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**TEMPERATURE AND PRECIPITATION VARIATIONS FOR TWO SLOPE  
AND VALLEY LOCATIONS IN NORTHEAST NEVADA 1998-2002**

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**Introduction**

Northeast Nevada is characterized by variations of complex topography in a semi-arid Great Basin climate regime. Examples of these variations are the close proximity valley and slope locations of Elko and Spring Creek, Nevada. (Fig 1.) The city of Elko, NV (pop. 18,642), lies within the Humboldt River Valley with a mean elevation of ~5000 ft. msl. Elko is surrounded by the Adobe Range and the Elko Hills, both ~7500 ft msl.

Spring Creek, Nevada (pop. 10,548), encompasses a 23.4 sq. mile area 10 to 15 miles southeast of Elko. Much of Spring Creek lies along the western slope of the Ruby Mountains, a rugged alpine mountain range 10 miles wide and 100 miles long. Several peaks are above 11,000 ft. with Ruby Dome the highest point at 11,387 ft. msl. The mean elevation of Spring Creek near the base of the Rubies is ~5500 to 6000 ft. msl.

Elko and Spring Creek are the two largest population centers in Elko county and also lie within the same forecast zone boundaries. This has presented meteorologists with several unique forecast problems, especially in winter. The purpose of this study is to outline the temperature and precipitation variations between these two slope/valley observation points and assess the climatological impact on future forecasts.

**Methodology**

The task of finding representative observational data was based on the availability of reliable daily temperature and precipitation readings from the years 1998 to 2002. The local Elko airport, J.C. Harris Field was chosen due to availability of AWOS data from 1998 to 2000 (Fehr 2001) and ASOS data in 2001 and 2002. J.C. Harris Field is located at the west end of Elko with an elevation of 5050 ft. msl (Fig. 1). The airport is located just north of the Humboldt River with a northeast to southwest drainage.

The observation site for Spring Creek, NV was chosen based on the close proximity to the Ruby Mountains (3 miles) and equipment availability. The station is located at the residence of a NWS meteorologist, 15 miles southeast of Elko, NV with an elevation

of 5720 ft. msl (Fig. 1). The drainage is from the southeast slope of the Rubies to the northwest. A Davis Instruments Wireless Weather Station was used to record the data, and automatically archived on a personal computer. The data obtained from Elko and Spring Creek were then consolidated into tables of monthly and annual maximum and minimum average temperatures (Figs. 2 and 3). The monthly and annual precipitation and snowfall were also consolidated into tables for comparison (Figs. 4 and 5). Three months were recorded missing (M) from Spring Creek due to equipment outages.

### **Temperature Results**

Maximum temperature differences between Elko and Spring Creek produced the least climatological variability on a monthly basis (Fig. 2). In 41 out of 57 months (72%), the Elko, Nevada Airport recorded maximum monthly temperatures higher than Spring Creek with a average difference of +2.3° F. The highest monthly difference of +4.6° F occurred in May, 2001. In 16 out of 57 months (28%), the Spring Creek weather station recorded maximum monthly temperatures higher than Elko with an average difference of +2.2° F. The highest monthly difference of +5.1° F occurred in July, 1998.

The annual maximum temperatures for 1998-2002 were plotted in the upper portion of a multiple series line graph to more clearly show the temperature differences (Fig. 6). The graph shows that in 3 out of 5 years (60%), the Elko Airport recorded higher annual average maximum temperatures with an average difference of +2.4° F. The highest annual difference of +2.7° F occurred in 2001. Spring Creek recorded higher annual average maximum temperatures in 2 out of 5 years (40%) with an average difference of +1.4° F. The highest annual difference of +2.4° F occurred in 1998.

Minimum temperature differences between Elko and Spring Creek produced the most climatological variability on a monthly basis (Fig. 3). In 56 out of 57 months (98%), the Elko, Nevada Airport recorded minimum monthly temperatures lower than Spring Creek with a average difference of -4.4° F. The highest monthly temperature difference of -12.2° F occurred in October, 1999. In April, 2001, Spring Creek and Elko recorded identical average minimum monthly temperatures of 31.1° F.

The annual minimum temperatures for 1998-2002 were plotted in the lower portion of a multiple series line graph and showed more notable temperature differences (Fig. 6). The graph shows that in all five years (100%), the Elko Airport recorded lower annual average minimum temperatures with an average difference of -4.4° F. The highest annual difference of -5.9° F occurred both in 1999 and 2000.

### **Precipitation and Snowfall Results**

Measurable precipitation differences between Elko and Spring Creek, NV produced a greater climatological variability than the temperature differences on a monthly basis (Fig. 4). In 50 out of 60 months (83%), the Spring Creek weather station recorded higher monthly precipitation than Elko with an average monthly difference of +0.52

inches. The highest monthly precipitation difference of +3.00 inches occurred in May, 1998. In 10 out of 60 months (17%), the Elko Airport recorded higher monthly precipitation than Spring Creek with an average monthly difference of +0.21 inches. The highest monthly precipitation difference of +0.62 inches occurred in July, 2001.

The annual measurable precipitation for 1998-2002 was plotted on the lower portion of a multiple series line graph to more clearly show the precipitation differences (Fig. 7). The graph shows that in all five years (100%), Spring Creek recorded higher annual precipitation than Elko with an average difference of +5.88 inches. The highest annual difference of +8.71 inches occurred in 1998.

Measurable snowfall differences between Elko and Spring Creek, NV produced the greatest climatological variability on a monthly basis (Fig. 5). In 35 out of 35 months (100%), the Spring Creek weather station recorded higher monthly snowfall than Elko, NV with an average monthly difference of +6.5 inches. The highest monthly snowfall difference of +16.7 inches occurred in February, 2000.

The annual measurable snowfall for 1998-2002 was plotted on the upper portion of a multiple series line graph to show a significant difference between Spring Creek and Elko, NV (Fig. 7). The graph shows that in all five years (100%), Spring Creek recorded higher annual snowfall than Elko with an average difference of +45.5 inches. The highest annual difference of +70.0 inches occurred in 2001.

## **Discussion and Conclusion**

The differences in average maximum temperature between Elko and Spring Creek, Nevada were small compared to the other data values, yet showed Elko with a +2.3° F higher average monthly maximum temperature. The most reasonable explanation for this difference is the ~700 ft. elevation change between the higher Spring Creek and Elko. Using the standard dry adiabatic lapse rate of 5.5° F per 1000 ft yields a +3.9° F differential between the two sites, while the standard moist adiabatic lapse rate of 3.3° F per 1000 ft (Holton 1979) yields a +2.3° F differential.

The most notable temperature differences between Elko and Spring Creek occurred with the average monthly minimum temperatures, showing Elko with a -4.4° F lower average monthly temperature than Spring Creek. The explanation for this difference is the location of Elko in a lower valley compared to a higher slope location for Spring Creek. The semi-arid climate regime of Northeast Nevada produces a substantial number of nights with clear skies, low humidity and light drainage winds. This pattern is very favorable for nocturnal inversions, especially in valley locations where the cooler air pools and the air flow becomes decoupled. Spring Creek, on the other hand, tends to remain near the top of the nocturnal valley inversions. Downslope southeast drainage winds are a prevalent nighttime flow at the Spring Creek station. This keeps cool air parcels from pooling and allows more mixing of the atmosphere.

Precipitation and snowfall produced the largest variation in the comparison study with Spring Creek averaging +0.52 inches of precipitation and +6.5 inches of snowfall more per month than Elko. The explanation for this lies in the close proximity of the Spring Creek weather station to the Ruby Mountains. With a distance of 3 miles separating Spring Creek and the highest peaks of the Ruby Mountains, orographic influences play a major role in the increased precipitation. During the summer months, the elevated terrain of the Rubies is an ideal focus for afternoon convection. During the winter months, orographic lifting coupled with a mean northwest winter flow pattern help to enhance the upslope snowfall in narrow band near the Ruby mountains.

Although these are general meteorological explanations for the differences, they help to focus the operational forecaster on the fact that complex terrain plays a significant role in climate variability between small distances. The fact that Elko and Spring Creek are the two largest population centers in Northeast Nevada within one zone forecast boundary make it imperative for the meteorologist to accurately forecast temperatures and precipitation for these areas.

### **Acknowledgements**

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### **References**

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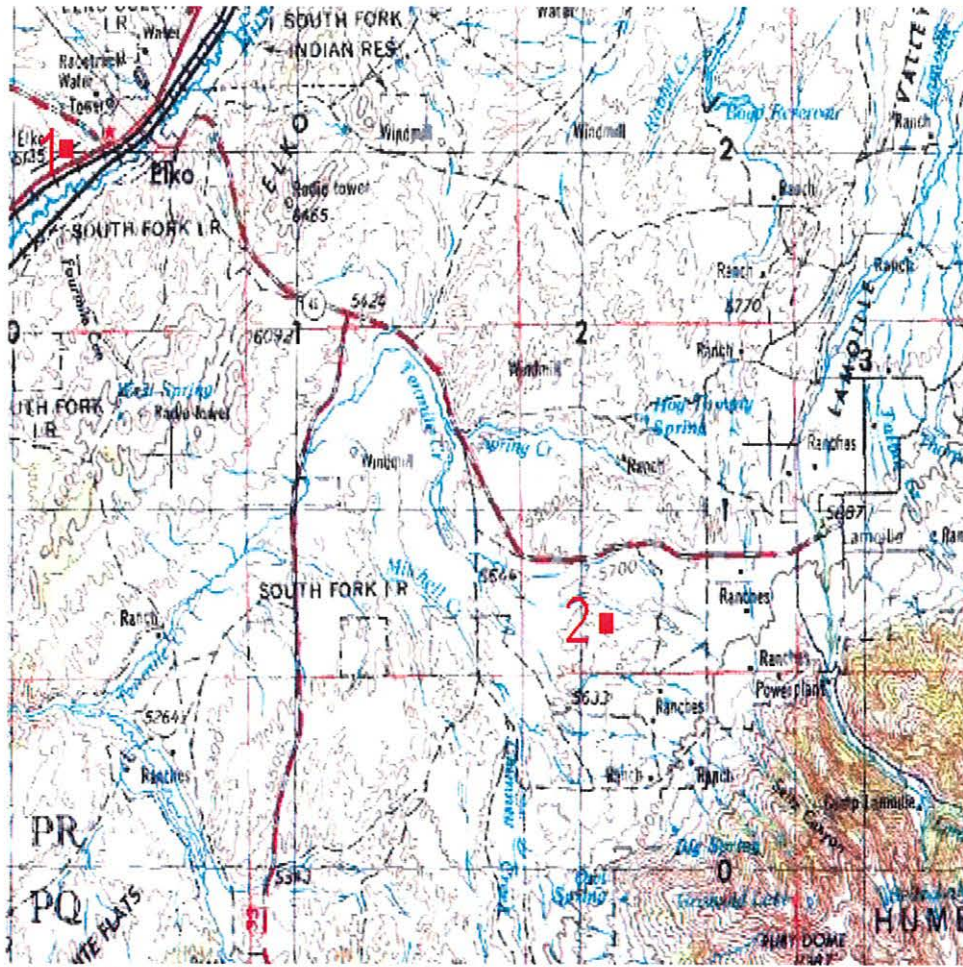


Fig. 1. Topographic Map of Elko, Nevada (#1), elevation 5050 ft. msl and Spring Creek, NV (#2), elevation 5720 ft. msl. The distance between the two sites is 15 statute miles.

Average Maximum Temperature (deg F)										
Month	1998		1999		2000		2001		2002	
	EKO	SP CK	EKO	SP CK	EKO	SP CK	EKO	SP CK	EKO	SP CK
Jan	42.1	43.8	41.4	43.1	41.7	40.6	33.2	31.6	33.1	32.8
Feb	40.5	44.8	43.9	45.8	46.3	44.7	38.9	35.5	36.6	35.1
Mar	49.7	54.1	53.2	54.4	51.6	48.3	54.4	49.9	47.6	43.3
Apr	55.6	58.3	53.2	55.0	65.8	64.0	58.4	53.9	61.6	57.2
May	61.9	66.2	65.7	66.5	71.1	69.2	77.8	73.2	69.9	65.3
Jun	71.9	M	77.9	77.5	83.2	82.8	84.2	81.2	82.9	79.5
Jul	89.2	94.3	88.5	89.5	90.1	M	89.8	87.1	94.4	92.8
Aug	89.9	M	85.9	87.2	89.4	88.0	92.7	90.5	87.2	85.8
Sep	75.9	77.8	78.5	76.8	78.0	75.7	82.5	79.9	78.4	75.9
Oct	59.8	58.6	70.4	69.4	62.2	59.7	68.7	66.1	63.0	60.0
Nov	49.2	49.4	58.3	56.8	40.0	36.7	51.8	49.1	50.8	48.7
Dec	36.8	38.3	42.0	40.4	39.1	38.5	32.4	32.0	42.3	40.5
Annual	55.6	58.0	63.2	63.5	60.8	58.9	63.7	61.0	62.3	59.7

Fig. 2. Average maximum temperatures for Elko and Spring Creek 1998-2001.

Average Minimum Temperature (deg F)										
Month	1998		1999		2000		2001		2002	
	EKO	SP CK	EKO	SP CK	EKO	SP CK	EKO	SP CK	EKO	SP CK
Jan	21.0	25.6	17.3	22.7	18.2	23.4	7.8	12.4	13.2	15.5
Feb	22.8	23.0	19.9	24.1	25.6	26.7	15.6	17.5	12.0	14.4
Mar	25.4	27.2	22.4	26.5	23.0	27.1	27.7	29.0	21.3	23.6
Apr	30.0	30.9	27.4	28.9	30.9	34.3	31.1	31.1	31.0	33.1
May	37.0	37.2	33.7	36.4	36.1	40.6	38.9	41.1	33.8	37.4
Jun	41.5	M	40.5	44.1	40.2	47.1	44.4	46.8	44.6	47.5
Jul	49.7	55.1	43.6	53.0	42.0	M	52.3	53.7	52.7	57.8
Aug	44.1	M	43.9	51.1	45.2	56.2	51.4	56.2	45.0	50.8
Sep	43.2	47.7	33.1	43.4	32.7	43.4	42.2	46.9	40.6	45.4
Oct	26.3	32.9	20.8	33.0	25.2	33.7	29.7	36.6	23.6	30.6
Nov	24.4	28.7	20.4	22.4	15.0	17.8	21.7	26.7	20.6	25.3
Dec	11.8	16.7	9.0	16.8	13.9	19.6	15.0	16.5	20.9	22.9
<b>Annual</b>	<b>28.8</b>	<b>32.2</b>	<b>27.6</b>	<b>33.5</b>	<b>27.8</b>	<b>33.7</b>	<b>31.5</b>	<b>34.6</b>	<b>29.9</b>	<b>33.7</b>

Fig. 3. Average minimum temperatures for Elko and Spring Creek 1998-2002

Measurable Precipitation (inches)										
Month	1998		1999		2000		2001		2002	
	EKO	SP CK	EKO	SP CK	EKO	SP CK	EKO	SP CK	EKO	SP CK
Jan	2.34	2.71	1.56	2.74	1.48	2.27	0.53	1.71	0.54	0.92
Feb	1.41	2.37	0.74	1.35	2.32	3.63	0.80	1.42	0.47	0.29
Mar	1.22	1.86	0.28	0.87	0.77	1.97	1.00	1.22	0.62	0.94
Apr	0.29	1.51	1.75	2.36	0.69	1.57	1.10	2.01	1.60	3.18
May	1.91	4.91	0.83	0.88	0.73	2.63	0.03	0.69	0.87	1.13
Jun	0.89	2.31	1.18	0.90	0.08	0.73	0.03	0.11	0.43	0.33
Jul	0.24	0.68	T	0.05	0.04	0.00	1.46	0.84	0.03	0.16
Aug	T	0.06	T	0.95	0.25	1.03	0.02	0.36	0.01	0.00
Sep	1.92	1.44	0.00	0.14	0.00	0.26	0.26	0.65	1.07	1.31
Oct	0.98	1.58	0.26	0.27	1.73	1.58	0.03	0.26	0.08	0.14
Nov	0.77	0.88	0.41	0.30	0.50	0.75	1.62	1.83	1.21	1.13
Dec	0.46	0.83	0.07	0.93	0.33	0.64	1.61	2.46	0.55	0.77
<b>Annual</b>	<b>12.43</b>	<b>21.14</b>	<b>7.08</b>	<b>11.74</b>	<b>8.92</b>	<b>17.06</b>	<b>8.49</b>	<b>13.56</b>	<b>7.48</b>	<b>10.30</b>

Fig. 4. Measurable precipitation for Elko and Spring Creek 1998-2001



<b>Measurable Snowfall (inches)</b>										
	<b>1998</b>		<b>1999</b>		<b>2000</b>		<b>2001</b>		<b>2002</b>	
<b>Month</b>	<b>EKO</b>	<b>SP CK</b>	<b>EKO</b>	<b>SP CK</b>	<b>EKO</b>	<b>SP CK</b>	<b>EKO</b>	<b>SP CK</b>	<b>EKO</b>	<b>SP CK</b>
Jan	5.5	13.0	8.8	15.3	5.1	6.8	8.2	22.0	9.1	18.6
Feb	11.0	21.3	4.2	10.2	12.3	29.0	8.4	20.0	1.2	2.6
Mar	10.5	21.0	6.1	10.9	8.2	17.6	0.9	18.2	2.5	9.0
Apr	0.6	7.0	16.6	23.8	0.0	0.0	4.1	9.7	3.8	12.0
May	0.2	4.7	1.1	1.6	T	0.0	0.0	0.4	1.5	10.0
Jun	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Jul	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Aug	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Sep	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Oct	0.0	T	0.0	0.0	0.9	7.7	0.0	0.0	T	0.1
Nov	2.3	3.1	0.7	2.6	5.0	9.2	0.0	10.7	0.5	2.3
Dec	6.9	9.0	1.2	9.2	4.8	6.7	20.9	31.5	5.3	8.9
<b>Annual</b>	<b>37.0</b>	<b>79.1</b>	<b>38.7</b>	<b>73.6</b>	<b>36.3</b>	<b>77.0</b>	<b>42.5</b>	<b>112.5</b>	<b>23.9</b>	<b>63.5</b>

Fig. 5. Measurable snowfall for Elko and Spring Creek 1998-2001

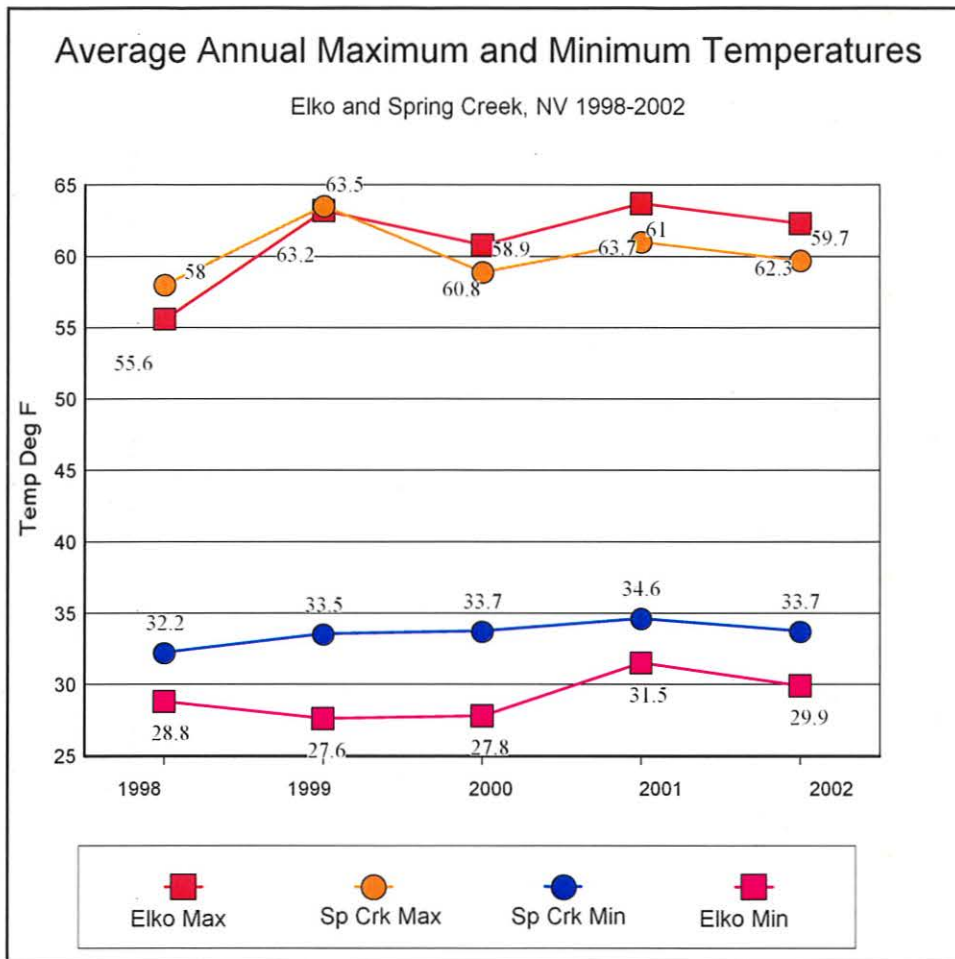


Fig. 6. Line graph of annual average maximum and minimum temperatures for Elko and Spring Creek, NV 1998-2002.

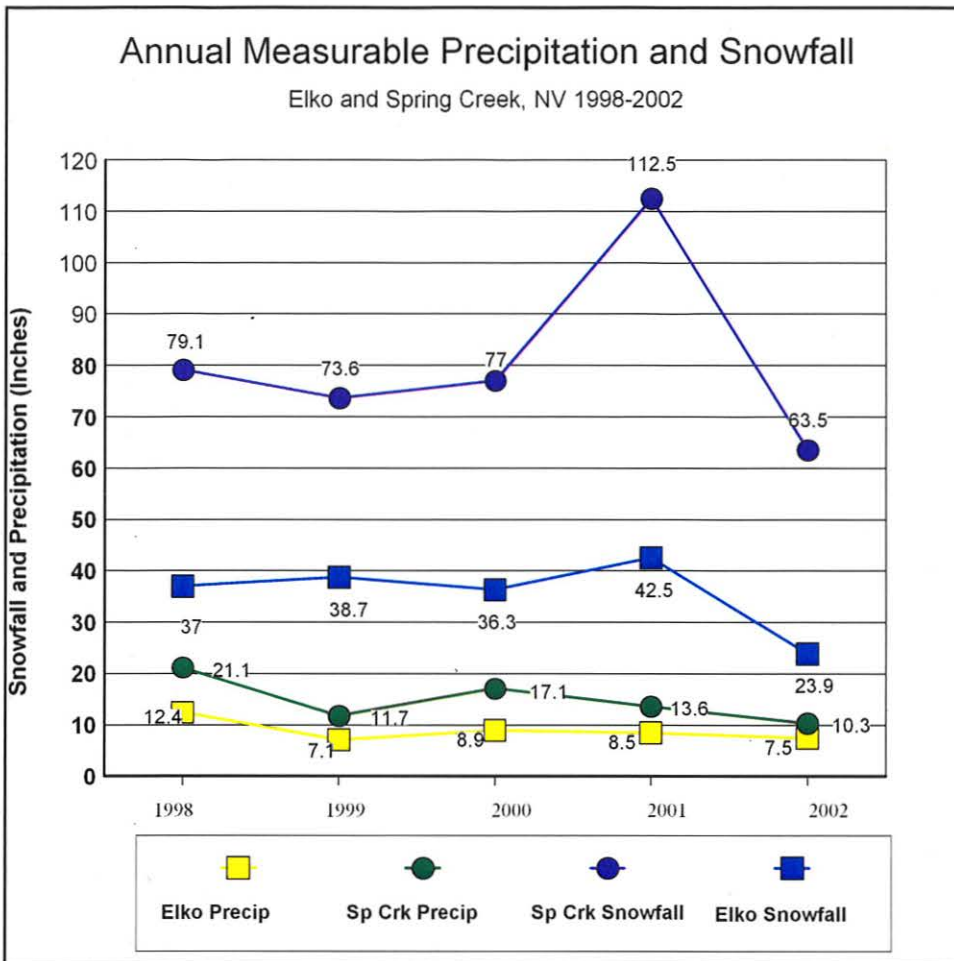


Fig. 7. Line graph of annual measurable precipitation and snowfall for Elko and Spring Creek, Nevada 1998-2002.