Technical Report No. 200

PRIMARY PRODUCERS, INVERTEBRATES, BIRDS, AND DECOMPOSERS ON THE JORNADA SITE, 1971

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ABSTRACT

Sampling for aboveground biomass of primary producers, invertebrates, birds, and decomposers was continued on the Jornada Site during 1971. Most of the sampling was conducted on the 25-acre permanent ungrazed area and in the temporary 5-acre exclosure on the grazed area.

Because of the drought continuing into the summer, biological activity remained at a low level until late in the summer. Each period of rainfall measurement recorded less than 15 mm of precipitation until August 2 and 6 when about 45 mm fell.

The peak aboveground biomass of standing live was 49.70 g/m^2 on the ungrazed area and 25.84 g/m^2 on the grazed area on September 11, 1971. The recent standing dead declined from the dormant season into the summer when there was very little present on either area. Old standing dead was somewhat variable, but apparently reached a low point during the early part of the summer.

Bird densities were very low during 1971. The average density was 3.9 birds/100 ha as determined by the plot census method. The average biomass of birds was 3.0 g/ha during the breeding season and 18.6 g/ha during the migration season. The Loggerhead Shrike was the most abundant bird during the breeding season followed by the Cactus Wren and the Mockingbird. During the migration season the Lark Bunting was the most abundant bird followed by Brewer's Sparrow and the Loggerhead Shrike.

Decomposer work showed that in these arid grassland soils, decomposition appears to be very closely associated with the amount of water being added to the soil. Substantial amounts of organic carbon were transformed when quantities of precipitation exceeded 25 mm. This so-called decomposition

occurred in a relatively short time (possibly 3 days). This suggests that decomposition in arid environments may be an explosive process and not a slow, protracted activity.

INTRODUCTION

Sampling on the Jornada Site was expanded for the 1971 field season to include birds in addition to the work on the primary producers, invertebrates, and decomposers which was continued from 1970. The basic treatment design is the same as that for the other Comprehensive Network Sites. The treatments are an ungrazed permanent exclosure and a temporary grazed exclosure. There are two replications per treatment. Most of the sampling is done on each replicate for each treatment.

The general objective of the research is to take measurements of the biomass of several compartments of primary producers and consumers on a desert grassland ecosystem and to relate these measurements to abiotic parameters. These basic data will serve to gain a better idea of ecosystem functioning as well as to develop and test predictive models developed for grassland ecosystems.

ABIOTIC PARAMETERS

The 1970 and 1971 precipitation totals were both well below long-term averages for the Jornada Experimental Range. Precipitation for 1971 on the grassland site is shown in Table 1. From January through July there was not enough precipitation to initiate any plant growth. On August 2 nearly 14 mm of precipitation fell, and on August 6 over 31 mm more rain fell. Another substantial storm occurred late in October. These records were taken with a standard weather bureau rain gage.

A standard micro-meteorological unit was installed in the early summer. The unit at the Jornada Site is battery powered. A description of the sensors and the type of data provided by the unit were given in Technical Report No. 85 (French, 1971). The soil water sensors were not installed in 1971.

Table 1. Precipitation records for the Jornada Site during 1971 on a standard weather bureau rain gage.

Date	Amount (mm)
January 7	0.76
April 15	7.87
June 20	8.13
July 22	4.83
July 25	11.99
July 30	10.97
August 2	13.97
August 6	31.24
August 25	3.05
August 29	0.51
September 8	1.02
September 17	8.64
September 18	0.25
September 23	6.63
September 29	3.06
October 19	9.14
October 25	30.99
October 26	10.46
TOTAL	163.51

PRIMARY PRODUCER STUDIES

Methods

The major changes in sampling were in quadrat shape and in the use of the weight-estimate method as a double sampling procedure to obtain better estimates of the biomass of individual species.

Two quadrat sizes were employed during 1971. A 0.5-m^2 quadrat was used for herbaceous species while a 2-m^2 quadrat was used for shrub species, mainly *Yucca elata* and *Gutierrezia sarothrae*. Both quadrats were circular in shape.

For the weight-estimate method, 20 quadrats were clipped and estimated per replication, making 40 per treatment. There were 100 quadrats which were estimated only per replicate or 200 per treatment.

The aboveground standing crop was clipped and estimated by species into the following compartments: standing live, recent dead, and old dead. Standing live included only that portion which grew during the 1971 growing season and was still alive at the time of sampling. Recent dead was produced during 1971 and died or turned brown prior to the time of sampling. After the 1970 growing season was over, all the herbage produced during 1970 was included in the recent dead category. Recent dead from 1970 was included in the old category when new growth started in 1971. Old dead included all standing dead produced before the current sampling season. Litter was collected from the quadrats, but was not separated by species. Litter was defined as detached plant parts lying on the surface of the soil.

Results

The peak standing crop of 49.7 g/m^2 on the ungrazed area and 28.5 g/m^2 on the grazed, occurred on September 11 (Table 2). However, samples

Table 2. Standing crop of live vegetation (g/m^2) on the Jornada Site during 1971.

Date	Ungrazed		Grazed	
	Mean	SD	Mean	SD
January 12	10.2	30.1	0.1	0.4
February 19	a/			
March 24	4.1	19.2	2.6	4.8
May 18				
June 22	37.7	91.4	13.0	27.5
July 13	5.2	17.7	0.3	1.3
August 3	2.7	7.8	7.0	13.2
August 20	16.7	8.5	15.2	25.7
September 11	49.7		25.8	

a/ Where there are no data in the table, the analysis has not yet been completed.

collected later in September and October were not completely analyzed at the time this report was written, and the peak may have occurred later than September 11. The biomass of standing live was consistently higher on the ungrazed area than on the grazed area. Peak biomass in 1971 was less than half that in 1971 for both the ungrazed and grazed areas.

Standing crop of recent dead is shown in Table 3. Starting March 24, there was a steady decline in recent standing dead on the ungrazed area. On the grazed area, the decline was from May 18. These declines probably represent additions to the old dead category as the recent dead material changes color from brown to gray. However, the old dead category does not show increases to account for the decline in recent dead (Table 4). There does appear to be a buildup of old dead late in the summer.

Litter declined from a peak of 120.3 to 36.5 g/m^2 on the ungrazed area and from 57.3 to 6.3 g/m^2 on the grazed area from June 22 to September 11, 1971 (Table 5). These declines may be a result of decomposer activities which were high during this period.

Data for belowground biomass have not been summarized and are not included in this report.

INVERTEBRATE STUDIES

Studies of invertebrates at the Jornada Site have been directed toward the establishment of both consistent and reliable methods of determining aboveground invertebrate populations and biomass. Other objectives of special interest included the examination of the habits of invertebrates encountered and the determination of trophic levels, including specific host-plant relationships.

Table 3. Standing crop of recent dead vegetation (g/m^2) on the Jornada Site during 1971.

Date	Ungrazed		Grazed	
	Mean	SD	Mean	SD
January 12	79.6	109.3	11.5	12.1
February 19	63.5	48.8	37.9	32.6
March 24	156.6	80.8	24.2	9.8
May 18	94.4	96.1	37.4	36.9
June 22	29.3	92.6	1.0	3.4
July 13	3.6	15.9	0.5	1.5
August 8	6.9	12.0	3.2	10.3
August 20[a/]				
September 11	0.1		1.6	

[a/] Data not summarized at this time.

Table 4. Standing crop of old dead vegetation (g/m^2) on the Jornada Site during 1971.

Date	Ungrazed		Grazed	
	Mean	SD	Mean	SD
January 12[a/]				
February 19	56.0		7.0	
March 24	4.1	19.2	18.6	54.8
May 18	28.2		14.0	
June 22	26.7	12.1	0.7	1.5
July 13	38.0	3.6	7.3	
August 3	6.9	12.0	1.6	7.3
August 20	5.0		24.2	
September 11	16.5		17.0	

[a/] Data not summarized at this time.

Table 5. Standing crop of litter (g/m^2) on the Jornada Site in 1971.

Date	Ungrazed		Grazed	
	Mean	SD	Mean	SD
January 12	60.4	99.8	30.3	26.5
February 19	65.6	87.3	20.5	16.1
March 24	70.4	151.9	43.0	56.0
May 18	40.4	154.4	24.8	100.8
June 22	120.3	350.7	57.3	159.0
July 13	41.6	111.4	17.5	19.1
August 3[a/]				
August 20				
September 11	36.5	125.7	6.3	7.4

[a/] Data not summarized at this time.

Methods

Field sampling was conducted as described in Technical Report No. 85 (French, 1971). Sampling was approximately monthly during the dormant season and semimonthly during the latter part of the growing season. The size of the sample was increased from 5 to 10 quick traps per replicate to decrease the variability of the data.

To test the effectiveness of the quick trap and D-vac, other sampling techniques have been used. These consisted of sweep sampling and pitfall trapping. Specimens collected by these methods have been either pinned or preserved in alcohol for further examination.

Results

Because of the mild winters on the Jornada Site, sampling was conducted throughout the year. Table 6 indicates the sampling dates, the number of quick traps sampled, and the status of samples at the present time.

Table 7 shows the very low density and biomass for each sampling date. Comparison of 1970 data (Pieper, Connaughton, and Fitzenrider, 1971) with those from 1971 reveals several differences (Table 8). Both density and biomass were greater on the grazed area than on the ungrazed area in 1970. The peak population density in 1971 was consistently lower than that for 1970.

A catalog of families collected at the Jornada Site is given in Table 9. Although this list includes representatives for 12 invertebrate orders and 33 families, only seven of these families (indicated by an asterisk) can be considered of major importance as indicated by density and biomass.

Additional families which have been collected by other sampling techniques are listed in Table 10. No effort was made to quantify the lists in Table 10

Table 6. Invertebrate samples taken at the Jornada Site, 1971.

Date	Total Sample Area Per Replicate (m)	No. of Replicates Per Treatment	No. of Treatments	Data Submitted	Analysis Returned
January 28	5	2	2	x	x
February 28	5	2	2	x	x
March 28	5	2	2	x	x
April 28	5	2	2	x	x
May 28	5	2	2	x	x
June 26	5	2	2	x	x
July 22	5	2	2	x	x
August 6	5	2	2	x	x
August 25	5	2	2	x	x
September 21	10	2	2	x	
October 14	10	2	2		
November 9	5	2	2		

Table 7. Aboveground invertebrate density (mean number/m^2) and biomass (g/m^2) of all groups collected at the Jornada Site, 1971.

Date	Treatment	Number/m^2	Biomass (g/m^2)	
January 28	Grazed	15.6	.001	
	Ungrazed	10.4	.002	
February 28	Grazed	2.0		all weights unavailable
	Ungrazed	4.4		
March 28	Grazed	12.8		
	Ungrazed	5.6		
April 28	Grazed	8.2		
	Ungrazed	7.8		
May 28	Grazed	2.8		
	Ungrazed	2.8		
June 26	Grazed	1.6		
	Ungrazed	.4		
July 22	Grazed	15.2	.005	
	Ungrazed	9.6	.003	
August 8	Grazed	6.2	.004	
	Ungrazed	8.2	.004	
August 25	Grazed	10.0	.004	
	Ungrazed	9.6	.004	
September 21	Grazed	11.0		not yet processed
	Ungrazed	20.7		

Table 8. Comparison of invertebrate density (number/m^2) and biomass (g/m^2) for selected sampling dates for both 1970 and 1971 at the Jornada Site.

Date	Treatment	Density	Biomass
July 14, 1970	Grazed	26.66	0.00742
	Ungrazed	6.54	0.00286
July 30, 1970	Grazed	80.0	0.01158
	Ungrazed	42.0	0.01475
August 10, 1970	Grazed	51.56	0.01634
	Ungrazed	27.80	0.00681
August 20, 1970	Grazed	43.60	Not
	Ungrazed	25.20	Available
September 1, 1970	Grazed	40.0	Not
	Ungrazed	27.8	Available
July 22, 1971	Grazed	15.2	0.005
	Ungrazed	9.6	0.003
August 8, 1971	Grazed	6.2	0.004
	Ungrazed	8.2	0.004
August 25, 1971	Grazed	10.0	0.004
	Ungrazed	9.6	0.004
September 21, 1971	Grazed	11.0	Not
	Ungrazed	20.7	Processed

Table 9. List of families collected at the Jornada Site from July 22, 1971, through October 14, 1971.

Order	Family	Trophic Level
Collembola	Sminthuridae	Herbivore
	Acrididae	Herbivore
	Tettigoniidae	Herbivore
	Tridactylidae	Herbivore
Homoptera	Cicadellidae*	Herbivore
	Psyllidae	Herbivore
	Aphididae	Herbivore
Hemiptera	Tingidae*	Herbivore
	Nabidae	Predator
	Lygaeidae	Herbivore
Coleoptera	Tenebrionidae*	Herbivore
	Curculionidae*	Herbivore
	Buprestedae	Herbivore
Lepidoptera	Tortricidae	Herbivore
Diptera	Sarcophagidae	Scavenger
	Bombyliidae	Parasite
	Tachinidae	Parasite
	Muscidae	Omnivore
	Phoridae	Omnivore
	Asilidae	Predator
Hymenoptera	Formicidae*	Omnivore
	Braconidae	Parasite
	Vespidae	Herbivore
Thysanoptera	Phloeothripidae	Herbivore
Neuroptera	Myrmeliontidae	Predator
Non-insect Arthropod Orders		
Araneida	Lycosidae*	Predator
	Thomisidae	Predator
	Linyphiidae	Predator
	Salticidae	Predator
Acarina	Caeculidae*	Herbivore
	Tetranychidae	Herbivore
Scolopendromorpha	1	Predator

* Indicates major groups by numbers and biomass.

Table 10. List of families collected on more than one occasion from pitfall traps, light trapping, and sweeping at the Jornada Site from July through October, 1971. This list includes only those families not shown in Table 9.

Order	Family	Trophic Level
Orthoptera	Blattidae	Omnivore
	Gryllidae	Omnivore
Hemiptera	Phymatidae	Predator
	Reduviidae	Predator
	Scutelleridae	Herbivore
Coleoptera	Cerambycidae	Herbivore
	Scarabeidae	Scavenger, Herbivore
	Elateridae	Herbivore
	Ciccindelidae	Predator
	Meloidae	Herbivore
	Chrysomelidae	Herbivore
Diptera	Calliphoridae	Scavenger
Hymenoptera	Pompilidae	Predator
	Mutillidae	Predator, Parasitoid
Isoptera	Termitidae	Scavenger
	Non-insect Arthropod Orders	
Acarina	Trombidiidae	Parasite, Parasitoid
Scorpiones	1	Predator
Solpugida	1	Predator

due to the inherent selectivity of pitfall trapping and sweep net sampling. These data show that there are at least 18 families present on the Jornada Site which are rarely, if ever, collected by traditional sampling.

ORGANIC MATTER DECOMPOSITION IN JORNADA SOILS

Transformations that occur under arid grassland conditions were suspected to proceed very slowly due to lack of moisture. Evaluation of this statement was more elusive than had been anticipated. Objectives of this work included (i) the determination of decomposition rates at selected soil depths and (ii) changes in decomposition rates as influenced by seasonal fluctuations at the Jornada Site.

Methods

Materials utilized for burial included bluestem hay, cellulose filter discs, and black grama leaves. The bluestem hay, supplied by Dr. John O. Harris of Kansas State University, was cut into 10-cm lengths and encased in thin nylon gauze bags. Both stems and leaves were employed, and the contents of each bag weighed approximately 10 g each prior to burial. Some 5-cm Whatman No. 1 filter paper discs were used for the cellulose studies and were similarly enclosed in nylon gauze bags. During April 1971 black grama leaves were collected and placed in nylon gauze bags for burial on April 24, 1971. Each bag containing black grama leaves weighed approximately 3 g prior to burial.

Burial procedures on the Jornada Site differed from those described by Dr. Francis Clark (1970) in his proposal for measuring decomposition at the Pawnee Site. Lifting out a tongue of sod in the Jornada sandy soils was impossible. Therefore, a trench was dug; and the litter or cellulose bags

were placed at the desired depths, generally 0-5, 5-10, 10-20, 20-30, or 30-50 cm. These bags were removed periodically, weighed, and ashed to determine the amount of organic material remaining.

Results

Bluestem burial information was not available at the final report date of 1970. Therefore, the 1970-1971 information is included here. Nylon gauze bags containing leaf and stem segments were buried on June 22, 1970 and were removed on August 11, September 30, and November 10, 1970 (Fig. 1a). Decomposition was basically the same at all depths in the August removal. Bags buried at the 0-5 cm depth exhibited no change between the August and September removal, while bags buried at a depth greater than 5 cm showed continued weight loss at the September removal. Determinations made during the November removal indicated that the bluestem bags buried at the 0-5 and 20-30 cm depths lost organic carbon content, those buried at 5-10 and 10-20 cm depths remained essentially the same, and those buried at the 30-50 cm depth accumulated organic carbon. This latter observation was believed to be an error until the December 1970 removal was evaluated; the bluestem bags at all levels had accumulated organic carbon over the previous determinations (Fig. 1b). During this removal, the organic contents of the bags were carefully examined for insects, and very few were observed. This was a period in which the soil water attained a very low level; and if any soil water was available, it was in the vicinity of the buried litter bags. Little or no change was observed between the December and January removal dates. No measurable decomposition was detected on litter bags removed during February, March, April, and May. Removal of litter bags during the 4 months mentioned

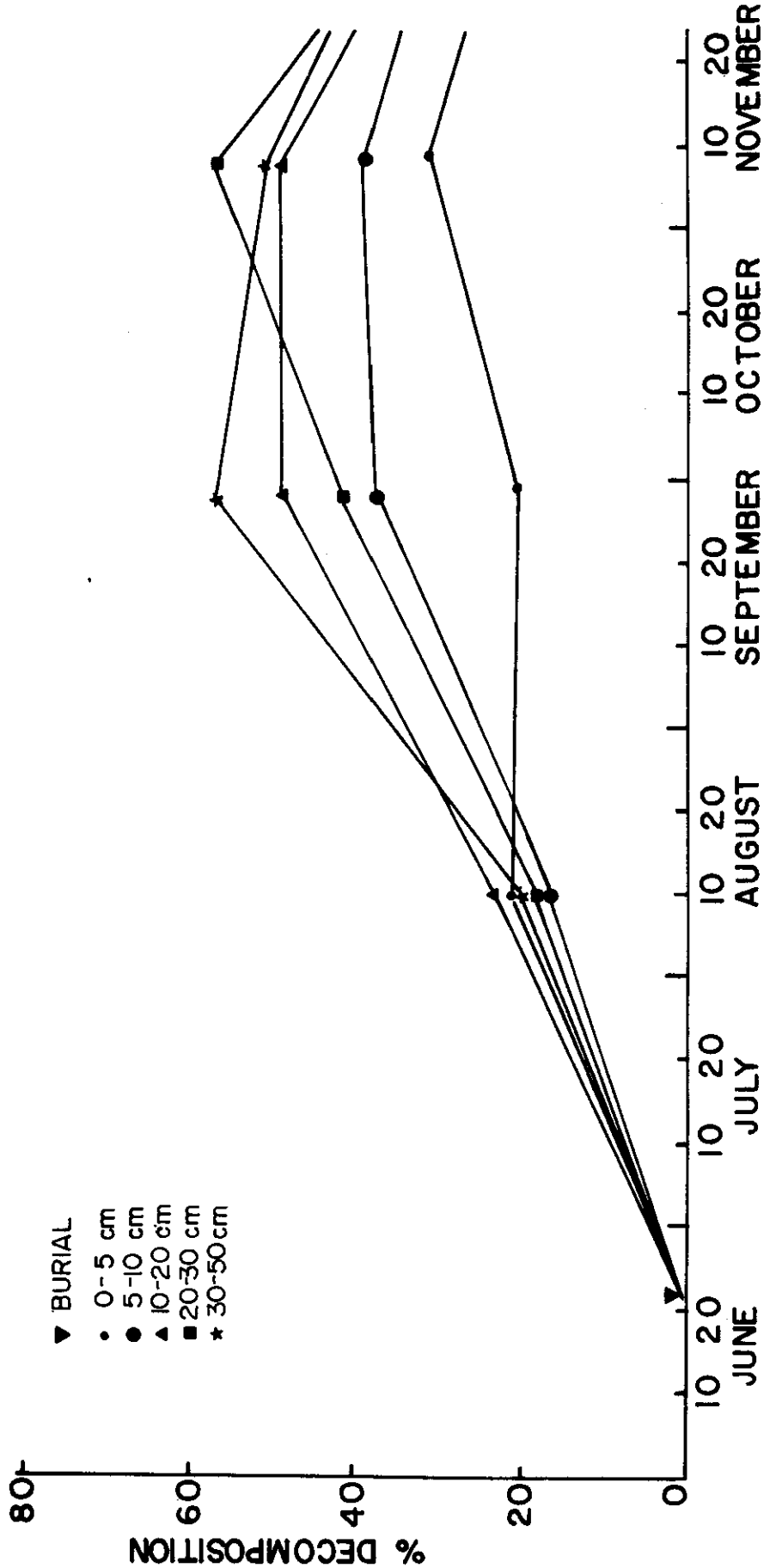

Fig. 1a. Measured decomposition of bluestem hay, 1970.

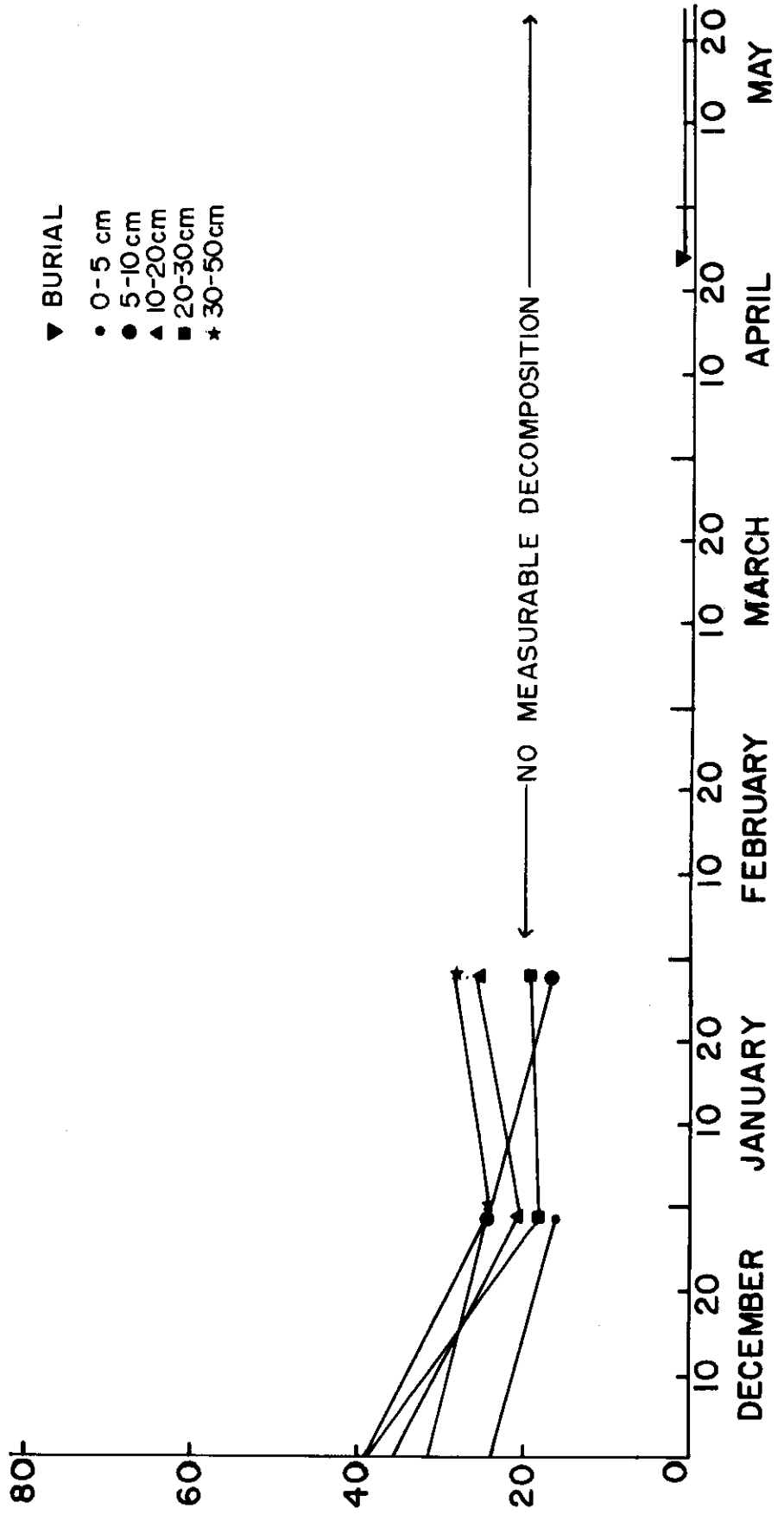

Fig. 1b. Measured decomposition of bluestem hay, 1970-1971.

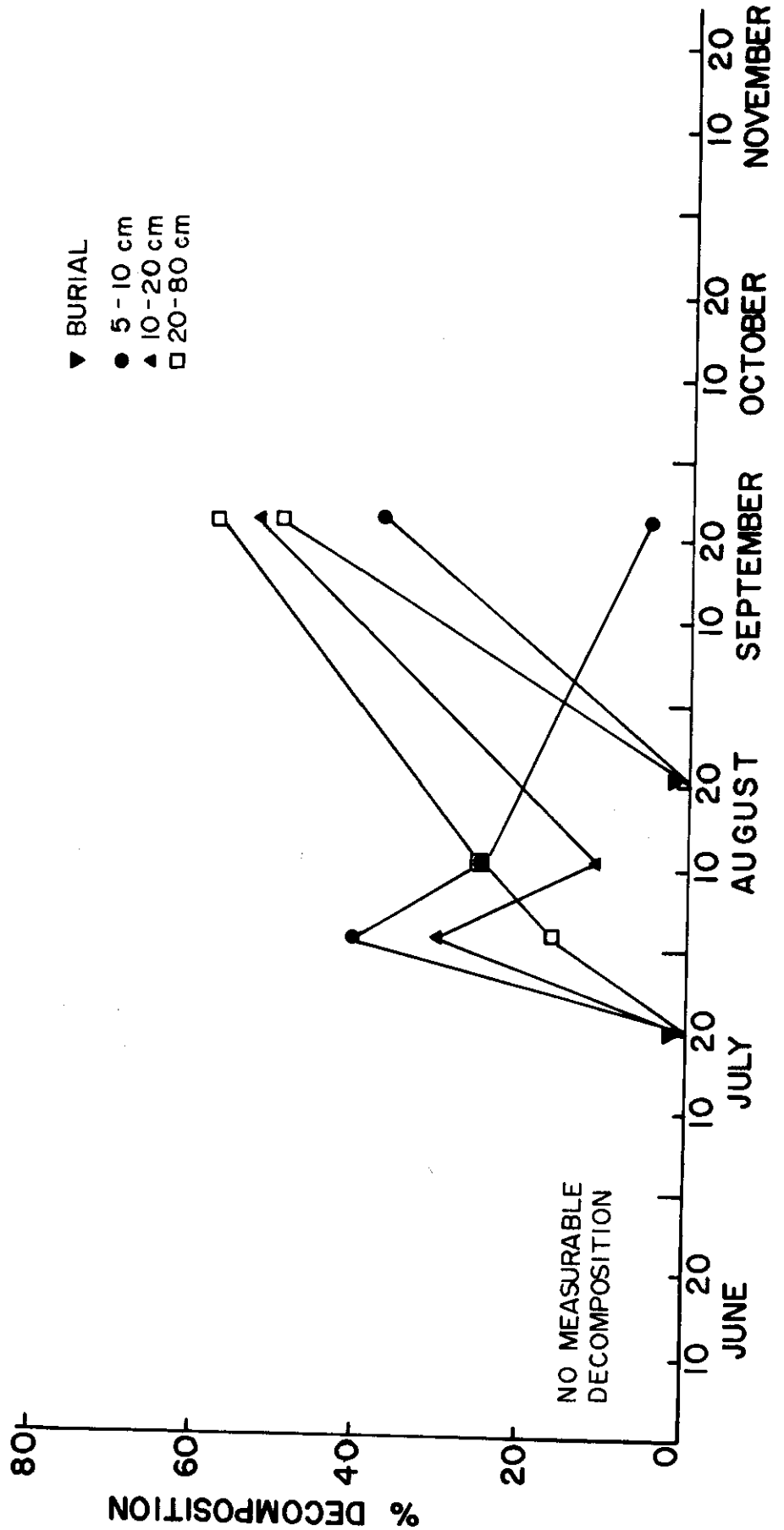

Fig. 1c. Measured decomposition of bluestem hay, 1971.

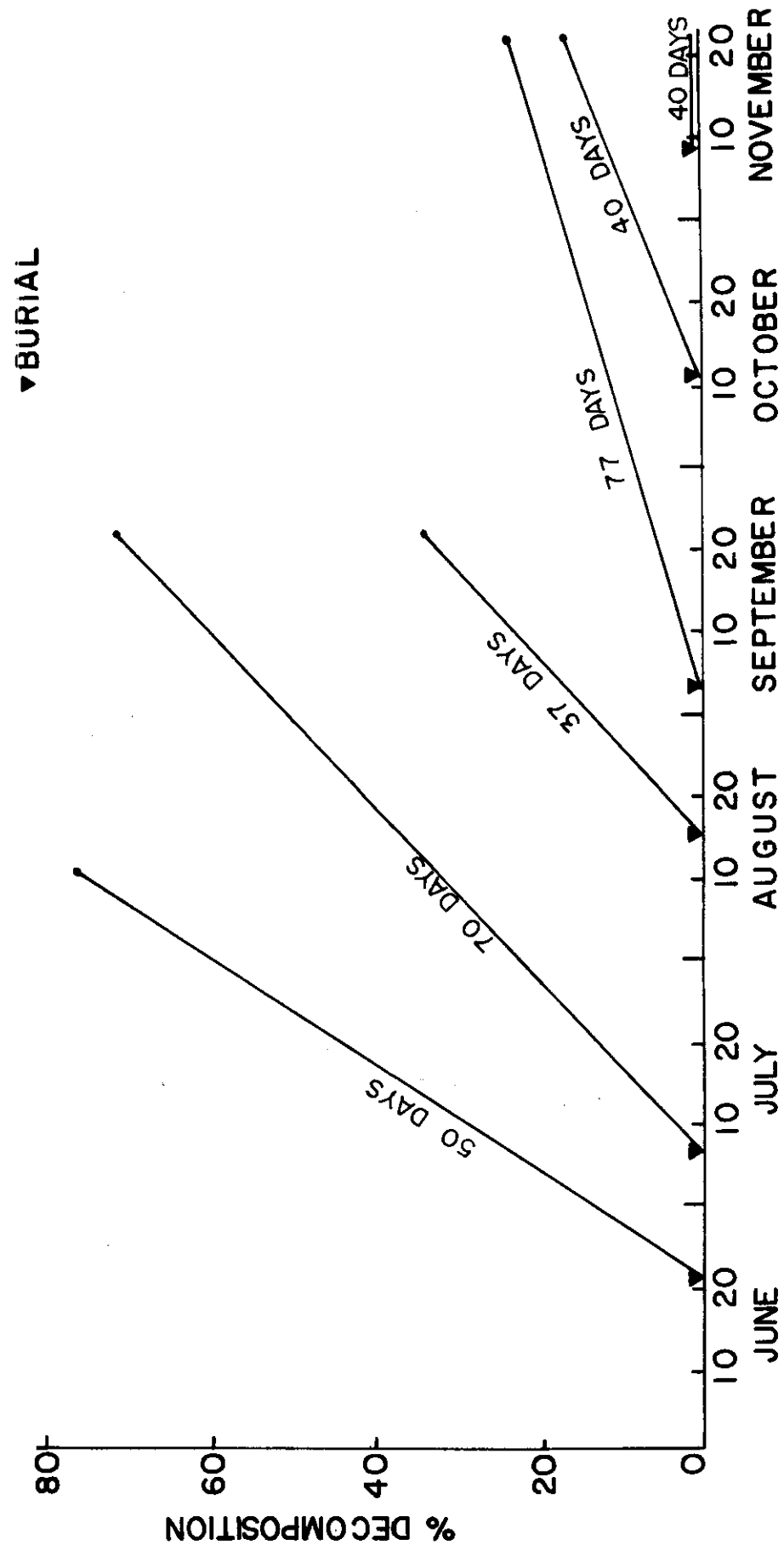

Fig. 2. Rates of filter paper decomposition when buried 5-10 cm in Jornada soil, 1970.

rapidly during June, July, and August than during the later months of the year. No decomposition was recorded for the November and December burials. Without moisture and temperature information these lines and their slopes become very difficult to evaluate. Mention should be made that in 1970, considered a very dry year, rainfall was below normal, yet substantial amounts of the filter paper was decomposed. Filter paper decomposition did show fluctuations which were associated with seasonal changes.

Both bluestem hay and filter paper were buried to maintain standards for the measurement of decomposition throughout the Grassland Biome. Leaves of black grama, a native grass of this area, were also buried (Fig. 3). Samples removed 3 days after the first rainfall showed that almost 80% of the material had been transformed. Some 9 days later there was again indication that organic carbon had accumulated within the material in the litter bags. The soil was drying out, and the available soil water was concentrated around the buried organic materials. Samples removed following the September rainfall showed that almost 90% of the black grama had been decomposed. Reporting this another way, 10% of the organic carbon was detected during this removal period; but one could not recognize this as the original carbon of the leaves or the carbon of the fungal mycelial fragments that could be observed. It appeared that black grama leaves were more susceptible to decomposition than filter paper, and filter paper was more susceptible to decomposition than bluestem leaves and stems. Assuming that decomposition started after the first rain in late July, 90% of the material was decomposed within 55 days. Probably more important is the fact that the majority of the decomposition occurred in the first 3 days. Again the 1971 year was exceptionally dry during the growing season. Decomposition occurred rapidly during short time periods. An interpretation of

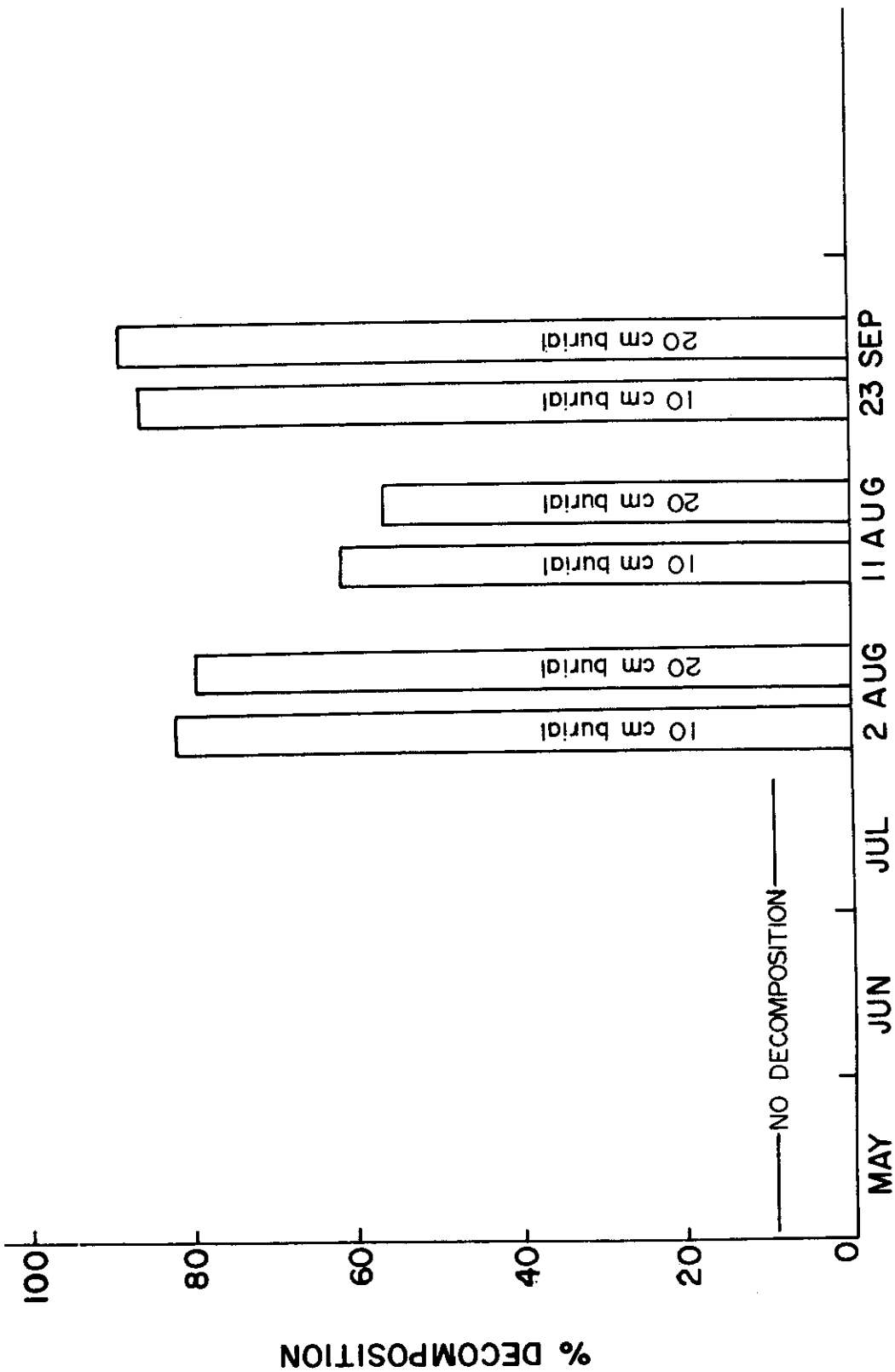

Fig. 3. Decomposition of black grama hay buried in Jornada soil on 24 April 1971.

decomposition in arid grassland conditions is that it is a "go" or "no-go" situation; and when it goes, it is rapid.

If the above is true, it would not conform to our general concept of decomposition. Traditionally a substrate is decomposed to a simple soluble compound such as glucose. This glucose is then respired to gain energy for the organism to assimilate new cell substance. Therefore, measurements of the CO_2 evolved and the increase in cell substance should account for the greatest majority of substrate decomposed. When 30, 40, and 80% of the substrate is transformed within a 3-day period, the above explanation will not account for the quantity of material transformed. Reexamination of what could be occurring in the arid grassland soils initiated the construction of the following flow diagram (Fig. 4). A substrate (black grama) is added to the soil and comes in contact with microbial cells. This contact induces the cells to produce exocellular enzymes. These enzymes react with the substrate and digestion occurs. Thus, the substrate is hydrolyzed to a simple soluble form which can accumulate in the soil in the immediate vicinity or be taken into the microbial cells. Once in the cell, if sufficient nitrogen is available, assimilation and respiration will increase substantially. If insufficient nitrogen is available, the compound could be converted into a microbial metabolic waste product as occurs in the fermentation industry. In the latter case tremendous quantities of substrate could be converted into organic compounds which would be deposited in the soil, but would not be accompanied by extensive CO_2 evolution or immediate and extensive increase in microbial cell substance.

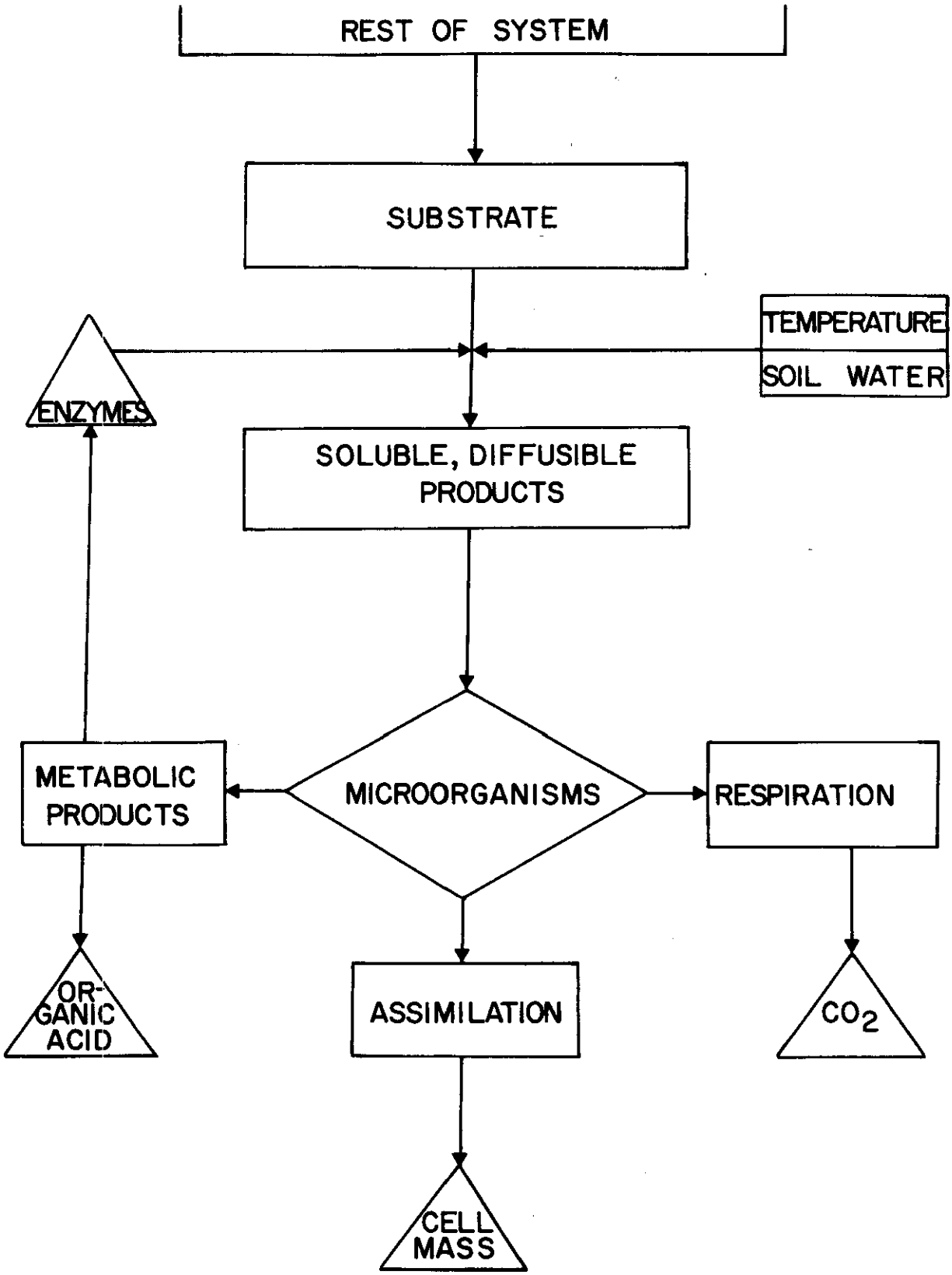

Fig. 4. Possible routes of substrate utilization by microbes.

BIRD INVESTIGATION

Objectives

The primary objective was to determine species composition, numbers, and standing crop biomass of the bird populations at the Jornada Site in at least the breeding season and in winter. Secondarily, we hoped to obtain some information on the diets of the birds.

Locations

The work reported was conducted on the Jornada Experimental Range, New Mexico, for the most part in areas of black grama-yucca community type. The two intensive census grids described are located very near to the grazed and ungrazed exclosures on which the work on vegetation, invertebrates, and decomposers was conducted. The grids were placed so as to include portions of the continuous tract of black grama-yucca on which the exclosures lie.

Methods

Proposed field methods are generally described in Technical Report No. 85 (French, 1971). They include three phases:

1. Breeding birds were to be censused on two 100-acre plots, using the territory-flush method (Wiens, 1971). In addition, we hoped to census breeding birds on these same plots using the standard spot-map method (Kendeigh, 1944) and a new strip-count method (Emlen, 1971) and to census the same plots in winter using the Emlen method.
2. Roadside counts were planned for breeding season, winter, and both migration seasons, following protocol and route established by Wiens (1971) in 1970.

3. Data on diets were to be obtained by collecting a sample of birds for stomach analysis in the breeding season and in winter and by collecting food items brought by parents to nestlings.

The actual procedures followed were modified from the above, in some instances to a considerable degree. The prime factor leading to these modifications was the extremely low density of breeding birds.

Intensive census. Two grids, marked by stakes at 200-ft intervals, were established. Spatial limitations dictated their dimensions; each is 1800 ft × 2400 ft (99.17 acres).

Attempts at actual census began in May and soon revealed that neither the territorial-flush method nor the spot-map method would be practical. Both rely upon enumeration of territories, and the birds were both too sparse and too mobile (either they were not maintaining territories or the territories were extraordinarily large) to make it possible to obtain meaningful results.

We persisted in attempting to obtain data via the Emlen method. It became obvious that this method also is impractical because it relies upon the calculation of a species-season-specific Coefficient of Detectability, based upon repeated sightings of members of each species, and our number of sightings of any given species were too few to provide such a basis.

A partial solution to the dilemma posed by the failure of the proposed census methods was to treat the enumeration data obtained in attempting to carry out the Emlen method as simple total strip counts. Plots had been cruised systematically as if they were a single strip, 800 ft wide and 4800 ft long. Each census effort has followed the same pattern by including at least one such "strip." Visibility was high and numbers were very low, giving us confidence that a very high proportion of birds present on a given plot in a given census period was detected.

Under this rationale, both plots were censused as often as possible since the onset of breeding in May. Numbers and semimonthly distribution of these censuses are indicated in Table 11.

Roadside census. Poor success with plot censusing made it necessary to place greater reliance upon roadside censuses. Accordingly, these were conducted each month, following in all respects the methods used in 1970.

Food habits. Very low densities made impractical the collection of large samples for stomach analysis. On June 18, 1971, we collected for this purpose two of each of the following species: *Tyrannus verticalis*, *Myiarchus cinerascens*, *Lanius ludovicianus*, and *Icterus parisorum*. Additional specimens for this purpose are being collected during the migration season. Analysis of stomach contents has just begun (December 1971).

Few nests were located and failure was frequent, but some data on nesting foods were obtained, as follows.

Species	No. Nests	Total Feedings
TYVE (*Tyrannus verticalis*)	1	4
MYCI (*Myiarchus cinerascens*)	1	2
LALU (*Lanius ludovicianus*)	2	10
CABR (*Campylorhynchus brunneicapillum*)	1	6
TOTALS	5	22

These food items are not yet identified.

Results

Plot censuses. Table 12 gives a comparison of the results on the two census areas. Similarities in the two sets of figures reflect the similarity

Table 11. Semimonthly distribution of censuses for Jornada during 1971.

Census Periods	No. of Censuses	Total Birds Recorded	Max Birds Per Census	Mean Birds Per Census
		Breeding Season		
May 15-31	10	24	5	2.5 (7.0)[a/]
June 1-15	5	6	2	1.2 (3.4)
June 16-30	4	0	0	0
July 1-15	7	5	3	0.7 (2.0)
July 16-31	3	5	3	1.7 (4.8)
TOTAL	29	41	5	1.4 (3.9)
		Migration Season		
August 1-15	1	4	4	4.0 (11.2)
August 16-31	2	19	19	9.5 (26.6)
September 1-15	2	147	110	73.5 (205.8)
September 16-30	0			
October 1-15	8	19	10	2.4 (6.7)
October 16-31	4	35	19	8.8 (24.5)
November 1-15	4	101	39	25.2 (70.7)
TOTAL	21	324	110	15.4 (43.1)

[a/] Figures in parentheses represent equivalents in number of birds/100 ha.

Table 12. Comparison of plots for Jornada during 1971.

Measurements	Upper Plot	Lower Plot	Total
	Breeding Season		
No. of censuses	13	16	29
Total birds	17	24	41
Birds/census	1.3	1.5	1.4
Mean biomass (g/ha)	3.9	1.8	3.0
	Migration Season		
No. of censuses	10	11	21
Total birds	127	198	325
Birds/census	12.7	18.0	15.4
Mean biomass (g/ha)	15.6	21.6	18.6

of the habitats, and in subsequent tables the data from the two plots are combined. Differences between plots probably reflect fairly accurately the sampling error of the method, but the lower plot does seem to be somewhat more favorable as a bird habitat.

Table 13 lists in order of abundance the species recorded in the plot censuses separately by season. Results of Wiens' plot census of May 1970 are included for comparison. Several points are noteworthy: (i) the breeding avifauna of eight species is comparatively rich for a grassland; (ii) the turnover in species composition between seasons is somewhat surprising, considering the low latitude and mild winter climate, but the absence of three breeding species (Scaled Quail, Cactus Wren, Black-throated Sparrow) in the migration season is probably an artifact of sampling; (iii) breeding species were similar in 1970 and 1971; apparent shifts in relative abundance were probably real, reflecting reduced densities and high incidences of breeding failure in 1971 among Mockingbirds and flycatchers.

The most important, quantitative results of the plot censuses are presented in Table 11. Consideration of how best to treat the results of the strip censuses led to the decision that the most meaningful expression would be the mean number of birds per census over several runs. This figure was then converted to an expression of density (birds/100 ha), assuming that all birds present were counted on each run and that negative runs compensate for ones in which wide-ranging birds were counted (i.e., that a bird with a home range of which the plot constitutes a proportion of, say, 0.1, would likely be sighted on one of 10 censuses, thus yielding a realistic density estimate). These assumptions are not made with complete confidence, but the figures obtained seem reasonable and useful. Densities obviously were very low in

Table 13. Species in plot censuses for Jornada during 1971.

Species	No. of Censuses	No. of Individuals	Result of Wiens' Plot Census May 1970 (birds/100 ha)
Breeding Season (May-July)			
Loggerhead Shrike	13	17	2.4
*Cactus Wren	6	6	0.5
*Mockingbird	5	6	9.9
*Ash-throated Flycatcher	3	3	3.8
*Western Kingbird	3	3	1.9
*Black-throated Sparrow	2	3	
*Scaled Quail	1	1	1.0
Swainson's Hawk	1	1	
(Brewer's Sparrow)[a/]	1	1	
TOTAL 9 species	29	41 (3.9/100 ha)	19.4
Migration Season (Aug.-Nov.)			
*Lark Bunting	9	215	
Brewer's Sparrow	10	54	
Loggerhead Shrike	11	18	
*Horned Lark	2	13	
*Sparrow Hawk	6	8	
*Lark Sparrow	4	4	
Swainson's Hawk	3	3	
*Western Meadowlark	1	3	
Cactus Wren	2	2	
*Sage Sparrow	1	2	
*Brown Towhee	1	1	
*White-crowned Sparrow	1	1	
*Burrowing Owl	1	1	
TOTAL 13 species	21	325 (43.4 birds/100 ha)	

* Asterisks indicate species recorded in only one season.

[a/] Brewer's Sparrow, although recorded in the breeding season (June 9), is not a breeding species.

comparison with 1970, and even other sites and errors of high magnitude do not vitiate this conclusion. Furthermore, as will be seen, the results of roadside counts agree quite well with those of the plot censuses.

The most significant result of the censuses is the indication of very low breeding bird density. The mean figure of 3.9 birds/100 ha is to be contrasted with densities of 19.8 and 18.8 on two Jornada plots in 1970 (Wiens, 1971). Densities at other Comprehensive Network Sites in 1970 were even higher, ranging from 108.8 at Bridger to 310.3 on the ungrazed plot at Cottonwood. Even nearby desert scrub habitats support higher densities; in 1964 an area near Las Cruces, dominated by creosote bush, had a breeding bird density of 42 birds/100 ha (Raitt and Maze, 1968).

Poor success of the breeding effort, evident from general observations and from work on the nearby IBP Desert Biome validation site, is confirmed by the semimonthly progression of plot censuses. One would expect that as the breeding season progresses, the density would rise as young are produced. In fact, numbers remained relatively constant from May through July.

The first fall migrants began to arrive in August, and therefore August 1 was chosen as the arbitrary beginning of the migration season. When compared with those of the breeding season, densities were higher but more irregular. Plot censuses will be continued through December to obtain results on winter densities, and it will be interesting to discover whether numbers fall again in winter.

Roadside censuses. Roadside censuses were made on two successive days late in each month, May though October. Results are given in Table 14, along with those from a similar census made in May 1970 (Wiens, 1971). Numbers in the main body of the table are combined counts for each 2-day period.

Table 14. Roadside censuses at Jornada during 1970-1971.

Species	1970	1971					
	May	May	June	July	Aug.	Sept.	Oct.
Turkey Vulture	1						
Swainson's Hawk	4	1	5	3	4	2	2
Ferruginous Hawk							1
Golden Eagle	4	1	1		1	1	
Marsh Hawk							5
Sparrow Hawk						5	4
Scaled Quail	6	2	3	16	3		21
Short-eared Owl	1						
Upland Plover					1		
Mourning Dove	4	2		7	2		
Lesser Nighthawk			2				
Western Kingbird	24	13	14	1	5	2	
Ash-throated Flycatcher	24		5				
Cliff Swallow				2			
White-necked Raven	1	1					
Cactus Wren	2	3	5	3	14	4	4
Mockingbird	51		3	1			
Curve-billed Thrasher	1						
Sage Thrasher						2	
Loggerhead Shrike	34	22	10	7	25	8	16
Eastern Meadowlark							1
Western Meadowlark				1			32
Yellow-headed Blackbird					1		
Scott Oriole	4	2	6				
Brown-headed Cowbird					20		
Dickcissel					1		
House Finch							3
Lark Bunting				3	87	32	429
Lark Sparrow						2	5
Black-throated Sparrow		4	1	2		2	5
Sage Sparrow							66
Brewer's Sparrow				1		25	66
TOTALS	162	51	55	47	164	85	660
No. of species	14	10	11	12	12	11	15
H'	1.90	1.69	2.14	2.06	1.50	1.75	1.32
J(H'/H'max)	0.72	0.73	0.89	0.83	0.58	0.73	0.49
Density[a/]	10	3	3	3	10	5	39
Plot census[a/]	19	6	1	6	116	7	4
Biomass (g/ha)	18.5	4.9	6.9	4.6	9.0	6.9	18.3

[a/] Birds/100 ha.

A comparison of May 1970 and May 1971 reveals a general reduction in 1971 both in numbers and in species. Highly insectivorous species such as the Western Kingbird, Ash-throated Flycatcher, and Mockingbird were most notably reduced.

Seasonal shifts are similar to those found in plot censuses. Among breeding species there is virtually none which shows the expected increase in numbers throughout the breeding season. The counts of Loggerhead Shrike and Cactus Wren for August were elevated above those for July, indicating some success in breeding, but in no other species was this evident.

The influx of migratory species began in July, as mentioned earlier, but the buildup of numbers was gradual. Again, it will be interesting to see whether numbers drop in November or December.

It is interesting that the increase in numbers of birds in late summer was not accompanied by an increase in species diversity. The number of species did not increase until November, and the informational theoretical measure of diversity (H') decreased and remained low (because of low equitability, J).

General parallels between the findings of plot censuses and of roadside counts and an impression that the detectability of birds in this very open habitat is quite high prompted an attempt to convert the roadside count index into an expression of density. A detectability radius of 300 m was used as a reasonable estimate, and the area assumed to have been censused via these counts was calculated on that basis. The resulting figures are shown near the bottom of Table 14, with the comparable figures from the plot censuses (i.e., estimates based on the plot censuses in the semimonthly periods before and after the particular roadside count). The agreement is close and tends to bolster confidence in the census methods.

Wiens (1971) used several ecological categories of birds to analyze his data on the 1970 breeding season censuses of the Comprehensive Network Sites. A graphical analysis of the 1970 and 1971 roadside counts for the Jornada Site is shown in Fig. 5. May 1971 was not dissimilar to May 1970. The higher proportion of raptors in 1971 reflects a marked decrease in roadside-brush birds such as Mockingbirds and thrashers rather than an absolutely greater number of raptors; in other words, raptors failed to decrease as much as other categories, but they did decrease (see Table 14). The principal seasonal trend is one of increasing proportions of small ground birds and of decreasing proportions of air-feeding insectivores. In the fall ground-feeding, largely granivorous, fringillid immigrants dominate in a community that supports ecologically much more diverse bird populations in the breeding season.

Biomass. Data on standing crop biomass were compiled only shortly before this report was written. Results were added to Tables 12 and 14. They seemed to show little more than was deduced from data on numbers. Biomass estimates from 1970 plot censuses were 12.7 g/ha and 4.8 g/ha from the two plots. As with the 1971 plot estimates, these showed less agreement *inter se* than did number estimates (increased error is probably due to sampling error involving large, uncommon raptors), and both years' plot estimates were generally similar to corresponding estimates from roadside counts. Estimates from the breeding season of 1971 were considerably lower than those from 1970 which in turn were lower than those from other sites.

The trend from month to month was similar to that shown by numbers except that the fluctuations were dampened and the autumn increase was lower.

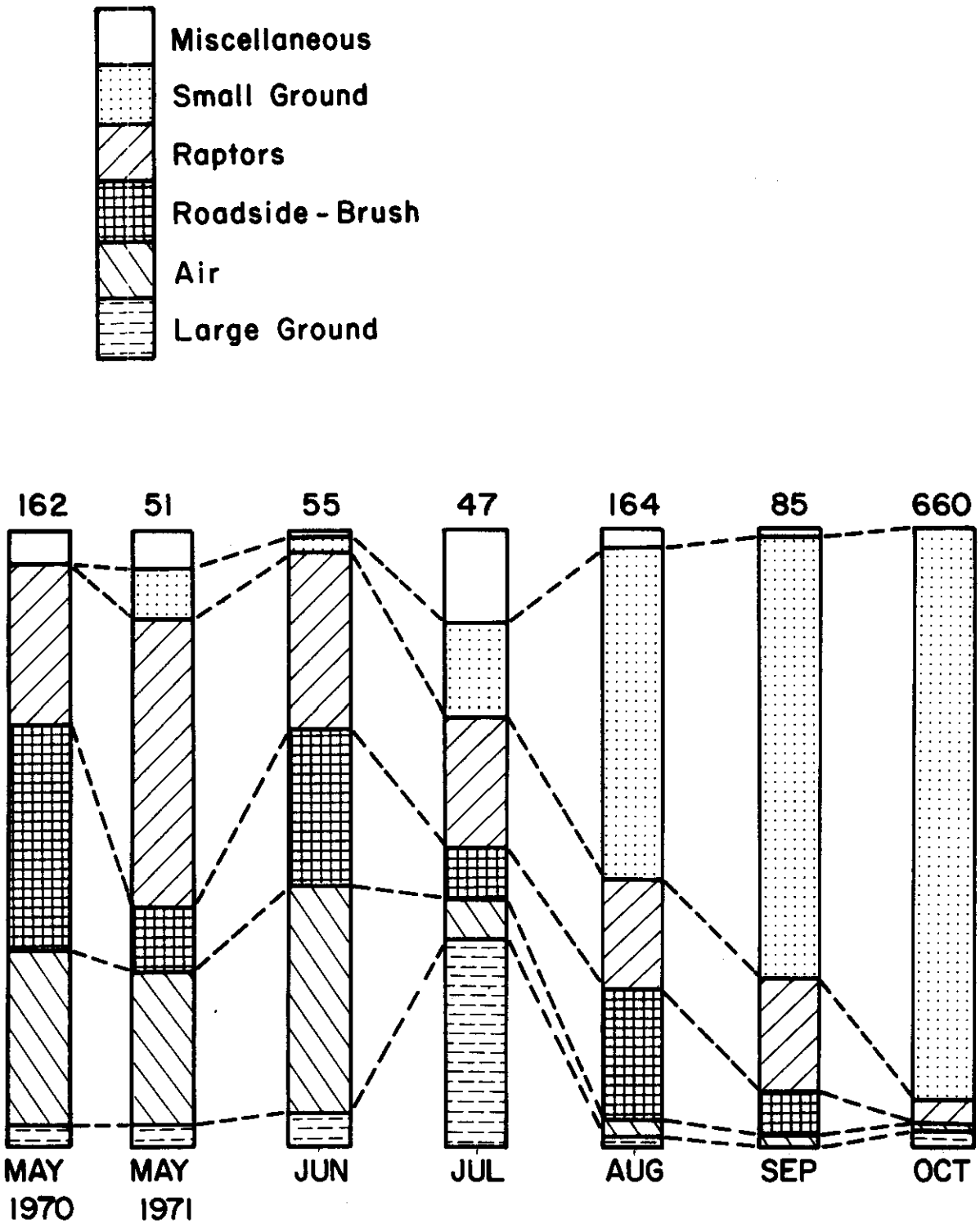

Fig. 5. Roadside counts of birds for Jornada during 1970 and 1971.

Discussion

In spite of the failure of the proposed methods of census, both the compromise method used on the intensive plots and the conversion of roadside counts to actual measures of density gave reasonably satisfactory results because they generally agreed with each other. Comparisons with data obtained by other methods in 1970 showed changes that both agreed with more subjective observations and were expected on the basis of data on weather, plant productivity, and numbers of insects and other animals.

Comparison of 1971 data with those of 1970, from both plot censuses and roadside counts, revealed a striking decrease in breeding bird density. Diversity of the avifauna was also lower in 1971, but the difference was less than with density. A disproportionate share of the decrease was accountable to reduction in numbers of three species that feed on large arthropods: the two flycatchers and the Mockingbird. Other species, including insectivorous ones such as shrikes and Cactus Wrens, also were reduced in numbers but to lesser degrees.

The obvious factor implicated in this reduction was rainfall. Amounts of rainfall have been exceedingly low since 1970, and the winter and spring of 1971 were virtually rainless. Whether the effects of this drought were exerted directly on the birds or indirectly via reduction in food supply or other habitat requirement is difficult to determine. The fact that certain insectivores suffered the greatest reduction suggests control via food reduction, but other factors cannot be ruled out.

Success of breeding was probably also reduced. The expected increase in numbers during the breeding season failed to materialize; very few young were observed, and only 30 young were produced by the 18 nests of which the

outcome was known. Similarly, on the nearby IBP Desert Biome validation site only a few pairs reproduced successfully. Low rainfall, again, was the most likely factor responsible for this low success.

Conclusions as to factors responsible for the general level of density and species diversity and the implications of the nature of the seasonal flux of numbers and species composition are possible, but are better postponed until data are available from all seasons for "normal years."

ACKNOWLEDGMENTS

Ralph J. Raitt, Professor of Biology, was in charge of the work. Donald F. Martin, graduate assistant, carried on much of the field work. Two students employed by the IBP Desert Biome validation project, who participated on a *quid pro quo* basis, were Byron Berger and Steve West.

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APPENDIX I

FIELD DATA

Aboveground Biomass Data

The 1971 Jornada Site aboveground biomass data is Grassland Biome data set number A2U00C8. The data were reported on form NREL-01. A sample data form and a listing of these data for one sampling date 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-EST.	GROWTH FM.	GENUS	SPECIES	SUBSPECIES	CATEGORY	WEIGHT ESTIMATE	SACK NO.	DRY WEIGHT	CROWN PLOT SIZE	CROWN WEIGHT
			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	35	36-40	42-45	47-52	54-57	59-64
01																				

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

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 Grazed 1970, ungrazed 1971
- 7
- 8
- 9

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

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

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

NREL-01 NATURAL RESOURCE ECOLOGY LABORATORY - COLORADO STATE UNIVERSITY— PHONE (303) 491-5571 - FORT COLLINS, COLORADO 80521

*** EXAMPLE OF DATA ***

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0108 JHC13077111   2.  272 3 7 YUEL  2   975
0108 JHC13077111   .5  278 3 1 SPFL  3     3
0108 JHC13077111   2.  278 3
0108 JHC13077111   .5  284 3 1 SPFL  3     3
0108 JHC13077111   .5  284 3 1 CRCO  3   1.5
0108 JHC13077111   2.  284 3
0108 JHC13077111   .5  290 3 1 BOER  3     4
0108 JHC13077111   .5  290 3 1 BOER  2     3
0108 JHC13077111   .5  290 3 1 CRCO  3    .3
0108 JHC13077111   2.  290 3
0108 JHC13077111   .5  296 3 1 SPFL  3    12
0108 JHC13077111   .5  296 3 1 BOER  3    21
^108 JHC13077111   2.  296 3 7 GUSA  3    .2
 108 JHC13077111   .5  302 3 1 ERPU  2    .8
0108 JHC13077111   2.  302 3
```

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0108JHC13077111  .5 308 2 1 ERPU  2    4    25    4.55
0108JHC13077111  .5 308 2 1 SPFL  3   .9    26    0.88
0108JHC13077111  2. 308 2
0108JHC13077111  .5 314 3 1 ERPU  2   .3
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0108JHC13077111  .5 320 3
0108JHC13077111  2. 320 3
0108JHC13077111  .5 326 3 1 ERPU  3   .6
0108JHC13077111  2. 326 3 7 GUSA  3   40
0108JHC13077111  2. 326 3 7 GUSA  2  100
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0108JHC13077111  .5 338 3 1 BOER  3   .2
0108JHC13077111  2. 338 3
0108JHC13077111  .5 344 3 1 BOER  3    3
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0108JHC13077111  2. 344 3 7 GUSA  2  150
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0108JHC13077111  .5 350 3 1 BOER  2    9
0108JHC13077111  .5 350 3 4 SAKA  3  3.5
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0108JHC13077111  .5 362 3 6 CRCO  3   .3
0108JHC13077111  2. 362 3
0108JHC13077111  .5 368 3 1 ERPU  3  2.5
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0108JHC13077111  .5 368 3 1 BOER  2    3
0108JHC13077111  2. 368 3 7 GUSA  3   18
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0108JHC13077111  2. 374 3 7 GUSA  3   45
0108JHC13077111  2. 374 3 7 GUSA  2   55
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0108JHC13077111  .5 380 3 1 ERPU  3  1.5
0108JHC13077111  2. 380 3 7 GUSA  2   85
0108JHC13077111  .5 392 3 1 BOER  3    3
0108JHC13077111  .5 392 3 1 BOER  2    2
0108JHC13077111  .5 392 3 1 ERPU  2   .7
0108JHC13077111  2. 392 3 7 GUSA  2   23
0108JHC13077111  .5 398 3 1 ARLO  3  2.5
0108JHC13077111  .5 398 3 1 ERPU  2   .4
0108JHC13077111  2. 398 3 7 GUSA  2   85
0108JHC13077111  .5 406 3 4 ERAB  3   .7
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0108JHC13077111  2. 406 3
0108JHC13077111  .5 412 3
0108JHC13077111  2. 412 3
0108JHC13077111  .5 418 2 4 SAKA  3    4    29    2.26
0108JHC13077111  2. 418 2 7 GUSA  2  160    30  198.71
0108JHC13077111  .5 424 3
0108JHC13077111  2.       3
0108JHC13077111  .5 430 3 1 ERPU  3    3
0108JHC13077111  2. 430 3 7 GUSA  3    5
```

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0108JHC13077111  .5 436 2 1 ERPU  3   2.5    31    3.14
0108 IHC13077111 2. 436 2 7 GUSA  3    10    32   13.77
0108JHC13077111  2. 436 2 7 GUSA  2    55    33   49.22
0108JHC13077111  .5 442 3 1 ERPU  3    .6
0108JHC13077111  2. 442 3
0108JHC13077111  .5 448 3 6 CRCO  3     5
0108JHC13077111  .5 448 3 4 LIAU  3    .4
0108JHC13077111  2. 448 3
0108JHC13077111  .5 454 3
0108JHC13077111  2. 454 3 7 YUEL  1     9
0108JHC13077111  .5 460 3 1 SPFL  3    .4
0108JHC13077111  2. 460 3 7 GUSA  3   110
0108JHC13077111  2. 460 3 7 YUEL  1   250
0108JHC13077111  2. 460 3 7 YUEL  2   130
0108JHC13077111  .5 466 2 1 ERPU  2   2.5    34    2.01
0108JHC13077111  2. 466 2 7 GUSA  3     5    35    3.16
0108JHC13077111  .5 478 3
0108JHC13077111  2. 478 3 7 GUSA  3    30
0108JHC13077111  .5 482 3 1 BOER  3     5
0108JHC13077111  .5 482 3 1 BOER  2     2
0108JHC13077111  .5 482 3 6 CRCO  3     1
0108JHC13077111  .5 482 3 4 CHIN  3     1
0108JHC13077111  2. 482 3
0108JHC13077111  .5 490 3 1 BOER  2   1.5
0108JHC13077111  2. 490 3
0108JHC13077111  .5 496 2 1 SPFL  2    .4    36    0.15
0108JHC13077111  .5 496 2 4 SAKA  3    .4    37    0.76
0108JHC13077111  2. 496 2 7 GUSA  3     4    38    3.49
0108JHC13077111  .5 502 3 1 BOER  3     5
0108JHC13077111  .5 502 3 1 BOER  2     9
0108JHC13077111  2. 502 3 7 GUSA  3    25
0108JHC13077111  2. 502 3 7 GUSA  2    70
0108JHC13077111  .5 508 3 4 SAKA  3     5
0108JHC13077111  .5 508 3 1 BOER  3    .2
0108 IHC13077111 .5 508 3 4 CHIN  3   1.5
0108JHC13077111  2. 508 3
0108JHC13077111  .5 520 3 1 SPFL  3     4
0108JHC13077111  .5 520 3 4 SAKA  3     5
0108JHC13077111  .5 526 3 6 CRCO  3     6
0108JHC13077111  .5 526 3 4 SAKA  3     2
0108JHC13077111  2. 526 3
0108JHC13077111  .5 532 3 4 CHIN  3     2
0108JHC13077111  2. 532 3
0108JHC13077111  .5 538 3 1 SPFL  3     4
0108JHC13077111  2. 538 3
0108JHC13077111  .5 544 3 6 CRCO  3     6
0108JHC13077111  .5 544 3 4 SAKA  3     4
0108JHC13077111  2. 544 3
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 108JHC13077111  2. 556 3
0108JHC13077111  .5 562 3 6 CRCO  3   1.5
0108JHC13077111  .5 562 3 4 ERAB  3    .4
```

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0108JHC13077111  2. 562 3
0108JHC13077111  .5 568 3 4 SAKA  3     3
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0108JHC13077111  .5 568 3 4 CHIN  3   1.5
0108JHC13077111  2. 568 3 7 YUEL  3   420
0108JHC13077111  2. 568 3 7 YUEL  2   600
0108JHC13077111  .5 574 3 4 SAKA  3     8
0108JHC13077111  .5 574 3 6 CRCO  3    13
0108JHC13077111  2. 574 3
0108JHC13077111  .5 586 2 6 CRCO  3     3   39   2.07
0108JHC13077111  .5 586 2 4 SAKA  3   1.5   40   1.12
0108JHC13077111  2. 586 2 7 YUEL  1   110   41  61.03
0108JHC13077111  2. 586 2 7 YUEL  2   790   42   8.97
0108JHC13077111  .5 592 3
0108JHC13077111  2. 592 3 7 GUSA  3    15
0108JHC13077111  2. 592 3 7 GUSA  2    45
0108JHC13077111  .5 598 3 1 SPFL  2     5
0108JHC13077111  2. 598 3 7 GUSA  3    90
0108JHC13077111  .5 606 3 4 CHIN  3    .3
0108JHC13077111  2. 606 3
0108JHC13077111  .5 612 3 4 LIAU  3    .6
0108JHC13077111  .5 612 3 6 CRCO  3   1.5
0108JHC13077111  2. 612 3
0108JHC13077111  .5 618 3 1 BOER  3    16
0108JHC13077111  .5 618 3 1 SPFL  2    12
0108JHC13077111  2. 618 3 7 YUEL  1    95
0108JHC13077111  2. 618 3 7 YUEL  2   140
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0108JHC13077111  2. 624 2
0108JHC13077111  .5 630 3
0108JHC13077111  2. 630 3 7 GUSA  3    30
0108JHC13077111  2. 630 3 7 GUSA  2    80
0108JHC13077111  .5 636 3 1 ERPU  3     8
0108JHC13077111  2. 636 3
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0108JHC13077111  2. 642 3
0108JHC13077111  .5 648 3 1 BOER  3    32
0108JHC13077111  .5 648 3 1 BOER  2    24
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0108JHC13077111  .5 654 3 1 BOER  3    25
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0108JHC13077111  .5 660 3 1 BOER  2     4
0108JHC13077111  .5 660 3 1 SPFL  2   1.5
0108JHC13077111  .5 666 2 6 CRCO  3     5   45   3.27
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0108JHC13077111  2. 666 2
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0108JHC13077111  2. 672 3
0108JHC13077111  .5 678 3 1 SPFL  3     5
0108JHC13077111  2. 678 3
```

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0108JHC13077111  .5 684 3
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0108JHC13077111  .5 690 3 1 BOER  3    9
0108JHC13077111  .5 690 3 1 BOER  2    7
0108JHC13077111  .5 690 3 1 SPFL  3   .3
0108JHC13077111  .5 690 3 1 ERPU  3   .4
0108JHC13077111  2. 690 3
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0108JHC13077111  .5 696 3 1 BOER  3   .4
0108JHC13077111  2. 696 3
0108JHC13077111  .5 708 3 1 SPFL  3    3
0108JHC13077111  .5 708 3 1 ERPU  2    4
0108JHC13077111  2. 708 3
0108JHC13077111  .5 714 3 1 SPFL  3   28
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0108JHC13077111  2. 714 3 7 GUSA  3   95
0108JHC13077111  .5 720 3 1 BOER  3    8
0108JHC13077111  .5 720 3 7 GUSA  3   15
0108JHC13077111  2. 720 3 7 GUSA  2   32
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0108JHC13077111  2. 726 2 7 GUSA  3  250   48 264.52
0108JHC13077111  .5 732 3
0108JHC13077111  2. 732 3 7 GUSA  3  220
0108JHC13077111  .5 738 3 1 SPFL  3  3.5
0108JHC13077111  2. 738 3 7 GUSA  3    8
0108JHC13077111  .5 744 3 1 ERPU  2   .4
0108JHC13077111  2. 744 3 7 GUSA     12
0108JHC13077111  .5 750 3 1 BOER  3   23
0108JHC13077111  .5 750 3 1 BOER  2   20
0108JHC13077111  .5 750 3 4 SAKA  3   12
0108JHC13077111  2. 750 3
0108JHC13077111  .5 756 3 1 BOER  3   21
0108JHC13077111  .5 756 3 1 BOER  2   25
0108JHC13077111  .5 756 3 4 SAKA  3    6
0108JHC13077111  .5 756 3 4 CHIN  3   .5
0108JHC13077111  .5 762 3 1 SPFL  3  1.5
0108JHC13077111  .5 762 3 1 ERPU  2    5
0108JHC13077111  2. 762 3
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0108JHC13077111  2. 774 2 7 GUSA  3  315   51 478.29
0108JHC13077111  .5 786 3 1 SPFL  3    2
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0108JHC13077111  .5 798 3 4 CHIN  3   .3
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0108JHC13077112  .5  06 3 1 BOER  2    8
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0108JHC13077112 2.  06 3
0108JHC13077112 .5  18 3 1 SPFL  2    4
0108JHC13077112 .5  18 3 1 BOER  3    2
0108JHC13077112 2.  18 3
0108JHC13077112 .5  24 3 1 BOER  3   13
0108JHC13077112 .5  24 3 1 BOER  2    9
0108JHC13077112 .5  24 3 1 SPFL  2  1.5
0108JHC13077112 2.  24 3
0108JHC13077112 .5  30 3 1 BOER  3   30
0108JHC13077112 .5  30 3 1 BOER  2   35
0108JHC13077112 2.  30 3 7 GUSA  2    8
0108JHC13077112 .5  36 2 1 BOER  3   28   55  37.55
0108JHC13077112 .5  36 2 1 BOER  2   29   56  39.50
0108JHC13077112 2.  36 2 7 YUEL  1  150   57 193.15
0108JHC13077112 .5  42 3 1 BOER  3   15
0108JHC13077112 .5  42 3 1 BOER  2   16
0108JHC13077112 2.  42 3
0108JHC13077112 .5  48 3 1 BOER  3   10
0108JHC13077112 .5  48 3 1 BOER  2    8
0108JHC13077112 2.  48 3
0108JHC13077112 .5  54 3 1 BOER  3    3
0108JHC13077112 .5  54 3 1 BOER  2    6
0108JHC13077112 2.  54 3 7 GUSA  3   25
0108JHC13077112 2.  54 3 7 YUEL  1  475
^108JHC13077112 2.  54 3 7 YUEL  2  400
 108JHC13077112 .5  60 2   BOER  2  2.4   58   1.96
0108JHC13077112 .5  60 2   SAKA  3    2   59   1.59
0108JHC13077112 2.  60 2
0108JHC13077112 .5  72 3 1 BOER  2   12
0108JHC13077112 2.  72 3 7 GUSA  3   45
0108JHC13077112 2.  72 3 7 GUSA  2   95
0108JHC13077112 .5  78 2 1 SPFL  2  3.5   60   1.87
0108JHC13077112 2.  78 2
0108JHC13077112 .5  84 3 4 SAKA  3   11
0108JHC13077112 .5  84 3 1 BOER  3    3
0108JHC13077112 2.  84 3 7 YUEL  1  365
0108JHC13077112 2.  84 3 7 YUEL  2  520
0108JHC13077112 .5  90 3 1 BOER  3  4.5
0108JHC13077112 .5  90 3 1 BOER  2    3
0108JHC13077112 .5  90 3 4 ERAB  3   .3
0108JHC13077112 2.  90 3
0108JHC13077112 .5  96 3 6 CRCO  3    3
0108JHC13077112 .5  96 3 4 SAKA  3   .9
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0108JHC13077112 2. 102 3
0108JHC13077112 .5 108 3   BOER  3  3.5
0108JHC13077112 .5 108 3   ERPU  3  2.5
0108JHC13077112 2. 108 3
0108JHC13077112 .5 114 3
0108JHC13077112 2. 114 3 7 GUSA  2  245
 .08JHC13077112 .5 120 2
0108JHC13077112 2. 120 2
0108JHC13077112 .5 126 3 6 CRCO  3   .8
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 108 JHC13077112  2.  126 3
0108 JHC13077112  .5  132 3 1 BOER  3    5
0108 JHC13077112  2.  132 3
0108 JHC13077112  .5  144 3 1 BOER  3    5
0108 JHC13077112  .5  144 3 1 SPFL  3    3
0108 JHC13077112  .5  144 3 1 ERPU  2   .8
0108 JHC13077112  2.  144 3
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0108 JHC13077112  2.  150 3
0108 JHC13077112  .5  156 3 1 SPFL  3    8
0108 JHC13077112  .5  156 3 1 SPFL  2    8
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0108 JHC13077112  .5  168 3 1 BOER  3  3.5
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0108 JHC13077112  .5  180 3 1 BOER  3    6
0108 JHC13077112  .5  180 3 1 BOER  2    8
0108 JHC13077112  .5  180 3 1 SPFL  3  2.5
0108 JHC13077112  2.  180 3
^108 JHC13077112  .5  186 2 1 BOER  3   19   61  22.96
 108 JHC13077112  .5  186 2 1 BOER  2   44   62  40.09
0108 JHC13077112  2.  186 2
0108 JHC13077112  .5  192 3 1 BOER  3    8
0108 JHC13077112  .5  192 3 1 BOER  2    6
0108 JHC13077112  2.  192 3
0108 JHC13077112  .5  198 3
0108 JHC13077112  2.  198 3
0108 JHC13077112  .5  206 3 1 BOER  3    9
0108 JHC13077112  .5  206 3 1 SPFL  3    4
0108 JHC13077112  .5  206 3 4 ERAB  3   .3
0108 JHC13077112  2.  206 3
0108 JHC13077112  .5  212 2 1 SPFL  3  2.5   63   1.74
0108 JHC13077112  .5  212 2 1 ARLO  2    2   64   2.97
0108 JHC13077112  .5  212 2 4 ERAB  3   .9   65   1.49
0108 JHC13077112  .5  212 2 4 CHIN  3   .4   66   0.12
0108 JHC13077112  .5  218 3 1 BOER  3    5
0108 JHC13077112  2.  218 3
0108 JHC13077112  .5  224 3 1 BOER  3  2.5
0108 JHC13077112  .5  224 3 1 BOER  2    4
0108 JHC13077112  2.  224 3
0108 JHC13077112  .5  230 3 1 BOER  2   .2
0108 JHC13077112  .5  230 3 4 ERAB  3    3
0108 JHC13077112  2.  230 3
0108 JHC13077112  .5  236 3 1 BOER  3   .6
0108 JHC13077112  .5  236 3 4 ERAB  3   .3
^108 JHC13077112  2.  236 3
 .08 JHC13077112  .5  242 3 1 BOER  3    6
0108 JHC13077112  .5  242 3 1 BOER  2    9
0108 JHC13077112  2.  242 3
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0108 JHC13077112  .5 248 3 1 BOER  3    8
0108 JHC13077112  .5 248 3 1 BOER  2   12
0108 JHC13077112  .5 248 3 4 SAKA  3    4
0108 JHC13077112  .5 248 3   SPFL  3   .8
0108 JHC13077112  2. 248 3
0108 JHC13077112  .5 254 2 1 BOER  3  2.5   67   1.71
0108 JHC13077112  .5 254 2 1 BOER  2  5.5   68   8.29
0108 JHC13077112  .5 254 2 4 CHIN  3   .4   69   0.42
0108 JHC13077112  .5 260 3 1 SPFL  2  1.5
0108 JHC13077112  .5 260 3 1 BOER  3   .6
0108 JHC13077112  .5 260 3 4 CHIN  3   .5
0108 JHC13077112  2. 260 3
0108 JHC13077112  .5 266 3 1 BOER  3    8
0108 JHC13077112  .5 266 3 1 BOER  2   12
0108 JHC13077112  .5 266 3 4 CHIN  3   .3
0108 JHC13077112  2. 266 3
0108 JHC13077112  .5 272 3 1 BOER  3    7
0108 JHC13077112  .5 272 3 1 BOER  2    7
0108 JHC13077112  .5 272 3 4 SAKA  3    3
0108 JHC13077112  2. 272 3
0108 JHC13077112  .5 278 3 1 BOER  3    6
0108 JHC13077112  .5 278 3 1 BOER  2   13
0108 JHC13077112  .5 278 3 4 SAKA  3    6
0108 JHC13077112  2. 278 3
0108 JHC13077112  .5 290 2 1 BOER  3    2   70   1.60
0108 JHC13077112  .5 290 2 1 SPFL  3  1.5   71   0.42
0108 JHC13077112  2. 290 2
0108 JHC13077112  .5 302 3   BOER  2   16
0108 JHC13077112  2. 302 3
0108 JHC13077112  .5 308 3 1 BOER  3   13
0108 JHC13077112  .5 308 3 1 BOER  2   14
0108 JHC13077112  2. 308 3
0108 JHC13077112  .5 314 2 1 BOER  3   32   72  20.71
0108 JHC13077112  .5 314 2 1 BOER  2   29   73  39.30
0108 JHC13077112  2. 314 2
0108 JHC13077112  .5 320 3 1 BOER  3   16
0108 JHC13077112  .5 320 3 1 BOER  2   21
0108 JHC13077112  2. 320 3
0108 JHC13077112  .5 326 3 1 BOER  3    8
0108 JHC13077112  2. 326 3
0108 JHC13077112  .5 332 3 1 BOER  3    5
0108 JHC13077112  2. 332 3
0108 JHC13077112  .5 338 3 1 SPFL  3   16
0108 JHC13077112  .5 338 3 1 SPFL  2   11
0108 JHC13077112  2. 338 3
0108 JHC13077112  .5 344 3 4 SAKA  3  1.5
0108 JHC13077112  2. 344 3
0108 JHC13077112  .5 350 2 1 SPFL  3    9   74   8.43
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0108 JHC13077112  2. 356 3
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0108 JHC13077112  .5 364 3 7 GUSA  3   35
0108 JHC13077112  2. 364 3
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0108	JHC13077112	.5	398	3	1	BOER	2	11		
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0108	JHC13077112	.5	406	2	1	SPFL	2	4	71A	3.86
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0108	JHC13077112	.5	418	3	1	BOER	2	17		
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0108	JHC13077112	.5	484	3	4	FRAB	3	.2		

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0108 JHC13077112  .5 532 3 4 SAKA  3  2.5
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0108 JHC13077112  .5 574 2 4 CHIN  3   .4   82   0.20
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.08 JHC13077112  2. 606 2
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0108 JHC13077112  2. 642 3
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0108 JHC13077112  .5 660 3 1 BOER  2    8
0108 JHC13077112  .5 660 3 1 SPFL      1.2
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0108 JHC13077112  .5 714 3 4 CHIN  3    3
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0108 JHC13077112  .5 720 3 1 BOER  2    18
0108 JHC13077112  .5 720 3 6 CRCO  3   3.5
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0108 JHC13077112  .5 726 3 4 CHIN  3    .3
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0108 JHC13077112  .5 738 2 6 CRCO  3   1.5   94   1.73
0108 JHC13077112  .5 738 2 4 SAKA  3     2   95   1.06
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0108 JHC13077112  .5 762 3 7 GUSA  3     8
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0108 JHC14077161   2. 072 3 7 GUSA  3   160
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0108 JHC14077161   2. 078 2 7 GUSA  3   230    98 196.77
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0108 JHC14077161   .5 096 3 4 ERAB  3    .3
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0108 JHC14077161   2. 156 3
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0108 JHC14077161   .5 266 3 4 ERAB  3   .3
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0108 JHC14077161  2. 290 3 7 GUSA  3   28
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0108 JHC14077161  2. 302 3
0108 JHC14077161   .5 308 3 1 ERPU  3    5
0108 JHC14077161  2. 308 3
0108 JHC14077161   .5 314 3 1 ERPU  2    2
0108 JHC14077161   .5 314 3 1 SPFL  2   .4
0108 JHC14077161  2. 314 3
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0108 JHC14077161  2. 320 3 7 GUSA  3  1.4
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0108	JHC14077161	2.	338	3	7	GUSA	3	5		
0108	JHC14077161	.5	344	3						
0108	JHC14077161	2.	344	3	7	GUSA	3	15		
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0108	JHC14077161	.5	356	3	1	SPFL	3	4		
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0108	JHC14077161	.5	368	3	7	GUSA	3	8		
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0108	JHC14077161	.5	374	3	4	SAKA	3	1		
0108	JHC14077161	2.	374	3						
0108	JHC14077161	.5	380	2						
0108	JHC14077161	2.	380	2	7	GUSA	3	60	106	83.28
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0108	JHC14077161	.5	412	3	6	CRCO	3	3.5		
0108	JHC14077161	2.	412	3						
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0108	JHC14077161	2.	418	3	7	GUSA	3	35		
0108	JHC14077161	.5	424	3						
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0108	JHC14077161	.5	430	3	1	SPFL	3	19		
0108	JHC14077161	.5	430	3	4	SAKA	3	2		
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0108	JHC14077161	.5	450	3	4	SAKA	3	.5		
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0108	JHC14077162	2.	162	3	7	GUSA	3	40		
0108	JHC14077162	.5	168	3	1	ERPU	3	2		
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0108	JHC14077162	.5	254	3						
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0108	JHC14077162	.5	272	2	7	YUEL	1	250	136	209.77
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0108	JHC14077162	2.	290	3	7	YUEL	3	15		
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0108 JHC14077162  2. 550 3   GUSA  3  100
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0108 JHC14077162  .5 586 3 6 CRCO  3    4
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0108 JHC14077162	2.	642	3						
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0108 JHC14077162	2.	636	3	7	GUSA	3	38		
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0108 JHC14077162	.5	654	3	1	ARLO	3	5		
0108 JHC14077162	.5	654	3	4	SAKA	3	.4		
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0108 JHC14077162	.5	660	3	6	CRCO	3	.4		
0108 JHC14077162	2.	660	3						
0108 JHC14077162	.5	666	2	1	ARLO	3	19	155	22.59
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0108 JHC14077162	.5	690	2	6	CRCO	3	.3	158	0.29
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0108 JHC14077162	.5	696	3	1	ARLO	3	10		
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0108 JHC14077162	.5	702	3	4	SAKA	3	.9		
0108 JHC14077162	.5	702	3	7	GUSA	2	40		
0108 JHC14077162	.5	708	3	1	SPFL	3	6		
0108 JHC14077162	.5	708	3	1	ARLO	3	5		
0108 JHC14077162	.5	708	3	1	BOER	3	2.5		
0108 JHC14077162	2.	708	3	7	GUSA	3	45		
0108 JHC14077162	.5	714	3	1	ARLO	3	8		
0108 JHC14077162	2.	714	3						
0108 JHC14077162	.5	720	3	1	ERPU	2	.2		
0108 JHC14077162	2.	720	3	7	GUSA	3	40		
0108 JHC14077162	.5	726	3	1	ARLO	3	6		
0108 JHC14077162	2.	726	3	7	GUSA	3	30		
0108 JHC14077162	.5	732	3	1	ERPU	2	.5		

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0108JHC14077162  .5 732 3 6 CRCO  3   .8
0108JHC14077162  2. 732 3
0108JHC14077162  .5 738 2 1 SPFL  2    9  159   6.92
0108JHC14077162  .5 738 2 1 BOER  2   11  160  15.27
0108JHC14077162  2. 738 2
0108JHC14077162  .5 744 3
0108JHC14077162  2. 744 3
0108JHC14077162  .5 750 2 1 BOER  3    4  161   3.64
0108JHC14077162  .5 750 2 4 CHIN  3   .5  162   0.15
0108JHC14077162  2. 750 2
0108JHC14077162  .5 756 3 1 BOER  3    7
0108JHC14077162  .5 756 3 1 SPFL  2    2
0108JHC14077162  2. 756 3
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0108JHC14077162  2. 762 3
0108JHC14077162  .5 768 3 1 SPFL  3  2.5
0108JHC14077162  .5 768 3 1 SPFL  2    6
0108JHC14077162  2. 768 3 7 GUSA  3   40
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0108JHC14077162  .5 780 3
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0108JHC14077162  .5 786 3
0108JHC14077162  2. 786 3 7 YUEL  1  350
0108JHC14077162  2. 786 3 7 YUEL  2  800
0108JHC14077162  .5 798 3 1 SPFL  3    3
0108JHC14077162  .5 798 3 1 BOER      2.5
0108JHC14077162  2. 798 3
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Invertebrate Data

Invertebrate data collected on the Jornada Site in 1971 is Grassland Biome data set A2U3008. Data were collected on form NREL-30. A copy of the form and an example of the data are attached.

IBP

GRASSLAND BIOME

U.S. INTERNATIONAL BIOLOGICAL PROGRAM

FIELD DATA SHEET - INVERTEBRATE

D. TYPE	SITE	INITIALS	DATE			TREATMENT	REPLICATE	PLOT SIZE	QUADRAT	TROPHIC	HOST	ORDER	FAMILY	GENUS	SPECIES	SUBSPECIES	LIFE STAGE	TOTAL NO.	DRY WT.	NO. WEIGH
			Day	Mo	Yr															
1-2	3-4	5-7	8-9	10-11	12-13	14	15	16-19	20-21	23	25-29	31-33	35-37	39-40	42-43	45	47-48	50-55	57-62	64-66

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

TROPHIC
- 0 Unknown
- 1 Plant feeding (tissue)
- 2 Plant feeding (sap)
- 3 Plant feeding (pollen and nectar)
- 4 Plant feeding (seed)
- 5 Predator
- 6 Parasitoid
- 7 Parasite
- 8 Scavenger
- 9 Non-feeding stage

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

LIFE STAGE
- 00 Undetermined
- 10 Adult
- 20 Pupae
- 30 Egg
- 40 Nymph or Larva
- 41 Nymph or Larva, early
- 42 Nymph or Larva, middle
- 43 Nymph or Larva, late
- 50 Instar
- 51 Instar, 1st
- 52 Instar, 2nd
- 53 Instar, 3rd

+++ EXAMPLE OF DATA +++

```
         1         2         3         4         5         6         7
1234567890123456789012345678901234567890123456789012345678901234567890123456789

3008MAE210971110.5001          ACARCAEC        10       15 .00122 020
3008MAE210971110.5001  1       HEMITING        40        1
3008MAE210971110.5001          HOMOCIC1        10        2 .00046 002
3008MAE210971110.5001          HOMOCIC1        40        3
3008MAE210971110.5001          THY2PHLO        10        4
3008MAE210971110.5002          ACARCAEC        10        1 .00122 020
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3008MAE210971110.5003          LEPITORT        40        1
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3008MAE210971110.5005          LEPI2           40        1
3008MAE210971110.5006
  JRMAE210971110.5007          COLEBUPR        10        1
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3008MAE210971120.5001          ACARCAEC        10      020 .00185 022
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3008MAE210971120.5001  1       HEMITING        10        1
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3008MAE210971120.5001          COLISMTN        10        1
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3008MAE210971120.5002          ARANLYCO        10        1
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   8MAE210971120.5003  1       HEMITING        10        1
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3008MAE210971120.5003	THY2PHLO	40	4		
3 8MAE210971120.5003	HOMOCIC1	10	3		
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3008MAE210971120.5003	ACARCAEC	10	1	.00185	22
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3008MAE210971120.5007	HOMOCIC1	10	3		
3008MAE210971120.5007	HOMOCIC1	40	1		
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3008MAE210971120.5007	ACARCAEC	10	12	.00185	22
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3008MAE210971120.5008	HOMOCIC1	40	1		
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3 8MAE210971120.5010	HOMOCIC1	10	1		
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3008MAE051071610.5004 1	HEMITING	10	1		
3008MAE051071610.5004	HOMOCIC1	10	1	.00144	7
3008MAE051071610.5005 1	HEMITING	10	1		
3008MAE051071610.5005	ACARCAEC	10	7	.00420	15
3008MAE051071610.5005	HOMOCIC1	10	1	.00144	5
3008MAE051071610.5005	HYMEFORM	10	2	.01143	5
3008MAE051071610.5006	ACARCAEC	10	6	.00420	15
3 3MAE051071610.5006	HOMOCIC1	10	2	.00144	7
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