CONCLUSIONS

1. The Lost Forest is located in the Christmas Lake Basin which has formed a lake under wetter climatic conditions.
2. The mean annual precipitation in the Lost Forest has been approximately 9.5 inches for the 60 year period beginning in 1901. The climate is further characterized by low humidity, low winter temperatures, high summer maxima and low summer minima.
3. During the past six hundred years the effective precipitation has been much as it is today. The most severe drought during the past six hundred years was from 1920 to 1936.
4. The climate was much cooler and wetter during the Wisconsin glacial period but gradually warmed up and became drier until about seven thousand years ago. A warm dry period, the Hypsithermal, persisted for approximately three thousand years. The dry and warm trend was reversed at about four thousand years ago toward the cooler and warmer climate of the present.
5. The climate of the Lost Forest is not substantially different from that of the surrounding area.

6. Heavier precipitation during the pluvial period produced a lake which covered all but the higher portions of what is now the Lost Forest.
7. Sediments deposited in this lake characterize the soils of the Lost Forest and vicinity. The finer sediments of the lakes have resulted in soils of low permeability. Sands blown from the lake beds and shores have overlain the soils in Lost Forest.
8. The Lost Forest sands provide more efficient moisture absorption and storage than do soils which lack a covering of sand. Low temperatures and shifting sands are more unfavorable for herbaceous plants competing for the moisture than for ponderosa pine trees.
9. There are two _Artemisia_ dominated communities contiguous to the forest. The forest contains five separate communities. Two of these, Ponderosa pine--Bitter brush and Idaho fescue--Juniper are probably climax. The other three forest communities are characterized by the relative density of ponderosa pine and juniper in the overstory since their understories appear to be badly disturbed by shifting sands. The two _Artemisia_ communities are associated with lake-sediment soils while the arboreal communities are associated with the sands.

10. The impact of modern man's use of the land and vegetation is outweighed if not obscured by natural changes produced by shifting sands and lake levels.
11. The presence of pine pollen in Mt. Mazama pumice sediments indicates that the forest existed near its present locality, at least as a few trees, approximately 6400 years ago.
12. The forest has been in existence at least on the higher points of the area since the late Wisconsin glacial period.
13. The forest has been maintaining itself as attested by the young seedlings of many ages found in favorable sites throughout the forest. Some reproduction occurred even during the drought of 1920-1936. Reproduction occurs most frequently under gray rabbit brush plants. In the sands this shrub protects seedlings from winds, high soil temperatures, low humidities, and excessive soil surface dessication while leaving moisture adequate for seedling development.
14. Seeds from the Lost Forest germinate quicker than seeds from other sources. Lost Forest seedlings do not appear to show superior survival ability under high soil moisture stress.
15. Mature ponderosa pine trees can survive for long

periods of time on sites too severe to permit reproduction under normal weather conditions.

It can be concluded that the forest is a relict of previous forests which covered most of the non-inundated area during the Wisconsin glacial period. Favorable moisture conditions in the sands have permitted the pine trees to survive on low precipitation while forests disappeared from the soils not favored with a sand mulch. No evidence was found that the trees of the forest have adaptations to lower moisture requirements for their physiological processes although rapid germination of seeds may be a genetic attribute. Constantly shifting sands have prevented the vegetation from reaching a climax in most of the forest. The two stable communities which do occur should be classed as edaphic climaxes. Grazing and other land uses have had some effects upon the forest but these are relatively small when compared with the natural changes produced by shifting sands and climatic fluctuations.

SUMMARY

The Lost Forest is a disjunct stand of ponderosa pine approximately 9,100 acres in size and is located at the eastern end of Christmas Lake Valley, a pluvial lake bed, in the northern part of the Great Basin in Lake County, Oregon. It is approximately thirty-five miles within the "Sagebrush Desert" from the nearest ponderosa pine forest to the west.

Precipitation for the general area in which the forest is located is approximately 9.6 inches and the local topography is such that a local variation in precipitation is extremely unlikely. An analysis of weather records at a station four miles from the forest during the years 1906-1916 and the records of other weather stations in the teneral area indicate that the Lost Forest is not situated in a peculiar local climatic province. This is also borne out by xeric vegetation associated with the ponderosa pine.

A study of growth rings of trees in the Lost Forest and in the surrounding area and correlation with existing weather records indicate that the present climate of the area is very similar to that of the past seven hundred years. The tree ring record also shows that the most

severe drought of seven hundred year period occurred between 1920 and 1936.

A study of geological literature show that weather conditions similar to those of the present existed in the area as far back as 4000 years ago. Previous to this a much drier and warmer climate had persisted from about 7000 years to 4000 years when the cooler, wetter trend began. During the last phase of the Wisconsin glacial period at about 11,000 years the climate was much cooler and wetter than at present.

The most conspicuous plant of the area is big sagebrush, Artemisia tridentata, with A. cana on the less alkaline portions of the old lake beds. A. tridentata var. Arbuscula is common on shallow soils on ridge tops and on playas. Greasewood, Sorcobatus vermiculatus is the most common shrub on the alkaline soils. Gray rabbit brush Chrysothamnus nauseosus and sticky flowered rabbit brush, C. viscidiflorus are also found in great abundance throughout most of the area. In addition to these several other chenopods also occur throughout the basin but in fewer numbers and much less conspicuously.

Associated grasses are Poa secunda and P. nevadensis, Sitanion hysterix, Elymus triticoides, Stipa comata, Stipa thurberiana and Oryzopsis hymenoides. Grasses found in the more alkaline portions are Distichilis stricta, Pucinella nutalliana, P. lemmoni. Other herbaceous plants were wooly sunflower, Eriophyllum lanatum, and many species of Eriogonum, Linum L. Lupinus, Penstemon, Erigeron. Several members of the phlox family are also common. Russian thistles, Salsola, kali var. tenuifolia, evening primrose, Oenothera L. sp., Scutellaria nana; Verbena Tourn.) L. sp., giant ryegrass, Elymus condensatus are commonly found on sand dunes and eroded lake beds.

The dominant woody vegetation within the forest consists of ponderosa pine, Pinus ponderosa; western juniper, Juniperus occidentalis; bitterbrush, Purshia tridentata; and occasionally, cutleaf mountain mahogany, Cercocarpus ledifolius. The only dominant grass in the forest is Idaho fescue, Festuca idahoensis. Of arboreal species only the juniper occurs outside the forest boundary.

Heavy grazing by cattle and sheep from circa 1900 to the 1930's and from circa 1915 to 1950 by wild horses may have resulted in considerable changes in vegetation but these influences may be outweighed by the impact of constantly shifting sands and climatic fluctuations. Timber has been removed from the forest by ranchers in the general area and in a planned light selective cut. Neither of these uses appear to have had any profound effect upon the forest but severe drought from 1920 to 1936, abetted by the western pine beetle, <u>Dendrectonus brevicomis</u>, destroyed many ponderosa pine trees particularly on shallow soils.

The soils of the forest and of the immediately surrounding area are characterized by two major factors. One of these is the nature of the ancient lake bed which provides the parent materials for many of the modern soils. The other major factor is the disposition of drifting sands from the dried up lake beds and lake shores.

The influence of sand dominates the characteristics of the better developed soils particularly in their "A" and "B" horizons. They have an even more profound effect by simply covering the soil to considerable depth with pure sand. The sands so dominate the soil situation that classical description by horizons is relatively meaningless.

The species of plants and their relationship to each other are also profoundly influenced by the sand. The shifting sands not only determine the stratification and character of communities but continually disrupt their trends toward a stable or climax state.

The sands are responsible for allowing the forest to maintain itself in a sub-marginal precipitation province. The sand compensates for the low precipitation through its high permeability and its efficient retention of moisture against evaporation.

Vegetation associated with ponderosa pine in the Lost Forest and the vegetation immediately adjacent areas is typically xeric. It can be divided roughly into seven types or communities. These are T-0, a relatively dense ponderosa pine stand with sparse understory; T-1, a juniper and occasional pine community with slightly heavier shrub understory; T-2, a juniper and *Artemisia tridentata* var. *arbuscula* community; T-3, an Upland Sage community in which *Artemisia tridentata* predominates; T-4, a sage community growing on the old lake bed sediments and in which *Artemisia cana* is usually present and often displaces *A. tridentata*; T-5, a *Festuca idahoensis* - juniper community; T-6, dense *Pinus ponderosa* growing on sand dunes, and T-OBB *Pinus ponderosa* with an understory of *Purshia tridentata*. The Idaho fescue and the ponderosa pine--bitterbrush communities are the only ones having the appearance of a climax. The T-0, or relatively dense ponderosa pine overstory appears to be climax but understory vegetation has had too much recent disturbance for a realistic evaluation of stability.

The forest appears to be a relict of more extensive ponderosa pine forest which was isolated by the late post glacial lakes rather than by encroaching desert. Ponderosa pine pollen along with the pollens of chenopods, grass and possibly juniper were found in Mt. Mazama ash near the center of the forest. Evidence in nearby Fossil Lake and in other lakes of the larger basin corroborates the evidence of a lake existing at this level after the beginning of the Hypsithermal interval.

Barring the introduction of some exotic enemy or disastrous fire the forest will probably continue to exist and reproduce itself.

As a result of this study, it appears that mature ponderosa pine can exist as individuals or even in a forest situation for long periods of time with far less precipitation than formerly assumed essential. Ponderosa pine's weakness in maintaining itself as a forest and in reproducing itself after harvesting usually lies in the poor survival characteristic of its seedlings. Seedlings are unable to survive except during infrequent occurrences of several consecutive "wet" years. In the Lost Forest the moisture holding properties of the sands provide a means which compensates for this disadvantage. Rapid germination characteristics of Lost Forest seeds as well as favorable microsites provided by gray rabbit brush plants also appear to be factors in survival of the forest. It is probably through moisture absorbtion and retaining characteristics of sand that the forest was able to maintain itself through the Hypsithermal period when the climate was somewhat warmer and dryer than the present.

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APPENDIX

Appendix I

ESTIMATED MONTHLY PRECIPITATION FOR LOST FOREST*

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
1960	.44	.24	.34	.85	1.15	1.20	.76	.57	.05	.32	.04	.89	6.85
1959	.00	.98	.63	1.07	1.07	.36	.36	.40	.04	00	1.46	.32	6.69
1958	.85	.82	2.02	2.52	1.57	.66	.44	1.02	1.66	.14	.07	.14	11.89
1957	1.85	.03	3.83	1.13	.97	1.81	.70	1.20	.26	.28	.11	1.24	13.41
1956	.30	1.85	5.90	3.49	.83	.14	1.22	3.19	.79	1.56	00	.50	19.77
1955	.14	.21	.59	.32	.19	.30	.70	.21	.04	.04	00	.48	3.22
1954	.32	2.03	1.11	2.10	.30	.66	.47	.60	.96	00	.14	.38	9.07
1953	.04	.22	2.57	2.86	1.23	.83	.36	1.82	.83	00	.72	.15	11.63
1952	1.21	1.11	4.34	1.47	1.71	.42	.33	.83	1.81	.04	00	.33	13.60
1951	3.18	1.23	1.97	1.69	1.38	.59	.19	1.09	.05	.43	.18	.07	12.05
1950	.06	.79	.64	1.52	.47	1.20	.08	.26	2.60	.05	00	00	7.67
1949	.39	1.47	1.19	.21	1.27	.74	.09	1.63	.03	.02	00	.12	7.16
1948	1.04	.14	.43	1.60	1.15	.71	.57	1.25	1.51	.26	.14	.48	9.28
1947	.67	1.43	.17	.88	.30	.57	.20	1.04	.99	.22	.36	.24	7.07
1946	.64	1.79	2.63	1.55	.15	.82	.07	1.52	.45	.38	.42	.66	11.08
1945	.92	1.25	.87	.39	1.00	.21	.19	3.66	.27	.14	.26	.05	9.21
1944	1.87	.64	.16	.22	.59	.35	.25	.44	2.96	2.08	00	.26	9.82
1943	00	3.48	2.07	2.44	.74	.15	.91	.25	.67	.38	.07	00	11.60
1942	1.35	1.64	1.75	1.24	1.15	.06	.41	1.95	.65	00	00	.14	10.34
1941	.85	.37	1.29	1.42	.85	.18	.40	.44	1.10	1.00	1.84	.44	10.18
1940	.40	00	2.67	1.52	2.25	1.82	.71	.59	.51	.33	00	1.74	12.54

*Basis for projection from Fremont is mean ratio of Fremont and Cliff for years 1910-1916

Appendix I (Cont.)

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
1939	.52	.74	.47	.58	.77	.45	.11	.96	.05	.33	00	.42	5.40
1938	.77	1.32	1.98	1.71	2.27	1.92	.33	.05	.09	.40	00	.56	11.40
1937	00	.10	.58	1.25	.51	.97	1.21	.08	2.08	.67	00	.38	7.83
1936	.98	.22	.92	2.71	.69	.25	1.02	.88	.82	.20	.46	.37	9.52
1935	1.01	.78	1.15	.56	.32	.45	1.27	.61	.31	.31	.08	.09	6.94
1934	.50	.07	1.01	.99	.40	.53	.75	.37	.89	00	.45	.13	6.09
1933	.06	.90	.36	.71	.38	.79	.29	.32	1.14	.31	.11	.35	5.72
1932	.90	.39	1.13	.85	.25	.43	1.65	1.29	.34	.03	00	.33	7.59
1931	.43	.24	.05	.14	.08	.89	.23	1.07	1.03	00	00	.45	4.61
1930	.51	.02	2.79	2.62	.48	.59	.64	.35	.14	00	.53	1.32	9.99
1929	.21	.45	.76	.35	.24	.31	.92	.03	.81	00	00	.01	4.09
1928	.64	.62	.78	1.24	.52	1.49	.60	.19	1.55	.43	.09	.13	8.28
1927	.70	3.25	1.36	.79	1.89	1.55	.94	.45	.55	.18	.49	.75	12.90
1926	.53	.58	.54	.48	1.00	.05	.71	.24	.06	.34	.07	.04	4.64
1925	1.54	1.54	1.37	.57	.82	.31	1.60	2.33	.91	.45	.12	.83	12.39
1924	.70	.07	1.47	.65	.41	.24	.08	.07	.24	.14	.34	.58	4.99
1923	1.11	1.41	1.55	1.21	.77	.10	1.07	.98	.83	.98	.24	.50	10.75
1922	.18	1.40	1.66	.46	2.17	.57	.38	.86	1.16	.06	.71	.02	9.63
1921	.47	.87	.80	1.17	1.60	.69	.30	1.92	.40	.12	00	.54	8.88
1920	.32	.45	1.95	.12	.45	1.07	.86	00	.51	.68	.37	.30	7.08
1919	1.16	.70	.23	.42	1.33	.16	.45	00	.82	.09	00	.57	5.93
1918	00	.39	.65	.69	.81	.43	.08	.14	.02	.28	.65	1.74	5.88
**1917	.05	.41	.81	.11	1.38	.24	.23	.50	.05	.06	00	.40	4.24
1916	.28	.97	.43	1.56	.36	.40	.92	1.47	1.33	.39	.36	00	8.47
1915	1.10	.11	.20	.21	1.20	1.34	.60	1.03	.11	1.20	00	.15	7.25

**Data between double lines are actual observations at Cliff.

Appendix I (Cont.)

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
1914	.31	1.40	.85	1.01	.68	.04	1.73	1.53	2.58	.13	00	1.41	11.67
1913	.26	.96	.44	.67	.13	.26	.70	.85	3.61	1.17	.65	.36	10.06
1912	.51	.41	.54	1.34	.89	.39	1.39	2.12	1.21	.59	.98	.58	10.95
1911	.33	2.93	.86	.68	.13	.06	.37	.64	1.78	.42	.18	1.31	9.69
1910	.74	2.50	1.01	.37	.97	.43	.34	.70	.63	.66	00	.90	9.25
1909	1.41	.10	.28	2.34	.58	.60	.07	.09	.67	.60	00	.89	7.63
1908	.15	.28	2.39	.92	.14	.45	.56	.72	.92	.33	.12	.78	7.76
Grand Mean	.65	.92	1.28	1.13	.85	.61	.60	.82	.77	.36	.24	.47	8.74
1908-16 Mean	.52	1.07	.73	1.01	.56	.44	.74	1.02	1.43	.61	.25	.71	9.62

Appendix 2

MONTHLY CLIMATOLOGICAL DATA FOR CLIFF
1908-1915 Calendar Years
(After Whistler 159)

	Temperature-Degree Fahrenheit						Precipitation-Inches			
Year	Mean for Month	Max.	Date	Min.	Date	Greatest Daily Range	Total for Month	Greatest in 24 hours	Total un-melted Snow	.01 or more no. of days
					JANUARY					
1908	26.2	52	11	-18	21	38	0.92	.30	7.0	4
1909	29.4	49	16	-20	12	37	2.34	.50	16.5	13
1910	23.6	52	23	-20	3	47	0.37	.10	5.0	9
1911	25.8	67	6	-11	23	53	0.68	.16	8.5	9
1912	29.6	48	14,31	-20	3	55	1.34	.36	5.0	19
1913	22.6	47	29,30,31	-21	6	47	0.67	.15	13.0	9
1914	36.6	67	6	6	19	39	1.01	.20	15.5	12
1915	25.2	59	30	-14	22	49	.21	.10	5.5	4
Mean	27.3	55.1	--	-13.5	--	--	.94	--	9.5	9.9
					FEBRUARY					
1908	30.8	60	26	0	3	38	0.14	.05	2.0	4
1909	32.0	52	2,16	- 4	8	39	0.58	0.24	5.0	7
1910	29.0	50	28	-14	3	42	0.97	0.20	4.0	10
1911	19.9	41	9	-11	15	47	0.13	0.06	3.1	4
1912	33.7	48	7,9,13, 26,27	5	25	37	0.89	0.18	T	10
1913	28.4	57	16	7	28	47	0.13	0.10	3.0	2
1914	36.3	68	28	0	3	49	0.68	0.12	1.0	10
1915	34.0	68	5	8	14	42	1.20	0.38	9.0	7
Mean	30.5	55.0		- 1.1			.59		3.4	6.8

Appendix 2 (Cont.)

Year	Temperature-Degree Fahrenheit						Precipitation-Inches			
	Mean for Month	Max.	Date	Min.	Date	Greatest Daily Range	Total for Month	Greatest in 24 Hours	Total Unmelted Snow	.01 or more no. of days
						MARCH				
1908	35.0	61	15,24	-3	4	40	0.45	0.22	4.0	5
1909	36.2	65	16	7	18	42	0.60	0.20	1.0	8
1910	47.0	66	13	14	29	44	0.43	0.32	0.0	5
1911	38.4	78	31	-7	1	56	0.06	0.04	0.0	2
1912	32.1	64	31	5	2,21	56	0.39	0.08	1.0	0
1913	34.0	63	9	-3	14	43	0.26	0.06	0.5	7
1914	45.2	84	17	4	26	66	0.04	0.02	0.5	2
1915	38.0	72	22	15	24,25	55	1.34	0.38	4.5	6
Mean	37.6	69		4			.45		1.4	5.4
						APRIL				
1908	42.8	77	11	9	4	57	0.56	0.27	0.0	5
1909	38.4	70	25	6	18	60	0.07	0.06	T	2
1910	46.6	85	23	11	14	53	0.34	0.22	0.0	4
1911	39.2	76	24	10	11,13,14	51	0.37	0.18	1.0	5
1912	38.5	71	9	11	5,13	54	1.39	0.31	4.0	11
1913	40.2	75	25	10	23	50	0.70	0.22	3.5	6
1914	48.8	84	18	17	17	61	1.73	0.44	0.5	12
1915	42.8	80	28	13	15	58	0.60	0.25	0.0	5
Mean	42.1	77.2		10.9			0.72			6.2

Appendix 2 (Cont.)

Year	Temperature-Degree Fahrenheit: Mean for Month	Max.	Date	Min.	Date	Greatest Daily Range	Precipitation-Inches: Total for Month	Greatest in 24 Hours	Total Unmelted Snow	.01 or more no. of days
					MAY					
1908	42.2	75	5	8	13	56	0.72	0.34	0.0	5
1909	43.4	85	31	9	12	57	0.09	0.03	0.0	4
1910	51.2	93	31	20	19	61	0.70	0.32	--	7
1911	43.8	76	30	13	25	53	0.64	0.23	0.0	7
1912	47.0	78	14	16	23	49	2.12	0.45	0.0	12
1913	48.9	85	26	10	1	53	0.85	0.58	0.0	3
1914	54.6	98	30	9	4	64	1.53	0.33	0.0	9
1915	45.4	77	7	18	2,5	52	1.03	0.26	0.0	10
Mean	47.0	83.7		12.9			0.96			7.1
					JUNE					
1908	50.8	87	24	21	2	56	0.92	0.39	T	4
1909	53.8	89	1	20	8	54	0.67	0.33	0.0	6
1910	54.4	90	25,26	19	21	57	0.63	0.40	0.0	3
1911	55.1	89	11	15	4	53	1.78	1.13	0.0	7
1912	55.4	89	5	23	15	51	1.21	0.54	0.0	4
1913	54.2	84	1	23	20	50	3.61	0.84	0.0	11
1914	55.0	93	15	14	5	57	2.58	1.58	0.5	8
1915	50.6	86	30	19	19	54	0.11	0.06	0.0	2
Mean	53.7						1.44			5.6

Appendix 2 (Cont.)

Year	Temperature-Degree Fahrenheit Mean for Month	Max.	Date	Min.	Date	Greatest Daily Range	Precipitation-Inches Total for Month	Greatest in 24 Hours	Total Unmelted Snow	.01 or more no. of days
						JULY				
1908	63.6	101	30	28	6	64	0.33	0.18	0.0	3
1909	57.2	93	2	20	18	56	0.60	0.35	0.0	5
1910	63.8	97	13	30	5	55	0.66	0.37	0.0	3
1911	63.0	97	15	25	8	55	0.42	0.17	0.0	3
1912	58.5	94	16,17	28	3	57	0.59	0.33	0.0	4
1913	59.8	91	18	25	13	52	1.17	0.72	0.0	4
1914	60.6	93	18	23	21	55	0.13	0.08	0.0	2
1915	57.3	97	23	19	17	62	1.20	0.56	0.0	5
Mean	60.5						.64			3.7
						AUGUST				
1908	58.5	98	8	15	30	63	0.12	0.12	0.0	1
1909	57.8	96	19	18	27	65	0.0	0.0	0.0	0
1910	56.1	91	19,25	18	29	66	0.0	0.0	0.0	0
1911	57.0	90	30	24	20	58	0.18	0.15	0.0	2
1912	57.0	92	23	23	30	55	0.98	0.30	0.0	8
1913	61.5	94	24	20	18	61	0.65	0.16	0.0	6
1914	59.4	95	1,2	20	17	59	0.0	0.0	0.0	0
1915	65.0	100	29	35	31	60	T	T	0.0	0
Mean	61.3						0.09			

Appendix 2 (Cont.)

	Temperature-Degree Fahrenheit						Precipitation-Inches			
Year	Mean for Month	Max.	Date	Min.	Date	Greatest Daily Range	Total for Month	Greatest in 24 Hours	Total Unmelted Snow	.01 or more no. of days
					SEPTEMBER					
1907	50.6	92	24	17	13	69	0.39	0.39	0.0	1
1908	52.4	90	4	9	25	61	0.78	0.40	0.0	2
1909	50.8	86	16	15	22	59	0.89	0.37	0.0	7
1910	49.8	82	5	14	7,11	61	0.90	0.37	0.0	6
1911	47.8	84	1	13	18	58	1.31	0.35	0.0	8
1912	48.0	82	18	14	24	59	0.58	0.24	0.0	5
1913	51.0	89	7	13	23	61	0.36	0.36	0.0	1
1914	48.9	82	2,10	14	12,13	67	1.41	0.39	0.0	10
1915	48.8	87	18	15	28,29	61	0.15	0.15	0.0	1
Mean	53.8						0.68			3.1
					OCTOBER					
1907	49.0	81	5	14	2	58	0.15	0.13	0.0	2
1908	42.2	81	8	16	4,21,22	56	1.41	0.85	T	5
1909	44.2	81	10	12	27	56	0.74	0.21	0.0	9
1910	44.8	81	8	10	27	58	0.33	0.25	0.0	3
1911	41.4	79	7	6	27	53	0.51	0.24	0.0	4
1912	38.2	72	3,13,14	6	21	62	0.26	0.12	0.0	3
1913	--	--	--	8	4,25	--	0.31	0.16	0.0	2
1914	43.1	78	13	17	22,25	50	1.10	0.30	0.0	7
Mean	43.3	--	--	--	--	--	0.60			4.4

Appendix 2 (Cont.)

Year	Temperature-Degree Fahrenheit Mean for Month	Max.	Date	Min.	Date	Greatest Daily Range	Precipitation-Inches Total for Month	Greatest in 24 Hours	Total Un-melted Snow	.01 or more no. of days
						NOVEMBER				
1907	34.7	66	8	5	3	56	0.28	0.09	T	5
1908	35.9	70	6	2	24	55	0.10	0.08	--	2
1909	40.4	66	3	-12	15	44	2.50	0.57	4.5	16
1910	34.6	68	1	-11	26	53	2.93	0.49	9.5	73
1911	33.2	65	3	-11	11	52	0.41	0.33	0.5	3
1912	36.4	57	12,27	5	24,29	49	0.96	0.30	0.0	6
1913	39.5	68	7	11	3,21	47	1.40	0.35	2.0	10
1914	33.0	61	4,8	- 1	21	56	0.11	0.11	T	1
Mean	36.0						1.09		2.1	7.0
						DECEMBER				
1907	31.4	59	3	- 1	16	45	2.39	1.10	8.0	7
1908	25.1	47	25	-20	18	50	0.28	0.11	3.0	3
1909	21.8	44	8,9,12, 18	-16	6	44	1.01	0.50	15.0	9
1910	30.6	53	1	3	22	38	0.86	0.25	2.0	8
1911	25.4	54	1	- 6	21	51	0.54	0.26	3.0	3
1912	25.8	50	11	- 6	26	51	0.44	0.17	2.0	7
1913	30.2	72	7	- 6	18	60	0.85	0.35	11.0	7
1914	17.4	45	1	-21	18,21	46	0.20	0.10	3.0	3
Mean	26.0						0.82		5.9	5.9

Appendix 3

PRECIPITATION AT ANA RIVER

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.
1915-16	.20	1.08	.52	1.82	.28	.39	.53	.97	.32	.37	.15	.02
1914-15	1.05	.15	.18	.19	.86	.35	.78	.93	.00	2.05	00	.13
1913-14	.13	.51	1.11	1.84	.31	00	.39	.54	1.09	.25	00	.12
1912-13	.23	.48	.79	1.03	.17	.04	.37	.35	2.14	2.33	.96	.23
1911-12	.41	.21	.16	.76	.13	.73	.82	1.49	.47	.26	.68	.12
1910-11	.69	2.88	.12	1.37	.34	.10	.55	.52	.54	.23	00	1.36
1909-10	.47	2.99	.72	.37	1.14	.12	.21	.46	.44	.12	00	.64
1909-09	1.04	.13	.22	2.60	.78	.76	.09	.16	.70	.46	00	.65
Mean	.42	1.38	.61	1.15	.59	.29	.45	.68	.84	.76	.22	.41

Appendix 4

PRECIPITATION AT THE POPLARS

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Mean
1959-60	.83	.09	.34	1.87	1.29	1.12	1.22	1.71	.00	.57	.08	.12	7.70
1958-59	.33	.74	.73	.45	.69	.51	.37	.96	.39	.10	1.44	.41	5.93
1957-58	.92	.82	1.61	2.15	1.45	.59	.68	1.55	3.55	1.09	.19	.47	12.56
1956-57	1.75	.07	.40	.85	1.48	2.05	.39	2.74	.46	.39	.11	1.62	9.96
1955-56	.33	1.67	3.42	2.74	1.67	.20	.86	2.06	.74	2.82	.17	.35	14.19
1954-55	.28	.64	.59	.58	.17	.50	.70	.39	.47	.48	.00	.77	4.64
1953-54	.50	3.97	1.08	1.86	.85	.61	.89	.72	1.34	00	.81	.66	11.08
1952-53	.13	.39	2.26	2.93	.70	.52	.32	2.21	2.97	00	1.50	.48	12.01
1951-52	1.24	1.00	2.38	.51	1.07	.89	.35	1.14	2.37	.12	00	.38	12.10
1950-51	3.03	1.05	2.48	1.65	1.20	.42	.17	1.65	.01	.35	.14	.15	10.25
1949-50	.21	.47	.39	2.52	.20	.76	.40	.48	4.32	00	.10	.07	8.27
1948-49	.22	1.50	1.34	.25	.62	.89	.12	1.97	.05	.04	.05	.09	5.95
1947-48	.94	.53	.77	1.56	.66	1.40	.56	1.56	2.25	.86	.47	.85	10.34
1946-47	.88	1.30	.14	.28	.26	.77	.30	1.47	1.43	.36	.41	.22	7.35
1945-46	.79	1.21	1.59	1.10	.36	1.39	.19	1.26	.75	.63	.98	.25	8.75
1944-45	1.56	1.04	.97	.59	.54	.26	.22	2.27	.20	.62	.04	.23	7.12
1943-44	1.19	.55	.51	.46	.82	.21	.44	.88	3.05	1.32	.03	.26	8.10
1942-43	.13	2.18	1.69	1.79	.30	.30	1.42	.91	.79	.38	.13	00	8.35
1941-42	1.50	1.82	2.02	1.25	.90	.10	.49	1.53	.60	.07	.03	.26	8.81
1940-41	.94	1.02	1.38	1.09	.63	.67	.42	1.37	1.44	.43	.22	.25	8.22
Mean	.88	1.10	1.32	1.32	.79	.71	.53	1.38	1.36	.53	.35	.39	

Appendix 5

MONTHLY OCCURRENCE OF PRECIPITATION

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
ANA RIVER (1909-1917)												
Mean	1.15	.59	.29	.45	.68	.84	.76	.22	.41	.42	1.38	.61
Maximum	2.60	1.26	.76	.82	1.49	2.14	2.33	.96	1.36	1.05	2.99	1.25
Minimum	.19	.13	T	.09	.16	.00	.12	.00	.02	.13	.15	.12
CLIFF (1907-1916)												
Mean	1.01	.56	.44	.74	1.02	1.43	.61	.25	.68	.57	1.07	.78
Maximum	2.34	1.20	1.34	1.73	2.12	3.61	1.20	.98	1.41	1.41	2.93	2.39
Minimum	.21	.13	.04	.07	.09	.11	.13	.00	T	.28	.10	.20
FREMONT (1909-1960)												
Mean	1.00	.98	.43	.58	.75	.86	.62	.37	.66	.48	1.11	1.01
Maximum	3.86	2.51	2.12	1.83	3.62	3.23	2.46	2.03	2.04	3.52	3.59	4.80
Minimum	.12	.07	.05	.08	00	.03	00	00	00	00	00	.05
LAKE (1926-1931)(1909-1916)												
Mean	.70	.59	.46	.78	.92	.97	.66	.22	.45	.37	.73	.65
Maximum	1.31	2.08	.88	1.16	1.87	3.35	1.60	.72	1.21	.84	2.32	1.66
Minimum	.08	.02	.00	.41	.10	.03	.00	.00	.00	.04	.00	.20
SILVER LAKE (1896-1924)												
Mean	1.10	1.40	.56	.70	.92	.76	.58	.32	.59	.55	.92	1.10
Maximum	3.50	4.25	3.23	2.27	2.52	2.65	5.20	1.45	1.61	2.09	3.28	2.43
Minimum	00	00	.10	.09	00	00	00	00	.05	.04	.12	.07

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
THE POPLARS (1946-1960)												
Mean	1.32	.79	.71	.53	1.38	1.36	.53	.35	.39	.88	1.10	1.32
Maximum	2.93	1.67	2.05	1.42	2.74	3.55	2.82	1.50	1.62	3.03	3.97	3.42
Minimum	.25	.17	.10	.12	.39	00	00	00	00	.21	.07	.39

Appendix 6

QUANTITY OF PRECIPITATION BY MONTHS

		ANA RIVER - 1909-1917					CLIFF - 1907-1916				
		Apr.	May	June	July	Aug.	Apr.	May	June	July	Aug.
No. of Years in which Monthly exceeded	.60	2	3	3	2	2	5	5	8	4	2
	1.00	1	1	2	2	0	2	4	5	2	0
	2.00	0	0	1	2	0	0	1	2	0	0
	3.00	0	0	0	0	0	0	0	1	0	0

Appendix 7

FROST DATA
(26^{o}F and Below; After Whistler & Lewis C.)

Year	APRIL First Date 26° or Below	APRIL Last Date 26° or Below	APRIL No. Days with 26° or Below	MAY First Date 26° or Below	MAY Last Date 26° or Below	MAY No. Days with 26° or Below	JUNE First Date 26° or Below	JUNE Last Date 26° or Below	JUNE No. Days with 26° or Below
1907	--	--	--	--	--	--	--	--	--
1908	1	29	17	3	30	17	1	28	8
1909	1	30	24	1	29	20	5	23	6
1901	3	29	12	1	21	9	2	21	8
1911	1	30	21	6	30	17	2	5	3
1912	1	27	20	2	30	9	15	21	3
1913	2	30	19	1	19	10	20	20	1
1914	6	30	10	1	28	8	5	22	4
1915	4	30	18	1	29	12	8	26	7
Mean			18			12.8			5.0

Appendix 7 (Cont.)

Year	JULY First Date 26° or Below	JULY Last Date 26° or Below	JULY No. Days with 26° or Below	AUGUST First Date 26° or Below	AUGUST Last Date 26° or Below	AUGUST No. Days with 26° or Below	SEPTEMBER First Date 26° or Below	SEPTEMBER Last Date 26° or Below	SEPTEMBER No. Days with 26° or Below
1907	--	--	--	19	31	4	2	30	14
1908	--	--	0	11	31	3	7	29	11
1909	7	18	2	2	29	6	1	30	12
1910	--	--	0	15	30	7	11	30	9
1911	8	8	1	20	20	1	1	29	14
1912	--	--	-	30	30	1	11	29	13
1913	--	--	0	18	19	2	1	29	15
1914	21	21	1	17	31	2	1	30	13
1915	14	17	2	0	0	0	5	30	14
Mean			0.75			3.44			13.7

Appendix 8

COMMON AND SCIENTIFIC NAMES OF SPECIES IN LOST FOREST AREA (132)

Scientific Name	Common Name
Trees	
Juniperus occidentalis Nutt.	Western juniper
Pinus ponderosa Dougl.	Western yellow pine
Shrubs	
Artemisia tridentata var. *arbuscula* (Nutt.)	Sagebrush
Artemisia tridentata Nutt.	Sagebrush
Artemisia cana Pursh.	Hoary sagebrush
Atriplex argentea Nutt.	Silverscale
Atriplex canescens (Pursh.) Nutt.	Wingscale
Atriplex nuttalii Wats.	Shadescale
Cercocarpus ledifolius Nutt.	Mountain mahogany
Chrysothamnus viscidiflorus (Hook.) Nutt.	Sticky-flowered rabbit brush
Chrysothamnus nauseosus (Pall.) Britt.	Rabbit brush
Eurotia lanata (Pursh.) Mod.	Winterfat
Gilia leptomeria	Gray naked-stemmed gilia
Grayia spinosa (Hook.) Mod.	Hopsage
Leptodactylon pungens (Torr.) Nutt.	Granite gilia

Appendix 8 (Cont.)

Scientific Name	Common Name
Shrubs (Cont.)	
Phlox diffusa Benth. var.	Spreading phlox
Purshia tridentata (Pursh.) D.C.	Antelope or bitter-brush
Ribes cereum Dougl.	Squaw currant
Sarcobatus vermiculatus (Hook.) Torr.	Greasewood
Tetradymia canescens D.C.	Gray tetradymia
Tetradymia glabrata Gray	Smooth tetradymia
Grasses & Forbs	
Achillea lanulosa Nutt.	Western yarrow
Agropyron cristatum (L.) Gaertn.	
Agropyron dasystachyum (Hook.) Scribn.	Downy wheat grass
Agropyron spicatum (Pursh.) Scribn. & Sm.	Wheat bunch grass
Antennaria rosea Greene	Rosy everlasting
Aster canescens Pursh.	Hoary aster
Calamagrostis rubescens Buckl.	Pine grass
Calochortus macrocarpus Dougl.	Green-banded mariposa lily
Carex rossii Bott.	Ross's sedge
Castilleja pilosa (Wats.) Rydb.	Hairy paint-brush

Appendix 3 (Cont.)

Scientific Name	Common Name
Grasses & Forbs (Cont.)	
Chaenactis douglasii Hook. & Arn.	Hoary chaenactis
Distichlis stricta (Torr.) Rydb.	Desert saltgrass
Elymus condensatus Presl.	Giant ryegrass
Elymus triticoides Buckl.	Alkali ryegrass
Erigeron filifolius (Hook.) Nutt.	Thread-leaved erigeron
Eriophyllum lanatum (Pursh.) Forbes	Common wooly sun-flower
Eriogonum baileyi Wats.	Bailey's eriogonum
Eriogonum ovalifolium Nutt.	Oval-leaved eriogonum
Erysimum (Tourn.) sp.	Wall flower
Festuca idahoensis Elm	Idaho bunch grass
Heliotropium curassivicum L.	Seaside heliotrope
Juncus (Tourn.) sp.	Rush
Koeleria cristata Pers.	Koeler's grass
Linum lewisii Pursh.	Western blue flax
Lupinus (Tourn.) L.	Lupine
Muhlenbergia asperifolia (Nees & Mey.) Paradt.	Scratchgrass
Nama densum Lam.	Matted nama
Oenothera caespitosa Nutt.	Desert evening prim-rose
Oryzopsis hymenoides (R & S) Ricker	Indian mountain-rice

Appendix 8 (Cont.)

Scientific Name	Common Name
Grasses & Forbs (Cont.)	
Penstemon (Mitch.) Ait. sp.	Penstemon
Phacelia linearis (Pursh.) Holz.	Narrow-leaved phacelia
Poa nevadensis Vas.	Nevada bluegrass
Poa secunda Presl.	Sandberg's bluegrass
Psoralea lanceolata Pursh.	Lance-leaved psoralea
Pucinellia nutalliana (Schult.) Hitchc.	Nuttal's alkali grass
Pucinellia lemmoni (Vas.) Scribn.	Lemmon's alkali grass
Salsola kali L. var. *tenuifolia* G.F.W. Mey.	Russian thistle
Scutellaria nana	Gray dwarf skullcap
Senecio canus Hook.	Gray senecio
Sitanion hysterix (Nutt.) J. G. Sm.	Bottle-brush-squirrel-tail
Stephanomeria panicultata Nutt.	Stiff-branched stephanomera
Stipa comata Trin. & Rupr.	Needle-and thread grass
Stipa thurberiana Piper	Thurber's stipa
Townsendia florifer (Hook.)	Showy townsendia
Verbena bracteosa Michx.	Bracted verbena

Appendix 9

SOIL CHEMICAL ANALYSES

Plot or Treatment	Soil pH	P ppm	K me/100g	Ca me/100g	Na me/100g	Mg me/100g	OM%	T.S. mmhos/cm	N%	CEC me/100g	Base Saturation
Occasional Pine Juniper T-1											
Surface	8.0	6.0	1.8	13.0	0.52	4.1	0.69	0.5	0.039	18.9	102.7
7-9"	8.4	4.5	2.64	20.5	1.15	6.9	0.52	0.69	0.032	28.0	111.4
11-14"	8.2	2.7	1.86	19.2	0.87	7.15	0.63	0.6	0.038	23.3	124.8
29-31"	8.4	3.0	1.47	18.2	3.22	7.5	0.32	0.8	0.020	22.6	130.0
44" Caliche	8.0	8.5	1.74	21.5	3.21	14.9	0.44	0.6	0.018	33.4	123.8
Pine-Coarse Loamy Sand T-0											
1-4"	7.7	7.2	0.89	4.7	0.11	3.05	0.55	0.35	0.024	8.8	51.4
7-11"	7.4	10.0	1.44	9.5	0.24	5.8	0.47	0.36	0.021	19.6	86.7
39"	8.3	10.7	1.3	22.8	0.87	10.45	0.30	0.36	0.016	26.3	134.7
Upland Sage T-3											
2-4"	7.6	16.5	3.59	8.9	0.26	5.6	1.76	0.36	0.099	18.0	73.9
8-11"	7.8	18.0	2.74	7.9	0.87	7.0	1.29	0.4	0.073	20.3	60.1
Caliche	8.6	4.5	1.8	24.3	12.37	19.24	1.32	2.2	0.074	37.0	156.0

Appendix 9 (Cont.)

Plot or Treatment	Soil pH	P ppm	K me/100g	Ca me/100g	Na me/100g	Mg me/100g	OM%	T.S. mmhos/cm	N%	CEC me/100g	Base Saturation
Lake Sage T-4											
1-5"	8.0	8.7	4.08	10.3	0.52	5.8	1.32	0.46	0.068	22.7	41.2
5-15"	8.2	3.5	3.43	14.2	1.82	5.6	0.63	0.5	0.035	20.8	120.4
15-22"	8.8	3.5	5.02	14.2	9.94	7.85	0.58	0.92	0.033	27.3	135.6
22-43"	8.8	3.0	6.07	16.0	23.0	12.15	0.25	2.5	0.020	36.7	155.9
4'	8.9	5.2	2.73	16.2	8.03	4.0	0.19	2.1	0.003	12.6	245.7
7'	8.8	3.7	2.09	10.2	3.69	6.0	0.16	2.0	0.003	10.1	217.6
Idaho fescue T-5											
Surface	7.4	7.2	0.89	5.3	0.13	3.35	0.44	0.24	0.029	14.6	80.0
4"	7.1	5.7	1.28	8.6	0.22	5.6	0.74	0.35	0.049	19.5	80.5
10"	7.1	5.7	0.96	8.4	0.33	5.6	0.80	0.4	0.043	19.8	77.2
(Caliche) 15"+	7.4	5.2	1.22	11.6	0.56	6.25	0.66	0.42	0.049	22.4	87.6
Fine Sand T-6											
Surface	7.7	9.7	1.28	6.2	0.13	2.95	0.36	0.25	0.019	11.0	96.0
1'	7.6	4.5	1.1	10.7	0.11	1.8	0.11	0.22	0.005	10.0	137.1
2'	7.6	5.2	1.05	10.0	0.09	1.6	0.08	0.3	0.006	10.3	123.6
3'	7.9	4.0	1.5	13.6	0.15	2.9	0.05	0.28	0.006	16.4	110.7
4'	8.1	5.7	1.44	11.9	0.17	2.9	0.14	0.3	0.007	14.7	116.3
5'	8.2	22.0	1.6	10.5	0.28	3.95	0.16	0.34	0.013	16.1	101.4