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NEVADA RANGELAND PHENOLOGY

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ACKNOWLEDGEMENT

The staff of NRC extends thanks to all of the field personnel in each BLM district. Due to everyone's hard work and efforts, the study ran very smoothly this year. We would also like to thank Mike Phillips and Don Jarvis for their interest and cooperation.

INTRODUCTION

This report presents phenological data obtained statewide for the third year of a four year study. The data has been summarized as a means of assisting range managers as they initiate grazing management systems in Nevada. The information presented here will be useful for the accurate prediction of range readiness, flowering or reproductive growth periods, and the prediction of initiation and duration of other plant phenological events.

Objectives:

1. To obtain phenology information for selected species from sites distributed statewide on BLM jurisdiction lands
2. To compare data for the growing seasons for the years 1976, 1977, and 1978 for selected species and sites
3. To present this data to the BLM in a useful format, along with some qualitative interpretations to serve the BLM as a guideline for their use and continued analysis and interpretation

METHODOLOGY

Each BLM district (Elko, Winnemucca, Carson City, Ely, Las Vegas, Battle Mountain [including Tonopah], Cedarville), and NRC, Inc. utilized mostly the same sites as the last two years (Map 1). Carson City (north of Reno) established a new plot in order to gather data on winterfat, budsage and shadscale. BLM personnel at Surprise Resource Area (Cedarville) added several new sites to supplement other studies that they are doing in that area.

Methodology for selection of species and vegetation communities, and methods for measuring vegetation remain the same as the past two years, and can be found in the 1976 and 1977 reports.

NRC staff visited each district at the beginning of the study (or when temporary or summer help began data collection) to answer questions, resolve problems from the 1976 and 1977 studies, and view the study sites.

Average vegetation phenophases and height/leader growths were rated and notated on the same form as used in the past. In addition to soil moisture depth (band of moisture), field personnel collected data on soil temperature. Temperatures (every site/each visit) were collected at the same place each week, 10 to 15 centimeters below the surface. Rain cans to measure precipitation were installed at (almost) every site; Elko utilized soil moisture bars instead of rain cans. All measurements were recorded in millimeters or centimeters and

Celsius degrees.

Data gathering began early this year, with some districts beginning as early as January (Las Vegas). Generally, sites were visited weekly March through June, approximately every 10 days in July and August, every other week in September, and at least once in October. Some districts gathered data for November and December. The November data was included in this year's report, but the December data will appear in next year's report.

Each district kept the same representative numeral, and vegetation community numbers remained the same as last year (Table 1). A complete description of each site included elevation, aspect, general soil type and steepness of slope (Table 2).

All phenological and soil moisture data recorded during the study was summarized (annual phenodynamic tables). In order to facilitate interpretation of the table, abbreviations of two key words in a particular phenophase were utilized (i.e., twig growth = TG).

NRC developed graphs comparing various aspects of the 1976, 1977, and 1978 data sets as examples of possible BLM utilization of the data. The same species used in the past were used again.

Four types of graphs were designed; one to three examples of each were illustrated for every district. Phenology of various species in 1976 and 1977 was compared with that of

Table 1. Key numbering system assigned to BLM district and NRC sites.

<u>DISTRICT</u>	<u>NUMBER</u>
Elko	01
Winnemucca	02
Carson City	03
Carson City (North of Reno)	03A
Ely	04
Las Vegas	05
Battle Mountain	06
Tonopah	06A
Carroll Summit	07
Cedarville, CA (Northern Washoe County)	09

<u>VEGETATION TYPE</u>	<u>NUMBER</u>
Southern desert shrub	-1
Salt desert shrub	-2
Northern desert shrub	-3
Seeding	-4
Pinyon/juniper	-5
Mountain meadow	-7
Coniferous forest	-8
Salt marsh	-9
Degraded with annual grasses	-10
Riparian	-11

Table 2. Elevation, aspect, slope and soil type of BLM and NRC, Inc. sites in Nevada utilized for data gathering.

<u>SITE</u>	<u>ELEVATION</u>	<u>ASPECT</u>	<u>% OF SLOPE</u>	<u>SOIL TYPE</u>
Las Vegas:				
05-1-1 (So.D.S.)	2,780	Level	0	-
05-1-2 (So.D.S.)	4,080	South	3	Sandy loam
05-2 (S.D.S.)	4,800	Level	0	Loam
05-3 (N.D.S.)	5,600	Level	0	Loam
05-7 (M.B.)	6,000	S.W.	15	Sandy clay loam
Carson City:				
03-2-1 (S.D.S.)	5,040	Level	0	Gravelly sand
03-3-1 (N.D.S.)	5,080	Level	0	Sandy
03-3-2 (N.D.S.)	5,326	East	2	Sandy
03-5-1 (P/J)	5,720	West	1	Rocky-sandy
03-5-2 (P/J)	6,880	East	5	Sandy
03-5-3 (P/J)	6,840	N.W.	5	Rocky
03-5-4 (P/J)	6,410	West	2	Meadow
03-7-1 (M.B.)	7,800	North	10	Sandy rocky loam
03-7-2 (M.B.)	7,260	N.W.	5	Rocky-sandy
03-7-3 (M.B.)	6,280	East	1	Sandy
03A-3 (N.D.S.)	5,000	N.E.	10	Sandy
03A-4 (seeding)	5,400	South	5	Sandy
03A-5 (P/J)	5,200	N.E.	19	Sandy
03A-7-1 (M.B.)	5,740	Level	0	Sandy
03A-7-2 (M.B.)	6,400	N.E.	53	Sandy loam
03A-2 (S.D.S. new)	4,240	S.E.	1-4	Sandy
Tonopah:				
06A-2-1 (S.D.S.)	6,170	North	6	Clay loam
06A-2-2 (S.D.S.)	5,520	East	3	Sandy loam
06A-3 (N.D.S.)	6,400	East-wash	6	Sandy loam
Elko:				
01-3 (N.D.S.)	6,170	N.E.	4	Clay loam
01-4 (seeding)	5,870	N.E.	4	Clay loam
01-6 (M.M.)	5,676	Level	0	Loamy sand
01-7 (M.B.)	6,266	North	40	Silty clay loam
01-10 (A. grass)	5,676	S.W.	4	Sandy loam
Battle Mountain:				
06-2-1 (S.D.S.)	4,547	Level	0	Sandy
06-2-2 (S.D.S.)	4,740	S.E.	5	Clay

Table 2 Continued-

<u>SITE</u>	<u>ELEVATION</u>	<u>ASPECT</u>	<u>% OF SLOPE</u>	<u>SOIL TYPE</u>
06-2-3 (S.D.S.)	4,590	East	2	Sandy loam
06-3 (N.D.S.)	6,100	West	85	Rocky
06-7 (M.B.)	6,150	East	-	-
Winnemucca:				
02-2 (S.D.S.)	4,800	East	2	Loamy
02-3-1 (N.D.S.)	6,200	S.E.	25	Clay skeletal
02-3-2 (N.D.S.)	5,200	East	4	Loamy
02-6 (M.M.)	6,900	S.E.	8	Clay skeletal
02-7 (M.B.)	7,200	S.E.	21	Clay skeletal
02-11 (Riper.)	5,600	East	7	Loamy
Ely:				
04-2 (S.D.S.)	6,600	West	5	Loam
04-3 (N.D.S.)	6,800	East	5	Loam
04-5 (P/J)	7,520	S.E.	5	Loam
04-6 (M.M.)	7,280	South	5	Silty loam
04-7 (M.B.)	8,000	Level	0	Stony loam
04-8 (Con.F.)	8,600	N.W.	30	Stony loam
04-9 (S.M.)	6,520	East	5	Silty loam
Carroll Summit:				
07-2 (S.D.S.)	5,200	N.W.	4	Stony loam
07-3 (N.D.S.)	6,080	S.W.	3	Loam
07-5 (P/J)	6,650	South	38	Sandy loam
07-6 (M.M.)	7,360	N.W.	14	Clay loam
07-7 (M.B.)	7,520	North	40	Rocky loam
Cedarville:				
09-2-1 (S.D.S.)	5,400	Level	0	-
09-2-2 (S.D.S.)	5,700	-	-	-
09-2-3 (S.D.S.)	5,700	Level	0	-
09-3 (N.D.S.)	5,500	-	-	-
09-4 (seeding)	-	-	-	-
09-5 (P/J)	5,800	East	7	-
09-2-4 (S.D.S.)	-	-	-	-
09-3-3 (N.D.S.)	-	-	-	-

the same species for 1978. Any possible correlation between soil moisture depth and phenophases of plants in the three years was depicted. In addition, soil moisture depth and its effect on height/leader growth in the three data sets were contrasted. In both of the aforementioned types of graphs, an "S" represents surface moisture and "D" represents soil dry (moisture found at a level greater than 30 centimeters). Bar graphs illustrating time of leaf growth and twig growth for shrubs; growth starts, full bloom, plants dry for forbs; and $\frac{1}{2}$ vegetative growth, flower stalks first appear, seed dissemination, and plants dry for grasses were formulated. These graphs will enable range managers to discern at a glance the time period in which important phenophases occur and how they vary from year to year.

Graphs and complete data sets for each district are listed by district, and include a discussion with each. A district map showing specific location of each sample site is provided.

Common and scientific names of all plants used in the study are listed in Appendix I.

In order to facilitate interpretation of the data sets, please refer to "Reading and Understanding the Annual Phenodynamic Tables".

ANALYSIS AND INTERPRETATION

At the end of the 1979 growth season, this project will have generated four years of data for plant phenology of important range plant species on a statewide basis. A good cross-section of the important range sites and environments will have been sampled. Such data is relatively not available in Nevada or elsewhere, and so constitutes an important data base upon which to base grazing management systems.

The data have been summarized and plotted in various ways and interpreted primarily in a subjective way. It should be suggested that a closer, more objective look at the data be made. In other words, the data should be further analyzed and certain relationships should be tested statistically. The strength of some of the general correlations between phenophase development and influential parameters such as soil moisture, soil temperature, and precipitation should be quantitatively evaluated.

In order to accomplish these analyses, it would be useful to key punch the data onto cards for computer analysis. Several statistical routines should be used to test the relationships suggested during the course of the study. The purpose would be to determine the probability that these relationships will hold true during the time frame of proposed management plans designed for rangelands in the future.

GENERAL RESULTS AND CONCLUSIONS

Full benefit from the data will be derived only after the information has been entered into the computer, where a series of comparisons can be easily made (see section on Analysis and Interpretation). After three years, however, it appears that some patterns are emerging relative to the growth and development of the key species measured or followed during these studies.

There are some relatively prominent relationships between the development of a given species and the contemporary moisture and temperature patterns. There appears to be some strong correlations between the initiation of twig and leaf growth and the receipt of some level of precipitation during the preceding 30 days. There is also quite likely an interaction with soil temperature. For example, the development of grasses is highly dependent upon April, May, and June precipitation, but significant growth of both vegetative and reproductive culms does not occur until soil temperatures warm up above 12-13 °C. The third year's data points this out clearly, and while this has generally been a known factor about grass development, the data presented here will better establish the timing and thresholds for development that have been difficult to determine in the past.

For some species at some sites, plotting of all three years showed that the phenophases were extremely close. In

other words, development was essentially the same for all three years. This included the initiation of growth, the length of the reproductive period and onset of maturation. All phenophases occurred on nearly the same dates and for the same number of days. However, the opposite was true for numerous other species, wherein the phenodynamic showed considerable variation when the three years were compared.

Many grasses and forbs, as in 1976 and 1977, complete their life cycle more rapidly when soil moisture is limiting. Some species show this potential, while others do not. The amount of variation found suggests that there may be no pat answers to phenodynamics analyses. These data strongly suggest that each site selected for a grazing management program will require an evaluation of the phenodynamics of key species. Hopefully, this statewide study will provide information that can be used directly or extrapolated to specific sites to satisfy the data demands of BLM range conservationists in this work.

PHENODYNAMIC TABLE GUIDELINES

READING AND UNDERSTANDING THE
ANNUAL PHENODYNAMIC TABLES

To facilitate interpretation of the data, look at the "Symbol Sheet" with the phenophase abbreviations.

Each graph is divided into months which are subdivided into weekly time periods. An abbreviation appearing within the first time period signifies that it occurred approximately between day 1 and day 7 of that month.

Soil moisture depth is listed in centimeters for all sites. The first number represents where moisture started (distance from the top of the surface), and the second shows to what depth the moisture continues. If the latter number is listed with no period after it, the moisture is considered to continue (i.e., 15-30 =15-30+ centimeters). Field personnel were often unable to dig much deeper due to hardpan, rocks, etc. If soil moisture is listed with a period after it, the moisture is considered as stopping at that point (i.e., 5-8.). Soil temperature is listed in Celsius degrees, and precipitation, in millimeters.

The scientific symbol for each plant is listed with its phenophases depicted. Phenophases are listed once and considered to continue until another phenotype is depicted.

Toward the latter months, some species had regrowth and that is shown with underlining.

In September, October, and November, data was sometimes collected only once or twice per month; therefore, some

phenophases may have been missed. In these instances, phenophases in-between will have to be interpolated.

Various abbreviations have been used on the graphs. The following is an explanation:

gu = green up

sn = snow

fr = frozen

gr = grazed

Legend for 1976, 1977, and 1978.

<u>1976</u>	<u>1977</u>	<u>Data Sheets</u>	<u>Phenophase</u>
<u>SHRUBS</u>	<u>SHRUBS</u>		
	D	0-9	Dormant
\\	LG	10-19	Leaf Growth
///	TG	20-29	Twig Growth
○	BV	30-39	Flower Buds First Visible
□	FG	40-49	Leaves Full Grown
◇	1B	50-59	First Bloom
◆	FB	60-69	Full Bloom
●	BO	70-79	Bloom Over
△	SR	80-89	Seed Ripe
▲	SD	90-99	Seed Dissemination
◇	LY	100-109	Leaves Turn Yellow
◆	LD	110-120	Leaves Dry & Drop
<u>GRASSES</u>	<u>GRASSES</u>		
	D	0-9	Dormant
\\	GS	10-19	Growth Starts
□	½V	20-29	½ Vegetative Growth
○	FS	30-39	Flower Stalks Appear
◆	HO	40-49	Heads Out Fully
*	An	50-59	Anthesis
△	DS	60-69	Dough Seed Set
△	HS	70-79	Hard Seeds
▲	SD	80-89	Seed Dissemination
◇	BD	90-99	Plants Begin to Dry
◆	PD	100-	Plants Dry-Summer

Legend for 1976 and 1977

<u>1976</u>	<u>1977</u>	<u>Data Sheets</u>	<u>Phenophase</u>
<u>FORBS</u>	<u>FORBS</u>		
	D	0-9	Dormant
W	GS	10-19	Growth Starts
O	FS	20-29	Flower Stalks Appear
◇	1B	30-39	First Bloom
◆	FB	40-49	Full Bloom
◇	BO	50-59	Bloom Over
△	SR	60-69	Seeds Ripe
▲	DS	70-79	Dissemination Starts
◇	BD	80-89	Plants Begin to Dry
◆	PD	90-	Plants Dry
○	GR		Grazed

Soil Moisture Depth:

S= surface moisture

D= soil dry

BR= any soil condition which prevents further digging. (i.e.,
hardpan, rocks, etc.)

fr= frozen

gr= grazed

gu= green-up

sn= snow

ELKO

Elko field personnel noted on their weekly sheets that the willow (Salix alba) on their mountain meadow site (01-6) did not bloom at all this year. Also, a new species of buttercup (Ranunculus testiculatus) appeared for the first time on their seeding plot (01-4).

Elko utilized soil moisture bars instead of rain cans to measure their "precipitation". While studying their annual phenodynamic tables, it should be kept in mind that -.2 represents saturation of the soil, -5.5 represents dry, and -15 means wilting point for the plants. Their readings of -60, therefore, represent extremely dry soil!

Field personnel took upper site (U) and lower site (L) measurements for soil temperature, etc. on their mountain brush site (see annual phenodynamic tables, 01-7). For simplicity, this site may be divided into two sites next year.

Examination of the phenodynamics for their sites reveals no extraordinary patterns. Grass species show a general drying and seed dissemination corresponding with high soil moisture bar readings (resistance), indicating rapid drying of the soil. Soil moisture offers a substantial clue to the growth, particularly seed development, in the grass species. The forbs generally show a similar pattern, with the possible exception of hoary aster (Machaeranthera canescens), which seemed to complete its life cycle during a relatively dry period.

Leader length and height of grasses showed the same erratic results (Table 1) as experienced at many of the other sites. No significant patterns are apparent with this interpretation. Further analysis may be required.

The three year comparison of the phenodynamic of antelope bitterbrush (Purshia tridentata) shows a striking similarity (Figure 1). The flowering phenophases occur over a period from two to four weeks long, depending on the year.

A similar plotting of Sandberg bluegrass (Poa sandbergii; Figure 2) and squirreltail grass (Sitanion hystrix; Figure 3) shows considerable phenological variation for the former and less annual correspondence for the latter. Height growth of squirreltail grass (Figure 4) was greater in 1976 and 1978 than in 1977. The reasons for this are not clear. Possibly, interactions with temperature and soil moisture were influential. Height growth for rabbitbrush (Chrysothamnus viscidiflorus) also shows considerable variability (Figure 5).

Figure 6 shows a very consistent pattern for various grasses with respect to the onset of vegetative growth. The appearance of flower stalks and seed dissemination shows much more variation.

Leaf growth of shrubs varies by species (Figure 7), as does twig growth. For example, twig growth of rabbitbrush tends to begin sooner than for buckwheat (Eriogonum sp.) and bitterbrush. The developmental variation for lungwort (Mer-
tensia oblongifolia) and arrowleaf balsamroot (Balsamorhiza

sagittata) is variable (Figure 8), but there are no significant patterns represented by the three year comparison.

NEW LEAF
GROWTH
LEAVES DRY
AND DROP
LEAVES TURN
YELLOW
SEED
DISSEMINATION
SEED-RIPE
BLOOM-OVER
FULL-BLOOM
FIRST-BLOOM
LEAVES FULL
GROWN
FLOWER BUDS
FIRST VISIBLE
TWIG-GROWTH
LEAF-GROWTH
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976 - - - - -
1977 —————
1978 + + + + +

Fig. 1. Phenology of
Purshia tridentata
on mountain brush vege-
tation type (site 01-7),
Elko District.

Fig. 2. Phenology of *Poa sandbergii* on northern desert shrub vegetation type (site 01-3), Elko District.

Fig. 3. Phenology of *Sitanion hystrix* compared to soil moisture depth (inches) on northern desert shrub vegetation type (site 01-3), Elko District.

Fig. 4. Height growth (mm) of Sitanion hystrix compared with soil moisture depth (inches), mountain brush vegetation type (site 01-7), Elko District.

1976 -----
1977 _____
1978 -x-x-x-

Fig. 5. Leader growth (mm) of *Chrysothamnus viscidiflorus* compared with soil moisture depth (inches) on northern desert shrub vegetation type (site 01-3), Elko District.

Fig. 6. Occurrence of various phenophases of selected grasses, Elko District.

01-7
Putr

1976

1977

1978

01-10
Chy

1976

1977

1978

01-7
Eriog sp

1976

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

LEAF-GROWTH

TWIG-GROWTH

Fig. 7. Occurrence of leaf and twig growth of selected shrubs, Elko District.

Fig. 8. Occurrence of various phenophases of selected forbs, Elko District.

Table 1. Leader (Shrubs) and Height (Grasses) Growth in the Elko District for 1976, 1977, and 1978.

	Millimeters					
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site Ol-3</u>						
<u>SHRUBS</u>						
1. Artr	70		110		140	
2. Chvi	70		120		180	LG*
<u>GRASSES</u>						
1. Elci	750		820		1000	
2. Stwe	220	100	200		250	
3. Posa	300	60	200		230	95
4. Sihy	300	100	240		250	130
<u>FORBS</u>						
1. Lone	50		40		80	
2. Meob	92		80		120	
3. Asle	110				170	10
4. Phlox sp.			50		50	9
5. Lule	110		100		210	
<u>Site Ol-4</u>						
<u>SHRUBS</u>						
1. Artr	110		200		150	
2. Chnac					240	
<u>GRASSES</u>						
1. Agcr	380		370		450	155

*Leaf growth

		Millimeters					
		1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>01-4 Con't.</u>							
2. Sihy	200			210		2310	100
3. Posa	200			230		140	55
<u>FORBS</u>							
1. Phlox sp.	30			90		25	2
2. Rate						25	
<u>Site 01-6</u>							
<u>SHRUBS</u>							
1. Saal	1000			470		370	
<u>GRASSES</u>							
1. Cane	650			450		550	
2. Juba	740			570		600	
3. Agst				540		900	
4. Popr				450		800	
5. Brin				760		1130	
<u>FORBS</u>							
1. Fraga sp.	500					could not find	
2. Migu	220					450	
3. Rumex sp.	700			670		920	
4. Mear				250		540	
<u>Site 01-7</u>							
<u>SHRUBS</u>							
1. Artr	210			160		205	
2. Putr	70			110		135	
3. Chvi	220			140		150	

Millimeters						
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>01-7 Con't.</u>						
4. Rosa sp.	90		100		80	
5. Eriog sp.	270		100		150	
6. Arar	150		110		200	
7. Chnac	200		210		270	
8. Amut			50		122	
<u>GRASSES</u>						
1. Feid	570		480		460	100
2. Elci	1230		960		1350	
3. Posa	350	50	230		300	70
4. Agsp	610	100	530		450	105
5. Sihy	300	100	180		300	125
6. Stth	470	70	230		450	
7. Brte					140	55
<u>FORBS</u>						
1. Meob	180		100		160	
2. Basa	600		270		450	
3. Maca	260				400	
4. Ragl					90	
5. Lupin sp.					320	
<u>Site 01-10</u>						
<u>SHRUBS</u>						
1. Artr	140		190		290	
2. Chvi	100		160		150	LG*

* Leaf growth

Millimeters					
	1976	Regrowth	1977	Regrowth	1978 Regrowth
<u>01-10 Con't.</u>					
<u>GRASSES</u>					
1. Brte	320	100	160		380 55
2. Elci	1330		940		1600
3. Agda			510		550 130
4. Posa			300		115
<u>FORBS</u>					
1. Sial	250		310		750 10
2. Erci	90	20	140		300 30

▲ SITE LOCATIONS
(Not all shown due
to closeness)

ELKO DISTRICT

SYMBOL 1978	FEB	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT			NOV
			S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S	S S		
SMD(From-To in cm)			30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30	30 30		
SM Blocks			2 4	3 3	2 4	3 3	2 4	3 3	2 4	3 3	2 4	3 3	2 4	3 3	2 4	3 3	2 4	3 3	2 4	3 3	2 4	3 3	2 4	3 3		
S.T.-°C			1 7	6 4	7 3	8 1	4 4	11 14	20 16	19 19	18 30	32 29	25 23	16 11	5 13	9 10	8 8	5 6								
Elko 1-3																										
SHRUBS																										
rtr			D					TG						BV												
hvi			D		LG			TG						BV												
RASSES																										
lci			D GS					$\frac{1}{2}$ V						FS HO An												
twe			D GS					$\frac{1}{2}$ V						FS An HS BD												
osa			GS					$\frac{1}{2}$ V						HO An DS SD PD												
ihy			D GS					$\frac{1}{2}$ V						FS HO An DS SD BD												
ORBS																										
asle			D					GS FS 1B FB						BO SR PD												
one			D FS					1B FB						BO SR DS BD PS												
ule			D					GS FS 1B FB						BO SR PD												
feob			D GS					FS 1B						FB BO SR DS BD PD												
phlox sp.			D GS					1B FB						BO SR DS BD												

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SYMBOL 1978	FEB	MARCH				APRIL				MAY			JUNE				JULY				AUG				SEPT				OCT				NOV				
SMD(From-To in cm)					S 30	S 30	S 30	S 30		S 30	S 30	S 30		S 30	S 30	S 30	S 30		S 30	S 30	S 30	S 30		S 30	S 30	S 30	S 30		9 30	S 30	S 30	S 30	S 30	S 30			
SM Blocks					-2	-2	-1	-1		-2	-1	-2		-2	-2	-2	-2		-2	-2	-2	-2		-2	-2	-2	-2		-2	-2	-2	-2	-2	-2			
S.T.-°C					7	5	10	7		7	10	14		10	12	12	12		13	13	17	17		17	15			11	9	11	9	9	9	6	7	2	
Elko 01-6																																					
<u>SHRUBS</u>																																					
Saal					D					LG		TG																							LY	LD	
<u>GRASSES</u>																																					
Brin					GS							1/2V							An	HS						SD									BD		
Popr					GS							1/2V	FS		HO				An	HS															BD		
Juba					GS							1/2V	FS		HO				An		DS														SD	BD	
Cane					GS							1/2V	FS		FS	HO	An			DS	HS														BD		
Agst																												An	DS	HS	SD					BD	
<u>FORBS</u>																																					
Rumex sp.					GS															FS	1B	FB	BO													DS	BD
Mear																				FS																PD	
Migu																				FS	FB															PD	
																					1B																

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	F	MARCH			APRIL			MAY			JUNE			JULY			AUGUST			SEPTEMBER			OCTOBER			NOV	
																										1	2
S.T. (°C)	U			0 7		12 5 7	2 14 20	6 14 18	30 18	23 31 20	33 35 31	30 30	19 10 6	15 2 13 11	7 6 5	4	S										
	L			0 3		8 3 5	1 10 17	4 8 16	25 17	20 25 19	26 30 29	24 23	16 8 3	9 6 7 6	5 4	S											
SMD (From-To	U			S S		S S	S 1 2	6 S	3 11 11	15 D D D D	D D D D	D D D D	D S S	2 8 10	10 S												
in cm)	L			30 30		30 30 30	30 30 30	30 30 30	30 30 30	D D D D	D D D D	D D D D	D S S	30 30 30	30 8 5	10 S											
SM BLOCKS	U			-2		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
	L			-2		-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2	-2
Elko																											
01-7																											
SHRUBS																											
Amut				D		LG				TG	FG	1B	BO	SR		SD				LY			LD				
Arar				D				LG	TG					BV			FG						1B	FB		BO	SD
Artr				D				TG						BV			FG						1B	FB		BO	SD
Chnaa				D		LG					TG					BV	FG						1B	FB		BO	SD
Chvi				D		LG				TG				BV			FG										
Eriog sp.				D		LG				TG			BV	FG		1B	1B			FB				BO		LY	SD
Putr				D		LG				TG	BV	1B	BO			SR	SD						LY		LD		
Rosa sp.				D		LG		TG			BV	1B	FB	BO	SR					SD				LY		LD	
GRASSES																											
Agsp				D	GS																						

	F	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOV
S.T. (°C)	U L									
SMD (From-To in cm)	U L									
SM BLOCKS	U L									
Elko 01-7 cort										
<u>GRASSES</u>										
Elci		D GS		$\frac{1}{2}V$	FS	HO An	DS SD SD HS	BD		PD
Feid		D GS	$\frac{1}{2}V$		FS HO An	DS HS	SD BD		<u>GS</u>	
Posa		GS	$\frac{1}{2}V$		FS BD	HS SD		<u>GS</u>	$\frac{1}{2}V$	
Sihy		D GS	$\frac{1}{2}V$		FS HO	An HS DS	SD BD	<u>GS</u>		
Stth		D GS	$\frac{1}{2}V$		FS HO	An DS	SD	BD		
Brte		GS		FS	HO	DS HS BD SD	PD	<u>GS</u>		
<u>FORBS</u>										
Basa		D	GS	FS	1B FB	BO SR DS	BD	PD		
Lupin sp.		D	GS	FS	1E FB	SR DS BD			PD	
Waca		D				FS 1B		FE	BO SR DS	BD
Meob		D GS		FS 1B	FB	BO DS BD	PD			
Ragl		GS FB		SR DS	PD					

SYMBOL 1978	FEB	MARCH				APRIL				MAY				JUNE				JULY				AUG				SEPT				OCT				NOV					
SMD (From-To in cm)						S	S	S			S	1	9		4	12	14	21	3	10	25						S	S	S	1	8	11	15	15	0-5	5			
						30	30	30	30		30	30	30		30	30	30	30	30	30	30	D	D	D	D	D	30	30	30	30	30	30	30	30	30	30	30		
SM Blocks						-2	-2	-2	-2	-2	-2	-4			-25	-6	-14	-35	-12	-15	-60	-60	-60	-60	-60	-60	-60	-2	-2	-9	-5	-11	-15	-20	-30	-8			
S.T.-°C						0	5	15	9		7	12	15		13	15	19	18	20	27	35	37	24	36	31	31	16	11	14	19	13	5	13	15	8	10	5	4	
Elko 1-10																																							
<u>SHRUBS</u>																																							
rtr						D					TG							BV					FG									1B	FB		BO		SD		
hvi						D					TG							BV					FG	1B		FB					BO	SR	SD			LY	LD	LG	LG
<u>GRASSES</u>																																							
gda						GS						$\frac{1}{2}$ V						FS	HO	An	DS	HS				SD	BD				PD	GS							
rte						GS						FS		HO			An	DS	SD	BD	PD										GS					BD			
lci						GS						$\frac{1}{2}$ V						FS	HO	An	DS		HS			SD		BD								PD			
osa						GS	$\frac{1}{2}$ V					FS		HO			DS		HS	BD	BD	PD									GS		$\frac{1}{2}$ V			BD			
<u>TORBS</u>																																							
rci						GS						FS	1B		FB				SR	DS	BD	PD									GS								
sial						GS							FS			1B	FB					BO			SR						DS	BD			GS				

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WINNEMUCCA

WINNEMUCCA

Winnemucca field personnel noted several interesting facts on their weekly data sheets. They wrote that last year's mature leaves were green as early as February 24, 1978, for squirreltail grass (Sitanion hystrix) on site 3-2, a northern desert shrub type. Also, thistle (Cirsium sp.) went directly from "growth starts" to "dry", with no flower stalks appearing (site 2-11).

Relatively good April and June precipitation tends to regulate plant development. Generally, the good April precipitation (1978) resulted in rapid growth rates of grasses, rapid elongation of twigs, and early bloom in forbs. The three year comparison of data reveal no important irregularities.

Vegetative growth of bluebunch wheatgrass (Agropyron spicatum) continued for a much longer period in 1978 than the other two years (Figure 1). This may, of course, be a result of variability among samplers. Other grasses do not show any significant changes (Figures 1 and 2).

Height growth of the annual cheatgrass (Bromus tectorum) seems to be regulated by April-May soil moisture depth (Figure 3). Good soil moisture after June does not revive this short-lived species. Leader growth of rubber rabbitbrush (Chrysothamnus nauseosus; Figure 4) shows a similar relationship, with elongation continuing into July and August.

The development of bud sagebrush (Artemisia spinescens) was very similar for all three years (Figure 5). This species completes its annual growth cycle from April 1 through about June 15 each year. Longflower snowberry (Symphoricarpos longiflorus) shows greater variation at the higher elevations where it is found (Figure 6). Most activity for this species occurs between June 1 and August 30. For squirreltail grass (Sitanion hystrix; Figure 7), the most active period is between May 1 and July 1, but a phenophase may occur up to four weeks apart from year to year.

An overall look at the leader and height growth data (Table 1) suggests that 1978 was a better growth year than 1977 on most sites, but not necessarily better than the growth recorded in 1976. Also, several species showed regrowth in 1978, but not in 1976 and 1977. Additional correlation analyses with soil moisture and/or precipitation will be required to test the predictability of these relationships.

Fig. 1. Occurrence of various phenophases for selected grasses Winnemucca District.

02-6
febr

1976

1977

1978

02-2
May

1976

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

VEGETATIVE
GROWTH

FLOWER STALKS
FIRST APPEAR

SEED
DISSEMINATION

PLANTS DRY

Fig.2.Occurrence of various
phenophases of selected
grasses, Winnemucca Dis-
trict.

Fig. 3. Height growth (mm) of *Bromus tectorum* compared with soil moisture depth (inches) on salt desert shrub vegetation type (site 02-2), Winnemucca District.

1976 - - - - -
1977 ————
1978 | | | |

Fig. 4. Leader growth (mm) of *Chrysothamnus viscidiflorus* compared with soil moisture depth (inches) northern desert shrub vegetation type (site 02-3-2), Winnemucca District.

NEW LEAF
GROWTH
LEAVES DRY
AND DROP
LEAVES TURN
YELLOW
SEED
DISSEMINATION
SEED RIPE
BLOOM OVER
FULL BLOOM
FIRST BLOOM
LEAVES FULL
GROWN
FLOWER BUDS
FIRST VISIBLE
TWIG GROWTH
LEAF GROWTH
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976
1977
1978

Fig. 5. Phenology of *Artemisia spinescens* compared with soil moisture depth (inches) on salt desert shrub vegetation type (site 02-2), Winnemucca District.

NEW LEAF
GROWTH
LEAVES DRY
AND DROP
LEAVES TURN
YELLOW
SEED
DISSEMINATION
SEED RIPE
BLOOM OVER
FULL BLOOM
FIRST BLOOM
LEAVES FULL
GROWN
FLOWER BUDS
FIRST VISIBLE
TWIG GROWTH
LEAF GROWTH
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976 ————
1977 ————
1978 + + + +

Fig. 6. Phenology of
Symphoricarpos longiflorus
in mountain brush vegeta-
tion type (site 02-7),
Winnemucca District.

Fig. 7. Phenology of *Sitanion hystrix* in salt desert shrub vegetation type (site 02-2), Winnemucca District.

Table 1. Leader (Shrubs) and Height (Grasses) Growth in Winnemucca District for 1976, 1977, and 1978.

		Millimeters				
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 02-2</u>						
<u>SHRUBS</u>						
1. Grsp	70		45		♀ 70 ♂ 55	
2. Arsp	25		15		30	
3. Atco	80		53		85	
<u>GRASSES</u>						
1. Brte	240		50		200	
2. Sihy	240		135		270	50
3. Posa	300		110		260	20
<u>FORBS</u>						
1. Lepe	180		150		200	
<u>Site 02-3-1</u>						
<u>SHRUBS</u>						
1. Arar	70		15		180	
2. Artr	45		27		230	
3. Tegl			60		100	
4. Chna			110		130	
<u>GRASSES</u>						
1. Agsp	600		330		350	30
2. Posa	200		63		280	15
3. Sihy	300		200		230	

	Millimeters					
	1976 Regrowth		1977 Regrowth		1978 Regrowth	
<u>02-3-1 Con't.</u>						
4. Brte	200	80	90		190	10
5. Stth			80		200	10
<u>FORBS</u>						
1. Luca	180		55		300	
2. Crac	190		160		120	
3. Phho	50		6		100	
4. Casti sp.	200		180		180	
5. Astra sp.			65		50	
<u>Site 02-3-2</u>						
<u>SHRUBS</u>						
1. Chvi	110		120		160	
2. Tegl	70		65		100	
3. Atco			50		110	
4. Arsp			15		30	
5. Artr			20		220	
<u>GRASSES</u>						
1. Posa			30	70	280	20
2. Sihy			165		260	40
3. Brte			20	70	180	30
<u>FORBS</u>						
1. Phho	50		2		40	
<u>Site 02-6</u>						
<u>SHRUBS</u>						
1. Salix sp.	140		155		110	

		Millimeters		
		1976 Regrowth	1977 Regrowth	1978 Regrowth
<u>02-6 Con't.</u>				
<u>GRASSES</u>				
1. Pobu	250		55	340
2. Hobr	450		100	500
3. Juncu sp.	400		300	300
4. Carex sp.	120		100	160
<u>FORBS</u>				
1. Taof	85		75	150
2. Iris sp.	500		450	400
3. Acla	300		290	340
4. Veca	1000		650	600
5. Cirsi sp.			460	400
<u>Site 02-7</u>				
<u>SHRUBS</u>				
1. Amal	45		9	30
2. Arar	170		15	140
3. Sylo	70		130	80
4. Hodi	60		73	85
<u>GRASSES</u>				
1. Agsp	610		400	500
2. Elci	1200		88-	1220
3. Posa	400		75	270 20
<u>FORBS</u>				
1. Pesi	60			70
2. Phho	40		14	80
3. Luca	400		250	360

		Millimeters		
		1976 Regrowth	1977 Regrowth	1978 Regrowth
<u>02-7 Con't.</u>				
4.	Zigad sp.		250	250
5.	Haplo sp.		12	60
<u>Site 02-11</u>				
<u>SHRUBS</u>				
1.	Riau	90	105	180
2.	Rowo	110	63	100
3.	Artr	120	50	280
4.	Prvi	160	120	120
5.	Chna		185	180
6.	Salix sp.		210	120
7.	Potr		90	260
<u>GRASSES</u>				
1.	Posa	310	97	280 20
2.	Pobu	330	125	400
3.	Elci		700	990
4.	Brte		180	200 30
5.	Carex sp.		85	130
<u>FORBS</u>				
1.	Erci	60	80	80
2.	Cirsi sp.		580	140
3.	Arlu		400	370
4.	Iris sp.		480	580

WINNEMUCCA DISTRICT

SYMBOL 1978

SYMBOL 1978	24 FEB	MARCH				APRIL				MAY				JUNE				JULY				AUG				SEPT				OCT				NOV
SMD(From-To in cm)	S 30	- 30	S 30	S 30	S 30	S 30	- 30	S 30	25 30	76 30	- 30	18 30	- 30	D 30	D 30	- 30	D 30	- 30	D 30	- 30	D 30	- 30	- 30	- 30	- 30	- 30	- 30	25 30						
Precip.(mm)						18	21	5	1	11	4	3	7	19					0	0							51							
S.T.(°C) Max						27	29	27	23	25	27	34	41	34					38	38							20							
Min						2	2	3	5	8	10	15	12	15					16	16							9							
Winn. 02-2																																		
SHRUBS																																		
Atco	D				LG				TG BV	FG	1B		FB		SR	SD			LY							LD				D				
Arsp	LG				BV		TG BV		1B		FB		BO		SR	SD		LD												D				
Grsp ♀	D				LG	BV			BV		1B		BO		SD	SD		LD												D				
♂	D				LG	TG			1B		1B		BO		SR	LY		LD												D				
GRASSES																																		
Sihy	GS								$\frac{1}{2}$ V	FS			HO		Ar	HS		SD		BD			PD									GS		
Posa						$\frac{1}{2}$ V	FS		HO				An		DS	SD		BD		PD												GS		
Brte					GS				$\frac{1}{2}$ V	FS	HO		DS			SD		BD				PD									D			
FORBS																																		
Lepe	D								1B		FB		SR			BD		PD													D			
55																																		

SYMBOL 1978	24 FEB	MARCH			APRIL			MAY			JUNE			JULY		AUG		SEPT			OCT			NOV
SMD(From-To in cm)	S 30	S 30	S 30		S 30			5 30	2 30		5 30	7 30	17 30	S 30	7 30	21 30	27 30			20 30				
Precip. (mm)					24	36	9	.3			11	1	114	16	.5	.14	0			57				
S.T.(°C) Max					25	27	27	18			21	29	30	29	33	38	38			27				
Min					-2	-4	-6	6			12	9	11	11	18	17	17			7				
Winnemucca 02-3-1																								
<u>SHRUBS</u>																								
Artr	D				LG		TG				BV					FG				1B				
Arar	D						TG				BV					FG				1B				
Tegl	D			LG			BV				TG FG			FB	SR	SD	LY			LD				
Chna	D			LG							TG					BV	FG			SD				
<u>GRASSES</u>																								
Agsp	D		GS				$\frac{1}{2}$ V				FS				HC		BD			PD GS				
Sihy	GS						$\frac{1}{2}$ V	FS			HO An		DS	HS		SD	PD							
Posa	GS				FS		HO				AN DS	SD	BD	PD						GS				
Brte	D			GS			$\frac{1}{2}$ V	FS			Ar	DS	BD	PD						GS				
Stth	D		GS				$\frac{1}{2}$ V				FS	HO	HS	SD		BD	PD			GS				
<u>FORBS</u>																								
Phho	D		GS		FS		1B	FB			BO SR	DS	BD	PD						D				
Crac	D			GS				FS				FE	DS	BD		PD				D				
Casti sp.	D				GS		1B	FE			BO	SR	DS		PD					D				

SYMBOL 1978

FEB
22

MARCH

APRIL

MAY

JUNE

JULY

AUG

SEPT

OCT

NOV

/innemucca
02-3-1 con't

ORBS

uca

stra sp.

D

GS

FS

1B FB

SR

DS

BD

PD

D

D

GS

FS

1B

FB

SR DS

PD

D

SYMBOL 1978	24 FEB	MARCH				APRIL				MAY				JUNE			JULY		AUG		SEPT			OCT		NOV	
SMD(From-To in cm)	S 30	S 30	S 30	2 30	S 30	S 30	S 30	S 30	5 30					10 45	12 30	27 30	D	D		D	D			17 30			
Precip.(mm)						21	28	6	.3					.4	2	.12	7.6	0		0	0			55			
S.T.(°C)Max Min					24 -2	26 -2	24 -4	23 3						26 7	37 10	58 15	30 12	31 15			38 16						
Winnemucca 02-3-2																											
<u>SHRUBS</u>																											
Atco	D				TG			BV						FG 1	EFB	BO	SR			SD				LY			
Arsp	LG				BV	TG BV			1B					FB	BO	SD	LD							D			
Artr	D				LG			TG	BV											FG	1B						
Tegl	D			LG	TG	BV								FG	1B	FB	SR		SD	LY				LD			
Chvi	D				LG			TG								BV			FG	FB				SD			
<u>GRASSES</u>																											
Posa	GS				$\frac{1}{2}$ V	FS		HO						An	DS	HS	BD	PD						GS			
Sihy	GS				$\frac{1}{2}$ V			FS						HO	An	DS	HS	SD		PD				GS			
Brte	D			GS				FS		HO				A	DS	HS	BD		PD					GS			
<u>FORBS</u>																											
Phho	D			GS	FS		1B	FB						BO	DS		BD	PD						D			

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SYMBOL 1978	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT			NOV
SMD (From-To in cm)										S 45	S 45	S 30	S 30	S 30		S 30	S 30			S 30					
Precip. (mm)																	0				55				
S.T.-(°C)																									
Winnemucca 02-6																									
SHRUBS																									
Salix sp.										SR		SD			LY										LD
GRASSES																									
Pobu										HO	An	DS		SD	BD			PD							D
Carex sp.										HO			An	DS		SD									BD
Hobr										$\frac{1}{2}$ V	HO	An	DS		SD		BD								D
Juncu sp.										$\frac{1}{2}$ V	FS	HO	DS	HS		SD									BD
FORBS																									
Taof										FB			DS	PD				D							
Iris sp.										GS	FS	FB	BO	SR			BD								PD
Acla										FS		LB	FB			BO	DS								PD
Cirsi sp.										GS		FS	LB	FB		SR	BD								PD
Veca										GS				gr.		BD	PD								

SYMBOL 1978	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT			NOV		
SMD (From-To in cm)									S 45	S 45	S 30	S 30	24 30		29 30	D											
Precip. (mm)										15		17	0		1						55						
S.T. (°C)																											
Winnemucca 02-7																											
<u>SHRUBS</u>																											
Amal											1B	FB	BO		SR		SD LY		LY						LD		
Sylo											BV				1B		BO		SR		LY				D		
Hodi											BV				1B		BO		SR		LY				LD		
Arar											TG						BV				FG				1B		
<u>GRASSES</u>																											
Agsp											$\frac{1}{2}$ V	FS					DS		HS		BI				PD		
Elci											$\frac{1}{2}$ V	FS	HO		An		DS		HS		SD				BD		
Posa											An		DS		SD				BD		PD				<u>GS</u>		
Sihy											FS		An		DS		HS		SD		PD				<u>GS</u>		
<u>FORBS</u>																											
Phho											FB		SR		BD		PD				D						
Luca											1B				BO		DS		BD		PD				D		
Pesi											1B		BO				SR		DS		BD				PD		
Zigad sp.											FS	1B	FB		SR		BD		PD		D						

SYMBOL 1978

MARCH

APRIL

MAY

JUNE

JULY

AUG

SEPT

OCT

NOV

Winnemucca
02-7 con't

FORBS

Haplo sp.

SNOW

SNOW

SNOW

FS 1B FB

SR

BD

PD

D

SYMBOL 1978	24 FEB	MARCH			APRIL			MAY			JUNE			JULY		AUG		SEPT		OCT		NOV
SMD(From-To in cm)	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	5		2 30	5 30	20 30	S 30	10 30	20 30	D			17 30		
Precip.(mm)					23		7.6	.3			12	4	5	10	0	1	0					
S.T.(°C) Max.					22	22	27	22			26	28	33	29	38	38	38		22			
Min.					0	-1	-4	5			7	9	10	12	18	17	12		5			
Winnemucca 02-11																						
<u>SHRUBS</u>																						
Salix sp.	D			LG				TG BV			BO	SRSD	LY									
Prvi	D			LG			BV	TG BV			1B	FE	BO	SR					LY			
Chna	D			LG							TG			BV			FG			1B		
Artr	D			LG			TG				BV						FG			1B		
Potr	D						LG	TG					BV			FG						
Riau	D			LG	BV		TG 1B	FB			BO	SR				SD	LD					
Rowo	D			LG				TG			BV	FG	1B	BO	SR					SD		
<u>GRASSES</u>																						
Posa	GS			$\frac{1}{2}$ V	FS		HO				An	DS	HS	BD	PD		D			<u>GS</u>		
Elci	GS						$\frac{1}{2}$ V	FS				HO	An	DS	HS	BD						
Pobu	D			$\frac{1}{2}$ V	FS		HO				DS	HS	SD	BD	PD	D						
Brte	D		GS				$\frac{1}{2}$ V	FS			DS	HS	BD		PD	D				<u>GS</u>		
Carex sp.	D		GS				$\frac{1}{2}$ V	FS	HO		An	DS	HS			D						

SYMBOL 1978	FEB 24	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
Winnemucca 02-11 con't										
<u>FORBS</u>										
Erci	GS		FS	1B FB BO	SR	DS	PD		D	
Cirsi sp.	D	GS					PD	D		
Clema sp.	D	GS		FS		1B BO	DS	BD		
Arлу	D	GS		FS		1B	BO	DS	BD	
Iris sp.	D	GS		FS	1B FB BO	SR	DS	BD	PD	

CARSON CITY

Data from the Carson City sites is similar to other locations relative to pattern correlations and general relationships. No outstanding anomalies are presented. The heading-out of grasses seems to be closely correlated with May precipitation and an onset of somewhat warmer temperatures in June. Also, vegetative growth of grasses appears to be strongly regulated by soil temperature when moisture is adequate.

An examination of leader and height growth (grasses and forbs) indicates that, overall, 1978 was a somewhat better growth year on many sites than either 1976 or 1977 (Table 1). However, not all species or sites show this trend. A quantitative analysis will be required before the strength of such relationships can be proven.

The three-year comparison for leader growth on big sagebrush (Artemisia tridentata; Figure 1) shows relative similarity among years with drying occurring two or three weeks earlier in 1978. Height growth of Indian ricegrass (Oryzopsis hymenoides; Figure 2) shows much greater variation with 1977 exhibiting remarkably greater growth than either 1976 or 1978. This phenomena is quite possibly a direct result of differing soil moisture depths for each of the three years.

The phenology of desert globemallow (Sphaeralcea ambigua; Figure 3) was quite similar in 1976 and 1977; but developed

faster in 1978, with most phenophases occurring two to four weeks earlier. Indian ricegrass development occurred early in 1978 and late in 1977 (Figure 4). The late development in 1977 occurred when the soil moisture depth was relatively deep (or dry) in April and May. A very similar pattern is shown for squirreltail grass (Sitanion hystrix; Figure 5).

Leaf growth of bitterbrush (Purshia tridentata) was evident in 1978, but not in the previous two years (Figure 6). The initiation of twig growth varied considerably from year to year for both bitterbrush and low sagebrush (Artemisia arbuscula) - black sagebrush (Artemisia nova). Seed dissemination varied more in Indian ricegrass than in Kentucky bluegrass (Poa pratensis; Figure 7). The onset of growth in arrowleaf balsamroot (Balsamorhiza sagittata) began earlier each progressive year for the three years (Figure 8).

Figure 9 shows a two year comparison for squirreltail grass as it developed on three sites. There appears to be slightly more variation from site to site in 1978. In 1977, the development of this species was very close. The growth of flower stalks and headings occurred in a very narrow time frame for both years and all three sites.

1976 —————
1977 - - - - -
1978 + + + + +

Fig. 1. Leader growth (mm) of *Artemisia tridentata* compared with soil moisture depth (inches) pinyon-juniper vegetation type site 03-5-4), Carson City District.

1976 -----
1977 -----
1978 + + +

Fig. 2. Height growth (mm) of *Oryzopsis hymenoides* compared with soil moisture depth (inches) on northern desert shrub vegetation type (site 03-3-1), Carson City District.

Fig. 3. Phenology of *Sphaeralcea ambigua* on salt desert shrub vegetation type (site 03-2-1), Carson City District.

Fig. 4. Phenology of *Oryzopsis hymenoides* compared with soil moisture depth (inches) on salt desert shrub vegetation type (site 03-2-1), Carson City District.

HARD SEED
 $\frac{1}{2}$ VEGETATIVE
 GROWTH
 REGROWTH
 PLANT DRY
 PLANT BEGINS
 TO DRY
 DISSEMINATION
 HARD SEED
 DOUGH SEED SET
 ANTHESIS
 HEADS OUT
 FULLY
 FLOWER STALKS
 $\frac{1}{2}$ VEGETATIVE
 GROWTH
 GROWTH STARTS
 DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976

1977

1978

Fig. 5. Phenology of *Sitanion hystrix* on northern desert shrub vegetation type (site 03-3-1), Carson City District.

Fig. 6. Occurrence of leaf and twig growth of selected shrubs, Carson City District.

03-5-4
Popr

1976

1977

1978

03-2-1
Orhy

1976

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

* VEGETATIVE
GROWTH

FLOWER STALKS
FIRST APPEAR

SEED
DISSEMINATION

PLANTS DRY

Fig. 7. Occurrence of various phenophases of selected grasses, Carson City District.

Fig. 8. Occurrence of various phenophases of *Balsamorhiza sagittata*, Carson City District.

1977
 Carroll Summit ————
 Carson City - - - - -
 Carson City (N) —●—●—●—
 1978
 Carroll Summit
 Carson City —·—·—·—
 Carson City (N) | | | | |

Fig. 9. Phenology of *Sitanion hystrix* on northern desert shrub vegetation types of Carroll Summit (site 07-3), Carson City (site 03-3-1), and Carson City (North; site 03A-3).

Table 1. Leader (Shrubs) and Height
(Grasses) Growth in the
Carson City District for
1976, 1977, and 1978.

		Millimeters				
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 03-2-1</u>						
<u>SHRUBS</u>						
1. Cela	70		80		125	
2. Artr	90		120		160	
3. Atca	118		70		85	
4. Tegl	120				90	
5. Chvi	71		100		105	
6. Atco	32		70		105	
7. Epne	240		80		0	
8. Chna	55		120		160	
9. Arsp			10		30	
10. Grsp			30		90	
<u>GRASSES</u>						
1. Orhy	190	150	290		310	
2. Sihy	250	100	270		215	
3. Stipa sp.					290	
<u>FORBS</u>						
1. Astra sp.	85		110		not found	
2. Spam	100		275		230	
<u>Site 03-3-1</u>						
<u>SHRUBS</u>						
1. Grsp	40		160		180	

Millimeters						
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>03-3-1 Con't.</u>						
2. Pran	120		50		120	
3. Artr	80		190		210	
4. Chvi	50		145		145	
5. Chna	35		140		150	
6. Epvi	110		75		90	
7. Lepu	80				180	
8. Teca			100		140	
9. Saca			110		70	
<u>GRASSES</u>						
1. Orhy	250		450		310	
2. Brte	120		140		140	
3. Sihy	130		250		245	
4. Stco			180		290	
<u>FORBS</u>						
1. Basa	200		250		250	
<u>Site 03-3-2</u>						
<u>SHRUBS</u>						
1. Artr	115		160		180	
2. Epne	100		115		100	
3. Putr	30		120		130	
4. Pran	35		70		90	
<u>GRASSES</u>						
1. Stth					230	
2. Sihy	90		195		210	

		Millimeters				
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>03-3-2 Con't.</u>						
3. Orhy	170		185		140	
4. Stco			140		140	
<u>Site 03-5-1</u>						
<u>SHRUBS</u>						
1. Arno-Arar	15		105		140	
2. Tegl	75				55	
3. Chna			145		140	
4. Grsp					90	
<u>GRASSES</u>						
1. Brte	90		90		100	
2. Sihy	109		160		240	
3. Stipa sp.			100		175	
4. Posa					80	
<u>FORBS</u>						
1. Erci			100		150	
<u>Site 03-5-2</u>						
<u>SHRUBS</u>						
1. Artr	220		220		280	
2. Pran	16		45		150	
3. Putr	25		70		170	
4. Chna	120		115		150	
5. Ribes sp.	100				50	
6. Symph sp.	70		100		90	
7. Tegl			100		140	

Millimeters

1976	Regrowth	1977	Regrowth	1978	Regrowth
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03-5-2 Con't.

GRASSES

1. Elci	850	335	680	800
2. Posa	32	70	160	150
3. Sihy	290	85	320	270
4. Stth				310

FORBS

1. Senec sp.		150	180
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Site 03-5-4

SHRUBS

1. Artr	300	280	230
2. Chna	120	170	150
3. Ribes sp.	15	105	80
4. Rowo	130	160	65

GRASSES

1. Popr	690	495	300
2. Juncu sp.	610	500	550
3. Carex sp.	370	175	160
4. Agrop sp.		520	670
5. Pobu		250	260
6. Agcr		440	600

FORBS

1. Poten sp.			380
2. Taof	205	140	120
3. Veth	640	1020	750

Millimeters						
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>03-5-4 Con't.</u>						
4. Acmi			380		550	
<u>Site 03-7-1</u>						
<u>SHRUBS</u>						
1. Putr	260		250		55	
2. Ribes sp.	100		125		60	
3. Syal	500		140		80	
4. Artr	300		220		170	
<u>GRASSES</u>						
1. Posa	70	100	185		130 (grazed)	
2. Brte	170		160		grazed	
3. Brca			375		200 (grazed)	
<u>FORBS</u>						
1. Alliu sp.			180		175 (grazed)	
<u>Site 03-7-3</u>						
<u>SHRUBS</u>						
1. Artr	290		340		300	
2. Pran	32		160		180	
3. Ribes sp.	14		170		90	
4. Teca					130	
5. Putr	75		135		140	
6. Chna	250		160		140	
7. Epvi	100		260		100	
<u>GRASSES</u>						
1. Agcr	485	165	500		450	

Millimeters

1976	Regrowth	1977	Regrowth	1978	Regrowth
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03-7-3 Con't.

2. Sihy	300	110	315	220
3. Orhy	400	106	425	400
4. Agtr	671		600	400
5. Brte	265	80	210	100

FORBS

1. Circi sp.		450	600
2. Lysp		305	200

CARSON CITY DISTRICT

SYMBOL 1978	FEE 23	MARCH				APRIL				MAY				JUNE				JULY				AUG		SEPT				OCT				NOV
SMD(From-To in cm)	S	S	S	4	4	1	4		S	21	5	11	13	29	D	D	D	D	D	D	D	D										
Precip.(mm)						0		12	12	0	0	0	0	0	0	0	0	0	3	0	0	0										
S.T.-°C				17	16	10	15		10	13	15	16	21	22	25	21	25	26	23	27		29		25		25						
arson City 03-2-1																																
HRUBS																																
ela	D			LG		TG					BV	1B	FB	SR				SD			LY		LD									
rsp	LG			BV		TG		1B		FB		BO		SD	SD				LY			LD										
atca	LG												TG	1B	FB				BO	SR												
hvi	LG					TG							BV						1B					FB		BO						
atco ♀	LG					TG								FB	1B	FB			BO	SR				SD								
♂	LG					TG								FG					BO	-				-								
eg1	LG						TG		BV				1B	FB				SR	SD			SD		LY								
Epne	D					BV							FB			BO			SD						LY							
Artr	LG						TG					BV																				
rsp ♀	LG			BV		TG		BO	SR					SD	-			-	SD	LY					LD							
♂	LG			BV		TG		FB	BO					-	SR			SD	SD	LY					LD							
Chna	D			LG						TG					BV																	

SYMBOL 1978	FEB 23	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD(From-To in cm)										
Precip.(mm)										
S.T.-°C										
Carson City 03-2-1 con't										
<u>GRASSES</u>										
Orhy	D	GS	$\frac{1}{2}$ V	FS	HO An DS HS SD BD BD	BD		PD		
Sihy	GS	$\frac{1}{2}$ V		FS	HO An DS HS SD BD BD			PD		
Stipa sp	GS	$\frac{1}{2}$ V		FS	HO DS HS HS SD BD BD			PD		
<u>FORBS</u>										
Spam	D	GS		FS	lB FB BO SR	DS		PD		

SYMBOL 1978	FEB 23	MARCH					APRIL			MAY				JUNE				JULY			AUG			SEPT			OCT			NOV	
SMD(From-To in cm)	S	S	S	4	3		5 30	5 30	S 30	7 30	11 30	11 30	13 30	15 30	25 40		14 30	D		D	D		D								
Precip.(mm)							0	10	6	0	1	1	1	1	1	0	4	0		0	3		0								
S.T.-°C				19	15	11	12		13	12	16	16	22	25	21	25	25	26	26	27		29	28		27						
Carson City 03-3-1						-																									
<u>SHRUBS</u>																															
Chvi	LG					TG											BV						1B	FB							
Grsp	D	LG		BV		TG		BO	SR	-				SD	-			SD		LY		LD									
	D	LG		BV		TG FG		FB	-		BO			-	SD				LY		LY		LD								
Epvi	D					BV					FB	BD					SR	SD													
Artr	D	LG						TG									BV														
Chna	D		LG										TG					BV													
Teca	D	LG						TG									BV	1B	FB			BO	SR		SD						
Pran	D			LG			BV	1B		FB	BO		TG	FG	SR		SD	SD		LY											
Lepu	LG					TG							BV	1B	FB		BO	SR				SD		LY							
Saca	D					LG				TG		BV	FB				BO					SD		LY		LD					
<u>GRASSES</u>																															
Sihy	GS			1/2	V					FS	HO	An	OS	HS	SD							PD									
																	BD	BD													

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SYMBOL 1978	FEE 23	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD(From-To in cm)										
Precip.(mm)										
S.T.-°C										
Carson City 03-3-1 con't										
<u>GRASSES</u>										
Orhy	D	GS	$\frac{1}{2}$ V	FS	HO DS	HS SD BD BD	BD			
Brte	D	GS		FS HO An	DS HS	SD BD	PD			
Stco	D	GS	$\frac{1}{2}$ V	FS HO Ar	DS	HS SD BD	BD	PD		
<u>FORBS</u>										
Basa	D	GS	FS	1B	FB	BO SR	DS	DS BD BD	PD	

SYMBOL 1978	FEB 23	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT			NOV
SMD(From-To in cm)	S		3	4	2	S 30	S 30	S 30	4 30	7 30	11 30	13 30	20 30	D	D	D	D	D	D	D						
Precip. (mm)					0				0	0	0	1	1	0	0	0	1	0		0	0	0				
S.T. - °C			15	17	9	14	11	13	18	15	20	22	23	22	23	25	25	26		28		26		25		
Carson City 03-3-2																										
<u>SHRUBS</u>																										
Artr	D		LG				TC							BV												
Epne	D										BV	FB	TG		SR			SR		LY						
												BO														
Pran	D		LG		BV		FC	FB			BO	SR			SD							LY				
							1B																			
Putr	LG								1B	BO	TG	FG		SR				SD				LY				
<u>GRASSES</u>																										
Orhy	D		GS		1/2 V						FS	HO	DS		HS	SD		BL		PD						
Sihy	GS				1/2 V						FS	HC	An	HS	HS	SD		BD		PD						
															BD	BD										
Stth	GS				1/2 V						FS	HC	An	HS		HS	SD		BD		PD					
																BL										
Stco												An	DS	HS	BL	SD		BD		PD						
																BD										
<u>FORBS</u>																										

SYMBOL 1978	FEB 23	MARCH				APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT			NOV		
SMD(From-To in cm)	S	S	S	5	4	1	5	8 30	S 30	12 30	12 30	12 30	14 30	16 30	21 30	23 45	27 30	23 30	D	D	D	D							
Precip.(mm)							0	-	7	0	3	1	1	1	1	1	0	3	0	0	8	0							
S.T.-°C				18	15	9	11		12	11	16	15	22	23	21	23	23	24	24	30	28	25	25						
Carson City 03-5-1																													
SHRUBS																													
Arar-Arno	D	LG				TG												BV	FG										
Chna	D	LG									TG								BV	FG			1B						
Tegl	D	LG							TG	BV				1B	FB			BO	BD	SD	LD								
																		LY	LD										
Grsp																SD		SD	LD		LD								
GRASSES																													
Sihy	GS		1/2V						FS		HO	An	DS	HS	BD			SD	PD		PD								
Brte	D	GS							1/2V	FS		HO	An	DS	HS	BD	SD	BD	PD		PD								
Stipa sp.	GS			1/2V					FS			An	DS	HS		HS	BD	SD	PD		PD								
Posa											An		DS	HS	SD	BD		SD	PD		PD								
FORBS																													
Erci	GS					1B					FB	BD	SR	BD	PD														

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SYMBOL 1978	FEB	MARCH				APRIL				MAY				JUNE				JULY				AUG		SEPT		OCT		NOV
SMD(From-To in cm)					S	S	1	S	S	S	S	S	6	7	25	26	29	20	D	D	D	D	D	D	D			
Precip.(mm)						0		11	20	0	2	2	3	1	2	0	0	6	0			0	0		0			
S.T.- ^o C		S	N	OW	6	4	6	7	6	8	10	17	19	15	16	18	19	19	20			21	18		20			
Carson City 03-5-2																												
<u>SHRUBS</u>																												
Putr					LG							BV	FB	BO		TG						SD						
Symph sp.					D			LG				TG			BV		1B	FB	BO			SR			SD	LY		
Ribes sp.					LG			BV			FG	1B	FB	BO	FG							SR			SD			
Artr					D	LG					TG						BV											
Chna					LG									TG			BV											
Tegl					D	LG								TG			BV					1B	BO		SD			
Pran					D			LG				BV	FB	BO		TG			SR				SD					
<u>GRASSES</u>																												
Elci					D		GS					$\frac{1}{2}$ V			FS	HC			An	DS		HS		SD	BD			
Posa						GS						$\frac{1}{2}$ V			HO	An	HS	SD	PD									
Sihy						GS						$\frac{1}{2}$ V	FS		HO	An		HS	SD		BD		PD					
Sthh																DS		HS	SD		BD		PD					

SNOW

[illegible]

Senec sp.

SYMBOL 1978	FEB	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT			NOV
SMD(From-To in cm)								W	E	T		M	E	A	D	O	W									
Precip.(mm)						0	12	15	3	3	1	3	1	1	0	0	4	0	0	0	1	0				
S.T.-°C						5	9	9	9	12	12	17	19	14	18	24	20	20	22	24	23	21				
Carson City 03-5-4		S	N	O	W																					
<u>SHRUBS</u>																										
Rowo						LG					TG				1B	FB	BO					SR				
Chna						LG					TG						BV					FG				
Artr						LG		TG									BV									
Ribes sp.						LG	BV				1B	FB	BO	FG			TG					SR				
<u>GRASSES</u>																										
Popr						GS		$\frac{1}{2}$ V			FS	HO	An	DS		HS	SD					BD				
Agrop sp.						GS	$\frac{1}{2}$ V				FS			HC	An		DS	HS			SD					
Popu						GS		$\frac{1}{2}$ V		FS	HO	An	DS		HS	BD	SD	BD			PD					
Juncu sp.						GS	$\frac{1}{2}$ V				FS			DS							SD					
Agcr						GS		$\frac{1}{2}$ V			FS			HC	An	DS		HS								
Carex sp.						D			$\frac{1}{2}$ V				FS	HO	HS		SD	BD		PD						
<u>FORBS</u>																										
Veth						GS											FS		1B		BO					
Poten sp.						GS								FS	1B		FB		BO		DS					

SYMBOL 1978	FEB	MARCH				APRIL				MAY				JUNE				JULY				AUG				SEPT				OCT				NOV
SMD(From-To in cm)																																		
Precip.(mm)																																		
S.T.-°C																																		
<u>Carson City</u> <u>03-5-4 con't</u>		S	N	O	W																													
<u>FORBS</u>																																		
Acmi						GS								1B				FB									BO							
Taof						GS		1B		FB		SR	DS			BD						PD												

SYMBOL 1978	FEE	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT			NOV
SMD(From-To in cm)											5 30	S 30	1 30	11 45	11 45	12 45	20 45									
Precip.(mm)											0	0	0	0	0	1										
S.T.-°C											9	14	11	11	21	12	12									
Carson City 03-7-1																										
<u>SHRUBS</u>																										
Ribes sp.											LG			TG												
Artr											LGTG					BV										
Putr											LG					BC										
Syal											LGTG					BV										
<u>GRASSES</u>																										
Brte											D			gr												
Posa											GS $\frac{1}{2}$ V	FS	gr													
Brca											GS $\frac{1}{2}$ V		gr													
<u>FORBS</u>																										
Alliu sp.											GS FS		gr													

SYMBOL 1978	FEB	MARCH				APRIL				MAY				JUNE				JULY				AUG				SEPT				OCT				NOV
SMD(From-To in cm)						S	2		S	S	3	4	7	10	12	25	D	D		11	D		D	D		D								
Precip.(mm)						0		14	21	0	3	1	1	1	1	1	0	0	5	0		0	0	0	0									
S.T.-°C						4	10		7	8	14	11	15	18	20	17	20	22	24	23		25	21		21									
Carson City 03-7-3		S	N	O	W																													
<u>SHRUBS</u>																																		
Artr						LG			TG									BV																
Chna						D	LG						TG					BV						1B		FB								
Epvi						D							TG										SD		LY									
Ribes sp.						BV			1B			BO	FC												SD		LY							
Pran						D			BV			FB		BO	TG	SR							SD		LY									
Teca						LG						TG				BV		1B		FB					BC		SE		SD					
Putr						LG						TG	1B	FB	BO							SR		SD										
<u>GRASSES</u>																																		
Agcr						GS			$\frac{1}{2}$ V					FS	HO	An				DS		HS	SD		SD									
Brte						GS						FS		HO	An	DS	HS	SD	PD															
Agtr						GS			$\frac{1}{2}$ V							FS	HO		An			DS		HS		SD								
Orhy						GS			$\frac{1}{2}$ V					FS	HO	An	DS	HS	SD				SD		BD									
76																																		

SYMBOL 1978

FEB	MARCH				APRIL				MAY				JUNE				JULY				AUG				SEPT				OCT				NOV			
	S	N	O	W																																
					GS		$\frac{1}{2}$ V		FS	HO	An		DS	HS	SD		BD		PD																	
					D		GS		FS		1B	FB							BO		SR															
					D			GS				FS		1B		BO		SR		DS																

CARSON CITY (NORTH OF RENO)

CARSON CITY (NORTH OF RENO)

Since these sites were established in 1977, data is compared for 1977 and 1978 only. No extraordinary species differences are seen. Vegetative growth of grasses at site 03A-3 was strongly related to May precipitation and warmer temperatures (annual phenodynamic tables). However, grasses on site 03A-4 and 03A-5 were quite advanced in early April. This followed a period of relatively warm temperature in late March, and soil moisture was probably plentiful. Such site differences may be related to elevation, or just two variable weather patterns in the early spring. A lack of predictability of such site-to-site variations may well reduce the utility of such data. An understanding of the possible magnitude of these variations is valuable.

The phenology of antelope bitterbrush (Purshia tridentata), Indian ricegrass (Oryzopsis hymenoides) and needle-and-thread grass (Stipa comata) shows a similarity of relationships (Figures 1 through 3). The length of the reproductive period (flowering) is of interest. Similar data is presented for squirreltail grass (Sitanion hystrix; Figure 4). With the beginning of growing season missed in 1977, comparisons of the two data sets is difficult for all four of the previous graphs.

Leader growth in antelope bitterbrush (Figure 5) and height growth of Indian ricegrass (Figure 6) shows some interesting differences between the two years. For example, 1978 was a year of early growth compared to 1977.

Figures 7 through 9 show phenophase development for squirreltail grass, antelope bitterbrush, and lupine (Lupinus caudatus). Again, the late start of data gathering in 1977 makes analyses difficult. However, some of the later phenophases are of interest. The periods of seed dissemination for squirreltail grass (Figure 7) were identical for both sites on each of the two years. The longer bloom period for tailcup lupine (Figure 9) in 1978 is interesting. Apparently forbs such as lupine can complete the flowering phenophases in a much shorter period during a dry year. This ability, or its lack, would be very influential for the welfare of a species.

Leader and height growth comparison for the two years reveals no clear cut trend (Table 1). Some sites had better growth in 1977, and others had better growth in 1978.

NEW LEAF
GROWTH
LEAVES DRY
AND DROP
LEAVES TURN
YELLOW
SEED
DISSEMINATION
SEED RIPE
BLOOM OVER
FULL BLOOM
FIRST BLOOM
LEAVES FULL
GROWN
FLOWER BUDS
FIRST VISIBLE
TWIG GROWTH
LEAF GROWTH
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1977 - - - - -
1978 + + + + +

Fig. 1. Phenology of *Purshia tridentata* in mountain brush vegetation type for Carson City north of Reno (Site 03A-7-2) for 1977 and 1978.

1977
1978-----
|||||

Fig. 3. Phenology of *Stipa comata* in northern desert shrub vegetation type for Carson City north of Reno (Site O3A-3) for 1977 and 1978.

REGROWTH
PLANT DRY
PLANT BEGINS
TO DRY
DISSEMINATION
HARD SEED
DOUGH SEED SET
ANTHESIS
HEADS OUT
FULLY
FLOWER STALKS
 $\frac{1}{2}$ VEGETATIVE
GROWTH
GROWTH STARTS
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1977 - - - - -
1978 / / / / /

Fig. 4. Phenology of *Sitanion hystrix* compared with soil moisture depth (inches) on northern desert shrub vegetation type for Carson City north of Reno (Site 03A-3) for 1977 and 1978.

1977 - - - - -
1978 + + + + +

Fig. 5. Leader growth(mm) of *Purshia tridentata* compared with soil moisture depth (inches) on mountain brush vegetation type for Carson City north of Reno (Site O3A-7-1) for 1977 and 1978.

1977 - - - - -
1978 - - - - -

Fig.6. Height growth(mm) of *Oryzopsis hymenoides* compared with soil moisture depth (inches) on northern desert shrub vegetation type for Carson City north of Reno (Site 03A-3) for 1977 and 1978.

Fig. 7. Occurrence of various phenophases of Sitanion hystrix for Carson City north of Reno (Sites 03A-3 and 03A-5) for 1977 and 1978.

1977
1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

LEAF-GROWTH

TWIG-GROWTH

Fig. 8. Occurance of various
phenophases of *Purshia*
tridentata on Carson City
north of Reno (Site 03A-7-1)
in 1977 and 1978.

GROWTH STARTS

FULL BLOOM

PLANTS DRY

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

Fig. 9. Occurrence of various phenophases of *Lupinus caudatus* for Carson City north of Reno (Site 03A-3) in 1977 and 1978.

Table 1. Leader (Shrubs) and Height
(Grasses) Growth in Carson City District
(North of Reno) in 1977 and 1978.

		<u>Millimeters</u>	
		1977 Regrowth	1978 Regrowth
<u>Site O3A-2</u>			
<u>Etab. 1978</u>			
<u>SHRUBS</u>			
1. Grsp			152
2. Atco			175
3. Artr			190
4. Save			160
5. Arsp			78
6. Atca			120
7. Cela			180
<u>GRASSES</u>			
1. Orhy			490
2. Sihy			340
3. Stth			505
4. Brte			315
<u>Site O3A-3</u>			
<u>SHRUBS</u>			
1. Artr	170		175
2. Chvi	150		180
3. Pran	80		150
4. Teca	160		160
5. Ribes sp.			270
6. Grsp	120		110
<u>GRASSES</u>			
1. Stco	750		560
2. Brte	250	220	225
3. Orhy	310		260

Site 03A-3 con't	Millimeters	
	1977 Regrowth	1978 Regrowth

GRASSES

1.Sihy 230 320

FORBS

1.Luca 180 470

Site 03A-4

SHRUBS

1.Teca 230

2.Atca 135 130

3.Chvi 110

GRASSES

1.Agr 70 920

2.Elci 875 1300

3.Agin 500 890

4.Sihy 280 500 (plowed up)

5.Sece 900 1200

6.Brte 280

FORBS

1.Basa 350 450

Site 03A-7-1

SHRUBS

1.Artr 150 170

2.Putr 35 100

3.Chvi 180 160

4.Ribes sp. 60 155

5.Teca 175 245

Site 03A-7-1 con't	Millimeters	
	1977 Regrowth	1978 Regrowth

GRASSES

1.Orhy	480	380
2.Stth	490	380
3.Brte	280	130
4.Sihy	400	390
5.Feme	22	45
6.Agcr	500	690

FORBS

1.Wyeth sp.	560	480
2.Luca	220	340

Site 03A-7-2

SHRUBS

1.Cele	125	40
2.Artr	165	200
3.Ceve	140	135
4.Ribes sp.	105	180
5.Chvi	130	120
6.Putr	100	110
7.Teca	190	180
8.Chna		180

GRASSES

1.Mebu	300	315
2.Posa	90	300
3.Sihy	460	285
4.Stth	470	340
5.Brte		225

	Millimeters	
<u>Site 03A--7-2 con't</u>	1977 Regrowth	1978 Regrowth

FORBS

1. Luca	250	320
2. Wyeth sp.	530	490

▲ SITE LOCATIONS
 (Not all sites shown due
 to closeness)

CARSON CITY DISTRICT

SYMBOL 1978	-	MARCH				APRIL				MAY				JUNE				JULY				AUG		SEPT		OCT		NOV	
SMD(From-To in cm)		S 45	S 45	3 45	3 45	S 45	5 45	3 45	2 45	3 45	3 45	6 45	9 45	5 45	15 45	21 45	23 45	D	D	D	D	D							
precip.(mm)									0	5	0	1	10	0	0	0	0	0	3	0	0	0	0						
S.T.-°C				13	13	9	14	11	14	17	16	18	15	19	21	21	20	25	26	25	29	29	26						
Carson City-N. 33A-2																													
<u>SHRUBS</u>																													
Brsp		LG		TG BV		FG			1B			FB				BO		SD	SD LY		LY								
Atco		LG				TG BV					FG		FB					BO	SR	SD LY					LY				
Artr		LG		TG												BV				FG									
Save		LG		TG			BV						FG	1B			FB	BO	SD	SD LY		LY							
Arsp		LG		TG	BV		FG	1B					FB	BO		SR	SD	LD											
Atca ♀		LG					TG	BV					1B		FB		-		BO	SR LY									
♂		LG					TG	BV					1B		FB			BO		-	LY								
Cela		LG		TG				BV		1B			FB		BO		SR		SD	SD LY		LY							
Regl		LG				TG BV		FG					1B	FB	FB LY			SR	SD LY	LD	LD								
<u>GRASSES</u>																													
Orhy		GS				1/2V		FS		HO				An		DS	HS	SD BD			BD		PD						
LIST																													

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD(From-To in cm)										
precip.(mm)										
S.T.-°C										
Carson City-N. 03A-2 con't										
<u>GRASSES</u>										
Si hy	GS	$\frac{1}{2}$ V	FS	HO	An DS HS	SD BD		PD		
St th	GS	$\frac{1}{2}$ V		FS HO	An DS HS	SD BD		PD		
Br te		GS	HO		An DS HS	SD BD	SD BD	PD		
<u>FORBS</u>										

YMBOL 1978

	FEB 24	MARCH				APRIL				MAY				JUNE				JULY				AUG		SEPT		OCT	NOV
MD(From-To in cm)	S 45	S 45	S 45	2 45	S 44	4 45	5 45	1 45	1 45	5 45	8 45	6 45	5 45	11 45	22 45	D	S 30	D	D			D	D				
recip.(mm)								1	10	0	3	12	0	0	0	0	0	11	0	0		3	0				
T.-°C				12	6	6	11	10	9	13	14	14	16	15	20	22	21	21	20	28	25	25	24				
rsn City-N. 3A-3																											
<u>HRUBS</u>																											
rtr		TG															BV	FG									
hvi	LG										TG						BV							BO			
ran	D		TG			BV	LG			1B	FB		BO					SR	SD						LY		
eca	D	LG	TG							BV								FG	1B	FB		BO		SD			
ibes sp.		TG			BV			1B			FB		BO			SR					SD LY		LD				
rsp ♀	LG				TG			BV			FG			1B	FB	BO	-	SR	SD				LY				
♂	LG				BV			-			FG			1B	FB	-	BD	SR	LY				-				
<u>RASSES</u>																											
tco	D	GS								1/2	V	FS	HO	An	DS	HS	HS	SD	BD	BD		BD		PD			
rte	GS										FS	HO			DS	HS	SD	BD		PD					-		
rhy	D	GS								1/2	V	FS	HO	An	DS	HS	SD	SD	BD			BD		PD			
ihy	GS									1/2	V	FS	HO	An		DS	HS	SD	BD			BD		PD			

SYMBOL 1978	FEB 24	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
MD(From-To in cm)										
precip.(mm)										
S.T.-°C										
Carson City-N. 03A-3 con't										
FORBS										
Luca	D	GS	FS	1B FB	30	SR DS	BD	PD		

SYMBOL 1978	FEB 24	MARCH					APRIL				MAY				JUNE				JULY				AUG			SEPT			OCT			NOV
MD(From-To in cm)	S 45	S 45	S 45	1 45	S 45	S 45	2 45	2 45	4 45	4 45	8 45	4 45	9 45	7 45	14 45	25 45	19 45	18 45	20 70	15 70	D		D		D							
precip.(mm)									0	8	0	6	13	0	0	0	0	1	11	0	1		7		0							
A.T.-°C				13	4		4	10	8	5	7	18	18	16	20	23	22	22	29	24	24	25		25		25						
Carson City-N. 03A-4																																
<u>SHRUBS</u>																																
Atca	D		LG	TG														FG	1B	BC					SR							
Chvi	LG												TG				BV	BV		FG									1B			
Ieca		LG		TG								BV								FG	1B			BO		SR						
<u>GRASSES</u>																																
Agcr	GS					1/2V						HO					An		DS					SD		SD			BD			
Elci	GS					1/2V						FS			HO		An		DS		HS			SD		SD			BD			
Agin	GS					1/2V						FS	HO								An	DS			SD							
Sece	D					GS					1/2V	FS	HO		An		DS		HS					SD		SD			BD			
Brte	GS						1/2V					HO			An	DS	DS	BD	HS	SD	BD		PD									
<u>FORBS</u>																																
Mesa	GS														FS	1B			FB	BC									SR			
Onobr sp.	GS											FS		1B				FB	BO	SR					DS							

117

SYMBOL 1978

SMD(From-To
in cm)

Precip.(mm)

S.T.-°C

Marson City-N.
3A-5HRUBS

irsp ♀

♂

artr

hvi

tibes sp.

pvi

GRASSES

arte

stco

orhy

sihy

FORBS

Basa

FEB 24	MARCH				APRIL				MAY				JUNE				JULY				AUG		SEPT		OCT		NOV
S 60	S 45	S 50	1 45	S 45	S 45	S 45	S 45	1 45	1 45	3 45	4 45	S 45	4 45	9 45	21 45	22 45	23 45	S 90	7 90	D							
							1	16	0	5	21	0	0	0	0	0	0	11	0	0		D 1	D 0				
				10	6	6	8	7	9	7	15	16	17	17	22	20	21	20	20	25	24						
LG				-	TG			BV		FG		1B	FB				BO	SR	SD			LY		LD			
LG				BV	TG		FG					1B	FB				BO	-	SR	SD	LY	-		LD			
D		TG																	BV								
LG					TG														BV					BO			
LG			BV		1B			FB		BO		TG	BO				SR		SR	SD	LY		LD				
D							TG					BV					1B	FB	BO	SD		LY					
GS										FS	HO			An	DS	HS	BD	SD	PD								
D	GS			1/2V						FS	HO			An	DS	HS	SD	SD	BD			BD		PD			
D	GS			1/2V						FS	HO			An	DS	HS	SD	BD				BD		PD			
GS				1/2V						FS	HO			An		DS	HS	SD	BD			PD					
D					GS			FS	1B	FB				BO		SR	SR	BD		DS		BD		BD			

SYMBOL 1978	FEB 24	MARCH				APRIL				MAY				JUNE				JULY				AUG			SEPT			OCT			NOV
MD(From-To in cm)	7 60	S 45	S 45	S 45	S 45	S 45	2 45	S 45	1 45	1 45	4 45	3 45	5 45	3 45	5 45	5 45	30 45	22 45	S 20	5 20	D		D		D						
recip.(mm)									0	11	0	5	14	0	0	0	0	1	20	0	0		5		0						
.T.-°C				9	4	4	10	8	9	9	13	15	17	14	20	19	23	19	20	21	25		24		22						
arson City-N. 3A-7-1																															
<u>HRUBS</u>																															
rtr	D		TC															BV	FG												
utr	LG		TC					BV			FG	1B	FB		BO						SR				SD						
hvi	D	LG										TC						BV		FG						FB					
ibes sp.	D	LG	TC			BV	1B					FB		BO									SR		SD						
eca	D	LG	TC								BV								FG		1B		FB		BO						
<u>GRASSES</u>																															
orhy	D		GS			$\frac{1}{2}$ V							FS		An		DS		HS	SD	SD		BD								
stth	D			GS							$\frac{1}{2}$ V			FS	HO	An		DS	HS		SD		BD								
rte	D	GS									$\frac{1}{2}$ V	FS	HO		An	DS	HS		SD	PD											
ihy		GS				$\frac{1}{2}$ V						FS		HO	An	DS			HS		SD		BD								
eme	D				GS							FS	HO			An	HS		SD	PD											
gcr	D	GS				$\frac{1}{2}$ V						FS		HO				An		DS				SD							

SYMBOL 1978	FEB 24	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
MD(From-To in cm)										
precip.(mm)										
T.-°C										
Carson City-N. 03A-7-1 con't										
FORBS										
Wyeth sp.	D	GS		FS	LB	FB	BO	DS	BD	
Luca	D	GS		FS	LB	FB	BO	SR	DS	DS BD

SYMBOL 1978

SYMBOL 1978	FEB 24	MARCH				APRIL				MAY				JUNE				JULY				AUG		SEPT		OCT		NOV
MD(From-To in cm)					S 45	S 45	2 45	2 45	2 45	2 45	2 45	3 45	3 45	7 45	19 45	20 45	25 45	11 70	D									
precip.(mm)									0	11	0	12	14	0	0	0	0	1	9	0	0	6	0					
i.T.-°C					2	2	5	3	5	7	9	16	14	13	18	17	17	16	20	20	21	20	20					
Carson City-N. 03A-7-2	S	N	O	W																								
<u>SHRUBS</u>																												
Cele					LG			BV				FG	FB			BO					SR	TG	SR			SD		
Artr					TG																BV	FG						
Ceve					TG						BV					FG	1B	FB		BO			SR			SD		
Ribes sp.					TG			BV	1B							FB	BO								SR	SD		
Chvi					D		LG							TG								BV				1B		
Putr					LG	TG								BV	FG	FB					BD				SR	SD		
Teca					D			TG													BV	FG				FB	BO	
Chna																					TG			BV				
<u>GRASSES</u>																												
Mebu					GS								HO		An			HS	SD	SD	BD							
Posa					GS			$\frac{1}{2}$ V			HO				An			DS	HS	SD	BD	PD						
Sihy					GS							FS		HO				An		DS		SD			SD	BD		
Stth					GS							$\frac{1}{2}$ V		FS	HO		An		DS		SD					BD		
121																												

SYMBOL 1978	FEE 24	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD(From-To in cm)										
Precip.(mm)										
S.T.-°C										
Carson City-N. 3A-7-2 con't										
<u>GRASSES</u>										
Arte			GS	FSHO		Am HS BD BD	SD PD BD			
<u>FORBS</u>										
Luca		D	GS	FS	1B FE	BC	SR DS	DS		
Wyeth sp.		D GS			FS 1B	FB	BO	DS	BD	

ELY

Ely field personnel observed that several species on their study sites did not produce any seeds this year. Included in those species are bluestem wheatgrass (Agropyron smithii; sites 04-3 and 04-8), and hook violet (Viola adunca; site 04-6). Bluestem wheatgrass growing on the mountain brush site (04-7) had only a few seeds. They noted that only one creeping barberry (Berberis repens) plant bloomed on site 04-8.

Field personnel also felt that their valley sites were generally ahead this year, but that the higher elevation sites appeared to be somewhat behind in phenological development when compared to the other years (1976 and 1977).

Twig growth for most shrubs was associated with warming soil temperatures. Grasses on these and other sites around the state begin their green growth early, usually in March. However, $\frac{1}{2}$ of the culm growth, or the growth of reproductive culms, does not occur until warming in late May and early June. This seems to hold true over a range of elevations. Twig growth of winterfat (Ceratoides lanata) starts approximately three weeks prior to most other woody species on site 04-2 (annual phenodynamic tables).

The data for leader and height growth (Table 1) suggests that 1978 was not as good a growth year as 1977. This trend generally holds true for all Ely sites.

The phenology of bluestem wheatgrass and fairway wheatgrass (Agropyron cristatum) in the northern desert shrub type are very similar in their development (Figures 1 and 2). Seed development occurred over an eight week period for fairway wheatgrass, while seed development of bluestem wheatgrass took only six weeks. This constitutes a good example of the kind of data required for grazing management.

Height growth of bluestem wheatgrass varied considerably from year to year on a coniferous forest site (Figure 3). Height growth in 1978 was relatively late and short at this site (04-8). Leader growth of rabbitbrush (Chrysothamnus viscidiflorus) on a northern desert shrub site showed much less variability.

Figure 5 compares three grasses. The point of $\frac{1}{2}$ vegetative growth varies more from year to year than from species to species. The onset of reproductive culms shows even less variability among years and species. Most reproductive culms appear during the first two weeks in June.

The phenological development of antelope bitterbrush (Purshia tridentata) in pinyon/juniper is relatively uniform from year to year (Figure 6). Some interesting departures are evident. In 1978, leaf and twig growth took place over a ten week period; in 1976, only two weeks; and in 1977, only three weeks. Such variations may have an important relationship to range readiness and productivity.

The onset of leaf and twig growth in selected shrubs (Figure 7) exhibits considerable variation among species and years. Figure 8 relates the annual phenodynamic of Indian ricegrass (Oryzopsis hymenoides) to soil moisture depth (Sites 04-3). No clear cut relationship is evident.

Fig. 1 . Phenology of *Agropyron smithii* in the northern desert shrub type (site 04-3), Ely District.

1976 ---
 1977 ———
 1978 | | | |

Fig. 2 . Phenology of *Agropyron cristatum* in the northern desert shrub vegetation type (site 04-3), Ely District.

500+
500
450
400
350
300
250
200
150
100
50
0

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976 - - - - -
1977 —————
1978 + + + + +

Fig. 3 . Height growth (mm) of *Agropyron smithii* compared with soil moisture depth (inches) in a coniferous forest (site 04-8), Ely District.

1976 -----
1977 -----
1978 |||||

500+
500
450
400
350
300
250
200
150
100
50
0

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

Fig. 4 . Leader length (mm) of *Chrysothamnus viscidiflorus* compared with soil moisture depth (inches) on a northern desert shrub vegetation type (site 04-3), Ely District.

Fig. 5 . Occurrence of various phenophases for selected grasses, Ely District.

04-5
Fiber

1976

1977

1978

04-2

Atco

1976

1977

1978

04-7

Wibes sp.

1976

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

LEAF GROWTH

TWIG GROWTH

Fig. 7 . Periods of leaf and twig growth for selected shrubs, Ely District.

1976 ----
1977 ———
1978 + + + + +

Fig. 8 . Phenology of *Oryzopsis hymenoides* compared to soil moisture depth (inches) on northern desert shrub vegetation type (site 04-3), Ely District.

Table 1. Table of Leader(Shrubs) and
Height (Grasses and Forbs) Growth in
Ely District for 1976, 1977, and 1978.

	Millimeters					
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 04-2</u>						
<u>SHRUBS</u>						
1.Artr	60		100		90	
2.Arsp	26		20		50	
3.Atco	50		105		90	
4.Cela	50		160		150	
5.Save	58		63		60	
<u>GRASSES</u>						
1.Orhy	240		190	165	200	
2.Sihy	255		210	100	280	
<u>Site 04-3</u>						
<u>SHRUBS</u>						
1.Artr	52		98		100	
2.Chvi	55		100		70	
<u>GRASSES</u>						
1.Agr	310		455	150	330	
2.Orhy	300	75	375	160	400	
3.Agsm	270		450	75	170	
<u>FORBS</u>						
1.Astra sp.	55		75		75	
2.Phho	51		25		70	
<u>Site 04-5</u>						
<u>SHRUBS</u>						
1.Arno	25		125		35	
2.Putr	105		60		75	

	Millimeters					
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 04-5 con't</u>						
<u>GRASSES</u>						
1. Posa	210	25	150	50	310	
<u>Forbs</u>						
1. Pepa	250		340		530	
<u>Site 04-6</u>						
<u>SHRUBS</u>						
1. Salix sp.			70		4	
<u>GRASSES</u>						
1. Popr	300		500		260	
2. Carex sp.	170		320		210	
3. Juba	270		380		400	
4. Agal			800		450	
<u>FORBS</u>						
1. Popa	95		200		90	
2. Acla	300		550		90	
3. Taof	150		150		75	
4. Viad	75		90		70	
5. Thmo			450		310	
<u>Site 04-7</u>						
<u>SHRUBS</u>						
1. Cela	20		10		10	
2. Ribes sp.	52		20		7	
3. Amal	155		30		20	
4. Sylo	150		185		80	
5. Bere	20		75		100	
6. Artr	50		150		100	

		<u>Millimeters</u>			
	<u>1976 Regrowth</u>	<u>1977 Regrowth</u>		<u>1978 Regrowth</u>	
<u>Site 04-7 con't</u>					
<u>GRASSES</u>					
1. Agsm	210	425	75	140	
2. Pone	360	310		300	
3. Orhy	305	380	150	300	
4. Stco		600	75	170	
5. Agsp		500	75	200	
<u>FORBS</u>					
1. Meob	178	150		150	
2. Delph sp.	210	355		125	
3. Lupin sp.		255		150	
4. Casti sp.		355		150	
5. Lomat sp.	76	60		30	
<u>Site 04-8</u>					
<u>SHRUBS</u>					
1. Sylo	105	110		30	
2. Artr	50	80		50	
3. Amal	15	28		30	
4. Bere	30	77		30	
<u>GRASSES</u>					
1. Agsm	155	400		150	75
2. Pone	305	300		75	150
<u>FORBS</u>					
1. Meob	180	110		90	
2. Penst sp.	250	400		100	

		Millimeters					
		1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 04-9 con't</u>							
<u>GRASSES</u>							
1. Carex sp.	230			250		240	
2. Juba	330			350		400	
3. Dist	70			140		150	
<u>FORBS</u>							
1. Plma	210			170		220

▲ SITE LOCATIONS
(Not all shown due
to closeness)

ELY DISTRICT

SYMBOL 1978	FEB	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT 19			NOV	
SMD(From-To in cm)				S 20			S 30			21 5 30 30	D		25 25 30 30		D		D	D	D	D	D	8 30	S 30	5 30		S	
Precip.(mm)							75			84	0	6	0	0			13	0	6	0	0	6	15	9			
S.T.-°C				8			4			14	13	20		16	20		24		22	30	16	23	20	16	13	10	8
<u>Ely 04-2</u>																											
<u>SHRUBS</u>																											
Artr				LG						TG			FG											1B		BO	
Arsp				TG BV						1B	FB		BO	LY		LD											
Cela				LG			TG			BV		1B	FB		FB LY		LY							SR LY			
Atco				LG						TG BV			FB				FB	BO	LY					SR	SD LY		
Save ♀				LG						TG	-	-	1B		FB LY		SD				SD LY						LD
♂				LG						TG	FG		BV	-	FB LY		SD				SD LY						LD
<u>GRASSES</u>																											
Orhy				GS						1V	FS		An DS DS BD		SD BD		PD										
Sihy				GS			1V				HO		An BD		PD												
<u>FORBS</u>																											

SYMBOL 1978

SYMBOL 1978	FEB	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT ₁₉			NOV
SMD(From-To in cm)				S 30		S 30		S 30	5 30	5 30	23 30	16 30		D		7 30	26 30	13 30	10 30	13 30	5 30	S 30	3 30		3 30	
Precip.(mm)						84		71	0	5		0		0		11	0	6	0	0	6	21	10		10	
S.T.-°C				5		1		4	12	12	13	15		20		20	23	14	17	18	11	8	6		9	
<u>Ely 04-3</u>				-																						
<u>SHRUBS</u>																										
Artr			LG						TG			BV		FG								1B			FB	
Chvi			LG						TG			FG					FB					30				
<u>GRASSES</u>																										
Agsm			GS							$\frac{1}{2}$ V		HC		DS BD		BD		PD				gu	PD			
Orhy			GS							$\frac{1}{2}$ V		HO An		SD BD		BD		PD				gu	PD			
Agcr			GS						$\frac{1}{2}$ V			FS DS		DS BD			HS	SD	BD	PD		gu	PD			
<u>FORBS</u>																										
Phho			GS							1B FB		BODS		BD					PD							
Astra sp.			GS					FS		FB				PD												

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SYMBOL 1978	FEB	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT				OCT			NOV
SMD(From-To in cm)				S 30			S 30	S 30		3 30	15 30	18 30	15		D		15 30	5 30		18 30	3 30	5 30	1 30		S		
Precip.(mm)							76	59		0	5	0	0		0		25	0	-	0	0	1	21	10			
S.T.-°C				5			4	5		14	13	15	15		24		22	21	12	17	16	10	8	7		10	
<u>Ely 04-5</u>				-																							
<u>SHRUBS</u>																											
Arno				LG						TG			BV FG										LB		BO		
Putr				LG						TG LB BV			BO				SR	SD			SD LY				LD		
<u>GRASSES</u>																											
Posa				GS						1/2 HO			An BD		PD												
<u>FORBS</u>																											
Pepa				GS						FS			FB BD				SR	DS	BD		PD						

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MBOL 1978	FEB	MARCH		APRIL		MAY		JUNE		JULY		AUG		SEPT		OCT	NOV
ID (From-To in cm)			S 30		S 30	S 30	S 30	S 30	S 30		S 30					S 30	
ecip. (mm)				82	(CAN STOLEN)												
T. °C			7		4	7		13	14 15		16	18 16	12 13	13	11 10	8	8
<u>Ely 04-6</u>																	
<u>SHRUBS</u>																	
Salix sp.					LG			TC FG	BO SR SD		SD			LY			LD
<u>GRASSES</u>																	
Carex sp.			GS			$\frac{1}{2}$ V		Ar	HS		HS SD	SD		BD			PD
Juba			GS			$\frac{1}{2}$ V			FS Ar		DS	HS SD		BD			PD
Agal			GS					$\frac{1}{2}$ V	HC		Ar	HS		BD	PD		
Popr			GS					FS HO	An		SD BD	PD					
<u>FORBS</u>																	
Popa			GS			FS		FB	BO							PD	
Viad			GS			1B		FB BO			BD	BD				PD	
Thmo			D		FS			FB BO			BO BD	DS	BD			PD	
Acla			GS						FS		1B	FB		BO BO BD		SR	PD
Taof			GS			1B		FB BD	DS BD							PD	

SYMBOL 1978	FEE	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD(From-To in cm)					2 10 10 20 30 30 30 30		1 13 5 10 15 + 30 30	12 2 S 1 30 30 30 30	S	
Precip.(mm)					4 - 0	3	41 1 - -	0 16 - 12		
S.T.-°C					10 10 12 13	20	18 16 10 14	12 10 8 7		
<u>Ely 04-7</u>	---	---	S N OW	---						
<u>SHRUBS</u>										
Cele					TG FB BO BV	SR	SD	LY FG LY	gu	
Ribes sp.					TG FB BO FG	LY	SR	SD SD LY LY	LD	
Amal					TG LB BO LY	BO LY	SR LY		LD	
Sylo					TG BV LB LY	BO LY	SR SD LY		LD	
Bere					LG FG	BO	LY		FG	
Artr					TG FG			LY LB	FE	
<u>GRASSES</u>										
Agsm					$\frac{1}{2}$ V HO	DS	BD PD			
Pone					FS HO An SD BD	BD		PD		
Orhy					GS $\frac{1}{2}$ V FS An	DS	SD BD	PD		
Stco					$\frac{1}{2}$ V FS DS	HS	BD	PD		
Agsp					GS $\frac{1}{2}$ V HO	DS	BD	PD		

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD (From-To in cm)										
Precip. (mm)										
S.T. - °C										
<u>Ely 04-7 con't</u>										
<u>FORBS</u>										
Meob					LB FE	PD				
Delph sp.					GS LB BD	FB BD	PD			
Lupin sp.					GS FS	LB BO	BD	PD		
Casti sp.					D	FB	BO		DS	PD
Lomat sp.					LB FB	BO PD				

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV					
SMD(From-To in cm)					S 30	D 10 30		D 12 30	7 5 30	12 1 30	- S 30		S		
Precip.(mm)					-	O		-	31 5	24 0	- 16	- 40			
S.T.-°C					7	10 15		20	17 14	8 10	11 8	7 4		5	
fly 04-8			S	N	O	W									
SHRUBS															
lylo					LG	TG	FG		BO		SR	SD	LY		LD
Artr					D	TG		FG					1B		FB
Amal					LG	BV	BO fr		SD		SFLY				LD
ere					LG	BV	BO fr		SD		LY				gu
GRASSES															
Agsm					GS		$\frac{1}{2}$ V	HO	DS		BD		PD		
Pone					GS		$\frac{1}{2}$ Van	SD BD	PD						
FORBS															
leob					1E	FB	BD		PD						
enst sp.					GS		FS		BO		SR	BD	PD		

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SYMBOL 1978	FEB	MARCH			APRIL			MAY			JUNE			JULY			AUG			SEPT			OCT			NOV
SMD(From-To in cm)				S		S			S	8		S	S		S		-	-	-	-	-	-	S		-	
Precip.(mm)					58			39	0	0	0	0	0		-		6	0	10	0	0	13	14	10		
S.T.-°C			7		10			12	16	18		15	-		20		20	18	18	18	14	12	10	8		8
<u>Ely 04-9</u>																										
<u>GRASSES</u>																										
Carey sp.			GS		FS			An					AS		SD			BD	PD							
Juba			GS					$\frac{1}{2}$ V					An		DS		HS	SD	SD	BD	BD				PD	
Dist			GS		$\frac{1}{2}$ V					FS		An	DS		DS	BD	HS		SD	PD						
<u>FORBS</u>																										
Plma			D		GS			FS		1B			FE		BO				BO			DS	BD			PD

LAS VEGAS

LAS VEGAS

Las Vegas field personnel noted that spreading creosote bush (Larrea divaricata) on one of their southern desert shrub sites (05-1-1) never lost its leaves during the winter. A similar situation occurred for blackbrush (Coleogyne ramossissima; site 05-1-2); sagebrush (Artemisia tridentata; site 05-3); and cliffrose (Cowania stansburiana, site 05-7). Winterfat (Ceratoides lanata; site 05-2) still had some seeds left on the plants from last year.

Many species react in a very positive way to a spring storm. For example, Stansbury cliffrose started its bloom cycle to coincide with a relatively heavy storm during the first week of May in 1978. Winterfat, blackbrush, littleleaf krameria (Krameria parvifolia) and desert globemallow (Sphaeralcea ambigua) all show a similar relationship (annual phenodynamic tables). This also seems to be related to warm soil temperatures occurring at the same time.

Spiny hopsage (Grayia spinosa) is another salt desert shrub species that shows a rather remarkable similarity in its phenodynamic when the three years are compared (Figure 1). Growth started in February and most activity ended by late June. This seems to be a rather long growth period, which is probably related to the more southerly location.

The phenology of big galleta grass (Hilaria rigida) showed considerably greater variability (Figure 2) over a long growing period. Reproductive activities for this species

occurred much later in 1977 than in either 1976 or 1978. The reasons are not clear, but are probably related to soil moisture. The prediction of such anomalies would be useful in a grazing management system.

Galleta grass (Hilaria jamesii; Figure 3) shows a similar long growth period as big galleta grass, but less variability. This is also evident as the two species are compared on Figure 4. Seed dissemination periods are all relatively short - one to two weeks - occurring mostly in late June or early July.

The three year record of phenology for Indian ricegrass (Oryzopsis hymenoides; Figure 5) shows a close annual correspondence in development, with the greatest variation occurring during the last phenophases and regrowth phenophases. Height growth in this same species (Figure 6) was greatest for 1978, but does not appear to be strongly related to soil moisture. These data show that growth and development take place over an approximate 12 to 14 week period, irrespective of the year, but that the beginning and end of development may differ by four to five weeks from year to year.

Leader growth of white bur-sage (Ambrosia dumosa) varies by year (Figure 7) and may take place rather rapidly when there is good soil moisture (1976 and 1978), and slowly when soil moisture is less adequate (1977).

The onset of various phenophases for desert globemallow (Figure 8) appears to be regulated by site more than year.

However, there is a several week variation in the initiation of growth at site 05-7. The onset of bloom and bloom period is rather uniform within each site, but took place several weeks sooner at site 05-1-1. This site is nearly 2,000 feet lower in elevation than the other sites, thus offering a reasonable explanation.

Leaf and twig growth in shrubs varies from species to species (Figure 9). The ratio of leaf to twig growth seems to be fairly constant for big sagebrush and littleleaf krameria (late start for study in 1976). Stansbury cliffrose shows six weeks of leaf growth prior to twig growth in 1977, but only one week of leaf growth prior to twig growth in 1978.

Leader and height growth data for these sites shows considerable variability with few clear-cut trends (Table 1). For some species, 1978 was a good growth year, while for others, 1977 seems to be the best year.

Fig. 1 . Phenology of *Grayia spinosa* on salt desert shrub vegetation type (site 05-2), Las Vegas District.

Fig. 2 . Phenology of *Hilaria rigida* in the southern desert shrub vegetation type (site 05-1-1), Las Vegas District.

Fig. 3. Phenology of *Hilaria jamesii* in the salt desert shrub vegetation type (site 05-2), Las Vegas District.

Fig. 4 . Occurrence of various phenophases for selected grasses in the Las Vegas District.

Fig. 5 . Phenology of *Oryzopsis hymenoides* compared with soil moisture depth (inches) on salt desert shrub vegetation type (site 05-2), Las Vegas District.

1976 - - - - -
 1977 —————
 1978 + + + + +

Fig. 6 . Height (mm) of *Oryzopsis hymenoides* compared with soil moisture depth (inches) on salt desert shrub vegetation type (site 05-2), Las Vegas District.

Fig. 7. Leader length (mm) of *Ambrosia dumosa* compared with soil moisture depth (inches) on southern desert shrub vegetation type (site 05-1-1), Las Vegas District.

Fig. 8 . Occurrence of various phenophases for *Sphaeralcea ambigua*, Las Vegas District.

Fig. 9 . Occurrence of leaf and twig growth for selected shrubs in the Las Vegas District.

Table 1. Table of Leader (Shrubs) and Height (Grasses and Forbs) Growth in the Las Vegas District for 1976, 1977, and 1978.

	Millimeters					
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 05-1-1</u>						
<u>SHRUBS</u>						
1.Amdu	101		60		143	
2.Ladi	50		101		44	
3.Dafr	101		140		205	
4.Grsp	152		32		140	
<u>GRASSES</u>						
1.Hiri	355	304	461	350	409	
<u>FORBS</u>						
1.Spam	508		182	85	485	
<u>Site 5-1-2</u>						
<u>SHRUBS</u>						
1.Cora	50		59		64	LG*
2.Krpa	25		193		105	60
3.Epne ♀ ♂	76		63 140		190 205	
<u>GRASSES</u>						
1.Hiri	304		420		120	75
<u>Site 05-2</u>						
<u>SHRUBS</u>						
1.Arsp	76		35		75	
2.Grsp	76		91 141		70 80	
3.Cela	76		121		200	

* LG - leaf growth

		Millimeters				
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 05-2 con't</u>						
<u>GRASSES</u>						
1.Hija	304		307	200	160	100
2.Orhy	330		363	190	420	100
3.Sihy	228		284	180	355	70
<u>FORBS</u>						
1.Spam	406		505	330	470	90
<u>Site 05-3</u>						
<u>SHRUBS</u>						
1.Artr	101		223		233	
2.Chvi			149		204	
<u>GRASSES</u>						
1.Orhy	203		302	260	300	130
2.Hija	177		421	275	160	195
3.Sihy	228		308	250	305	110
<u>Site 05-7</u>						
<u>SHRUBS</u>						
1.Cost	50		87		101	
2.Epvi	76		♀ 35		165	
			♂ 48			
3.Artr	76		170		202	
<u>GRASSES</u>						
1.Hija	203		245	330	200	135
2.Bogr	203		169	225	84	93
3.Sihy	254		247	146	236	70
<u>FORBS</u>						
1.Spam	254		281	202	235	50

LAS VEGAS DISTRICT

Symbol 1978	J 76	FEBRUARY				MARCH				APRIL				MAY				JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER				NOVEMBER																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																				
SMD (From-To in cm)	S	S	S	S	S	S	S	2	S	1	S	S	7	9	15	20	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0</

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SMD (From-To in cm)	S	S	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S	1	S	1	S	S

Symbol 1978	FEBRUARY				MARCH				APRIL				MAY				JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER				NOVEMBER			
SMD(From-To in cm)	S 10	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30	S 30						
Precip. (mm)								14	-	-	-	25	0	-	0	0	0	0	0	0	0	0	23	1	0	0	0	6	28	0	0	0	12	8	31	0	50			
S.T.-°C																																								
Las Vegas 05-3																																								
<u>SHRUBS</u>																																								
Artr	D						LG	TC											BV																					
Chv1	D						LG		TC										BV																					
<u>GRASSES</u>																																								
Hija	D						LG												HO	Am	SD																			
Orhy	D						GS		JV										FS	HO	Am	SD	SD	BD																
Shy	GS								JV										FS	HO	Am	SD	SD	BD																
<u>FORBS</u>																																								

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Symbol 1976	FEBRUARY				MARCH				APRIL				MAY				JUNE				JULY				AUGUST				SEPTEMBER				OCTOBER				NOVEMBER				
SMD(From-To in cm)	S	5	5	S	1	S	5	1	S	1	S	1	S	1	4	9	14	15	15	16	10	15	18		D	D	D	D	D	D	D	D	12	2	8	5	S				
	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	D											30	30	30	fr	30		
Precip. (mm)								12						12	0			0	0	0	0	0	0		0	1	4	0	0	8	27	0	0	0	12	6	33	0	52	50	
S.T.-°C														14	20	21	22	26	30	2	28	31	2	4	23	30	34	29	28	30	18	17	22	16	22	24	10	2	0	4	0
Las Vegas OS-7																																									
<u>SHRUBS</u>																																									
Cost	D							LG	TG					BV	1B	FB	BO						SR	SD							LY							LD			
Epvi	D							BV						TG				1B	FB	BO		BO	SR	SD							LY							LD			
Artr	D							LCTG														BV								FG				1B			FB	HO	SR	SD	LY
<u>GRASSES</u>																																									
Hija	D						GS										FS	HO	An	DS	SD	BD								GS			LV	An	DS		BD				
Bogr							GS														LV	BD								GS			LV			FS	HO		D		
Sihy	D	GS								LV							FS	HO	An		SD	BD				PD					GS		LV					BD			
<u>FORBS</u>																																									
Span	D						GS										FS	LB	FB		DS	FS	BD	BD		PD						GS					BD		PD		

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BATTLE MOUNTAIN

BATTLE MOUNTAIN

After three years, patterns of growth and development continue to exhibit considerable variability. Further evidence is given of the general relationship between variables such as soil moisture depth and phenological development.

Figures 1 through 3 suggest that in spite of phenodynamic variability, certain similarities in development tend to occur. For example, the onset of full bloom in desert globemallow (Sphaeralcea ambigua) begins within a two week period when all years are compared (Figure 1). Arrowleaf balsamroot (Balsamorhiza sagittata) is similar (Figure 1), with both the start of growth and full bloom occurring within a narrow time frame (less than two weeks). For halogeton (Halogeton glomeratus; Figure 1), the pattern is not so straightforward. A possible reason, of course, is that halogeton is annual, while the other two species are perennials.

For selected shrubs (Figure 2), there is greater variability of phenophase occurrence than for the forbs and/or grasses. It is possible that the onset of growth in these shrubs is highly temperature-dependent. Further data analyses with attempted correlations between development and climatic factors must be attempted.

The grasses seem to be intermediate in variability between shrubs and forbs. In 1976, the period of $\frac{1}{2}$ vegetative growth was considerably later than in 1977 and 1978 (where this period is relatively close) for all three grasses

(Figure 3). This, of course, may be the result of a late start in data gathering during the spring of 1976. Perhaps a safer comparison for all three groups, i.e., grasses, forbs, and shrubs, would be to compare only later phenophases. In this case, both squirreltail grass (Sitanion hystrix) and bluebunch wheatgrass (Agropyron spicatum) reach a dry state within one or two weeks when comparing the three years. For Indian ricegrass (Oryzopsis hymenoides), dryness was apparent four weeks earlier in 1976. It is of interest to note that seed dissemination took place, or at least began, two to three weeks later in 1977 (wet growing season) than either 1976 or 1978 (drier growing seasons) for both squirreltail grass and Indian ricegrass. This data substantiates a trend noticed last year - that plants tend to mature earlier under drier conditions. However, this pattern did not occur for bluebunch wheatgrass. Such data may be of important application in the timing of heavy grazing in an intensive grazing management system.

The phenodynamic of bluebunch wheatgrass compared for three years (Figure 4) was surprisingly similar. This attests to the general stability and desirability of this excellent grass. The closeness of development among the three years suggests the value of this species as an indicator for range readiness and range condition.

A salt desert shrub species such as bud sagebrush (Artemisia spinescens) shows greater variability (Figure 5). However, in Figure 5 there is an apparent relationship between

onset of phenophase and soil moisture depth.

Indian ricegrass (Figure 6) seems quite similar when comparing 1976 and 1978, but for reasons not clear in this data, flower stalks appeared later in 1977.

Figure 7 does not offer any compelling reason for a lack of correlation between height growth and soil moisture depth. The interaction with both soil and air temperature is not recorded and, of course, may be influential in this seeming lack of a strong relationship. However, there seems to be a somewhat better relationship when this same data is evaluated for rabbitbrush (Chrysothamnus viscidiflorus; Figure 8). The shorter leader growth seems to be somewhat related to shallower soil moisture during early spring growth.

Table 1 shows leader (shrubs) and height (grasses) growth for the three years. None of the years appeared to be a better growth year than the others.

Fig. 1. Occurrence of various phenophases of selected forbs, Battle Mountain District.

06-7
Putr

1976

1977

1978

06-2-2

Epne

1976

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

LEAF-GROWTH

TWIG-GROWTH

Fig. 2. Occurrence of leaf and twig growth for selected shrubs, Battle Mountain District.

6-2-2
Siny

1976

1977

1978

6-3

Agsp

1976

1977

1978

6-2-3

Only

1976

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

VEGETATIVE
GROWTH

FLOWER STALKS
FIRST APPEAR

SEED
DISSEMINATION

PLANTS DRY

Fig. 3. Occurrence of various phenophases of selected grasses, Battle Mountain District.

TWIG GROWTH
NEW LEAF
GROWTH
LEAVES DRY
AND DROP
LEAVES TURN
YELLOW
SEED
DISSEMINATION
SEED RIPE
BLOOM OVER
FULL BLOOM
FIRST BLOOM
LEAVES FULL
GROWN
FLOWER BUDS
FIRST VISIBLE
TWIG GROWTH
LEAF GROWTH
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976 ————
1977 ————
1978 ————

Fig. 5. Phenology of *Artemisia spinescens* compared with soil moisture depth (inches) on salt desert shrub vegetation type (site 06-2-2), Battle Mountain District.

Fig. 6. Phenology of *Oryzopsis hymenoides* on salt desert shrub vegetation type (site 06-2-3), Battle Mountain District.

500+
500
450
400
350
300
250
200
150
100
50
0

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976 -----
1977 —————
1978 —+—+—+—+—

Fig. 7. Height growth (mm) of Sitanion hystrix compared with soil moisture depth (inches) on salt desert shrub vegetation (site 06-2-2), Battle Mountain District.

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Table 1. Leader (Shrubs) and Height
(Grasses) Growth in the
Battle Mountain District for
1976, 1978, and 1978.

	Millimeters					
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 06-2-1</u>						
<u>SHRUBS</u>						
1.Tegl	64		66		105	
2.Chna	283		130		185	
3.Save	127		70		122	
4.Atco	120		75		125 ♀ 110 ♂	
<u>GRASSES</u>						
1.Elci	584		1100		765	
2.Spai	416		500		270	15
<u>Site 06-2-2</u>						
1.Arsp	36	42	19		50	
2.Atco	48		50		160 ♀ 154 ♂	
3.Epne	204		120		180	
4.Grsp	33		90		165	
<u>GRASSES</u>						
1.Brte	145		140		100	70
2.Sihy	113	73	185		170	105
3.Posa	145	81	160		62	50
<u>FORBS</u>						
1.Sphae sp.	130	103	175		102	40
2.Lomat sp.					60	

	Millimeters					
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 06-2-3</u>						
<u>SHRUBS</u>						
1.Cela	70				215	
2.Atco	65				155	
3.Grsp	25	20			168 ♀	
4.Arsp	20	12			160 ♂	
					52	
<u>GRASSES</u>						
1.Sihy	178				170	70
2.Orhy	150				360	170
3.Brte	145	55			130	50
<u>FORBS</u>						
1.Sphae sp.	200				80	
2.Hagl	155				175	
<u>Site 06-3</u>						
<u>SHRUBS</u>						
1.Arar	62		30		188	
2.Eriog sp.	65		46		100	
3.Chvi	86		75		158	
4.Pran	97		25		110	
<u>GRASSES</u>						
1.Posa	205		65		94	80
2.Sihy	279		185		215	105
3.Agsp	437		500		375	200
4.Brte	90		56		100	105
<u>FORBS</u>						
1.Crac	90		85		125	
2.Zigad sp.	381		240		255	

Millimeters					
1976	Regrowth	1977	Regrowth	1978	Regrowth

Site 6-3 con't

FORBS

3. Phlox sp.	13	15	52	16
4. Lomat	90		75	
5. Astra sp.	25	68	150	
6. Eriog sp.		4	55	
7. Alliu sp.			100	

Site 06-7

SHRUBS

1. Putr	76	40	185	
2. Chvi	92	165	138	
3. Eriog sp.	89	40	110	
4. Artr	154	65	255	
5. Pran	74	65	145	

GRASSES

1. Agsp	383	310	313	165
2. Posa	175	200	100	90
3. Sihy	251	225	210	135
4. Brte	125	60	108	50
5. Astra sp.		90	80	
6. Agros sp.			110

BATTLE MOUNTAIN DISTRICT

SYMBOL 1978	FEB					MARCH					APRIL					MAY					JUNE					JULY					AUG			SEPT			OCT			NOV
	S	S	S	S	2	S	2	2	S		5	5	5	5	7	15	15	15	15	17	20	20	20	S	S		5	15	22											
MD(From-To in cm)	60	60	60	60		60	60	60	60		60	60	60	60	60	60	60	60	60	60	60	60	60	60	60		60	60	60											
precip. (mm)						4	31	44	56		10	0	1	0	0	13	0	0	0	0	23	0	0	31	18		0	0		0										
A.T. (°C)			2	45		7	9	7	11		9	17	7	10	14	16	15	14	16	18	22	20	16	14	11		12	12	7	3										
attle Mtn. 06-2-1																																								
HRUBS																																								
Regl	D			LG					TG		BV						FB	BO	SR	SD	LY			LD																
hna	D							LG	TG							FG			BV		1B		FB	BO		SD		LY				LI								
ave	D			LG					TG		BV				FG											LY		LD												
atco ♀	D			LG					TG		BV		1B			FB	BO			SD			LY	LY		LD		LD												
♂	D			LG					TG		BV		1B			FB	SR			LY			SD	LY		LY		LD												
GRASSES																																								
Elci	D			GS	$\frac{1}{2}$ V									FS			An	DS			HS			SD	BD					PD										
Spai	D							GS					$\frac{1}{2}$ V				HO		An	HS	SD					BD				<u>GS</u>		<u>PD</u>	PI							

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SYMBOL 1978	FEB 28	MARCH				APRIL				MAY				JUNE				JULY				AUG				SEPT				OCT				NOV 16					
SMD(From-To in cm)	S 60	S 50	S 60	S 60	2 60	S 60	S 60	S 60	S 60	S 7 55	10 60	7 20	22 22	22 22	D	D		D	D	D				7 14	15 21	10 20	15 20	15 20											
recip.(mm)						13 20	11 26			13 0	7 7	0 0	1 0	0 0	0 0			2 0	0 0	0 0			31 11	11 0	0 0	0 0	0 0	0 0	0 0	0 0									
.T.-°C			11	8		7	13	9	15		14	18	8	16	20	18	19	22	21	20		24	22	22	18	10	12	12	7	15									
attle Mtn. 5-2-2																																							
HRUBS																																							
rsp	LG* TG			BV FG		1B		FB		BO			SD		LY	LD																							
tco ♀	D			LG TG						BV			BO SR	SR		SD					LY					LD													
♂	D			LG TG						BV			BO BO	LY		LY					LD					LD													
pne	D			LG			TG			BV			1B BO			SR SD							LY																
rsp	D			LG TG BV			1B			BO			SR			SD	LY					LD																	
RASSES																																							
rte	D* GS			$\frac{1}{2}V$						HO	An			DS SD BD	PD										<u>GS</u>		$\frac{1}{2}V$				PD								
ihy	GS*			$\frac{1}{2}V$						FS HO				DS HS	SL BD	PD										$\frac{1}{2}V$					PD								
osa	D* GS			$\frac{1}{2}V$			FS			HO	An			DS SD BD	PD											<u>GS</u>		$\frac{1}{2}V$			PD								
ORBS																																							
phae sp.	D			FS			1B			FB				BO SR		DS					BD			PD				<u>GS</u>			PD								
omat sp.	D			FS 1B						FB				BO BD		PD																							
henotype from Feb.9,1978																																							

[illegible]

[illegible]

SYMBOL 1978

FEB
28

MARCH

APRIL

MAY

JUNE

JULY

AUG

SEPT

OCT

NOV
16

attle Mtn.
06-3 con't

ORBS

rac

D

GS

FSLB FB BO DS BD

PD

lliu sp.

D

FS

LB FB BO PD

omat sp.

D

FS LB FB

BOSR DS BD PD

enotype
rom Feb.9,1973

SYMBOL 1978	FEB 28	MARCH				APRIL				MAY				JUNE				JULY				AUG			SEPT			OCT			NOV 16			
SMD(From-To in cm)	S 20	S 20	S 20	S 20	S 20	S 60	S 60	S 60	S 60	2 60	S 60	S 60	12 60	12 60	20 60	20 60	25 60	D	D		D	D		D	S 30	S 30		7 30	15 30	20 30				
Precip.(mm)						15	19	24		4	0	9	0	0	3	0	0	0	0		0	0		0	33	10		0	0	0				
S.T.-°C				11	9		8	12	12	13		15	14	7	12	16	17	23	17	26	24		30	20		19	15	7		11	12	8		
Battle Mtn. 06-7																																		
SHRUBS																																		
Putr	D			LG					TG BV			1B		FB	BO		SR					SD	FG SD							LY				
Chvi	D			LG				TG						FG	BV		1B					FB				BO		SR		SD			LI	
Eriog sp.	D							LG				TG			BV		1B		FB			BO			SR			SD					LI	
Pran	D					LG			TG BV			FB	BO				SR						SD					LY					LI	
Artr	D			LG				TG						FG	BV		1B					FB		BO			SR						SI	
GRASSES																																		
Agsp	D			GS							$\frac{1}{2}$ V		FS			An	DS	HS		SD		BD				PD	GS		$\frac{1}{2}$ V				PI	
Posa	D* GS								$\frac{1}{2}$ V					HO	An	HS		BD		PD							$\frac{1}{2}$ V						PI	
Si hy	GS*				$\frac{1}{2}$ V									FS	HO	DS		SD	BD			PD				GS		$\frac{1}{2}$ V					PI	
Brte	D	GS							$\frac{1}{2}$ V					FS	HO	An	DS	SD	BD	PD								GS	$\frac{1}{2}$ V				PI	
FORBS																																		
Phlox sp.	D			GS					1B				FB		BO	SR	BD					PD				GS							PI	
Lupin sp.	D								FS				1B		FB	BO		SR				DS		BD		PD								
*Phenotype from Nov. 9, 1978																																		

SYMBOL 1978		FEB 28	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV 16
Battle Mtn. 06-7 con't											
Basa	D			GS	FS 1B FB	BOSR DS	BD	PD			
Eriog sp.	D			GS	FS	1B	FB BODS	BD PD			
Astra sp.	D				1B BO	SR BDPD					
Agros sp.	D			GS	FS	1B	SR DS BD	PD			
*Phenotype from Feb. 9, 1978											

TONOPAH

With addition of the 1978 data, the annual phenodynamic comparisons show a rather marked similarity. Deviations in the case of the grasses are closely related to soil moisture depths (Figure 1). Also of note is the shape of the grass curves (Figure 2), which suggest longer time periods for the vegetative phenostages when compared with the reproductive phenophases. For Indian ricegrass (Oryzopsis hymenoides; Figure 1) and squirreltail grass (Sitanion hystrix; Figure 2), the reproductive phenophases average five and six weeks, respectively. Information on those time periods will be useful for intensive grazing management systems.

For the forb desert globemallow (Sphaeralcea ambigua, Figure 3) and the shrub budsage (Artemisia spinescens; Figure 4), the phenodynamic curves show greater annual variability. In fact, the curves tend to cross over from year to year. The reasons are not clear for this phenomena.

Leaf and twig growth data is easy to plot, but difficult to interpret. The data for black sagebrush (Artemisia nova) suggest a relatively long leaf growth period relative to twig growth. The other two species plotted in Figure 5, Nevada ephedra (Ephedra nevadensis) and shadscale (Atriplex confertifolia), have a much larger ratio of leaf/twig growth.

The grass data is quite variable (Figure 6). The ratio of vegetative to reproductive values is of interest. For

both grasses plotted in Figure 6, the vegetative growth period is greater than the period of growth of the flower stalks.

The height growth of squirreltail grass (Figure 8) appears to be strongly regulated by soil moisture depth. However, the relationship of soil moisture depth and leader growth of Nevada ephedra (Figure 7) is not as clearly defined.

Leader growth (shrubs) and height growth (grasses) appear to be greater in 1976 than in 1977 or 1978. It is interesting to note that 1978 is the only year that showed any regrowth at all (Table 1).

Fig. 1 . Phenology of *Oryzopsis hymenoides* compared with soil moisture depth (inches) on a salt desert shrub vegetation type (site 06A-2-1), Tonopah District.

Fig. 2 . Phenology of *Sitanion hystrix* on a salt desert shrub vegetation type (site 06A-2-1), Tonopah District.

Fig. 3 . Phenology of *Sphaeralcea ambigua* on salt desert shrub vegetation type (site 06A-2-2), Tonopah District.

LEAVES DRY
AND DROP
NEW LEAF
GROWTH
LEAVES DRY
AND DROP
LEAVES TURN
YELLOW
SEED
DISSEMINATION
SEED RIPE
BLOOM OVER
FULL BLOOM
FIRST BLOOM
LEAVES FULL
GROWN
FLOWER BUDS
FIRST VISIBLE
TWIG GROWTH
LEAF GROWTH
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976 - - - - -

1977 —————

1978 + + + + +

Fig. 4 . Phenology of
Artemisia Spinescens on salt
desert shrub vegetation type
(site 06A-2-1), Tonopah
District.

05A-2-1

Grhy

1976

1977

1978

05A-2-1

Hija

1976

1977

1978

JAN

FEB

MAR

APR

MAY

JUNE

JULY

AUG

SEPT

OCT

 $\frac{1}{2}$ VEGETATIVE
GROWTHFLOWER STALKS
FIRST APPEARSEED
DISSEMINATION

PLANTS DRY

Fig. 6 . Occurrence of various phenophases of selected grasses, Tonopah District.

1976 -----
1977 -----
1978 + + + +

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

Fig. 7. Leader growth (mm) of *Ephedra nevadensis* compared with soil moisture depth (inches) on a salt desert shrub vegetation type (site 06A-2-1), Tonopah District.

Fig. 8. Height growth (mm) of *Oryzopsis hymenoides* compared with soil moisture depth (inches) on a salt desert shrub vegetation type (site 06A-2-1), Tonopah District.

Table 1. Leader (Shrubs) and Height
(Grasses) Growth in the Tonapah
District for 1976, 1977, and 1978.

		Millimeters			
	1976	Regrowth	1977	Regrowth	1978 Regrowth
<u>Site 06A-2-1</u>					
<u>SHRUBS</u>					
1.Arno	230		200		220
2.Arsp	30		20		23
3.Atco	60		60		87
4.Cela	170		45		23
5.Epne	250		105		135
6.Grsp	110		60		70
<u>GRASSES</u>					
1.Hija	340		330		105 52
2.Orhy	324		280		310 97
3.Sihy	400		290		400 140
<u>FORBS</u>					
1.Sphae sp.	450		340	110	440 30
<u>Site 06A-2-2</u>					
<u>SHRUBS</u>					
1.Atco	70		70		155
2.Arsp	40		20	2	43 LG*
3.Cela	235		180		180
<u>GRASSES</u>					
1.Orhy	314		260		367 145

*LG=leaf growth

	Millimeters				Regrowth
	1976	Regrowth	1977	Regrowth	1978
<u>Site 06A-2-2</u>					
<u>con't</u>					
<u>FORBS</u>					
1.Spam	500		310	310	440 GS*
<u>Site 06A-3</u>					
<u>SHRUBS</u>					
1.Artr	220		125		180
2.Come	120		75		90

*GS= growth starts

BATTLE MOUNTAIN DISTRICT

	MARCH				APRIL				MAY				JUNE				JULY				AUG				SEPT				OCT				NOV	
	S 60	25 60	25 60	12 60	12 60	12 60	25 60	12 60	2 60	5 60	6 60	10 61	17 61	16 61	20 60		D	D	D	D	D	22 64	D		12 43	10 61		10 61			11 61	S 6		
					13	7	8	0	20	0	0	0	0	0	-	-	-	-	-	-	47	-			0									
			12	11	11	14	13	12	14	19	25	19	20	25	21	21	23	23	27	27	27	25	21		8	22		20			8	3		
	D			LG							TG					BV	FG								1B		FB				SD	LY		
LG					BV						FG	FB	BO			SR	SD	LY									LD							
D		LG			TG						BV	1B	BO	BO					SR												SD			
D		LG			TG						BV	1B	FB	BO					LY											LY				
D		LG									TG						BO															SD		
D											LG	TG		BV			SR				SD		LY											
LG						TG					BV	1B			1B		SD				LY						LD							
LG						TG					BV	1B			BO		LY				LY						LD							
D									GS			$\frac{1}{2}$ V	FS	An			SD	BD							<u>GS</u>									
D			GS				$\frac{1}{2}$ V				FS		An	DS	HS	SD	BD		PD						<u>GS</u>									
GS				$\frac{1}{2}$ V							FS	HO	An	DS		SD	BD		PD						<u>GS</u>									
GS									FS		1B	FB	BO		DS		BD			PD					<u>GS</u>									

SYMBOL 1978	MARCH					APRIL					MAY					JUNE					JULY					AUG					SEPT					OCT					NOV	
SMD(From-To in cm.)	S	12	25	12	12	12	12	25	12	2	5	75	10	23	23	20	25													12	5		22			23	1					
	60	60	60	60	60	60	60	60	60	60	61	61	61	61	61	60	60	D	D	D	D		D		D				12	5		34	51		60		23	1				
Prec(mm)						-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-		0		-		-	-	-	-	-	-	-	-	-	-	-	-			
ST (°C)				14	12	11	15	15	13	13	19	23	19	22	26	21	23	23	28	27	29					25		20		10	22			20			10					
Tono.O6A-2-2																																										
SHRUBS																																										
Cela	LG								TG					BV	FB	BO					SR																	SD	L			
Arsp	LG									1B				BO		SD		LY	LD																LG							
Atco	D			LG		TG								BV	1	FB	SR	SR							SD																	
	D			LG		TG								BV	FB	BO	BO	LY						LY																		
GRASSES																																										
Orhy	D	GS					1/2V							FS		HO	HS	SD	BD			PD																GS				
FORBS																																										
Sphae sp.	GS								FS					1B	FB		BO	SR	DS		BD		PD																GS			

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SYMBOL 1978	MARCH					APRIL					MAY					JUNE					JULY					AUG					SEPT					OCT					NOV	
SMD (From-To in Cm.)	S 60	S 60	12 60	S 60	12 60	12 60	12 60	25 60	S 60	2 60	7 61	7 61	10 61	25 61	25 61	17 60	20 61	23 30	25 30	28 30	10 61		25 60	38 61	12 40	10 61		9 61				11 61	13 61									
Prec (mm)					18	7	16	0	28	-	-	0	0	0	0	-	-						25	-		16	0	-				-										
ST (°C)			12	12	11	16		15	15	17	24	18	23	25	21	27	24	24	27	27	31		25	20		9	23		21			10	4									
Tono. 06A-2-3																																										
SHRUBS																																										
Artr	D										TG					BV			FG								1B		FB			BO	LY									
Come	D										LG	BV		FB			BO		SR				SD	LY																		
GRASSES																																										
FORBS																																										

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CARROLL SUMMIT

CARROLL SUMMIT

Several species on the Carroll Summit sites went directly from "growth starts" to "dry" without progressing through reproductive phenophases. The most interesting species was shadscale (Atriplex confertifolia) on the salt desert shrub site (07-2). This species is dioecious, and female plants progressed through all phenophases, but the male plants did not. Other species not having reproductive phases include tapertip hawksbeard (Crepis acuminata; site 07-3), Thurber needlegrass (Stipa thurberiana; site 07-7), goose-foot violet (Viola purpurea; site 07-7), groundsel (Senecio sp.; site 07-7), and pale agoseris (Agoseris glauca; site 07-7). The last four species all occurred on the mountain brush site.

The Carroll Summit vegetation showed strong leaf, culm, and leader growth relatively early in the spring. This growth occurred prior to a reasonably heavy storm during the third week in April, and must therefore be a result of wet soils resulting from snow melt or earlier storms. Good grass growth appears to be related to the April storm. Growth of species on the mountain brush site started immediately after snow melt. The three year comparison of leader and height growth data (Table 1) reveals no striking patterns, although some species showed greater growth in 1978. Some of the most noticeable species in this regard are fairway wheatgrass (Agropyron cristatum; site 07-3), squirreltail grass (Sitanion

hystrix; sites 07-6 and 07-7), groundsel (Senecio sp.; Site 07-6), Kentucky bluegrass (Poa pratensis; Site 07-6), and desert globemallow (Sphaeralcea ambigua; Site 07-2).

The start of growth for squirreltail grass varied considerably from year to year (Figure 1), as did the height growth of fairway wheatgrass, which grew the tallest in 1978 as indicated above (Figure 2).

The phenology of Kentucky bluegrass in a mountain meadow is characterized by regrowth periods in 1976 and 1977, but not 1978 (Figure 3). Longflower snowberry (Symphoricarpos longiflorus) phenology was very similar all three years (Figure 4). Sandberg bluegrass (Poa sandbergii) phenology showed greater variation with considerably later development in 1978 (Figure 5).

Leader growth of antelope bitterbrush (Purshia tridentata) was much earlier and longer in 1976 than either 1977 or 1978 (Figure 6). This does not necessarily appear to be related to soil moisture depth. Growth was possibly regulated by soil temperature.

Antelope bitterbrush began growth prior to longflower snowberry in all three years at site 07-7 (Figure 7). There was considerably annual fluctuation in both species relative to the onset of leaf and twig growth.

Full bloom for desert globemallow occurred up to five weeks apart between the three years (Figure 8), but was within a one to two week period for phlox (Phlox sp.).

Grass exhibited a great variation among phenophases (Figure 9), although fairway wheatgrass began dissemination during the same week for all three years.

REGROWTH

PLANT DRY

PLANT BEGINS
TO DRY

DISSEMINATION

HARD SEED

DOUGH SEED SET

ANTHESIS

HEADS OUT
FULLY

FLOWER STALKS

$\frac{1}{2}$ VEGETATIVE
GROWTH

GROWTH STARTS

DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976 - - - - -

1977 - - - - -

1978 // // // //

Fig. 1. Occurrence of phenophases of *Sitanion hystrix* as compared to soil moisture depth (inches) in northern desert shrub vegetation (site 07-3), Carroll Summit.

1976 -----
1977 —————
1978 |||||

Fig. 2 . Height growth (mm) of *Agropyron cristatum* compared with soil moisture depth (inches) on northern desert shrub vegetation (site 07-3), Carroll Summit.

REGROWTH DRY
REGROWTH
PLANT DRY
PLANT BEGINS TO DRY
DISSEMINATION
HARD SEED
DOUGH SEED SET
ANTHESIS
HEADS OUT FULLY
FLOWER STALKS
 $\frac{1}{2}$ VEGETATIVE GROWTH
GROWTH STARTS
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976 - - - - -
1977 —————
1978 / / / / /

Fig. 3 . Phenology of *Poa pratensis* in mountain meadow vegetation (site 07-6), Carroll Summit.

NEW LEAF
GROWTH
LEAVES DRY
AND DROP
LEAVES TURN
YELLOW
SEED
DISSEMINATION
SEED-RIPE
BLOOM OVER
FULL BLOOM
FIRST BLOOM
LEAVES FULL
GROWN
FLOWER BUDS
FIRST VISIBLE
TWIG-GROWTH
LEAF-GROWTH
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1976 ————

1977 ————

1978 ————

Fig. 4. Phenology of
Symphoricarpos longiflorus
on mountain brush vegetation
(site 07-7), Carroll Summit.

1976 - - - - -
1977 ————
1978 // / / /

Fig. 5 . Phenology of *Poa sandbergii* in mountain brush vegetation (site 07-7), Carroll Summit.

1976 -----
1977 -----
1978 // // //

Fig. 6 . Leader growth (mm) of *Purshia tridentata* compared to soil moisture depth (inches) in mountain brush vegetation (site 07-7), Carroll Summit.

07-7
Putr

1976

1977

1978

07-7
Sylv

1976

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

LEAF-GROWTH

TWIG-GROWTH

Fig. 7 . Occurrence of leaf and twig growth of selected shrubs, Carroll Summit.

Fig. 8 .Occurrence of various phenophases of selected forbs, Carroll Summit.

07-7
Stth

1976

1977

1978

07-3
Ager

1976

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

VEGETATIVE
GROWTH

FLOWER STALKS
FIRST APPEAR

SEED
DISSEMINATION

PLANTS DRY

Fig. 9 . Occurrence of various phenophases of selected grasses, Carroll Summit.

Table 1. Leader (Shrubs) and Height
(Grasses) Growth at Carroll
Summit (Carson City and
Battle Mountain Districts) for
1976, 1977, and 1978.

<u>Site 07-2</u>	<u>Millimeters</u>					
	1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>SHRUBS</u>						
1. Saba	50		35		70	
2. Grsp	85		85		150	
3. Arsp	35		25		40	
4. Chvi	140		120		130	
5. Atco	100		100		180	
6. Cela	150		200		250	
7. Epne	145		175		220	
<u>GRASSES</u>						
1. Brte	200	30	170		250	30
2. Sihy			140		210	60
3. Orhy			200		345	140
4. Agcr			500		400	90
<u>FORBS</u>						
1. Phra	250	3	175		90	
2. Hagl	130		185		170	
3. Maloc sp.	90				100	
4. Spam	200	50	180		350	
<u>Site 07-3</u>						
<u>SHRUBS</u>						
1. Artr	140		170		215	
2. Chvi	90		130		160	

Site 07-3 Con't	Millimeters					
	1976	Regrowth	1977	Regrowth	1978	Regrowth
3.Chna	180		230		225	
4.Epne	100		130		145	
<u>GRASSES</u>						
1.Posa	70		200		230	50
2.Brte	130		150		160	35
3.Sihy	210		180		250	110
4.Agr	430		380		500	140
<u>FORBS</u>						
1.Lomat sp.	40		20		80	
2.Erci			10		130	50
3.Crac					95	
4.Delph sp.					350	
<u>Site 07-5</u>						
<u>SHRUBS</u>						
1.Artr	60		150		180	
2.Chvi	95		160		110	
3.Eriog sp.	25	20	90		100	leaf growth
<u>GRASSES</u>						
1.Brte	150	40	160		120	20
2.Sihy	170	80	180		200	70
3.Posa	200	50	200		245	40
4.Stth	250	60	170		310	green-up
<u>FORBS</u>						
1.Phlox sp.	30	4	18		20	1
2.Lupin sp.	130		150		200	
3.Aswh	30		25		45	

		Millimeters					
		1976	Regrowth	1977	Regrowth	1978	Regrowth
<u>Site 07-6</u>							
<u>GRASSES</u>							
1. Carex sp.	120			150		220	30
2. Sihy	400	80		360		500	60
3. Popr	450	80		540	170	600	150
4. Posa				360		450	160
<u>FORBS</u>							
1. Taof	15			70	70	60	20
2. Vipu	35			45		40	12
3. Senec sp.				80		400	
4. Aster sp.				280		310	
5. Aggl				140		90	
6. Libu				150		250	
<u>Site 07-7</u>							
<u>SHRUBS</u>							
1. Sylo	150			100		160	
2. Artr	150			190		170	
3. Rive	90			230		105	
4. Chvi	110			100		200	
5. Putr	150	55		95		90	
<u>GRASSES</u>							
1. Posa	300	60		350		310	80
2. Stth	250	50		140		160	
3. Sihy	180	60		250		330	30
<u>FORBS</u>							
1. Vipu	35			20		35	8

		Millimeters			
		1976	Regrowth	1977	Regrowth
					1978
					Regrowth
<u>Site 07-7</u>					
<u>con't</u>					
2.Lupin sp.	110		70		130(grazed)
3.Liliu sp.			280		100(grazed)
4.Phlox sp.	35		20	3	28
5.Senec sp.	60		50		70
6.Liba	20				could not find
7.Aggl	150		45		70
8.Astra sp.	30				could not find
9.Saka	300				190

▲ SITE LOCATIONS
(Not all sites shown due
to closeness)

CARSON CITY DISTRICT

SYMBOL 1978														FEB	MARCH		APRIL				MAY			JUNE				JULY			AUG			SEPT			OCT				NOV				
SMD(From-To in cm)															S 30	2 30	1 30	1 30	S 30	S 30	3 30	6 30		9 30	11 30	14 30	17 30	22 30	6 30	D			7 30												
Precip.(mm)																		12			0	0	1		1	0	0	0	12	1			48												
S.T.-°C																15	17	14	13	10	19	16	15		16	13	15	15	17				16												
Carroll Sum. 07-2																																													
<u>SHRUBS</u>																																													
Saba	♀		D	LG BV		TG			1B		FE				SR		SD		LY																LD			D							
	♂		D	LG BV		TG			1B	BO	SFSD								LY																LD			D							
Grsp	♀		LG	BV		TG			1B		FE		BO	SRSD		LD																						D							
	♂		LG	BV		TG		FG		FE	BO			SD		SD		LD																				D							
Arsp			LG					FG	1B	BO					SFSD		SD																			LD			D						
				BV												LY	LD																												
Chvi			LG			TG									BV	BV	FG																1B	BO				SR, LD							
Atco	♀		LG			TG	BV		FG	1B		FE		BO	SRSD																			LY					LD						
	♂		LG			TG																													LY					LD					
Epne			D				BV			TG		1B		BO	SRSD																				LY										
Cela			LG			TG									BV	1B	BO																		BO, LY										
227																																													

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD (From-To in cm)										
Precip. (mm)										
S.T. - °C										
<u>07-2 Con't.</u>										
<u>GRASSES</u>										
Brte		GS	$\frac{1}{2}$ V	FS HO	Ar HS SD SD BD BD BD PD			PD	<u>GS</u>	
Sihy		GS	$\frac{1}{2}$ V	FS HO	HS SD BD BD	SD PD		PD	<u>GS</u>	
Orhy		D GS	$\frac{1}{2}$ V	FS HC	DS HS SD BD BD		PD		<u>GS</u>	
Agcr		GS	$\frac{1}{2}$ V	FS	HO Ar DS BD BD		HS SD BD PD		<u>GS</u>	
<u>FORBS</u>										
Phra		D		GS	FS FB	BO BO SR BD BD	DS PD	PD		
Hagl		D	GS				FS	1B	SR	
Maloc sp.		D	GS	FS	1E	FB BO BC DS BD BD	PD			
Spam		D GS	FS		1B	FB BO SR DS BD BD		PD		

SYMBOL 1978

	FEB	MARCH		APRIL			MAY				JUNE			JULY			AUG		SEPT		OCT			NOV
SMD(From-To in cm)		S 30	S 30	S 30	S 30	S 30	S 30	1 30	4 30	6 30	7 30	11 30	13 30	17 30	21 30	13 30	D		8 30					
precip.(mm)					12		0	0	0	1		0	0	0	0	-	-		-					
S.T.-°C			15	14	10		10	16	17	14		13	13	15	15	17	-		-					
Carroll Sum. 07-3																								
<u>SHRUBS</u>																								
Artr		LG					TG					BV		FG									FB	
Chvi		D	LG		TG							BV			FG LY	1B LY	FB LD					SR LD		
Chna		D		LG						TG							BV	FG					1B	
Epne		D								TG BV					1B		SR LY						LY	
<u>GRASSES</u>																								
Posa		GS		$\frac{1}{2}$ V			FS		HCAn BD		DS BD	HS PD	SD PD				PD						<u>GS</u>	
Brte		GS					$\frac{1}{2}$ V FS		HO		An	HS BD	SD PD					PD					<u>GS</u>	
Sihy		GS		$\frac{1}{2}$ V					FS		HO	An	DS BD	SD BD	SD PD			PD					<u>GS</u>	
Agcr		GS		$\frac{1}{2}$ V							FS HO	An	DS		DS BD	HS BD	SD PD						<u>GS</u>	

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD(From-To in cm)										
Precip.(mm)										
S.T.-°C										
<u>07-3 Con't.</u>										
<u>Forbs</u>										
Lomat sp.		GS FS	1B FB	BO	BO	SR DS PD BD PD				
Crac.		D	GS			BI	PD			
Erci		D		GS FS 1B BO		SR DS BD	PD			
Delph sp.		D	FS		1B FB	BO	SR BD	DS BD	PD	

SYMBOL 1978

	FEB	MARCH		APRIL				MAY		JUNE				JULY		AUG		SEPT		OCT	NOV
SMD(From-To in cm)		S 30	1 30	S 30	S 30	S 30	S 30	4 30	4 30	5 30	7 30	8 30	12 30	16 30	7 30	D		7 30			
precip.(mm)				12		37		1	0	0	0	0	0	0	12	0		70			
S.T.-°C		Sn	15	13	15	14	13	18	13		13	13	15	14	14			-			
Carroll Sum. 07-5																					
<u>SHRUBS</u>																					
Artr		LG						TG					BV	FG						FB	
Chvi		D	LG					TG					BV		FG	LB LY				SR LY	
Eriog sp.		LG						FG	LB	BO	SR	SD		LY	LD					LG	
Eriog sp.		LG					BV	TG FB			BO	SD		SD LY	LD					LG	
<u>GRASSES</u>																					
Brte		GS						FS	HO	An	DS	HS BL	SD BD			PD				GS	
Sihy		D	GS		$\frac{1}{2}$ V			FS	HC		Ar	HS BD	SD BD	SD PD	PD					GS	
Posa		GS				$\frac{1}{2}$ V		HO	Ar	DS	gr			PD						GS	
Sthh		D	GS					$\frac{1}{2}$ V	FS		gr									gu	
<u>FORBS</u>																					
Phlox sp.		D	GS					FB	BO		SR	DS	BD		PD					GS	

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD(From-To in cm)										
Precip.(mm)										
S.T.-°C										
<u>07-5 Con't.</u>										
Lupin sp.		D	GS		FS 1B FB	BO SR	DS BD		PD	
Aswh		D GS	FS		BO DS	DS BD	PD			
Casti sp.		D	GS		FS 1B FB	gr				
Liliu sp.		D	GS		FS	gr				
Arabi sp.		D	GS	FS	1B BO	SR DS PD		PD		

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD (From-To in cm)										
Precip. (mm)										
S.T. - °C										
Carroll Sum. 07-6										
SHRUBS - NONE										
GRASSES		SNOW	SNOW							
Carex sp.				GS	$\frac{1}{2}$ V	FS An	DS	HS	HS PD	<u>GS</u>
Sihy				D	GS $\frac{1}{2}$ V	FS HO	An	SD BD	SD PD	<u>GS</u>
Popr				D	GS $\frac{1}{2}$ V	FS HO	DS	HS BD	SD PD	<u>GS</u>
Posa				GS	$\frac{1}{2}$ V	FS HO	DS	HS BD	SD PD	<u>GS</u>
FORBS										
Taof				D	GS 1B	FB DS	BD		PD	<u>GS</u>
Vipu				GS	1B	FB BO	DS BD		PD	<u>GS</u>
Senec sp.				GS	FS	1B FB BO	DS BD	PD		

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD (From-To in cm)										
Precip. (mm)										
S.T. - °C										
<u>07-6 Con't.</u>		snow	snow							
Aggl				GS	FS 1B30	SR	PD			
Libu				GS	FS 1B FB BCSR	PD				
Aster sp.				D		GS	1B FB	SR PD		

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
SMD(From-To in cm)		SNOW	SNOW	SNOW	S 3 30 30	4 5 8 8 30 30 30 30	11 30	13 30	D	5 30
Precip.(mm)		SNOW	SNOW	SNOW	1	- 1 0	0	6	0	67
S.T.-°C		SNOW	SNOW	SNOW	10 11	- 14 11 -	11	11	-	-
Carroll Sum. 07-7										
SHRUBS										
Sylo				LG	TG BV	FG 1B	BO			SR LD
Artr				LG	TG	BV		FG		FB
Ribes sp.				LG 1B BV	TG BO					SD LD
Chvi				D LG	TG		BV	1B LY		BO LY
Putr		D	LG		TG BV	1B BO	SD	LY		
GRASSES										
Posa				GS	$\frac{1}{2}$ V FS BD	An BD	DS BD	SD PD	PD	GS
Stth				GS	$\frac{1}{2}$ V			$\frac{1}{2}$ V BD		PD
Sihy				GS	$\frac{1}{2}$ V	FS	An	SD BD		GS

SYMBOL 1978	FEB	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV
3MD(From-To in cm)										
Precip.(mm)										
S.T.-°C										
<u>07-7 Con't.</u>										
<u>FORBS</u>										
Vipu				GS FS		BD PD		<u>GS</u>		
Lupin sp.				GS		FS FB BC	gr			
Liliu sp.				GS		FS gr				
Phlox sp.				GS	FS LB FB	BO DS	BD PD			
Senec sp.				GS		GS BD PD				
Aggl				D	GS FS	BD PD				
Saka				D		GS FS	FB	PD		

CEDARVILLE

CEDARVILLE

The Cedarville phenology record is not as complete as some of the other sites, since they did not join the study until late May of 1977. However, their data does provide some important clues relative to species development in the northwest corner of Nevada.

A two year comparison of Sandberg bluegrass (Poa sandbergii) phenology shows a strong similarity in development (Figure 1). Flowery phlox (Phlox multiflora) growing in the pinyon/juniper woodland shows greater variation (Figure 2), with the 1978 growth pattern lagging several weeks behind that of 1977. Rabbitbrush (Chrysothamnus viscidiflorus) in the salt desert shrub type shows well the relative lateness of bloom for this species (Figure 3). The phenology of squirrel-tail grass (Sitanion hystrix) in a salt desert shrub type is similar for both years, with the 1978 phenology sometimes ahead and sometimes lagging behind that of 1977. Reasons for this crossing-over effect are not clear.

Height growth of crested wheatgrass (Agropyron desertorum) was less and began earlier in 1978 (Figure 5). Twig growth of low sagebrush (Artemisia arbuscula) on two salt desert shrub sites occurred later in 1978. Period of twig growth was identical on both sites in 1977, and almost the same in 1978 (Figure 6).

Examination of leader and height growth for the two years (Table 1) shows no definite growth patterns. Better growth occurred in 1977 for some species, and in 1978 for other species.

Fig.1. Phenology of *Poa sandbergii* on northern desert shrub vegetation type (Site 09-3-1), Cedarville (northern Washoe County)

REGROWTH
PLANTS DRY
PLANTS BEGIN
TO DRY
DISSEMINATION
STARTS
SEEDS RIPE
BLOOM-OVER
FULL BLOOM
FIRST BLOOM
FLOWER STALKS
APPEAR
GROWTH STARTS
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1977

1978

Fig.2. Phenology of *Phlox*
multiflora on pinyon-
juniper vegetation type
(Site 09-5), Cedarville
(Northern Washoe County)

NEW LEAF
GROWTH
LEAVES DRY
AND DROP
LEAVES TURN
YELLOW
SEED
DISSEMINATION
SEED RIPE
BLOOM OVER
FULL BLOOM
FIRST BLOOM
LEAVES FULL
GROWN
FLOWER BUDS
FIRST VISIBLE
TWIG GROWTH
LEAF GROWTH
DORMANT

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1977 - - - - -
1978 + + + + +

Fig. 3. Phenology of
Chrysothamnus viscidiflorus
on salt desert shrub
vegetation type (Site 09-2-2
Cedarville (Northern
Washoe County)

1977
1978

|||||

Fig.4. Phenology of *Sitanion hystrix* on salt desert shrub vegetation type (Site 09-2-1), Cedarville (Northern Washoe County)

500+
500
450
400
350
300
250
200
150
100
50
0

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

1977
1978

|||||

Fig.5. Height growth of Agropyron desertorum on a seeded area (Site 9-4), Cedarville (Northern Washoe County) for 1977 and 1978.

Site 9-2-1

Arar

1977

1978

Site 9-2-3

Arar

1977

1978

JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT

LEAF-GROWTH

TWIG-GROWTH

Fig.6. Occurrence of leaf and twig growth in 1977 and 1978 for *Artemisia arbuscula* on salt desert shrub vegetation sites (09-2-1 and 09-2-3), Cedarville (Northern Washoe County)

Table 1. Leader (Shrubs) and Height
(Grasses) Growth in Cedarville
District for 1977 and 1978.

		<u>Millimeters</u>	
		<u>1977</u>	<u>Regrowth</u>
		<u>1978</u>	<u>Regrowth</u>
<u>Site 9-2-1</u>			
<u>SHRUBS</u>			
1.Arar	130	194	
<u>GRASSES</u>			
1.Posa	61	41	
2.Sihy	150	190	
<u>FORBS</u>			
1.Trma		61	
2.Phho		80	
3.Lomat		113	
4.Senec		100	
<u>Site 9-2-2</u>			
<u>SHRUBS</u>			
1.Teca	120	209	
2.Artr	120	205	
3.Chvi	120	205	
<u>GRASSES</u>			
1.Agde	360	235	GS*
2.Stco		185	
<u>Site 9-2-3</u>			
<u>SHRUBS</u>			
1.Arar		180	

GS*=growth starts

Millimeters			
1977	Regrowth	1978	Regrowth

Site 9-2-3
con't

GRASSES

1.Posa	42
2.Sihy	189

FORBS

1.Trma	64
2.Lomat sp.	90
3.Erth	59
4.Phmu	18
5.Alliu sp.	141

Site 9-2-4
(Estab.1978)

SHRUBS

1.Grsp	230
2.Save	129
3.Arsp	50
4.Artr	203
5.Atco	83

GRASSES

1.Elci	431
--------	-----

Site 9-3-1

SHRUBS

1.Artr	130	161
2.Chna		170

Millimeters			
1977	Regrowth	1978	Regrowth

Site 9-3-1
con't

GRASSES

1. Dist	95	100	
2. Posa	100	63	
3. Pule		107	

FORBS

1. Logr	50	87	
---------	----	----	--

Site 9-3-3
(Estab. 1978)

SHRUBS

1. Arar		228	
2. Grsp		155	

GRASSES

1. Stth		176	
2. Sihy		117	
3. Posa		60	

Site 9-4

SHRUBS

1. Chvi	200	155	
2. Artr	150	157	

GRASSES

1. Sihy	200	166	
2. Stth	230	147	
3. Agde	360	302	GS*
4. Posa	250	49	
5. Carex sp.	90	89	

GS*=growth starts

Millimeters			
1977	Regrowth	1978	Regrowth

Site 9-4 con't

FORBS

1.Erov	50	45
--------	----	----

Site 9-5-1

SHRUBS

1.Arar	120	175
--------	-----	-----

GRASSES

1.Posa	45	66
--------	----	----

2.Sihy	220	228
--------	-----	-----

FORBS

1.Alliu sp.		129
-------------	--	-----

2.Senec sp.		128
-------------	--	-----

3.Lomat sp.		89
-------------	--	----

4.Trma		47
--------	--	----

5.Phmu		21
--------	--	----

SYMBOL 1978

DMD(From-To
in cm)

Precip.(mm)

S.T.-°C

Bedarville
0-02-1HRUBS

war

GRASSES

Posa

Shy

ORBS

rma

Pho

omat sp.

enec sp.

-

JUNE

JULY

AUG

SEPT

OCT

FG TG

BV

LB FB

BO

SR

SD

DS

SD

BD PD

HO

DS

SD BD

PD

SR DS

BD

PD

FB BO

SR

DS

BD PD

FB BO

SR

DS BD

PD

FB SR

PD

SYMBOL 1978

- JUNE JULY AUG SEPT OCT

MD(From-To
in cm)

recip.(mm)

T.-°C

edarville
9-02-2SHRUBS

Chvi TG BV 1B FB SF LY LD

Artr TG BV FG 1B FB BO SD LY

Teca TG 1B FB BO SR LD

GRASSES

Agde FSDS SD BL GS PD

Stco FS HO DS SDBD PD

FORBS

[illegible]

[illegible]

FORBS

SYMBOL 1978

MD(From-To
in cm)

Precip.(mm)

T.-°C

edarville
9-03-1SHRUBS

Artr

Chna

GRASSES

Posa

Pule

Dist

FORBS

Logr

-

JUNE

JULY

AUG

SEPT

OCT

TG

BV

FG

LB

BO

SR

SD

TG

BV

LB FB

BO

SR

SD

LY

FS An

DS

SD

BD PD

HO

DS

SD BD

PI

 $\frac{1}{2}$ V

BD

PD

BO

BD

PD

[illegible]

SYMBOL 1978

SMD (From-To
in cm)

Precip. (mm)

S.T. - °C

Jedarville

9-04SHRUBS

Chvi

TG

BV

1B FB

BO

SR

LY

LD

Artr

TG

BV

FG

1B

BO

SD

LY

GRASSES

Sihy

FS HC

DS

SD BD

PI

Stth

FS An

DS

BD

PD

Agde

FS HO

DS

HS

SD

BD

GS

PD

Posa

An HS

BD

PD

Carex sp.

An

HS

BD

PD

FORBS

Erov

FB

BO

DS

BD

PD

SYMBOL 1978

SMD (From-To
in cm)

Precip. (mm)

S.T. - °C

Jedarville
9-05-1SHRUBS

Arar

FG TG

BV

LB

FB

BO

SR

SD

GRASSES

Sihy

LV

HO

DS

SD

BD

PD

Posa

DS

SD

BD

PD

FORBS

Alliū sp.

FB

BO

DS

PD

Senec sp.

FB

SR

DS

BD

PD

Lomat sp.

FB BO

DS

BD

PD

Phmu

FB

BO

DS

BD

PD

Trma

BO

SR

DS

PD

APPENDIX I

Appendix I. Symbol and scientific name (alphabetically by symbol) of species presented in phenodynamic tables.

<u>SYMBOL</u>	<u>SCIENTIFIC NAME</u>
SHRUBS:	
Amal	<u>Amelanchier alnifolia</u>
Amdu	<u>Ambrosia dumosa</u>
Amut	<u>Amelanchier utahensis</u>
Arar	<u>Artemisia arbuscula</u>
Arno	<u>Artemisia nova</u>
Arpa	<u>Arctostaphylos patula</u>
Arsp	<u>Artemisia spinescens</u>
Artr	<u>Artemisia tridentata</u>
Atca	<u>Atriplex canescens</u>
Atco	<u>Atriplex confertifolia</u>
Atle	<u>Atriplex lentiformis</u>
Bere	<u>Berberis repens</u>
Cegr	<u>Ceanothus greggii</u>
Cela	<u>Ceratoides lanata</u>
Cele	<u>Cercocarpus ledifolius</u>
Cepr	<u>Ceanothus prostratus</u>
Ceve	<u>Ceanothus velutinus</u>
Chna	<u>Chrysothamnus nauseosus</u>
Chvi	<u>Chrysothamnus viscidiflorus</u>
Come	<u>Cowania mexicana</u>
Cora	<u>Coleogyne ramosissima</u>

SYMBOLSCIENTIFIC NAME

Cost	<u>Cowania stansburiana</u>
Dafr	<u>Dalea fremontii</u>
Epne	<u>Ephedra nevadensis</u>
Epvi	<u>Ephedra viridis</u>
Eriog sp.	<u>Eriogonum</u>
Grsp	<u>Grayia spinosa</u>
Haco	<u>Haplopappus cooperi</u>
Hodi	<u>Holodiscus discolor</u>
Hodu	<u>Holodiscus dumosus</u>
Juos	<u>Juniperus osteosperma</u>
Krpa	<u>Krameria parvifolia</u>
Ladi	<u>Larrea divaricata</u>
Lepu	<u>Leptodactylon pungens</u>
Lysp	<u>Lygodesmia spinosa</u>
Mare	<u>Mahonia repens</u>
Potr	<u>Populus tremuloides</u>
Potr3	<u>Populus trichocarpa</u>
Pran	<u>Prunus andersonii</u>
Prju	<u>Prosopis juliflora</u>
Prvi	<u>Prunus virginiana</u>
Putr	<u>Purshia tridentata</u>
Riau	<u>Ribes aureum</u>
Ribes sp.	<u>Ribes</u>
Rice	<u>Ribes cereum</u>
Rive	<u>Ribes velutinum</u>
Rosa sp.	<u>Rosa</u>

SYMBOLSCIENTIFIC NAME

Rowo	<u>Rosa woodsii</u>
Saal	<u>Salix alba</u>
Saba	<u>Sarcobatus baileyi</u>
Saca	<u>Salix cascadenis</u>
Salix sp.	<u>Salix</u>
Save	<u>Sarcobatus vermiculatus</u>
Syal	<u>Symphoricarpos albus</u>
Sylo	<u>Symphoricarpos longiflorus</u>
Symph sp.	<u>Symphoricarpos</u>
Syoc	<u>Symphoricarpos occidentalis</u>
Teca	<u>Tetradymia canescens</u>
Tegl	<u>Tetradymia glabrata</u>
Yubr	<u>Yucca brevifolia</u>

GRASSES:

Agal	<u>Agrostis alba</u>
Agcr	<u>Agropyron cristatum</u>
Agda	<u>Agropyron dasystachyum</u>
Agde	<u>Agropyron desertorum</u>
Agin Ag	<u>Agropyron intermedium</u>
Agrop sp.	<u>Agropyron</u>
Agros sp.	<u>Agrostis</u>
Agsm	<u>Agropyron smithii</u>
Agsp	<u>Agropyron spicatum</u>
Agst	<u>Agrostis stolonifera</u>
Agtr	<u>Agropyron trachycaulum</u>

SYMBOLSCIENTIFIC NAME

Bogr	<u>Bouteloua gracilis</u>
Brca	<u>Bromus carinatus</u>
Brin	<u>Bromus inermis</u>
Brja	<u>Bromus japonicus</u>
Brte	<u>Bromus tectorum</u>
Cane	<u>Calamagrostis neglecta</u>
Carex sp.	<u>Carex</u>
Deca	<u>Deschampsia caespitosa</u>
Disti sp.	<u>Distichlis</u>
Dist	<u>Distichlis stricta</u>
Elci	<u>Elymus cinereus</u>
Eltr	<u>Elymus triticoides</u>
Feid	<u>Festuca idahoensis</u>
Feme	<u>Festuca megalura</u>
Hija	<u>Hilaria jamesii</u>
Hiri	<u>Hilaria rigida</u>
Hobr	<u>Hordeum brachyantherum</u>
Juba	<u>Juncus balticus</u>
Juncu sp.	<u>Juncus</u>
Kocr	<u>Koeleria cristata</u>
Muri	<u>Muhlenbergia richardsonis</u>
Orhy	<u>Oryzopsis hymenoides</u>
Orwe	<u>Oryzopsis webberi</u>
Poam	<u>Poa ampla</u>
Pobu	<u>Poa bulbosa</u>

SYMBOLSCIENTIFIC NAME

Pocu	<u>Poa cusickii</u>
Pofe	<u>Poa fendleriana</u>
Pone	<u>Poa nevadensis</u>
Popr	<u>Poa pratensis</u>
Posa	<u>Poa sandbergii</u>
Pule	<u>Puccinellia lemmoni</u>
Sece	<u>Secale cereale</u>
Sihy	<u>Sitanion hystrix</u>
Spai	<u>Sporobolus airoides</u>
Stco	<u>Stipa comata</u>
Stipa sp.	<u>Stipa</u>
Stth	<u>Stipa thurberiana</u>
Stwe	<u>Stipa webberi</u>
FORBS:	
Acca	<u>Aconitum columbianum</u>
Acla	<u>Achillea lanulosa</u>
Acmi	<u>Achillea millefolium</u>
Aggl	<u>Agoseris glauca</u>
Alliu sp.	<u>Allium</u>
Arabi sp.	<u>Arabis</u>
Argem sp.	<u>Argemone</u>
Arlu	<u>Artemisia ludoviciana</u>
Asle	<u>Astragalus lemmonii</u>
Aster sp.	<u>Aster</u>

<u>SYMBOL</u>	<u>SCIENTIFIC NAME</u>
Astra sp.	<u>Astragalus</u>
Aswh	<u>Astragalus whitneyi</u>
Basa	<u>Balsamorhiza sagittata</u>
Casti sp.	<u>Castilleja</u>
Cirsi sp.	<u>Cirsium</u>
Clema sp.	<u>Clematis</u>
Crac	<u>Crepis acuminata</u>
Delph sp.	<u>Delphinium</u>
Erci	<u>Eriodinium cicutarium</u>
Eriog sp.	<u>Eriogonum</u>
Erca	<u>Eriogonum caespitosum</u>
Erov	<u>Eriogonum ovalifolium</u>
Erth	<u>Eriogonum thomasii</u>
Fraga sp.	<u>Fragaria</u>
Haar	<u>Haplopappus armerioides</u>
Hagl	<u>Halogeton glomeratus</u>
Halog sp.	<u>Halogeton</u>
Haplo sp.	<u>Haplopappus</u>
Hyc	<u>Hydrophyllum capitatum</u>
Iris sp.	<u>Iris</u>
Irmi	<u>Iris missouriensis</u>
Lepe	<u>Lepidium perfoliatum</u>
Libu	<u>Lithophragma bulbifera</u>
Liliu sp.	<u>Lilium</u>
Logr	<u>Lomatium grayi</u>

SYMBOLSCIENTIFIC NAME

Lomat sp.	<u>Lomatium</u>
Lone	<u>Lomatium nevadense</u>
Lotr	<u>Lomatium triternatum</u>
Luca	<u>Lupinus caudatus</u>
Lule	<u>Lupinus leucophyllus</u>
Lupin sp.	<u>Lupinus</u>
Lysp	<u>Lygodesmia spinosa</u>
Maca	<u>Machaeranthera canescens</u>
Maloc sp.	<u>Malocathrix</u>
Mear	<u>Mentha arvensis</u>
Meob	<u>Mertensia oblongifolia</u>
Merte sp.	<u>Mertensia</u>
Mesa	<u>Medicago sativa</u>
Migu	<u>Mimulus guttatus</u>
Onobr sp.	<u>Onobrychis</u>
Peki	<u>Penstemon kingii</u>
Penst sp.	<u>Penstemon</u>
Pepa	<u>Penstemon palmeri</u>
Pesi	<u>Pediocactus simpsoni</u>
Phace sp.	<u>Phacelia</u>
Phho	<u>Phlox hoodii</u>
Phlo	<u>Phlox longifolia</u>
Phlox sp.	<u>Phlox</u>
Phmu	<u>Phacelia mustelina</u>
Phra	<u>Phacelia ramosissima</u>
Plma	<u>Plantago major</u>

<u>SYMBOL</u>	<u>SCIENTIFIC NAME</u>
Popa	<u>Potentilla</u> <u>pacifica</u>
Poten sp.	<u>Potentilla</u>
Ragl	<u>Ranunculus</u> <u>glaberrimus</u>
Ranun sp.	<u>Ranunculus</u>
Rate	<u>Ranunculus</u> <u>testiculatus</u>
Rumex sp.	<u>Rumex</u>
Saka Salsola	<u>Salsola</u> <u>kali</u>
Senec sp.	<u>Senecio</u>
Sial	<u>Sisymbrium</u> <u>altissimum</u>
Sidel sp.	<u>Sidalcea</u>
Spam	<u>Sphaeralcea</u> <u>ambigua</u>
Sphae sp.	<u>Sphaeralcea</u>
Taof	<u>Taraxacum</u> <u>officinale</u>
Tarax sp.	<u>Taraxacum</u>
Thmo	<u>Thermopsis</u> <u>montana</u>
Trma	<u>Trifolium</u> <u>macilentum</u>
Veca	<u>Veratrum</u> <u>californicum</u>
Veth	<u>Verbascum</u> <u>thapsus</u>
Viad	<u>Viola</u> <u>adunca</u>
Viola sp.	<u>Viola</u>
Vipu	<u>Viola</u> <u>purpurea</u>
Wyeth sp.	<u>Wyethia</u>
Zigad sp.	<u>Zigadenus</u>
Zipa	<u>Zigadenus</u> <u>paniculatus</u>

Borrower's Card

Nevada rangeland phenology.

Borrower	Division	Date Ret'd

DSC 1279-3a (Feb. 1977)