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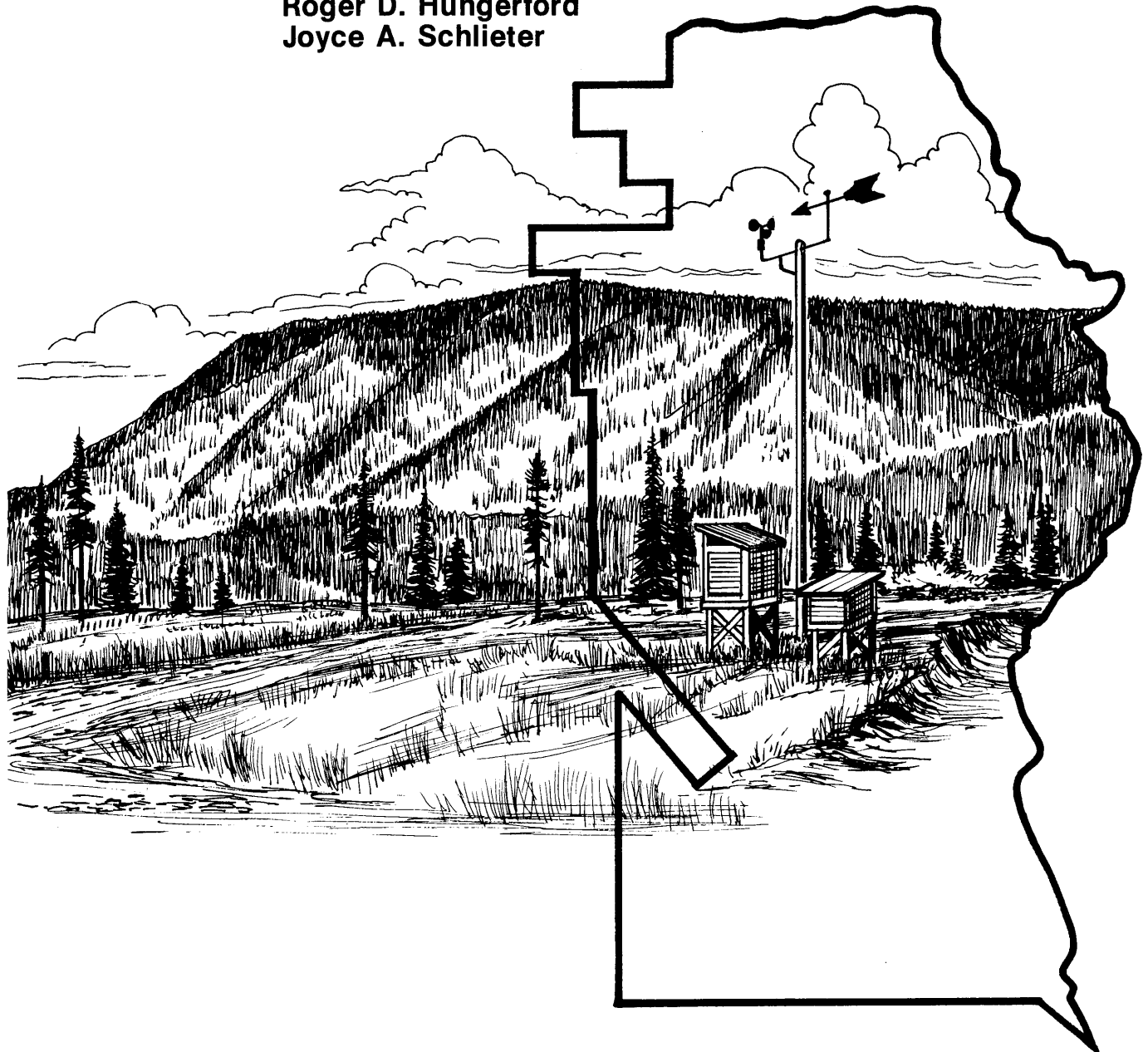
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# Weather Summaries for Coram Experimental Forest, Northwestern Montana —an International Biosphere Reserve

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## ACKNOWLEDGMENTS

This summary report represents contributions of many people in planning, establishing, and maintaining weather stations. Ray Shearer has been instrumental in initial selection and establishment of many of the sites. He has been responsible for seeing that much of the data were collected and stations were maintained properly. Jack Schmidt has been involved with maintaining and supervising maintenance of many stations for the last 12 years. Without the efforts of these people and many technicians, these data would not be available.

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## RESEARCH SUMMARY

The Coram Experimental Forest, 28 miles (45 km) east of Kalispell, Mont., and 5 miles (8 km) south of Glacier National Park, occupies 7,460 acres (3 019 ha) on the Flathead National Forest. It was designated an experimental forest of the western larch/Douglas-fir type in 1933. Research was initiated in the late 1940's, and it became a Biosphere Reserve in 1976. Weather data have been recorded at 18 locations for varying periods of time. The earliest location near the Forest was established at the Coram Ranger Station in 1926. Data are still being obtained at seven locations.

Air temperature, precipitation, and relative humidity data have been collected at most of the stations. The remaining stations were established to measure differences in soil temperature and microsite treatment. Several of the stations were instrumented to record solar and net irradiance, wind, soil heat flux, evaporation, and soil temperature for various depths. The latter data were part of a residue utilization study in the 1970's. Because data were inadequate for analysis, relative humidity, soil heat flux, and evaporation will not be presented.

Mean annual temperatures on the forest range from 36° to 45° F (2° to 7° C), with mean summer temperatures of 55° to 62° F (13° to 17° C). Maximum

temperatures seldom exceed 100° F (38° C). Winter temperatures typically fall below 0° F (-18° C), but rarely lower than -20° F (-29° C). Minimum temperatures are dramatically influenced by topographic features, as illustrated by differences of 60 to 90 frost-free days.

Annual precipitation averages 33 inches (84 cm) at lower elevations and increases to about 40 inches (102 cm) at the highest elevations. Summer precipitation is similar at all locations.

Mean annual soil temperatures at the 20-inch (50.8-cm) depth average from 39° to 43° F (4° to 6° C), with mean summer temperatures from 50° to 53° F (10° to 12° C). Litter surface temperatures on unvegetated clearcuts often reach 140° F (60° C) or more for several hours at a time.

This report brings together weather data summaries for most of the stations within the Forest. Several adjacent long-term stations are also included for comparison. These data provide excellent opportunities for interpreting results of silvicultural and other biological research, particularly in describing climatological variations associated with forest growth and productivity. Topographic features, periods of record, types of data collected, habitat types, and vegetation conditions are included for each weather station.

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## INTRODUCTION

Weather—the daily variations in atmospheric conditions—and climate—long-term atmospheric trends—play an important role in forested environments and attendant biological processes. Weather influences events such as seedling survival, seed crop and dispersal, calf elk survival, and the spread of diseases and insects; climate influences the species of trees present and their growth rates. Local weather and climate are determined by regional air masses, modified by topography. Man's activities—logging, wildfire, and prescribed burning—can affect the microclimate (conditions close to the ground), to the benefit or detriment of forest management.

Weather data on the Coram Experimental Forest have been recorded in conjunction with several short-term studies. In addition, long-term records exist for several stations adjacent to the Forest. The records are valuable for reference, along with other information, in explaining seedling success, stand development, and other forest events. The data also will aid in interpreting results of current and future studies on the Forest and will be useful for ecological modeling. Because results of most studies on the Forest are applicable to other western larch (Type 212) stands, weather records provide a means of extrapolating results to similar sites. Biological consequences and the corresponding environmental conditions can be used in conjunction with weather data on other sites.

Our objective is to present a compendium of weather summary tables for the Coram Experimental Forest and several adjacent weather stations in one document. The United Nations Educational, Scientific and Cultural Organization (UNESCO) has recognized the Forest as a Biosphere Reserve to be managed to show and document the effect of man's activities on the ecosystem serving research and education (Franklin 1977). This report should be useful for interpreting results of silvicultural studies and other research. These data summaries also provide a unique opportunity to examine local weather variations in mountainous terrain. Habitat types are described for each site. Among other things, this will

enable the reader to compare variations of microclimates within a habitat type.

Because many of the weather stations were operated only during the summer months, or because of the relatively short duration of the data-taking period, the weather summaries presented in the appendix do not lend themselves to detailed or long-term climatological studies. Nevertheless, the data are useful for general observations and comparisons within the Forest, several of which are offered in this report.

## CORAM EXPERIMENTAL FOREST General Description

The Coram Experimental Forest (fig. 1) is located off Highway 2 at Martin City, 28 miles (45 km) east of Kalispell, Mont. Glacier National Park is approximately 5 miles (8 km) north of the northern boundary of the Forest. Abbott Creek and its south fork are the major drainages and are oriented in a north-south direction until the main fork reaches gentler terrain and approaches the western boundary of the Forest. Ridges run north-south, with the eastern boundary a major ridge. As a result, aspects are generally east or west. Slopes range from nearly flat at the western edge of the Forest (3,500 feet [1 067 m]) to steep (60 to 70 percent) along upper Abbott Creek and the ridge up to the eastern boundary. The highest point is Desert Mountain at 6,370 feet (1941 m).

Timber stands are primarily even-aged western larch (*Larix occidentalis* Nutt.) and Douglas-fir (*Pseudotsuga menziesii* var. *glauca* [Beissn.] Franco), with two-thirds being mature. The stands are intermediate in productive capacity; mature stands contain 15,000 to 25,000 board feet per acre. Habitat types include *Pseudotsuga menziesii*/*Physocarpus malvaceus*-*Physocarpus malvaceus* phase; *Tsuga heterophylla*/*Clintonia uniflora*-*Aralia nudicaulis* phase; *Abies lasiocarpa*/*Oplopanax horridum*; *Abies lasiocarpa*/*Clintonia uniflora*-*Clintonia uniflora* phase; *Abies lasiocarpa*/*Clintonia uniflora*-*Aralia nudicaulis* phase; *Abies lasiocarpa*/*Clintonia uniflora*-*Xerophyllum tenax* phase; and *Abies lasiocarpa*/

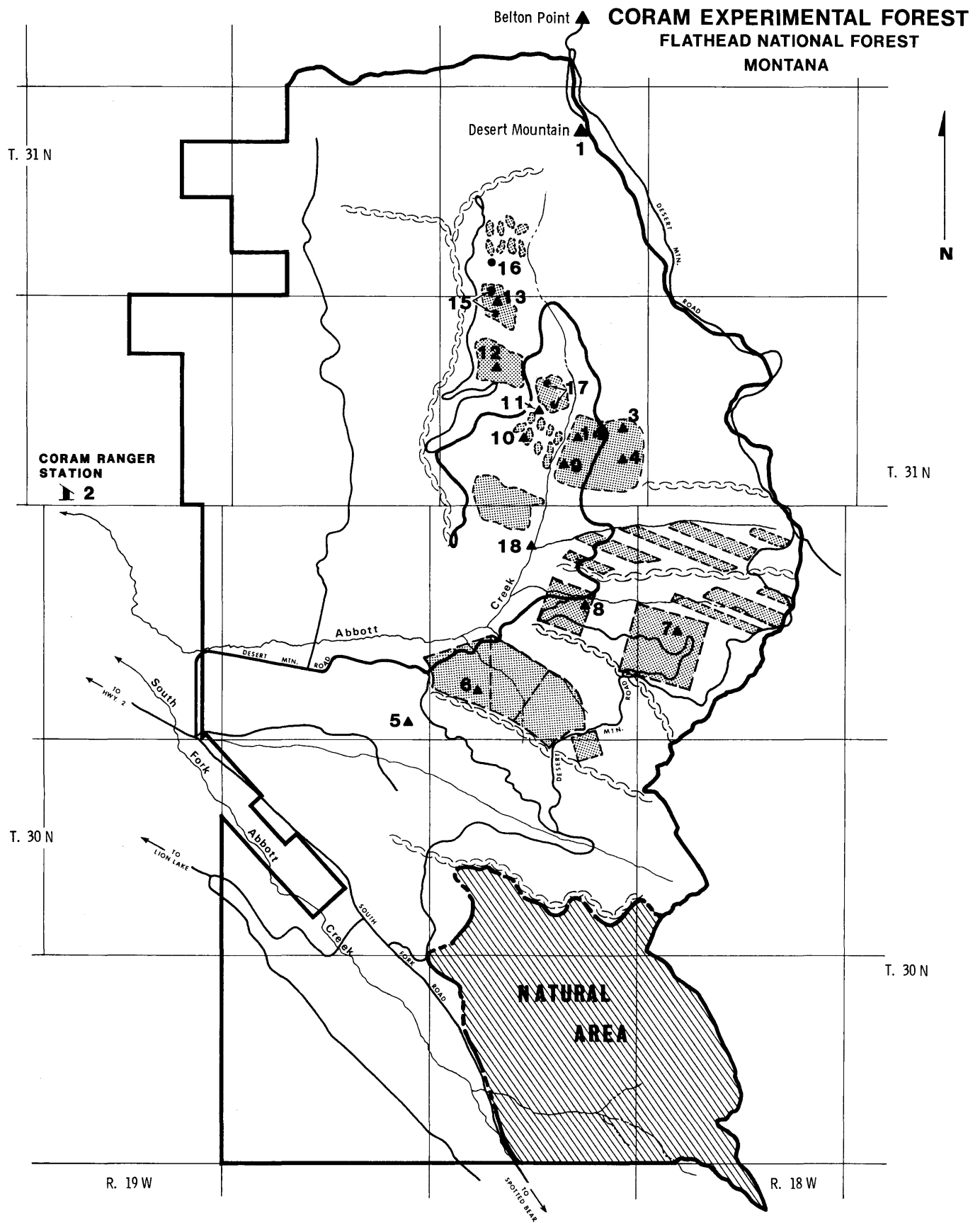


Figure 1.—Coram Experimental Forest, showing locations of climatic sites on the forest and adjacent long-term sites.

*Clintonia uniflora*-*Menziesia ferruginea* phase (Pfister and others 1977).

Soils are typical of those in the Northern Rockies, being derived from argillite and quartzite with glacial outwash and till deposited on the lower areas. Klages and others (1976) described the soils of the Forest.

## Weather Stations

Within the Forest, and at the Coram Ranger Station, 13 of the 18 sites (numbers 1-13, fig. 1) have recorded air temperature, relative humidity, and precipitation. Unfortunately these stations were not all running concurrently, which makes it difficult to compare sites (table 1). Some of these (3-8, fig. 1, and table 1) operated during different silvicultural studies at different times. The others (9-13, fig. 1) were operated during a residue utilization and harvesting study conducted 1974-81. These are termed the residue utilization study sites (also include numbers 14-18).

Soil temperature was measured for varying periods and microsites at stations 10-17. Solar and net irradiance, wind, evaporation, and soil heat flux were measured at 10-13 and solar irradiance at 9. Precipitation was also recorded on a year-round basis at 14. For several years precipitation was measured using rain cans at numerous locations around the residue utilization study sites. These data are not included in this report, but are available on request.

Coram Ranger Station and Desert Mountain Lookout, representing the lowest to highest elevations (fig. 1), provide long-term records for portions of the year. Coram Ranger Station was discontinued in 1957 prior to most research on the Forest; Desert Mountain Lookout was

terminated in 1973. Fire weather data are now measured at the Hungry Horse Ranger Station (3 miles [5 km] west of the Forest) and at Firefighter Mountain (5 miles [8 km] southeast of the Forest) but these data are not presented. A Soil Conservation Service snow measurement site is located about 1½ miles (2 km) east of Desert Mountain and records air temperature, precipitation, and snow depth, but we have not included SCS data in this report.

Long-term climatic data summaries for West Glacier and Hungry Horse Dam are presented. Both of these stations are considered to represent weather in the major valley bottoms. West Glacier is located 5 miles (8 km) north; Hungry Horse Dam, 1 mile (1.6 km) south of the Forest (fig. 1).

Original records, summaries, or computer data bases are available at the Forestry Sciences Laboratory, Missoula, for all the weather stations shown in figure 1.

## Instrumentation

Climatic stations on the Forest using Cotton region shelters were fitted with hygrothermographs for measuring air temperature and relative humidity. In 1978 these instruments at stations 10, 12, and 13 were replaced by thermistor sensors attached to a cassette tape data acquisition system. Calibration procedures for temperature gave us accuracies of ±2° F (1° C). Precipitation has been measured with standard rain gages, weighing gages, or tipping bucket gages. The Hungry Horse Dam and West Glacier stations used maximum and minimum thermometers for measuring air temperature, sling psychrometer readings for relative humidity, and standard rain gages for precipitation. Solar irradiance

Table 1.—Weather station periods of record and type of data collected

	Station	Length	Period	Data
1	Desert Mountain Lookout	1936-73	July-Aug.	T,RH,P,W,C
2	Coram Ranger Station	1934-57	May-Oct.	T,RH,P,W,C
3	Abbott Basin South	1958-64	May-Oct.	T,RH,P
4	Abbott Basin North	1958-60	May-Oct.	T,RH,P
5	Wartime Cuttings	1961-64	May-Oct.	T,RH,P
6	Spacing Study	1968-82	May-Oct.	T,RH,P
7	60-Acre Clearcut	1971-80	May-Oct.	T,RH,P
8	30-Acre Clearcut	1981	May-Oct.	T,RH,P
9	Abbott Creek	1974-77	Jan.-Dec.	T,RH,S
10	Group Selection	1975-81	Jan.-Dec.	T,RH,P,S,NR,W,E,HF,ST
11	Uncut	1974-78	Jan.-Dec.	T,RH,P,S,NR,W,E,HF,ST
12	Shelterwood	1975-81	Jan.-Dec.	T,RH,P,S,NR,W,E,HF,ST
13	Clearcut	1974-81	Jan.-Dec.	T,RH,P,S,NR,W,E,HF,ST
14	Abbott Creek Snow Gage	1974-78	Jan.-Dec.	P
15	Clearcut Soil Temperature	1975-81	Jan.-Dec.	ST
16	Uncut Block 24	1975-77	Jan.-Dec.	ST
17	Clearcut Block 13	1978-81	Jan.-Dec.	ST
18	Flume	1975-82	Jan.-Dec.	H <sub>2</sub> O,WT

T = air temperature  
 RH = relative humidity  
 P = precipitation  
 W = wind  
 C = clouds  
 S = solar irradiance

NR = net irradiance  
 E = evaporation  
 HF = soil heat flux  
 ST = soil temperature  
 H<sub>2</sub>O = water flow  
 WT = water temperature

measurements were made with mechanical pyranographs and LICOR pyranometers. Net irradiance was measured using Funk-type radiometers attached to 30-day chart recorders or the data acquisition system.

Wind run and azimuth (stations 10–13) were measured with a cup anemometer and vane at 10 feet (3 m) above the ground attached to 30-day chart recorders. Wind was measured at 20 feet (6 m) at Coram Ranger Station, Desert Mountain, Hungry Horse Dam, and West Glacier. Soil temperature was measured with mercury sensors attached to 30-day charts or thermistors wired to the data acquisition system. Heat flux was measured using a double-sided thermopile unit attached to a 30-day chart recorder.

We have not included relative humidity summaries in this report because of difficulties calibrating hygrothermographs among climatic stations on the Forest. Data are not consistent enough to provide reliable summaries.

## INDIVIDUAL WEATHER STATION HISTORIES

### Desert Mountain Lookout

This station (1, fig. 1) was in operation from 1936 to 1973, with air temperature and relative humidity data being recorded from the time the lookout was manned, generally in June, to sometime in September when it was closed for the year. As a result, we were able to obtain complete monthly data only for July and August (appendix table 16).<sup>1</sup> Long-term averages cover the entire 38-year period. The station was located approximately 300 feet (91 m) south of the lookout on the crest of the ridge at an elevation of 6,370 feet (1 941 m). The area surrounding the station was open, with the nearest trees 100 feet (30 m) away. Habitat type is *Abies lasiocarpa*/*Clintonia uniflora*-*Xerophyllum tenax* phase.

### Coram Ranger Station

This station (2, fig. 1) measured humidity and precipitation, beginning in 1926, and was maintained through 1957 when the Ranger Station was moved to its current location in Hungry Horse. Air temperature readings were started in 1934. In this report, monthly summaries and long-term averages of temperature and precipitation cover the 24-year period from 1934 to 1957 (appendix tables 14 and 15). This station was usually operated between late April and October. It was located in the open at the Ranger Station headquarters at an elevation of 3,200 feet (975 m). Habitat type for surrounding forested areas is *Abies lasiocarpa*/*Clintonia uniflora*-*Aralia nudicaulis* phase.

### Abbott Basin South

This station (3, fig. 1) was established in 1958 in a 2-year-old 125-acre (50.5-ha) seed tree cutting and maintained from late April to early November each year through 1964. The station was located at the toe of a steep south-facing slope (70 percent) on a 20-percent



Figure 2.—Abbott Basin north station in clearcut as it appeared in 1958.



Figure 3.—Spacing study station in thinned larch stand as it appeared in 1972.

slope. Elevation was approximately 4,250 feet (1 295 m). Air temperature and precipitation were measured and are included in this report (appendix table 11). Relative humidity was recorded, but is not presented. Habitat type at this location is *Abies lasiocarpa*/*Clintonia uniflora*-*Xerophyllum tenax* phase.

### Abbott Basin North

This station (4, fig. 1) was established in 1958 in a 2-year-old 125-acre (50.5-ha) seed tree cutting and maintained from late April to early November each year through 1960. The station was located (fig. 2) at the toe of a steep north-facing slope (60 percent) on a 10-percent slope. Elevation was approximately 4,250 feet (1 295 m). Air temperature, relative humidity, and precipitation were measured, but only air temperature and precipitation are summarized here (appendix table 11). Habitat type at this location is *Abies lasiocarpa*/*Clintonia uniflora*-*Clintonia uniflora* phase.

<sup>1</sup>Data summaries were obtained from Arnold Finklin, meteorologist at the Northern Forest Fire Lab, Missoula, Mont.

## Wartime Cuttings

This station (5, fig. 1) was started in 1961 and used through 1964, being maintained from May through October each year. It was located within a 1,300-acre (526-ha) seed tree cutting completed during World War II. The five seed trees per acre (12 per ha) were removed by 1960. Slope is 5 to 10 percent, with a western aspect on a small ridge at 3,500 feet (1 067 m). Air temperature, relative humidity, and precipitation measurements were taken. Air temperature and precipitation are presented in this report (appendix table 12). Habitat type at this location is *Abies lasiocarpa*/*Clintonia uniflora*-*Xerophyllum tenax* phase.

## Spacing Study

This station (6, fig. 1) was established in 1968 in a 15-year-old thinned larch stand that had an average tree height of 15 feet (4.6 m). Trees were thinned to a 7- by 7-foot (2.1- by 2.1-m) spacing and have been maintained at that spacing. The instruments have been maintained from late April to October each year through the present. The site (fig. 3) is a northwest-facing 20-percent slope at an elevation of 3,900 feet (1 189 m). In 1977, the instruments were moved about 60 feet (18 m) west to a more typical opening. Topographic features for the new location are the same. Air temperature and precipitation are summarized in this report (appendix tables 9 and 10). Relative humidity was recorded but is not presented. Habitat type for this site is *Abies lasiocarpa*/*Clintonia uniflora*-*Aralia nudicaulis* phase.

## 60-Acre Clearcut

This station (7, fig. 1) was established in 1971 and used through 1980, but data for 1979 are not complete. The station was generally maintained from late April through October. The location was in a 60-acre (24-ha) clearcut within a regenerated 18-year-old larch stand which had been thinned to a 12- by 12-foot (3.7- by 3.7-m) spacing at the time of instrumentation. Instruments were located in a broad draw bottom on a north-facing 20-percent slope at 4,150 feet (1 265 m) elevation. Air temperature is given in this report (appendix table 13). Relative humidity and precipitation data were recorded but are not presented. Habitat type for this site is *Abies lasiocarpa*/*Clintonia uniflora*-*Aralia nudicaulis* phase.

## 30-Acre Clearcut

This station (8, fig. 1) was established in 1981 and used only 1 year. The location was a north-facing 20-percent slope in a 28-year-old thinned larch stand at 3,900 feet (1 189 m) elevation. The stand was thinned to a 13- by 13-foot (4.0- by 4.0-m) spacing in 1961. Air temperature, relative humidity, and precipitation measurements were collected from May through October. Only air temperature is summarized here (appendix table 13). Habitat type for this site is *Abies lasiocarpa*/*Clintonia uniflora*-*Aralia nudicaulis* phase.

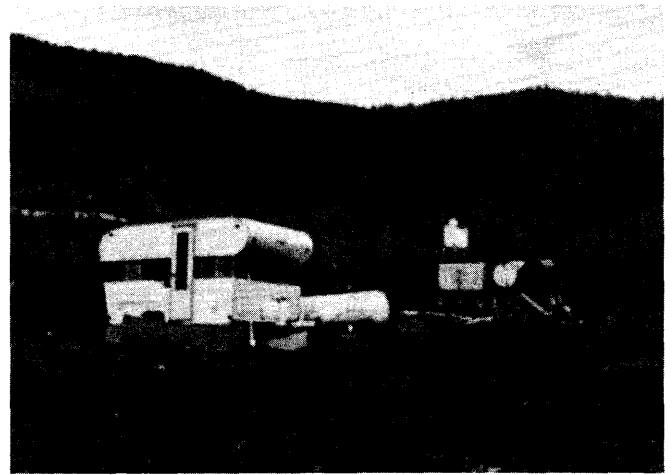


Figure 4.—Abbott Creek station in old clearcut as it appeared in 1974. Abbott Basin south and north stations were located in the background.

## Abbott Creek

This station (9, fig. 1) was established in 1974 in a 16-year-old 125-acre (50.5-ha) group seed tree cutting unit and maintained 12 months of the year until mid-1977. Instruments were located (fig. 4) on a 5-percent west-facing slope at 3,950 feet (1 204 m) elevation on a bench about 20 feet (6 m) above the creek. The area surrounding the station was open, with shrubs 4 to 5 feet (1.2 to 1.5 m) tall and young birch 10 to 15 feet (3.0 to 4.6 m) tall. Air temperature and solar irradiance data are summarized in this report (appendix tables 3-7, 19-20). Relative humidity was recorded but not presented. Habitat type at this location is *Abies lasiocarpa*/*Clintonia uniflora*-*Clintonia uniflora* phase.

## Group Selection

This station (10, fig. 1) was established in 1975 and maintained 12 months of the year through the present, with some lapses due to instrument failures. The site was harvested in 1974 and consists of 2-acre (0.8-ha) cutting units, which appear to be larger because trees between units were killed during burning. Instruments are located (fig. 5) on an east-facing 50-percent slope at an elevation of 4,250 feet (1 295 m) in the middle of a cutting unit 300 vertical feet (91 m) above Abbott Creek. Habitat type at this station is *Abies lasiocarpa*/*Clintonia uniflora*-*Clintonia uniflora* phase. In addition to the usual measurements (air temperature, relative humidity, and precipitation), soil heat flux, wind run and azimuth (at 10 feet [3 m]), solar and net irradiance, evaporation, and soil temperature (1-, 10-, 20-inch [2.5-, 25.4-, 50.8-cm] depths) were recorded. Chart-type recorders were replaced in 1978 by a data acquisition system that records soil and air temperature at hourly intervals and gives integrated readings of precipitation and solar irradiance. Data for soil heat flux, humidity, and evaporation are not presented here. All other summaries are given (appendix tables 3-8, 19-21, 25-29).

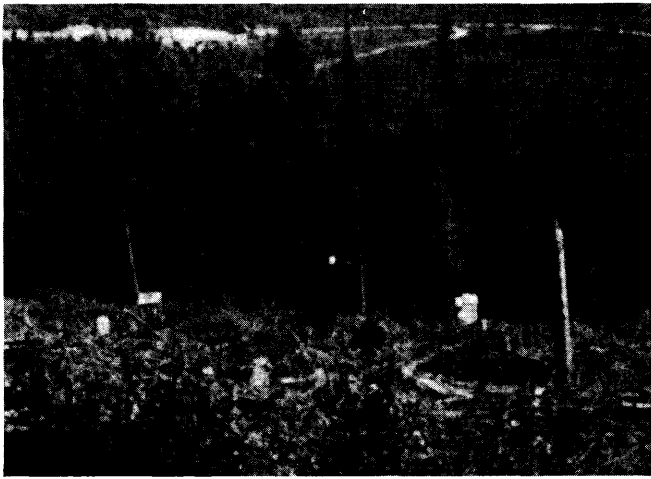


Figure 5.—Group selection station as it appeared in 1975 before broadcast burning. Abbott Basin is visible below.

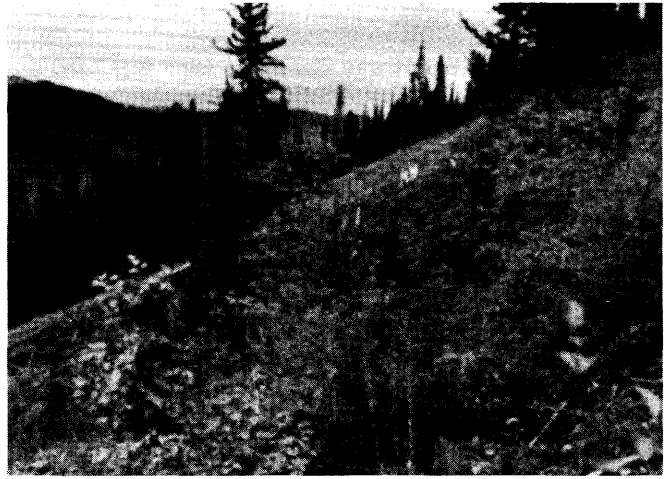


Figure 7.—Clearcut station as it appeared in 1975 before broadcast burning.

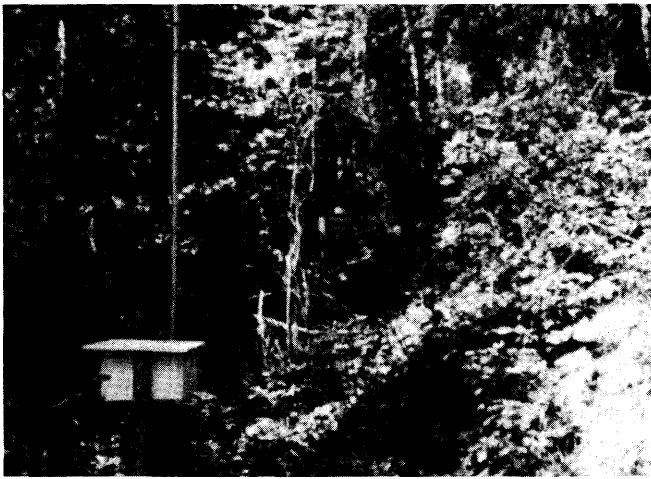


Figure 6.—Uncut station as it appeared in 1975.

## Uncut

This station (11, fig. 1) was established in 1973 and maintained year-round through July 1978. The station was moved (fig. 6) about 660 feet (201 m) in 1974 because cutting on the group selection units altered the site too much. Both sites were located in mature timber stands on 60-percent slopes at an elevation of 4,450 feet (1 356 m), 400 vertical feet (122 m) above Abbott Creek. The first site faced southeast; the second faced east. Data represent conditions under the canopy in an *Abies lasiocarpa/Clintonia uniflora-Clintonia uniflora* habitat type. Solar and net irradiance, soil heat flux, wind run and azimuth, evaporation, and soil temperature (1-, 10-, 20-inch [2.5-, 25.4-, 50.8-cm] depths) were measured, in addition to air temperature, relative humidity, and precipitation. Chart-type recorders were used to collect all data at this station. Data for all except soil heat flux, relative humidity, and evaporation are summarized in this report (appendix tables 3-8, 19-21, 25-29).

## Shelterwood

This station (12, fig. 1) was established in 1975 and maintained 12 months of the year through the present, with some lapses due to equipment failure. The site was harvested in 1974 with 50 percent of the stand volume removed. Residue and remaining understory were burned in 1975 where our station is located. Residual stocking is 65 per acre (161 per ha), with mature larch, 100 to 120 feet (30 to 37 m) tall, near the station. Instruments were located on a 50-percent east-facing slope at 4,900 feet (1 494 m), 800 vertical feet (244 m) above Abbott Creek. Habitat type at this station is *Abies lasiocarpa/Clintonia uniflora-Xerophyllum tenax* phase. In addition to air temperature, relative humidity, and precipitation, the following factors were measured: solar and net irradiance, soil heat flux, wind run and azimuth, evaporation, and soil temperature (1-, 10-, 20-inch [2.5-, 25.4-, 50.8-cm] depths). Chart-type instruments were removed in 1978, with air and soil temperature being added to a data acquisition system. Data for all but soil heat flux, relative humidity, and evaporation are given here (appendix tables 3-8, 19-21, 25-29).

## Clearcut

This station (13, fig. 1) was started in the fall of 1973 before harvesting and has been maintained year-round through the present. Data from October 1973 through July 1974 represent the preharvest condition of a mature stand. Seventeen acres (6.9 ha) were clearcut in October 1974 and a portion was broadcast burned in 1975 where our station is located. Instruments were placed near the center of the clearcut (fig. 7) on an 80-percent east-facing aspect at an elevation of 5,200 feet (1 585 m), 600 vertical feet (183 m) above Abbott Creek. Habitat type at the station is *Abies lasiocarpa/Clintonia uniflora-Xerophyllum tenax* phase. In addition to the usual measurements (air temperature, relative humidity, and precipitation), soil heat flux, wind run and azimuth, solar and net irradiance, evaporation, and soil temperature (1-, 10-, 20-inch [2.5-, 25.4-, 50.8-cm] depths) data

were collected. Chart-type instruments were removed in 1978 and replaced with a data acquisition system recording air and soil temperature at hourly intervals and providing integrated readings of precipitation and solar irradiance. All but soil heat flux, relative humidity, and evaporation are summarized in this report (appendix tables 3-8, 19-21, 25-29).

### Abbott Creek Snow Gage

This site (14, fig. 1), established in January 1974, was equipped with a propane-heated snow gage. This gage was maintained 12 months of the year through 1978 for measuring total precipitation. The site was about 660 feet (201 m) up the creek from the Abbott Creek station. The measuring device of the snow gage was a tipping bucket attached to a long-term chart recorder. These data are summarized along with other precipitation data (appendix table 8).

### Clearcut Soil Temperature

These sites (15, fig. 1) were set up in 1975 to measure soil and residue temperatures on conventionally logged and burned units, and on intensively utilized but unburned units within the clearcut. Microsite temperatures for litter surface, decayed wood, duff-soil interface, as well as the top, center, and under surfaces of residue, were measured periodically through 1977. In 1978, temperatures for litter surface and decayed wood were added to the continuous data acquisition system and have been recorded hourly through the present time. Sensors (thermistors) for both sites within the clearcut were on 60-percent east-facing slopes at 5,250 feet (1 600 m). Habitat type is *Abies lasiocarpa/Clintonia uniflora-Xerophyllum tenax* phase. Litter surface temperatures are summarized in this report (appendix tables 22-24).

### Uncut Block 24

This site (16, fig. 1) was established in an uncut unit in 1975 to serve as a control in the study of soil temperatures in clearcuts. Microsites were similar to site 15, but the habitat type is *Abies lasiocarpa/Clintonia uniflora-Menziesia ferruginea* phase. Data from this site were not added to the continuous data acquisition system, so this site was not used after June 1977. Sensors were located on a 30-percent east-facing slope at 5,400 feet (1 646 m). Litter surface temperatures are presented (appendix tables 22-24).

### Clearcut Block 13

This site (17, fig. 1) was established in 1978 when the continuous data acquisition system was installed. Litter surface temperature and decayed wood temperatures were recorded hourly through the present time for a burned, conventionally utilized unit and an unburned, intensively utilized unit within the 13.6-acre (5.5-ha) clearcut logged in 1974. Both sites are on northeast-facing, 50-percent slopes at 4,250 feet (1 295 m) elevation. Thermistors are used as temperature sensors. Habitat type for the unburned unit is *Abies lasiocarpa/Clintonia*

*uniflora-Aralia nudicaulis* phase, while the burned unit is *Tsuga heterophylla/Clintonia uniflora-Aralia nudicaulis* phase. Litter surface temperatures for this unit are presented (appendix tables 22-24).

### Flume

This site (18, fig. 1) was established in 1975 to monitor streamflow and water temperature on Abbott Creek. An H-flume with a stilling well and a chart recorder measures water level and temperature. Records are maintained currently but are not summarized in this report. Location is such that runoff from all utilization study cutting units empties into Abbott Creek above this flume. Habitat type for this site is *Tsuga heterophylla/Clintonia uniflora-Aralia nudicaulis* phase.

## OBSERVATIONS OF CLIMATE AND TOPOGRAPHIC INFLUENCES

### Air Temperature

Mean annual air temperatures for the Coram Experimental Forest and adjacent locations range from 36° to 45° F (2° to 8° C) (appendix tables 2-3). Long-term average for Hungry Horse Dam is 43.0° F (6.1° C) as compared to 41.8° F (5.4° C) for West Glacier (table 2). The lowest mean annual temperatures (36° to 39° F [2° to 4° C]) were recorded at Abbott Creek for the years 1974-77 (appendix table 3) and are probably representative of other nearby drainages. Stations such as the uncut site and group selection site, with means of 40° to 45° F (4° to 7° C), are probably representative of many slopes on the Forest.

Mean summer temperatures range from 55° to 62° F (13° to 17° C) (table 2 and appendix table 3), with long-term summer averages of 60.9° F (16.0° C) for Hungry Horse Dam and 58.6° F (14.8° C) for West Glacier. Mean summer temperatures decrease with elevation and changes in exposure toward the north. Southerly aspects would likely have means of 63° to 66° F (17° to 19° C). Recent measurements (data on file at Forestry Sciences Lab, Missoula) on other sites comparing north slopes with south slopes indicate daytime summer temperatures are 3° to 7° F (2° to 4° C) warmer on some south aspects.

Maximum air temperature on the Forest may exceed 100° F (38° C) at lower elevations, but rarely at the upper elevations. Maximums for any given year on the Abbott Basin sites (appendix table 6) quite often do not exceed 90° F (32° C) within a summer. Winters are cold (appendix table 7) and most winters have short periods of subzero temperatures. These typically last only a few days at a time.

During the growing season, maximum temperatures are generally higher at lower elevations but minimum temperatures are higher on the slopes. Average temperatures along the elevation gradient on the slopes follow the expected pattern, decreasing with an increase in elevation from the valley floor. Mean monthly maximum temperatures follow this trend also (fig. 8), but the situation is reversed for mean minimum temperatures (fig. 9). Differences for maximum temperatures between

the clearcut and the valley floor at Hungry Horse Dam are 5° to 10° F (3° to 6° C) from April through September (fig. 8). The clearcut at 1,840 feet (561 m) above Hungry Horse Dam is the highest elevational slope site. Maximum temperatures for other slope sites in between decreased with elevation. Even the local drainage bottom station (Abbott Creek) fits this pattern. Comparisons of long-term monthly average maximums revealed the same pattern, with Coram Ranger Station having the highest average maximum and Desert Mountain Lookout the lowest.

Minimum temperatures at Abbott Creek were coldest and the higher slope positions were warmest by 5° to 10° F (3° to 6° C) (fig. 9), especially from August through December. Hungry Horse Dam was not as cold as Abbott Creek. The same basic pattern occurs for the long-term average minimum temperatures, with Coram Ranger Station being coldest and Desert Mountain Lookout minimums as warm as Hungry Horse Dam and warmer than West Glacier.

### Frost-Free Days.

The frost-free period (number of days between occurrences of 32° F [0° C]) for the clearcut on the slope is 89 days longer than for nearby Abbott Creek, and 60 days longer than at West Glacier (fig. 10). These data are for the year 1976, but data are similar in other years. Abbott Creek has the shortest frost-free season of any station we have data for on or near the Forest. This site is

probably representative of other drainages on the Forest. There is apparently little difference (15 to 18 days, fig. 10) for sites with different positions on the same slope. Silvicultural treatment appeared to have little influence. Differences of 60 to 89 days in length of frost-free season may significantly affect biological systems and plant growth. These differences also illustrate the difficulty of extrapolating weather data from valley bottoms to nearby mountain slopes, especially during the spring and fall.

### Precipitation

Annual precipitation averages 34 inches (86 cm) at Hungry Horse Dam and 30 inches (76 cm) at West Glacier (table 2). These averages are typical of lower elevations of the Forest. Snow survey data suggest 40 inches (102 cm) of precipitation at Desert Mountain Lookout and other ridges within the Forest. Increased precipitation is received in the form of snow in the winter months (November-March). Precipitation for Abbott Creek (appendix table 8) should be higher than recorded. The heated snow gage caused evaporation and thus artificially low readings. We estimate that amounts for November, December, January, February, and March should be 2 to 2.5 times greater than shown.

During the growing season precipitation seems to fall uniformly on the Forest (appendix tables 8, 10, 17-18). Amounts for Abbott Basin stations (appendix table 8) and amounts at Hungry Horse Dam for the same years

Table 2.—Long-term averages of air temperature and precipitation

Station <sup>1</sup>	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Mean Monthly Air Temperature (°F)													
Hungry Horse Dam <sup>2</sup>	22	28	32	41	51	58	65	64	54	43	32	26	43
Coram RS <sup>3</sup>						56	63	61	54				
Desert Mt. LO <sup>4</sup>							59	59					
West Glacier <sup>5</sup>	21	27	31	41	50	57	63	62	53	42	31	25	42
Mean Monthly Maximum Air Temperature (°F)													
Hungry Horse Dam	28	35	41	51	63	71	80	78	66	53	38	32	53
Coram RS						71	83	82	72				
Desert Mt. LO							70	69					
West Glacier	28	35	41	52	64	71	80	78	66	53	37	31	53
Mean Monthly Minimum Air Temperature (°F)													
Hungry Horse Dam	15	20	22	31	39	46	50	49	41	33	26	20	33
Coram RS						41	43	41	36				
Desert Mt. LO							49	49					
West Glacier	14	19	22	29	36	43	47	46	39	32	24	19	31
Precipitation Averages (inches)													
Hungry Horse Dam <sup>2</sup>	3.83	2.66	2.20	2.13	2.74	3.19	1.61	2.20	2.56	3.00	3.56	3.82	33.50
Coram RS <sup>3</sup>						2.66	1.36	1.39	1.54				
Desert Mt. LO <sup>4</sup>							1.25	1.36					
West Glacier <sup>5</sup>	3.61	2.61	1.78	1.79	2.57	3.24	1.61	1.87	2.14	2.18	2.98	3.54	29.92

<sup>1</sup>RS = Ranger Station; LO = Lookout.

<sup>2</sup>1951-80. Averages based on readings for 24-h period taken at 8 a.m. 1951-53; 8 p.m. 1953-66; 9 a.m. 1967-80.

<sup>3</sup>1934-57. Averages based on readings for 24-h period taken at 5:30 p.m. 1935-45; 5 p.m. 1946-48; 4 p.m. 1949-57.

<sup>4</sup>1936-73. Averages based on readings for 24-h period taken at 5 p.m. prior to 1950 and 4 p.m. after 1950.

<sup>5</sup>1951-80. Averages based on readings for 24-h period taken at 5 p.m.

(appendix table 17) are quite similar. Precipitation patterns may differ by storm or for individual months; however, precipitation differences balance out over a season or over several years. Long-term averages (table 2) for Desert Mountain Lookout in July and August are less than for Hungry Horse Dam and West Glacier. Some of this difference may be attributed to using dif-

ferent periods for calculating the averages. Further, the amounts at Desert Mountain were incomplete in many years (footnotes, appendix table 16). Another influence is the greater exposure to wind, which affects gage catch (Hayes 1944). A stricter comparison, using only those days with measurements at both stations during July and August 1941-70, actually shows about 10 percent more precipitation at Desert Mountain than at West

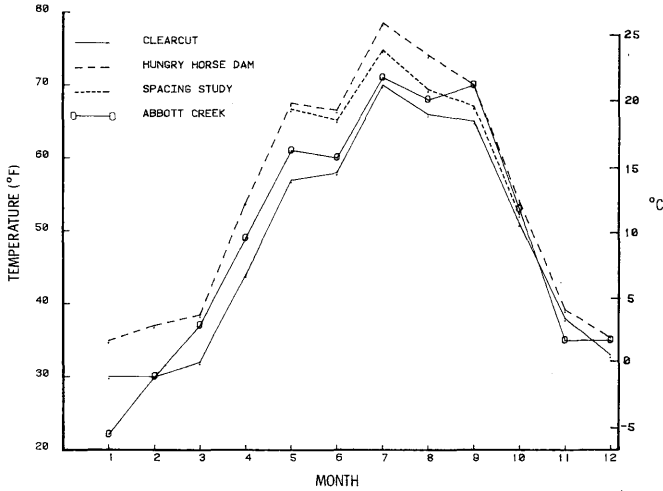


Figure 8.—Mean maximum monthly air temperatures for valley bottom station (Hungry Horse Dam), mid-slope stations (clearcut and spacing study), and local mountain drainage (Abbott Creek) for 1976.

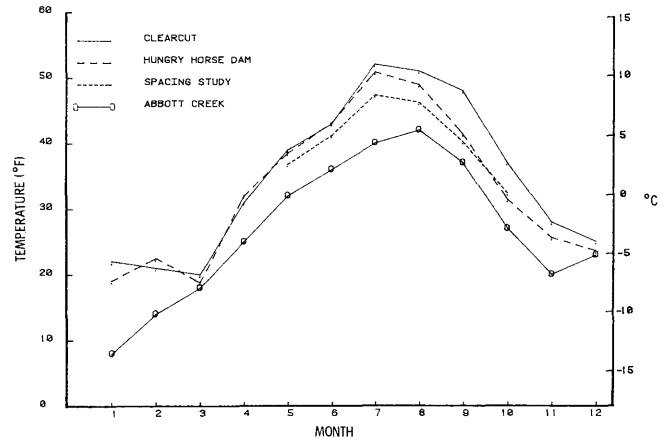


Figure 9.—Mean minimum monthly air temperatures for valley bottom station (Hungry Horse Dam), mid-slope stations (clearcut and spacing study), and local mountain drainage (Abbott Creek) for 1976.

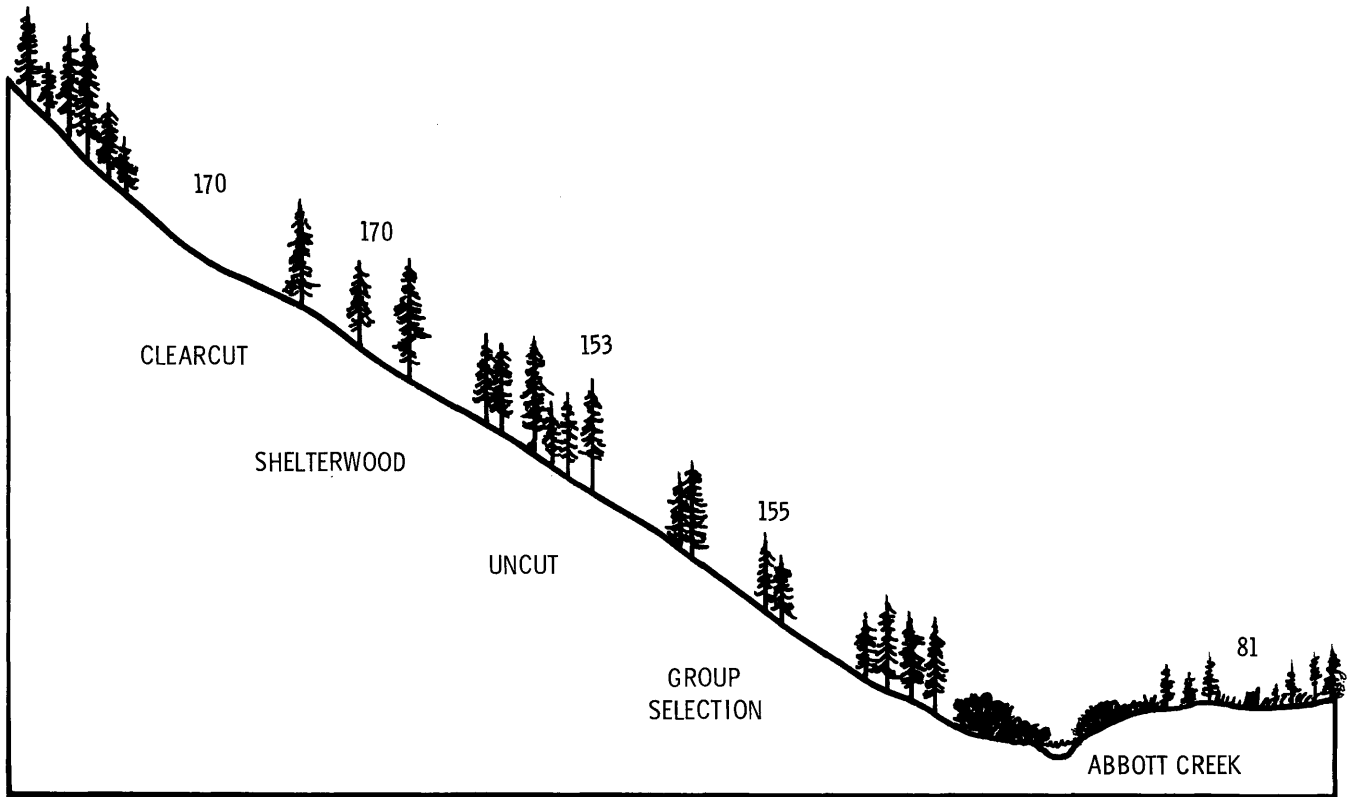


Figure 10.—Frost-free days for stations in 1976 from Abbott Creek and the slope above. West Glacier had 110 frost-free days for the same period. Frost-free days are based on number of days between occurrences of 32° F (0° C).

Glacier. These data were analyzed by Arnold Finklin, Northern Forest Fire Lab, Missoula, Mont.

The period from 1973 through 1981, for which the most intensive data collection occurred, was slightly wetter (0.5 inch [1.27 cm]) than the 30-year normal. Five years were wetter, with 1980 having 6.8 inches (17.3 cm) more than normal and 5.6 inches (14.2 cm) of this increase were received from May through September. Four years were drier, with 1979 having 6.4 inches (16.3 cm) less than normal and 5.4 inches (13.7 cm) of this deficit occurred from June through September.

### Microsite and Treatment Differences

Shortwave solar irradiance was similar for all sites in the open. Small differences were caused by slope position and horizon shading by nearby ridges (appendix tables 19-20). The amount received on the uncut unit is 25 percent of that received at the clearcut unit (fig. 11)—a difference that is important to understory vegetation and tree regeneration.

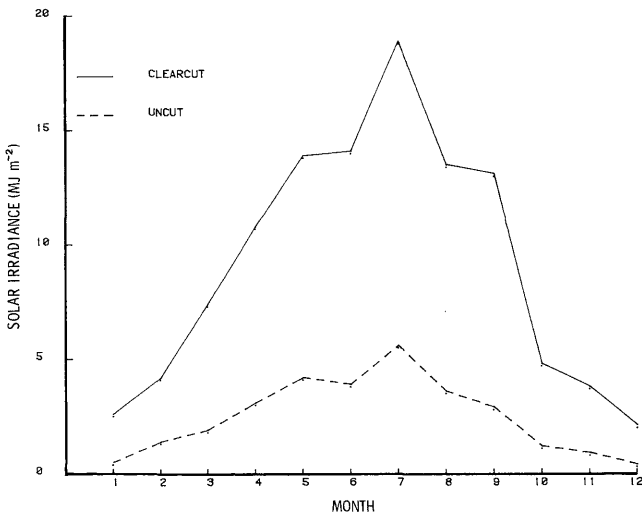


Figure 11.—Mean solar irradiance for uncut and clearcut stands on a 55-percent east-facing slope for 1975.

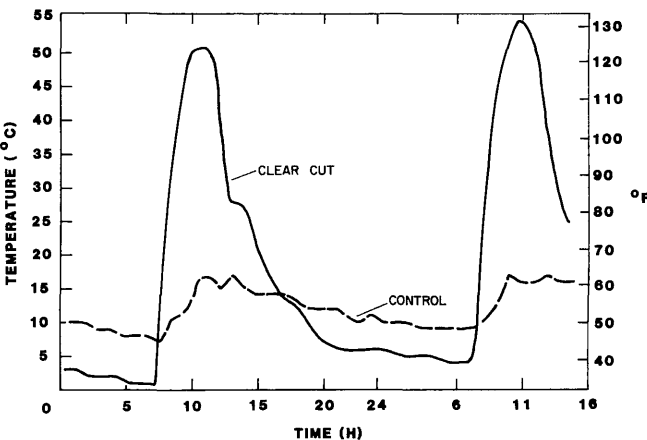


Figure 12.—Diurnal litter surface temperatures for uncut and clearcut stands on a 55-percent east-facing slope.

Differences in irradiance translate into large differences in litter surface temperatures. A typical diurnal comparison (fig. 12) for the clearcut and uncut units shows that maximum temperatures on the clearcut surface approach lethal temperatures of 122° to 131° F (50° to 55° C) for plant tissue (Levitt 1980). Minimum temperatures are also lower on the clearcut. These values are fairly typical of conditions that can occur on slopes in the Forest (appendix tables 22-24). Because these values are from east-facing aspects, we would expect conditions to be more severe on south- and west-facing aspects and less severe on north aspects. Other observations (Hungerford 1980) indicate that surface condition, such as litter residues, vegetation, or mineral soil, can significantly affect surface temperatures.

A typical annual trace of soil temperature by depth in a clearcut that is partially vegetated shows the changes with season and the lag of the maximum by depth (fig. 13). Other locations (appendix tables 25-27) show similar trends and values, except that summer soil temperatures in the uncut unit are typically lower than in the cut unit. Mean annual soil temperatures for the upper Abbott Basin sites for the 1974-78 period at the 20-inch (50.8-cm) depth average 39° to 43° F (4° to 6° C) (appendix table 27). Mean summer temperature at the 20-inch (50.8-cm) depth averaged 50° to 53° F (10° to 12° C).

Wind data for all cutting treatments in Abbott Basin showed the diurnal shift in wind direction during the summer months (appendix table 29). As should be expected, winds were upslope (from the southeast and east) during the day and downslope (from the south and southwest) at night. This pattern has significant implications for seed fall and distribution (Shearer 1980). Wind data, at 10 feet (3 m) (appendix table 28), also suggest that windspeeds are greater in the clearcut than the other units and that surface speeds are greater in all cutting units than in the uncut.

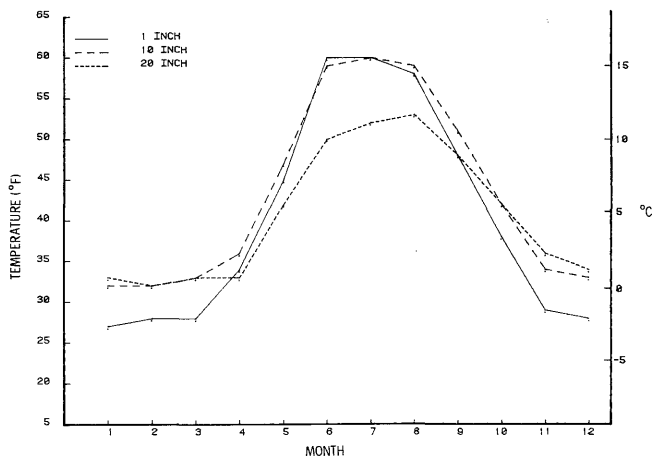


Figure 13.—Mean soil temperatures (°F) at depths of 1, 10, and 20 inches in a clearcut for 1977.

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# APPENDIX

## Weather Summary Tables

Table 3.—Mean monthly air temperature for residue utilization study sites (°F)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Group Selection													
1975					45	51	70	59	53	40	29	27	41*
1976	27	28	30	38	47	49	59	59	58	46	36	32	43
1977	26	36	35	47	48	63	64	63	53	44	30	24	45
1978	21	26	34	36	44	57	63	58	54*	44*	28	21	41
1979	12	26	35*		48*	54*			61*	47	30	32	43*
1980	19	30	31	46	50*	56	60*			45*	34	31	43*
1981	29	29	36		48	50*	63*						43*
Uncut													
1973								68	55	46	29	30	44*
1974	19	30	30	40	44	61	65	61	54	47	33	29	43
1975	23	23	27	37	45	51	66	56	51	39	29	26	40
1976	26	26	27	38	48	49	59	55	53	44	32	27	41
1977	18	30	29	42	44	64	65	64	53	41	31	17	44
1978	22	28	35	39	44	56	59						42*
Shelterwood													
1974								55	48	45	33	29	41*
1975	26	25	29	38	44	47	63	51	50	39	31	26	41
1976	29	27	27	38	48	50	61	57	57	43	35	29	42
1977	22	31	30	41	43	60	62						42*
1978						55	61	56	51	40	22	15	41*
1979	7	22	30*			52			57*	43	25	27	38*
1980	12	26	25	42	47*	53	56*			42	29	26	39*
1981	26	24	32		45	47	57*			37	33	22	39*
Clearcut													
1973										39	24	25	
1974	14	26	26	35	40	56	57			47	31	27	36
1975	20	19	24	31	43	50	65	55	51	39	28	26	38
1976	26	25	25	37	48	50	61	58	56	43	32	28	41
1977	20	33	30	43	45	59	62	61	51	42	26	21	42
1978	21	26	34	37	42	54	58	55	52	40	22	15	38
1979	8	22	32*		45	53			60*	49	34	34	41*
1980	24	30	28	42	46*	51	54*			41	29	26	40*
1981	26	24	32		44	45	56*			36	32	21	39*
Abbott Creek													
1974	17	23	24	33	42	59	60	57	47	39	32	27	39
1975	21	19	25	32	42	47	63	51	44	35	22	12	36
1976	15	21	27	36	46	48	54	53	51	38	27	29	37
1977	18	27	29	39	43	64	65						41*

\*Estimated means from partial records.

<sup>1</sup>Period before cutting.

Table 4.—Mean monthly maximum air temperature for residue utilization study sites (°F)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Group Selection													
1975					55	62	83	70	66	46	34	31	49*
1976	32	34	36	46	58	58	70	70	70	54	41	36	50
1977	29	41	41	58	56	74	75	73	63	53	35	29	53
1978	26	33	44	49	52	70	76	68	63	54	33	25	49
1979	18	32	42*			65			74*	55	35	37	51*
1980	25	35	37	56	61*	68	70*			54*	39	36	52*
1981	32	35	46		60*	60*	75*			55*			
Uncut													
1973								82	64	52	32	34	52*
1974	24	34	36	46	51	72	74	70	64	55	37	31	50
1975	26	28	31	41	53	59	76	64	61	44	32	30	47
1976	30	31	33	45	58	57	69	63	62	51	36	31	48
1977	23	35	34	49	50	74	74	72	59	48	35	20	50
1978	25	33	41	45	50	65	69						49*
Shelterwood													
1974								64	55	51	36	31	47*
1975	29	30	33	43	51	55	73	59	58	44	35	30	46
1976	32	31	34	45	58	58	70	65	65	49	39	33	49
1977	26	36	35	50	51	69	69						50*
1978						66	72	65	58*	46	27	19	45*
1979	12	27	36*			62*			67*	49	28	32	46*
1980	18	29	31	50	56*	64	66*			48	33	31	46*
1981	30	29	40		54	55	70*			43	37	26	46*
Clearcut													
1973										44	26	27	
1974	20	29	30	40	45	65	65			55	35	30	40
1975	25	26	30	37	50	58	75	63	60	44	32	30	44
1976	30	30	32	44	57	58	70	66	65	51	38	33	48
1977	25	38	35	51	53	68	70	69	58	49	31	26	49
1978	26	31	40	44	47	64	69	64	58	47	27	20	45
1979	14	27	38*			61			70*	54	37	38	45*
1980	29	33	33	49	54*	60	63*			48	33	31	47*
1981	30	29	39		52	52	66*			42	37	26	45*
Abbott Creek													
1974	23	31	34	44	53	75	77	74	68	59	38	32	51
1975	28	28	34	44	55	61	81	65	65	45	28	19	48
1976	22	30	37	49	61	60	71	68	70	53	35	35	49
1977	24	37	38	56	56	80	80						53*

\*Estimated from partial records.  
<sup>1</sup>Period before cutting.

Table 5.—Mean monthly minimum air temperature for residue utilization study sites (°F)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Group Selection													
1975					35	43	59	51	42	35	25	22	35*
1976	22	23	22	31	37	41	49	51	49	39	32	29	35
1977	22	30	30	37	41	53	55	54	46	37	26	18	38
1978	20	24	31	35	38	46	51	49	48	36	23	17	35
1979	7	22	28*			44			48*	40	27	29	39*
1980	13	27	26	36	40*	47	51*			33*	30	24	35*
1981	26	25	28		41	44*	51*			45			36*
Uncut													
1973								57	47	41	26	27	40*
1974	17	27	24	34	38	51	55	52	43	39	30	25	37
1975	18	18	23	32	39	43	57	49	43	35	25	22	34
1976	21	23	21	32	38	42	50	48	44	37	28	25	34
1977	14	25	25	34	37	54	57	56	47	36	28	12	38
1978	18	24	30	33	39	47	52						35*
Shelterwood													
1974								48	39	38	30	25	36*
1975	21	21	24	32	38	40	54	44	42	35	27	22	35
1976	24	23	22	32	39	43	53	52	50	38	31	26	36
1977	19	26	25	33	37	52	54						35*
1978						45	52	48	45	33	17	10	34*
1979	2	17	24*			44			47*	37	21	23	35*
1980	5	22	20	34	38*	44	49*			36	26	21	32*
1981	22	20	26		38	40	47*			32	30	18	33*
Clearcut													
1973										36	21	23	
1974	14	23	22	31	35	48	50			41	27	24	31
1975	16	14	19	25	37	43	56	48	43	34	23	21	32
1976	22	21	20	31	39	43	52	51	48	37	28	25	35
1977	16	28	25	34	38	50	54	54	45	37	23	16	36
1978	17	20	28	31	37	45	50	47	47	34	17	11	32
1979	2	17	26*			44			51*	44	32	32	35*
1980	20	27	23	35	37*	43	47*			35	25	21	34*
1981	22	19	25		38	38	45*			31	29	17	33*
Abbott Creek													
1974	12	17	16	25	32	43	45	43	32	26	26	23	29
1975	14	11	16	20	31	35	47	39	30	26	13	7	25
1976	8	14	18	25	32	36	40	42	37	27	20	23	27
1977	11	20	22	26	32	47	49						29*

\*Estimated from partial records.

<sup>1</sup>Period before cutting.

**Table 6.**—Monthly maximum air temperature for residue utilization study sites (°F)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<b>Group Selection</b>												
1975					69	80	95	87	77	69	61	53
1976	48	46	60	64	75	82	81	85	83	78	52	50
1977	45	52	52	80	76	86	90	91	78	66	50	44
1978	41	51	57	63	68	82	88	88	81	70	57	37
1979	34	43	54		77	81			84	77	43	46
1980	43	48	48	77	66	81	82				54	55
1981	39	52	57		73		88			66		
<b>Uncut</b>												
1973								91	86	67	45	41
1974	42	44	54	66	66	86	88	89	77	71	46	40
1975	40	40	40	50	70	73	89	79	73	64	60	49
1976	42	43	51	66	74	81	80	75	73	71	48	44
1977	37	45	47	73	69	85	90	88	76	59	47	29
1978	32	43	59	59	66	80	83					
<b>Shelterwood</b>												
1974								72	64	64	44	42
1975	40	39	47	52	71	69	84	77	70	64	58	48
1976	44	42	54	61	75	82	81	77	78	71	50	46
1977	41	48	48	76	70	80	76					
1978						79	84	84	77	61	52	32
1979	32	41	46		73	77			75	70	41	41
1980	36	43	41	72		75	79			72	54	48
1981	45	46	50		70	82	82			55	55	43
<b>Clearcut</b>												
1973										54	40	35
1974	37	35	43	58	57	80	78			65	44	40
1975	38	38	46	50	67	71	87	80	73	66	60	48
1976	44	42	52	59	73	80	80	80	77	72	53	46
1977	41	49	48	74	70	82	84	86	74	62	48	39
1978	37	44	59	56	65	77	80	81	75	63	52	32
1979	32	37	50		72	73			77	70	46	45
1980	39	43	43	70		73	77			70	54	48
1981	45	45	48		64	75	77			52	55	41
<b>Abbott Creek</b>												
1974	39	43	48	67	68	91	90	91	81	72	54	39
1975	42	41	48	58	77	81	91	77	78	68	61	38
1976	37	49	59	68	79	86	83	84	83	78	52	46
1977	41	51	52	79	79	94	94					

Table 7.—Monthly minimum air temperature for residue utilization study sites (°F)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Group Selection												
1975					27	34	49	42	34	27	3	9
1976	2	-5	-2	23	30	32	39	44	38	26	14	20
1977	8	22	21	28	31	42	46	48	40	29	2	-4
1978	-3	3	2	29	30	37	43	41	39	30	7	-9
1979	-9	5	19			32			39	28	16	3
1980	-4	5	3	23		37	46			28	12	7
1981	16	-4	19		34		45					
Uncut												
1973								43	32	29	8	17
1974	-5	19	11	27	31	39	46	40	33	28	22	16
1975	-8	-4	14	30	29	37	48	40	35	27	2	10
1976	1	-4	-10	26	31	33	44	39	33	25	8	9
1977	-1	16	14	18	29	44	47	48	35	27	3	1
1978	3	2	0	28	30	39	44					
Shelterwood												
1974								40	27	20	19	12
1975	-1	4	8	29	27	33	43	34	32	26	14	9
1976	8	-2	-4	23	33	33	43	42	38	24	16	15
1977	6	22	14	18	31	39	51					
1978						37	41	39	34	25	-2	-18
1979	-17	-2	14			32			41	23	5	-8
1980	-15	-6	-4	18		34	45			23	7	0
1981	9	-18	14		28	32	36			19	14	3
Clearcut												
1973										23	2	2
1974	-8	17	7	23	28	35	40			30	17	11
1975	-10	-6	1	3	27	35	44	38	33	24	0	5
1976	2	-7	-11	22	33	34	42	41	35	22	11	8
1977	0	22	14	17	29	40	44	45	34	27	-3	-8
1978	-5	1	0	25	27	35	41	37	37	25	-2	-17
1979	-17	-2	10			34			45	34	19	10
1980	3	10	9	21		34	43			21	7	3
1981	12	-18	14		27	32	34			18	14	3
Abbott Creek												
1974	-14	3	-5	16	21	29	37	31	23	17	16	1
1975	-7	-17	-9	-1	23	23	34	21	22	21	-11	-11
1976	-13	-20	-17	19	25	28	34	34	27	10	-10	1
1977	-9	7	9	9	19	36	45					

**Table 8.—Monthly precipitation for residue utilization study sites (inches)**

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Group selection													
1975						2.43	1.99	3.78	1.52	3.97			
1976					2.27	2.96	2.44	3.20	.95	.46			
1977					1.75	.53							
1978					1.89	.75	1.46	4.00	1.90	.40			
1979						1.44	.34			2.30			
1980						4.70	1.08						
Uncut													
1974					1.94	1.80	1.37	1.25	1.21	0.15			
1975					2.43	1.98	1.61	3.71	1.25	3.62			
1976					2.36	2.88	1.96	2.12	.46	.29			
1977					1.50	.27	2.47	1.94	1.05				
Shelterwood													
1974									1.26	0.17			
1975					1.67	2.83	1.96	4.64	1.41	3.60			
1976					2.39	3.13	2.54	3.35	1.05	.52			
1977					1.38	.81	3.71	2.96	3.72				
Clearcut													
1974						2.16	1.63						
1975					1.58	3.37	2.11	4.62	1.69	3.99			
1976					1.51	3.54	3.00	3.93	1.33	.71			
1977					2.67	.87	3.49	2.52	3.36				
1978					1.54	.56	1.69	4.43	2.18	.24			
1979						1.47	.44			2.40			
1980						4.58	1.28						
Abbott Creek													
1974	2.62	1.83	2.26	1.96	2.33	2.41	1.49	1.81	1.51	0.32	1.43	1.15	21.12
1975	2.25	2.03	1.48	1.45	2.21	3.04	1.95	4.34	1.59	4.44	2.24	.93	27.95
1976	1.75	2.01	.68	2.96	2.71	3.52	2.90	3.62	1.27	.69	1.57	.82	24.50
1977	.72	1.57	2.82	.89	2.59	.75	3.40	2.93	3.59	1.22	2.14	3.85	26.47
1978	1.60	.92	1.22	2.37	4.47	.81	1.72	4.13*	2.21*	.65*	.83*	1.07*	22.00*

\*Estimated using regression techniques.

**Table 9.**—Mean monthly, mean monthly maximum, and mean monthly minimum air temperature for spacing study site (°F)

Year	May	June	July	Aug.	Sept.	Oct.
Mean Monthly Air Temperature						
1968	50	59	63	59	51	40
1969	51	54	60	67	60	48
1970	50	59	63	62	46	38
1971	52	53	61	67	48	39
1972	54	61	62	67	51	43
1973	49	55	64	63	50	41
1974	44	59	61	51	46	38
1975		48	61	57	51	41
1976	52	53	61	58	54	43
1977	45	62	64*	63	53	46
1978	48	60	66	63	56	50*
1979	58*	61	68	69	61	56*
1980	56	58	67*	59*	57*	49*
1981	52	53	61	66	60	44
1982	48	58	62	63	53	43
Mean Monthly Maximum Air Temperature						
1968	65	73	82	74	64	48
1969	68	68	78	82	69	54
1970	65	74	80	83	59	48
1971	68	66	79	87	61	50
1972	68	75	78	84	64	53
1973	65	68	84	82	64	50
1974	56	76	76	66	62	51
1975		61	78	69	64	48
1976	67	65	75	69	67	52
1977	55	77		75	62	55
1978	59	74	80	74	65	61*
1979		75	85	84	74	
1980	67	71	80*	73*	67*	
1981	63	63	73	80		51
1982	61	71	74	76	64	52
Mean Monthly Minimum Air Temperature						
1968	36	44	44	44	39	32
1969	34	41	42	53	50	42
1970	35	44	45	42	32	28
1971	36	40	43	47	34	29
1972	39	46	47	50	38	33
1973	34	41	44	43	37	32
1974	32	42	46	36	30	24
1975		35	45	44	37	34
1976	37	41	47	46	40	33
1977	34	47		50	44	37
1978	38	46	53	51	47	40*
1979		48	52	54	47	
1980	44	47	53*	48*	47*	
1981	42	44	48	51		36
1982	36	46	49	50	42	34

\*Estimated values.

**Table 10.—Precipitation for spacing study site (inches)**

Year	May	June	July	Aug.	Sept.	Oct.
1968	3.33	1.96	0.87	4.59	3.78	1.32
1969	1.32	5.49	.22	0	1.15	1.80
1970	.40	1.64	1.27	1.25	.30	1.17
1971	1.53	2.50	1.67	0	.48	2.38
1972	.20	1.72	.22	.40	.77	.85
1973		2.25	.08	0	0	.28
1974	2.22	0	.02	1.15	.42	.24
1975		1.65				
1976	1.93	1.80	2.37	3.37	.85	.28

Precipitation was periodically measured from rain cans, beginning in 1978:

5-3-78 to 6-9-78	3.33	5-1-81 to 6-18-81	8.16
6-9-78 to 7-4-78		6-18-81 to 7-17-81	.50
7-4-78 to 8-4-78	1.83	7-17-81 to 8-13-81	.38
8-4-78 to 9-14-78	3.66	8-13-81 to 9-11-81	1.15
9-14-78 to 10-19-78	.20	9-11-81 to 10-4-81	.95
5-17-79 to 6-12-79	1.39	4-30-82 to 5-28-82	1.48
6-12-79 to 6-27-79	.66	5-28-82 to 7-22-82	
6-28-79 to 7-26-79	.24	7-22-82 to 8-5-82	.41
7-27-79 to 8-20-79	.35	8-5-82 to 9-15-82	
8-20-79 to 10-30-79	1.77	9-15-82 to 10-20-82	1.79
5-6-80 to 6-5-80	5.07		
6-5-80 to 8-7-80	4.10		
8-7-80 to 9-29-80	4.21		

**Table 11.—Monthly air temperature and precipitation for Abbott Basin south and north sites**

Year	Abbott Basin south						Abbott Basin north					
	May	June	July	Aug.	Sept.	Oct.	May	June	July	Aug.	Sept.	Oct.
Mean Monthly Maximum Air Temperature (°F)												
1958		68	72	81	62	55		69	75	82	64	55
1959	55	71	81	68	57	49	55	69	80	72	58	48
1960	55	68	87	69	69	52	55	67	85	70	70	54
1961	66	79	84	86	60	51						
1962	60	72	78	75	69							
1963	62	67	74	79	72	60						
1964	62	66	78	69	61	54						
Mean Monthly Minimum Air Temperature (°F)												
1958		45	48	52	40	36		46	50	54	42	37
1959	34	45	51	47	38	33	34	45	50	48	41	34
1960	35	44	52	44	38	33	35	44	54	48	41	35
1961	38	45	48	48	35	30						
1962	38	40	43	44	36							
1963	34	42	42	43	40	34						
1964	32	41	44	42	35	33						
Total Precipitation (inches)												
1958		3.39	0.47	0.50	1.78	0.55		3.00	0.60	0.30	1.75	0.40
1959	3.21	.87	.10	1.23	3.89	2.41	2.90	1.63	.05	.63	3.60	3.14
1960	3.26	1.33	0	3.83	.42	2.07	2.96	.85	0	3.52	.14	1.74
1961	.95	.52	1.68	.79	3.00	2.09						
1962	2.62	.82	.45	1.25	.56	1.50						
1963	.86	5.03	.95	.60	1.10	1.00						
1964		5.23	2.35	1.50	1.80	1.23						

**Table 12.**—Monthly air temperature and precipitation for wartime cuttings

Year	May	June	July	Aug.	Sept.	Oct.
Mean Monthly Maximum Temperatures (°F)						
1961		83	87	89	62	51
1962	60	73	80	75	68	
1963	67	72	82	84	76	59
1964	62	72	83	72	64	57
Mean Monthly Minimum Temperatures (°F)						
1961		45	46	47	35	30
1962	34	37	40	41	33	
1963	36	44	45	45	43	35
1964	36	43	46	44	37	34
Total Precipitation (inches)						
1961	0.83	0.14	1.44	0.79	2.69	2.19
1962	2.36	.55	.22	1.60	.85	
1963	.72	4.07	.57	.38	1.44	1.52
1964	1.09	4.73	2.33	1.70	1.68	1.92

**Table 13.**—Monthly air temperature for 60-acre clearcut and 30-acre clear-cut sites

Year	May	June	July	Aug.	Sept.	Oct.
Mean Monthly Maximum Temperatures (°F)						
1971				78*	64	56
1972	65	71	74	82		54
1973	59	60	73	81	65	50
1974	55	76	78	73	67	58
1975		69	85	72	69	
1976	63	62	74	68	66	50
1977	60	80	78	76	63	57
1978	60	75	79	73	64	62*
1979		80	89			
1980	70	78	79	72	66	
1981	62	61	72	79	65	50
Mean Monthly Minimum Temperatures (°F)						
1971				53*	45	41
1972	38	45	46	49		31
1973	37	42	42	41	35	30
1974	33	42	42	40	33	29
1975		42	50	44	38	
1976	30	36	42	42	35	28
1977	34	45	48	47	41	34
1978	41	45	47	46	43	33*
1979		43	47			
1980	42	45	49	45	43	
1981	41	42	47	49	41	34

\*Based on fewer than 20 days.

<sup>1</sup>30-acre clearcut.

**Table 14.—Mean monthly, mean monthly maximum, and mean monthly minimum air temperature for Coram Ranger Station (°F)**

Year	Mean monthly air temperature				Mean monthly maximum air temperature				Mean monthly minimum air temperature			
	June	July	Aug.	Sept.	June	July	Aug.	Sept.	June	July	Aug.	Sept.
1934		67	63	49		87	86	65		46	40	33
1935	56*	62	59	57	74*	82	78	75	37*	44	39	39
1936	59	66	62	52	73	87	84	67	44	45	41	37
1937	56	64	59	55	71	83	77	73	42	45	42	36
1938	58	64	61	59	75	84	81	80	42	45	40	39
1939	52	63	62	54	64	82	84	69	40	44	39	38
1940	58	65	62	57	76	85	86	73	41	45	38	42
1941	57	66	63	48	72	86	81	58	42	47	45	38
1942	54	62	61	53	65	81	80	70	44	44	42	36
1943	50	62	61	53	62	82	82	74	38	43	40	32
1944	56	63	60	54	70	83	78	71	42	42	41	37
1945	55	64	64	54*	68	84	86	70*	42	43	41	37*
1946	55	64	62	54	72	84	84	71	39	42	40	37
1947	57	66	62	56*	70	88	81	73*	44	43	42	40*
1948	61	59	62	56	75	77	80	78	47	42	43	34
1949	57	62	63	52	74	82	87	74	40	42	39	31
1950	54*	62	62	53	68*	81	82	76	41*	43	41	31
1951	54*	63	60	50	69*	84	81	68	39*	42	39	32
1952	56	61	62	56	72	82	83	78	40	40	41	34
1953	54	62	62	55	69	86	82	75	39	39	41	35
1954	54*	62	59	51	68*	80	78	67	39*	43	41	36
1955	55	60	60	54	73	76	83	72	37	44	36	35
1956	56*	63	59	54	72*	82	79	72	40*	44	40	36
1957	58	63	60	55	72	83	80	76	44	44	40	34
Average	°F 56	63	61	54	71	83	82	72	41	43	40	36
	°C 13	17	16	12	22	28	28	22	5	6	4	2

\*Based on fewer than 20 days.

**Table 15.—Monthly precipitation for Coram Ranger Station (inches)**

Year	June	July	Aug.	Sept.
1934		0	0.25	0.90
1935	1.10	1.79	.74	.31
1936	1.56	.21	.18	1.44
1937	3.17	.84	1.81	1.68
1938	1.79	1.27	1.74	.74
1939	3.85	.60	.19	1.70
1940	1.26	2.19	.20	1.90
1941	1.86	.54	1.46	4.58
1942	3.82	2.56	.79	1.33
1943	3.45	.64	.43	1.26
1944	1.09	.27	2.46	2.28
1945	3.24	.32	.45	2.17
1946	2.73	1.05	1.48	2.08
1947	5.44	.57	3.36	1.66*
1948	3.52	3.75	1.44	.02
1949	.72	1.97	.89	2.13
1950	1.77	1.73	1.75	1.33
1951	2.18	1.81	2.70	3.79
1952	3.44	2.11	1.16	.52
1953	2.97	.09	1.71	.64
1954	2.92	2.58	4.60	.87
1955	2.72	3.13	0	2.30
1956	2.68	1.74	2.86	1.19
1957	3.86	.89	.74	.15
Average	inch 2.66	1.36	1.39	1.54
	cm 6.76	3.45	3.53	3.91

\*Based on fewer than 20 days.

Table 16.—Monthly air temperature and precipitation for Desert Mountain Lookout

Year	Mean monthly air temperature		Mean monthly maximum air temperature		Mean monthly minimum air temperature		Total precipitation	
	July	Aug.	July	Aug.	July	Aug.	July	Aug.
	°F						Inches	
1936	66	61	77	72	55	51	0.25	0.35
1937	62	55	71	65	52	46	1.36	1.84
1938	61	56	70	65	52	48	1.32	1.30
1939	62	62	71	72	54	52	.25	.37
1940	60	61	70	71	51	51	2.31	.10
1941	61	<sup>1</sup> 63	69	72	54	53	.38	<sup>1</sup> .51
1942	<sup>2</sup> 56	59	64	69	47	50	<sup>2</sup> 2.03	<sup>3</sup> .90
1943	59	59	69	69	49	48	.67	.37
1944	58	55	68	65	49	46	.37	2.08
1945	60	60	70	70	51	50	.15	.76
1946	<sup>2</sup> 61	<sup>3</sup> 58	72	66	51	50	<sup>2</sup> .28	<sup>4</sup> .84
1947	<sup>2</sup> 62	<sup>1</sup> 57	72	68	52	46	.51	<sup>1</sup> 2.27
1948		<sup>5</sup> 56		67		45		<sup>5</sup> .90
1949	<sup>2</sup> 56	61	67	72	45	50	<sup>2</sup> 1.97	.65
1950	<sup>2</sup> 56	58	66	68	47	48	<sup>2</sup> 1.23	1.25
1951	60	56	70	66	50	47	1.58	<sup>3</sup> 2.86
1952	<sup>2</sup> 56	58	67	68	46	48	<sup>2</sup> 1.31	<sup>3</sup> 1.23
1953	62	59	73	70	51	49	.11	1.32
1954	<sup>2</sup> 60	<sup>4</sup> 56	69	63	51	49	1.38	<sup>4</sup> 3.89
1955	<sup>3</sup> 56	61	65	72	46	50	<sup>3</sup> 4.45	0
1956	60	57	69	67	50	48	1.67	3.04
1957	57	56	69	68	46	45	1.49	.88
1958	58	64	68	76	48	53	1.15	.75
1959	60	55	73	65	48	45	.12	1.66
1960	67	<sup>3</sup> 55	77	64	57	45	.09	<sup>4</sup> 3.70
1961	61	67	72	78	50	56	2.13	1.36
1962	55	54	68	66	42	42	.95	1.74
1963	57	60	67	72	47	49	1.10	.84
1964	56	49	69	60	43	39	2.97	2.02
1965	61	<sup>3</sup> 57	70	66	52	49	1.15	<sup>1</sup> 2.66
1966	58	56	68	67	48	46	2.16	1.55
1967	<sup>3</sup> 62	66	74	78	51	55	.29	.07
1968	60		71		48		1.16	<sup>6</sup> 2.10
1969	57	62	67	74	47	49	.44	0
1970	62	62	72	74	52	51	2.61	1.35
1971	57	66	68	77	45	56	1.69	1.64
1972	54	61	65	72	44	51	3.08	1.67
1973	59	61	72	73	46	49	.14	1.02

<sup>1</sup>7-9 days missing at end of month

<sup>2</sup>July 11-31.

<sup>3</sup>Includes estimates for missing days.

<sup>4</sup>4-5 days missing at end of month.

<sup>5</sup>August 1-20.

<sup>6</sup>August 1-16.

Table 17.—Mean monthly air temperature and monthly precipitation for Hungry Horse Dam, 1968-81

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Mean Monthly Air Temperature (°F)													
1968	24	30	39	40	50	57	64	61	53	41	33	19	43
1969	12	25	31	45	54	58	64	65	56	39	34	28	42
1970	23	31	32	38	52	64	66	65	49	39	30	26	43
1971	23	28	30	41	52	54	62	69	49	40	34	22	42
1972	18	27	37	40	51	59	61	66	50	39	33	21	42
1973	19	24	36	41	52	58	67	67	54	44	29	30	43
1974	21	31	31	42	47	62	65	63	53	44	35	31	44
1975	23	20	28	35	48	57	67	59	54	42	31	29	41
1976	27	30	29	43	53	55*	65	62	56*	43	32	30	44*
1977	21	32	33	45	50	63	62	63	51	43	31	22	43
1978	21	28	35	44	48	60	65	62	54	44	27	20	42
1979	3	24	34	42	52	61	68	67	58	46	29	32	43
1980	15	27	30	45	55	58	65	59	53	43	34	28	43
1981	29	30	39	44	54	54	64	69	56	42	34	27	45
Total Precipitation (inches)													
1968	3.13	3.21	2.85	1.37	3.37	2.91	2.17	3.71	6.57	4.83	3.63	3.75	41.50
1969	7.85	.83	1.17	1.74	2.29	5.26	.46	.14	3.05	2.82	1.83	2.24	29.68
1970	6.20	3.52	2.92	1.79	2.24	3.72	3.30	.58	3.56	3.18	3.83	4.51	39.35
1971	5.49	1.95	2.38	1.27	3.24	5.26	2.23	1.60	1.76	4.04	2.99	4.10	36.31
1972	5.39	4.03	2.51	2.71	2.23	3.69	3.10	2.29	3.00	3.07	1.00	4.89	37.91
1973	2.24	1.09	1.04	1.63	2.39	2.85	.16	1.01	2.63	4.10	10.84	4.97	34.95
1974	7.50	3.82	4.23	2.28	2.89	3.16	1.66	1.07	2.41	.42	4.11	2.81	36.36
1975	3.73	3.61	2.71	1.21	2.57	3.38	1.57	4.07	1.10	5.89	3.09	3.81	36.74
1976	3.75	3.10	1.50	2.75	2.89	3.66	2.98	4.74	1.36	.90	2.18	1.93	31.74
1977	1.63	1.70	2.20	1.10	2.74	.68	3.84	3.04	3.81	1.00	3.95	7.16	32.85
1978	3.05	1.44	1.27	2.32	4.28	2.44	1.69	4.13	2.34	.68	2.89	3.01	29.54
1979	2.17	4.87	2.68	2.60	3.08	1.51	.70	1.30	.68	3.04	.60	3.87	27.10
1980	2.94	2.54	3.20	2.44	4.19	5.48	1.50	3.61	3.19	1.32	2.82	7.11	40.34
1981	1.20	3.91	1.05	4.55	6.17	6.83	2.45	.87	1.72	1.04	2.95	4.06	36.80

\*Estimated by regression techniques.

Table 18.—Mean monthly air temperature and monthly precipitation for West Glacier, 1968-81

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Mean Monthly Air Temperature (°F)													
1968	22	30	39	40	49	57	64	59	52	41	33	18	42
1969	12	24	32	44	52	58	62	63	55	39	34	27	42
1970	22	29	31	38	51	62	64	62	47	38	30	24	42
1971	21	28	30	41	52	55	62	67	49	40	32	20	41
1972	16	27	36	39	50	59	60	64	49	40	33	19	41
1973	19	25	36	41	51	58	65	65	54	44	29	28	43
1974	21	30	32	43	47	61	64	61	53	44	33	29	43
1975	22	20	29	36	48	54	68	59	52	41	30	28	41
1976	26	29	30	42	52	54	63	61	54	43	32	29	43
1977	20	31	34	44	49	60	62	61	50	42	29	20	42
1978	21	27	35	43	48	59	63	59	54	42	26	17	41
1979	4	24	33	42*	51	58	65	65	56	44	28	30	42*
1980	14	27	30	46	53	56	61	57	53	44	33	26	42
1981	28	28	37	43	52	53	62	65	54	42	34	25	44
Total Precipitation (inches)													
1968	1.97	2.58	1.57	1.15	4.94	3.22	0.86	3.66	6.17	4.16	2.38	4.04	36.70
1969	6.67	.66	.71	1.61	1.90	4.55	.48	.01	3.20	1.98	1.16	1.64	24.57
1970	5.31	3.56	1.97	1.38	3.41	3.73	1.73	.70	3.21	1.93	4.74	3.72	35.39
1971	5.55	2.14	2.28	.95	2.84	5.94	1.75	1.91	1.24	2.88	3.77	4.90	36.15
1972	5.13	5.07	2.76	1.57	2.13	2.69	1.99	1.60	1.62	1.05	1.20	4.83	31.64
1973	2.48	1.07	1.26	1.59	2.09	2.32	.22	1.14	2.62	2.59	4.63	3.27	25.28
1974	5.77	2.98	2.87	2.47	2.18	2.24	1.37	1.12	1.32	.14	4.53	2.52	29.51
1975	4.45	2.58	1.67	1.17	2.19	2.54	2.00	4.06	1.14	4.17	2.81	3.78	32.56
1976	3.75	3.08	.96	1.88	2.83	3.29	3.05	4.09	.80	.30	1.22	1.91	27.16
1977	1.29	1.40	2.16	.33	2.13	.75	3.13	2.55	3.24	1.17	2.70	6.02	26.87
1978	2.83	1.06	.51	2.43	3.68	2.12	3.04	4.48	1.64	.64	2.14	2.56	27.13
1979	1.05	3.59	1.23	2.23	2.66	1.47	1.12	.85	.80	2.37	.65	2.64	20.66
1980	2.26	2.04	1.15	1.24	3.96	5.12	1.62	2.37	2.27	.86	2.89	7.72	33.50
1981	1.32	2.46	1.32	2.55	3.96	6.83	1.67	1.70	1.14	.90	2.76	2.43	29.04

\*Estimated by regression techniques.

**Table 19.—Mean daily solar irradiance by month for residue utilization study sites (MJ m<sup>-2</sup>)**

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<b>Group Selection</b>												
1975					15	15	18	14	14	6	4	2
1976	3	5	10	12	16	14	17	14	14	8	4	3
1977	3	6	8	17	14	20	17	15	11			
1978				12	12	20	19	14	9*	7*	3	
1979						17*	19		13*	6	3	
1980						16	16*			7	2	
1981			11		14	14	20*			6	3	
<b>Uncut</b>												
1973								4	4	2	1	1
1974	1	1	3	4	5	8	8	6	5	3	1	0
1975	0	1	2	3	4	4	6	4	3	1	1	0
1976	1	1	2	2	5	4	5	3	2	1	1	1
1977	1	1	1				5	3	2			
<b>Shelterwood</b>												
1974								8	8	5	2	1
1975	2	3	6	8	10	9	12	8	8	3	2	1
1976	2	3	6	8	11	10	11	9	9	5	3	2
1977	2	4	5	11	10	13	10	10	7			
<b>Clearcut</b>												
1973										1	0	0
1974	0	0	1	3	4	7	6			9	3	1
1975	3	4	7	11	14	14	19	14	13	5	4	2
1976	3	4	7	12	16	13	18	13	13	8	4	3
1977	4	6	8	16	14	20	17	15	10	8	3	2
1978	2	5	10	12	11	22	19	14	8*	7*	4	
1979						18*	20		13*	7	3	
1980				14	18*	18	17*			7	2	
1981			10		14	13	21*			6	3	
<b>Abbott Creek</b>												
1974	2	2	8	12	12	19	18	16	13	9	3	2
1975	2	4	7	12	13	13	19	14	13	6	3	2
1976	3	5	8	11	16	15	17	13	13	7	4	2
1977	3	5	7	15	13	19	16	13	10			

Note: 1 MJ m<sup>-2</sup> = 23.9 CAL cm<sup>-2</sup>

\*Estimated from partial records.

<sup>1</sup>Period before clearcutting.

**Table 20.—Maximum daily solar irradiance by month for residue utilization study sites  
(MJ m<sup>-2</sup>)**

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<b>Group Selection</b>												
1975					21	25	24	22	19	15	10	8
1976	8	11	18	22	23	24	24	20	19	15	9	7
1977	8	12	19	23	24	26	25	22	20			
1978				21	25	28	26	23	18	11	7	
1979		10	20		24	22	23	22		12	8	
1980	10	11				25	24			12	6	
1981		11	16		25	26	26			11	8	
<b>Uncut</b>												
1973								5	7	4	3	3
1974	4	2	6	8	9	10	11	10	8	5	2	1
1975	2	3	4	5	8	8	8	9	5	3	2	1
1976	2	2	3	5	8	8	8	5	4	2	2	2
1977	2	2	2				10	6	4			
<b>Shelterwood</b>												
1974								12	13	6	5	3
1975	4	8	14	14	17	15	15	16	12	7	6	3
1976	5	6	11	15	15	16	14	16	14	8	6	4
1977	5	6	14	18	15	18	15	14	13			
<b>Clearcut</b>												
1973										<sup>1</sup> 2	<sup>1</sup> 2	<sup>1</sup> 1
1974	<u>1</u>	<u>1</u>	<u>4</u>	<u>6</u>	<u>8</u>	<u>10</u>	<u>10</u>			11	7	6
1975	8	14	15	22	23	25	24	22	17	13	9	6
1976	7	9	15	22	24	24	23	21	18	13	8	7
1977	8	13	18	22	24	25	25	22	19	14	7	6
1978	6	12	18	22	23	27	26	23	17	11	7	
1979			13		26	24	24	23		13	8	
1980	10	16	12	23	26	28	28			11	6	
1981		14	15		25	27	26			11	8	
<b>Abbott Creek</b>												
1973												4
1974	7	8	18	21	22	24	24	21	20	12	7	5
1975	6	16	14	21	20	24	24	22	17	12	6	6
1976	7	11	15	20	23	24	22	20	16	14	7	5
1977	8	10	18	20	23	24	25	20	16			

Note: 1 MJ m<sup>-2</sup> = 23.9 CAL cm<sup>-2</sup>  
<sup>1</sup>Period before clearcutting.

**Table 21.**—Mean daily net irradiance by month for residue utilization study sites (Langleys)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Group Selection												
1975						276	290	202	189	46	7	9
1976	13	4	37	163	248	254	256	209	189	74	17	-29
1977	9	19	30	165	198	241	224	207	135	80	11	-2
1978	-4	-6	52	194	170	300*		176	132*	54*		
1979							265		151*	62		
Uncut												
1973										19	3	-1
1974				67	82	162	205	135	55	9	20	9
1975	9	11	28					54	28	33	17	9
1976	12	9	23	64	104	91	85	31	9	10	20	-8
1977	8	22	14	46	44							
Shelterwood												
1974								134	126	28	-5	-15
1975	9	0	22	41	174	205	147	120	117	50	-1	7
1976	20	11	43	76	192	140	139	122	135	38	3	-16
1977	-11	13	12	88	135							
Clearcut												
1973											22	9
1974	2	-7	-4	21	57	144	134			137	16	-4
1975	2	23	29	88	222	211	263	183	158	61	4	-3
1976	8	-8	34	114	286	231	271	211	168	58	1	-32
1977	-18	-14	8	146	206	272	235	246	172	119		

\*Estimated from partial records.

<sup>1</sup> Period before clearcutting.

**Table 22.**—Mean daily litter surface temperature by month for residue utilization study sites (°F)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Clearcut-B												
1975							68	57	55	39	37	
1976					57	54	61	57	48	36	34	28
1977	30	32	32	48								32
1978	32	32	32	32*	43	54*	55	54	50	37	32	32
1979	32	32	32			48*	57	61*	50*	41	30	32
1980	32	32	32	34	45*	54	59*			39	30	32
1981	32	32	32		48	46	57*			34	32	32
Clearcut-U												
1975							68	59	54	37	37	32
1976					55	54	64	59	48	34	32	30
1977	30	30	32	50	52	61						32
1978	32	32	32	34*	45	66*	68	59	52	39	32	32
1979	32	32	32			61*	70	75*	54*	39	25	30
1980	30	30	32	36	48*	54	57*			41	32	32
1981	32	32	32		48	50	59*			36	34	32
Clearcut Block 13-B												
1978	32	32		41*	45	59*						
1979						48	59	61*	41*	36*		
1980					45*	54	57*					
Clearcut Block 13-U												
1978	32	32		43*	46	57*	63	59	54*	41*	33	33
1979	32	32	32			57	66	70*	57*	45	31	32
1980	32	32	32	41	54*	57	61*					
Uncut												
1975							63	54	46	37	34	32
1976					43	46	57	54	45	36	34	30
1977	30	30	30	37	45	52						

\*Estimated from partial records.

Note: B = area burned; U = area unburned.

**Table 23.—Mean monthly maximum litter surface temperature<sup>1</sup> for residue utilization study sites (°F)**

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Clearcut-B												
1975							113	88	109	55	52	
1976					111	97	86	79	73	43	39	28
1977	30	32		84								32
1978	32	32	32*	32	64	75	66	66	57	45	34	32
1979	32	32	32			59	72		68*	50	30	32
1980	32	32	32	37	61*	86	93*			57	37	32
1981	32	32	32		73	68	93*			54	41	32
Clearcut-U												
1975							117	99	106*	52	50	32
1976					109	93	106	100	91	41	37	30
1977	30	32		100	97	106						
1978	34	34	32*	36	66	129	117	99	72	61	36	32
1979	32	32	32			111	124		99*	61	30	32
1980	32	32	32	41	81*	86	93*			55	36	32
1981	32	32	32		72	66	102*			46	37	32
Clearcut Block 13-B												
1978	32	32		55*	61	90*						
1979					86*	77*	100	109*	68*	57*		
1980				70*	79*	82	86*					
Clearcut Block 13-U												
1978	32	32		66*	72	93*	100	95	70*	75*	36	34
1979	34	32	32		100*	95*	118	140*	117	75	39	32
1980	32	32	32	57	104*	90	100*					
Uncut												
1975							99	73	55	41	36	32
1976					70	68	73	63	52	37	36	30
1977	30	32		55	66	77						

<sup>1</sup>Mean monthly maximum temperature was obtained by dividing the sum of the daily maximum temperatures by the number of days readings were available.

\*Estimated from partial records.

Note: B = area burned; U = area unburned.

**Table 24.—Mean monthly minimum litter surface temperature<sup>1</sup> for residue utilization study sites (°F)**

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
<b>Clearcut-B</b>												
1975							46	41	32	30	32	
1976					23	36	48	46	36	28	30	28
1977	28	32		30								32
1978	32	32	32	32	32	39	46	45	45	32	32	32
1979	32	32	32	32*	36*	39	45	46*	39*	34	28	32
1980	32	32	32	32	36*	37	41*			32	25	30
1981	30	32	32		34	36	39*			25	28	32
<b>Clearcut-U</b>												
1975							45	39	32	30	30	32
1976					23	34	45	43	32	27	25	30
1977	28	30		27	28	39						32
1978	32	32	32	32	34	36	45	43	45	32	30	32
1979	32	32	32	32*	36*	39	45	45*	34*	28	21	30
1980	30	30	32	32	30*	39	45*			34	30	30
1981	32	32	32		37	41	45*			30	30	32
<b>Clearcut Block 13-B</b>												
1978	30	30		33*	34	39*						
1979					27*	32*	36	36*	25*	21		
1980				36*	27*	39	43*					
<b>Clearcut Block 13-U</b>												
1978	32	32		32*	34	41*	46	45	46*	30	32	33
1979	32	32	32*		34*	39	41	41*	34*	32	28	32
1980	32	32	32	32	32*	39	45*					
<b>Uncut</b>												
1975							52	48	41	34	34	32
1976					34	39	50	48	41	34	30	30
1977	28	30		32	36	45						

<sup>1</sup>Mean monthly minimum temperature was obtained by dividing the sum of the daily minimum temperatures by the number of days readings were available.

\*Estimated from partial records.

Note: B = area burned; U = area unburned.

**Table 25.**—Mean monthly soil temperature at a depth of 1 inch for residue utilization study sites (°F)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Group Selection													
1975						50	65	55	51	38	31	27	40*
1976	26	27	27	33	49	51	59	56	51	40	29	26	40
1977	26	27	29	40	49	59	60	59	49	40	30	28	41
1978	29	29	29	37	42	55	60	60	56	41	33	33	44
1979	32	32	32*			58			60	46	32	32	45*
1980	32	32	32	40		57	60			46	39	36	44*
1981	35	35	38		54	56	62*			45	39	33	46*
Uncut													
1974						60	62	60	53	45	34	31	45*
1975	31	31	32	33	40	48	60	53	50	41	35	31	41
1976	30	28	30	31	42	46	54	52	50	43	35	31	39
1977	27	30	31	36	43	54	55	57	50	42	34	32	40
1978	32	33	34	38	42	51	55	56	49				41*
Shelterwood													
1974								58	49	40	33	32	42*
1975	31	32	32	33	39	50	60	54	50	39	34	31	40
1976	32	32	33	32	46	51	60	58	54	41	33	32	42
1977	32	32	33	37	47	58	59	59	51	42	34	33	42
1978	33	34	34	35	43	53	58	55	50	44	32	32	42
1979	32												
1980						53	54			40	33	32	43*
1981	31	32	32		46	54	63			42	35	33	43*
Clearcut													
1974						59	54			38	31	29	40*
1975	29	30	28	30	36	48	60	52	46	35	28	27	38
1976	28	28	28	28	46	49	59	56	50	38	29	28	38
1977	27	28	28	34	45	60	60	58	48	38	29	28	40
1978	28	28	28	29	41	54	59	57					39*

\*Estimated from partial records.

**Table 26.**—Mean monthly soil temperature at a depth of 10 inches for residue utilization study sites (°F)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
<b>Group Selection</b>													
1975						46	58	53	50	42	35	31	41*
1976	30	31	30	34	46	49	56	55	50	42	34	31	41
1977	29	30	31	38	47	55	57	57	50	43	35	32	42
1978	32	31	31	37	41	50	55	57			37	36	41*
1979	35	34	34			54							
1980						54	57				41		
1981					51	52	56			45	41	36	44*
<b>Uncut</b>													
1974						59	61	60	52	45	40	36	45*
1975	35	34	35	35	40	48	58	54	51	44	38	34	42
1976	33	32	36	37	46	50	58	59	56	48	41	37	44
1977	33	34	35	39	45	55	57	59	53	47	39	37	44
1978	36	36	36	40	45	52	57	58	52				44*
<b>Shelterwood</b>													
1974								53	46	41	35	33	39*
1975	30	31	31	31	35	46	55	52	50	43	37	35	40
1976	34	34	35	34	43	48	56	57	53	45	38	35	43
1977	34	33	34	35	44	53	56	57	51	43	37	35	43
1978	35	35	34	35	42	48	54	54	50	45			42*
<b>Clearcut</b>													
1974						51	49			37	33	32	40*
1975	31	31	30	32	36	46	58	53	48	39	32	31	39
1976	31	31	31	30	45	49	59	58	53	42	36	32	41
1977	32	32	33	36	47	59	60	59	51	42	34	33	43
1978	33	33	32	33	42	52	58	58	50	41	35	34	42
1979	34	33	32			47			48*	42	33	32	40*
1980	32	32	32	33	43*	48	51			41	34	32	40*
1981	32	32	32		43	45	50			38	35	33	40*

\*Estimated from partial records.

**Table 27.**—Mean monthly soil temperature at a depth of 20 inches for residue utilization study sites (°F)

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Group Selection													
1975						44	52	51	49	44	37	33	41*
1976	33	31	30	32	43	46	52	54	51	45	38	35	41
1977	32	32	33	37	45	52	54	56	52	46	38	35	43
1978	35	34	33	37	42	48	54	56					42*
Uncut													
1974						55	56	56	52	47	42	37	45*
1975	36	35	35	35	39	46	55	54	52	47	40	37	43
1976	36	34	34	35	41	45	51	53	52	47	42	37	42
1977	33	32	34	37	44	50	53	57	53	47	41	38	43
1978	38	37	38	40	45	49	54	55	53				45*
Shelterwood													
1974								49	46	41	37	35	40*
1975	34	32	32	32	35	43	51	50	48	43	38	34	39
1976	34	34	34	32	39	44	51	54	53	47	41	37	42
1977	36	36	35	36	43	50	54	56	51	45	40	38	43
1978	37	37	36	35	41	47	52	54	50	46			42*
Clearcut													
1974						46	46			38	36	34	40*
1975	33	33	31	33	34	42	51	50	46	41	35	33	39
1976	33	33	32	31	40	44	52	52	49	42	36	34	40
1977	33	32	33	33	42	50	52	53	48	42	36	34	41
1978	34	34	33	33	39	47	53	54					41*

\*Estimated from partial records.

Table 28.—Mean daily wind run by month for residue utilization study sites (mi/h) at 10 feet

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Group Selection-N <sup>1</sup>												
1975						1	2	1	1	1	1	1
1976	1	1	1	1	2	1		2	1	1		
Group Selection-D <sup>1</sup>												
1975						2	2	1	2	1	1	1
1976	1	2	2	2	2	2		2	1	1		
Uncut-N												
1973									0	0		0
1974	0	0	0	0	0		0	0	0	0	1	0
1975	0		1	1	1	1	1	1	1	1		
1976	1	1	1	1								1
1977	0	1	1	1								
Uncut-D												
1973									1	0		0
1974	1	0	1	1	1		1	0	0	0	0	0
1975	1		1	1	2	1	1	1	1	0		
1976	1	1	1	1								1
1977	0	1	1	1								
Shelterwood-N												
1974								1	1	1	1	0
1975		0	1	1	1	1		1	1	1	1	1
1976	1		0	1	1	1	1	1	1	1	1	1
Shelterwood-D												
1974								2	2	1	1	0
1975		1	1	1	1	2		2	2	1	1	1
1976	1		1	1	2	2	2	2	2	1	1	1
Clearcut-N												
1973										<sup>2</sup> 0	1	0
1974					0	0	1	0		2	1	1
1975	2	1	2	2	2	2	2	2	2	2	2	1
1976	1	2	2	2	2	2	2	2	2	2	1	2
1977	1	2	2	2								
Clearcut-D												
1973										<sup>2</sup> 0	1	0
1974					1	1	1	1		2	1	1
1975	2	2	2	3	3	3	3	3	3	2	2	1
1976	1	2	2	2	3	3	3	2	2	2	1	1
1977	1	1	2	2								

<sup>1</sup>N = night period is 0100-0700 and 1900-2400.

D = daylight hours are 0800-1800.

<sup>2</sup>Period before cutting.

Table 29.—Mean daily wind azimuth by month for residue utilization study sites at 10 feet

Site	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Group Selection-N <sup>1</sup>												
1975						SW	SW	W	W	SW	SW	S
1976	SW	SW	SW	SW	SW	SW	W	W	W	S		
Group Selection-D <sup>1</sup>												
1975						SE	SE	S	S	SW	S	S
1976	S	SE	SE	SE	SE	SE	SE	S	SE	S		
Uncut-N												
1973									SW	W		W
1974	SW	S	S	S	SW	SW	S	S	SW	SW	W	SW
1975	SW		W	SW	W	W	S	W	W	W		
1976	W	SW	W	W						SW		W
1977	SW	W	SW	W								
Uncut-D												
1973									S	S		SW
1974	SW	S	S	S	SE	SE	SE	SE	SE	S	SW	SW
1975	W		S	S	SE	S	S	SW	SW	SW		
1976	SW	SW	S	S						SE		SW
1977	S	SW	S	S								
Shelterwood-N												
1974								SW	SW	SW	SW	SW
1975		SW	S	S	S	SW	SW	W	SW	SW	SW	S
1976	SW	S	SW	SW	SW	SW	W	SW	W	W	W	SW
Shelterwood-D												
1974								E	SE	SE	S	S
1975		SE	E	E	SE	SE		SE	SE	SE	S	SE
1976	SW	SE	E	SE	SE	E	E	E	S	S	SW	W
Clearcut-N												
1973										<sup>2</sup> S	SE	S
1974				SW	SW	S	SW			W	S	S
1975	SW	S	SW	S	S	SW	SW	SW	SW	SW	S	S
1976	SW	S	S	S	S	S	SW	SW	SW	SW	SW	SW
1977	SW	S	S	SW								
Clearcut-D												
1973										<sup>2</sup> S	SE	SW
1974				S	S	S	SE			S	SE	SE
1975	S	SE	S	S	SE	SE	E	SE	S	S	S	SE
1976	S	S	SE	SE	E	E	E	SE	SE	SE	S	S
1977	S	S	S	SW								

<sup>1</sup>N = night period is 0100-0700 and 1900-2400.

D = daylight hours are 0800-1800.

<sup>2</sup>Period before cutting.

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Hungerford, Roger D.; Schlieter, Joyce A. Weather summaries for Coram Experimental Forest, northwestern Montana—an International Biosphere Reserve. General Technical Report INT-160. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station; 1984. 34 p.

Presents weather data summaries (1934-82) for most of the weather stations within the Coram Experimental Forest (a Biosphere Reserve) in northwestern Montana and for three stations adjacent to the Forest. These data aid in the interpretation of silvicultural and other biological research, particularly the relationships of climatological variations to forest growth and productivity.

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**KEYWORDS:** climate, weather, temperature, precipitation, solar irradiance, frost-free, northwestern Montana, Biosphere Reserve

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The Intermountain Station, headquartered in Ogden, Utah, is one of eight regional experiment stations charged with providing scientific knowledge to help resource managers meet human needs and protect forest and range ecosystems.

The Intermountain Station includes the States of Montana, Idaho, Utah, Nevada, and western Wyoming. About 231 million acres, or 85 percent, of the land area in the Station territory are classified as forest and rangeland. These lands include grasslands, deserts, shrublands, alpine areas, and well-stocked forests. They supply fiber for forest industries; minerals for energy and industrial development; and water for domestic and industrial consumption. They also provide recreation opportunities for millions of visitors each year.

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