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CHAPTER 2

H.J. ANDREWS EXPERIMENTAL FOREST, OREGON

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SITE DESCRIPTION

The H.J. Andrews Experimental Forest is located on the western slope of the Cascade Range about 80 km (50 mi) east of Eugene, Oregon. It includes the entire watershed of Lookout Creek, about 6400 ha (15,800 acres), and ranges in elevation from 410 to 1630 m (1350 to 5340 ft). Slopes are steep and stream drainages are deeply incised. When established in 1948, it was unroaded virgin forest and about two-thirds remain pristine today. Broadly representative of the rugged mountainous landscape of the Pacific Northwest, it contains excellent examples of the region's conifer-dominated forest and stream ecosystems (Fig. 2.1).

Intra-site climatic variation is typical of mountainous terrain. Temperature varies with elevation, aspect, and topographical shading. Temperature inversions are common. Precipitation generally increases with elevation as does the proportion that falls as snow.

Climatic data (Tables 2.1 - 2.3, Figs. 2.3, 2.4), with the exception of precipitation, are taken from the primary meteorological station (Fig. 2.2). This station, established May 1972, is located in a clearing on a Pleistocene alluvial terrace at 426 m. Temperature data for the period from January 1951 through May 1972 have been estimated by regression analysis between data from the primary station and a NOAA reporting site at Leaburg (elev 206 m) 48 km away. Precipitation data are from another Andrews site 0.2 km away. Only 1951 precipitation data had to be estimated. The valley bottom site location and close proximity (less than 3 tree heights distant) of 76 m tall old growth Douglas-fir trees are considerations in data interpretation.

VEGETATION

Old-growth conifer forest with greater than 400 year old dominant trees covers about 45 percent of the H.J. Andrews Forest. Mature conifer stands with dominants 100-130 years old occupy about 25 percent of the Andrews Forest, and about 30 percent has young stands which have grown up following logging during the past 30 years. The lower elevation forest is composed of stands dominated by Douglas-fir *(Pseudotsuga menziesii)*, western hemlock *(Tsuga heterophylla)*, and western red cedar *(Thuja plicata)*. Upper elevation stands consist of mixtures of true firs *(Abies procera, Abies amabilis)* and mountain hemlock *(Tsuga mertensiana)*. As elevation increases, the western hemlock in the lower elevation stands is replaced by silver fir *(Abies amabalis)* and Douglas-fir and western red cedar decline in importance. A number of forest communities are associated with moisture and temperature gradients at different elevations.

SYNOPTIC CLIMATOLOGY

The general climate of the H.J. Andrews Forest is controlled by its close mid-latitude proximity to the Pacific Ocean and by the orientation of the Coast and Cascade mountain ranges perpendicular to the prevailing westerly flow. The Andrews Forest is located near the border between temperate maritime and temperate continental climates as a result of these mountains which present barriers to the passage of air masses. Temperatures are moderated at all times of the year by maritime air, particularly in winter.

Winter precipitation is high. Low pressure areas and associated storms are steered into the area by the polar jet stream. Passage of the usually strongly occluded fronts is slowed by the mountains resulting in long duration but generally low intensity storms. Temperatures associated with these storms are often mild enough that rain falls at lower elevations of the forest while snow falls at higher elevations, usually producing a deep (2 to 4 m), long lasting snowpack above approximately 1050 m. Summertime precipitation is usually low to nonexistent. The North Pacific anticyclone intensifies and bulges to the northeast along the coast, blocking the passage of cyclonic storms and stabilizing the air.

WATER BALANCE

The H.J. Andrews site has one of the most remarkable water balances of all of the LTER sites (Table 2.4, Fig. 2.5). It is notable for its very large winter precipitation which leads to significant soil water surpluses and implied runoff in this season. The runoff is not as large as implied in Table 2.4, however, because some of the precipitation especially at the higher elevations is in the form of snow. It is also noteworthy that a soil water deficit occurs during the summer of most years because of the low rainfall. The actual evapotranspiration value is also not high compared to some of the LTER sites because of the relatively low summer temperatures and the lack of rainfall at this season.

CLIMATIC FACTORS AFFECTING FLORA AND FAUNA

Summer drought, mild, wet winters, a heavy snowpack above 1050 m, and light to nonexistent snowpack below 762 m are factors affecting the flora and fauna. Late summer moisture stress of the forest plays an important part in determining the composition and structure of various forest communities. Snow and lower temperatures at upper elevations play an important role in the formation of a distinctly different forest zone through mechanical force and modification of temperature and moisture regimes. Large animals such as elk and deer are forced to lower elevations by the heavy, upper elevation snowpack, while smaller animals use it for shelter and cover. At lower elevations the mildness and wetness of the winters combined with little snow produces a nearly stress free environment for plants and animals. The mild climate also results in a long growing season.

Fig. 2.1. General view of the H.J. Andrews Experimental Forest.

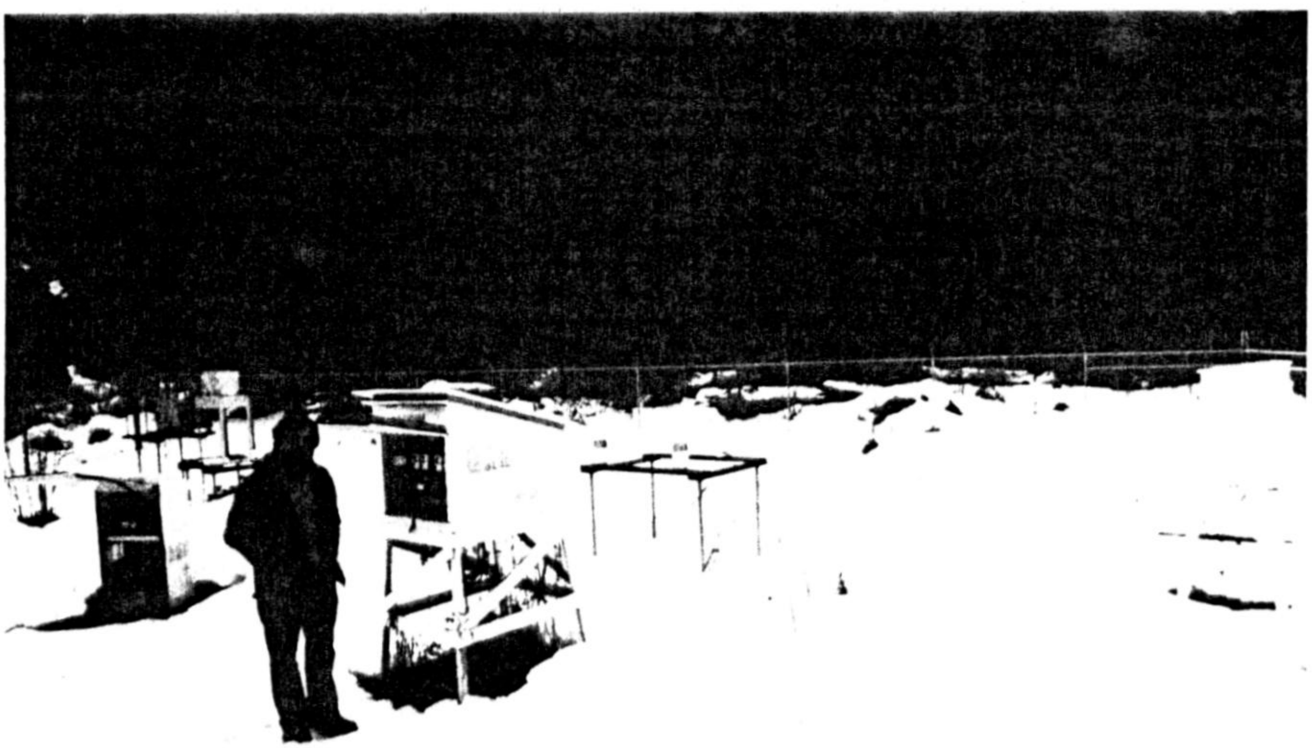

Fig. 2.2. The primary meteorological station.

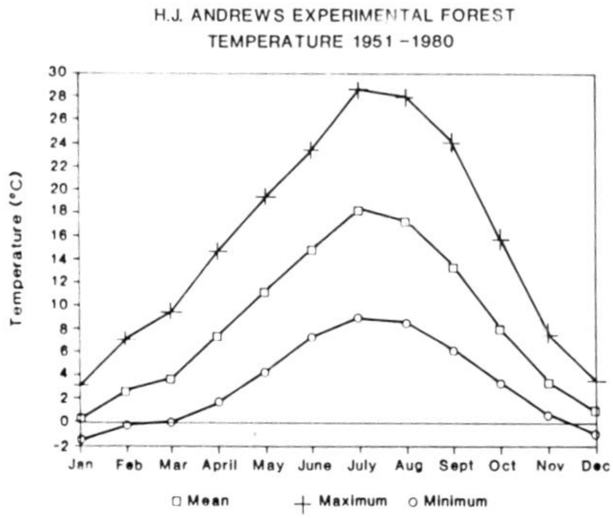

Fig. 2.3. Average annual temperature values at H.J. Andrews Experimental Forest.

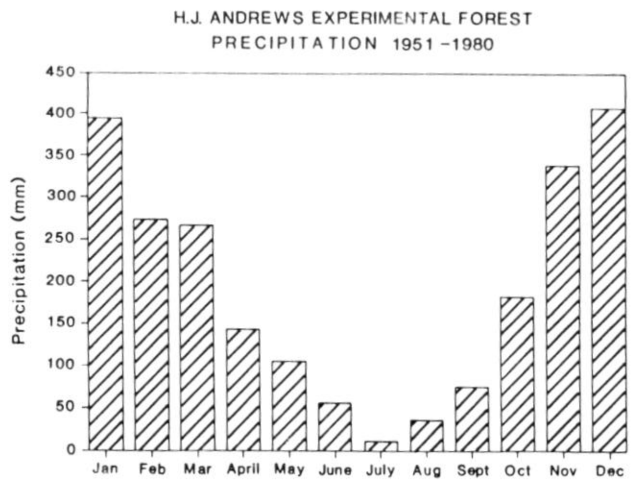

Fig. 2.4. Average annual precipitation totals at H.J. Andrews Experimental Forest.

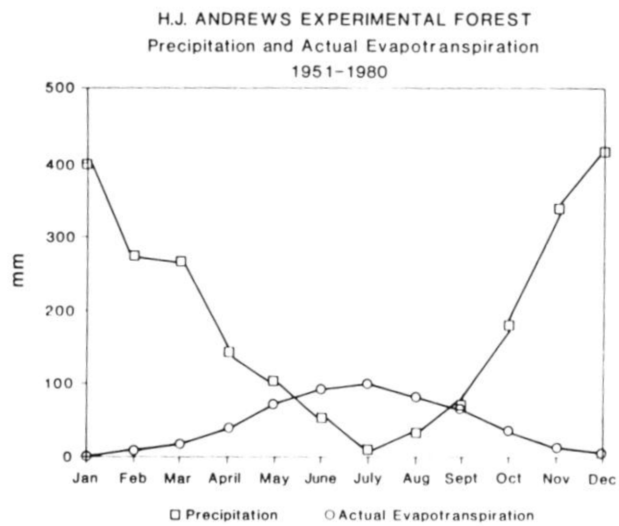

Fig. 2.5. Monthly water budget values at H.J. Andrews Experimental Forest.

Table 2.1

SUMMARY STATISTICS H.J. ANDREWS EXPERIMENTAL FOREST

TEMPERATURE
Deg. C.

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mon Mean	0.30	2.70	3.80	7.40	11.30	14.90	18.30	17.40	13.50	8.10	3.50	1.10
An Mean	8.60	St Dev	0.70									
Mean Mx T	3.20	7.00	9.40	14.60	19.30	23.30	28.70	28.00	24.10	15.80	7.50	3.60
Mean Mi T	-1.50	-0.20	0.10	1.70	4.40	7.30	9.00	8.60	6.30	3.40	0.70	-0.90

Mean Temp Warmest Month	18.60	St Dev	1.10
Mean Temp Coldest Month	-0.40	St Dev	1.50
Annual Range of Monthly Mean Temps		18.00	
Num months with mean temp >0		12	
Num months with mean temp >15		2	
Highest monthly mean		20.80	
Lowest monthly mean		-3.10	

PRECIPITATION
mm

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mon mean	394.6	273.5	266.4	143.5	105.8	56.1	11.6	36.2	74.9	181.8	338.3	407.3

Mean annual total	2289.2
Wettest year in period	3055
Driest year in period	1503

Monthly totals during wettest year in period — Year 1953

Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
783	420	253	143	177	79	0	78	42	87	506	488

Monthly totals during driest year in period — Year 1952

Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
282	209	273	73	45	68	2	4	35	8	72	422

Total precip in months with temp >0 2290

Table 2.2

ADDITIONAL SUMMARY STATISTICS H.J. ANDREWS EXPERIMENTAL FOREST

These statistics were extracted from data from the Andrews primary meteorological station which has existed since May 1972.

AIR TEMPERATURE
Deg. C.

Mean annual heating degree days	5585	
Overall maximum	44.4	(1981)
Mean max warmest month	29.2	
Mean min coolest month	-2.65	
Mean frost free period length	134 days	

VAPOR PRESSURE (mb)
(Calculated by Teten's equa (see Greenland, 1986))

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mon Mean	6.40	6.90	7.70	8.20	9.80	11.90	13.80	13.30	11.30	9.30	7.40	6.40
An Mean	9.40											

WIND VELOCITY (m/sec)

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mon Mean	0.31	0.32	0.37	0.57	0.71	0.76	0.85	0.79	0.48	0.27	0.26	0.25
An Mean	0.53											

No peak gust data. Wind direction not measured.

GLOBAL RADIATION (J/sq.cm)

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
Mon Mean	338.20	513.20	955.20	1420.30	1755.60	2084.60	2238.30	1910.90	1412.40	864.40	406.50	252.00
An Mean	1176.3											

FIELD CAPACITY OF ROOTING ZONE (mm) : 495. Rooting zone 0 to 1.22 m.

Table 2.3

NOTES ON ESTABLISHMENT OF THE 30 YEAR TEMPERATURE AND PRECIPITATION DATA SET FOR THE H.J. ANDREWS EXPERIMENTAL FOREST

The temperature data set started June 1972 and earlier data were estimated by regression analysis. A NWS site at Leaburg, 48 km away, was used for the independent variables. The precipitation data set is more complete with only data for one year being estimated. Below is a list of correlation coefficients for values between the sites. The values of some coefficients lack strength. Standard errors are usually less than 0.2 deg. C.

	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec
TEMPERATURE												
Mean												
Corr Coef	0.77	0.72	0.89	0.77	0.75	0.61	0.62	0.82	0.66	0.43	0.77	0.81
St. Error	0.18	0.24	0.15	0.26	0.21	0.21	0.22	0.19	0.18	0.24	0.19	0.15
Mean maximum												
Corr Coef	0.67	0.72	0.92	0.87	0.87	0.64	0.74	0.79	0.93	0.94	0.79	0.75
St. Error	0.22	0.25	0.15	0.17	0.15	0.23	0.15	0.20	0.10	0.18	0.18	0.17
Mean minimum												
Corr Coef	0.87	0.59	0.72	0.63	0.54	0.29	0.39	0.72	0.46	0.64	0.81	0.86
St. Error	0.12	0.26	0.18	0.27	0.29	0.23	0.46	0.2	0.23	0.24	0.18	0.13
PRECIPITATION												
Corr Coef	0.90	0.92	0.90	0.73	0.85	0.78	0.82	0.91	0.86	0.91	0.91	0.89
St. Error	0.10	0.07	0.10	0.11	0.08	0.08	0.07	0.06	0.09	0.08	0.08	0.10

Table 2.4.

WATER BUDGET FOR H.J. ANDREWS EXPERIMENTAL FOREST

Water budget for Latitude 44.2 N, Longitude 122.2 W
Field capacity 495.0 mm Resistance curve C

MON	TEMP	UPE	APE	PREC	DIFF	ST	DST	AE	DEF	SURP	SMT	SST
Jan	0.3	1	1	395	393	495	0	1	0	393	0	0
Feb	2.7	13	11	274	263	495	0	11	0	263	0	0
Mar	3.8	19	19	266	247	495	0	19	0	247	0	0
Apr	7.4	37	41	144	102	495	0	41	0	102	0	0
May	11.7	58	74	106	31	495	0	74	0	31	0	0
Jun	14.9	75	97	56	-40	456	-39	95	2	0	0	0
Jul	18.3	92	120	12	-109	366	-90	102	18	0	0	0
Aug	17.4	88	105	36	-69	318	-48	84	21	0	0	0
Sep	13.5	68	70	75	5	323	5	70	0	0	0	0
Oct	8.1	40	38	182	144	468	144	38	0	0	0	0
Nov	3.5	17	14	338	325	495	27	14	0	297	0	0
Dec	1.1	5	4	407	403	495	0	4	0	403	0	0
	Yearly Totals:		593	2290				552	41	1738		

Explanation for Water Balance Columns. (All units are millimeters depth of water unless otherwise specified.)

MON	Month of the year
TEMP	Mean monthly air temperature in deg. C.
UPE	Unadjusted potential evapotranspiration
APE	Adjusted potential evapotranspiration
PREC	Precipitation
DIFF	PREC minus APE
ST	Soil moisture storage
DST	Change in storage from preceeding month
AE	Actual evapotranspiration
DEF	Soil moisture deficit
SURP	Soil moisture surplus
SMT	Snowmelt
SST	Water equivalent held in snowpack.