1974

Curlew Valley Validation Site

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CURLEW VALLEY VALIDATION SITE

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ABSTRACT

Curlew Valley is a 3460 km² drainage basin in northern Utah and southern Idaho. Validation sites are located at the north and south ends of the valley to represent the range of soil and climate conditions typical of the Great Basin northern desert shrub region. At both the north and south validation sites a native shrub community adjoins a crested wheatgrass (*Agropyron desertorum*) community (Balph et al., 1973).

In 1973 several abiotic and biotic measurements were made on the validation sites. Abiotic measurements included air temperatures, relative humidity, wind speeds, precipitation, soil temperatures, soil water potentials, and total incoming solar radiation. Biotic measurements included estimates of above-ground plant biomass and below-ground plant biomass for annuals and perennials, estimates of productivity for some shrubs, estimates of litter standing crops, density and biomass estimates of rodents and lagomorphs, and density and biomass estimates of plant-dwelling and soil-dwelling invertebrates.

On the south site, hourly mean air temperatures at 1.25 m rose evenly from -8 C in January to 20 C in August. Air temperature then fell steadily to 0 C in December. Shaded air temperatures tended to be only 1-2 C cooler than unshaded air temperatures at the same height. Air temperatures at 10 cm above the soil surface were 1-2 C warmer than those at 50-100 cm above the soil surface. Total incoming solar radiation at nearby Snowville, Utah, averaged 544 ly/day in June and 110 ly/day in early December. In the spring at midday, net radiation over bare ground was about 80% of total radiation. In the winter at midday over snow, net radiation was about 35% of total radiation. Precipitation for the 1973 calendar year totaled 273 mm on the south site. January and February snow accounted for 54 mm. Rain during the March-July growing season accounted for 129 mm. Total precipitation in 1973 was greater than normal. About 70% of the total precipitation occurred as snowpack and growing season precipitation available for soil-water recharge and plant growth. Relative humidity at 1.25 m averaged 60% in June and 32% in December. Relative humidity was found to be 1-2% greater at 10 cm than at 50 cm. June wind speeds on the south site averaged 7400 km per week at 2 m and 1200 km per week at .5 m. December wind speeds averaged 5400 km per week at 2 m and 3250 km per week at .5 m. Wind speeds at .5 m averaged about 60% of wind speeds at 2 m. Daytime soil temperatures at 5 cm ranged from 0 C in winter to 32 C in late August. Soil temperatures at 15, 30 and 50 cm ranged from 0-22 C. Soil temperatures were generally 1-3 C cooler under plant canopies than in plant interspaces. Soil water potentials at 15 and 30 cm were generally greater than -15 bars in May and June. Water potentials at these depths ranged between -20 and -40 bars throughout the rest of the summer. During the growing season there was less available water under plant canopies than in the plant interspaces.

The Curlew Valley south validation site was divided into four vegetation types. The ART-ATR-SIT vegetation type is dominated by two shrubs; *Artemisia tridentata* and *Atriplex confertifolia*. Shrub density averaged three per m². Plant cover is about 25 %. Total above-ground biomass in 1973 was estimated to be 5480 kg/ha; below-ground biomass to 60 cm was 23900 kg/ha. Net primary above-ground productivity was estimated to be 2280 kg/ha for these shrubs in 1973. The AGRDES vegetation type is a seeded crested wheatgrass (*A. desertorum*) field. Grass density averages 12 *A. desertorum* per m² with a cover of about 5%. In 1973 above-ground biomass of *A. desertorum* was 2157 kg/ha and below-ground biomass was 32250 kg/ha. Seventy-nine percent of the 1973 above-ground grass biomass was new growth. The two other vegetation types, in which cool desert annuals dominate, are the ANNUALS vegetation type and the HAL-ART vegetation type dominated by *Halogeton glomeratus* and standing dead *Artemisia tridentata*. These two vegetation types were combined and studied by Klikoff and Freeman (US/IBP Desert Biome Res. Memo. 74-15) in 1973. They reported that *Descurainia pinnata* production peaked in early June with a density of 3.6 plants per m² and a combined above- and below-ground biomass of 441 kg/ha. *Bassia hyssopifolia* peaked in mid-August with a density of 1.9 per m² and a total biomass of 5945 kg/ha. *Halogeton glomeratus* peaked in late October. Density was 1.5 per m². Total biomass was 6812 kg/ha. Reproductive parts constituted about two-thirds of total annual biomass at maturity.

Reptile and amphibian populations have never been sampled on the Curlew Valley validation sites because of their relatively low numbers.

Plans to continue periodic bird censuses on the south sites using the Emlen (1971) line transect method failed to materialize. A subjective evaluation of the bird population on the southern site, however, indicates that the patterns of previous years held true in 1973, with horned larks (*Eremophila alpestris*) being the most abundant bird.

A number of horned larks were captured inadvertently during a rodent snap-trapping conducted near the south shrub site. The three vegetation types present on the site were sampled with equal intensity, with 96% of the horned larks captured being collected from the ANNUALS and HAL-ART vegetation types.

The rodent live-trapping program begun in 1971 was continued in 1973. The sampling schedule was intensified on the south shrub site to allow sampling in April, June and August in each of the three vegetation types present. The most common rodent species on the Curlew Valley validation sites are *Peromyscus maniculatus* and *Perognathus parvus*. These two species are found on all four sites. *Eutamias minimus* is common on all sites except the south grass. The periodic sampling on the south shrub site indicated some possible movement of animals, particularly *Peromyscus maniculatus*, into the ANNUALS vegetation type as seeds became available in the late summer.

Estimated densities of these species and the estimated total rodent biomass (air-dry) on each site are as follows: **north shrub** -- *Peromyscus maniculatus*, 4.9/ha; *Perognathus parvus*, 11.1/ha; *Eutamias minimus*, 6.6/ha; estimated total rodent biomass, 136.7 g/ha; **north grass** -- *Peromyscus maniculatus*, 3.2/ha; *Perognathus parvus*, 10.5/ha; *Eutamias minimus*, 3/ha; estimated total rodent biomass, 117.9 g/ha; **south shrub** (ART-ATR-SIT) -- *Peromyscus maniculatus*, 1/ha; *Perognathus parvus*, 14.1/ha; *Eutamias minimus*, 1.6/ha; estimated total rodent biomass, 117.8 g/ha; **south shrub** (ANNUALS) -- *Peromyscus maniculatus*, 5.6/ha; *Perognathus parvus*, 3.4/ha; *Eutamias minimus*, .3/ha; estimated total rodent biomass, 66.7 g/ha; **south shrub** (HAL-ART) -- *Peromyscus maniculatus*, 1.1/ha; *Perognathus parvus*, 1.7/ha; *Eutamias minimus*, 2.2/ha; estimated total rodent biomass, 50.5 g/ha; **south grass** (two samples) -- *Peromyscus maniculatus*, 1.9-5.3/ha; *Perognathus parvus*, 3.8-8.7/ha; estimated total rodent biomass, 51.3-55.7 g/ha.

These figures represent a density increase for *Perognathus parvus* in 1973 on all sites except the north shrub and the HAL-ART vegetation type on the south shrub. *Peromyscus maniculatus* decreased in density in 1973 on all sites except the ANNUALS vegetation type of the south shrub and the northern portion of the south grass site. The populations of *Eutamias minimus* generally declined in 1973. Changes in estimated total rodent biomass on each site in 1973 are as follows: north shrub — 33.3 g/ha; north grass + 9.7 g/ha; south shrub (ART-ATR-SIT) + 11.4 g/ha; south shrub (ANNUALS) + 23.4 g/ha; south shrub (HAL-ART) — 77.3 g/ha; south grass (two samples) — 5.8 g/ha + 25.7 g/ha.

The jackrabbit population (*Lepus californicus*) on the south shrub site was censused by drive count as in past years. The population continued to decline in 1972, with a density of .16/ha and a biomass of .1 kg/ha.

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Category	Assistance in laboratory or field	Authorship in report
Abiotic	R. D. Anderson, M. J. Perlmutter, R. Schwarze, B. Osborne, R. Shinn	R. Shinn
Plants	R. D. Anderson, M. J. Perlmutter, R. Shinn, N. Unhanand, M. Wright-Smith	R. Shinn
Invertebrates	C. Gist, B. Osborn, R. Schwarze, N. Unhanand, P. Sferra, N. Bohart	C. Gist
Vertebrates	R. Anderson, R. Howard, R. Shinn, N. Unhanand	R. Anderson
Data Processing	K. Marshall, A. Olsen, C. Romesburg	

DATA COLLECTION DESIGN

The types of data collected on the four validation sites at Curlew Valley are summarized in Table 1. The procedures used to measure each parameter are described in detail within the appropriate sections that follow.

Table 1. Information matrix of data collection on Curlew Valley Validation Sites, 1973-1974

System Component	Parameters Measured	DSCODE	North Shrub 1973	North Shrub 1974	North Grass 1973	North Grass 1974	South Shrub 1973	South Shrub 1974	South Grass 1973	South Grass 1974	Reported on Page
Meteorological	Weather	BJM2,4									
	Air Temperature					end Sept.			X	X	9,10
	Relative Humidity					end Sept.			X	X	
	Wind Speed (2 meters)					end Sept.			X	X	
	Wind Speed (.5 meters)					end Sept.			X	X	
	Precipitation (recording gauge, rain)					end Sept.			X	X	
	Precipitation (overflow cans, snow)					end Sept.			X	X	
	Soil Surface Temperature					end July			end July	X	
	Soil Temperature (7 depths at weather station)								X	X	
	Evaporation Rate (recording meter)							X			
	Temperature Profile										
	Air Temperature Profile (recording thermographs; several heights; shaded, plant canopy, interspaces, 9 locations)							X			
	Soil Temperature Profile (recording thermo graphs; 4 depths)							X			
Soils	Soil Temperature and Water Potential (thermocouple psychrometers)	BJP5					X	X		X	10
	Two Vegetation Types, shaded and interspace, 4 depths						X				
	Four Vegetation Types, shaded and interspace, 4 depths							X		X	
Vegetation Above Ground	Biomass (off-site)	BJC1-4					X		X		32
	Species						X		X		
	Size ($cm)_2$						X		X		
	Cover (cm^2)						X		X		
	Basal Area (cm^2)						X		X		
	Phenology						X		X		
	Sex						X		X		
	Dry Weight						X		X		
	Biomass Dynamics of Shrub Components	BJS3	X				X	X			33
	Species (ARTTRI and ATRCON)		X				X	X			
	Actual Size (cm)		X				X	X			
	Basal Area (cm^2)		X				X	X			
	Dry Weight Woody Stems (g)		X				X	X			
	Dry Weight Young Stems (g)		X				X	X			
	Dry Weight Leaves (g)		X				X	X			
	Dry Weight Inflorescence (g)		X				X	X			
	Dry Weight Seeds (g)		X				X	X			
	Dry Weight Deadwood (g)		X				X	X			
	Total Dry Weight (g)		X				X	X			
	Estimated Age (yrs) (ARTTRI only)		X				X	X			
	Biomass Dynamics of Grass Components	BJY4							X	X	34
	Species								X	X	
	Dry Weight New Growth								X	X	
	Dry Weight Old Growth								X	X	
	No. Seed Heads								X	X	
Litter	Necromass Dynamics of Litter Components	BJD3-4					X	X	X	X	33
	Dry Weight Wood (g)						X	X	X	X	
	Dry Weight $>$ 2mm (g)						X	X	X	X	
	Dry Weight $<$ 2mm (g)						X	X	X	X	
	Dry Weight Fecal Litter (g)						X	X	X	X	
	Total Dry Weight						X	X	X	X	
Below Ground	Dynamics of Root Biomass	BJE3-4					X	X	X	X	33
	Species						X	X	X	X	
	Type						X	X	X	X	

Table 1. Continued

System Component	Parameters Measured	DSCODE	North Shrub 1973	North Shrub 1974	North Grass 1973	North Grass 1974	South Shrub 1973	South Shrub 1974	South Grass 1973	South Grass 1974	Reported on Page
	Dry Weight 0-20 cm (g)						X	X	X	X	
	Dry Weight 21-40 cm (g)						X	X	X	X	
	Dry Weight 41-60 cm (g)						X	X	X	X	
		MM01					X	X	X	X	34
Nutrient Analysis	For each plant part by species:										
	Calories/g Dry Weight						X	X	X	X	
	Ash Content %						X	X	X	X	
	Ash Free Calories/(g)						X	X	X	X	
	% Protein						X	X	X	X	
	% Carbohydrates						X	X	X	X	
	% Fat						X	X	X	X	
		MM2A,B					X	X	X	X	
Chemical Analysis	For each plant part by species:										
	Phosphorous %						X	X	X	X	
	Potassium %						X	X	X	X	
	Calcium %						X	X	X	X	
	Magnesium %						X	X	X	X	
	Silicon %						X	X	X	X	
	Zinc %						X	X	X	X	
	Copper ppm						X	X	X	X	
	Iron ppm						X	X	X	X	
	Manganese ppm						X	X	X	X	
	Boron ppm						X	X	X	X	
	Aluminum ppm						X	X	X	X	
	Titanium ppm						X	X	X	X	
	Cobalt ppm						X	X	X	X	
	Molybdenum ppm						X	X	X	X	
	Strontium ppm						X	X	X	X	
	Barium ppm						X	X	X	X	
	Lead ppm						X	X	X	X	
	Sodium ppm						X	X	X	X	
	Sodium %						X	X	X	X	
	Plant, Root, and Litter Plot Synthesis	BJC5					X		X		
	Biomass gm/m^2						X		X		
Invertebrates	Biomass - Soil (2500 cc sample, bi-weekly)	BJX1,2,3					X		X		44
	Invertebrate Taxa						X		X		
	Number						X		X		
	Stage						X		X		
	Feeding Type						X		X		
	Dry Weight						X		X		
	Vegetation Species						X		X		
	Soil Surface Temperature, ^{o}C						X		X		
	Air Temperature @10 cm, ^{o}C						X		X		
	Relative Humidity @10 cm						X		X		
	Time of Day						X		X		
	Biomass - Surface (Pit-fall sample, weekly)	BJZ1,2,3					X		X		44
	Invertebrate Taxa						X		X		
	Number						X		X		
	Stage						X		X		
	Feeding Type						X		X		
	Dry Weight						X		X		
	Vegetation Species						X		X		
	Cover %						X		X		
	Biomass - Above Ground (D-Vac sample, bi-weekly)	BJX1,2,3					X		X		44
	Invertebrate Taxa						X		X		
	Number						X		X		
	Stage						X		X		
	Feeding Type						X		X		
	Dry Weight						X		X		
	Vegetation Species						X		X		
	Plant Height						X		X		
	width, 2 heights						X		X		
	length, 2 heights						X		X		
	cover %						X		X		
	Soil Surface Temperature ^{o}C						X		X		
	Air Temperature @ 10 cm, ^{o}C						X		X		
	Relative Humidity @10 cm						X		X		
	Time of Day						X		X		

Table 1. Continued

System Component	Parameters Measured	DSCODE	North Shrub 1973	North Shrub 1974	North Grass 1973	North Grass 1974	South Shrub 1973	South Shrub 1974	South Grass 1973	South Grass 1974	Reported on Page
	Insect Emergence (weekly)	BJX5,6,7					X		X		
	Invertebrate Taxa						X		X		
	Number						X		X		
	Stage						X		X		
	Feeding Type						X		X		
	Dry Weight						X		X		
	Vegetation Species						X		X		
	Height						X		X		
	Cover %						X		X		
	Biomass - Soil (2500 cc							X		X	
	sample, biweekly)							X		X	
	Invertebrate taxa							X		X	
	Number							X		X	
	Stage							X		X	
	Feeding type							X		X	
	Dry weight							X		X	
	Vegetation Species										
	Relative Humidity										
	@ 10 cm							X		X	
	Time of Day							X		X	
	Biomass - Surface										
	(pit-fall traps,										
	3 days per week)							X		X	
	Invertebrate taxa							X		X	
	Number							X		X	
	Stage							X		X	
	Feeding type							X		X	
	Dry weight							X		X	
	Vegetation Species							X		X	
	Time of Day							X		X	
	Biomass - Above Ground										
	(D-Vac sample, weekly)							X		X	
	Invertebrate taxa							X		X	
	Number							X		X	
	Stage							X		X	
	Feeding type							X		X	
	Dry weight							X		X	
	Vegetation Species							X		X	
	Plant height							X		X	
	width @ 2 heights							X		X	
	length @ 2 heights										
	cover %							X		X	
	Phenology										
	Relative Humidity							X		X	
	@ 10 cm							X		X	
	Time of Day										
	Insect Emergence										
	(sampled bi-weekly)							X		X	
	Invertebrate taxa							X		X	
	Number							X		X	
	Stage							X		X	
	Feeding type							X		X	
	Dry weight							X		X	
	Vegetation Species							X		X	
	% cover							X		X	
	Time of Day							X		X	
Vertebrates											
Rodents	Biomass - on site	BJH1-4	X		X		X	X	X	X	49
	Periodic samples (April,										
	June, August)		X		X		X	August only	X	August only	
	Species		X		X		X	X	X	X	
	Sex		X		X		X	X	X	X	
	Age		X		X		X	X	X	X	
	Nipple Condition		X		X		X	X	X	X	
	Vaginal Condition		X		X		X	X	X	X	
	Testical Condition		X		X		X	X	X	X	
	Weight		X		X		X	X	X	X	
	Density		X		X		X	X	X	X	
Lagomorphs	Jackrabbit Biomass	BJI1					X	X			50
	Density (drive count)						X	X			

FINDINGS

A. ABIOTIC

R. Shinn

A.1. Air Temperature

Air temperature has been recorded continuously since August, 1971, on both north and south sites by a recording hygrothermograph located 1.5 m above ground level in a standard weather instrument shelter. Temperatures are entered bihourly in the data bank (DSCODE A3UBJM2, south sites; A3UBJM4, north sites). The computer program "Curlew Valley Temps" is available at the data bank. This reduces the bihourly recorded data and writes out the daily maximum, daily minimum and daily mean temperatures.

Table 1 provides monthly minima, maxima and mean temperatures, and ranges of these values by month, for 1973 on southern sites. Graphic representation of daily minima, maxima and mean are given in Figures 1-3. Corresponding data for the northern sites are presented and illustrated in Table 5 and Figures 50-52.

The south site is in a relatively flat valley bottom which traps cold air in winter and warm air in summer. The north site is on a south-facing slope. The south site has colder winter and higher summer temperatures than the north.

Temperatures in January, February and March are generally sub-freezing and therefore limit biological activities. The spring thaw begins early in April and most biological components of the system become active at this time. April, May and June temperatures are mild and we feel this is the period of most vigorous biological activity. July and August are the hottest months of the year and biological activity may be depressed slightly. Semptember and October have mild temperatures. By November, biological activity has declined in response to cooler temperatures. Sub-zero temperatures are common in December.

Air temperatures at several strata are being recorded hourly in detailed sunrise-to-sunset abiotic samples. These measurements are taken by thermocouples exposed to solar radiation, screened from solar radiation and shaded.

Four three-point thermographs have been purchased and will be installed in March, 1974. Probes will be stratified to record several shaded and unshaded air temperatures.

A.2. Solar Radiation

Total incoming solar radiation has been measured continuously since August, 1971. Readings are taken in Snowville, Utah, approximately equidistant from the north and south sites. Radiation is monitored with a Star Pyrometer in conjunction with a volt-time integrator.

The pyrometer is mounted on a post 2 m above ground level. Integrated values are recorded hourly in millivolts (A3UBJW1). The computer program "Curlew Valley Solar" is available through the data bank. It converts the data into total Langleys per day.

Figure 4 gives integrated values of total incoming solar radiation in Langleys per day for 1973. Data are missing for May.

January through April is a period of generally cloudy, overcast skies. The days of May through September are characteristically bright and sunny. Cloudy conditions are again common in October, November and December.

Net radiation and total incoming radiation are being measured together from sunrise to sunset during the detailed abiotic samples taken monthly.

A.3. Precipitation

Precipitation data has been measured and recorded on the north and south sites since August, 1971. Rainfall events are measured continuously by a weighing, recording rain gauge. Precipitation which falls as snow is captured and held in a 20 cm diameter precipitation can and is weighed weekly. These data are entered in the Curlew meteorological data sets A3UBJM2 and A3UBJM4. Rainfall events, total precipitation and rate of rainfall are tabled by month for 1973 for the southern (Table 2) and northern sites (Table 6). Figures 5 and 53 illustrate weekly precipitation for the two sites for 1973.

Precipitation accumulates in the form of snow during the winter months of November through February. The south site often has a 20 cm snow pack. The north site has more than twice that of the south. During the April thaw the north site experiences considerable run-off. On the south sites the thaw generates 3-5 cm of standing water. This condition lasts 1 or 2 weeks. No run-on or run-off is apparent on the site. Generally several significant rainfall events occur in April and May. June, July and August are the driest months. The probability of getting significant amounts of rain increases in September and October. The north site averages 350 mm total precipitation per year; the south site 300 mm.

A.4. Relative Humidity

Relative humidity is recorded continuously by a hygrothermograph at 150 cm above ground level in a standard weather instrument shelter. In addition, wet bulb

and dry bulb temperature readings are made around mid-day when the weather charts are changed once a week. The hygrothermograph data are maintained under A3UBJM2 and A3UBJM4.

Percent relative humidity is shown on a daily mean basis for 1973 on the southern (Figure 6) and northern sites (Figure 54). The 1-point-per-week, mid-day percent relative humidity values for the south and north sites are shown in Figures 7 and 55.

The hygrothermograph readings are known to be consistently inaccurate. However, they do give an index to changes in relative humidity. The weekly readings provide points with which the hygrothermograph data can be calibrated.

Daily mean relative humidities cycle through the seasons and are generally lower in summer than winter. The daily pattern shows humidity to be high in the early morning becoming lower as the day progresses.

Percent relative humidity is measured by the wet bulb-dry bulb method at 10 cm and 50 cm hourly during the sunrise to sunset detailed monthly abiotic samples.

A.5. Wind

Wind speed has been recorded on the sites since August, 1971. Wind speeds are measured by totalizing anemometers which are read weekly. Data are entered in the data bank in miles of wind passing the anemometer per week (A3UBJM2 and A3UBJM4).

Weekly wind velocities are given in miles per week at 2 m in Figure 8 and at .5 m in Figure 9 for the south site. Figure 56 gives the wind velocities at 2 m for the north site.

Wind velocities are highest in the spring. Velocities decline through the summer and fall and are lowest in the winter.

Wind speed data are recorded hourly at 2 m and .5 m during the detailed abiotic sampling periods.

A.6. Soil Temperatures

Soil surface temperatures were monitored in 1972 on the north and south sites with thermographs. These instruments proved to be unreliable and inaccurate. In 1973 we discontinued using the thermographs in preference for less frequent, but more accurate readings.

Weekly mid-day readings of soil temperatures in the open at 1 cm were made in the *Artemisia-Atriplex-Sitanion* (ART-ATR-SIT), *Halogeton-Artemisia* (HAL)ART) and *Agropyron desertorum* (AGRDES) vegetation types. These data are given in Figures 10, 11 and 12. Thermocouples installed adjacent to the south site weather station were read around mid-day during the weekly changing of the strip charts. The thermocouples were placed in an unshaded location. Temperatures at 7 depths through winter and spring of 1973 are shown in Figures 13 through 19. The instruments do not read sub-zero temperatures. In the spring of 1973, eight sets of thermocouple psychrometers were installed under plant canopies and in plant interspaces in the ANNUALS and HAL-ART vegetation types. Soil temperatures at 5 cm, 15 cm, 30 cm, and 50 cm were read weekly through spring, summer and fall. These are shown in Figures 20 to 27. All readings were made within a 1-hr period. Figure 28 is a summary graph showing the mean temperatures under plant canopies. Figure 29 shows the mean temperatures in the plant interspaces. Combining the under-plant cover and plant interspace values produces Figures 30 and 31 which summarize the mean temperatures by vegetation type. Figure 32 is an overall summary of soil temperatures which combines the values from all locations in both vegetation types.

Soil temperatures at depths of 1-30 cm are sub-freezing in December, January and February. Temperatures at 1 cm during the spring, summer and fall of 1973 ranged from 0-42 C. Temperatures at 5 cm ranged from 0-32 C. Temperatures at 15, 30 and 50 cm ranged from 0-22 C. Temperatures at the above depths were highest in late August. Soil temperatures at 60 cm did not go below freezing in 1973. The minimum soil temperature at 200 cm was 5 C. Mean soil temperatures recorded in plant interspaces and under plant cover among vegetation types rarely differ by more than 3 C. The differences in soil temperatures between vegetation types are equally small.

Soil temperatures at seven depths are monitored hourly during the sunrise-to-sunset monthly abiotic samples.

A.7. Soil Water

Soil water was measured irregularly on the south sites by neutron and gamma probes in 1971 and 1972 (A3UBJP1 and A3UBJP3). In 1972 and 1973 weekly measurements of soil moisture at 1 cm were made in the ART-ATR-SIT, HAL-ART and AGRDES vegetation types. These data are shown in Figures 33, 34 and 35. In the spring of 1973, Wescor Thermocouple psychrometers were installed on the south sites. Installations were made in two vegetation types at four depths in plant interspaces and under plant canopies. Each treatment was replicated. The psychrometers were read by a S-B Systems Thermocouple Psychrometer Readout, model 500-B. This instrument has an internal timer and needle stop which reduces reader error. The instruments were read weekly through spring, summer and fall of 1973 (A3UBJP5). A computer program is available to convert the temperature and microvolt data into soil water potentials.

The weekly soil water potentials from each location are given in Figures 36 through 43. Figure 44 is a summary graph giving the mean values taken from under plant canopies. Figure 45 summarizes the data from plant interspaces. Figure 46 gives the mean values for the ANNUALS vegetation type. Figure 47 gives the means for the HAL-ART vegetation type. Combining the values for all locations in both vegetation types generates the overall mean soil water potentials shown in Figure 48.

Data on south site soil water properties from RM 73-1 (Balph et al., 1973, p. 56) were used to graph the relationship between total water potential and water content by weight (Figure 49). This curve is specific to the Thiokol silt loam soils of the south sites. Effects of hysteresis limit the use of this curve for predicting total potential given water content or for predicting water content given total potential.

About one-half of the annual precipitation occurs as snow on the south sites. During the spring thaw the soil matrix was saturated. Spring rains maintained favorable soil-water-plant conditions until July. In July and August water potentials at 10-40 cm ranged from negative 20-40 bars. September precipitation significantly increased available soil water. Soil water conditions remained favorable to plant growth throughout the fall.

Root density is greatest at depths ranging from 10-40 cm. At these depths in May and June the soil in plant interspaces had more available soil-water than did soil under plant canopies. In late August and September the situation reversed and the under-canopy had more available water. A similar situation existed between vegetation types. Early in the season the ANNUALS soils retained more available soil water. In August and September the ANNUALS had less available water than did the HAL-ART. These trends show up particularly well at the 30 cm depth. The HAL-ART under-canopy-psychrometers were placed in the shade and root zone of low vigor *Artemisia tridentata*.

Investigations of rates of infiltration and percolation will be made in 1974. Operations will be expanded to include additional vegetation types.

A.8 Detailed Abiotic Measurements

In May, 1973, a detailed abiotic sample was made at the south site weather station. Twenty-one abiotic parameters were recorded hourly for an 18-hr period. These data are given in Table 3. Thermocouples placed 1 cm deep in shaded and unshaded soil were used to collect soil surface temperatures. Shaded and unshaded air temperatures were collected with thermocouples at 10 cm. Air temperatures at 10 cm, 50 cm and 100 cm were recorded. These thermocouples were on a tower and each was shielded from radiation by plexiglass above and below the sensor. The air temperature at 150 cm in the weather instrument shelter was recorded. All temperatures are given in degrees centigrade. Humidity data were collected by placing a Psychron wet bulb-dry bulb psychrometer on shaded tower platforms at 10 cm and 50 cm. Wind speeds were monitored at 2 m and .5 m with totalizing anemometers. Total radiation was collected at 50 cm with a Star Pyrometer. Net radiation was collected at 50 cm with a Frischen miniature net radiometer. Radiation measurements were instantaneous and made simultaneously. Soil temperatures were recorded at seven depths. These thermocouples were beneath an unshaded soil surface. Qualitative comments on cloud conditions were recorded. Table 4 gives the data from a 12-hr detailed abiotic sample taken in February, 1974. The thermocouple instrumentation does not read sub-zero temperatures.

Some generalities may be drawn from the May, 1973, data. Shaded and unshaded soil temperatures differed by 1 to 4 C. Shaded and unshaded air temperatures at 10 cm varied by only 1 or 2 C. Daytime shielded air temperatures become cooler as one ascends from 10 cm to 100 cm. Nighttime temperatures are equal over this range. Relative humidities at 10 cm are greater than those at 50 cm. These differences are greatest during the warmest part of the day. Wind speed at .5 m averages 62% of that at 2 m. Soil temperatures under the soil exposed continuously to solar radiation vary through the diel period as a function of depth. Those nearest the surface varied over a range of 13 C. At 15 cm they varied over a range of 7 C. At 30 cm they varied over a range of 1.5 C. At 60 cm and below, the range of variation was less than 1 C.

In February, 1974, most temperatures were sub-freezing. The snow depth was 4 cm. Air temperatures were above freezing for about 5 hr. Soil temperatures from 3-30 cm were never above 0 C. The soil temperature at 1 cm was above freezing for 2 hr. Soil temperatures at 60 cm and below did not reach 0 C. Relative humidity at 10 cm and 50 cm had the same pattern as in May, 1973.

More frequent detailed abiotic samples will be made through 1974.

Literature Cited

Balph, D.F. (Coordinator). 1973. Curlew Valley Validation Site Report. US/IBP Desert Biome Res. Memo. 73-1.

Table 1. Monthly air temperature (C) on southern sites, 1973

Date	Min.	Max.	Hourly Mean	Range of Daily Min.	Range of Daily Max.	Range of Daily Mean
Jan 73	-32	3	- 8	-27 - -4	-10 - 4	-21 - -2
Feb 73	-23	11	- 5	-17 - -2	- 4 - 6	-10 - 0
Mar 73	-12	12	- 1	-10 - -2	1 - 9	- 4 - 3
Apr 73	-12	22	6	- 9 - 5	5 - 21	0 - 11
May 73	- 9	31	13	- 6 - 8	11 - 29	5 - 18
Jun 73	- 4	35	17	- 2 - 14	13 - 34	9 - 24
Jul 73	1	38	21	4 - 17	18 - 37	13 - 25
Aug 73	2	37	20	4 - 18	26 - 36	15 - 26
Sep 73	- 4	31	13	- 1 - 14	9 - 31	7 - 21
Oct 73	-12	26	8	- 7 - 11	7 - 25	4 - 14
Nov 73	-19	19	3	-11 - 6	1 - 19	- 2 - 10
Dec 73	-25	12	0	-12 - 4	- 2 - 12	- 6 - 6

Table 2. Monthly precipitation on southern sites, 1973

Month	Number of Events	Total Rainfall Inches	mm	Rate of Rainfall In/hr	mm/hr	Snow	Snow Depth Inches	mm
Jan 73		1.14	29.0			Snow	10.25	260
Feb 73		1.00	25.4			Snow	13.50	340
Mar 73	4	1.00	25.4	.22	5.6			
Apr 73	4	.43	10.9	.05	1.3			
May 73	6	.77	19.6	.13	3.3			
Jun 73	2	1.74	44.2	.12	3.0			
Jul 73	10	1.14	29.0	.10	2.5			
Aug 73	3	.46	11.7	.12	3.0			
Sep 73	9	1.31	33.3	.05	1.3			
Oct 73	1	.60	15.2	.04	1.0			
Nov 73	7	.80	20.3	.05	1.3			
Dec 73		.34	8.6			Snow	6.0	150

Table 3. Detailed abiotic measurements monitored in May, 1973

	May 1973																		
Time of Day (x 100)	5/3/73	12	13	14	15	16	17	18	19	20	21	22	5/4/73	5	6	7	8	9	10	11
Soil surface temp. shade		15.0	15.6	15.8	16.3	16.0	15.5	15.2	12.8	12.2	11.2	11.0		8.2	8.0	8.1	9.8	10.0	11.1	11.8
Soil surface temp. sun		13.0	15.0	16.9	18.2	19.1	19.5	18.6	17.2	16.2	14.9	13.8		9.6	9.0	9.0	9.5	10.4	11.9	13.9
Air temp. 10 cm shade		19.0	23.7	24.1	24.4	21.3	20.2	17.2	14.4	13.8	11.0	10.6		6.0	6.0	6.5	9.8	11.1	14.2	16.2
Air temp. 10 cm sun		18.0	24.5	23.6	24.1	24.4	24.1	18.2	14.2	13.1	10.9	10.3		6.0	6.1	6.5	11.2	14.0	16.6	18.1
Air temp. 10 cm tower		19.0	25.2	26.4	25.5	24.3	23.4	18.3	14.6	13.5	11.0	10.6		6.4	6.5	7.0	15.0	14.0	18.5	18.5
Air temp. 50 cm tower		18.0	23.0	23.0	22.8	23.7	22.2	18.8	15.0	13.6	11.2	10.8		6.8	6.6	6.9	12.8	13.3	16.0	17.2
Air temp. 100 cm tower		18.0	20.5	21.0	20.9	20.8	21.4	18.6	15.1	13.6	11.1	10.8		6.2	6.5	6.7	10.6	12.4	14.2	15.8
Air temp. 150 cm weather station		16.0	19.0	21.0	21.0	21.0	21.0	18.0	16.0	14.0	12.0	11.0		7.0	7.0	7.0	12.0	13.0	14.0	14.0
Humidity 10 cm shade		23 %	33 %	17 %	22 %	18 %	19 %	27 %	33 %	45 %	53 %	57 %		98 %	93 %	98 %	70 %	72 %	52 %	53 %
Humidity 50 cm shade		20 %	15 %	14 %	19 %	14 %	15 %	21 %	26 %	40 %	53 %	57 %		98 %	93 %	93 %	69 %	61 %	55 %	46 %
Wind speed 200 cm			23.8		19.6	19.6	23.3	15.3	5.5	16.2	39.4	34.4			11.9	2.4	4.8	21.2	24.2	24.2
Wind speed 50 cm			16.2		12.8	12.8	15.7	10.8	3.0	9.6	22.8	20.3			7.1	1.3	2.9	13.0	15.3	15.6
Total radiation 50 cm		.53	1.51	1.38	1.13	.94	.41	.11	0	0	0	0		0	.01	.08	.66	.88	1.22	1.37
Net radiation 50 cm		.43	1.14	.98	.72	.57	.28	0	0	0	0	0		0	0	.01	.50	.57	.79	.89
Soil temp. 1 cm sun		21.0	24.6	25.1	26.1	25.8	25.0	18.2	15.2	13.7	11.6	11.0		7.6	7.3	8.0	16.1	15.4	18.9	17.9
Soil temp. 3 cm sun		20.0	23.7	24.1	25.1	24.9	24.1	18.1	15.2	13.7	11.8	11.1		7.9	7.8	8.0	15.4	15.1	18.3	17.6
Soil temp. 7.5 cm sun		18.0	20.3	20.9	22.1	21.9	21.3	17.4	15.2	13.5	12.2	11.6		8.4	8.1	8.4	13.3	13.7	16.0	16.1
Soil temp 15 cm sun		13.0	14.1	14.9	16.1	16.2	16.4	15.0	14.2	13.5	12.8	12.2		9.9	9.1	9.1	10.8	11.1	12.0	12.8
Soil temp. 30 cm sun		9.0	8.5	9.0	9.6	9.5	9.8	9.9	10.0	9.9	10.0	9.9		10.0	9.5	9.4	9.3	9.4	9.2	9.3
Soil temp. 60 cm sun		7.0	6.3	6.8	7.2	6.8	6.8	6.9	7.0	6.9	6.9	6.8		7.3	6.9	6.9	6.8	6.8	6.2	6.1
Soil temp. 200 cm sun		6.0	5.3	5.5	5.9	5.5	5.4	5.5	5.7	5.6	5.6	5.5		6.1	5.8	5.8	5.7	5.7	5.0	5.0
Conditions		hazy	sunny	sunny	sunny	sunny	sunny	cldy	cldy	cldy							hazy	sunny	sunny	sunny	sunny

Table 4. Detailed abiotic measurements monitored 2/12/74

February 1974

Time of Day (x 100)	2/12/74	8	9	10	11	12	13	14	15	16	17	18	19
Soil surface temp. shade		Neg.*	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Soil surface temp. sun		Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	0	0	.1	0	Neg.	Neg.
Air temp. 10 cm shade		Neg.	Neg.	Neg.	Neg.	Neg.	2.3	.9	1.5	1.1	.1	Neg.	Neg.
Air temp. 10 cm sun		Neg.	Neg.	Neg.	Neg.	3.5	5.0	4.7	3.8	2.4	.1	Neg.	Neg.
Air temp. 10 cm tower		Neg.	Neg.	Neg.	Neg.	3.2	5.0	4.0	4.0	3.2	.5	Neg.	Neg.
Air temp. 50 cm tower		Neg.	Neg.	Neg.	Neg.	2.6	7.0	4.6	4.0	3.5	1.0	Neg.	Neg.
Air temp. 100 cm tower		Neg.	Neg.	Neg.	Neg.	3.2	5.0	5.0	3.1	3.0	.1	Neg.	Neg.
Air temp. weather station		Neg.	Neg.	Neg.	Neg.	2.0	5.0	3.0	4.0	3.0	1.0	Neg.	Neg.
Humidity 10 cm shade		F*	F	F	F	63 %	59 %	64 %	65 %	64 %	71 %	90 %	66 %
Humidity 50 cm shade		F	F	F	F	67 %	45 %	58 %	51 %	57 %	70 %	89 %	77 %
Wind speed 200 cm			4.2	2.6	4.2	4.3	2.9	5.5	4.2	5.0	2.9	1.6	.3
Wind speed 50 cm			2.6	1.6	2.6	2.7	1.8	3.4	2.6	3.1	1.8	.5	.2
Total radiation 50 cm		.03	.26	.63	.70	.85	.83	.74	.63	.28	.12	.07	0
Net radiation 50 cm		-.25	.05	.17	.24	.30	.30	.32	.18	.08	.26	.33	0
Soil temp. 1 cm sun		Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	0	.2	.2	0	Neg.	Neg.
Soil temp. 3 cm sun		Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	0	Neg.	Neg.	Neg.
Soil temp. 7.5 cm sun		Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Soil temp. 15 cm sun		Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Soil temp. 30 cm sun		Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.	Neg.
Soil temp. 60 cm sun					3.0	2.9	3.1	2.9	3.1	3.0	2.8	2.6	2.5
Soil temp. 200 cm sun					6.9	6.8	6.8	6.3	6.5	6.6	6.5	6.2	6.5
Conditions		foggy	hazy	clear	clear	clear	clear	clear	clear	clear	cldy	cldy	cldy

Neg.* - Termperatures sub-zero; below the range of the recording instruments.

F* - No measurement made; wet bulb frozen.

Table 5. Monthly air temperature (C) on northern sites, 1973

Date	Min.	Max.	Hourly Mean	Range of Daily Min.	Range of Daily Max.	Range of Daily Mean
Jan 73	-22	3	- 5	-22 - -3	-11 - 5	-16 - 0
Feb 73	-14	11	- 4	-14 - -1	- 4 - 9	-10 - 3
Mar 73	-11	9	1	- 8 - 2	1 - 10	- 3 - 5
Apr 73	-10	19	4	- 7 - 4	- 1 - 16	- 1 - 9
May 73	- 6	29	11	- 4 - 8	2 - 25	4 - 17
Jun 73	- 1	33	18	1 - 19	5 - 32	10 - 24
Jul 73	6	36	19	8 - 16	11 - 34	14 - 24
Aug 73	6	34	18	5 - 17	16 - 31	14 - 23
Sep 73	1	29	12	2 - 8	9 - 21	11 - 13

Table 6. Monthly precipitation on the northern sites, 1973

Month	Number of Events	Total Rainfall Inches	mm	Rate of Rainfall In/hr	mm/hr	Snow	Snow Depth Inches	mm
Jan 73		1.67	42.4			Snow	13.75	350
Feb 73		1.11	28.2			Snow	17.75	450
Mar 73	8	1.20	30.5	.07	1.8			
Apr 73	2	.13	3.3	.05	1.3			
May 73	4	1.06	26.9	.18	4.6			
Jun 73	4	1.85	47.0	.09	2.3			
Jul 73	7	3.24	82.3	.17	4.3			
Aug 73	5	.74	18.8	.12	3.0			
Sep 73	7	2.50	63.5	.07	1.8			

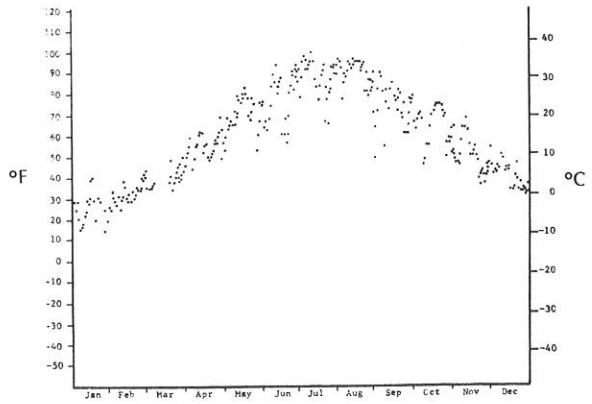

Figure 1. Daily maximum air temperature on southern sites, 1973.

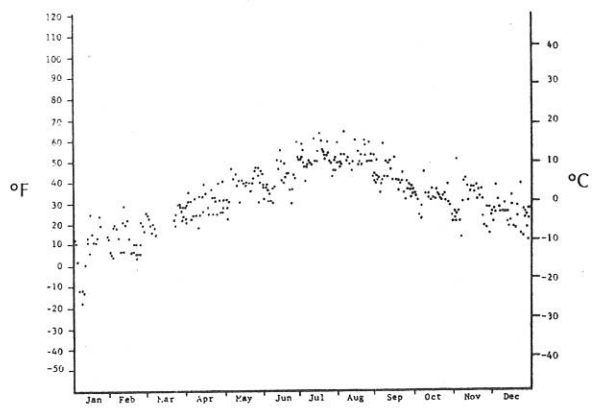

Figure 2. Daily minimum air temperature on southern sites, 1973.

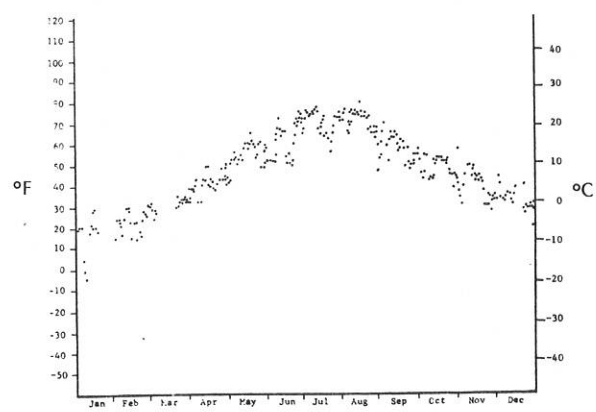

Figure 3. Daily mean air temperature on southern sites, 1973.

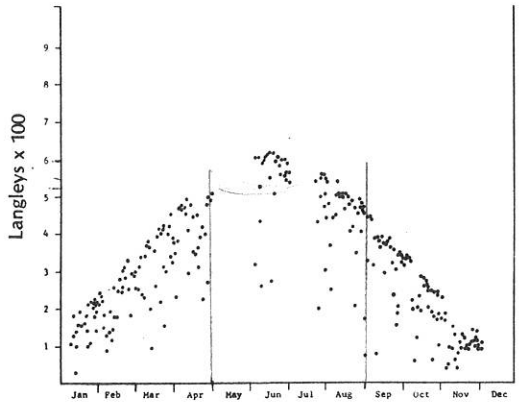

Figure 4. Solar radiation at Snowville, Utah, 1973.

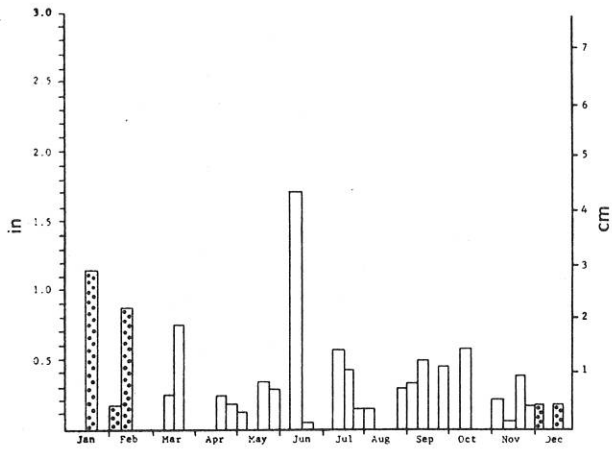

Figure 5. Weekly precipitation on southern sites, 1973.

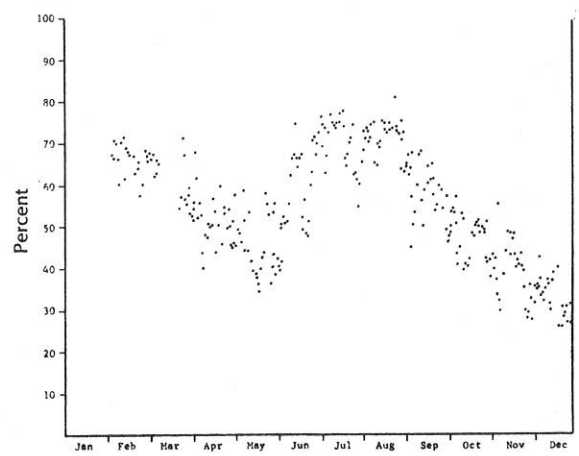

Figure 6. Daily mean relative humidity on southern sites, 1973.

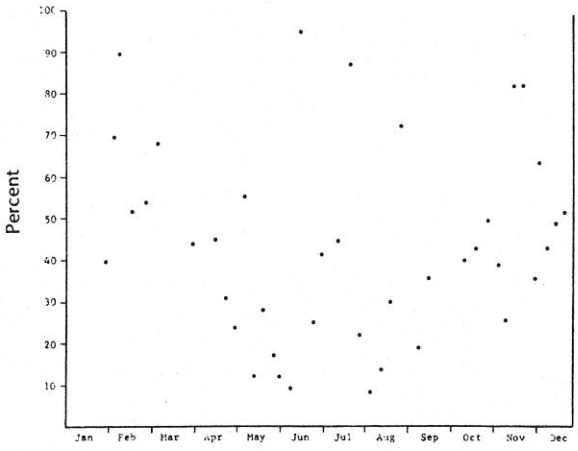

Figure 7. Weekly mid-day relative humidity on southern sites, 1973.

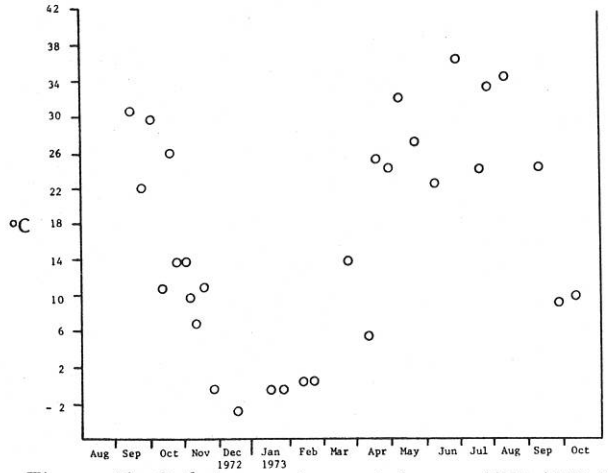

Figure 10. Soil temperatures at 1 cm; ART-ATR-SIT vegetation type, 1972-73.

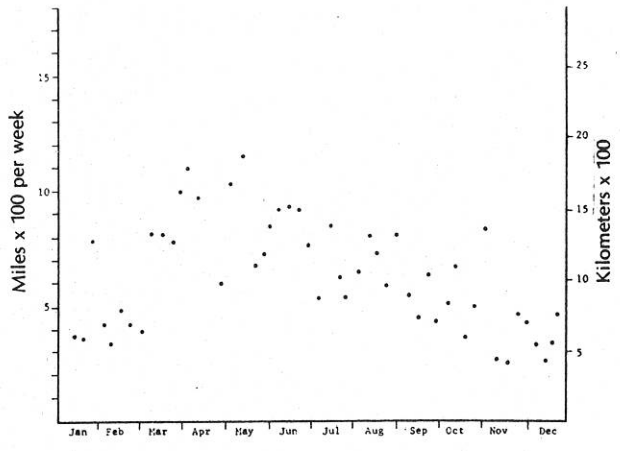

Figure 8. Mean weekly wind velocity (at 2 m) on southern sites, 1973.

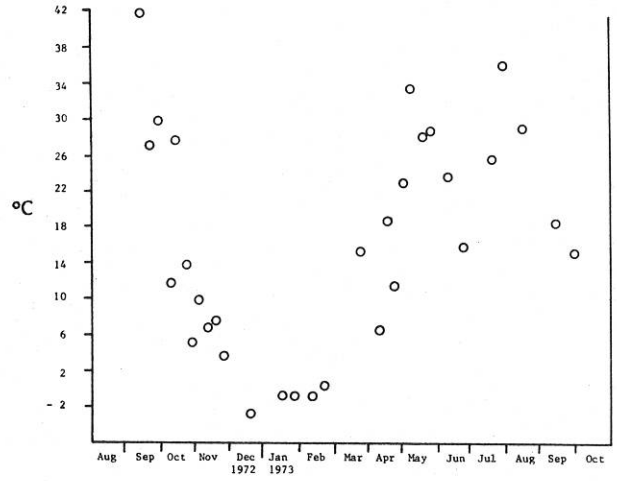

Figure 11. Soil temperatures at 1 cm; HAL-ART vegetation type, 1972-73.

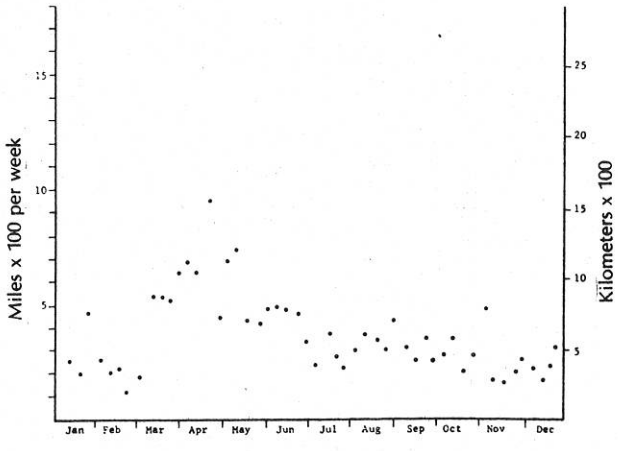

Figure 9. Mean weekly wind velocity (at .5 m) on southern sites, 1973.

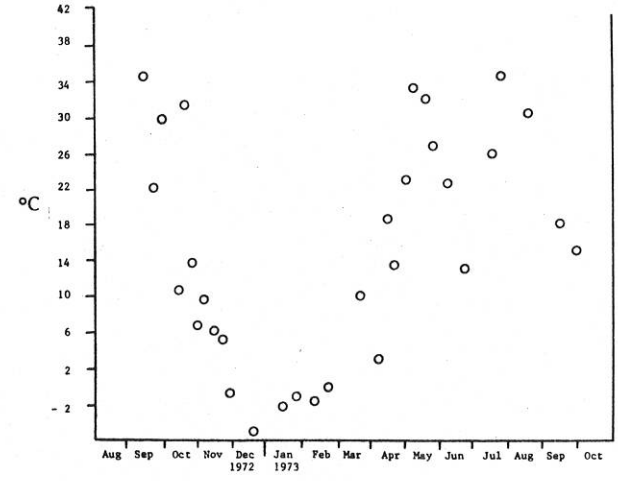

Figure 12. Soil temperatures a 1 cm; AGRDES vegetation type, 1972-73.

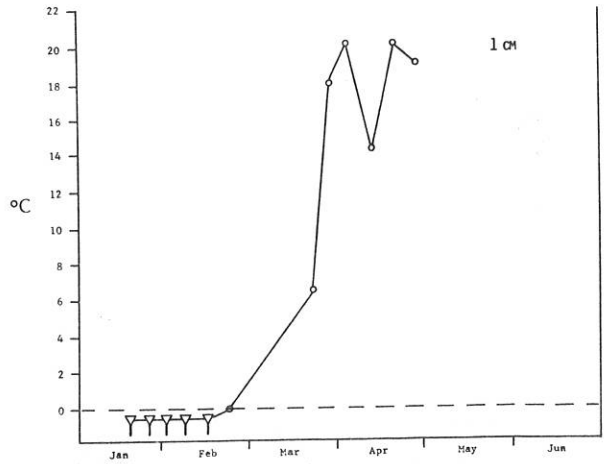

Figure 13. Soil temperatures at 1 cm at the south site weather station, 1973.

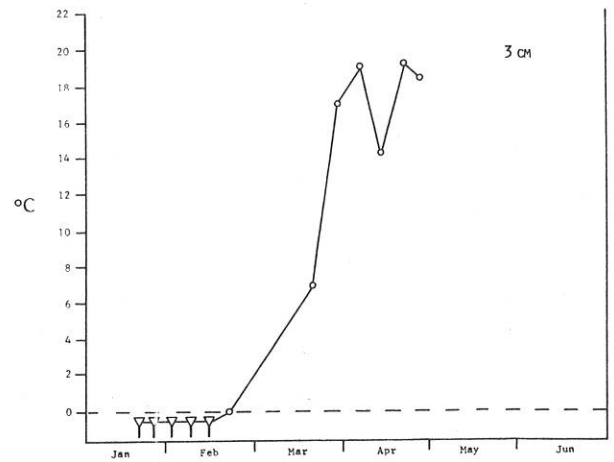

Figure 14. Soil temperatures at 3 cm at the south site weather station, 1973.

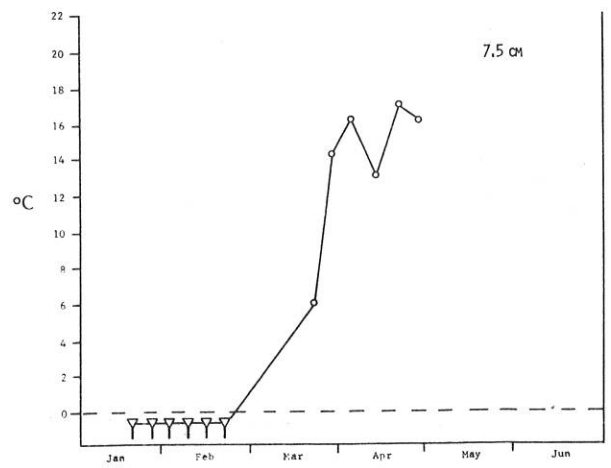

Figure 15. Soil temperatures at 7.5 cm at the south site weather station, 1973.

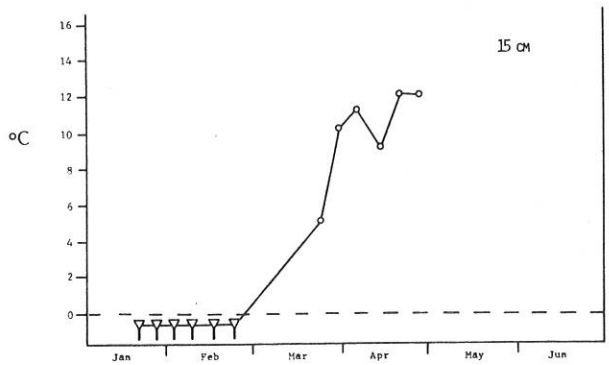

Figure 16. Soil temperatures at 15 cm at the south site weather station, 1973.

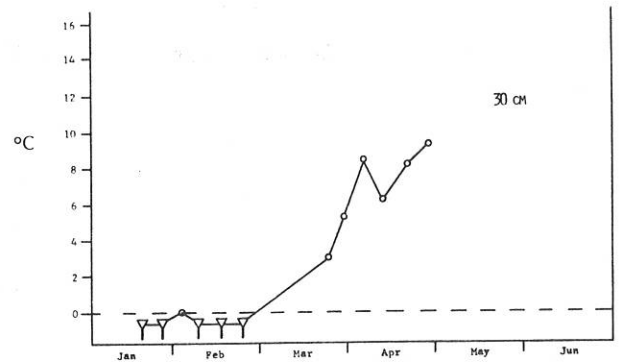

Figure 17. Soil temperatures at 30 cm at the south site weather station, 1973.

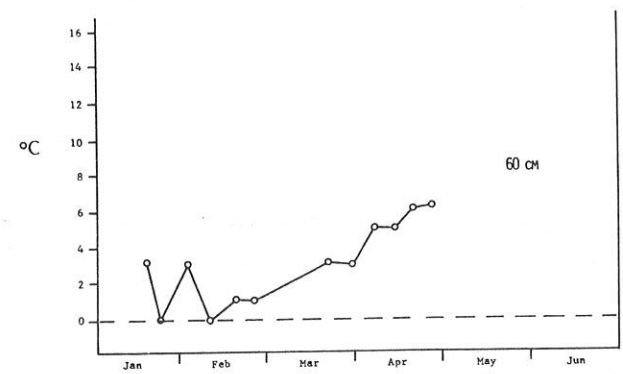

Figure 18. Soil temperatures at 60 cm at the south site weather station, 1973.

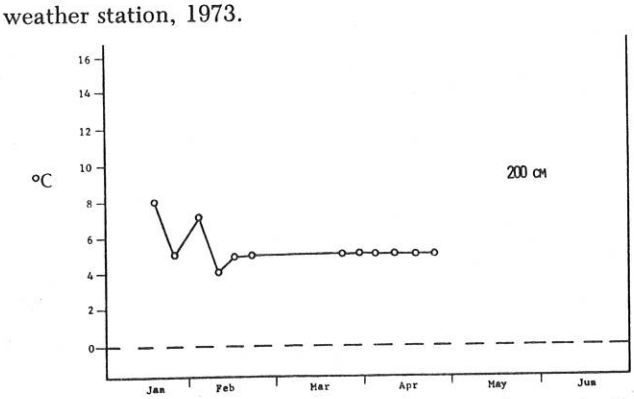

Figure 19. Soil temperatures at 200 cm at the south site weather station, 1973.

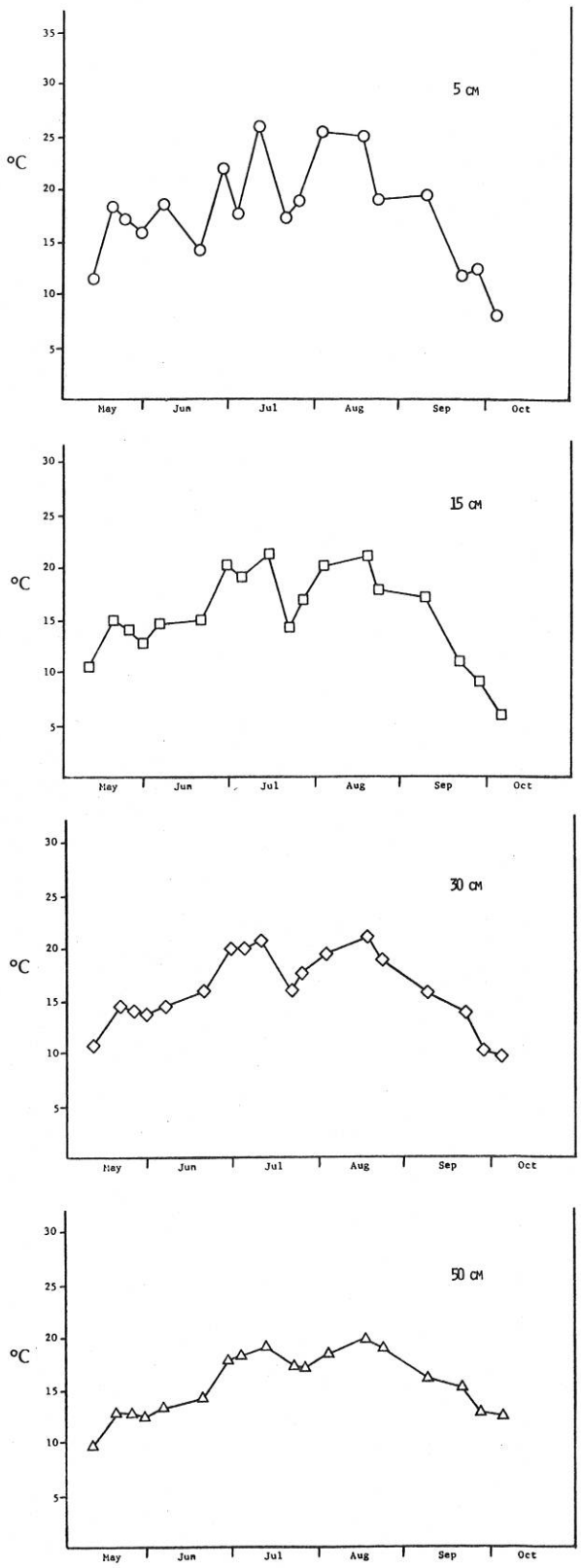

Figure 20. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; ANNUALS vegetation, under plant cover, probe set A, 1973.

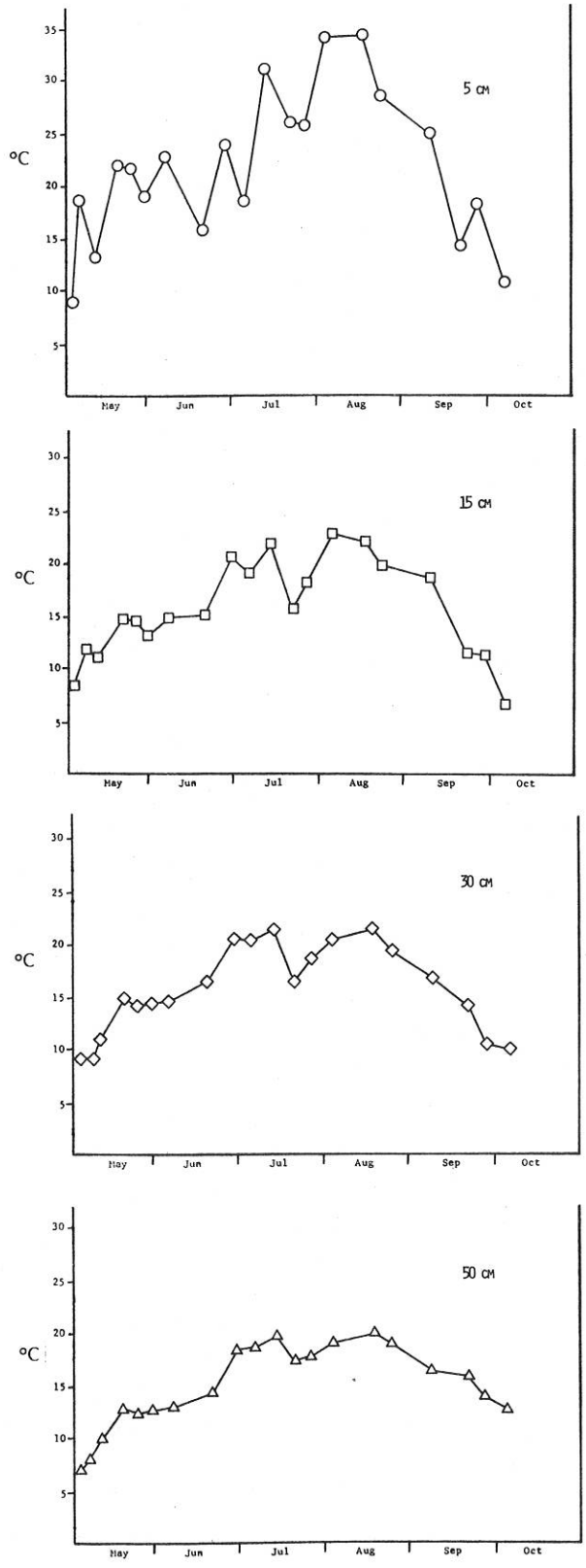

Figure 21. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; ANNUALS vegetation, under plant cover, probe set C, 1973.

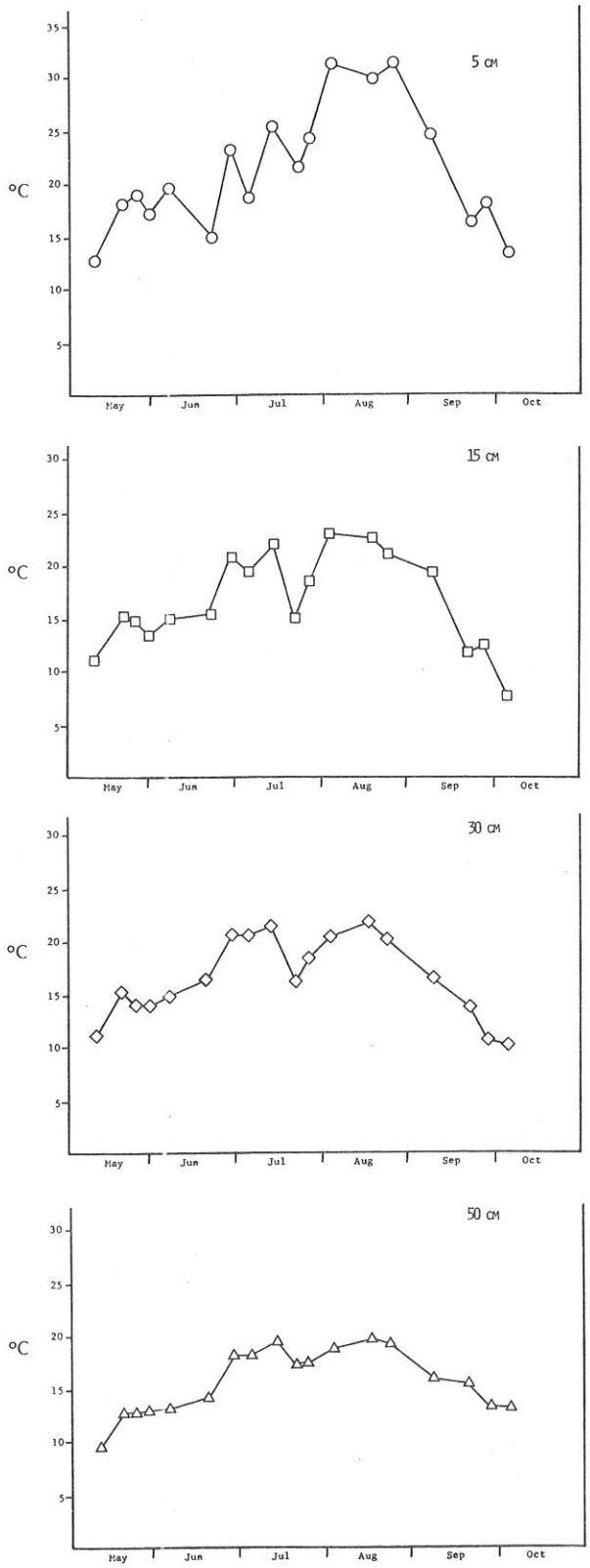

Figure 22. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; ANNUALS vegetation, plant interspaces, probe set B, 1973.

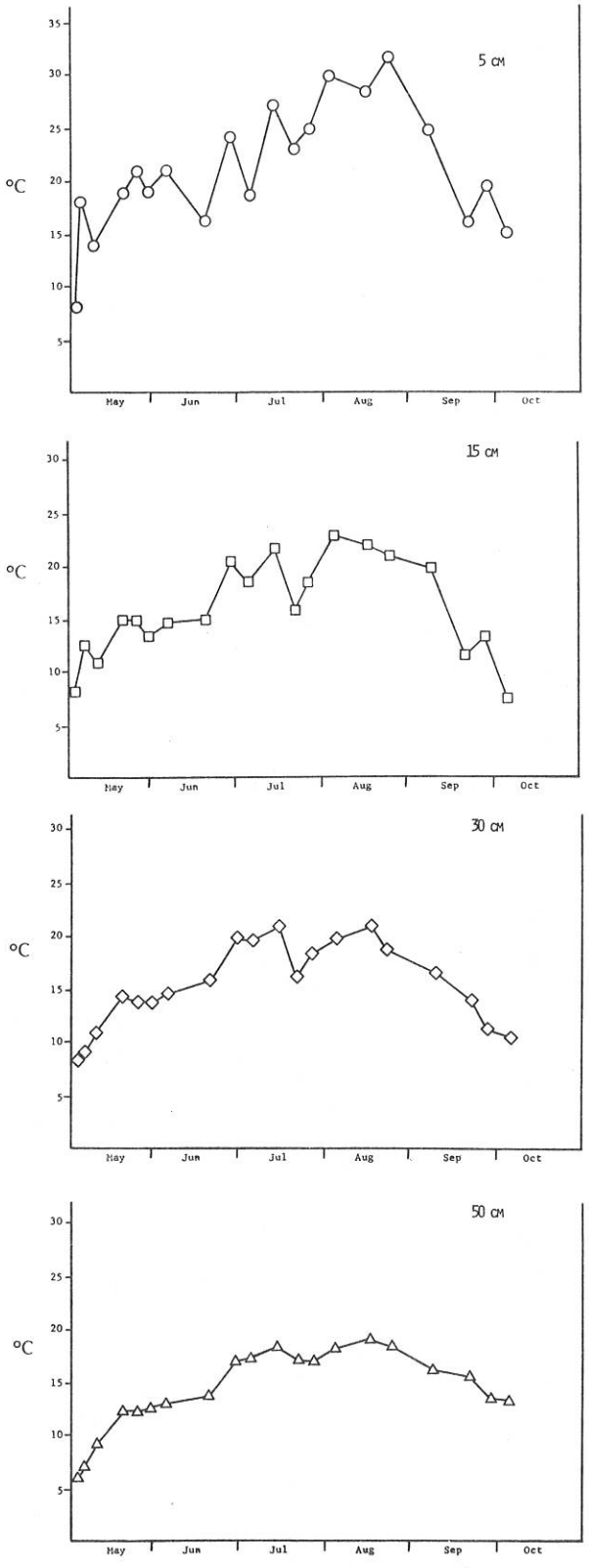

Figure 23. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; ANNUALS vegetation, plant interspaces, probe set D, 1973.

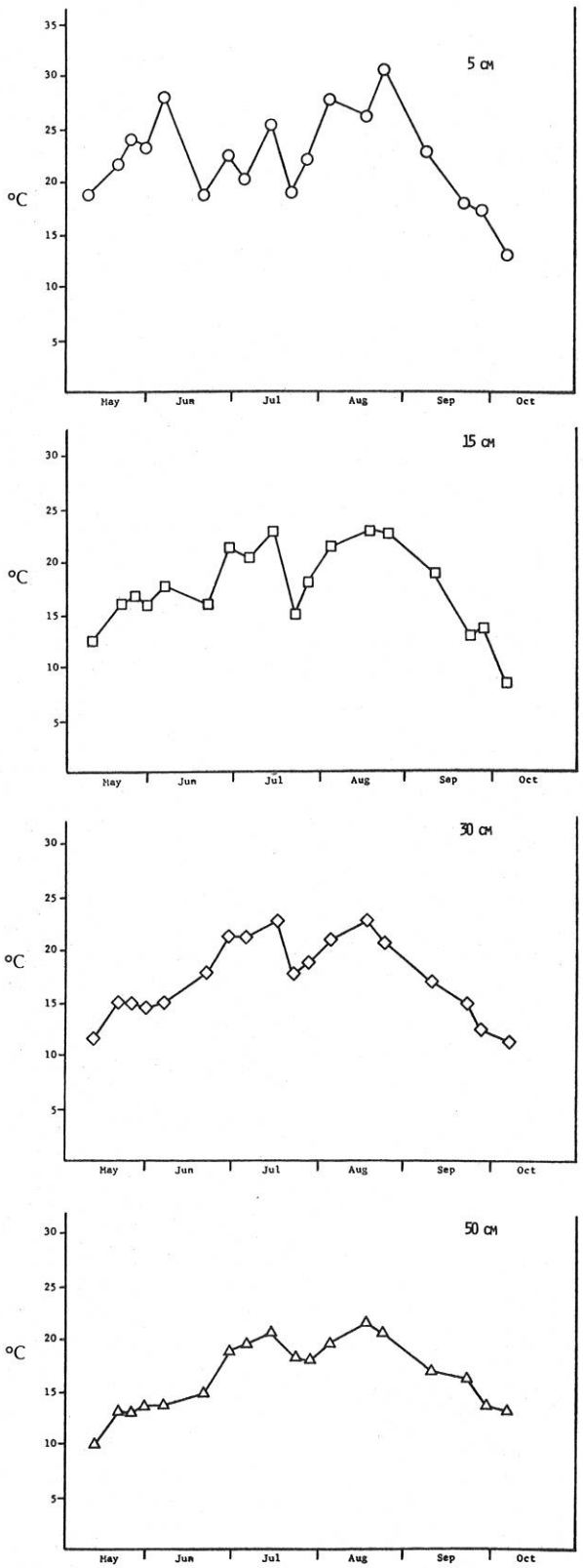

Figure 24. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; HAL-ART vegetation, under plant cover, probe set E, 1973.

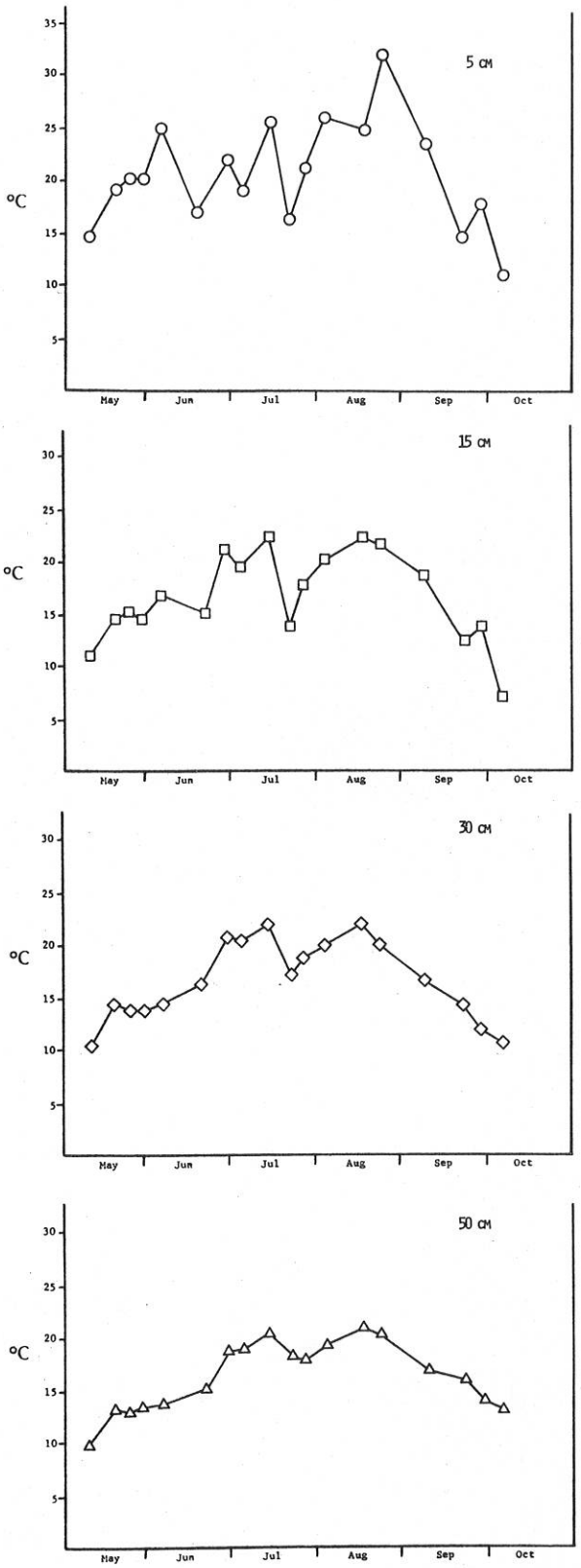

Figure 25. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; HAL-ART vegetation, under plant cover, probe set G, 1973.

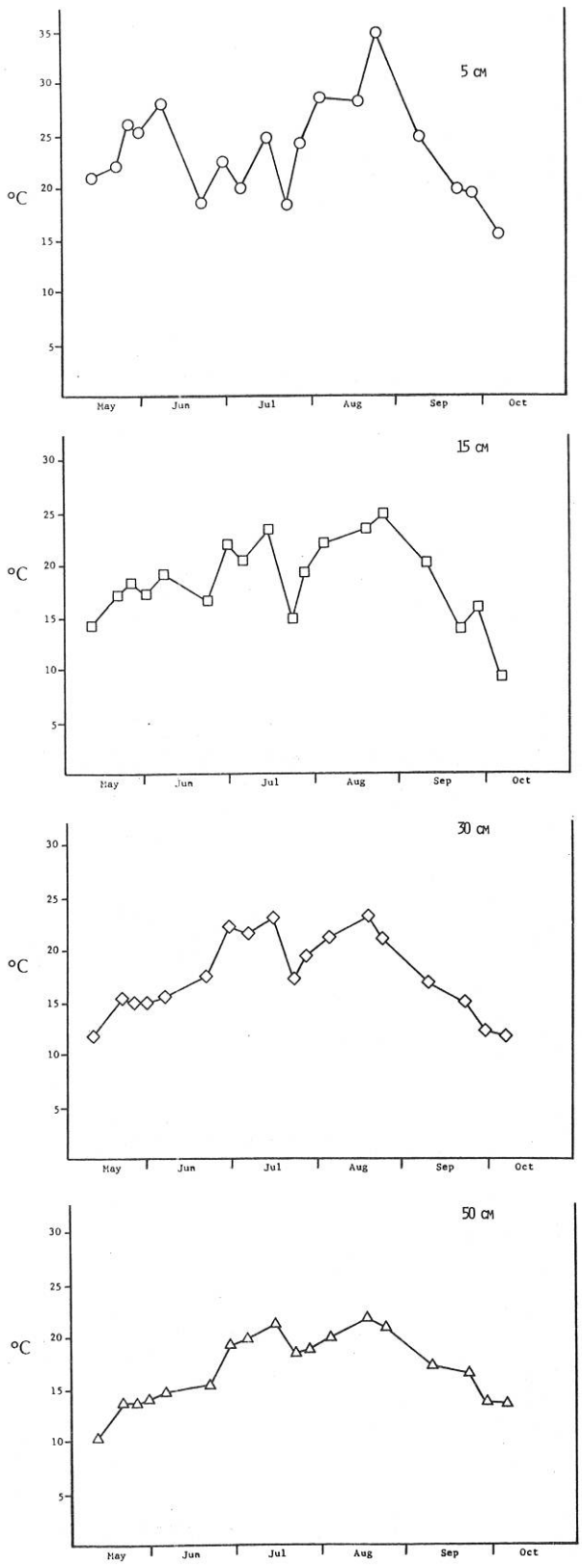

Figure 26. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; HAL-ART vegetation, plant interspaces, probe set F, 1973.

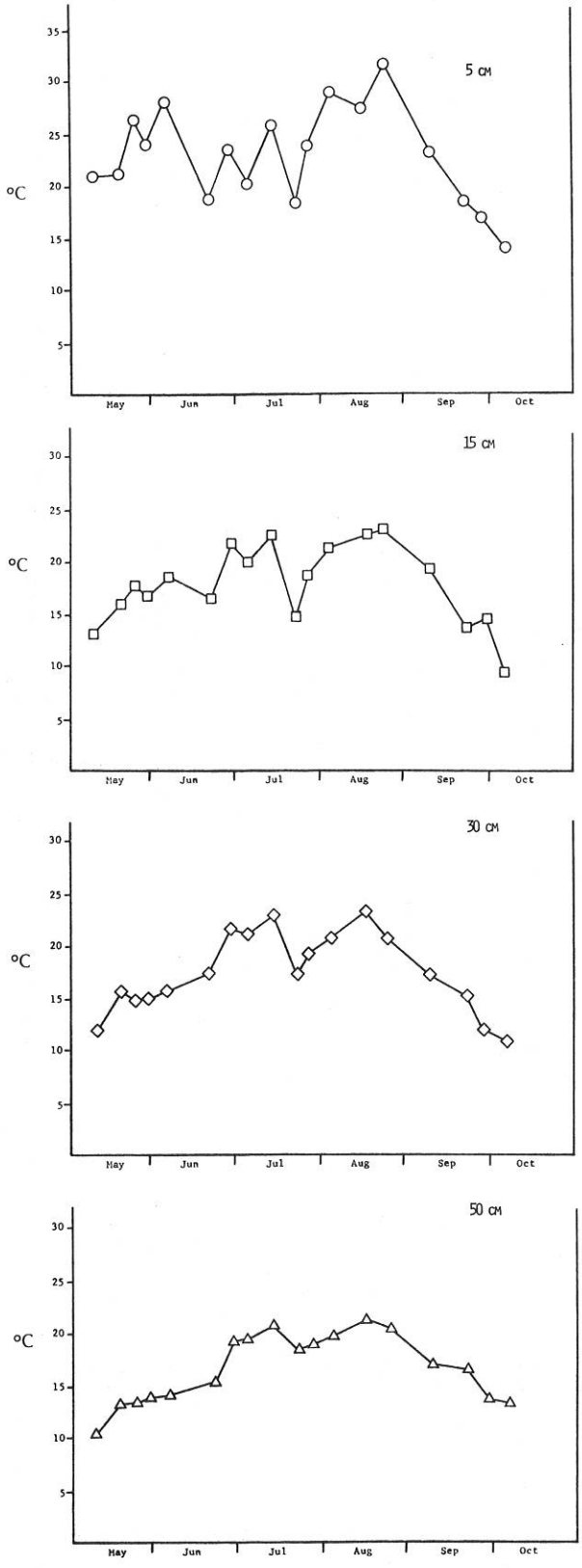

Figure 27. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; HAL-ART vegetation, plant interspaces, probe set H, 1973.

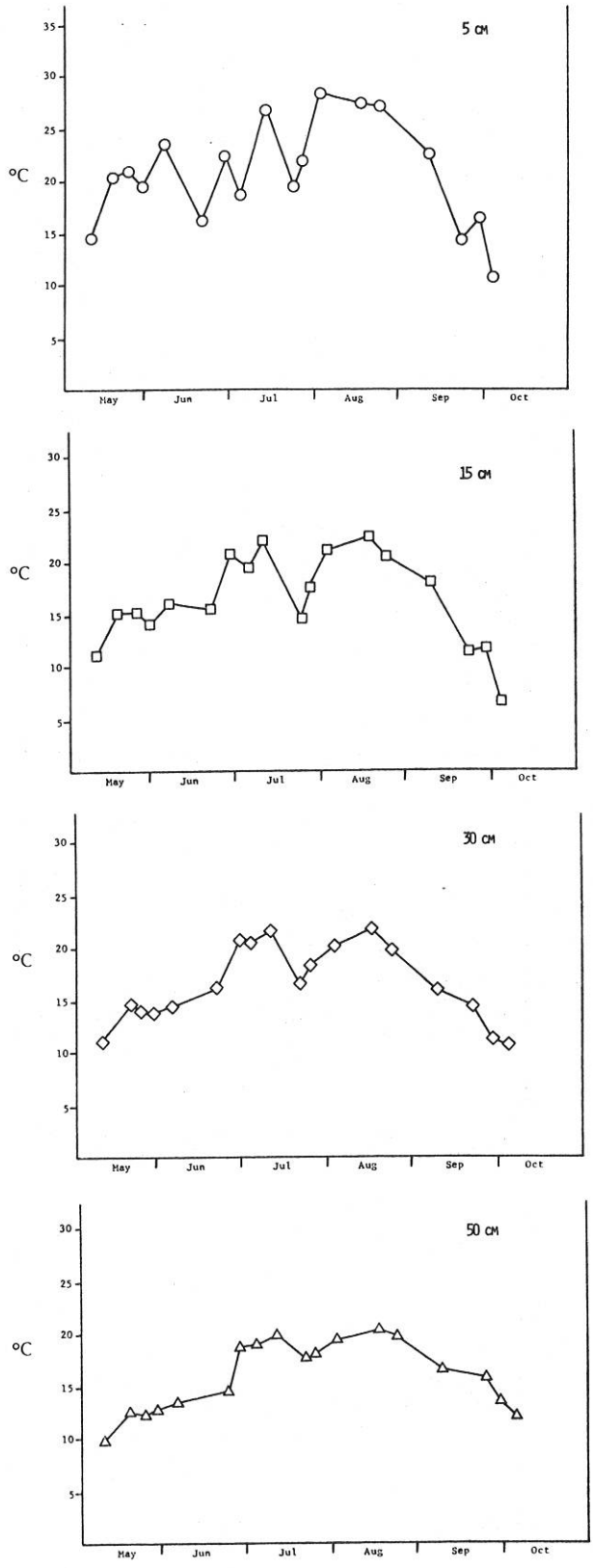

Figure 28. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken under plant cover, 1973.

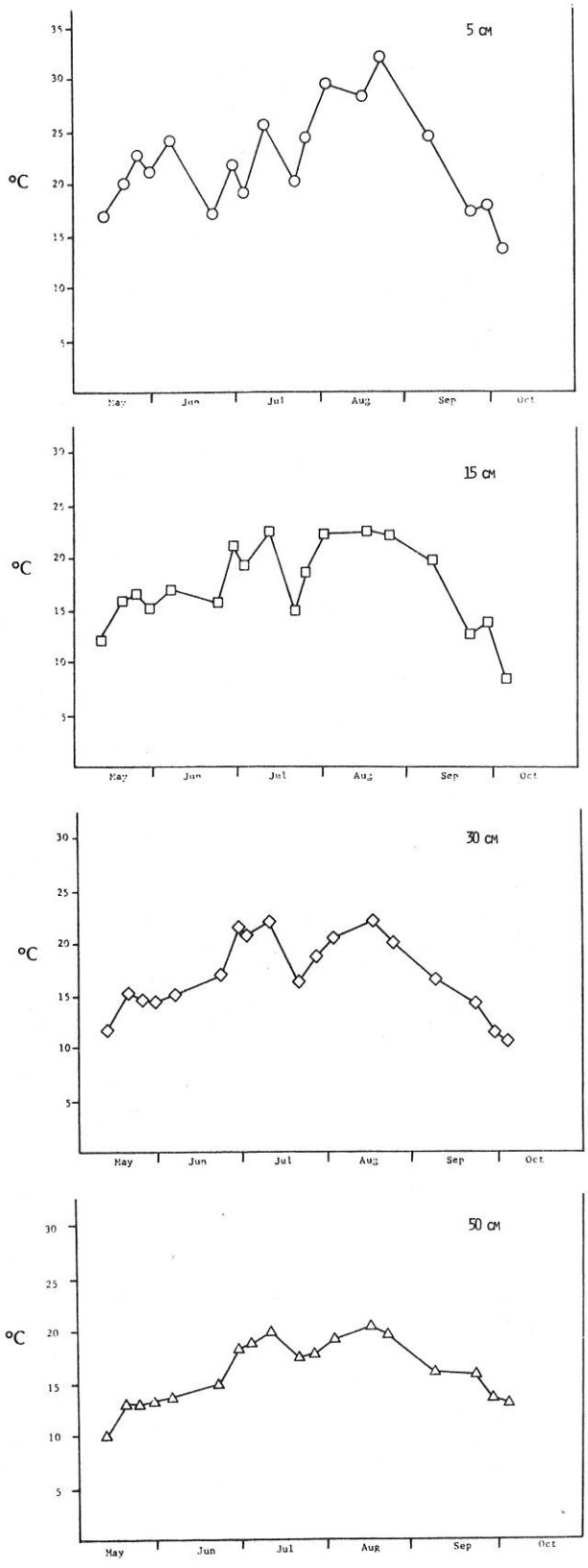

Figure 29. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken in plant interspaces, 1973.

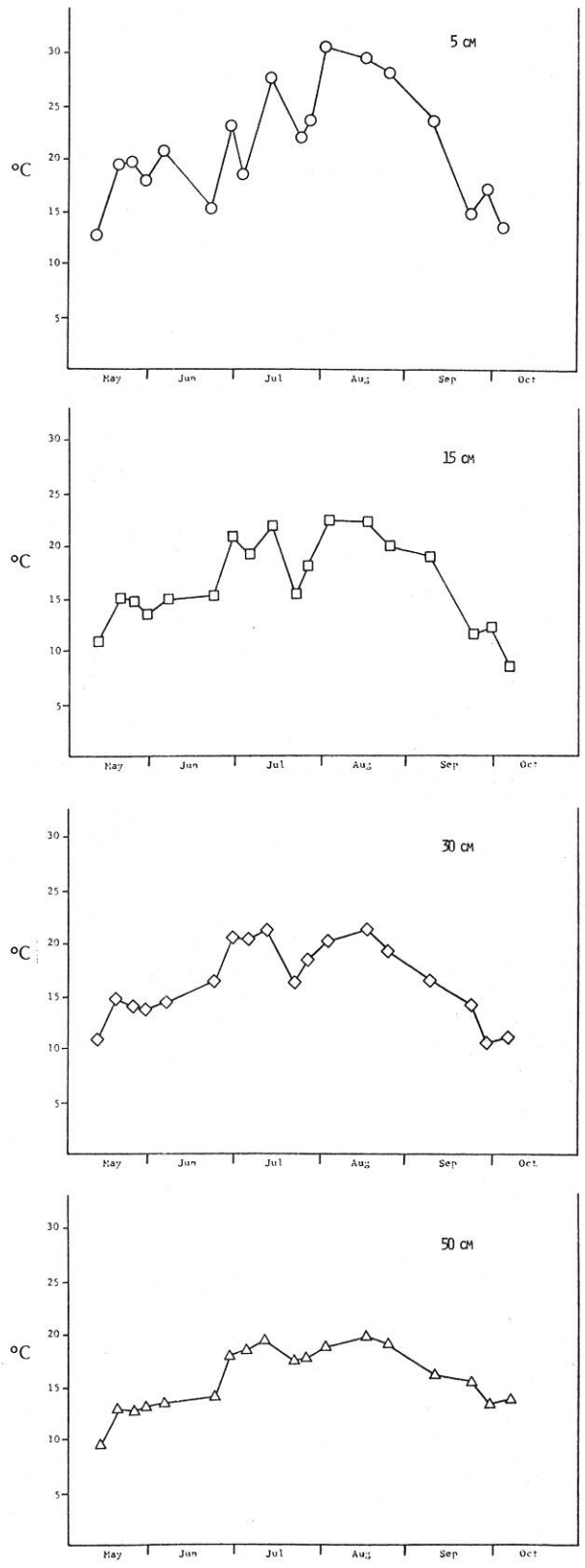

Figure 30. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken in the ANNUALS vegetation, 1973.

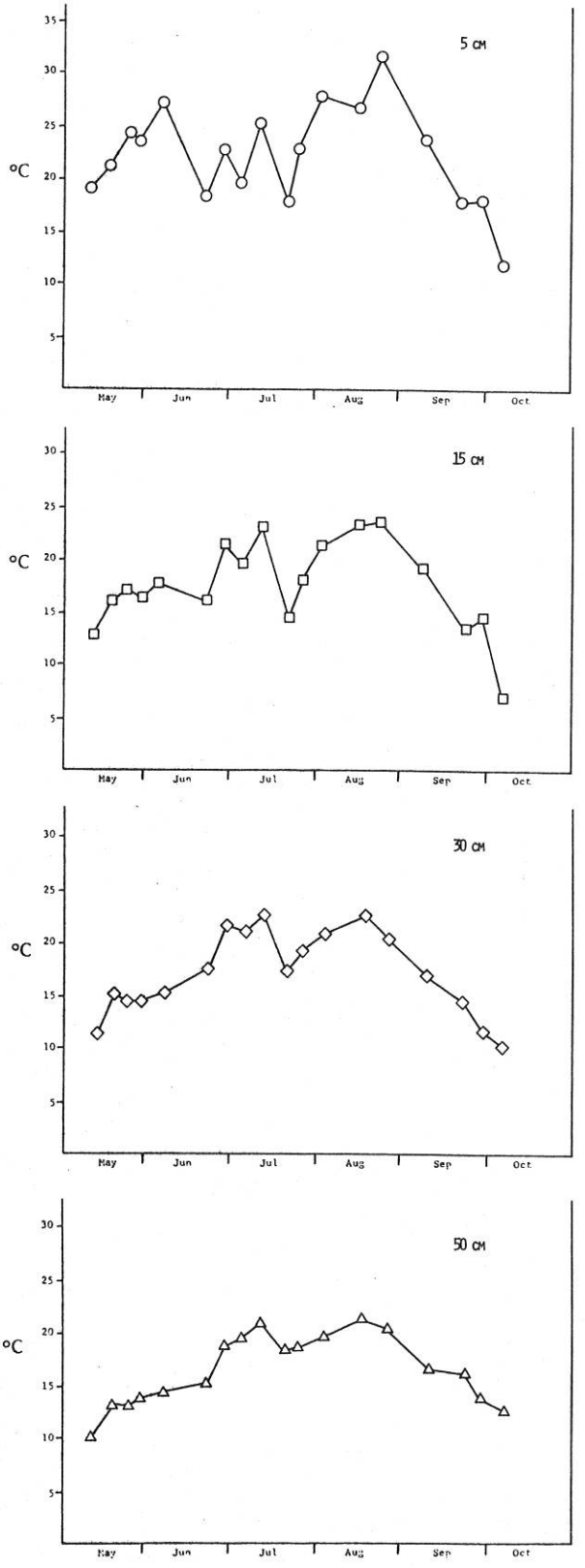

Figure 31. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken in the HAL-ART vegetation, 1973.

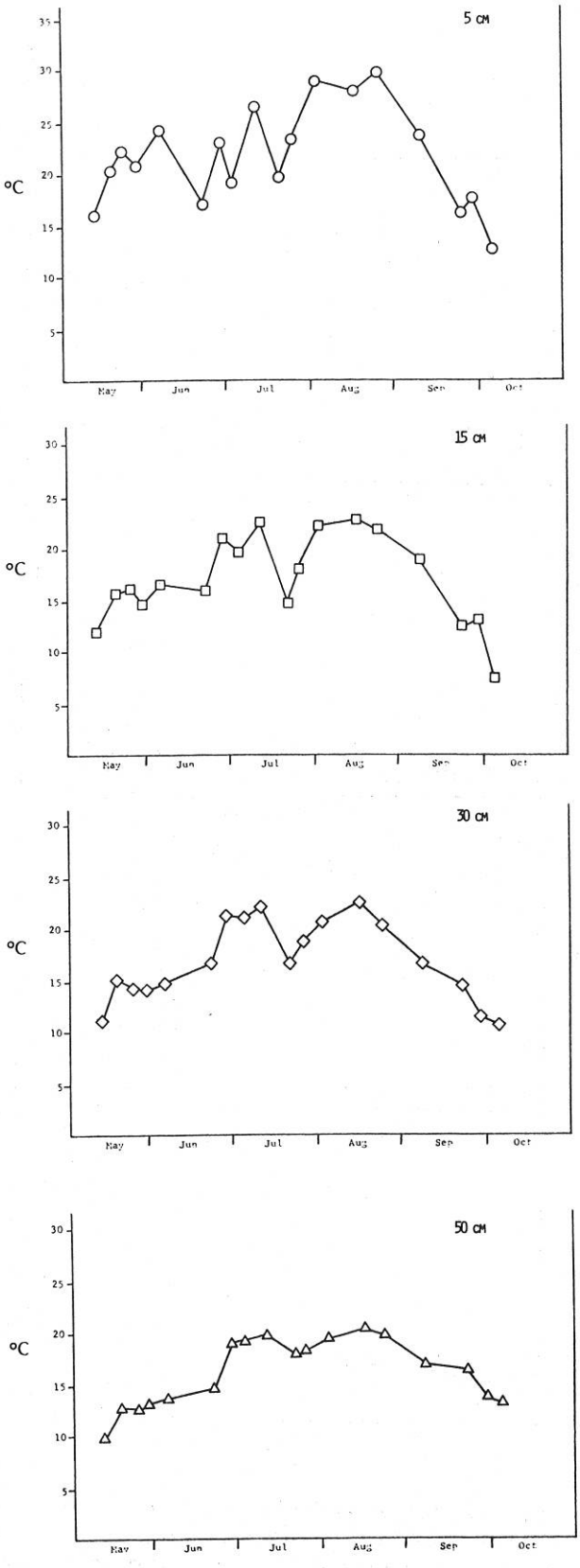

Figure 32. Soil temperatures at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken in 1973.

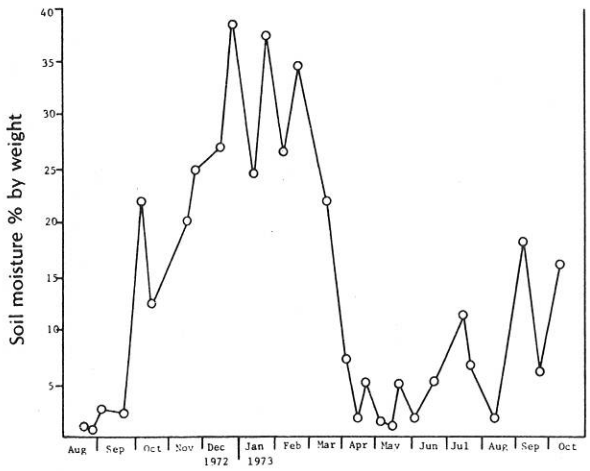

Figure 33. Soil moisture in percent by weight at 1 cm; ART-ATR-SIT vegetation, 1972-1973.

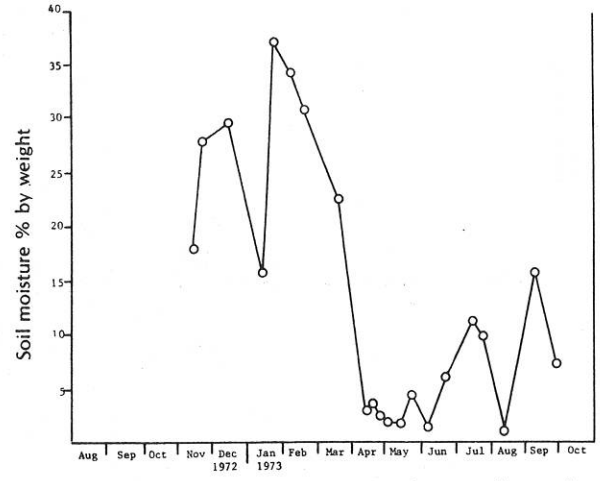

Figure 34. Soil moisture in percent by weight at 1 cm; HAL-ART vegetation, 1973.

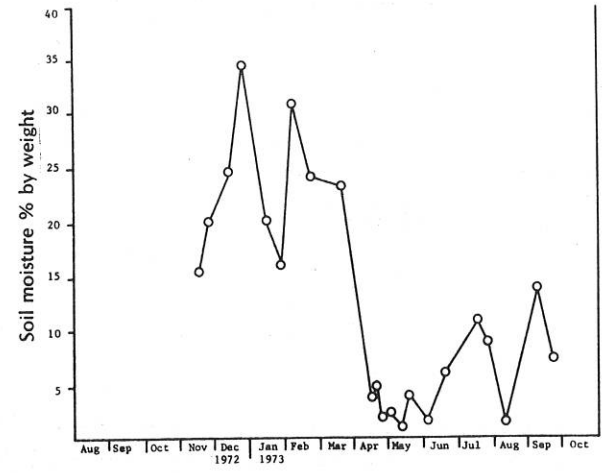

Figure 35. Soil moisture in precent by weight at 1 cm; AGRDES vegetation, 1972-1973.

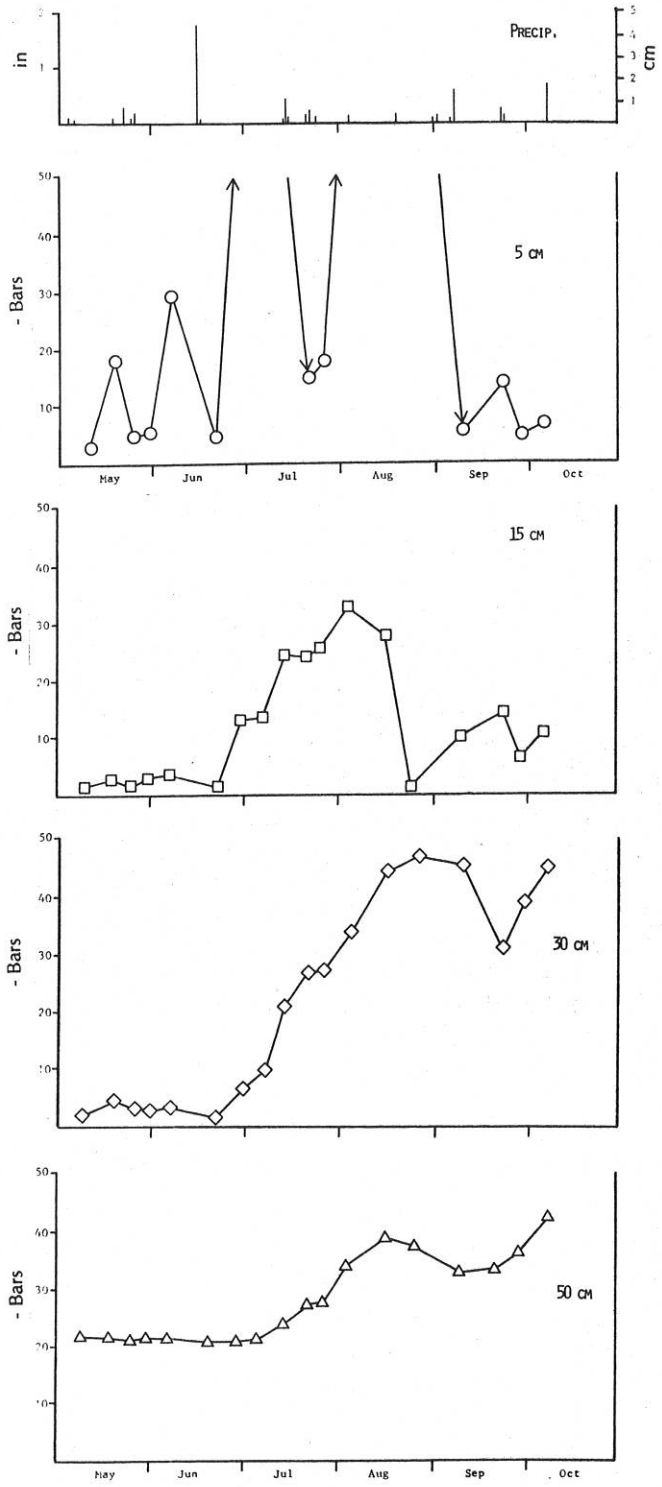

Figure 36. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; ANNUALS vegetation, under plant cover, probe set A, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

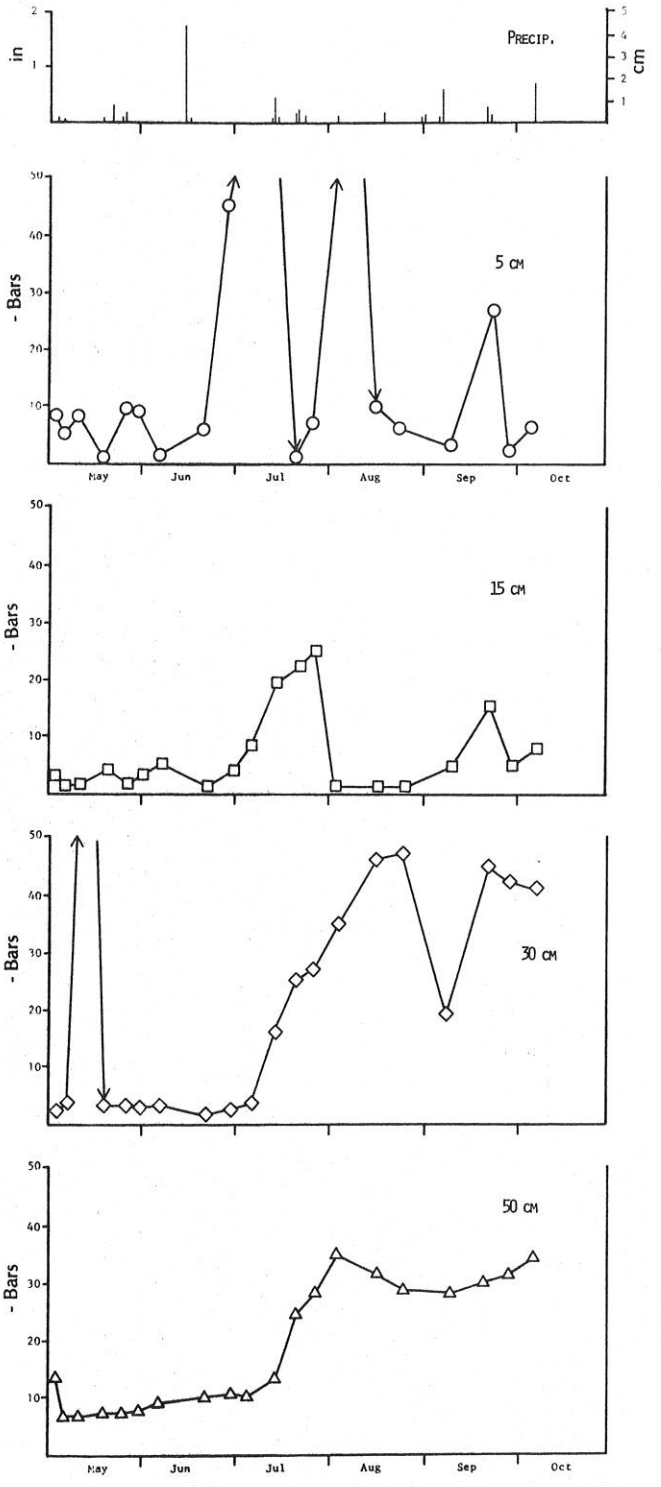

Figure 37. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; ANNUALS vegetation, under plant cover, probe set C, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

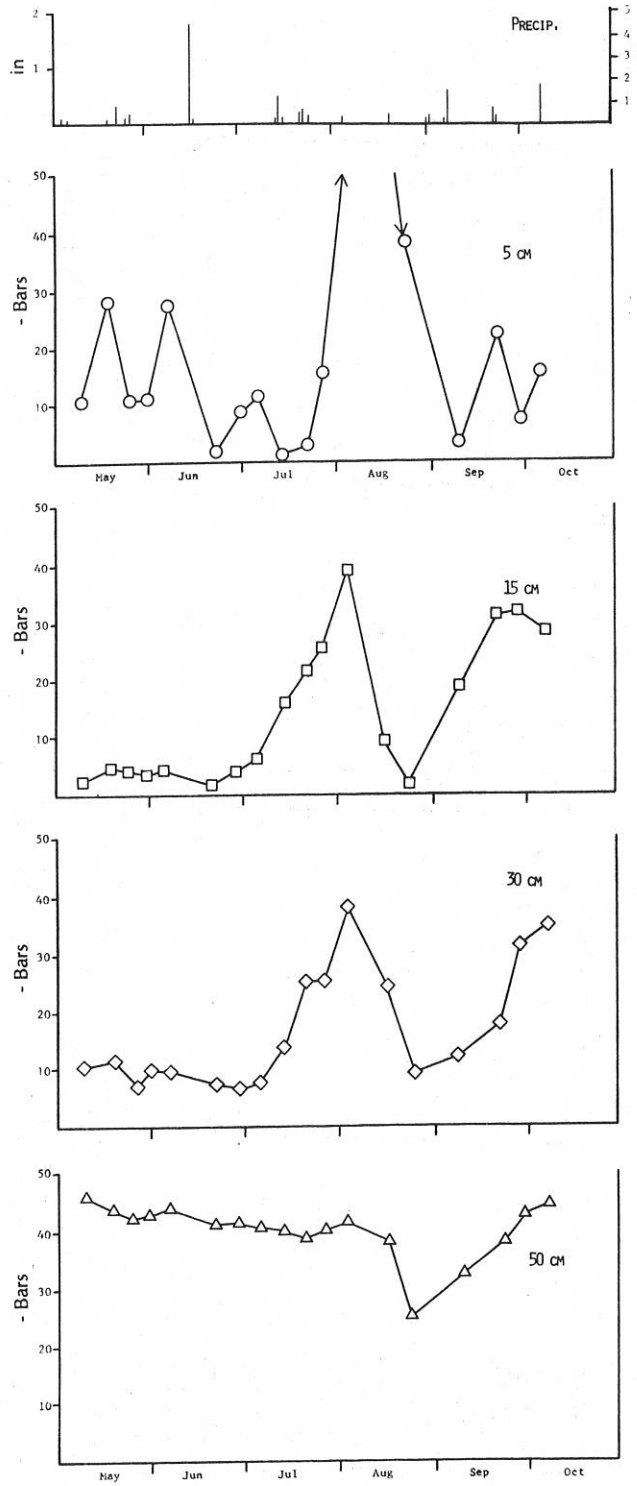

Figure 38. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; ANNUALS vegetation, plant interspaces, probe set B, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

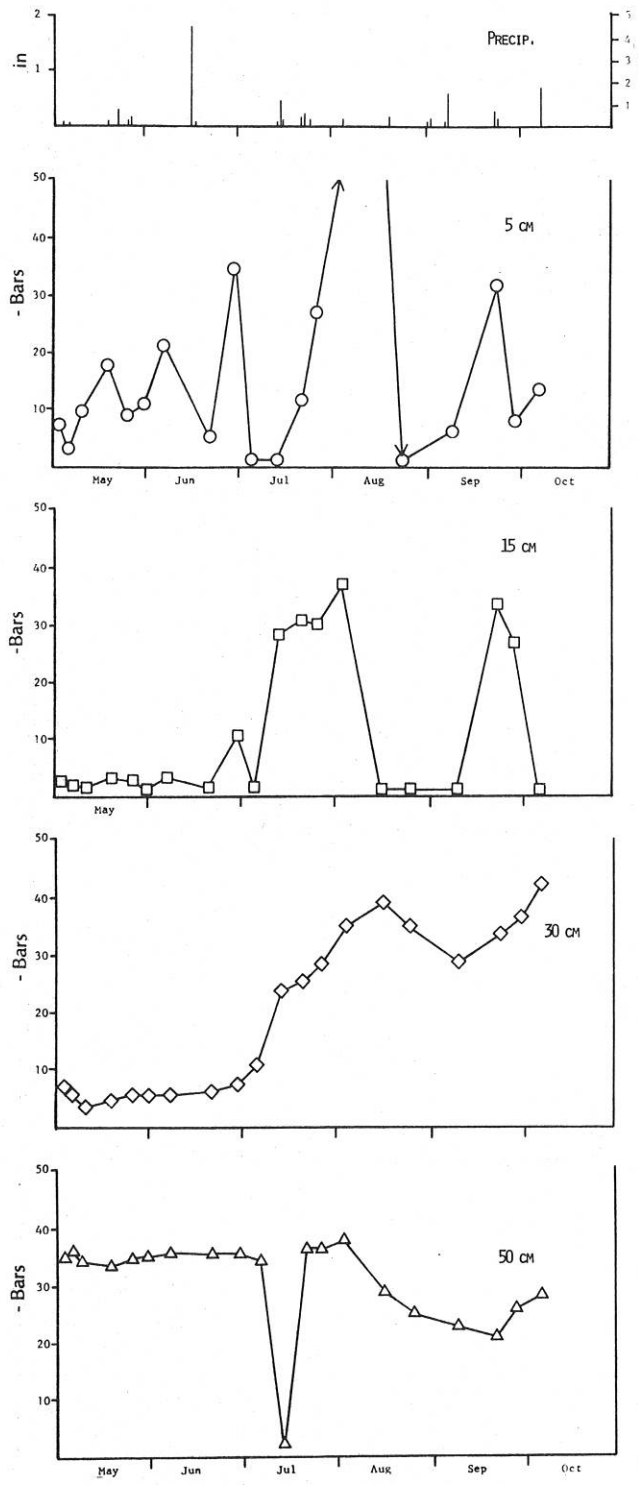

Figure 39. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; ANNUALS vegetation, plant interspaces, probe set D, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

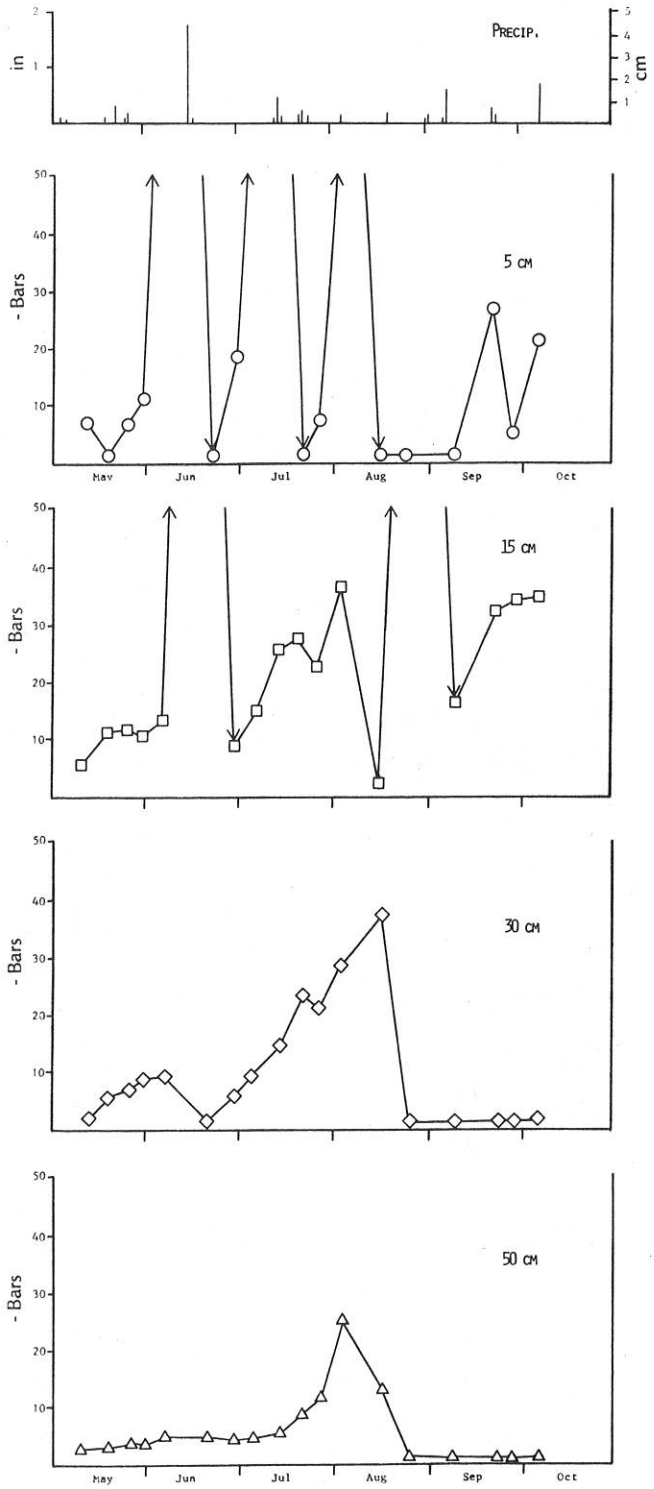

Figure 40. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; HAL-ART vegetation, under plant cover, probe set E, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

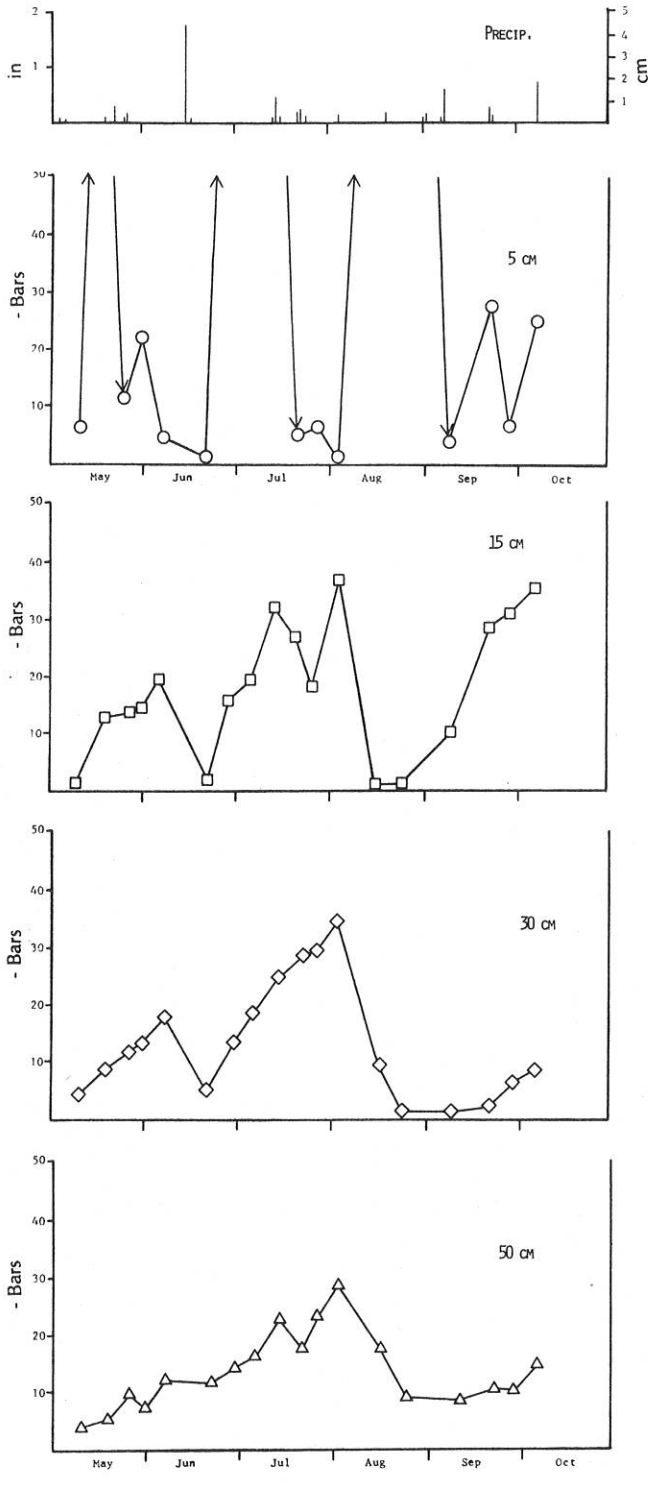

Figure 41. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; HAL-ART vegetation, under plant cover, probe set G, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

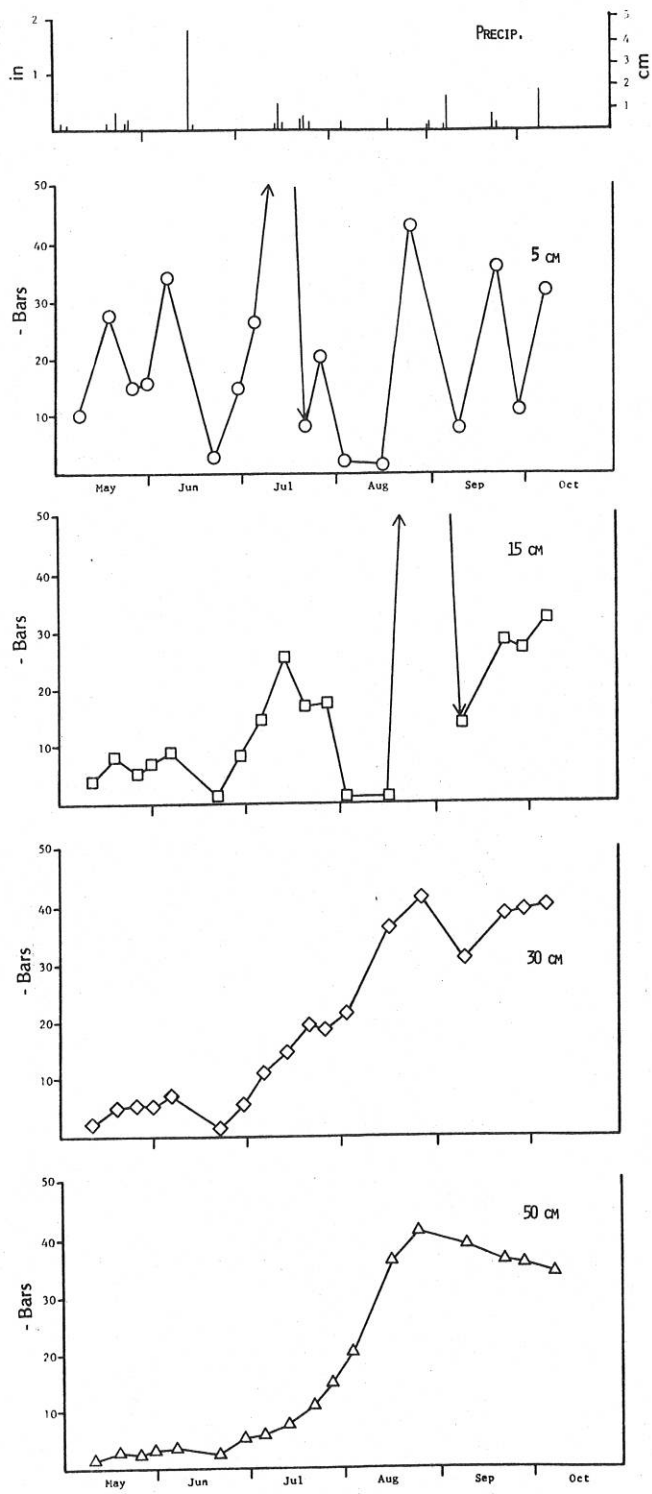

Figure 42. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; HAL-ART vegetation, plant interspaces, probe set F, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

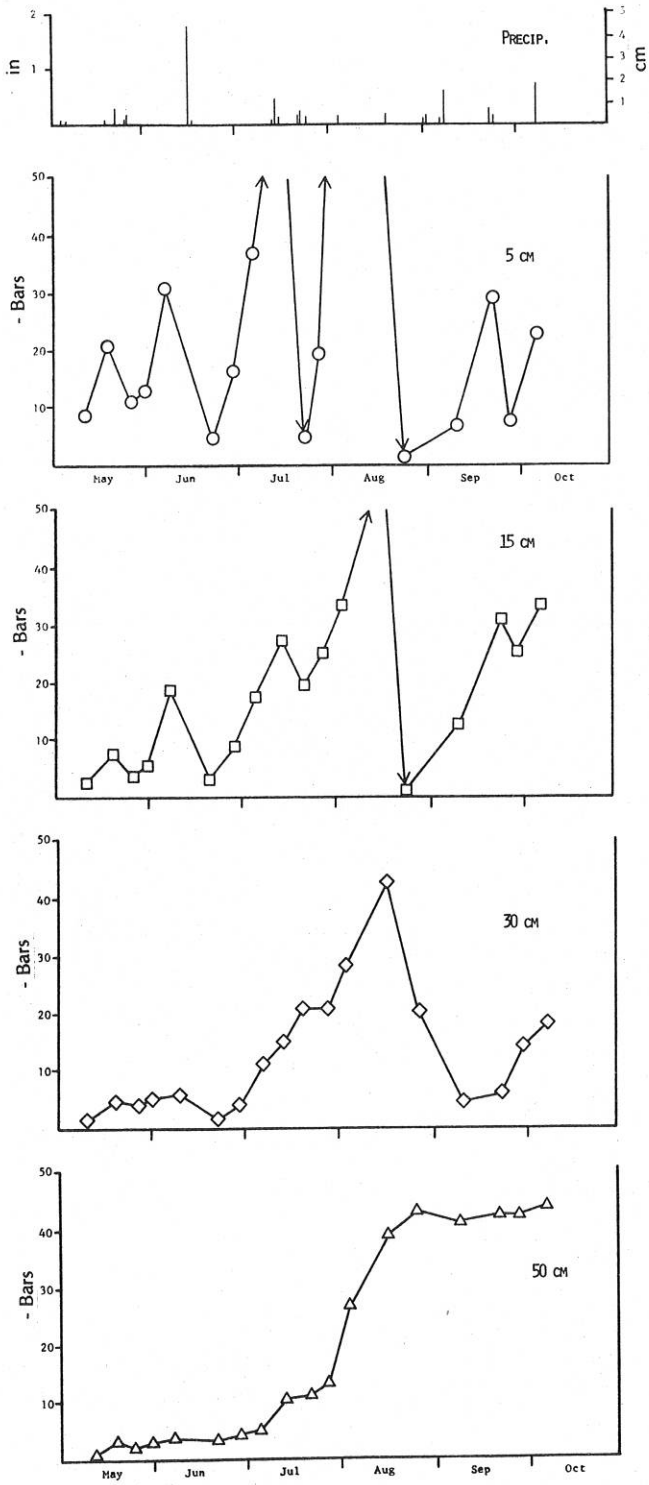

Figure 43. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; HAL-ART vegetation, plant interspaces, probe set H, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

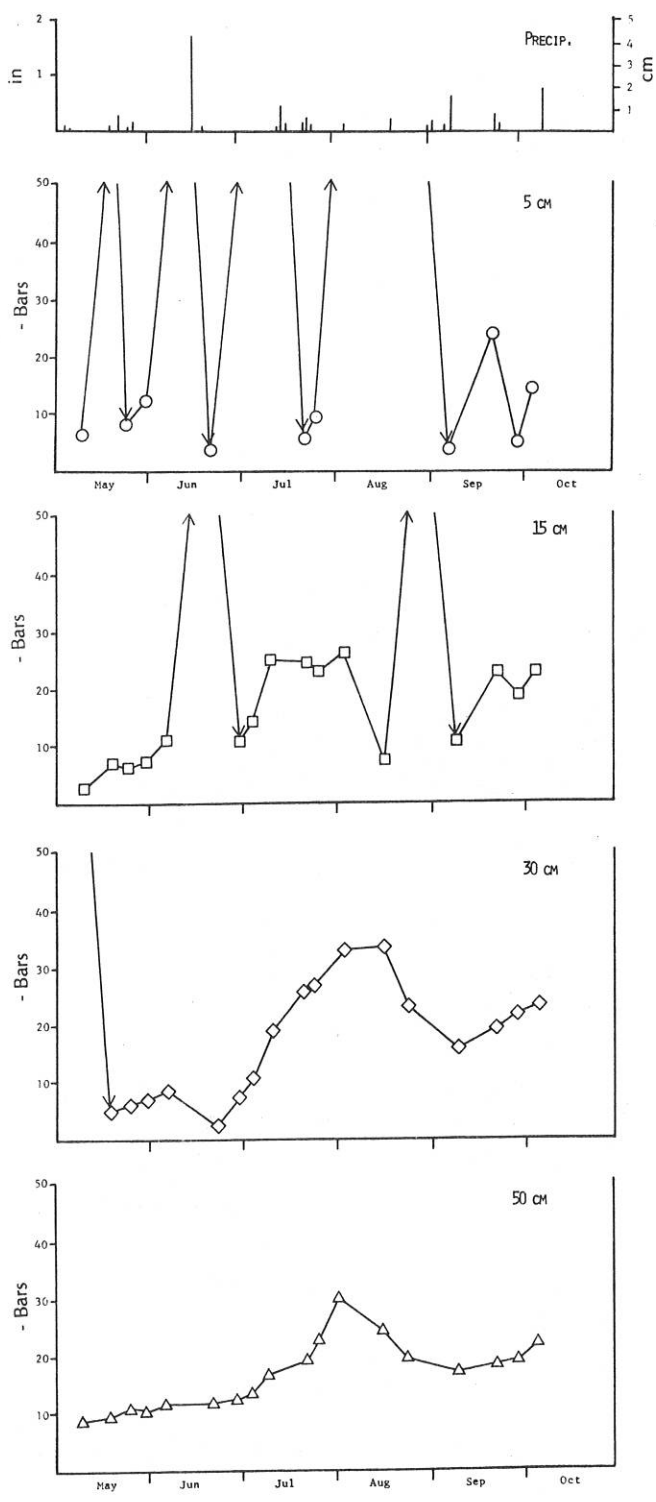

Figure 44. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken under plant cover, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

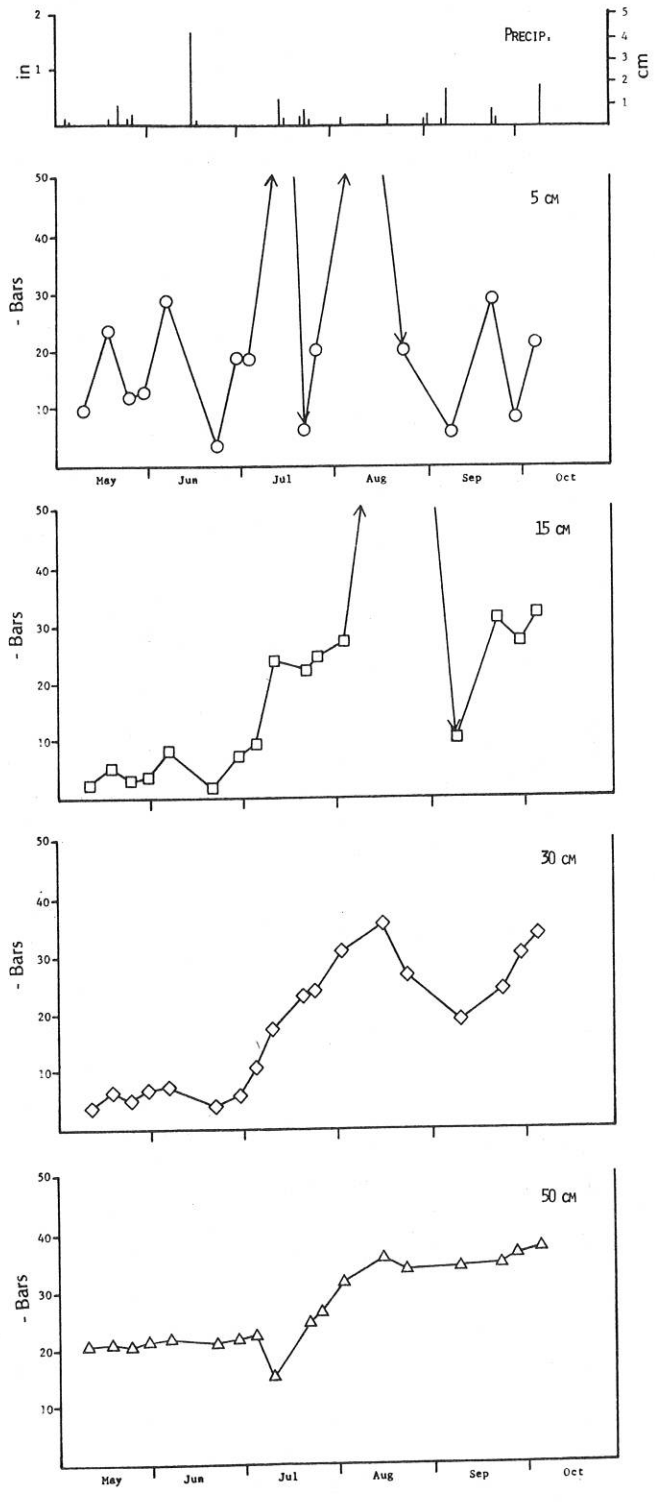

Figure 45. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken in plant interspaces, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

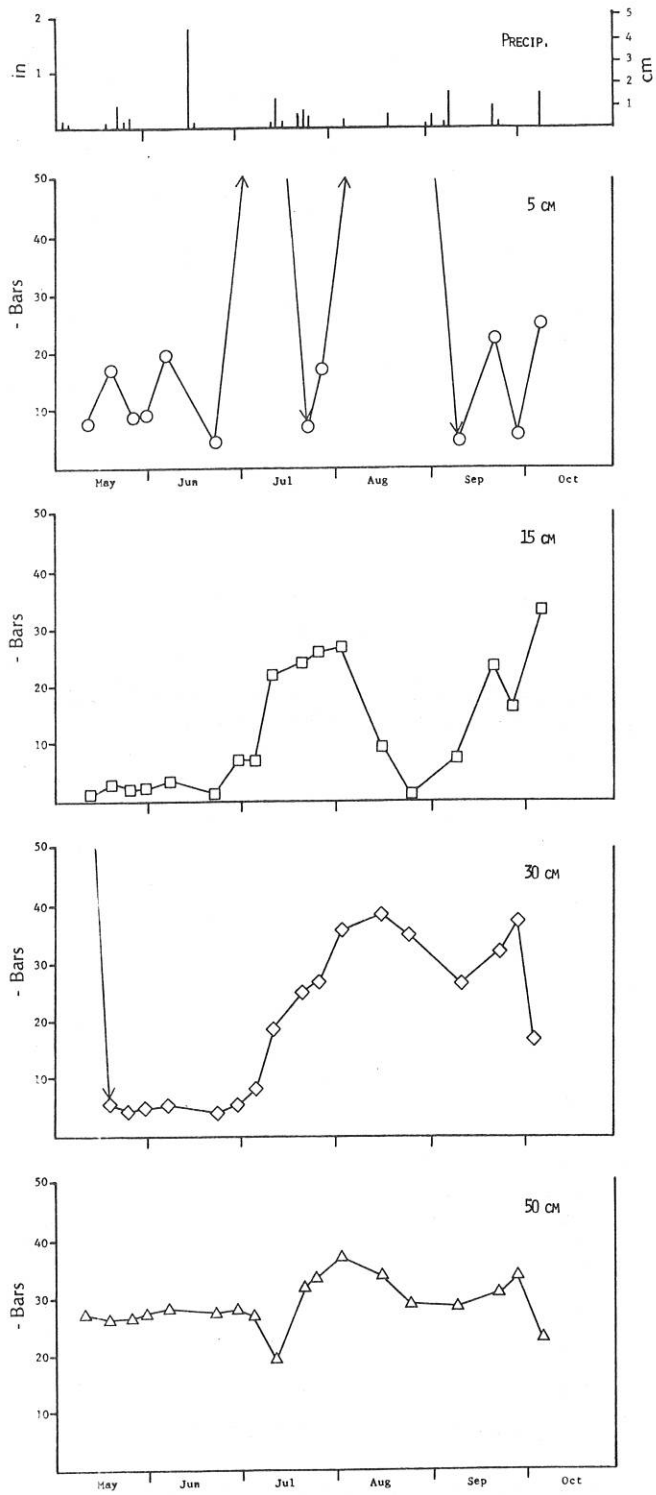

Figure 46. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken in the ANNUALS vegetation, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

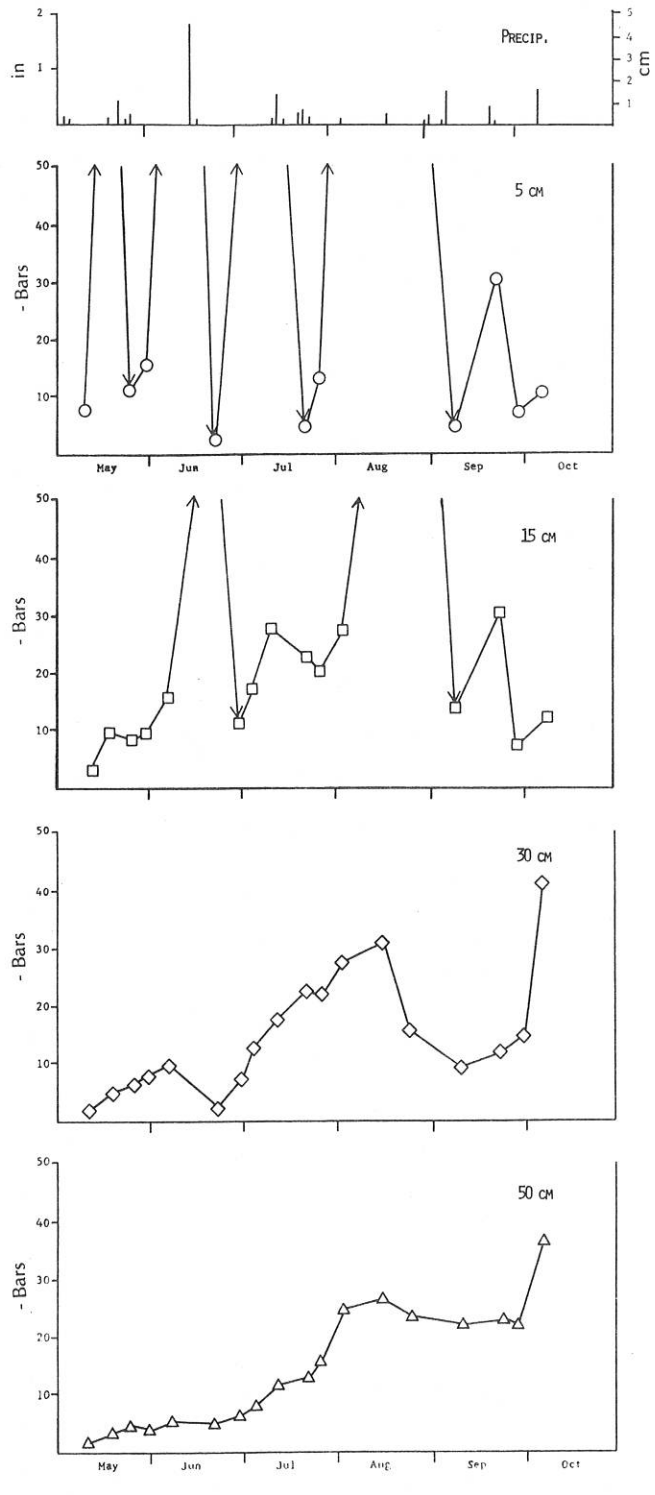

Figure 47. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken in the HAL-ART vegetation, 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

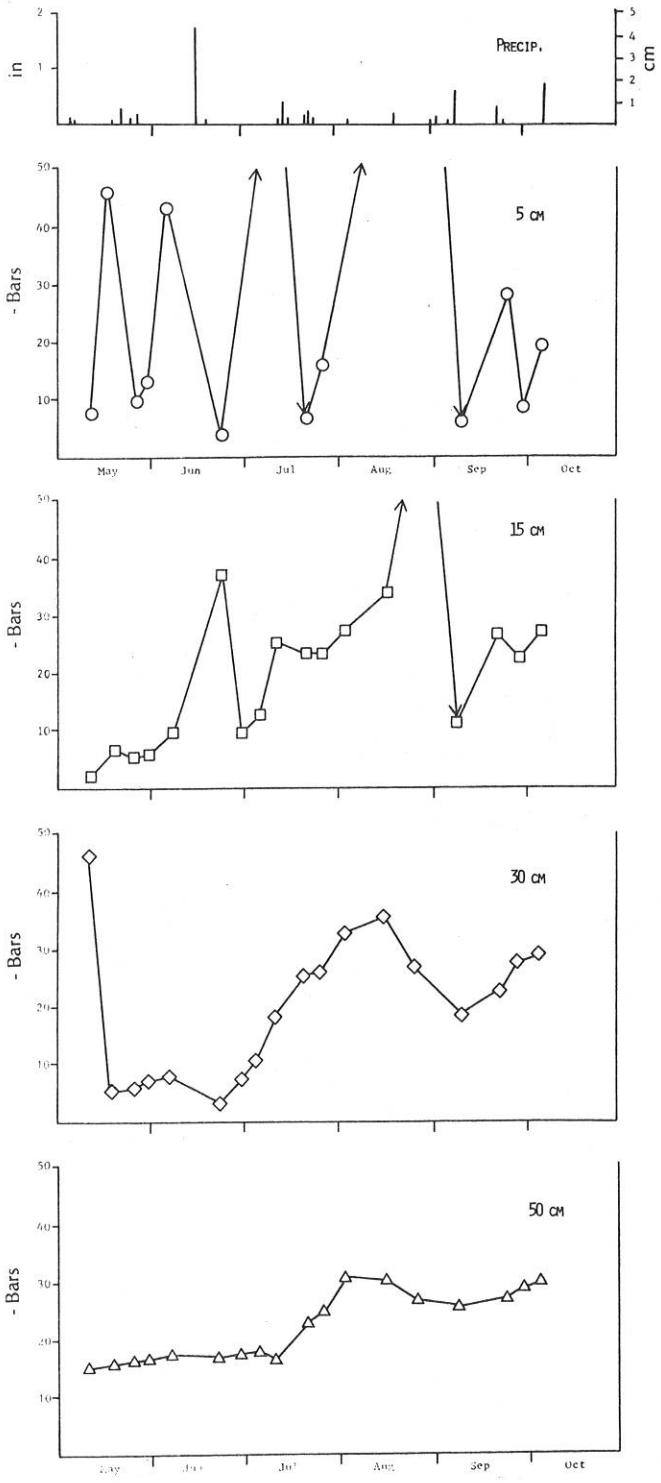

Figure 48. Soil water potentials at 5 cm, 15 cm, 30 cm and 50 cm; summary of all readings taken in 1973. Upper portion shows total precipitation fallen since last reading of the psychrometers.

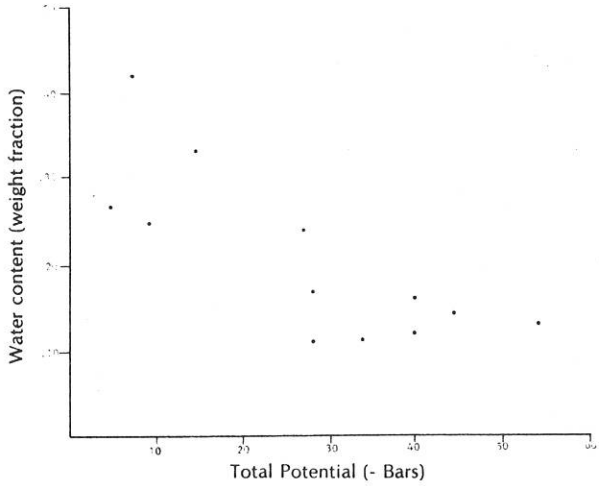

Figure 49. Relationship between soil water content and soil water potential for the Thiokol silt loam soils of the south sites.

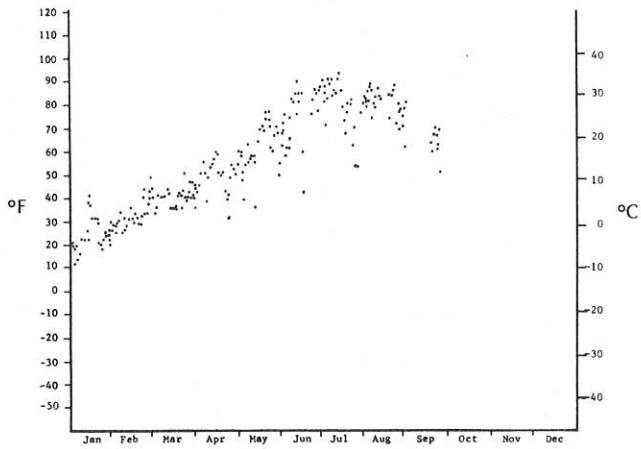

Figure 50. Daily maximum air temperatures on the northern sites, 1973.

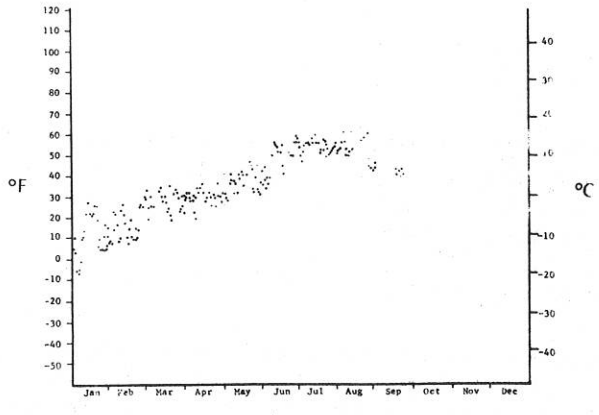

Figure 51. Daily minimum air temperatures on the northern sites, 1973.

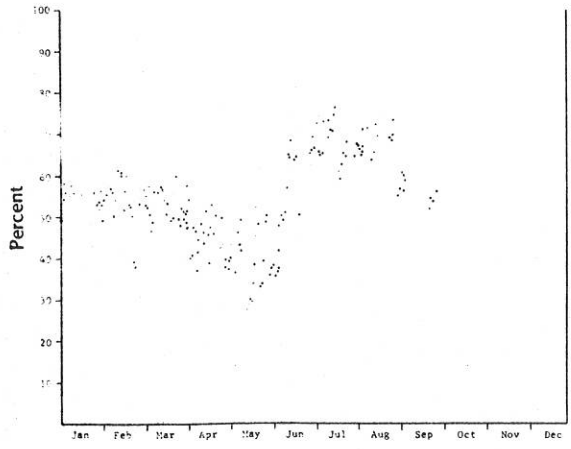

Figure 54. Daily mean relative humidity on the northern sites, 1973.

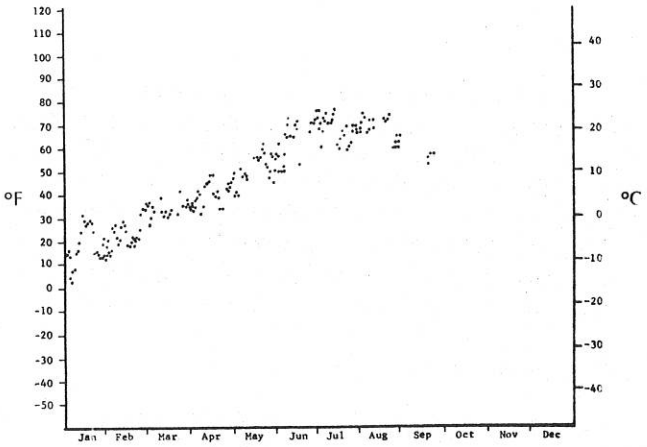

Figure 52. Daily mean air temperatures on the northern sites, 1973.

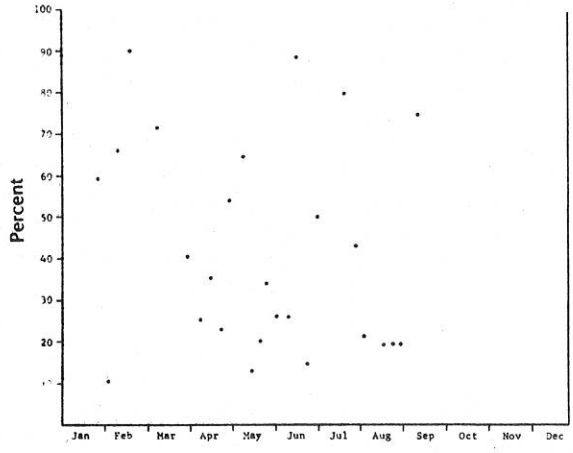

Figure 55. Weekly mid-day relative humidity on the northern sites, 1973.

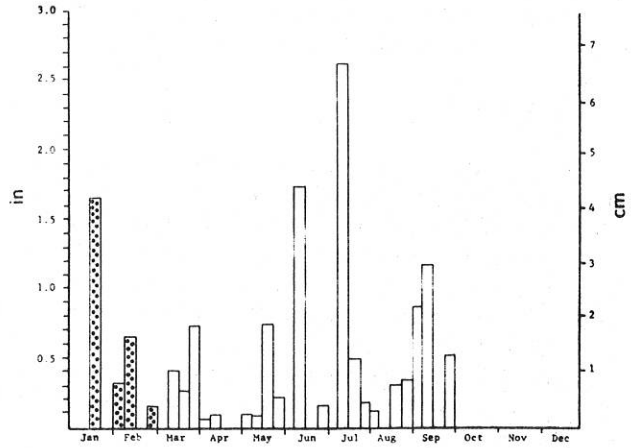

Figure 53. Weekly precipitation on the northern sites, 1973.

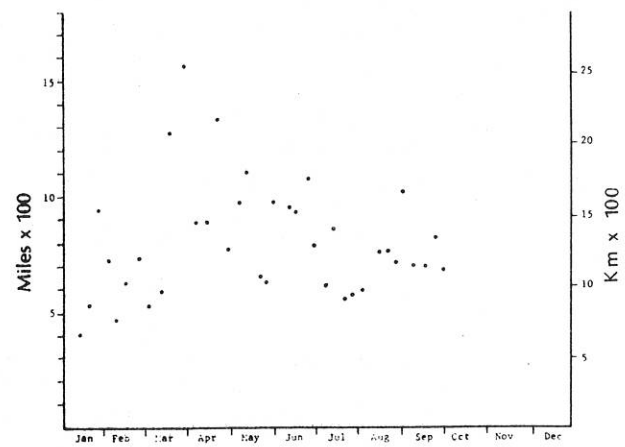

Figure 56. Weekly mean wind velocity (at 2 m) on the northern sites, 1973.

B. PLANTS

R. Shinn

Validation studies on vegetation in Curlew Valley began in June, 1971. Study sites were laid out in the north and south ends of the valley. At each site a representative shrub community adjoined a crested wheatgrass community. June and July were spent defining and documenting the structure of several vegetation types within the sites. August and September were spent harvesting plants, roots and litter from off-site locations in an effort to make standing crop estimates for each vegetation type. Tables summarizing the structure and biomass of each vegetation type are in the Curlew Valley Validation Site report, RM 73-1 (Balph et al., 1973).

In 1972 plant validation studies were done only on the south sites. Four vegetation types were studied and named for their dominant species: (1) *Artemisia-Atriplex-Sitanion*, (2) *Halogeton-Artemisia*, (3) ANNUALS, and (4) *Agropyron*. Documentation of the extent and structure of each vegetation type was continued through the summer of 1972. Each vegetation type was harvested for above-ground standing crop in the fall of 1972. The ART-ATR-SIT and *Agropyron* were sampled for root and litter biomass. Samples of the two dominant shrubs, *Artemisia tridentata* and *Atriplex confertifolia* were collected for laboratory breakdown into their component parts. The results were expressed in grams per plant in the last progress report (Balph et al., 1973).

In 1973 *Artemisia tridentata* were collected from the northern shrub community for productivity and distribution of biomass comparisons with those from the southern site (Table 24). A harvest study documenting productivity and material flow in *Artemisia* and *Atriplex* of the south site was begun. The fall quadrat harvest of plants, roots and litter was made in the ART-ATR-SIT and *Agropyron* vegetation. Productivity of annuals in the HAL-ART and ANNUALS vegetation types was documented as part of a process study undertaken by Lionel Klikoff of the University of Utah.

Plant validation studies for 1973 are herein reported along with summary tables drawn from data in RM 73-1 (Balph et al., 1973) for vegetation types of the north and south sites.

B.1. North Curlew Valley Sites

North Curlew Valley Shrub Site

The north site was studied only in 1971. On-site quadrat analysis data and off-site harvest data from several locations have been combined to provide the summary tables. Table 1 gives densities, mean heights, cover, basal area, and biomass values for the four most prominent perennial shrubs. Table 2 shows densities and biomass of perennial grasses. Table 3 gives the density and biomass of the Great Basin succulent *Opuntia polyacantha*. Table 4 gives the densities and biomass of the most important annual forbs and grasses of the shrub site (A3UBJC1).

North Curlew Valley Grass Site

This site was studied only in 1971. Table 5 shows the densities, mean heights, cover, basal area, and biomass of the dominant perennial shrubs. Table 6 gives the densities and biomass of the perennial grasses. Table 7 shows densities and biomass for the annual forbs and grasses of the grass site (A3UBJC2).

B.2. South Curlew Valley Sites

Annuals

The ANNUALS vegetation type comprises about 20 ha of the validation site. No data were collected in 1971. Data from 1972 show that *Halogeton glomerata* and *Bassia hyssopifolia* were the two highest biomass species. Table 8 gives the density and biomass estimates for the annual plants for August, 1972. The only perennial plant is the grass *Sitanion hystrix*. Its density and biomass are given in Table 9 along with that of standing dead shrubs (A3UBJC3).

Halogeton-Artemisia

The HAL-ART vegetation type comprises about 20 ha of the validation site. The only shrub is *Artemisia tridentata*. *Halogeton glomerata* and *Bassia hyssopifolia* are the dominant annuals. There is a high density of standing dead *Artemisia*. Densities and biomass of the annual plant species are given for August, 1972, in Table 10. Table 11 gives density, mean height, percent cover, percent basal area, and biomass for live and standing dead *Artemisia* and *Sitanion hystrix* (A3UBJC3).

Artemisia-Atriplex-Sitanion

This vegetation type of 60 ha is dominated by *Artemisia tridentata, Atriplex confertifolia* and *Sitanion hystrix*. The only annual plant with a relatively high biomass is *Halogeton glomerata*. Table 12 summarizes data taken on density, mean height, percent cover, percent basal area, and biomass of the dominant perennial shrubs for 1971-1973. Table 13 shows density and biomass of the perennial grass *Sitanion hystrix*. Table 14 gives density and biomass estimates for the annual plants for August, 1972. Data are stored under A3UBJC3.

In August of 1973, 10 sample quadrats were harvested for

plants; subsamples were taken on roots (A3UBJE3) and litter (A3UBJD3). Data are summarized in Table 15. Means and 90% confidence intervals are shown for cover, basal area, height, and biomass per individual by plant species. Root and litter sample means and confidence intervals are shown on a per sample basis. Biomass estimates are also given in kilograms per hectare for each component sampled. Refer to RM 73-1, page 101, Table 7, for the corresponding 1971 data and page 105, Table 17, for the 1972 data (Balph et al., 1973).

In April, 1973, we initiated a new approach to validation studies on the two dominant shrubs, *Artemisia* and *Atriplex*. The modeling effort requires that we determine the states of the plant community at several points through the growing season. The modellers must know how much structural plant material is in each component of the plant subsystem at several points in time. They require data on the conversion of living structural plant material into dead fallen material available to other subsystems. They need to know how much carbon and nitrogen is tied up in each component. This work endeavors to provide some data on these questions.

In the first week in April, 1973, we color-tagged 120 plants of both species. All plants were selected for their dimensional uniformity and resemblance to the statistical "average" plant. Beginning in April and continuing through September, 20 randomly selected tagged plants (A3UBJS3) of each species were harvested at intervals through the growing season. Each plant harvested was measured in the field and cut at ground level. A litter (A3UBJD3) and two root (A3UBJE3) subsamples were made under each plant canopy. Harvested materials were brought into the lab and separated into 11 categories.

Each component was dried and weighed. Changes in the plant subsystem are measured as changes in plant dimensions and changes in the distribution of biomass among plant and litter components. Each biomass component has been submitted for protein, caloric, ash, and fat content analysis. When the analytic work is finished we will have the biomass, protein, caloric, ash, and fat content of each plant component at several points in time. This data will be available to validate the model simulation of the flow of these materials through the system.

Means and confidence intervals of plant dimensions and biomass of plant components of *Atriplex* are shown in Table 16. Analysis of variance and least significant difference tests were made to check for significant differences between consecutive sample dates. Asterisks on the table denote significant differences ($\alpha = .1$). Many of the parameters monitored are shown in time scale graphs in Figures 1-16.

Atriplex may produce a small amount of new leaf and herbaceous stem material during the winter or very early spring. The most rapid leaf production occurred at an even rate from April through late June (Figure 6). Herbaceous stem production appears greatest from May through August (Figure 5). Reproductive material is produced mainly in June. Data show that the average plant sheds about 20 g of woody material between April and May (Figures 4 and 7). Examination of Figures 10-13 on litter show that much of the wood lost from the plants appears as < 2mm size litter particles under the plant canopy.

Net changes through the season include horizontal and vertical growth returning the plants to their pre-May dimensions. There is a net loss of 24 g of woody material and an increase of 21 g new leaf and 12 g herbaceous material. Figure 9 shows the sum of new leaf, plus new herbaceous, plus reproductive parts as the current years net above-ground primary production. This totaled 35 g per plant at the end of the season. Root biomass showed a net increase. Amounts and rates of material storage appear greater in the 0-20 cm root zone than the 20-40 cm zone (Figures 14-16). All categories of soil surface litter showed a net decrease through the season (Figures 10-13). The mass of the larger categories decreased most rapidly in April and May as the mass of the < 2mm category increased. The < 2 mm category then began decreasing at the end of May. Note that measurements of root and litter material only reflect the state of the system at a point in time. We did not separate the plant's input to these categories from that removed by death and detritivory.

The category "discolored leaves" found in Table 16 is a measure of leaf herbivory. Microscopic examination of these leaves by entomologists yielded evidence of sap-sucking activity by insects. Eighteen percent by weight of the total leaves were discolored in late June. Nine percent were found discolored in mid-August.

Table 17 summarizes the findings on *Artemisia tridentata*. This shrub maintains active leaves throughout the winter but does not produce any measurable new leaf or herbaceous material. The first sample of the season taken in mid-April documents the state of the plants before they became active in the spring. The mid-April sample of leaves and herbaceous stems reflects their biomass remaining from the previous growing season. Figures 17-32 show the changes in the components with respect to time. As *Artemisia* becomes active in the spring there is a shedding of about 72 g per plant of old and dead woody material (Figures 20 and 23). There is a coincident decrease in the height, cover and basal area of the plant (Figures 17-19). This material falls as litter and causes some increase in the woody and < 2 mm litter categories (Figures 26 and 28). The biomass of root material is at its lowest point of the growing season (Figures 30-32). A flush of new leaf production begins in April and continues into June. In June these highly photosynthetic leaves begin to fall as soil water potentials decrease. These leaves are replaced by a fewer number and biomass of lower productivity maintenance leaves. Leaf production between April and May was about

24 g per plant. Production of new herbaceous stems begins in late May and continues through the growing season. Herbaceous stem production totaled about 17 g per plant. As the growing season progresses there is an increase in woody material as the previous seasons' herbaceous growth becomes lignified. The above-ground net standing primary productivity peaked in early June, flowering began late in July. The total production of measurable leaves plus herbaceous stems plus infloresences averaged 44 g per plant. Plant size peaked in July and there was another shedding of woody materials in late August. Total root biomass increased from April through July and then began to decrease. Rates of material storage and withdrawal appear to be greater in the 0-20 cm root zone than in the 20-40 cm zone (Figures 30-32).

Woody litter increases from April through June, decreases into late July and increases again in August and September. Fluctuations in the two other litter categories correspond with, but lag behind, the woody litter fluctuations (Figures 26-29).

Examination of discolored leaves showed signs of insect herbivore activities. In late July, 29% by weight of the total leaves were discolored. In September, 23% were affected.

We assume densities of *Artemisia* and *Atriplex* did not change significantly between August, 1972, and August, 1973. Table 18 compares the distribution of biomass among the component parts of *Atriplex* for the two years. Table 19 gives the same information for *Artemisia*. Growing season precipitation in 1972 was 186 mm. It totaled 391 mm in 1973. *Atriplex* showed a significant response to the differences in total precipitation in 1972 and 1973. In 1972 new leaves plus herbaceous stems plus flower biomass was less than 1% of the total biomass of the plant. In 1973 the same components comprised 52% of the total biomass. In contrast net primary productivity of *Artemisia* was 13% of the total in 1972 and 15% of the total in 1973. Two different strategies are apparent. *Atriplex* appears to have the genetic capability of large productivity over only a limited range of favorable soil water conditions. In contrast, *Artemisia* apparently does not have the genetic potential for high productivity but produces a lesser amount of new material per plant over a very broad range of soil water conditions.

Agropyron

This vegetation type comprises about 100 ha. Forty ha have been fenced to exclude cattle. Three shrubs occur in the area. Table 20 gives their densities, mean height, percent cover, percent basal area, and mean biomass for 1971-73 (A3UBJC4). The major contributor to plant biomass is *Agropyron desertorum* (erroneously labeled *Agropyron cristatum* in RM 73-1). Table 21 gives the density and biomass of the perennial grasses. *Halogeton glomerata* is the most prevalent annual with a 1973 density of only 750 per hectare and biomass of .28 kg per ha.

In August, 1973, 10 sample quadrats were harvested and subsampled for roots (A3UBJE4) and litter (A3UBJD4). The findings are summarized in Table 22.

Combining data collected from the same sample hectare in August, 1971 (RM 73-1, page 114, Table 28), August, 1972 (RM 73-1, page 117, Table 33) and 1973 yields three years of above-ground standing crop estimates. Figure 33 shows the relationship between above-ground standing crop and September through August precipitation for these three years.

Table 23 shows the caloric, ash, protein, and fat content of the plant material harvested in late August, 1972 and 1973. Protein was the only material which changed significantly in concentration between years. Protein concentration of new above-ground growth, measured in percent by weight, decreased almost 50% from 1972 to 1973. August through September precipitation was less than 200 mm in 1972 and greater than 400 mm in 1973. Assuming new growth-old growth ratios equal for the two years, there was about 35 kg/ha of protein in the 1972 above-ground standing crop and 90 kg/ha in 1973 (A3UBJY4).

Protein and ash have higher concentrations per gram than below-ground materials. Calories and fats have higher concentrations in above-ground materials. The amounts of carbon, ash, protein and fat, tied up per hectare in below-ground materials far exceeds the amounts estimated for above-ground (A3UMM01).

In 1974 no work will be done in north Curlew Valley. Studies will be continued on the four vegetation types identified on the south sites. More effort will be put into determining net primary productivity and material flow in the three major perennials, *Artemisia tridentata*, *Atriplex confertifolia* and *Agropyron desertorum*. Klikoff will combine his work in the ANNUALS and *Halogeton-Artemisia* vegetation types.

Literature Cited

Balph, D.F. (Coordinator). 1973. Curlew Valley Validation Site Report. US/IBP Desert Biome Res. Memo. 73-1.

Table 1. Densities, height, percent cover, percent basal area and biomass of perennial shrubs on the Curlew Valley northern shrub site, 1971

Species	Density N/Ha	Mean Height (cm)	Cover %	Basal Area %	Biomass Kg/Ha
Artemisia tridentata	32,900	48	30.5	.30	5813
Chrysothamnus nauseous	1,000	38	.4	.01	11
Chrysothamnus viscidiflorus	6,000	35	4	.16	346
Gutierrezia sarothrae	15,500	26	10		944

Table 2. Densities and biomass of perennial grasses of the Curlew Valley northern shrub site, 1971

Species	Density N/Ha	Biomass Kg/Ha
Agropyron smithii	1,000	27
Agropyron spicatum	700	12
Poa secunda	6,600	60
Sitanion hystrix	8,000	212

Table 3. Density and biomass of the perennial succulent *Opuntia polyacantha* of the Curlew Valley northern shrub site, Fall 1971

Density N/Ha	Biomass Kg/Ha
2,000	166

Table 4. Densities and biomass of annual forbs and grasses of the Curlew Valley northern shrub site, Fall 1971

Species	Density N/Ha	Biomass Kg/Ha
Agoseris glauca	1,000	< 1
Allium acuminatum	8,000	13
Astragalus beckwithii	2,000	4
Astragalus convallarius	3,300	94
Bromus tectorum	9,300	136
Camelina microcarpa	3,300	1
Chaenactis douglasii	1,300	1
Collinisia parviflora	8,300	17
Cordylanthus ramosus	2,300	13
Descurainia pinnata	700	< 1
Erigeron pumilis	700	1
Eriogonum microthecum	700	11
Gayophytum ramosissimum	2,600	1
Lepidium densiflorum	1,000	< 1
Microsteris gracilis	8,700	15
Phlox longifolia	3,300	2
Polygonum douglasii	1,300	< 1
Ranunculus testiculatus	1,000	1
Veronica bilboba	3,300	9

Table 5. Densities, height, percent cover, percent basal area and biomass of perennial shrubs on the Curlew Valley northern grass site, Fall 1971

Species	Density N/Ha	Mean Height (cm)	Cover %	Basal Area %	Biomass Kg/Ha
Artemisia tridentata	28,500	56	34.38	.56	12451
Chrysothamnus nauseous	4,500	29	1.49	.01	299
Chrysothamnus viscidiflorus	7,000	22	.65	.02	575

Table 6. Densities and biomass of perennial grasses of the Curlew Valley northern grass site, Fall 1971

Species	Density N/Ha	Biomass Kg/Ha
Agropyron desertorum	73,000	417
Poa bulbosa	7,000	240
Poa secunda	2,500	20

Table 7. Densities and biomass of annual forbes and grasses of the Curlew Valley northern grass site, Fall 1971

Species	Density N/Ha	Biomass Kg/Ha
Allium acuminatum	1,000	< 1
Aster sp.	1,000	1
Astragalus beckwithii	1,000	1
Astragalus convallarius	3,000	2
Bromus tectorum	3,000	7
Collinisia parviflora	1,500	13
Gayophytum ramosissimum	1,000	< 1
Microsteris gracilis	1,500	< 1

Table 8. Densities and biomass of annual plants of the Curlew Valley south site ANNUALS vegetation type

Species	Density N/Ha 1972	Biomass Kg/Ha 1972
Bassia hyssopifloia	5,132,133	308
Chenopodium album	2,750	1
Descurainia pinnata	201,917	18
Halogeton glomerata	2,199,917	335
Lepidium perfoliatum	34,500	17
Salsola kali	345,833	131

Table 9. Density and biomass of the perennial grass *Sitanion hystrix* and standing dead shrubs of the Curlew Valley south site ANNUALS vegetation type, 1971-73

Species	Density N/Ha	Biomass Kg/Ha
Sitanion hystrix	3650	7
STANDING DEAD	2400	2529

Table 10. Densities and biomass of annual plants of the Curlew Valley south site *Halogeton - Artemisia* vegetation type

Species	Density N/Ha 1972	Biomass Kg/Ha 1972
Bassia hyssopifolia	12,750	2,879
Descurainia pinnata	231,197	27
Halogeton glomerata	545,417	1,330
Salsola kali	275,000	105

Table 11. Density, height, cover, basal area and biomass of perennial shrubs and grass of the Curlew Valley south site *Halogeton - Artemisia* vegetation type, 1971-73

Species	Density N/Ha	Mean Height (cm)	Cover %	Basal Area %	Biomass Kg/Ha
Artemisia tridentata	1250	72	3	.04	643
DEAD *Artemisia*	5875				6191
Sitanion hystrix	800				2

Table 12. Density, height, cover, basal area and biomass of perennial shrubs of the south site *Artemisia - Atriplex - Sitanion* vegetation type, 1971-73

Species	Density N/Ha	Mean Height (cm)	Cover %	Basal Area %	Biomass Kg/Ha
Artemisia tridentata	9391	56	10	.47	2188
Atriplex confertifolia	23491	28	9	.47	1362
Chrysothamnus viscidiflorus	1380	45	2	.05	
Standing dead shrubs	11366				2114

Table 13. Density, height, cover, basal area and biomass of the perennial grass *Sitanion hystrix* of the Curlew Valley south site *Artemisia tridentata - Atriplex confertifolia - Sitanion hystrix* vegetation type, 1971-73

Density N/Ha	Mean Height cm	Cover %	Basal Area %	Biomass Kg/Ha
59982	21	.63	.63	120

Table 14. Densities and biomass of annual forbs and grasses of the Curlew Valley south site *Artemisia - Atriplex - Sitanion* vegetation type, August 1973

Species	Density N/Ha 1972	Biomass Kg/Ha 1972
Descurainia pinnata	47,375	8
Halogeton glomerata	28,875	70
Lepidium perfoliatum	1,750	.88
Phlox longifloia	250	.05
Bromus tectorum	375	.19

Table 15. Quadrat analysis of ART-ATR-SIT vegetation type on southern shrub site (sample taken off-site hectare No. 10, August, 1973)

Species	Density (m^2)	Frequency	Cover per Indiv. (cm^2)	90% C.I.	Basal Area per Indiv. (cm^2)	90% C.I.	Height per Indiv. (cm)	90% C.I.	Weight per Indiv. (g)	90% C.I.	Cover %	Basal Area (%)	Biomass (kg/ha)
ARTTRI	1.43	.9	977	±240	18	±4	48	±4	262	±59	14	.25	3747
ATRCON	2.98	1	228	± 70	6	±1	23	±1	54	±12	7	.17	1609
SITHYS	4.10	.9			8	±2	19	±1	3	± 1	.33	.33	123
STADEA	1.50	1											4132
Woody litter									17.15	± 2.52			3430
Leaf litter									39.95	± 3.66			7990
Fecal litter									.34	± .07			68
Roots (0-20 cm)									8.61	± .55			17134
Roots (20-40 cm)									5.84	± .39			11622
Roots (40-60 cm)													5607

Table 16. Dynamics of productivity and biomass flux among components of *Atriplex confertifolia* of the Curlew Valley south *Artemisia-Atriplex-Sitanion* vegetation type, 1971-73

	4/21/73 N=10		5/17/73 N=20		6/26/73 N=20		8/11/73 N=20
Height (cm)	31.00 ± 1.34		21.50 ± .49		29.95 ± 1.42		30.55 ± 1.04
Cover (cm^2)	666.00 ± 91.07	*	381.80 ± 37.76	*	501.05 ± 74.41	*	618.95 ± 57.57
Basal (cm^2)	7.70 ± 1.47		2.95 ± .77		3.40 ± .59		3.40 ± .52
Discolored Leaves (g/p)	0		0		3.31 ± .68		2.24 ± .56
Woody (g/p)	54.07 ± 10.10	*	34.44 ± 6.91		36.86 ± 6.20		37.88 ± 5.30
Herb. stems (g/p)	1.52 ± .43		1.57 ± .25		7.71 ± 1.39		13.88 ± 4.00
Leaf (g/p)	3.93 ± .94	*	9.53 ± 1.05	*	18.44 ± 3.56	*	24.95 ± 4.48
Flower (g/p)	0		.0023 ± .0022		3.51 ± 6.05		0
Total (g/p)	71.66 ± 12.74	*	52.50 ± 8.97	*	71.19 ± 9.84		80.21 ± 9.73
Dead wood (g/p)	12.14 ± 4.66	*	6.99 ± 2.89		3.74 ± 2.18		4.76 ± 1.68
Woody litter (g/s)	15.65 ± 9.65	*	10.46 ± 2.31	*	5.94 ± 1.65		5.80 ± 1.42
> 2mm litter (g/s)	15.25 ± 2.75		14.43 ± 1.75	*	11.95 ± 1.09	*	14.33 ± 1.25
< 2mm litter (g/s)	23.88 ± 3.19	*	31.80 ± 4.63	*	24.21 ± 3.74		22.05 ± 3.04
Litter Total (g/s)	54.93 ± 13.43	*	57.04 ± 6.54	*	42.51 ± 5.21		42.46 ± 4.46
0-20 roots (g/s)	7.10 ± .51		10.38 ± 1.40		10.45 ± 1.43		10.26 ± 1.01
20-40 roots (g/s)	3.43 ± .26		4.77 ± .51		5.42 ± .45		5.96 ± .40
Roots Total (g/s)	10.53	*	15.15		15.87		16.22

Table 17. Dynamics of productivity and biomass flux among components of *Artemisia tridentata* of the Curlew Valley south *Artemisia - Atriplex - Sitanion* vegetation type, April - September, 1973. $\mathcal{L} = .10$

	4/15/73 N=10		5/10/73 N=20		6/4/73 N=20		7/25/73 N=20		9/17/73 N=20
Height (cm)	54.4 ± 1.45		53.10 ± 1.38		57.65 ± 3.06	*	65.65 ± 2.15	*	59.20 ± 6.16
Cover (cm^2)	1957.0 ±280.0	*	1293.65 ±195.33		1241.35 ±167.77	*	1564.20 ±200.65	*	1204.95 ±164.17
Basal (cm^2)	23.1 ± 3.49	*	14.20 ± 1.76		11.75 ± 1.52	*	17.35 ± 3.47	*	11.85 ± 2.34
Discolored leaves (g/p)	0		0		0	*	9.39 ± 1.52	*	4.08 ± .83
Woody (g/p)	209.12 ± 30.14	*	158.64 ± 11.84	*	197.20 ± 19.83		215.35 ± 19.17		205.66 ± 17.41
Herb. stems (g/p)	19.69 ± 3.51	*	0	*	8.45 ± 1.38	*	15.13 ± 1.27		16.95 ± 2.43
Leaf (g/p)	28.13 ± 5.30	*	35.01 ± 3.25	*	52.56 ± 5.29	*	32.10 ± 3.91	*	17.80 ± 1.98
Flower (g/p)	0		0		0		1.13 ± .28		2.21 ± .43
Total (g/p)	311.59 ± 40.28	*	224.21 ± 17.12	*	288.53 ± 27.27		316.91 ± 28.37		298.99 ± 23.78
Age (yr/p)	18.00 ± 2.10		17.70 ± 1.53		19.20 ± 1.29		17.25 ± 1.71		16.00 ± 1.22
Dead wood (g/p)	54.60 ± 13.06	*	32.81 ± 5.70		30.37 ± 4.85		33.58 ± 8.84		32.44 ± 6.60
Woody litter (g/s)	6.10 ± 2.34		7.96 ± 2.15		9.30 ± 3.34	*	6.05 ± 1.15	*	9.38 ± 1.99
> 2mm litter (g/s)	13.57 ± 2.03		11.90 ± 1.75	*	15.95 ± 2.30	*	17.80 ± 1.56		15.82 ± 1.62
< 2mm litter (g/s)	32.28 ± 3.32		32.53 ± 2.95	*	48.00 ± 5.22		50.23 ± 6.43	*	41.75 ± 3.68
Litter Total (g/s)	55.55 ± 8.63		52.74 ± 5.38	*	73.44 ± 7.43		74.32 ± 7.52	*	67.55 ± 8.43
0-20 roots (g/s)	7.51 ± 5.43		9.01 ± .94		11.29 ± 1.07		10.79 ± 1.07		9.99 ± 1.04
20-40 roots (g/s)	3.26		3.97 ± .26		4.92 ± .42		6.06 ± .63		5.48 ± .50
Roots Total (g/s)	10.77	*	12.98	*	16.21		16.85		15.47

Table 18. Biomass of separate plant components of *Atriplex confertifolia*, Curlew Valley south site *Artemisia - Atriplex - Sitanion* vegetation, 1972 and 1973

	August, 1972	August, 1973
Density (N/Ha)	23,491	23,491
Woody stems (Kg/Ha)	1,106	890
Herbaceous stems (Kg/Ha)	23	326
Leaves (Kg/Ha)	108	586
Inflorescences (Kg/Ha)		82
Deadwood (Kg/Ha)		112
Total (Kg/Ha)	1,269	1,884

Table 19. Biomass of separate plant components of *Artemisia tridentata* of the Curlew Valley south site *Artemisia - Atriplex - Sitanion* vegetation, 1972 and 1973

	August, 1972	August, 1973
Density (N/Ha)	9,391	9,391
Woody stems (kg/Ha)	1,534	2,022
Herbaceous stems (Kg/Ha)	122	149
Leaves (Kg/Ha)	176	301
Inflorescences (Kg/Ha)	26	21
Dead wood (Kg/Ha)	480	315
Total (Kg/Ha)	2,413	2,976

Table 20. Density, height, cover, basal area and biomass of perennial shrubs of the Curlew Valley south site *Agropyron* vegetation type, 1971-73

Species	Density N/Ha	Mean Height (cm)	Cover %	Basal Area %	Biomass Kg/Ha
Artemisia tridentata	600	25	.06	.01	5
Atriplex confertifolia	9411	20	1.27	.06	103
Chrysothamnus viscidiflorus	1478	27	.31	.01	85

Table 21. Density and biomass of the perennial grasses of the Curlew Valley south site *Agropyron* vegetation type, 1971-73

Species	Density N/Ha	Biomass Kg/Ha 1971	1972	1973
Agropyron desertorum	107,344	2,227	596	2,040
Sitanion hystrix	8,500	69	27	

Table 22. Quadrat analysis of vegetation on southern grass site (sample taken off-site hectare No. 15, August, 1973)

Species	Density (m^2)	Frequency	Cover per Indiv. (cm^2)	90% C.I.	Basal Area per Indiv. (cm^2)	90% C.I.	Height per Indiv. (cm)	90% C.I.	Weight per Indiv. (g)	90% C.I.	Cover (%)	Basal Area (%)	Biomass (kg/ha)
AGRCRI	11.35	1			38	±4	37	±1	19	±2	4	4	2157
Woody litter									12.58	±2.14			2516
Grass litter									23.65	±1.48			4730
Roots (0-20 cm)									8.97	± .63			17850
Roots (20-40 cm)									4.77	± .26			9492
Roots (40-60 cm)													4922

Table 23. Concentration of calories, ash, protein and fat in four plant components of *Agropyron desertorum* harvested in late August 1972 and 1973

Components	Calories (Cal/g) 1972	1973	Ash (%) 1972	1973	Protein (%) 1972	1973	Fat (%) 1972	1973
New Growth	4214 ± 48	4234 ± 1.07	6.00 ± .73	6.27 ±1.85	6.70 ± .78	3.58 ±<2	4.47	4.25 ±3.03
Old Growth	3934 ± 32	3561 ± 1.78	11.96 ±1.32	22.5 ± .21	4.79 ±2.05	5.95 ±<2	2.29	2.74 ± .80
Roots 0-20 cm	2985 ± 30	2848 ± 1.30	32.81 ± .18	37.16 ± .15	9.95 ±<2	9.57 ±<2	.92 ±8.47	.59 ±2.13
Roots 20-40 cm	2981 ± 52	2957 ± .70	32.10 ± .36	31.82 ± .03	9.48 ±<2	8.85 ±<2	1.08 ± .30	.81 ±1.98

Table 24. Comparisons of density, biomass and age between *Artemisia tridentata* of the north and south Curlew Valley sites, Fall, 1973

Components	North	South
N	10	20
Density (m^2)	.68	1.35
Height per Indiv. (cm) 90% C.I.	70 ± 4	59 ± 6
Cover per Indiv. (cm^2) 90% C.I.	1488 ±272	1205 ±164
Basal Area per Indiv. (cm^2) 90% C.I.	20 ± 8	12 ± 2
Woody Stems per Indiv. (g) 90% C.I.	318 ± 56	206 ± 17
Herb-Stems per Indiv. (g) 90% C.I.	13 ± 5	17 ± 2
Leaves per Indiv. (g) 90% C.I.	27 ± 6	18 ± 2
Standing Deadwood per Indiv. (g) 90% C.I.	33 ± 11	32 ± 7
Infloresence per Indiv. (g) 90% C.I.	6 ± 5	2 ± 1
Total Weight per Indiv. (g) 90% C.I.	396 ± 65	299 ± 24
Age per Indiv. (years) 90% C.I.	18 ± 1	18 ± 2
Total Kg/ha	2693	4036

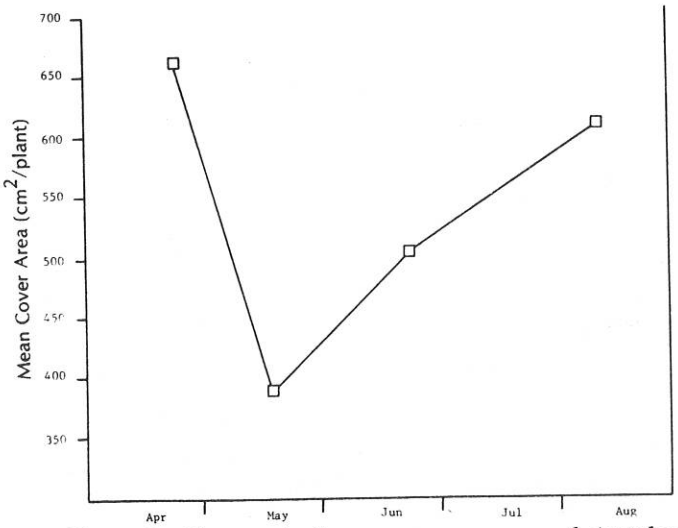

Figure 2. Changes in the mean cover area of *Atriplex confertifolia* through the 1973 growing season.

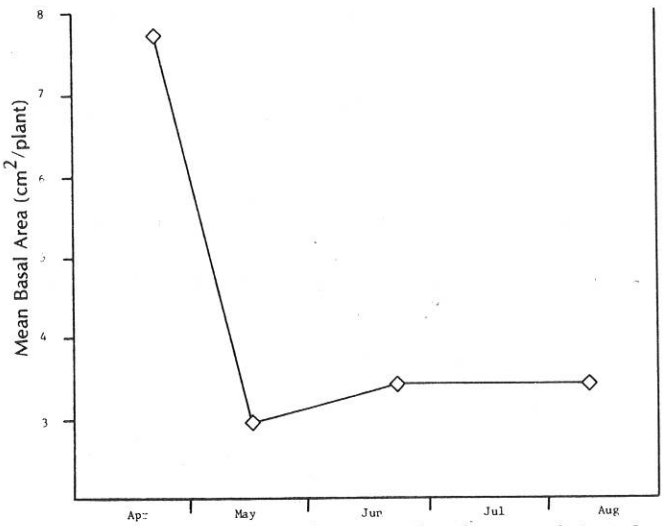

Figure 3. Changes in the mean basal area of *Atriplex confertifolia* through the 1973 growing season.

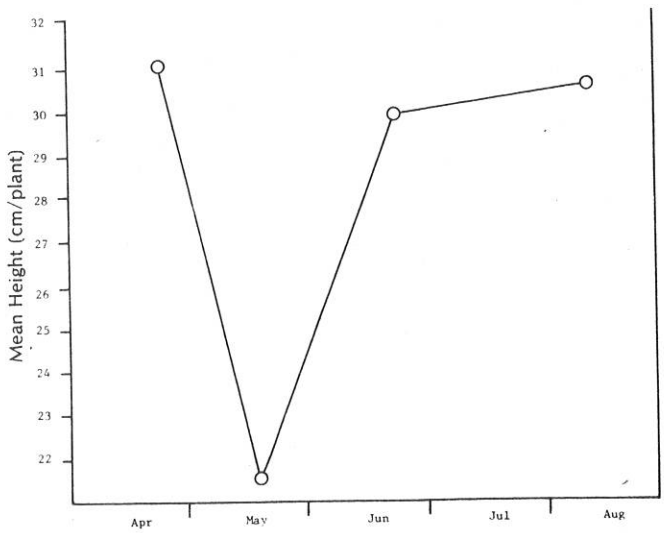

Figure 1. Changes in the mean height of *Atriplex confertifolia* through the 1973 growing season.

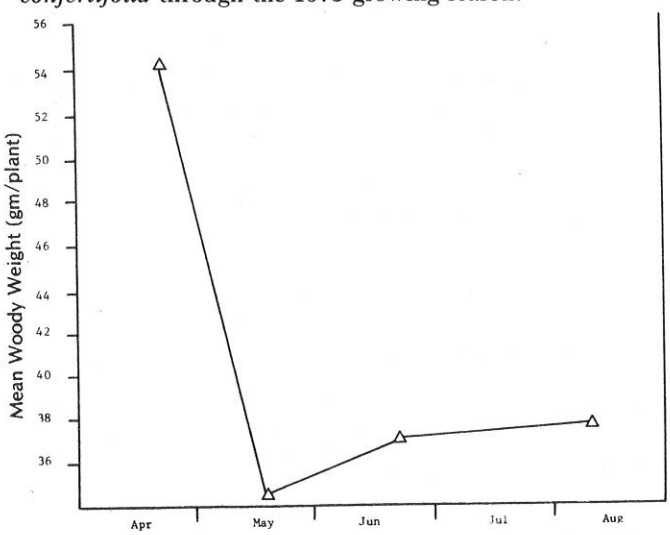

Figure 4. Changes in the mean weight of woody plant parts of *Atriplex confertifolia* through the 1973 growing season.

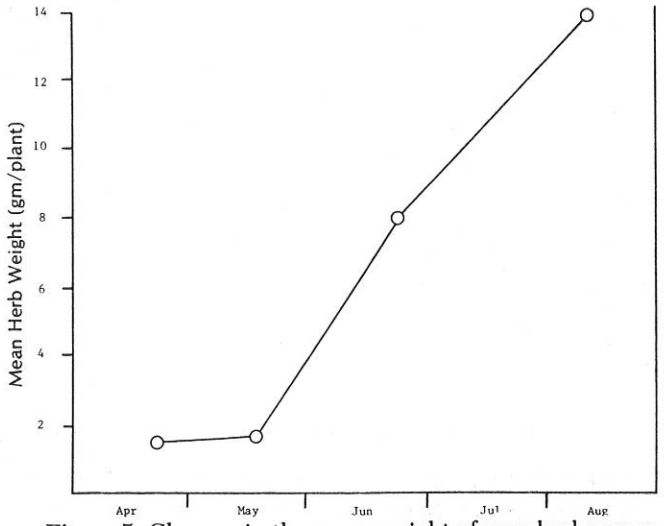

Figure 5. Changes in the mean weight of new herbaceous growth of *Atriplex confertifolia* through the 1973 growing season.

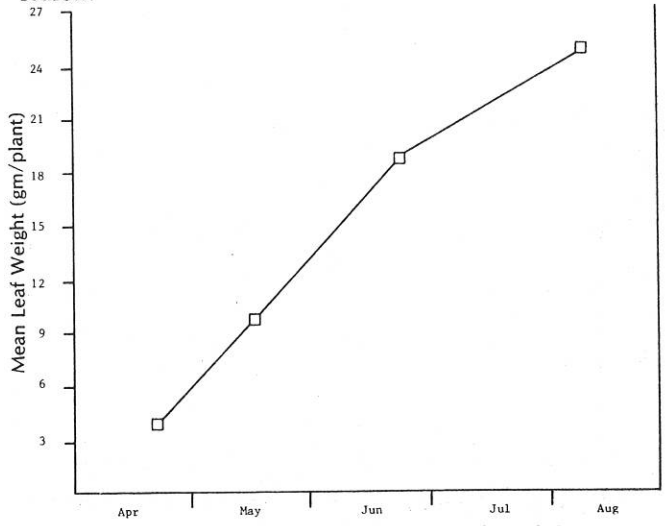

Figure 6. Changes in the mean weight of leaves on *Atriplex confertifolia* through the 1973 growing season.

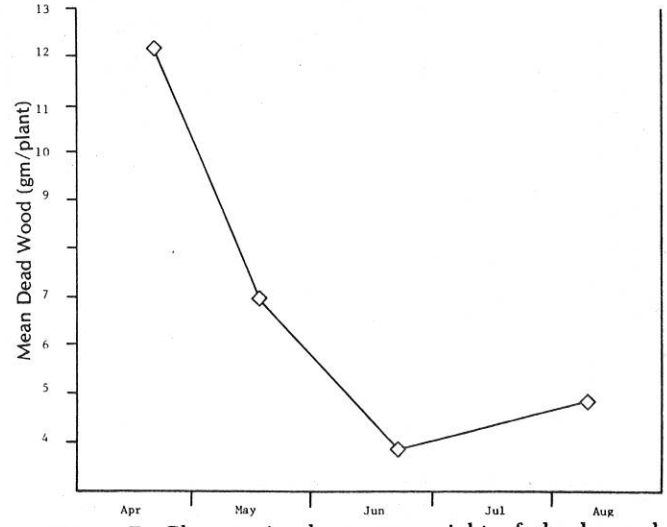

Figure 7. Changes in the mean weight of dead wood attached to *Atriplex confertifolia* through the 1973 growing season.

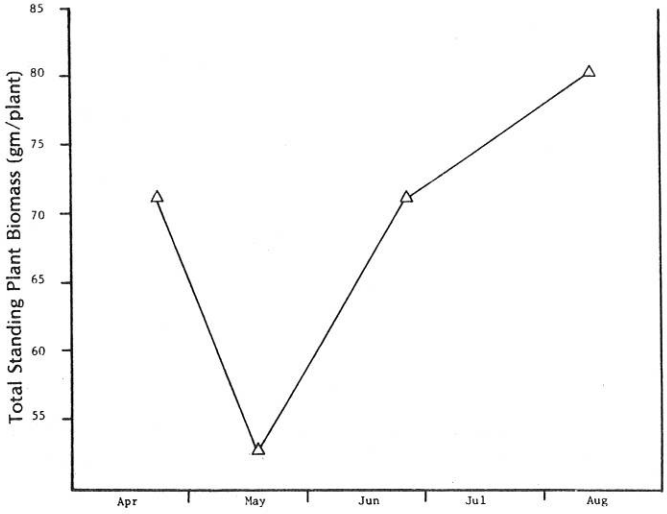

Figure 8. Changes in the mean above-ground biomass of *Atriplex confertifolia* through the 1973 growing season.

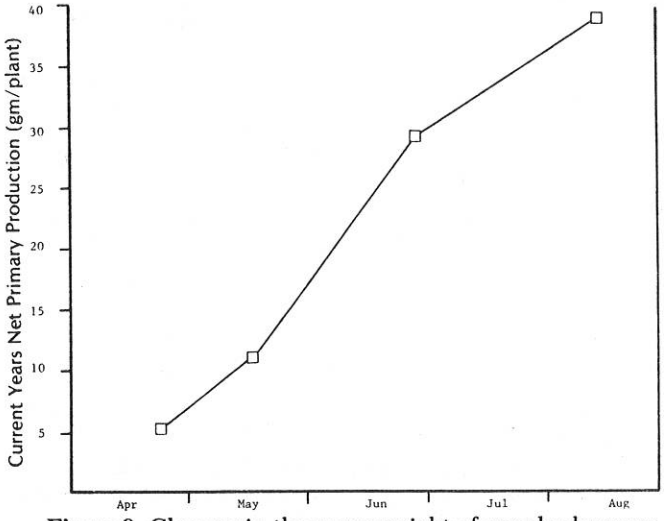

Figure 9. Changes in the mean weight of new herbaceous and leaf and inflorescence biomass of *Atriplex confertifolia* through the 1973 growing season.

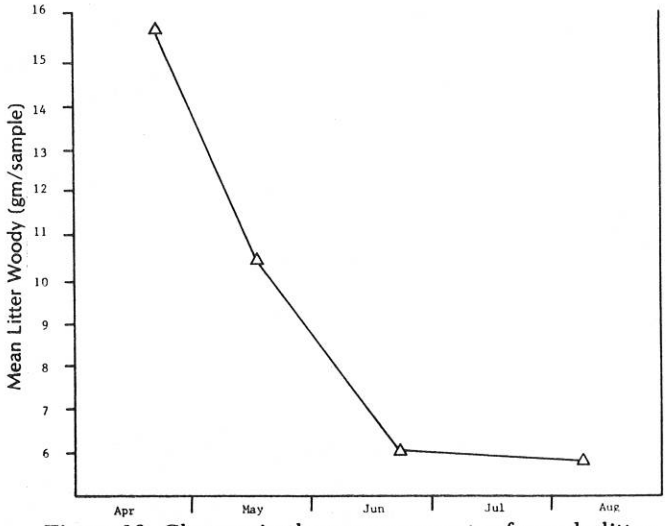

Figure 10. Changes in the mean amounts of woody litter subsampled from under *Atriplex confertifolia* canopies through the 1973 growing season.

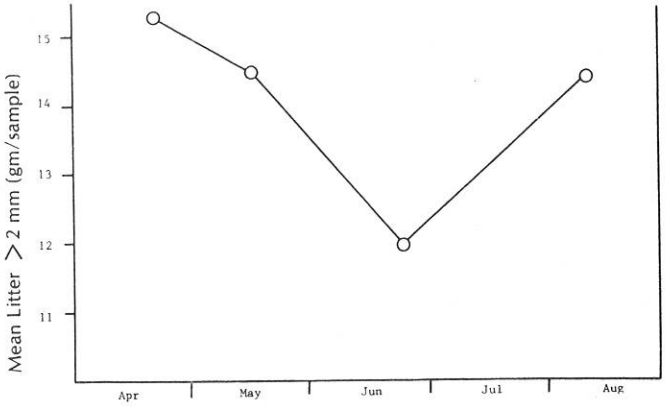

Figure 11. Changes in the mean amounts of >2 mm litter subsampled from under *Atriplex confertifolia* canopies through the 1973 growing season.

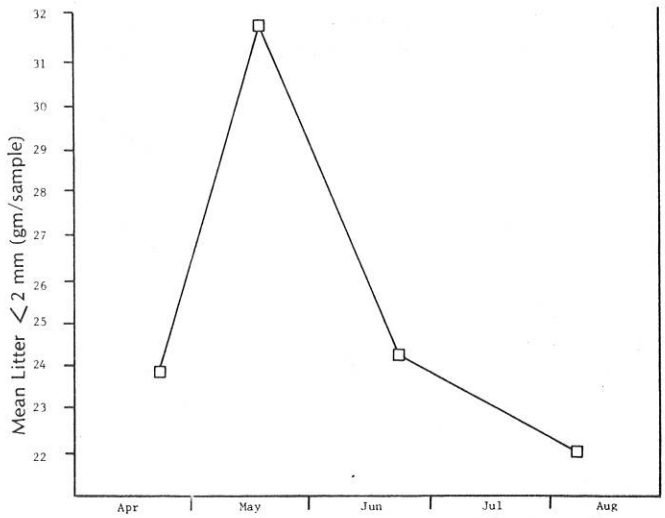

Figure 12. Changes in the mean amounts of <2 mm litter subsampled from under *Atriplex confertifolia* canopies through the 1973 growing season.

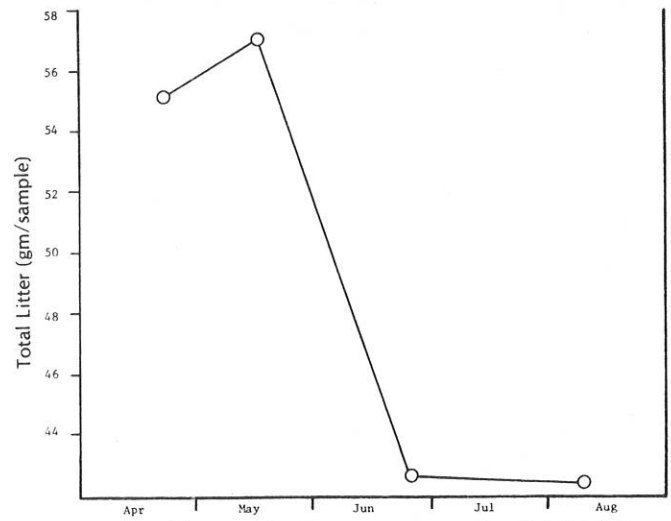

Figure 13. Changes in the mean amounts of total litter materials subsampled from under *Atriplex confertifolia* canopies through the 1973 growing season.

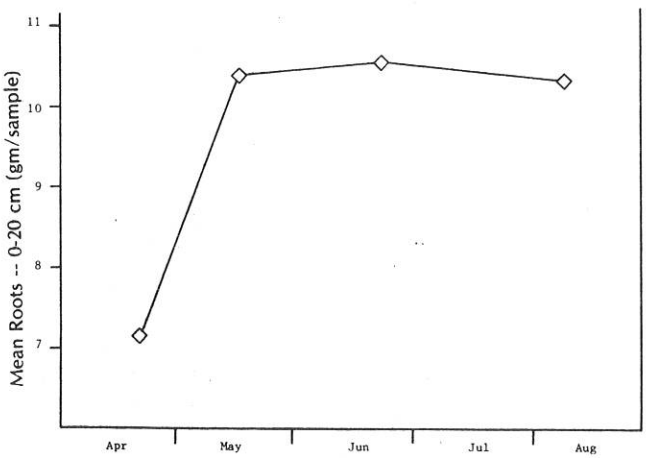

Figure 14. Changes in the mean amounts of root material subsampled from 0-20 cm deep under *Atriplex confertifolia* canopies through the 1973 growing season.

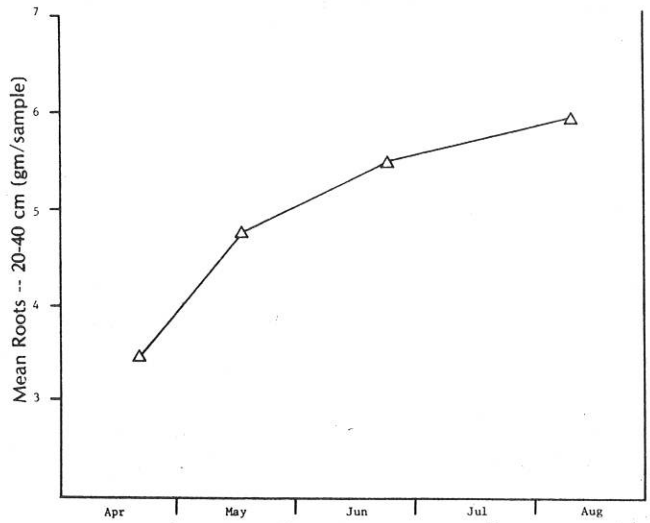

Figure 15. Changes in the mean amounts of root materials subsampled from 20-40 cm deep under *Atriplex confertifolia* canopies through the 1973 growing season.

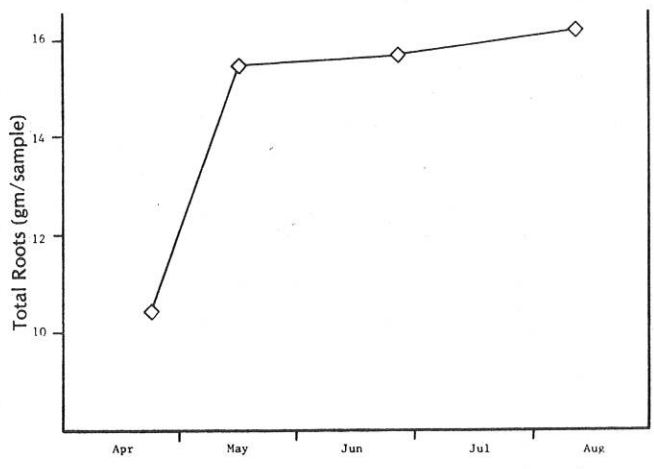

Figure 16. Changes in the mean amounts of total roots (0-40 cm) subsampled from under *Atriplex confertifolia* canopies through the 1973 growing season.

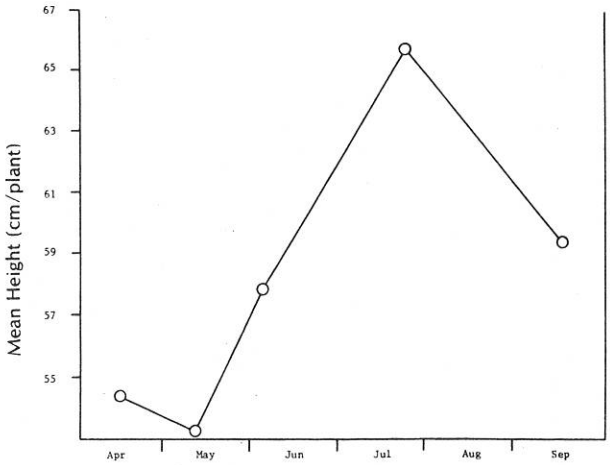

Figure 17. Changes in the mean height of *Artemisia tridentata* through the 1973 growing season.

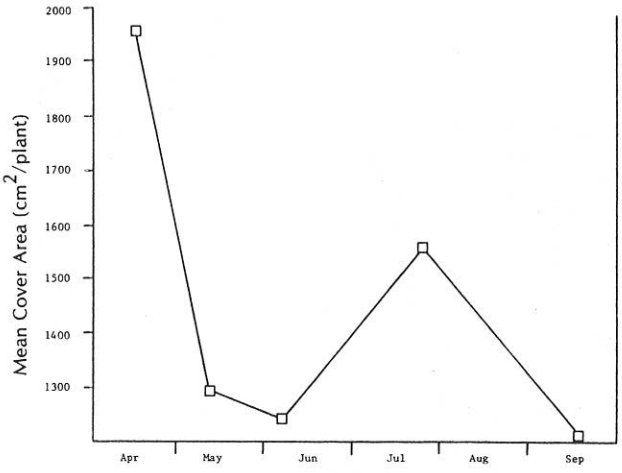

Figure 18. Changes in the mean cover area of *Artemisia tridentata* through the 1973 growing season.

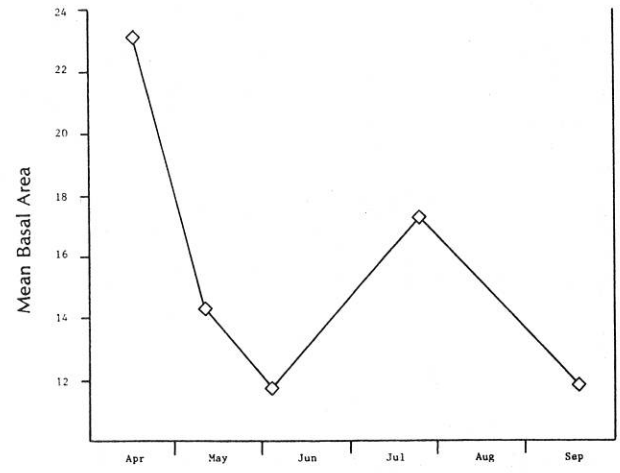

Figure 19. Changes in the mean basal area of *Artemisia tridentata* through the 1973 growing season.

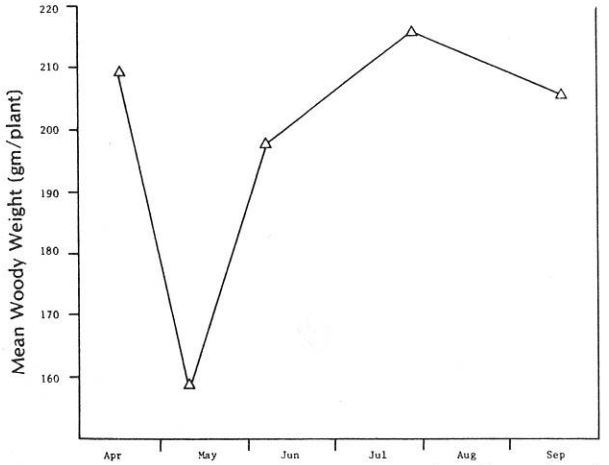

Figure 20. Changes in the mean weight of woody plant parts of *Artemisia tridentata* through the 1973 growing season.

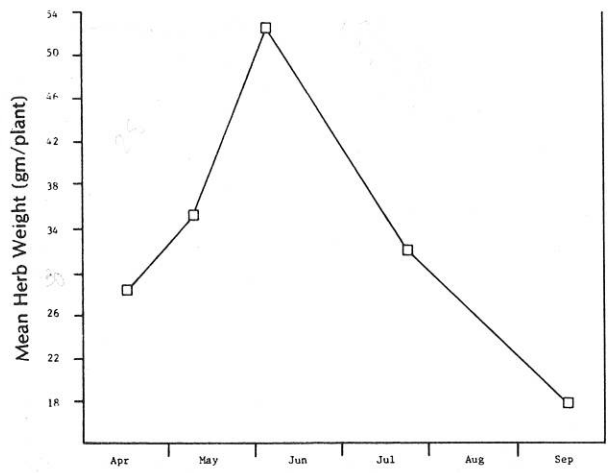

Figure 21. Changes in the mean weight of new herbaceous growth of *Artemisia tridentata* through the 1973 growing season.

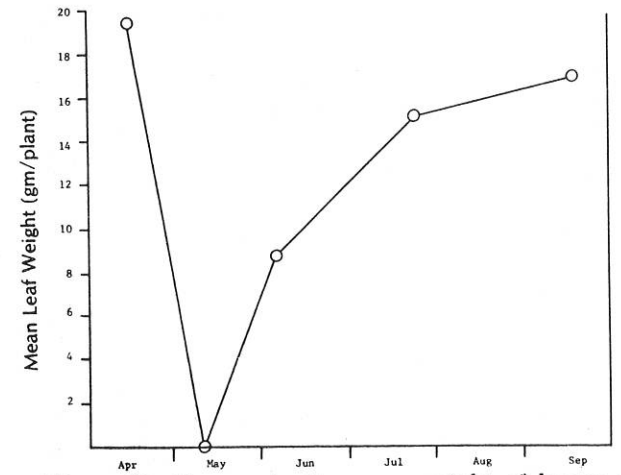

Figure 22. Changes in the mean weight of leaves on *Artemisia tridentata* through the 1973 growing season.

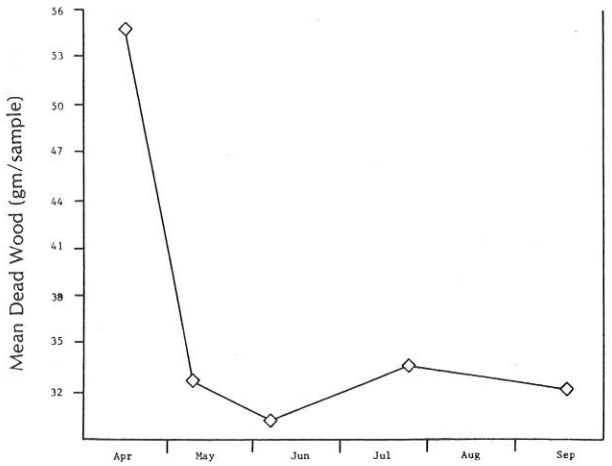

Figure 23. Changes in the mean weight of dead wood attached to Artemisia tridentata through the 1973 growing season.

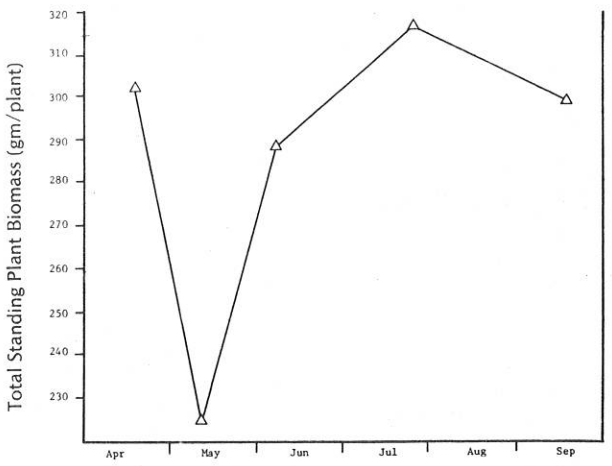

Figure 24. Changes in the mean above-ground biomass of *Artemisia tridentata* through the 1973 growing season.

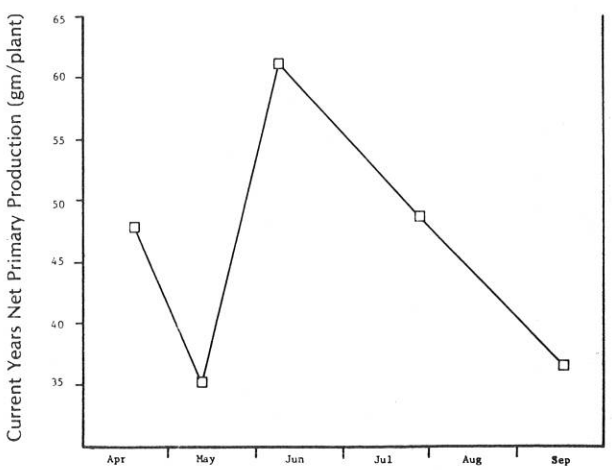

Figure 25. Changes in the mean weight of new herbaceous and leaf and infloresence biomass of *Artemisia tridentata* through the 1973 growing season.

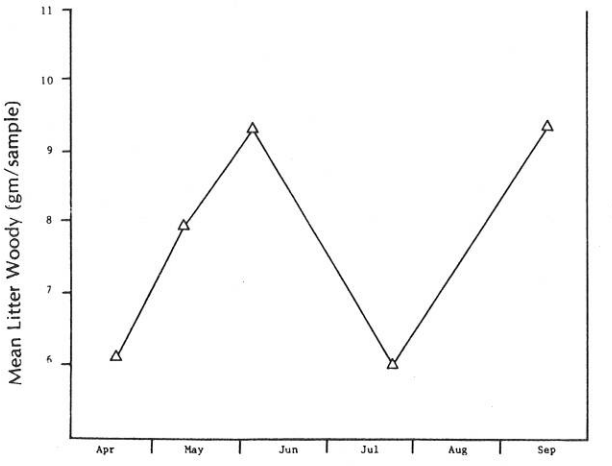

Figure 26. Changes in the mean amounts of woody litter subsampled from under *Artemisia tridentata* canopies through the 1973 growing season.

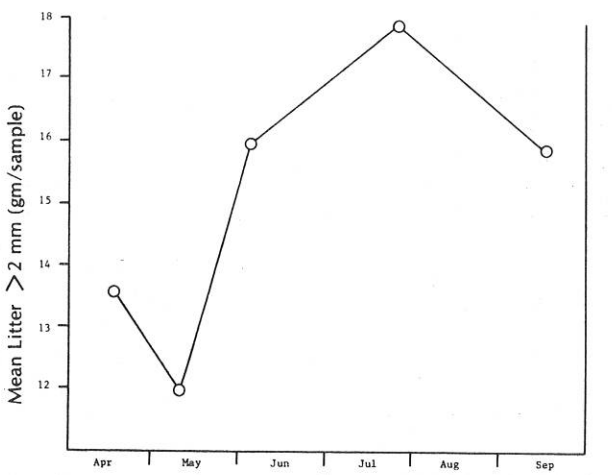

Figure 27. Changes in the mean amounts of >2 mm litter subsampled from under *Artemisia tridentata* canopies through the 1973 growing season.

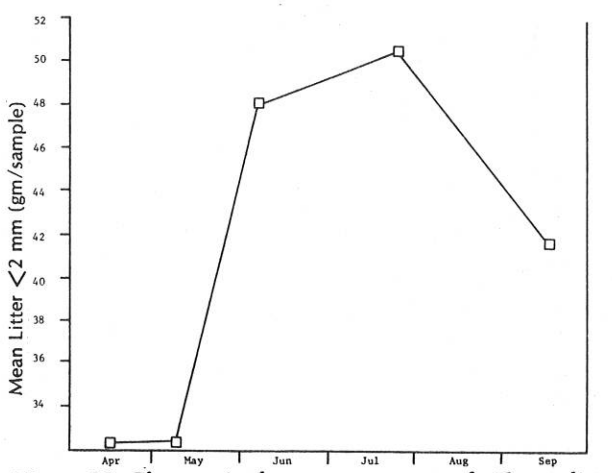

Figure 28. Changes in the mean amounts of <2 mm litter subsampled from under *Artemisia tridentata* canopies through the 1973 growing season.

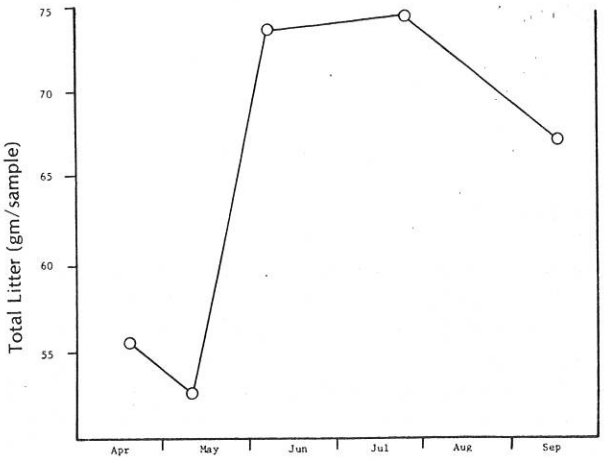

Figure 29. Changes in the mean amounts of total litter materials subsampled from under *Artemisia tridentata* canopies through the 1973 growing season.

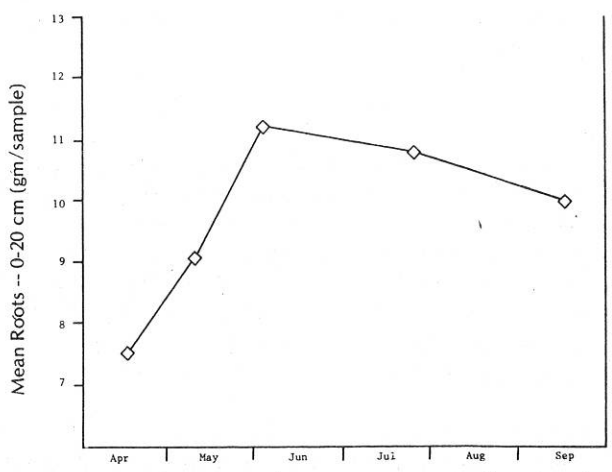

Figure 30. Changes in the mean amounts of root material subsampled from 0-20 cm deep under *Artemisia tridentata* canopies through the 1973 growing season.

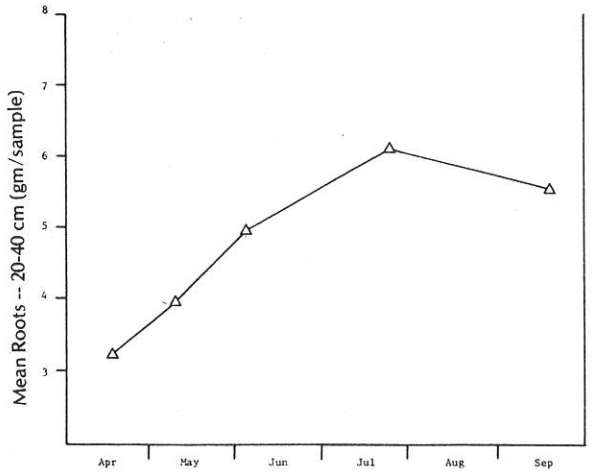

Figure 31. Changes in the mean amounts of root materials subsampled from 20-40 cm deep under *Artemisia tridentata* canopies through the 1973 growing season.

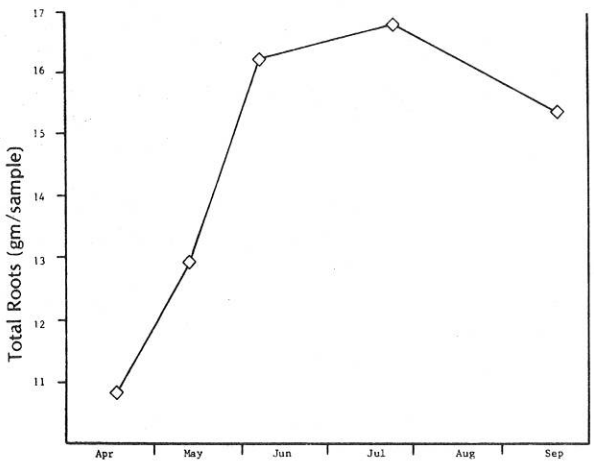

Figure 32. Changes in the mean amounts of total roots (0-40 cm) subsampled from under *Artemisia tridentata* canopies through the 1973 growing season.

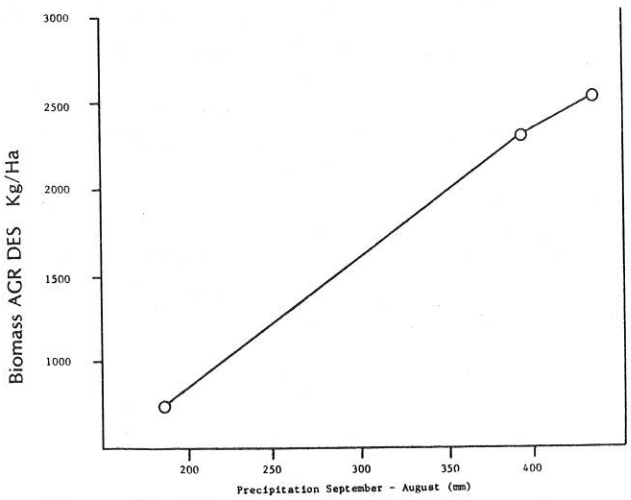

Figure 33. The relationship between growing season precipitation and above-ground biomass of *Agropyron desertorum*.

C. INVERTEBRATES

C. Gist

The information presented in this report represents a preliminary data reduction effort. The portions of the data which lent themselves to immediate and straightforward analysis are presented here. The remainder shall be examined at a later date using more sophisticated, and as yet undetermined approaches. The effort in data analysis was focused on the needs of the various modelling efforts as the authors interpreted them. Therefore, the lumping of categories is not consistent with respect to taxonomic level. The information contained herein is expressed as numbers per m^2 and/or biomass per m^2. The range associated with each value is based on plus or minus two standard deviations (95% confidence interval assuming a normal or near normal distribution) and that the error terms associated with each parameter in calculating the densities and biomass are additive. This assumption is rather robust when one is dealing with the addition and multiplication complexes of arithmetic operations.

The pit-fall data presented here represent only the "true" ground-dwelling arthropods and do not represent all insect species captured in the pit-fall trap grids. In addition, only those ground-dwelling arthropods with sufficient captures to obtain an adequate estimate of the capture-removal slope were used in this analysis.

C.1. Methods and Results

D-Vac

D-Vac samples were collected by placing a large cage over the vegetation to be sampled and applying suction through the D-Vac apparatus. The animals were dislodged by continually manipulating the vegetation and were subsequently sucked into a collection bag (A3UBJX1).

The sampling cage area was 0.50 m^2. The experimental design consisted of sampling each major species of shrub vegetation, the major grasses and the annual species. The samples were made weekly. Results are presented in Tables 1-9.

Pit-fall Trapping

The basic design and concept of the pit-fall trapping followed Gist and Crossley (1973). The physical construction of the pit-fall grids was modified using 6 in metal flashing fencing in place of the tack-trap barriers as descibed by Gist and Crossley (1973). The area of the grids was 3.14 m^2 and they were relocated every two weeks. Each grid was placed to sample a major vegetation type. The animals trapped in the pit-falls were recorded daily for each sampling period and a capture rate (animals per trap night) was plotted against the total number of animals removed. The x-intercept was calculated using least squares regression techniques. Numbers and biomass per m^2 are presented in Tables 10-12 (A3UBJX3).

C.2. Discussion

The design of the field techniques during the period of this study was, for the most part, somewhat inadequate and has been modified or grossly overhauled for the next field season. It was found that the pit-fall trapping grids were much too small and were moved too frequently. The new design calls for 100 m^2 grids which will remain in place throughout the entire field season. These new grids will be placed in each of the southern vegetation types.

The D-Vac sampling suffered greatly from lack of calibration. The calibration associated with this effort was performed during the summer only and was not resolved for insect groups specifically, only for plant species. In other words, the overall efficiency of the sampling technique for a given shrub species is known, but not the efficiency for a given insect group.

For the coming season there will be extensive effort in calibration of the D-Vac sampling procedure.

Literature Cited

Gist, C. S., and D. A. Crossley. 1973. A method for quantifying pitfall trapping. Environ. Ent. 2:951-952.

Table 1. Invertebrate population densities (as sampled by D-Vac) for *Artemisia tridentata* on a monthly basis

		June		July		August		September	
Taxon	Value	#m-2	gm-2	#m-2	gm-2	#m-2	gm-2	#m-2	gm-2
Araneida	n	6		2		3		4	
	lower limit	0	.017	25	.081	0	0	5.558	0
	mean	21.93	.086	32.89	.107	43.596	.059	18.278	.085
	upper limit	152.58	.399	88.03	.286	116.67	.379	78.25	.645
Coleoptera (immature)	n	6		1		0		0	
	lower limit	0	0	25	.150				
	mean	34.73	.193	32.89	.197				
	upper limit	283.6	.516	88.03	.527				
Coleoptera (phytophage)	n	3		4		0		1	
	lower limit	1.316	0	0	0			8.333	.015
	mean	10.965	.014	19.189	.024			10.965	.020
	upper limit	29.343	.126	107.54	.134			29.343	.052
Coleoptera (predator)	n	6		3		0		0	
	lower limit	0	0	1.483	0				
	mean	18.311	.511	14.616	.038				
	upper limit	106.690	4.104	72.917	.292				
Diptera (nectivore)	n	6		0		0		1	
	lower limit	0	0					8.333	.007
	mean	21.93	.019					10.965	.088
	upper limit	132.917	.374					29.343	.024
Diptera (saprovore)	n	6		1		0		0	
	lower limit	0	.040	8.333	.003				
	mean	20.102	.083	10.965	.037				
	upper limit	122.397	.305	29.342	.100				
Hemiptera (predator)	n	0		1		0		0	
	lower limit			16.667	5.958				
	mean			21.930	7.840				
	upper limit			58.685	20.980				
Hemiptera (phytophage)	n	12		0		2		1	
	lower limit	0	0			8.333	0	8.333	.0002
	mean	94.118	.007			10.965	.004	10.965	.0003
	upper limit	852.64	.720			29.343	.034	29.343	.0009
Homoptera	n	25		7		5		9	
	lower limit	0	0	3.225	0	0	0	0	0
	mean	87.28	1.077	12.531	.091	21.930	.113	21.930	.378
	upper limit	1438.58	15.86	33.535	1.349	58.685	1.635	151.48	3.977
Hymenoptera (non-formicid)	n	14		4		2		2	
	lower limit	0	0	8.333	0	8.333	0	8.333	0
	mean	36.81	.0014	10.965	.006	10.965	.0015	10.965	.002
	upper limit	349.19	.146	29.343	.038	29.342	.011	29.343	.013
Lepidoptera (immature)	n	10		1		1		0	
	lower limit	0	0	8.333	.019	8.333	2.105		
	mean	36.18	.088	10.965	.025	10.965	2.770		
	upper limit	238.028	.689	29.343	.067	29.343	7.412		
Orthoptera (acridid)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								

Table 2. Invertebrate population densities (as sampled by D-Vac) for *Atriplex confertifolia* on a monthly basis

		June		July		August		September	
Taxon	Value	#m-2	gm-2	#m-2	gm-2	#m-2	gm-2	#m-2	gm-2
Araneida	n	4		5		9		6	
	lower limit	0	0	0	0	0	0	0	0
	mean	4.997	.042	6.397	.046	5.034	.028	3.554	.018
	upper limit	30.960	.322	38.110	.297	39.549	.248	22.253	.143
Coleoptera (immature)	n	6		3		3		6	
	lower limit	0	0	1.603	0	1.603	0	0	0
	mean	8.795	.052	2.665	.009	2.685	.009	3.998	.01
	upper limit	81.770	.499	7.502	.060	7.502	.060	23.856	.089
Coleoptera (phytophage)	n	9		6		4		6	
	lower limit	0	0	0	0	.545	.0004	0	0
	mean	3.731	.059	15.458	.020	3.998	.006	4.797	.006
	upper limit	21.455	.803	199.550	.248	19.955	.032	31.508	.039
Coleoptera (predator)	n	9		1		0		0	
	lower limit	0	0	3.206	.001				
	mean	7.996	.055	5.331	.002				
	upper limit	53.864	.733	15.004	.005				
Diptera (nectivore)	n	4		2		1		9	
	lower limit	0	0	1.603	.005	1.603	.005	0	0
	mean	3.998	.005	2.665	.009	2.665	.009	8.262	.006
	upper limit	26.257	.057	7.502	.024	7.502	.024	52.663	.035
Diptera (saprovore)	n	5		0		1		0	
	lower limit	0	0			3.206	.0005		
	mean	3.731	.0007			5.331	.001		
	upper limit	23.856	.005			15.004	.0026		
Hemiptera (predator)	n	0		1		0		0	
	lower limit			6.412	.459				
	mean			10.661	.762				
	upper limit			30.008	2.101				
Hemiptera (phytophage)	n	18		10		10		7	
	lower limit	0	0	0	0	0	0	0	0
	mean	9.328	.029	14.392	.194	13.593	.117	6.850	.004
	upper limit	69.317	.684	184.546	3.396	102.026	2.185	57.840	.027
Homoptera	n	16		9		10		9	
	lower limit	.064	0	0	0	0	0	0	0
	mean	3.998	.047	4.451	.128	4.264	.002	4.158	.031
	upper limit	22.206	.581	27.532	1.388	35.709	.022	24.906	.422
Hymenoptera (non-formicid)	n	9		3		5		1	
	lower limit	0	0	0	0	1.603	0	1.603	.0001
	mean	9.488	.002	5.331	.020	2.665	.016	2.665	.0001
	upper limit	21.097	.021	7.502	.245	7.502	.186	7.502	.0004
Lepidoptera (immature)	n	7		1		1		1	
	lower limit	0	0	1.603	.004	1.603	.014	1.603	.004
	mean	4.957	.017	2.665	.006	2.665	.022	2.665	.006
	upper limit	35.859	.097	7.502	.017	7.502	.063	7.502	.017
Orthoptera (acridid)	n	1		1		2		0	
	lower limit	1.603	.136	1.603	.136	1.603	.416		
	mean	2.665	.226	2.665	.226	2.665	.862		
	upper limit	7.502	.637	7.502	.637	7.502	2.906		

Table 3. Invertebrate population densities (as sampled by D-Vac) for *Chrysothamnus viscidiflorus* on a monthly basis

		June		July		August		September	
Taxon	Value	#m-2	gm-2	#m-2	gm-2	#m-2	gm-2	#m-2	gm-2
Araneida	n	1		3		4		3	
	lower limit	3.526	.012	1.763	0	1.622	.005	1.763	.006
	mean	5.537	.018	2.769	.023	9.690	.032	2.769	.009
	upper limit	12.895	.042	6.448	.164	39.201	.128	6.448	.021
Coleoptera (immature)	n	1		0		1		1	
	lower limit	1.763	.011			5.288	.010	1.769	.003
	mean	2.769	.017			8.306	.016	2.769	.005
	upper limit	6.448	.039			19.342	.037	6.448	.012
Coleoptera (phytophage)	n	1		0		5		4	
	lower limit	1.769	.003			0	0	0	0
	mean	2.769	.005			6.091	.368	37.375	.014
	upper limit	6.448	.012			42.166	4.617	301.096	.099
Coleoptera (predator)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Diptera (nectivore)	n	1		0		3		3	
	lower limit	5.288	.003			.335	.0001	0	0
	mean	8.306	.005			3.682	.0008	6.368	.007
	upper limit	19.342	.012			15.925	.0035	50.935	.047
Diptera (saprovore)	n	0		1		0		0	
	lower limit			1.769	.0006				
	mean			2.769	.001				
	upper limit			6.448	.002				
Hemiptera (predator)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Hemiptera (phytophage)	n	0		1		12		7	
	lower limit			7.051	.002	0	0	0	0
	mean			11.074	.003	4.845	.009	5.537	.006
	upper limit			25.790	.007	25.983	.051	34.816	.044
Homoptera	n	3		0		6		4	
	lower limit	0	0			0	0	0	0
	mean	7.392	.145			7.835	.071	4.153	.0008
	upper limit	36.944	11.562			60.155	.523	22.566	.005
Hymenoptera (non-formicid)	n	2		2		9		6	
	lower limit	1.769	0	.141	0	0	0	0	0
	mean	2.769	.009	4.153	.0002	5.233	.074	16.141	.008
	upper limit	6.448	.082	18.827	.001	33.978	6.842	104.642	.097
Lepidoptera (immature)	n	1		1		2		1	
	lower limit	1.769	.015	1.769	.0004	1.516	.0003	3.526	.008
	mean	2.769	.023	2.769	.006	4.153	.009	5.537	.013
	upper limit	6.448	.054	6.448	.015	18.788	.043	12.895	.029
Orthoptera (acridid)	n	1		1		0		0	
	lower limit	1.769	.091	1.769	.610				
	mean	2.769	.144	2.769	.958				
	upper limit	6.448	.334	6.448	2.230				

Table 4. Invertebrate population densities (as sampled by D-Vac) for *Agropyron desertorum* on a monthly basis

Taxon	Value	June		July		August		September	
		#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}
Araneida	n	7		9		2		4	
	lower limit	1.125	0	1.128	.024	2.86	.009	2.146	.039
	mean	3.925	.050	4.959	.090	3.434	.011	6.010	.110
	upper limit	8.126	.166	10.706	.188	4.292	.014	11.805	.215
Coleoptera (immature)	n	4		2		0		4	
	lower limit	0	0	0	0			.515	0
	mean	6.010	.036	8.585	.051			4.567	.021
	upper limit	15.75	.944	23.6	.173			10.646	.055
Coleoptera (phytophage)	n	3		1		1		2	
	lower limit	5.72	.175	5.72	.005	2.86	.077	2.86	.005
	mean	6.868	.210	6.868	.006	3.434	.177	3.434	.006
	upper limit	8.585	.263	8.585	.008	4.292	.851	4.292	.008
Coleoptera (predator)	n	0		5		1		0	
	lower limit			2.86	0	2.86	.015		
	mean			3.434	.020	3.434	.018		
	upper limit			4.292	.076	4.292	.227		
Diptera (nectivore)	n	2		0		1		3	
	lower limit	0	0			2.86	.002	0	0
	mean	12.019	.009			3.434	.0023	26.099	.016
	upper limit	45.5	.249			4.292	.0029	110.32	.069
Diptera (saprovore)	n	6		8		3		5	
	lower limit	2.86	0	2.86	.0003	2.86	0	0	0
	mean	3.434	.0008	3.434	.001	3.434	.001	17.17	.011
	upper limit	4.292	.002	4.292	.002	4.292	.004	84.82	.052
Hemiptera (predator)	n	0		1		0		0	
	lower limit			2.86	.205				
	mean			3.434	.246				
	upper limit			4.292	.307				
Hemiptera (phytophage)	n	4		2		1		1	
	lower limit	0	0	0	0	2.86	.002	2.86	.119
	mean	7.727	.153	10.302	.010	3.434	.002	3.434	.143
	upper limit	25.949	.919	37.174	.034	4.292	.003	4.292	.179
Homoptera	n	11		7		1		11	
	lower limit	0	0	2.86	0	2.86	.146	0	0
	mean	11.538	.323	3.434	.006	3.434	.175	33.379	.031
	upper limit	56.53	2.61	4.292	.024	4.292	.219	165.737	.189
Hymenoptera (non-formicid)	n	4		2		0		0	
	lower limit	0	0	.246	0				
	mean	6.010	.032	5.151	.0008				
	upper limit	15.732	.135	12.509	.003				
Lepidoptera (immature)	n	3		2		1		0	
	lower limit	2.86	0	2.86	.024	2.86	.003		
	mean	3.434	.0013	3.434	.029	3.434	.004		
	upper limit	4.292	.051	4.292	.036	4.292	.005		
Orthoptera (acridid)	n	4		3		0		1	
	lower limit	2.86	0	.764	0			2.86	.990
	mean	3.434	.935	4.567	1.247			3.434	1.188
	upper limit	4.292	2.431	10.680	4.309			4.292	1.485

Table 5. Invertebrate population densities (as sampled by D-Vac) for *Sitanion hystrix* on a monthly basis

Taxon	Value	June		July		August		September	
		#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}
Araneida	n	2		1		1		1	
	lower limit	.157	0	3.640	.066	3.640	.066	7.281	.132
	mean	5.054	.042	6.739	.122	6.739	.122	13.477	.245
	upper limit	71.247	.704	48.900	.888	48.900	.888	97.800	1.776
Coleoptera (immature)	n	0		2		0		1	
	lower limit			.157	0			5.461	.033
	mean			5.054	.023			10.108	.060
	upper limit			71.247	.521			73.35	.439
Coleoptera (phytophage)	n	1		2		2		1	
	lower limit	1.820	.002	3.640	.007	1.820	.003	1.820	.003
	mean	3.369	.004	6.739	.012	3.369	.005	3.369	.006
	upper limit	24.450	.030	48.900	.087	24.450	.037	24.450	.044
Coleoptera (predator)	n	1		0		0		0	
	lower limit	1.820	.0006						
	mean	3.369	.001						
	upper limit	24.450	.008						
Diptera (nectivore)	n	1		0		0		0	
	lower limit	1.820	.0002						
	mean	3.369	.0003						
	upper limit	24.450	.002						
Diptera (saprovore)	n	1		1		1		1	
	lower limit	5.461	.0005	1.820	.0005	7.281	.0006	1.820	.0007
	mean	10.108	.0009	3.369	.001	13.477	.001	3.369	.0013
	upper limit	73.350	.007	24.450	.007	97.800	.008	24.450	.01
Hemiptera (predator)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Hemiptera (phytophage)	n	9		5		3			
	lower limit	0	0	0	0	0	0	0	.001
	mean	8.996	.006	10.108	.011	6.739	.052	8.423	.003
	upper limit	238.386	.144	173.594	.337	133.496	1.491	164.792	.031
Homoptera	n	5		2		1		2	
	lower limit	0	0	1.820	0	32.763	.002	2.621	.005
	mean	9.434	.412	3.369	.007	60.647	.004	28.639	.01
	upper limit	216.626	11.355	24.450	.167	440.098	.026	380.440	.068
Hymenoptera (non-formicid)	n	5		2		0		2	
	lower limit	0	0	1.820	0			1.820	0
	mean	8.996	.001	3.369	.082			3.369	.083
	upper limit	140.098	.013	24.45	2.278			24.450	1.435
Lepidoptera (immature)	n	1		1		0		1	
	lower limit	1.820	.004	5.461	.004			1.820	.015
	mean	3.369	.008	10.108	.007			3.369	.028
	upper limit	24.450	.056	73.350	.048			24.450	.206
Orthoptera (acridid)	n	0		2		0		0	
	lower limit			1.820	.155				
	mean			3.369	.286				
	upper limit			24.45	2.077				

Table 6. Invertebrate population densities (as sampled by D-Vac) for *Lepidium perfoliatum* on a monthly basis

Taxon	Value	June		July		August		September	
		#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}
Araneida	n	2		0		1		1	
	lower limit	0	0			1.820	.033	1.820	.033
	mean	6.739	.022			3.369	.061	3.369	.061
	upper limit	117.359	.384			24.450	.444	24.450	.444
Coleoptera (immature)	n	2		0		0		0	
	lower limit	.157	.001						
	mean	5.054	.030						
	upper limit	71.247	.426						
Coleoptera (phytophage)	n	5		2		0		1	
	lower limit	0	0	0	0			1.820	.003
	mean	12.129	.016	43.801	.054			3.369	.006
	upper limit	215.159	.260	870.416	1.080			24.450	.044
Coleoptera (predator)	n	0		1		0		0	
	lower limit			1.820	.0006				
	mean			3.369	.001				
	upper limit			24.450	.008				
Diptera (nectivore)	n	4		0		0		0	
	lower limit	1.820	0						
	mean	3.369	.035						
	upper limit	24.450	1.157						
Diptera (saprovore)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Hemiptera (predator)	n	1		0		0		0	
	lower limit	1.820	.009						
	mean	3.369	.016						
	upper limit	24.450	.115						
Hemiptera (phytophage)	n	8		0		0		0	
	lower limit	0	0						
	mean	13.814	.510						
	upper limit	315.403	17.084						
Homoptera	n	3		0		0		0	
	lower limit	.255	0						
	mean	4.380	.005						
	upper limit	60.147	.119						
Hymenoptera (non-formicid)	n	4		1		1		1	
	lower limit	1.820	0	7.281	.001	1.820	.0008	1.820	.0008
	mean	3.369	.002	13.477	.002	3.369	.0014	3.369	.0014
	upper limit	24.450	.033	97.800	.017	24.450	.010	24.450	.0103
Lepidoptera (immature)	n	3		1		0		0	
	lower limit	.255	0	1.820	.004				
	mean	4.380	.023	3.369	.008				
	upper limit	60.147	.593	24.450	.056				
Orthoptera (acridid)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								

Table 7. Invertebrate population densities (as sampled by D-Vac) for *Descurainia pinnata* on a monthly basis

Taxon	Value	June		July		August		September	
		$\#_m^{-2}$	gm^{-2}	$\#_m^{-2}$	gm^{-2}	$\#_m^{-2}$	gm^{-2}	$\#_m^{-2}$	gm^{-2}
Araneida	n	4		6		2		2	
	lower limit	0	0	0	0	1.820	.006	1.820	.033
	mean	10.108	.184	6.166	.087	3.369	.011	3.369	.061
	upper limit	178.973	3.250	92.665	1.756	24.450	.080	24.450	.444
Coleoptera (immature)	n	4		3		1		1	
	lower limit	0	0	.939	.006	3.640	.022	3.640	.022
	mean	77.493	.469	5.627	.034	6.739	.040	6.739	.040
	upper limit	1779.951	10.584	69.047	.413	48.900	.292	48.900	.292
Coleoptera (phytophage)	n	9		15		1		1	
	lower limit	0	0	0	0	1.820	.003	1.820	.003
	mean	18.194	.049	127.022	.216	3.369	.006	3.369	.006
	upper limit	405.868	1.28	3889.976	6.899	24.450	.044	24.450	.044
Coleoptera (predator)	n	2		6		0		0	
	lower limit	.146	.033	0	0				
	mean	5.054	.236	7.749	.020				
	upper limit	71.394	2.989	132.029	.630				
Diptera (nectivore)	n	2		1		0		0	
	lower limit	1.820	.002	1.820	.006				
	mean	3.369	.003	3.369	.011				
	upper limit	24.450	.020	24.450	.079				
Diptera (saprovore)	n	0		2		1		0	
	lower limit			1.820	.0005	1.820	.0006		
	mean			3.369	.0012	3.369	.001		
	upper limit			24.450	.011	24.450	.008		
Hemiptera (predator)	n	1		0		0		0	
	lower limit	1.820	.001						
	mean	3.369	.002						
	upper limit	24.450	.016						
Hemiptera (phytophage)	n	16		20		8		1	
	lower limit	0	0	.837	0	0	0	1.820	.076
	mean	15.364	.311	4.043	.349	27.965	.545	3.369	.140
	upper limit	351.100	11.355	47.433	9.711	1014.67	14.643	24.450	1.018
Homoptera	n	7		4		0		0	
	lower limit	.572	0	.455	0				
	mean	4.346	.296	4.212	.007				
	upper limit	55.403	11.416	55.012	.146				
Hymenoptera (non-formicid)	n	4		5		2		1	
	lower limit	0	0	0	0	.157	0	1.820	.0008
	mean	12.803	.011	5.391	.151	5.054	.0015	3.369	.0014
	upper limit	342.298	.406	82.641	5.887	71.247	.038	24.450	.010
Lepidoptera (immature)	n	3		0		0		0	
	lower limit	3.932	0						
	mean	11.119	.011						
	upper limit	108.558	.207						
Orthoptera (acridid)	n	1		1		1		0	
	lower limit	1.820	.094	1.820	.630	1.820	.630		
	mean	3.369	.175	3.369	1.165	3.369	1.165		
	upper limit	24.450	1.268	24.450	8.457	24.450	8.457		

Table 8. Invertebrate population densities (as sampled by D-Vac) for *Halogeton glomeratus* on a monthly basis

Taxon	Value	June		July		August		September	
		$\#_m^{-2}$	gm^{-2}	$\#_m^{-2}$	gm^{-2}	$\#_m^{-2}$	gm^{-2}	$\#_m^{-2}$	gm^{-2}
Araneida	n	2		6		3		4	
	lower limit	.157	0	0	0	0	0	.455	0
	mean	5.054	.067	8.423	.128	6.739	.039	4.212	.039
	upper limit	71.247	1.627	128.606	2.515	97.800	.575	55.012	.657
Coleoptera (immature)	n	3		0		0		0	
	lower limit	0	0						
	mean	10.108	.056						
	upper limit	171.149	1.092						
Coleoptera (phytophage)	n	3		12		1		2	
	lower limit	0	0	0	0	3.640	.065	.157	.0003
	mean	8.996	.011	21.563	.080	6.739	.121	5.054	.009
	upper limit	140.098	.173	591.687	2.760	48.900	.878	71.247	.127
Coleoptera (predator)	n	0		4		0		1	
	lower limit			0	.131			1.820	.047
	mean			5.054	.299			3.369	.087
	upper limit			85.575	2.576			24.450	.632
Diptera (nectivore)	n	1		0		3		0	
	lower limit	1.820	.049			1.820	0		
	mean	3.369	.090			3.369	.002		
	upper limit	24.450	2.979			24.450	.029		
Diptera (saprovore)	n	1		0		3		0	
	lower limit	1.820	.0002			0	0		
	mean	3.369	.0003			5.627	.0016		
	upper limit	24.450	.002			116.626	.041		
Hemiptera (predator)	n	1		2		0		0	
	lower limit	1.820	.007	1.820	.130				
	mean	3.369	.013	3.369	.241				
	upper limit	24.450	.092	24.450	1.748				
Hemiptera (phytophage)	n	6		8		9		3	
	lower limit	0	0	0	0	0	0	.939	0
	mean	19.643	.726	6.739	.207	25.067	.259	5.627	.141
	upper limit	698.044	29.062	135.452	5.084	807.824	11.609	69.047	3.041
Homoptera	n	0		6		3		2	
	lower limit			.644	0	1.820	0	1.820	.0007
	mean			3.942	.036	3.369	.059	3.369	.0013
	upper limit			48.558	1.228	24.450	1.841	24.450	.009
Hymenoptera (non-formicid)	n	2		1		0		4	
	lower limit	1.820	0	1.820	.0008			0	0
	mean	3.369	.026	3.369	.0014			5.054	.0006
	upper limit	24.450	.556	24.450	.010			85.575	.013
Lepidoptera (immature)	n	1		1		0		0	
	lower limit	9.101	.006	1.820	.004				
	mean	16.846	.011	3.369	.008				
	upper limit	122.249	.080	24.450	.056				
Orthoptera (acridid)	n	0		2		1		0	
	lower limit			1.820	0	1.820	.155		
	mean			3.369	.670	3.369	.286		
	upper limit			24.450	15.030	24.450	2.077		

Table 9. Invertebrate population densities (as sampled by D-Vac) for *Salsola kali* on a monthly basis

Taxon	Value	June		July		August		September	
		$\#_m^{-2}$	gm^{-2}	$\#_m^{-2}$	gm^{-2}	$\#_m^{-2}$	gm^{-2}	$\#_m^{-2}$	gm^{-2}
Araneida	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Coleoptera (immature)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Coleoptera (phytophage)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Coleoptera (predator)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Diptera (nectivore)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Diptera (saprovore)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Hemiptera (predator)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Hemiptera (phytophage)	n	0		0		0		2	
	lower limit							0	.022
	mean							11.793	.076
	upper limit							256.724	.810
Homoptera	n	0		0		0		2	
	lower limit							.157	0
	mean							5.054	.087
	upper limit							71.247	2.371
Hymenoptera (non-formicid)	n	0		0		0		2	
	lower limit							1.820	.00001
	mean							3.369	.00002
	upper limit							24.450	.00012
Lepidoptera (immature)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								
Orthoptera (acridid)	n	0		0		0		0	
	lower limit								
	mean								
	upper limit								

Table 10. Ground-dwelling arthropods in the southern *Artemisia-Atriplex* complex

		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
Taxon	Value	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}
Araneida	n	3		3		1		2		0	
	mean	7.266	.132	27.7	.503	54.372		258.52	.987		
	95% C.I.	0–15.93	0–.289	0–59.11	0–1.073			0–419.12			
Tenebrionidae (Coleoptera)	n	5		1		1		0		0	
	mean	64.14	3.929	7.982	.489	2.44	.149				
	95% C.I.	0–292.9	0–17.94								
Carabidae (Coleoptera)	n	1		0		0		0		1	
	mean	.085	.002							18.9	.488
	95% C.I.										
Lygaeidae (Hemiptera)	n	1		0		0		0		1	
	mean	1.254	.052							.295	.012
	95% C.I.										
Stenopelmatus (Gryllacrididae, Orthoptera)	n	0		0		1		2		2	
	mean					7.428	.952	183.71	23.54	5.56	.713
	95% C.I.							0–579	0–74.2	0–11.50	0–1.47
Solpugida	n	0		0		1		0		1	
	mean					10.40	.796			26.04	1.99
	95% C.I.										

Table 11. Ground-dwelling arthropods in the southern ANNUALS site

		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
Taxon	Value	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}
Araneida	n	1		1		4		2		2	
	mean	5.99	.109	45.84	.832	79.05	1.435	258.52	4.69	28.93	.528
	95% C.I.					0–178.63	0–3.24	97.92–419.12	1.78–7.61	26.55–31.31	.482–.568
Tenebrionidae (Coleoptera)	n	0		3		0		5		0	
	mean			16.21	.99			27.08	1.659		
	95% C.I.			0–63.6	0–3.896			0–65.14	0–3.99		
Carabidae (Coleoptera)	n	0		0		1		2		3	
	mean					1.70	.044	5.92	.153	2.01	.052
	95% C.I.							0–14.12	0–.365	0–5.60	0–.145
Lygaeidae (Hemiptera)	n	0		2		3		1		2	
	mean			49.98	2.08	16.057	.669	523.3	21.79	7.62	.32
	95% C.I.			28.75–71.21	1.45–2.97	0–41.73	0–1.74			0–21.39	0–.89
Stenopelmatus (Gryllacrididae, Orthoptera)	n	0		2		1		2		2	
	mean			5.95	.76	21.33	2.733	8.98	1.15	6.87	.88
	95% C.I.			0–18.39	0–2.36			0–21.58	0–2.76	4.83–8.91	.62–1.14
Solpugida	n	0		0		3		3		1	
	mean					8.8	.67	8.9	.68	4.2	.32
	95% C.I.					.45–17.14	.03–1.31	0–26.19	0–2.00		

Table 12. Ground-dwelling arthropods in the southern *Agropyron* grass site

		MAY		JUNE		JULY		AUGUST		SEPTEMBER	
Taxon	Value	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}	#m^{-2}	gm^{-2}
Araneida	n	0		1		0		1		3	
	mean			.735	.013			113.28	2.057	22.73	.422
	95% C.I.									4.65–40.81	.084–.730
Tenebrionidae (Coleoptera)	n	0		0		0		0		0	
	mean										
	95% C.I.										
Carabidae (Coleoptera)	n	0		0		0		1		0	
	mean							6.49	.168		
	95% C.I.										
Lygaeidae (Hemiptera)	n	0		2		1		0		0	
	mean			.793	.033	3.395	.141				
	95% C.I.			.451–1.133	.019–.047						
Stenopelmatus (Gryllacrididae, Orthoptera)	n	2		2		1		1		0	
	mean	1.56	.20	9.68	1.24	6.22	.797	8.1	1.04		
	95% C.I.	0–1.81	0–.232	0–22.65	0–2.9						
Solpugida	n	0		0		0		0		0	
	mean										
	95% C.I.										

D. VERTEBRATES

R. Anderson

D.1. Reptiles and Amphibians

A decision was made not to sample reptiles and amphibians since so few are found on the sites.

D.2. Birds

We had planned to continue to conduct periodic bird censuses using the Emlen (1971) line transect method. Unfortunately these plans failed to materialize and no transects were run.

A subjective evaluation of the bird population on the southern site, however, indicates that the same patterns observed in previous years (Balph et al., 1973) held true in 1973. Horned larks were definitely the most abundant bird on the validation sites, though sage thrashers, sage and brewers sparrows, and mourning doves were also present.

A number of horned larks and one sage thrasher were collected inadvertently during the rodent snap trapping program conducted in May and June. A total of 25 horned larks were collected from the ANNUALS and HAL-ART vegetation types. Only one bird was captured in the ART-ATR-SIT vegetation type though sampling intensity was the same.

Traps had been baited with either rolled oats or Quaker Oats, using Gerbers Baby Cereal as a binder. The baby cereal was mixed with water to a fairly thick consistency, then placed in a plastic squeeze bottle. A small amount was applied to the treadle of a Museum Special snap trap and the inverted trap then pressed into a container of the bait. The cereal acted as an excellent adhesive for the grain bait and greatly eliminated problems of wind-caused bait loss. No bait preference was shown by the horned larks.

This may be a useful technique for measuring relative abundance and feeding distribution of granivorous birds. All birds collected have been saved; examination of crop and stomach contents may provide valuable information as to horned lark food habits.

D.3. Rodents

Introduction

A live-trapping program started in August, 1971, for the estimation of rodent density and biomass was continued in 1973. The sampling schedule was intensified, however, to allow for samples in April, June and August in each of the three vegetation types on the south shrub site. The sampling schedule on both northern sites and the south grass site remained the same as in 1972 (A3UBJH1-4).

Methods

The methods used were essentially those used since 1971 and described in Balph et al., 1973. Certain changes were made for logistical reasons during the April and June samples on the south shrub site. Single traps only were used at each station in the 12 x 12 grid during these samples. This allowed all three grids to be installed and remain in place during the summer. The original two traps per station design was reverted to for the sake of consistency during the August sample.

The use of numbered ear tags as a means of marking animals was tried experimentally during the April and June samples. All animals captured were marked both by toe clipping and by attaching National Band and Tag Company #1 self piercing tags.

Biomass estimates for 1973 are based upon the mean weight calculated for each species in all samples, rather than on a mean weight per sample. Previous biomass figures have been recalculated on this basis for presentation in Figure 1 and in the tables showing changes since 1972.

A snap-trapping program was conducted in off-site areas during the summer of 1973. Each of the major vegetation types represented on the south shrub site were sampled. All animals collected were preserved for later study. Eyeballs were removed at the time of capture and stored in 10% Formalin for 10 days to two weeks. Lenses were then removed and dried at 80 C, after which they were weighed. Stomachs and reproductive tracts were also removed and stored in 10% Formalin. Stomach contents were eventually washed, dried and are now preserved as dry material.

Results

A list of all rodent species observed on the sites to date and their codes is found in Table 1. The results are presented for each site in Tables 2-34. The six-letter species code used in the collection of data is used in all tables for brevity.

The apparent discrepancy in number of animals between the sex and age ratio tables and the other tables for a sample is due to the fact that sex and age data are not available for all individuals because of escapes, etc. The sex and age ratios include only those animals for which these data are available.

Most home range estimates combine the Jennrich and Turner (1969) and regression methods as described in Balph et al., 1973. In those cases where home range estimation was not possible using these methods the area sampled was based on the arbitrary expansion of the grid by the intertrap distance. These cases are indicated by an asterisk in the Pooled Home Range column.

Changes in estimated density of *Peromyscus maniculatus* and *Perognathus parvus* on all sites from 1971-1973 are shown in Figures 1 and 2, respectively. Figure 3 shows the changes in estimated total rodent biomass on all sites during these same years.

Changes that occurred from April to August, 1973, in species composition and density in the three vegetation types on the south shrub are shown in Figures 4-6. These present the results of the periodic sampling conducted during 1973. Although an increase in density of each species would be expected as animals were added to the population through reproduction, this was not necessarily the case. An increase was shown in some species, but in others an apparent decrease was seen, particularly from June to August. The erratic nature of these results is probably due to sampling error and may not reflect the true trend of the population.

All estimates based upon trapping data are necessarily biased due to the failure of certain assumptions that must be made. Certain species in Curlew Valley, for instance, fail to meet the assumption that all individuals are equally catchable; this was demonstrated during the 1972 research (Balph et al., 1973). In many cases, estimates based on trapping data probably underestimate the true density of the population. This must be kept in mind when evaluating density and biomass estimates or when attempting to compare results between areas or times of the year.

In Figure 6, there is an apparent increase in density of *Peromyscus maniculatus* in hectare 72 (ANNUALS) on the south shrub site. This is correlated with an apparent decrease in *Peromyscus* density in hectares 15 (ART-ATR-SIT) and 75 (HAL-ART). A possible explanation is that it indicates a movement of these animals into the ANNUALS vegetation type where seeds were becoming available as a food source.

Examination of Figures 1-6 indicates that each area sampled seems to fluctuate independently in terms of density and biomass. Even closely adjacent areas do not conform to any pattern of temporal change. This is particularly evident if Figures 4-6 are compared with their August, 1972, counterpart (Figure 9, Balph et al., 1973). Some independence between different vegetation types would be expected, but even on the south grass site, a uniform vegetation type, there are signs of independence. Whether these are real or are due to sampling error alone is not known. These results serve to exemplify the problems involved in studying animal populations with trapping programs and attempting to extrapolate from the results.

The experimental use of numbered ear tags was not successful. They proved to be rather difficult to attach, and were easily lost by the animals. Toe clipping alone will be used in all future work in Curlew Valley.

The frequency distribution of eye lens weights for *Peromyscus maniculatus* and *Perognathus parvus* is shown in Figure 7. Because of the small sample size obtained in any one sampling period these curves are based on the pooled data for all samples. The curve for *Perognathus* shows very few young animals in the population; this is most likely because of the late breeding of this species. Young do not appear in the live-trapping samples until August (see the sex and age structure tables).

D.4. Lagomorphs

Introduction

Blacktail jackrabbits (*Lepus californicus*) are the only lagomorph considered abundant enough to be censused on the Curlew Valley sites. Drive-censuses of this species have been conducted each October since 1971 on the south shrub site (A3UBJI1).

Methods

Methods used to census jackrabbits are those described in Balph et al., 1973.

Results

Only the south shrub site was censused in 1973. Table 35 shows density, biomass and the changes in each since the 1972 sample. Figure 8 illustrates the changes in jackrabbit density and biomass since October, 1971.

Jackrabbit populations continued to decline in 1973. The low density found on the south shrub site reflects the situation throughout Curlew Valley (L.C. Stoddart, personal communication). Possible factors responsible for the decline were discussed in Balph et al., 1973.

Literature Cited

Balph, D.F. (Coordinator). 1973. Curlew Valley Validation Site Report. US/IBP Desert Biome Res. Memo. 73-1.

Emlen, J.T. 1971. Population densities of birds derived from transect counts. Auk 8:323-342.

Jennrich, R.I., and F.B. Turner. 1969. Measurement of non-circular home range. J. Theoret. Biol. 22:227-237.

Table 1. Rodent species observed on Curlew Valley validation sites

Species	Species Code	N. Shrub	N. Grass	S. Shrub	S. Grass
Spermophilus townsendii	SPETOW			X	X
Ammospermophilus leucurus	AMMLEU	X			
Eutamias minimus	EUTMIN	X	X	X	X
Perognathus parvus	PERPAR	X	X	X	X
Dipodomys microps	DIPMIC			X	X
Dipodomys ordii	DIPORD	X		X	
Reithrodontomys megalotis	REIMEG		X	X	X
Peromyscus maniculatus	PERMAN	X	X	X	X
Peromyscus truei	PERTRU		X		
Onychomys leucogaster	ONYLEU	X	X	X	
Mus musculus	MUSMUS			X	
Lagarus curtatus	LAGCUR	X	X	X	X

Table 2. Species, sex and age structure of rodents on north shrub site, hectare 27, 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	29	19	10	34.48	10	7	12
PERPAR	59	30	29	49.15	4	11	44
EUTMIN	27	15	12	44.44	0	0	27
ONYLEU	2	0	2	100.00	0	0	2
LAGCUR	3	2	1	33.33	0	0	3
DIPORD	1	1	0	0	0	0	1
AMMLEU	1	0	1	100.00	0	0	1

Table 3. Estimated population numbers, density and biomass on north shrub site, hectare 27, August 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	29	1	30	20-41	.52	6.07	4.94	5.1	25.19
PERPAR	59	0	55	44-69	.26	4.95	11.11	5.1	56.00
EUTMIN	27	1	37	22-57	1.46	9.08	4.07	9.3	37.85
ONYLEU	2	0	-	-	*	3.24	.62	6.6	3.91
LAGCUR	3	0	-	-	*	3.24	1.64	5.7	9.35
DIPORD	1	0	-	-	*	3.24	.31	14.1	4.37
AMMLEU	1	0	-	-	*	3.24	.31	-	-
Total									136.67

Table 4. Changes in estimated rodent density and biomass on north shrub site, hectare 27, 1972-1973

Species	No Captured 1972	No Captured 1973	Change in Captures 1972-1973	Estimated Density 1972	Estimated Density 1973	Change in Density 1972-1973	Estimated Biomass 1972	Estimated Biomass 1973	Change in Biomass 1972-1973
PERMAN	31	29	- 2	5.39	4.94	- .45	27.49	25.19	- 2.30
PERPAR	67	59	- 8	15.27	11.11	-4.16	77.83	56.00	-21.83
EUTMIN	14	27	+13	6.60	4.07	-2.53	61.38	37.85	-23.53
ONYLEU	1	2	+ 1	.22	.62	+ .40	1.45	3.91	+ 2.46
LAGCUR	1	3	+ 2	.31	1.64	+1.33	1.77	9.35	+ 7.58
DIPORD		1	+ 1		.31	+ .31		4.37	+ 4.37
AMMLEU		1	+ 1		.31	+ .31			
Total							169.92	136.67	-33.25

Table 5. Species, sex and age structure of rodents on north grass site, hectare 72, 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	26	20	6	23.08	0	3	23
PERPAR	18	14	4	22.22	0	7	11
EUTMIN	28	16	12	42.86	0	0	28
LAGCUR	10	5	5	50.00	0	0	10
REIMEG	1	0	1	100.00	0	0	1

Table 6. Estimated population numbers, density and biomass on north grass site, hectare 72, August 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	26	4	25	17-35	1.00	7.72	3.24	5.1	16.52
PERPAR	18	0	17	9-29	.97	1.62	10.49	5.1	53.50
EUTMIN	28	6	32	20-47	2.01	10.56	3.03	9.3	28.18
LAGCUR	10	0	16	4-46	.25	4.90	3.27	5.7	18.64
REIMEG	1	0	-	-	*	3.24	.31	3.6	1.08
Total									117.92

Table 7. Changes in estimated rodent density and biomass on north grass site, hectare 72, 1972-1973

Species	No Captured 1972	No Captured 1973	Change in Captures 1972-1973	Estimated Density 1972	Estimated Density 1973	Change in Density 1972-1973	Estimated Biomass 1972	Estimated Biomass 1973	Change in Biomass 1972-1973
PERMAN	33	26	- 7	4.34	3.24	-1.10	22.13	16.52	- 5.61
PERPAR	24	18	- 6	6.2	10.49	+4.29	31.62	53.50	+21.88
EUTMIN	18	28	+10	4.52	3.03	-1.49	42.04	28.18	-13.86
LAGCUR	5	10	+ 5	1.10	3.27	+2.17	6.27	18.64	+12.37
REIMEG		1	+ 1		.31	+ .31		1.08	+ 1.08
ONYLEU	3		- 3	.93		- .93	6.14		- 6.14
Total							108.20	117.92	+ 9.72

Table 8. Species, sex and age structure of rodents on south shrub site, hectare 15, April 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	6	4	1	33.33	1	0	5
PERPAR	18	18	0	0	0	0	18
EUTMIN	5	2	3	60.00	0	0	5
DIPMIC	7	2	5	71.43	2	0	5

Table 9. Estimated population numbers, density and biomass on south shrub site, hectare 15, April 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	6	0	6	3-11	1.19	8.30	.72	5.1	3.67
PERPAR	18	2	19	13-24	.47	5.87	3.24	5.1	16.52
EUTMIN	5	-	-	-	*	3.24	1.54	9.3	14.32
DIPMIC	7	4	7	2-16	*	3.24	2.20	17.7	38.94
Total									73.45

Table 10. Species, sex and age structure of rodents on south shrub site, hectare 15, June 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	24	13	11	45.83	4	10	10
PERPAR	39	16	23	58.97	0	2	37
EUTMIN	15	5	10	66.67	1	8	6
DIPMIC	3	2	1	33.33	0	1	2
MUSMUS	1	0	1	100.00	0	0	1

Table 11. Estimated population numbers, density and biomass on south shrub site, hectare 15, June 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	24	4	24	14-31	1.25	8.48	2.83	5.1	14.43
PERPAR	39	8	39	30-51	.82	7.14	5.46	5.1	27.85
EUTMIN	15	2	21	8-41	1.13	8.12	2.59	9.3	24.09
DIPMIC	3	0	-	-	*	3.24	.93	17.7	16.46
MUSMUS	1	0	-	-	*	3.24	.31	3.6	1.12
Total									69.83

Table 12. Species, sex and age structure of rodents on south shrub site, hectare 15, August 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	6	6	0	0	1	0	5
PERPAR	63	35	28	44.44	19	6	38
EUTMIN	14	5	9	64.29	0	0	14
ONYLEU	2	1	1	50.00	0	0	2
DIPMIC	6	3	3	50.00	0	1	5

Table 13. Estimated population numbers, density and biomass on south shrub site, hectare 15, August 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	6	0	6	3-10	.55	6.18	.97	5.1	4.95
PERPAR	63	4	70	55-93	.26	4.95	14.14	5.1	72.11
EUTMIN	14	0	15	8-24	1.56	9.36	1.60	9.3	14.88
ONYLEU	2	-	-	-	*	3.24	.62	6.6	4.09
DIPMIC	6	1	7	2-15	.43	5.71	1.23	17.7	21.77
Total									117.80

Table 14. Changes in estimated rodent density and biomass on south shrub site, hectare 15, August 1972-August 1973

Species	No Captured 1972	No Captured 1973	Change in Captures 1972-1973	Estimated Density 1972	Estimated Density 1973	Change in Density 1972-1973	Estimated Biomass 1972	Estimated Biomass 1973	Change in Biomass 1972-1973
PERMAN	13	6	- 7	2.22	.97	-1.25	11.32	4.95	- 6.37
PERPAR	44	63	+19	6.42	14.14	+7.72	32.74	72.11	+39.37
EUTMIN	15	14	- 1	3.14	1.60	-1.54	29.20	14.88	-14.32
ONYLEU		2	+ 2		.62	+ .62		4.09	+ 4.09
DIPMIC	10	6	- 4	1.87	1.23	- .64	33.10	21.77	-11.33
Total							106.36	117.80	+11.44

Table 15. Species, sex and age structure of rodents on south shrub site, hectare 72, April 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	9	5	4	44.44	0	0	9
PERPAR	7	7	0	0	0	0	7
EUTMIN	1	0	1	100.00	0	0	1
DIPORD	4	1	3	75.00	0	0	4

Table 16. Estimated population numbers, density and biomass on south shrub site, hectare 72, April 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	9	2	7	3-11	.92	7.47	.94	5.1	4.79
PERPAR	7	0	6	3-10	*	3.24	2.16	5.1	11.02
EUTMIN	1	-	-	-	*	3.24	.31	9.3	2.88
DIPORD	4	1	4	1- 8	-	3.24	1.27	14.1	17.91
Total									36.60

Table 17. Species, sex and age structure of rodents on south shrub site, hectare 72, June 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	4	2	2	50.00	1	1	2
PERPAR	9	4	5	55.56	0	0	9
EUTMIN	2	1	1	50.00	1	0	1
DIPORD	6	5	1	16.67	0	4	2
SPETOW	1	1	0	0	0	1	0

Table 18. Estimated population numbers, density and biomass on south shrub site, hectare 72, June 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	4	0	3	1- 7	*	3.24	1.23	5.1	6.27
PERPAR	9	1	7	3-13	2.19	2.78	2.52	5.1	12.85
EUTMIN	2	-	-	-	*	3.24	.62	9.3	5.77
DIPORD	6	1	7	3-11	.23	4.80	1.45	14.1	20.45
SPETOW	1	-	-	-	*	3.24	-	-	-
Total									45.34

Table 19. Species, sex and age structure of rodents on south shrub site, hectare 72, August 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	12	10	2	16.67	1	5	6
PERPAR	21	12	9	42.86	7	0	14
DIPORD	4	2	2	50.00	3	0	1
DIPMIC	1	0	1	100.00	1	0	0

Table 20. Estimated population numbers, density and biomass on south shrub site, hectare 72, August 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	12	1	18	6-44	*	3.24	5.62	5.1	28.66
PERPAR	21	0	20	12-29	.49	5.95	3.36	5.1	17.14
DIPORD	4	1	4	1- 5	*	3.24	1.09	14.1	15.37
DIPMIC	1	-	-	-	*	3.24	.31	17.7	5.49
Total									60.66

Table 21. Changes in estimated rodent density and biomass on south shrub site, hectare 72, August 1972-August 1973

Species	No Captured 1972	No Captured 1973	Change in Captures 1972-1973	Estimated Density 1972	Estimated Density 1973	Change in Density 1972-1973	Estimated Biomass 1972	Estimated Biomass 1973	Change in Biomass 1972-1973
PERMAN	18	12	- 6	3.24	5.62	+2.38	16.52	28.66	+12.14
PERPAR	11	21	+10	2.17	3.36	+1.19	11.07	17.14	+ 6.07
DIPORD	8	4	- 4	.89	1.09	+ .20	12.55	15.37	+ 2.82
DIPMIC		1	+ 1		.31	+ .31		5.49	+ 5.49
EUTMIN	1		- 1	.31		- .31	2.88		- 2.88
Total							43.02	66.66	+23.64

Table 22. Species, sex and age structure of rodents on south shrub site, hectare 75, April 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	13	8	5	38.46	3	1	9
PERPAR	17	17	0	0	0	0	17
EUTMIN	14	5	9	64.29	0	0	14

Table 23. Estimated population numbers, density and biomass on south shrub site, hectare 75, April 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	13	1	11	6-16	1.03	7.81	1.41	5.1	7.19
PERPAR	17	2	15	8-23	.99	7.69	1.95	5.1	9.95
EUTMIN	14	3	15	7-23	1.99	10.51	1.43	9.3	13.30
Total									30.44

Table 24. Species, sex and age structure of rodents on south shrub site, hectare 75, June 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	8	3	5	62.50	2	0	6
PERPAR	15	11	3	26.67	0	0	15
EUTMIN	8	2	6	75.00	4	2	2
LAGCUR	1	0	1	100.00	0	0	1
DIPORD	2	1	1	50.00	0	1	1
DIPMIC	1	1	0	0	0	0	1

Table 25. Estimated population numbers, density and biomass on south shrub site, hectare 75, June 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	8	0	9	3-23	.39	5.54	1.62	5.1	8.26
PERPAR	15	1	20	9-34	.31	5.19	3.85	5.1	19.64
EUTMIN	8	1	31	2-604	1.16	8.21	3.78	9.3	35.15
LAGCUR	1	-	-	-	*	3.24	.31	5.7	1.77
DIPORD	2	-	-	-	*	3.24	.62	14.1	8.74
DIPMIC	1	-	-	-	*	3.24	.31	17.7	5.49
Total									78.05

Table 26. Species, sex and age structure of rodents on south shrub site, hectare 75, August 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	7	6	1	14.29	1	0	6
PERPAR	10	8	2	20.00	6	0	4
EUTMIN	7	3	4	57.14	0	1	6
DIPMIC	3	2	1	33.33	0	0	3

Table 27. Estimated population numbers, density and biomass on south shrub site, hectare 75, August 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	7	0	7	4-11	.61	6.40	1.09	5.1	5.56
PERPAR	10	0	8	3-17	.24	4.85	1.65	5.1	8.42
EUTMIN	7	0	14	1-273	*	3.24	2.16	9.3	20.09
DIPMIC	3	0	3	1- 6	*	3.24	.93	17.7	16.46
Total									50.53

Table 28. Changes in estimated rodent density and biomass on south shrub site, hectare 75, August 1972-August 1973

Species	No Captured 1972	No Captured 1973	Change in Captures 1972-1973	Estimated Density 1972	Estimated Density 1973	Change in Density 1972-1973	Estimated Biomass 1972	Estimated Biomass 1973	Change in Biomass 1972-1973
PERMAN	56	7	-49	9.38	1.09	-8.29	47.84	5.56	-42.28
PERPAR	11	10	- 1	2.11	1.65	- .46	10.76	8.42	- 2.34
EUTMIN	16	7	- 9	1.92	2.16	+ .24	17.86	20.09	+ 2.23
DIPMIC	1	3	+ 2	.31	.93	+ .62	5.49	16.46	+10.97
ONYLEU	1		- 1	.31		- .31	2.05		- 2.05
DIPORD	19		-19	2.87		-2.87	40.47		-40.47
REIMEG	3		- 3	.93		- .93	3.35		- 3.35
Total							127.82	50.53	-77.29

Table 29. Species, sex and age structure of rodents on south grass site, hectare 16, August 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	29	22	7	24.14	2	5	22
PERPAR	18	13	5	27.78	3	3	12
LAGCUR	2	1	1	50.00	0	0	2
REIMEG	1	0	1	100.00	0	0	1

Table 30. Estimated population numbers, density and biomass on south shrub site, hectare 16, August 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	29	5	33	20-44	.56	6.22	5.31	5.1	27.08
PERPAR	18	0	23	11-43	.49	5.95	3.83	5.1	19.53
LAGCUR	2	-	-	-	*	3.24	.62	5.7	3.53
REIMEG	1	-	-	-	*	3.24	.31	3.6	1.12
Total									51.26

Table 31. Changes in estimated rodent density and biomass on south grass site, hectare 16, August 1972-August 1973

Species	No Captured 1972	No Captured 1973	Change in Captures 1972-1973	Estimated Density 1972	Estimated Density 1973	Change in Density 1972-1973	Estimated Biomass 1972	Estimated Biomass 1973	Change in Biomass 1972-1973
PERMAN	8	29	+21	1.18	5.31	+4.13	6.02	27.08	+21.06
PERPAR	18	18	0	2.93	3.83	+ .90	14.94	19.53	+ 4.59
LAGCUR		2	+ 2		.62	+ .62		3.53	+ 3.53
REIMEG	5	1	- 4	1.28	.31	- .97	4.61	1.12	- 3.49
Total							25.57	51.26	+25.69

Table 32. Species, sex and age structure of rodents on south grass site, hectare 72, August 1973

Species	Number Captured	Males	Females	Females %	Juvenile	Subadults	Adults
PERMAN	5	4	1	20.00	1	1	3
PERPAR	21	14	7	33.33	8	1	12
REIMEG	2						

Table 33. Estimated population numbers, density and biomass on south grass site, hectare 72, August 1973

Species	Number Captured	Number Dead	Schnabel Estimate	Schnabel 95% Confidence Limits	Pooled Home Range (ha)	Area Sampled (ha)	Estimated Density (no/ha)	Mean Dry Weight (g)	Estimated Biomass (g/ha)
PERMAN	5	0	21	2-409	*	3.24	1.85	5.1	9.44
PERPAR	21	1	44	15-99	2.8	5.05	8.71	5.1	44.42
REIMEG	2	-	-	-	*	3.24	.62	3.6	1.86
Total									55.72

Table 34. Changes in estimated rodent density and biomass on south grass site, hectare 72, 1972-1973

Species	No Captured 1972	No Captured 1973	Change in Captures 1972-1973	Estimated Density 1972	Estimated Density 1973	Change in Density 1972-1973	Estimated Biomass 1972	Estimated Biomass 1973	Change in Biomass 1972-1973
PERMAN	11	5	- 6	1.94	1.85	- .09	9.89	9.44	- .45
PERPAR	27	21	- 6	5.41	8.71	+3.30	27.59	44.42	+16.83
REIMEG	2	2	0	.62	.62	0	2.23	1.86	- .37
DIPMIC	4		- 4	1.23		-1.23	21.77		-21.77
Total							61.48	55.72	- 5.76

Table 35. Density and estimated biomass of jackrabbits on south shrub site, October 1972 and 1973

No. Counted 1972	No. Counted 1973	Change 1972-1973	No./11a 1972	No./Ha 1973	Change 1972-1973	Biomass (kg/ha) 1972	Biomass (kg/ha) 1973	Change 1972-1973
0	0	--	0	0	--	0	0	--
55	16	-39	.55	.16	-.39	.35	.1	-.25

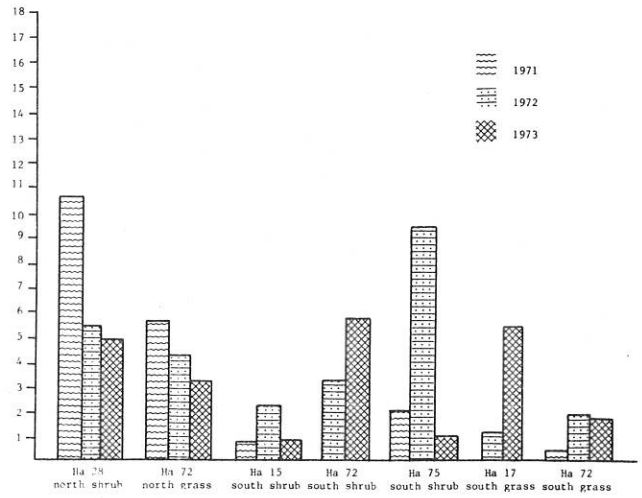

Figure 1. Changes in estimated density of *Peromyscus maniculatus* on Curlew Valley sites, August, 1971-73.

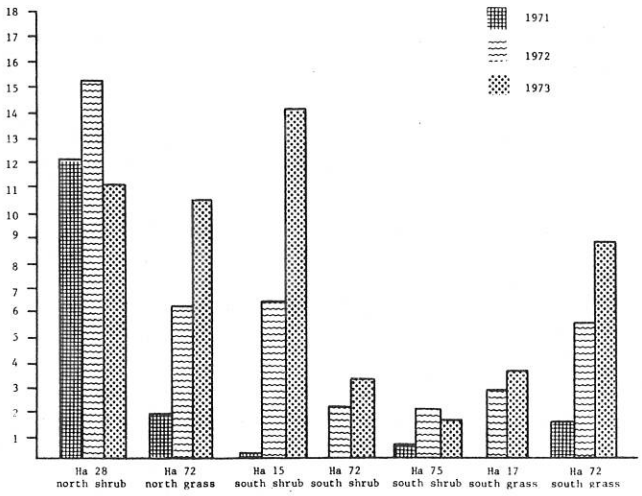

Figure 2. Changes in estimated density of *Perognathus parvus* on Curlew Valley sites, August, 1971-73.

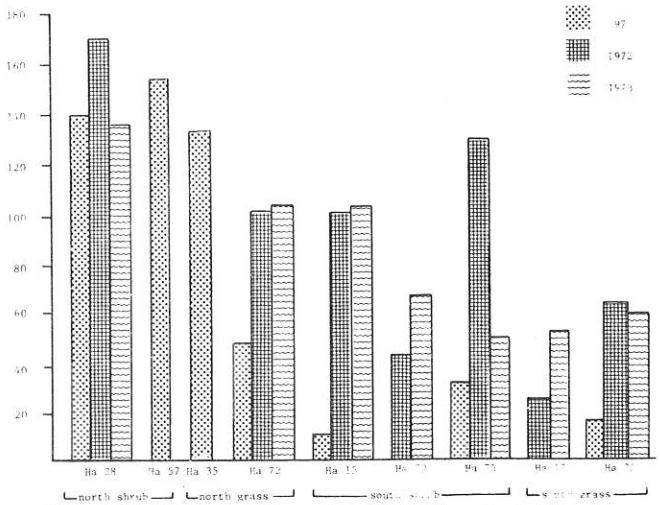

Figure 3. Changes in total estimated rodent biomass on Curlew Valley validation sites, August, 1971-73.

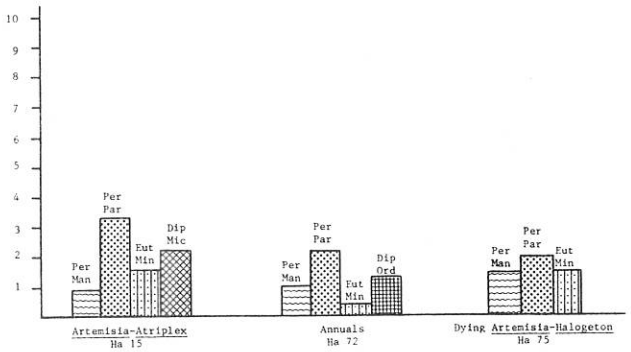

Figure 4. Estimated rodent density by species in three vegetation types, south shrub site, April, 1973.

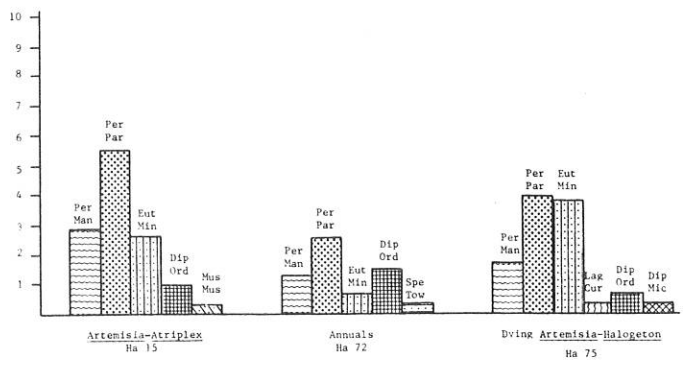

Figure 5. Estimated rodent density by species in three vegetation types, south shrub site, June, 1973.

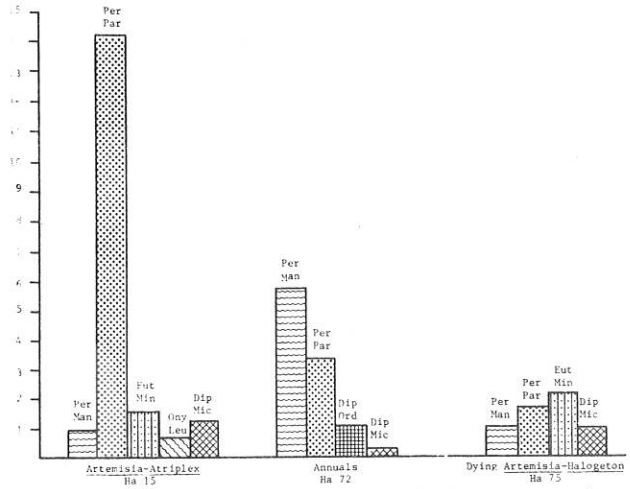

Figure 6. Estimated rodent density by species in three vegetation types, south shrub site, August, 1973.

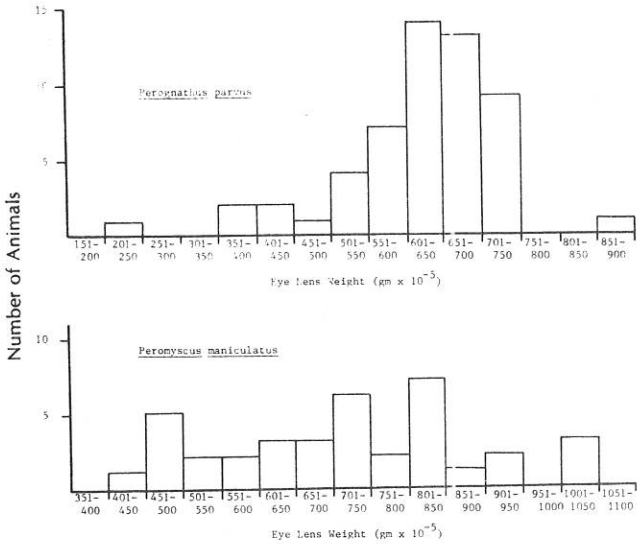

Figure 7. Frequency distribution of eye lens weight in *Perognathus parvus* and *Peromyscus maniculatus* snap-trapped on the south shrub site, 1973.

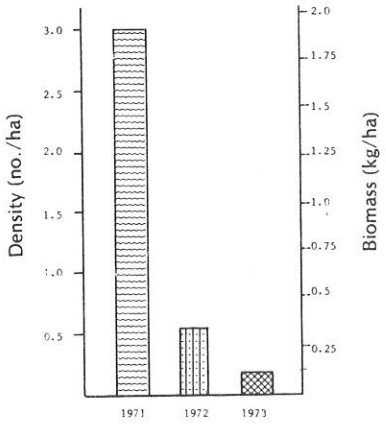

Figure 8. Estimated jackrabbit density and biomass on south shrub site, October 1971 through October 1973.