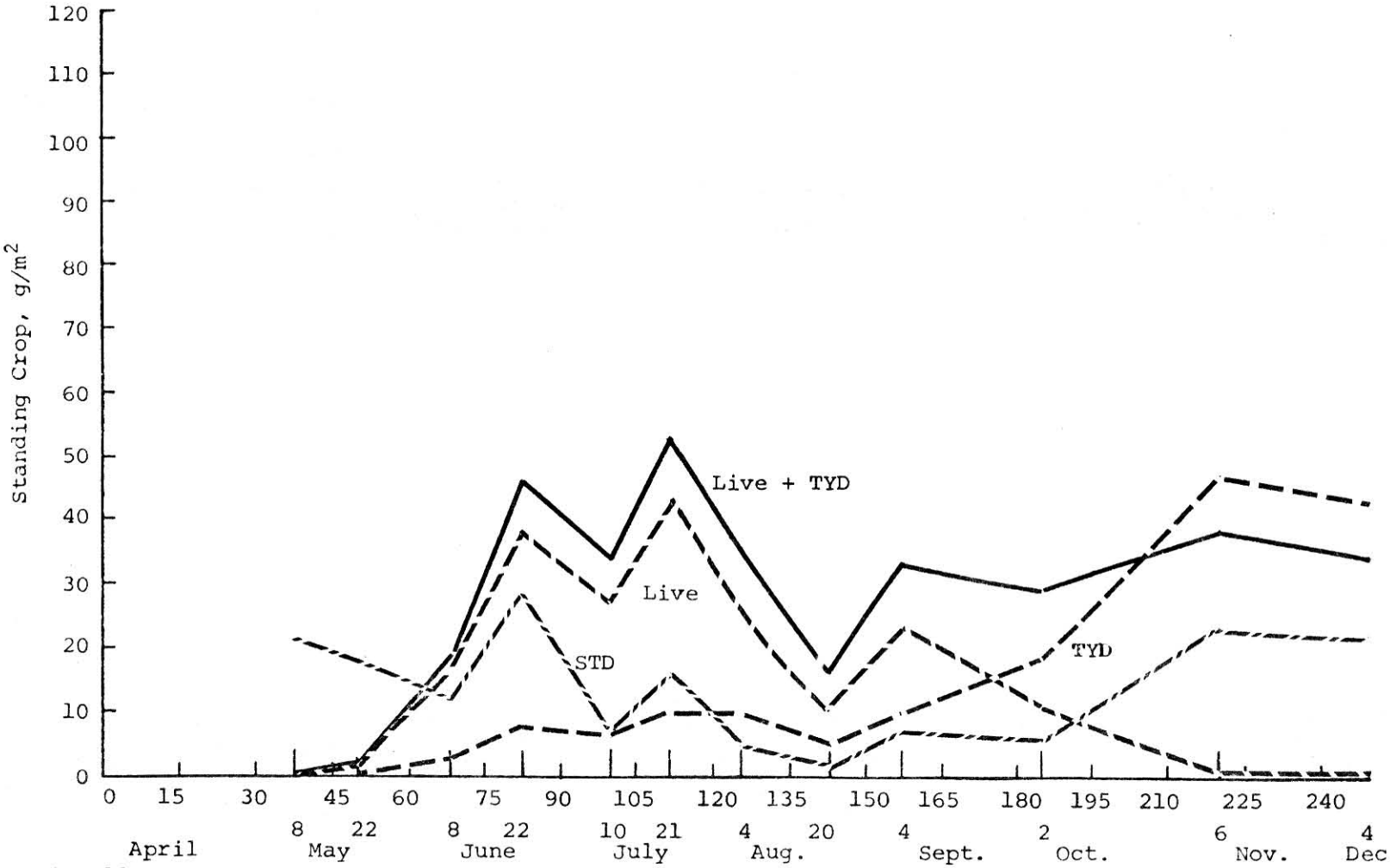

Fig. 13. Seasonal change in live, this year's dead (TYD), standing dead (STD), and live + TYD standing crop (oven-dry g/m^2) for Buchloe dactyloides--permanent exclosure, high range condition. Cottonwood, 1970.

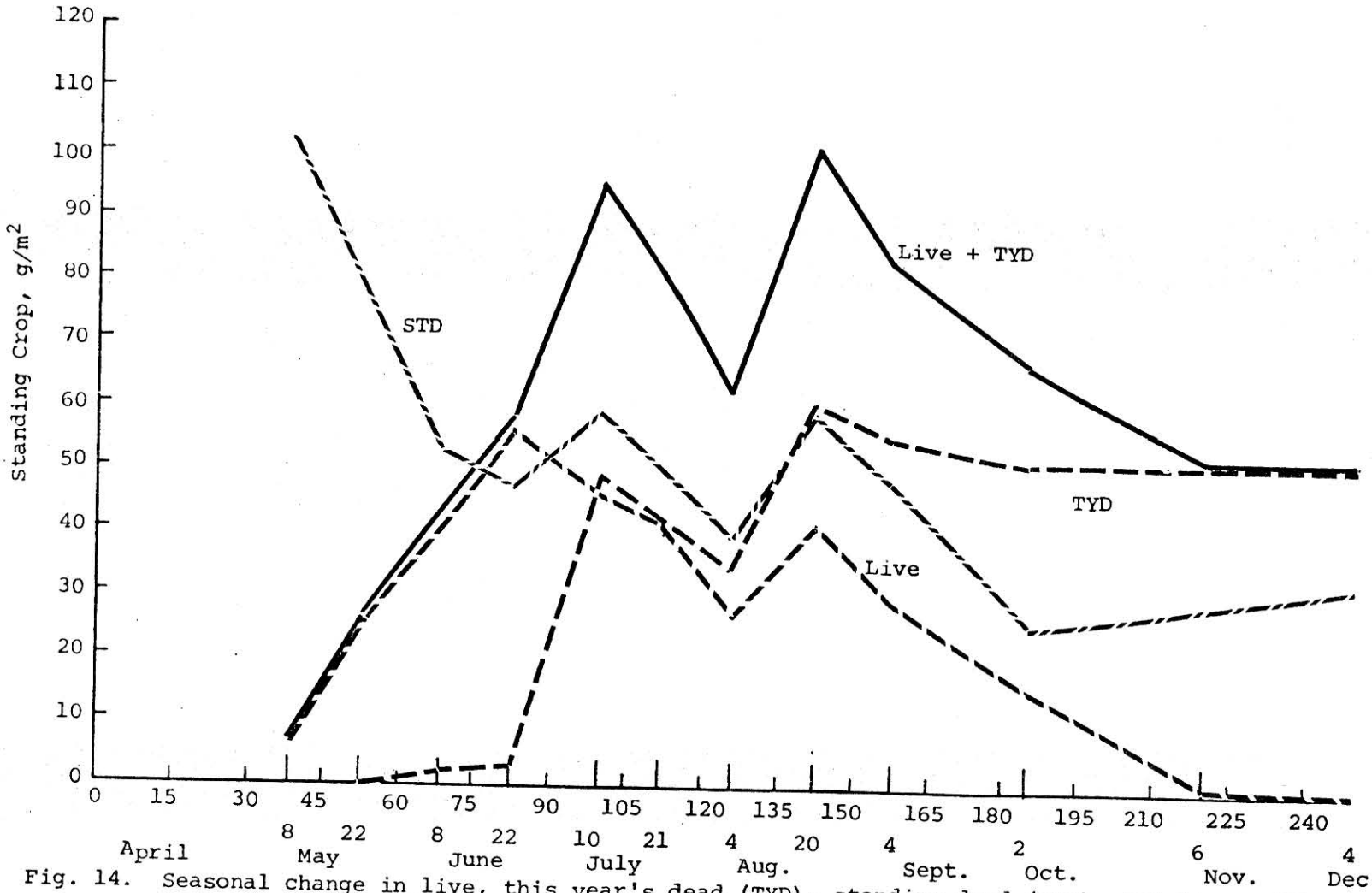

Fig. 14. Seasonal change in live, this year's dead (TYD), standing dead (STD), and live + TYD standing crop (oven-dry g/m^2) for Buchloe dactyloides--temporary exclosure, low range condition. Cottonwood, 1970.

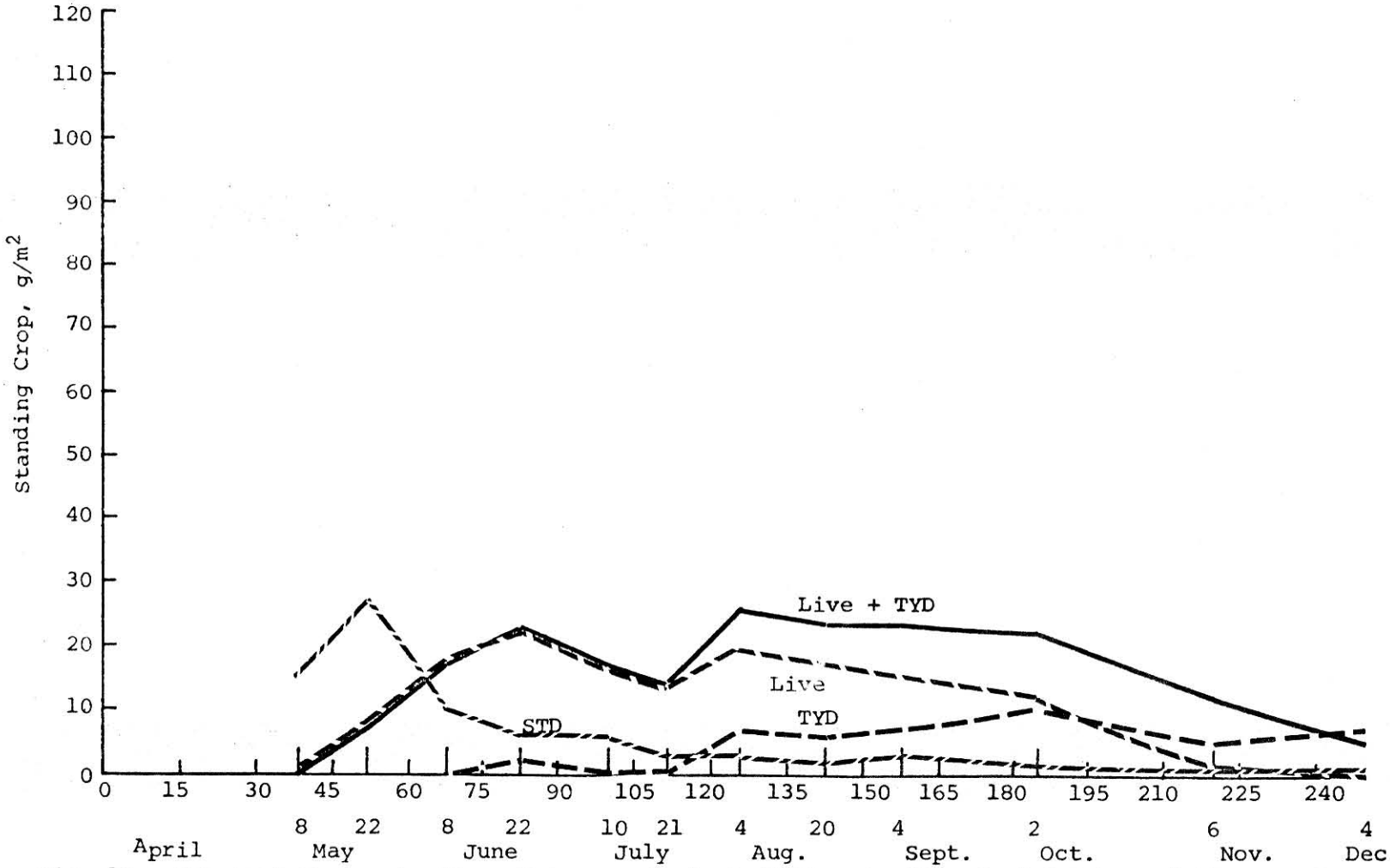

Fig. 15. Seasonal change in live, this year's dead (TYD), standing dead (STD), and live + TYD standing crop (oven-dry g/m^2) for Bouteloua gracilis--permanent exclosure, high range condition. Cottonwood, 1970.

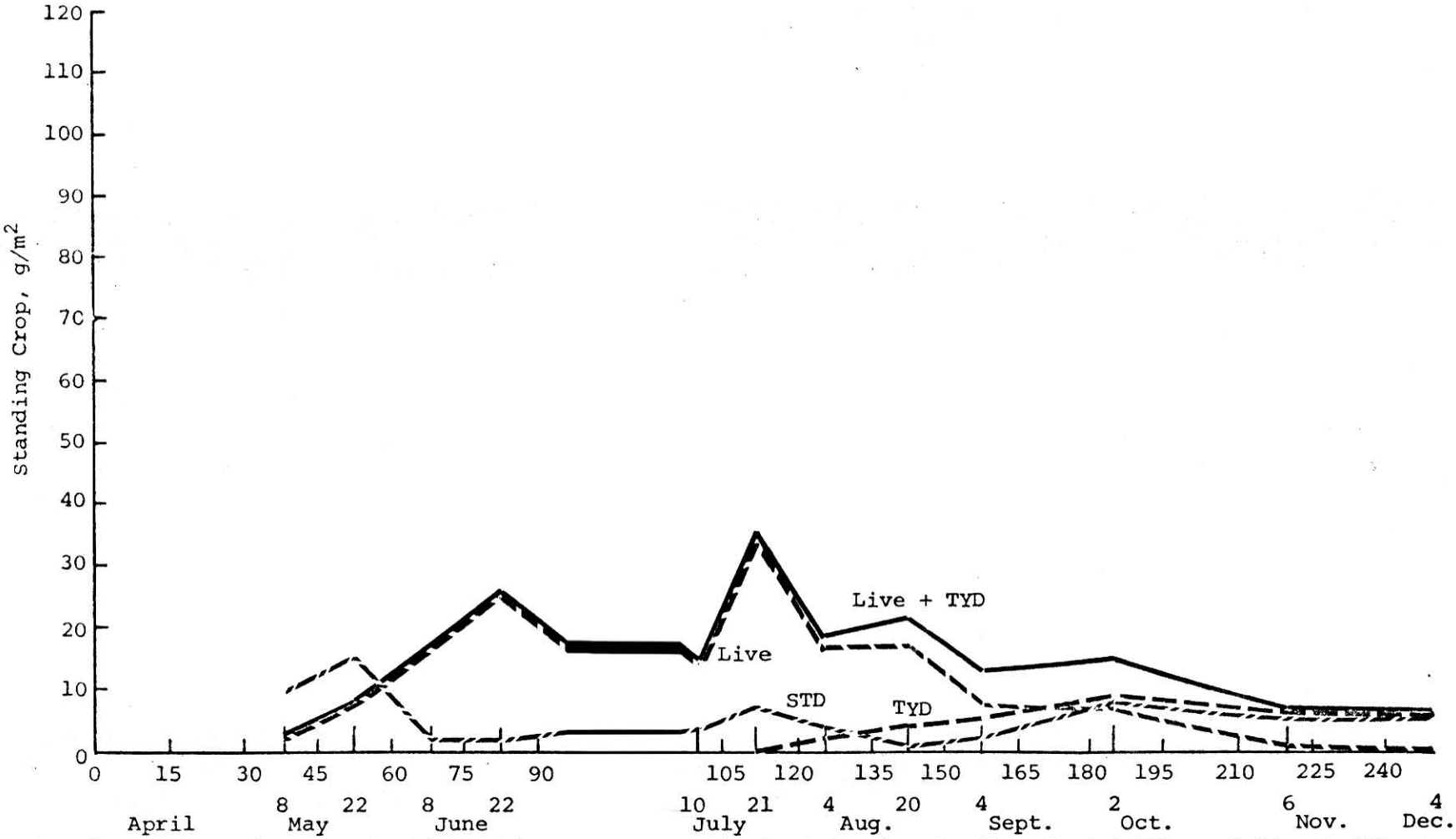

Fig. 16. Seasonal change in live, this year's dead (TYD), standing dead (STD), and live + TYD standing crop (oven-dry g/m^2) for Boutelloua gracilis--temporary exclosure, low range condition. Cottonwood, 1970.

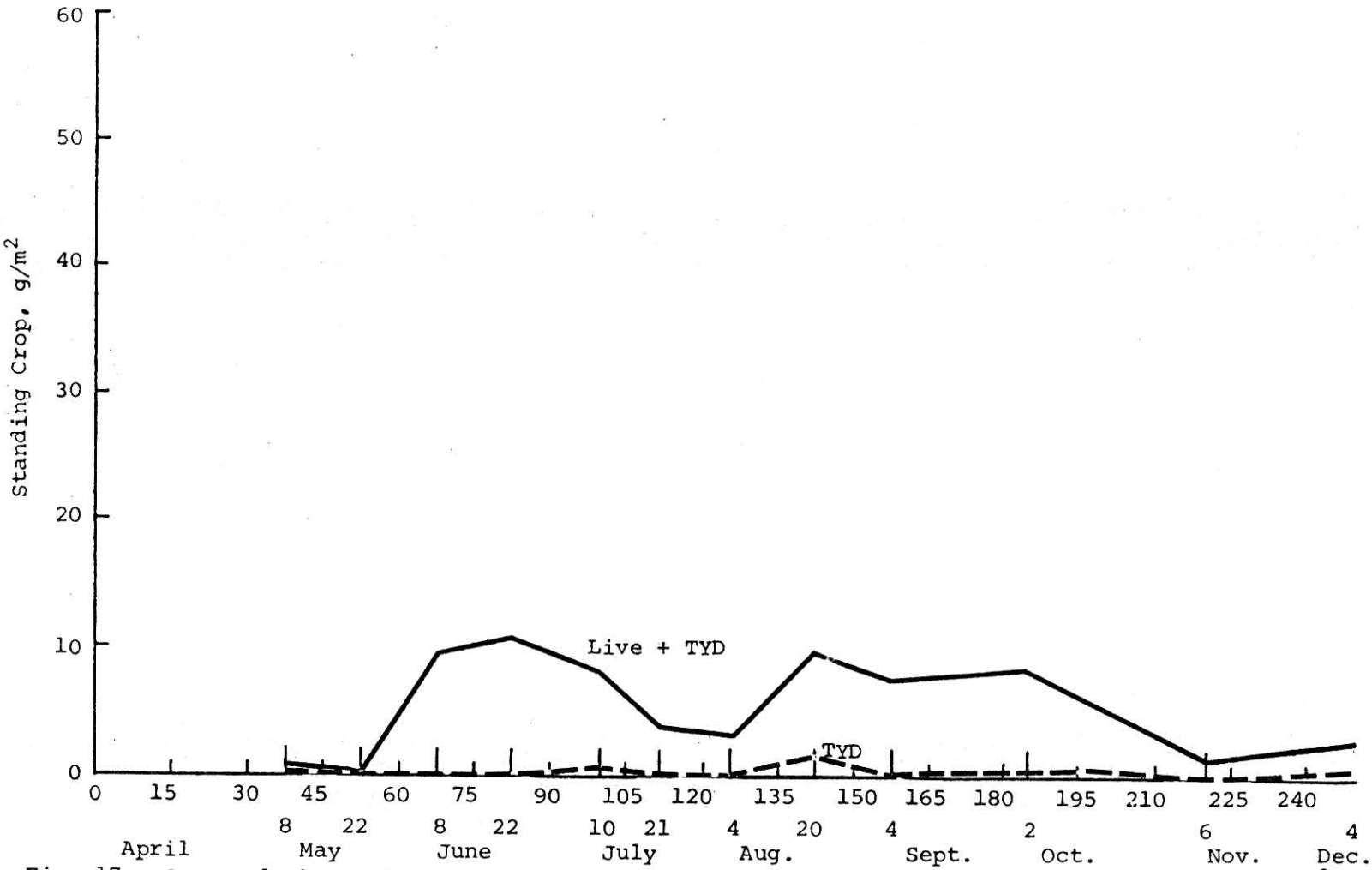

Fig. 17. Seasonal change in this year's dead (TYD) and live + TYD standing crop (oven-dry g/m^2 of Carex eleocharis--permanent exclosure, high range condition. There was no standing dead. Cottonwood, 1970.

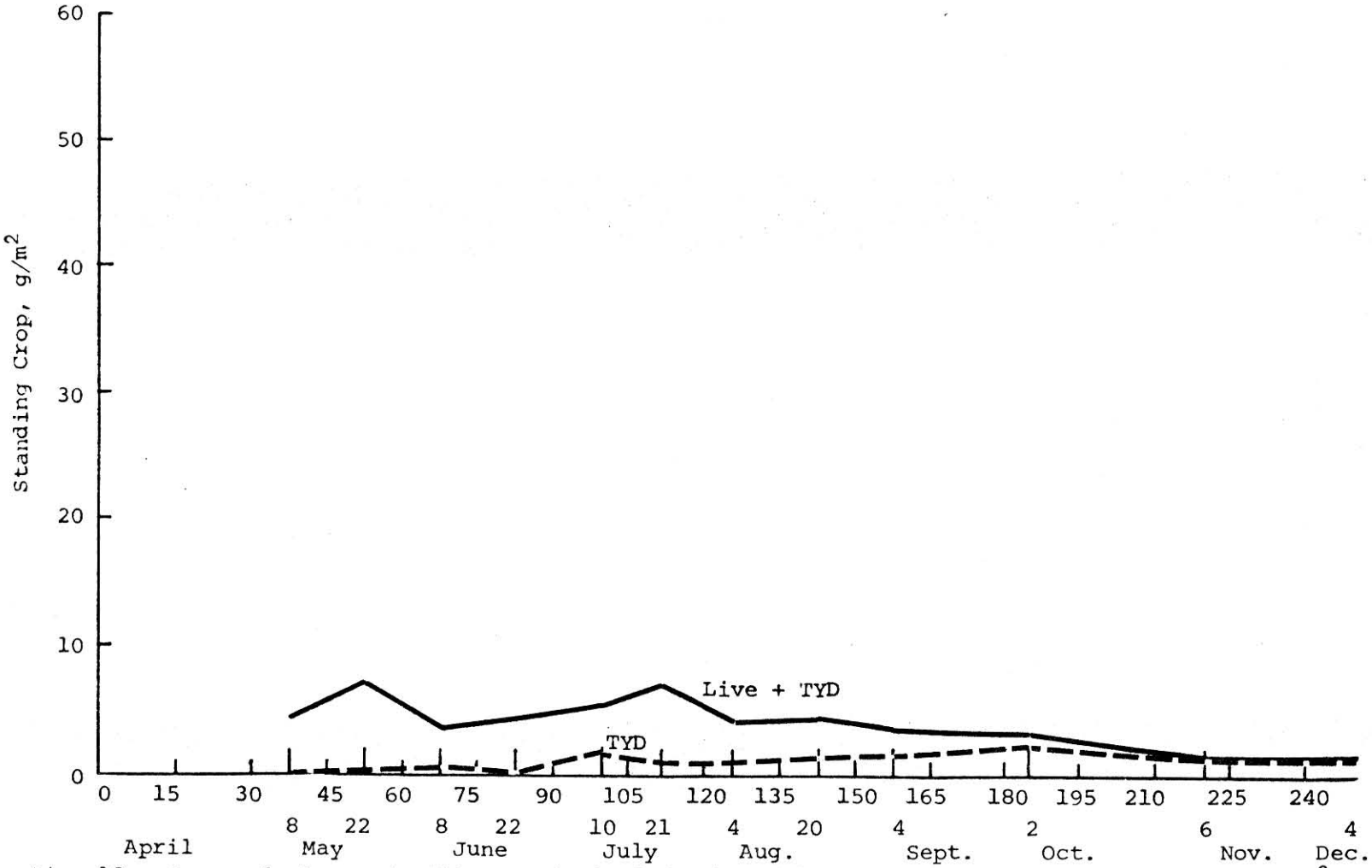

Fig. 18. Seasonal change in this year's dead (TYD) and live + TYD standing crop (oven-dry g/m^2) of Carex eleocharis--temporary exclosure, low range condition. There was no standing dead. Cottonwood, 1970.

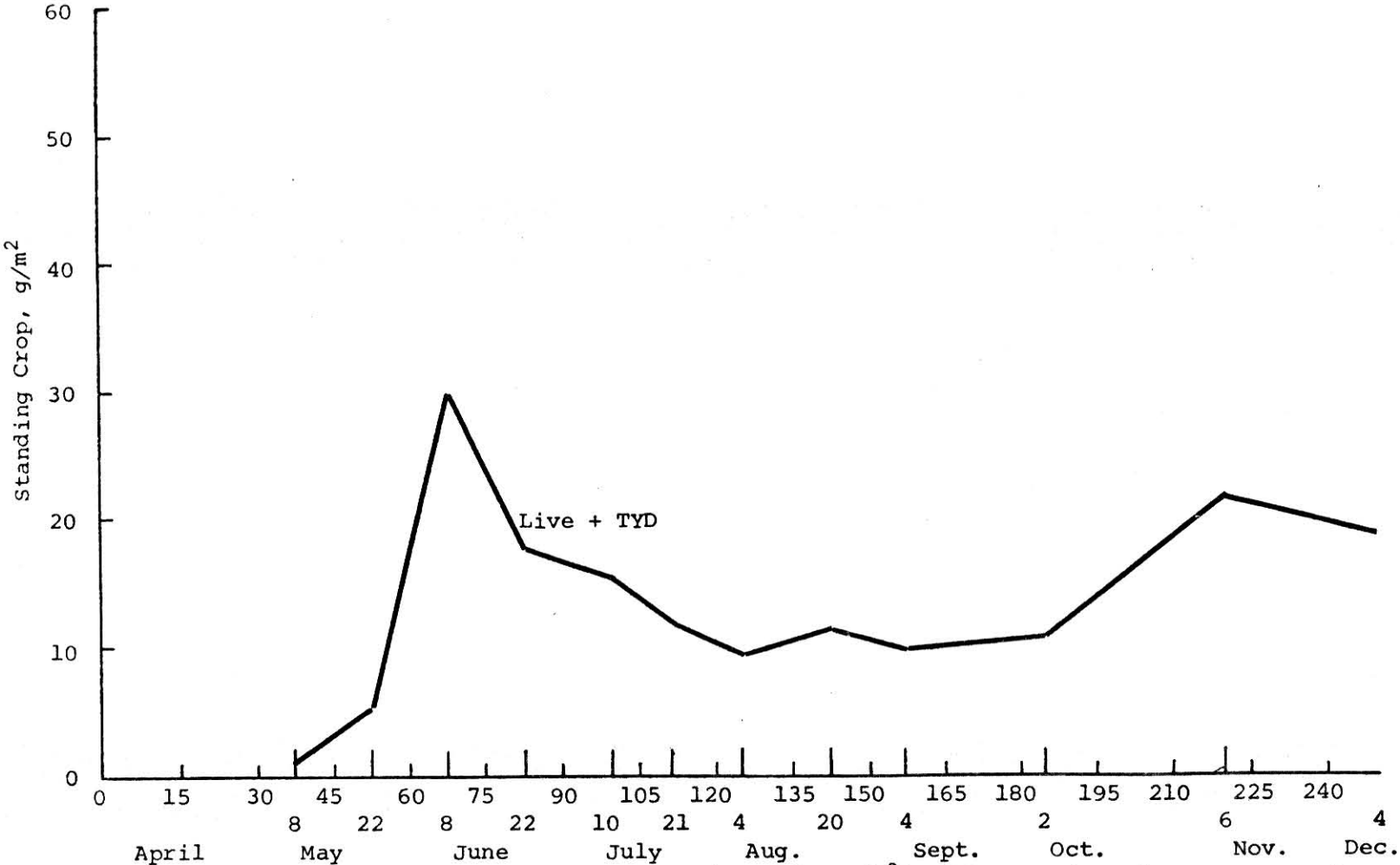

Fig. 19. Seasonal change in live standing crop (oven-dry g/m^2) of Bromus japonicus--permanent exclosure, high range condition. This year's dead was zero; standing dead was a trace. Cottonwood, 1970.

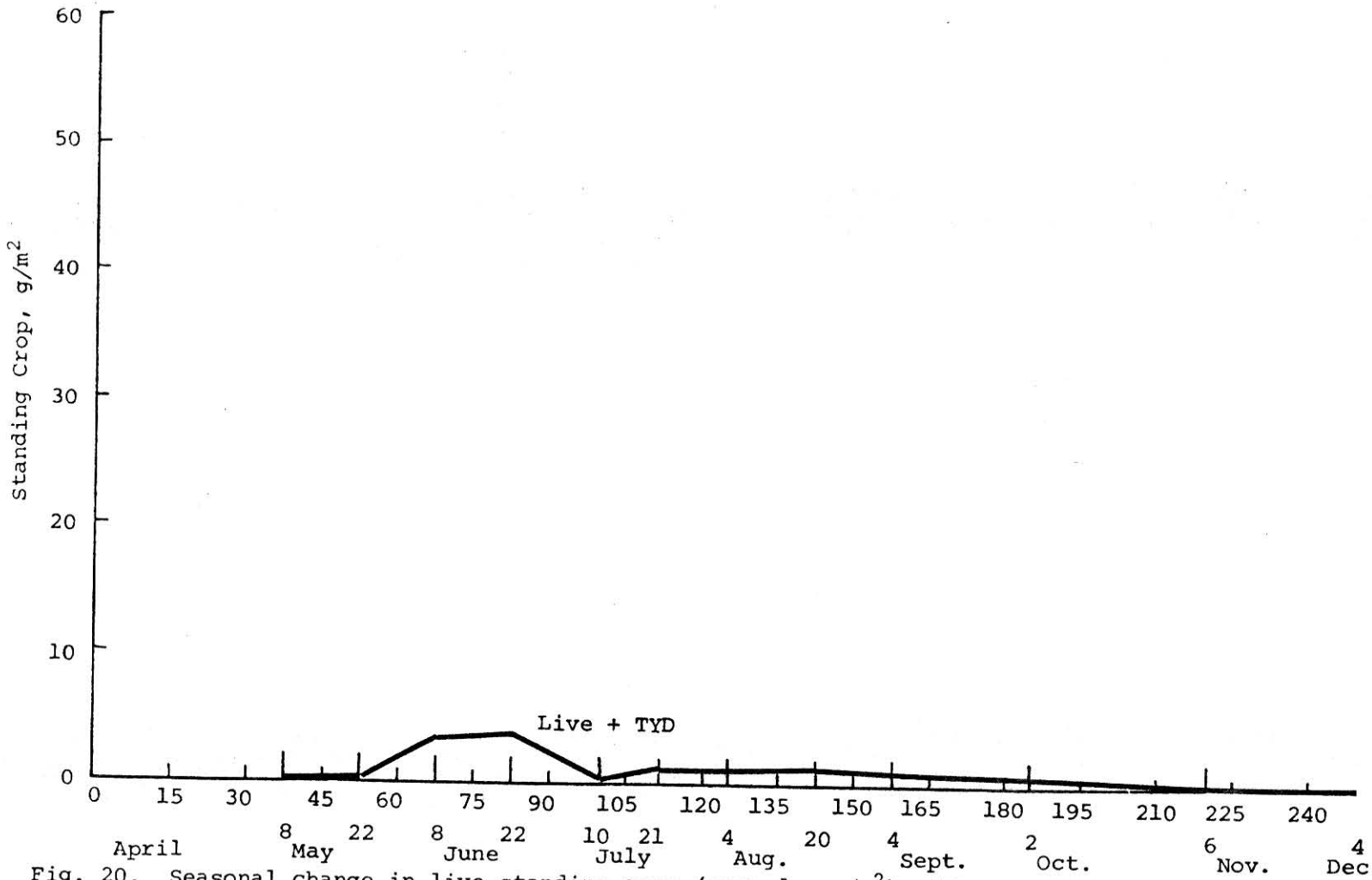

Fig. 20. Seasonal change in live standing crop (oven-dry g/m^2) of Bromus japonicus--temporary exclosure, low range condition. This year's dead and standing dead were zero. Cottonwood 1970.

Biomass of B. japonicus was much greater in the exclosure in high range condition, while the reverse was true of C. eleocharis. Collectively, these two species accounted for 5 to 25% of the current year's standing crop during the season for both treatments (Table 9). Since both are cool-season species their percentage contribution to the total decreased rapidly after early or late June.

The herbage dynamics of the combined total of all species is shown in Fig. 10 and 11. Seasonal changes in A. smithii are shown in Fig. 12 while those for B. dactyloides and B. gracilis are shown in Fig. 13 and 14 and Fig. 15 and 16, respectively. Seasonal changes in C. eleocharis and B. japonicus (two cool-season species) are shown in Fig. 17 and 18 and 19 and 20, respectively.

The seasonal peak for live herbage biomass of the entire community in the high range condition exclosure occurred in late June while the biomass for live plus this year's dead increased to late July and then peaked in early September following an apparent August decline (Fig. 10). In the low range condition exclosure, live herbage biomass for the community peaked in late June while the live plus this year's dead peaked in late July and late August (Fig. 11). As expected, this year's dead generally increased throughout the season while standing dead decreased. Standing dead or "old dead" was mainly the result of growth in previous years, thus increases in this compartment during the season reflect sampling or identification error.

Within the high range condition exclosure, the seasonal high for live A. smithii biomass occurred in late June while the seasonal high for live plus this year's dead was reached on September 4 (Fig. 12).

A. smithii increased in biomass in a very regular manner to a maximum in late July and then declined as would be expected of a cool-season grass. The large increase at the September 4 sampling date was due to very large values for two plots in replicate one, which are also responsible for the large standard error at this date. B. dactyloides exhibited both a live and a live plus this year's dead biomass peak on July 21 (Fig. 13), while B. gracilis showed a small peak in live plus this year's dead biomass in early August (Fig. 15) although live biomass was slightly higher in late June. In contrast, the seasonal peak of live plus this year's dead for C. eleocharis (Fig. 17) was reached in late June and for B. japonicus was reached in early June (Fig. 19).

Seasonal changes in biomass for species and species groups in the low range condition exclosure were similar to but apparently not identical with corresponding fluctuations in the high range condition exclosure. In the low range condition treatment the seasonal biomass peak for both live and live plus this year's dead B. dactyloides was in late August (Fig. 14) while for B. gracilis both peaks occurred in late July (Fig. 16). Amounts of C. eleocharis were small and variable but peak weights were recorded in late May and late July (Fig. 18). Amounts of B. japonicus were slightly higher in late June than in early June (Fig. 20). A. smithii was a very minor component of the vegetation in low range condition (Table 9) and trends are not presented graphically.

The community peak standing crop of live plus this year's dead was 210 and 139 g/m^2 for the permanent exclosure in high range condition and the temporary exclosure in low range condition, respectively (Table 9). The sum of the peak standing crop of the individual species and species groups was 261.0 and 151.5 g/m^2, respectively, for high and low range condition or about 21% more than the community peak standing crop.

Crowns and Stolons. Standing crops of above-ground live and dead crowns and stolons (oven-dry organic matter) are presented by treatment, replication and sampling date in Table 10, while seasonal trends are shown graphically in Fig. 21a,b.

Biomass of dead crowns and stolons appeared to be greater than that of live crowns and stolons at all but one sampling date. Crown and stolon biomass was generally greater on the high range condition treatment than on the low. Date-to-date variation was great and may reflect procedural, sampling, and identification error as well as seasonal changes. However, both live and dead crown and stolon biomass in both treatments was low in early May with peaks in June and early August.

Mulch (Jerrold L. Dodd and James K. Lewis)

Seasonal changes in oven-dry ash-free weights of fresh and humic mulch and total weight of fresh and humic mulch and live and dead crowns and stolons are shown by treatment and date in Table 11 and by replicate, treatment and date in Appendix Table 12. Trends are shown

Table 10. Seasonal Change in Live Crowns and Stolons and Dead Crowns and Stolons (g/m^2, Ash-Free Mean of 10 Plots/Replicate), Cottonwood, 1970

Date	Live Crowns and Stolons						Dead Crowns and Stolons					
	Rep I		Rep II		Rep I & II		Rep I		Rep II		Rep I & II	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Permanent Exclosure, High Range Condition												
May 8	16.3	2.8	14.7	0.7	15.5	1.4	21.1	2.1	28.7	1.5	24.9	1.5
May 22	22.7	3.2	12.1	2.6	17.1	2.3	42.3	4.3	20.7	3.7	31.5	3.7
June 8	50.8	7.0	39.0	4.4	44.9	4.2	124.1	14.7	87.3	8.5	104.2	9.5
June 22	85.3	8.7	111.7	8.6	103.5	6.8	64.0	4.2	52.3	2.3	55.9	2.3
July 10[a/]	51.5	4.7	38.4	4.4	46.8	3.6	68.0	6.6	54.5	4.9	63.2	4.7
July 21	49.9	3.3	38.0	4.5	43.8	3.0	65.2	4.5	70.7	3.5	68.0	2.8
Aug. 4	55.8	9.4	63.8	6.0	59.8	5.5	75.6	5.3	92.3	9.5	84.0	5.6
Aug. 20	24.2	2.4	34.3	1.5	29.3	1.8	54.2	4.4	50.8	1.8	52.5	2.4
Sept. 4	18.4	3.5	30.4	3.8	24.4	2.9	63.4	5.5	69.9	6.8	66.6	4.3
Oct. 2	27.7	3.4	39.0	4.0	34.3	3.0	39.4	2.3	56.5	6.5	47.5	3.8
Nov. 6	25.2	3.2	33.9	4.6	29.5	2.9	20.5	1.7	25.0	2.5	22.8	1.6
Dec. 4	22.4	3.0	21.1	4.3	21.8	2.5	21.8	2.4	24.2	1.8	23.0	1.5
Temporary Exclosure, Low Range Condition												
May 8	22.3	2.4	9.8	1.8	16.1	2.0	29.3	2.6	23.1	2.2	26.2	1.8
May 22	30.8	3.2	28.3	2.1	29.6	1.9	49.5	5.8	58.8	2.0	54.1	3.2
June 8	33.8	3.3	18.7	1.4	26.2	2.5	76.5	3.2	52.5	4.6	64.5	3.9
June 22	29.3	1.6	41.3	2.9	37.3	2.2	76.5	9.5	74.8	4.2	75.4	4.1
July 10	13.3	1.9	16.7	2.3	15.0	1.5	21.4	1.9	35.9	2.0	28.7	2.1
July 21	15.9	2.1	18.1	1.6	17.0	1.3	35.1	2.6	37.8	2.7	36.5	1.8
Aug. 4	39.7	10.9	40.8	6.9	40.3	6.3	93.4	9.2	68.4	4.6	80.9	5.8
Aug. 20	19.6	1.9	23.3	2.9	21.4	1.7	48.4	7.9	60.7	2.9	54.5	4.4
Sept. 4	16.9	1.2	38.0	2.6	27.4	2.9	38.4	2.4	46.1	3.9	42.3	2.4
Oct. 2	26.6	3.1	33.7	2.8	30.1	2.2	38.9	1.7	48.3	4.1	43.6	2.4
Nov. 6	13.7	0.5	16.4	1.7	15.0	0.9	22.6	1.7	20.7	1.8	21.7	1.2
Dec. 4	13.0	1.1	19.8	1.7	15.7	1.4	34.1	3.1	40.3	2.7	36.5	2.3

[a/] Replicate I contained 18 plots and treatment mean is weighted accordingly.

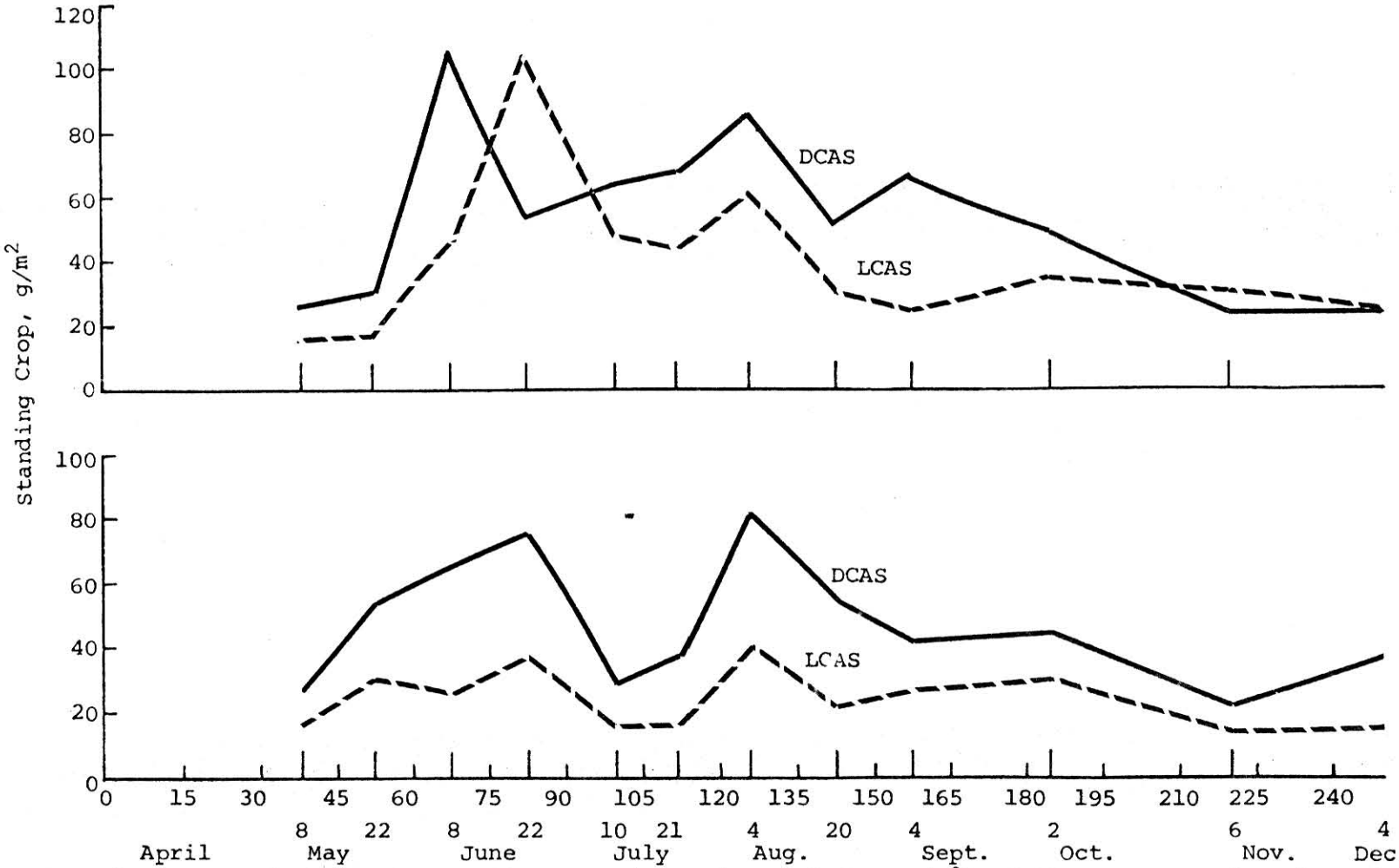

Fig. 21. Seasonal change in standing crop (oven-dry, ash-free g/m^2) of live crowns and stolons (LCAS) and dead crowns and stolons (DCAS) for the (a) permanent exclosure, high range condition and (b) temporary exclosure, low range condition. Cottonwood, 1970.

Table 11. Seasonal Change in Fresh and Humic Mulch and in Total Weight of Mulch and Live and Dead Crowns and Stolons, Oven-dry Organic Matter, g/m^2, Cottonwood, 1970

Date	Fresh		Humic		Total	
	Mean	SE	Mean	SE	Mean	SE
	Permanent Exclosure High Range Condition					
May 8	155	7.7	63	4.2	258	10.0
May 22	261	10.7	111	7.2	408	16.7
June 8	235	11.0	85	6.9	469	21.6
June 22	332	10.7	106	8.4	597	20.9
July 10	309	12.0	107	5.4	526	19.0
July 22	361	15.4	118	7.7	591	21.5
Aug. 3	320	12.3	119	7.3	582	20.5
Aug. 20	301	14.9	98	8.4	480	21.9
Sept. 4	287	14.1	64	4.7	442	18.4
Oct. 2	218	6.8	49	5.4	344	10.0
Nov. 6	218	11.4	56	2.8	326	14.7
Dec. 4	198	10.0	41	1.9	284	11.5
	Temporary Exclosure Low Range Condition					
May 8[a/]	49	3.4	37	4.5	128	--
May 22	113	6.0	39	4.1	235	12.2
June 8	134	8.0	62	4.6	287	15.7
June 22	168	10.3	82	5.5	362	19.8
July 10	94	7.7	85	13.0	222	20.2
July 22	136	6.3	45	4.8	235	10.4
Aug. 3	160	7.0	79	3.6	360	15.7
Aug. 20	134	4.5	54	1.7	264	7.3
Sept. 4	114	4.6	46	2.4	230	10.4
Oct. 2	87	4.8	68	6.6	229	11.2
Nov. 6	80	2.8	47	2.5	163	6.4
Dec. 4	74	3.3	54	2.8	179	8.5

[a/] Computer output for the temporary exclosure on May 8 showed no fresh mulch. Fresh mulch values were supplied from hand-calculated data and the standard error calculated. These values were added to the total but the standard error was not calculated.

graphically in Fig. 22a,b. In the high range condition exclosure values for total mulch plus live and dead crowns and stolons were low in early May (258 g/m^2), increased to a late July peak (591 g/m^2) and then decreased throughout the growing season. A similar pattern was apparent for the low range condition exclosure with a low at the beginning of sampling in early May of 79 g. However, a double peak was observed in this treatment, one in late June (362 g/m^2) and another in early August (360 g/m^2).

In the high range condition exclosure fresh mulch increased from a low of 155 g/m^2 in early May to a peak of 361 g/m^2 in late July and then declined slowly, while the humic mulch increased somewhat erratically from 63 g/m^2 in early May to a peak of 119 g/m^2 in late July and early August and then decreased. In the low range condition exclosure both fresh and humic mulch values were somewhat erratic with peaks in late June and early July, respectively.

Both fresh and humic mulch compartments increased in weight during early spring when moisture was favorably and decomposition rates were high, because of transfers of material from the herbage to the fresh mulch (mainly standing dead) and transfers from fresh to humic mulch.

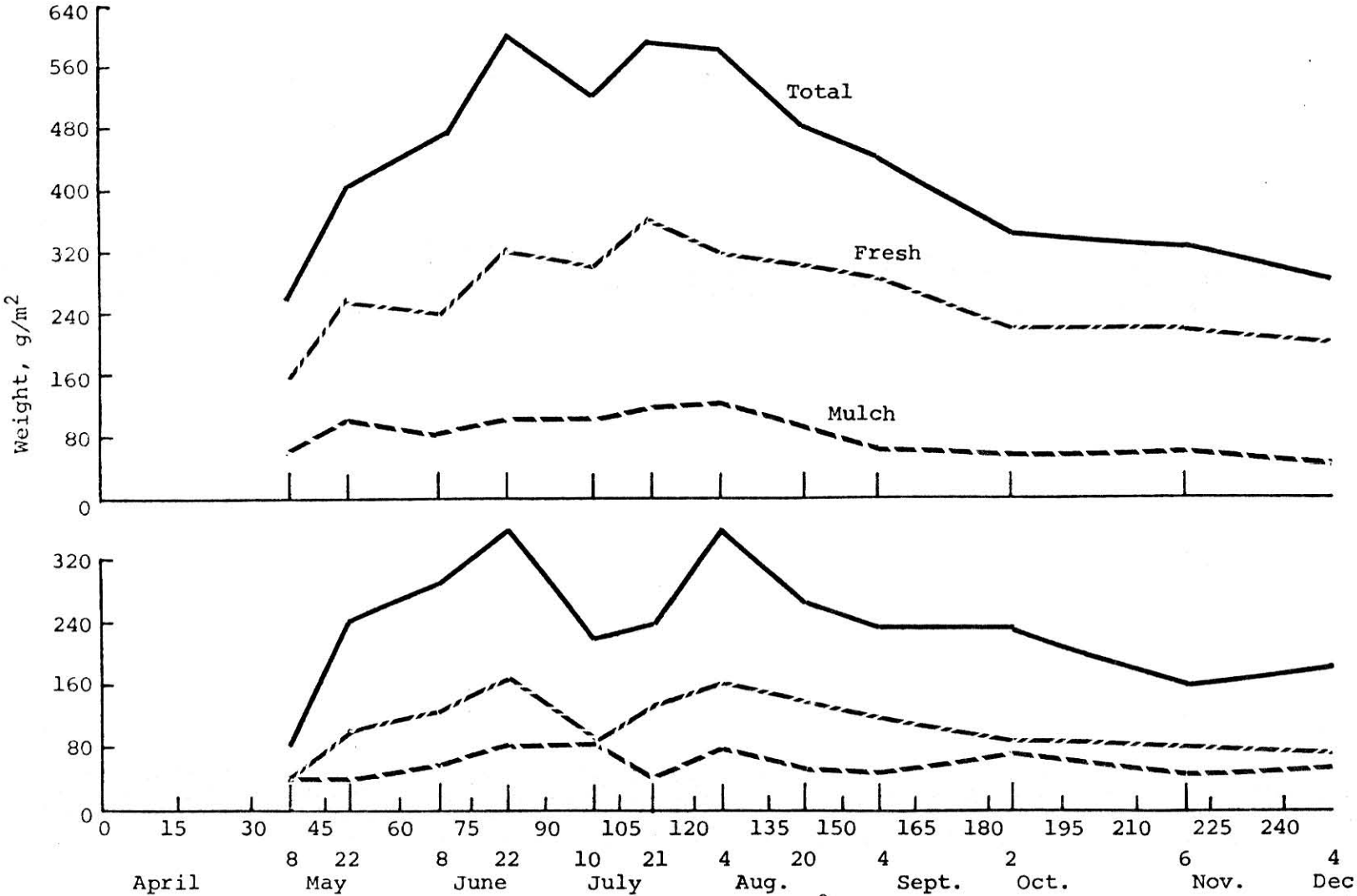

Fig. 22. Seasonal change in weight (oven-dry, ash-free g/m^2) of fresh mulch, humic mulch and total weight of fresh mulch, humic mulch, dead crowns and stolons, and live crowns and stolons for the (a) permanent exclosure, high range condition and (b) temporary exclosure, low range condition.

Below-Ground Plant Biomass (H. L. Hutcheson, Jerrold L. Dodd, James K. Lewis)

Weights of below-ground plant crowns, rhizomes, and roots are shown by sampling date and depth for the permanent exclosure in high range condition in Table 12 and for the temporary exclosure in low range condition in Table 13. Data by replicates and the number of plots per replicate are shown in Appendix Tables 12 and 13.

Crowns. This category consisted mainly of the below-ground crowns: the area where the root system converged. Minor amounts of above-ground stem crowns which were missed in clipping were included, however. The barrenness of the clipped quadrats was evidence that stem crowns represented only a small part of this compartment.

Rhizomes. The rhizome standing crop was small (Tables 12 and 13), sampling errors were large, and consistent seasonal trends were not apparent. However, mean seasonal rhizome weights were about 50% greater in the high range condition exclosure than in the low (32 versus 20 g/m^2).

Roots. The seasonal variation in total root biomass for the two treatments is graphed in Fig. 23. A much higher root biomass is apparent in the low range condition exclosure. A peak biomass of roots and rhizomes in the upper 60 cm of soil of 1908 g/m^2 occurred on July 10 while a peak of 1218 g/m^2 occurred on the same date in the high range condition exclosure. These differences could be a direct result of the past grazing history of the treatments, or more likely, an indirect effect of the grazing history altering the species composition. The low range condition treatment was dominated by B. dactyloides and B. gracilis, while the high range condition treatment

Table 12. Seasonal Change in Below-Ground Plant Biomass (Oven Dry, Ash-Free g/m^2) by Compartments and Depth (cm). Permanent Exclosure, High Range Condition, Cottonwood, 1970

	May 8	June 8	July 10	Aug. 4	Sept. 4	Oct. 2	Nov. 6
Crowns	124	187	148	95	195	149	237
Rhizomes							
0-5	21	29	17	22	21	39	22
5-10	17	7	6	7	12	13	11
10-20	1	t	2	t	2	2	t
Total	39	36	25	29	35	54	33
Roots							
0-5	314	353	359	302	327	308	348
5-10	148	145	180	134	166	166	170
10-20	167	191	214	174	180	199	197
20-30	105	130	133	133	133	156	134
30-40	71	98	123	93	105	116	99
40-50	65	79	100	77	74	74	74
50-60	64	73	84	61	62	73	55
Total	934	1069	1193	974	1047	1092	1077
Total	1097	1292	1366	1098	1277	1295	1347

Table 13. Seasonal Change in Below-Ground Plant Biomass (Oven Dry, Ash-Free g/m^2) by Compartments and Depth (cm). Temporary Exclosure, Low Range Condition, Cottonwood, 1970

	May 8	June 8	July 10	Aug. 4	Sept. 4	Oct. 2	Nov. 6
Crowns	205	235	318	183	262	235	284
Rhizomes							
0-5	15	15	20	18	18	12	16
5-10	2	3	3	3	4	11	t
10-20	0	t	t	1	1	t	t
Total	17	18	23	22	23	23	16
Roots							
0-5	453	493	668	586	493	581	623
5-10	295	313	319	289	299	286	393
10-20	341	358	347	346	311	367	351
20-30	217	228	222	199	215	228	206
30-40	141	169	153	153	130	150	135
40-50	97	103	105	103	96	108	110
50-60	76	64	72	90	64	76	69
Total	1620	1728	1886	1766	1608	1796	1887
Total	1842	1981	2227	1971	1893	2054	2187

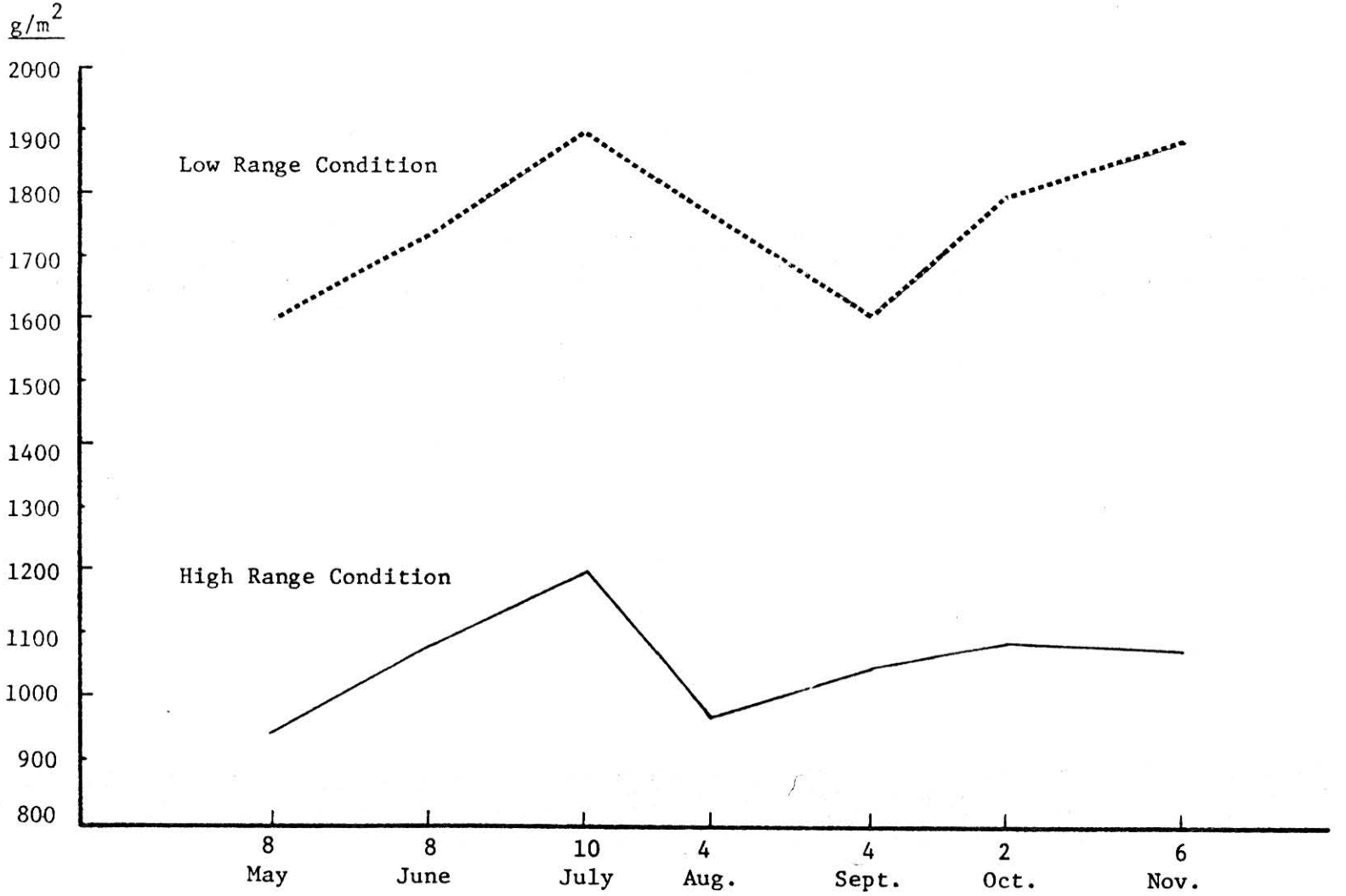

Fig. 23. Seasonal change in root biomass in the permanent exclosure in high range condition and in the temporary exclosure in low range condition. Cottonwood, 1970.

was dominated by these two species in combination with A. smithii.

Root biomass in both treatments increased from May 8 to a peak on July 10. It then decreased in low range condition until September 4 when the biomass was almost as low as at the beginning of the sampling period in May. Biomass then increased until November 6, when it was almost equal to the July 10 peak. The proportionate decrease following the peak was not as great in the high range condition treatment. Furthermore, the low point was reached on August 4, a month earlier than the minimum in the low range condition treatment. The subsequent increase was also less and did not reach the equivalent of the July 10 peak. Seasonal changes in root biomass may have been affected by the seasonal distribution of soil moisture (Fig. 5) and accompanying changes in above-ground productivity. However, root biomass changes also reflect shifts in carbohydrate sinks during the growing season. Although the trends were evident at all depth increments, the fluctuations were much greater in the upper levels.

At the time of peak below-ground standing crop, the biomass of the three components and their percentages were: roots: 1194 (87%), crowns: 148 (11%), and rhizomes: 24 g/m^2 (2%) in the high range condition exclosure; and roots: 1885 (85%), crowns: 318 (14%), and rhizomes: 23 g/m^2 (1%) in the low range condition exclosure.

Fig. 24 shows the mean root biomass (May through November) by depth increment. Almost half of the total biomass is in the top 10 cm (46% in the high range condition and 44% in the low range condition). The differences in biomass between the two treatments is also proportionately greater in the upper levels.

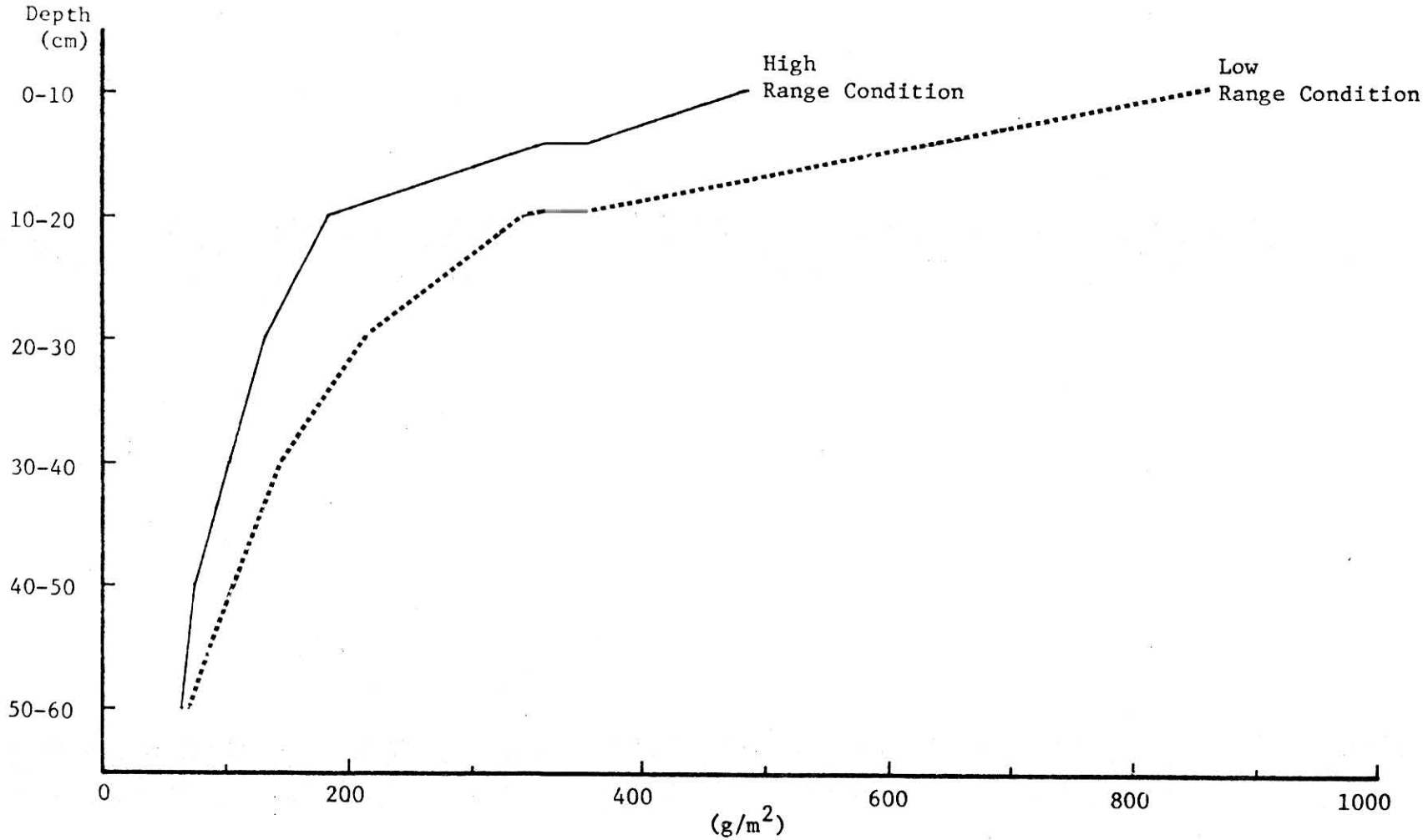

Fig. 24. Distribution of root biomass by depth, mean of all sampling dates. Cottonwood, 1970.

Turnover rates were calculated for the root component using the formula of Dahlman and Kucera (1965) of

$$T = \frac{B_{max} - B_{min}}{\text{Total B}}$$

where T is the turnover, B_{max} is the maximum root biomass, B_{min} is the minimum root biomass and Total B is the total mean root biomass for the year. This method indicated a turnover rate of .158 for the low range condition treatment and .249 for the high range condition treatment.

Plant Biomass by Compartments (James K. Lewis, H. L. Hutcheson, and Jerrold L. Dodd)

Estimates of above- and below-ground oven-dry ash-free plant biomass by components is shown for the high range condition exclosure in Fig. 25 and for the low range condition exclosure in Fig. 26.

Above-ground components reached a peak of 842 g/m^2 in late June in high range condition; however, differences were small from late June through early August. In the low range condition exclosure a peak of 343 g/m^2 was reached in late June, although differences were small through late August except for an unexplained low in late July.

Below-ground plant components increased from a low in early May to a peak in early July in both treatments (1097 and 1842 to 1366 and 2227 g/m^2, respectively, for high and low range condition exclosures), then declined to a low in early August in high range condition (1098 g/m^2) and a low in early September in low range condition (1893 g/m^2), then both increased to a November maximum, 1347 g/m^2 in the permanent exclosure and 2187 g/m^2 in the temporary exclosure.

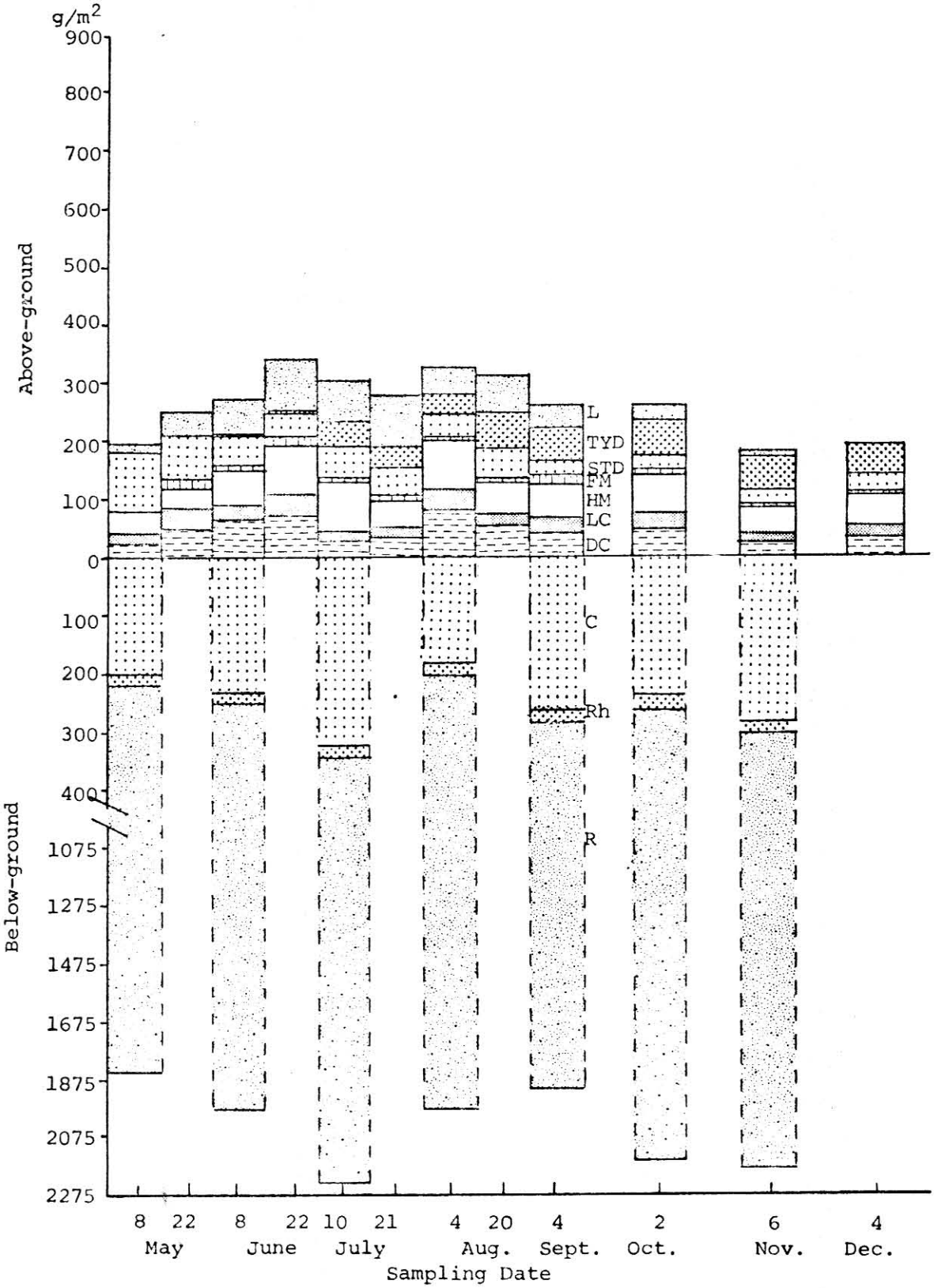

Fig. 26. Above and below-ground oven-dry, ash-free plant biomass by components, temporary exclosure, low range condition, Cottonwood, 1970. (L: live shoots; TYD: this year's dead; STD: standing dead; FM: fresh mulch; HM: humic mulch; LC: live crowns above; DC: dead crowns above; C: crowns below, live and dead; Rh: rhizomes; R: roots).

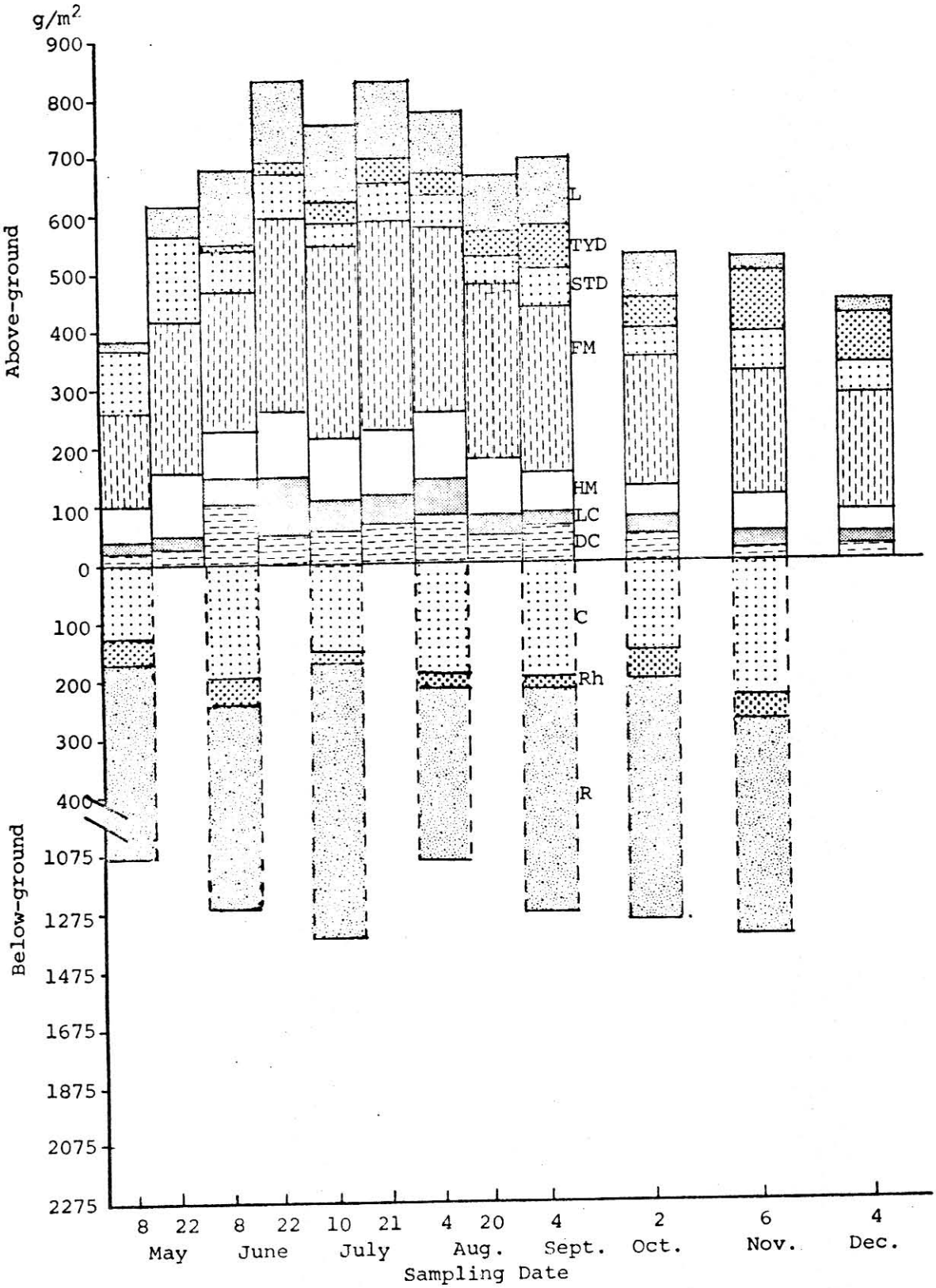

Fig. 25. Above and below-ground oven-dry, ash-free plant biomass by components, permanent exclosure, high range condition, Cottonwood, 1970. (L: live shoots; TYD: this year's dead; STD: standing dead; FM: fresh mulch; HM: humic mulch; LC: live crowns above; DC: dead crowns above; C: crowns below, live and dead; Rh: rhizomes; R: roots).

Below-:above-ground standing crop ratios ranged from 1:1 to 3:1 in the high range condition exclosure and from 4:1 to 7:1 in the low range condition exclosure.

Transfer From Herbage to Mulch (Jerrold L. Dodd and James K. Lewis)

A pilot study was conducted August 12-31 to test the feasibility of partially delittered plots to measure the transfer from the herbage to the mulch layer. Five 0.1 m^2 (0.32 x 0.32 m) permanent plots were randomly located in each of two replicates per treatment. The plots were marked with 4 1/2-inch steel rods and light-weight wire. The wire was looped around each rod so that the corners of the plot were determined by the intersection of the wire and the rod was outside the plot. The wire was positioned about 1/2 inch above the ground surface and was tightened to prevent lateral movement of the wire between visitations of the plots.

On August 12 the bright-colored dead material and live material was removed from the mulch layer of the plots. All detached live and this year's dead material was again removed from the plots on August 31 with long tweezers (290 mm) to minimize disturbance, taken to the laboratory and sorted by species, dried at 65° C, and weighed.

Total transfer to mulch for the high range condition exclosure in 19 days, August 12-31, averaged 0.12±.01 versus 0.04±.01 g m^{-2} day^{-1} ($P<.05$) for the low range condition exclosure (Table 14). These transfer rates were minimal because the period was long enough for significant decomposition to occur. Shorter intervals, weekly or less, would be required to minimize this error.

Table 14. Transfer From Herbage to the Mulch Layer From August 12-31 by Treatments Cottonwood, 1970

Plot	Agsm g/m^2	Buda g/m^2	Bogr g/m^2	Cael g/m^2	Brja g/m^2	Misc. g/m^2	Total g/m^2
Permanent Exclosure High Range Condition, Replicate I							
1	1.2	0.3	-	0.3	T	0.1	1.9
2	0.2	1.9	T	T	0.3	0.1	2.5
3	1.8	-	-	-	0.1	-	1.9
4	1.6	0.2	-	T	0.7	0.4	2.9
5	1.6	-	0.1	T	0.3	0.4	2.4
Mean	1.3	0.5	T	0.1	0.3	0.2	2.3
Permanent Exclosure High Range Condition, Replicate II							
1	0.8	1.2	T	0.2	0.2	-	2.4
2	-	0.9	-	0.2	0.9	0.2	2.2
3	0.9	0.1	0.3	T	0.7	0.3	2.3
4	0.5	0.4	0.1	-	0.6	0.2	1.8
5	0.8	0.7	0.4	T	1.8	0.7	4.4
Mean	0.6	0.7	0.2	0.1	0.8	0.3	2.6
Mean of both reps	0.9	0.6	0.1	0.1	0.6	0.3	2.2
Temporary Exclosure Low Range Condition, Replicate I							
1	-	T	-	0.1	0.1	-	0.2
2	-	0.1	0.1	0.1	0.2	-	0.5
3	-	1.0	-	-	0.1	-	1.1
4	-	0.2	-	-	-	-	0.2
5	-	0.3	0.1	0.5	-	-	0.9
Mean	-	0.3	T	0.1	0.1	-	0.6
Temporary Exclosure Low Range Condition, Replicate II							
1	-	0.6	-	-	0.8	-	1.4
2	-	1.0	0.1	0.3	-	-	1.4
3	-	0.6	0.2	-	0.1	0.1	1.0
4	-	0.1	-	-	T	0.4	0.5
5	-	1.0	-	-	0.1	T	1.1
Mean	-	0.7	0.1	0.1	0.2	0.1	1.1
Mean of both reps	-	0.5	T	0.1	0.1	0.1	0.8

All transferred material that was examined appeared to be this year's dead, mainly the lower leaves of A. smithii in high range condition and entire leaves and leaf tips of B. dactyloides in low range condition. B. japonicus, C. eleocharis, and B. gracilis materials were also transferred but in lower amounts than the Agropyron and Buchloe components.

Estimates of Net Primary Production (James K. Lewis, Jerrold L. Dodd and H. L. Hutcheson)

Methods of estimating net primary production were reviewed by Lewis (1970b). Energy dynamics within the plant, net primary production losses, and mulch dynamics are diagrammed in Fig. 27. Change in different above-ground plant biomass components and removed by herbivores can be monitored more readily than compartment changes and herbivory below-ground. Consequently, a separate assessment of above- and below-ground contributions is desirable, even though the two strata are parts of the same organisms and material is translocated both up and down in accordance with the requirements of plant function.

Above-ground herbage biomass. The above-ground plant biomass is a resultant of the net primary production above-ground minus losses from parasitism, herbivory, sap removal, translocation, death and decomposition, and transfer to the mulch layer. Inside the exclosures, the amount of the standing crop estimated to have been removed by herbivory never reached 1% in any plot at any sampling date. Losses to disease and phyllosphere organisms are completely unknown but are assumed to be negligible. Losses from sap removal by some categories of above-ground sucking insects are being estimated from their numbers, biomass, and metabolic rates. Preliminary estimates indicate that the

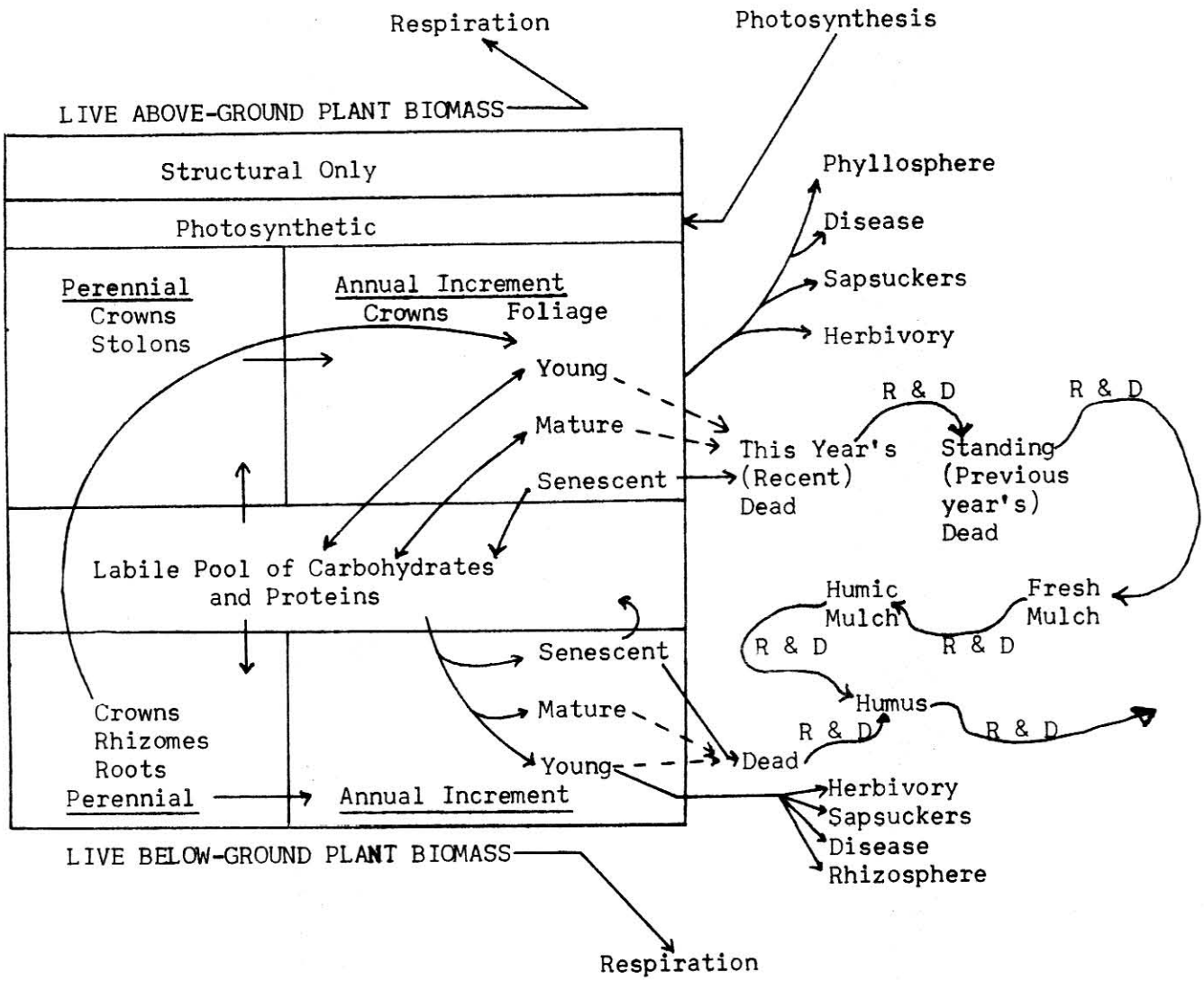

Fig. 27. Energy dynamics of the live plant system and losses of net primary production, semi-arid temperate grassland.

net primary production removed by these consumers is relatively large. Translocation changes are unknown but probably will sum to zero over the entire season. Even so they may distort estimates of net primary production based on summing the increases in standing crops. Death and decomposition losses of standing material were not measured but are assumed to be negligible. Transfer from the herbage to the mulch layer was measured only from August 12 to 31 when changes in these compartments were very slow. Consequently, the method of calculating net primary production recommended by Lewis (1970) which involved measuring changes in biomass compartments of live and this year's dead by species and the transfer to the mulch layer cannot be used.

Since data on biomass compartments of live, this year's dead, standing dead, fresh mulch and humic mulch were available and since these compartments are dynamically inter-related, an estimate of net primary production above-ground can be calculated (Table 15) which accounts for a portion of the transfer to the mulch layer. However, decomposition losses are only partly accounted for. Values from different methods of estimating net primary production from different compartments are shown in Table 16. The values underlined are those used to calculate a total minimal estimate. The below-ground plant standing crops of various components were quite variable among sampling dates. Consequently, the increase from the first sampling date in early May to the peak biomass of that component was used. It is recognized that when differences from low to peak values are used that the values are biased upward. However, since this method

Table 15. Estimation of Minimal Above-ground Herbage Production (Oven-dry Organic Matter, g/m^2) from Standing Crops of Herbage and Mulch Categories, Cottonwood, 1970[a]

Component	Near Start of Season May 8	Peak or Minimum Late Season			Minimum Contribution to Net Primary Production
		Standing Crop	Date	Dec. 4	
	Permanent Exclosure High Range Condition				
Live	20	151	22/6	22	131
This Year's Dead	0	104	6/11	87	104
Standing Dead	106	39	22/5	60	-67
Fresh Mulch	155	361	22/7	198	206
Humic Mulch	63	119	4/8	41	56
Total					430
	Temporary Exclosure Low Range Condition				
Live	14	93	22/6	1	79
This Year's Dead	0	59	20/8	56	59
Standing Dead	100	28	2/10	29	-72
Fresh Mulch	49	168	22/6	74	119
Humic Mulch	37	85	10/7	54	48
Total					233

[a] Conversion to organic matter basis was made using actual ash percentages for fresh and humic mulch and assumed ash percentages of 8, 10, and 13 for live, this year's dead, and standing dead, respectively.

Table 16. Comparison of Methods of Estimating Net Primary Production (Oven Dry Ash-free g/m^2) From Biomass Data. Values Used to Estimate Total Are Underlined. Cottonwood, 1970.

Component	Method	Permanent Exclosure High Range Condition	Temporary Exclosure Low Range Condition
Above-ground			
Herbage	(1) Community peak standing crop	191	126
	(2) Sum species peaks	236	149
	(3) (1) plus minimum transfer to mulch	430	233
Crowns and Stolons	(1) Live increase to peak live	88	24
	(2) (1) plus dead increase to peak dead	167	79
	(3) Live increase to peak of L + TYD Buda and Bogr	45	5
	(4) (3) plus increase in dead to same date	104	33
Below-ground			
Crowns	(1) Increase to peak	113	113
	(2) Sum of all increases	251	241
Rhizomes	(1) Increase to peak	0	6
	(2) Sum of all increases	30	7
	(3) Data too variable	0	0
Roots	(1) Increase to peak	261	266
	(2) Sum of all increases	378	544
Total		908	651

has been standard and since many losses are not measured, these values are presented as minimal values.

Total minimal net primary production is thus estimated to be 908 and 651 g/m^2, respectively, for the permanent exclosure in high range condition and the temporary exclosure in low range condition.

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APPENDIX I

APPENDIX TABLES

Appendix Table 1. Daily, Weekly and Monthly Abiotic Data, Cottonwood, South Dakota - 1970.

Explanation of Data

All data are from 0800-0800 MST. The air temperature, relative humidity, radiation and 1 and 2 meter wind values are common for Pastures 1 and 3. The instrumentation for these data is located in Pasture 2. The information in the columns in the table is as follows:

Column

1 Month

2 Day

3 Maximum daily air temperature (°F).

4 Minimum daily air temperature (°F).

5 Average daily air temperature based on maximum and minimum temperatures.

6 Average daily air temperature based on two hourly temperature readings starting at 0800 (°F).

7 Average daily relative humidity based on two hourly relative humidity ratings starting at 0800.

8 11:00 a.m. (MST) relative humidity.

9 Daily evaporation in inches.

10 Maximum daily evaporation pan temperature (°F).

11 Minimum daily evaporation pan temperature (°F).

12 Average daily evaporation pan temperature (°F).

13 Evaporation pan temperature at about 0800 (°F).

14 Daily radiation in Langleys.

Column

15 Total 24-hour pan wind movement in miles. (Data from Pastures 1 and 3).

16 Average daily wind velocity in miles per hour (Data from Pastures 1 and 3).

17 Total 24-hour wind movement at 1 meter in miles.

18 Average daily wind velocity at 1 meter in miles per hour.

19 Total daily wind movement at 2 meters in miles.

20 Average daily wind velocity at 2 meters in miles per hour.

21 The first digit of each day is the prevailing wind direction from 0800-2000; the second digit is the prevailing wind direction from 2000-0800 (Code: 0-N; 1-NE; 2-E; 3-SE; 4-S; 5-SW; 6-W; 7-NW; 8-Variable).

22 Daily precipitation in inches at the evapotranspiration plots in Pastures 1 and 3.

23 Daily runoff in inches from the evapotranspiration plots in Pastures 1 and 3.

24 Daily soil temperatures at 10 cm on the evapotranspiration plots in Pastures 1 and 3 (°F).

25 Daily soil temperature at 20 cm on the evapotranspiration plots in Pastures 1 and 3 (°F).

26 Average daily soil temperatures for the 5, 10, 20, and 50 cm depths in Pastures 1 and 3 (°F).

27 Average daily soil temperatures of the 5, 10, 20, 50, 100, and 150 cm depths for Pastures 1 and 3 (°F).

28 Cloud cover at about 0800 (Code: 0-Clear; 1-25% cloud cover; 2-50% cloud cover; 3-75% cloud cover; 4-Overcast).

29 Code to indicate if precipitation is falling at about 0800 (Code: 0-No; 1-Yes).

The date given for the average values is the beginning of the week or month. The monthly averages are for 28 days.

DAILY E. T. DATA PASTURE 1 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE	AIR TEMPS				RH		EVAPORATION					RADIA		WIND (MILES / DAY) (MPH)						PREC	RO	SOIL TEMPS				MX COND	
	MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M	DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
4	30	56	29	42	41	57	30	0.23	59	36	47	40	565.35	211.10	8.79	209.09	8.71	264.29	11.01	66	0.00	0.00	48	48	47	46	0	0
5	1	53	31	42	40	58	36	0.26	55	31	43	35	591.65	222.09	9.25	230.50	9.60	342.38	14.26	07	0.00	0.00	42	44	43	42	1	0
5	2	56	32	44	43	58	32	0.30	58	35	46	42	617.94	184.79	7.69	183.90	7.66	254.12	10.58	76	0.00	0.00	44	45	44	43	1	0
5	3	71	41	56	56	48	28	0.37	66	41	53	47	578.50	129.30	5.38	118.29	4.92	169.72	7.07	76	0.00	0.00	45	45	44	43	1	0
5	4	74	35	54	55	54	28	0.37	71	42	56	45	670.53	109.39	4.55	120.00	5.00	166.67	6.94	08	0.00	0.00	44	46	44	42	1	0
5	5	81	39	60	60	48	38	0.37	77	45	61	58	631.09	136.70	5.69	168.00	7.00	189.65	7.90	41	0.00	0.00	50	50	49	46	0	0
5	6	68	46	57	57	53	45	0.39	68	47	57	51	644.24	194.29	8.09	215.50	8.97	296.42	12.35	34	0.00	0.00	54	54	52	49	1	0
5	7	85	45	65	65	49	35	0.48	75	50	62	60	565.35	167.60	6.98	168.20	7.00	197.58	8.23	44	0.00	0.00	55	54	54	50	1	0
5	8	87	50	68	67	53	29	0.39	78	51	64	54	433.87	174.09	7.25	191.40	7.97	238.86	9.95	20	0.08	0.00	56	55	54	50	4	0
5	9	54	40	47	45	78	68	0.12	58	39	48	40	223.51	232.90	9.70	240.39	10.01	364.95	15.20	66	0.00	0.00	51	54	52	50	4	0
5	10	53	35	44	43	77	76	0.18	53	38	45	42	341.84	160.89	6.70	160.10	6.67	220.77	9.19	77	0.00	0.00	47	49	48	47	1	0
5	11	67	45	56	54	66	47	0.23	72	42	57	50	578.50	110.50	4.60	116.50	4.85	150.40	6.26	11	0.16	0.00	51	51	50	48	1	0
5	12	71	48	59	57	48	22	0.33	69	50	59	50	617.94	128.50	5.35	143.79	5.99	183.35	7.63	68	0.00	0.00	56	56	55	52	2	0
5	13	70	45	57	56	72	53	0.28	75	48	61	48	486.46	135.40	5.64	154.29	6.42	192.09	8.00	20	0.00	0.00	55	55	54	51	4	0
5	14	49	42	45	45	86	71	0.02	51	43	47	45	131.47	119.70	4.98	149.29	6.22	175.82	7.32	00	0.34	0.00	52	53	52	50	4	1
5	15	50	34	42	42	74	70	0.06	48	35	41	45	236.66	136.69	5.69	152.40	6.35	230.32	9.59	06	0.00	0.00	0	0	0	0	0	0
5	16	63	40	51	51	52	39	0.30	66	43	54	50	696.83	117.60	4.90	123.29	5.13	192.09	8.00	06	0.00	0.00	0	0	0	0	0	0
5	17	77	44	60	62	50	28	0.44	77	47	62	66	696.83	127.59	5.31	138.90	5.78	170.33	7.09	74	0.00	0.00	0	0	0	0	0	0
5	18	91	53	72	72	43	27	0.42	85	56	70	61	683.68	67.70	2.82	62.89	2.62	112.37	4.68	58	0.00	0.00	0	0	0	0	0	0
5	19	80	46	63	63	49	39	0.47	80	48	64	50	657.39	166.20	6.92	200.29	8.34	247.61	10.31	11	0.00	0.00	0	0	0	0	1	0
5	20	73	50	61	61	53	39	0.41	71	49	60	54	578.50	160.09	6.67	175.90	7.32	227.27	9.46	22	0.00	0.00	58	58	56	53	2	0
5	21	80	50	65	64	64	46	0.33	83	51	67	51	578.50	161.29	6.72	197.90	8.24	210.19	8.75	00	0.07	0.00	60	60	59	56	4	0
5	22	61	45	53	53	74	71	0.10	61	51	56	51	197.21	86.00	3.58	91.29	3.80	155.69	6.48	01	0.00	0.00	58	58	57	55	4	0
5	23	63	48	55	54	72	52	0.09	68	50	59	55	394.43	56.69	2.36	55.00	2.29	87.77	3.65	15	0.02	0.00	57	57	55	53	1	0
5	24	75	50	62	61	59	47	0.23	82	55	68	62	565.35	74.50	3.10	69.80	2.90	77.60	3.23	68	0.00	0.00	62	61	60	56	1	0
5	25	70	36	53	51	57	38	0.24	72	40	56	46	368.13	136.50	5.68	144.00	6.00	207.95	8.66	76	0.06	0.00	54	56	54	52	1	0
5	26	72	38	55	57	49	23	0.39	71	46	58	52	696.83	116.70	4.86	116.40	4.85	167.69	6.98	78	0.00	0.00	57	58	57	54	0	0
5	27	86	48	67	65	62	40	0.29	81	53	67	56	617.94	87.50	3.64	99.29	4.13	135.56	5.64	48	0.00	0.00	60	60	59	56	0	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
4 30	50	50	54	33	2.29	0.32	52	4299.33	614.18	169.67	7.06	177.89	7.41	240.46	10.01	46	47	46	44	0.00	0.000
5 7	56	55	63	47	2.01	0.28	57	3247.50	463.92	158.55	6.60	167.81	6.99	221.14	9.21	53	53	52	50	0.24	0.000
5 14	56	57	58	44	2.12	0.30	57	3681.38	525.91	127.94	5.33	143.28	5.97	193.69	8.07	55	55	54	51	0.34	0.000
5 21	58	58	63	45	1.67	0.23	61	3418.42	488.34	102.74	4.28	110.52	4.60	148.92	6.20	58	58	57	54	0.15	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
4 30	55	55	59	42	8.09	0.29	57	14646.64	523.09	139.72	5.82	149.88	6.24	201.05	8.37	52	53	52	50	0.73	0.000

DAILY E. T. DATA PASTURE 1 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS				RH		EVAPORATION				RADIA			WIND (MILES / DAY) (MPH)					PREC	RO	SOIL TEMPS				WX COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
5	28	74	55	64	63	71	51	0.28	80	55	67	64	617.94	115.69	4.82	139.59	5.81	165.65	6.90	12	0.00	0.00	62	61	60	56	1	0
5	29	71	42	56	57	71	60	0.18	70	47	58	50	354.99	102.90	4.28	95.60	3.98	158.74	6.61	06	0.00	0.00	57	58	57	54	0	0
5	30	76	54	65	64	65	44	0.33	78	50	64	60	657.39	102.19	4.25	124.29	5.17	161.59	6.73	38	0.01	0.00	64	63	62	58	0	0
5	31	77	51	64	61	77	57	0.46	83	51	67	54	539.05	132.40	5.51	151.70	6.32	204.09	8.50	77	0.23	0.00	61	63	61	58	3	0
6	1	65	45	55	55	70	61	0.16	64	46	55	48	302.39	131.50	5.47	138.00	5.75	216.29	9.01	77	0.03	0.00	56	59	57	55	3	0
6	2	70	38	54	55	60	36	0.31	70	47	58	52	696.83	97.09	4.04	113.79	4.74	159.15	6.63	77	0.00	0.00	55	56	55	53	0	0
6	3	77	46	61	63	55	29	0.31	81	51	66	57	670.53	87.00	3.62	72.80	3.03	105.05	4.37	07	0.00	0.00	58	59	57	54	0	0
6	4	74	42	58	59	63	45	0.35	79	46	62	55	670.53	93.30	3.88	96.40	4.01	136.98	5.70	34	0.00	0.00	56	57	56	54	0	0
6	5	73	45	59	60	50	33	0.33	80	55	67	56	683.68	58.00	2.41	67.29	2.80	92.85	3.86	34	0.00	0.00	65	67	64	61	0	0
6	6	84	48	66	67	50	25	0.26	87	61	74	60	683.68	43.40	1.80	46.20	1.92	64.79	2.69	44	0.00	0.00	60	61	58	54	0	0
6	7	86	52	69	72	44	24	0.40	87	60	73	60	696.83	83.79	3.49	96.00	4.00	133.12	5.54	44	0.00	0.00	68	68	66	62	1	0
6	8	92	62	77	77	36	24	0.56	82	58	70	63	683.68	148.10	6.17	176.80	7.36	219.75	9.15	44	0.00	0.00	70	71	68	64	0	0
6	9	91	60	75	73	58	43	0.42	85	60	72	63	696.83	103.40	4.30	100.70	4.19	139.83	5.82	45	0.00	0.00	69	69	67	62	0	0
6	10	91	58	74	73	55	39	0.41	86	58	72	59	499.61	146.60	6.10	158.69	6.61	210.60	8.77	46	0.09	0.00	67	67	65	61	3	0
6	11	73	45	59	59	66	54	0.26	76	54	65	57	525.91	96.00	4.00	106.20	4.42	154.88	6.45	08	0.00	0.00	64	62	60	57	3	0
6	12	72	56	64	63	66	39	0.27	68	58	63	58	341.84	208.29	8.67	250.80	10.45	321.84	13.41	12	0.60	0.00	0	0	0	0	4	1
6	13	70	50	60	58	82	86	0.15	70	52	61	60	381.28	140.40	5.85	153.19	6.38	207.75	8.65	27	0.17	0.00	61	63	61	58	0	0
6	14	76	62	69	67	74	56	0.28	82	61	71	64	644.24	113.50	4.72	125.80	5.24	195.96	8.16	33	0.00	0.00	68	68	67	63	3	0
6	15	86	52	69	68	75	69	0.25	90	58	74	62	565.35	60.80	2.53	67.80	2.82	96.31	4.01	35	0.00	0.00	67	67	65	61	0	0
6	16	79	45	62	61	73	44	0.17	83	53	68	59	433.87	70.00	2.91	76.59	3.19	102.41	4.26	84	0.00	0.00	65	67	65	62	1	0
6	17	84	53	68	68	58	43	0.36	86	58	72	61	709.98	87.29	3.63	82.60	3.44	130.88	5.45	77	0.00	0.00	67	68	66	63	0	0
6	18	77	50	63	64	66	45	0.45	78	54	66	60	709.98	155.70	6.48	163.89	6.82	235.81	9.82	77	0.00	0.00	67	67	66	63	0	0
6	19	74	51	62	62	69	46	0.23	81	56	68	60	604.79	65.69	2.73	74.10	3.08	111.56	4.64	34	0.00	0.00	65	67	65	61	0	0
6	20	83	51	67	68	57	36	0.36	84	56	70	56	670.53	131.89	5.49	139.09	5.79	212.63	8.85	70	0.00	0.00	0	0	0	0	1	0
6	21	72	46	59	60	63	41	0.38	77	52	64	62	736.27	105.40	4.39	122.10	5.08	159.15	6.63	08	0.00	0.00	71	70	70	66	1	0
6	22	80	53	66	68	60	37	0.32	86	57	71	62	696.83	57.19	2.38	77.10	3.21	120.30	5.01	43	0.00	0.00	68	69	67	63	0	0
6	23	94	63	78	79	53	40	0.50	87	62	74	70	709.98	118.30	4.92	133.09	5.54	163.62	6.81	44	0.00	0.00	75	75	73	68	1	0
6	24	85	54	69	72	63	42	0.39	80	62	71	64	499.61	76.09	3.17	89.20	3.72	131.29	5.47	08	0.00	0.00	67	68	66	62	0	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)					SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN	1 METER		2 METER		10	20	50	150	(INS)	(INS)
5 28	60	60	67	48	2.03	0.29	62	3839.15	548.45	109.82	4.57	119.40	4.97	167.22	6.96	59	59	58	55	0.27	0.000
6 4	68	69	51	33	2.73	0.39	70	4614.87	659.26	96.65	4.02	106.01	4.41	142.56	5.94	65	65	63	60	0.09	0.000
6 11	64	63	71	55	1.74	0.24	67	3602.49	514.64	110.89	4.62	123.28	5.13	172.86	7.20	65	65	64	61	0.77	0.000
6 18	66	67	62	41	2.63	0.37	69	4628.02	661.14	101.47	4.22	114.10	4.75	162.05	6.75	68	69	68	64	0.00	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)					SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN	1 METER		2 METER		10	20	50	150	(INS)	(INS)
5 28	64	65	62	44	9.13	0.33	67	16684.55	595.87	104.71	4.36	115.70	4.82	161.17	6.71	64	65	63	60	1.13	0.000

DAILY E. T. DATA PASTURE 1 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS				RH		EVAPORATION					RADIA		WIND (MILES / DAY) (MPH)						PREC	RO	SOIL TEMPS				WX COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M	DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
6	25	86	62	74	74	68	51	0.43	86	64	75	66	683.68	150.90	6.28	142.19	5.92	196.16	8.17	36	0.11	0.00	72	71	70	65	1	0
6	26	93	53	73	74	58	35	0.58	86	60	73	75	723.12	101.50	4.22	138.10	5.75	187.62	7.81	08	0.00	0.00	68	68	66	62	1	0
6	27	91	63	77	77	54	37	0.53	88	61	74	73	709.98	106.69	4.44	125.70	5.23	163.82	6.82	33	0.00	0.00	72	72	69	65	1	0
6	28	107	72	89	90	41	36	0.65	90	69	79	70	683.68	132.60	5.52	149.60	6.23	198.60	8.27	44	0.00	0.00	0	0	0	0	1	0
6	29	102	71	86	86	45	39	0.62	92	66	79	69	736.27	128.70	5.36	150.79	6.28	201.04	8.37	62	0.00	0.00	78	78	76	70	1	0
6	30	100	69	84	83	60	50	0.56	89	65	77	64	617.94	165.39	6.89	191.60	7.98	260.62	10.85	46	0.00	0.00	79	79	77	72	0	0
7	1	93	53	73	72	53	36	0.67	82	55	68	61	709.98	135.50	5.64	137.19	5.71	175.42	7.30	78	0.00	0.00	74	74	73	68	0	0
7	2	96	51	73	74	45	32	0.50	86	59	72	62	709.98	80.29	3.34	79.90	3.32	113.80	4.74	68	0.00	0.00	74	74	73	68	0	0
7	3	95	56	75	77	44	29	0.48	88	59	73	62	709.98	86.70	3.61	97.29	4.05	130.07	5.41	07	0.00	0.00	75	77	74	70	0	0
7	4	81	50	65	67	59	41	0.50	77	54	65	60	736.27	124.29	5.17	142.39	5.93	210.60	8.77	08	0.00	0.00	72	72	71	67	0	0
7	5	88	56	72	73	51	37	0.37	87	60	73	60	657.39	62.39	2.59	77.20	3.21	102.61	4.27	03	0.00	0.00	75	75	74	69	4	0
7	6	99	65	82	79	54	41	0.40	90	60	75	68	631.09	76.50	3.18	77.89	3.24	101.80	4.24	46	0.09	0.00	78	79	76	71	0	0
7	7	99	68	83	84	44	32	0.48	90	67	78	68	617.94	83.40	3.47	100.50	4.18	132.30	5.51	00	0.04	0.00	80	80	79	74	1	0
7	8	96	58	77	78	44	35	0.53	88	61	74	64	696.83	84.09	3.50	94.50	3.93	129.66	5.40	08	0.00	0.00	74	78	74	70	1	0
7	9	97	65	81	80	53	32	0.50	87	63	75	69	604.79	157.80	6.57	174.89	7.28	215.48	8.97	34	1.91	0.01	72	75	72	68	1	0
7	10	90	63	76	75	68	51	0.33	87	67	77	70	657.39	78.19	3.25	88.39	3.68	136.37	5.68	31	0.00	0.00	74	75	73	69	1	0
7	11	89	63	76	76	67	49	0.30	85	69	77	70	525.91	67.90	2.82	70.80	2.95	99.56	4.14	22	0.00	0.00	75	76	74	70	0	0
7	12	97	70	83	83	58	49	0.37	95	70	82	70	631.09	75.00	3.12	83.69	3.48	106.27	4.42	38	0.00	0.00	79	80	77	73	2	0
7	13	94	69	81	77	66	40	0.30	92	66	79	68	486.46	88.39	3.68	95.59	3.98	130.47	5.43	85	0.00	0.00	75	75	74	70	1	0
7	14	87	65	76	76	60	54	0.32	87	65	76	65	670.53	147.69	6.15	167.00	6.95	197.79	8.24	30	0.01	0.00	0	0	0	0	1	0
7	15	77	53	65	65	60	42	0.46	77	53	65	58	696.83	159.40	6.64	149.40	6.22	275.47	11.47	77	0.00	0.00	70	74	71	69	0	0
7	16	86	56	71	72	47	31	0.34	86	59	72	64	696.83	70.79	2.94	76.20	3.17	103.02	4.29	74	0.00	0.00	72	74	72	69	0	0
7	17	100	59	79	81	42	25	0.37	92	64	78	71	670.53	51.29	2.13	52.89	2.20	66.82	2.78	66	0.00	0.00	76	75	75	71	1	0
7	18	98	60	79	79	56	35	0.40	87	64	75	65	552.20	76.29	3.17	80.30	3.34	113.80	4.74	28	0.00	0.00	74	78	74	70	1	0
7	19	98	62	80	75	64	37	0.59	87	67	77	66	447.02	87.00	3.62	92.59	3.85	117.66	4.90	00	0.63	0.00	74	76	74	71	4	7
7	20	74	55	64	65	62	62	0.30	75	56	65	56	420.72	116.60	4.85	141.00	5.87	179.28	7.47	23	0.00	0.00	69	72	70	68	3	0
7	21	83	60	71	70	59	42	0.39	78	55	66	63	644.24	149.09	6.21	186.00	7.75	237.64	9.90	44	0.00	0.00	68	70	69	66	1	0
7	22	91	67	79	78	49	43	0.59	82	61	71	70	644.24	234.50	9.77	267.50	11.14	324.68	13.52	44	0.00	0.00	73	74	73	70	3	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
6 25	79	79	54	40	4.04	0.57	75	4864.68	694.95	131.61	5.48	147.88	6.16	197.61	8.23	73	73	72	67	0.11	0.000
7 2	75	76	49	35	3.26	0.46	73	4759.50	679.92	85.38	3.55	95.67	3.98	131.55	5.48	75	76	74	70	0.13	0.000
7 9	77	76	62	45	2.58	0.36	75	4273.03	610.43	110.62	4.60	118.54	4.93	165.92	6.91	74	75	74	70	1.92	0.010
7 16	74	74	54	39	2.98	0.42	72	4075.81	582.25	112.22	4.67	128.07	5.33	163.27	6.80	72	74	72	69	0.63	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
6 25	76	76	55	40	12.86	0.46	74	17973.03	641.89	109.96	4.58	122.54	5.10	164.59	6.85	73	75	73	69	2.79	0.010

DAILY E. T. DATA PASTURE 1 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE	AIR TEMPS			RH		EVAPORATION			RADIA	WIND (MILES / DAY) (MPH)					PREC	RO	SOIL TEMPS				WX COND	
	MA	MI	AV	AV	11	INS	MA	MI	AV PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12 13	14	15	16	17	18	19	20 21	22	23	24	25	26	27	28	29
7	23	90	65	77	79	58	54	0.45	84	63	73 64	394.43	177.50	7.39	201.90	8.41	224.83	9.36 44	0.58	0.00	72	75	72	70	2	1
7	24	76	57	66	64	76	89	0.14	74	63	68 65	381.28	57.50	2.39	57.39	2.39	117.25	4.88 74	0.00	0.00	70	72	70	68	1	0
7	25	92	63	77	78	53	46	0.36	90	63	76 67	644.24	66.59	2.77	90.79	3.78	123.96	5.16 04	0.00	0.00	75	70	71	67	1	0
7	26	102	64	83	83	46	33	0.53	89	64	76 68	657.39	129.10	5.37	141.10	5.87	176.43	7.35 44	0.00	0.00	78	79	77	75	1	0
7	27	92	60	76	77	60	48	0.46	86	62	74 65	683.68	113.20	4.71	134.50	5.60	176.43	7.35 00	0.00	0.00	74	75	74	71	0	0
7	28	91	63	77	78	52	40	0.46	86	64	75 75	617.94	97.19	4.04	109.70	4.57	137.59	5.73 24	0.00	0.00	78	78	77	73	1	0
7	29	97	64	80	81	48	35	0.53	87	64	75 68	670.53	120.80	5.03	124.29	5.17	178.47	7.43 46	0.00	0.00	80	80	78	74	0	0
7	30	97	62	79	80	54	35	0.49	88	63	75 69	617.94	93.50	3.89	115.79	4.82	159.55	6.64 73	0.00	0.00	76	78	75	71	0	0
7	31	100	60	80	79	54	26	0.43	88	62	75 72	565.35	101.69	4.23	115.40	4.80	152.23	6.34 66	0.00	0.00	79	79	78	74	1	0
8	1	91	65	78	76	47	40	0.47	90	62	76 65	617.94	110.60	4.60	131.00	5.45	167.28	6.97 83	0.00	0.00	80	70	76	72	1	0
8	2	92	61	76	75	64	56	0.37	88	64	76 64	617.94	101.00	4.20	125.59	5.23	158.74	6.61 32	0.00	0.00	80	80	77	73	2	0
8	3	80	56	68	69	59	41	0.41	74	57	65 62	447.02	152.20	6.34	166.00	6.91	211.00	8.79 22	0.00	0.00	74	77	75	72	2	0
8	4	81	56	68	68	57	40	0.36	75	56	65 64	447.02	104.89	4.37	121.50	5.06	180.09	7.50 33	0.00	0.00	71	73	72	69	1	0
8	5	93	65	79	79	66	46	0.32	88	65	76 74	578.50	115.20	4.80	138.29	5.76	168.70	7.02 22	0.00	0.00	77	78	76	72	2	0
8	6	89	69	79	78	67	51	0.40	86	68	77 70	512.76	140.09	5.83	156.00	6.50	225.04	9.37 33	0.00	0.00	75	78	75	71	3	0
8	7	92	68	80	78	73	57	0.34	89	69	79 76	591.65	120.10	5.00	134.79	5.61	183.75	7.65 38	0.24	0.00	79	80	78	74	1	0
8	8	95	66	80	80	68	44	0.40	90	69	79 77	591.65	70.39	2.93	82.30	3.42	120.71	5.02 04	0.00	0.00	79	77	76	73	1	0
8	9	95	67	81	81	61	45	0.52	89	61	75 62	565.35	155.70	6.48	186.79	7.78	239.07	9.96 30	0.00	0.00	79	81	78	74	4	0
8	10	72	58	65	65	77	48	0.30	66	58	62 64	223.51	61.50	2.56	78.59	3.27	112.98	4.70 10	1.07	0.00	71	74	72	70	3	0
8	11	88	64	76	74	66	55	0.28	85	63	74 68	512.76	74.79	3.11	90.90	3.78	116.85	4.86 33	0.00	0.00	71	72	71	69	1	0
8	12	99	62	80	78	47	30	0.45	86	61	73 66	552.20	86.30	3.59	90.29	3.76	117.66	4.90 44	0.00	0.00	70	70	68	66	1	0
8	13	100	60	80	80	45	35	0.38	91	61	76 68	591.65	53.29	2.22	70.29	2.92	84.51	3.52 84	0.00	0.00	73	72	71	68	0	0
8	14	105	60	82	82	41	27	0.51	88	61	74 64	604.79	83.39	3.47	80.70	3.36	116.24	4.84 68	0.00	0.00	74	76	74	72	1	0
8	15	90	60	75	72	62	39	0.49	85	58	71 64	604.79	114.70	4.77	133.50	5.56	167.28	6.97 07	0.16	0.00	78	77	75	71	1	1
8	16	83	52	67	68	52	33	0.34	79	57	68 64	617.94	68.40	2.85	72.09	3.00	109.32	4.55 74	0.00	0.00	0	0	0	0	0	0
8	17	96	66	81	80	51	32	0.46	85	62	73 68	604.79	129.39	5.39	151.30	6.30	193.51	8.06 44	0.00	0.00	73	76	73	71	1	0
8	18	103	60	81	82	45	36	0.40	87	59	73 62	552.20	129.00	5.37	150.39	6.26	202.46	8.43 47	0.00	0.00	73	75	72	70	2	0
8	19	95	55	75	76	35	21	0.56	81	53	67 57	578.50	114.80	4.78	131.70	5.48	188.63	7.85 00	0.00	0.00	72	75	72	70	3	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)					SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
7 23	76	77	56	49	2.93	0.41	74	4049.52	578.50	108.84	4.53	122.81	5.11	162.14	6.75	75	75	74	71	0.58	0.000
7 30	75	75	57	40	2.85	0.40	72	3891.74	555.96	111.29	4.63	130.51	5.43	171.09	7.12	76	76	75	72	0.00	0.000
8 6	77	76	66	47	2.69	0.38	74	3549.90	507.12	101.27	4.21	117.10	4.87	159.44	6.64	74	76	74	71	1.31	0.000
8 13	77	77	47	31	3.14	0.44	71	4154.70	593.52	99.00	4.12	112.85	4.70	151.71	6.32	73	75	73	70	0.16	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)					SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
7 23	76	76	57	42	11.61	0.41	73	15645.87	558.78	105.10	4.37	120.82	5.03	161.09	6.71	75	75	74	71	2.05	0.000

DAILY E. T. DATA PASTURE 1 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS				RH		EVAPORATION				RADIA		WIND (MILES / DAY) (MPH)					PREC	RO	SOIL TEMPS				WX COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
8	20	83	47	65	65	52	37	0.30	78	51	64	58	552.20	55.29	2.30	63.40	2.64	88.78	3.69	04	0.00	0.00	67	71	68	67	0	0
8	21	90	63	76	75	49	25	0.49	79	57	68	73	591.65	173.20	7.21	208.69	8.69	245.58	10.23	44	0.00	0.00	72	72	72	70	3	0
8	22	93	51	72	72	43	40	0.55	81	54	67	56	552.20	105.29	4.38	108.09	4.50	168.30	7.01	76	0.00	0.00	70	73	71	68	0	0
8	23	91	52	71	72	42	27	0.33	82	58	70	59	591.65	46.40	1.93	59.59	2.48	74.95	3.12	04	0.00	0.00	0	0	0	0	1	0
8	24	95	63	79	78	35	25	0.51	82	57	69	60	565.35	98.19	4.09	117.80	4.90	162.60	6.77	34	0.00	0.00	72	72	70	68	3	0
8	25	103	58	80	80	39	27	0.51	82	58	70	69	447.02	134.90	5.62	130.30	5.42	164.03	6.83	55	0.00	0.00	75	75	76	73	0	0
8	26	103	61	82	82	32	19	0.52	89	60	74	64	552.20	63.50	2.64	79.59	3.31	115.63	4.81	03	0.00	0.00	70	74	71	69	1	0
8	27	110	60	85	84	32	18	0.69	84	60	72	65	552.20	143.30	5.97	154.90	6.45	192.90	8.03	60	0.00	0.00	74	75	73	70	1	0
8	28	88	61	74	74	44	38	0.52	80	58	69	61	565.35	157.69	6.57	172.69	7.19	229.10	9.54	22	0.00	0.00	76	78	76	74	2	0
8	29	87	56	71	72	55	42	0.40	78	60	69	64	512.76	114.59	4.77	123.20	5.13	179.28	7.47	28	0.00	0.00	73	74	71	69	0	0
8	30	98	60	79	78	39	31	0.51	88	58	73	63	512.76	116.90	4.87	151.90	6.32	178.06	7.41	00	0.00	0.00	76	76	76	73	1	0
8	31	78	58	68	69	48	48	0.40	78	56	67	60	565.35	117.80	4.90	137.39	5.72	188.43	7.85	22	0.00	0.00	70	71	69	68	0	0
9		1101	72	86	84	36	35	0.56	84	59	71	67	539.05	155.59	6.48	164.10	6.83	211.21	8.80	44	0.00	0.00	75	75	74	71	0	0
9		2101	69	85	85	37	26	0.63	84	64	74	66	525.91	152.19	6.34	163.89	6.82	209.78	8.74	46	0.00	0.00	76	76	75	72	3	0
9		3	92	60	76	75	50	39	0.40	81	60	70	62	354.99	95.70	3.98	109.09	4.54	157.32	6.55	05	0.12	0.00	71	74	72	70	1	0
9		4	89	54	71	71	52	41	0.26	84	57	70	60	539.05	50.59	2.10	65.30	2.72	90.82	3.78	04	0.00	0.00	68	71	69	68	0	0
9		5101	71	86	84	32	16	0.61	80	59	69	70	512.76	199.59	8.31	215.40	8.97	263.07	10.96	54	0.00	0.00	72	73	72	70	0	0
9		6	96	60	78	79	37	30	0.44	85	58	71	68	499.61	64.70	2.69	76.89	3.20	94.48	3.93	58	0.00	0.00	79	76	76	73	3	0
9		7	91	55	73	72	59	30	0.55	80	58	69	61	368.13	193.10	8.04	197.89	8.24	267.34	11.13	76	1.00	0.00	0	0	0	0	3	0
9		8	83	59	71	69	52	37	0.47	74	56	65	59	525.91	160.59	6.69	168.60	7.02	240.29	10.01	74	0.00	0.00	62	67	65	65	0	0
9		9	94	51	72	73	45	27	0.52	80	49	64	49	499.61	237.90	9.91	245.89	10.24	335.46	13.97	57	0.00	0.00	69	72	70	70	4	0
9	10	62	40	51	49	69	50	0.25	56	39	47	49	341.84	235.00	9.79	238.00	9.91	306.99	12.79	76	0.00	0.00	58	67	63	65	1	0
9	11	77	50	63	61	42	29	0.30	71	47	59	50	525.91	103.00	4.29	111.79	4.65	170.33	7.09	64	0.00	0.00	65	70	67	67	0	0
9	12	81	41	61	57	54	29	0.46	71	38	54	42	525.91	246.60	10.27	287.60	11.98	386.91	16.12	00	0.00	0.00	60	65	63	65	4	0
9	13	49	35	42	44	70	68	0.08	50	38	44	38	223.51	115.00	4.79	132.30	5.51	191.48	7.97	03	0.08	0.00	57	62	60	63	4	0
9	14	43	37	40	40	89	89	0.05	41	36	38	40	105.18	150.89	6.28	150.69	6.27	238.46	9.93	33	0.50	0.00	54	64	59	61	4	0
9	15	48	40	44	43	90	86	0.06	45	40	42	44	118.33	73.10	3.04	76.39	3.18	110.75	4.61	26	0.04	0.00	55	64	59	61	1	0
9	16	64	41	52	51	64	54	0.14	67	45	56	48	407.58	60.00	2.50	77.90	3.24	104.64	4.36	63	0.00	0.00	57	62	59	61	3	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
8 20	75	75	42	28	3.21	0.45	69	3852.30	550.32	96.68	4.02	109.64	4.56	145.70	6.07	71	72	71	69	0.00	0.000
8 27	78	78	42	34	3.71	0.53	70	3773.41	539.05	136.87	5.70	152.58	6.35	198.40	8.26	74	75	73	71	0.00	0.000
9 3	75	74	47	31	3.25	0.46	68	3300.09	471.44	143.17	5.96	154.15	6.42	206.97	8.62	70	72	71	69	1.12	0.000
9 10	50	49	68	57	1.34	0.19	48	2248.27	321.18	140.51	5.85	153.52	6.39	215.65	8.98	58	64	61	63	0.62	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
8 20	69	69	50	37	11.51	0.41	64	13174.09	470.50	129.31	5.38	142.47	5.93	191.68	7.98	68	71	69	68	1.74	0.000

DAILY E. T. DATA PASTURE 1 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS				RH		EVAPORATION				RADIA			WIND (MILES / DAY) (MPH)					PREC	RO	SOIL TEMPS				WX COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
9	17	58	38	48	48	83	68	0.13	57	44	50	50	170.92	55.19	2.29	69.00	2.87	90.41	3.76	38	0.00	0.00	50	54	53	57	0	0
9	18	80	47	63	60	53	43	0.19	73	50	61	52	486.46	41.39	1.72	49.19	2.04	72.11	3.00	64	0.00	0.00	50	54	52	55	0	0
9	19	90	57	73	70	44	27	0.33	75	53	64	59	499.61	111.20	4.63	108.70	4.52	137.39	5.72	45	0.00	0.00	0	0	0	0	2	0
9	20	95	50	72	71	41	24	0.23	78	51	64	57	460.17	108.39	4.51	100.19	4.17	135.76	5.65	56	0.00	0.00	0	0	0	0	2	0
9	21	88	44	66	62	58	41	0.54	75	47	61	43	447.02	172.80	7.20	175.20	7.30	250.25	10.42	77	0.00	0.00	60	63	61	62	1	0
9	22	70	39	54	55	61	36	0.35	65	41	53	49	512.76	164.09	6.83	167.29	6.97	239.68	9.98	76	0.00	0.00	56	59	58	60	1	0
9	23	70	42	56	54	52	35	0.26	66	41	53	48	460.17	108.60	4.52	113.00	4.70	139.42	5.80	54	0.00	0.00	56	59	57	59	1	0
9	24	79	43	61	60	54	37	0.30	69	46	57	49	460.17	153.39	6.39	182.50	7.60	243.95	10.16	47	0.00	0.00	55	58	57	59	3	0
9	25	52	40	46	45	83	83	0.11	51	40	45	41	144.62	163.00	6.79	171.40	7.14	255.13	10.63	07	0.00	0.00	53	57	56	58	1	0
9	26	57	33	45	43	66	51	0.17	55	37	46	40	354.99	135.29	5.63	126.09	5.25	192.09	8.00	77	0.00	0.00	48	52	51	54	0	0
9	27	67	42	54	53	51	29	0.29	62	40	51	48	499.61	140.40	5.85	137.20	5.71	199.62	8.31	77	0.00	0.00	52	56	54	56	0	0
9	28	74	43	58	59	53	40	0.25	68	44	56	48	486.46	102.29	4.26	88.20	3.67	130.68	5.44	76	0.00	0.00	54	57	56	58	0	0
9	29	81	43	62	61	46	32	0.20	72	45	58	47	433.87	34.20	1.42	49.89	2.07	67.84	2.82	66	0.00	0.00	54	57	55	58	0	0
9	30	87	42	64	62	46	27	0.22	73	46	59	49	433.87	32.50	1.35	42.60	1.77	56.45	2.35	08	0.00	0.00	53	57	55	57	0	0
10	1	87	48	67	64	39	24	0.30	72	49	60	49	433.87	77.69	3.23	76.19	3.17	98.95	4.12	57	0.00	0.00	55	58	56	57	1	0
10	2	78	45	61	60	46	33	0.40	68	49	58	51	433.87	120.00	5.00	105.00	4.37	169.31	7.05	77	0.00	0.00	0	0	0	0	0	0
10	3	72	33	52	53	52	32	0.32	63	38	50	45	460.17	137.70	5.73	132.10	5.50	201.65	8.40	04	0.00	0.00	60	63	60	61	0	0
10	4	77	45	61	58	46	38	0.23	65	45	55	47	420.72	75.10	3.12	87.29	3.63	117.46	4.89	45	0.00	0.00	54	56	55	57	1	0
10	5	91	44	67	66	43	31	0.27	73	45	59	52	420.72	65.50	2.72	74.90	3.12	87.56	3.64	55	0.00	0.00	52	55	54	56	0	0
10	6	89	50	69	67	46	26	0.29	75	49	62	49	381.28	112.79	4.69	125.50	5.22	186.80	7.78	47	0.00	0.00	59	61	60	61	1	0
10	7	57	32	44	42	80	60	0.13	53	29	41	30	249.80	212.10	8.83	247.39	10.30	337.29	14.05	70	0.27	0.00	52	56	54	57	4	1
10	8	34	31	32	32	86	87	0.00	38	31	34	35	197.21	128.89	5.37	146.60	6.10	223.00	9.29	00	0.00	0.00	51	59	54	56	1	0
10	9	48	24	36	33	74	64	0.09	49	32	40	34	433.87	122.50	5.10	110.39	4.59	165.86	6.91	07	0.00	0.00	45	49	48	53	1	0
10	10	46	30	38	35	76	48	0.09	48	34	41	34	302.39	73.29	3.05	91.50	3.91	120.30	5.01	72	0.00	0.00	0	0	0	0	3	0
10	11	44	29	36	37	82	63	0.06	46	32	39	38	197.21	80.70	3.36	85.70	3.57	105.25	4.38	24	0.00	0.00	0	0	0	0	1	0
10	12	62	36	49	46	70	54	0.11	58	37	47	41	407.58	95.79	3.99	90.79	3.78	126.81	5.28	64	0.00	0.00	42	46	45	50	0	0
10	13	77	39	58	54	61	38	0.15	65	40	52	43	368.13	153.50	6.39	185.10	7.71	239.27	9.96	57	0.10	0.00	47	51	49	52	1	0
10	14	56	35	45	43	79	55	0.08	55	37	46	38	262.95	88.40	3.68	90.69	3.77	133.32	5.55	77	0.00	0.00	48	51	50	54	3	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)					SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN	1 METER		2 METER		10	20	50	150	(INS)	(INS)
9 17	62	60	56	39	2.03	0.29	58	3037.14	433.87	108.81	4.53	111.79	4.65	152.14	6.33	54	57	56	58	0.00	0.000
9 24	55	55	57	42	1.54	0.22	53	2813.62	401.94	108.72	4.53	113.98	4.74	163.68	6.82	52	56	55	57	0.00	0.000
10 1	60	59	50	34	1.94	0.27	55	2800.48	400.06	114.41	4.76	121.19	5.04	171.29	7.13	55	58	56	58	0.27	0.000
10 8	42	40	75	58	0.58	0.08	43	2169.38	309.91	106.15	4.42	114.39	4.76	159.12	6.63	46	51	49	53	0.10	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)					SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN	1 METER		2 METER		10	20	50	150	(INS)	(INS)
9 17	55	53	60	43	6.09	0.22	52	10820.63	386.45	109.52	4.56	115.34	4.80	161.56	6.73	52	56	54	57	0.37	0.000

DAILY E. T. DATA PASTURE 1 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS				RH		EVAPORATION				RADIA			WIND (MILES / DAY) (MPH)						PREC	RO	SOIL TEMPS				WX COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M	DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
10	15	52	24	38	35	69	50	0.10	50	33	41	37	315.54	55.39	2.30	59.80	2.49	91.43	3.80	04	0.00	0.00	41	46	44	49	0	0

DAILY E. T. DATA PASTURE 3 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS				RH		EVAPORATION					RADIA		WIND (MILES / DAY) (MPH)						PREC	RO	SOIL TEMPS				WX COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M	DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
4	30	56	29	42	41	57	30	0.28	60	34	47	40	565.35	186.59	7.77	209.09	8.71	264.29	11.01	66	0.00	0.00	43	46	44	43	0	0
5	1	53	31	42	40	58	36	0.21	56	32	44	35	591.65	221.50	9.22	230.50	9.60	342.38	14.26	07	0.00	0.00	42	44	42	42	1	0
5	2	56	32	44	43	58	32	0.39	58	36	47	44	617.94	171.40	7.14	183.90	7.66	254.12	10.58	76	0.00	0.00	44	45	44	43	1	0
5	3	71	41	56	56	48	28	0.32	66	41	53	48	578.50	116.00	4.83	118.29	4.92	169.72	7.07	76	0.00	0.00	41	41	41	40	1	0
5	4	74	35	54	55	54	28	0.39	71	42	56	45	670.53	115.50	4.81	120.00	5.00	166.67	6.94	08	0.00	0.00	44	44	43	41	1	0
5	5	81	39	60	60	48	38	0.37	77	44	60	49	631.09	149.39	6.22	168.00	7.00	189.65	7.90	41	0.00	0.00	47	47	46	44	0	0
5	6	68	46	57	57	53	45	0.36	69	48	58	52	644.24	183.90	7.66	215.50	8.97	296.42	12.35	34	0.00	0.00	53	53	52	50	1	0
5	7	85	45	65	65	49	35	0.44	75	51	63	62	565.35	143.00	5.95	168.20	7.00	197.58	8.23	44	0.00	0.00	51	52	50	47	1	0
5	8	87	50	68	67	53	29	0.36	80	52	66	55	433.87	161.70	6.73	191.40	7.97	238.86	9.95	20	0.09	0.00	53	52	51	47	4	0
5	9	54	40	47	45	78	68	0.16	58	39	48	40	223.51	228.59	9.52	240.39	10.01	364.95	15.20	66	0.00	0.00	47	48	46	44	4	0
5	10	53	35	44	43	77	76	0.14	52	38	45	44	341.84	148.20	6.17	160.10	6.67	220.77	9.19	77	0.00	0.00	47	49	48	47	1	0
5	11	67	45	56	54	66	47	0.30	73	43	58	52	578.50	100.29	4.17	116.50	4.85	150.40	6.26	11	0.23	0.00	51	51	50	48	1	0
5	12	71	48	59	57	48	22	0.34	71	49	60	50	617.94	129.60	5.40	143.79	5.99	183.35	7.63	68	0.00	0.00	49	48	47	45	2	0
5	13	70	45	57	56	72	53	0.25	76	48	62	48	486.46	125.59	5.23	154.29	6.42	192.09	8.00	20	0.00	0.00	55	55	54	51	4	0
5	14	49	42	45	45	86	71	0.02	51	43	47	45	131.47	119.69	4.98	149.29	6.22	175.82	7.32	00	0.34	0.00	52	53	51	49	4	1
5	15	50	34	42	42	74	70	0.07	47	38	42	45	236.66	137.30	5.72	152.40	6.35	230.32	9.59	06	0.00	0.00	0	0	0	0	0	0
5	16	63	40	51	51	52	39	0.29	67	43	55	50	696.83	119.29	4.97	123.29	5.13	192.09	8.00	06	0.00	0.00	0	0	0	0	0	0
5	17	77	44	60	62	50	28	0.44	77	48	62	69	696.83	123.60	5.15	138.90	5.78	170.33	7.09	74	0.00	0.00	0	0	0	0	0	0
5	18	91	53	72	72	43	27	0.36	85	58	71	62	683.68	56.09	2.33	62.89	2.62	112.37	4.68	58	0.00	0.00	0	0	0	0	0	0
5	19	80	46	63	63	49	39	0.46	81	47	64	50	657.39	172.59	7.19	200.29	8.34	247.61	10.31	11	0.00	0.00	0	0	0	0	1	0
5	20	73	50	61	61	53	39	0.40	73	49	61	55	578.50	145.69	6.07	175.90	7.32	227.27	9.46	22	0.00	0.00	53	53	52	49	2	0
5	21	80	50	65	64	64	46	0.33	83	52	67	55	578.50	169.70	7.07	197.90	8.24	210.19	8.75	00	0.07	0.00	53	54	52	50	4	0
5	22	61	45	53	53	74	71	0.11	61	51	56	51	197.21	85.59	3.56	91.29	3.80	155.69	6.48	01	0.00	0.00	53	54	53	51	4	0
5	23	63	48	55	54	72	52	0.12	69	50	59	56	394.43	51.40	2.14	55.00	2.29	87.77	3.65	15	0.06	0.00	51	51	50	48	1	0
5	24	75	50	62	61	59	47	0.23	82	54	68	62	565.35	66.60	2.77	69.80	2.90	77.60	3.23	68	0.00	0.00	57	57	56	53	1	0
5	25	70	36	53	51	57	38	0.26	72	41	56	48	368.13	129.00	5.37	144.00	6.00	207.95	8.66	76	0.07	0.00	51	54	52	50	1	0
5	26	72	38	55	57	49	23	0.36	72	45	58	54	696.83	111.90	4.66	116.40	4.85	167.69	6.98	78	0.00	0.00	52	53	52	49	0	0
5	27	86	48	67	65	62	40	0.27	81	54	67	57	617.94	84.20	3.50	99.29	4.13	135.56	5.64	48	0.00	0.00	58	58	57	54	0	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION		RADIATION			WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
4 30	50	50	54	33	2.32	0.33	52	4299.33	614.18	163.47	6.81	177.89	7.41	240.46	10.01	44	45	44	43	0.00	0.000
5 7	56	55	63	47	1.99	0.28	57	3247.50	463.92	148.14	6.17	167.81	6.99	221.14	9.21	50	50	49	47	0.32	0.000
5 14	56	57	58	44	2.04	0.29	57	3681.38	525.91	124.89	5.20	143.28	5.97	193.69	8.07	52	53	51	49	0.34	0.000
5 21	58	58	63	45	1.68	0.24	61	3418.42	488.34	99.77	4.15	110.52	4.60	148.92	6.20	53	54	53	51	0.20	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION		RADIATION			WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
4 30	55	55	59	42	8.03	0.29	57	14646.64	523.09	134.07	5.58	149.88	6.24	201.05	8.37	49	50	49	47	0.86	0.000

DAILY E. T. DATA PASTURE 3 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS				RH		EVAPORATION					RADIA		WIND (MILES / DAY) (MPH)						PREC	RO	SOIL TEMPS				WX COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M	DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
5	28	74	55	64	63	71	51	0.26	80	57	68	65	617.94	109.99	4.58	139.59	5.81	165.65	6.90	12	0.00	0.00	58	57	57	53	1	0
5	29	71	42	56	57	71	60	0.19	70	48	59	49	354.99	89.09	3.71	95.60	3.98	158.74	6.61	06	0.00	0.00	54	55	54	51	0	0
5	30	76	54	65	64	65	44	0.30	79	51	65	60	657.39	98.90	4.12	124.29	5.17	161.59	6.73	38	0.02	0.00	61	61	60	57	0	0
5	31	77	51	64	61	77	57	0.46	84	51	67	55	539.05	125.30	5.22	151.70	6.32	204.09	8.50	77	0.27	0.00	61	61	60	57	3	0
6	1	65	45	55	55	70	61	0.18	64	45	54	48	302.39	111.69	4.65	138.00	5.75	216.29	9.01	77	0.06	0.00	52	55	53	51	3	0
6	2	70	38	54	55	60	36	0.24	71	47	59	53	696.83	92.70	3.86	113.79	4.74	159.15	6.63	77	0.00	0.00	53	54	53	51	0	0
6	3	77	46	61	63	55	29	0.26	81	52	66	60	670.53	58.00	2.41	72.80	3.03	105.05	4.37	07	0.00	0.00	56	56	55	52	0	0
6	4	74	42	58	59	63	45	0.33	80	51	65	56	670.53	83.69	3.48	96.40	4.01	136.98	5.70	34	0.00	0.00	60	61	60	57	0	0
6	5	73	45	59	60	50	33	0.30	81	53	67	57	683.68	52.59	2.19	67.29	2.80	92.85	3.86	34	0.00	0.00	58	60	57	54	0	0
6	6	84	48	66	67	50	25	0.28	88	56	72	63	683.68	39.00	1.62	46.20	1.92	64.79	2.69	44	0.00	0.00	60	61	58	55	0	0
6	7	86	52	69	72	44	24	0.39	87	57	72	60	696.83	73.00	3.04	96.00	4.00	133.12	5.54	44	0.00	0.00	65	65	63	58	1	0
6	8	92	62	77	77	36	24	0.54	84	58	71	65	683.68	131.20	5.46	176.80	7.36	219.75	9.15	44	0.00	0.00	65	65	63	59	0	0
6	9	91	60	75	73	58	43	0.42	86	62	74	65	696.83	82.19	3.42	100.70	4.19	139.83	5.82	45	0.00	0.00	66	65	64	60	0	0
6	10	91	58	74	73	55	39	0.38	86	58	72	59	499.61	129.59	5.39	158.69	6.61	210.60	8.77	46	0.09	0.00	61	62	60	57	3	0
6	11	73	45	59	59	66	54	0.26	76	54	65	57	525.91	90.00	3.75	106.20	4.42	154.88	6.45	08	0.00	0.00	57	60	58	55	3	0
6	12	72	56	64	63	66	39	0.30	67	56	61	58	341.84	208.10	8.67	250.80	10.45	321.84	13.41	12	0.58	0.00	0	0	0	0	4	1
6	13	70	50	60	58	82	86	0.15	70	57	63	62	381.28	127.29	5.30	153.19	6.38	207.75	8.65	27	0.30	0.00	59	59	58	56	0	0
6	14	76	62	69	67	74	56	0.26	83	61	72	63	644.24	106.30	4.42	125.80	5.24	195.96	8.16	33	0.00	0.00	65	65	63	60	3	0
6	15	86	52	69	68	75	69	0.21	90	59	74	64	565.35	50.29	2.09	67.80	2.82	96.31	4.01	35	0.00	0.00	63	63	62	58	0	0
6	16	79	45	62	61	73	44	0.14	82	54	68	63	433.87	56.29	2.34	76.59	3.19	102.41	4.26	84	0.00	0.00	65	67	65	62	1	0
6	17	84	53	68	68	58	43	0.32	86	60	73	62	709.98	71.20	2.96	82.60	3.44	130.88	5.45	77	0.00	0.00	63	63	62	60	0	0
6	18	77	50	63	64	66	45	0.42	78	55	66	61	709.98	141.60	5.90	163.89	6.82	235.81	9.82	77	0.00	0.00	64	64	63	60	0	0
6	19	74	51	62	62	69	46	0.24	82	55	68	60	604.79	57.10	2.37	74.10	3.08	111.56	4.64	34	0.00	0.00	63	64	62	60	0	0
6	20	83	51	67	68	57	36	0.32	81	57	69	58	670.53	125.39	5.22	139.09	5.79	212.63	8.85	70	0.00	0.00	0	0	0	0	1	0
6	21	72	46	59	60	63	41	0.43	77	53	65	69	736.27	88.10	3.67	122.10	5.08	159.15	6.63	08	0.00	0.00	67	67	66	63	1	0
6	22	80	53	66	68	60	37	0.34	88	57	72	62	696.83	65.19	2.71	77.10	3.21	120.30	5.01	43	0.00	0.00	66	66	65	61	0	0
6	23	94	63	78	79	53	40	0.46	89	62	75	72	709.98	103.39	4.30	133.09	5.54	163.62	6.81	44	0.00	0.00	72	70	69	64	1	0
6	24	85	54	69	72	63	42	0.35	82	60	71	66	499.61	60.70	2.52	89.30	3.72	131.29	5.47	08	0.00	0.00	66	64	64	61	0	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
5 28	60	60	67	48	1.89	0.27	62	3839.15	548.45	97.95	4.08	119.40	4.97	167.22	6.96	56	57	56	53	0.35	0.000
6 4	68	69	51	33	2.64	0.37	70	4614.87	659.26	84.47	3.51	106.01	4.41	142.56	5.94	62	62	60	57	0.09	0.000
6 11	64	63	71	55	1.64	0.23	68	3602.49	514.64	101.35	4.22	123.28	5.13	172.86	7.20	62	62	61	58	0.88	0.000
6 18	66	67	62	41	2.56	0.36	69	4628.02	661.14	91.64	3.81	114.10	4.75	162.05	6.75	66	65	65	61	0.00	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
5 28	64	65	62	44	8.73	0.31	67	16684.55	595.87	93.85	3.91	115.70	4.82	161.17	6.71	61	61	60	57	1.32	0.000

DAILY E. T. DATA PASTURE 3 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS			RH		EVAPORATION				RADIA		WIND (MILES / DAY) (MPH)						PREC	RO	SOIL TEMPS				#X COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M	DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
6	25	86	62	74	74	68	51	0.43	88	63	75	67	683.68	112.10	4.67	142.19	5.92	196.16	8.17	36	0.12	0.00	70	71	69	65	1	0
6	26	93	53	73	74	58	35	0.56	85	59	72	70	723.12	112.60	4.69	138.10	5.75	187.62	7.81	08	0.00	0.00	68	69	67	63	1	0
6	27	91	63	77	77	54	37	0.51	91	62	76	76	709.98	100.19	4.17	125.70	5.23	163.82	6.82	33	0.00	0.00	71	70	69	64	1	0
6	28	107	72	89	90	41	36	0.63	92	68	80	70	683.68	118.39	4.93	149.60	6.23	198.60	8.27	44	0.00	0.00	0	0	0	0	1	0
6	29	102	71	86	86	45	39	0.58	92	65	78	70	736.27	111.90	4.66	150.79	6.28	201.04	8.37	62	0.00	0.00	78	78	76	70	1	0
6	30	100	69	84	83	60	50	0.58	90	66	78	68	617.94	151.69	6.32	191.60	7.98	260.62	10.85	46	0.00	0.00	79	79	77	71	0	0
7	1	93	53	73	72	53	36	0.62	85	56	70	63	709.98	118.00	4.91	137.19	5.71	175.42	7.30	78	0.00	0.00	73	74	73	68	0	0
7	2	96	51	73	74	45	32	0.48	88	58	73	64	709.98	62.39	2.59	79.90	3.32	113.80	4.74	68	0.00	0.00	72	72	71	67	0	0
7	3	95	56	75	77	44	29	0.48	90	59	74	62	709.98	83.70	3.48	97.29	4.05	130.07	5.41	07	0.00	0.00	76	75	74	69	0	0
7	4	81	50	65	67	59	41	0.47	80	54	67	62	736.27	113.29	4.72	142.39	5.93	210.60	8.77	08	0.00	0.00	72	72	71	67	0	0
7	5	88	56	72	73	51	37	0.32	89	57	73	61	657.39	59.50	2.47	77.20	3.21	102.61	4.27	03	0.00	0.00	72	72	70	67	4	0
7	6	99	65	82	79	54	41	0.34	90	60	75	69	631.09	63.79	2.65	77.89	3.24	101.80	4.24	46	0.04	0.00	76	76	74	70	0	0
7	7	99	68	83	84	44	32	0.47	93	66	79	70	617.94	70.60	2.94	100.50	4.18	132.30	5.51	00	0.05	0.00	77	77	75	71	1	0
7	8	96	58	77	78	44	35	0.55	89	61	75	66	696.83	73.79	3.07	94.50	3.93	129.66	5.40	08	0.00	0.00	70	72	70	66	1	0
7	9	97	65	81	80	53	32	0.50	89	63	76	72	604.79	142.29	5.92	174.89	7.28	215.48	8.97	34	1.79	0.00	73	75	73	70	1	0
7	10	90	63	76	75	68	51	0.31	88	67	77	70	657.39	63.29	2.63	88.39	3.68	136.37	5.68	31	0.00	0.00	77	77	76	72	1	0
7	11	69	63	76	76	67	49	0.27	89	67	78	70	525.91	58.40	2.43	70.80	2.95	99.56	4.14	22	0.00	0.00	76	76	74	71	0	0
7	12	97	70	83	83	58	49	0.36	96	70	83	74	631.09	61.59	2.56	83.69	3.48	106.27	4.42	38	0.00	0.00	78	80	76	72	2	0
7	13	94	69	81	77	66	40	0.29	93	61	77	68	486.46	72.50	3.02	95.59	3.98	130.47	5.43	85	0.00	0.00	75	78	74	70	1	0
7	14	87	65	76	76	60	54	0.35	89	64	76	66	670.53	137.00	5.70	167.00	6.95	197.79	8.24	30	0.02	0.00	0	0	0	0	1	0
7	15	77	53	65	65	60	42	0.45	79	54	66	60	696.83	140.29	5.84	149.40	6.22	275.47	11.47	77	0.00	0.00	70	72	70	67	0	0
7	16	86	56	71	72	47	31	0.35	88	59	73	65	696.83	58.60	2.44	76.20	3.17	103.02	4.29	74	0.00	0.00	71	73	71	69	0	0
7	17	100	59	79	81	42	25	0.35	93	64	78	76	670.53	46.39	1.93	52.89	2.20	66.82	2.78	66	0.00	0.00	76	74	75	71	1	0
7	18	98	60	79	79	56	35	0.44	89	64	76	68	552.20	61.40	2.55	80.30	3.34	113.80	4.74	28	0.00	0.00	76	77	74	70	1	0
7	19	98	62	80	75	64	37	0.49	88	63	75	65	447.02	79.29	3.30	92.59	3.85	117.66	4.90	00	0.63	0.00	72	76	73	71	4	7
7	20	74	55	64	65	62	62	0.28	76	56	66	57	420.72	105.00	4.37	141.00	5.87	179.28	7.47	23	0.00	0.00	68	73	70	68	3	0
7	21	83	60	71	70	59	42	0.31	80	57	68	64	644.24	136.00	5.66	186.00	7.75	237.64	9.90	44	0.00	0.00	67	69	68	65	1	0
7	22	91	67	79	78	49	43	0.57	85	63	74	72	644.24	204.10	8.50	267.50	11.14	324.68	13.52	44	0.00	0.00	73	73	72	69	3	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)					SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN	1 METER		2 METER		10	20	50	150	(INS)	(INS)
6 25	79	79	54	40	3.91	0.55	75	4864.68	694.95	117.84	4.91	147.88	6.16	197.61	8.23	73	73	72	67	0.12	0.000
7 2	75	76	49	35	3.11	0.44	73	4759.50	679.92	75.30	3.13	95.67	3.98	131.55	5.48	73	73	72	68	0.09	0.000
7 9	77	76	62	45	2.53	0.36	76	4273.03	610.43	96.48	4.02	118.54	4.93	165.92	6.91	74	76	74	70	1.81	0.000
7 16	74	74	54	39	2.79	0.39	73	4075.81	582.25	98.68	4.11	128.07	5.33	163.27	6.80	71	73	72	69	0.63	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)					SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN	1 METER		2 METER		10	20	50	150	(INS)	(INS)
6 25	76	76	55	40	12.34	0.44	74	17973.03	641.89	97.07	4.04	122.54	5.10	164.59	6.85	73	74	72	69	2.65	0.000

DAILY E. T. DATA PASTURE 3 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE	AIR TEMPS				RH		EVAPORATION					RADIA		WIND (MILES / DAY) (MPH)						PREC	RO	SOIL TEMPS				WX COND	
	MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M	DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
7	23	90	65	77	79	58	54	0.51	86	62	74	65	394.43	164.79	6.86	201.90	8.41	224.83	9.36	44	0.65	0.00	74	75	73	70	2	1
7	24	76	57	66	64	76	89	0.15	75	59	67	65	381.28	50.39	2.09	57.39	2.39	117.25	4.88	74	0.00	0.00	72	75	73	72	1	0
7	25	92	63	77	78	53	46	0.31	91	65	78	69	644.24	69.80	2.90	90.79	3.78	123.96	5.16	04	0.00	0.00	76	78	76	73	1	0
7	26	102	64	83	83	46	33	0.43	91	64	77	70	657.39	108.29	4.51	141.10	5.87	176.43	7.35	44	0.00	0.00	76	78	76	72	1	0
7	27	92	60	76	77	60	48	0.45	87	62	74	67	683.68	111.50	4.64	134.50	5.60	176.43	7.35	00	0.00	0.00	67	69	67	64	0	0
7	28	91	63	77	78	52	40	0.47	87	66	76	79	617.94	86.70	3.61	109.70	4.57	137.59	5.73	24	0.00	0.00	76	73	74	70	1	0
7	29	97	64	80	81	48	35	0.52	87	64	75	70	670.53	95.29	3.97	123.69	5.15	178.47	7.43	46	0.00	0.00	76	76	75	72	0	0
7	30	97	62	79	80	54	35	0.47	89	64	76	71	617.94	94.89	3.95	116.40	4.85	159.55	6.64	73	0.00	0.00	78	78	77	73	0	0
7	31	100	60	80	79	54	26	0.41	88	61	74	75	565.35	95.90	3.99	115.40	4.80	152.23	6.34	66	0.00	0.00	80	80	79	75	1	0
8	1	91	65	78	76	47	40	0.43	92	60	76	66	617.94	99.40	4.14	131.00	5.45	167.28	6.97	83	0.00	0.00	79	80	79	75	1	0
8	2	92	61	76	75	64	56	0.36	89	62	75	68	617.94	95.29	3.97	125.59	5.23	158.74	6.61	32	0.00	0.00	78	78	77	73	2	0
8	3	80	56	68	69	59	41	0.34	75	57	66	64	447.02	126.39	5.26	166.00	6.91	211.00	8.79	22	0.00	0.00	72	72	72	69	2	0
8	4	81	56	68	68	57	40	0.33	76	57	66	65	447.02	103.30	4.30	121.50	5.06	180.09	7.50	33	0.00	0.00	74	75	74	71	1	0
8	5	93	65	79	79	66	46	0.35	88	65	76	74	578.50	97.69	4.07	138.29	5.76	168.70	7.02	22	0.00	0.00	77	79	76	72	2	0
8	6	89	69	79	78	67	51	0.36	88	69	78	71	512.76	120.80	5.03	156.00	6.50	225.04	9.37	33	0.00	0.00	73	73	72	68	3	0
8	7	92	68	80	78	73	57	0.34	90	70	80	78	591.65	111.00	4.62	134.79	5.61	183.75	7.65	38	0.34	0.00	78	78	77	73	1	0
8	8	95	66	80	80	68	44	0.40	91	70	80	77	591.65	64.79	2.69	82.30	3.42	120.71	5.02	04	0.00	0.00	77	77	76	73	1	0
8	9	95	67	81	81	61	45	0.48	91	62	76	61	565.35	134.00	5.58	186.79	7.78	239.07	9.96	30	0.00	0.00	78	79	76	73	4	0
8	10	72	58	65	65	77	48	0.30	66	59	62	65	223.51	52.89	2.20	78.59	3.27	112.98	4.70	10	0.74	0.00	70	72	71	70	3	0
8	11	88	64	76	74	66	55	0.29	87	63	75	69	512.76	71.80	2.99	90.90	3.78	116.85	4.86	33	0.00	0.00	73	75	74	72	1	0
8	12	99	62	80	78	47	30	0.40	87	62	74	67	552.20	69.69	2.90	90.29	3.76	117.66	4.90	44	0.00	0.00	69	71	69	67	1	0
8	13	100	60	80	80	45	35	0.40	92	61	76	70	591.65	54.40	2.26	70.29	2.92	84.51	3.52	84	0.00	0.00	72	73	72	70	0	0
8	14	105	60	82	82	41	27	0.45	90	63	76	66	604.79	61.59	2.56	80.70	3.36	116.24	4.84	68	0.00	0.00	72	75	73	71	1	0
8	15	90	60	75	72	62	39	0.55	86	59	72	64	604.79	112.10	4.67	133.50	5.56	167.28	6.97	07	0.25	0.00	70	71	70	68	1	1
8	16	83	52	67	68	52	33	0.35	79	57	68	66	617.94	68.20	2.84	72.09	3.00	109.32	4.55	74	0.00	0.00	0	0	0	0	0	0
8	17	96	66	81	80	51	32	0.45	86	62	74	70	604.79	116.09	4.83	151.30	6.30	194.12	8.08	11	0.00	0.00	72	73	72	70	1	0
8	18	103	60	81	82	45	36	0.41	88	60	74	64	552.20	116.69	4.86	150.39	6.26	202.46	8.43	47	0.00	0.00	74	74	73	71	2	0
8	19	95	55	75	76	35	21	0.56	82	54	68	56	578.50	106.00	4.41	131.70	5.48	188.63	7.85	00	0.00	0.00	70	73	71	69	3	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
7	23	76	77	56	49	2.84	0.40	74	4049.52	578.50	98.11	4.08	122.72	5.11	162.14	6.75	73	74	73	70	0.65	0.000
7	30	75	75	57	40	2.69	0.38	73	3891.74	555.96	101.84	4.24	130.60	5.44	171.09	7.12	76	77	76	72	0.00	0.000
8	6	77	76	66	47	2.57	0.36	75	3549.90	507.12	89.28	3.72	117.10	4.87	159.44	6.64	74	75	73	71	1.08	0.000
8	13	77	77	47	31	3.17	0.45	72	4154.70	593.52	90.72	3.78	112.85	4.70	151.80	6.32	71	73	72	70	0.25	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
7	23	76	76	57	42	11.27	0.40	73	15645.87	558.78	94.99	3.95	120.82	5.03	161.11	6.71	74	75	74	71	1.98	0.000

DAILY E. T. DATA PASTURE 3 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS				RH		EVAPORATION				RADIA			WIND (MILES / DAY) (MPH)					PREC	RO	SOIL TEMPS				WX COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M	DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
8	20	83	47	65	65	52	37	0.31	78	52	65	58	552.20	55.90	2.32	63.40	2.64	88.78	3.69	04	0.00	0.00	68	70	69	67	0	0
8	21	90	63	76	75	49	25	0.49	80	58	69	74	591.65	158.00	6.58	208.69	8.69	245.58	10.23	44	0.00	0.00	69	69	68	66	3	0
8	22	93	51	72	72	43	40	0.53	81	55	68	57	552.20	92.40	3.85	108.09	4.50	180.50	7.52	76	0.00	0.00	70	74	71	68	0	0
8	23	91	52	71	72	42	27	0.36	83	56	69	58	591.65	52.50	2.18	59.59	2.48	74.95	3.12	04	0.00	0.00	0	0	0	0	1	0
8	24	95	63	79	78	35	25	0.44	84	58	71	61	565.35	94.50	3.93	117.80	4.90	162.60	6.77	34	0.00	0.00	70	71	70	68	3	0
8	25	103	58	80	80	39	27	0.52	83	58	70	68	447.02	106.50	4.43	130.30	5.42	164.03	6.83	55	0.00	0.00	74	74	73	71	0	0
8	26	103	61	82	82	32	19	0.46	87	60	73	66	552.20	67.59	2.81	79.59	3.31	115.63	4.81	03	0.00	0.00	74	74	73	71	1	0
8	27	110	60	85	84	32	18	0.69	85	60	72	68	552.20	123.19	5.13	154.90	6.45	192.90	8.03	60	0.00	0.00	74	74	73	70	1	0
8	28	88	61	74	74	44	38	0.46	82	58	70	62	565.35	135.30	5.63	172.69	7.19	229.10	9.54	22	0.00	0.00	75	75	75	72	2	0
8	29	87	56	71	72	55	42	0.37	79	60	69	65	512.76	101.30	4.22	123.20	5.13	179.28	7.47	28	0.00	0.00	73	72	71	69	0	0
8	30	98	60	79	78	39	31	0.43	89	58	73	64	512.76	109.29	4.55	151.90	6.32	178.06	7.41	00	0.00	0.00	74	74	73	71	1	0
8	31	78	58	68	69	48	48	0.43	80	56	68	61	565.35	109.59	4.56	137.39	5.72	188.43	7.85	22	0.00	0.00	74	71	72	69	0	0
9		1101	72	86	84	36	35	0.50	84	60	72	68	539.05	130.00	5.41	164.10	6.83	211.21	8.80	44	0.00	0.00	74	74	73	71	0	0
9		2101	69	85	85	37	26	0.58	85	64	74	67	525.91	130.30	5.42	163.89	6.82	209.78	8.74	46	0.00	0.00	77	77	76	73	3	0
9		3 92	60	76	75	50	39	0.37	82	59	70	62	354.99	88.19	3.67	109.09	4.54	157.32	6.55	05	0.09	0.00	73	75	73	71	1	0
9		4 89	54	71	71	52	41	0.28	85	59	72	61	539.05	52.30	2.17	65.30	2.72	90.82	3.78	04	0.00	0.00	66	70	68	66	0	0
9		5101	71	86	84	32	16	0.57	82	61	71	71	512.76	168.80	7.03	215.40	8.97	263.07	10.96	54	0.00	0.00	76	75	75	73	0	0
9		6 96	60	78	79	37	30	0.41	86	61	73	69	499.61	58.59	2.44	76.89	3.20	94.48	3.93	58	0.00	0.00	81	78	79	76	3	0
9		7 91	55	73	72	59	30	0.57	81	55	68	61	368.13	174.70	7.27	197.89	8.24	267.34	11.13	76	1.02	0.00	0	0	0	0	3	0
9		8 83	59	71	69	52	37	0.47	74	56	65	60	525.91	121.59	5.06	168.60	7.02	240.29	10.01	74	0.00	0.00	63	68	65	65	0	0
9		9 94	51	72	73	45	27	0.52	81	50	65	50	499.61	234.10	9.75	245.89	10.24	335.46	13.97	57	0.00	0.00	65	68	67	67	4	0
9	10	62	40	51	49	69	50	0.24	57	40	48	51	341.84	208.50	8.68	238.00	9.91	306.99	12.79	76	0.00	0.00	57	63	61	63	1	0
9	11	77	50	63	61	42	29	0.27	72	48	60	51	525.91	93.79	3.90	111.79	4.65	170.33	7.09	64	0.00	0.00	61	64	63	65	0	0
9	12	81	41	61	57	54	29	0.45	72	39	55	43	525.91	235.40	9.80	287.60	11.98	386.91	16.12	00	0.00	0.00	59	64	62	64	4	0
9	13	49	35	42	44	70	68	0.10	50	38	44	39	223.51	102.50	4.27	132.30	5.51	191.48	7.97	03	0.11	0.00	58	68	63	66	4	0
9	14	43	37	40	40	89	89	0.07	41	38	39	41	105.18	131.39	5.47	150.69	6.27	238.46	9.93	33	0.53	0.00	55	55	56	59	4	0
9	15	48	40	44	43	90	86	0.00	46	41	43	46	118.33	62.40	2.60	76.39	3.18	110.75	4.61	26	0.04	0.00	53	55	55	59	1	0
9	16	64	41	52	51	64	54	0.14	67	45	56	48	407.58	63.59	2.64	77.90	3.24	104.64	4.36	63	0.00	0.00	54	58	57	59	3	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
8 20	75	75	42	28	3.11	0.44	69	3852.30	550.32	89.62	3.73	109.64	4.56	147.44	6.14	70	72	70	68	0.00	0.000
8 27	78	78	42	34	3.46	0.49	71	3773.41	539.05	119.85	4.99	152.58	6.35	198.40	8.26	74	73	73	71	0.00	0.000
9 3	75	74	47	31	3.19	0.45	69	3300.09	471.44	128.32	5.34	154.15	6.42	206.97	8.62	70	72	71	70	1.11	0.000
9 10	50	49	68	57	1.27	0.18	49	2248.27	321.18	128.22	5.34	153.52	6.39	215.65	8.98	56	61	59	62	0.68	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
8 20	69	69	50	37	11.03	0.39	64	13174.09	470.50	116.51	4.85	142.47	5.93	192.11	8.00	67	69	68	68	1.79	0.000

DAILY E. T. DATA PASTURE 3 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE		AIR TEMPS				RH		EVAPORATION					RADIA		WIND (MILES / DAY) (MPH)					PREC	RO	SOIL TEMPS				WX COND	
		MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	1 M	1 M	2 M	2 M DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
9	17	58	38	48	48	83	68	0.04	57	44	50	52	170.92	52.69	2.19	69.00	2.87	90.41	3.76	38	0.00	0.00	54	56	56	59	0	0
9	18	80	47	63	60	53	43	0.23	76	51	63	53	486.46	36.50	1.52	49.19	2.04	72.11	3.00	64	0.00	0.00	52	56	55	56	0	0
9	19	90	57	73	70	44	27	0.31	76	54	65	62	499.61	84.70	3.52	108.70	4.52	137.39	5.72	45	0.00	0.00	53	55	54	55	2	0
9	20	95	50	72	71	41	24	0.26	78	53	65	59	460.17	77.69	3.23	100.19	4.17	135.76	5.65	56	0.00	0.00	55	57	56	57	2	0
9	21	68	44	66	62	58	41	0.43	75	43	59	48	447.02	160.99	6.70	175.20	7.30	250.25	10.42	77	0.00	0.00	56	58	57	59	1	0
9	22	70	39	54	55	61	36	0.34	65	41	53	49	512.76	147.30	6.13	167.29	6.97	239.68	9.98	76	0.00	0.00	59	62	60	62	1	0
9	23	70	42	56	54	52	35	0.25	67	43	55	50	460.17	85.79	3.57	113.00	4.70	139.42	5.80	54	0.00	0.00	54	58	57	58	1	0
9	24	79	43	61	60	54	37	0.29	70	46	58	49	460.17	142.70	5.94	182.50	7.60	243.95	10.16	47	0.00	0.00	58	60	59	60	3	0
9	25	52	40	46	45	83	83	0.10	51	40	45	42	144.62	145.29	6.05	171.40	7.14	255.13	10.63	07	0.00	0.00	52	55	54	56	1	0
9	26	57	33	45	43	66	51	0.13	55	37	46	42	354.99	120.79	5.03	126.09	5.25	192.09	8.00	77	0.00	0.00	49	53	51	54	0	0
9	27	67	42	54	53	51	29	0.29	62	40	51	49	499.61	119.50	4.97	137.20	5.71	199.62	8.31	77	0.00	0.00	52	55	54	56	0	0
9	28	74	43	58	59	53	40	0.21	69	45	57	50	486.46	74.70	3.11	88.20	3.67	130.68	5.44	76	0.00	0.00	55	59	57	59	0	0
9	29	81	43	62	61	46	32	0.20	72	45	58	50	433.87	39.79	1.65	49.89	2.07	67.84	2.82	66	0.00	0.00	55	58	57	59	0	0
9	30	87	42	64	62	46	27	0.22	74	48	61	51	433.87	36.20	1.50	42.60	1.77	56.45	2.35	08	0.00	0.00	55	58	56	58	0	0
10	1	87	48	67	64	39	24	0.29	73	48	60	51	433.87	59.00	2.45	76.19	3.17	98.95	4.12	57	0.00	0.00	57	59	58	59	1	0
10	2	78	45	61	60	46	33	0.36	68	49	58	51	433.87	100.00	4.16	105.00	4.37	169.31	7.05	77	0.00	0.00	0	0	0	0	0	0
10	3	72	33	52	53	52	32	0.28	63	38	50	48	460.17	125.60	5.23	132.10	5.50	201.65	8.40	04	0.00	0.00	56	59	58	60	0	0
10	4	77	45	61	58	46	38	0.20	65	44	54	47	420.72	67.10	2.79	87.29	3.63	117.46	4.89	45	0.00	0.00	52	56	54	55	1	0
10	5	91	44	67	66	43	31	0.27	73	47	60	55	420.72	62.39	2.59	74.90	3.12	87.56	3.64	55	0.00	0.00	57	59	58	59	0	0
10	6	89	50	69	67	46	26	0.28	75	48	61	49	381.28	107.50	4.47	125.50	5.22	186.80	7.78	47	0.00	0.00	57	60	58	59	1	0
10	7	57	32	44	42	80	60	0.10	54	31	42	32	249.80	195.29	8.13	247.39	10.30	337.29	14.05	70	0.23	0.00	51	55	54	56	4	1
10	8	34	31	32	32	86	87	0.00	38	31	34	35	197.21	126.70	5.27	146.60	6.10	223.00	9.29	00	0.00	0.00	50	55	53	56	1	0
10	9	48	24	36	33	74	64	0.10	48	32	40	35	433.87	96.50	4.02	110.39	4.59	165.86	6.91	07	0.00	0.00	45	49	48	52	1	0
10	10	46	30	38	35	76	48	0.10	48	34	41	34	302.39	67.10	2.79	91.50	3.81	120.30	5.01	72	0.00	0.00	0	0	0	0	3	0
10	11	44	29	36	37	82	63	0.06	46	32	39	38	197.21	67.29	2.80	85.70	3.57	105.25	4.38	24	0.00	0.00	0	0	0	0	1	0
10	12	62	36	49	46	70	54	0.11	57	38	47	44	407.58	71.20	2.96	90.79	3.78	126.81	5.28	64	0.00	0.00	45	48	47	51	0	0
10	13	77	39	58	54	61	38	0.15	65	41	53	43	368.13	130.50	5.43	185.10	7.71	239.27	9.96	57	0.11	0.00	49	51	50	53	1	0
10	14	56	35	45	43	79	55	0.07	56	37	46	39	262.95	86.19	3.59	90.69	3.77	133.32	5.55	77	0.00	0.00	50	52	51	54	3	0

WEEKLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
9 17	62	60	56	39	1.86	0.26	58	3037.14	433.87	92.24	3.84	111.79	4.65	152.14	6.33	54	57	56	58	0.00	0.000
9 24	55	55	57	42	1.44	0.20	53	2813.62	401.94	97.00	4.04	113.98	4.74	163.68	6.82	53	56	55	57	0.00	0.000
10 1	60	59	50	34	1.78	0.25	55	2800.48	400.06	102.41	4.26	121.19	5.04	171.29	7.13	55	58	56	58	0.23	0.000
10 8	42	40	75	58	0.59	0.08	43	2169.38	309.91	92.21	3.84	114.39	4.76	159.12	6.63	47	51	50	53	0.11	0.000

MONTHLY E. T. DATA COTTONWOOD, S. D. 1970

DATE	AIR TEMP		RH		EVAPORATION			RADIATION		WINDS (AV DAILY MILES) (AV MPH)						SOIL TEMPS				PREC	RO
	AV	AV2H	AV	11	TOTAL	MEAN	TEMP	TOTAL	AV	PAN		1 METER		2 METER		10	20	50	150	(INS)	(INS)
9 17	55	53	60	43	5.67	0.20	52	10820.63	386.45	95.96	3.99	115.34	4.80	161.56	6.73	53	56	55	57	0.34	0.000

DAILY E. T. DATA PASTURE 3 COTTONWOOD, S. D. 1970 APPENDIX TABLE 1 CONTINUED

DATE	AIR TEMPS				RH		EVAPORATION					RADIA		WIND (MILES / DAY) (MPH)						PREC	RO	SOIL TEMPS				MX COND	
	MA	MI	AV	AV	AV	11	INS	MA	MI	AV	PRE	LYS	PAN	PAN	I M	I M	2 M	2 M	DIR	INS	INS	10	20	50	150	CLD	RN
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
10	15	52	24	38	35	69	50	0.10	51	34	42	41	315.54	55.30	2.30	59.80	2.49	91.43	3.80	04	0.00	0.00	43	47	45	49	0	0

// * END OF JOB

Appendix Table 1 Continued - Daily Weather Data
4/1/1970 to 4/29/1970, Cottonwood, South Dakota

Date	Air Temperature [a]			Evaporation [a]
	Maximum	Minimum	Average	(Inches)
4/1	48	11	30	--
2	54	30	42	--
3	47	19	33	--
4	64	15	40	--
5	65	37	51	--
6	76	23	50	--
7	84	42	63	--
8	59	27	43	--
9	67	22	44	.19
10	76	23	50	.27
11	68	40	54	.15
12	49	28	38	--
13	36	26	31	--
14	35	28	31	.04
15	38	31	34	--
16	40	20	30	.10
17	38	22	30	--
18	32	30	31	--
19	37	30	33	--
20	37	29	33	.04
21	44	24	34	.10
22	42	28	35	.02
23	54	30	42	--
24	64	32	48	.27
25	66	35	50	.20
26	64	36	50	.12
27	64	34	49	.26
28	60	41	50	.20
29	61	36	48	

[a] U. S. Weather Bureau record at Field Station Headquarters, observation at 1800 daily.

Appendix Table 1 Continued - Daily Weather Data
10/16/1970 to 11/7/1970, Cottonwood, South Dakota

Date	Air Temperature[a]			Relative Humidity[a]		Radiation[a]	2 meter wind[a]
	Maximum	Minimum	Average	Average	11 a.m.	Langleys	MPH
10/16	58	30	44	59	44	381.29	3.61
17	70	34	52	52	28	381.29	5.46
18	72	27	50	53	25	381.29	2.40
19	65	34	50	66	44	368.14	5.32
20	70	32	51	57	35	328.70	5.15
21	70	40	55	48	31	328.70	4.17
22	72	31	51	59	34	315.55	5.38
23	67	44	56	55	34	328.70	5.03
24	64	31	46	76	52	276.10	2.78
25	75	41	58	55	28	262.96	9.53
26	51	24	37	63	60	262.96	7.67
27	50	27	38	77	56	118.33	5.68
28	45	32	38	75	45	262.96	15.42
29	41	30	36	M	M	170.92	17.76
30	34	26	30	M	M	157.77	15.59
31	39	19	29	M	M	249.81	9.77
11/1	38	23	31	M	M	302.40	8.61
2	38	29	34	M	M	105.18	19.52
3	34	28	31	M	M	105.18	13.15
4	34	25	30	89	89	78.89	13.49
5	36	20	28	87	82	236.66	3.95
6	60	34	38	73	48	289.25	5.16
7	58	30	44	74	48	289.25	

[a] Data from Pasture 2, observation at 0800 daily.

Appendix Table 1 Continued - Daily Weather Data
11/8/1970 to 12/6/1970, Cottonwood, South Dakota

Date	Air Temperature[a]			Relative Humidity[a]		Radiation[a]	Wind[a]
	Maximum	Minimum	Average	Average	11 a.m.	Langleys	MPH
11/8	47	30	38	95	80	92.03	M
11/9	40	35	38	98	97	26.30	M
11/10	M	M	M	M	M	262.96	M
11/11	M	M	M	M	60	131.48	14.99
11/12	37	29	32	89	78	92.03	4.07
11/13	39	30	34	89	79	170.92	2.82
11/14	34	26	31	94	94	65.73	2.82
11/15	38	22	29	78	52	157.77	4.32
11/16	56	20	34	77	46	249.81	4.01
11/17	53	26	40	77	66	210.36	4.01
11/18	54	28	41	76	50	144.63	7.84
11/19	45	25	34	91	74	131.48	7.84
11/20	45	24	32	79	70	197.22	7.84
11/21	45	25	33	80	56	157.77	7.84
11/22	40	13	25	81	70	118.33	7.84
11/23	18	7	13	59	50	236.66	7.84
11/24	25	6	16	57	50	223.51	7.84
11/25	52	21	40	55	50	78.89	7.84
11/26	57	22	37	74	78	78.89	6.88
11/27	26	18	22	91	82	131.48	6.88
11/28	34	18	24	94	76	105.18	6.88
11/29	49	19	33	87	83	184.07	6.88
11/30	60	27	41	67	44	184.07	6.88
12/1	62	33	45	65	50	157.77	15.99
12/2	56	23	37	70	35	236.66	4.57
12/3	48	22	33	74	44	144.63	14.39
12/4	40	20	30	65	50	223.51	9.40
12/5	57	17	34	57	26	236.66	4.01
12/6	29	14	19	62	40	197.22	4.26

[a] Data from pasture one, observation at 1100 daily for wind measurements. All other measurements are midnight-to-midnight readings for previous day.

Appendix Table 2. Soil Bulk Density (g/cm^3) by Depth Increment Cottonwood, October 1970[a/]

Depth cm	Plot no. 1	2	3	4	5	6	7	8	9	10	Mean
Permanent Exclosure High Range Condition, Replication I											
0-5	1.01	1.02	0.96	1.15	0.90	0.87	0.84	0.95	0.79	0.95	0.94
5-10	1.34	1.34	1.29	0.99	1.12	1.26	1.37	1.37	1.10	1.26	1.24
10-20	1.08	1.20	1.35	1.23	1.12	1.36	1.41	1.38	1.27	1.28	1.27
20-30	0.91	1.26	1.40	0.99	1.24	1.54	1.34	1.55	1.49	1.36	1.31
30-40	1.07	1.61	1.54	1.23	1.56	1.55	1.55	1.31	1.57	1.40	1.44
40-50	1.18	1.55	1.50	1.43	1.44	1.67	1.24	1.37	1.70	1.53	1.46
50-60	1.50	1.46	1.67	1.65	1.65	1.60	1.65	1.49	1.45	1.54	1.57
Permanent Exclosure High Range Condition, Replication II											
0-5	1.08	1.10	1.20	1.01	0.99	1.22	1.05	1.13	0.88	1.22	1.09
5-10	1.41	1.13	1.27	1.39	1.34	1.33	1.25	1.36	1.14	1.22	1.28
10-20	1.46	1.39	1.32	1.29	1.31	1.54	1.09	1.26	1.27	1.50	1.34
20-30	1.54	1.27	1.55	1.43	1.37	1.36	0.95	1.51	1.37	1.38	1.37
30-40	1.58	1.51	1.54	1.77	1.71	1.54	1.34	1.71	1.24	1.57	1.55
40-50	1.39	1.84	1.22	1.42	1.55	1.61	0.83	1.64	1.26	1.63	1.44
50-60	1.54	1.68	1.17	1.56	1.58	1.71	1.48	1.54	1.58	1.42	1.53

Appendix Table 2 Continued

Depth cm	Plot no. 1	2	3	4	5	6	7	8	9	10	Mean
Temporary Exclosure Low Range Condition, Replication I											
0-5	0.91	1.00	1.09	0.96	1.08	1.05	1.10	1.20	0.90	1.16	1.05
5-10	1.24	1.28	1.54	1.12	1.28	1.32	1.26	1.35	1.39	1.43	1.32
10-20	1.26	1.25	1.34	1.11	1.42	1.31	1.20	1.49	1.31	1.11	1.28
20-30	1.65	1.29	1.46	1.33	1.39	1.33	1.27	1.37	1.41	1.45	1.40
30-40	1.28	1.14	1.24	1.17	1.37	1.21	1.08	1.45	1.58	1.49	1.30
40-50	1.51	1.29	1.33	1.64	1.51	1.62	1.45	1.56	1.70	1.31	1.49
50-60	1.50	1.55	1.28	1.51	1.52	1.35	1.62	1.34	1.65	1.41	1.47
Temporary Exclosure Low Range Condition, Replication II											
0-5	1.01	1.08	1.01	1.06	1.00	1.11	1.11	0.99	1.01	1.32	1.07
5-10	1.37	1.38	1.21	1.18	1.20	1.35	1.24	1.22	1.20	1.18	1.25
10-20	1.38	1.23	1.29	1.37	1.32	1.35	1.35	1.20	1.23	1.37	1.31
20-30	1.49	1.42	1.36	1.31	1.50	1.61	1.55	1.31	1.49	1.53	1.46
30-40	1.46	1.51	1.55	1.37	1.41	1.58	1.55	1.11	1.49	1.52	1.46
40-50	1.43	1.48	1.45	1.51	1.60	1.62	1.70	0.95	1.25	1.42	1.44
50-60	1.54	1.51	1.53	1.43	1.50	1.64	1.58	1.35	1.38	1.51	1.50

a/ Samples taken with a 4.2 cm diameter tube on a hydraulic core sampler.

Appendix Table 3. Soil Moisture and Total Soil Water by Depth Increment, Plot, Replication, Treatment and Date, Cottonwood, 1970
May 8, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
					Soil moisture (%)								
Permanent Exclosure High Range Condition, Replication I													
0-5		24.0		23.2	23.6		19.8	21.9			22.5	1.06	1.15
5-10		24.0		27.0	22.8		24.3	30.4			25.7	1.59	1.54
10-20	29.6	29.1		27.9	29.7		27.1	29.1			28.8	3.66	3.74
20-30	28.5	26.6	30.6		27.9		26.9	28.5			28.2	3.69	3.72
30-40	26.3	25.5	27.5		26.8		26.1				26.4	3.80	3.89
40-50	26.2	24.2	25.0		24.5		25.7	25.2			25.1	3.66	3.60
50-60	23.7	20.8	22.6		20.7		23.8	23.6			22.5	3.53	3.46
											Total	20.99	21.10
Permanent Exclosure High Range Condition, Replication II													
0-5	22.0	25.8	19.2	25.3			21.8				22.8	1.24	
5-10	22.5	20.9	22.4	22.7			27.4				23.2	1.48	
10-20	28.6	28.5	30.1	28.0			27.1				28.5	3.82	
20-30	27.2	27.0	28.7	28.8			25.4				27.4	3.75	
30-40	27.0	24.8	27.0	23.4			26.1				25.7	3.98	
40-50	26.2	25.4	24.7	20.3			26.2				24.6	3.54	
50-60	25.2	21.0	21.8	16.7			25.9				22.1	3.38	
											Total	21.19	
Temporary Exclosure Low Range Condition, Replication I													
0-5	20.5			29.2	28.2		27.0	29.0			26.8	1.41	1.51
5-10	25.2			28.2	28.5		28.5	27.6			27.6	1.82	1.77
10-20	30.9			27.6	27.1		29.8	27.6			28.6	3.66	3.58
20-30	29.0			27.3	26.0		26.4	28.5			27.4	3.84	3.84
30-40	25.6			24.4	25.0		25.6	27.2			25.6	3.33	3.58
40-50	26.0			24.2	24.6		23.9	24.0			24.5	3.65	3.57
50-60	23.5			22.6	15.8		23.8	22.2			21.6	3.18	3.14
											Total	20.89	20.99
Temporary Exclosure Low Range Condition, Replication II													
0-5		26.1		26.2	36.0		29.3	32.6			30.0	1.61	
5-10		28.4		23.1	27.2		28.0	30.8			27.5	1.72	
10-20		27.7		24.9	28.4		26.8	25.7			26.7	3.50	
20-30		26.8		24.7	26.8		24.8	28.5			26.3	3.84	
30-40		25.3		25.2	26.2		27.0	27.2			26.2	3.83	
40-50		22.8		24.7	21.8		26.7	24.8			24.2	3.48	
50-60		18.0		19.7	20.2		21.4	23.6			20.6	3.09	
											Total	21.07	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
May 22, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
					Soil moisture (%)								
Permanent Exclosure High Range Condition, Replication I													
0-10	23.2		20.5		27.2		16.2		25.0		22.4	2.44	2.25
10-20	28.6		24.4		28.2		27.2		26.9		27.1	3.44	3.45
20-30	25.9		24.8		25.9		26.5		25.2		25.7	3.37	3.51
30-40	25.2		26.3		26.3		25.7		25.8		25.9	3.73	3.78
40-50	25.0		25.3		26.2		24.2		25.2		25.2	3.68	3.53
50-60	22.5		26.6		24.6		24.2		27.4		25.1	3.94	3.80
											Total	20.60	20.32
Permanent Exclosure High Range Condition, Replication II													
0-10	17.9			12.6		16.6	21.2			18.5	17.4	2.06	
10-20	24.7			22.9		24.3	27.5			29.6	25.8	3.46	
20-30	26.1			26.9		26.6	26.5			27.0	26.6	3.64	
30-40	24.6			24.6		24.0	26.3			23.9	24.7	3.83	
40-50	26.4			23.5		21.1	23.2			23.4	23.5	3.38	
50-60	26.1			23.8		21.1	25.3			23.2	23.9	3.66	
											Total	20.03	
Temporary Exclosure Low Range Condition, Replication I													
0-10		20.0	21.6			19.9			21.3		20.7	2.45	2.25
10-20		17.7	24.6			24.6			27.1		23.5	3.01	3.05
20-30		17.5	25.5			26.3			27.7		24.3	3.40	3.51
30-40		18.8	27.4			24.7			26.7		24.4	3.17	3.43
40-50		15.3	27.3			21.1			24.8		22.1	3.29	3.35
50-60		15.8	26.4			17.4			23.7		20.8	3.06	3.15
											Total	18.38	18.74
Temporary Exclosure Low Range Condition, Replication II													
0-10		18.6	19.5			17.4	15.5			17.6	17.7	2.05	
10-20		25.7	25.3			20.2	23.5			23.1	23.6	3.09	
20-30		24.7	24.4			23.4	25.9			25.6	24.8	3.62	
30-40		24.3	23.5			25.2	27.6			25.4	25.2	3.68	
40-50		23.7	19.4			22.9	27.2			24.9	23.6	3.40	
50-60		21.1	--			21.0	23.7			20.7	21.6	3.24	
											Total	19.08	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
June 8, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Total soil water (cm) Mean Rep I & II
					Soil moisture (%)								
Permanent Exclosure High Range Condition, Replication I													
0-5	12.1		9.4		11.6			13.5		11.3	11.6	0.55	0.57
5-10	20.7		17.5		14.4			18.8		12.7	16.8	1.04	1.04
10-20	22.4		17.5		19.1			18.8		16.7	18.9	2.40	2.64
20-30	23.6		15.6		17.8			19.5		17.7	18.8	2.46	2.86
30-40	23.2		21.3		19.5			22.5		22.0	21.7	3.12	3.36
40-50	23.9		20.3		17.1			21.4		21.1	20.8	3.04	3.22
50-60	25.0		23.5		17.4			22.5		22.2	22.1	3.47	3.58
											Total	16.08	17.27
Permanent Exclosure High Range Condition, Replication II													
0-5		13.2		9.8		7.9	9.7		13.8		10.9	0.59	
5-10		20.6		14.5		14.3	13.9		17.9		16.2	1.04	
10-20		24.1		22.1		18.8	17.9		24.3		21.4	2.87	
20-30		26.5		23.0		21.9	21.5		25.8		23.7	3.25	
30-40		25.5		20.1		18.8	23.6		28.2		23.2	3.60	
40-50		25.3		22.9		17.9	24.4		27.7		23.6	3.40	
50-60		26.3		22.1		20.8	24.4		27.0		24.1	3.69	
											Total	18.44	
Temporary Exclosure Low Range Condition, Replication I													
0-5		12.4		12.8		10.9	17.1		12.9		13.2	0.69	0.70
5-10		16.6		17.4		17.3	18.3		16.2		17.2	1.14	1.09
10-20		15.9		17.6		17.6	18.1		19.8		17.8	2.28	2.24
20-30		15.2		20.6		20.9	18.9		21.5		19.4	2.72	2.73
30-40		17.8		20.9		20.4	20.5		26.7		21.3	2.77	2.92
40-50		15.7		22.4		16.6	22.0		25.7		20.5	3.05	3.11
50-60		19.7		24.7		18.0	23.4		22.4		21.6	3.18	3.33
											Total	15.83	16.12
Temporary Exclosure Low Range Condition, Replication II													
0-5	13.5		13.0		13.6			13.3	13.0		13.3	0.71	
5-10	17.9		16.0		17.6			15.5	16.5		16.7	1.04	
10-20	17.6		16.0		16.7			16.1	17.1		16.7	2.19	
20-30	18.5		17.0		19.0			21.5	17.4		18.7	2.73	
30-40	22.7		20.1		22.5			21.1	18.8		21.0	3.07	
40-50	23.5		19.9		22.6			23.3	20.5		22.0	3.17	
50-60	26.5		21.4		25.0			23.0	20.1		23.2	3.48	
											Total	16.39	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
June 22, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Total soil water (cm) Mean Rep I & II
					Soil moisture (%)								
Permanent Exclosure High Range Condition, Replication I													
0-10	15.7		13.9			16.0		14.7	11.6		14.4	1.57	1.52
10-20	16.1		18.3			15.2		19.2	17.6		17.3	2.20	2.30
20-30	17.0		18.7			20.7		20.5	18.0		19.0	2.49	2.44
30-40	16.2		19.0			17.8		20.1	17.9		18.2	2.62	2.69
40-50	16.6		20.4			17.8		20.8	18.9		18.9	2.76	2.63
50-60	17.3		22.1			16.4		23.3	18.8		19.6	3.08	2.84
											Total	14.72	14.42
Permanent Exclosure High Range Condition, Replication II													
0-10		11.3	15.4			12.2		10.4	12.0		12.3	1.46	
10-20		15.1	17.2			18.8		16.3	21.3		17.7	2.39	
20-30		15.9	17.0			18.4		14.0	21.8		17.4	2.38	
30-40		14.4	17.3			17.7		16.3	23.1		17.8	2.76	
40-50		13.9	18.2			17.9		15.1	21.5		17.3	2.49	
50-60		13.4	17.4			17.6		15.5	20.5		16.9	2.59	
											Total	14.07	
Temporary Exclosure Low Range Condition, Replication I													
0-10		12.2	14.1		17.4		16.4		15.5		15.1	1.80	1.70
10-20		13.6	16.0		17.0		18.2		14.9		15.9	2.04	2.07
20-30		13.5	17.2		17.4		20.7		15.1		16.8	2.35	2.38
30-40		14.9	18.7		16.7		20.7		15.4		17.3	2.25	2.38
40-50		14.9	19.9		17.3		19.9		16.3		17.7	2.64	2.62
50-60		15.6	19.6		16.0		17.8		15.4		16.9	2.48	2.53
											Total	13.56	13.68
Temporary Exclosure Low Range Condition, Replication II													
0-10	12.1			15.4		15.0		13.4	12.7		13.7	1.59	
10-20	13.5			16.6		17.6		17.1	15.0		16.0	2.10	
20-30	13.8			16.6		19.1		17.3	15.7		16.5	2.41	
30-40	13.8			18.4		19.6		17.3	17.0		17.2	2.51	
40-50	14.8			19.8		19.5		17.1	19.2		18.1	2.61	
50-60	15.0			18.5		17.0		17.2	19.3		17.4	2.61	
											Total	13.83	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
July 10, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
					Soil moisture (%)								
Permanent Exclosure High Range Condition, Replication I[a]													
0-5		31.3		24.8	30.2		27.8		29.0		28.1	1.32	1.37
5-10		28.4		27.0	29.9		29.7		30.9		29.2	1.81	1.75
10-20		24.7		22.0	29.2		24.3		25.4		25.1	3.19	3.21
20-30		15.4		16.4	18.8		14.7		14.9		16.0	2.10	2.02
30-40		15.7		14.9	15.0		13.8		14.5		14.8	2.13	2.22
40-50		14.7		14.4	14.7		14.0		14.8		14.5	2.12	2.08
50-60		14.7		14.8	16.4		12.8		14.1		14.6	2.29	2.26
											Total	14.96	14.91
Permanent Exclosure High Range Condition, Replication II													
0-5		26.4	28.2			23.3	24.3		26.8		25.8	1.41	
5-10		25.1	29.7			25.4	23.1		28.2		26.3	1.68	
10-20		24.4	22.5			24.5	24.3		24.9		24.1	3.23	
20-30		13.9	14.3			15.6	11.1		15.4		14.1	1.93	
30-40		13.6	15.3			14.3	14.1		15.3		14.5	2.25	
40-50		14.2	14.9			13.5	13.3		15.2		14.2	2.04	
50-60		18.5	13.2			14.1	13.2		14.0		14.6	2.23	
											Total	14.77	
Temporary Exclosure Low Range Condition, Replication I													
0-5	29.0			27.8	26.9		25.8		28.1		27.5	1.44	1.37
5-10	28.6			27.8	15.4		31.0		25.4		25.6	1.69	1.63
10-20	24.3			31.7	21.2		27.7		24.4		25.9	3.32	3.08
20-30	20.2			14.6	12.9		22.8		13.0		16.7	2.34	2.51
30-40	12.6			13.8	12.2		19.6		13.5		14.3	1.86	2.11
40-50	11.7			13.2	11.1		13.3		14.3		12.7	1.89	1.97
50-60	11.8			11.9	11.1		12.9		14.5		12.4	1.82	2.10
											Total	14.36	14.77
Temporary Exclosure Low Range Condition, Replication II													
0-5		29.3		25.2		24.6	25.7		16.7		24.3	1.30	
5-10		27.5		26.5		29.2	25.1		16.1		24.9	1.56	
10-20		28.4		22.2		19.0	17.7		20.8		21.6	2.83	
20-30		21.7		11.8		22.3	14.3		21.2		18.3	2.67	
30-40		18.5		12.2		23.2	12.8		14.0		16.1	2.35	
40-50		16.1		12.1		15.3	12.7		14.6		14.2	2.04	
50-60		21.7		13.9		14.3	13.2		16.1		15.8	2.37	
											Total	15.12	

[a] Values shown for plots 1-8 are plots 101-108 and do not correspond with entomological and bacteriological data for this replicate. Plots 1-8 were measured July 7 before heavy rain on July 9 and the data are presented at the end of this Appendix Table and do correspond with the entomological-bacteriological data.

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
July 21, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
					Soil moisture (%)								
Permanent Exclosure High Range Condition, Replication I													
0-10		22.9	21.5			23.8		22.8		23.6	22.9	2.50	2.34
10-20		15.9	17.0			20.9		18.5		19.0	18.3	2.32	2.36
20-30		15.7	16.2			17.1		16.9		17.0	16.6	2.17	2.14
30-40		15.4	14.5			15.7		15.7		15.7	15.4	2.22	2.24
40-50		15.5	14.1			15.5		15.3		15.7	15.2	2.22	2.15
50-60		15.2	14.3			15.3		15.2		15.4	15.1	2.37	2.27
											Total	13.80	13.50
Permanent Exclosure High Range Condition, Replication II													
0-10		16.8	19.1		20.8		15.6		19.5		18.4	2.18	
10-20		16.5	18.1		18.9		17.4		18.0		17.8	2.39	
20-30		13.4	16.3		15.8		15.7		15.9		15.4	2.11	
30-40		13.0	15.2		14.4		14.9		14.9		14.5	2.25	
40-50		13.3	15.2		14.2		14.9		14.4		14.4	2.07	
50-60		13.3	14.9		14.2		14.4		13.9		14.1	2.16	
											Total	13.16	
Temporary Exclosure Low Range Condition, Replication I													
0-10		21.1	15.6		20.8			18.4	21.1		19.4	2.31	2.16
10-20		19.4	12.3		18.1			14.9	17.4		16.4	2.10	2.11
20-30		16.8	14.9		15.4			13.9	16.8		15.4	2.16	2.18
30-40		16.8	14.8		13.5			14.2	15.8		15.0	1.95	2.06
40-50		17.2	15.9		12.9			14.2	16.0		15.2	2.26	2.18
50-60		17.5	17.7		13.3			14.6	16.1		15.8	2.32	2.26
											Total	13.10	12.95
Temporary Exclosure Low Range Condition, Replication II													
0-10	16.2		18.3			16.0	17.3		18.6		17.3	2.01	
10-20	15.5		15.0			15.0	16.7		18.6		16.2	2.12	
20-30	14.5		14.1			14.4	15.5		16.3		15.0	2.19	
30-40	14.5		14.2			14.3	15.3		15.6		14.8	2.16	
40-50	14.0		14.8			14.2	14.7		15.3		14.6	2.10	
50-60	14.3		15.3			12.7	15.2		15.7		14.6	2.19	
											Total	12.77	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
August 4, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
						Soil moisture (%)							
Permanent Exclosure High Range Condition, Replication I													
0-5		11.1	10.3		6.2			7.7	7.8		8.6	0.40	0.39
5-10		12.3	15.4		13.7			13.8	12.7		13.6	0.84	0.77
10-20		16.0	15.9		15.2			15.6	15.6		15.7	1.99	1.95
20-30		16.4	14.9		15.2			16.3	15.0		15.6	2.04	2.02
30-40		15.0	15.0		14.6			15.6	14.5		14.9	2.15	2.12
40-50		14.8	14.7		14.7			14.1	14.1		14.5	2.12	2.01
50-60		15.1	15.3		14.1			13.7	14.2		14.5	2.28	2.15
											Total	11.82	11.41
Permanent Exclosure High Range Condition, Replication II													
0-5		6.4		6.6		6.6		7.9	5.8		6.7	0.37	
5-10		10.6		11.0		11.5		12.1	9.6		11.0	0.70	
10-20		16.3		14.1		14.0		13.6	12.9		14.2	1.90	
20-30		17.2		14.5		14.1		13.6	13.5		14.6	2.00	
30-40		16.2		12.7		13.1		12.9	12.7		13.5	2.09	
40-50		15.3		12.2		12.6		13.1	12.6		13.2	1.90	
50-60		14.8		12.9		13.2		13.0	12.1		13.2	2.02	
											Total	10.98	
Temporary Exclosure Low Range Condition, Replication I													
0-5		8.8		7.5		7.0		8.7	8.5		8.1	0.42	0.42
5-10		14.2		10.5		10.8		11.2	12.6		11.9	0.79	0.79
10-20		15.1		11.4		13.0		12.3	12.7		12.9	1.65	1.70
20-30		15.4		13.2		13.2		12.1	13.3		13.4	1.88	1.93
30-40		14.9		13.6		12.9		12.0	13.9		13.5	1.76	1.85
40-50		15.5		13.2		11.8		13.2	14.6		13.7	2.04	1.97
50-60		16.1		13.0		10.3		12.7	12.6		12.9	1.90	1.94
											Total	10.44	10.60
Temporary Exclosure Low Range Condition, Replication II													
0-5	7.2			8.7	7.2		8.1			8.1	7.9	0.42	
5-10	12.6			12.1	11.6		12.4			13.1	12.4	0.78	
10-20	13.1			13.8	12.5		13.3			14.0	13.3	1.74	
20-30	12.4			14.6	13.6		13.5			13.6	13.5	1.97	
30-40	12.7			14.1	13.0		13.5			13.1	13.3	1.94	
40-50	13.0			13.2	13.1		12.9			13.4	13.1	1.89	
50-60	13.4			14.9	13.1		11.4			13.0	13.2	1.98	
											Total	10.72	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
August 20, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Total soil water (cm) Mean Rep I & II
					Soil moisture (%)								
Permanent Exclosure High Range Condition, Replication I													
0-10	12.9			15.0	20.2			11.1	13.5		14.5	1.58	1.46
10-20	15.2			14.7	15.6			15.7	15.5		15.3	1.94	2.00
20-30	15.2			14.4	15.3			14.7	14.5		14.8	1.94	2.03
30-40	15.9			14.7	15.4			14.6	14.0		14.9	2.15	2.21
40-50	15.9			15.0	15.3			14.5	14.0		14.9	2.18	2.11
50-60	15.0			15.1	14.8			13.9	14.1		14.6	2.29	2.23
											Total	12.08	12.04
Permanent Exclosure High Range Condition, Replication II													
0-10	9.7		10.9			15.3		9.0	11.6		11.3	1.34	
10-20	14.8		15.7			16.5		14.5	16.2		15.5	2.07	
20-30	14.6		15.6			16.1		15.6	15.7		15.5	2.12	
30-40	14.2		14.9			14.8		14.9	14.3		14.6	2.26	
40-50	13.2		14.6			14.2		14.7	14.3		14.2	2.04	
50-60	13.4		14.9			14.0		14.6	13.9		14.2	2.17	
											Total	12.00	
Temporary Exclosure Low Range Condition, Replication I													
0-10		11.9	11.7			12.4	11.5		12.5		12.0	1.43	1.43
10-20		12.8	13.8			14.9	15.6		15.7		14.6	1.87	1.87
20-30		11.4	13.7			14.8	15.3		14.8		14.0	1.96	2.02
30-40		13.8	13.7			14.4	15.3		14.4		14.3	1.86	1.93
40-50		14.4	14.4			14.4	15.8		14.2		14.6	2.18	2.09
50-60		14.7	15.0			14.1	15.5		14.4		14.7	2.16	2.13
											Total	11.46	11.47
Temporary Exclosure Low Range Condition, Replication II													
0-10		10.5		12.0		11.9	14.0		12.6		12.2	1.42	
10-20		14.4		13.2		13.5	15.3		15.0		14.3	1.87	
20-30		14.8		12.7		13.7	14.2		15.3		14.1	2.06	
30-40		15.1		12.4		14.2	13.7		14.9		14.1	2.06	
40-50		14.9		11.9		14.2	13.8		14.7		13.9	2.00	
50-60		14.6		11.7		14.8	14.1		14.7		14.0	2.10	
											Total	11.51	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
September 4, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
					Soil moisture (%)								
Permanent Exclosure High Range Condition, Replication I													
0-5		10.2		9.9		9.8	10.6			7.0	9.5	0.45	0.40
5-10		13.8		13.9		13.4	11.5			10.6	12.6	0.78	0.69
10-20		14.9		15.3		15.6	13.8			14.4	14.8	1.88	1.81
20-30		14.8		14.4		14.8	15.3			14.3	14.7	1.93	1.99
30-40		14.0		14.3		15.3	14.8			13.2	14.3	2.06	2.10
40-50		13.8		14.5		15.0	14.7			13.4	14.3	2.09	2.02
50-60		11.6		14.0		15.2	13.9			12.5	13.4	2.10	2.08
											Total	11.29	11.09
Permanent Exclosure High Range Condition, Replication II													
0-5	6.9			7.1		5.9	6.0		6.3		6.4	0.35	
5-10	9.1			10.4		12.2	7.5		8.0		9.4	0.60	
10-20	12.5			14.3		14.7	10,7		12.8		13.0	1.74	
20-30	13.3			14.4		15.3	15.1		16.3		14.9	2.04	
30-40	11.5			13.9		15.0	13;6		14.8		13.8	2.14	
40-50	11.8			13.8		14.0	13.8		13.9		13.5	1.94	
50-60	11.3			14.5		14.9	13.5		13.0		13.4	2.05	
											Total	10.86	
Temporary Exclosure Low Range Condition, Replication I													
0-5	14.0		9.3		9.1			12.8		11.9	11.4	0.60	0.52
5-10	13.0		12.0		10.6			13.0		12.0	12.1	0.80	0.77
10-20	13.7		13.4		14.4			13.8		13.9	13.8	1.77	1.75
20-30	13.2		14.1		14.3			13.3		15.2	14.2	1.99	1.96
30-40	11.5		13.7		14.2			13.4		15.1	13.6	1.77	1.87
40-50	12.7		14.0		13.9			13.4		15.2	13.8	2.06	2.01
50-60	11.6		14.3		14.2			12.5		14.9	13.5	1.98	2.02
											Total	10.97	10.90
Temporary Exclosure Low Range Condition, Replication II													
0-5	7.8		8.3		8.1		9.6			9.0	8.6	0.46	
5-10	10.5		12.2		12.2		11.8			11.9	11.7	0.73	
10-20	12.5		14.0		13.6		12.8			12.7	13.1	1.72	
20-30	13.0		13.9		13.6		13.8			12.8	13.2	1.93	
30-40	13.2		13.8		14.5		13.6			12.6	13.5	1.97	
40-50	13.4		13.3		15.6		13.1			12.8	13.6	1.96	
50-60	13.9		13.9		15.7		11.6			13.6	13.7	2.06	
											Total	10.83	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
October 2, 1970

Depth cm \ Plot no.	Soil moisture (%) 1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
Permanent Exclosure High Range Condition, Replication I													
0-5	11.2	13.7	10.2	11.2	9.3	9.9	12.4	14.0	7.3	12.2	11.1	0.52	0.52
5-10	15.7	17.5	16.8	18.4	13.9	17.3	15.6	17.9	14.7	17.7	16.6	1.03	1.00
10-20	16.6	15.7	15.0	15.6	13.5	14.7	14.2	14.6	14.3	14.5	14.9	1.89	1.98
20-30	13.3	13.4	13.2	12.2	13.0	12.7	12.1	12.0	12.6	12.0	12.7	1.66	1.74
30-40	13.1	12.9	12.7	11.9	12.9	12.5	11.9	11.5	12.3	11.6	12.3	1.77	1.86
40-50	12.4	12.4	12.7	12.3	12.8	12.3	10.7	11.6	11.9	11.6	12.1	1.77	1.74
50-60	12.1	11.4	12.5	12.4	12.2	12.7	10.0	11.3	11.4	11.2	11.7	1.84	1.85
											Total	10.48	10.69
Permanent Exclosure High Range Condition, Replication II													
0-5	10.7	10.9	11.5	8.6	10.5	5.8	10.5	6.6	10.5	9.0	9.5	0.52	
5-10	16.0	20.4	17.7	17.0	14.8	14.9	13.8	11.9	11.6	12.6	15.1	0.97	
10-20	15.6	17.3	14.8	17.1	16.2	15.3	13.4	14.4	15.6	14.5	15.4	2.06	
20-30	12.4	14.2	13.0	13.1	13.1	13.5	12.8	13.2	14.2	13.7	13.3	1.82	
30-40	11.6	12.8	12.7	12.3	11.9	12.8	11.9	12.4	13.2	13.3	12.5	1.94	
40-50	11.1	12.2	12.5	9.6	12.0	12.6	10.9	12.0	11.8	12.9	11.8	1.70	
50-60	10.9	16.4	12.2	11.8	11.8	11.9	11.0	11.0	11.4	12.2	12.1	1.85	
											Total	10.86	
Temporary Exclosure Low Range Condition, Replication I													
0-5	10.6	11.0	13.2	10.3	13.6	8.9	12.6	11.4	10.3	14.1	11.6	0.61	0.61
5-10	15.3	16.3	17.1	18.8	20.3	16.7	20.0	15.6	17.1	18.7	17.6	1.16	1.15
10-20	13.7	13.7	14.8	13.4	13.4	15.3	15.1	13.7	12.3	15.2	14.1	1.80	1.39
20-30	12.2	11.4	11.8	11.9	12.0	12.8	11.3	13.2	11.9	13.5	12.2	1.71	1.81
30-40	10.4	11.0	11.8	11.3	11.5	11.9	11.3	13.3	11.8	13.0	11.7	1.52	1.68
40-50	9.7	11.3	11.1	10.9	11.2	11.6	11.(	13.2	11.6	12.1	11.4	1.70	1.75
50-60	8.4	11.6	10.9	9.9	8.7	11.4	11.0	13.3	12.1	11.6	10.9	1.60	1.73
											Total	10.10	10.12
Temporary Exclosure Low Range Condition, Replication II													
0-5	10.2	11.5	10.5	11.5	11.4	12.3	11.1	11.8	11.1	12.5	11.4	0.61	
5-10	17.4	19.2	18.8	14.0	18.8	18.7	15.9	19.4	19.3	18.3	18.0	1.13	
10-20	14.8	14.8	15.4	14.3	15.8	15.1	14.7	14.7	15.8	14.7	15.0	1.97	
20-30	12.9	12.5	13.9	12.4	13.8	12.9	13.5	12.6	13.0	12.4	13.0	1.90	
30-40	12.2	11.6	13.2	12.2	12.5	13.0	13.7	12.3	12.9	12.0	12.6	1.84	
40-50	12.5	11.5	12.9	12.2	12.1	13.2	12.3	13.1	12.8	11.8	12.4	1.79	
50-60	12.7	11.7	12.2	12.9	12.1	13.1	11.5	13.4	12.8	11.4	12.4	1.86	
											Total	11.10	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
November 6, 1970

Depth cm \ Plot no.	1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
					Soil moisture (%)								
Permanent Exclosure High Range Condition, Replication I													
0-10		21.0		21.7	22.5		25.4		22.5		22.6	2.46	2.77
10-20		14.2		15.2	15.4		15.7		15.6		15.2	1.53	2.28
20-30		12.1		13.7	13.3		13.3		13.6		13.2	1.73	1.75
30-40		12.1		13.3	13.1		12.7		13.2		12.9	1.86	1.88
40-50		13.3		13.1	12.4		12.9		13.0		12.9	1.88	1.79
50-60		12.6		12.3	12.6		12.5		12.6		12.5	1.96	1.88
											Total	11.82	12.35
Permanent Exclosure High Range Condition, Replication II													
0-10		27.5		27.9	25.1		24.3		24.5		25.9	3.07	
10-20		18.9		24.2	20.3		18.7		15.9		19.6	2.63	
20-30		12.7		13.8	13.7		11.8		12.7		12.9	1.77	
30-40		12.5		12.0	13.0		11.5		11.9		12.2	1.89	
40-50		11.8		11.7	12.6		11.6		11.3		11.8	1.70	
50-60		11.2		11.8	12.4		11.4		11.5		11.7	1.79	
											Total	12.85	
Temporary Exclosure Low Range Condition, Replication I													
0-10		26.8	32.6			30.3	29.3			29.3	29.7	3.53	3.39
10-20		15.1	16.6			22.2	16.8			19.1	18.0	2.30	2.17
20-30		13.2	14.1			15.6	15.3			14.3	14.5	2.03	2.05
30-40		8.1	13.1			14.1	15.0			12.8	12.6	1.64	1.85
40-50		12.7	12.1			14.0	14.4			12.2	13.1	1.95	1.98
50-60		12.8	11.7			14.3	24.8			11.6	15.0	2.21	2.17
											Total	13.66	13.61
Temporary Exclosure Low Range Condition, Replication II													
0-10		26.9	25.2		31.0		31.5			25.6	28.0	3.25	
10-20		14.7	15.7		16.1		15.4			15.9	15.6	2.04	
20-30		13.0	14.2		14.9		14.2			14.1	14.1	2.06	
30-40		12.9	14.8		14.7		14.6			13.7	14.1	2.06	
40-50		13.1	13.7		14.6		14.6			13.7	13.9	2.00	
50-60		13.8	14.3		14.5		14.4			13.8	14.2	2.13	
											Total	13.54	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
December 4, 1970

Depth cm \ Plot no.	Soil moisture (%) 1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
Permanent Exclosure High Range Condition, Replication I													
0-10		32.6	30.3			30.8		27.0	28.7		29.9	3.26	3.31
10-20		22.8	21.3			20.5		16.1	19.2		20.0	2.54	2.82
20-30		14.1	15.6			14.9		15.2	15.5		15.1	1.98	2.05
30-40		13.7	15.0			13.9		15.1	14.8		14.5	2.09	2.17
40-50		13.5	14.7			13.8		14.5	14.7		14.2	2.07	2.03
50-60		13.6	14.6			13.9		14.4	14.3		14.2	2.23	2.16
											Total	14.17	14.54
Permanent Exclosure High Range Condition, Replication II													
0-10		30.8	29.9		26.6			26.2		27.4	28.2	3.36	
10-20		23.8	24.6		23.5			23.5		20.1	23.1	3.10	
20-30		15.7	16.5		15.5			13.8		15.4	15.4	2.11	
30-40		15.2	15.3		14.8			13.0		14.1	14.5	2.25	
40-50		14.3	15.2		13.9			12.1		13.5	13.8	1.99	
50-60		14.1	15.2		13.7			11.6		13.5	13.6	2.08	
											Total	14.89	
Temporary Exclosure Low Range Condition, Replication I													
0-10	31.9			32.7		25.2	31.6			33.5	31.0	3.69	3.62
10-20	19.4			23.4		18.2	22.3			26.5	22.0	2.82	2.84
20-30	12.4			15.4		15.1	15.6			14.9	14.7	2.06	2.07
30-40	11.8			15.4		14.6	15.2			14.2	14.2	1.85	1.94
40-50	11.8			15.2		14.6	15.4			13.6	14.1	2.10	2.05
50-60	11.8			15.1		15.3	15.8			12.2	14.0	2.06	2.04
											Total	14.58	14.56
Temporary Exclosure Low Range Condition, Replication II													
0-10		32.3	32.0		29.4			30.4	28.8		30.6	3.55	
10-20		22.0	24.4		20.5			19.7	22.5		21.8	2.86	
20-30		14.3	14.5		14.2			14.4	13.8		14.2	2.07	
30-40		14.1	13.6		13.5			14.1	14.0		13.9	2.03	
40-50		14.4	13.0		13.3			14.6	13.9		13.8	1.99	
50-60		14.4	12.7		12.9			14.7	12.2		13.4	2.01	
											Total	14.51	

Appendix Table 3 Continued. Soil Moisture and Total Soil Water
July 7 , 1970

Depth cm \ Plot no.	Soil moisture (%) 1	2	3	4	5	6	7	8	9	10	Mean	Total soil water (cm) Mean	Mean Rep I & II
Permanent Exclosure High Range Condition, Replication I													
0-5		7.6		7.1		8.3	8.8				8.0	0.38	
5-10		14.6		13.7		14.1	14.6				14.3	0.89	
10-20		14.3		14.7		14.8	15.1				14.7	1.87	
20-30		14.3		14.7		14.4	14.4				14.5	1.90	
30-40		14.0		14.9		14.6	14.0				14.4	2.07	
40-50		13.8		14.3		15.8	13.0				14.2	2.07	
50-60		15.8		14.4		13.0	13.8				14.3	2.24	
											Total	11.42	

Appendix Table 4

PRELIMINARY ANALYSIS OF ABOVE GROUND HERBAGE BIOMASS FOR COTTONWOOD

DATA SET	SPECIES	PHEN-OLOGY	SAMPLE SIZE	REGRESSION FOR THE SINGLE SQUARES						REGRESSION FOR THE ENTIRE PLOTS					
				XBAR	YBAR	A	B	R	RSQ	XBAR	YBAR	A	B	R	RSQ
1	ACLA	10	1	.0300	.0300	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	AGSM	12	12	.1042	.0983	.0048	.8982	.90	.81	.1275	.1185	0.0000	0.0000	.48	.23
1	AGSM	17	12	.1417	.1333	.0195	.8036	.88	.77	.1025	.1159	.0303	.8353	.80	.64
1	AGSM	19	12	.0758	.0742	.0009	.9660	.96	.91	.0700	.0846	.0315	.7584	.92	.84
1	ANOC	13	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	ARFR	2	1	.0200	.0200	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	BOGR	12	12	.0250	.0277	.0042	.9416	.94	.89	.0300	.0325	0.0000	0.0000	.49	.24
1	BOGR	17	12	.0025	.0046	.0032	.5706	.41	.17	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	BOGR	19	7	.0114	.0131	.0025	.9273	.98	.96	.0157	.0145	0.0000	0.0000	.32	.10
1	BRJA	13	13	.0246	.0322	.0073	1.0117	.85	.72	.0208	.0267	.0034	1.1231	.96	.92
1	BUDA	12	11	.0627	.0560	-.0047	.9671	.95	.90	.0518	.0490	-.0154	1.2415	.86	.74
1	BUDA	17	11	.0218	.0162	.0002	.7348	.94	.89	.0282	.0205	.0002	.7180	.82	.68
1	BUDA	19	11	.0300	.0253	.0052	.6706	.86	.75	.0255	.0195	.0096	.3909	.73	.54
1	CAEL	12	11	.0164	.0119	.0063	.3438	.47	.22	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	CAEL	19	10	0.0000	.0086	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	DCAS	-0	12	.0442	.0421	-.0093	1.1631	.89	.79	.0633	.0392	0.0000	0.0000	.42	.18
1	ERAS	12	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	FEOC	13	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	FMUL	-0	12	.2550	.2858	.0442	.9475	.61	.37	.2083	.2700	.1413	.6178	.68	.47
1	HMUL	-0	12	.0900	.0600	.0120	.5338	.58	.33	.0925	.0716	0.0000	0.0000	.45	.21
1	LCAS	-0	12	.0792	.0858	-.0165	1.2929	.97	.93	.0992	.0815	-.0234	1.0583	.85	.73
1	MISC	13	3	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	MISC	19	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	OPER	-0	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	PESP	12	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	PLPU	13	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	SOIL	-0	12	.0133	.0260	.0046	1.6065	.71	.50	.0342	.0340	.0080	.7629	.64	.41
1	SPCO	13	9	.0067	.0196	.0117	1.1708	.44	.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	STVI	19	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	TRPR	13	3	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
1	VIAM	13	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00

Appendix Table 4 Continued

PRELIMINARY ANALYSIS OF ABOVE GROUND HERBAGE BIOMASS FOR COTTONWOOD

DATA SET	SPECIES	PHEN-OLOGY	SAMPLE SIZE	REGRESSION FOR THE SINGLE SQUARES XBAR	YBAR	A	B	R	RSQ	REGRESSION FOR THE ENTIRE PLOTS XBAR	YBAR	A	B	R	RSQ
2	AGSM	12	7	.0014	.0043	.0050	-.5000	.35	.12	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	AGSM	19	7	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	ALTE	13	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	ANOC	13	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	BOGR	12	12	.1000	.0617	.0427	.1893	.34	.11	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	BOGR	17	12	.0167	.0150	.0059	.5455	.44	.19	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	BOGR	19	7	.0186	.0114	.0083	.1667	.09	.01	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	BRJA	13	9	0.0000	.0089	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	BUDA	12	12	.1958	.1625	.0613	.5167	.76	.58	.1767	.1500	.0811	.3903	.81	.65
2	BUDA	17	12	.2192	.1933	.0886	.4777	.68	.47	.2017	.1985	.1391	.2946	.75	.56
2	BUDA	19	12	.2150	.1758	.0090	.7761	.80	.63	.1875	.1778	.0552	.6535	.87	.75
2	CAEL	12	11	.0109	.0091	.0050	.3750	.29	.08	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	CAEL	19	11	.0118	.0073	-.0002	.6290	.73	.53	.0118	.0061	-.0000	.5190	.79	.62
2	DCAS	-0	12	.0425	.0875	.0501	.8797	.65	.42	.0608	.0904	0.0000	0.0000	.47	.22
2	FEOC	13	8	0.0000	.0062	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	FEOC	15	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	FMUL	-0	12	.0067	.0100	.0071	.4286	.25	.06	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	HEHI	13	5	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	HMUL	-0	12	.0733	.0942	.0268	.9193	.92	.84	.0700	.0880	.0410	.6718	.71	.51
2	LCAS	-0	12	.0592	.0892	.0160	1.2372	.86	.74	.0692	.0892	-.0088	1.4170	.93	.87
2	LICH	-0	12	.0008	.0075	.0009	7.9091	.99	.98	.0067	.0273	.0009	3.9545	.50	1.00
2	LIRI	13	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	LOFO	12	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	LOOR	13	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	MISC	13	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	OPFR	2	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	PLPU	13	11	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	SOIL	-0	12	.0375	.0675	.0409	.7091	.66	.44	.0500	.0705	.0422	.5660	.87	.76
2	SPCO	12	7	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
2	VIAM	12	5	.0020	.0060	.0000	3.0000	1.00	1.00	0.0000	.0000	0.0000	0.0000	0.00	0.00

Appendix Table 4 Continued

PRELIMINARY ANALYSIS OF ABOVE GROUND HERBAGE BIOMASS FOR COTTONWOOD

DATA SET	SPECIES	PHEN-OLOGY	SAMPLE SIZE	REGRESSION FOR THE SINGLE SQUARES XBAR	YBAR	A	B	R	RSQ	REGRESSION FOR THE ENTIRE PLOTS XBAR	YBAR	A	B	R	RSQ
3	ACLA	2	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	AGSM	2	8	.0562	.0612	.0125	.8661	.70	.49	.0900	.0807	.0221	.6519	.93	.87
3	AGSM	17	8	.3000	.2525	.1021	.5014	.74	.55	.2712	.2375	.1125	.4607	.90	.81
3	AGSM	19	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	ANOC	9	7	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	BOGR	2	7	.0071	.0057	.0016	.5789	.49	.24	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	BOGR	17	7	.0843	.0429	.0011	.4957	.90	.81	.1014	.0570	.0223	.3425	.78	.61
3	BRJA	3	7	.0043	.0100	.0075	.5833	.31	.10	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	BUDA	2	6	.0050	.0050	0.0000	1.0000	1.00	1.00	.0133	.0067	.0000	.5000	.84	.70
3	BUDA	17	7	.0843	.0329	.0019	.3668	1.00	.99	.0929	.0350	.0018	.3575	.98	.96
3	BUDA	19	5	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	CAEL	8	7	.0014	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	CAEL	19	3	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	DCAS	-0	6	.0467	.0533	.0135	.8545	.84	.71	.0383	.0362	0.0000	0.0000	.37	.13
3	ERAS	7	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	FMUL	-0	8	.2462	.2875	-.0177	1.2395	.76	.58	.2575	.3154	.1657	.5815	.57	.32
3	HMUL	-0	8	.1787	.2475	.0473	1.1199	.79	.63	.1187	.2223	0.0000	0.0000	.05	.00
3	LCAS	-0	6	.0267	.0250	.0065	.6951	.72	.52	.0250	.0238	.0123	.4610	.84	.71
3	LEMO	8	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	LOOR	9	6	0.0000	.0017	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	MISC	2	7	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	MISC	17	5	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	SOIL	-0	3	.0033	.0100	.0100	.0000	.00	.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	SPAS	17	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	SPCO	4	3	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	TRBR	3	4	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	TRPR	3	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
3	VIAM	8	4	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00

Appendix Table 4 Continued

PRELIMINARY ANALYSIS OF ABOVE GROUND HERBAGE BIOMASS FOR COTTONWOOD

DATA SET	SPECIES	PHEN-OLOGY	SAMPLE SIZE	------REGRESSION FOR THE SINGLE SQUARES----- XBAR	YBAR	A	B	R	RSQ	-------REGRESSION FOR THE ENTIRE PLOTS------ XBAR	YBAR	A	B	R	RSQ
4	AGSM	2	7	.0100	.0157	.0044	1.1333	.96	.92	.0071	.0076	.0037	.5495	.80	.65
4	AGSM	17	2	.0050	.0050	0.0000	1.0000	1.00	1.00	0.0000	.0050	0.0000	0.0000	0.00	0.00
4	ALTE	4	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	ANDC	9	4	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	BOGR	2	9	.0167	.0178	.0014	.9815	.94	.88	.0222	.0221	.0124	.4388	.72	.52
4	BOGR	17	9	.1656	.1433	-.0068	.9068	.99	.98	.1189	.1081	-.0105	.9974	.98	.96
4	BOGR	19	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	BRJA	13	5	.0020	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	BUDA	2	9	.0844	.0611	.0038	.6790	.95	.90	.0911	.0732	.0087	.7080	.98	.96
4	BUDA	17	9	.4111	.4122	.0097	.9791	.98	.96	.4033	.4177	-.0057	1.0497	.99	.97
4	BUDA	19	8	0.0000	.0025	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	CAEL	8	8	.0350	.0275	.0174	.2879	.56	.31	.0425	.0282	.0197	.2006	.73	.53
4	CAEL	19	5	0.0000	.0020	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	DCAS	-0	9	.1078	.1344	.0763	.5397	.47	.22	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	DRRE	13	7	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	FEOC	2	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	FMUL	-0	4	.0125	.0025	-.0007	.2558	.97	.94	.0200	.0025	-.0001	.1279	.82	.67
4	HMUL	-0	9	.1022	.1133	-.0061	1.1685	.97	.93	.1244	.1237	-.0045	1.0306	.85	.72
4	LCAS	-0	9	.0522	.0556	-.0006	1.0753	.77	.59	.0611	.0651	-.0110	1.2461	.91	.82
4	LICH	-0	2	0.0000	.0100	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	LOOR	9	8	0.0000	.0037	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	MISC	2	5	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	MISC	17	5	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	MUDI	2	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	OPFR	6	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	OPFR	17	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	OPFR	20	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	PLPU	3	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	POSE	2	1	.0700	.0300	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	POSE	19	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	SOIL	-0	6	.0100	.0083	-.0017	1.0000	.97	.94	.0133	.0133	.0024	.8182	.81	.65
4	SPCO	12	5	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	TRBR	2	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	VIAM	-0	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
4	VINU	7	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00

Appendix Table 4 Continued

PRELIMINARY ANALYSIS OF ABOVE GROUND HERBAGE BIOMASS FOR COTTONWOOD

DATA SET	SPECIES	PHENOLOGY	SAMPLE SIZE	REGRESSION FOR THE SINGLE SQUARES XBAR	YBAR	A	B	R	RSQ	REGRESSION FOR THE ENTIRE PLOTS XBAR	YBAR	A	B	R	RSQ
5	ACLA	12	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	AGSM	4	11	.1582	.1664	.0293	.8668	.92	.84	.1282	.1372	.0029	1.0481	.97	.94
5	AGSM	17	11	.1845	.1709	.0159	.8399	.95	.90	.1691	.1617	.0134	.8772	.99	.97
5	AGSM	19	10	.0230	.0175	.0069	.4602	.63	.40	.0310	.0189	.0109	.2574	.85	.71
5	ANOC	13	7	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	ARFR	2	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	BOGR	2	11	.0291	.0271	-.0002	.9376	.97	.94	.0364	.0339	-.0020	.9889	.98	.96
5	BOGR	17	11	.0027	.0032	.0005	.9674	.97	.95	.0055	.0049	-.0001	.9170	.95	.90
5	BOGR	19	1	.0400	.0400	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	BRJA	8	11	.0227	.0367	.0120	1.0859	.66	.43	.0300	.0417	.0091	1.0859	.97	.94
5	BUDA	6	9	.0878	.0887	-.0020	1.0327	.98	.97	.0711	.0749	-.0027	1.0906	.97	.95
5	BUDA	17	9	.0633	.0600	-.0006	.9573	.98	.97	.0622	.0615	-.0030	1.0369	.99	.98
5	BUDA	19	8	.0162	.0131	.0032	.6095	.75	.56	.0262	.0169	.0035	.5115	.94	.88
5	CAEL	12	10	.0240	.0280	.0116	.6842	.57	.33	.0280	.0307	.0141	.5942	.98	.97
5	CAEL	19	8	.0012	.0011	.0000	.9000	1.00	1.00	0.0000	.0000	0.0000	0.0000	0.00	0.00
5	DCAS	-0	11	.0164	.0195	.0060	.8222	.57	.33	.0309	.0269	.0083	.6022	.89	.79
5	ERAS	8	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	ERSP	4	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	FMUL	-0	11	.2827	.2773	.0675	.7421	.86	.73	.2609	.2773	.0295	.9496	.98	.95
5	HMUL	-0	11	.0327	.0291	-.0038	1.0039	.89	.79	.0464	.0355	-.0006	.7782	.89	.79
5	LASP	4	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	LCAS	-0	11	.0582	.0655	.0072	1.0019	.94	.88	.0673	.0791	.0005	1.1689	.99	.98
5	LOOR	13	6	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	MISC	13	11	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	MISC	17	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	PESP	4	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	PSTE	4	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	SOIL	-0	11	.0264	.0200	.0024	.6695	.74	.55	.0327	.0209	.0031	.5430	.98	.95
5	SPCO	5	7	.0014	.0014	0.0000	1.0000	1.00	1.00	.0100	.0057	-.0043	1.0000	.73	.54
5	TRBR	12	3	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	TRPR	2	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	VIAM	8	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
5	VINU	10	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00

Appendix Table 4 Continued

PRELIMINARY ANALYSIS OF ABOVE GROUND HERBAGE BIOMASS FOR COTTONWOOD

DATA SET	SPECIES	PHEN-OLOGY	SAMPLE SIZE	REGRESSION FOR THE SINGLE SQUARES XBAR	YBAR	A	B	R	RSQ	REGRESSION FOR THE ENTIRE PLOTS XBAR	YBAR	A	B	R	RSQ
6	AGGL	12	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	AGSM	4	8	.0137	.0287	.0086	1.4685	.66	.43	.0075	.0196	.0086	1.4685	.80	.64
6	AGSM	17	4	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	AGSM	19	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	ALTE	10	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	ANOC	13	8	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	BOGR	4	10	.1430	.0940	.0328	.4279	.60	.36	.1430	.0966	.0236	.5104	.96	.91
6	BOGR	17	10	.0100	.0050	-.0050	1.0000	.00	.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	BRJA	8	8	.0012	.0075	.0014	4.8571	.98	.96	.0025	.0075	.0014	2.4286	1.00	1.00
6	BUDA	7	10	.2340	.1900	-.1332	1.3810	.83	.70	.2400	.1983	-.0772	1.1478	.83	.69
6	BUDA	17	10	.1990	.2040	.0362	.8430	.80	.64	.1840	.2032	.0497	.8338	.95	.91
6	BUDA	19	10	.0100	.0070	-.0030	1.0000	.00	.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	CAEL	12	10	.0120	.0140	.0011	1.0789	.78	.61	.0150	.0151	.0008	.9520	.90	.82
6	CAEL	19	7	.0029	.0043	.0020	.8000	.73	.53	.0029	.0043	.0020	.8000	1.00	1.00
6	DCAS	-0	10	.0760	.0960	.0285	.8882	.51	.26	.0760	.0960	.0079	1.1590	.57	.32
6	DRRE	13	8	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	FFOC	12	10	0.0000	.0050	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	FMUL	-0	9	.0011	.0044	.0025	1.7500	.80	.64	.0033	.0064	.0025	1.1667	.76	.57
6	HEHI	12	5	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	HMUL	-0	10	.1150	.1080	.0077	.8722	.57	.33	.1050	.1063	.0534	.5029	.75	.57
6	LCAS	-0	10	.1080	.1370	-.0314	1.5595	.97	.93	.1070	.1261	-.0191	1.3568	.96	.92
6	LICH	-0	8	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	LIRI	8	3	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	LOFO	10	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	LOOR	13	5	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	MISC	10	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	OPER	2	3	.0033	.0033	0.0000	1.0000	1.00	1.00	.0233	.0233	0.0000	1.0000	1.00	1.00
6	OPER	20	2	0.0000	0.0000	0.0000	1.0000	0.00	0.00	0.0000	0.0000	0.0000	1.0000	0.00	0.00
6	PLPU	9	9	0.0000	.0011	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	SOIL	-0	10	.0600	.0630	-.0141	1.2857	.92	.84	.0660	.0514	0.0000	0.0000	.43	.18
6	SPCO	8	6	.0050	.0133	.0048	1.7143	.95	.91	.0083	.0162	0.0000	0.0000	.40	.16
6	TRBR	3	1	.0100	.0200	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
6	VIAM	9	7	.0186	.0357	.0110	1.3295	.96	.91	.0200	.0319	.0148	.8547	.77	.60
6	VINU	13	3	0.0000	.0033	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00

Appendix Table 4 Continued

PRELIMINARY ANALYSIS OF ABOVE GROUND HERBAGE BIOMASS FOR COTTONWOOD

DATA SET	SPECIES	PHEN-OLOGY	SAMPLE SIZE	REGRESSION FOR THE SINGLE SQUARES XBAR	YBAR	A	B	R	RSQ	REGRESSION FOR THE ENTIRE PLOTS XBAR	YBAR	A	B	R	RSQ
7	AGSM	12	9	.0489	.0444	.0005	.8996	.98	.95	.0411	.0384	.0015	.8994	1.00	1.00
7	AGSM	17	9	.1511	.1467	.0060	.9307	.97	.95	.1300	.1260	.0072	.9136	.97	.94
7	AGSM	19	9	.1800	.1778	-.0045	1.0128	.95	.90	.1611	.1530	-.0019	.9619	.99	.98
7	ANOC	13	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
7	ARFR	7	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
7	BOGR	12	7	.0029	.0029	0.0000	1.0000	1.00	1.00	.0086	.0071	.0003	.8014	1.00	1.00
7	BOGR	17	7	.0029	.0014	0.0000	.5000	.65	.42	.0100	.0036	-.0000	.3571	.98	.96
7	BOGR	19	7	.0129	.0114	.0077	.2879	.34	.11	0.0000	0.0000	0.0000	0.0000	0.00	0.00
7	BRJA	13	8	.0612	.0612	.0191	.6883	.63	.39	.0525	.0535	.0226	.5881	.95	.90
7	BRJA 1	1	8	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
7	BUDA	12	6	.0083	.0083	.0026	.6883	.94	.89	.0117	.0106	.0026	.6883	1.00	1.00
7	BUDA	17	6	.0283	.0233	-.0038	.9569	.98	.96	.0567	.0489	.0057	.7610	.96	.91
7	BUDA	19	6	.1000	.0967	-.0031	.9975	1.00	.99	.0850	.1033	.0216	.9615	.92	.85
7	CAEL	12	7	.0057	.0100	.0000	1.7500	.81	.66	.0114	.0200	.0000	1.7500	1.00	1.00
7	CAEL	19	7	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
7	DCAS	-0	9	.0078	.0078	.0070	.1000	.13	.02	0.0000	0.0000	0.0000	0.0000	0.00	0.00
7	ERAS	13	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
7	FMUL	-0	9	.3456	.3489	-.0092	1.0364	.99	.99	.3378	.3454	.0403	.9035	.92	.85
7	HMUL	-0	9	.0244	.0256	.0225	.1250	.13	.02	0.0000	0.0000	0.0000	0.0000	0.00	0.00
7	LCAS	-0	9	.0422	.0422	-.0066	1.1554	.98	.96	.0533	.0538	-.0097	1.1900	.98	.97
7	SOIL	-0	9	.0233	.0267	-.0025	1.2500	.94	.89	.0311	.0350	-.0007	1.1480	.96	.92
7	SPCO	12	3	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
7	TRPR	13	2	.0400	.0550	.0050	1.2500	1.00	1.00	.0100	.0175	0.0000	0.0000	0.00	0.00

Appendix Table 4 Continued

PRELIMINARY ANALYSIS OF ABOVE GROUND HERBAGE BIOMASS FOR COTTONWOOD

DATA SET	SPECIES	PHEN-OLOGY	SAMPLE SIZE	------REGRESSION FOR THE SINGLE SQUARES----- XBAR	YBAR	A	B	R	RSQ	-------REGRESSION FOR THE ENTIRE PLOTS------ XBAR	YBAR	A	B	R	RSQ
8	AGSM	12	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	AGSM	19	7	.0057	.0186	.0130	.9815	.76	.58	.0100	.0214	.0148	.6543	.97	.93
8	ALTE	-0	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	ANOC	-0	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	BOGR	12	10	.0180	.0140	.0014	.7020	.83	.69	.0200	.0147	.0021	.6289	.95	.90
8	BOGR	17	10	.0380	.0380	.0056	.8529	.91	.83	.0360	.0389	-.0010	1.1058	.99	.98
8	BOGR	19	10	.0310	.0370	.0108	.8462	.61	.38	.0320	.0370	.0130	.7485	.91	.82
8	BRJA	13	10	0.0000	.0040	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	BUDA	12	10	.0360	.0330	.0019	.8648	.93	.87	.0370	.0321	.0021	.8109	1.00	.99
8	BUDA	17	10	.2000	.1750	.0081	.8345	.81	.66	.1890	.1700	-.0066	.9346	.99	.99
8	BUDA	19	10	.3670	.3060	-.1001	1.1065	.90	.81	.3490	.2971	-.0920	1.1150	.98	.96
8	CAEL	12	9	.0011	.0011	.0012	-.1250	.13	.02	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	CAEL	19	9	.0089	.0122	.0085	.4231	.31	.09	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	DCAS	-0	10	.0500	.0580	-.0099	1.3571	.73	.53	.0600	.0634	-.0048	1.1376	.94	.88
8	FEOC	13	6	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	FMUL	-0	10	0.0000	.0030	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	GRSQ	12	2	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	HMUL	-0	10	.1340	.1300	-.0287	1.1842	.59	.34	.1330	.1395	.0044	1.0159	.94	.88
8	LCAS	-0	10	.0690	.0900	.0017	1.2797	.79	.62	.0790	.0938	-.0059	1.2621	.87	.75
8	LICH	-0	10	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	LIRI	13	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	OPFR	2	1	.3200	.5100	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	OPFR	20	1	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	PLPU	13	5	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00
8	SOIL	-0	10	.0120	.0350	-.0030	3.1633	.95	.91	.0200	.0382	.0099	1.4151	.79	.63
8	SPCO	12	3	0.0000	0.0000	0.0000	0.0000	0.00	0.00	0.0000	0.0000	0.0000	0.0000	0.00	0.00

Appendix Table 5. Species List and Codes of Plants Found in Clip and Weight-Rank Plots. Cottonwood, 1970

6ACLA *Achillea millefolium* L. (common yarrow)

6AGGL *Agoseris glauca* (Nutt.) Greene. (pale agoseris)

1AGSM *Agropyron smithii* Rydb. (western wheatgrass)

6ALTE *Allium textile* Nels & Macbr. (textile onion)

4AMRE *Amaranthus retroflexus* L. (rough pigweed)

4ANOC *Androsace occidentalis* Pursh. (western rockjasmine)

5ARHI *Arabis hirsuta* (L.) Scop. (hairy rockcress)

1ARLO *Aristida longiseta* Steud. (red threeawn)

7ARFR *Artemisia frigida* Willd. (fringed sagewort)

6ARLU *Artemisia ludoviciana* Nutt. *var. gnaphalodes* (Nutt.) T & G (Cudweed sagewort)

6ASER *Aster ericoides* L. (heath aster)

6ASSP *Astragalus* species (milkvetch)

6ASTR *Astragalus tryphyllus* Pursh. (threeleaf milkvetch)

1BOGR *Bouteloua gracilis* (H.B.K.) Lag. ex Steud. (blue grama)

2BRJA *Bromus japonicus* Thurb. (japanese brome)

1BUDA *Buchloe dactyloides* (Nutt.) Engelm. (buffalograss)

3CAEL *Carex eleocharis* Bailey (needleleaf sedge)

6DEVI *Delphinium virescens* Nutt. (plains larkspur)

4DRRE *Draba reptans* (Lam.) Fern. (creeping draba)

6ERCA *Erigeron canus* A. Gray (hoary Fleabane)

4ERSP *Erigeron* spp. (fleabane)

4ERST *Erigeron strigosus* Muhl. ex Willd. (daisy fleabane)

5ERAS *Erysimum asperum* (Nutt.) DC. (plains erysimum)

Appendix Table 5 Continued. Species List and Codes

2FEOC	*Festuca octaflora* Walt. (sixweeks fescue)
6GACO	*Gaura coccinea* Nutt. (scarlet gaura)
5GRSQ	*Grindelia squarrosa* (Pursh.) Dural (curlycup gumweed)
6GUSA	*Gutierrezia sarothrae* (Pursh.) Britton & Rusby (broom snakeweed)
4HEHI	*Hedeoma hispida* Pursh. (rough falsepennyroyal)
4HEAN	*Helianthus annuus* L. (common sunflower)
2HOPU	*Hordeum pusillum* Nutt. (little barley)
6LAPU	*Lactuca pulchella* (Pursh.) DC. (chicory lettuce)
4LASE	*Lactuca serriola* L. (prickly lettuce)
4LASP	*Lappula* spp. (stickseed)
6LEMO	*Leucocrinum montanum* Nutt. (common starlily)
4LEDE	*Lepidium densiflorum* Schrad. (prairie pepperweed)
6LIPU	*Liatris punctata* Hook. (dotted gayfeather)
6LIIN	*Lithospermum incisum* Lehm (yellow gromwell)
4LIRI	*Linum sulcatum* Riddell (grooved flax)
6LOFO	*Lonatium foeniculaceum* (Nutt.) Coult & Rose (yellowflowered lomatium)
6LOOR	*Lomatium orientale* Coult. & Rose (whiteflowered lomatium)
7MAMI	*Mammillaria missouriensis* Sweet (pincushion cactus)
6MUDI	*Musineon divaricatum* (Pursh.) Coult & Rose (Wild parsley)
7OPFR	*Opuntia fragilis* (Nutt.) Haw (brittle pricklypear)
7OPPO	*Opuntia polycantha* Haw (plains pricklypear)
6OXST	*Oxalis stricta* L. (erect woodsorrel)
6PESP	*Penstemon* spp. (penstemon)
4PLPU	*Plantago purshii* Roem & Schult (wooly indianwheat)

Appendix Table 5 Continued. Species List and Codes

1POSE	*Poa secunda* Presl. (sandberg bluegrass)
6POPE	*Potentilla* spp. (cinquefoil)
6PSAR	*Psoralea argophylla* Pursh. (silverleaf scurfpea)
6PSCU	*Psoralea cuspidata* Pursh. (tallbread scurfpea)
6PSES	*Psoralea esculenta* Pursh. (common breadroot scurfpea)
6PSTE	*Psoralea tenuiflora* Pursh. (slimflower scurfpea)
6RACO	*Ratibida columnifera* (Nutt.) Wooton & Standley (upright prairieconeflower)
2SCPA	*Schedonnardus paniculatus* (Nutt.) Trel. (Tumblegrass)
6SPCO	*Sphaeralcea cocinea* (Pursh.) Rydb. (scarlet globemallow)
1SPAS	*Sporobolus asper* (Michx.) Kunth. (tall dropseed)
1SPCR	*Sporobolus cryptandrus* (Torr.) A. Gray (sand dropseed)
1STVI	*Stipa viridula* Trin. (green needlegrass)
6TAOF	*Taraxicum officinale* Weber (common dandelion)
6TRBR	*Tradescantia bracteata* Small (bracted spiderwort)
5TRPR	*Tragopogon pratensis* L. (meadow salsify)
6VIAM	*Vicia americana* Muhl. (american vetch)
6VINU	*Viola nuttallii* Pursh. (nuttall violet)

Appendix Table 6. Seasonal Change in Oven Dry Biomass, g/m^2 of Live, This Year's Dead (TYD) and Standing Dead (STD) Components of *Agropyron smithii*, Cottonwood, 1970[a]

	Replicate I						Replicate II						Treatment					
	Live		TYD		STD		Live		TYD		STD		Live		TYD		STD	
Date	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Permanent Exclosure High Range Condition																		
May 8	26.6	12.7	0.0	0.0	96.2	34.6	16.2	8.9	0.5	1.6	16.1	34.9	18.4	11.0	0.2	1.1	86.1	34.8
May 22	34.7	16.1	0.0	0.0	137.3	52.7	48.3	26.0	0.0	0.0	108.2	26.2	41.5	21.7	0.0	0.0	122.8	41.6
June 8	63.0	22.0	3.6	3.4	66.0	14.7	62.3	24.5	6.4	3.1	51.0	30.0	62.7	23.3	5.0	3.2	58.5	23.6
June 22	76.2	32.9	10.6	1.8	59.2	29.1	58.3[b]	31.5	9.7[b]	3.7	48.6[b]	23.8	64.3	32.0	10.0	3.2	52.2	25.7
July 7	68.1[c]	16.7	38.3[c]	10.2	64.0[c]	15.5	56.1	30.2	28.3	7.7	42.3	15.7	63.8	22.5	34.7	9.4	56.2	15.6
July 21	70.2	15.7	29.5	7.6	53.9	10.0	63.6	8.6	38.2	8.9	51.9	7.8	66.9	12.6	33.9	8.3	52.9	9.0
Aug. 4	41.8	13.1	27.1	9.6	38.8	9.1	51.0	22.2	36.2	6.7	53.7	13.1	46.4	18.2	31.6	8.2	46.3	11.2
Aug. 20	46.8	10.7	40.0	15.5	47.8	16.8	45.6	9.8	35.4	6.6	49.6	13.7	46.2	10.3	37.7	11.9	48.7	15.3
Sept. 4	80.7	54.9	69.3	32.7	74.3	34.1	45.4	15.2	58.9	11.2	43.9	12.1	63.0	40.3	64.1	24.4	59.1	25.6
Oct. 2	30.1	13.5	36.6	12.7	42.5	18.4	41.5	16.3	43.6	9.5	33.0	12.5	35.8	15.0	40.1	11.2	37.7	15.8
Nov. 6	.4	.1	64.5	40.5	51.0	30.6	.5	.1	62.7	27.4	47.7	20.7	.4	.1	63.6	34.6	49.4	26.1
Dec. 4	.4	.1	64.4	27.3	50.4	23.9	.3	.1	29.0	28.3	22.8	21.6	.3	.1	46.7	27.8	36.6	22.8
Temporary Exclosure Low Range Condition																		
May 8	2.3	3.5	0.0	0.0	0.0	0.0	.5	.4	0.0	0.0	0.0	0.0	1.4	2.5	0.0	0.0	0.0	0.0
May 22	1.0[d]	0.8	0.0[d]	0.0	0.0[d]	0.0	.2	.4	0.0	0.0	0.0	0.0	.6	.6	0.0	0.0	0.0	0.0
June 8	1.6	1.7	0.0	0.0	0.0	0.0	2.9	2.7	0.0	0.0	0.0	0.0	2.2	2.2	0.0	0.0	0.0	0.0
June 22	3.7	3.0	0.0	0.0	0.0	0.0	5.3[b]	3.5	0.0[b]	0.0	0.0[b]	0.0	4.8	3.3	0.0	0.0	0.0	0.0
July 7	2.1	1.7	1.0	1.3	0.0	0.0	2.1	3.7	1.1	2.0	0.0	0.0	2.1	2.9	1.0	1.7	0.0	0.0
July 21	14.4	19.8	4.1	5.1	.4	1.1	2.7	3.6	.3	.8	0.0	0.0	8.6	14.2	2.2	3.7	.2	.8
Aug. 4	1.3	2.2	.4	.8	0.0	0.0	2.6	3.0	.6	1.0	0.0	0.0	1.9	2.6	.5	.9	0.0	0.0
Aug. 20	4.4	5.2	.7	1.5	0.0	0.0	1.5	2.6	.6	1.3	0.0	0.0	3.0	4.1	.7	1.4	0.0	0.0
Sept. 4	.4	.9	.2	.8	0.0	0.0	1.7	2.2	1.4	1.6	0.0	0.0	1.1	1.7	.8	1.2	0.0	0.0
Oct. 2	.2	.6	1.6	1.6	0.0	0.0	1.1	1.4	2.9	2.3	0.0	0.0	.6	1.1	2.2	2.0	0.0	0.0
Nov. 6	0.0	0.0	2.1	1.7	0.0	0.0	0.0	0.0	2.6	2.0	0.0	0.0	0.0	0.0	2.3	1.8	0.0	0.0
Dec. 4	0.0	0.0	1.8	1.6	0.0	0.0	0.0	0.0	2.6	1.6	0.0	0.0	0.0	0.0	2.2	1.6	0.0	0.0

[a] Values are means of 10 plots per replicate unless otherwise indicated.
[b] Means based on 20 quadrats.
[c] Means based on 18 quadrats.
[d] Means based on 9 quadrats.

Appendix Table 7. Seasonal Change in Oven Dry Biomass, g/m^2 of Live, This Year's Dead (TYD) and Standing Dead (STD) Components of Buchloe dactyloides, Cottonwood, 1970[a/]

	Replicate I						Replicate II						Treatment					
	Live		TYD		STD		Live		TYD		STD		Live		TYD		STD	
Date	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Permanent Exclosure High Range Condition																		
May 8	.2	.6	0.0	0.0	13.4	21.5	.4	.9	0.0	0.0	29.1	18.8	.3	.7	0.0	0.0	21.3	20.2
May 22	1.3	2.2	0.0	0.0	18.7	15.5	1.3	2.2	0.0	0.0	17.4	16.0	1.3	2.2	0.0	0.0	18.1	15.7
June 8	17.6	11.6	3.4	3.6	9.0	12.8	14.7	15.8	1.8	1.6	15.8	17.6	16.2	13.9	2.6	2.8	12.4	15.4
June 22	40.7	26.0	7.8	6.3	26.6	21.3	37.0[b/]	19.8	7.7[b/]	5.7	28.3[b/]	26.4	38.3	22.1	7.7	5.9	27.7	24.8
July 7	25.7[c/]	16.0	7.5[c/]	7.6	5.1[c/]	5.2	28.5	20.1	6.7	6.3	9.4	9.7	26.7	17.6	7.2	7.2	6.7	7.1
July 21	48.2	17.2	10.5	5.8	19.6	11.4	37.3	28.3	10.0	9.1	11.9	8.8	42.8	23.4	10.2	7.6	15.8	10.2
Aug. 4	31.8	13.4	12.3	3.3	8.5	4.5	19.0	12.7	7.2	6.7	1.4	2.3	25.4	13.1	9.7	5.2	5.0	3.6
Aug. 20	7.9	7.5	4.0	5.4	1.8	3.3	14.2	7.4	5.4	3.0	2.5	2.4	11.0	7.4	4.7	4.4	2.1	2.9
Sept. 4	18.8	28.8	6.8	10.2	6.2	10.5	26.3	16.6	14.0	8.0	7.4	6.3	22.5	23.5	10.4	9.2	6.8	8.7
Oct. 2	7.5	8.3	14.9	18.4	4.6	7.1	15.4	11.2	20.9	11.4	7.3	5.9	11.4	9.9	17.9	15.3	5.9	6.6
Nov. 6	.9	.5	44.7	33.6	22.9	19.8	1.4	.4	49.6	38.6	22.5	20.0	1.1	.4	47.2	36.2	22.7	19.9
Dec. 4	1.0	.4	39.4	25.2	19.3	16.6	.9	.2	47.0	22.6	24.4	14.1	1.0	.3	43.2	23.9	21.9	15.4
Temporary Exclosure Low Range Condition																		
May 8	8.4	7.7	0.0	0.0	89.4	38.8	5.0	2.9	0.0	0.0	15.7	60.4	6.7	5.8	0.0	0.0	102.6	50.8
May 22	21.9[d/]	18.6	.2[d/]	.7	87.4[d/]	60.5	28.7	14.8	0.0	0.0	70.1	29.4	25.5	16.7	.1	.5	78.3	46.8
June 8	38.0	7.3	2.2	.4	52.2	12.1	43.6	7.3	2.1	.4	53.3	9.4	40.8	7.3	2.1	.4	52.7	10.8
June 22	55.7	21.1	3.0	1.8	47.6	19.1	56.8[b/]	15.6	2.4[b/]	.5	46.0[b/]	10.3	56.4	17.6	2.6	1.1	46.6	13.9
July 7	41.7	12.1	48.6	11.2	52.5	16.2	50.7	11.9	48.4	11.3	65.4	21.0	46.2	12.0	48.5	11.3	59.0	18.8
July 21	39.3	12.2	28.0	12.8	39.4	11.4	42.2	8.0	51.7	15.8	60.6	16.0	40.8	10.3	39.9	14.4	50.0	13.9
Aug. 4	27.3	9.2	25.1	11.7	35.1	11.4	27.6	6.0	42.3	14.0	42.7	9.2	27.4	7.8	33.7	12.9	38.9	10.4
Aug. 20	40.4	10.7	58.4	15.0	60.8	15.1	40.8	11.3	62.0	18.2	56.9	16.8	40.6	11.0	60.2	16.7	58.8	16.0
Sept. 4	24.3	5.6	50.9	13.0	41.5	9.2	32.8	8.8	58.4	15.1	54.5	14.0	28.6	7.4	54.7	14.6	48.0	11.9
Oct. 2	16.4	3.4	49.7	10.6	26.0	5.8	15.6	3.6	52.9	15.5	26.6	6.8	16.0	3.5	51.3	13.3	26.3	6.3
Nov. 6	.3	.1	48.6	7.1	26.4	4.3	1.5	.3	53.1	11.4	31.8	6.5	.9	.2	50.9	9.5	29.1	5.5
Dec. 4	.3	.1	52.3	17.1	31.3	10.1	.3	.1	51.1	16.1	31.8	10.7	.3	.1	51.7	16.6	31.5	10.4

[a/] Values are means of 10 plots per replicate unless otherwise indicated.
[b/] Means based on 20 quadrats.
[c/] Means based on 18 quadrats.
[d/] Means based on 9 quadrats.

Appendix Table 8. Seasonal Change in Oven Dry Biomass, g/m^2 of Live, This Year's Dead (TYD) and Standing Dead (STD) Components of Bouteloua gracilis, Cottonwood, 1970[a/]

	Replicate I						Replicate II						Treatment					
	Live		TYD		STD		Live		TYD		STD		Live		TYD		STD	
Date	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Permanent Exclosure High Range Condition																		
May 8	.4	1.1	0.0	0.0	16.0	9.4	0.0	0.0	0.0	0.0	13.5	8.6	.2	.8	0.0	0.0	14.8	9.0
May 22	2.8	3.9	0.0	0.0	24.6	22.2	10.5	10.1	0.0	0.0	28.3	20.5	6.6	7.6	0.0	0.0	26.4	21.4
June 8	18.4	13.2	0.0	0.0	7.6	9.3	14.7	8.2	0.0	0.0	11.7	13.6	16.6	11.0	0.0	0.0	9.7	11.6
June 22	21.8	15.5	0.0	0.0	7.8	10.8	21.5[b/]	11.6	2.5[b/]	5.6	5.0[b/]	7.8	21.6	13.0	1.7	4.6	5.9	9.0
July 7	18.4[c/]	10.8	0.0[c/]	0.0	5.0[c/]	7.1	15.8	11.8	0.0	0.0	8.5	12.5	17.4	11.2	0.0	0.0	6.2	9.4
July 21	10.7	11.4	0.0	0.0	1.5	3.3	16.4	11.7	0.0	0.0	4.4	8.4	13.5	11.5	0.0	0.0	3.0	6.4
Aug. 4	19.2	9.2	8.6	6.3	4.2	6.2	19.1	10.4	5.3	4.6	1.6	3.8	19.2	9.8	6.9	5.5	2.9	5.2
Aug. 20	11.4	7.5	2.8	2.9	0.0	0.0	21.9	9.2	8.7	7.2	4.7	5.2	16.7	8.4	5.8	5.5	2.3	3.7
Sept. 4	11.2	6.0	1.7	3.6	0.0	0.0	19.4	13.5	12.6	10.5	5.9	8.0	15.3	10.4	7.2	7.9	2.9	5.6
Oct. 2	8.8	8.5	7.1	6.9	.9	1.1	15.4	11.5	13.4	11.6	1.8	1.9	12.1	10.1	10.3	9.6	1.3	1.6
Nov. 6	0.0	0.0	5.2	8.3	.6	1.2	1.5	2.0	5.4	5.7	.4	.8	.7	1.4	5.3	7.1	.5	1.0
Dec. 4	0.0	0.0	2.6	2.6	.5	.8	0.0	0.0	10.4	6.3	1.6	1.6	0.0	0.0	6.5	4.8	1.0	1.3
Temporary Exclosure Low Range Condition																		
May 8	3.3	3.1	0.0	0.0	5.5	14.0	2.0	1.1	0.0	0.0	13.5	42.6	2.7	2.4	0.0	0.0	9.5	31.7
May 22	8.3[d/]	3.7	0.0[d/]	0.0	26.7[d/]	40.3	6.9	3.6	0.0	0.0	3.8	8.4	7.6	3.6	0.0	0.0	14.6	28.4
June 8	19.9	4.5	0.0	0.0	2.2	.4	14.5	2.8	0.0	0.0	2.1	.4	17.2	3.7	0.0	0.0	2.1	.4
June 22	22.2	10.0	0.0	0.0	2.3	1.1	27.1[b/]	13.8	0.0[b/]	0.0	2.3[b/]	.9	25.4	12.6	0.0	0.0	2.3	1.0
July 7	9.7	6.9	0.0	0.0	2.4	1.9	19.4	3.1	0.0	0.0	4.6	3.0	14.6	5.4	0.0	0.0	3.5	2.5
July 21	32.1	18.5	0.0	0.0	5.3	4.2	36.9	12.7	0.0	0.0	8.0	2.1	34.5	15.9	0.0	0.0	6.6	3.3
Aug. 4	20.1	12.9	2.3	1.7	4.3	2.9	13.7	5.3	2.4	2.0	3.1	2.0	16.9	9.9	2.4	1.8	3.7	2.5
Aug. 20	18.8	3.0	4.7	2.3	2.5	1.0	14.5	6.6	3.3	1.8	.3	.9	16.6	5.1	4.0	2.1	1.4	1.0
Sept. 4	6.4	2.0	4.3	1.0	2.0	.4	9.0	3.7	5.5	1.6	2.7	1.2	7.7	3.0	4.9	1.3	2.4	.9
Oct. 2	6.4	1.8	8.6	3.4	11.4	11.0	6.7	1.6	8.1	2.2	5.1	1.5	6.5	1.7	8.4	2.8	8.2	7.9
Nov. 6	.3	.1	6.6	1.0	5.7	1.2	1.2	.2	6.0	1.3	4.6	1.0	.7	.2	6.3	1.1	5.2	1.1
Dec. 4	.3	.1	5.7	1.8	4.7	1.4	.3	.1	6.6	1.7	5.0	1.3	.3	.1	6.2	1.8	4.8	1.3

[a/] Values are means of 10 plots per replicate unless otherwise indicated.
[b/] Means based on 20 quadrats.
[c/] Means based on 18 quadrats.
[d/] Means based on 9 quadrats.

Appendix Table 9. Seasonal Change in Oven Dry Biomass, g/m^2 of Live, This Year's Dead (TYD) and Standing Dead (STD) components of Carex eleocharis, Cottonwood, 1970[a]

	Replicate I						Replicate II						Treatment					
	Live		TYD		STD		Live		TYD		STD		Live		TYD		STD	
Date	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Permanent Exclosure High Range Condition																		
May 8	--	--	--	--	--	--	.8	1.7	0.0	0.0	0.0	0.0	.4	1.2	0.0	0.0	0.0	0.0
May 22	--	--	--	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0
June 8	10.8	9.1	0.0	0.0	0.0	0.0	8.3	5.4	0.0	0.0	0.0	0.0	9.6	7.5	0.0	0.0	0.0	0.0
June 22	11.8	8.9	0.0	0.0	0.0	0.0	10.0[b]	5.1	0.0[b]	0.0	0.0[b]	0.0	10.6	6.6	0.0	0.0	0.0	0.0
July 7	8.4[c]	5.6	0.0[c]	0.0	0.0[c]	0.0	6.2	3.9	1.3	2.2	0.0	0.0	7.6	5.0	.5	1.3	0.0	0.0
July 21	4.0	4.5	0.0	0.0	0.0	0.0	3.8	4.8	0.0	0.0	0.0	0.0	3.9	4.6	0.0	0.0	0.0	0.0
Aug. 4	1.1	1.8	0.0	0.0	0.0	0.0	5.2	4.7	0.0	0.0	0.0	0.0	3.2	3.6	0.0	0.0	0.0	0.0
Aug. 20	10.9	6.4	2.7	2.8	0.0	0.0	4.8	4.0	.5	1.5	0.0	0.0	7.9	5.3	1.6	2.2	0.0	0.0
Sept. 4	8.6	9.7	0.0	0.0	0.0	0.0	6.2	5.9	0.0	0.0	0.0	0.0	7.4	8.0	0.0	0.0	0.0	0.0
Oct. 2	10.5	7.4	.4	1.2	0.0	0.0	5.4	5.0	0.0	0.0	0.0	0.0	8.0	6.3	.2	.9	0.0	0.0
Nov. 6	--	--	--	--	--	--	2.7	4.6	0.0	0.0	0.0	0.0	1.4	3.2	0.0	0.0	0.0	0.0
Dec. 4	.9	3.0	0.0	0.0	0.0	0.0	3.6	3.2	1.1	1.8	0.0	0.0	2.2	3.1	.5	1.3	0.0	0.0
Temporary Exclosure Low Range Condition																		
May 8	5.3	2.7	0.0	0.0	0.0	0.0	3.7	1.9	0.0	0.0	0.0	0.0	4.5	2.4	0.0	0.0	0.0	0.0
May 22	7.9[d]	2.5	.5[d]	1.0	0.0[d]	0.0	6.0	1.6	0.0	0.0	0.0	0.0	6.9	2.1	.2	.7	0.0	0.0
June 8	3.7	1.7	.4	.2	0.0	0.0	3.3	1.6	.2	.2	0.0	0.0	3.5	1.6	.3	.2	0.0	0.0
June 22	5.6	2.0	.1	.3	0.0	0.0	3.2[b]	1.3	.0[b]	.1	0.0[b]	0.0	4.0	1.6	.1	.2	0.0	0.0
July 7	2.5	2.0	1.9	.8	0.0	0.0	4.4	2.5	1.5	.7	0.0	0.0	3.4	2.2	1.7	.8	0.0	0.0
July 21	6.9	3.5	.9	.8	0.0	0.0	5.3	2.4	1.0	1.1	0.0	0.0	6.1	3.0	.9	1.0	0.0	0.0
Aug. 4	3.4	1.6	.8	.5	0.0	0.0	3.0	2.5	1.5	2.0	0.0	0.0	3.2	2.1	1.1	1.5	0.0	0.0
Aug. 20	4.7	1.9	1.6	1.1	0.0	0.0	1.2	1.7	1.2	.6	0.0	0.0	2.9	1.8	1.4	.9	0.0	0.0
Sept. 4	2.0	.4	1.7	.7	0.0	0.0	2.5	1.1	1.4	.6	0.0	0.0	2.2	.8	1.5	.6	0.0	0.0
Oct. 2	.2	.7	2.6	1.4	0.0	0.0	1.8	1.0	1.8	1.0	0.0	0.0	1.0	.9	2.2	1.2	0.0	0.0
Nov. 6	0.0	0.0	1.6	.4	0.0	0.0	.1	.4	1.5	.3	0.0	0.0	.1	.3	1.6	.4	0.0	0.0
Dec. 4	0.0	0.0	1.6	.7	0.0	0.0	0.0	0.0	1.7	.4	0.0	0.0	0.0	0.0	1.6	.6	0.0	0.0

[a] Values are means of 10 plots per replicate unless otherwise indicated.
[b] Means based on 20 quadrats.
[c] Means based on 18 quadrats.
[d] Means based on 9 quadrats.

Appendix Table 10. Seasonal Change in Oven Dry Biomass, g/m^2 of Live, This Year's Dead (TYD) and Standing Dead (STD) components of *Bromus japonicus*, Cottonwood, 1970[a/]

	Replicate I						Replicate II						Treatment					
	Live		TYD		STD		Live		TYD		STD		Live		TYD		STD	
Date	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Permanent Exclosure High Range Condition																		
May 8	--	--	--	--	--	--	2.0	6.3	0.0	0.0	0.0	0.0	1.0	4.5	0.0	0.0	0.0	0.0
May 22	4.4	4.4	0.0	0.0	0.0	0.0	5.7	10.2	0.0	0.0	0.0	0.0	5.0	7.8	0.0	0.0	0.0	0.0
June 8	35.1	23.1	0.0	0.0	0.0	0.0	24.2	13.0	0.0	0.0	0.0	0.0	29.6	18.7	0.0	0.0	0.0	0.0
June 22	14.1	8.5	0.0	0.0	0.0	0.0	19.4[b/]	13.8	0.0[b/]	0.0	0.0[b/]	0.0	17.7	12.3	0.0	0.0	0.0	0.0
July 7	14.0[c/]	12.1	0.0[c/]	0.0	0.0[c/]	0.0	18.4	7.3	0.0	0.0	0.0	0.0	15.5	10.6	0.0	0.0	0.0	0.0
July 21	12.8	15.0	0.0	0.0	0.0	0.0	11.1	5.6	0.0	0.0	0.0	0.0	11.9	11.3	0.0	0.0	0.0	0.0
Aug. 4	8.1	6.3	0.0	0.0	.5	1.5	10.1	6.5	0.0	0.0	0.0	0.0	9.1	6.4	0.0	0.0	.2	1.1
Aug. 20	12.4	11.0	0.0	0.0	0.0	0.0	9.8	4.6	0.0	0.0	0.0	0.0	11.1	8.4	0.0	0.0	0.0	0.0
Sept. 4	8.2	10.2	0.0	0.0	0.0	0.0	11.3	9.2	0.0	0.0	0.0	0.0	9.7	9.8	0.0	0.0	0.0	0.0
Oct. 2	9.0	5.3	0.0	0.0	0.0	0.0	11.4	2.7	0.0	0.0	0.0	0.0	10.2	4.2	0.0	0.0	0.0	0.0
Nov. 6	15.4	8.1	0.0	0.0	0.0	0.0	28.2	11.2	0.0	0.0	0.0	0.0	21.8	9.8	0.0	0.0	0.0	0.0
Dec. 4	18.0	8.7	0.0	0.0	0.0	0.0	19.3	6.0	0.0	0.0	0.0	0.0	18.6	7.5	0.0	0.0	0.0	0.0
Temporary Exclosure Low Range Condition																		
May 8	--	--	--	--	--	--	--	--	--	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0
May 22	--	--	--	--	--	--	.4	.8	0.0	0.0	0.0	0.0	.2	.6	0.0	0.0	0.0	0.0
June 8	.2	0.0	0.0	0.0	0.0	0.0	6.8	7.8	0.0	0.0	0.0	0.0	3.5	5.5	0.0	0.0	0.0	0.0
June 22	3.6	7.4	0.0	0.0	0.0	0.0	4.1[b/]	6.8	0.0[b/]	0.0	0.0[b/]	0.0	3.9	7.0	0.0	0.0	0.0	0.0
July 7	--	--	--	--	--	--	.8	2.4	0.0	0.0	0.0	0.0	.4	1.7	0.0	0.0	0.0	0.0
July 21	.2	.8	0.0	0.0	0.0	0.0	2.2	3.4	0.0	0.0	0.0	0.0	1.2	2.5	0.0	0.0	0.0	0.0
Aug. 4	--	--	--	--	--	--	2.2	3.7	0.0	0.0	0.0	0.0	1.1	2.6	0.0	0.0	0.0	0.0
Aug. 20	--	--	--	--	--	--	1.1	1.9	0.0	0.0	0.0	0.0	.6	1.3	0.0	0.0	0.0	0.0
Sept. 4	.2	.8	0.0	0.0	0.0	0.0	.6	1.4	0.0	0.0	0.0	0.0	.4	1.1	0.0	0.0	0.0	0.0
Oct. 2	.4	1.4	0.0	0.0	0.0	0.0	.3	1.0	0.0	0.0	0.0	0.0	.4	1.2	0.0	0.0	0.0	0.0
Nov. 6	.2	.6	0.0	0.0	0.0	0.0	.1	.4	0.0	0.0	0.0	0.0	.2	.5	0.0	0.0	0.0	0.0
Dec. 4	--	--	--	--	--	--	.2	.8	0.0	0.0	0.0	0.0	.1	.5	0.0	0.0	0.0	0.0

[a/] Values are means of 10 plots per replicate unless otherwise indicated.
[b/] Means based on 20 quadrats.
[c/] Means based on 18 quadrats.

Appendix Table 11. Seasonal Change in Oven Dry Biomass, g/m^2, of Live, This Year's Dead (TYD), and Standing Dead (STD) Components of All Species, 1970[a/]

	Replicate I						Replicate II						Treatment					
	Live		TYD		STD		Live		TYD		STD		Live		TYD		STD	
Date	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Permanent Exclosure High Range Condition																		
May 8	21.1	12.5	0.0	0.0	125.6	29.3	22.2	17.8	.5	1.6	118.7	29.8	21.6	15.4	.2	1.1	122.2	29.5
May 22	43.2	16.2	0.0	0.0	180.6	43.5	71.4	26.7	0.0	0.0	153.9	31.7	57.3	22.1	0.0	0.0	167.3	38.1
June 8	152.7	28.0	6.9	4.2	82.6	16.8	143.1	49.2	8.2	2.2	78.5	25.0	147.9	40.0	7.6	3.4	80.6	21.3
June 22	180.6	29.6	18.3	6.6	96.9	19.1	156.3[b/]	37.0	19.9[b/]	7.9	81.9[b/]	26.4	164.4	34.7	19.4	7.5	86.9	24.2
July 7	145.5[c/]	34.2	46.7[c/]	17.0	74.4[c/]	17.1	137.1	21.6	36.4	10.4	60.2	17.0	142.5	30.3	43.0	15.0	69.3	17.0
July 21	158.5	26.4	40.5	12.2	75.5	17.0	151.2	39.3	48.2	14.5	68.2	10.2	154.8	33.5	44.3	13.4	71.9	14.0
Aug. 4	110.5	31.2	50.1	22.6	52.0	11.5	109.2	22.4	48.7	10.2	56.7	14.0	109.8	27.2	49.4	17.6	54.4	12.8
Aug. 20	106.0	25.1	49.5	16.8	49.5	16.3	99.7	7.7	50.3	8.8	56.8	15.7	102.8	18.5	49.9	13.4	53.1	16.0
Sept. 4	139.7	67.8	80.4	33.4	81.0	28.6	113.6	23.7	85.5	12.8	57.1	9.5	126.7	50.8	82.9	25.3	69.1	21.3
Oct. 2	72.6	17.9	59.8	10.8	48.0	15.7	93.4	24.8	78.0	18.0	42.0	12.0	83.0	21.6	68.9	14.9	45.0	14.0
Nov. 6	18.1	7.0	114.4	25.0	74.6	20.7	36.9	15.2	117.8	32.4	70.6	17.9	27.5	11.8	116.1	29.0	72.6	19.4
Dec. 4	23.0	8.5	106.4	20.6	70.2	16.2	24.9	6.8	87.5	21.6	48.8	16.4	23.9	7.7	97.0	21.1	59.5	16.3
Temporary Exclosure Low Range Condition																		
May 8	19.4	10.7	0.0	0.0	101.7	24.8	11.4	3.7	0.0	0.0	129.2	44.7	15.4	8.0	0.0	0.0	115.4	36.2
May 22	39.3[d/]	18.9	.8[d/]	1.6	114.2[d/]	33.2	49.2	17.2	0.0	0.0	73.8	32.5	44.5	18.0	.4	1.1	92.9	32.9
June 8	67.0	11.5	2.5	.6	54.3	12.5	74.9	15.1	2.3	.5	55.4	9.7	71.0	13.4	2.4	.6	54.8	11.2
June 22	93.4	27.3	3.1	2.0	50.0	19.6	105.0[b/]	23.2	2.5[b/]	.5	48.3[b/]	10.6	101.2	24.6	2.7	1.2	48.8	14.2
July 7	56.6	11.1	51.5	11.6	55.0	15.5	86.9	41.8	51.0	12.6	70.0	23.6	71.8	30.6	51.2	12.1	62.5	20.0
July 21	97.0	26.4	33.0	13.6	45.0	14.1	90.6	18.5	53.0	16.1	68.6	16.6	93.8	22.8	43.0	14.9	56.8	15.4
Aug. 4	52.1	22.5	28.5	12.8	39.4	13.7	49.6	12.7	46.9	15.7	45.8	10.4	50.8	18.3	37.7	14.3	42.6	12.1
Aug. 20	82.4	56.3	65.4	18.5	63.2	15.1	62.6	27.6	67.2	19.9	57.2	16.9	72.5	44.4	66.3	19.2	60.2	16.0
Sept. 4	33.9	7.9	57.2	14.7	43.4	9.6	47.2	14.0	66.7	18.1	57.2	14.8	40.5	11.4	61.9	16.5	50.3	12.4
Oct. 2	24.0	5.5	62.6	14.2	37.4	15.5	29.6	11.8	65.7	17.2	31.6	8.0	26.8	9.2	64.1	15.8	34.5	12.3
Nov. 6	4.8	10.4	58.8	8.6	32.1	4.5	3.0	.7	63.2	13.8	36.4	7.3	3.9	7.4	61.0	11.5	34.3	6.1
Dec. 4	.6	.2	61.4	18.9	36.0	11.4	.9	.9	61.9	18.6	36.8	12.0	.7	.6	61.7	18.8	36.4	11.7

[a/] Values are means of 10 plots per replicate unless otherwise indicated.
[b/] Means based on 20 quadrats.
[c/] Means based on 18 quadrats.
[d/] Means based on 9 quadrats.

Appendix Table 12. Seasonal Change in Fresh and Humic Mulch and in Total Weight of Mulch and Live and Dead Crowns and Stolons, Oven Dry Organic Matter g/m^2, Cottonwood, 1970.

Component	Fresh						Humic						Total					
Replicate	I		II		Mean		I		II		Mean		I		II		Mean	
Date	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
							Permanent Exclosure High Range Condition											
May 8	153.8	8.6	156.4	13.3	155.1	7.7	63.0	4.9	63.0	7.0	63.0	4.2	254.1	10.5	262.8	17.7	258.5	10.0
May 22	269.8	17.9	251.6	11.9	260.7	10.7	119.1	12.1	102.8	7.7	110.9	7.2	430.6	24.8	387.1	21.6	407.7	16.7
June 8	224.1	9.8	246.1	19.6	235.1	11.0	96.6	8.2	73.9	10.2	85.2	6.9	495.6	29.5	443.2	30.7	469.4	21.6
June 22	322.4	21.5	336.4	12.3	332.1	10.7	71.1	7.6	121.6	9.9	105.9	8.4	542.8	33.4	622.0	25.0	597.4	20.9
July 10	290.9	9.3	341.4	27.2	308.9	12.0	100.6	4.5	118.5	12.5	107.0	5.4	511.0	20.9	552.7	37.6	525.9	19.0
July 22	349.3	18.3	372.3	25.2	360.8	15.4	141.2	7.2	95.7	9.0	118.5	7.7	605.4	28.7	576.7	32.9	591.0	21.5
Aug. 3	289.2	12.2	349.8	16.9	319.5	12.3	137.2	10.9	100.1	5.6	118.7	7.3	557.8	28.6	606.1	28.6	582.0	20.5
Aug. 20	318.2	26.7	283.3	12.7	300.8	14.9	93.0	15.9	102.9	5.9	97.9	8.4	489.7	40.5	471.2	19.1	480.5	21.9
Sept. 4	314.1	19.2	260.6	17.5	287.4	14.1	54.7	5.8	73.4	6.3	64.0	4.7	450.5	26.4	434.3	26.9	442.4	18.4
Oct. 2	239.4	6.6	196.4	7.3	217.9	6.8	27.7	1.1	71.0	4.3	49.4	5.4	329.0	9.6	354.9	15.7	343.6	10.0
Nov. 6	196.8	17.1	238.2	12.8	217.5	11.4	56.6	2.5	56.2	5.2	56.4	2.8	299.1	19.9	353.2	18.9	326.1	14.7
Dec. 4	207.5	8.1	188.1	18.4	197.8	10.0	42.7	2.8	40.2	2.6	41.4	1.9	294.4	12.4	273.7	19.5	284.0	11.5
							Temporary Exclosure Low Range Condition											
May 8[a]	58.0	4.6	40.8	3.5	49.4	3.4	40.0	8.7	33.4	2.9	36.7	4.5	149.7	--	107.0	--	128.4	--
May 22	94.9	4.8	130.7	7.7	112.8	6.0	25.9	2.0	51.5	5.6	38.7	4.1	201.0	12.4	269.3	14.6	235.2	12.2
June 8	137.6	6.8	131.1	15.0	134.4	8.0	75.6	5.2	48.4	4.6	62.0	4.6	323.5	11.5	250.7	24.7	287.1	15.7
June 22	161.7	21.8	170.7	11.4	167.7	10.3	80.2	11.4	82.8	6.3	81.9	5.5	347.6	42.2	369.6	21.7	362.2	19.8
July 10	76.5	12.0	110.9	6.4	93.7	7.7	69.9	25.1	100.2	6.0	85.1	13.0	181.2	35.4	263.7	10.0	222.4	20.2
July 22	139.5	9.2	133.4	9.0	136.4	6.3	26.2	2.1	64.5	3.1	45.3	4.8	216.6	14.5	253.8	12.9	235.2	10.4
Aug. 3	162.1	12.4	157.3	7.2	159.7	7.0	69.2	3.5	88.4	4.6	78.8	3.6	364.3	25.3	354.8	20.0	359.6	15.7
Aug. 20	147.7	5.6	121.1	4.0	134.4	4.5	56.1	2.0	51.3	2.6	53.7	1.7	271.7	10.8	256.4	9.8	264.1	7.3
Sept. 4	107.9	5.7	120.2	7.0	114.0	4.6	40.2	1.8	52.7	3.6	46.5	2.4	203.4	9.9	257.0	14.1	230.2	10.4
Oct. 2	101.7	5.2	71.7	4.5	86.7	4.8	55.6	11.1	81.0	5.0	68.3	6.6	222.7	17.4	234.8	14.8	228.7	11.2
Nov. 6	84.4	4.4	75.3	3.2	79.9	2.8	45.8	4.5	47.6	2.4	46.7	2.5	166.5	10.0	160.0	8.3	163.3	6.4
Dec. 4	69.5	4.2	79.8	4.1	73.6	3.3	53.6	3.8	53.4	4.6	53.5	2.8	107.1	11.6	193.2	9.9	179.4	8.5

[a] Computer output for the temporary exclosure on May 8 showed no fresh mulch. Fresh mulch values were supplied from hand-calculated data and the standard error was calculated. These values were added to the total but the standard error was not calculated.

Appendix Table 13. Below-Ground Standing Crop (Oven Dry, Ash-Free g/m^2) of Plant Crowns, Rhizomes and Roots by Sampling Date and Depth (cm) in the Permanent Exclosure in High Range Condition Cottonwood, 1970[a/]

Date	May 8		June 8		July 10		August 4		September 4		October 2		November 6	
Replicate	I	II	I	II	I	II	I	II	I	II	I	II	I	II
Crowns	117 (9)	131	183 (9)	191	141	154 (9)	95	94	172 (9)	219	108	190	115 (8)	359
Rhizomes														
0-5	21 (9)	20	24	34	20	13	25	19	22 (9)	20	48	30	27 (9)	17
5-10	12 (9)	22	7	6	9	2	9	5	17	6	17	9	12 (9)	10
10-20	1 (9)	1	1	--	1	2	--	1	1	3	4	--	1 (9)	
Total rhizomes	34	43	32	40	30	17	34	25	40	30	69	38	40	27
Roots														
0-5	299	329 (9)	346 (7)	359	327	392 (9)	305	298	303 (8)	352	289	326	289 (9)	406
5-10	143	154 (9)	142	147	176	185 (9)	113 (8)	154	167	164	170	162	164 (9)	175
10-20	174	159	196 (9)	185	206 (9)	222	163 (8)	184	187	174	200	197 (9)	196 (9)	197
20-30	106 (7)	103 (9)	133 (9)	128	143	123 (9)	142	123	131 (9)	135	172	139	123 (9)	144
30-40	62 (6)	80	103 (9)	93	146 (8)	100	100	85	110	100 (9)	136	94 (9)	89 (9)	110
40-50	56 (6)	74	80 (7)	79	100 (8)	100 (9)	84	69	79	69	79	70 (9)	64 (9)	84
50-60	46 (8)	82	82 (5)	64	89 (9)	79 (9)	74 (9)	48 (9)	69 (9)	55	81	64	48 (9)	62
Total roots	886	980	1082	1055	1188	1201	982	963	1047	1048	1127	1052	974	1178

[a/] Values are means of 10 samples unless indicated otherwise by numeral in parenthesis.

Appendix Table 14. Below-Ground Standing Crop (Oven Dry, Ash-Free g/m^2) of Plant Crowns, Rhizomes and Roots by Sampling Date and Depth (cm) in the Temporary Exclosure in Low Range Condition Cottonwood, 1970[a/]

Date	May 8		June 8		July 10		August 4		September 4		October 2		November 6	
Replicate	I	II	I	II	I	II	I	II	I	II	I	II	I	II
Crowns	185	224	204	265	333 (9)	302 (9)	122	243	292	232 (9)	206 (9)	263	288	279
Rhizomes														
0-5	20	10	13	16 (9)	20	20	21	15	17	18	10	14 (9)	22	10 (9)
5-10	2	3	4	2	3 (9)	2	5	0	1	6	20	2	1	--
10-20	--	--	--	1	1	0	2	--	1	1	1		1	--
Total rhizomes	22	14	17	19	24	22	28	15	19	25	31	16	24	10
Roots														
0-5	459 (9)	448	533	452 (8)	655 (9)	681 (9)	572	601 (9)	551 (9)	434 (8)	557	604 (9)	659	587
5-10	275 (9)	315	337	288 (9)	292 (9)	347 (9)	267	312	336	262 (9)	297	275	433 (9)	352
10-20	338	344	380 (9)	337	328	365	359 (8)	333	347	274	365	369 (7)	396	306
20-30	206	228	223	232	215	230 (9)	259 (7)	13[illegible] (5)	237	193	217	240	234	179
30-40	140	141	184	154	134	173	164	142 (8)	153	107	147	153	147	124
40-50	96 (9)	98	101 (9)	106	95	116	106 (8)	100 (9)	95	97	102 (8)	113 (9)	116	104 (9)
50-60	86 (7)	67 (9)	69 (9)	59	75	68	80 (9)	100 (9)	67 (8)	61	69	82	74	64
Total roots	1598	1642	1827	1627	1792	1978	1807	1726	1785	1428	1752	1837	2057	1715

[a/] Values are means of 10 samples unless indicated otherwise by numeral in parenthesis.

APPENDIX II

FIELD DATA

Aboveground Biomass Data - I

Aboveground biomass data collected in 1970 at the Cottonwood Site is Grassland Biome data set A2U0064. Data were recorded as follows.

Columns	Contents
1-40	As on Form NREL-01
41-46	Total sample weight (air dry)
47-52	Predicted component weight
53-54	Total sample estimate for each component
55-56	Mean of all square estimates for each component
57-58	Single square estimate for each component
59-60	Single square separation for each component
61-62	Percent of dry matter
63-64	Data set 01 = Herndon: July, Aug., Sept. Permanent exclosure 02 = Weber: July, Aug., Sept. Temporary exclosure 03 = Talsma: May Permanent exclosure 04 = Jacobs: May Temporary exclosure 05 = Herndon: June Permanent exclosure 06 = Weber: June Temporary exclosure

65	Use of data 1 = Weight ranked 2 = Not weight ranked
66	Kind of lab estimate 1 = Total sample estimate 2 = Square estimations and separations included
67-68	Mean of squares of subsample predicted as though squares were separated
69-70	Total sample estimate predicted as mean of separated squares

An example of the data follows.

*** EXAMPLE OF DATA ***

```
        1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

0104RLT190870510.71 001 2 2 FEOC   13 10152.80       00       920211
0104RLT190870510.71 001 2 1 BUDA   12 01152.80       08       920211
0104RLT190870510.71 001 2 1 BUDA   17 02152.80       27       920211
0104RLT190870510.71 001 2 1 BUDA   19 03152.80       24       920211
0104RLT190870510.71 001 2 1 BOGR   10 04152.80       06       920211
0104RLT190870510.71 001 2 1 BOGR   17 06152.80       01       920211
0104RLT190870510.71 001 2 1 BOGR   19 08152.80       03       920211
0104RLT190870510.71 001 2 3 CAEL   12 05152.80       01       920211
0104RLT190870510.71 001 2 3 CAEL   19 09152.80       02       920211
0104RLT190870510.71 001 2 2 BRJA   13 07152.80       00       920211
0104RLT190870510.71 001 2 4 MISC   13 11152.80       --       920211
0104RLT190870510.71 001 2   FMUL        152.80       --       920221
0104RLT190870510.71 001 2   HMUL        152.80       11       920221
0104RLT190870510.71 001 2   SOIL        152.80       01       920221
0104RLT190870510.71 001 2   DCAS        152.80       08       920221
0104RLT190870510.71 001 2   LCAS        152.80       08       920221
0104RLT190870510.71 001 2   LICH        152.80                920221
0104RLT190870510.71 002 2 1 BUDA   12 01112.70       13       920211
0104RLT190870510.71 002 2 1 BUDA   17 03112.70       27       920211
0104RLT190870510.71 002 2 1 BUDA   19 02112.70       24       920211
0104RLT190870510.71 002 2 1 BOGR   10 04112.70       07       920211
0104RLT190870510.71 002 2 1 BOGR   17 06112.70       01       920211
0104RLT190870510.71 002 2 1 BOGR   19 05112.70       01       920211
0104RLT190870510.71 002 2 3 CAEL   12 07112.70       02       920211
0104RLT190870510.71 002 2 3 CAEL   19 11112.70       01       920211
0104RLT190870510.71 002 2 2 BRJA   13 08112.70       00       920211
0104RLT190870510.71 002 2 2 FEOC   13 09112.70       00       920211
0104RLT190870510.71 002 2 1 AGSM   12 10112.70       03       920211
0104RLT190870510.71 002 2   FMUL        112.70       01       920221
0104RLT190870510.71 002 2   HMUL        112.70       05       920221
0104RLT190870510.71 002 2   SOIL        112.70       03       920221
0104RLT190870510.71 002 2   DCAS        112.70       05       920221
0104RLT190870510.71 002 2   LCAS        112.70       07       920221
0104RLT190870510.71 002 2   LICH        112.70                920221
0104RLT190870510.71 003 2 1 AGSM   12 05295.30       03       920211
0104RLT190870510.71 003 2 1 AGSM   19 16295.30       00       920211
0104RLT190870510.71 003 2 1 BUDA   12 03295.30       07       920211
0104RLT190870510.71 003 2 1 BUDA   17 06295.30       15       920211
0104RLT190870510.71 003 2 1 BUDA   19 13295.30       13       920211
0104RLT190870510.71 003 2 1 BOGR   10 04295.30       05       920211
0104RLT190870510.71 003 2 1 BOGR   17 07295.30       00       920211
0104RLT190870510.71 003 2 1 BOGR   19 14295.30       01       920211
0104RLT190870510.71 003 2 3 CAEL   12 08295.30       01       920211
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0104RLT190870510.71 003 2 2 BRJA   13 11295.30       00       920211
0104RLT190870510.71 003 2 2 FEOC   13 10295.30       00       920211
0104RLT190870510.71 003 2 4 PLPO   13 12295.30       00       920211
0104RLT190870510.71 003 2 6 OPFR   02 01295.30       26       650211
0104RLT190870510.71 003 2 6 OPFR   20 02295.30       11       920211
0104RLT190870510.71 003 2 6 SPCO   12 09295.30       00       920211
0104RLT190870510.71 003 2   FMUL        295.30                920221
0104RLT190870510.71 003 2   HMUL        295.30       06       920221
0104RLT190870510.71 003 2   SOIL        295.30       02       920221
0104RLT190870510.71 003 2   DCAS        295.30       04       920221
0104RLT190870510.71 003 2   LCAS        295.30       05       920221
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0104RLT190870510.71 004 2 1 BUDA  19 03128.50       20        920211
0104RLT190870510.71 004 2 1 BOGR  10 04128.50       08        920211
0104RLT190870510.71 004 2 1 BOGR  17 06128.50       01        920211
0104RLT190870510.71 004 2 1 BOGR  19 07128.50       01        920211
0104RLT190870510.71 004 2 3 CAEL  12 05128.50       01        920211
0104RLT190870510.71 004 2 3 CAEL  19 09128.50       01        920211
0104RLT190870510.71 004 2 2 BRJA  13 10128.50       00        920211
0104RLT190870510.71 004 2 2 FEOC  13 11128.50       00        920211
0104RLT190870510.71 004 2 6 LOOR  13 12128.50       00        920211
0104RLT190870510.71 004 2   FMUL      128.50                  920221
0104RLT190870510.71 004 2   HMUL      128.50       08         920221
0104RLT190870510.71 004 2   SOIL      128.50       06         920221
0104RLT190870510.71 004 2   DCAS      128.50       06         920221
0104RLT190870510.71 004 2   LCAS      128.50       05         920221
0104RLT190870510.71 004 2   LICH      128.50       00         920221
0104RLT190870510.71 005 2 1 AGSM  12 04155.50       02        920211
0104RLT190870510.71 005 2 6 SPCO  12 07155.50       00        920211
0104RLT190870510.71 005 2 1 BUDA  12 01155.50       18        920211
0104RLT190870510.71 005 2 1 BUDA  17 02155.50       24        920211
0104RLT190870510.71 005 2 1 BUDA  19 03155.50       21        920211
0104RLT190870510.71 005 2 1 BOGR  10 05155.50       07        920211
0104RLT190870510.71 005 2 1 BOGR  17 08155.50       01        920211
0104RLT190870510.71 005 2 1 BOGR  19 09155.50       01        920211
0104RLT190870510.71 005 2 3 CAEL  12 06155.50       02        920211
0104RLT190870510.71 005 2   FMUL      155.50       01         920221
0104RLT190870510.71 005 2   HMUL      155.50       06         920221
0104RLT190870510.71 005 2   SOIL      155.50       02         920221
0104RLT190870510.71 005 2   DCAS      155.50       09         920221
0104RLT190870510.71 005 2   LCAS      155.50       06         920221
0104RLT190870510.71 005 2   LICH      155.50       00         920221
0104RLT190870510.71 006 2 1 AGSM  12 05205.97       02        940211
0104RLT190870510.71 006 2 1 AGSM  19 12205.97       01        940211
0104RLT190870510.71 006 2 2 FEOC  13 11205.97       00        940211
0104RLT190870510.71 006 2 1 BUDA  12 01205.97       17        940211
0104RLT190870510.71 006 2 1 BUDA  17 02205.97       23        940211
0104RLT190870510.71 006 2 1 BUDA  19 03205.97       27        940211
0104RLT190870510.71 006 2 1 BOGR  12 04205.97       05        940211
0104RLT190870510.71 006 2 1 BOGR  17 07205.97       01        940211
0104RLT190870510.71 006 2 1 BOGR  19 08205.97       02        940211
0104RLT190870510.71 006 2 3 CAEL  12 06205.97       02        940211
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0104RLT190870510.71 006 2   HMUL      205.97       08         940221
0104RLT190870510.71 006 2   SOIL      205.97       04         940221
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0104RLT190870510.71 006 2   LCAS      205.97       03         940221
0104RLT190870510.71 006 2   LICH      205.97                  940221
0104RLT190870510.71 007 2 6 SPCO  12 07131.00       00        940211
0104RLT190870510.71 007 2 2 FEOC  13 10131.00       00        940211
0104RLT190870510.71 007 2 4 PLPU  13 09131.00       00        940211
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0104RLT190870510.71 007 2 1 BUDA  17 02131.00       25        940211
0104RLT190870510.71 007 2 1 BUDA  19 03131.00       23        940211
0104RLT190870510.71 007 2 1 BOGR  12 04131.00       07        940211
0104RLT190870510.71 007 2 1 BOGR  17 05131.00       01        940211
0104RLT190870510.71 007 2 1 BOGR  19 08131.00       01        940211
0104RLT190870510.71 007 2 3 CAEL  12 06131.00       02        940211
0104RLT190870510.71 007 2   FMUL      131.00                  940221
0104RLT190870510.71 007 2   HMUL      131.00       08         940221
0104RLT190870510.71 007 2   SOIL      131.00       03         940221
0104RLT190870510.71 007 2   DCAS      131.00       07         940221
```

```
0104RLT190870510.71 007 2    LCAS        131.00      06      940221
0104RLT190870510.71 007 2    LICH        131.00      00      940221
0104RLT190870510.71 008 2 6  SPCO    12 08139.30      0000    940212
0104RLT190870510.71 008 2 4  PLPO    13 10139.30      000000  940212
0104RLT190870510.71 008 2 1  BUDA    12 01139.30      16171818940212
0104RLT190870510.71 008 2 1  BUDA    17 02139.30      22262421940212
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0104RLT190870510.71 008 2 1  BOGR    12 04139.30      07060705940212
0104RLT190870510.71 008 2 1  BOGR    17 05139.30      01010100940212
0104RLT190870510.71 008 2 1  BOGR    19 07139.30      02020201940212
0104RLT190870510.71 008 2 3  CAEL    12 06139.30      020101  940212
0104RLT190870510.71 008 2 3  CAEL    19 09139.30      01010201940212
0104RLT190870510.71 008 2 2  BRJA    13 11139.30      0000  00940212
0104RLT190870510.71 008 2 6  LOOR    13 12139.30      0000    940212
0104RLT190870510.71 008 2    FMUL        139.30        000101940222
0104RLT190870510.71 008 2    HMUL        139.30      09060610940222
0104RLT190870510.71 008 2    SOIL        139.30      03050811940222
0104RLT190870510.71 008 2    DCAS        139.30      07040207940222
0104RLT190870510.71 008 2    LCAS        139.30      05050303940222
0104RLT190870510.71 008 2    LICH        139.30      00000000940222
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0104RLT190870510.71 009 2 6  SPCO    12 04158.30      00      940211
0104RLT190870510.71 009 2 1  BUDA    12 01158.30      14      940211
0104RLT190870510.71 009 2 1  BUDA    17 02158.30      27      940211
0104RLT190870510.71 009 2 1  BUDA    19 05158.30      23      940211
0104RLT190870510.71 009 2 1  BOGR    12 06158.30      07      940211
0104RLT190870510.71 009 2 1  BOGR    17 08158.30      01      940211
0104RLT190870510.71 009 2 1  BOGR    19 11158.30      02      940211
0104RLT190870510.71 009 2 3  CAEL    12 07158.30      02      940211
0104RLT190870510.71 009 2 3  CAEL    19 09158.30      02      940211
0104RLT190870510.71 009 2 2  BRJA    13 10158.30      00      940211
0104RLT190870510.71 009 2 6  VIAM    12 12158.30      00      940211
0104RLT190870510.71 009 2 4  PLPO    13 14158.30      00      940211
0104RLT190870510.71 009 2    FMUL        158.30      01      940221
0104RLT190870510.71 009 2    HMUL        158.30      06      940221
0104RLT190870510.71 009 2    SOIL        158.30      03      940221
0104RLT190870510.71 009 2    DCAS        158.30      04      940221
0104RLT190870510.71 009 2    LCAS        158.30      03      940221
0104RLT190870510.71 009 2    LICH        158.30      00      940221
0104RLT190870510.71 009 2 4  MISC    13  158.30      00      940211
0104RLT190870510.71 009 2 6  OPER    02  158.30      01      650211
0104RLT190870510.71 010 2 1  BUDA    12 01098.60      16      940211
0104RLT190870510.71 010 2 1  BUDA    17 02098.60      28      940211
0104RLT190870510.71 010 2 1  BUDA    19 06098.60      24      940211
0104RLT190870510.71 010 2 1  BOGR    12 03098.60      07      940211
0104RLT190870510.71 010 2 1  BOGR    17 07098.60      01      940211
0104RLT190870510.71 010 2 1  BOGR    19 08098.60      02      940211
0104RLT190870510.71 010 2 3  CAEL    12 04098.60      01      940211
0104RLT190870510.71 010 2 3  CAEL    19 09098.60      02      940211
0104RLT190870510.71 010 2 2  BRJA    13 10098.60      00      940211
0104RLT190870510.71 010 2 6  HEAN    04 05098.60      00      940211
0104RLT190870510.71 010 2 6  PSAR    12 11098.60      00      940211
0104RLT190870510.71 010 2    FMUL        098.60              940221
0104RLT190870510.71 010 2    HMUL        098.60      06      940221
0104RLT190870510.71 010 2    SOIL        098.60      04      940221
0104RLT190870510.71 010 2    DCAS        098.60      06      940221
0104RLT190870510.71 010 2    LCAS        098.60      03      940221
0104RLT190870510.71 010 2    LICH        098.60      00      940221
```

Aboveground Biomass Data - II

Data set A2U0064, previously described, is not in the standard form for Comprehensive Site aboveground biomass data. To get those data in the proper form, each set is run through a series of regression procedures. The resultant output file is structured exactly as the standard Comprehensive Site aboveground biomass data. That is, it looks like it was collected on Form NREL-01. The information content is not the same, however, as what appear to be dry weights by clipping and weighing and regression estimates of the clipped weights. These data constitute data set A2U0004. A copy of Form NREL-01 and an example of the data follow.

IBP

GRASSLAND BIOME

U.S. INTERNATIONAL BIOLOGICAL PROGRAM

FIELD DATA SHEET - ABOVEGROUND BIOMASS

DATA TYPE	SITE	INITIALS	DATE			TREATMENT	REPLICATE	PLOT SIZE	QUADRAT	CLIP-RANK	GROWTH FM.	GENUS	SPECIES	SUBSPECIES	PHENOLOGY	RANK	SACK NO.	DRY WT.	SPECIAL	DRY WT. SP.
			Day	Mo	Yr															
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	36-37	39-40	42-45	47-52	54-57	59-64

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

SITE
- 01 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
- 7
- 8
- 9

PHENOLOGY
- 01 Germinated or sprouted
- 02 Early vegetation
- 03 Prebud
- 04 Bud stage
- 05 Early bloom
- 06 Mid-bloom
- 07 Full bloom
- 08 Late bloom
- 09 Milk stage
- 10 Dough stage
- 11 Ripe seed
- 12 Past ripe
- 13 Stem cured
- 14 Vegetative regrowth
- 15 Regrowth flowering
- 16 Regrowth ripe seed
- 17 Standing dead
- 18 Winter dormant

CLIP RANK
- 1 Harvested
- 2 Harvested and ranked
- 3 Ranked

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         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

104RLT20 870510.71
104RLT20 870510.71 001 2 1 BOGR   10 04        5.16
104RLT20 870510.71 001 2 1 BOGR   17 06        1.41
104RLT20 870510.71 001 2 1 BOGR   19 08        2.11
104RLT20 870510.71 001 2 2 BRJA   13 07        0.00
104RLT20 870510.71 001 2 1 BUDA   12 01       11.95
104RLT20 870510.71 001 2 1 BUDA   17 02       39.25
104RLT20 870510.71 001 2 1 BUDA   19 03       30.61
104RLT20 870510.71 001 2 3 CAEL   12 05        1.41
104RLT20 870510.71 001 2 3 CAEL   19 09        1.41
104RLT20 870510.71 001 2 2 FEOC   13 10         .00
104RLT20 870510.71 001 2 4 MISC   13 11         .00
104RLT20 870510.71 002 2 1 AGSM   12 10        1.90
104RLT20 870510.71 002 2 1 BOGR   10 04        4.44
104RLT20 870510.71 002 2 1 BOGR   17 06        1.04
104RLT20 870510.71 002 2 1 BOGR   19 05         .52
104RLT20 870510.71 002 2 2 BRJA   13 08        0.00
104RLT20 870510.71 002 2 1 BUDA   12 01       14.32
104RLT20 870510.71 002 2 1 BUDA   17 03       28.95
104RLT20 870510.71 002 2 1 BUDA   19 02       22.57
104RLT20 870510.71 002 2 3 CAEL   12 07        2.07
104RLT20 870510.71 002 2 3 CAEL   19 11         .52
104RLT20 870510.71 002 2 2 FEOC   13 09         .00
104RLT20 870510.71 003 2 1 AGSM   12 05        4.99
104RLT20 870510.71 003 2 1 AGSM   19 16        0.00
104RLT20 870510.71 003 2 1 BOGR   10 04        8.32
104RLT20 870510.71 003 2 1 BOGR   17 07        0.00
104RLT20 870510.71 003 2 1 BOGR   19 14        1.36
104RLT20 870510.71 003 2 2 BRJA   13 11        0.00
104RLT20 870510.71 003 2 1 BUDA   12 03       20.21
104RLT20 870510.71 003 2 1 BUDA   17 06       42.14
104RLT20 870510.71 003 2 1 BUDA   19 13       32.04
104RLT20 870510.71 003 2 3 CAEL   12 08        2.72
104RLT20 870510.71 003 2 3 CAEL   19 15        1.36
104RLT20 870510.71 003 2 2 FEOC   13 10         .00
104RLT20 870510.71 003 2 6 OPFR    2 01       30.55
104RLT20 870510.71 003 2 6 OPFR   20 02       18.30
104RLT20 870510.71 003 2 4 PLPU   13 12        0.00
104RLT20 870510.71 003 2 6 SPCO   12 09        0.00
104RLT20 870510.71 004 2 1 BOGR   10 04        5.79
104RLT20 870510.71 004 2 1 BOGR   17 06        1.18
104RLT20 870510.71 004 2 1 BOGR   19 07         .59
104RLT20 870510.71 004 2 2 BRJA   13 10        0.00
104RLT20 870510.71 004 2 1 BUDA   12 01       27.63
104RLT20 870510.71 004 2 1 BUDA   17 02       25.67
104RLT20 870510.71 004 2 1 BUDA   19 03       21.45
104RLT20 870510.71 004 2 3 CAEL   12 05        1.18
104RLT20 870510.71 004 2 3 CAEL   19 09         .59
104RLT20 870510.71 004 2 2 FEOC   13 11         .00
104RLT20 870510.71 004 2 6 LOOR   13 12        0.00
104RLT20 870510.71 004 2 6 SPCO   12 08        0.00
104RLT20 870510.71 005 2 1 AGSM   12 04        1.75
104RLT20 870510.71 005 2 1 BOGR   10 05        6.13
104RLT20 870510.71 005 2 1 BOGR   17 08        1.43
104RLT20 870510.71 005 2 1 BOGR   19 09         .72
```

```
104RLT20 870510.71 005 2 1 BUDA   12 01    27.36
104RLT20 870510.71 005 2 1 BUDA   17 02    35.50
104RLT20 870510.71 005 2 1 BUDA   19 03    27.25
104RLT20 870510.71 005 2 3 CAEL   12 06     2.86
104RLT20 870510.71 005 2 6 SPCO   12 07     0.00
104RLT20 870510.71 006 2 1 AGSM   12 05     2.37
104RLT20 870510.71 006 2 1 AGSM   19 12      .97
104RLT20 870510.71 006 2 1 BOGR   12 04     5.93
104RLT20 870510.71 006 2 1 BOGR   17 07     1.94
104RLT20 870510.71 006 2 1 BOGR   19 08     1.94
104RLT20 870510.71 006 2 2 BRJA   13 09     0.00
104RLT20 870510.71 006 2 1 BUDA   12 01    34.97
104RLT20 870510.71 006 2 1 BUDA   17 02    46.05
104RLT20 870510.71 006 2 1 BUDA   19 03    47.42
104RLT20 870510.71 006 2 3 CAEL   12 06     3.87
104RLT20 870510.71 006 2 3 CAEL   19 10      .97
104RLT20 870510.71 006 2 2 FEOC   13 11      .00
104RLT20 870510.71 007 2 1 BOGR   12 04     5.28
104RLT20 870510.71 007 2 1 BOGR   17 05     1.23
104RLT20 870510.71 007 2 1 BOGR   19 08      .62
104RLT20 870510.71 007 2 1 BUDA   12 01    22.24
104RLT20 870510.71 007 2 1 BUDA   17 02    31.83
104RLT20 870510.71 007 2 1 BUDA   19 03    25.69
104RLT20 870510.71 007 2 3 CAEL   12 06     2.46
104RLT20 870510.71 007 2 2 FEOC   13 10      .00
104RLT20 870510.71 007 2 4 PLPU   13 09     0.00
104RLT20 870510.71 007 2 6 SPCO   12 07     0.00
104RLT20 870510.71 008 2 1 BOGR   12 04     5.61
104RLT20 870510.71 008 2 1 BOGR   17 05     1.31
104RLT20 870510.71 008 2 1 BOGR   19 07     1.31
104RLT20 870510.71 008 2 2 BRJA   13 11     0.00
104RLT20 870510.71 008 2 1 BUDA   12 01    22.26
104RLT20 870510.71 008 2 1 BUDA   17 02    29.79
104RLT20 870510.71 008 2 1 BUDA   19 03    29.70
104RLT20 870510.71 008 2 3 CAEL   12 06     2.62
104RLT20 870510.71 008 2 3 CAEL   19 09      .65
104RLT20 870510.71 008 2 6 LOOR   13 12     0.00
104RLT20 870510.71 008 2 4 PLPU   13 10     0.00
104RLT20 870510.71 008 2 6 SPCO   12 08     0.00
104RLT20 870510.71 009 2 1 AGSM   12 03     2.73
104RLT20 870510.71 009 2 1 AGSM   19 13      .74
104RLT20 870510.71 009 2 1 BOGR   12 06     6.38
104RLT20 870510.71 009 2 1 BOGR   17 08     1.49
104RLT20 870510.71 009 2 1 BOGR   19 11     1.49
104RLT20 870510.71 009 2 2 BRJA   13 10     0.00
104RLT20 870510.71 009 2 1 BUDA   12 01    22.13
104RLT20 870510.71 009 2 1 BUDA   17 02    41.55
104RLT20 870510.71 009 2 1 BUDA   19 05    31.05
104RLT20 870510.71 009 2 3 CAEL   12 07     2.98
104RLT20 870510.71 009 2 3 CAEL   19 09     1.49
104RLT20 870510.71 009 2 4 MISC   13        .00
104RLT20 870510.71 009 2 6 OPFR    2        .63
104RLT20 870510.71 009 2 4 PLPU   13 14     0.00
104RLT20 870510.71 009 2 6 SPCO   12 04     0.00
104RLT20 870510.71 009 2 6 VIAM   12 12      .00
104RLT20 870510.71 010 2 1 BOGR   12 03     3.97
104RLT20 870510.71 010 2 1 BOGR   17 07      .93
104RLT20 870510.71 010 2 1 BOGR   19 08      .93
104RLT20 870510.71 010 2 2 BRJA   13 10     0.00
104RLT20 870510.71 010 2 1 BUDA   12 01    15.76
104RLT20 870510.71 010 2 1 BUDA   17 02    26.84
104RLT20 870510.71 010 2 1 BUDA   19 06    20.18
104RLT20 870510.71 010 2 3 CAEL   12 04      .93
104RLT20 870510.71 010 2 3 CAEL   19 09      .93
104RLT20 870510.71 010 2 6 HEAN    4 05      .00
104RLT20 870510.71 010 2 6 PSAR   12 11      .00
```

Belowground Biomass Data

Belowground biomass data collected in 1970 at the Cottonwood Site is Grassland Biome data set A2U0024. Data were recorded on Form NREL-03. One exception should be noted. Wash weight is not recorded in Columns 43-47. Instead, a single digit in Column 47 indicates the plant part being sampled (1 = Belowground plant crown, 2 = Rhizome, 3 = Root). A copy of Form NREL-03 and an example of the data follow.

IBP

GRASSLAND BIOME

U.S. INTERNATIONAL BIOLOGICAL PROGRAM

FIELD DATA SHEET - BELOWGROUND BIOMASS

DATA TYPE	SITE	INITIALS	DATE			TREATMENT	REPLICATE	PLOT SIZE	QUADRAT	CORE DIAM.	HORIZON	TOP DEPTH	BOTTOM DEP.	LENGTH	WASH WT.	DRY WT.	ASH WT.	CROWN DRY WT.
			Day	Mo	Yr													
1-2	3-4	5-7	8-9	10-11	12-13	14	15	16-19	21-23	25-27	29	31-33	35-37	39-41	43-47	49-54	56-61	63-68

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

SITE
- 01 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
- 7
- 8
- 9

HORIZON
- 1 AO
- 2 A
- 3 B
- 4 C

*** EXAMPLE OF DATA ***

```
         1         2         3         4         5         6         7         8
12345678901234567890123456789012345678901234567890123456789012345678901234567890

0304    08057011      001 6.5   000 005 005     1
                      001 6.5   000 005 005     2
                      001 6.5   000 005 005     3 008.03 007.61
                      001 6.5   005 010 005     2 007.30 007.28
                      001 6.5   005 010 005     3 007.89 007.42
                      001 6.5   010 020 010     2
                      001 6.5   010 020 010     3 007.84 007.33
                      001 6.5   020 030 010     3 008.06 007.55
                      001 6.5   030 040 010     3 008.15 007.80
                      001 6.5   040 050 010     3 008.01 007.66
                      001 6.5   050 060 010     3 007.51 007.33
                      002 6.5   000 005 005     1   7.89   7.58
                      002 6.5   000 005 005     2
                      002 6.5   000 005 005     3
                      002 6.5   005 010 005     2
                      002 6.5   005 010 005     3 007.61 007.37
                      002 6.5   010 020 010     2
                      002 6.5   010 020 010     3 007.66 007.37
                      002 6.5   020 030 010     3 008.25 007.91
                      002 6.5   030 040 010     3 007.85 007.70
                      002 6.5   050 060 010     3 008.19 008.04
                      002 6.5   040 050 010     3 007.98 007.65
                      003 6.5   000 005 005     2 007.71 007.56
                      003 6.5   000 005 005     1 008.41 007.75
                      003 6.5   000 005 005     3 008.88 007.86
                      003 6.5   005 010 005     2 007.45 007.43
                      003 6.5   005 010 005     3 008.99 008.20
                      003 6.5   010 020 010     2 007.34 007.31
                      003 6.5   010 020 010     3 009.46 008.37
                      003 6.5   020 030 010     3 008.14 007.72
                      003 6.5   030 040 010     3 008.17 007.78
                      003 6.5   040 050 010     3 008.35 007.61
                      003 6.5   050 060 010     3 007.71 007.52
                      004 6.5   000 005 005     1 007.75 007.63
                      004 6.5   000 005 005     2 007.12 007.05
                      004 6.5   000 005 005     3 008.35 007.61
                      004 6.5   005 010 005     2 007.37 007.30
                      004 6.5   005 010 005     3 008.06 007.69
                      004 6.5   010 020 010     2
                      004 6.5   010 020 010     3 009.27 008.45
                      004 6.5   020 030 010     3
                      004 6.5   030 040 010     3
                      004 6.5   040 050 010     3
                      004 6.5   050 060 010     3
                      005 6.5   000 005 005     1 007.73 007.38
                      005 6.5   000 005 005     2 007.52 007.45
                      005 6.5   000 005 005     3 009.26 008.37
                      005 6.5   005 010 005     2 008.08 008.01
                      005 6.5   005 010 005     3 008.31 007.93
                      005 6.5   010 020 010     2
                      005 6.5   010 020 010     3 007.82 007.48
                      005 6.5   020 030 010     3 007.88 007.68
                      005 6.5   030 040 010     3 007.98 007.82
                      005 6.5   040 050 010     3 007.78 007.58
                      005 6.5   050 060 010     3 007.41 007.14
```

		006	6.5	000 005 005	1	008.02	007.50
		006	6.5	000 005 005	2	007.70	007.61
		006	6.5	000 005 005	3	009.83	008.71
		006	6.5	005 010 005	2	008.08	008.00
		006	6.5	005 010 005	3	008.29	007.80
		006	6.5	010 020 010	2		
		006	6.5	010 020 010	3	009.18	008.58
		006	6.5	020 030 010	3		
		006	6.5	030 040 010	3		
		006	6.5	040 050 010	3		
		006	6.5	050 060 010	3		
		007	6.5	000 005 005	1	008.01	007.84
		007	6.5	000 005 005	2	007.01	006.91
		007	6.5	000 005 005	3	010.99	009.97
		007	6.5	005 010 005	2	007.57	007.54
		007	6.5	005 010 005	3	007.59	007.27
		007	6.5	010 020 010	2		
		007	6.5	010 020 010	3	008.01	007.71
		007	6.5	020 030 010	3	007.96	007.71
		007	6.5	030 040 010	3	007.31	007.13
		007	6.5	040 050 010	3	007.50	007.47
		007	6.5	050 060 010	3	007.38	007.31
		008	6.5	000 005 005	1	008.15	007.00
		008	6.5	000 005 005	2	007.61	007.50
		008	6.5	000 005 005	3	008.95	008.06
		008	6.5	005 010 005	2	007.32	007.26
		008	6.5	005 010 005	3	007.88	007.25
		008	6.5	010 020 010	2		
		008	6.5	010 020 010	3	007.78	007.27
		008	6.5	020 030 010	3	008.66	008.23
		008	6.5	030 040 010	3		
		008	6.5	040 050 010	3	008.27	008.03
		008	6.5	050 060 010	3	007.41	007.25
		009	6.5	000 005 005	1	007.67	007.49
		009	6.5	000 005 005	2		
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		009	6.5	005 010 005	2	007.52	007.52
		009	6.5	005 010 005	3		
		009	6.5	010 020 010	2		
		009	6.5	010 020 010	3		
		009	6.5	020 030 010	3		
		009	6.5	030 040 010	3	007.36	007.31
		009	6.5	040 050 010	3		
		009	6.5	050 060 010	3	007.96	007.84
		010	6.5	000 005 005	1	007.39	007.19
		010	6.5	000 005 005	2	007.32	007.28
		010	6.5	000 005 005	3	009.34	008.21
		010	6.5	005 010 005	2		
		010	6.5	005 010 005	3	008.90	008.31
		010	6.5	010 020 010	2		
		010	6.5	010 020 010	3	009.42	008.69
		010	6.5	020 030 010	3	008.41	008.07
		010	6.5	030 040 010	3		
		010	6.5	040 050 010	3	006.80	006.73
		010	6.5	050 060 010	3	007.54	007.47
0304	08057012	001	6.5	000 005 005	1	007.74	007.62
		001	6.5	000 005 005	2	007.46	007.38
		001	6.5	000 005 005	3	009.56	008.51
		001	6.5	005 010 005	2	007.17	007.15
		001	6.5	005 010 005	3	008.23	007.88
		001	6.5	010 020 010	2	008.19	008.19
		001	6.5	010 020 010	3	007.97	007.62
		001	6.5	020 030 010	3	007.78	007.48
		001	6.5	030 040 010	3	007.88	007.65
		001	6.5	040 050 010	3	007.58	007.37
		001	6.5	050 060 010	3	007.83	007.63

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002 6.5   005 010 005    2 007.34 007.31
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005 6.5   000 005 005    2 007.44 007.42
005 6.5   000 005 005    3 008.97 008.07
005 6.5   005 010 005    2 009.11 008.56
005 6.5   005 010 005    3
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006 6.5   050 060 010    3 007.73 007.38
007 6.5   000 005 005    1 008.11 007.55
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007 6.5   005 010 005    2 006.97 006.92
007 6.5   005 010 005    3 008.44 007.88
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007 6.5   020 030 010    3 008.03 007.55
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008	6.5	010	020	010	2	007.51	007.50
008	6.5	010	020	010	3	008.60	007.89
008	6.5	020	030	010	3	007.94	007.32
008	6.5	030	040	010	3	008.06	007.71
008	6.5	040	050	010	3	007.72	007.41
008	6.5	050	060	010	3	007.91	007.67
009	6.5	000	005	005	1	007.41	007.09
009	6.5	000	005	005	2	007.52	007.45
009	6.5	000	005	005	3	010.00	008.97
009	6.5	005	010	005	2	007.40	007.37
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009	6.5	010	020	010	2	007.52	007.51
009	6.5	010	020	010	3	008.73	007.93
009	6.5	020	030	010	3	008.15	007.70
009	6.5	030	040	010	3	008.54	008.19
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009	6.5	050	060	010	3	007.94	007.57
010	6.5	000	005	005	1	008.01	007.91
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010	6.5	005	010	005	2	008.24	008.20
010	6.5	005	010	005	3	008.71	008.22
010	6.5	010	020	010	2		
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010	6.5	050	060	010	3	007.46	007.28