Return to Joe Caprio
8701 Kolb Rd. (18-272)
Tucson, AZ

State Climate Center
Circular No.2

A COLLECTION OF THE ANNUAL "REPORTS TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES" AND RELATED PHENOLOGICAL INFORMATION FOR THE PERIOD 1956-1992.

Joseph M. Caprio
Professor and State Climatologist
Plant and Soil Science Department
Montana Agricultural Experiment Station
Bozeman, Montana

JUNE, 1993

A Report to Cooperators of Lilac Bloom Survey (Spring, 1956)

by Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
April, 1957

In order to learn more about the climate of Montana and to have a better basis for making garden and crop varietal recommendations, the Montana Agricultural Experiment Station conducted a survey of lilac bloom last spring with the cooperation of the U. S. Weather Bureau and the various garden clubs throughout the state. Approximately 200 cooperators sent the dates of beginning, peak, and final withering of the lilac bloom to the Montana Agricultural Experiment Station at Bozeman where analyses were made to determine the relation between environment and plant development.

Experiments have shown that certain plants (the lilac being one of these) are good climatic indicators and reflect accumulated heat units available for crop development. There is also evidence which suggests that plant development is related to the amount of water extracted from a soil well supplied with moisture.

Since indicator plants are widely distributed and available for observation purposes, they can serve as "measuring sticks" of local climatic differences. For example, reports on stages of plant development from many locations within an agricultural area may point out climatic differences which are the cause of success or failure in growing certain varieties of crops and garden plants.

You may be interested to know that a number of countries throughout the world have well-organized phenological networks (a term applied to observations of plant development) somewhat similar to the Weather Bureau's climatological network. Phenological observers report stages of plant development just as the climatological observer reports weather data. This information has been used very effectively to learn more about their climates, to assist in the farm planning program, and as a basis for making crop varietal recommendations.

The lilac bloom survey conducted last spring with your help has provided useful information about the climate and plant development in this state. These data were plotted on maps and "early" and "late" areas were determined. Statistical analysis of this information indicates that latitude and elevation were significantly correlated with dates of lilac bloom. It was found that the season was retarded about one day for each 20 miles of northward distance. The bloom was also delayed one day for every 200 feet increase in elevation. Differences were also found between mountain and plains locations.

As more information is accumulated, analyses will be made to determine the relation between weather measurements at the climatological stations and plant development.

Figure 1 shows when lilacs came into bloom throughout Montana in the spring of 1956. Early areas, indicated by horizontal lines, bloomed before May 20. Locations with no lines were intermediate with bloom beginning between May 20 and May 25, and the areas of slanted lines were last with the onset of bloom coming after May 25. Due to the scarcity of reports and the great influence of the irregular terrain above 5,000 feet, this initial analysis does not extend to higher elevations.

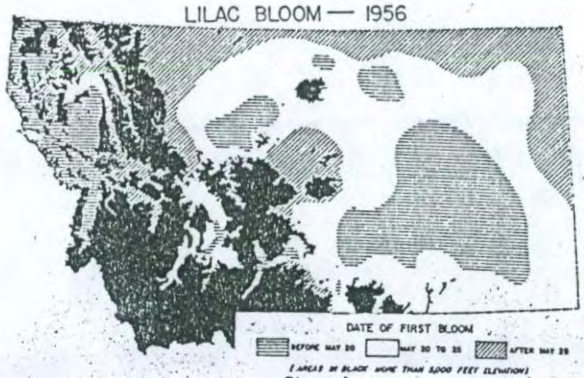


Figure 1

Two large early blooming areas are shown on this map, one in the east-central part of the state and the other in the far western valleys. Earliest reports of bloom dates came from Hardin (elevation 2,895 feet) in southeastern Montana. Included in the early eastern section are Ashland, Billings, Bruset, Custer, Melstone, Miles City, and Roundup. Observations of bloom in this region came mostly from river valleys and it is quite possible that there are later locations within this general area, especially at higher elevations.

Stations reporting early bloom in the far western region are Darby, Heron, Libby, Missoula, Polson, Rexford, Superior, and Thompson Falls. Reports of early bloom also came from some valleys in the southwestern part of Montana including Big Timber, Bridger, Ennis, Livingston, and the Three Forks – Toston area. A number of reports of early bloom also came from the north-central part of the state, including locations in and near Great Falls and Highwood and the towns of Chinook and Dodson.

Lilacs bloomed late in the northern communities bordering Canada and in some of the mountain valleys of the west. Latest reports of bloom dates came from Elliston (elevation 5,075 feet) in west-central Montana. Among the stations reporting late bloom are Augusta, Hogeland, Opheim, Ovando, Scobey, and Sweetgrass.

Figure 2 shows the duration, in days, of the period between the beginning and end of the lilac bloom. Lilacs remained in bloom less than 14 days where there are horizontal lines, and more than 20 days in regions covered by slanted lines. This map tends to reflect the weather which occurred during the blooming period and could provide a basis for understanding relationships between weather and plant development.

Figure 2

For the state as a whole, it required an average of 7 days for the lilacs to advance from opening of first bloom to the date of peak of full bloom, and 9 days to develop from peak of full bloom to end of bloom. The highest station reporting lilac bloom was Lima in southwestern Montana with an elevation of 6,265 feet and the lowest station to report lilac bloom was Hinsdale in the northeastern section which has an elevation of 2,170 feet.

After reviewing results of the lilac survey conducted in Montana last year, agricultural scientists attending a regional project meeting for eleven western states in Bozeman this winter decided that a similar survey would be desirable for their areas. The Weather Bureau, through their cooperative climatological observers, is helping this spring to obtain the needed phenological information over the entire western area from Montana to New Mexico and westward to the Pacific coast.

Since lilacs were not available for observation purposes in some parts of Montana last spring, an alternative indicator plant, the large common caragana (also known as the Siberian pea) is listed for this year's survey. The red berry pyracantha is being used as the alternative plant in the other western states with the exception of Idaho and Wyoming where the caragana is also being observed.

This report is being sent to garden clubs and the selected list of climatological observers prepared by Mr. R. A. Dightman, State Climatologist, for last year's survey. It is felt that some of you who could not or did not care to participate in the survey last year may be interested in this report and might have located a common purple lilac or be able to report on the alternative plant this spring.

TABLE OF CONTENTS

166-171	1978	Nov. 30, 1978	1L	1	Av. length of zabeli bloom period
172-177	1979	Dec. 15, 1979	1L	1	Days lilac begin bloom to wheat 1/10 bloom
178-184	1980	Dec. 22, 1980	2LH	---	
185-190	1981	Dec. 18, 1981	2LH	---	
191-195	1982	Nov. 15, 1982	2LH	---	
196-199	1983	Nov. 28, 1983	2LH	---	
200-206	1984	Dec. 14, 1984	2LH	---	
207-212	1985	Nov. 25, 1985	2LH	---	
213-216	1986	Dec. 10, 1986	2LH	---	
217-220	1987	Dec. 8, 1987	2LH	---	
221-224	1988	Dec. 28, 1988	2LH	---	
225-228	1989	Dec. 28, 1989	2LH	---	
229-232	1990	Dec. 21, 1990	2LH	---	
233-242	1991	Dec 20, 1991	2LH	---	
243-246	1992	Dec 30, 1992	2LH	---	

* See list of other charts and/or maps below.

** Honeysuckle maps for these years show only days departure from normal. Isophanal lines are not included on the map. Anomalies are for the medians of begin bloom dates for the years 1968 to 1992. Anomalies are given only for those locations that had at least four years of data during the 1968-1992 period.

MAPS INCLUDED UNDER THE PHENOLOGICAL YEAR INDICATED OTHER THAN HONEYSUCKLE AND LILAC BEGIN BLOOM ANOMALY MAPS

1957

a. Dates when lilac started to bloom at various elevations in 1957. (27 maps)
b. Elevations at which lilac started to bloom on various dates in 1957. (3 maps)

1958

a. Dates when lilac started to bloom at various elevations in 1958. (27 maps)
b. Elevations at which lilac started to bloom on various dates in 1958. (3 maps)
c. Number of days difference at various elevations between dates of lilac bloom in 1958 and 1957. (5 maps)

1959

a. Dates when lilac started to bloom at various elevations in 1959. (27 maps)
b. Elevations at which lilac started to bloom on various dates in 1959. (3 maps)
c. Number of days difference at various elevations between dates of lilac bloom in 1959 and 1958. (6 maps)
d. Date when winter wheat reached combine ripe stage at various elevations in 1959. (27 maps)
e. Elevations at which winter wheat reached combine ripe stage on 4 different dates. (4 maps)
f. Principal varieties of wheat reported at 4 different elevation ranges. (4 maps)
g. Dates when wheat was seeded at 4 different elevation ranges. (4 maps)

1960

a. Dates when lilacs started to bloom at various elevations in 1960. (27 maps)
b. Elevations at which lilac started to bloom on various dates in 1960. (3 maps)
c. Number of days difference at various elevations between dates of lilac bloom in 1960 and 1969. (6 maps)
d. Average date when lilacs began to bloom (Montana).

1961

a. Average date when alfalfa reach 1/10 bloom (Montana).
b. Average date when lilacs begin to bloom (Montana).
c. Above data for 239 communities in Montana (Table).
d. Average dates when lilac starts to bloom at different elevations (based on period 1957-1961). (27 maps)
e. Average elevations when lilac started to bloom on various dates (based on period 1957-1961). (3 maps)
f. Lilac anomaly maps for 6 different elevations (based on 1957-61 normal). (6 maps)

1963

a. Normal length of lilac bloom period in days. (1 map)
b. Departure of end lilac bloom date from normal. (1 map)
c. Departure of wheat headed date from normal. (1 map)
d. Departure of wheat combine ripe date from normal. (1 map)

1964

a. Average date when alfalfa reaches 1/10 bloom stage. (1 map)
b. Departure of average March-May temperature from normal in 1964 for the United States. (1 map)

1967

a. Average dates lilac started to bloom at 6 elevations (based on 1957-1961 data). (6 maps)
b. Average elevations at which lilac started on 7 different dates (based on 1957-1961 data). (7 maps)
c. Latitudinal progression of lilac begin bloom (based on 1957-1961 data) (1 map)
d. Elevation progression of lilac begin bloom (based on 1957-1961 data) (1 map)
e. Orientation of isophases of begin lilac bloom (based on 1957-1961 data) (1 map)
f. Zones of departure of actual begin lilac bloom date from map indicated average date (1957-1961) (1 map)

1968

a. Days adjustment of 1957-1961 begin lilac bloom equal level isophanal maps to obtain the 10-year (1957-1966) normal (1 map)

1969

a. Standard deviation of plant development (lilac) based on 1957-1966 period (1 map)

1971

a. Relation between daily values of solar radiation, mean temperatures and Solar-Thermal Units (1 map)

1972

a. Average date of green wave passage - Northern Hemisphere (1 map)

1973

a. Northern Hemisphere map of average date when lilacs begin to bloom (1 map)

1977

a. Difference in days between average dates when lilac and honeysuckle begin to bloom (1 map)

1978

a. Average length of Zabeli honeysuckle bloom period in days (1 map)

1979

a. Average interval (days) from date of begin lilac bloom to date when dryland winter wheat is ten percent headed (1 map)

Introduction

In an effort to learn more about the effects of weather on the areal and temporal variations of plant development, a phenological network of observers was established throughout the western United States in the spring of 1957 to report on several phases of the purple common lilac. This network was established by the Montana Agricultural Experiment Station as a contributing project to Regional Project W-48 of the Western Experiment Stations entitled "Climatic Patterns for Agriculture."

The Montana Agricultural Experiment Station had initiated a phenological network of about 150 observers of purple common lilac in the spring of 1956. Observers of the 1956 Montana survey were largely members of local garden clubs and Weather Service climatological observers who volunteered to assist by observing already established purple common lilac plants for three flowering phases: begin, peak, and end of bloom. After reviewing the geographical pattern of dates of bloom developed from the initial 1956 Montana network, the Technical Committee for Regional Project W-148 decided that the network should be extended throughout the entire 11-state area of the Western Region. In 1970 Texas became the twelfth state to be included in the network.

With the cooperation of Weather Service climatological observers and others who volunteered to help with the observations, a region-wide network of more than 1,200 phenological observers of the purple common lilac was established in the spring of 1957. About two-thirds of the cooperators were Weather Service climatological observers. Most of the other observers were enlisted through the cooperation of agricultural county agents and farm advisors.

After data became available for the 5-year period, 1957-1961, maps were drawn showing departures from normal dates of bloom. The normal date of begin bloom for each site was considered to be the medium date of the 5-year record. Because of the high labor input required to develop these anomaly maps, only the date of begin bloom was selected for map analysis.

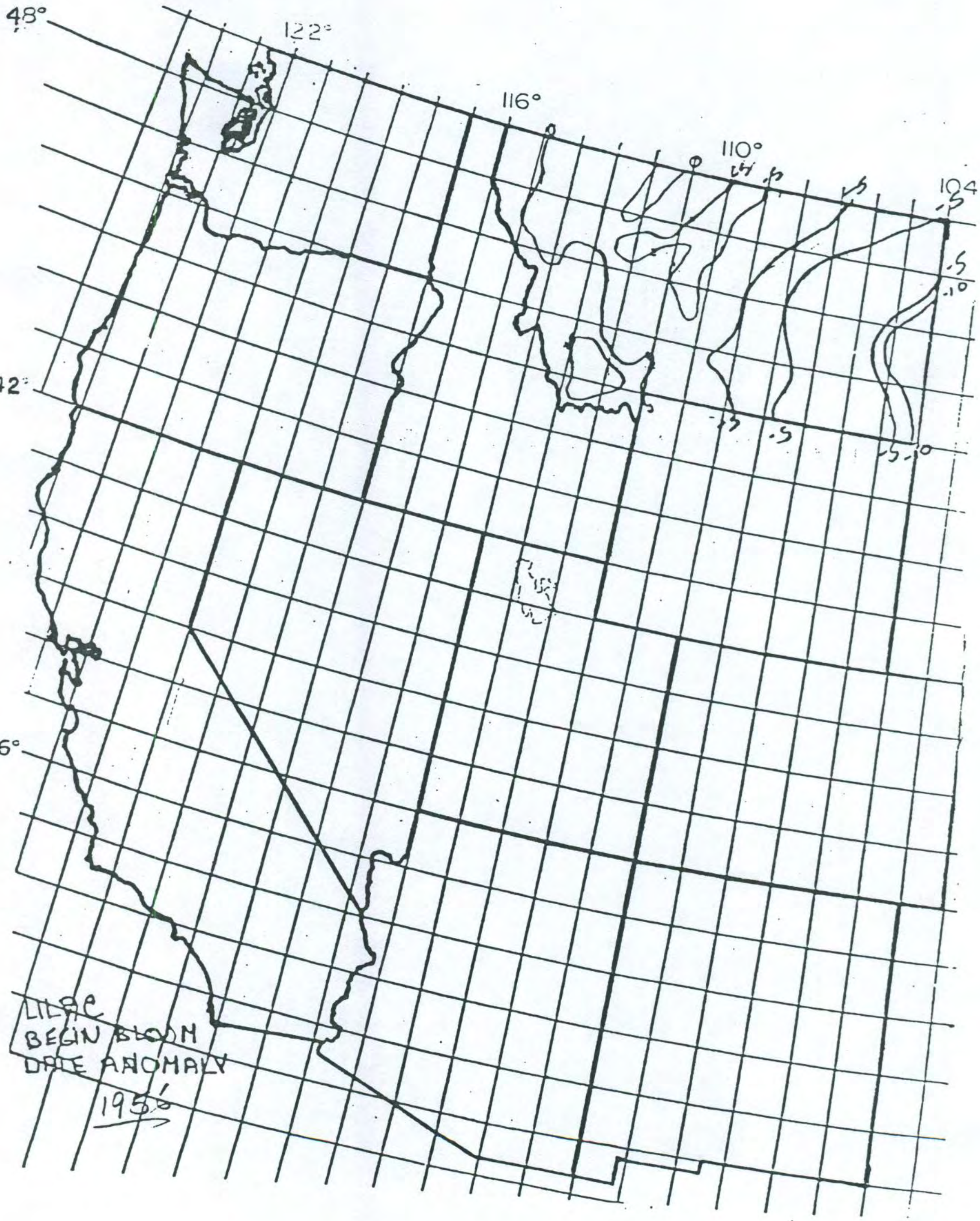
Annual anomaly maps of begin bloom were drawn for each year since 1961 and were included in the Annual Report to Phenological Cooperators. Some of these maps were published in the National Weekly Weather and Crop Bulletin.

After the 10-year record from 1957 to 1966 became available, anomaly maps were based on station mediums for this longer period of record. Analyses of the difference in the medium dates of the 5-year, 1957-1961, records compared to the median dates of the 10-year, 1957-1966, record indicated that changes in the medium dates generally varied only by about a day or two. The annual anomaly maps for the first five years, 1956-1964, were drawn later using station medium dates for the 10-year period, 1957-1966. The anomaly maps for 1956-1964 are included in this circular but were never included in a Report to Cooperators.

Since the network of observers was more dense during the earlier years of the phenological survey, greater detail is evident in the anomaly maps of the earlier years compared to those of the later years. Less detail is especially noticeable since the late 1970's when the number of observers dropped to about 500 observers.

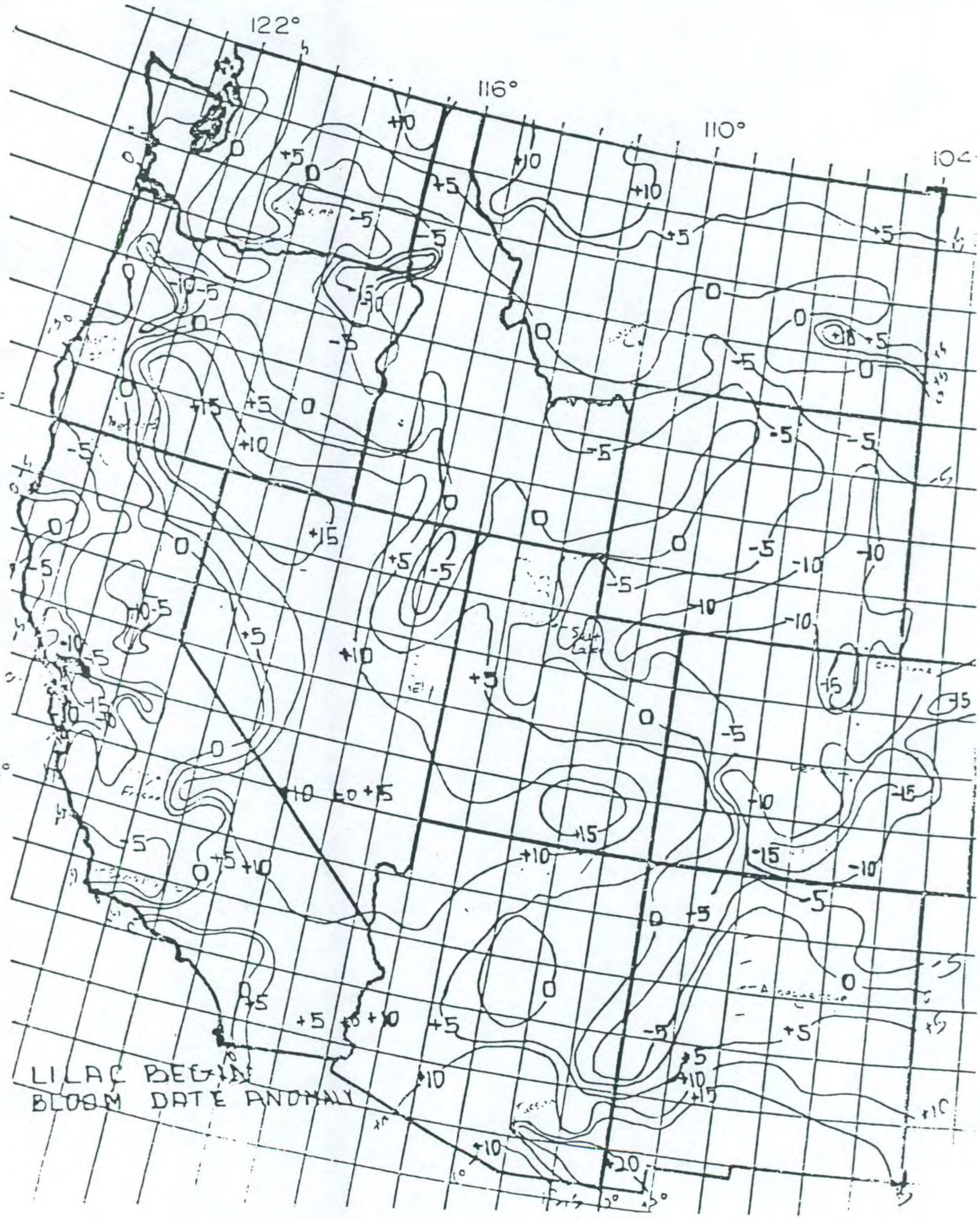
While regional anomalies for such climatological elements as precipitation and temperature are routinely published, very little information is available on regional anomalies of plant development. It is hoped that this unique record of region-wide anomalies of plant development will be helpful to agriculturists, foresters, ecologists, and others.

NOTE: When this project was began in 1956, the U.S. Weather Bureau was the proper name of the organization. Since then the name has been changed to the U.S. Weather Service, but we have continued to use the term "Weather Bureau" for phenological identification purposes.



48°
122°
116°
110°
104
42°
36°
LILAC
BEGIN BLOOM
DATE ANOMALY
1956

1957



A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE U. S. - SPRING 1957

by Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
Bozeman, Montana
February 13, 1958

Studies of periodic biological phenomena in relation to the environment, often referred to as phenology, are being made throughout the Western Region in order to learn more about climate and its relation to agriculture. In the spring of 1956, the Montana Agricultural Experiment Station, in cooperation with the U. S. Weather Bureau and local garden clubs began a survey of various stages of development of the common purple lilac. After reviewing the results of the Montana survey the Technical Committee for Regional Project W-48 decided that the phenological survey should be extended throughout the entire area of the 11 western states. In the spring of 1957 reports on dates of three stages of lilac bloom were received from about 1,200 observers in the Western Region. Additional reports were obtained for two alternative plants, the red berry pyracantha and the large common caragana.

Because of the ruggedness of the terrain over much of the Western Region, phenological and climatic analyses are very difficult to make, and the results are of questionable accuracy when presented on small single maps which contain data from all elevations. The <u>300 foot elevation interval isophanal maps</u> presented in this report were constructed in order to circumvent some of the disadvantages of analyses in which one map is used for a wide range of elevations.

An <u>isophane</u> is a line connecting points where plants reach a given stage of development on the same date. These isophanes correspond to lines of equal rainfall (isohyets) or equal elevations on a topographic map. The amount of data received for the lilac was adequate to construct the 300-foot interval isophanal charts presented in this report for date of first bloom. There were not enough reports on the pyracantha and caragana to permit a similar analysis of these two plants. Nevertheless, the information obtained on the alternative plants will contribute to our understanding of the relation between weather and plant development. The data on peak and end of bloom are presently in process of analysis and for this reason are not presented here.

Temperatures usually tend to decrease very rapidly as elevation increases and dates of lilac bloom are correspondingly much delayed at higher altitudes. Previous studies have demonstrated that this delay averages about 1 day for every 100 feet increase in altitude. Therefore, the greatest error due to elevation differences on any 300-foot interval isophanal chart would normally be only $1\frac{1}{2}$ days. The average error due to elevation difference is less than one day. The <u>300 foot interval</u> is used because the 3-day difference in bloom dates normally found in this elevation range is not considered excessive in view of the fact that local factors such as soil, slope, etc. could easily cause this kind of variation. An analysis over such a tremendous area as the 11 western states with the amount of data available could not hope to give detail which can account for these local factors of exposure and soil conditions.

Analyses of beginning of lilac bloom have been made for every 300-foot interval of elevation starting at sea level and extending to an altitude of 7,800 feet. Perhaps with additional reports in subsequent surveys it will be possible to draw maps for even higher altitudes. The analytical procedure involves first the plotting and analysis of all data reported within each 300-foot elevation <u>range</u> on single maps. Second, the construction, from these preliminary isophanal maps, of a cross-section for every one degree latitude. Third, the plotting of the final isophanal maps--one for every 300-foot elevation <u>interval</u>--from the smoothed cross-sectional analysis. This presentation has the advantage of permitting the determination of the general bloom date quite accurately for any location providing the elevation and approximate location are known. To obtain an estimate of the date of bloom for any place in the Western Region one simply enters his location on the map which includes his particular elevation.

The maps tend to reflect date of bloom under average environmental conditions during the spring of 1957, in the various localities. Some insight as to local conditions might be obtained however, by determining the difference between the date of lilac bloom as actually observed at a particular location and as indicated by the isophanal maps. Cold or retarded local areas will tend to report bloom dates which are later than indicated by estimation from the isophanal maps. A similar analytical procedure is under study to map various climatic elements, particularly thermal factors, so that the relation between weather and plant development can be more thoroughly understood and greater use can be made in agriculture of the available climatic data.

The isophanes on most of the maps are generally oriented in an east-west direction, but at lower elevations along the coast in California the lines run more north and south, tending to parallel the coast. In this area distance inland appears to have more influence on the advance of lilac bloom than distance in the southward direction. Also the usual relation of later bloom date with higher elevations does not appear to apply in some places in California at low altitudes (from sea level up to about 2,000'). The reports suggest that bloom is actually earlier at higher levels in this area than at the lower elevations. Those general areas with the inverted condition are indicated on the maps by dotted isophanes. The same inverted condition is shown for southern Arizona and New Mexico (up to about 3,500'). However, more reports will be needed before it can be definitely established just exactly where this condition prevails. A possible explanation for the apparent inverted condition may be related to the dormancy requirement of the lilac. Higher temperatures aloft than near sea level may also be linked to this phenomenon.

An interesting feature of the phenological maps is the "early ridge" which appears in the central part of the Western Region running north and south. The ridge appears to shift eastward with increasing elevation particularly in central and southern areas.

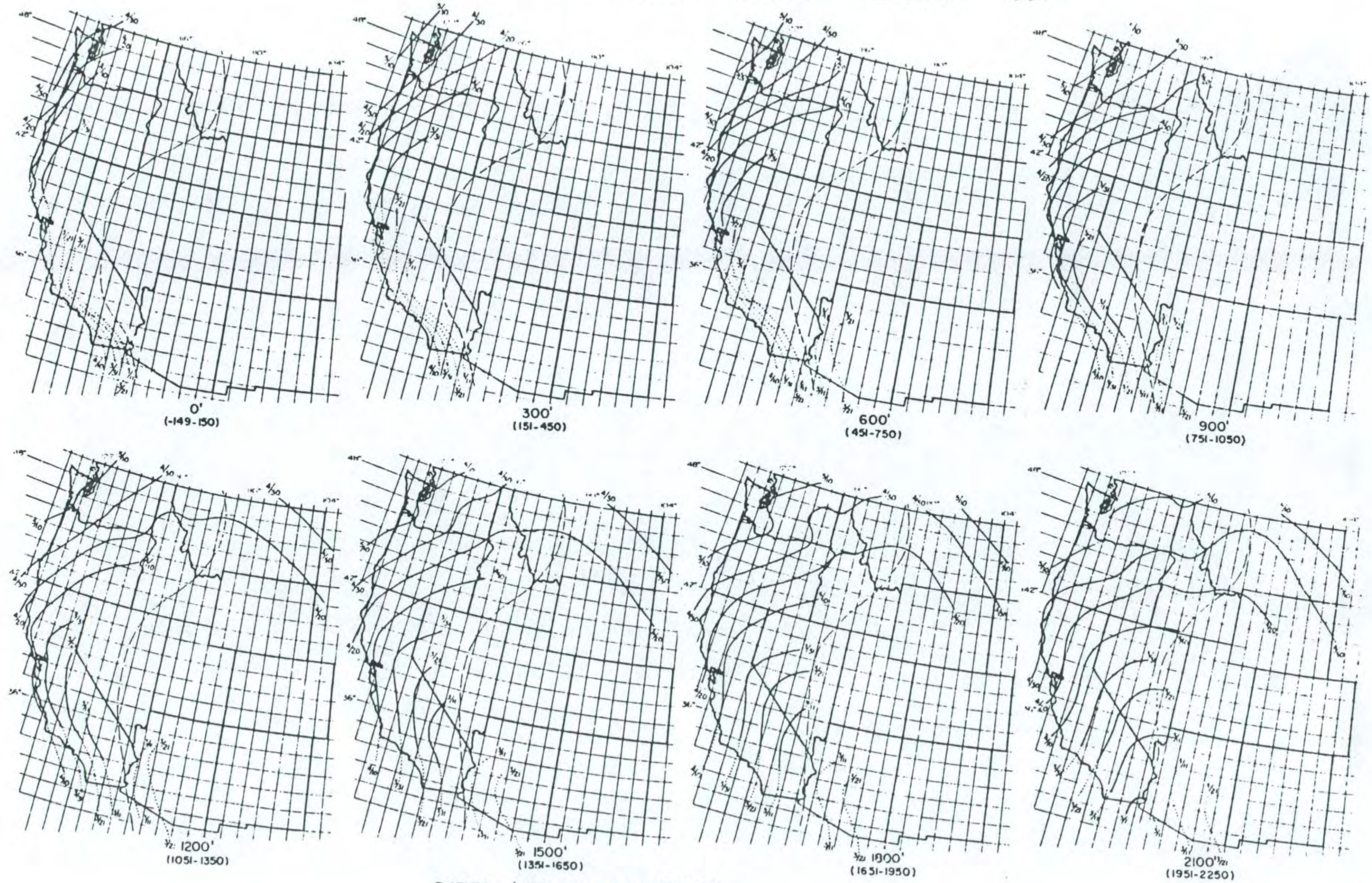
The three maps on the last page indicate where lilacs began to bloom on April 10, May 10 and June 9 respectively. In this case the lines indicate at which elevation the bloom began on the particular date. Similar maps can easily be constructed for any day from the 300-foot interval isophanal maps. Many interesting comparisons can be made from these maps. For example, lilacs began to bloom near sea level in northwestern Washington on May 10 and on the same day lilacs were also starting to bloom at 7,500 foot elevation in southern Arizona.

Observations on the date when the lilac seed pod matures may be made this summer in order to understand more about the number of "heat units" available for plant development during the growing season. The survey may also be extended to agricultural crops, such as winter wheat and alfalfa, through the assistance of the county agricultural agents in the Western Region who would enlist the cooperation of individual farmers. This data is being collected and analyzed for the purpose of learning more about climate and for application in agriculture.

As more is learned about the configuration of the isophanes at different levels, it may become possible to devise a system of phenological analysis utilizing machine-computing methods. One possible development of the phenological survey may be the forecasting of when various crops will reach given stages of maturity, such as headed, combine-ripe, etc. Perhaps you can tell us of some direct use of the isophanal maps contained in this report or of similar maps which may be prepared for agricultural crops. If so, we shall be glad to hear from you.

Your assistance in making this survey possible is very much appreciated.

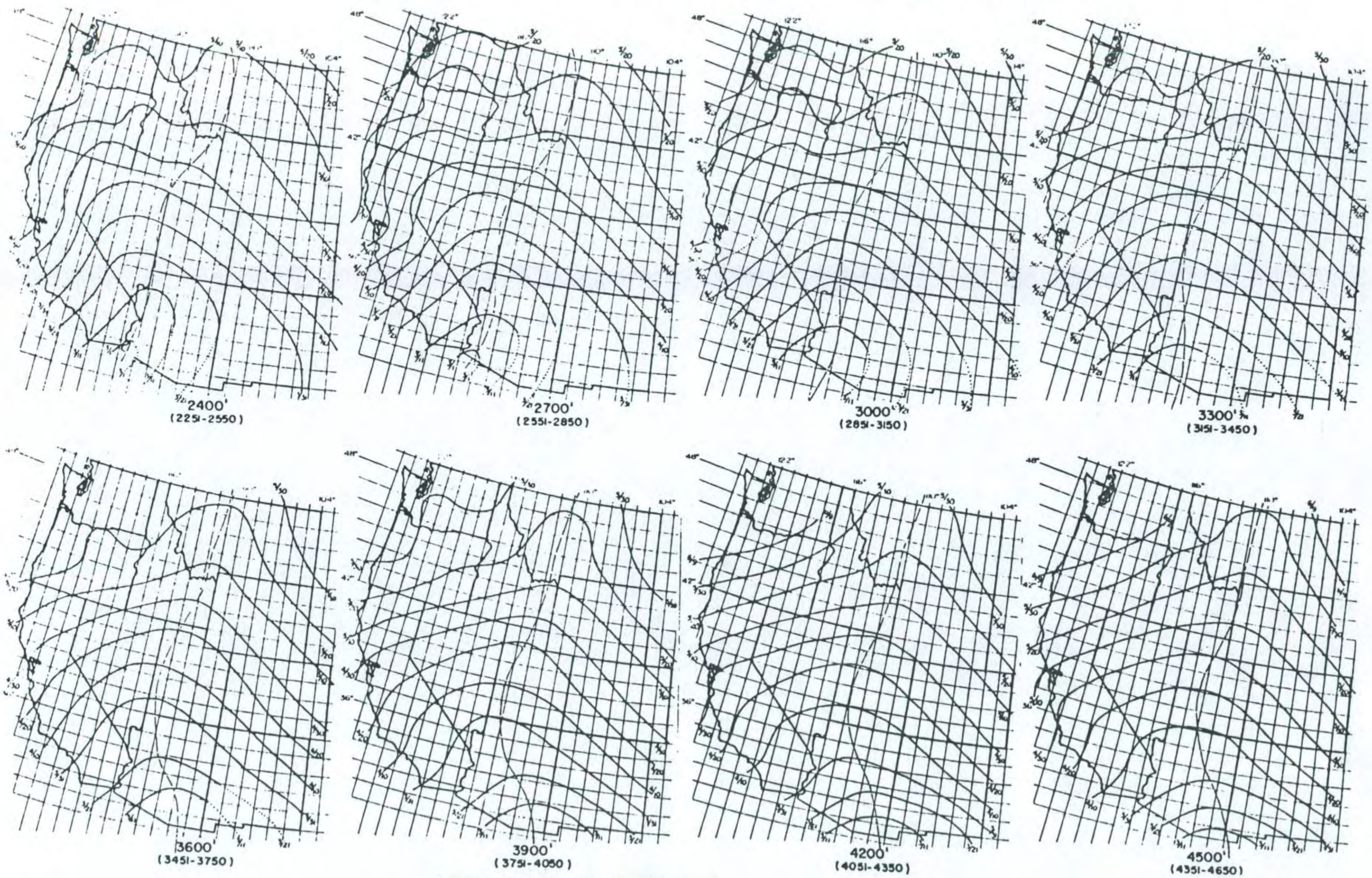
DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1957



DATES (10 DAY INTERVALS)
EARLY RIDGE
GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

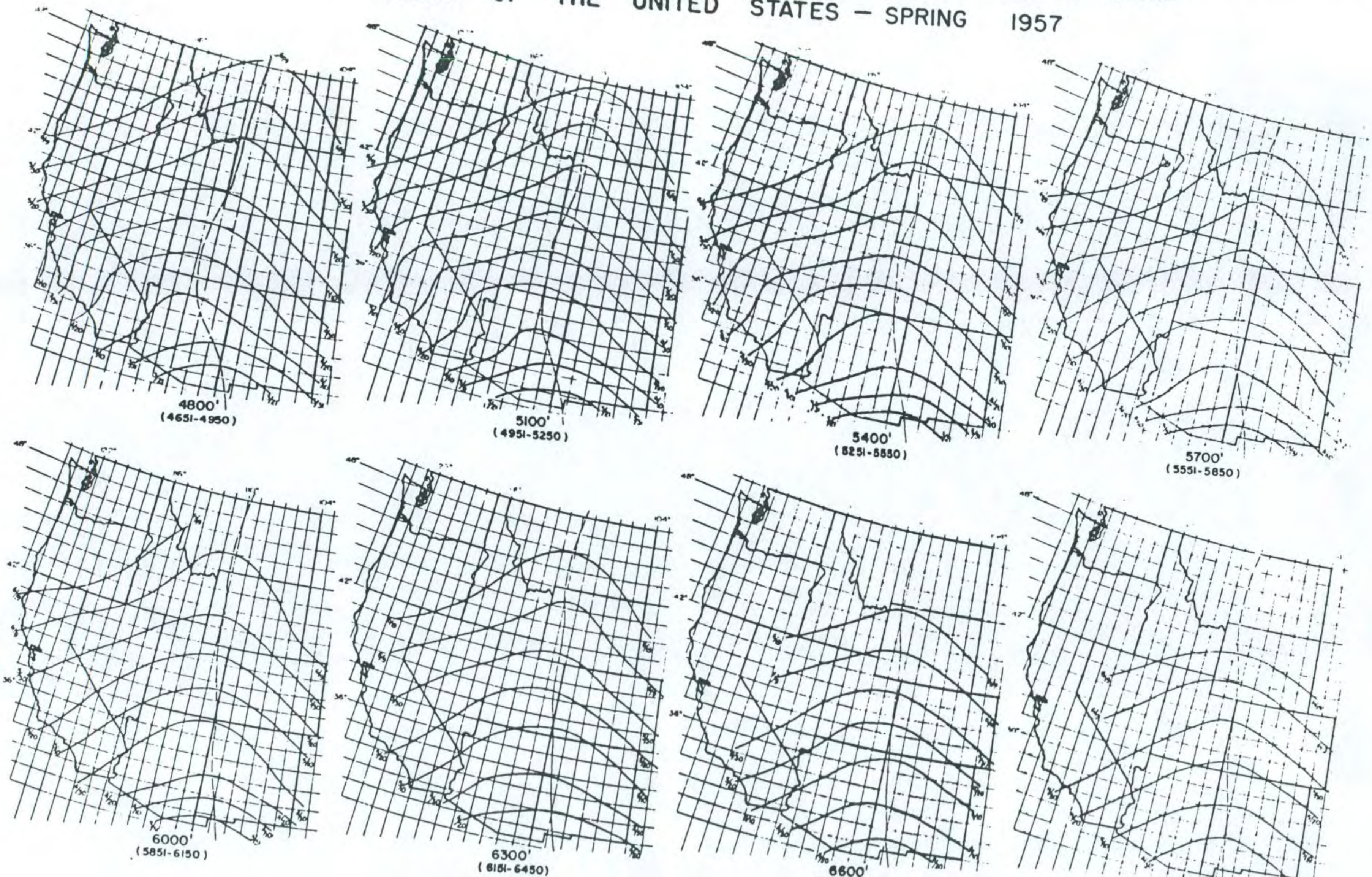
GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1957



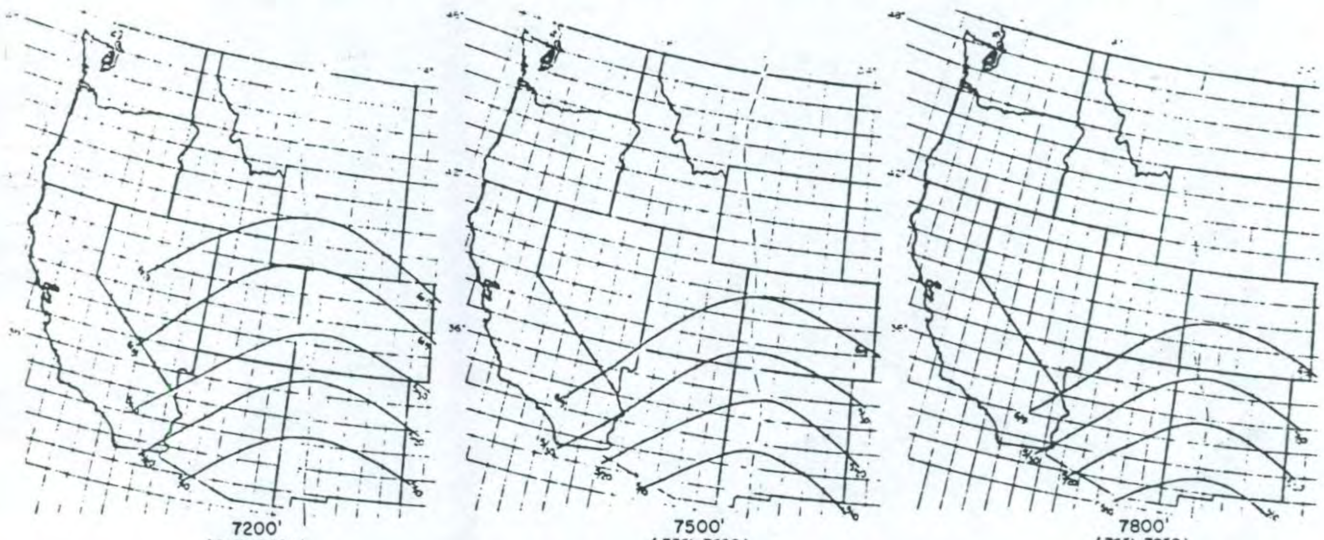
——— DATES (10 DAY INTERVALS)
– – – – EARLY RIDGE
.... GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES – SPRING 1957



——— DATES (10 DAY INTERVALS)
- - - - EARLY RIDGE

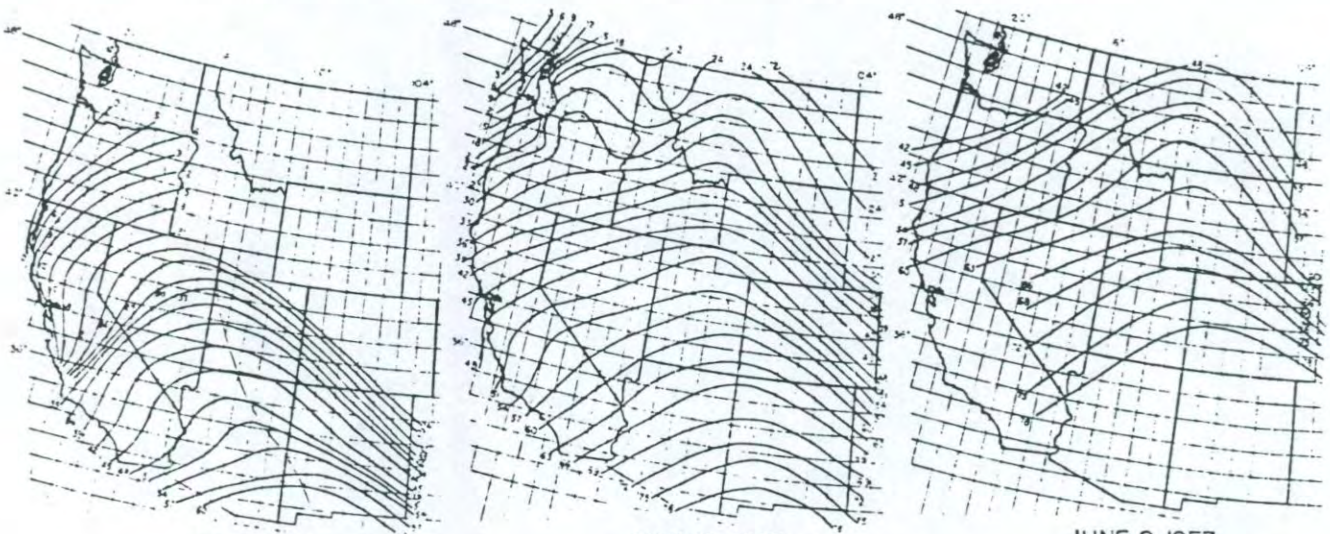
DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1957



7200' (7051-7350) | 7500' (7351-7650) | 7800' (7651-7950)

——— DATES (10 DAY INTERVALS)
– – – – EARLY RIDGE

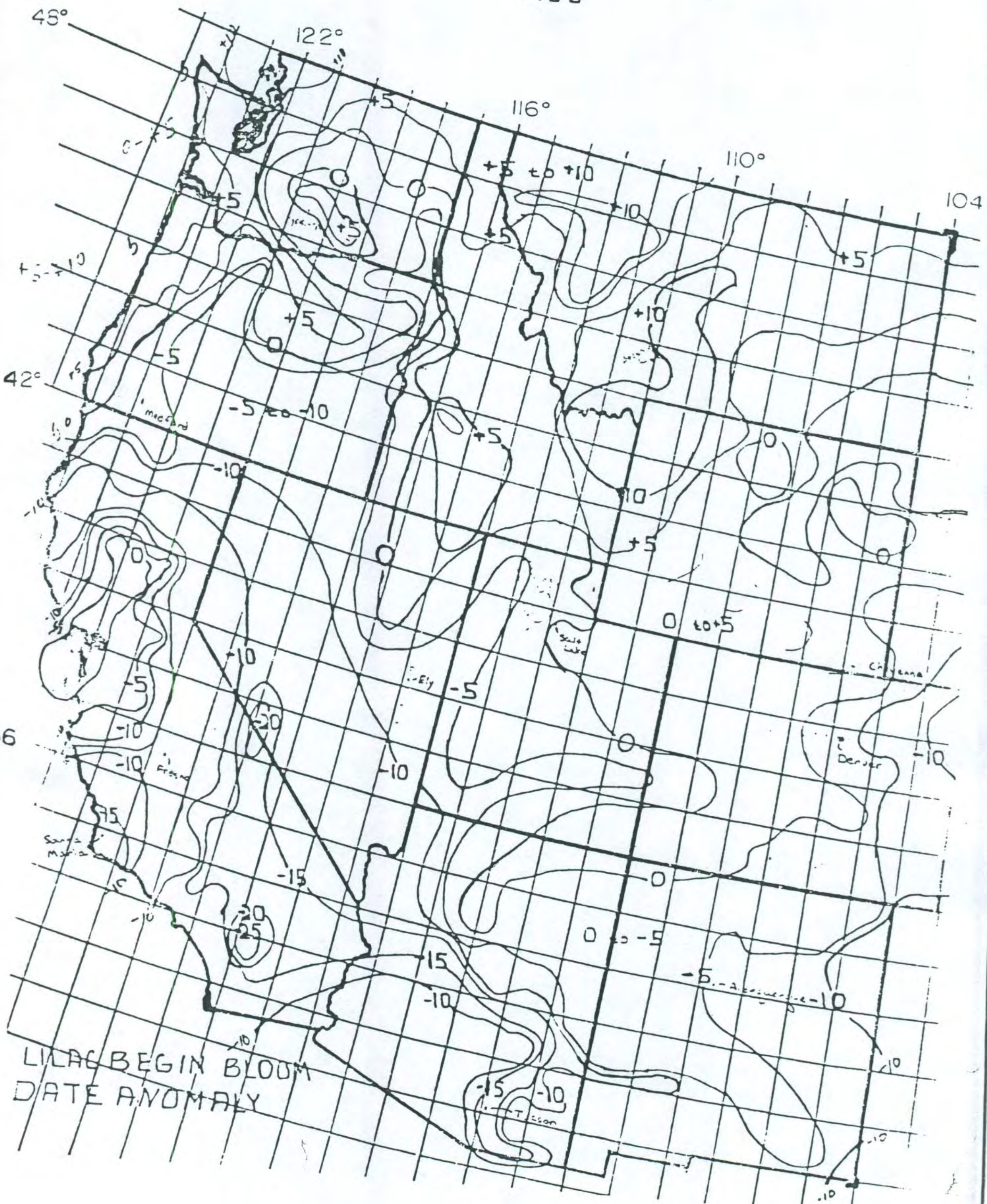
ELEVATIONS AT WHICH THE COMMON PURPLE LILAC STARTED TO BLOOM ON VARIOUS DATES THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1957



APRIL 10, 1957 | MAY 10, 1957 | JUNE 9, 1957

——— ELEVATIONS (300 FOOT INTERVALS)
– – – – EARLY RIDGE
· · · · · GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

1958



48°
122°
116°
110°
104
42°
36
+5
0
+5 to +10
+10
+5
+10
-5
-5 to -10
-10
0
0 to +5
+10
-5
-10
-20
-15
-20
-25
-15
-10
0
0 to -5
-5
-10
-15
-10
Medford
Salt Lake
Ely
Fresno
Santa Maria
Cheyenne
Denver
Albuquerque
Tucson
LILAC BEGIN BLOOM
DATE ANOMALY

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE U. S. - SPRING 1958

Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
Bozeman, Montana
February 2, 1959

This report presents an analysis of the second survey of dates when lilacs bloomed in the western region of the U. S. The first regional survey was conducted in the spring, 1957. The analysis is based on about 1200 reports on bloom dates of the common purple lilac for the spring of 1958. Cooperators include U. S. Weather Bureau climatological observers, members of garden clubs, farmers, and others living in the area.

Reports were received on dates of three stages of bloom--beginning of bloom, peak of full bloom, and final fading of bloom. Similar data were reported for two alternative plants, the red berry pyracantha and the large common caragana. Although information on alternative plants is useful, regional mapping is not possible because these plants are not as widely distributed as the lilac, and few reports are available.

The analytical mapping procedure used this year is the same used for last year's analysis. Only analyses of beginning dates of lilac bloom were mapped for this report.

An isophane is a line connecting points where plants reached a given stage of development on the same date. These isophanes correspond to lines of equal rainfall (isohyets) or equal elevations on a topographic map. Isophanes are drawn for 5-day intervals in this report whereas 10-day intervals were used last year. Mapping involved first plotting and analyzing all data reported within each 300-foot elevation range on single maps. Second, constructing from these preliminary isophanal maps, a cross-section for every one-degree latitude. Third, plotting the final isophanal maps--one for every 300-foot elevation interval--from the smoothed cross-sectional analysis.

This presentation has the advantage of permitting the general bloom date to be determined quite accurately for any location providing elevation and approximate location are known. To get an estimate of bloom date for any place in the western region you enter your location on the map which includes your particular elevation.

In general, there is a marked resemblance between 1957 and 1958 in the regional patterns of the isophanal maps at all elevations. However, outstanding differences are also evident.

One conspicuous similarity in maps for both years is the early ridge. This is a line connecting the most northern points of the various isophanes. It is the line connecting points on the various latitudinal lines where lilacs bloomed earliest. As in the first survey, this line tends to be in the central part of the western region. In 1958, the ridge appears to have shifted somewhat more to the east in central and southern areas, particularly at elevations up to about 4000 feet.

Another similarity between the two years is the tendency of isophanes to parallel the coast of California at lower elevations. This tendency appeared to extend from sea level to the 3000-foot elevation in 1958, while in 1957 the isophanes paralleled the coast only up to about 1500 feet.

The northward bulge in the isophanes, apparent in Oregon and Washington last year, does not appear on the 1958 maps. Also, the tendency for the relation between bloom dates and elevation to be inverted from the normal condition was not evident at lower elevations in California in 1958. However, an inverted area does seem to occur between 3000- and 4000-foot elevations in parts of California. (Normally plants bloom later as elevation increases. This averages about 1 day later for every 100-foot increase in elevation. The inverted condition means that bloom dates occur earlier as elevation increases.)

The three maps on the bottom of page 6 indicate where lilacs began to bloom on April 10, May 10 and June 4, respectively. In this case, the lines indicate the elevation at which bloom began on the particular date. June 4 map is used this year rather than June 9 because bloom was earlier in 1958 in northern areas at high elevations, and most locations had already begun to bloom by June 9, 1958. Again interesting comparisons can be made. For example, lilacs were just beginning to bloom at elevations near sea level along the coast of northern California and southern Oregon on April 10. On the same date, lilacs were also coming into bloom at 4500-foot elevations in southern Arizona and New Mexico. A comparison on the May 10 map shows that lilacs were just beginning to bloom at 1800-foot elevations in northern Montana and on the same date lilacs were also beginning to bloom at 7200-foot elevations in southern Arizona and New Mexico.

The maps on the last page show the number of days difference between the dates of lilac bloom in 1958 and 1957 for five different elevations--300, 1500, 3000, 4500, and 6000 feet. Plus signs indicate earlier bloom in 1958 than in 1957, and minus signs indicate later bloom in 1958.

Locations near sea level in the Northwest, as indicated on the 300-foot elevation map, were in bloom more than a week earlier in 1958 compared to the previous year. In general, bloom occurred about the same time in both years along the coast of California but tended to be later in 1958 at inland, low-elevation locations particularly in the San Joaquin Valley.

The 1500-foot map indicates that nearly all areas in the western region at this elevation bloomed later in 1958 than in 1957. An exception occurred in parts of eastern Oregon and southwestern Washington where bloom was a day or two earlier in 1958. Bloom occurred more than 3 weeks later in southern California in 1958 at this elevation.

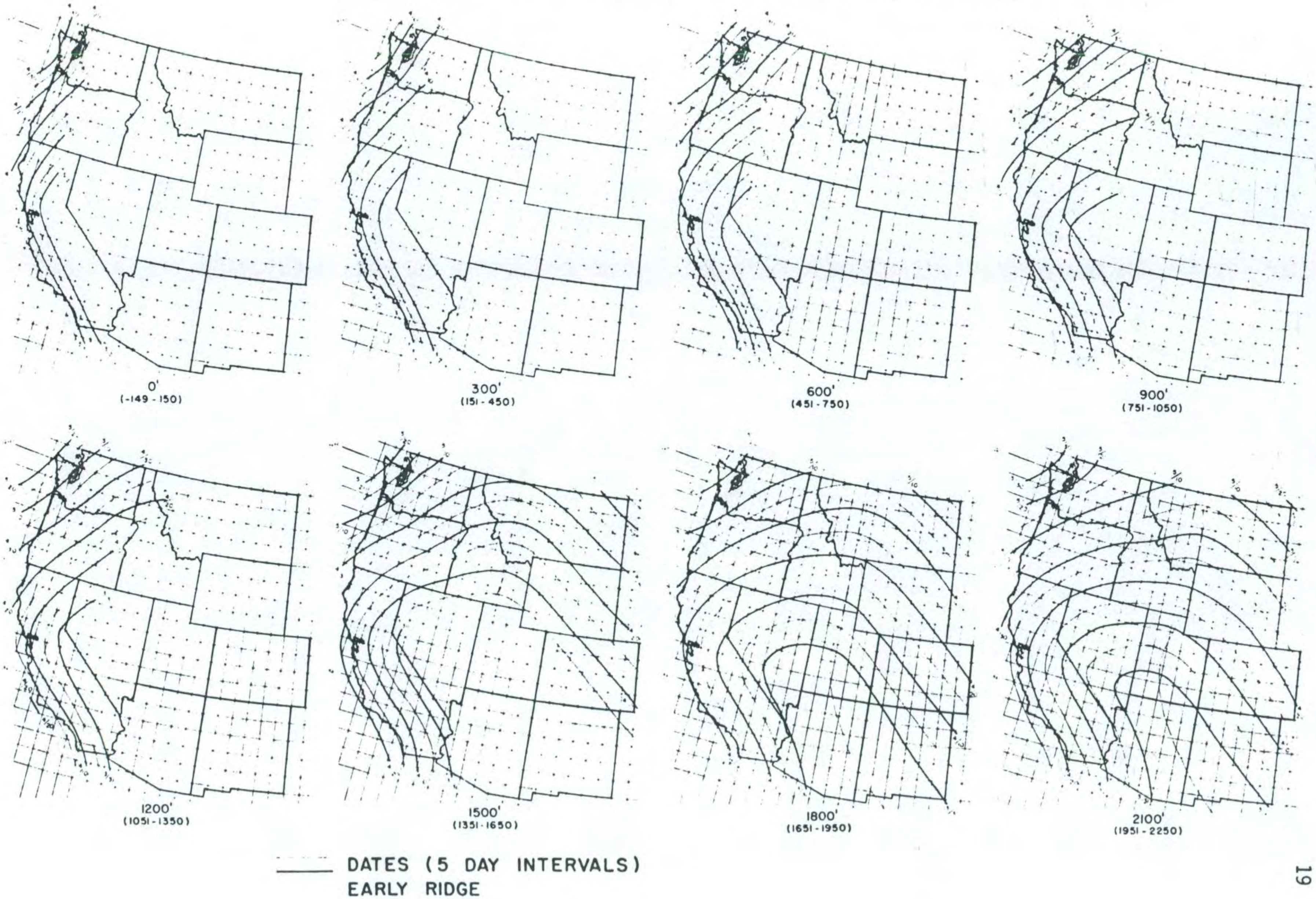
At 3000-foot elevations bloom began later than the previous year over most of the region. Earlier bloom occurred in Montana, Wyoming, northeastern Colorado, and a small area in northwestern California. Much of the southern area bloomed more than 2 weeks later in 1958.

The 4500-foot and 6000-foot maps both indicate later bloom in 1958 compared to 1957 in southern areas, but earlier bloom dates further north. At 4500-foot elevations, bloom was more than 20 days later in the extreme south while northern locations reported bloom 10 days earlier than in the previous year. At 6000-foot elevations, extreme southern locations were 10 days later, while northern locations were 15 days earlier compared to 1957.

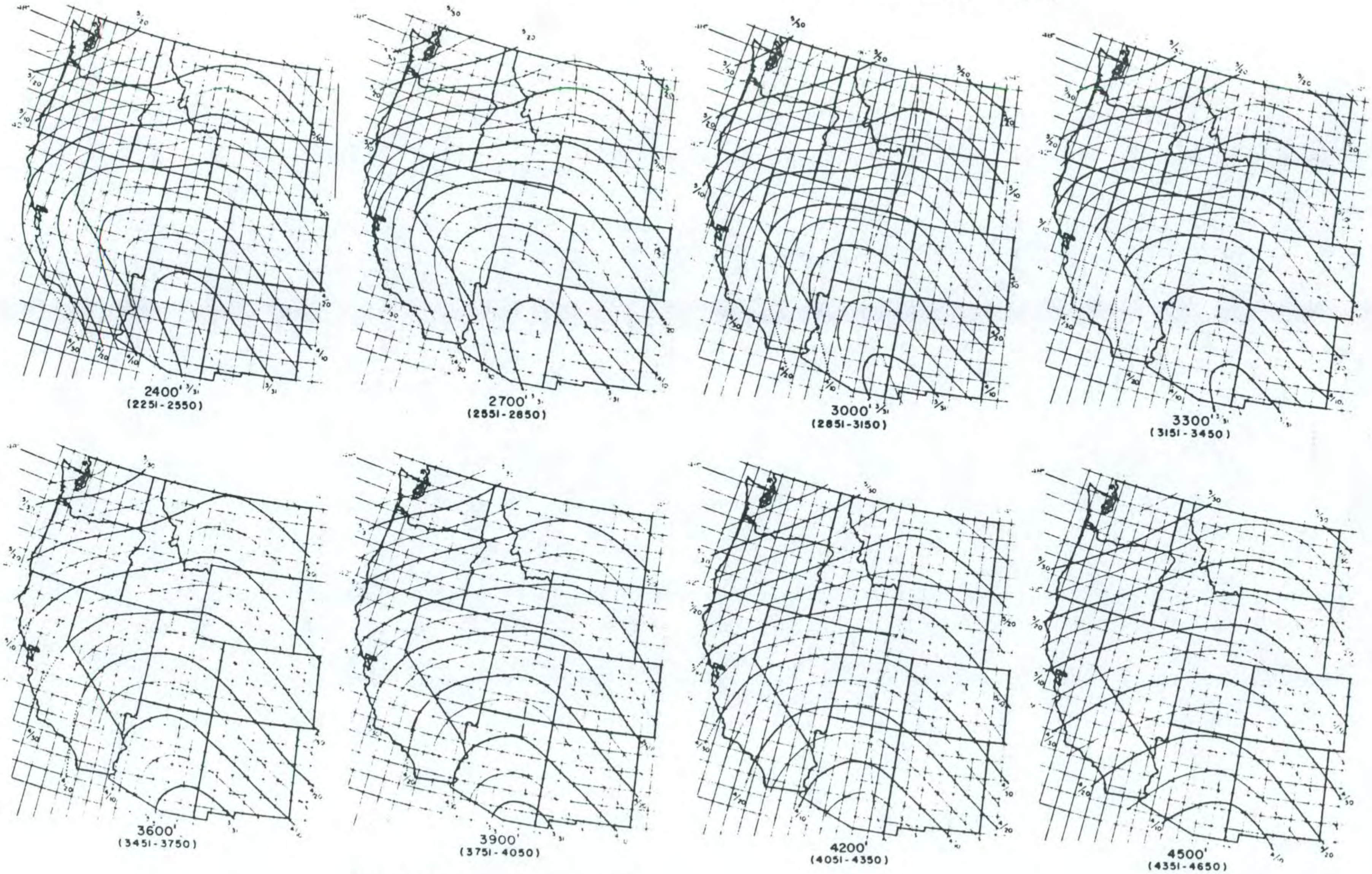
During the growing season of 1958, a preliminary survey was conducted throughout Montana on various stages of development of winter wheat and irrigated alfalfa hay. A number of farmers in the state, recommended by agricultural extension agents, cooperated in these surveys. In addition, a preliminary survey was conducted on dates when seed pods of the common purple lilac matured as evidenced by color changes and opening of the pods. The regional survey may be extended in 1959 to include one or more of the plants tried in Montana last season.

The help of the many cooperators who reported phenological data is contributing much to our over-all understanding of the geographical progression of plant development and its relation to climate in the western region of the United States.

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1958



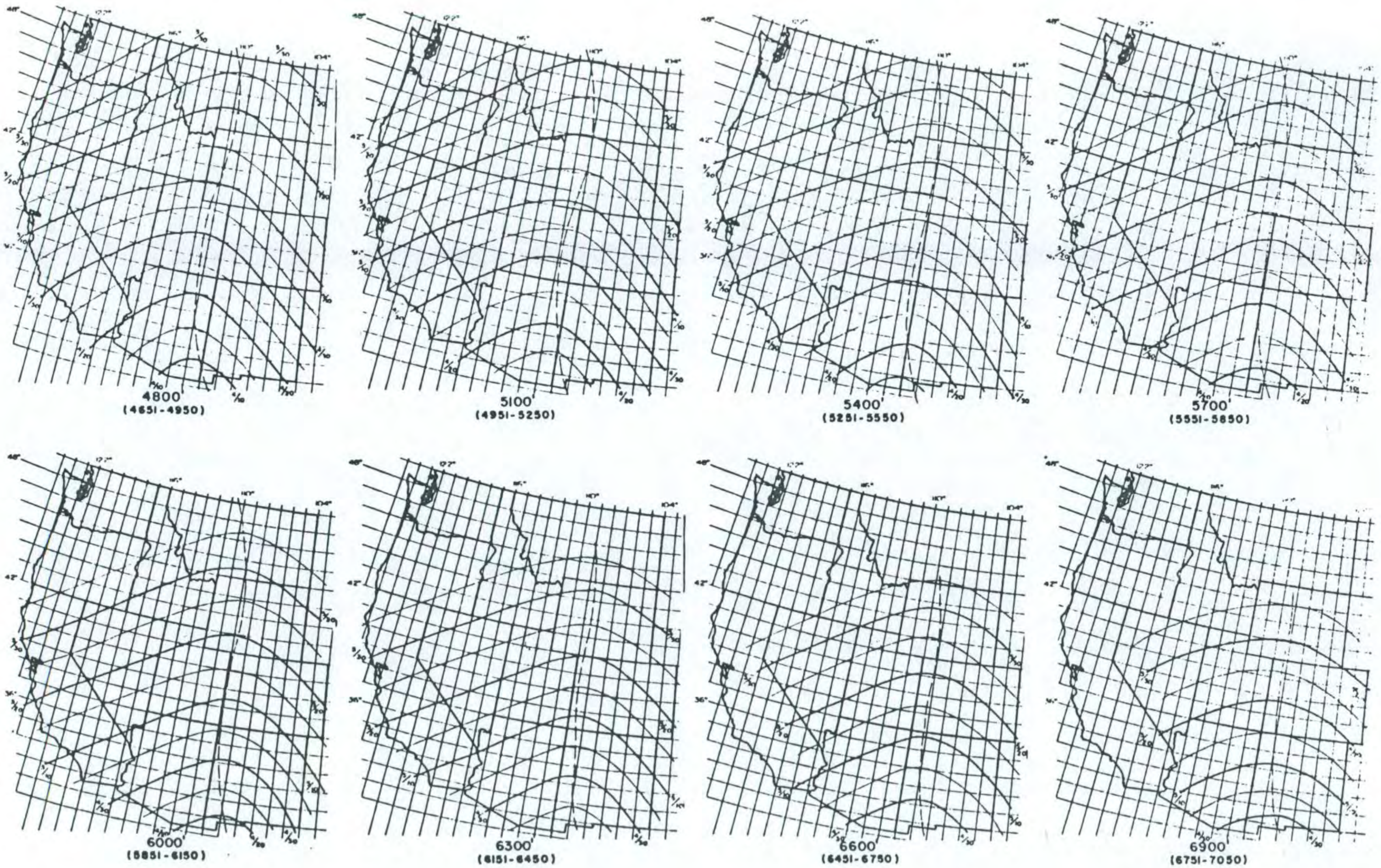
DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1958



—— DATES (5 DAY INTERVALS)
EARLY RIDGE
······ GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

EARLY RIDGE
GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1958



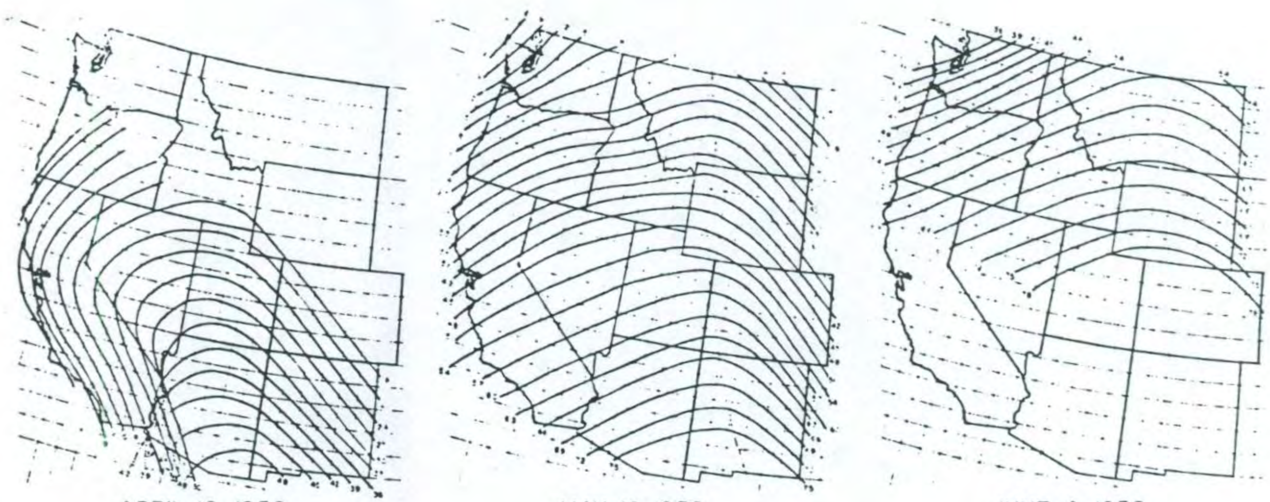
—— DATES (5 DAY INTERVALS)
---- EARLY RIDGE

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1958

7200' (7051-7350) | 7500' (7351-7650) | 7800' (7651-7950)

——— DATES (5 DAY INTERVALS)
- - - - EARLY RIDGE

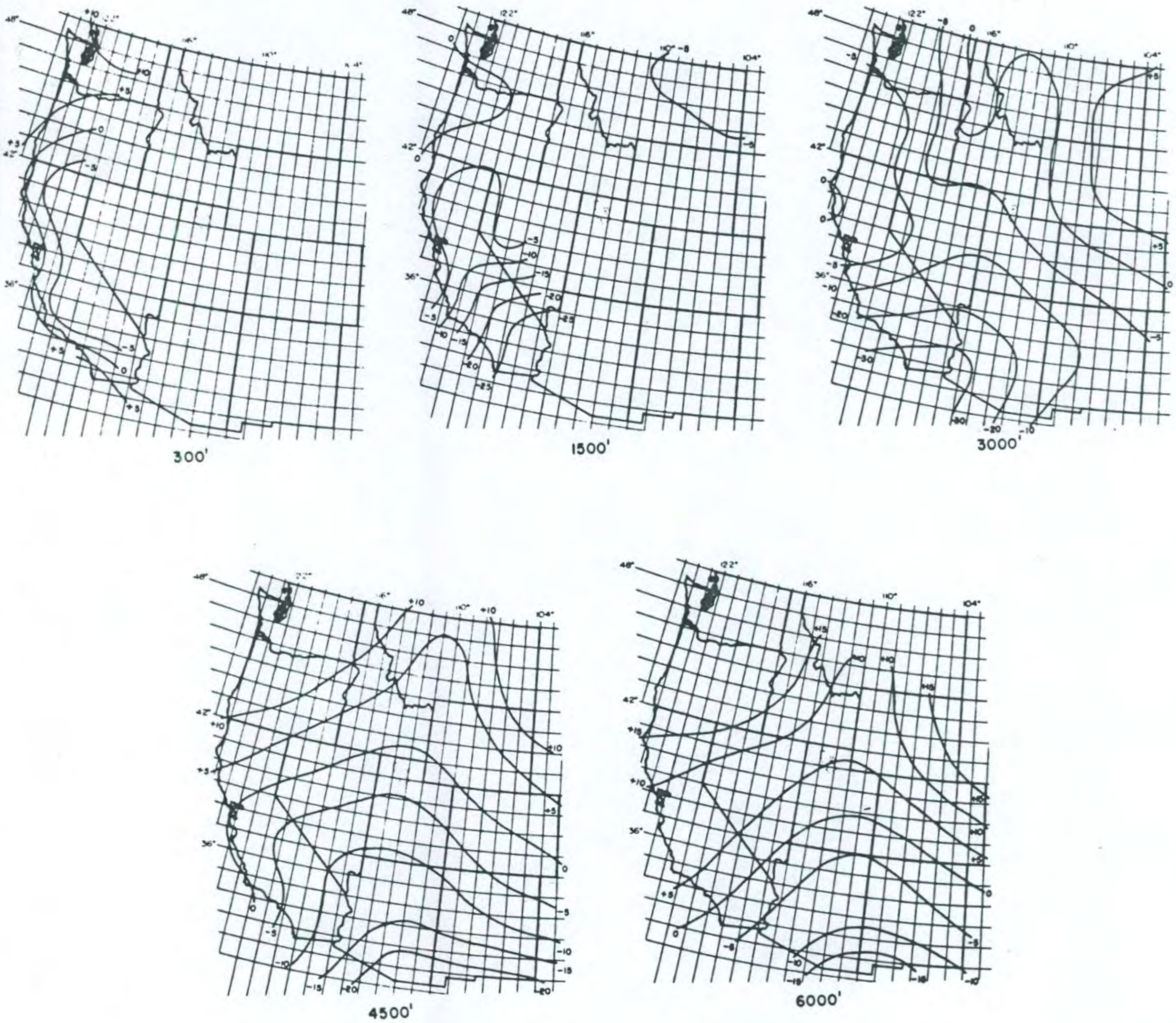
ELEVATIONS AT WHICH THE COMMON PURPLE LILAC STARTED TO BLOOM ON INDICATED DATES THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1958



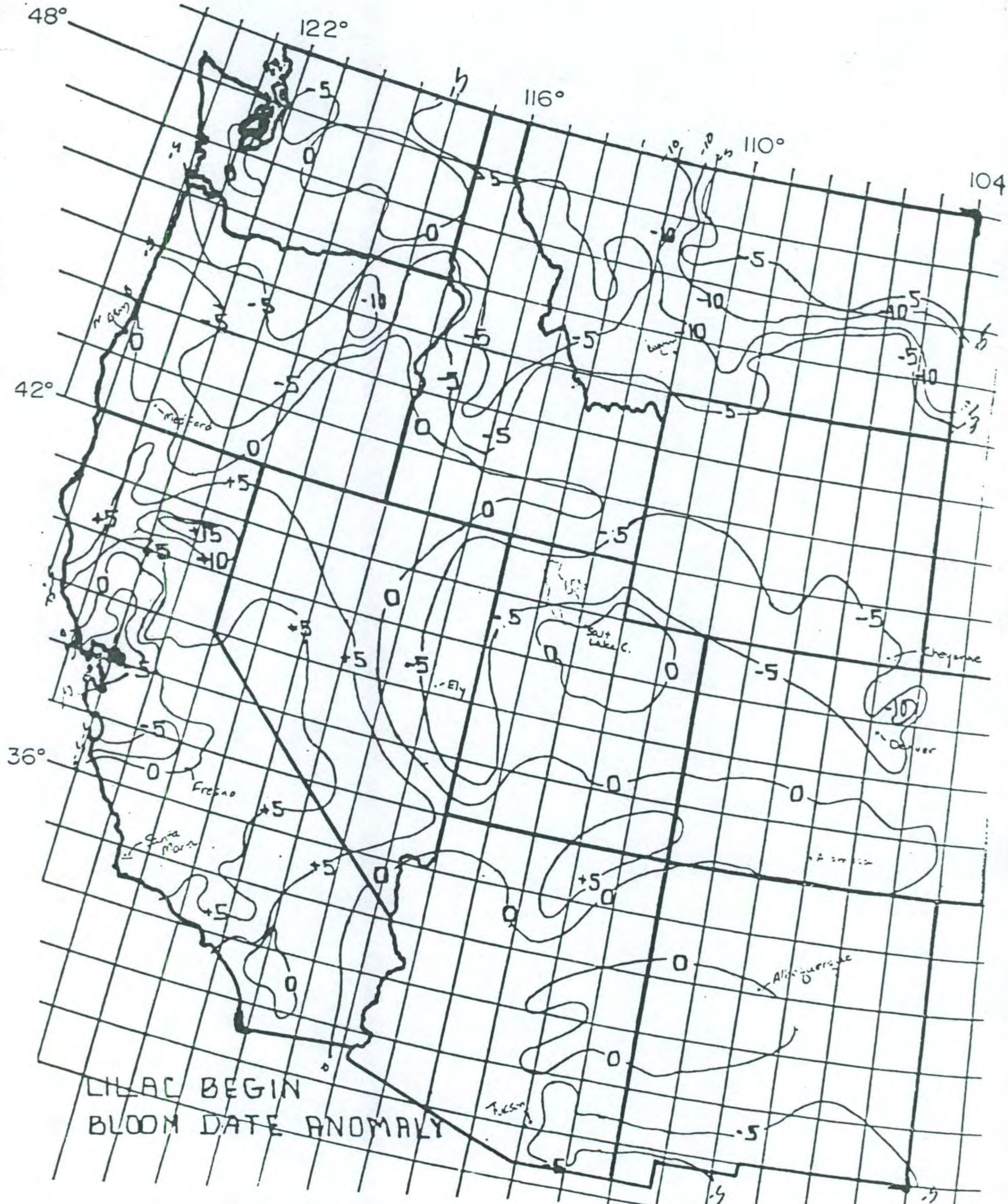
APRIL 10, 1958 | MAY 10, 1958 | JUNE 4, 1958

——— ELEVATIONS (300 FOOT INTERVALS)
- - - - EARLY RIDGE
.... GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

NUMBER OF DAYS DIFFERENCE AT INDICATED ELEVATIONS BETWEEN TIME WHEN COMMON PURPLE LILAC BEGAN TO BLOOM IN 1958 AND 1957 (POSITIVE VALUES INDICATE EARLIER BLOOM DATES IN 1958)



1959


48°
122°
116°
110°
104
42°
36°
Medford
Fresno
Santa Maria
Ely
Salt Lake C.
Cheyenne
Denver
Albuquerque
Tucson
LILAC BEGIN
BLOOM DATE ANOMALY

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE U. S. ON COMMON PURPLE LILAC AND ALTERNATIVE PLANTS SPRING 1959

Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
Bozeman, Montana
February 25, 1960

Bloom dates of the common purple lilac (Syringa vulgaris L.) and the alternative plants, the red berry pyracantha and large common caragana, have been observed for three consecutive years (1957-1959) throughout the eleven states which comprise the Western Region. Considerable information has been accumulated through the cooperation of about 1200 observers. Some general conclusions can now be drawn regarding the pattern and progression of plant development in this region.

The analytical mapping procedure used this year is the same as was used in the 1957 and 1958 analyses. Only analyses of beginning dates of lilac bloom were mapped for this report. Although information on the red berry pyracantha and large common caragana are useful, regional mapping for these plants is not possible because of their restricted distribution.

An isophane is a line connecting points where plants reached a given phase of development on the same date. These isophanes correspond to lines of equal rainfall (isohyets) or equal elevations on a topographic map. Isophanes are drawn for 5 - day intervals in this report. The mapping procedure involved: (1) plotting and analyzing all data reported within each 300 - foot elevation range on single maps; (2) constructing, from these preliminary isophanal maps, a cross-section for every one-degree latitude; and (3) plotting the final isophanal maps -- one for every 300 - foot elevation interval -- from the smoothed cross sectional analysis.

This presentation has the advantage of permitting the general bloom date to be determined quite accurately for any location, providing elevation and approximate location are known. To obtain an estimate of bloom date for a desired location simply enter the location on the map which includes the particular elevation. For example, to determine when lilacs began to bloom in 1959 in Salt Lake City, Utah, located at 40° 46' latitude and 111° 54' W longitude at about 4200' elevation, you plot this location on the 4200' map. The isophanes on this map indicate that lilacs began to bloom in Salt Lake City on April 27.

The general pattern of the progression of isolines is very similar to the patterns in 1957 and 1958. Isophanes tend to parallel the west coast at lower elevations, particularly in California, and the early ridge is present near the center of the region at all elevations.

The northward bulge in the isophanes in Washington and northern Oregon at elevations below 3500 feet resembles the bulge in the 1957 analysis. This characteristic was not present in the northwest on the 1958 maps.

Whereas the bloom date over much of the region tends to be about one day later for each increase of 100 feet in elevation, some areas from sea level up to about 3500 feet elevation in California are characterized by the reverse, or inverted condition. In much of this region bloom dates appear to be somewhat earlier at higher than at lower altitudes. A similar tendency was indicated for parts of the southern area in the 1957 and 1958 analyses.

The early ridge tends to be at about the same location as in 1958 at all elevations in the northern latitudes. However, at middle and lower latitudes of the region, up to 5000 feet, the ridge tends to be located further east than in 1958. Above 5,000 feet, the position of the early ridge is about the same as in 1958 except in the extreme southern area where it continues to be east of the 1958 position.

The three maps on the bottom of page 6 indicate where lilacs began to bloom on April 10, May 10 and June 4, respectively. In this case, the lines indicate the elevation at which bloom began on the particular date. Again, interesting comparisons can be made. For example, lilacs were beginning to bloom along the coast of southwestern Oregon on April 10. On the same day at 5100 feet elevation lilacs were coming into bloom in southern California, southern Arizona and southwestern New Mexico. The May 10 map indicates that lilacs were beginning to bloom at sea level in northwestern Washington and also at 7800 foot elevations in Arizona on this date.

The maps of page 7 show the number of days difference between the dates of lilac bloom in 1959 and 1958 for six different elevations -- 300, 1500, 3000, 4500, 6000 and 7500 feet. Plus signs indicate earlier bloom in 1959 than in 1958 and minus signs indicate later bloom in 1959. It is known that lilacs will generally bloom earlier at a given location in one year than another because of warmer spring weather. However, the exact relations between weather and bloom dates are not completely understood and studies are presently underway to determine quantitative relations.

Locations near sea level bloomed earlier in 1959 than in 1958 in northern California. However, the bloom date was later in 1959 in both extreme northern and southern areas. Places in both southern California and northwestern Washington experienced bloom more than a week later in 1959 compared to 1958 at this elevation, while bloom was earlier by about a week in parts of northern California.

The 1500 - foot map indicates that bloom was earlier over California in 1959 at this elevation as compared to the previous year and that it was generally later in the more northern states. Much of California was about two weeks earlier in 1959 while the northwestern tip of Washington was more than two weeks later than in 1958.

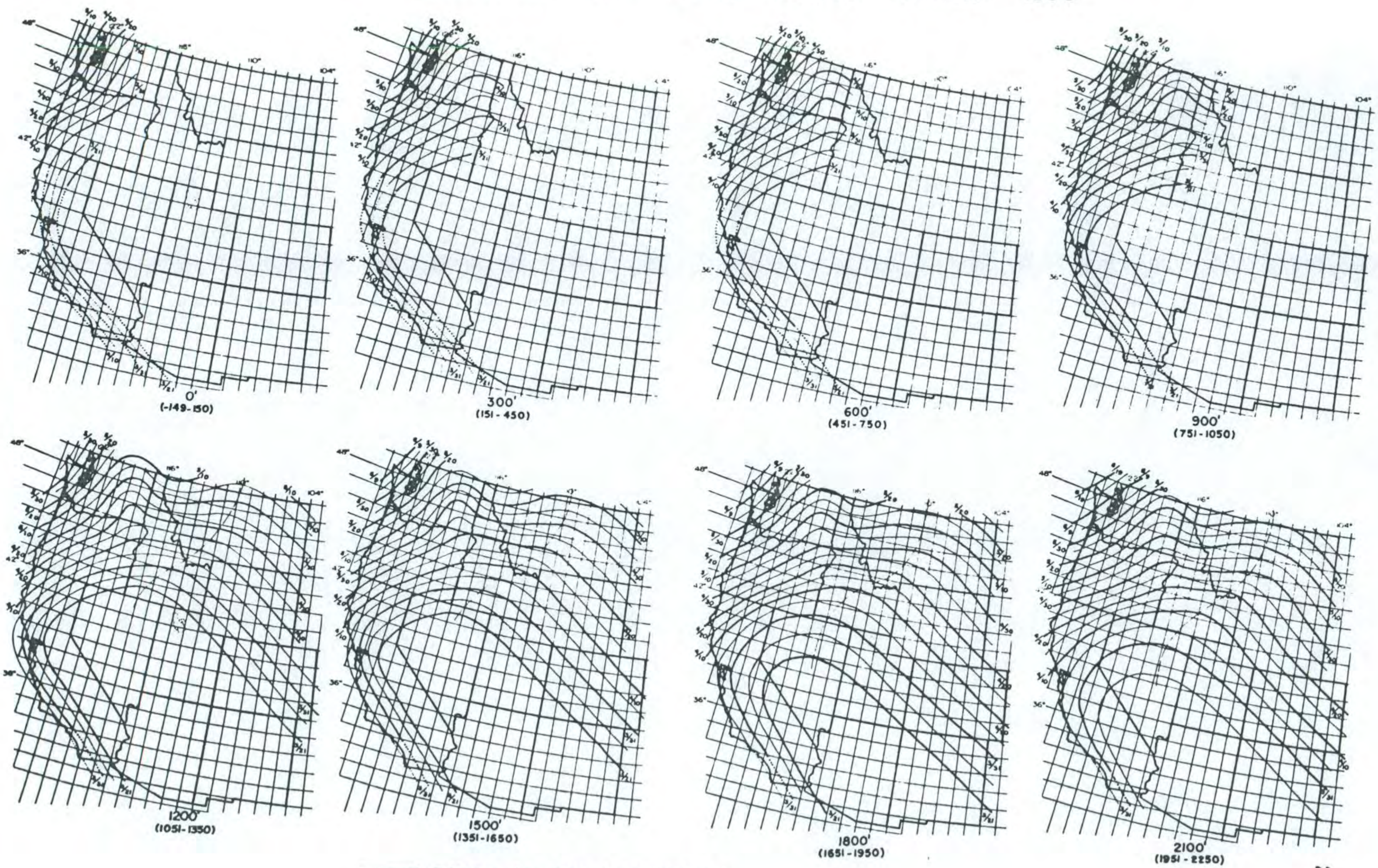
At 3000 - foot elevations bloom was generally earlier in the southern half of the region and later in the northern half of the region in 1959 as compared to 1958. The southwestern third of California was about three weeks earlier in 1959 and most of Washington and northern parts of Idaho and Montana were more than two weeks later. Bloom in northwestern Washington at this elevation was about three weeks later in 1959 compared to the previous year.

The 4500 - foot and 600 - foot maps both indicate very late bloom in northern areas and earlier bloom in southern sections. Bloom was more than three weeks later in 1959 compared to 1958 in much of Montana, Washington and northern Idaho. In the southern sections, both southern California and eastern Arizona indicate bloom dates about two weeks earlier in 1959.

The 7500 - foot map retains the same general relations as indicated on all the maps at lower elevations, with bloom later in the north and earlier in southern sections.

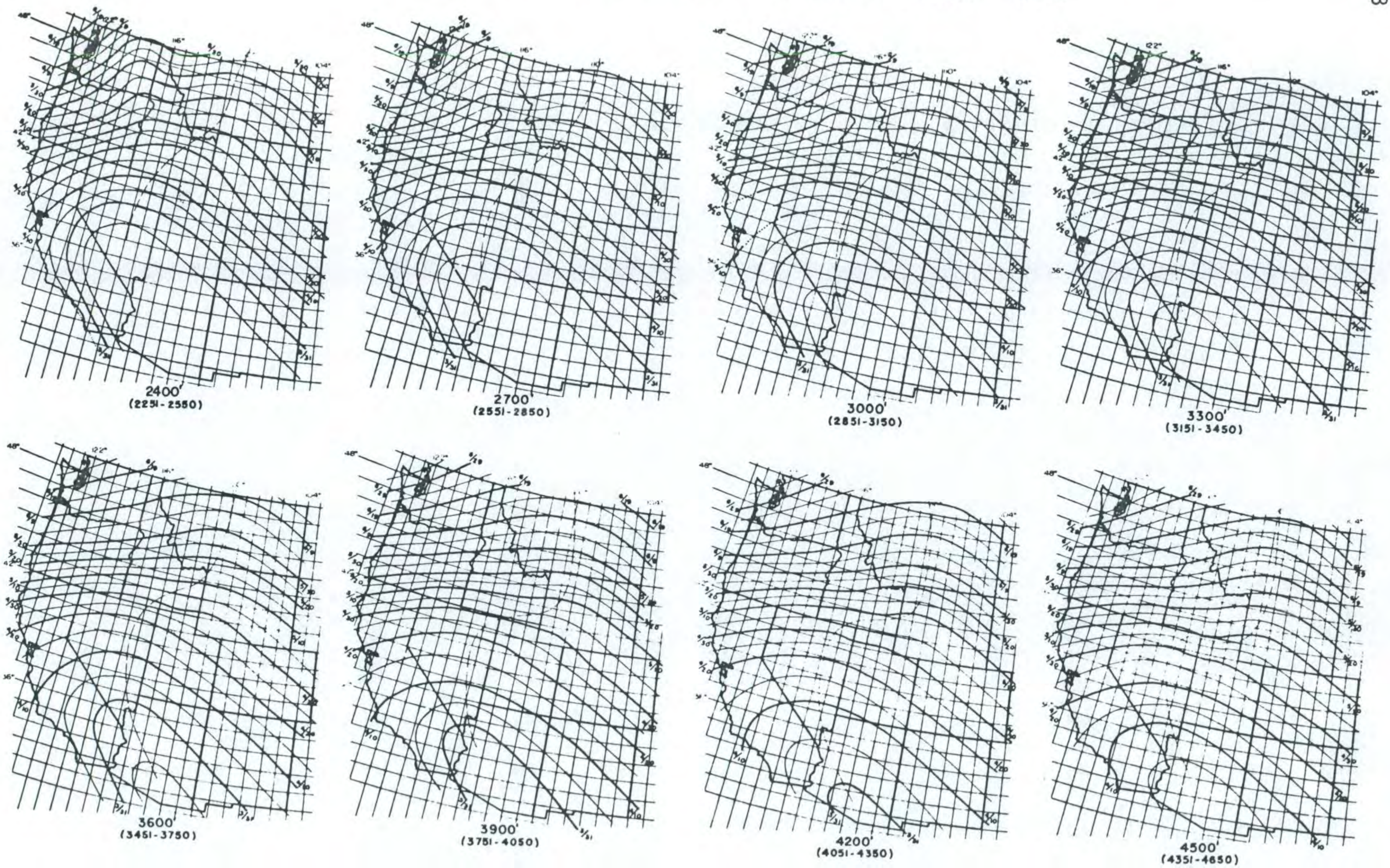
A separate report is being prepared for the regional phenological survey on winter wheat and fall or winter planted spring wheat. If you wish to participate in the wheat survey or would like a copy of the report, please note this on your lilac card.

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1959



DATES (5 DAY INTERVALS)
EARLY RIDGE
GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

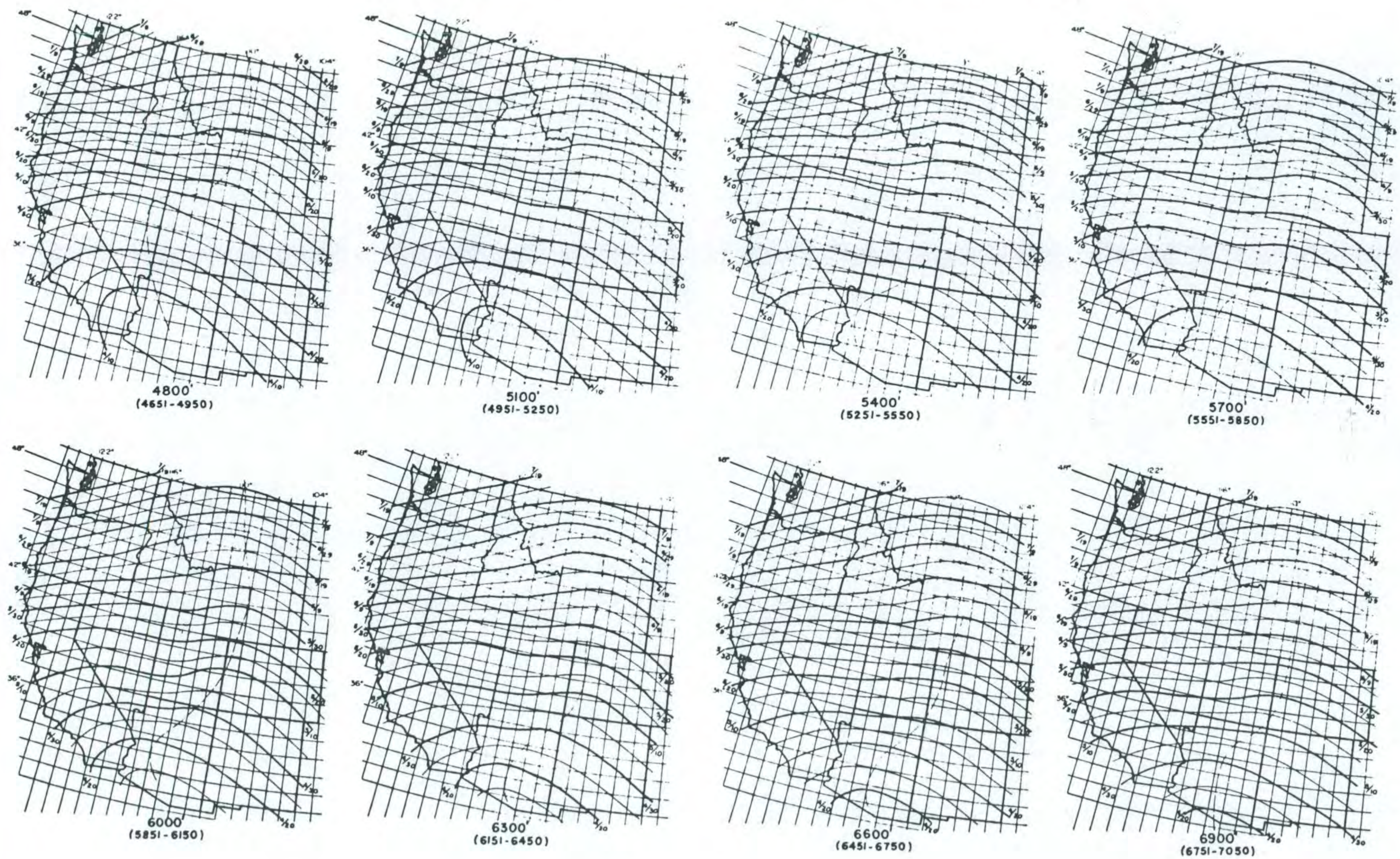
DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1959



DATES (5 DAY INTERVALS)
EARLY RIDGE
GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

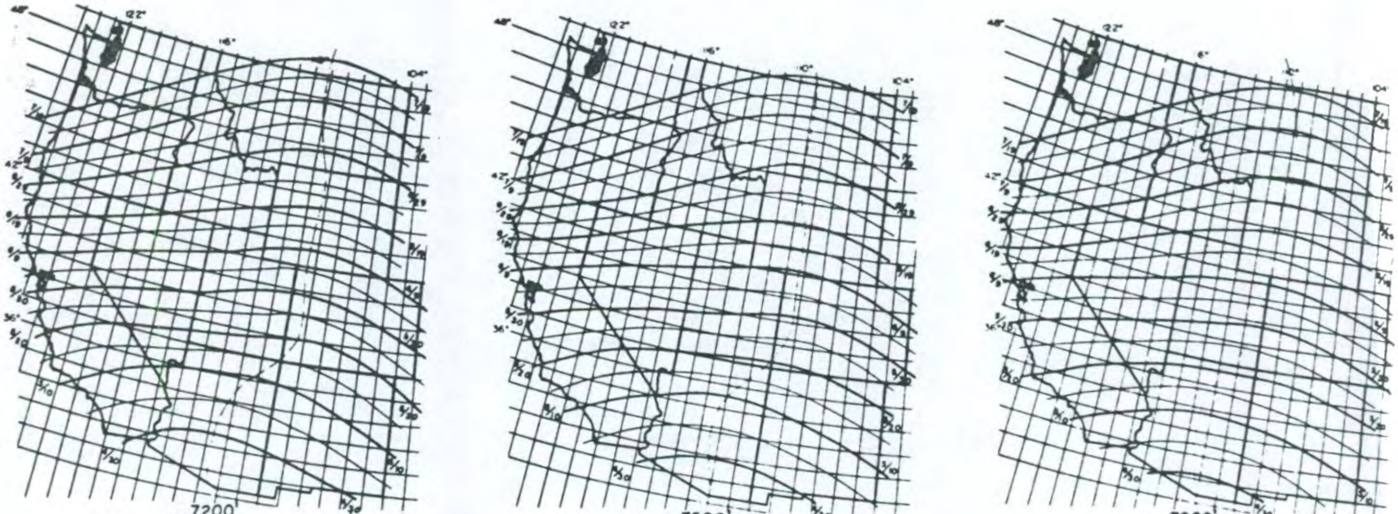
GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1959



—— DATES (5 DAY INTERVALS)
- - - - EARLY RIDGE

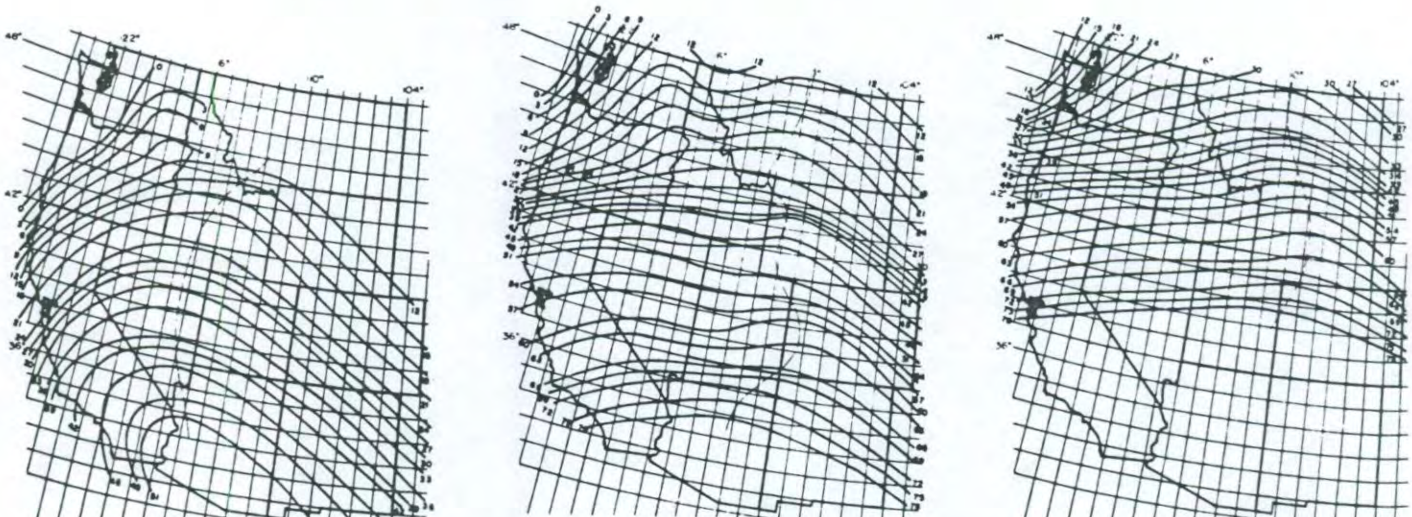
DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1959



7200' (7051-7350) — 7500' (7351-7650) — 7800' (7651-7950)

═══ DATES (5 DAY INTERVALS)
---- EARLY RIDGE

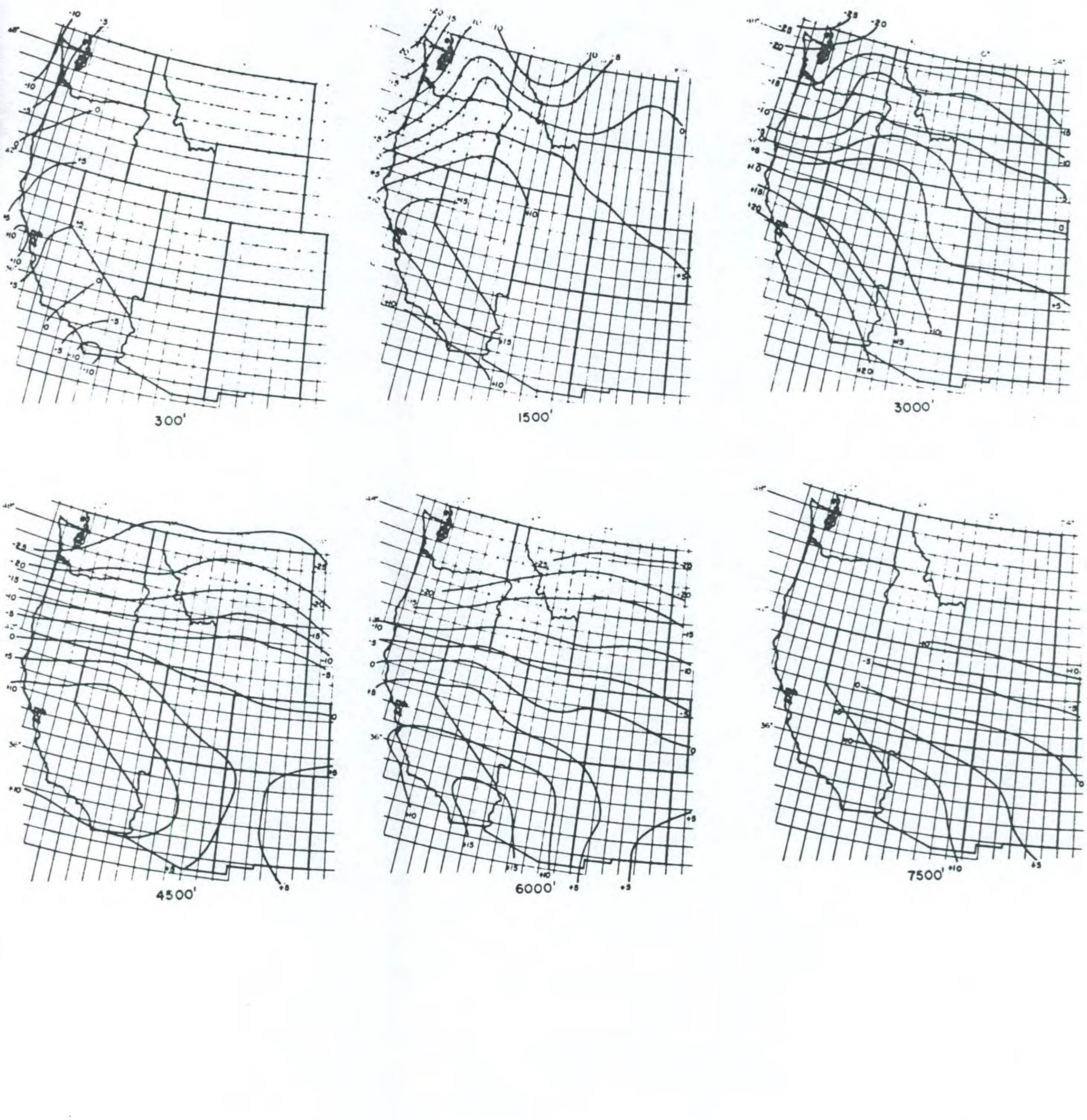
ELEVATIONS AT WHICH THE COMMON PURPLE LILAC STARTED TO BLOOM ON VARIOUS DATES THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1959



APRIL 10, 1959 — MAY 10, 1959 — JUNE 4, 1959

——— ELEVATIONS (300 FOOT INTERVALS)
---- EARLY RIDGE

NUMBER OF DAYS DIFFERENCE AT INDICATED ELEVATIONS BETWEEN TIME WHEN COMMON PURPLE LILAC BEGAN TO BLOOM IN 1959 AND 1958 (POSITIVE VALUES INDICATE EARLIER BLOOM DATES IN 1959)



ACKNOWLEDGEMENTS

This survey has been made possible through the voluntary cooperation of about 1200 phenological observers in the eleven Western States. In addition, the establishment of the phenological network was assisted through the help of county agents who supplied lists of possible cooperators and of county assessors who gave information on the location of observers.

The success in establishing the lilac network is largely attributed to the assistance of the U. S. Weather Bureau and their climatological observers. Mr. Marvin Magnuson, Weather Bureau Northwestern Area Climatologist, Seattle, Washington, and Mr. H. C. Steffan, Meteorologist in Charge, Weather Bureau Weather Records Processing Center, San Francisco, California, arranged for the cooperation of the climatological observers and facilitated the collection of phenological data.

The collection and analysis of phenological data is being conducted by the Montana Agricultural Experiment Station under a contributing project to Western Regional Project W-48 entitled "Climatic and Phenological Patterns of the Western Region". In addition to state experiment stations in the Western Region, the State Experiment Stations Division, the Agricultural Research Service and the United States Weather Bureau are participating in this regional project.

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE U.S. ON FALL AND WINTER SOWN WHEAT HARVESTED IN 1959

Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
March 1961

Organization for marketing and other farm and research activities necessitates an understanding of the effect of environment on the rate of plant development and the geographical progression of the various stages in their life cycles. The study of how plants develop in relation to the environment is known as phenology. Information on the time when plants reach various stages in their development, such as heading and combine ripe, is called phenological data. Many factors can influence the rate at which a plant passes through the stages of its life cycle. Some of the elements that can modify plant development are differences in temperature, radiation, and soil type. Thus the plant reflects the complex of the environment to which it is exposed and links together into one value the many environmental factors that influence plant development. Conclusions can be drawn regarding the relative developmental rate of a crop in two communities by comparing the average dates when similar plants reach a given stage of development at each location.

Phenological data can be used in a number of ways, particularly in agriculture. Such information can serve as a basis for scheduling farm operations, provide an objective measure of the length of the growing season, assist in predicting maturity date and crop yield, indicate "early" and "late" seasons, and allow a comparison of yearly changes in weather, particularly as related to plant development.

After conducting a preliminary phenological survey in Montana for fall and winter sown wheat harvested in 1958, the collection of data for this crop was extended in 1959 to the eleven western states. Approximately 500 wheat growers throughout the area cooperated by recording information on dates of planting, heading, combine ripe, and harvest.

In view of the general interest in the time when wheat is ready for harvest throughout the area, detailed maps were constructed of the dates when the crop was combine ripe in 1959. The 300-foot interval isophane method, developed in connection with previous analyses of bloom dates of the common purple lilac, was used.

The date when wheat reaches combine ripe stage differs somewhat between varieties. Reports for many different varieties are included in this survey. To reduce the analysis to a common basis, combine ripe date for all varieties relative to the standard variety, Kharkof (C.I. No. 1442)* was estimated by use of historical varietal records from experiment stations throughout the region. Before proceeding with the analysis of the geographical pattern of combine ripe date, a correction was first applied to all varieties that differ from Kharkof. The differences in combine ripe date of some of the more common varieties compared to Kharkof are given in the table on page 2.

The accompanying analysis therefore applies specifically to Kharkof and to varieties that reach combine ripe stage at the same time as this standard variety. A correction must be applied to map indicated date in order to estimate combine ripe date for earlier and later varieties.

*Cereal investigation accession number of the Crops Research Division, U.S.D.A.

Relative Dates of Combine Ripe for Different Varieties Compared to Kharkof

Varieties Earlier than Kharkof		Varieties the Same	Varieties Later than Kharkof	
Variety	Days Earlier	as Kharkof	Variety	Days Later
Blackhull	2	Cheyenne	Brevor	1
Westmont	3	Columbia	Burt	1
Federation	3	Elmar	Cache	1
Onas	4	Itana	Fortyfold	1
Newturk	4	Karmont	Golden	1
Lemhi	4	Omar	Pacific Bluestem	1
Baart	4	Oro	Yogo	1
Ramona	5	Rio	Elgin	2
Marfed	5		Orfed	2
White Federation	8		Red Russian	6

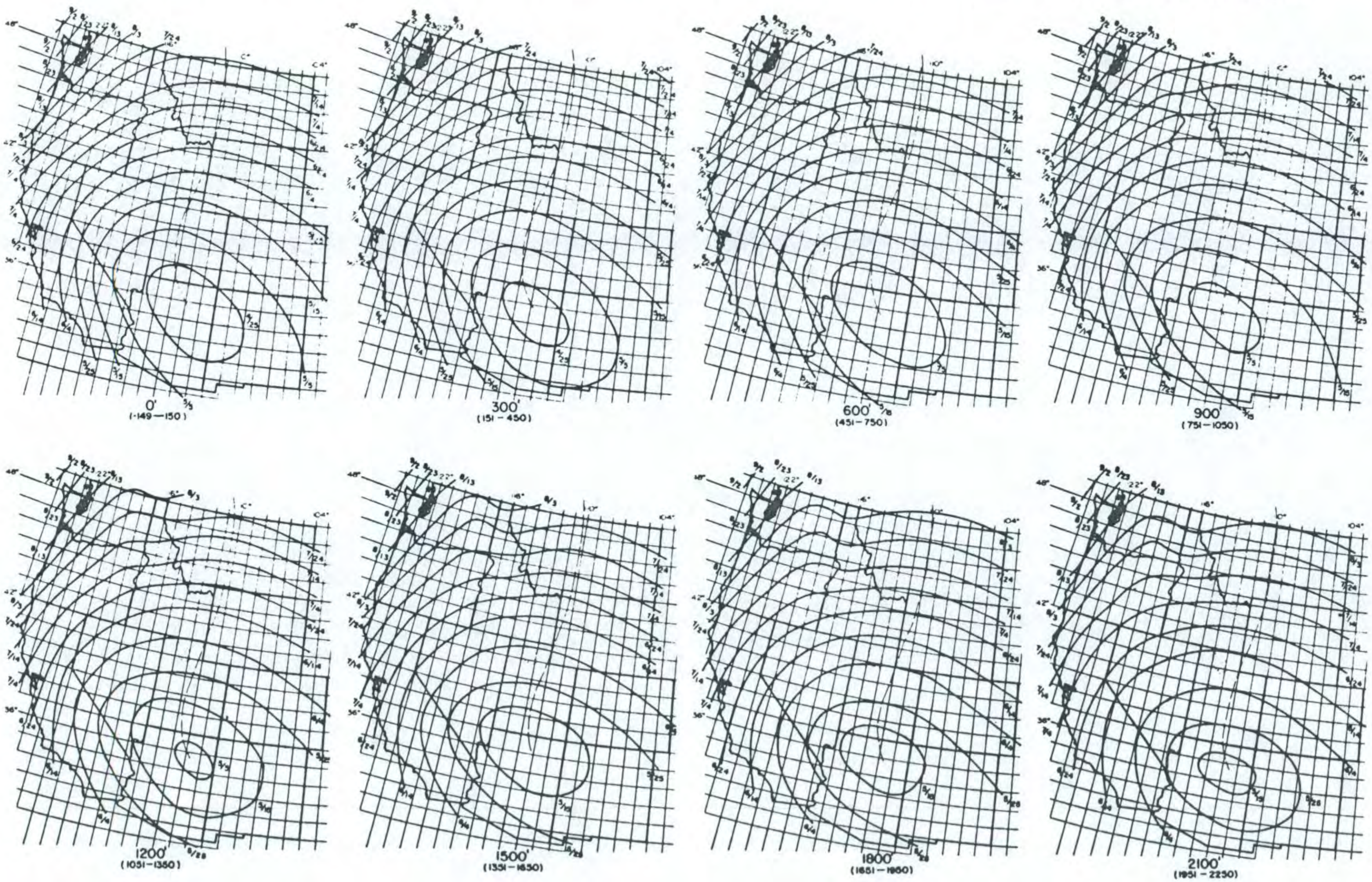
An isophane is a line connecting points where plants reach a given stage of development on the same date. These isophanes correspond to lines of equal rainfall (isohyets) or equal elevations on a topographic map. Isophanes are drawn for 10-day intervals in this report. The mapping procedure involved is: (1) plotting and analyzing all data reported within each 300-foot elevation range on single maps; (2) constructing, from these preliminary isophanal maps, a cross section for every one degree latitude; and (3) plotting the final isophanal maps--one for every 300-foot elevation interval--from the smoothed cross-sectional analysis. This presentation has the advantage of permitting the general date of combine ripe to be determined for any location in the West up to elevations of 7800 feet, providing elevation and approximate location are known. The maps give a broad general picture of the advance of combine ripe stage over the region. One should bear in mind, however, that local factors such as aspect, slope, and nighttime cold air drainage may tend to bring wheat to combine ripe stage somewhat earlier or later than the map indicated date. This local variation can even be observed in a specific field where lack of uniformity in maturation is an expression of local variation of one or more factors that influence the rate of plant development.

Isophanes that extend over regions where none of the land is at the particular height on some of the maps were drawn by projection from other elevations. Most of the zero elevation map, for example, represents projection of data from elevations considerably above sea level since reports near sea level are available only from the coastal states of California, Oregon, and Washington.

To obtain an estimate of combine ripe date for a desired location, simply enter the location on the map that includes the particular elevation,or for more accurate estimates, interpolate between two maps to the exact elevation. For example, to determine when the wheat was combine ripe in 1959 at Pullman, Washington, located at 46°44' N latitude and 117°10' W longitude at 2550' elevation, plot this location on the 2400' and the 2700' maps. The isophanes at this location indicate the combine ripe dates as July 30 and August 1, respectively. Since 2550' is halfway between the maps for 2400' and 2700', the estimated combine ripe date for Pullman is July 31.

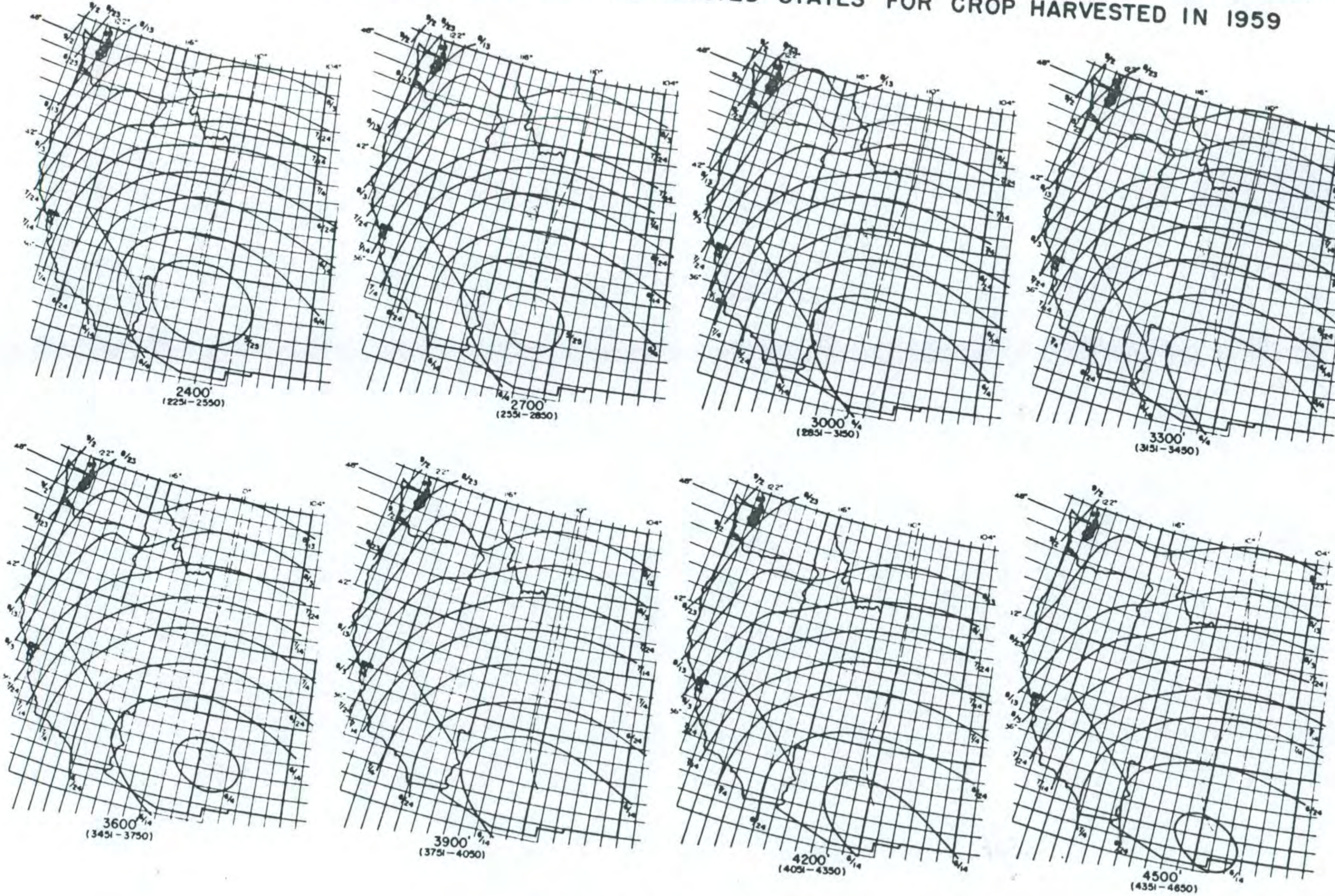
At a given elevation the ripening of wheat generally progresses from south to north but not precisely in parallel with latitudinal lines. The general pattern of isophanes from west to east is to curve northeastward from the Pacific Coast reaching the northernmost point near the center of the region and then to turn southeastward as they approach the eastern part of the region. The northernmost points of all the isophanes on each map are connected by a dashed line that is designated early ridge. Along any latitudinal line, wheat reached combine ripe stage earliest at the point of

DATES WHEN FALL AND WINTER SOWN WHEAT REACHED COMBINE RIPE STAGE AT VARIOUS ELEVATIONS THROUGHOUT THE WESTERN REGION OF THE UNITED STATES FOR CROP HARVESTED IN 1959



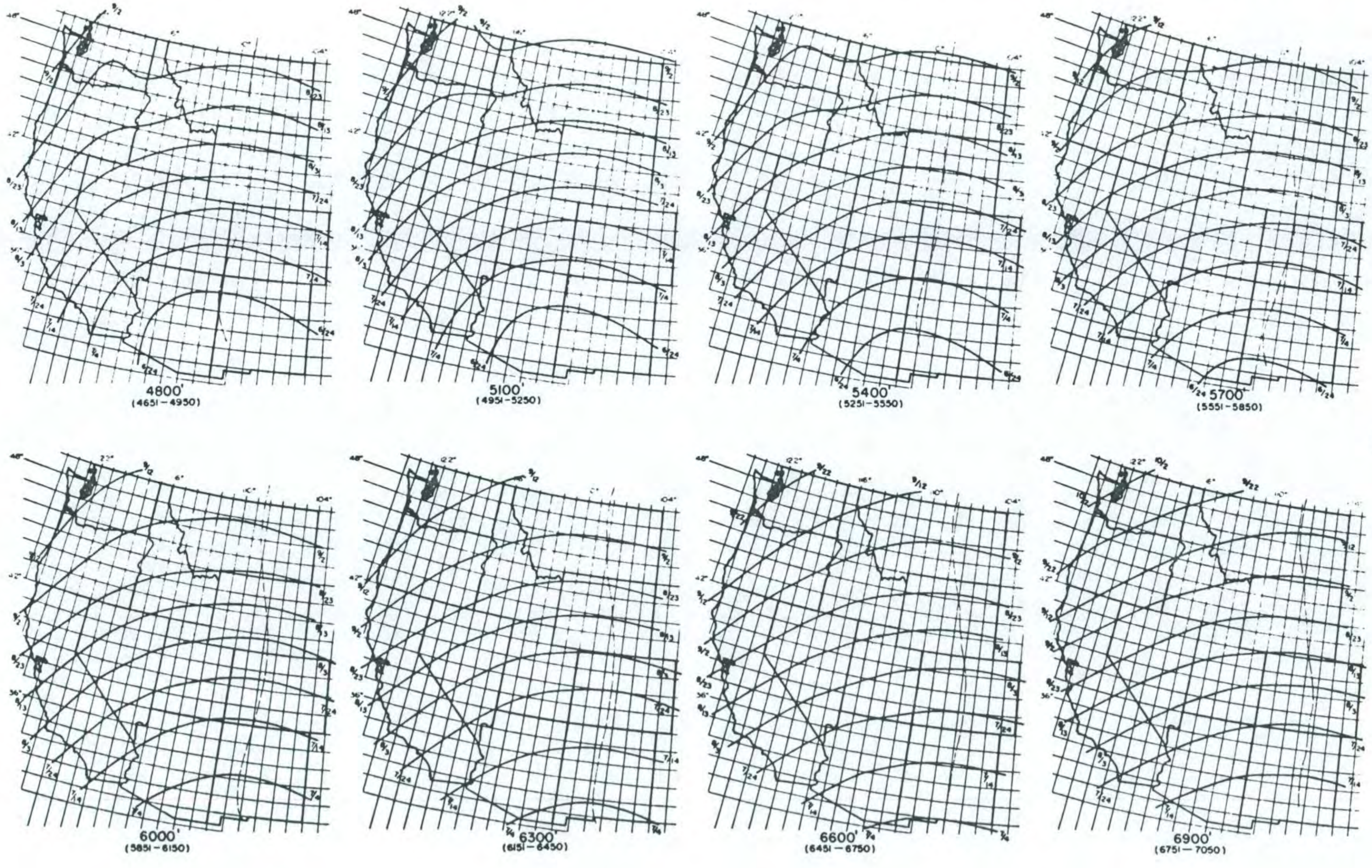
——— DATES (10 DAY INTERVALS)
– – – – EARLY RIDGE

DATES WHEN FALL AND WINTER SOWN WHEAT REACHED COMBINE RIPE STAGE AT VARIOUS ELEVATIONS THROUGHOUT THE WESTERN REGION OF THE UNITED STATES FOR CROP HARVESTED IN 1959



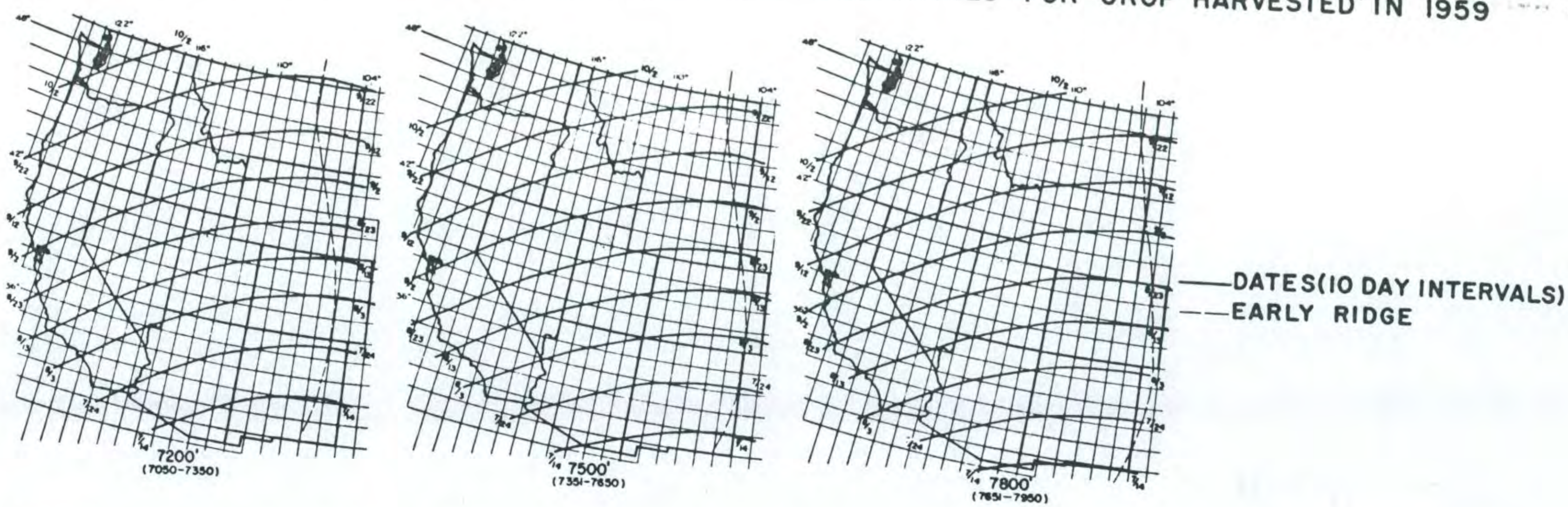
——— DATES (10 DAY INTERVALS)
- - - - EARLY RIDGE

DATES WHEN FALL AND WINTER SOWN WHEAT REACHED COMBINE RIPE STAGE AT VARIOUS ELEVATIONS THROUGHOUT THE WESTERN REGION OF THE UNITED STATES FOR CROP HARVESTED IN 1959

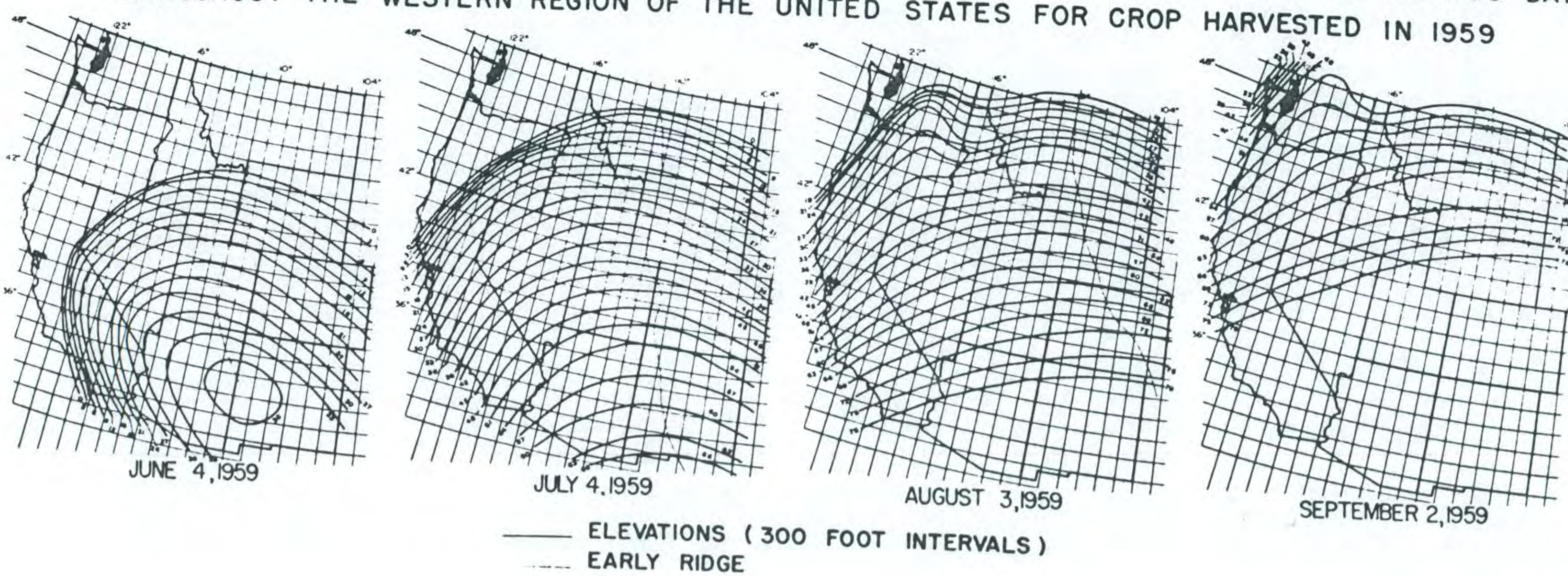


——— DATES (10 DAY INTERVALS)
– – – – EARLY RIDGE

DATES WHEN FALL AND WINTER SOWN WHEAT REACHED COMBINE RIPE STAGE AT VARIOUS ELEVATIONS THROUGHOUT THE WESTERN REGION OF THE UNITED STATES FOR CROP HARVESTED IN 1959

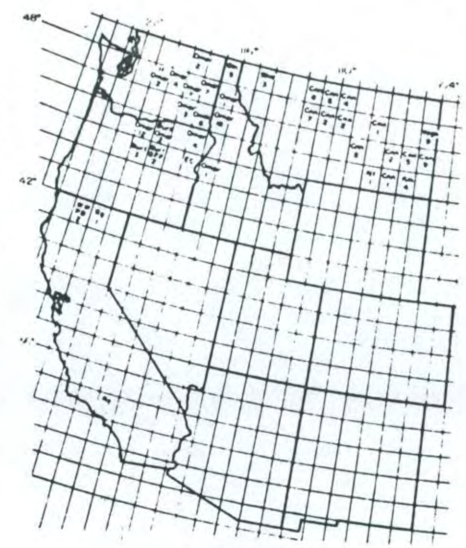


ELEVATIONS AT WHICH FALL AND WINTER SOWN WHEAT REACHED COMBINE RIPE STAGE ON VARIOUS DATES THROUGHOUT THE WESTERN REGION OF THE UNITED STATES FOR CROP HARVESTED IN 1959

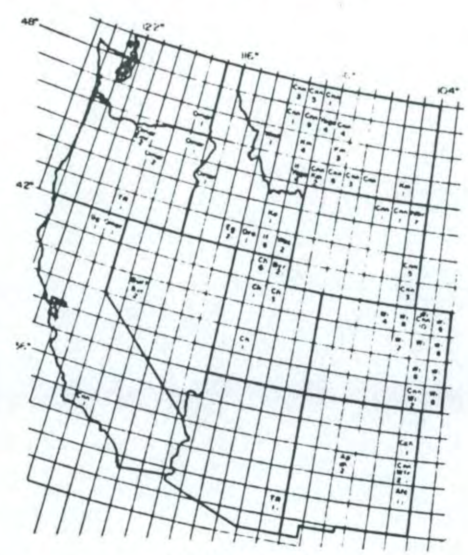


PRINCIPAL VARIETIES OF WHEAT REPORTED

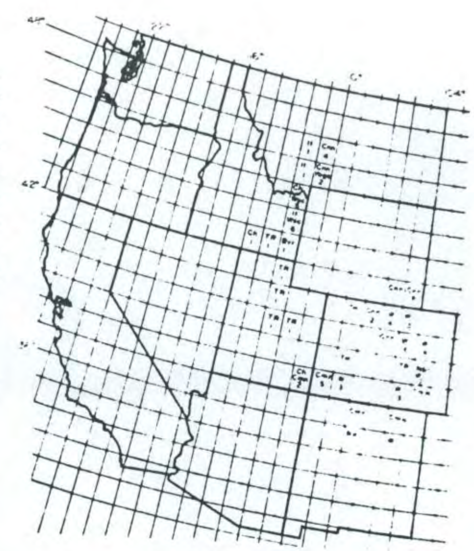
-149' – 1650'



1651' – 3450'

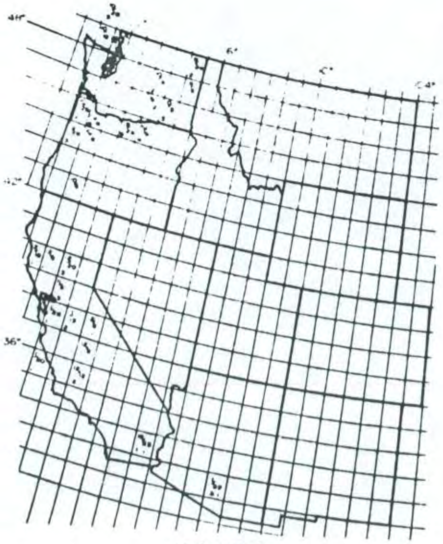


3451' – 5250'

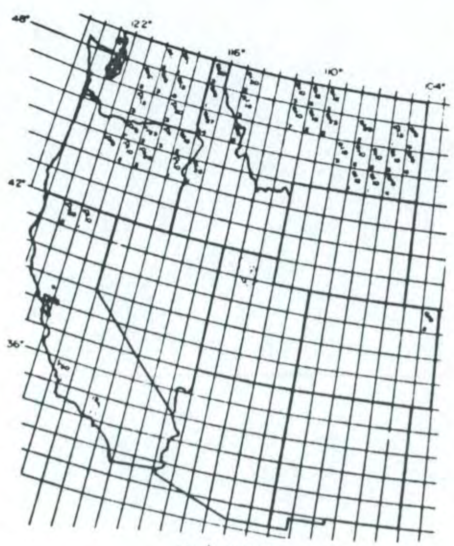


5251' – 7050'

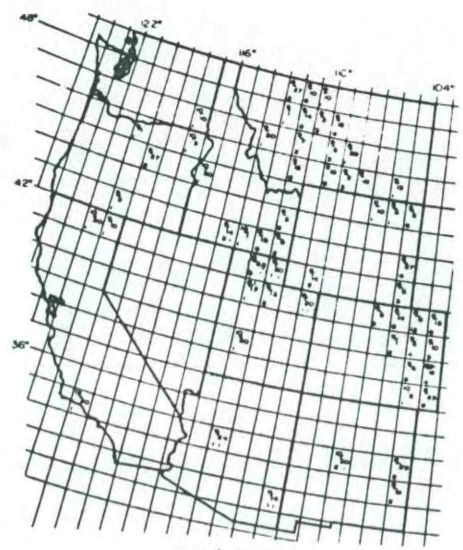
DATE WHEN WHEAT WAS SEEDED



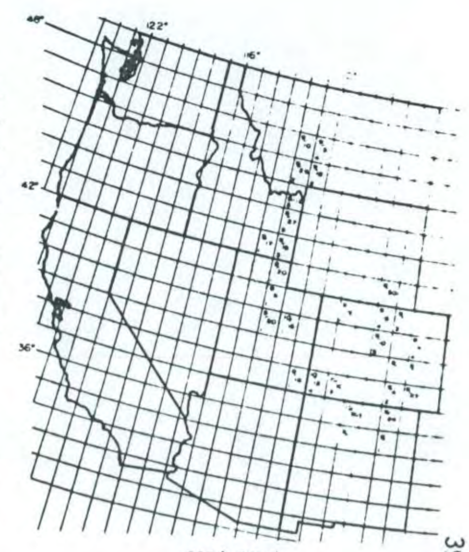
-149' – 1650'



1651' – 3450'



3451' – 5250'



5251' – 7050'

intersection with the early ridge. There appears to be a tendency for the early ridge to migrate eastward with increasing elevations.

Cross sections constructed in connection with the second step of the analysis (not included in this report) indicate that wheat generally reached combine ripe stage later with increasing elevation. However, the rate of elevational advancement does not appear to be uniform over the entire region. Locations near the Pacific Coast appear to be characterized by little, if any, delay in maturity with increasing elevation, particularly below 2000' elevation. This situation was also noted in previous studies on the common purple lilac. On the other hand, combine ripe stage advanced at rates exceeding 100 feet elevation per day in central and eastern parts of the region.

The lines on the four maps at the bottom of page 6 indicate at which elevations wheat reached combine ripe stage on June 4, July 4, August 3, and September 2, respectively. The elevation lines are in hundreds of feet, with 300-foot intervals between each line. Interesting comparisons can be made on these maps. For example, the July 4 map shows that wheat reached combine ripe stage at locations near sea level in northern California and at 5000' elevations in southern Colorado on this same date.

Additional information received from wheat farmers on varieties sown and seeding dates is summarized on page 7. Data for unit blocks one degree on each side are presented on summary maps for each item arranged according to four elevation groups: -149 to 1650, 1651 to 3450, 3451 to 5250, and 5251 to 7050. Information from experimental plots, which were used in the analysis of combine ripe dates, is not included in this tally. Also excluded are reports for irrigated wheat except in the case where only irrigated reports were received for the unit blocks. If the data within the block are all for irrigated wheat, the letter "i" is denoted within the block.

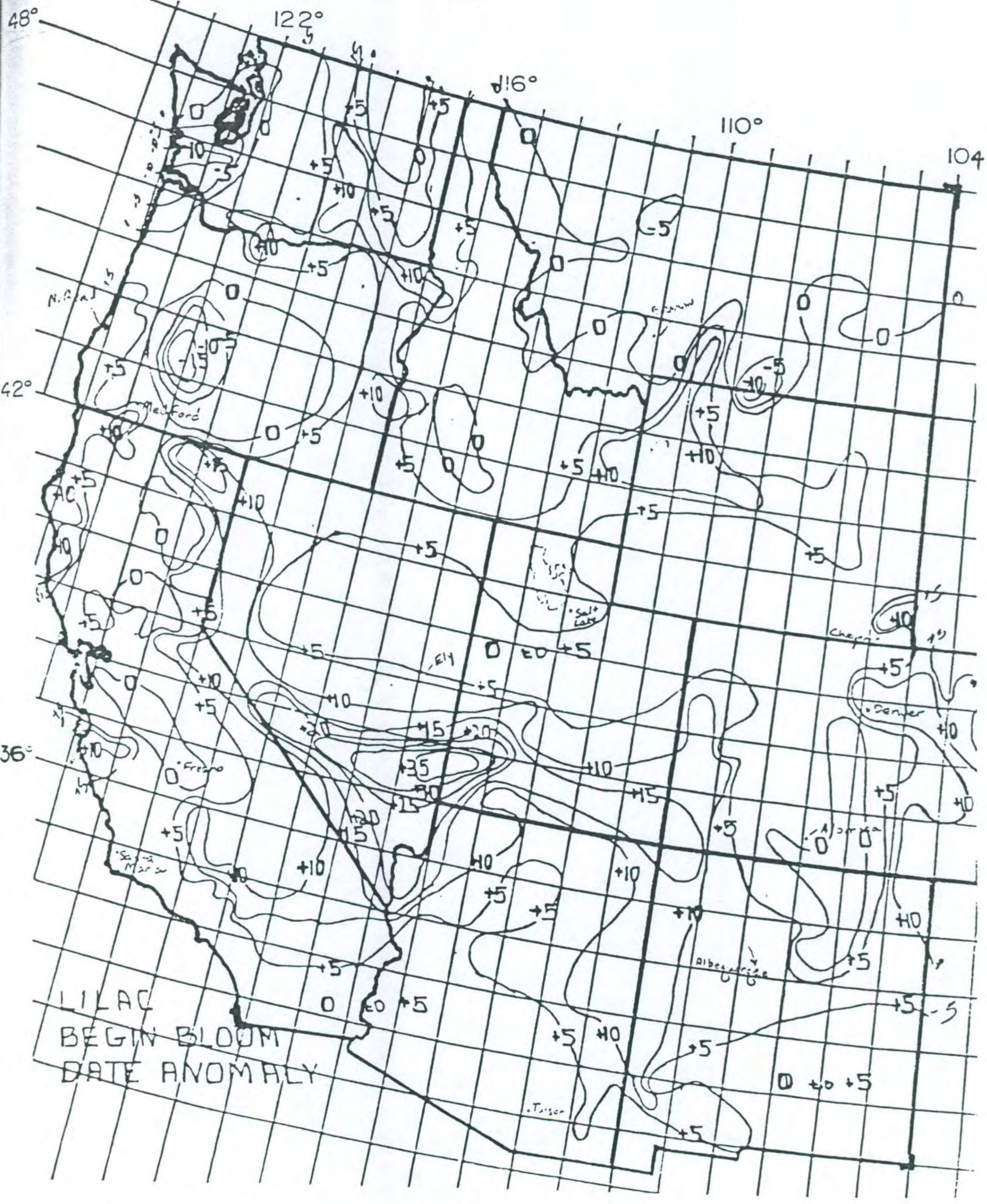
The predominant variety or varieties of wheat grown in each block at the indicated elevations are shown in abbreviated form. The number in the block shows the total number of farmers who reported from within the area. Only the variety most commonly grown is listed. If a block indicates "Cnn 4", for example, it means that four farmers reported on wheat in that block and that Cheyenne was grown by more farmers than any other variety. If two varieties were reported equally, both varieties are listed. The symbols for the varieties indicated on the map are as follows:

Abbrev.	Variety	Abbrev.	Variety	Abbrev.	Variety	Abbrev.	Variety
Ap	Apache	Eg	Elgin	Nt	Newturk	RK	Russian Kharkof
A053	Awned Onas 53	Emr	Elmar	Omar	Omar	Tm	Tenmarq
Atc	Aztec	Fr38	Federation 38	Onas	Onas	TR	Turkey Red
BC	Big Club	Gg	Galgalos	Oro	Oro	Wsc	Wasatch
Bvr	Brevor	Gln	Golden	PB	Pacific Bluestem	Wtr	Westar
Burt	Burt	It	Itana			Wmt	Westmont
Ch	Cache	Km	Karmont	Prh	Prohi	WFd	White Federation
Cnn	Cheyenne	Ko	Kiowa	Ro	Ramona	WFd38	White Federation 38
Cmn	Commanche	Lmh	Lemhi	Ro50	Ramona 50	Wi	Wichita
Cch	Concho	Mf	Marfed	Rm	Redman	WW	White Winter
Dc	Druchamp	Nbr	Nebred	RR	Red Russian	Yogo	Yogo

Median dates when wheat was seeded in each square are presented at the bottom of page 7. If the seeding dates reported by five farmers in one square, for example, are September 10, 11, 15, 18, and 19, the median date of September 15 would be registered in the block. If an even number of reports was received from an area, the average of the two central values is recorded. In general, wheat is seeded earliest in the colder parts of the region, with some seeding taking place as early as late August. Latest seeding is conducted in the warmer locations, with November through January seeding dates common in California.

The collection and analysis of phenological data is being conducted by the Montana Agricultural Experiment Station under a contributing project to Western Regional Project W-48 entitled Climatic and Phenological Patterns of the Western Region. In addition to state experiment stations in the Western Region, the State Experiment Stations Division, the Agricultural Research Service, and the United States Weather Bureau are participating in this regional project.

1960


48°
122°
116°
110°
104
42°
36°
Medford
Salt Lake
Ely
Denver
Fresno
Tucson
LILAC
BEGIN BLOOM
DATE ANOMALY

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE U. S. ON COMMON PURPLE LILAC AND ALTERNATIVE PLANTS SPRING 1960

Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
Bozeman, Montana
February 22, 1961

Bloom dates of common purple lilac (Syringa vulgaris L.) and the alternative plants, red berry pyracantha and large common caragana, have been observed for four consecutive years (1957-1960) throughout the 11 states that comprise the Western Region. Due to severe spring freeze damage to lilac buds throughout much of the Region this year, several hundred regular observers were unable to report on lilac bloom dates. However, the total of about 800 reports was adequate to construct 300-foot elevation interval isophanal maps similar to those drawn in the past three years.

The analytical mapping procedure used this year is the same as was used during the past three years. Only analyses of beginning dates of lilac bloom were mapped for this report. Regional mapping of information on red berry pyracantha and large common caragana is not possible because of their restricted distribution. The pyracantha is not found in the colder areas where the caragana thrives.

An isophane is a line connecting points where plants reached a given stage of development on the same date. The isophanes correspond to lines of equal rainfall (isohyets) or equal elevations on a topographic map. Isophanes, are drawn for 10-day intervals in this report. The mapping procedure involved: (1) plotting and analyzing all data reported within each 300-foot elevation range on single maps; (2) constructing, from these preliminary isophanal maps, a cross-section for every one-degree latitude; and (3) plotting the final isophanal maps--one for every 300-foot elevation interval--from the smoothed cross sectional analysis.

This presentation has the advantage of permitting the general bloom date to be determined quite accurately for any location, providing elevation and approximate location are known. To obtain an estimate of bloom date for a desired location, simply enter the location on the map which includes the particular elevation or, for somewhat more accurate estimates, interpolate between the two maps that include the particular elevation. For example, to determine when lilacs began to bloom in 1960 in Denver, Colorado, located at 39° 45' N latitude and 105° 00' W longitude at about 5250' elevation, you plot this location on both the 5100' and 5400' maps. Estimated bloom dates for these elevations are May 4 and May 6 respectively. Since 5250' elevation is half-way between the elevations of these two maps, the estimated date when lilacs began to bloom in Denver is May 5.

The general pattern of the progression of isolines this year corresponds closely to the patterns of the past three years. Again, the isophanes tend to parallel the west coast at lower elevations, particularly in California and the early ridge--the line connecting points on the various latitudinal lines where lilacs bloomed earliest--is located near the center of the region at all elevations.

The northward bulge in the isophanes conspicuous on the 1957 and 1959 maps in Washington and northern Oregon at elevations below 3500 feet is not apparent in the 1960 analysis.

Whereas bloom dates over much of the region tends to be about one day later for each increase of 100 feet in elevation, lilacs appear to bloom earlier with increasing elevation from sea level up to about 1800' in some areas south of 36° N latitude in California and Arizona. A similar tendency for this inverted condition in this general area was indicated on the maps for each of the past three years.

The maps on the last page show the number of days difference between the dates of lilac bloom in 1960 and 1959 for six different elevations--300, 1500, 3000, 4500, 6000, and 7500 feet. Plus signs indicate earlier bloom in 1960 than in 1959, and minus signs indicate later bloom in 1960. Over most of the Region, bloom dates in 1960 did not differ greatly from those in 1959, and the location of the early ridge was quite similar during these two years.

Locations near sea level, as indicated on the 300-foot elevation map, did not differ markedly in their bloom dates in 1960 compared to 1959. Lilacs bloomed about five days later in the San Joaquin Valley of California and along the northwestern tip of Washington. Bloom was more than 5 days earlier in northern California at this elevation.

The 1500 foot-map indicates earlier bloom dates in 1960 compared to 1959 by more than five days in northern Idaho and eastern Washington and Oregon. Bloom was more than five days later in central California.

At 3000-foot elevations bloom was more than five days earlier in 1960 compared to 1959 over much of Montana, northern Idaho, and eastern sections of Washington and Oregon. An earlier zone is also indicated in southeastern California and southwestern Arizona. Lilacs bloomed later at this elevation by more than five days in northwestern California and the northwestern part of Washington.

The 4500- and 6000-foot maps both indicate that lilacs began to bloom at least five days earlier over much of the central and eastern parts of the region in 1960 compared to 1959. Bloom was more than ten days earlier in sections of Arizona and Utah and parts of neighboring states at these elevations. Lilacs bloomed more than five days later in 1960 in northern California and southwestern Oregon.

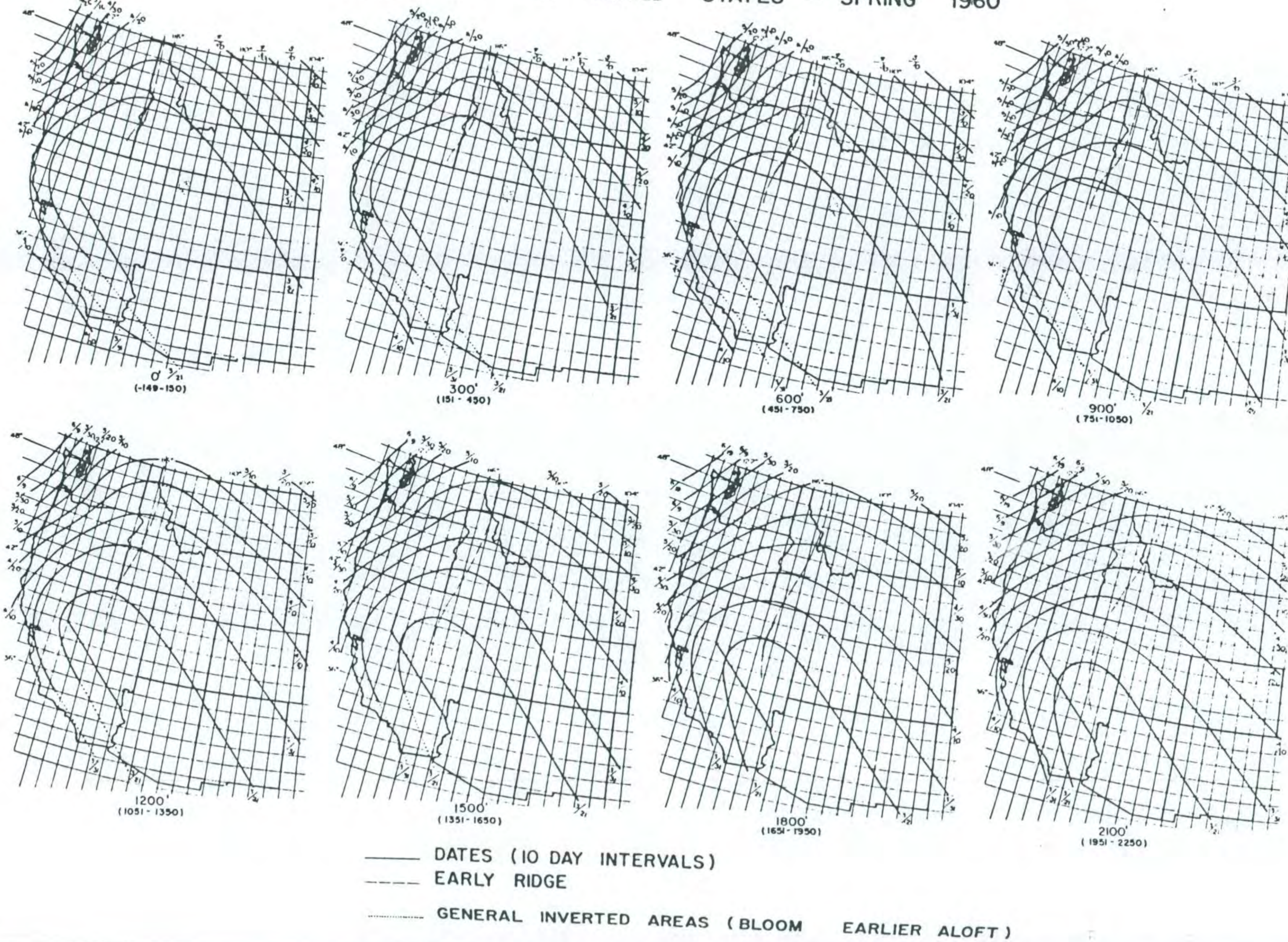
The 7500-foot map indicates that lilacs bloomed more than five days later in the extreme southern parts of the area in 1960 compared to 1959. Bloom was earlier in 1960 relative to 1959 over most of the central and eastern sections of the Region at this elevation

During the past year, the second annual collection of phenological data for winter wheat (*Triticum aestivum* L.) was conducted throughout the eleven Western States. Reports were received from about 500 cooperators on yield, dates of seeding, heading, combine ripe, and harvest. The first report on the winter wheat survey will soon be ready for distribution.

Surface Lilac Map for Montana

A surface map of Montana has been drawn showing average dates when lilacs begin to bloom. This map, shown on the last page of this report, was developed from the five years of phenological information already collected in Montana (1956-1960). Five-year average 100-foot elevation interval isophanal maps were constructed from the 300-foot interval isophanal maps of the past five years. The surface lilac map was drawn from these maps and is based on average dates when lilacs begin to bloom at lowest elevations in unit areas of 10,000 meters on a side

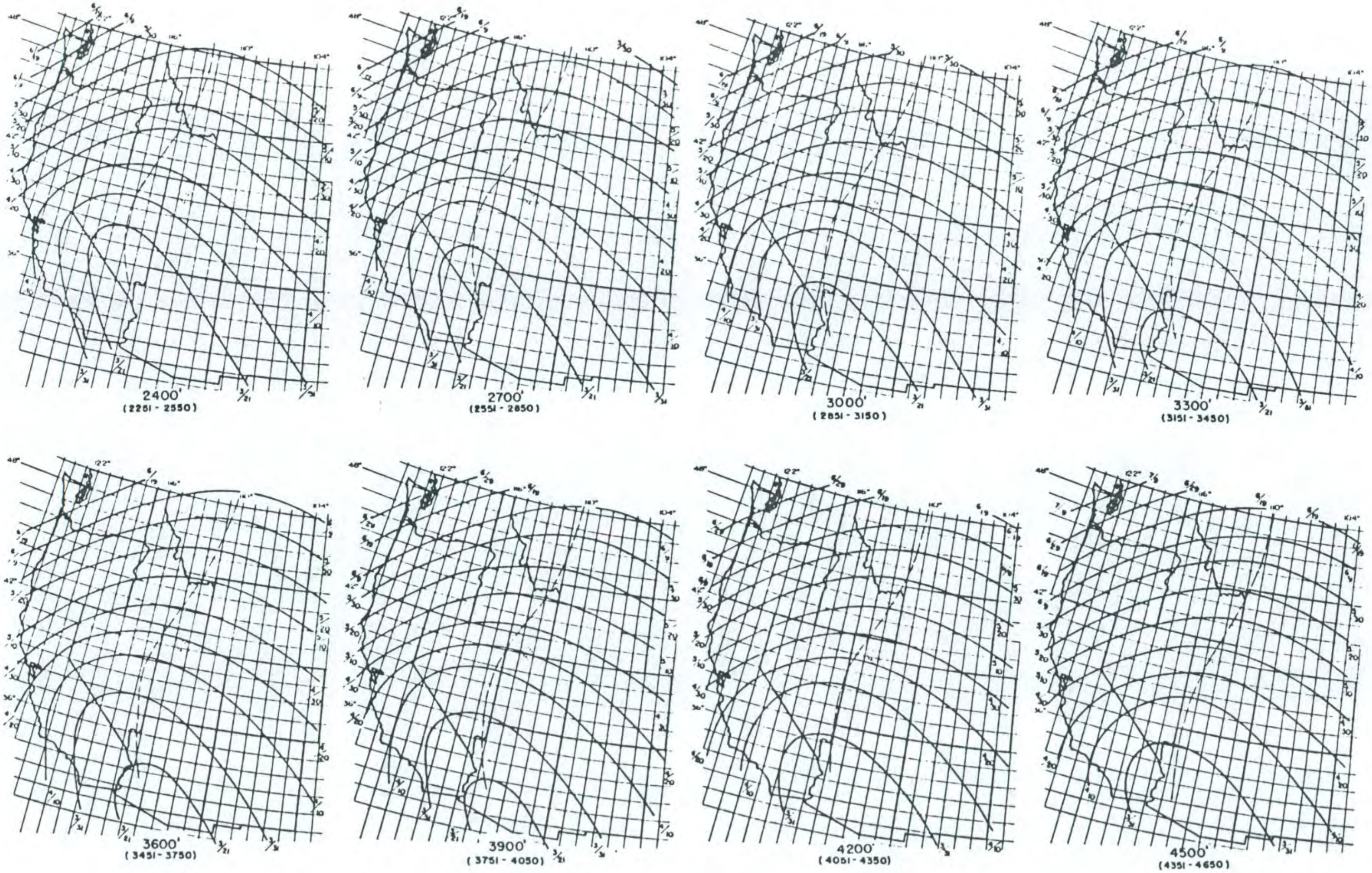
DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1960



―――― EARLY RIDGE

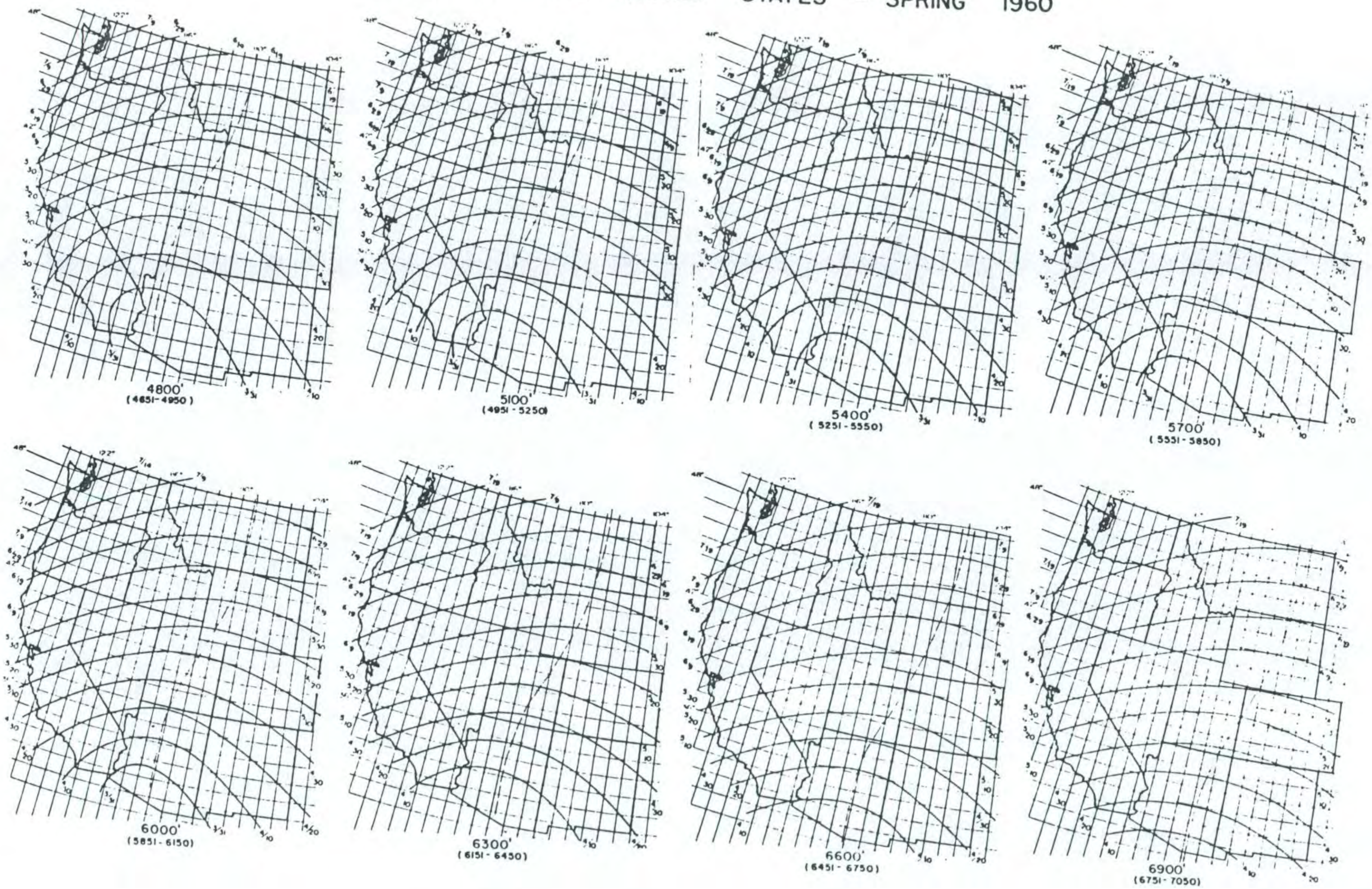
············ GENERAL INVERTED AREAS (BLOOM EARLIER ALOFT)

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1960



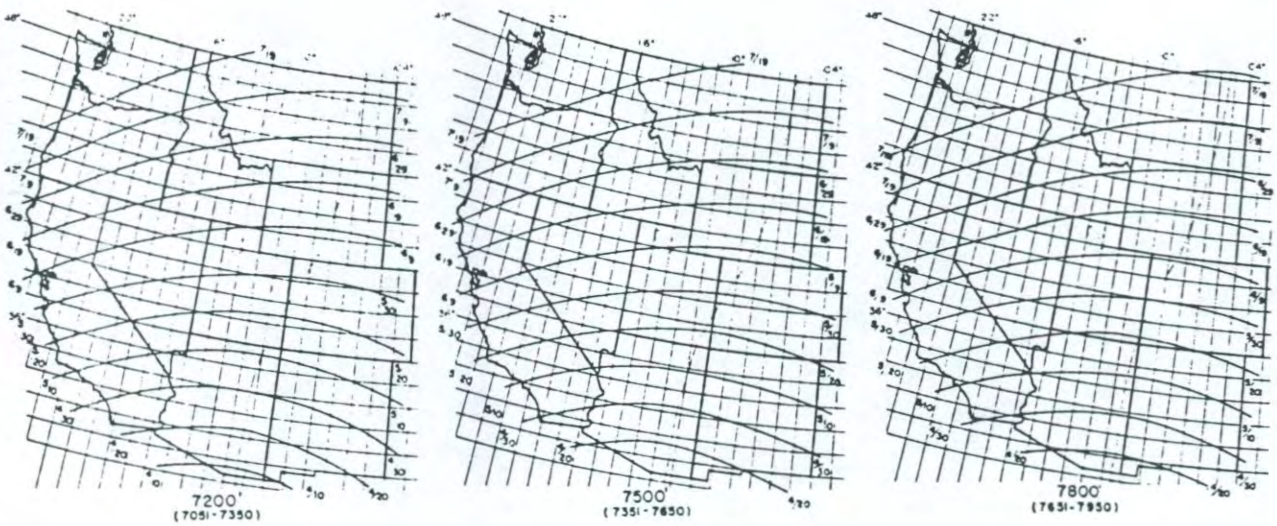
―――― DATES (10 DAY INTERVALS)
– – – – EARLY RIDGE

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1960



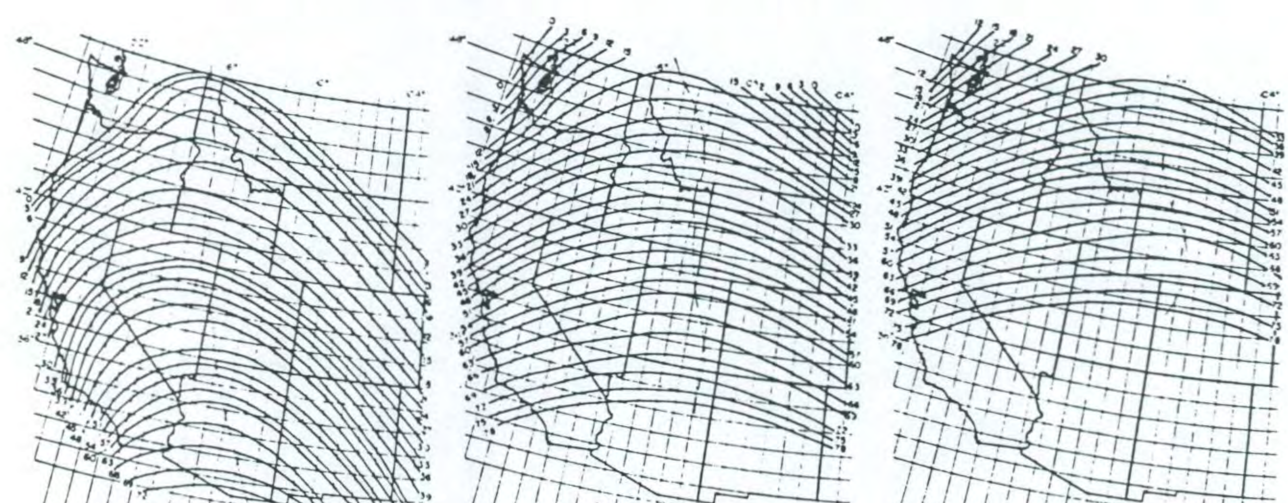
——— DATES (10 DAY INTERVALS)
- - - - EARLY RIDGE

DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS (300 FOOT INTERVALS) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1960



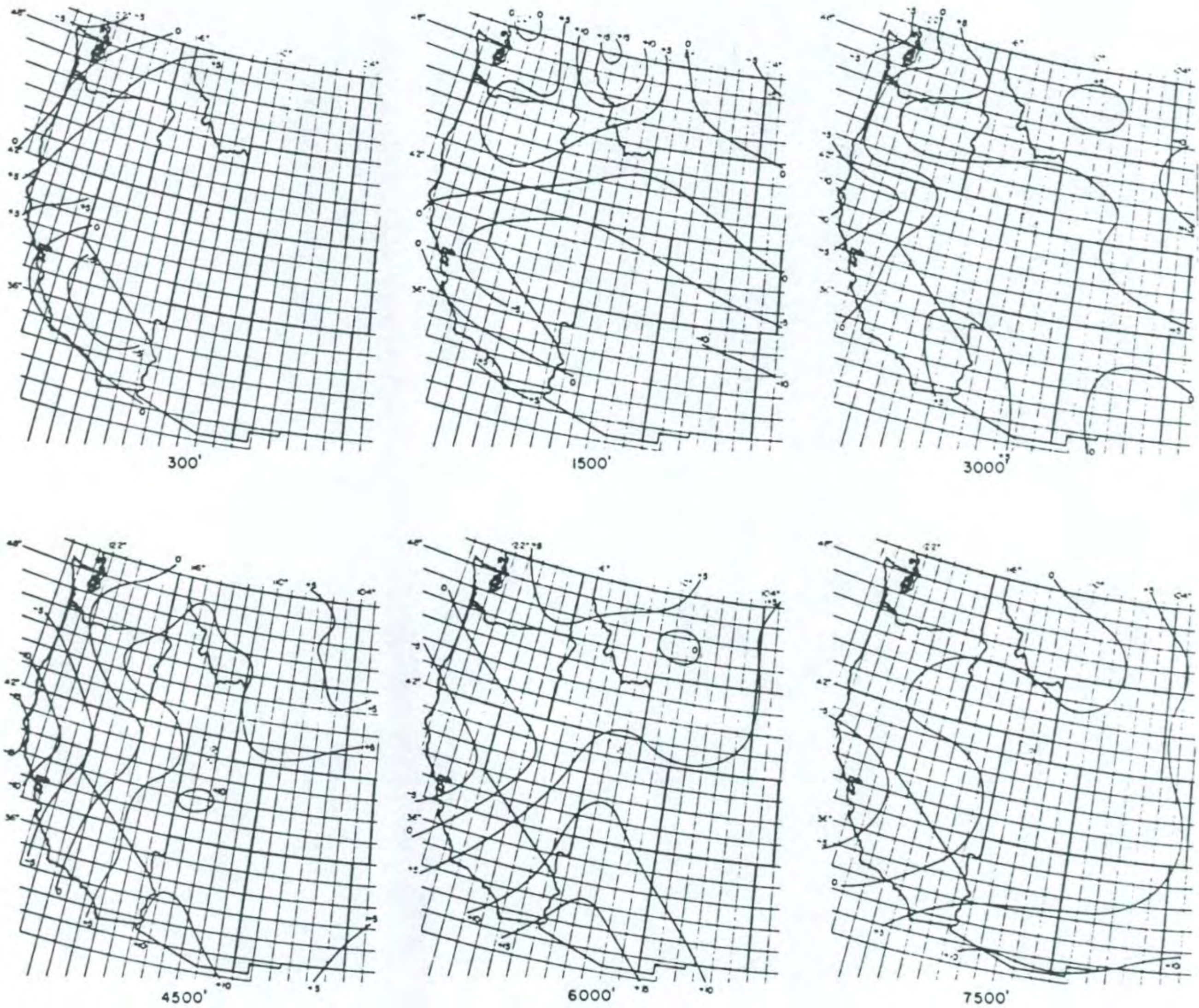
—— DATES (10 DAY INTERVALS)
---- EARLY RIDGE

ELEVATIONS AT WHICH THE COMMON PURPLE LILAC STARTED TO BLOOM ON VARIOUS DATES THROUGHOUT THE WESTERN REGION OF THE UNITED STATES — SPRING 1960



—— ELEVATIONS (300 FOOT INTERVALS)
---- EARLY RIDGE

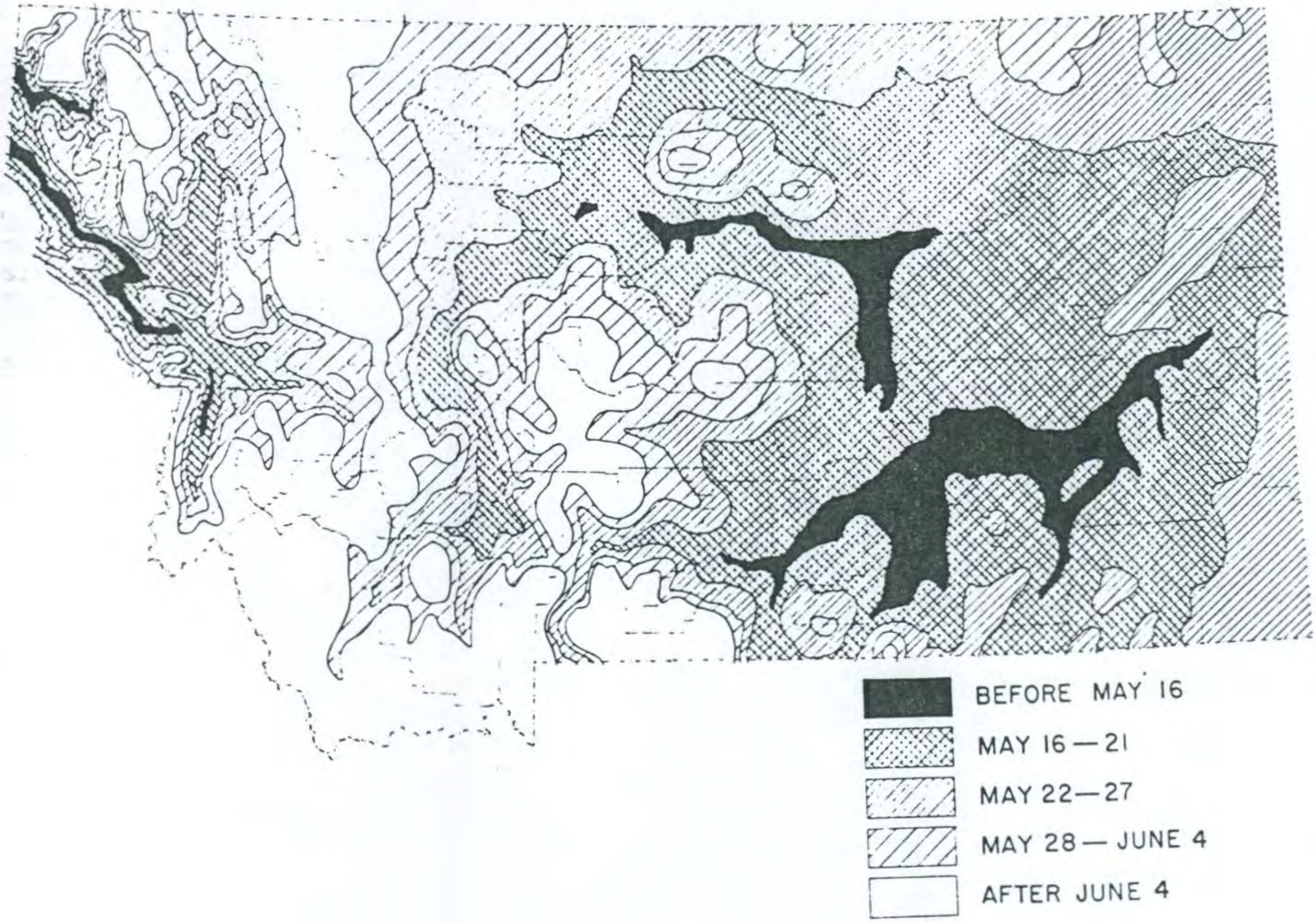
NUMBER OF DAYS DIFFERENCE AT INDICATED ELEVATIONS BETWEEN TIME WHEN COMMON PURPLE LILAC BEGAN TO BLOOM IN 1960 AND 1959
(POSITIVE VALUES INDICATE EARLIER BLOOM DATES IN 1960)



(approximately 6 miles) east of longitude 114° W and areas of 5 minutes on a side (approximately 4 x 6 miles) west of longitude 114° W.

This map shows the average date of lilac bloom over broad general areas and can be used for general planning purposes. The average date when lilacs began to bloom serves as an index to the relative advance of vegetative development in the spring throughout the state since many perennial plants develop in parallel with this indicator plant and some species even flower about the same time as the lilac. To determine the average date of lilac bloom for a particular location, the specific elevation must be considered in addition to such local factors as aspect and slope of the land.

AVERAGE DATE WHEN LILACS BEGIN TO BLOOM



A surface freeze hazard map has also been drawn for Montana. This map, (not shown in this report), is based on the degree of vegetative advancement, as indicated by the average date of lilac bloom, at the time of average last spring freeze. Areas where vegetation is well advanced at the time of average last freeze date are known as high freeze hazard areas. Areas where the average date of the last spring freeze occurs at a time when vegetation is normally less advanced are known as low freeze hazard areas. Thus, the difference in the number of days between the average date when the lilac begins to bloom and the average last freeze date can be used as an index of freeze hazard.

Similar maps for other states in the Western Region can be drawn when at least five years of data are available for analysis.

The collection and analysis of phenological data is being conducted by the Montana Agricultural Experiment Station under a contributing project to Western Regional Project W-48 entitled "Climatic and Phenological Patterns of the Western Region". In addition to state experiment stations in the Western Region, the State Experiment Stations Division, the Agricultural Research Service and the United States Weather Bureau are participating in this regional project.

A Report To Cooperators Of The Phenological Survey In Montana On Irrigated Alfalfa Hay

Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
April 1961

Climate and its effects on plants and animals must be understood to attain maximum efficiency in agricultural production. Both climatic and biological measurements are needed to arrive at a better understanding of environmental effects. The study of the relations between environment and periodic biological phenomena is known as phenology. Information on the time when plants reach various stages in their development, such as flowering or combine ripe, is called phenological data.

Phenological data can be used in a number of ways, particularly in agriculture. Such information can serve as a basis for scheduling farm operations, provide an objective measure of the length of the growing season, assist in predicting maturity dates and crop yields, indicate "early" and "late" seasons, and serve as a basis for recommending certain crops for specific areas.

In the spring of 1958, a network of phenological observers for irrigated alfalfa hay was established throughout the state by the Montana Agricultural Experiment Station, with the assistance of the county agricultural extension agents. Three years of data have now been accumulated from 75 cooperative observers who reported dates of one-tenth bloom and times of cutting of irrigated alfalfa hay.

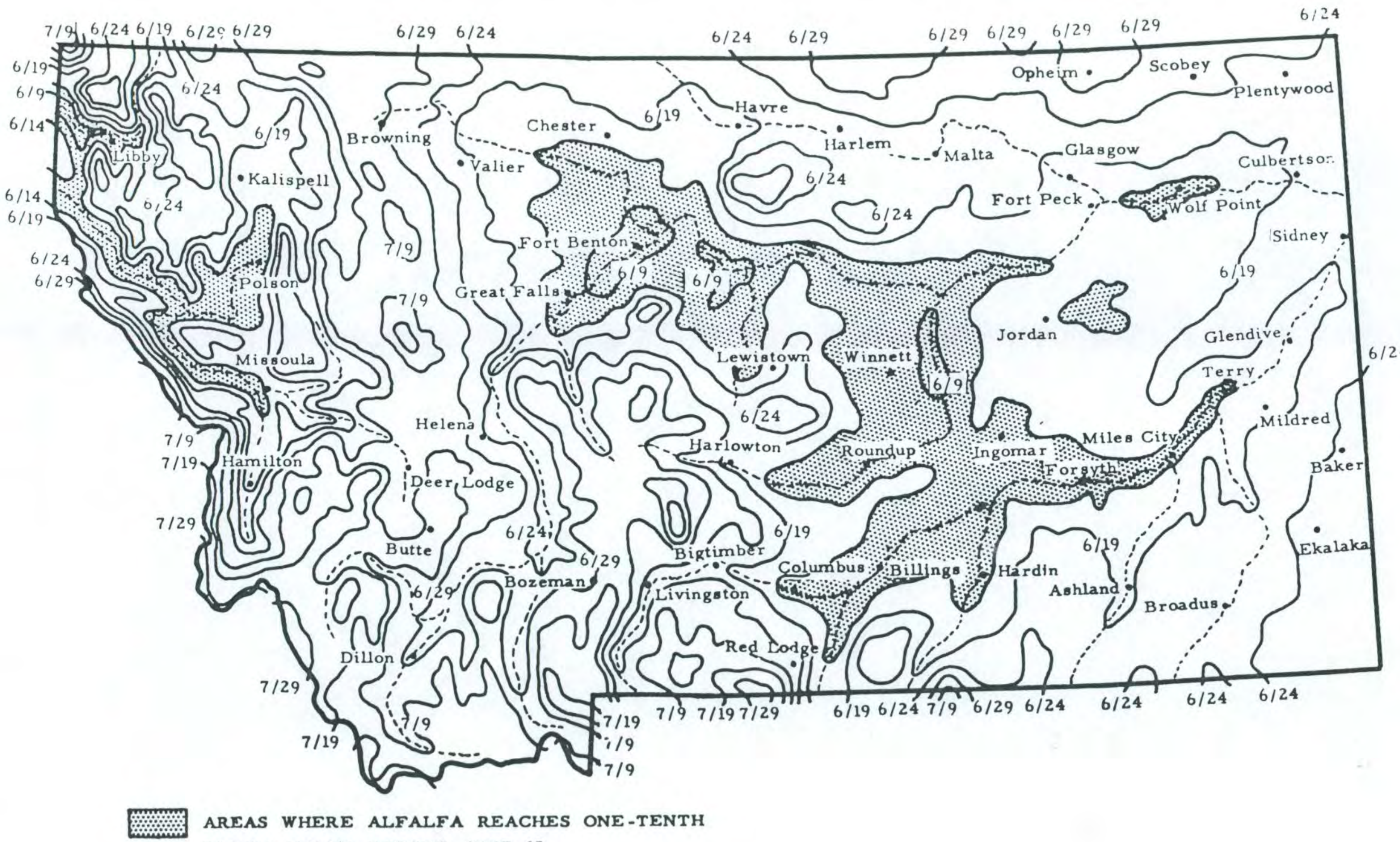
It is generally recommended that alfalfa be cut when it reaches one-tenth bloom stage. In certain areas where the bloom may sometimes partly or entirely fail, agronomists have recommended cutting when the shoots for the next crop appear at the crowns.

A number of different varieties of alfalfa have been observed, the majority of which are Grimm, Ladak, and Ranger. Little difference was apparent in the relative time that the different varieties reached one-tenth bloom stage.

During any one year, actual date of one-tenth bloom may vary from the average date for that location because preceding spring weather may have been colder or warmer than usual. A colder than normal spring will generally retard the development of plants in the community while warm springs bring forth early development. An estimate as to when alfalfa will reach one-tenth bloom stage during a particular year relative to the average date can be made by observing whether other plants in the community that reach a conspicuous stage in their life cycle, such as flowering, are advanced or retarded in their development prior to alfalfa bloom date. Although a number of kinds of plants can serve as indicators of relative vegetative advance, information on a statewide basis is available only on the common purple lilac. If during a particular year lilacs begin to bloom May 15 in an area where the normal date is May 25, it can be expected that alfalfa will also reach one-tenth bloom earlier than the average date unless lilac bloom is followed by unusually cold weather.

A preliminary map of the average date when irrigated alfalfa reaches first one-tenth bloom stage is shown on page 2. This is based on data for the 3-year period,

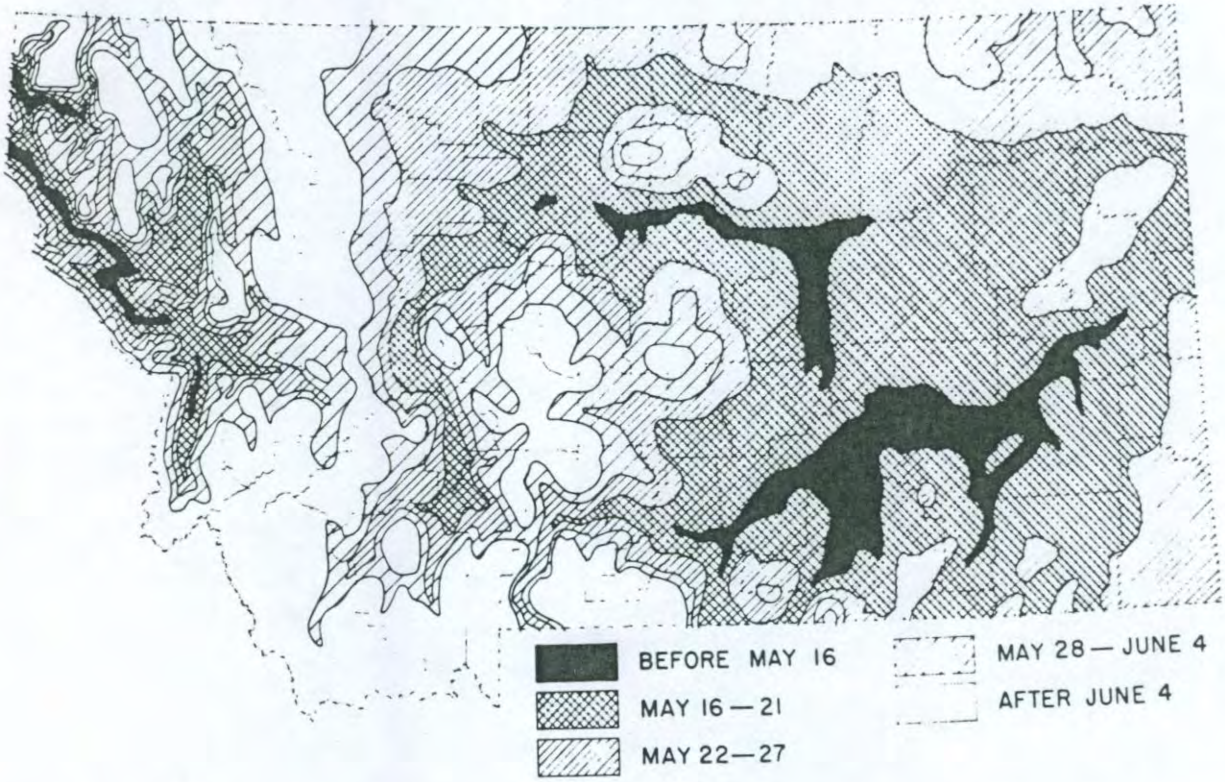
PRELIMINARY MAP OF AVERAGE DATE WHEN ALFALFA REACHES FIRST ONE-TENTH BLOOM STAGE



AREAS WHERE ALFALFA REACHES ONE-TENTH BLOOM STAGE BEFORE JUNE 15

ISOPHANES ARE DRAWN FOR 5-DAY INTERVALS TO JUNE 29 AND 10-DAY INTERVALS THEREAFTER

AVERAGE DATE WHEN LILACS BEGIN TO BLOOM



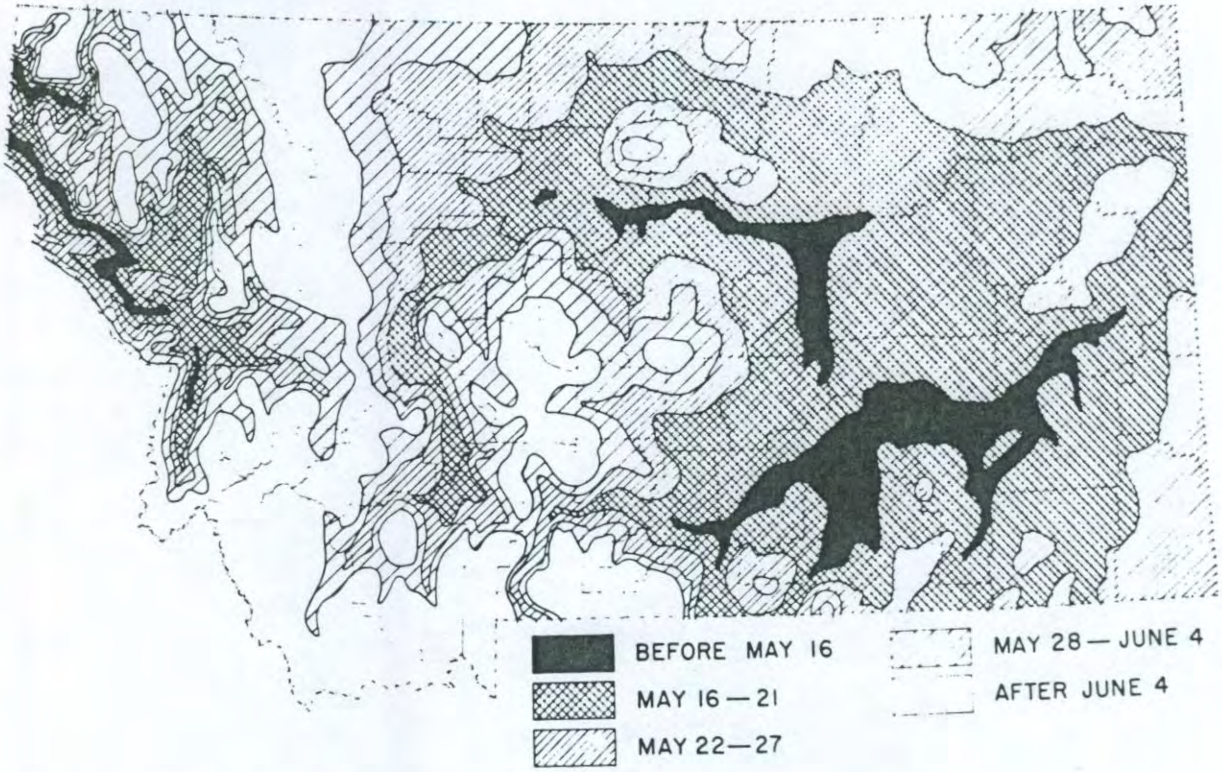
1958-60. With the accumulation of additional information, a more accurate map can be drawn. The dashed lines show locations of some of the principal rivers. The lines on the map connecting points where alfalfa reaches one-tenth bloom stage on the same date are called isophanes. The isophanes are labelled with identifying dates. They are drawn for 5-day intervals to June 29 and 10-day intervals thereafter. The shaded parts of the map indicate those areas where irrigated alfalfa hay reaches one-tenth bloom before June 15.

Two large areas of early bloom are indicated, one east of the Continental Divide and the other west of the Divide. Several locations within the shaded zones have average one-tenth bloom date before June 9. The alfalfa map is drawn in areas where no reports were received by projection, based on the general areal difference between lilac bloom dates and alfalfa bloom dates for the three years of observation.

The map on page 3 shows the average date when lilacs begin to bloom in Montana. The lilac map is based on reports of 5 years of data from about 300 observers.

During the three years of records, half of the farmers did not cut their hay until at least four days after one-tenth bloom stage while the other half had their hay cut within three days of one-tenth bloom stage. This was true for all three cuttings. Some fields were left for 10 days or more after one-tenth bloom stage before they were harvested. The percentage reporting at least ten days delay for the first cutting was 26% in 1958, 25% in 1959 and 14% in 1960. For the interval between second

AVERAGE DATE WHEN LILACS BEGIN TO BLOOM



1958-60. With the accumulation of additional information, a more accurate map can be drawn. The dashed lines show locations of some of the principal rivers. The lines on the map connecting points where alfalfa reaches one-tenth bloom stage on the same date are called isophanes. The isophanes are labelled with identifying dates. They are drawn for 5-day intervals to June 29 and 10-day intervals thereafter. The shaded parts of the map indicate those areas where irrigated alfalfa hay reaches one-tenth bloom before June 15.

Two large areas of early bloom are indicated, one east of the Continental Divide and the other west of the Divide. Several locations within the shaded zones have average one-tenth bloom date before June 9. The alfalfa map is drawn in areas where no reports were received by projection, based on the general areal difference between lilac bloom dates and alfalfa bloom dates for the three years of observation.

The map on page 3 shows the average date when lilacs begin to bloom in Montana. The lilac map is based on reports of 5 years of data from about 300 observers.

During the three years of records, half of the farmers did not cut their hay until at least four days after one-tenth bloom stage while the other half had their hay cut within three days of one-tenth bloom stage. This was true for all three cuttings. Some fields were left for 10 days or more after one-tenth bloom stage before they were harvested. The percentage reporting at least ten days delay for the first cutting was 26% in 1958, 25% in 1959 and 14% in 1960. For the interval between second

Preliminary Estimates for 239 Communities in Montana of Average Date When Lilacs Begin to Bloom and When Irrigated Alfalfa Reaches One-Tenth Bloom Stage

Community	Elev.	Lilac Bloom	Alfalfa Bloom
Beaverhead Co.			
Armstead	5490	6/1	7/2
Dell	6010	6/7	7/7
Dillon	5228	5/29	6/29
Grant	5820	6/6	7/8
Jackson	6477	6/17	7/21
Lima	6265	6/10	7/10
Monida	6790	6/15	7/14
Polaris	6700	6/18	7/21
Wisdom	6058	6/12	7/17
Big Horn Co.			
Busby	3500	5/18	6/22
Crow Agency	3030	5/12	6/15
Decker	3550	5/18	6/22
Hardin	2885	5/11	6/13
Lodge Grass	3380	5/16	6/20
Pryor	4000	5/19	6/19
Wyola	3705	5/18	6/22
Blaine Co.			
Chinook	2420	5/18	6/21
Cleveland	3503	5/27	6/28
Harlem	2371	5/18	6/22
Hays	3540	5/26	6/26
Lloyd	3900	5/31	7/1
Broadwater Co.			
Toston	3950	5/19	6/23
Townsend	3833	5/17	6/20
Carbon Co.			
Bridger	3685	5/15	6/14
Joliet	3700	5/15	6/13
Red Lodge	5575	6/1	6/30
Roberts	4570	5/22	6/20
Roscoe	5225	5/18	6/16
Carter Co.			
Albion	3380	5/23	6/27
Alzada	3420	5/22	6/26
Belltower	3350	5/24	6/28
Boyes	3500	5/22	6/26
Ekalaka	3425	5/25	6/29
Hammond	3715	5/24	6/28
Ridgway	3300	5/23	6/27
Ridge	3974	5/26	6/30
Cascade Co.			
Adel	5200	6/6	7/7
Fort Shaw	3500	5/20	6/18
Great Falls	3328	5/19	6/13
Sun River	3415	5/20	6/17
Chouteau Co.			
Big Sandy	2700	5/18	6/14
Fort Benton	2636	5/14	6/6
Geraldine	3135	5/18	6/10
Highwood	3400	5/20	6/12
Iliad	2800	5/17	6/13
Loma	2572	5/15	6/8
Custer Co.			
Fallon	2208	5/14	6/15
Garland	2600	5/13	6/16
Ismay	2500	5/16	6/19
Knowlton	3500	5/26	6/29
Miles City	2392	5/12	6/14
Volborg	3030	5/17	6/21
Daniels Co.			
Four Buttes	2415	5/25	6/25
Scobey	2458	5/26	6/25
Dawson Co.			
Glendive	2076	5/15	6/16
Lindsay	2681	5/21	6/20
Richey	2490	5/20	6/18
Fallon Co.			
Baker	2929	5/21	6/25
Plevna	2770	5/19	6/23
Webster	3080	5/22	6/26
Fergus Co.			
Buffalo	4305	5/27	6/19
Denton	3605	5/20	6/12
Garneill	4415	5/28	6/20
Grass Range	3480	5/21	6/14
Hilger	4079	5/28	6/21
Lewistown	3950	5/25	6/17
Roy	3895	5/26	6/21
Valentine	2800	5/16	6/12
Winifred	3250	5/21	6/16
Flathead Co.			
Columbia Falls	3095	5/24	6/18
Creston	2991	5/22	6/17
Essex	3871	5/30	6/24
Hungry Horse Dam	3150	5/25	6/19
Kalispell	2960	5/22	6/17
Polebridge	3690	5/31	6/25
Somers	2800	5/19	6/14

Community	Elev.	Lilac Bloom	Alfalfa Bloom
Whitefish	3033	5/24	6/18
Gallatin Co.			
Belgrade	4450	5/22	6/26
Bozeman	4850	5/26	6/29
Grayling	6500	6/13	7/11
Manhattan	4245	5/18	6/22
Sappington	4200	5/19	6/22
Sedan	5500	6/3	7/8
Three Forks	4070	5/18	6/22
Trident	4036	5/17	6/21
West Yellowstone	6665	6/12	7/10
Garfield Co.			
Brunelda	3300	5/21	6/18
Cohagen	2716	5/17	6/15
Jordan	2674	5/18	6/15
Glacier Co.			
Babb	4461	6/12	7/6
Browning	4370	6/8	7/2
Cut Bank	3760	5/30	6/22
Golden Valley Co.			
Barber	3800	5/19	6/13
Emory	3200	5/15	6/8
Lavina	3434	5/16	6/10
Rothiemay	4675	5/29	6/22
Ryegate	3640	5/17	6/11
Granite Co.			
Philipsburg	5280	6/6	7/11
Hill Co.			
Havre	2488	5/17	6/17
Hingham	3036	5/23	6/19
Kremlin	2832	5/21	6/19
Simpson	2700	5/21	6/19
Jefferson Co.			
Basin	5350	6/4	7/9
Boulder	4904	5/30	7/4
Whitehall	4371	5/22	6/26
Judith Basin Co.			
Hobson	4117	5/26	6/18
Moccasin Exp. Sta.	4300	5/28	6/20
Raynesford	4011	5/25	6/17
Stanford	4270	5/28	6/20
Uitca	4700	5/31	6/23
Lake Co.			
Dayton	2925	5/19	6/15
Polson	2927	5/18	6/14
Saint Ignatius	2900	5/16	6/13
Swan Lake	3100	5/21	6/16
Lewis & Clark Co.			
Augusta	4071	5/28	6/26
Austin	5000	6/2	7/7
Canyon Ferry	3470	5/16	6/18
Canyon Creek	4395	5/28	7/1
Helena	4066	5/22	6/26
Lincoln	4500	5/30	7/1
Marysville	5750	6/12	7/16
Liberty Co.			
Chester	3140	5/23	6/16
Joplin	3307	5/25	6/19
Lothair	3308	5/25	6/17
Lincoln Co.			
Eureka	2577	5/22	6/16
Fortine	2975	5/26	6/20
Libby	2075	5/12	6/8
Troy	1900	5/9	6/5
McCone Co.			
Circle	2424	5/18	6/15
Vida	2409	5/21	6/17
Madison Co.			
Alder	5110	5/27	6/26
Cameron	5500	5/31	6/29
Ennis	4953	5/26	6/24
Pony	5550	6/3	7/5
Twin Bridges	4655	5/24	6/25
Virginia City	5847	6/5	7/4
Meagher Co.			
Findon	4900	5/31	6/26
Martinsdale	4820	5/29	6/26
Ringling	5285	6/2	7/3
White Sul. Spring	5187	6/3	7/2
Mineral Co.			
Haugan	3150	5/21	6/19
Superior	2730	5/14	6/12
Missoula Co.			
Missoula	3210	5/16	6/15
Musselshell Co.			
Delphia	3059	5/15	6/10
Melstone	2887	5/15	6/12
Roundup	3227	5/16	6/10
Park Co.			
Clyde Park	4812	5/25	6/28
Corwin Springs	5120	5/25	6/23
Emigrant	5000	5/25	6/25
Jardine	6450	6/12	7/11
Livingston	4485	5/21	6/23
Wilsall	5050	5/29	7/2
Petroleum Co.			
Dovetail	2700	5/15	6/12
Winnett	2960	5/17	6/12
Phillips Co.			
Content	2260	5/16	6/17

Community	Elev.	Lilac Bloom	Alfalfa Bloom
Dodson	2291	5/17	6/21
Malta	2255	5/18	6/21
Saco	2181	5/18	6/20
Telegraph Creek	2537	5/17	6/17
White Water	2355	5/21	6/25
Pondera Co.			
Conrad	3519	5/24	6/16
Dupuyer	4125	6/1	6/25
Heart Butte	4460	6/7	7/1
Valier	3805	5/29	6/21
Powder River Co.			
Biddle	3339	5/18	6/22
Graham	3200	5/18	6/22
Moorhead	3350	5/18	6/22
Powderville	2800	5/16	6/20
Sonnett	3975	5/25	6/29
Powell Co.			
Avon	4694	5/30	7/4
Deer Lodge	4530	5/27	7/1
Ovando	4101	5/25	6/24
Prairie Co.			
Mildred	2407	5/16	6/18
Terry	2248	5/13	6/14
Ravalli Co.			
Darby	3815	5/18	6/22
Hamilton	3524	5/16	6/20
Stevensville	3370	5/16	6/17
Richland Co.			
Fairview	1902	5/19	6/20
Savage	1985	5/17	6/18
Sidney	1950	5/19	6/20
Roosevelt Co.			
Bredette	2280	5/23	6/21
Culbertson	1921	5/19	6/18
Poplar	2000	5/19	6/16
Wolf Point	1990	5/18	6/15
Rosebud Co.			
Ashland	3000	5/15	6/19
Colstrip	3221	5/17	6/20
Forsyth	2520	5/11	6/12
Ingomar	3041	5/16	6/15
Lame Deer	3331	5/17	6/21
Rock Springs	3024	5/20	6/19
Vananda	2800	5/14	6/14
Sanders Co.			
Heron	2253	5/14	6/11
Lonepine	2840	5/17	6/13
Thompson Falls	2435	5/14	6/11
Trout Creek	2375	5/14	6/11

Community	Elev.	Lilac Bloom	Alfalfa Bloom
Sheridan Co.			
Dooley	2200	5/26	6/24
Medicine Lake	1950	5/23	6/21
Outlook	2350	5/27	6/25
Plentywood	2043	5/24	6/22
Redstone	2107	5/24	6/22
Westley	2105	5/25	6/24
Silver Bow Co.			
Butte	5765	6/9	7/14
Melrose	5180	5/31	7/4
Stillwater Co.			
Absorokee	4000	5/17	6/15
Busteed	4050	5/20	6/18
Columbus	3624	5/14	6/12
Fishtail	4500	5/21	6/19
Nye	5025	5/25	6/24
Rapelje	4038	5/20	6/17
Reedpoint	3730	5/15	6/14
Sweetgrass Co.			
Big Timber	4100	5/19	6/20
McLeod	4710	5/23	6/24
Melville	5020	5/30	6/30
Teton Co.			
Bynum	3972	5/30	6/23
Choteau	3810	5/26	6/20
Fairfield	3983	5/27	6/24
Pendroy	4260	6/3	6/27
Toole Co.			
Ethridge	3544	5/27	6/19
Goldbutte	4500	6/10	7/3
Shelby	3276	5/25	6/17
Sunburst	3351	5/28	6/20
Sweetgrass	3466	5/29	6/21
Treasure Co.			
Hysham	2653	5/12	6/12
Valley Co.			
Fort Peck	2180	5/18	6/17
Frazer	2068	5/18	6/16
Glasgow	2090	5/17	6/17
Glentana	3080	5/30	7/1
Hinsdale	2200	5/19	6/21
Opheim	3265	6/1	7/4
Thoeny	2380	5/23	6/26
Wheatland Co.			
Harlowtown	4165	5/24	6/19
Judith Gap	4570	5/29	6/22
Wibaux Co.			
Wibaux	2694	5/21	6/23

Community	Elev.	Lilac Bloom	Alfalfa Bloom	Community	Elev.	Lilac Bloom	Alfalfa Bloom
Yellowstone Co.							
Ballantine	3000	5/12	6/11	Custer	2740	5/11	6/11
Billings	3097	5/12	6/11	Huntley Exp. Sta.	2989	5/11	6/9
Broadview	3863	5/20	6/17	Laurel	3300	5/14	6/11

one-tenth bloom stage and cutting, corresponding values are 11% in 1958, 27% in 1959, and 10% in 1960. A frequent cuase for delay in harvest is the occurrence of wet weather. Delay of this length is bound to give a coarser less palatable hay that is lower in nutritive value.

Median dates of first one-tenth bloom based on all reports were June 16 in 1958, June 28 in 1959 and June 22 in 1960. Corresponding dates for second one-tenth bloom are August 10 in 1958, August 15 in 1959 and August 5 in 1960.

The table on pages 4 to 7 lists, by counties, preliminary estimates of average dates when alfalfa reaches first one-tenth bloom stage for different communities. Average dates when lilacs begin to bloom are also listed for each community. The estimated dates for a specific community applies for the general area at approximately the same elevation. However, unusual local conditions such as exposure and air drainage can cause lilacs or alfalfa to bloom somewhat earlier or later than estimated dates at the specific location. For example, vegetation on a north facing slope is slower to develop than a level exposed location. Likewise, vegetation on a south facing slope may develop faster than the standard level exposure.

To estimate average one-tenth bloom stage of alfalfa for your particular location, select a community on the list that is nearby. Adjust the date of the selected near-by community by one day for every 100 feet elevation that your location differs from the chosen community, earlier if you are lower, and later if you are higher. Also adjust the date by one day for every 20 miles difference in north-south direction, earlier if you are south of the near-by community, and later if you are north of it. For example, if the selected community has an average first one-tenth bloom date on June 20 and is 20 miles north and 500 feet lower in elevation than your location, you subtract one day because you are 20 miles to the south and add 5 days because you are 500 feet higher. You then compute that your location is 4 days later than the near-by community and therefore has average one-tenth bloom occurrence on June 24.

Similar elevational and latitudinal adjustments to the average date when lilacs begin to bloom can be made to compute average lilac bloom date at your location. In Montana, on an average, alfalfa reaches first one-tenth bloom stage 30 days after lilacs begin to bloom. Second one-tenth bloom stage, follows first cutting by about 40 to 45 days throughout the state and the interval between second cutting and third one-tenth bloom stage is also about 40 to 45 days.

The percentage of observers who reported alfalfa to reach third one-tenth bloom stage varied from year to year. The percentage in 1958, 1959 and 1960 were 23, 4, and 21, respectively. The small percentage in 1959 was due to the cold growing season that year which retarded the development of alfalfa so that a third cutting of the crop could not be made in most areas.

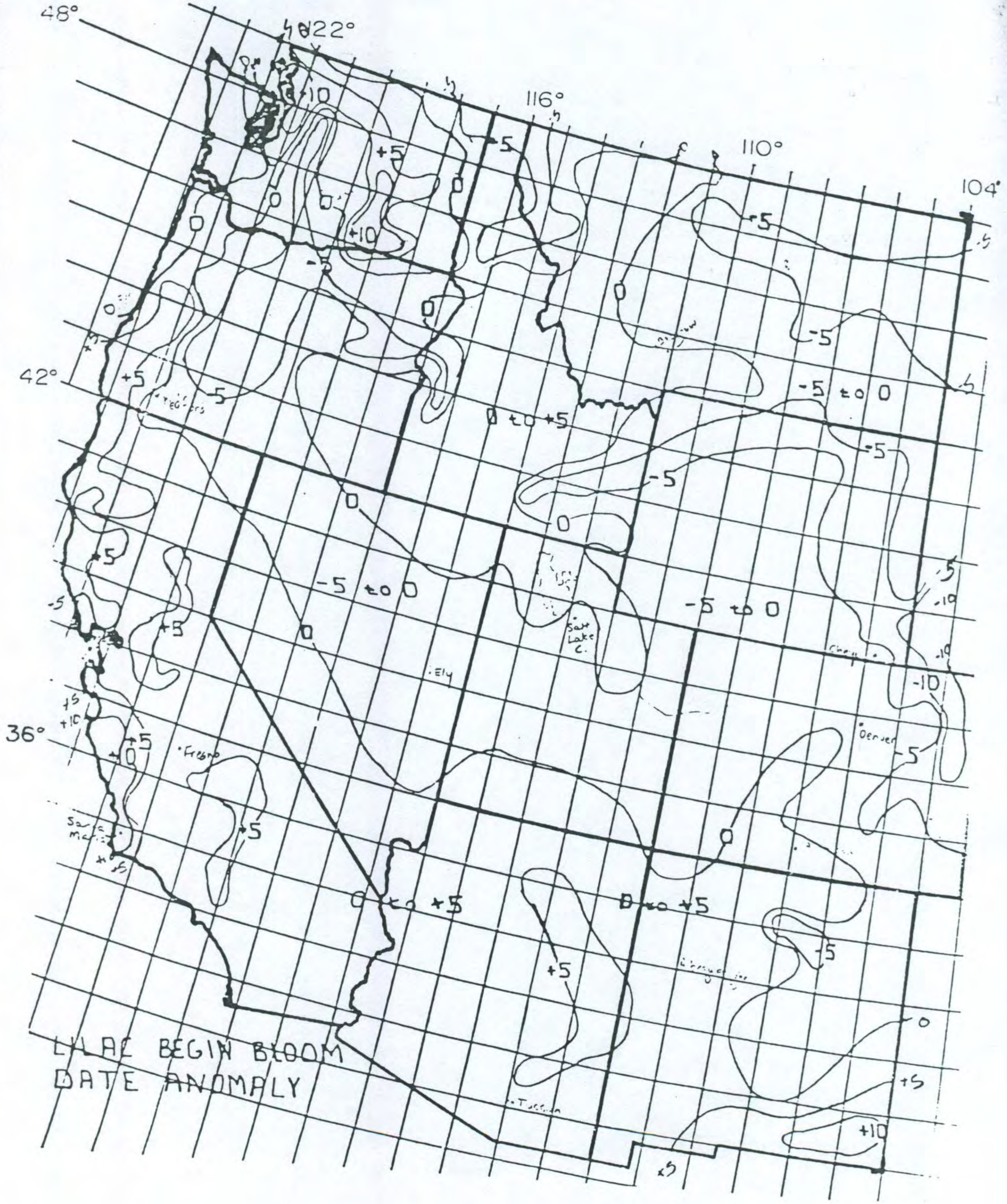
It appears that in those years and areas where a third one-tenth bloom stage is realized, lilacs generally began to bloom on or before May 15. Also, years of three blooms are generally characterized by the occurrence of first one-tenth bloom stage of alfalfa on or before June 17.

Climatic and phenological studies are being conducted by the Montana Agricultural Experiment Station in order to better understand the climatic resources of Montana agriculture. The preliminary results reported here will lead to more accurate and detailed analyses as additional phenological data becomes available. The continuing success of these surveys depends upon the voluntary cooperation of many phenological observers throughout the state and the assistance of Weather Bureau climatological observers.

ACKNOWLEDGEMENTS

The kind cooperation of the phenological observers in Montana who made this study possible is very much appreciated. Thanks are also extended to R. E. Eslick, H. N. Metcalf and A. H. Post of the Montana Agricultural Experiment Station for their suggestions and encouragement, to C. S. Cooper, R. D. Mercer and A. F. Shaw for their consultation on applications of phenological information in agronomic practice, and to Mrs. Beatrice Taylor for her valuable assistance in assembling and editing the material for this report.

1961


48°
122°
116°
110°
104°
42°
36°
+10
+5
0
-5
0 to +5
-5 to 0
-5 to 0
-10
Salt Lake C.
Ely
Fresno
Santa Maria
Denver
Tucson
0 to +5
+5
LILAC BEGIN BLOOM
DATE ANOMALY

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE U. S. ON COMMON PURPLE LILAC AND ALTERNATIVE PLANTS SPRING 1961

Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
Bozeman, Montana
February 1, 1962

For the fifth consecutive year, (1957-1961), bloom dates of common purple lilac (Syringa vulgaris L.) and the alternative plants, red berry pyracantha and large common caragana, were collected last spring throughout the eleven states that comprise the Western Region. Over 900 individuals and U. S. Weather Bureau personnel cooperated in the 1961 survey.

Bloom dates for the 1961 season were mapped and analyzed according to the procedure previously established. The mapping procedure involves: (1) plotting and analyzing all data reported within each 300-foot elevation range on single maps; (2) constructing, from these preliminary isophanal maps, a cross section for every one-degree latitude (An isophane is a line connecting points where plants reached a given stage of development on the same date. The isophanes in this report are drawn for 10-day intervals.); (3) plotting the final isophanal maps--one for every 300-foot elevation interval--from the smoothed cross sectional analysis.

In addition to the mapping of the 1961 data, averages were determined for the five-year period, 1957-1961, and were subjected to the same analytical and mapping procedure. The maps on pages 3-6 show the average dates when the common purple lilac started to bloom at various elevations throughout the Western Region. These maps were constructed from data accumulated during the five year period. Thus, with yearly differences removed, the isophanes are smoother than for the annual maps. The general pattern of the isolines in the five-year average is to parallel the west coast at lower elevations, particularly in California, and to form an early ridge (a line connecting points of the various latitudinal lines where lilacs bloomed earliest) near the center of the region at all elevations. The early ridge shows a tendency to move slightly eastward with increasing elevation.

The three lower maps on page 6 show the average elevations at which the common purple lilac started to bloom on April 10, May 10, and June 4 for the period 1957-1961. These maps are an extension of the isophanal maps shown on pages 3-6 and show more clearly the retarding effect of elevation on lilac bloom. The elevation lines are extended over areas where these elevations do not occur by the use of interpolation.

The maps on page 7 show a comparison of the date of first bloom of the common purple lilac in 1961 and for the five year average. At each cross-bar the average date of lilac bloom was plotted against the date of lilac bloom in 1961, the difference in dates was taken, and isolines were drawn to show the patterns. Positive values indicate earlier bloom dates in 1961 than the average. Thus a positive number, in general, indicates an earlier spring. At low elevations, common purple lilac bloomed at least a week earlier than average in 1961 in the southern portion of the Western Region, earliest near the coast at 300-foot elevations and in the southeast at 1500-foot elevations. The "early" dates move northwestward with increasing elevation, and at the 6000-foot and 7500-foot elevations lilacs bloomed earliest, compared with the average, in Washington.

The map drawn for 300-foot elevations shows a northeast progression across the Region from an area of lilac bloom 2½ weeks earlier than average in southern California to an area where lilacs bloomed over a week later than average in eastern Montana. This trend is interrupted by an area centered in Oregon which experienced bloom dates up to 8 days earlier than average in 1961.

The 1500-foot map shows a general north-south trend within the Region from a later spring than average in the north to bloom dates up to twelve days earlier in the southeast portion of New Mexico. This progression is broken by an area of earlier bloom in northern California and southern Oregon.

The 3000-foot map shows an area of later bloom dates in 1961 centered in northern Idaho and western Montana. Lilacs bloomed as much as two weeks earlier than average in southern Arizona and New Mexico and slightly earlier than average in northern California and southern Oregon. The central portion of the Region showed little variation from the average at this elevation.

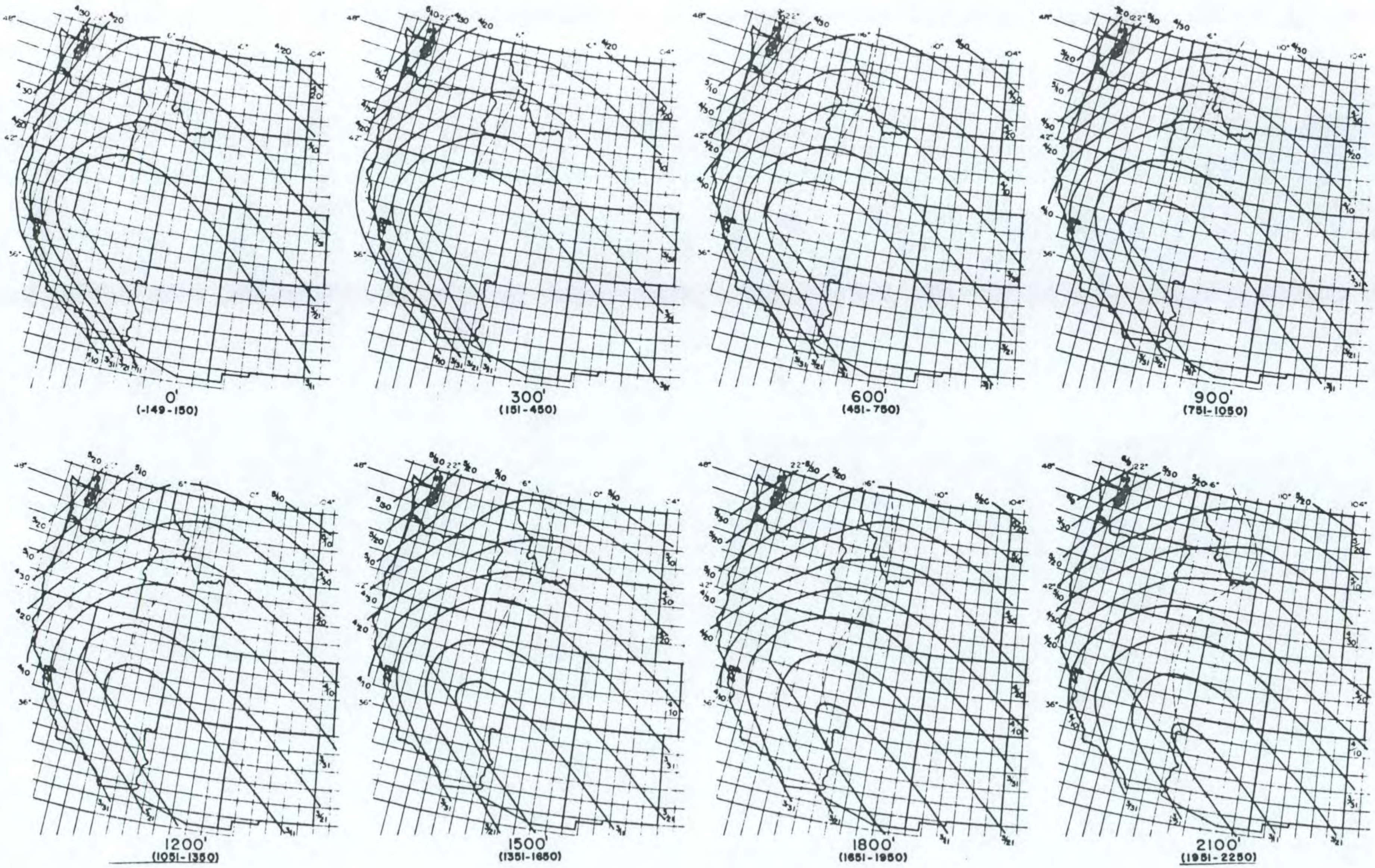
At 4500-foot elevations, 1961 showed little change from the average throughout much of the Region, with the only later area centered in Wyoming. Southern Arizona and New Mexico experienced an earlier spring at this elevation, but the difference was not as marked as at lower elevations.

The 6000-foot map shows a reversal of the previous patterns with the earlier blooming period in the northwest, principally in Washington and Oregon. Some areas in the southern portion of the Region at this elevation experienced a slightly later spring.

The 7500-foot map shows an average to slightly earlier spring throughout the southern states, with parts of Nevada and California experiencing the only later bloom dates. The northern half of the Region had lilacs blooming from 4 to 16 days earlier than average for this elevation.

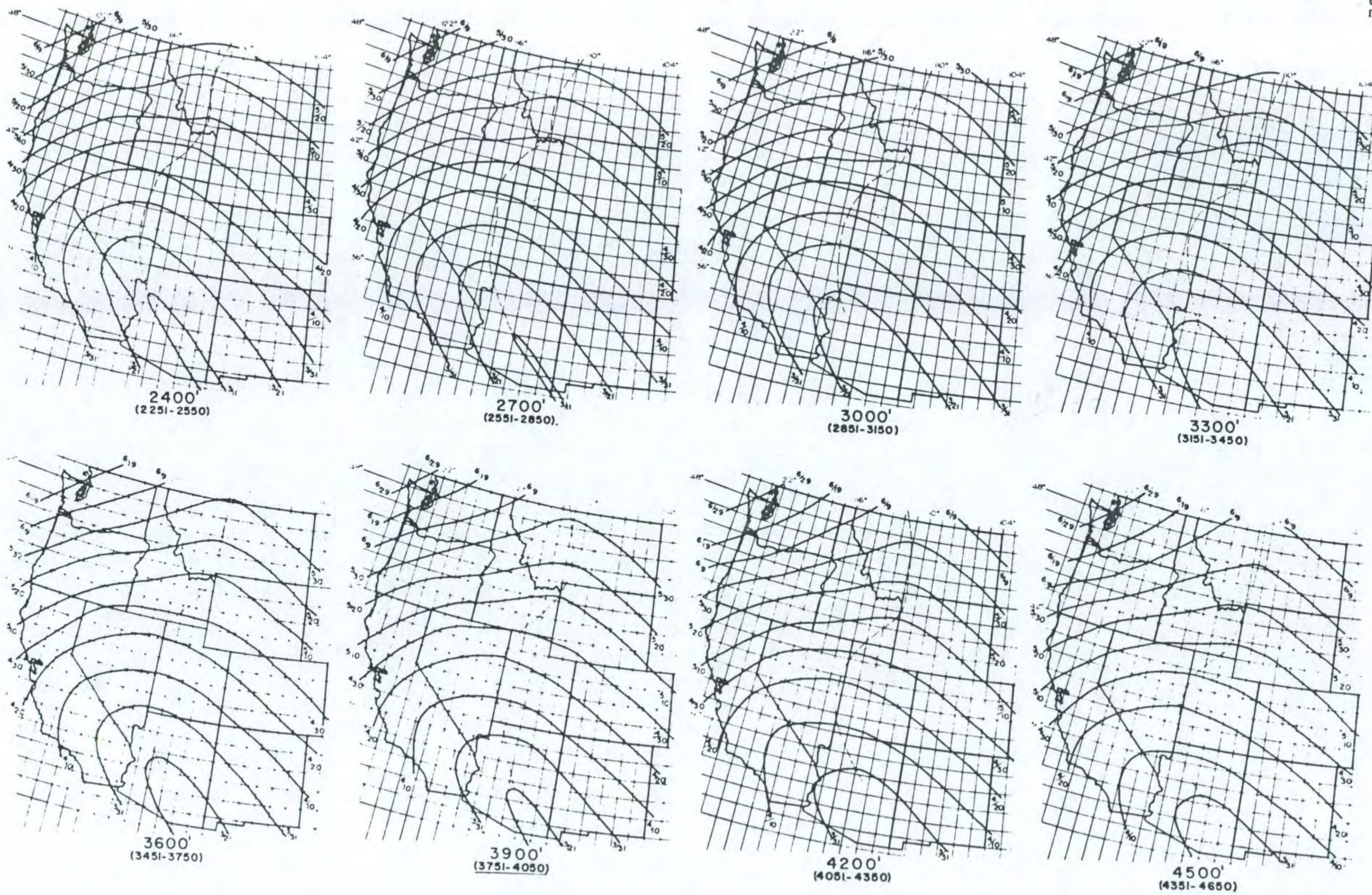
Note: This report was assembled by Beatrice R. Taylor from material prepared by Mr. Caprio before departing on a United Nations assignment in Iran.

AVERAGE DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS THROUGHOUT THE WESTERN REGION OF THE UNITED STATES - 1957-1961



—— DATES (10 DAY INTERVALS)
- - - EARLY RIDGE

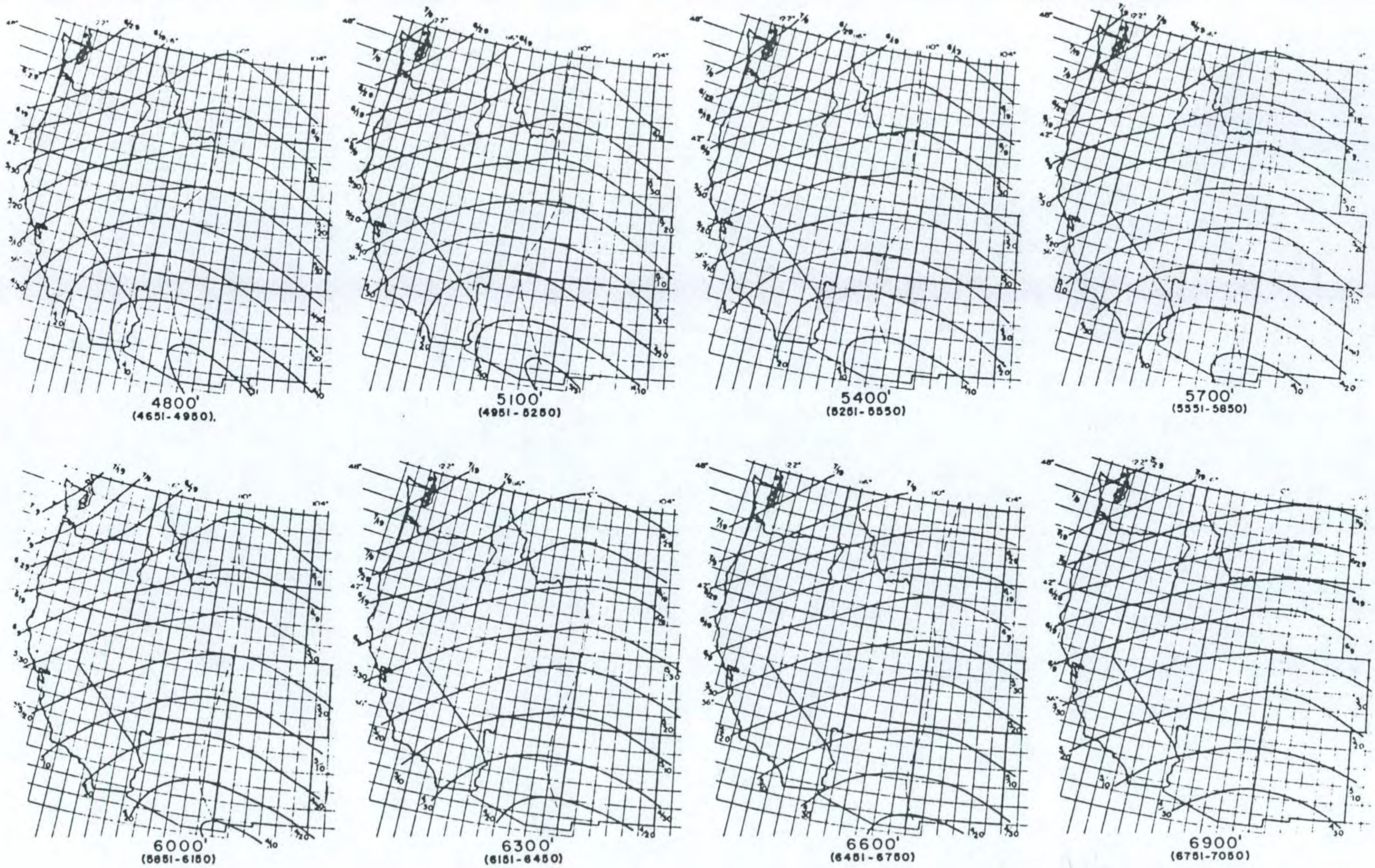
AVERAGE DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS THROUGHOUT THE WESTERN REGION OF THE UNITED STATES – 1957-1961



——— DATES (10 DAY INTERVALS)
- - - - EARLY RIDGE

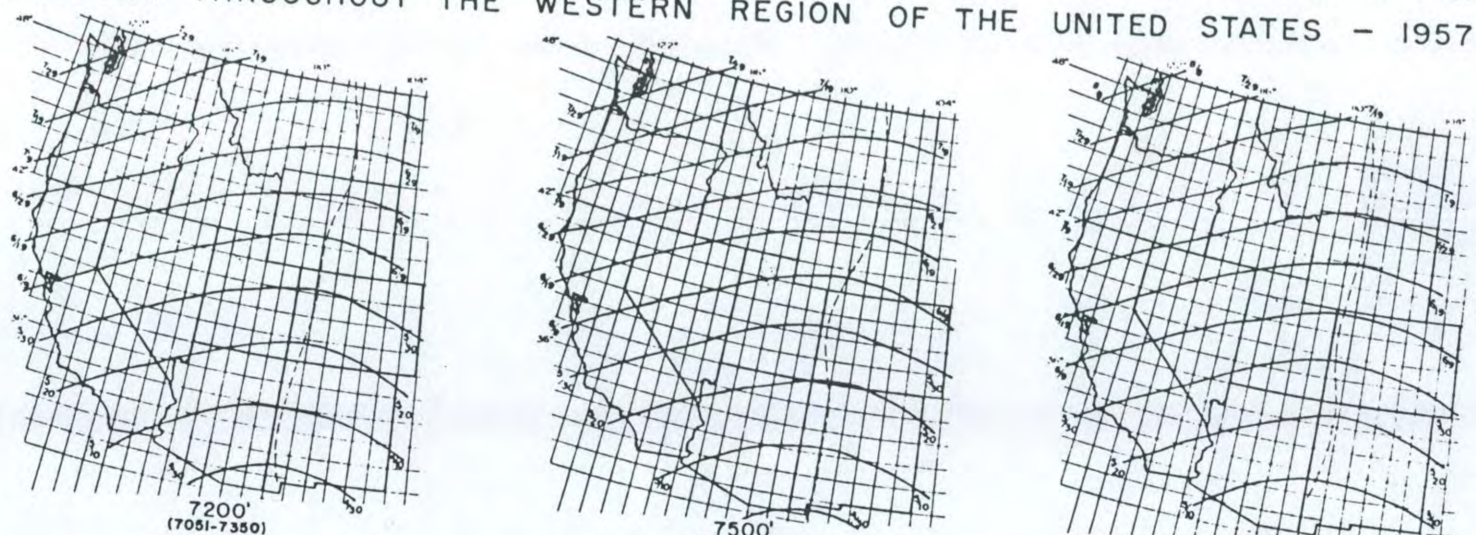
DATES (10 DAY INTERVALS)
EARLY RIDGE

AVERAGE DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS THROUGHOUT THE WESTERN REGION OF THE UNITED STATES – 1957-1961



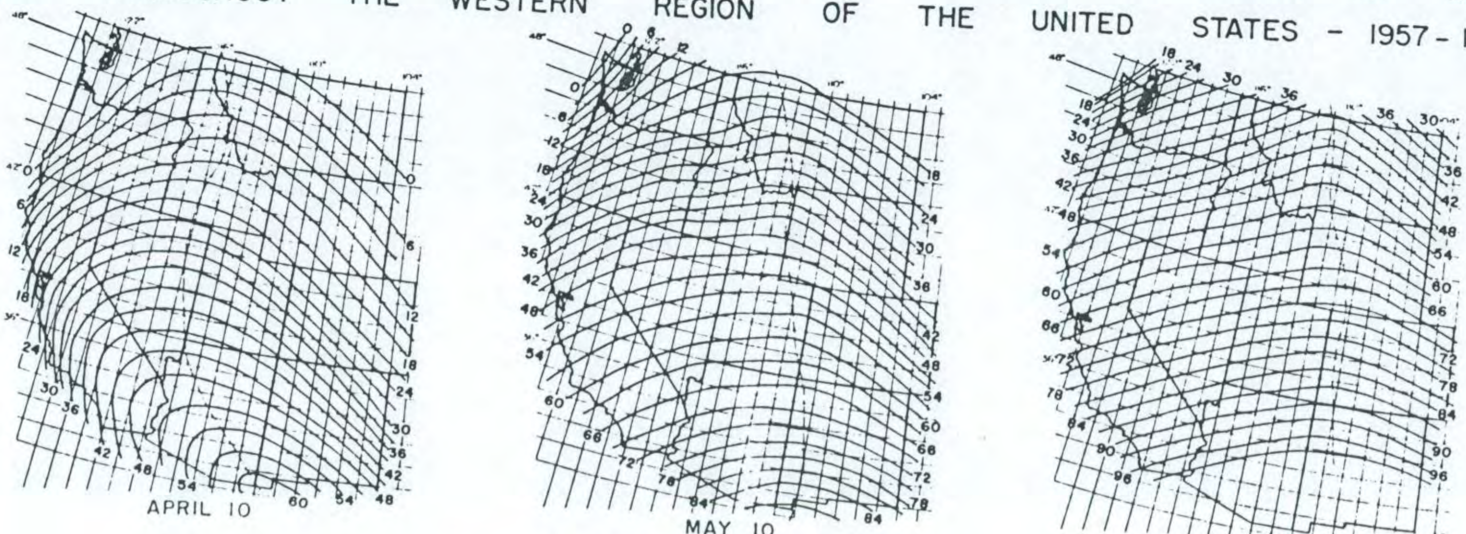
——— DATES (10 DAY INTERVALS)
- - - - - EARLY RIDGE

AVERAGE DATES WHEN THE COMMON PURPLE LILAC STARTED TO BLOOM AT VARIOUS ELEVATIONS THROUGHOUT THE WESTERN REGION OF THE UNITED STATES - 1957-1961



—— DATES (10 DAY INTERVALS)
--- EARLY RIDGE

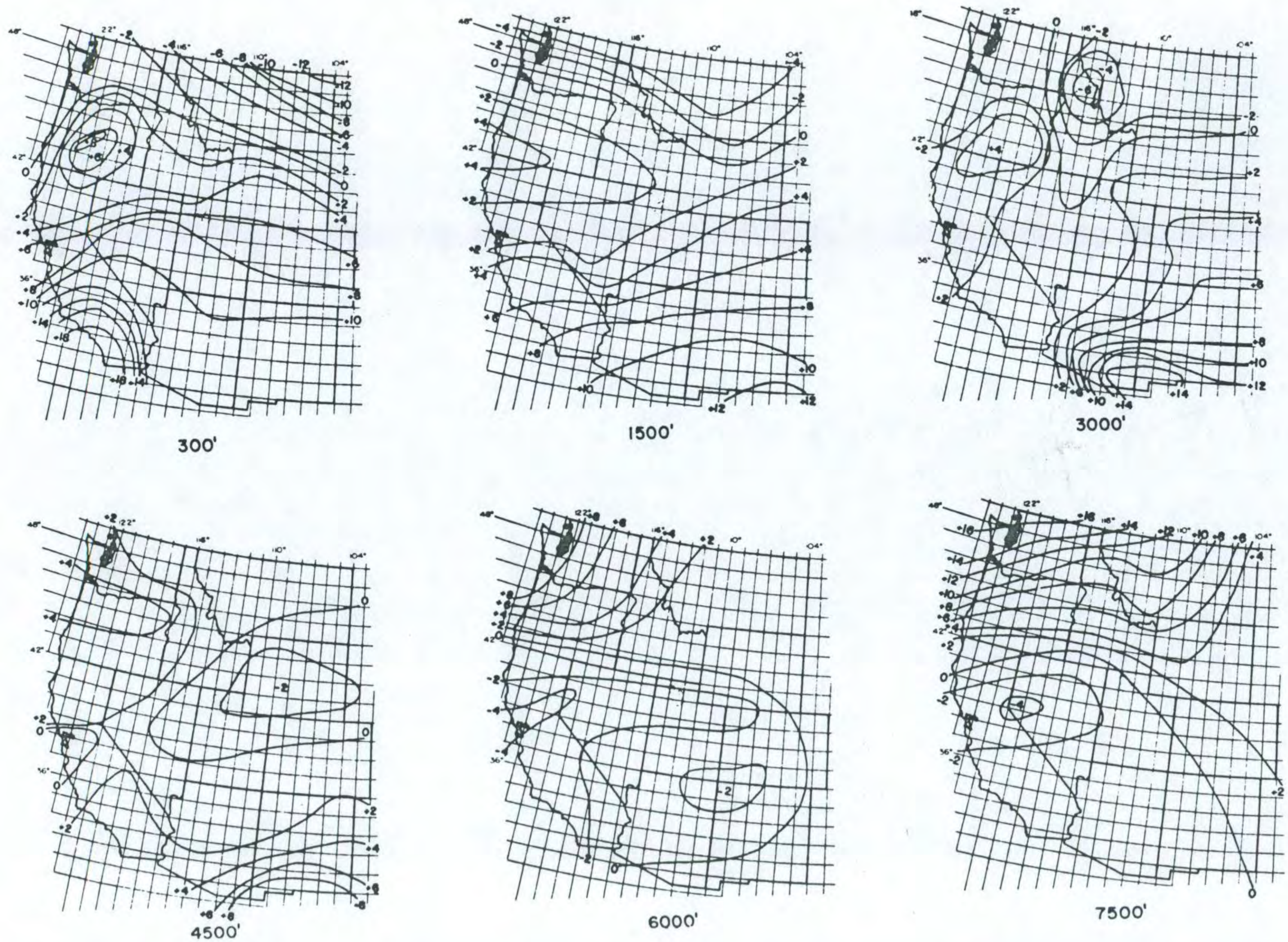
AVERAGE ELEVATIONS AT WHICH COMMON PURPLE LILAC STARTED TO BLOOM ON VARIOUS DATES THROUGHOUT THE WESTERN REGION OF THE UNITED STATES - 1957 - 1961

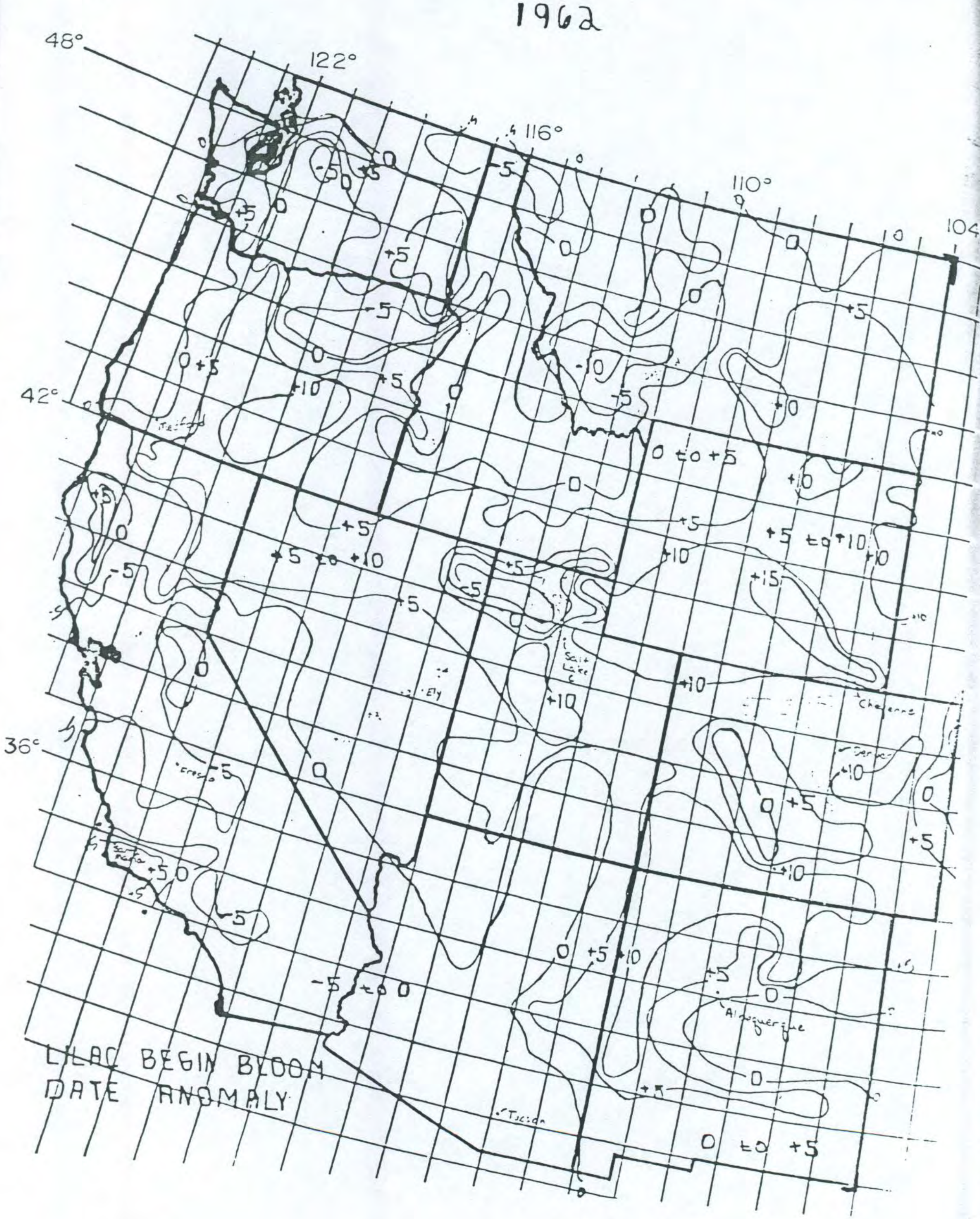


—— ELEVATIONS (300 FOOT INTERVALS)
--- EARLY RIDGE

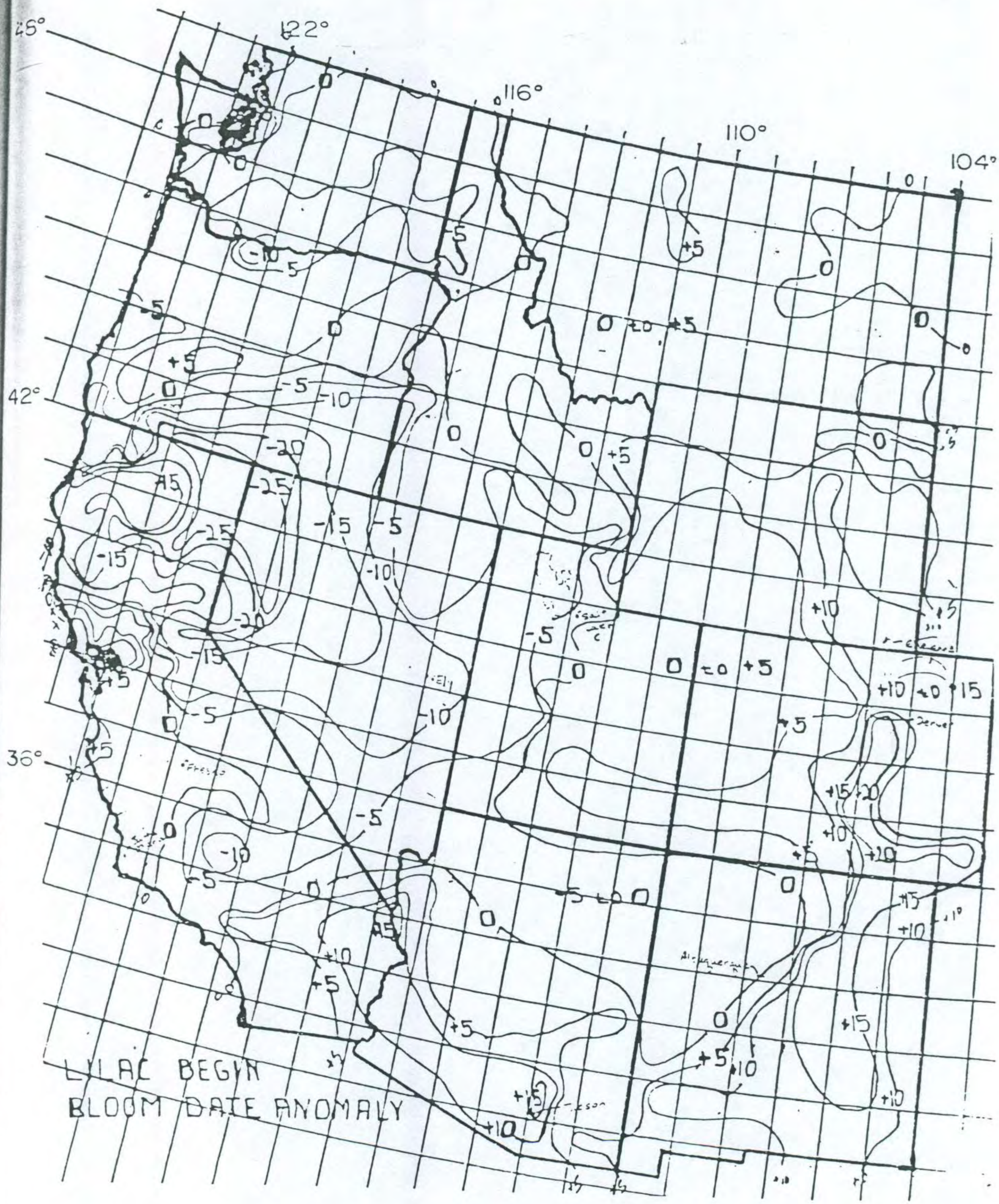
NUMBER OF DAYS DIFFERENCE AT INDICATED ELEVATIONS BETWEEN TIME WHEN COMMON PURPLE LILAC BEGAN TO BLOOM IN 1961 AND AVERAGE (1957 - 1961)

(POSITIVE VALUES INDICATE EARLIER BLOOM DATES IN 1961)




1962
48°
122°
116°
110°
104°
42°
36°
0
-5
-10
+5
+10
+15
0 to +5
+5 to +10
-5 to 0
Medford
Salt Lake C
Ely
Fresno
Santa Maria
Cheyenne
Denver
Albuquerque
Tucson
LILAC BEGIN BLOOM
DATE ANOMALY

/963



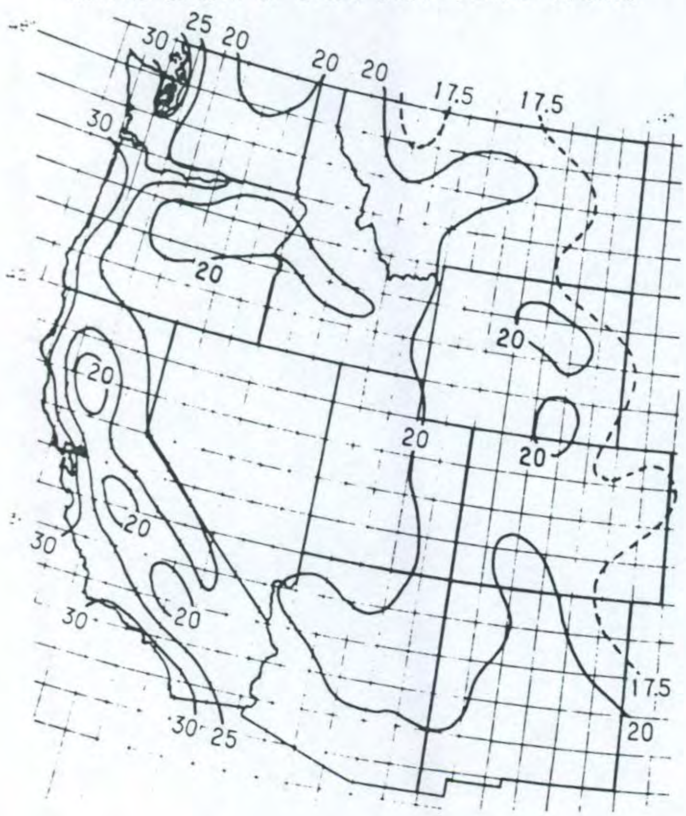
A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES ON WHEAT AND LILACS

Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
Bozeman, Montana
February 26, 1964

An interesting outcome of the analysis of lilac bloom data is finding that lilacs pass through their bloom period faster in some parts of the Western Region than in other parts. The normal interval between dates of begin and end bloom varies from about 17 days in some areas of the Great Plains, to about twice that time or more than 30 days in a narrow belt extending almost the entire length of the Pacific Coast. (See preliminary map below). In general, lilacs are in bloom for <u>less</u> than 20 days in the eastern half of the Region and <u>more</u> than 20 days in the western half of the Region. Exceptions are southern New Mexico where lilacs are in bloom for more than 20 days, and parts of the interior valleys of California, northeastern Washington, and a belt extending from Oregon into Idaho where lilacs are in bloom less than 20 days.

The reasons for this areal difference in the bloom period probably relate to varying climates over the area, especially during the bloom period. The coastal region is generally cool and cloudy during the normal bloom season, while clear skies and higher day-time temperatures are more common where lilacs are in bloom for shorter periods. The slow advance in lilac development along the Pacific Coast has also been reflected in isophanal analyses which show that the rate at which bloom progresses upward to higher elevations is less rapid along the Pacific Coast than in areas farther to the east.

NORMAL LENGTH OF LILAC BLOOM PERIOD IN DAYS



Paralleling this observation of the lilac bloom period, it has also been found that the period from date headed to combine ripe for fall and winter sown wheat varies from about 40 days in the extreme eastern areas of the Region to near 60 days in some locations near the Pacific Coast.

Collection of phenological information on the common purple lilac and fall and winter sown wheat was again conducted in 1963 throughout the Western Region. Information for 7 years is available since the regional survey on lilacs started in 1957. The regional wheat survey began in 1959, which makes 5 years of data accumulated to date.

A 5-year summary analysis of these two species of plants (1957-61 for lilacs, 1959-63 for wheat) is now being prepared for publication.

Normal dates of the different bloom phases of the lilac and phases in the life cycle of wheat can be estimated by utilizing the median (central date) of the 5 years of information. Such normals have been computed for both lilacs and wheat for all phenological stations active in the project.

Using the normals, it is now possible to determine for each year whether the season is relatively early or late. Preliminary maps (page 3) showing these departures from normal in 1963 have been drawn for each of the following:

(1) Date when lilacs begin to bloom.
(2) Date when lilac bloom ends.
(3) Date when wheat is 10% headed.
(4) Date when wheat is combine ripe.

The normal sequence of phenological events is as follows:

(1) Begin lilac bloom (generally from March in the warmest areas to May in the north).
(2) End lilac bloom (generally from April in the warmest areas to early June in the north.
(3) Wheat headed date (generally from mid-April in the warmer areas to mid-June in the north).
(4) Wheat combine ripe date (generally from June in the warmer areas to late July in the north.

Departure of Begin Lilac Bloom from Normal

The figure on page 3 indicates that lilacs were more than 10 days earlier than normal in the northeastern corner of New Mexico, eastern Colorado, and southern Wyoming. An area in the plains of Colorado was more than 20 days earlier than normal. A small area of southern California and locations in the vicinity of San Francisco and northeastward were also more than 10 days earlier than normal.

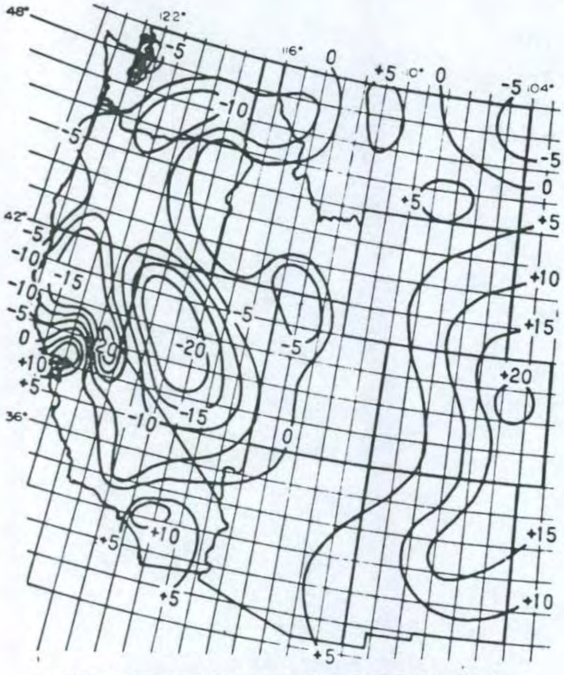
Much of Nevada and northern and east-central California reported lilac bloom dates later than normal. Most of the area was more than 10 days later than normal and 20-day departures from normal were reported from locations in Nevada. Bloom in south-central Washington and adjoining parts of Oregon was more than 10 days later than normal.

Weather Bureau records for 1963 indicate that March and April were cooler than normal in Nevada and northern California while April and May were warmer than normal in the central Great Plains region.

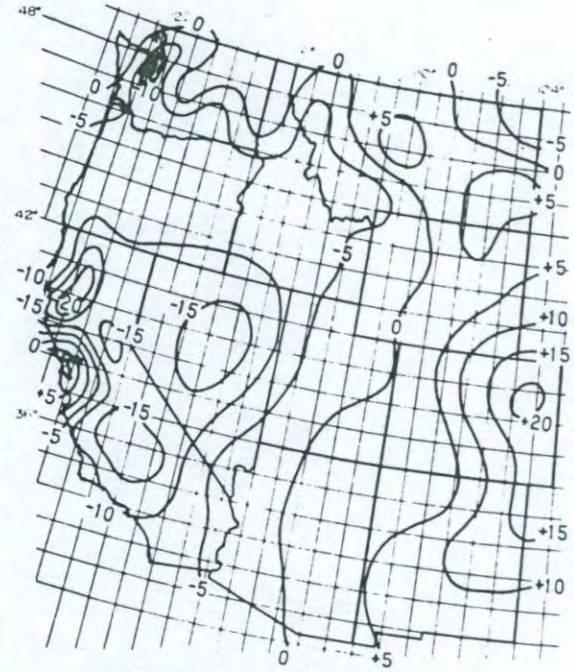
Departure of End Lilac Bloom from Normal

The anomaly pattern of begin lilac bloom generally continued to persist throughout the lilac bloom period. In general, lilac bloom terminated earlier

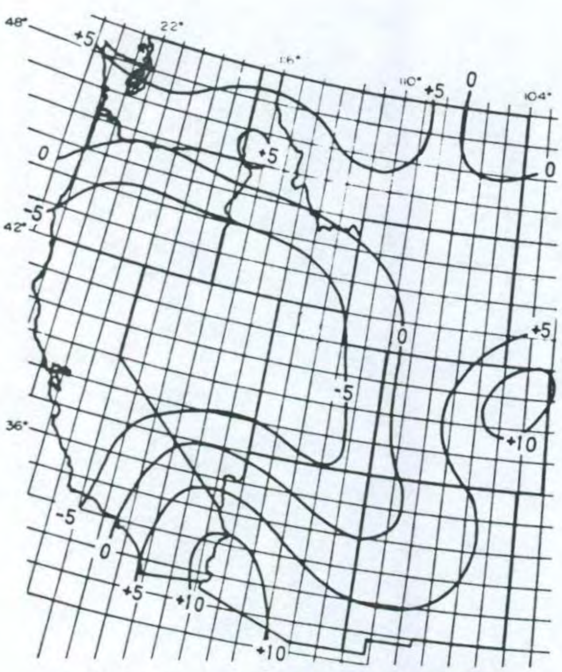
DEPARTURE FROM NORMAL OF THE LILAC AND WHEAT PHENOLOGICAL SEASONS IN 1963 *



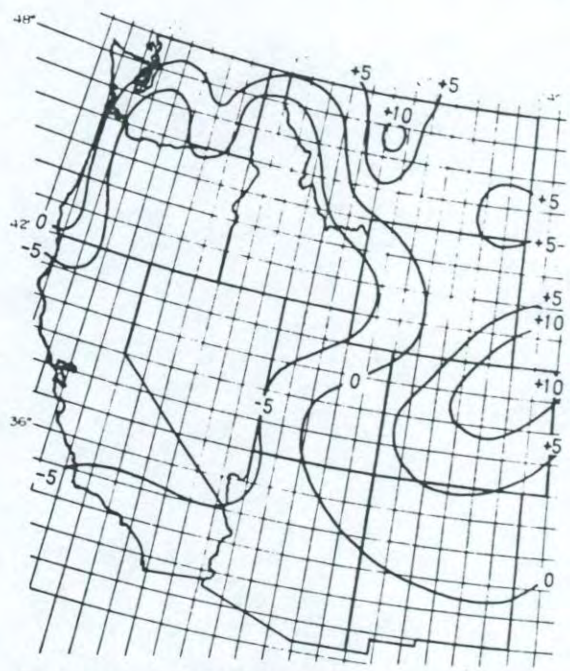
DEPARTURE OF BEGIN LILAC BLOOM FROM NORMAL



DEPARTURE OF END LILAC BLOOM FROM NORMAL



DEPARTURE OF WHEAT HEADED DATE FROM NORMAL



DEPARTURE OF WHEAT COMBINE RIPE DATE FROM NORMAL

* POSITIVE NUMBERS INDICATE DAYS EARLIER THAN NORMAL AND NEGATIVE NUMBERS INDICATE DAYS LATER THAN NORMAL

than normal in the Plains Region of New Mexico, Colorado, and Wyoming and later than normal in the western areas of the Western Region. A small area of northeastern Colorado remained more than 20 days earlier than normal, and much of Nevada and northern California remained more than 10 days later than normal.

Departure of Wheat Headed and Combine Ripe Dates from Normal

The anomaly pattern for wheat headed and combine ripe dates closely resembles the lilac anomaly patterns. The season tended to be earlier than normal in eastern areas and later than normal in western areas. The major early areas, as with lilacs, are in the Great Plains area of Colorado. In parts of this area wheat headed and combine ripe dates were more than 10 days earlier than normal. Both headed dates and combine ripe dates were more than 5 days late over most of the western half of the region. It is possible that areas in the large "later than 5 days late" region for headed and combine ripe dates are really more than 10 days late. There are large gaps in the wheat network in parts of this area particularly in Nevada where most of the agricultural land is devoted to grazing.

At this point in the development of the phenological work it may be well to list some of the accomplishments which have been made possible by the many individuals who have assisted in these surveys.

(1) Analysis of the phenological data has contributed greatly to an understanding of the general geographical progression of plant development over the entire Western Region. It is now possible to describe in greater detail how plant development deviates from Hopkin's Bioclimatic Law throughout the Western Region.

(2) The presence of an "early ridge" has been ascertained within the Western Region. This is the north-south oriented line at any given elevation where plants develop earlier than all locations (at that elevation) either to the west or to the east of that line.

(3) A manual procedure for mapping phenological data has been developed which permits more precise evaluation of the geographical progression of plant development. Using the manually derived maps as analytical guides, mathematic models have been developed for electronic machine processing of punch-card data.

(4) The phenological network on lilacs is of adequate density in some areas so that local areas of deviation from the generalized smoothed Regional isophanal analysis can be determined. For example, two such local areas have been found in the northern part of the Region. One is situated east of the Cascade Range in Washington, centered between Wenatchee and Pasco, and the other east of the Rocky Mountains in Montana, centered in the Fort Benton-Great Falls area. Plants in these areas developed about 5 days earlier than indicated by the smoothed regional isophanal analysis.

(5) Studies to date suggest that observations on indicator plants, such as lilacs, can be valuable guides to the progress of other agricultural crops in the area.

(6) More has been learned about the variability of dates of phenological events for lilacs and wheat throughout the Western Region.

(7) Data has been collected which can now be used for studies in environmental factors controlling variation in the dates of phenological events.

(8) These surveys have led to a greater appreciation by farmers and research workers of the potential value of phenological surveys in both applications on the farm and in agricultural research.

(9) As a result of this survey, we have learned of the fine cooperative spirit of the general public and of their interest in the results of the analyses.

This phenological survey is being conducted by the Montana Agricultural Experiment Station as a contributing project to Regional Project W-48 entitled, "Climatic and Phenological Patterns for Agriculture in the Western Region".

In addition to state experiment stations in the Western Region, the State Experiment Stations Division, the Agricultural Research Service and the United States Weather Bureau are participating in this regional project.

A major portion of the regional project is devoted to climatic analysis of weather records with the aim of making such data available to the public.

Each of the 11 western states has a representative on the Technical Committee of W-48. The Technical Committee members meet once a year to discuss progress of the cooperative regional effort and plan work for the coming year.

The cooperating agencies and principal leaders for the Regional Project are as follows:

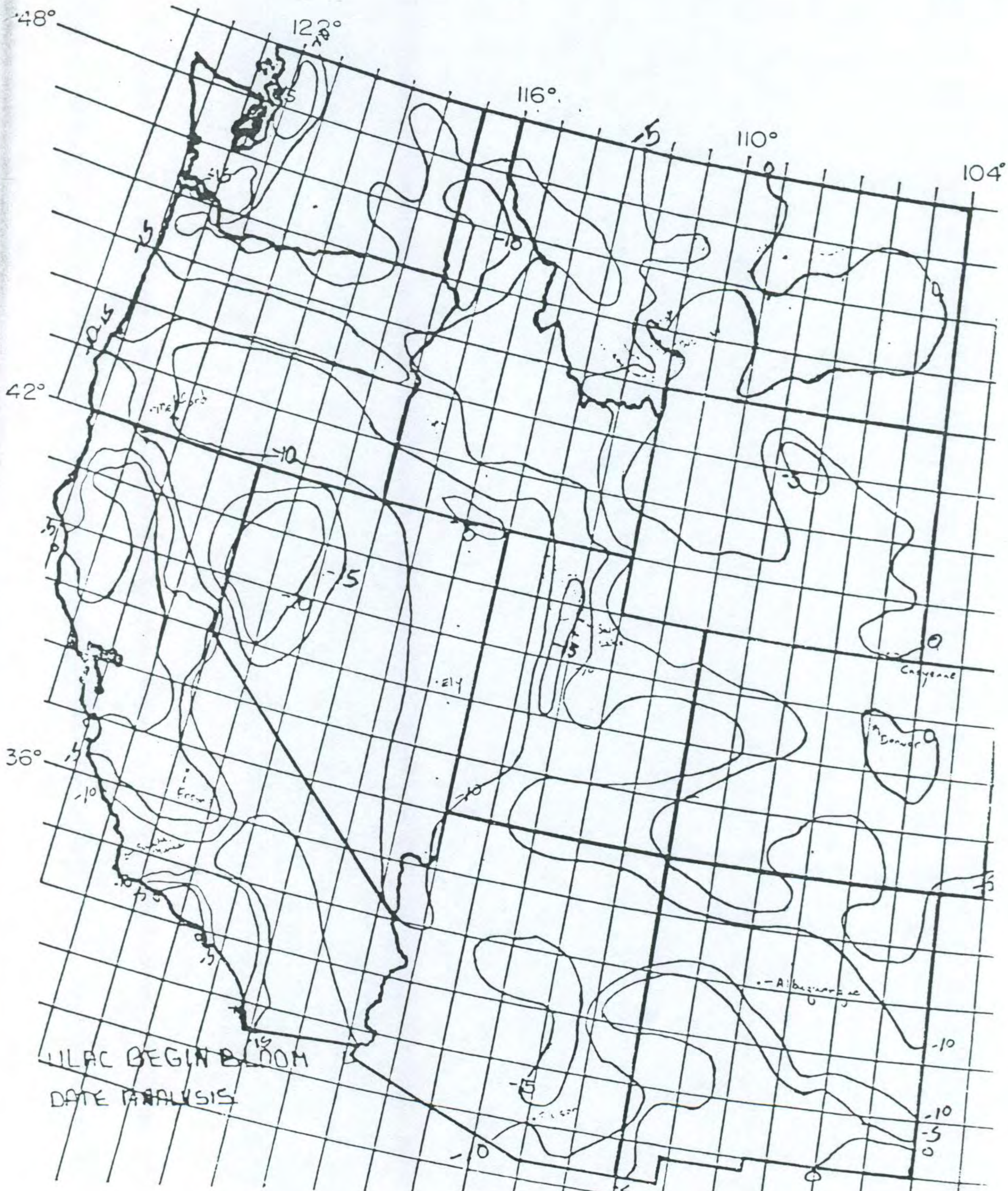
Agricultural Experiment Stations

Administrative Advisor	J. A. Asleson
Arizona	S. D. Resnick
California (Davis)	H. B. Schultz
California (Los Angeles)	M. H. Kimball
Colorado	A. T. Corey
Idaho	D. O. Everson
Montana	J. M. Caprio
Nevada	R. O. Gifford
New Mexico	M. D. Finkner
Oregon	W. P. Lowry
Utah	G. L. Ashcroft
Washington	M. C. Jensen
Wyoming	C. F. Becker

Federal Agencies

USDA - CR, ARS	W. Keller
USDA - SWC, ARS	K. G. Renard
USDA - Forest Service	W. B. Critchfield
USDA - CSESS	A. J. Loustalot
USDC - Weather Bureau	M. D. Magnuson

1964


48°
122°
116°
110°
104°
42°
36°
Ely
Cheyenne
Denver
LILAC BEGIN BLOOM
DATE ANALYSIS

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN MONTANA ON IRRIGATED ALFALFA HAY

Montana Agricultural Experiment Station
May 1964

Reproduced from an Article Published in Montana Farmer Stockman
Vol. 51, No. 17, page 26, May 21, 1964 by
Arthur F. Shaw and Joseph M. Caprio

Since the summer of 1958 approximately 80 growers of irrigated alfalfa in Montana have volunteered their assistance in providing "phenological" information for alfalfa growing on their farms.

Phenology is the science of the relations between climate and periodic biological phenomena. By periodic event is meant some unique pattern in the life cycle of a plant or animal. The beginning of bloom in the spring of a particular plant is an example of a periodic event since it occurs during a particular time in the plant's life cycle. The phenological events being observed in the life cycle of alfalfa are dates of one-tenth bloom and cutting.

Of what value is this kind of information? There are numerous areas of possible use. The data provides a basis for constructing detailed maps for the entire state showing when irrigated alfalfa is normally at one-tenth bloom stage. Such maps can be useful in making decisions concerning which varieties to recommend for specific areas. For the entomologist and plant pathologist, who are concerned with insect and disease problems, the data and maps can be useful guides in decisions concerning the fight against these crop hazards.

In order to determine relations between weather and plant development and production both phenological and weather data are needed. In addition, since the plant reflects the environment to which it is exposed, phenological data itself gives information about the climate of the area. Phenological data can also be useful as a guide in farm management decisions where timing of various farm activities is an important consideration. Phenology will undoubtedly play an important role in furthering agricultural progress in the future.

Cut forage, drying in the windrow, loses much of its potential nutritive value when rained upon. On the average as much as one-third of the nutritive potential is lost before baling or stacking. Some times with heavy rains a total loss results. Therefore, the prediction of a period of rainless days can be of real importance to a farmer whether harvesting 50 or 1,000 tons. As the accuracy of weather forecasting increases so may our hay harvest practices increase in efficiency.

Early harvest of the first crop is real important. It's the first cutting that becomes quite coarse as maturity progresses beyond the one-tenth bloom stage. Then too, new shoots which are to produce the second crop begin to make their appearance at or soon after the tenth-bloom stage is reached.

The new shoots may be cut off if harvesting of the first crop is delayed beyond the tenth-bloom stage. Cutting of new shoots delays the recovery of the second crop and the subsequent harvest.

Begin cutting in the late bend stage if your hay harvest requires several days. The maturity of the crop advances rapidly. The one-half bloom stage being reached within 7 or 10 days after initial bloom. About a week being required to advance to full-bloom after the half-bloom stage is reached.

Earlier than normal hay or silage harvest may become more commonplace as a means of combatting the alfalfa weevil. There are alfalfa weevils in two or three small areas in southcentral Montana, exhibiting considerable tolerance to present chemicals used in control. Unless effective and safe chemicals can be found to control the pest then harvest management seems to be the answer. Timing in harvest will be important. That is, begin the hay harvest immediately at or soon after the appearance of the first weevil. Early detection of the larvae is difficult unless there is some other means to associate with their appearance. It is at this point where we may help you associate phenology data to your farm operation. It has already been fairly well established that alfalfa will reach the tenth-bloom stage within 27 to 30 days on an average after the first bloom of common purple lilac shows in the immediate locality.

The map on the following page shows the average date when alfalfa reaches one-tenth bloom stage just before cutting. Two large areas of early bloom are indicated, one east of the Continental Divide and the other west of the Divide. Several locations within the shaded early zones have average one-tenth bloom date before June 9. The alfalfa map is drawn in areas where no reports were received by projection, based on the general areal differences between average date of begin lilac bloom and alfalfa bloom date.

On the average, alfalfa reaches one-tenth bloom stage 30 days after lilacs begin to bloom, 20 days after peak of lilac bloom and 10 days after end of lilac bloom. These intervals tend to be a day or so shorter in eastern parts of the state and a day or two longer in western Montana. It is best to use an average of a number of lilac bushes when making comparisons of this kind. It takes on an average a day or two more than 45 days for alfalfa to reach one-tenth bloom after first cutting except in the eastern third and central parts of the state where it takes several days fewer than 45 days for each one-tenth bloom. After second cutting, it takes about 45 days for alfalfa to reach one-tenth bloom stage throughout the entire state providing severe freeze does not terminate the season prior to this.

The following instructions are followed when making phenological observations on the common purple lilac:

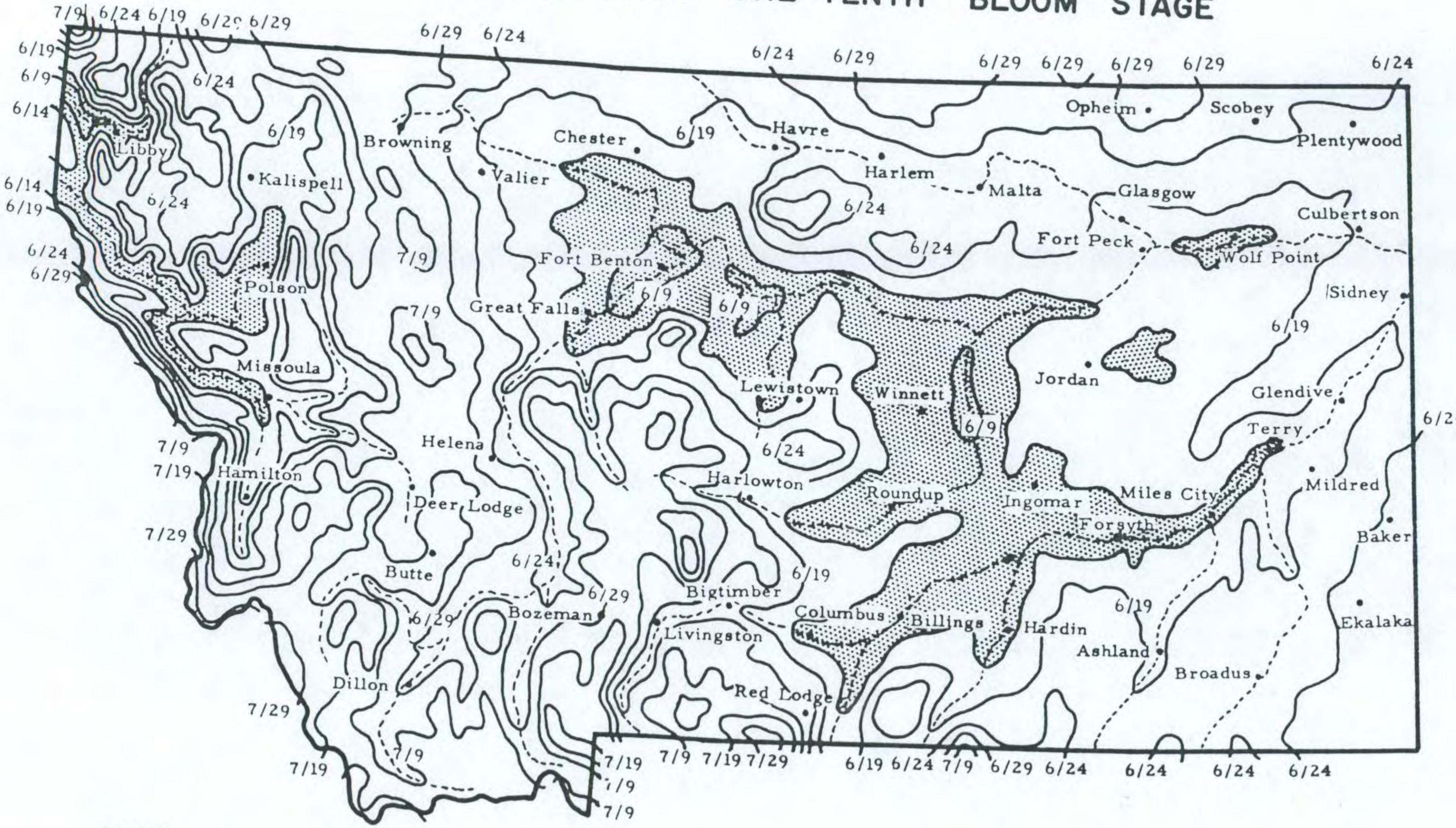
1. The date of first bloom shall be considered as the date when the first flower is fully open. The lilac flower cluster is really a grouping of many small individual flowers, so the date to record is the date when one of the small flowers in a cluster is fully open.

2. The date of peak of full bloom shall be considered as the date when the greater proportion of the flowers on the plant are open, but before any appreciable number of them have withered or dried up.

3. The date when nearly all (at least 95%) of the flowers have withered or dried up shall be considered as the time when the floral display has ended, except possibly for several clusters on the bush.

If you do use the lilac as a reference point for estimating alfalfa development, select lilac plants that are located in an open, unshaded area away from buildings, trees, and other obstructions. It is best to select several lilac bushes and use the central date. For example, if begin lilac bloom dates for 5 bushes are May 20, 20, 22, 23, and 24, the best date to use is the central one, i.e., May 22. In statistics this is referred to as the median date.

PRELIMINARY MAP OF AVERAGE DATE WHEN ALFALFA REACHES FIRST ONE-TENTH BLOOM STAGE



AREAS WHERE ALFALFA REACHES ONE-TENTH BLOOM STAGE BEFORE JUNE 15

ISOPHANES ARE DRAWN FOR 5-DAY INTERVALS TO JUNE 29 AND 10-DAY INTERVALS THEREAFTER

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
Bozeman, Montana
February 22, 1965

The study of the relations between climate and plant development is known as phenology. Maps showing lines of equal dates when plants reach a given phase in their development are known as phenological maps. Phenological maps supplement maps of weather elements.

Many countries of the world have well organized phenological networks in which observers report on the development of different kinds of plants. In those parts of the world where phenological networks have been maintained, the data has proved useful in many kinds of human activity. Plant geographers, for example, have used phenological information in efforts to divide areas into natural zones. Agricultural scientists base their crop and varietal recommendations in part on the phenology of the recommended plant and on indicator plants in the region under study. The time of phenological events of certain plants has been used to predict when crops are expected to reach various stages in their development, and this kind of forecast assists in anticipating needs for labor, fertilizer, sprays, equipment, etc. Phenological plants have been used as guides for determining when to begin cattle on permanent pasture. Employment services in agricultural areas are guided by phenological information when estimating labor requirements. Certain plants are also used as indicators of microclimate differences, since they are "accumulators" of the meteorological environment.

Phenology is often taken into account when quantitative and qualitative fertilizer recommendations are made. The selection of sources of seed and the kinds of foreign plants introduced in an area are often based on phenological knowledge of both the source and receiving areas. Phenological data also provides guidance in assessing the value of farm land.

Doctors advise patients as to which health resort is most suitable - climatherapy - based on climatic and phenological data. Phenological information is also referred to in such diverse areas as tourism, law suits, literature and industry. The scope of possible application of phenological information is very broad indeed.

People in western United States will recall that the weather was cooler than normal in the spring of 1964. It was also a season of heavier than normal precipitation in many parts of the region. Farmers and gardners, particularly, look back upon last spring as one in which plants were late to develop and many of their outdoor activities were correspondingly delayed.

In the mountainous West, it is easy to observe that plants begin to develop at different times of the year at different places. While locations at high elevations or at more northerly latitudes are still covered with snow, places at lower elevations or in the south are already green and in bloom. Different species and varieties of plants may reach their various developmental phases at different times of the year at a given location. In order to have some common basis for comparing earliness or lateness of the season at different locations, it is necessary to compare similar kinds of plants. Although data on important agricultural crops have been recorded for many years at agricultural experiment stations the number of locations making these observations is inadequate for accurately determining areal patterns of plant development in the mountainous West.

In order to obtain a comparable measure of plant development over a wide area, a network of approximately 200 observers of common purple lilac bloom was established throughout Montana in the spring of 1956. Observers in the different parts of the state recorded the time lilacs began to bloom as well as other information on plant development. In the spring of 1957, the network was extended to include eleven western states which encompasses all the area from the Western Great Plains to the Pacific coast. Approximately 1,000 volunteer observers have been recording the dates when lilacs reach various stages of development. Data are mailed by the observers to the Montana Agricultural Experiment Station where the information is placed on punch-cards and analyzed. This work is being supported in part by funds from Regional Project W-48 which is concerned with the relation between climate and agriculture.

While it might be more desirable to take into account the bloom dates of additional spring flowering plants as a basis for indicating the onset of the spring season, the date when the common purple lilac begins to bloom can serve this purpose at least until more information becomes available on other kinds of plants. Defined as such, spring normally begins near mid-March in the Sacramento and San Joaquin Valley of California and some other lowland areas of the extreme southwest and progresses to other points of the Western Region at later dates. By late June, spring has begun everywhere except in the higher mountains.

There are many elements of the physical environment that may influence the rate at which lilacs develop; of these, temperature is undoubtedly one of the most important. In addition, temperature tends to be highly correlated with solar radiation which also influences the rate of plant development.

For the common purple lilac, normal dates on which lilacs begin to bloom have been determined throughout the Western Region based on data collected during the 5-year period 1957-61.

Using the 5-year median reference as a base, it is possible to compare the current year's bloom reports to obtain a quantative measure of the earliness or lateness of the season. It can generally be expected that agricultural crops in areas where lilacs are late will also tend to be later in their development for that year. Likewise, earlier than normal lilac bloom is likely to be associated with an early maturing crop. The kind of weather that occurs between the time of lilac bloom and the developmental phase of a particular agricultural crop could, however, tend to reduce or increase somewhat the usual time interval expected between these two events. Comparison of lilac data in the spring of 1963 with reports from the winter wheat phenological network throughout the same area showed a close parallel between departures of lilac bloom from normal and subsequent wheat headed and wheat harvest date departures from their normal time of occurrence. The phenological network for wheat was established in Montana in 1958 and extended throughout the Western Region in 1959. Approximately 500 farmers are cooperating in the wheat study. In 1963, the season for lilacs and wheat was relatively early in eastern sections, particularly in the Great Plains areas of Colorado and southern Wyoming, and relatively late over most of the Central and middle Pacific areas of the Western Region.

Figure 1 shows lines of equal departure from normal of the dates when the common purple lilac began to bloom in 1964. The phenological map supplements maps of weather elements since it conveys information regarding the time delay or advance of phenological events which are not given by climatic maps. Also, the plant gives an expression of the integration over time of not only a single environment element but of the many environmental elements that may influence its developmental rate.

Figure 1 shows that the 1964 spring season was later than normal over most of the eleven western states. Much of the West was more than 10 days later than normal in 1964 and there were some locations in every state except Colorado and Wyoming where lilacs were more than 15 days later than normal.

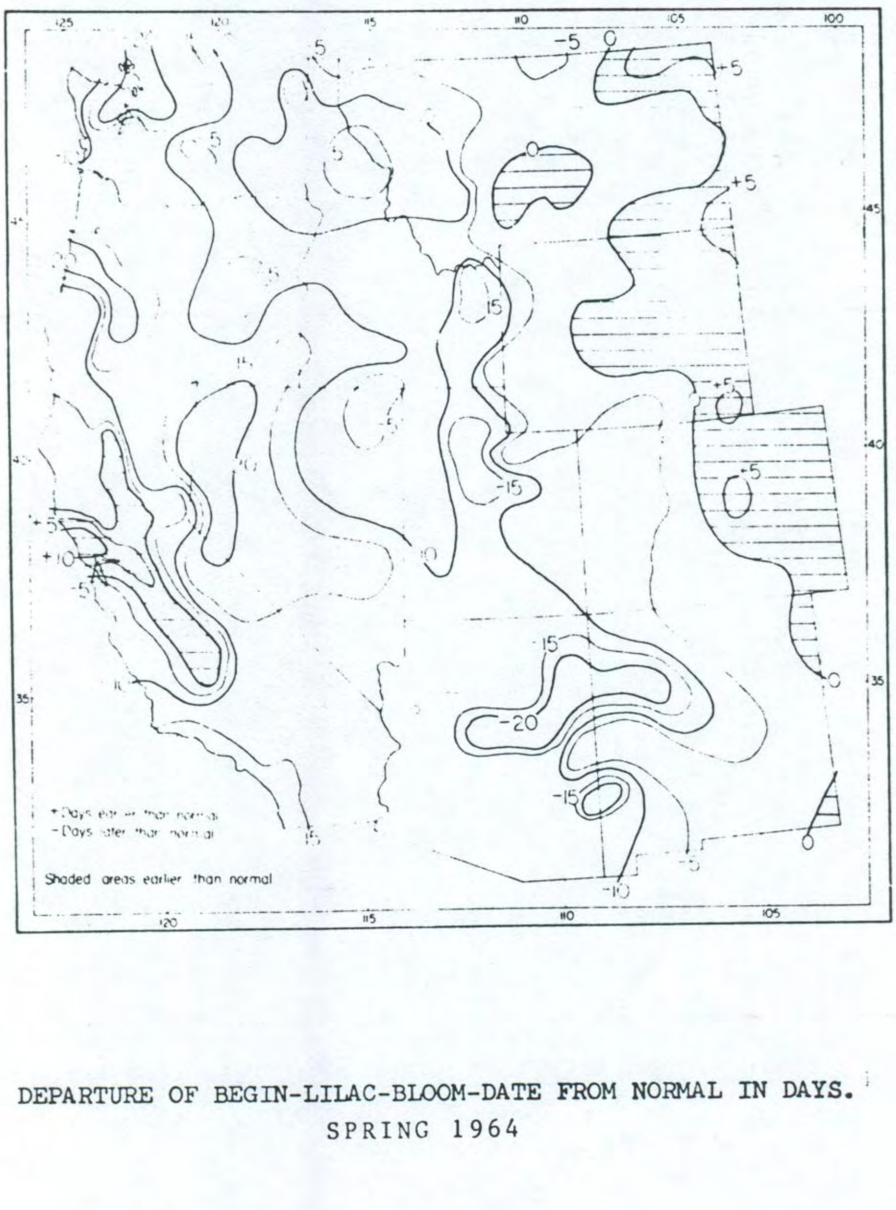


Fig. 1. DEPARTURE OF BEGIN-LILAC-BLOOM-DATE FROM NORMAL IN DAYS.
SPRING 1964

In the Great Plains of Montana, Wyoming, Colorado and New Mexico, lilac bloom was generally near or somewhat earlier than normal. Several zones within this area are indicated as more than five days earlier than normal this year.

Bloom was also earlier than normal in the San Joaquin and Sacramento Valleys of California and in a coastal area near and north of San Francisco. Most of the early zones in California were between one and five days earlier than normal, but a small section in the proximity of the coast north of San Francisco was more than 10 days early this year.

The late bloom over most of the West appears to reflect the cooler than normal temperatures that occurred last spring in most sections. Temperatures for every month from February through June averaged colder than normal over almost the entire area. Figure 2 shows that temperatures during the interval from March

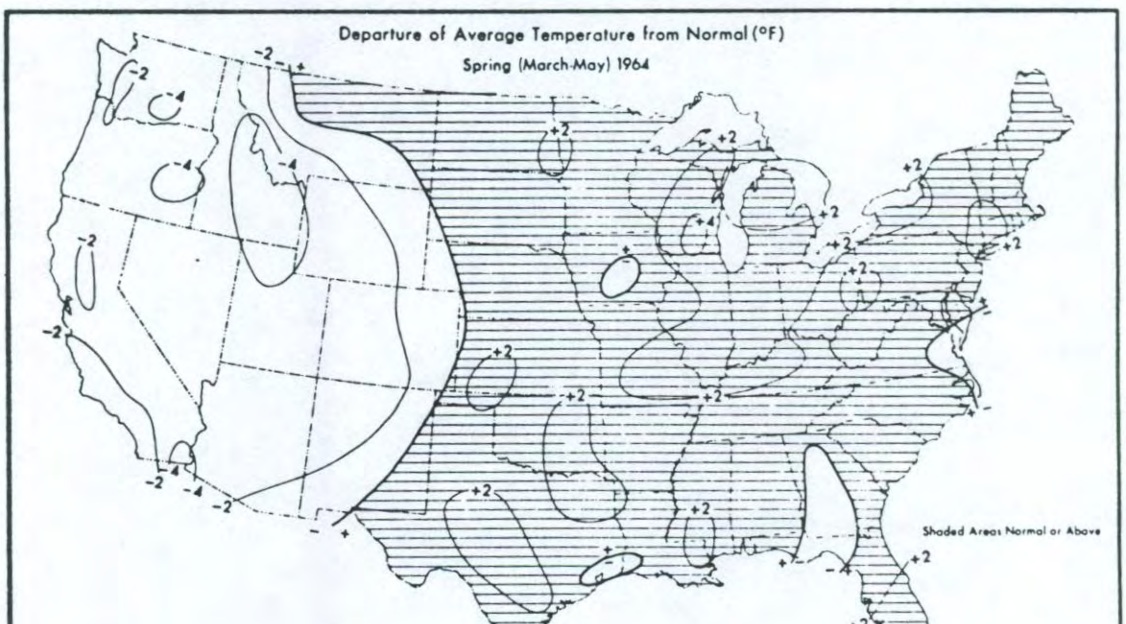


Fig. 2. DEPARTURE OF AVERAGE TEMPERATURE FROM NORMAL IN DEGREES FAHRENHEIT. USWB CHART.

through May, which is the period during which lilacs normally begin to bloom over most of the Region, averaged colder than normal except in eastern sections where it was warmer than usual for this three month period. The earlier than normal bloom in the central valleys of California may be partially attributable to the warmer than average weather that occurred during periods in February and again near the middle of March when lilacs were coming into bloom.

In certain areas of the southern part of the Western Region, the data of lilac bloom may not always be a good indicator of the advancing "thermal" season. Lilacs, like many other perennial plants, require a certain minimum amount of cold winter temperatures before they are ready to terminate their rest period. This cold requirement is often referred to as "chilling". If they do not receive this cold, they do not respond as readily to the warm days of the advancing spring and consequently lag in their vegetative and flowering development. Thus, during certain years in these areas, lilacs may bloom somewhat late because of inadequate cold during the winter months. Thus, of two seasons with similar springs but with different winters, the spring that produces the earliest bloom may be the one that had the coldest winter. This zone of possible "delayed bloom" is generally limited to lower elevations of Arizona and California. Throughout the major portion of the Western Region, the winter chilling requirement is more than adequate for the lilac.

Since many other perennial plants also require a period of winter chilling, this raises the question as to whether lilac bloom could provide useful information relative to characterizing the winter season in these southern areas. Does delayed development of lilacs due to inadequate chilling tend to reflect inadequate chilling for such important crops as peaches, pears and apples and reduction in the subsequent harvest? Further study may bring to light relationships of this [illegible].

Some locations at low elevations in southern California and southwestern Arizona have so little winter chilling that lilacs do not produce a bloom.

Most of the perennial plants which are presently being observed in the phenological network of the Western Region were already well established when these studies were inaugurated. In order to have as similarly responding plants as possible, it is expected that the phenological network for certain kinds of plants will eventually consist of carefully selected vegetatively propagated material from a common parent plant in order to assure genetic homogeneity. The use of genetically homogeneous plant material will add even greater refinement in our quest for an understanding of plant-climate zones and of the relation between the physical and biological environments. Progress is already being made in selecting and distributing such plant material throughout the phenological network in the Western Region.

This phenological survey is being conducted by the Montana Agricultural Experiment Station as a contributing project to Regional Project W-48 entitled, "Climatic and Phenological Patterns for Agriculture in the Western Region."

In addition to state experiment stations in the Western Region, the State Experiment Stations Division, the Agricultural Research Service and the United States Weather Bureau are participating in this regional project.

A major portion of the regional project is devoted to climatic analysis of weather records with the aim of making such data available to the public.

Each of the 11 western states has a representative on the Technical Committee of W-48. The Technical Committee members meet once a year to discuss progress of the cooperative regional effort and plan work for the coming year.

The cooperating agencies and principal leaders for the Regional Project are as follows:

Agricultural Experiment Stations

Administrative Advisor	J. A. Asleson	Nevada	R. O. Gifford
Arizona	S. D. Resnick	New Mexico	M. D. Finkner
California (Davis)	H. B. Schultz	Oregon	W. P. Lowry
California (Los Angeles)	M. H. Kimball	Utah	G. L. Ashcroft
Colorado	A. T. Corey	Washington	M. C. Jensen
Idaho	D. O. Everson	Wyoming	C. F. Becker
Montana	J. M. Caprio		

Federal Agencies

USDA - CR, ARS	W. Keller
USDA - SWC, ARS	K. G. Renard
USDA - Forest Service	W. B. Critchfield
USDA - CSESS	A. J. Loustalot
USDC - Weather Bureau	M. D. Magnuson

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Agricultural Climatologist
Montana Agricultural Experiment Station
Bozeman, Montana
February 21, 1966

Normal dates on which the common purple lilac (Syringa vulgaris L.) begins to bloom have been determined throughout the Western Region based on data collected during the 5-year period 1957-61. Figure 1 shows lines of equal days of departure from normal of the time when the common purple lilac began to bloom in 1965. The phenological map supplements maps of weather elements since it conveys information regarding the time delay or advance of phenological events which are not given directly by climatic maps. Also, the plant gives an expression of the integration over time of not only a single environmental element but of the many environmental factors that may influence its developmental rate.

Figure 1 shows that the 1965 spring season, as indicated by the beginning of lilac bloom, was later than normal over the greater portion of the Western Region.

Eastern Great Plains Area

Much of the Great Plains area including eastern Wyoming, eastern Colorado, and northeastern New Mexico was earlier than normal. Lilacs began to bloom more than 10 days earlier than normal in parts of northeastern Colorado.

Central Sections

A large central section extending from Montana and Idaho in the north to Arizona and southeastern California in the south was later than normal. Two areas in Montana are indicated as having had bloom occurrence more than 10 days later than normal. Extensive areas in eastern California, Nevada, and northwestern Arizona also reported bloom dates more than 10 days later than normal.

Northern California, Oregon and Southern Washington

Earlier than normal bloom dates were reported in most parts of northern California, Oregon, and southern Washington. Some locations in northern California were more than 10 days early and parts of Oregon and Washington reported bloom occurrence more than 5 days earlier than normal. Reports from an area extending along the Pacific coast in Oregon indicated bloom occurrence somewhat later than normal. Later than normal bloom was also reported in northern Washington. Bloom occurred more than 10 days late in a portion of this Washington area located north of Seattle.

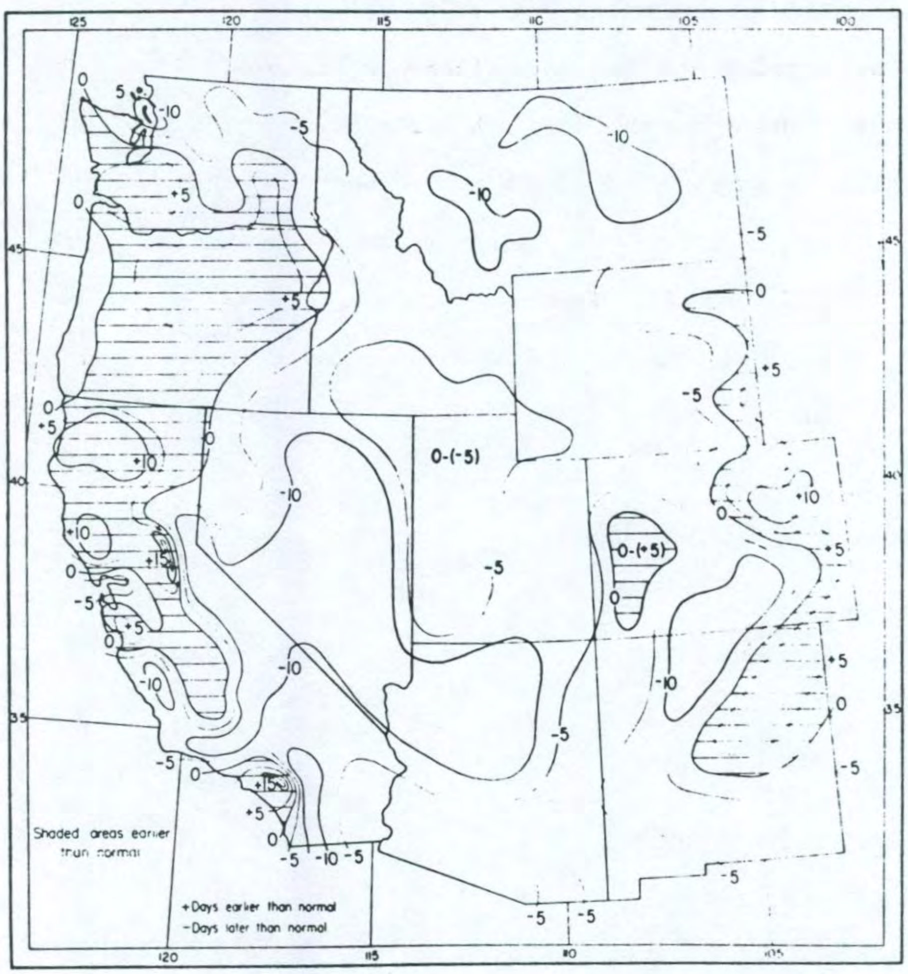


Fig. 1. DEPARTURE OF BEGIN-LILAC-BLOOM-DATE FROM NORMAL IN DAYS.

Central and Southern California East of the Sierra Cascade Mountains

The anomaly pattern is most complex in central and southern California. Bloom occurred somewhat earlier than normal in the San Joaquin Valley. A narrow area in the foothills to the east of Sacramento at elevations near 1,000 to 3,000 feet reported bloom dates more than 15 days earlier than normal. Several stations within the 15 day line reported that bloom occurred more than 20 days earlier than normal. Bloom appeared in this area in mid-March, whereas the usual time of bloom comes in late March or early April. The San Francisco Bay area was somewhat later than normal, but an earlier than normal zone is indicated just to the south near Monterey Bay. The rest of the coastal area to the south was later than normal except for an area near Los Angeles. In a part of this area to the east of Los Angeles at elevations near 1,000 to 3,000 feet, lilac bloom was more than 15 days earlier than normal. Lilacs in this early section began to bloom in late February and early March whereas they normally begin to bloom about the middle of March.

DESCRIPTION OF THE COMMON PURPLE LILAC

The Common Purple Lilac is a popular flowering shrub in nearly all parts of western United States. The plant is native to southeastern Europe and was introduced into American gardens during early colonial times. Both George Washington and Thomas Jefferson mention the lilac in their diaries. The scientific name of the common purple lilac is *Syringa vulgaris* L. The name comes from the Greek word, syrinx, meaning a tube which is descriptive of its flower. It belongs to the olive family, Oleaceae. The plant grows to be a large shrub or small tree to 20 feet in height and the trunk can attain a thickness of about a foot in diameter. In home gardens, its height is often limited to about 10 feet by frequent pruning. The plants are sometimes set close together in the form of a hedge.

The tubular flowers are born on panicles. The light purple flowers are fragrant and are very conspicuous against the dark green foliage. The leaves are opposite and heart shaped. Panicles are generally from 4 to 8 inches in length.

Each panicle consists of scores of flowers of one-quarter to one-half inch in diameter. The plant usually sends out many suckers, a feature which undoubtedly helped in its dissemination.

Flower initiation occurs during the summer preceeding the year of bloom. The common purple lilac loses its leaves in the fall and requires winter chilling for normal growth the following season. If taken into the greenhouse (near 70°F) in the winter after having received adequate chilling, the plants will bloom in three to five weeks (1). Plants which do not receive enough winter chilling exhibit a delay in their vegetative and flowering development when warm weather commences in the spring (2). For this reason, the date of lilac bloom may not always be a good indicator of the advancing "thermal" season in certain areas of Arizona and California. Of two seasons with similar springs but with different winters, the spring that produces earliest bloom in these southern areas may be the one that had the coldest winter. Lilacs do not produce a bloom at some locations at low elevations in southern California and southwestern Arizona because of inadequate winter chilling.

The common purple lilac seems to be day-neutral; variations in length of day have little effect upon growth, development and onset of dormancy (3)(4). When the lilac is growing under natural conditions the time of bloom is probably most dependent upon the "thermal environment".

Dormancy in trees and shrubs generally is located within individual buds (5). Any branch of such plants exposed to a different environment develops with no apparent relationship to the rest of the plant. This can be seen in the spring when lilac branches growing adjacent to a south facing brick wall are often far more advanced in development than the rest of the branch.

BIBLIOGRAPHY

1. Bailey, L. H. and Bailey, E. Z. 1941. Hortus Second (A concise dictionary of gardening, general horticulture and cultivated plants in North America). The Macmillan Company, New York.

2. Lammerts, W. E. 1954. United States Patent Office, Plant Patent 1238, Lilac Plant, January 5.

3. Chouard, P. 1949. Experiences de longue dureé sur le photopériodisme; lecons que en découlent. Mem. Soc. Bot. France 96, 106-146.

4. Waxman, S. 1957. The Development of Woody Plants as Affected by Photoperiodic Treatments. Ph.D. Thesis, Cornell University, Ithaca, New York. (193 pages).

5. Loomis, W. D. Growth and Differentiation in Plants. A Monograph of the American Society of Plant Physiologists, edited by W. E. Loomis, Chapter 8, Dormancy by Thornton, N. C. Pages 135-148 (458 pages).

This phenological survey is being conducted by the Montana Agricultural Experiment Station as a contributing project to Regional Project W-48 entitled, "Climate and Phenological Patterns for Agriculture in the Western Region".

In addition to state experiment stations in the Western Region, the State Experiment Stations Division, the Agricultural Research Service and the United States Weather Bureau are participating in this regional project.

A major portion of the regional project is devoted to climatic analysis of weather records with the aim of making such data available to the public.

Each of the 11 western states has a representative on the Technical Committee of W-48. The Technical Committee members meet once a year to discuss progress of the cooperative regional effort and plan work for the coming year.

The cooperating agencies and principal leaders for the Regional Project are as follows:

Agricultural Experiment Stations

Administrative Advisor	J. A. Asleson	Nevada	R. O. Gifford
Arizona	M. M. Fogel	New Mexico	M. D. Finkner
California (Davis)	H. B. Schultz	Oregon	W. P. Lowry
Colorado	D. F. Heermann	Utah	G. L. Ashcroft
Idaho	D. O. Everson	Washington	M. C. Jensen
Montana	J. M. Caprio	Wyoming	C. F. Becker

Federal Agencies

USDA - CR, ARS	W. Keller
USDA - SWC, ARS	K. G. Renard
USDA - Forest Service	W. B. Fowler
USDA - CSESS	A. J. Loustalot
USDC - Weather Bureau	M. D. Magnuson

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio and Sharon L. Crawford

Montana Agricultural Experiment Station
Bozeman, Montana
February 14, 1967

BEGINNING OF SECOND DECADE OF PHENOLOGICAL STUDIES IN WESTERN U.S.

In the spring of 1957, just 10 years ago, phenological studies were initiated in the Western Region of the U. S. The primary core of lilac observers was established through the assistance of the Weather Bureau climatological observers. Only individuals who already had a common purple lilac growing in their area were able to cooperate. The data obtained during the first ten-year period has provided a basis for investigations into the pattern of plant development throughout the western United States.

A regional research publication showing how spring advances geographically over the region as indicated by the development of the common purple lilac is now with the publisher and will soon be ready for distribution. After learning of the results of these surveys in the West, areas to the east have initiated similar studies. The University of Nebraska has been directing a program in the north-central states and recently the University of Vermont started a program in the Northeast.

When the phenological program was initiated, the network in the West consisted entirely of observations on plants that had already long been established. During the past several years some vegetatively propagated plants of different species were sent to selected locations. Plants vegetatively propagated from a single "mother plant" provide more precise information since such plants have the same genetic composition. More vegetatively propagated plants will be distributed to some observers in the future, but the main core of phenological observations will continue to be on common purple lilac plants that have been established at observation sites for many years.

Since information on genetically similar plants are needed for some locations, there is a question on the enclosed card relative to the willingness of the cooperator to establish and observe a plant which may be provided by us. If the observer would like to have a plant and his area is designated to receive one, the plant will be provided, without cost. The observer should indicate a check for this question only if he has an unshaded area away from buildings, trees, etc. on which to locate the bush, and also the means to water the plant should the station be located in a dry area. A long series of years of information are needed on phenological plants, and an effort is made to send vegetatively propagated plants only to those places where an observer or an alternate is likely to be for an extended period.

Observations on red berry pyracantha and large common caragana are being discontinued. Those who have cooperated in the past by observing only these plants will be supplied with a lilac or some other phenological bush if they wish to receive one, as soon as such plants become available for distribution. A check on the enclosed card will inform us whether these observers wish to receive a phenological plant.

DEFINITION OF PHENOLOGY

Phenology is the science concerned with periodic biological events in their relation to seasonal climatic changes. Some examples of biological events are the seasonal migration of birds; the hibernation of animals; and the sprouting, flowering, and fall foliage change of plants. Periodic changes in morphology, chemistry, and activity of both plants and animals, which may not be so easily detected as these examples, are also the subject of phenological study.

Information on dates when plants and animals reach various stages in their development is referred to as phenological data. Phenology is known as the science of appearance, because emphasis is placed on dates of various occurrences. The term "phenology" appears to have been first applied in 1853 by the Belgian botanist, Charles Morren, to that branch of science which studies the periodic phenomena in the vegetable and animal world insofar as they depend upon the climate of any locality. The word phenology itself is derived from the Greek word "phaino", meaning to show. Plants can be used as indicators of climatic differences because the time of occurrence of phenological events of many plants is to a large degree controlled by the weather. Thus, phenology represents a merging of the meteorological and biological sciences, each contributing something to the other.

A difference exists between plants and animals in their relation to seasonal changes; for while animals can change their environment by moving to different locations, plants are usually firmly positioned at the same site throughout their entire life and exposed to a single climate.

To learn about climatic effects, the phenologist studies the meteorological records associated with differences in timing of specific phenological events of a given kind of plant or animal at a given site and determines geographical patterns of plant or animal development. Such patterns can provide an insight into biotic responses to environment that might not be possible through the analysis of information gathered at only a single location.

In the analysis of phenological data, it is also necessary to consider the numerous local factors of the environment that can influence the time of phenological events. These include the nature of the soil and its moisture content and fertility level, as well as the topographic characteristics of the surrounding area and its vegetative cover. In addition to their influence on the availability of moisture and nutrients for the plant, such local factors can contribute to sharp microclimatic differences. Plants growing in close proximity often develop at much different rates due to these microclimatic contrasts. All of these local effects are superimposed on the broad general regional pattern of phenological development which is predominantly a function of the macro-meteorological environment.

Phenology is making important contributions to academic knowledge of biotic-weather relations, meteorology and regional geography. While phenology's contribution to fundamental research is impressive in itself, phenology is also a science which has broad applications.

APPLICATIONS OF PHENOLOGY

The observation of phenological events at numerous locations, resembling in some respects national climatological networks, provides useful information for many aspects of human activity. Phenological observations on plants have been used as guides for determining when to begin grazing cattle on permanent pasture. Phenology is often taken into account when quantitative and qualitative fertilizer recommendations are made. Selection of seed sources and kinds of foreign plants introduced in an area are often based on phenological knowledge of both the source and receiving areas. Employment services in agricultural areas are guided by phenological information when estimating labor requirements. Phenological data also provides guidance in assessing value of farm land.

Plant geographers have used phenological information in efforts to divide areas into natural zones. Doctors advise patients as to which health resort is most suitable (climatherapy) based on climatic and phenological data. Phenological information is also referred to in such diverse areas as tourism, law suits, literature and industry. The scope of possible application of phenological information is very broad indeed.

The American phenologist, A. D. Hopkins, wrote, "The results of phenological investigations have led to the conclusion that for every kind of periodical farm and garden practice in which, on account of climatic and seasonal conditions, there is a best time to do the work to secure the best results, there is usually some periodical event in the seasonal development of one or more species of wild or cultivated plants on the farm or in the immediate locality which will serve as a guide to this best time for any given locality or season. If such guide plants do not occur on the farm, they can be found among ornamental trees and shrubs and hardy flowering plants of other localities or countries and transplanted."

C. F. Talman of the United States Weather Bureau prophesied that "almost unlimited fields of usefulness will be opened up when the now strangely neglected science of phenology comes into its own".

DEPARTURE FROM NORMAL OF THE 1966 SPRING VEGETATIVE SEASON - AS INDICATED BY BEGIN-LILAC-BLOOM-DATE

Figure 1 shows the time of begin lilac bloom in the spring of 1966 in comparison to the normal time of bloom based on the five-year period 1957-1961.

Lilacs bloomed earlier than normal over most of the Western Region in 1966, as indicated by the extensive shaded area on the map. Bloom occurred more than 15 days earlier than normal in a zone which includes northwestern California, central Oregon, and parts of western Nevada. A smaller area around Denver, Colorado, also reported bloom dates more than 15 days earlier than normal. Extensive areas in the central part of the Region were in bloom from 5 to 15 days earlier than normal. Because earlier than normal plant development was followed by freezing temperatures, many observers reported that lilac flowers were damaged by low temperatures.

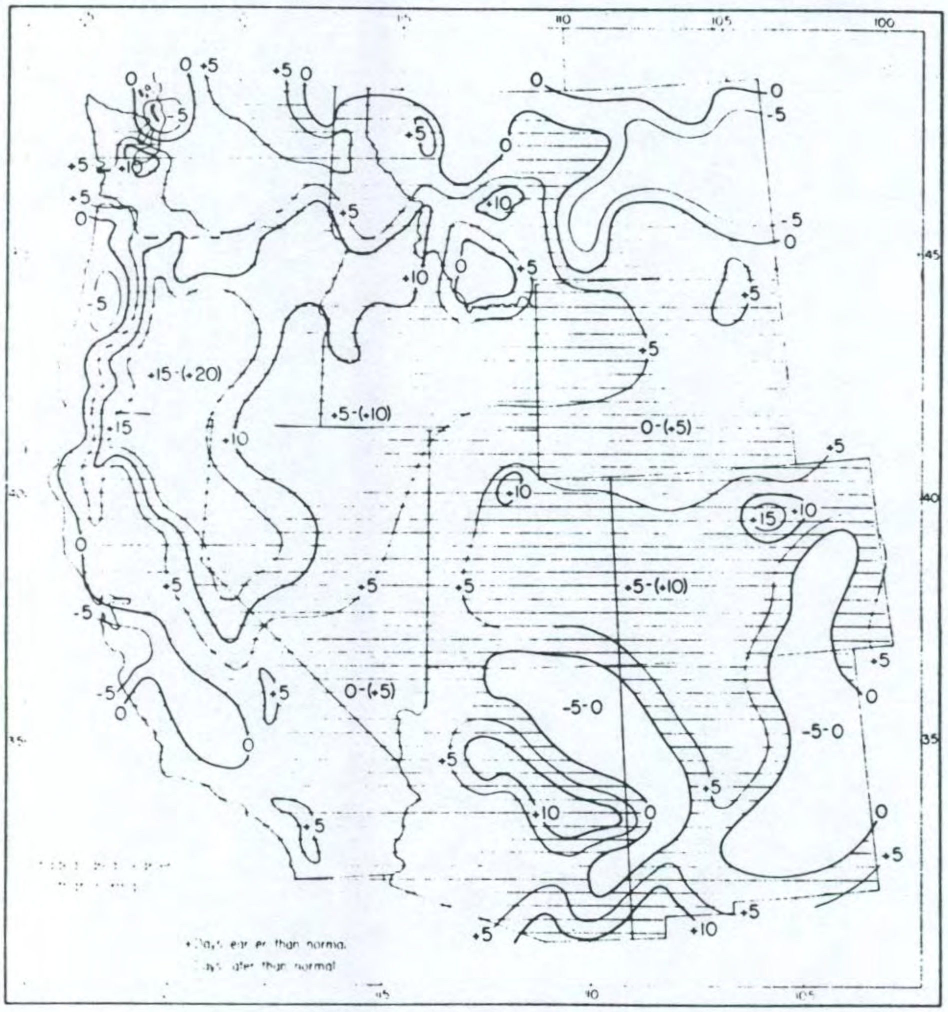


Fig. 1. DEPARTURE OF BEGIN-LILAC-BLOOM-DATE FROM NORMAL IN DAYS.

Bloom occurred more than 5 days later than normal in parts of central and eastern Montana, areas near the California coast south of San Francisco, in a section of Washington north of Seattle, and in the Corvallis-Eugene area of Oregon. Later than normal bloom dates were also reported in parts of Arizona, Colorado, and New Mexico.

Temperatures averaged higher than normal over nearly the entire region during March and May, and western sections also reported warmer than normal temperatures in April. Temperatures were lower than normal in June over the northern part of the Western Region. Higher than normal temperatures during the March through May period appear to be largely responsible for the extensive area in the west-central part of the region which reported lilac bloom more than 10 days earlier than normal in the spring of 1966.

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Montana Agricultural Experiment Station
Bozeman, Montana
January 18, 1968

DEPARTURE OF LILAC BLOOM DATES IN 1967 FROM THE 10-YEAR NORMAL (1957-66) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Normal dates of begin lilac bloom have been determined from phenological data collected during the 10-year period 1957-1966. The dates of begin bloom in the spring of 1967 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and analyzed (Figure 1).

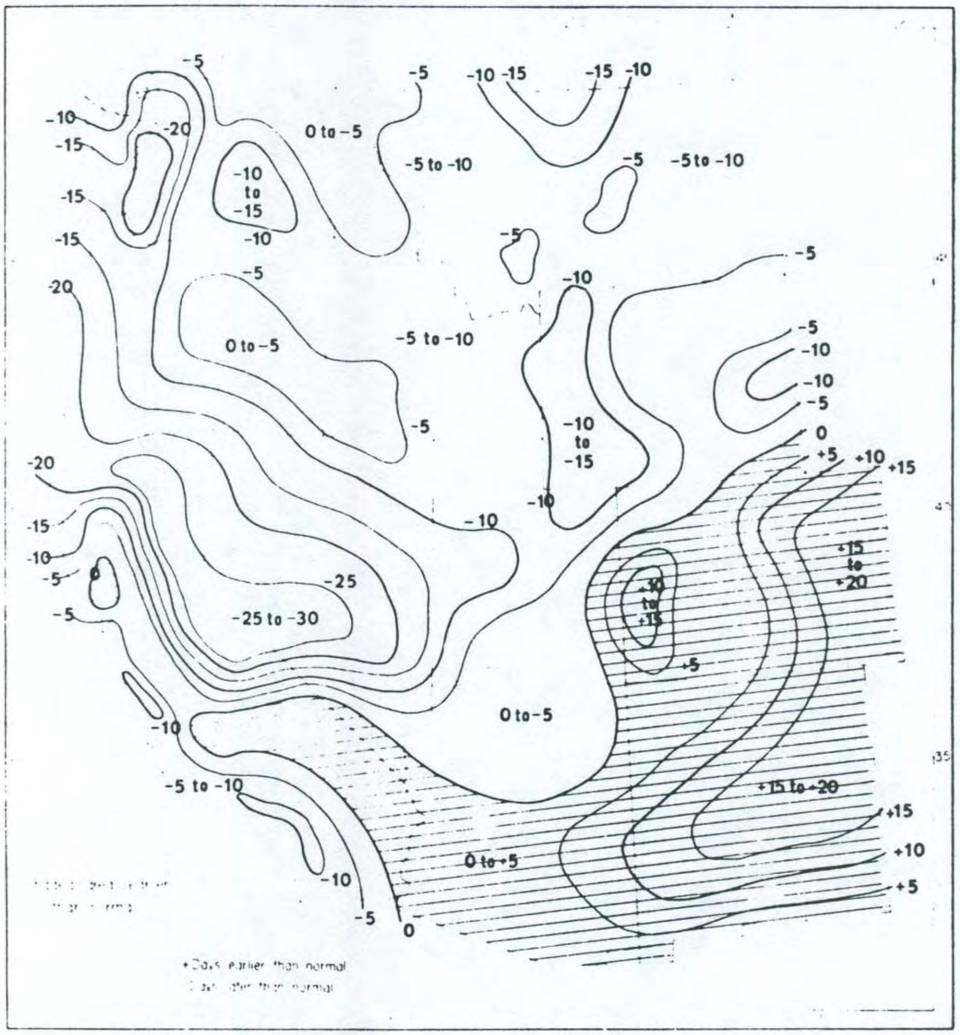


Fig. 1. Departure of "Begin Lilac Bloom" from normal, Spring, 1967.

Shaded areas on the map indicate those places where lilac bloom was earlier than normal in the spring of 1967. Areas not shaded were later than normal.

Later than normal conditions were experienced over most of the Western Region in the spring of 1967. A 5 to 10 day late zone is most predominate in the northern half of the Western region. A large area in Washington extending from near Seattle southward to near the Oregon border is indicated as being more than 20 days later than normal.

Largest departures from the normal occurred in an area extending from the foothills of the Sierra Nevada Mountains of northern and central California eastward into parts of west-central Nevada. Bloom was more than 25 days later than normal in this area.

The lateness of the season is no doubt related to cool conditions which prevailed over the general area during the month of April. Temperature anomalies averaged more than 10°F colder than normal during April in parts of California and Nevada.

Bloom was earlier than normal over the entire state of New Mexico and nearly all of Colorado. Most of the Great Plains area of Colorado and New Mexico was more than two weeks earlier than normal. Parts of Arizona, Utah, Nevada, and California were also earlier than normal in 1967. The early season in New Mexico and Colorado appears to be related to the very warm April experienced there. Temperatures were more than 6°F warmer than normal in April in parts of eastern New Mexico.

Lilacs can be found in bloom from early March through June somewhere in the Western Region and undoubtedly some features of the pattern are influenced by weather conditions extending from February through June. However, the major features of the anomaly pattern for 1967 appear to be largely the result of the unusual weather extremes that occurred during the month of April.

AN ANALYSIS OF FIVE YEARS OF OBSERVATIONS (1957-61) ON THE DATES WHEN THE COMMON PURPLE LILAC BEGINS TO BLOOM*

Phenological maps have been published for the area east of the Rocky Mountains, especially for agriculturally important plants, but little is known about the progression of plant development in the mountainous West largely because the great variation in topography makes it difficult to detect any general pattern throughout the area. To circumvent the confounding influence of elevation, a manual mapping procedure was developed which considers a three-dimensional pattern, then stratifies the data by using a separate map for each 100-foot elevation interval.

Figure 2 shows the pattern of isophanes (isophenes) at various elevations. An isophane is a line connecting points where plants reach a given stage of development on the same date. Sea-level isophanes were drawn by projection from higher elevations assuming constant isophanal gradients. The north-south orientation of isophanes at sea level, particularly in California, is a conspicuous feature of this map. Lilacs begin to bloom about March 31 at sea level, for example, along the entire length of California. The tendency of the isophanes to reach a northern extreme in the central part of the region is another characteristic of the sea-level isophanal pattern. The line (not shown in Fig. 2) connecting the points at which isophanes reach their northernmost limits is called the "Early Ridge".

---

*The following is from a chapter by J. M. Caprio in the book "Ground Level Climatology", published in 1967 by the American Association for the Advancement of Science

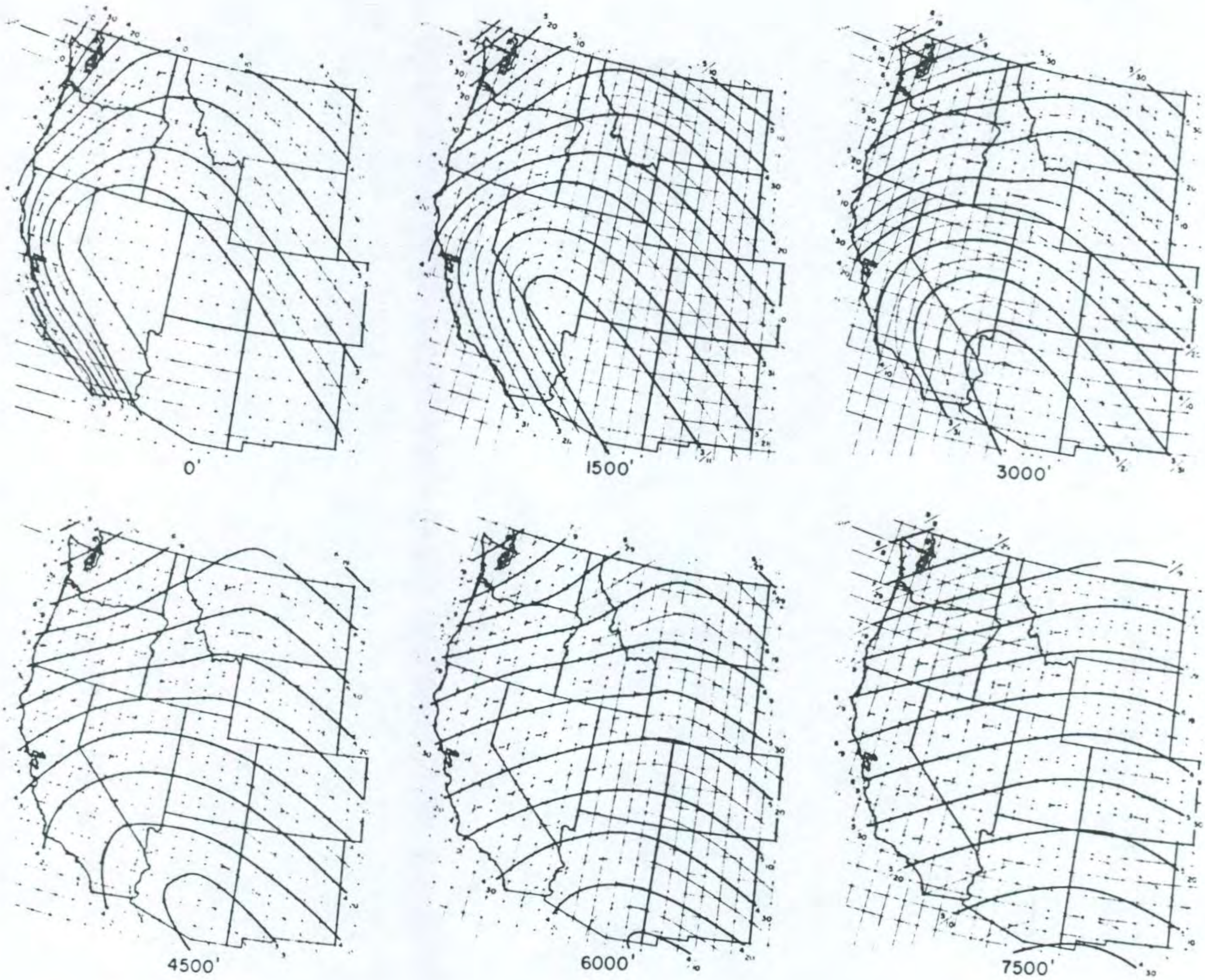


Fig. 2. Average dates when the common purple lilac started to bloom at six elevations throughout the western region of the United States (1957-61).

The pattern at 3,000 feet is somewhat similar but the isophanes are farther apart than they were at sea level along the California coast. Again there is a conspicuous peaking in the central part of the region, the Early Ridge, and a tendency for isophanes to become less curved and assume a more latitudinal orientation. At 6,000 feet the isophanes are even less curved and more latitudinally oriented, but still the Early Ridge appears to move eastward at higher elevations, particularly in the northern part of the region.

From equal-level isophanal maps which have been drawn for every 100-foot interval of elevation it is possible to construct maps which show those elevations where lilacs normally begin to bloom on any given date. The map labeled March 16 in Figure 3 indicates those elevations at which lilacs begin to bloom on March 16.

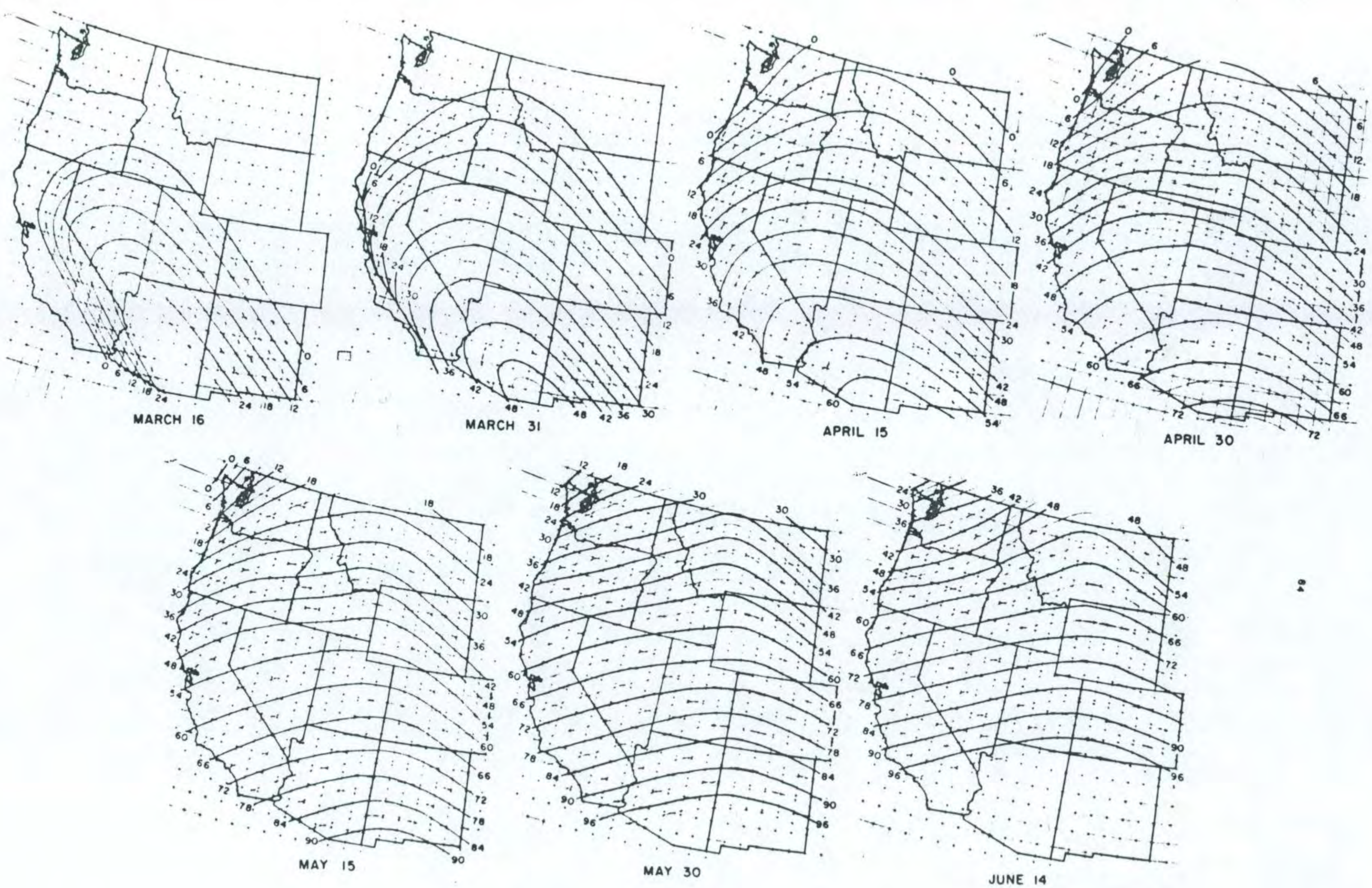


Figure 3. Elevations at which the common purple lilac began to bloom on various dates throughout the western region of the United States (1957-61). Elevations indicate hundreds of feet. Each point on the map at which the elevation coincides with the curved lines indicates the lilac's beginning bloom on the date at the bottom of the charts.

Any location at 2,400-foot elevation along the line labeled 24, for example, has an average beginning bloom date of March 16. The other maps are interpreted similarly. For example, on the map for April 15, any place located at 4,200 feet elevation along the line marked 42 would have an average first bloom date of April 15. According to this map, lilacs begin to bloom on April 15 along the central coast of Oregon. The May 15 map indicates that lilacs on this date are just beginning to bloom at the northwestern tip of Washington near sea level whereas in Arizona and New Mexico they are beginning to bloom at elevations above 8,000 feet in the southern parts of the states. The June 14 map is of particular significance because phenological stations do not have mean dates of lilac bloom much beyond mid-June. Therefore, the elevations indicated here closely approximate the extreme northern limits of lilacs. While lilacs can develop and bloom at 9,000 feet in Colorado, for example, their highest extent in northwestern Washington is about 3,000 feet. Beginning lilac bloom generally does not occur before the middle of March. Therefore, the first map in this series, dated March 16, indicates the approximate southern limits for the common purple lilac

The data for a five-year period (1957-61) were also analyzed statistically for different zones While the statistical approach may be more objective than the manual mapping procedure, the mapping method may provide the more accurate estimates of bloom dates since the simple equations used in the statistical approach are relatively inflexible, considering the climatic complexity of such extensive geographic areas.

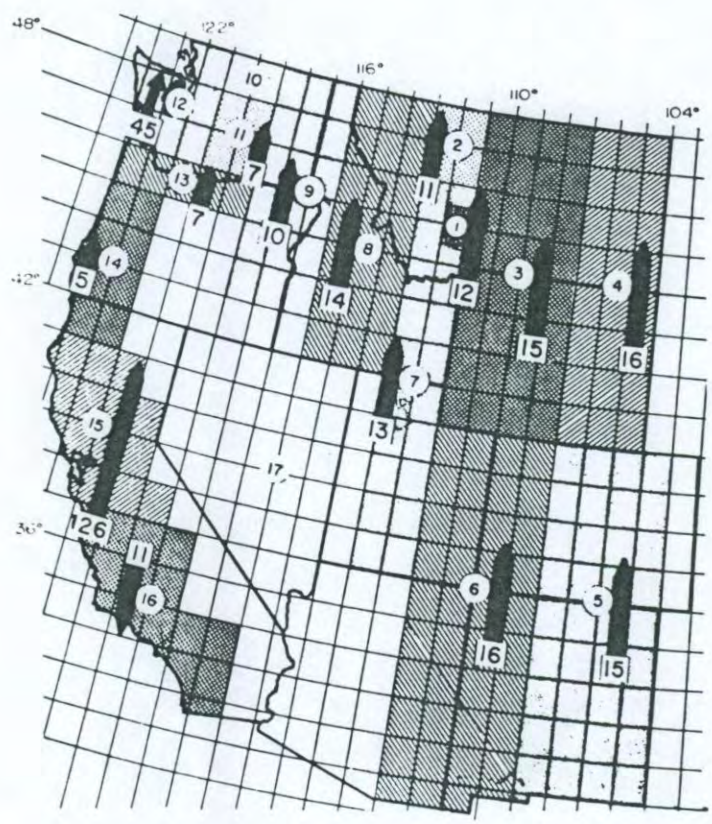


Fig. 4 Latitudinal movement of beginning lilac bloom in minutes per day (indicated by boxes) Shading and circled numbers indicate geographic zones.

In Figure 4 the length of the bars is proportional to the north and south speed of beginning lilac bloom at a given elevation according to the statistical approach. When speed is too great to indicate in proper proportions, an arrow is used. The speed of progression in minutes per day is written under each of the bars. Zones are identified by circled numbers. All movement is northward except in California where there is southward progression of lilac bloom. According to Hopkins' Bioclimatic Law (1918), the movement is fifteen minutes per day northward. Hopkins states that ".... the time of occurence of a given periodical event in life activity in temperate North America is at the general average rate of 4 days to each 1 degree of latitude, 5 degrees of longitude, 400 feet of altitude, later northward, eastward, and upward in the spring and early summer, and the reverse in late summer and autumn". There are large deviations from his values, particularly along the West Coast. The speeds of northward movement in the eastern half of the region are very close to Hopkins' fifteen minutes per day. Northward movement of the lilac bloom phase is slower in Oregon but more rapid in western Washington. This is in agreement with mapped isophanes which tend to parallel the Washington coast at lower elevations with a steep gradient in an east-west direction. The negative value in southern California indicates that lilacs develop later near the coast than in the warmer interior. This is probably due to the northwest-southeast orientation of the coast, which causes cooler temperatures to prevail on approaching the coast from the north. Northward movement in the foehn areas of Washington and Montana (Zones 11 and 2) is indicated as being rather slow. (A foehn is a warm, dry wind which occurs on the lee side of a mountain range).

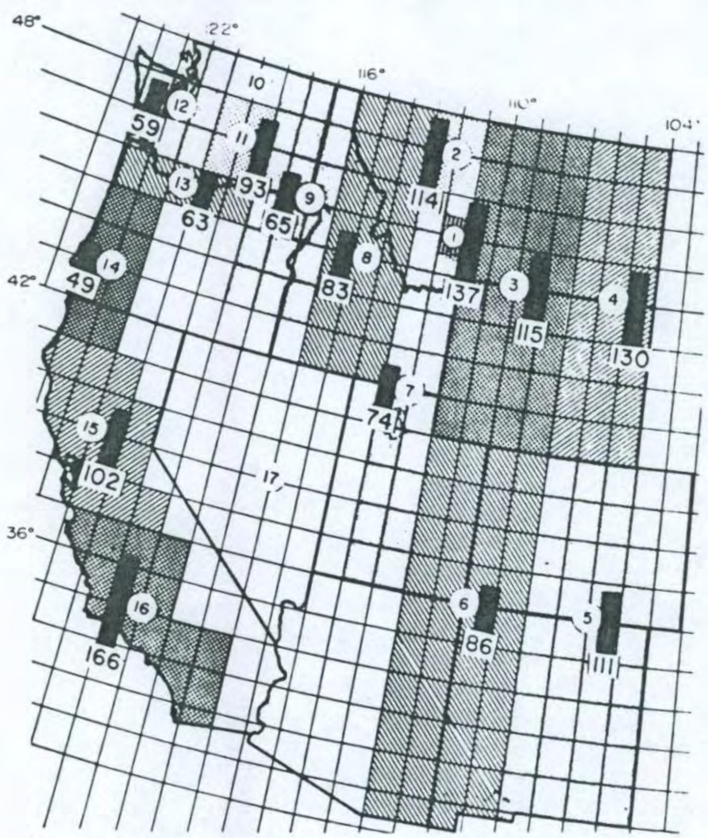


Fig. 5. Movement of beginning lilac bloom upward in elevation in feet per day. Shading and circled numbers indicate geographic zones.

The derived rates of progression of lilac beginning bloom to higher elevations are given in Figure 5. According to Hopkins' Law, the rate of progression to higher elevations is 100 feet per day. Computed rates are greater than this in the Great Plains area. A complex pattern prevails along the West Coast. In southern California lilac beginning bloom progresses rapidly to higher elevations. Figure 5 indicates the rate of progression upward at mean location of phenological plants for each zone. For Zones 15 and 16, this is 1,561 and 2,245 feet of elevation, respectively. Rates of progression upward near sea level, according to the statistical equations are more than 200 feet per day in Zones 15 and 16. In contrast, the movement to higher elevations is slower in eastern Oregon and Washington.

The computed orientation of isophanes and the speed of progression of lilac bloom at a given elevation in a direction perpendicular to isophanes are indicated in Figure 6. The large pointed bar indicates the horizontal direction of plant progression. The values change according to location and elevation in Zones 15 and 16 in California; values indicated for these zones are for the mean location and elevation of all the phenological plants studied in each zone. The length of the bar is proportional to the speed, which is indicated at the base of the bar by a number indicating miles per day. The progression in all zones has a component towards the north except in southern California (Zone 16) where the direction is to the southwest. Generally the direction is towards the northeast in the eastern part of the region and the northwest in the western part of the region. The orientation

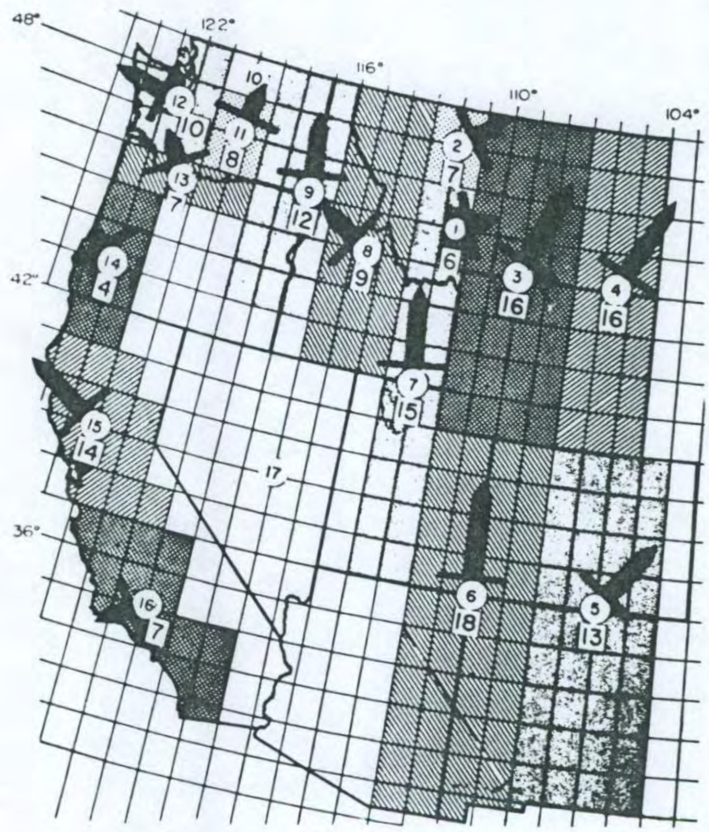


Fig 6. Orientation of isophanes and movement of beginning lilac bloom perpendicular to isophanes in miles per day (indicated by boxes). Each bar points in the direction of movement and the length of the bar is drawn in proportion to the speed. The line at the base of the bar is drawn parallel to the isophanes. Shading and circled numbers indicate geographic zones.

of isophanes, indicated by the line at the base of the bar, corresponds closely to those of the manually drawn maps (Fig. 2). They are oriented southeast-northwest in southern California, southwest-northeast along most of the coast, and northwest-southeast in the Great Plains. Note the northwest-southeast orientation of isophanes in the foehn areas. It may be a general rule in middle latitudes of the Northern Hemisphere that windward of mountain systems isophanes are oriented from southwest to northeast, and leeward of these mountain systems the orientation is from northwest to southeast. The rule may be applicable both for entire regions such as the western region and for more local situations.

A comparison of the actual reports of lilac bloom from different stations and the smooth isophanal patterns reveals local zones of departure; that is, areas where there is a relatively large proportion of stations having mean lilac beginning bloom either earlier or later than indicated by the regional equal-level isophanal maps. Figure 7 shows zones of departure and how early or late they are. Most departures are about five days earlier or later than the date indicated on the map. In general, places where bloom begins earlier than one would expect from the smooth regional map analysis occur in those areas which are to the lee of mountain ranges. The foehn areas in Washington and Montana are two examples. Blooms which occur later than indicated by map analysis in parts of southwestern Arizona and southeastern California may be attributed to the lack of adequate winter chilling and the resultant delay in foliation and blooming. The early zone extending from Nevada to Oregon and into California is one for which there are only few reports and its extent, therefore, is rather vague. It is indicated on the map by dashed lines.

J. M. Caprio
S. L. Crawford
H. N. Metcalf

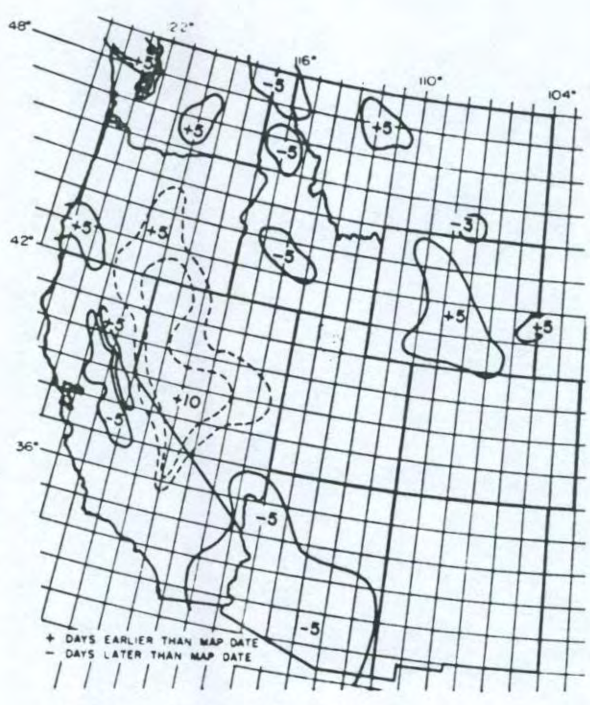


Fig. 7. Zones of departure of actual beginning lilac bloom date from map-indicated average date (1957-61).

The following persons have contributed to the phenological survey through their representation on the W-48 Technical Committee and/or serving as state phenological coordinators.

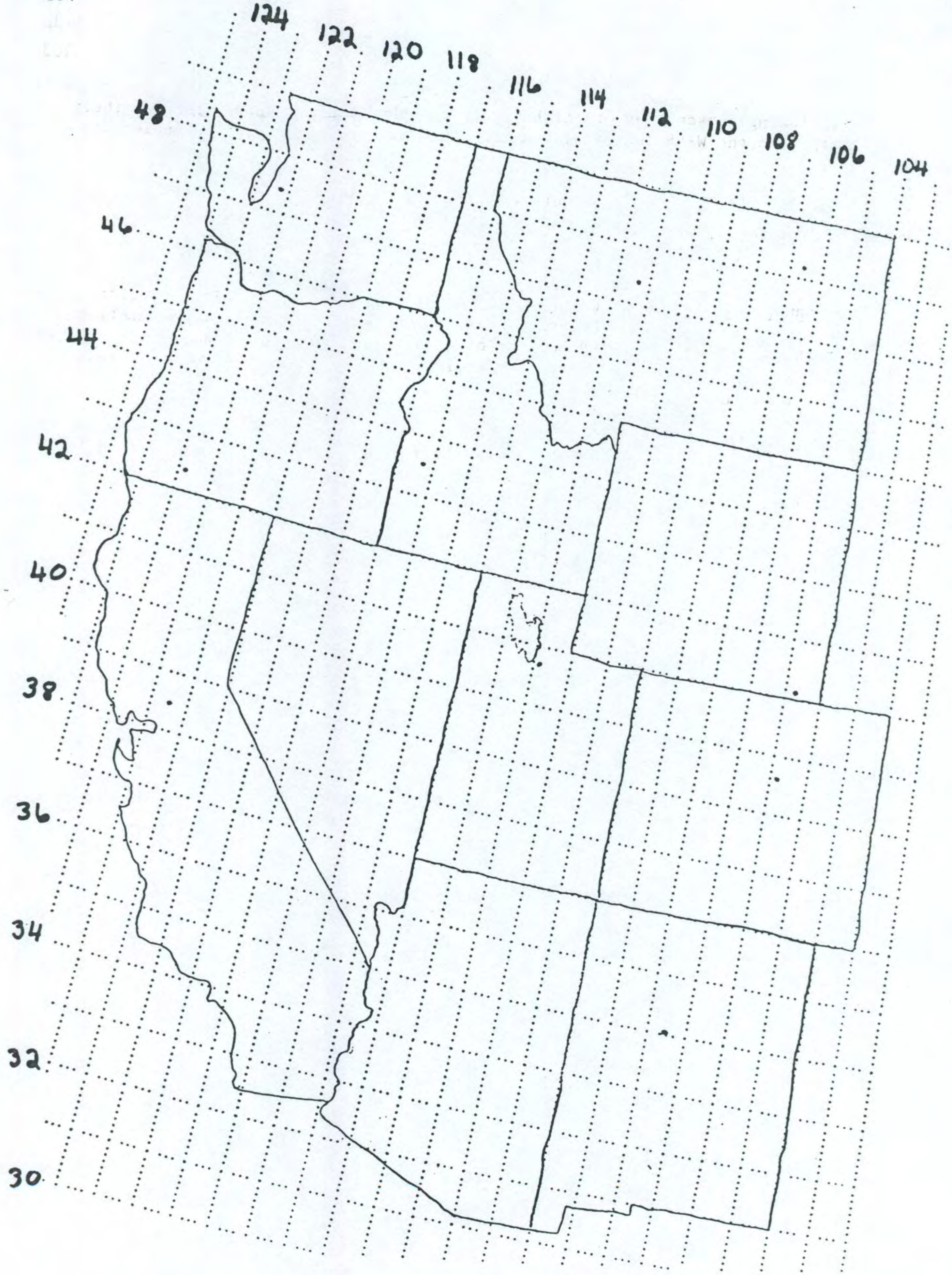
M. M. Fogel	University of Arizona	Tucson
M. Massengale	University of Arizona	Tucson
H. B. Schultz	University of California	Davis
D. F. Heermann	Colorado State University	Fort Collins
E. G. Siemer	Colorado State University	Grand Junction
D. L. Everson	University of Idaho	Moscow
J. R. Ridley	University of Idaho	Moscow
J. M. Caprio	Montana State University	Bozeman
R. O. Gifford	University of Nevada	Reno
M. D. Finkner	New Mexico State University	Las Cruces
W. P. Lowry	Oregon State University	Corvallis
W. H. Foot	Oregon State University	Corvallis
G. L. Ashcroft	Utah State University	Logan
M. C. Jensen	Washington State University	Pullman
C. F. Becker	University of Wyoming	Laramie
L. H. Paules	University of Wyoming	Laramie
J. A. Asleson (Admin. Adv.)	Montana State University	Bozeman

U. S. DEPARTMENT OF AGRICULTURE REPRESENTATIVES

W. Keller	Crops Research Division, ARS	Logan, Utah
K. G. Renard	Soil and Water Conservation, ARS	Tucson, Arizona
W. B. Fowler	Forest Service	Wenatchee, Washington
A. J. Loustalot	Cooperative State Research Service	Washington, D. C.

U. S. DEPARTMENT OF COMMERCE REPRESENTATIVE

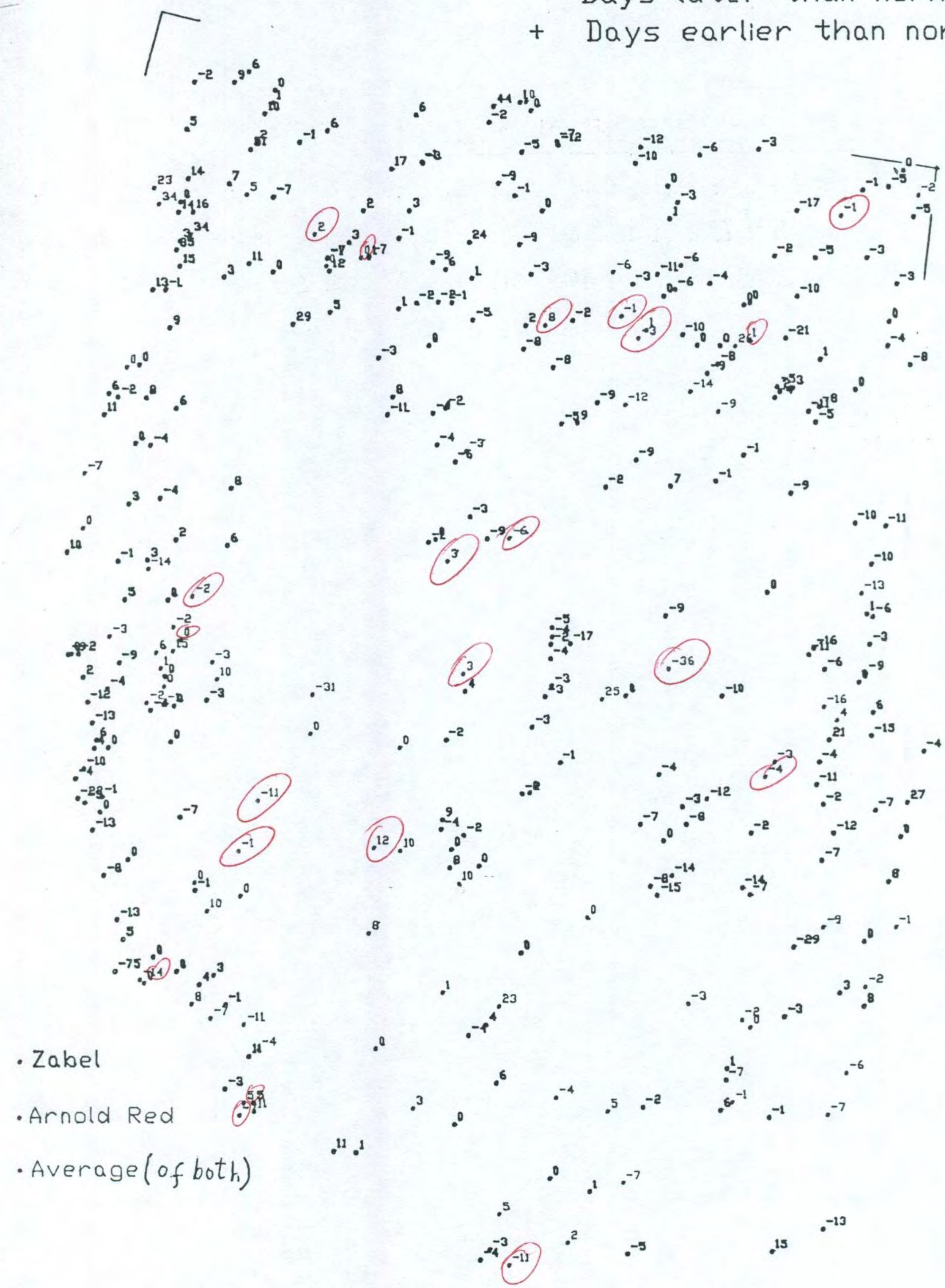
M. D. Magnuson	ESSA, Weather Bureau	Salt Lake City, Utah


124
122
120
118
116
114
112
110
108
106
104
48
46
44
42
40
38
36
34
32
30

Honeysuckle First Flower Anomaly, Spring 1968

\- Days later than normal

\+ Days earlier than normal



A Report to Cooperators of the Phenological Survey in the
Western Region of the United States

Montana Agricultural Experiment Station
Bozeman, Montana
January 3, 1969

A. Departure of Lilac Bloom Dates in 1968 from the 10-year Normal (1957-66) Throughout the Western Region of the United States

Normal dates of the time when lilacs begin to bloom have been determined from phenological data collected during the 10-year period 1957-66. The dates of begin bloom in the spring of 1968 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and analyzed (Figure 1).

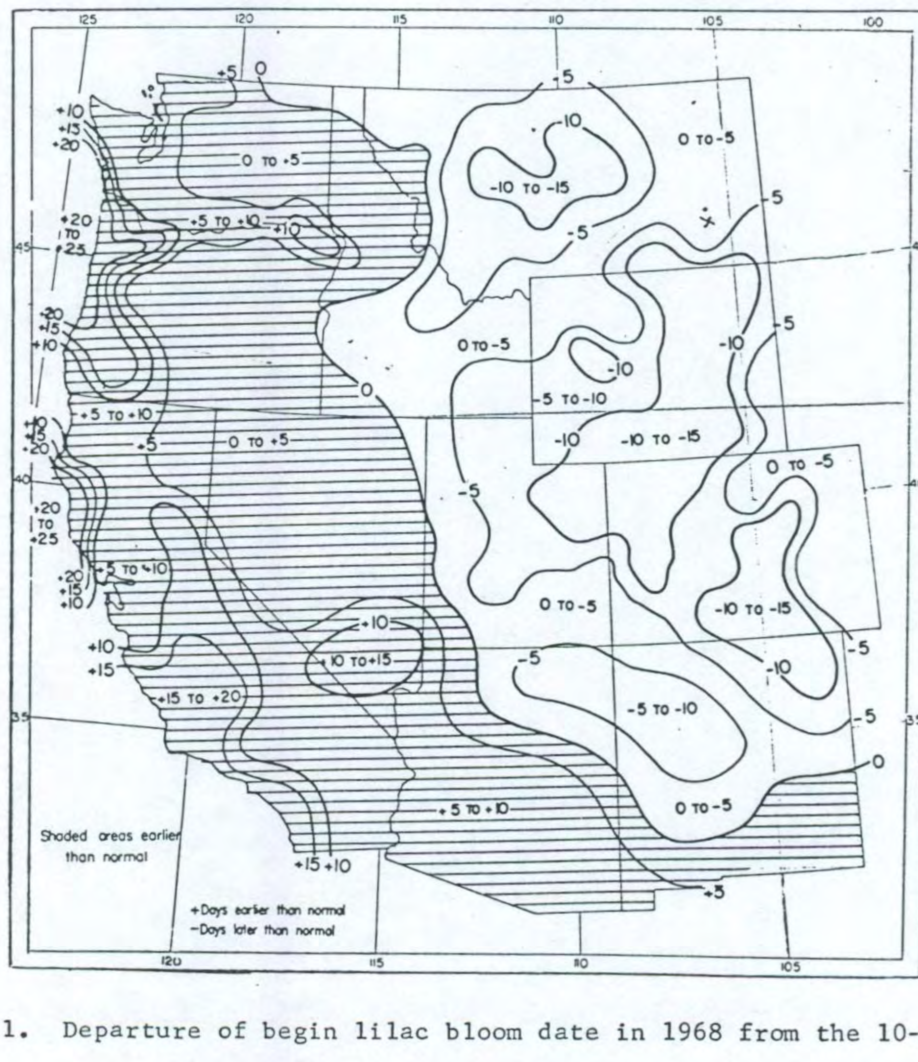


Figure 1. Departure of begin lilac bloom date in 1968 from the 10-year (1957-66) normal.

Shaded areas on the map indicate those places where lilac bloom was earlier than normal in the spring of 1968. Areas not shaded were later than normal. Bloom was generally earlier than normal in the western half and later than normal in eastern half of the Western Region.

Greatest departures from normal occurred in places along the Pacific Coast where the season was from 20 to 25 days earlier than normal. The large departures from normal reported this year along the coast are quite unusual and areas along the Oregon and Washington coast had the earliest season recorded during the 12 years of this study. Most of Nevada and interior sections of Oregon and Washington were a few days earlier than normal in 1968. The season was later than normal in most of Montana, Wyoming, Utah, Colorado, and New Mexico. Parts of all of these five states were from 10 to 15 days later than normal.

The phenological anomaly pattern seems to reflect the temperature anomaly pattern. Both March and April were warmer than normal in nearly all of the Western Region. These unseasonably warm temperatures appear to have pushed the normally early southern and western sections into bloom at an earlier than normal date. April and May, on the other hand, were colder than normal over most of the Region which relates to a later than normal bloom in northern areas and locations at high elevations where the season is normally late relative to the rest of the Western Region. In these late areas, warmer than normal weather in February and March do not have much bearing on plant development since even warmer than normal temperatures at these places so early in the season are still too low to cause much advance in plant development. By April and May southern locations have already had their bloom and the colder than normal temperatures of these months are not a factor in the timing of current season bloom.

B. Adjustment of 1957-61 Equal-level Isophanal Maps to Obtain 1957-66 Normal

Figure 2 shows the adjustment that must be made in the 1957-61 equal-level isophanal maps to arrive at the 1957-66 ten-year normal. This adjustment can be considered to represent a composite for both (a) Zones of Departure and (b) the 5-year shift in pattern of bloom dates. Equal-level isophanal maps for 1957-61 have been published and were included in an earlier Report to Cooperators dated February 1, 1962.

Adjustments extend over a larger area of the Western Region than do the 1957-61 Zones of Departure. Part of the reason for this is that two days of difference are designated in Figure 2, whereas Zones of Departure of the 1957-61 study were mostly indicated only in places where there was an adjustment of five days or more. The shift in the normal pattern during the last 5-year period of record (1962-66) is also a factor contributing to the larger area. Approximately ten percent of the area of the Western Region experienced a two to three day shift in pattern of normal bloom dates. The largest area of change was in the Western Great Plains where normal bloom dates were two to three days earlier for the 10-year period 1957-66 compared to the 5-year period from 1957-61.

The large area of adjustment shown in Figure 2 and identified by the ten day later adjustment center covering parts of Arizona, California, and southern Nevada appears to be due to a lack of cold weather during the winter months. In places where winters are warm the rest period of the plant is not satisfied and it fails to respond to warming temperatures in the spring. While the center of the area is designated "10 days later", some individual plants in this section bloom as many as 20 days later than indicated by the 1957-61 equal-level isophanal maps. Due to the above considerations and the uncertainty of the precise geographical limits of this zone, estimates of the normal time of begin lilac bloom cannot be made as accurately here as in other parts of the region.

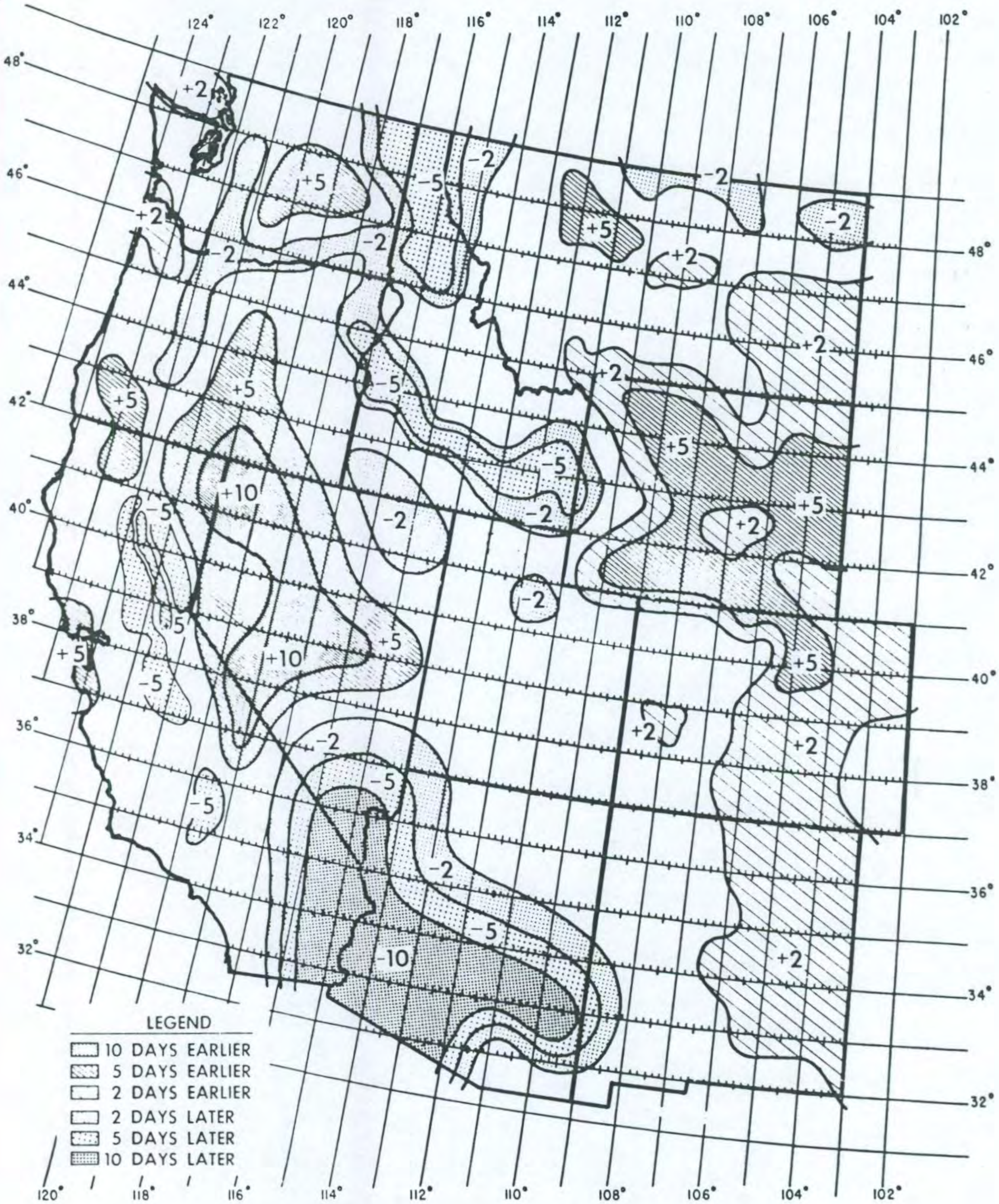


Figure 2. Days adjustment of 1957-61 begin lilac bloom equal-level isophanal maps to obtain the 10-year (1957-66) normal.

The boundary of the other large area of adjustment (five and ten days) just to the north and centered in Nevada are also rather vague due to limitations placed on mapping by the small number of observation sites.

The use of Figure 2 in conjunction with the previously published equal-level isophanal maps is quite simple. For example, suppose the 3,000 foot equal-level isophanal map, which is based on the 1957-61 period, indicates a May 25 begin lilac bloom date for a site located at an elevation of 3,000 feet in northern Idaho. Figure 2 indicates a 5-day later correction for this general area. The 1957-66 normal begin lilac bloom date for this site can now be estimated to be 5 days later than May 25, which is May 30.

C. Phenological Network for Honeysuckle Established Throughout Western Region

In 1967 and 1968 two varieties of honeysuckle were distributed for planting to more than two thousand locations throughout the eleven western states. These genetically uniform plants were selected for observation because of their desirable phenological characteristics. One honeysuckle is called 'Arnold Red' and the other 'Zabeli'.

They are distinguishable from each other by flower color and leaf morphology. The flower bud of the 'Arnold Red' is a deep red; the 'Zabeli' flower bud is deep pink in color. Some observation sites have only one plant while others have both. The honeysuckle, which produces a red berry, exhibits many conspicuous observation phases extending over a large portion of the growing season. Since each of the two selected honeysuckle are genetically uniform, phenological comparisons between two locations are more likely to reflect climatic differences than when observations are made on plants of unknown genetic constitution. The honeysuckle is also capable of initiating reproductive phases at an early age compared to many other shrubs. Thus, we might consider the honeysuckle to be a more precise and versatile "instrument" than plants that may have fewer conspicuous phases and which are of unknown genetic constitution.

The following persons have contributed to the phenological survey through their representation on the W-48 Technical Committee and/or serving as state phenological coordinators.

M. M. Fogel	University of Arizona	Tucson
M. A. Massengale	University of Arizona	Tucson
H. B. Schultz	University of California	Davis
D. F. Heermann	Colorado State University	Fort Collins
E. G. Siemer	Colorado State University	Grand Junction
D. L. Everson	University of Idaho	Moscow
J. R. Ridley	University of Idaho	Moscow
J. M. Caprio	Montana State University	Bozeman
R. O. Gifford	University of Nevada	Reno
M. D. Finkner	New Mexico State University	Las Cruces
W. P. Lowry	Oregon State University	Corvallis
W. H. Foote	Oregon State University	Corvallis
G. L. Ashcroft	Utah State University	Logan
M. C. Jensen	Washington State University	Pullman
C. F. Becker	University of Wyoming	Laramie
L. H. Paules	University of Wyoming	Laramie
J. A. Asleson (Admin. Adv.)	Montana State University	Bozeman

U. S. DEPARTMENT OF AGRICULTURE REPRESENTATIVES

W. Keller	Crops Research Division, ARS	Logan, Utah
K. G. Renard	Soil and Water Conservation, ARS	Tucson, Arizona
W. B. Fowler	Forest Service	Wenatchee, Washington
A. J. Loustalot	Cooperative State Research Service	Washington, D. C.

U. S. DEPARTMENT OF COMMERCE REPRESENTATIVE

M. D. Magnuson	ESSA, Weather Bureau	Salt Lake City, Utah

J. M. Caprio 10/15/68
S. L. Crawford
H. N. Metcalf
J. I. Preshinger

Honeysuckle First Flower Anomaly, Spring 1969

− Days later than normal
+ Days earlier than normal

A Report to Cooperators of the Phenological Survey in the
Western Region of the United States

Montana Agricultural Experiment Station

Bozeman, Montana

January 2, 1970

A. Departure of Lilac Bloom Date in 1969 from the 10-year Normal (1957-66) Throughout the Western Region of the United States

The normal dates of the time when lilacs begin to bloom have been determined from phenological data collected during the 10-year period 1957-66. The dates of begin bloom in the spring of 1969 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and analyzed (Figure 1).

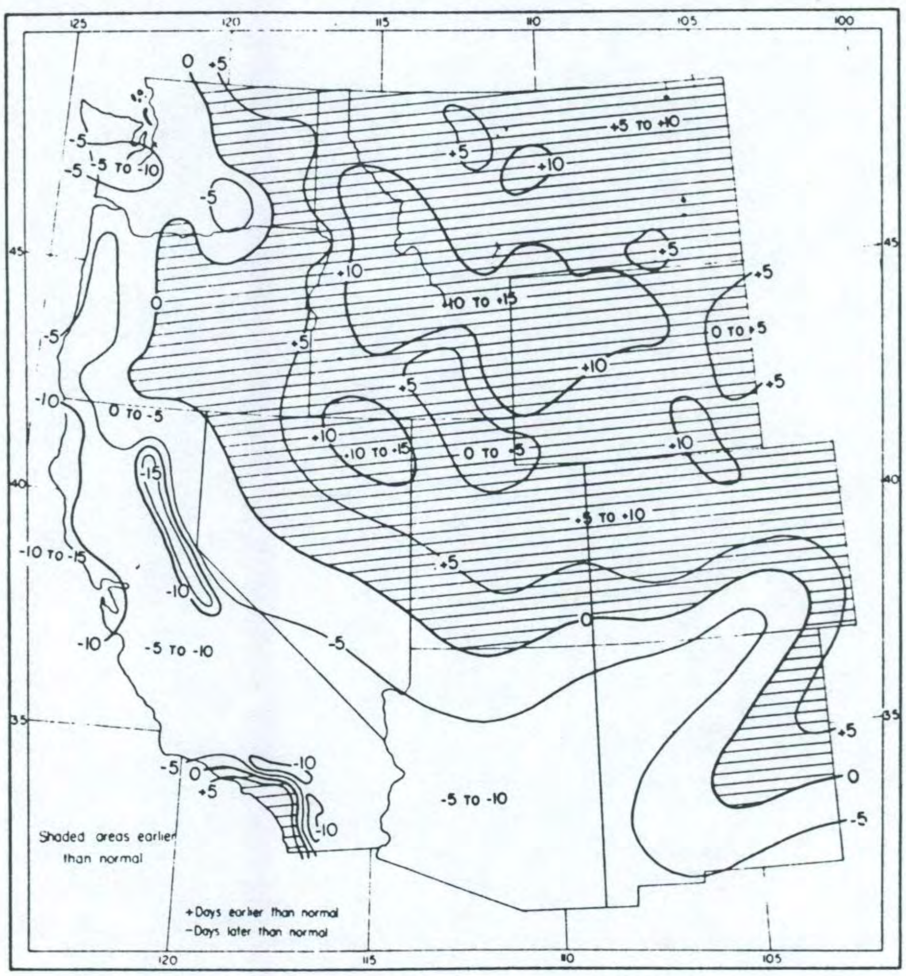


Figure 1. Departure of begin lilac bloom date in 1969 from the 10-year (1957-66) normal.

Shaded areas on the map indicate those places where lilac bloom was earlier than normal in the spring of 1969. Areas not shaded were later than normal.

In the spring of 1969 southern and western parts of the Western Region were generally later than normal while the rest of the Region was earlier than normal. An exception is an earlier than normal section near the southern California coast.

Included in the extensive later than normal area are most of Arizona, California and New Mexico, western Oregon and Washington, southern and western Nevada, and parts of southern Utah and southern Colorado. Most of this section was less than 10 days later than normal. The season was more than 10 days later than normal along the coast of central and northern California, in the Sierra Nevada mountains of Central California and in the mountain ranges of southwestern California.

Remaining parts of the Western Region, consisting of the greater portion of the interior, were earlier than normal. The season was generally 10 to 15 days earlier than normal over a large area extending from northwestern Wyoming into Idaho and Montana. Other smaller areas of 10 to 15 days early departures are centered in northeastern Nevada, south-central Wyoming and central Montana.

It is interesting to note that the anomaly pattern this year was almost the exact reverse of what it was in the spring of 1968. Those areas that were late in 1969 were generally early in 1968 and vice versa. The magnitude of the anomalies in 1969, however, tended to be smaller than those in 1968.

As has been noted in previous years, the phenological anomaly pattern seems to reflect the temperature anomaly pattern, and this year is no exception. March, for example, was generally colder than normal throughout the Western Region. An exception was a warmer than normal zone in the southern coastal area of California where lilacs bloomed earlier than normal in 1969. The cold March combined with an April that was cooler than normal over much of Washington, Oregon, California, Nevada, and Arizona appears to have retarded plant development in western and southern parts of the Region causing later than normal bloom dates in this area.

Temperatures were warmer than normal over the greater portion of the interior of the Western Region in both April and May and this was associated with a much earlier than normal appearance of lilac bloom in this part of the Region. Temperature anomalies of near 4°F warmer than normal occurred in both April and May over large parts of this interior region.

B. Long-Term Variability of Begin Lilac Bloom Dates

Almost everyone is affected in some way when the vegetative season departs markedly from the normal. Farmers and home gardeners are well aware than perennial plants develop earlier in some years than in other years and that certain activities cannot be scheduled according to the calendar but are dependent upon stage of plant development. Civic events are sometimes scheduled to coincide with a vegetative event. Spokane, Washington, for example, schedules its Lilac Festival each year at about the time when lilacs are normally in bloom.

Variability of the timing of plant development of such major crops as wheat and barley can be an important consideration in a crop breeding program, since wide departures of phenological events (heading, maturation, etc.) from the normal time may lead to adverse weather exposure. Readiness of pasture for grazing is definitely linked with variations in vegetative development from year to year. Timing of vegetative development also tends to be associated with variation in the timing of other biological events such as the prevalence of plant diseases and insect infestations. One could go on and on giving examples of how sensitive man and his environment are to annual variations in plant development.

In spite of the profound effect on man of yearly differences in timing of the vegetative season, little information has been available which could serve as a basis for geographical mapping of the characteristic magnitude of these seasonal departures from normal (called "anomalies" by the statistician).

Information collected over the 10 year period 1957-66 is now providing an indication of the tendency for dates of lilac bloom to vary from their normal times of occurrence. A statistical measure of the variation, dubbed "standard deviation" was computed for all stations in the West having at least 5 annual reports on lilac bloom.

Figure 2 shows the distribution of standard deviation of plant development based on begin lilac bloom dates (1957-66) throughout the eleven western states. A simple rule for interpreting a standard deviation is that in two out of three years begin bloom will occur within (plus or minus) one standard deviation of the normal date, and events will not depart by more than two standard deviations from the normal date in 19 out of 20 or 95 percent of the years.

Thus, a location with an average bloom date occurrence on May 15 and a standard deviation of five days can expect bloom to occur in two out of three years (67 percent of the years) between May 10 and May 20 (that is, May 15 plus and minus five days) The same location can expect bloom to occur between May 5 and May 25 (May 15 plus and minus two standard deviations of 10 days) in 19 out of 20 or 95 percent of the years.

Least variable areas (indicated with line hatching) are in central Washington, and an extensive area in the northeastern part of the region, including northwestern Colorado, northern Utah and most of Idaho, Montana and Wyoming. The Big Horn Basin of Wyoming is particularly stable, having standard deviations

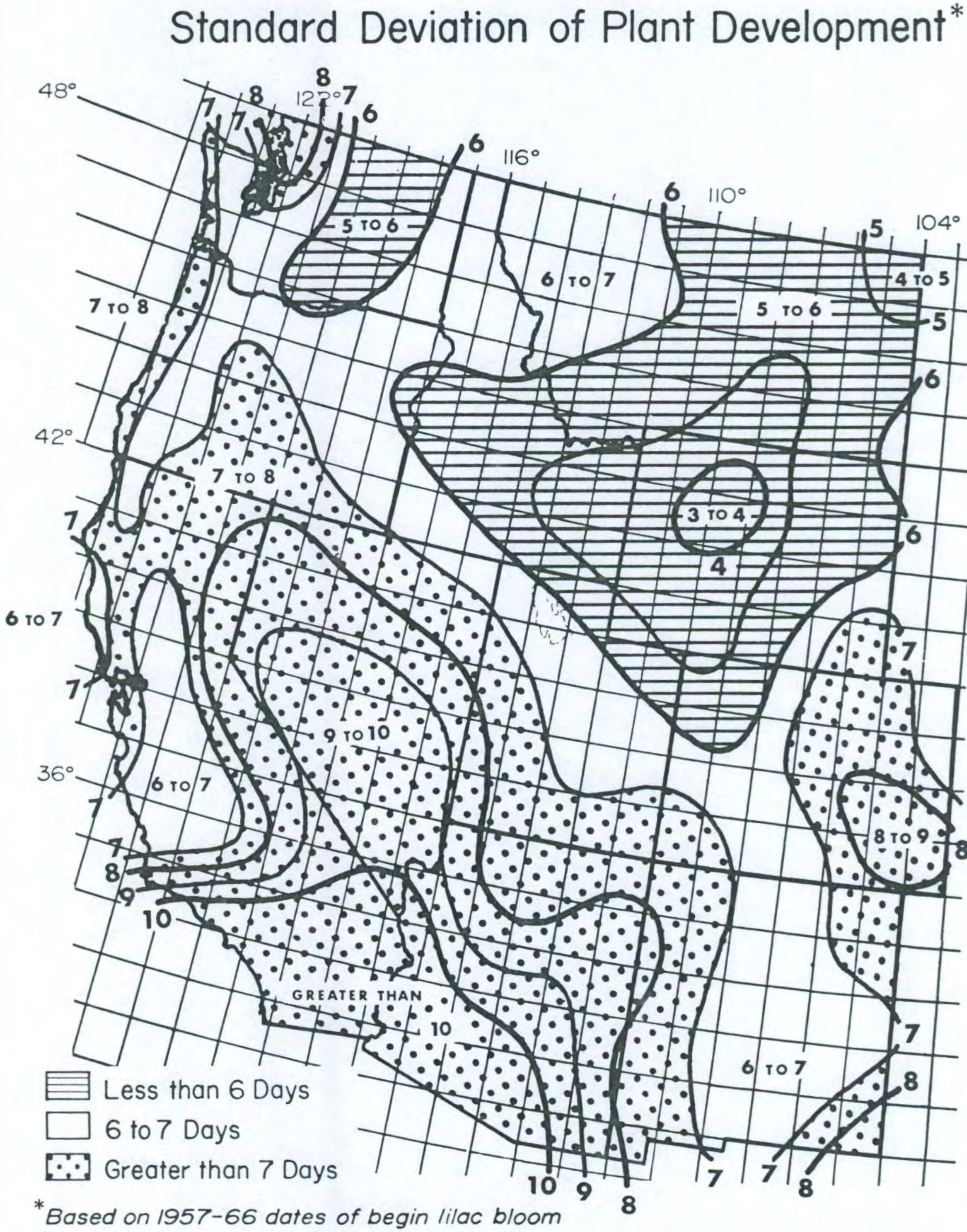


Figure 2. Variability of date of begin lilac bloom throughout the Western United States.

of less than four days.

Extremes of variability are evident in the western Great Plains with standard deviations ranging from less than four days in parts of Wyoming to more than eight days in southeastern Colorado. Information of this kind may be fundamental to an understanding of why certain species and varieties of native and cultivated plants are more adaptable in some areas than in others.

Highly variable areas (indicated with dotted hatching) are located in northwestern Washington, eastern Colorado and New Mexico and a large section of the Southwest including all of Arizona and much of California and Nevada. Greatest variability occurs in the extreme southwestern section where standard deviations exceed 10 days. Some of the variability in the warmer areas of the Southwest is probably related to the fact that winters are not always cold enough for lilacs. If the lilac is not exposed to a certain minimum amount of cold during the winter, its rest period is not broken and it fails to respond normally to increasing temperatures during the following spring.

Unhatched areas of the map indicate standard deviations between six and seven days. It is interesting to note that much of the intensively farmed Central Valley of California falls in this intermediate zone of variability.

Analyses of peak and end lilac bloom dates indicate very similar patterns of variability for these two phenological phases.

C. Texas Joins Western Phenological Network

The State of Texas has joined the Western Regional Phenological Network. Observations there on purple common lilacs will begin in 1970. Honeysuckle plants will be established in 1970. Observations on honeysuckle in Texas will begin in 1971. The addition of Texas brings the total land covered by the lilac and honeysuckle plant-climate network to half of the area of the contiguous United States.

The following persons have contributed to the phenological survey through their representation on the W-48 Technical Committee and/or serving as state phenological coordinators.

M. M. Fogel	University of Arizona	Tucson
M. A. Massengale	University of Arizona	Tucson
H. B. Schultz	University of California	Davis
D. F. Heermann	Colorado State University	Fort Collins
E. G. Siemer	Colorado State University	Grand Junction
D. L. Everson	University of Idaho	Moscow
J. R. Ridley	University of Idaho	Moscow
J. M. Caprio	Montana State University	Bozeman
R. O. Gifford	University of Nevada	Reno
M. D. Finkner	New Mexico State University	Las Cruces
W. P. Lowry	Oregon State University	Corvallis
W. H. Foote	Oregon State University	Corvallis
E. A. Hiler	Texas A & M University	College Station
G. L. Ashcroft	Utah State University	Logan
M. C. Jensen	Washington State University	Pullman
L. O. Pochop	University of Wyoming	Laramie
L. H. Paules	University of Wyoming	Laramie

U. S. DEPARTMENT OF AGRICULTURE REPRESENTATIVES

W. Keller	Crop Research Division, ARS	Logan, Utah
K. G. Renard	Soil and Water Conservation, ARS	Tucson, Ariz.
W. B. Fowler	Forest Service	Wenatchee, Wash.
A. J. Loustalot	Cooperative State Research Service	Washington, DC

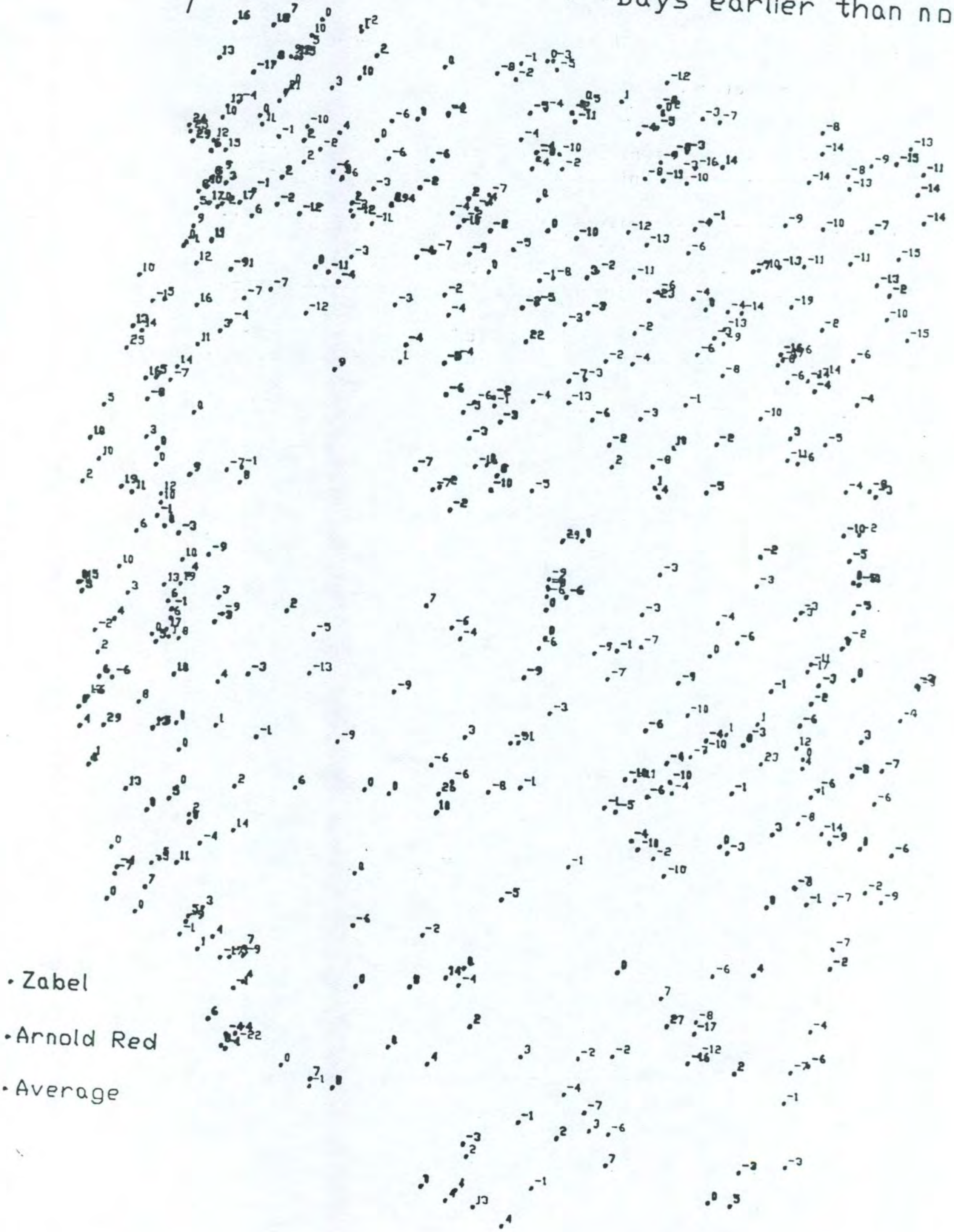
U. S. DEPARTMENT OF COMMERCE REPRESENTATIVE

M. D. Magnuson	ESSA, Weather Bureau	Salt Lake City, Utah

Report prepared by Joesph M. Caprio and Homer N. Metcalf, Plant and Soil Science Department, Montana State University, Bozeman, Montana.

Honeysuckle First Flower Anomaly, Spring 1970

− Days later than normal
\+ Days earlier than normal



A Report to Cooperators of the Phenological Survey in the
Western Region of the United States

Montana Agricultural Experiment Station

Bozeman, Montana

January 6, 1971

A. Departure of Lilac Bloom Date in 1970 from the 10-year Normal (1957-66) Throughout the Western Region of the United States

The normal dates of the time when purple common lilacs begin to bloom have been determined from phenological data collected during the 10-year period 1957-66. The dates of begin bloom in the spring of 1970 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and analyzed (Figure 1).

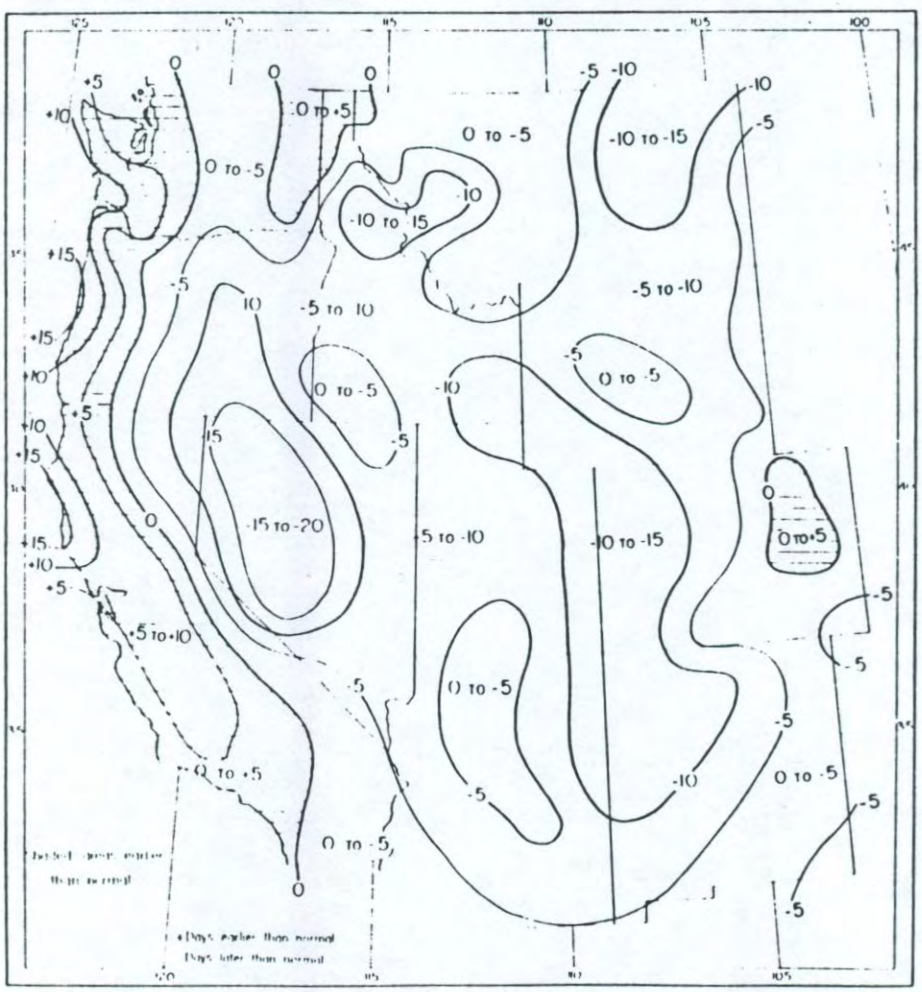


Figure 1. Departure of begin bloom date in 1970 from the 10-year (1957-66) normal.

Shaded areas on the map indicate those places where lilac bloom was earlier than normal in the spring of 1970. Areas not shaded were later than normal.

Lilacs began to bloom earlier than normal in 1970 over most of California, western Oregon and western Washington. Bloom was more than 15 days earlier than normal along some coastal sections of Oregon and northern California. Lilacs generally bloomed later than normal over the rest of the Western Region. Exceptions were earlier than normal bloom over a portion of eastern Colorado and in a zone extending from northeastern Washington into northwestern Montana. Anomalies of more than 10 days later than normal were common over extensive areas east of the Pacific coastal states. A zone of more than 15 days later than normal is indicated in central Nevada.

The earlier than normal bloom along the West Coast was associated with higher than normal February and March temperatures in that area. The lateness of the season over most of the Western Region was associated with a colder than normal March and a very cold April. April temperatures over a large portion of the Western Region were more than six degrees Fahrenheit below normal. Temperatures in May were generally near normal throughout most of the West; but in eastern Colorado, where bloom was early, May averaged more than three degrees Fahrenheit above normal. June was three to six degrees Fahrenheit warmer than normal along extreme northern parts of the region.

Honeysuckle Bushes Observed for Third Year

Phenological data on the two genotypes of honeysuckle, Arnold Red and Zabeli, were collected for the third year throughout the eleven western states. Honeysuckle data for Texas will be recorded for the first time in the spring of 1971.

Observers Instruction Booklet:

The Western Regional publication "Instructions for Phenological Observations of Purple Common Lilac and Red Berry Honeysuckle" will be sent to observers this winter in time for the 1971 observation season. This publication, identified as Montana Agricultural Experiment Station Circular 250, contains instructions for establishing and maintaining phenological sites and for making phenological observations on the purple common lilac and red berry honeysuckle. The booklet also includes a discussion of phenology and how this science provides useful information for many aspects of human activity.

The Phenology Program of the U. S. International Biological Program:

The Committee for the Phenology Program of the United States International Biological Program (IBP) is presently headed by Dr. Forest W. Stearns of the University of Wisconsin at Milwaukee. Efforts by the Committee are currently directed to the realization of nation-wide phenological observations. Among other applications, such a program could contribute to the realization of useful systems analysis output in ecological studies on the various biomes being conducted in connection with the United States International Biological Program. Phenological data may also prove valuable by providing "ground truth" needed in connection with the Earth Resources Technical Satellites (ERTS)-A and -B which are scheduled for launching in 1971 and 1972.

Some Observations on the Phenology in Europe by J. M. Caprio:

An invitation to attend the UNESCO sponsored Seminar on "Plant Response to Climatic Factors" in Uppsala, Sweden, September 15-20 afforded me the opportunity to visit a number of places in Europe where phenological programs are being conducted.

In West Germany, I visited the German Weather Service at Offenbach near Frankfurt. The government center for phenology is located here. The German network includes approximately 2,500 phenological observers. Phenological data are gathered and processed by the Agricultural Meteorology Section of the German Weather Service. These data and analyses are utilized by the National Agricultural Department to provide advisories to farmers relative to managerial decisions in agriculture. Phenological data are also used in many other ways in West Germany.

The Royal Dutch Meteorological Institute, De Bilt, Netherlands, established a network of about 45 phenological stations throughout the country. They are observing phenophases on 15 different kinds of native plants. Five to ten different plants are observed at each site. These genetically similar plants are propagated vegetatively by the Botanical Division of the University of Utretch. Among the plants being observed are common lungwort, crossleaf heath, raggedrobin, common coltsfoot and marsh betony.

In Norway, I visited the Botanical Laboratory at Oslo University where a research group is in the process of analyzing phenological observations which were made at about 75 sites during the three year period 1965 through 1967. They provided me with information on purple common lilac bloom dates at three of their experimental sites in the Bergen area of Norway. Many measurements of the atmosphere and soil were made during this program. The study includes native species as well as agricultural crops planted in small plots. A nation-wide phenological network was started in 1928 and is directed by Dr. H. Printz of Oslo University.

A very intensive system of phenological observations on a large number of species is maintained at the Norwegian Agricultural College located at Vollebekk near Ås. There are 700 different species of trees and shrubs maintained on the grounds of the campus. A group at the College is also conducting an intensive study on the phenology of agricultural crops in southern Norway.

At the Norwegian Agricultural College I had an opportunity to see one of the International Phenological Gardens. These phenological gardens are maintained at about 50 locations throughout Europe extending from Sweden in the north to Yugoslavia in the south. This garden was established in 1958 and is one of five located in Norway. There are three or four plants of each of 14 different tree species growing at this site in an area of somewhat more than half an acre. As is the case with the honeysuckle phenological network in the western United States, only genetically similar plants are observed at all the sites.

In Sweden a yearbook on phenology is published in connection with a national club of young adults. The study of nature, broadly speaking, is their goal and phenology is only one aspect of their activity. More than 500 people throughout Sweden participate by reporting phenological phase dates for various native plants and animals. They observe about seven plants, four insects and 16 birds. Local clubs are doing their own intensive phenological studies in various parts of Sweden.

The following persons have contributed to the phenological survey through their representation on the W-48 Technical Committee and/or serving as state phenological coordinators.

M. M. Fogel----------------University of Arizona------------------------Tucson
M. A. Massengale-----------University of Arizona------------------------Tucson

H. B. Schultz--------------University of California----------------------Davis

D. F. Heermann-------------Colorado State University--------------Fort Collins
E. G. Siemer---------------Colorado State University-----------Grand Junction

D. L. Everson--------------University of Idaho--------------------------Moscow
J. R. Ridley---------------University of Idaho--------------------------Moscow

J. M. Caprio---------------Montana State University--------------------Bozeman

R. O. Gifford--------------University of Nevada---------------------------Reno

M. D. Finkner--------------New Mexico State University--------------Las Cruces

W. P. Lowry----------------Oregon State University-------------------Corvallis
W. H. Foote----------------Oregon State University-------------------Corvallis

E. A. Hiler----------------Texas A & M University--------------College Station

G. L. Ashcroft-------------Utah State University-------------------------Logan

D. L. Bassett--------------Washington State University-----------------Pullman

L. O. Pochop---------------University of Wyoming----------------------Laramie
L. H. Paules---------------University of Wyoming----------------------Laramie

U. S. DEPARTMENT OF AGRICULTURE REPRESENTATIVES

W. Keller------------------Crop Research Division, ARS-------------Logan, Utah
K. G. Renard---------------Soil and Water Conservation, ARS------Tucson, Ariz.
W. B. Fowler---------------Forest Service---------------------Wenatchee, Wash.
A. J. Loustalot------------Cooperative State Research Service---Washington, DC

U. S. DEPARTMENT OF COMMERCE REPRESENTATIVE

M. D. Magnuson-------------NOAA, Nat'l Weather Service----Salt Lake City, Utah

---

Report prepared by Joseph M. Caprio, Plant and Soil Science Department, Montana State University, Bozeman, Montana.

Honeysuckle First Flower Anomaly, Spring 1971

\- Days later than normal

\+ Days earlier than normal

A Report to Cooperators of the Phenological Survey in the Western Region of the United States

Montana Agricultural Experiment Station

Bozeman, Montana

December 10, 1971

A. <u>Departure of Lilac Bloom Date in 1971 from the 10-year Normal (1957-66) Throughout the Western Region of the United States</u>

The normal dates of the time when purple common lilacs begin to bloom have been determined from phenological data collected during the 10-year period 1957-66. The dates of begin bloom in the spring of 1971 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and analyzed (Figure 1).

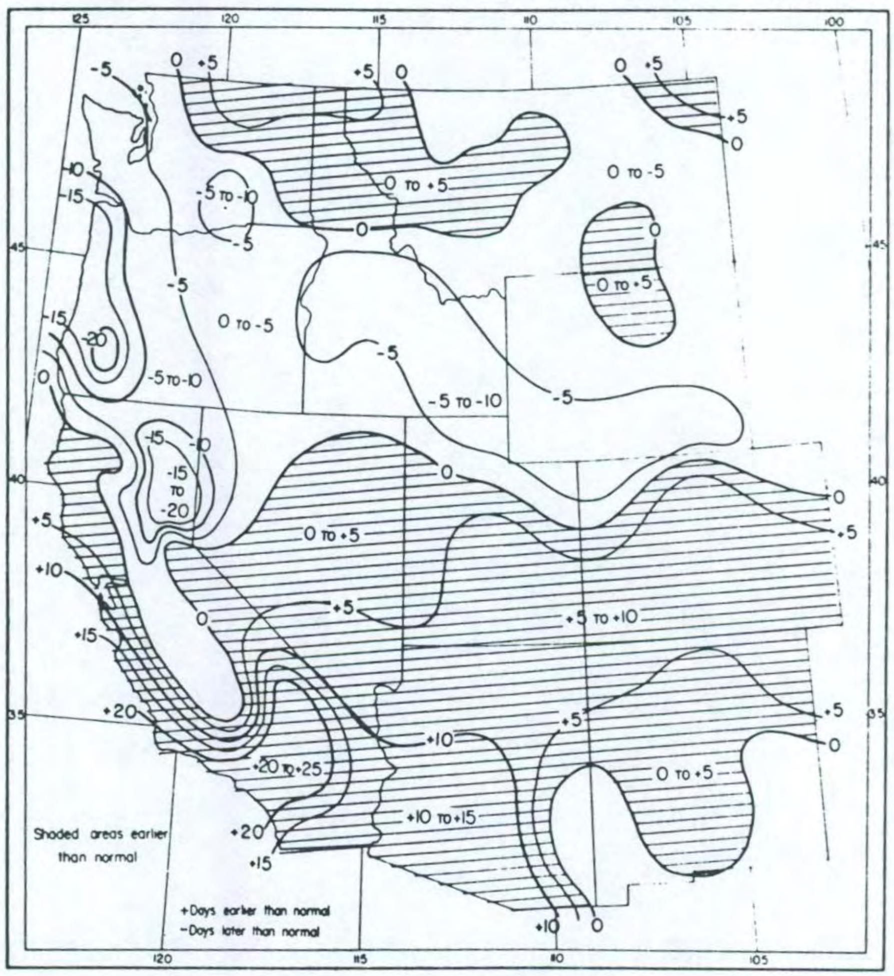


Figure 1. Departure of begin lilac bloom date in 1971 from the 10-year (1957-66) normal.

Shaded areas on the map indicate those places where lilac bloom in the spring of 1971 was earlier than normal. Areas not shaded were later than normal.

Lilacs bloomed earlier than normal in 1971 over most of the southern half of the Region while later than normal bloom was recorded over a greater portion of the northern half of the Region. Exceptions to this were as follows:

1. Bloom was later than normal in parts of northern California, northwestern Nevada, southeastern Arizona and southeastern New Mexico.
2. Bloom was earlier than normal in a continuous area covering eastern Washington, northern Idaho and western Montana, as well as in parts of eastern Montana and northcentral Wyoming.

In general, the time of bloom departed from normal by less than 10 days except in the northern California - western Oregon area where the time of bloom was more than 15 days later than normal and in southern California and southwestern Arizona where bloom was more than 10 days earlier than normal. Bloom was more than 20 days earlier than normal in parts of southern California.

Associated with the earlier than normal bloom in southern areas were warmer than average temperatures in January, February and March. April and May were cooler than normal over most of the Western Region, but the earlier than normal lilac bloom area of eastern Washington, northern Idaho and northwestern Montana averaged warmer than normal for the month of May.

Honeysuckle Observations Now in Fifth Year

Observations on honeysuckle were first begun at many locations in the spring of 1968. Plants observed in 1968 were established in the spring of 1967. Thus, the 1972 season will be the fifth year of honeysuckle data collection. In Texas, lilac observations were begun in 1970 and honeysuckle were first observed in 1971.

Model Developed Linking Time of Lilac Bloom to Weather Factors[1]

For the past several years lilac bloom data and weather records have been studied in an effort to determine which climatic factors control the timing of lilac bloom. These studies have led to a theory linking the climatic environment to the rate at which lilacs and many other plants advance through their seasonal development. The equation which describes the theory is based on phenological information on the purple common lilac recorded over a 10-year period by hundreds of phenological observers throughout the 11 western states.

Energy received from the sun is one facet of this equation. Another element is mean daily temperature which is computed by adding the highest and lowest temperature for that day and dividing by two. These temperatures are measured each day in standard Weather Service climatological shelters at a height of about 5 feet. Mean daily temperature becomes "effective" in advancing plant development when it rises above $31.0^{\circ}F$. At a given effective temperature the number of Solar-Thermal Units increases in direct proportion to the amount of solar radiation. Likewise, at a given solar radiation, Solar-Thermal Units accumulate in direct proportion to the effective temperature.

The equation which describes the accumulation of Solar-Thermal Units to the time of begin lilac bloom is on page 4

According to this equation, 380,000 Solar-Thermal Units are required to bring the common purple lilac into bloom It has been observed that many kinds of plants advance in parallel with the lilac in the spring, so this response of the lilac is characteristic of many plant species.

While total solar radiation, direct and indirect, is an element in the Solar-Thermal Unit equation, some parts of the solar spectrum (mostly included in the .3 to 4 micron wavelength range) might actually be more important than other parts. Also, while these relations with plant development appear to hold over extensive areas, environmental extremes such as very low atmospheric moisture could interfere with normal functioning of the plant. These are finer points that can be resolved through further research.

Solar-Thermal Units (STU) were compared with experimental results of different researchers who have related potential evapotranspiration[2] to

---

[1] The following is extracted from Montana Agricultural Experiment Station Circular 251, "The Solar-Thermal Unit Theory in Relation to Plant Development and Potential Evapotranspiration".

[2] Potential-evapotranspiration is the amount of water that escapes by evaporation and transpiration from a field that has an abundant supply of water and is completely covered with vegetation such as alfalfa.

$$STU = \sum_{Te>0}^{BB} \left[\frac{\text{calories (.3-4 micron } \lambda)}{\text{centimeters}^2 \text{ day}}\right]\left[\left(\frac{T\ max + T\ min}{2}\right) - 31.0\right] = 380{,}000$$

where: T max = daily maximum temperature in degrees Fahrenheit

T min = daily minimum temperature in degrees Fahrenheit

λ = wavelengths of solar radiation measured on a horizontal surface

Σ = (sigma) summation of daily Solar-Thermal Units from the time when mean daily temperature becomes effective (Te>0) to the time when lilacs begin to bloom (BB).

$$Te = \left[\frac{T\ max + T\ min}{2}\right] - 31.0 = \text{effective temperature}$$

daily solar radiation and mean daily temperature. It was apparent that the multiplication of Solar-Thermal Units by 10^{-5} provides an estimate of potential evapotranspiration in inches that is near the mean of estimates derived by these researchers through field experimentation. Associated with the time when lilacs begin to bloom in the spring are 380,000 STU or STU x 10^{-5} = 3.80 inches of accumulated potential evaptranspiration. Thus, Solar-Thermal Units are indicative of both plant development and potential evapotranspiration.

The developmental status of different species of plants can be related through the Solar-Thermal Unit concept. For example, when lilacs begin to bloom the development of alfalfa toward one-tenth bloom stage for harvest is about 50 percent complete since bloom of lilacs requires 380,000 STU and one-tenth bloom of alfalfa requires roughly 800,000 STU. By the end of lilac bloom, which requires about 660,000 STU, alfalfa has completed about 80 percent of its development toward one-tenth bloom or harvest stage.

Work is presently underway to determine the number of Solar-Thermal Units required to bring different kinds of plants (native, garden and crop species) into various stages of development. It is known, for example, that the timing of developmental phases for some plants can be influenced by other environmental factors such as the length of night, available moisture, etc. Historical phenological records for the various plant species are serving as a basis for these determinations.

Figure 2 shows the relation between daily values of solar radiation, mean temperature and Solar-Thermal Units.

As an example of how to use Figure 2, when solar radiation accumulated over a given day totals 500 langleys (calories per square centimeter) and the mean daily temperature is 51.0°F, the total number of Solar-Thermal Units is 500 x (51-31) or 10,000 and potential evapotranspiration is estimated as 0.100 inches (Solar-Thermal Units x 10^{-5}).

In areas along the northern Pacific Coast where the weather in winter and spring is cloudy and where mean temperatures do not fall below freezing during the winter months, it may be possible to determine the date when plant rest is broken by accumulating Solar-Thermal Units backwards in time from the normal time of bloom. The data indicate that this occurs late in the fall of the previous year in some Pacific coastal areas.

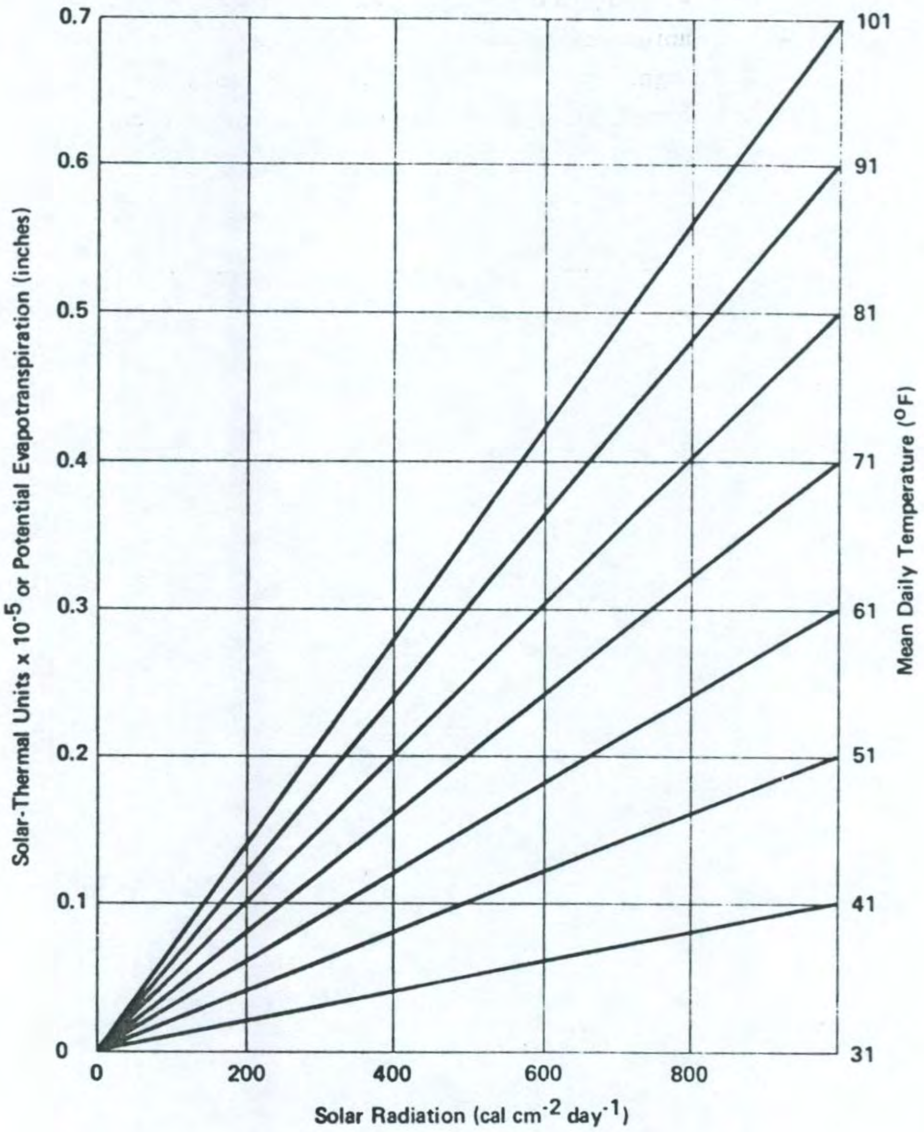


Figure 2. Relation between daily values of solar radiation, mean temperature and Solar-Thermal Units.

If normal temperatures and average date of lilac bloom are known for a given location it will be possible to estimate the normal pattern of solar radiation at the site during the early part of the growing season. This principle may prove to be important because instruments that measure solar radiation are expensive and cannot feasibly be located at many sites. When using the plant for this purpose, it may not be possible to indicate solar radiation as conveniently and accurately as the sophisticated instrumentation now in use, but estimates of solar radiation by this method may have wide application. A plant used in this way can be thought of as a plant "pyranometer," a technical term for an instrument which measures solar radiation. If an instrument should be built to register Solar-Thermal Units it could be called a phytophenometer.

Listed below are other ways in which this knowledge about the response of plants to climate may be applied:

1. Length of freeze-free season can be more rationally defined for many purposes as the total number of Solar-Thermal Units accumulated during the year rather than in number of degree-days or consecutive freeze-free days.

2. Freeze hazard for plants at any particular time of year can be expressed as the probability of a freeze occurence in connection with the average accumulated number of Solar-Thermal Units at particular times of year.

3. Plant hardiness zones may be related not only to minimum winter temperatures but also to the total seasonal accumulation of Solar-Thermal Units.

4. Easily computed estimates of potential evapotranspiration have many uses including applications in hydrology and irrigation practice.

5. Knowing this response of plants to climate, more rational decisions concerning plant care and crop management can be made. Examples are the forecasting of seasonal plant development, the scheduling of planting to provide for an orderly flow of produce at harvest time, the proper control of micro-climatic conditions through plant spacing, row orientation, artificial shading, etc., and the selection of the most suitable crop and variety for given local conditions.

6. This plant response could be an important factor in the interpretation of field and greenhouse research results, in the planning of crop breeding programs and in decisions relative to the introduction of new plant species.

7. Weed and pest control personnel can use this kind of information in conjunction with the planning of field operations.

8. Knowledge of this plant-climate relation could be a factor in the proper interpretation of ecological data. Natural resource inventories, for this reason, should include an assessment of the number of available Solar-Thermal Units.

9. The relation between Solar-Thermal Units and plant development could be important in the interpretation of tree-ring records and, more generally, of paleoclimatological data.

10. Basic findings of the relation between living organisms and their environment provide man with information he needs to intelligently deal with environmental problems.

The Solar-Thermal Unit concept presently provides the best model available for estimating the rate of development for many plant species. More research will be required to learn to what extent these relations apply throughout the plant kingdom. For some kinds of plants, for example, it may be necessary to use a value other than 31.0 in the equation. Further study should also establish the environmental limits to which this theory can be applied and to determine whether other associated environmental factors may have a more direct influence on the rate of plant development.

The Solar-Thermal Unit method also provides easily computed estimates of potential evapotranspiration which tend to be more accurate than estimates based only on temperature and/or daylength.

Future phenological investigations could play an important role in elucidating further on the basic mechanisms involved in the response of plants to their climatic environment.

The following persons have contributed to the phenological survey through their representation on the W-48 Technical Committee and/or serving as state phenological coordinators.

M. M. Fogel	University of Arizona	Tucson
M. A. Massengale	University of Arizona	Tucson
H. B. Schultz	University of California	Davis
D. F. Heermann	Colorado State University	Fort Collins
E. G. Siemer	Colorado State University	Grand Junction
D. L. Everson	University of Idaho	Moscow
J. R. Ridley	University of Idaho	Moscow
J. M. Caprio	Montana State University	Bozeman
R. O. Gifford	University of Nevada	Reno
M. D. Finkner	New Mexico State University	Las Cruces
W. P. Lowry	Oregon State University	Corvallis
W. H. Foote	Oregon State University	Corvallis
E. A. Hiler	Texas A & M University	College Station
G. L. Ashcroft	Utah State University	Logan
D. L. Bassett	Washington State University	Pullman
L. O. Pochop	University of Wyoming	Laramie
L. H. Paules	University of Wyoming	Laramie

U. S. DEPARTMENT OF AGRICULTURE REPRESENTATIVES

W. Keller	Crop Research Division, ARS	Logan, Utah
K. G. Renard	Soil and Water Conservation, ARS	Tucson, Ariz.
W. B. Fowler	Forest Service	Wenatchee, Wash.
A. J. Loustalot	Cooperative State Research Service	Washington, DC

U. S. DEPARTMENT OF COMMERCE REPRESENTATIVE

M. D. Magnuson	NOAA, Nat'l Weather Service	Salt Lake City, Utah

---

Report prepared by Joseph M. Caprio, Plant and Soil Science Department, Montana State University, Bozeman, Montana.

Honeysuckle First Flower Anonaly, Spring 1972

21

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES*

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
January 10, 1973

DEPARTURE OF LILAC BLOOM DATES IN 1972 FROM THE 10-YEAR NORMAL (1957-66) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Normal dates of begin bloom of purple common lilac have been determined from phenological data collected during the 10-year period, 1957-66. Recorded dates of begin bloom in the spring of 1972 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and lines of equal departures from normal were drawn (Figure 1).

Shaded areas on the map indicate those places where lilacs began to bloom earlier than normal in the spring of 1972. Areas not shaded were later than normal.

Earlier than normal conditions were experienced over most of the Western Region in the spring of 1972. However, some northern sections were later than normal. Lilacs began to bloom more than 10 days later than normal in western Washington and northwestern Oregon. An unusually extensive area in the southern part of the Western Region experienced extreme anomalies of more than 20 days earlier than normal. This 20 to 30 day earlier than normal zone covers southern parts California, Nevada, and Utah, southwestern Colorado, most of New Mexico and the entire state of Arizona.

The extremely early bloom was associated with higher than normal temperatures over most sections in January and much higher than normal temperatures over nearly the entire Western Region in February and March. March temperatures averaged between 6 and 9 degrees Fahrenheit above normal over extensive areas in the West. Such large and geographically extensive monthly temperature anomalies are a rare occurrence in the Western Region. The late bloom in northern sections appears to be related to the lower than normal temperatures that occurred in April over these areas, particularly in the northwestern states.

The earlier than normal lilac bloom in southern and central areas was associated with early blooming of deciduous fruit trees. In many orchards this early development led to fruit crop failure due to subsequent freeze injury.

A WORLD MAP OF THE GEOGRAPHICAL PROGRESSION OF THE GREEN WAVE

With the ending of sub-freezing temperatures in the spring of the year vegetative growth is initated first in southern areas at low elevations and progresses late in the season to tundra zones of higher elevations and the far north. When an adequate amount of vegetative growth has occurred, there is a change in the color of the landscape, usually from a predominate brown or yellow to a predominate green color. Thus, the green color advances over the globe in the spring like a wave moving from the south to the north.

*Not for publication without permission of the author.

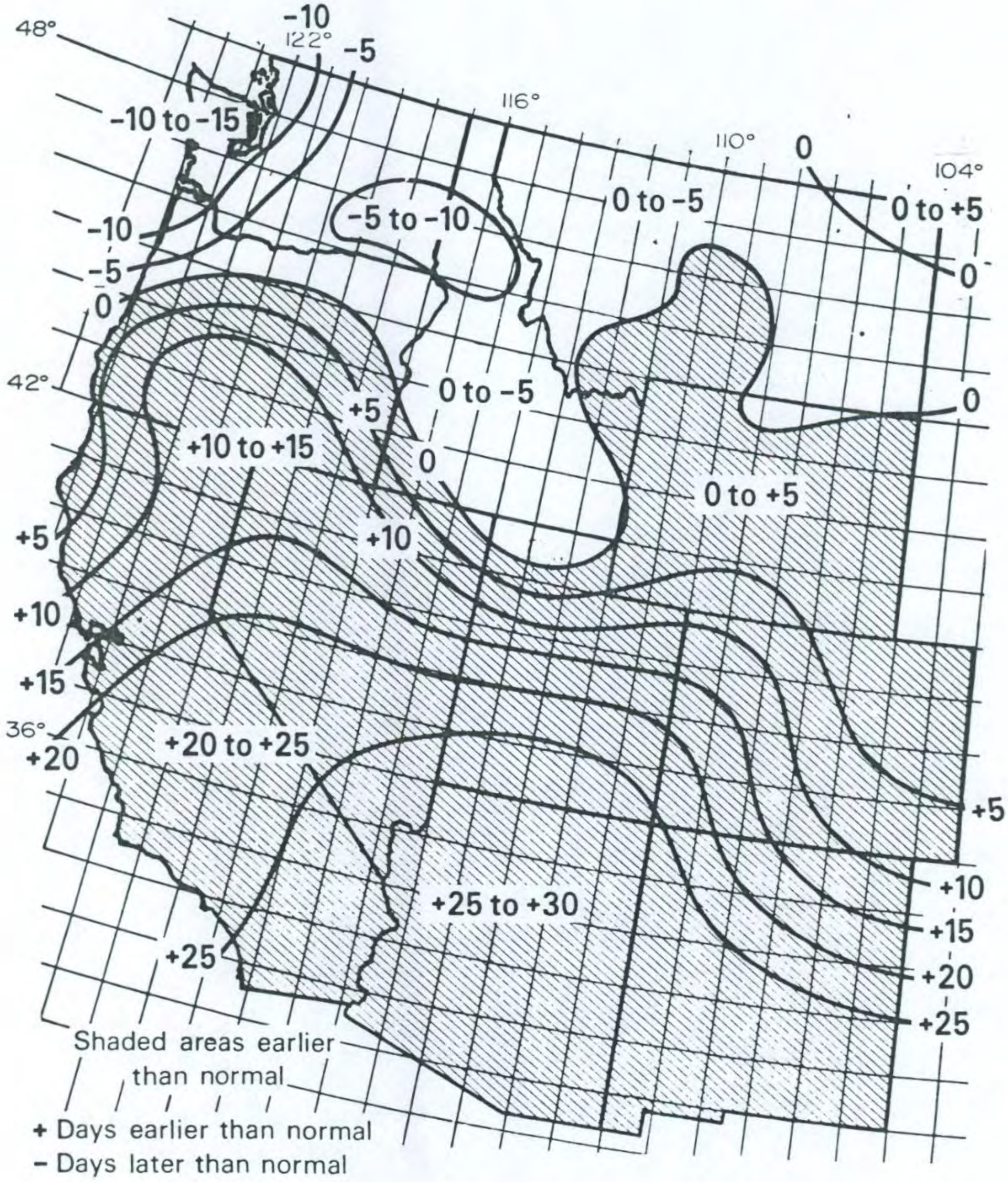


Figure 1. Departure of Begin Lilac Bloom Date from Normal, Spring 1972.

In an effort to obtain an estimate of the timing of the "green wave", observations were made on the greening of a three-acre level bluegrass lawn on the Montana State University campus adjacent to the Weather Service climatological station. This field is exposed to full sunlight and is irrigated during the growing season. In the spring of 1972, colored pictures were taken of the field every several days. Information on phenological stages of the purple common lilac and two honeysuckle species growing in one corner of the field were made during the same period. It was determined from this information that the field changed from a predominate brown to a predominate green color at approximately the same time that 200,000 Solar-Thermal Units (STU) had accumulated. This corresponds approximately to the time when potential evapotranspiration has reached a total accumulation of about two inches(1).

Since information on only temperature and solar radiation is required to determine the accumulation of STU in the spring, a rough estimate of the average date of green wave passage can be made for those locations where both temperature and solar radiation are measured. The average date when 200,000 STU accumulate was determined for more than 100 locations in middle and high latitudes of the northern hemisphere. It was assumed that plant growth was not limited by lack of soil moisture. Also, lines of average green wave arrival were drawn only for places where minimum temperature during the coldest time of the year averages near or below 31 degrees Fahrenheit.

Since mean temperatures for the coldest month at stations in the Southern Hemisphere north of Antarctica are nearly all above freezing, no lines have been drawn in the Southern Hemisphere. This suggests that most of the land in the Southern Hemisphere could be green the entire year, given proper vegetative cover and an adequate supply of moisture. No attempt has been made to account for the many irregularities in the pattern in mountainous terrain.

The map of the geographical progression of the green wave is given in Figure 2. The estimated isopleths of dates of green wave passage make an interesting pattern. The April 15 line, for example, extends from a southern extreme of about 35 degrees north latitude in the United States and Japan to a northern extreme of about 55 degrees north latitude in western North American and western Europe. The July 15 line appears to correspond rather closely with the southern margin of the tundra zone. The tundra extends from the poleward limit of forest, northward to the southern edge of the zone of perpetual ice where practically no plant life is found.

Undoubtedly, numerous modifications of this preliminary estimate of the average advance of the green wave will have to be made as more information from ground, aircraft and satellite observations becomes available. Remote sensing information from aircraft and satellites was not utilized in constructing this map.

PHENOLOGY SATELLITE EXPERIMENT

Scientists are involved in scores of research projects designed to determine possible applications for satellite information in their particular fields. One such research project entitled "Phenology Satellite Experiment" is designed to determine possible uses of satellite data in phenology.

On July 23, 1972 the National Aeronautics and Space Administration lauched the first Earth Resources Technology Satellite (ERTS-1). The satellite is orbiting the earth from north to south at a height of about 500 miles and returns to the

(1) Caprio, J. M. "The Solar-Thermal Unit Theory in Relation to Plant Development and Potential Evapotranspiration", Circular 251, Montana Agricultural Experiment Station, Bozeman, 10 pages, March 1971.

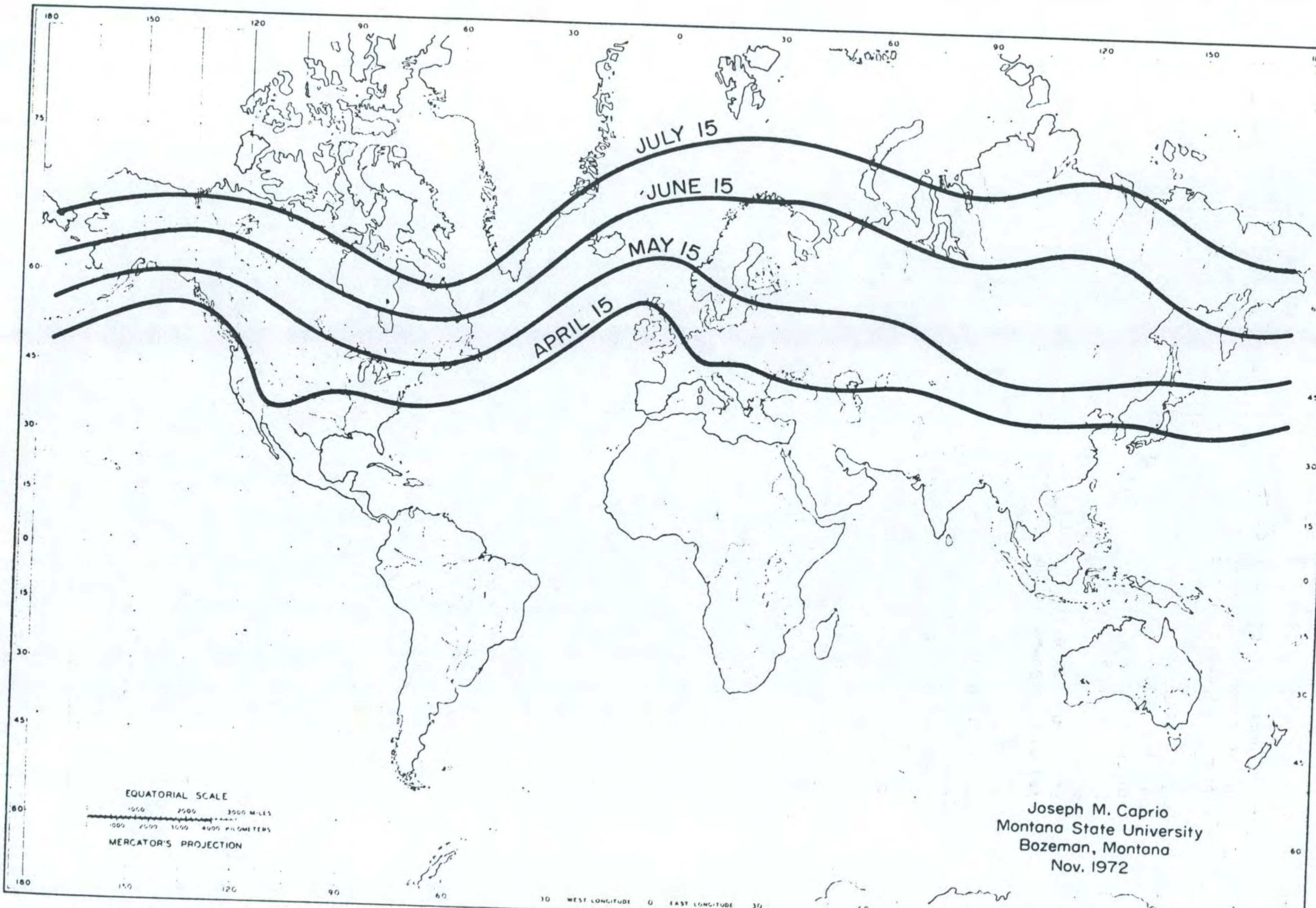


Figure 2. Average Date of Green Wave Passage (After Preliminary Model).

same path every 18 days. It is an experimental spacecraft, intended to demonstrate the usefulness of repeated satellite observations of the earth's surface. It will take photographs and relay spectral (surface color) information back to earth for at least a year.

One of the objectives of the Phenology Satellite Experiment is to learn more about the polar advance of the green wave of new vegetative growth in the spring. Numerous agricultural experiment stations throughout the country are participating in this project under sponsorship of the National Aeronautics and Space Administration.

The timing of the green wave will vary from year to year due to annual differences in weather conditions in a manner similar to annual fluctuations of such phenological events as the blooming of lilacs and honeysuckle. It will be possible in the future to determine the average date of green wave passage at a given point in the earth's surface if records of the greening of the vegetation are kept at the site for a number of years. Thus, by utilizing ground observations or possibly aircraft and satellite data, accurate maps of the average date of green wave passage for given geographical areas may be developed. This information on the green wave could be very useful for resource management agencies and others concerned with managing the extensive farm and forest areas of the nation.

Honeysuckle First Flower Anomaly, Spring 1973

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
Sept. 25, 1973

Departure of Lilac Bloom Dates in 1973 from the 10-year Normal (1957-66) throughout the Western Region of the United States

The normal dates when flowers on common purple lilac panicles begin to bloom have been determined from phenological data collected in the western United States during the 10-year period 1957-66. The dates of begin bloom in the spring of 1973 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and analyzed.

The map showing lines of departure of begin lilac bloom date from normal are shown in Figure 1. Shaded areas on the map indicate those places where lilacs began to bloom earlier than normal in the spring of 1973. Areas not shaded were later than normal.

Last year the very early development of lilacs and other plants (in many cases about 3 weeks earlier than normal) was linked to fruit crop failures caused by sub-freezing temperatures coming at a time when the crops were at advanced stages of development. Unlike the spring of 1972, lilacs began to bloom later than normal over the greater portion of the Western Region. Several areas with anomalies greater than 10 days later than normal are indicated in central and southern parts of the Region. Anomalies of 15 to 20 days later than normal are indicated for parts of eastern Arizona and western New Mexico.

The earlier than normal zone includes all or portions of those states which border on the Pacific Ocean on the west and Canada on the north including all of Washington and large parts of California, Oregon, Idaho and Montana. Bloom was reported to have occurred from 15 to 20 days earlier than normal along the Oregon coast as well as in parts of eastern Washington and northern Idaho.

The later than normal occurrence of bloom over much of the West appears to be related to the lower than normal April temperatures that prevailed throughout the area, except in the Pacific coastal states and southern Arizona where temperatures in April averaged warmer than normal. Temperature anomalies in April of more than 6 degrees cooler than normal were reported over extensive areas.

May and June were generally warmer than normal except in southern and eastern parts of the Region which appears to relate to the earlier than normal bloom at northern locations. Both February and March averaged warmer than normal in northern areas.

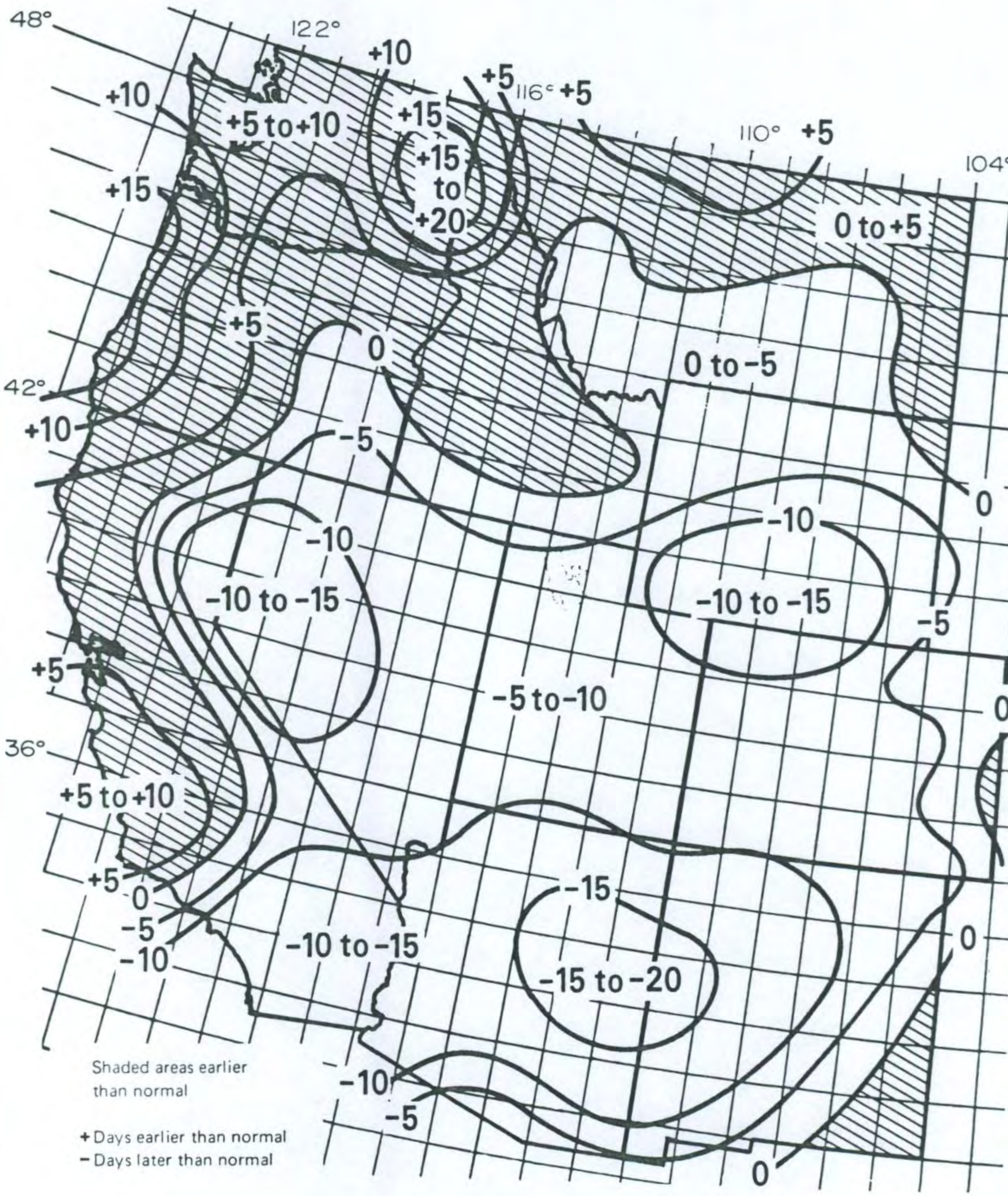


Figure 1. Departure of Begin Lilac Bloom Date from Normal, Spring 1973

A World Map of Dates When Common Purple Lilacs Begin to Bloom

Analysis of the information to date has revealed how spring (as indicated by plant development) advances from south to the north and from lower to higher elevations throughout the West. Correlative studies of environment and plant data have also led to the development of an equation which appears to account for much of the variation in the observed dates of phenological events of many plants. This equation links rate of plant development to both ambiant atmospheric temperatures and solar radiation.

According to the equation plant development is initiated in the spring about the time when mean daily temperatures exceed 31°F. Mean daily temperatures are computed by adding the daily maximum and minimum temperatures and dividing by two. Thus, the mean temperature of a day with a high of 60°F and a low of 40°F is 50°F. A Solar Thermal Unit (STU) is then simply computed for a given day by multiplying mean daily temperature minus 31 by the total amount of solar radiation received during that day on a horizonal surface expressed as calories per square centimeter. Thus, a day with a mean temperature of 61°F and solar radiation of 500 calories per square centimeter is assigned a Solar Thermal Unit value of 61 minus 31 (or 30) times 500 which equals 15,000 STU.

The number of Solar Thermal Units of each day in the spring are accumulated and when the number reaches 380,000 STU lilacs are likely to start blooming in that particular area.

This accumulation of 380,000 STU can be used to estimate the average date when lilacs begin to bloom at any location where daily records of both temperature and solar radiation are recorded. Solar Thermal Units were calculated by computer for more than 100 locations in middle and high latitudes of the Northern Hemisphere where mean monthly temperatures during the coldest time of the year average near or below 31 degrees Fahrenheit. Isophanes were not drawn in the Southern Hemisphere since only a very small proportion of the stations between Antarctica and the equator have mean temperatures less than 31 F during the coldest time of year. In drawing the world map of begin lilac bloom shown in Figure 2, no attempt has been made to account for the many irregularities in the pattern in mountainous areas.

In western United States it has been determined that the average begin bloom date for lilacs generally does not occur after June 15. Thus, areas north of the June 15th isophane on the global map are likely to be places where lilacs do not grow or where they do not produce bloom every year.

AVERAGE DATE WHEN PURPLE COMMON LILAC BEGINS TO BLOOM (AFTER BIOCLIMATIC MODEL)

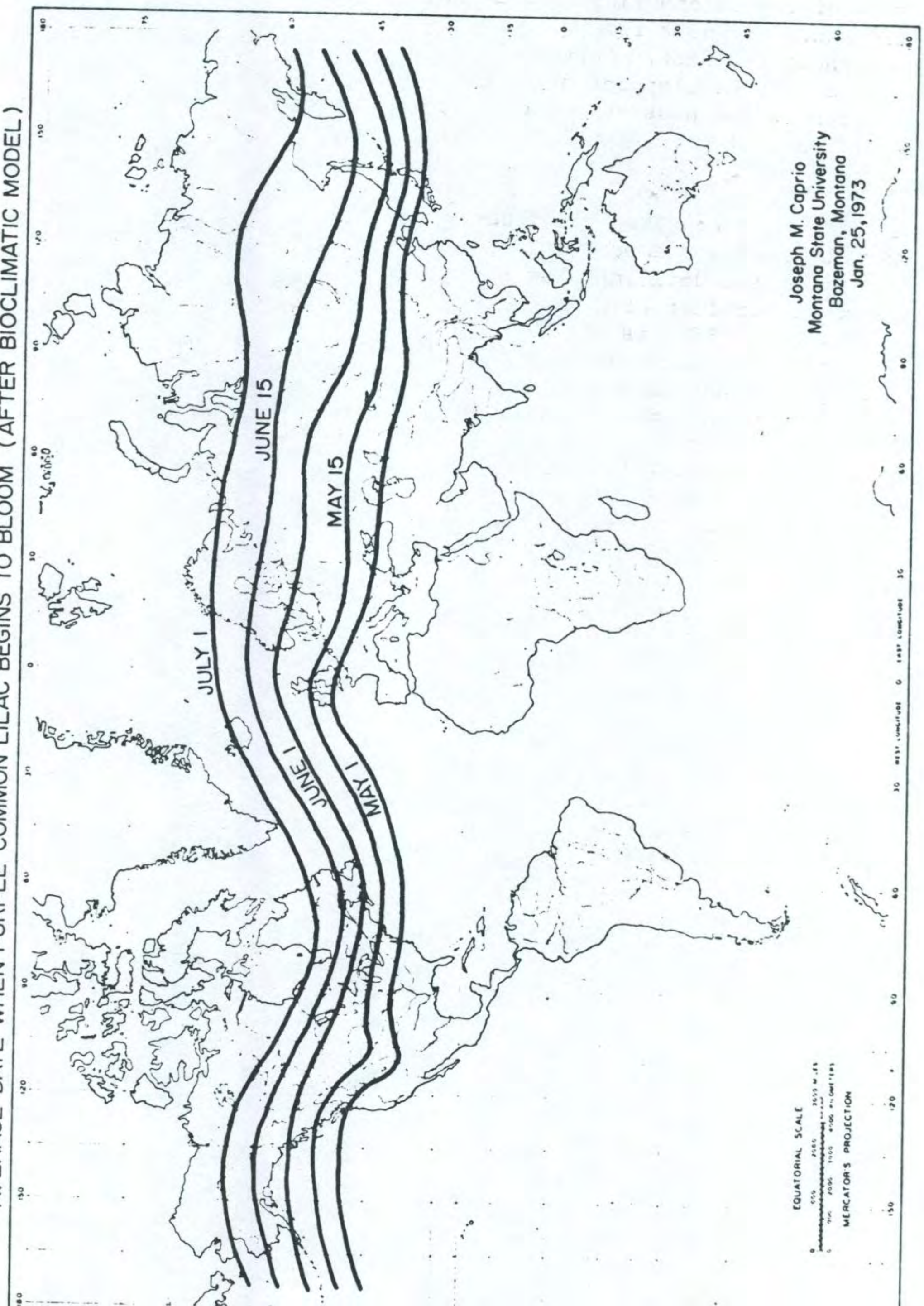


Figure 2.

Honeysuckle First Flower Anomaly, Spring 1974

− Days later than normal

\+ Days earlier than normal

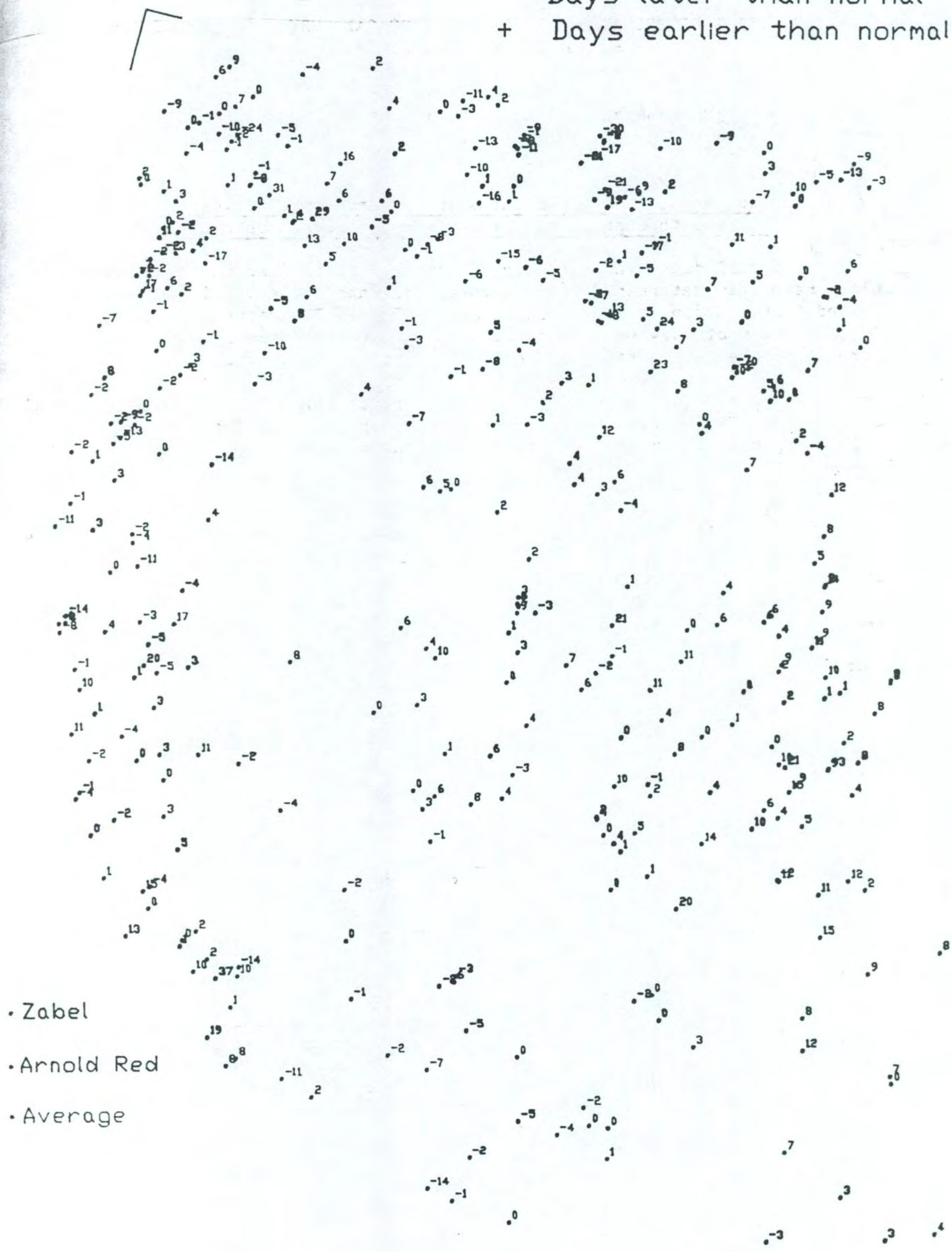


Figure 2.

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
Nov. 20, 1974

Departure of Lilac Bloom Dates in 1974 from the 10-year Normal (1957-66) throughout the Western Region of the United States

The normal dates when flowers on common purple lilac panicles begin to bloom have been determined from phenological data collected in the western United States during the 10-year period 1957-66. The dates of begin bloom in the spring of 1974 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and analyzed.

The map showing lines of departure of begin lilac bloom date from normal are shown in Figure 1. Shaded areas on the map indicate those places where lilacs began to bloom earlier than normal in the spring of 1974. Areas not shaded were later than normal.

The timing of lilac bloom in 1974 was generally characterized by relatively small departures from normal throughout the Western Region. Whereas lilac bloom date departures from normal in past years have often exceeded 20 days, only one narrow section along the California coast experienced bloom dates of more than 15 days from normal in the spring of 1974 (in this case earlier than normal). There were several small areas in the eastern part of the Western Region where bloom was from 10 to 15 days earlier than normal.

Only two small zones in the vicinity of the Cascade and Sierra Nevada Ranges and one area located in southwestern Montana are indicated as blooming more than 10 days later than normal. Bloom was generally earlier than normal over the Great Plains portion of the Region except in northeastern Montana where bloom was later than normal. Utah, for the most part, was earlier than normal in 1974. Bloom was generally later than normal in Nevada, Oregon and coastal and northern Washington.

The earlier than normal bloom in sections of central California and southern parts of Arizona and New Mexico appears to be related to the warmer than normal March that occurred throughout the entire Region as well as in Texas where March averaged more than 9°F warmer than normal in some areas.

The later than normal bloom in northern California and Nevada was associated with lower than normal temperatures during April in that area. The later than normal bloom throughout much of the Northwest appears to be related to lower than normal temperatures during the month of May. June averaged warmer than normal over the entire area except along parts of the coast of California, Oregon and Washington.

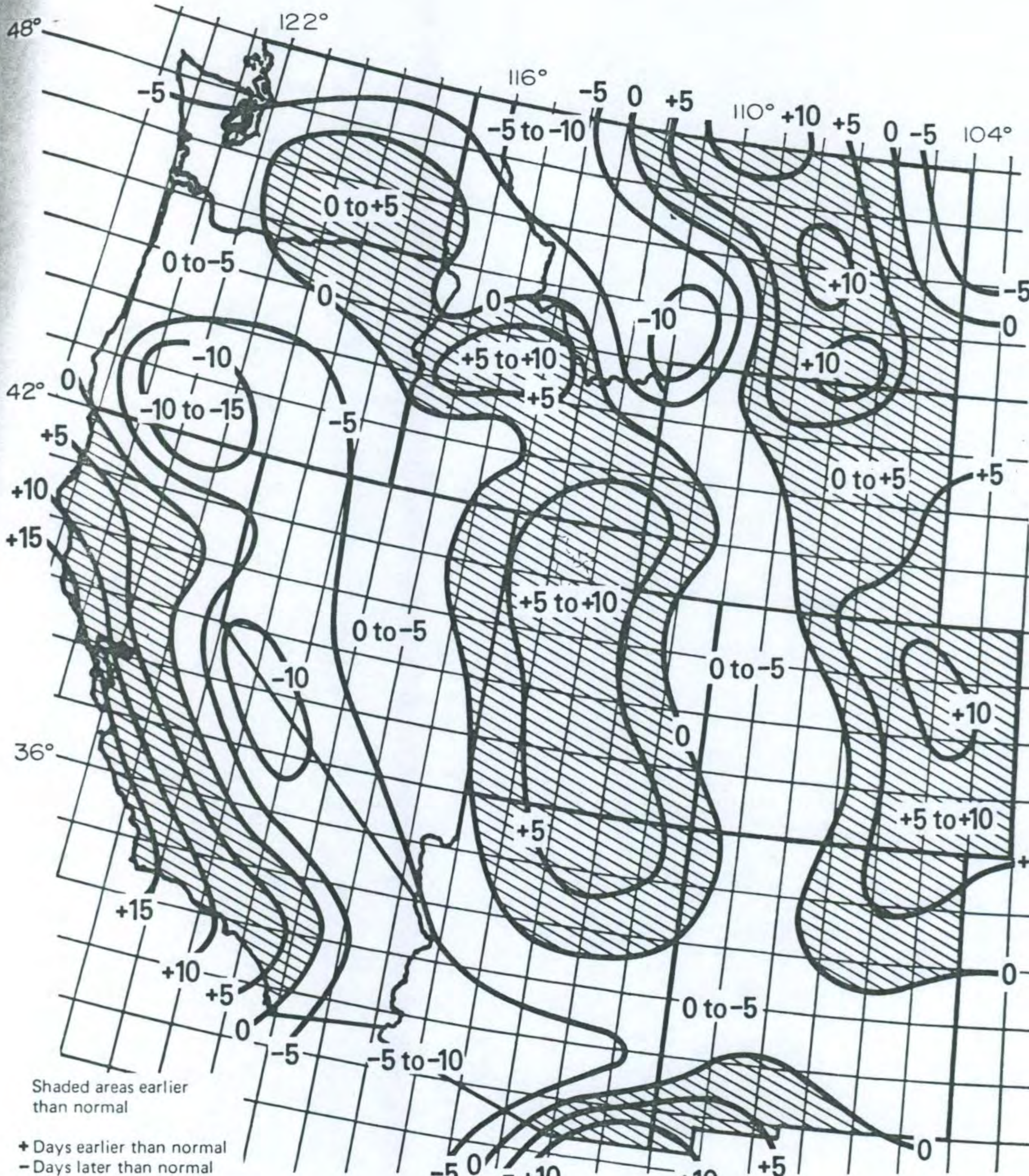
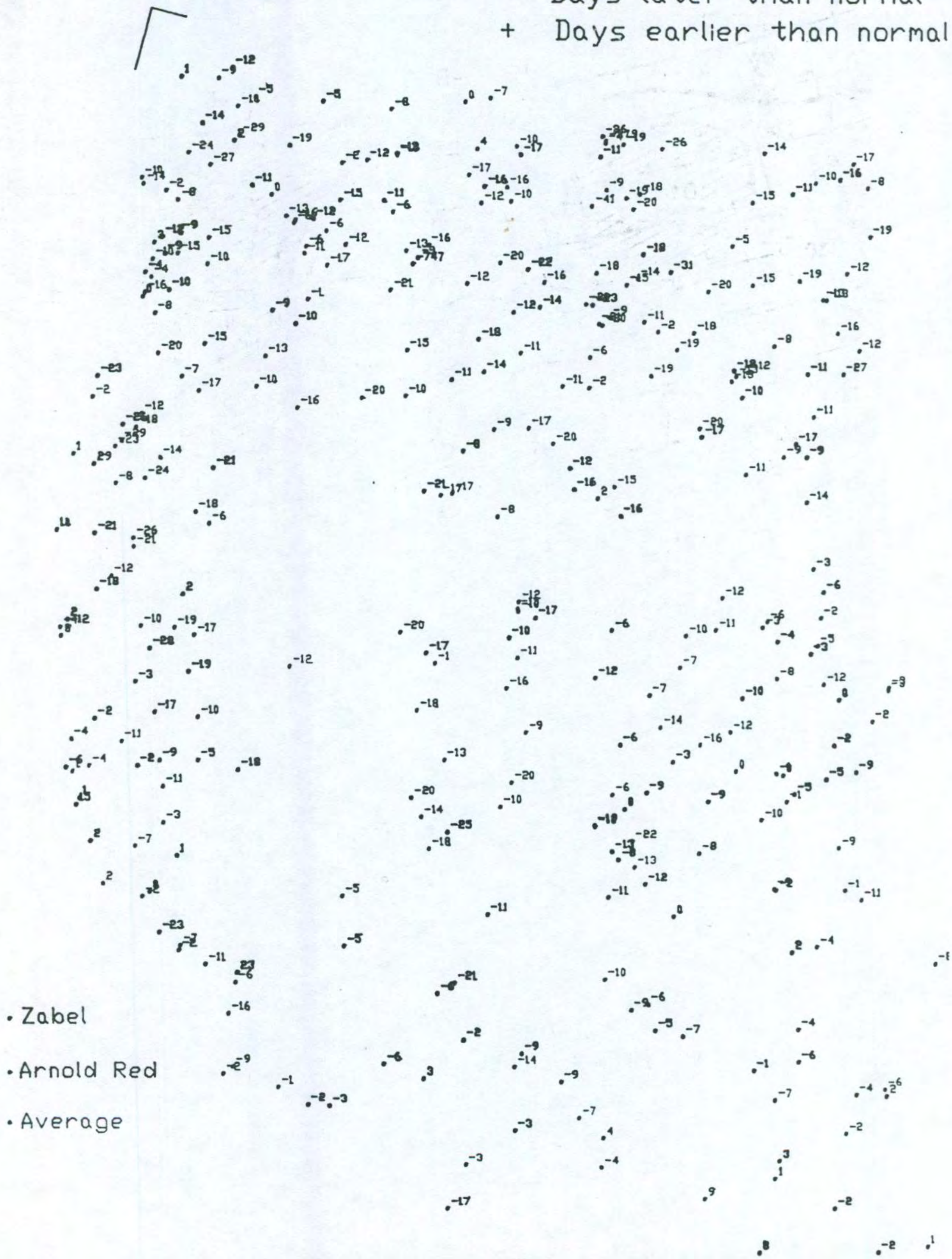


Figure 1. Departure of Begin Lilac Bloom Date from Normal, Spring 1974

Honeysuckle First Flower Anomaly, Spring 1975

− Days later than normal

\+ Days earlier than normal



A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
December 10, 1975

DEPARTURE OF LILAC BLOOM DATES IN 1975 FROM THE 10-YEAR NORMAL (1957-66) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

The Western Regional Phenological Survey was initiated throughout the eleven western states in the spring of 1957. The initial survey was conducted in Montana in the spring of 1956. This will be the twentieth year of the region-wide survey. Texas joined the survey as the twelfth state in 1970.

Initially the purple common lilac was used as the observation species. Observers chose lilac plants for observation which were already growing in the area.

In the spring of 1967 two cultivars of honeysuckle were distributed to those cooperators who wished to participate. The first phenological data on honeysuckle were recorded in the spring of 1968 making this the ninth year of honeysuckle observations.

Normal dates of begin bloom of purple common lilac have been determined from phenological data collected during the 10-year period, 1957-66. Recorded dates of begin bloom in the spring of 1975 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and lines of equal departures from normal were drawn (Figure 1).

Shaded areas on the map indicate those places where lilacs began to bloom earlier than normal in the spring of 1975. Areas not shaded were later than normal.

Lilacs bloomed later than normal in 1975 over most of the Western Region. A major portion of the Western Region was between 10 and 20 days later than normal. Anomalies of about 3 weeks later than normal were common in the southern half of Oregon, northern and eastern mountainous parts of California, most of Nevada, and central and southwestern sections of Idaho. A small section of Washington is also indicated as being about 3 weeks later than normal. Most of Utah was about 2 weeks later than normal. Southwestern Montana and northwestern Wyoming varied from 2 to 3 weeks later than normal.

The map shows an earlier than normal zone extending along most of the coastal area of California and another early area in the southeastern corner of the Region covering sections of Arizona, Colorado and New Mexico. A narrow strip near the coast of southern and central California was more than 10 days earlier than normal and another small section in the southeastern corner of New Mexico was also more than 10 days earlier than normal.

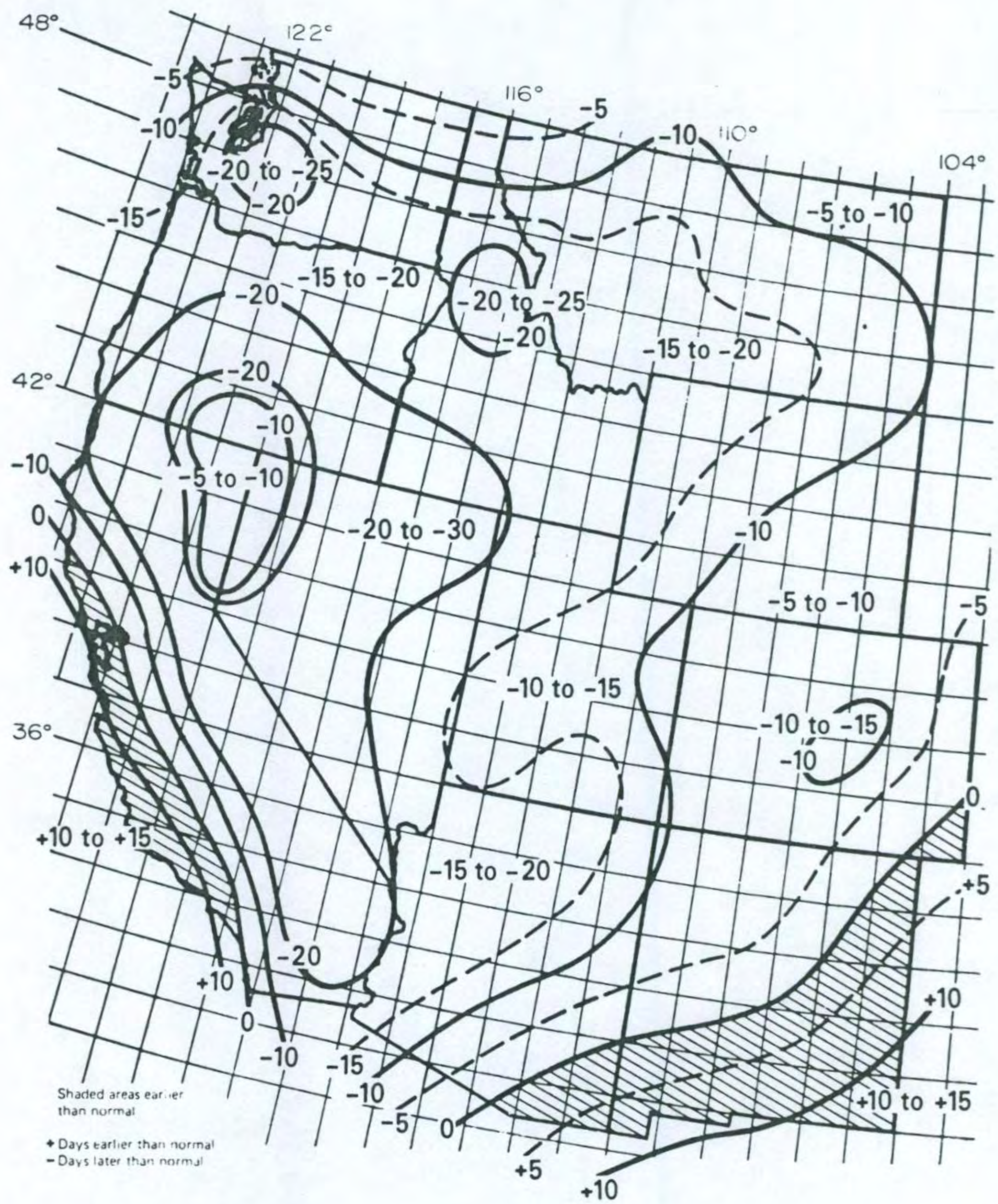


Figure 1. Departure of Begin Lilac Bloom Date from Normal, Spring 1975

Late development in the western and southern parts of the region was associated with temperatures about 2°F lower than normal in February and from about 4 to 8 degrees lower than normal in April.

Earlier than normal bloom in the southeastern part of the region was associated with warmer than normal temperatures in January, February and March in that area.

The late development of lilacs in much of the remainder of the region was associated with a very cold April with temperatures generally running about 6 degrees lower than normal for the month. Temperatures in May and June averaged about 4 and 2 degrees colder than normal, respectively, over much of the area.

The predominantly late season throughout the West meant that fruit blossoms, generally, were not subject to spring freeze damage, and with the extended mild autumn this year, western deciduous fruit crops generally produced abundantly. Because of the late season, some small grain farmers in the colder parts of the region were not able to harvest their fields until very late in the year.

Estimating Average Date of Begin Bloom of Lilacs in Areas Where Mean Temperature of the Coldest Month is Above 31° Fahrenheit

A procedure for estimating date of begin bloom of lilacs has been developed for areas where mean temperatures during the winter are 31°F or lower. The method involves the accumulation of Solar Thermal Units (STU) to a total of 380,000. STU are determined each day by multiplying mean daily temperature in degrees Fahrenheit minus 31 by langleys of solar radiation.

Many perennial plants will not commence growth when subjected to high temperatures until they have first been exposed to a period of cold weather which will take them out of "rest". Agricultural scientists in Israel and at Utah State University have investigated chill-units needed for breaking "rest" for certain deciduous crops and how the chilling requirement can be quantified by using temperature records. The number of chill units needed to break the "rest" varies for different plant species and crop varieties. According to the Utah studies, the number of chilling units for each hour of plant exposure varies with temperature as follows:

Temperature	Units	Temperature	Units
34° or less	0	55-60°F	0
35-36°F	0.5	61-65°F	-0.5
37-48°F	1.0	Above 65°F	-1.0
49-54°F	0.5		

As shown in the table above, temperatures below 35°F and from 55 to 60°F do not contribute to breaking "rest". Temperatures above 60°F have a negative effect.

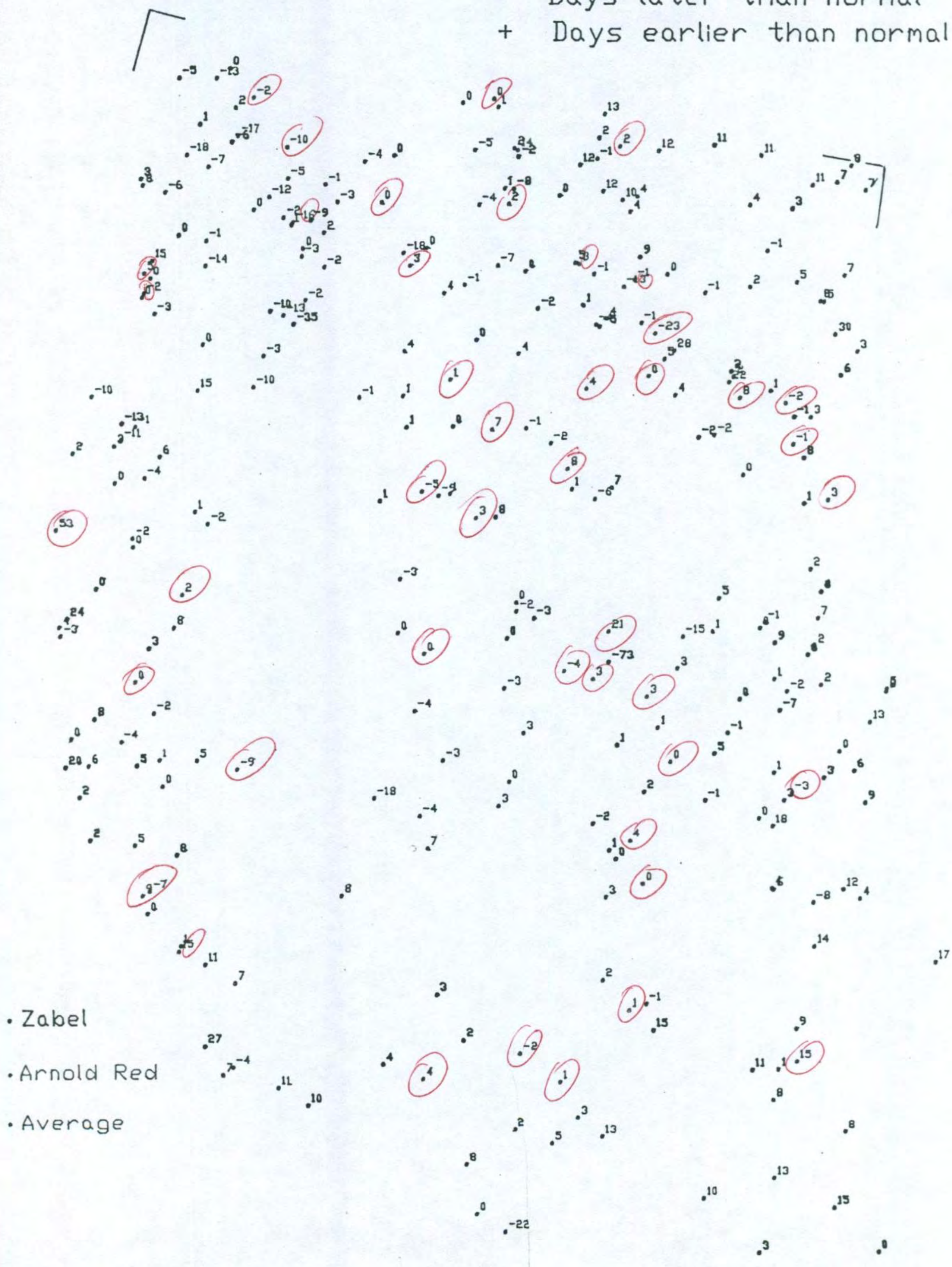
Preliminary results of our research indicate that the average date when lilacs begin to bloom in warmer areas can be estimated from long-term average weather records. Chilling degree hours based on long-term average daily weather data and assuming sine curves for diurnal temperature distributions are accumulated to a total of 1,110 and from that time Solar Thermal Units are accumulated from long-term average daily solar radiation and temperature records to a total of 380,000. This has provided good estimates of average begin bloom dates for lilacs at a number of locations tested in the western and southern sections of the Western Region where winters are relatively mild. Studies are in progress to determine similar relations for honeysuckle and to further test and refine the bioclimatic models for applications on an individual year basis.

These findings will assist in assessing the potential for successful cultivation of many deciduous plants in areas where winters are relatively warm and help provide guidelines for management practices wherever such plants are grown. Extension of the world map of average date of begin bloom of lilacs to more southerly areas can also be made by using this kind of information.

Honeysuckle First Flower Anomaly, Spring 1976

\- Days later than normal

\+ Days earlier than normal



A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricutlural Experiment Station
Bozeman, Montana
December 10, 1976

DEPARTURE OF LILAC BLOOM DATES IN 1976 FROM THE 10-YEAR NORMAL (1957-66) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Normal dates of begin bloom of purple common lilac have been determined from phenological data collected during the 10-year period, 1957-66. Recorded dates of begin bloom in the spring of 1976 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and lines of equal departures from normal were drawn (Figure 1).

Shaded areas on the map indicate those places where lilacs began to bloom earlier than normal in the spring of 1976. Areas not shaded were later than normal.

Lilacs generally bloomed earlier than normal in eastern parts of the Western Region and later than normal in western parts of the Region. An exception was the coastal area of southern California where bloom was earlier than normal in 1976.

Earliest anomalies occurred in northern Montana and extreme eastern Colorado where bloom was more than 10 days earlier than normal. Bloom in the extreme northern part of central Montana was earlier than normal by more than 15 days. Latest anomalies are indicated in central and northern California, eastern Nevada, northwestern Oregon and western Washington. Anomalies of more than 10 days later than normal are indicated in these areas with some sections reporting anomalies of more than 15 days later than normal.

Early bloom in southern California, Arizona, and New Mexico followed a gnerally warmer than normal January and February. Temperatures during March were also warmer than normal in eastern New Mexico.

The later than normal bloom in northern California and Nevada was associated with a cooler than normal March and April.

Later than normal bloom in the northwest was preceded by cooler than normal weather in March and April.

Earlier than normal bloom in the Montana-Wyoming area was associated with generally warmer than normal weather during all of the months from January through May. Temperatures in northern parts of Montana were more than four degrees warmer than normal during every month from January through May.

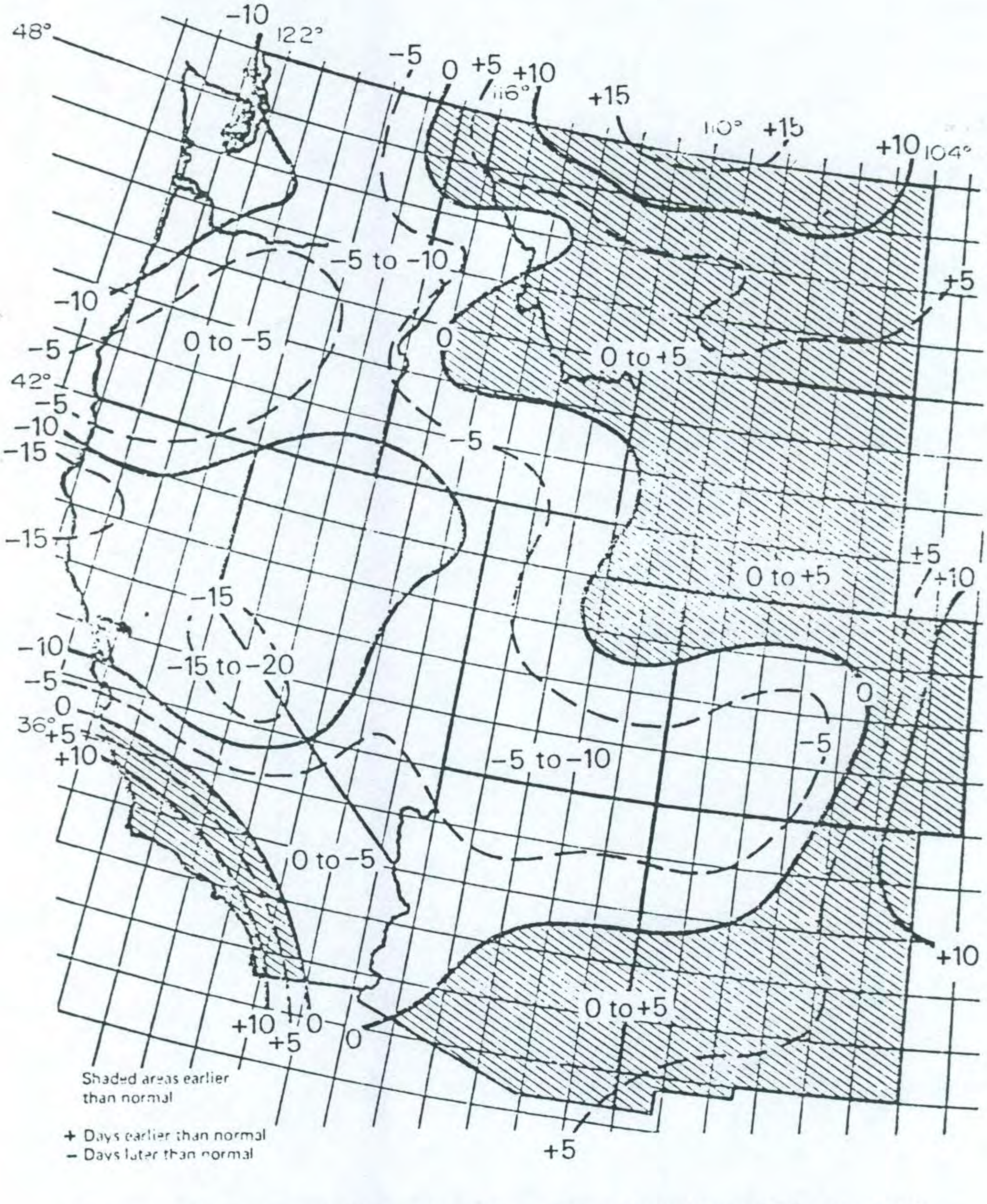


Figure 1. Departure of Begin Lilac Bloom Date from Normal, Spring 1976

COMPARISON OF NORMAL DATES WHEN LILAC AND HONEYSUCKLE BEGIN TO BLOOM

A map-plot of normal dates of begin bloom of lilacs and honeysuckles in the Western Region of the United States indicates that there is not a constant relation between them, but that iliacs tend to bloom earlier than honeysuckle in some areas and later than honeysuckle in other areas.

Lilacs generally bloom earlier than honeysuckle in those areas of the region where winters are colder, and later than honeysuckle in those parts of the region where winters are warmer. States where lilacs generally bloom first include Colorado, Idaho, Montana, and Wyoming. States where lilacs generally bloom later than honeysuckle include Arizona, California, New Mexico, and Oregon.

A map showing the noraml region-wide pattern of difference in the timing of developmental phases of lilacs and honeysuckle should be ready for next year's report to cooperators.

INITIATION OF NEW WESTERN REGIONAL PROJECT ON CLIMATE AND PHENOLOGY

On October 1, 1976 a new regional project was initiated by the western agricultural experiment stations. It is known as Project W-143 and is entitled "Climatic and Phenological Models for Resource Planning and Management." Most of the western states have already appointed technical representatives to this project. They are as follows:

PROJECT LEADERS

A. Agricultural Experiment Stations

Arizona	Richard K. Frevert Roger Huber	Soils, Water, & Engineering Entomology
California	Joe McBride Jerry Hatfield Harry P. Bailey	Forestry & Conservation Land, Air, and Water Resources Earth Science
Colorado	Thomas B. McKee John Benci	Atmospheric Science Atmospheric Science
Idaho	Dale O. Everson Myron Molnau	Station Statistician Agricultural Engineering
Montana	Joseph M. Caprio	Plant & Soil Science
New Mexico	Morris D. Finkner	Experimental Statistics
Nevada	Richard O. Gifford	Plant, Soil, & Water
Utah	Gaylen Ascroft	Soils & Biometerology
Wyoming	Larry Pochop	Agricultural Engineering

B. Agencies

USDA, Agricultural Research Service	Dale Heerman	Agricultural Engineering

The overall objective of the new project is to develop climatic and phenological models for use in environmental planning and management. The specific objectives are:

1. Develop techniques for extending data from limited station locations to areal coverage.

2. Develop techniques to forecast long-term series of events from short-term records.

3. Describe interrelationships between climatic variables.

4. Describe relationships between derived climatic descriptors and physical and biological processes.

Future phenological surveys will be conducted in conjunction with this new project of the western agricultural experiment stations.

PHENOLOGY SATELLITE EXPERIMENT

Results of the Phenology Satellite Experiment have been published in the Cornell University Agricultural Experiment Station publication SEARCH, Vol. 6, No. 1, entitled "Satellite Sensing of Phenological Events". Since the data provided by western phenological observers were used in the study, we are enclosing excerpts from that report. Should you be interested in receiving the entire 47-page manuscript write to:

Cornell University
Agricultural Experiment Station
Publications Section
Ithaca, NY 14850

Your help in providing the additional observations several years ago on the green and brown waves made a very substantial contribution to the success of this nation-wide study.

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
October 10, 1977

DEPARTURE OF LILAC BLOOM DATES IN 1977 FROM THE 10-YEAR NORMAL (1957-66) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Normal dates of begin bloom of purple common lilac have been determined from phenological data collected during the 10-year period, 1957-66. Recorded dates of begin bloom in the spring of 1977 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and lines of equal departures from normal were drawn (Figure 1).

Shaded areas on the map indicate those places where lilacs began to bloom earlier than normal in the spring of 1977. Areas not shaded were later than normal.

Lilacs generally bloomed earlier than normal in northern and east-central parts of the Western Region. Bloom was later than normal in most southern sections except in southwestern California.

Earliest departures from normal were recorded in northeastern Montana where the season was more than 20 days earlier than normal. Latest departures from normal were registered in the east-central California area near the Nevada border where the season was more than 15 days later than normal.

Temperatures tended to be above normal in northern and east-central parts of the region for all months from February through June except for May which was colder than normal in the entire western two-thirds of the region. The western two-thirds of the region was also colder than normal in March except for Washington, northern Idaho and most of Montana. Thus, later than normal bloom in southern and west-central areas appears to be linked to a colder than normal March for early locations at low elevations and to a colder than normal May for later locations at higher elevations.

Eastern Montana and most of Colorado and Wyoming registered higher than normal temperatures during every month from February through June. The very large early bloom date anomalies in 1977 were associated with the persistant warm weather from late winter through the spring months.

Information from nothern and central Texas indicates that lilacs bloomed there about 5 days later than normal. This part of Texas was warmer than normal in February and March but much colder than normal in January. Lilacs usually bloom about mid-March in central and northern Texas.

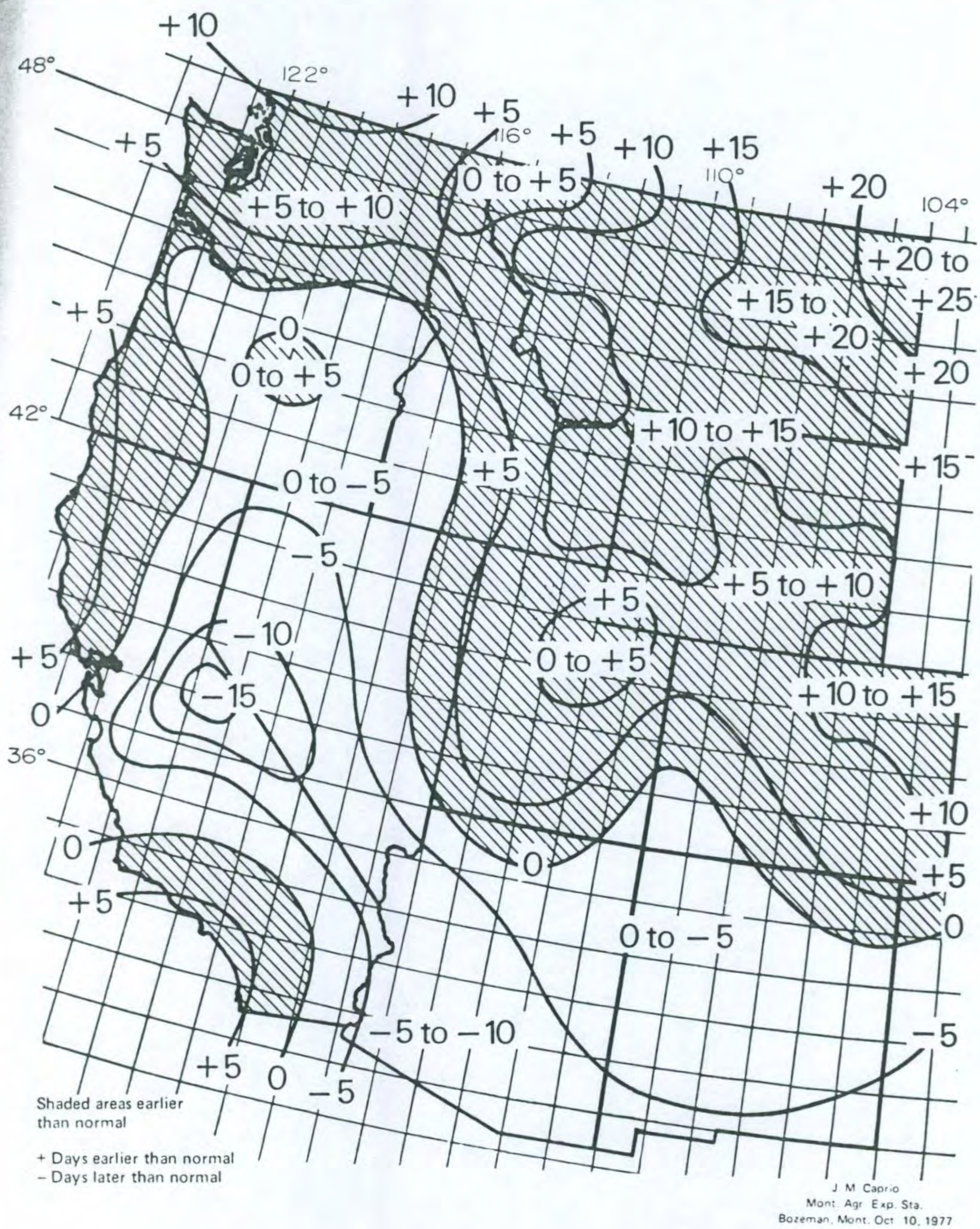


Figure 1. Departure of Begin Lilac Bloom Date from Normal, Spring 1977

PATTERN OF NUMBER OF DAYS DIFFERENCE IN AVERAGE DATES OF FIRST BLOOM OF LILAC AND HONEYSUCKLE

Figure 2 shows the difference in days between the average date when lilacs begin to bloom, compared to the same phase date for honeysuckle. Positive values indicate places where honeysuckle bloom before lilacs. Negative values indicate places where lilacs bloom before houeysuckle. Dashed lines indicate those areas where there is low confidence in the analysis due to the few number of reports. Data for the lilac are for the purple common lilac. Data for the honeysuckle are based on information of both the Arnold Red and Zabeli varieties. These honeysuckles reach first bloom phase on about the same dates.

Areas Where Lilacs Bloom First

Lilacs generally bloom before honeysuckle in the northeastern sector of the Western Region. The entire state of Wyoming and all of Montana except the extreme northwestern and northeastern corners of the state, are indicated as having lilac bloom prior to honeysuckle bloom. Lilac bloom precedes honeysuckle bloom by more than 5 days in most of Montana and Wyoming. Two zones are indicated in Montana and Wyoming where lilac bloom appears to precede honeysuckle bloom by more than 10 days. Most of Colorado, Idaho and Utah have lilac bloom prior to honeysuckle bloom. Lilac bloom also precedes honeysuckle bloom in northeastern Nevada, northeastern Arizona and northwestern and northcentral New Mexico.

Lilacs also precede honeysuckle bloom in the northwestern portion of Washington. Lilacs appear to precede honeysuckle bloom by more than 5 days in parts of this area. A small zone in northwest California and southern Oregon is also shown where lilac bloom appears to precede honeysuckle bloom.

Areas Where Honeysuckle Bloom First

Honeysuckle bloom precedes lilac bloom in most of Oregon, Nevada, California, Arizona and New Mexico. In general, areas in these states having the warmer winters are where honeysuckle bloom precedes lilac bloom by the greatest number of days. For example, honeysuckle bloom precedes lilac bloom by more than 15 days in western Oregon, western California and southern Arizona. Coastal areas of central and southern California have honeysuckle bloom from 20 to 35 days prior to lilac bloom.

Data from northern and central Texas (not on map) indicate that honeysuckle bloom generally precedes lilac bloom by about one week in that area.

Possible Explanation for Difference in Bloom Dates

At least part of the variation in timing of lilacs and honeysuckle bloom probably relates to the greater chilling requirement of lilacs to complete the "rest" compared to honeysuckle. When many deciduous trees and shrubs in the temperate zone enter the cold season they do not start to respond to warm days that may occur in the late autumn and winter until they have been subjected to an extended period of low temperatures. Once the rest is broken by an adequate amount of cold they can develop in response to higher temperatures.

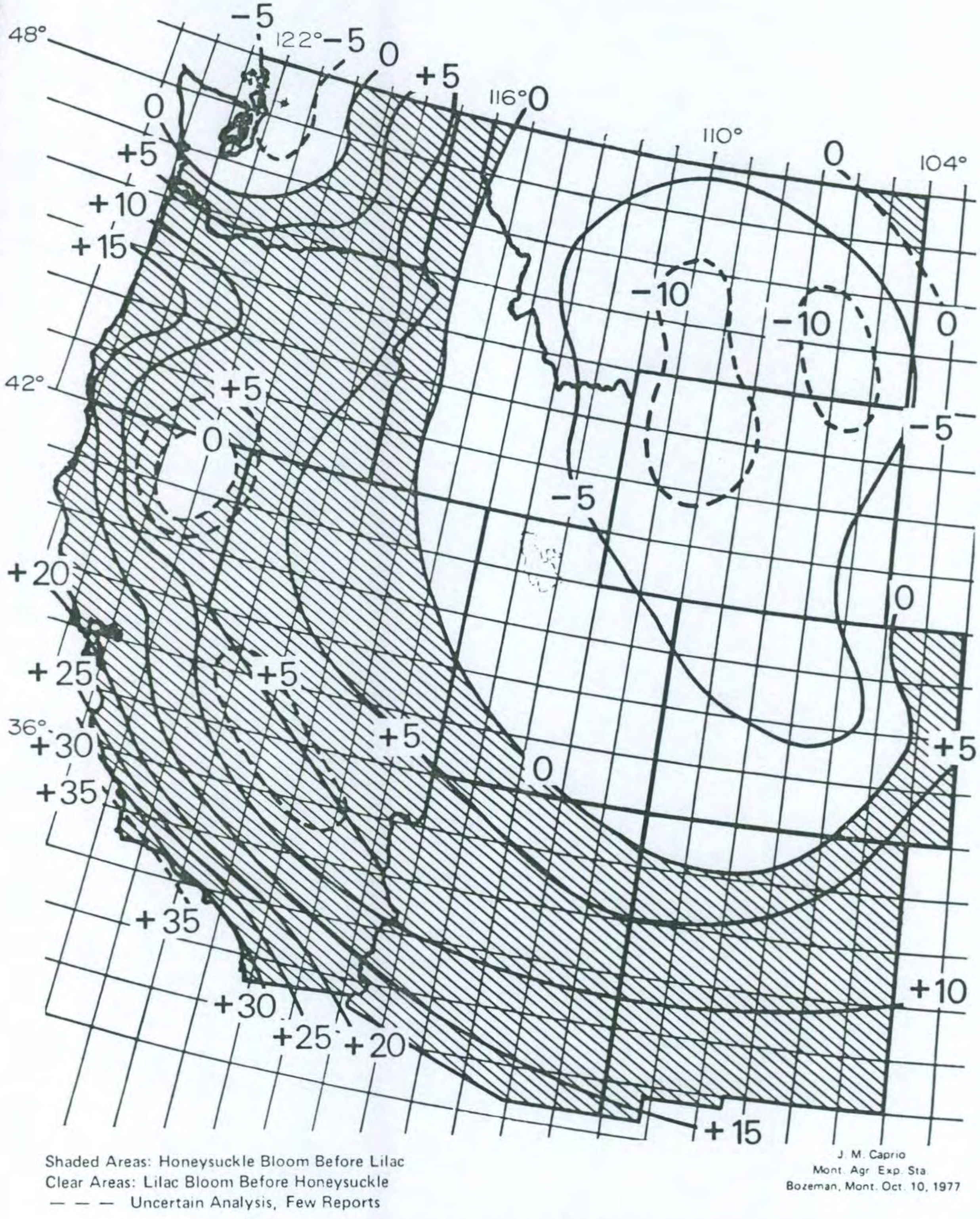


Fig. 2 Difference in Days Between Average Dates When Lilac and Honeysuckle Begin to Bloom

Using quantitative values suggested by Utah State University scientists we have made preliminary estimates that lilacs require about 1,110 chilling degrees hours to break rest but that honeysuckle require only about 930 chilling degree hours.

It has already been estimated that lilacs require 380,000 Solar Thermal Units (STU) from the end of rest to begin bloom and that honeysuckle require 430,000 STU to reach begin bloom phase.

In areas with cold winters, such as Montana and Wyoming, it appears that both lilacs and honeysuckle have adequate chilling in the autumn and neither species makes significant growth during the cold winter. With the onset of warm weather in the spring both lilac and honeysuckle develop in response to the warmth but lilacs, which requires fewer STU, bloom first.

In areas where the winters are relatively warm, honeysuckle probably starts developing in the mild winter even before lilacs are able to respond because honeysuckle complete their "rest" first. Thus, while lilacs are still in need of more cool weather to complete the rest, honeysuckle are already developing in response to the relatively warm temperatures of the mild winter.

This type of information may prove to be of value to orchardists, home gardeners, landscape architects and others who need to evaluate the suitability of various plant materials for use in different climatic areas. For example, the major citrus areas in the West are located only in areas were honeysuckle bloom precedes lilac bloom by at least 10 days.

Time of end of rest can be determined by taking cuttings from plants periodically during the late autumn and winter and placing them under mist spray in the greenhouse. Those cuttings that are made before rest is completed will remain dormant or bud out very slowly in the greenhouse. Those cuttings that have already completed rest will bud out rapidily in the greenhouse.

Cuttings of lilac and honeysuckle were made in Bozeman starting late in the autumn of 1976, but by that time the plants had already completed rest. Thus, the time of rest in Bozeman was not determined last year. This year cuttings were started in mid-August and will continue periodically so that the date of completion of rest can be determined.

Further work on modeling of lilac and honeysuckle should help to advance our understanding geographical patterns of plant development.

The Western Phenological Survey is being conducted in conjunction with Regional Project W-148 of the western agricultural experiment stations. Committee representatives for this project are as follows:

A. Administrative Advisor, Montana Agri. Exp. Sta.	Johan A. Asleson	Plant & Soil Science
B. Agricultural Experiment Stations		
Arizona	Richard K. Frevert	Soil, Water, & Engineering
	Roger Huber	Entomology
California	Joe McBride	Forestry & Conservation
	Jerry Hatfield	Land, Air, & Water Resources
	Harry P. Bailey	Earth Science
Colorado	Thomas B. McKee	Atmospheric Science
Idaho	Dale O. Everson	Station Statistician
	Myron Molnau	Agricultural Engineering
Montana	Joseph M. Caprio	Plant & Soil Science
New Mexico	Morris D. Finkner	Experimental Statistics
Nevada	Richard O. Gifford	Plant, Soil, & Water
Utah	Gaylen L. Ashcroft	Soils & Biometeorology
Wyoming	Larry O. Pochop	Agricultural Engineering
C. Agencies		
USDA, Forest Service, Missoula	Robert G. Baughman	Forestry
USDA, Agricultural Research Service	Dale Heerman	Agricultural Engineering
USDA, Cooperative State Research Service	Boyd W. Post	Forest Biology
NOAA-EDS Columbia, MO	Clarence M. Sakamoto	Agricultural Meteorology

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
November 30, 1978

DEPARTURE OF LILAC BLOOM DATES IN 1978 FROM THE 10-YEAR NORMAL (1957-66) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Normal dates of begin bloom of purple common lilac have been determined from phenological data collected during the 10-year period, 1957-66. Recorded dates of begin bloom in the spring of 1978 were compared with the 10-year normal. These departures from the normal time of bloom were plotted on a map and lines of equal departures from normal were drawn (Figure 1).

Shaded areas on the map indicate those places where lilacs began to bloom earlier than normal in the spring of 1978. Areas not shaded were later than normal.

Lilacs began to bloom earlier than normal over most of the Western Region. Bloom was slightly later than normal along parts of the northern and eastern borders of the Region, in south central sections and in the Sierra Nevada portions of California and Nevada. Latest departures from normal were from 5 to 10 days in the northwestern New Mexico - southwestern Colorado area and in the Sierra Nevada section. Earliest departures from normal were observed in coastal sections of California, Oregon and Washington. Lilacs bloomed from 25 to 30 days earlier than normal along the coast of California and from 20 to 25 days earlier than normal in some coastal parts of Oregon and Washington. Such large anomalies as observed along the Pacific Coast this year are a rare occurrence for any given area. Last year such extreme departures from normal were observed only in northeastern Montana where the season was 20 to 25 days earlier than normal. Lilacs began to bloom from 10 to 15 days earlier than normal in a large section in the central area of the Western Region which includes parts of Idaho, Utah, Wyoming, and Colorado. Temperatures were higher than normal over most of this area during January, February, March and April. However, May temperatures averaged lower than normal in this section.

Temperatures during January and February were extremely low in about the eastern two-thirds of the United States. Eastern parts of the Western region were in this cold zone. The central and western parts of the Western Region were warmer than normal during January and February, with large sections experiencing anomalies of 4°F to more than 8°F warmer than normal during these two winter months. March was much warmer than normal throughout all sections of the Western Region. Anomalies during March were mostly greater than 4°F warmer than normal and central sections

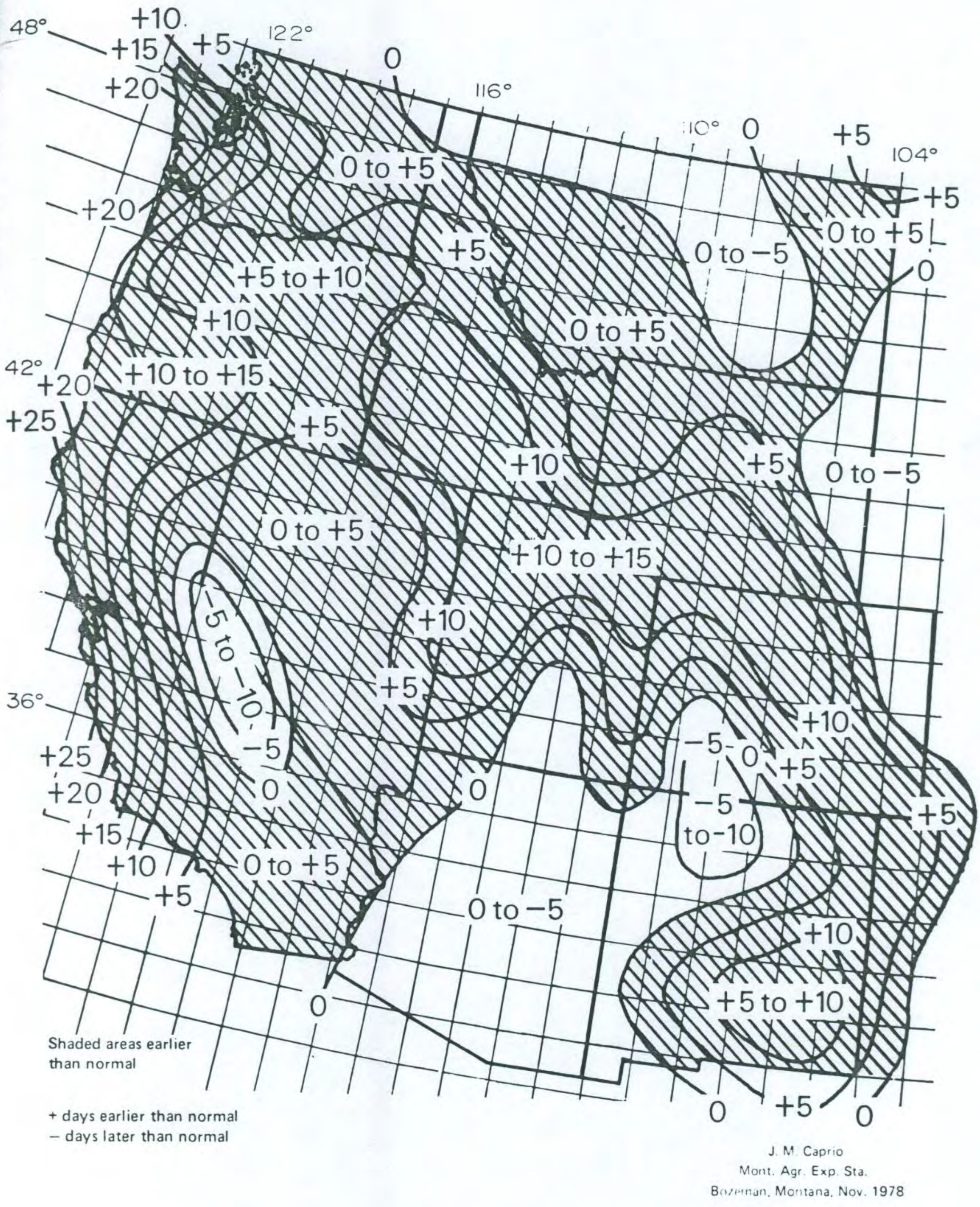


Figure 1. Departure of Begin Lilac Bloom Date from Normal, Spring 1978.

reported even 8°F to 10°F higher than normal temperatures. The eastern half of the U.S., including central and eastern Texas, remained cooler than normal in March. Lilac bloom reports from this cooler than normal part of Texas, where lilacs normally begin to bloom during March, indicate the season there was two to three weeks later than normal. However, lilac bloom in the western border area of Texas was near normal. The earlier than normal lilac bloom in central and eastern New Mexico appears to be related to a warmer than normal March along with a warm January and February in some sections.

Coastal areas of California, Oregon and Washington, which reported very early bloom this year, also were much warmer than normal during January, February and March. Much of the coastal area also had higher than normal temperatures in April, May and June. The early season along the coast was no-doubt related to the unusually warm weather experienced there during the winter and spring months. The later than normal lilac bloom in the Sierra Nevada mountain area was associated with lower than normal temperatures during April and May. The later than normal bloom along north-central and north-eastern border sections of the Region were mostly associated with lower than normal temperatures during May.

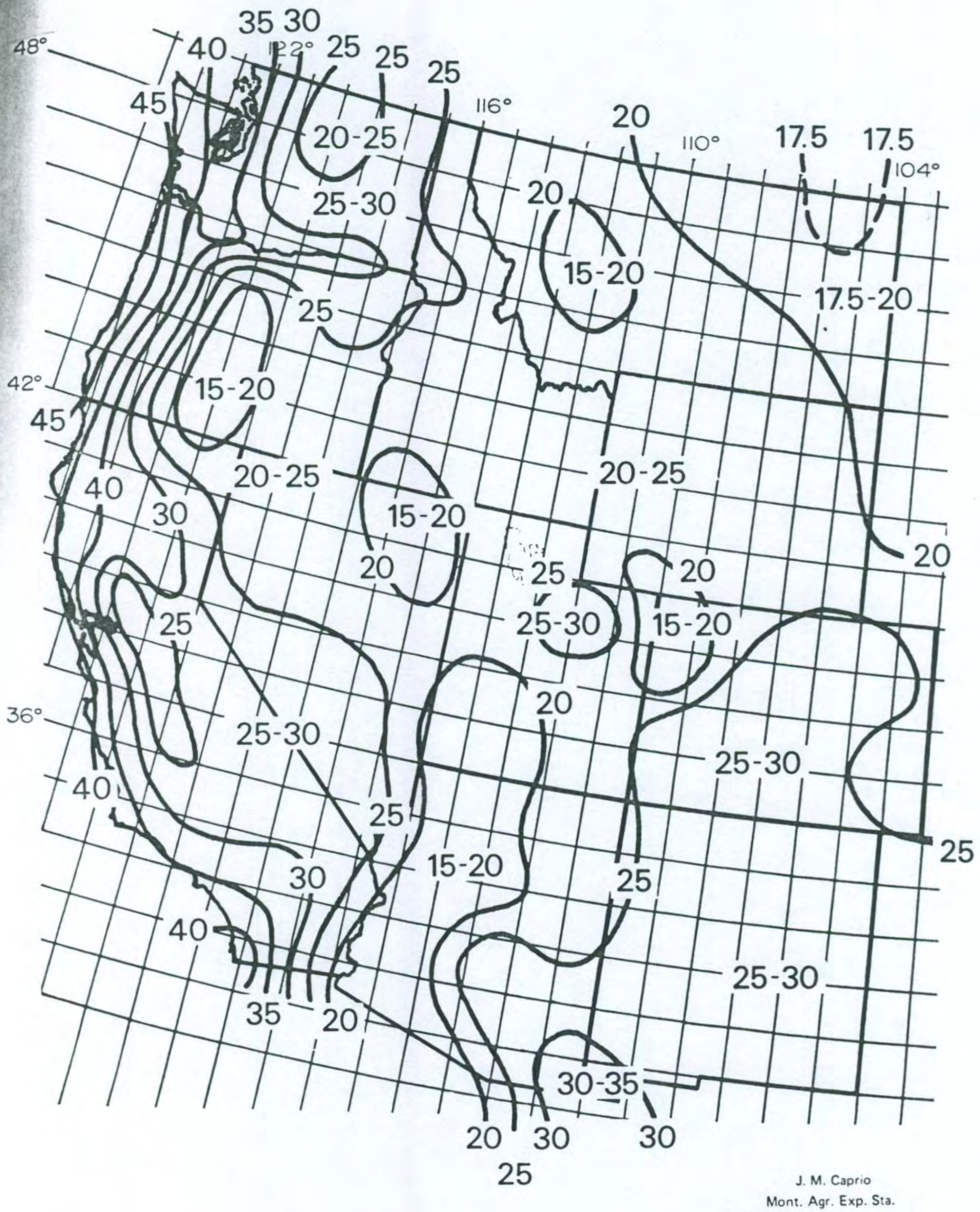
REGIONAL MAP OF AVERAGE LENGTH OF ZABELI

HONEYSUCKLE BLOOM STAGE

Average dates of begin and end bloom of Zabeli honeysuckle for the 8-year period 1968-75 has provided a basis for constructing a map (Figure 2) of the areal differences in the average length of the honeysuckle bloom stage. The average interval between the dates of begin and end bloom varies from less than 20 days in scattered locations throughout the region to more than 40 days in a narrow belt extending along much of the length of the Pacific Coast.

There is a general tendency in the Great Plains for the length of the bloom period to decrease from south to north but the difference between the southern Great Plains and the northern Great Plains is only about 10 days. In contrast to the situation in the Great Plains, large gradients in length of bloom period are evident when going from areas east of the Cascades to the Pacific Coast in Washington and Oregon and from the interior valley to the Pacific Coast in California. Gradients of bloom period across these relatively short east-west transects are on the order of 20 to 30 days. The length of the bloom period is usually about 40 days near the coast and about 20 days at the inland locations. The coastal areas where the bloom period is of long duration are relatively cool and cloudy in the spring compared to inland sites which have much shorter bloom periods.

A similar map of average length of the lilac bloom period was drawn earlier in this phenological study. The two maps have many common features. For example, the lilac bloom period tends to be of somewhat shorter duration in the northern Great Plains compared to the southern Great features. For example, the lilac bloom period tended to be of somewhat shorter duration in the northern Great Plains compared to the southern



J. M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, Montana, Nov. 1978

Figure 2. Average Length of Zabeli Honeysuckle Bloom Period in Days

Great Plains but for lilac the change in length of the period was only about 5 days in this north-south transect compared to about 10 days for the honeysuckle. The two maps are similar in that the largest gradients of bloom length are in the western part of the Western Region between coastal and inland areas. However, the lilac bloom length gradient across east-west transects tends to be only about 10 to 15 days compared to 20 to 30 days for the honeysuckle.

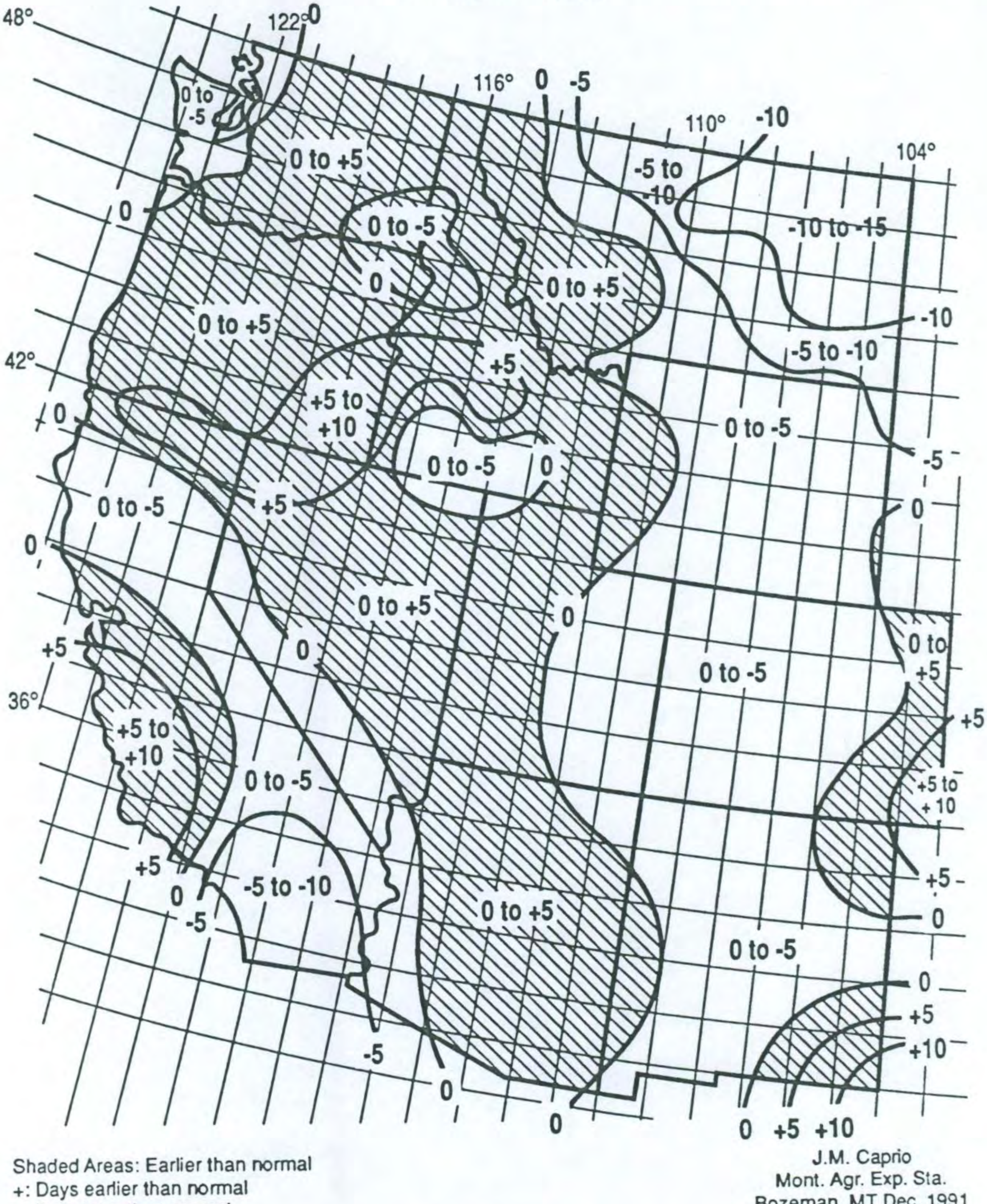
The average length of the honeysuckle bloom stage generally exceeds that of the lilac by about 5 days, but in the Pacific coastal area the honeysuckle bloom period is about 10 days longer than that of the lilac.

While the major trends in this honeysuckle map are undoubtedly significant, the smaller zones indicated throughout the region are less certain since they are typically based on only several reports.

The Western Phenological Survey is being conducted in conjunction with Regional Project W-148 of the western agricultural experiment stations. Committee representatives for this project are as follows:

A.	Administrative Advisor, Montana Agri. Exp. Sta.	Johan A. Asleson	Plant & Soil Science
B.	Agricultural Experiment Stations		
	Arizona	Richard K. Frevert Roger Huber	Soil, Water, & Engineering Entomology
	California	Joe McBride Jerry Hatfield Harry P. Bailey	Forestry & Conservation Land, Air, & Water Resources Earth Science
	Colorado	Thomas B. McKee	Atmospheric Science
	Idaho	Dale O. Everson Myron Molnau	Station Statistician Agricultural Engineering
	Montana	Joseph M. Caprio	Plant & Soil Science
	New Mexico	Morris D. Finkner	Experimental Statistics
	Nevada	Richard O. Gifford	Plant, Soil, & Water
	Utah	Gaylen L. Ashcroft	Soils & Biometeorology
	Washington	Gaylen Campbell	Agronomy and Soils
	Wyoming	Larry O. Pochop	Agricultural Engineering
C.	Agencies		
	USDA, Forest Service, Missoula	Robert G. Baughman	Forestry
	USDA, Agricultural Research Service	Dale Heerman	Agricultural Engineering
	USDA, Cooperative State Research Service	Boyd W. Post	Forest Biology
	NOAA-EDS Columbia, MO	Clarence M. Sakamoto	Agricultural Meterology

This anomaly map was not included in the Report to Cooperators for spring of 1979.



Shaded Areas: Earlier than normal
+: Days earlier than normal
–: Days later than normal

J.M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, MT Dec. 1991
revised

Departure of Lilac Begin Bloom Date from Normal, Spring 1979

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
December 15, 1979

DEPARTURE OF LILAC BLOOM DATES IN 1979 FROM THE 10-YEAR NORMAL (1957-66) THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

In the spring of 1979, lilac begin bloom dates throughout the Western Region tended not to vary greatly from the normal pattern of development. A noted exception was in eastern parts of Montana, where bloom was more than 10 days later than normal this year. This near normal pattern corresponds with near normal temperatures throughout much of the Region during the important month of April. April was, however, much colder than normal in eastern Montana.

Phenology of Lilac and Honeysuckle in Relation to Dryland Winter Wheat Phenology in the Western United States

Observations on common purple lilac and Red Delicious apples at numerous locations indicate that these plants tend to bloom on about the same date. Since both lilacs and Red Delicious applies are deciduous woody perennials, it may not be surprising that such a close phenological relation might exist between them. However, it is more usual for the bloom dates of different cultivars to differ, and these differences often vary with location.

As part of the western regional phenological survey during the 10-year period from 1959 to 1968, phenological data were collected on both dryland winter wheat and common purple lilac from throughout the 11 western states.

The average date of begin bloom of lilac was compared with the average date of 10% headed of winter wheat and this was plotted on a map of the Western Region and lines of difference were drawn. The map is shown in Figure 1.

In areas where very little winter wheat is grown, such as in the southwestern and southern parts of the region, it is not possible to draw a map showing much detail, although some general conclusions can be drawn from this preliminary map.

It is apparent from this analysis that the date of begin lilac bloom precedes the 10% wheat headed date over the entire Western Region, however, the interval between lilac bloom and wheat headed date varies widely throughout the region. In central Washington, southern Arizona, and parts of New Mexico and eastern Colorado, the date of begin lilac bloom precedes the 10% wheat headed date by less than 20 days. Along the Pacific Coast and in southern Idaho and northern Utah, the 10% wheat headed date follows lilac bloom by more than 35 days.

It appears, from the general patterns on the map, that the difference in lilac bloom and wheat headed date can be largely attributed to differences in climate throughout the Western Region. However, differences in wheat planting dates and the natural tendency for some wheat varieties in certain areas to head unusually late or unusually early could have some influence.

The following table shows how some of the important wheat varieties tend to head with respect to the selected standard variety, Kharkof. Almost all the varieties listed tend to head within 5 days of Kharkof. Exceptions are White Federation, which heads 8 days earlier than Kharkof, and Red Russian, which heads 6 days later than Kharkof.

Relative Dates of Combine Ripe for Different Varieties Compared to Kharkof

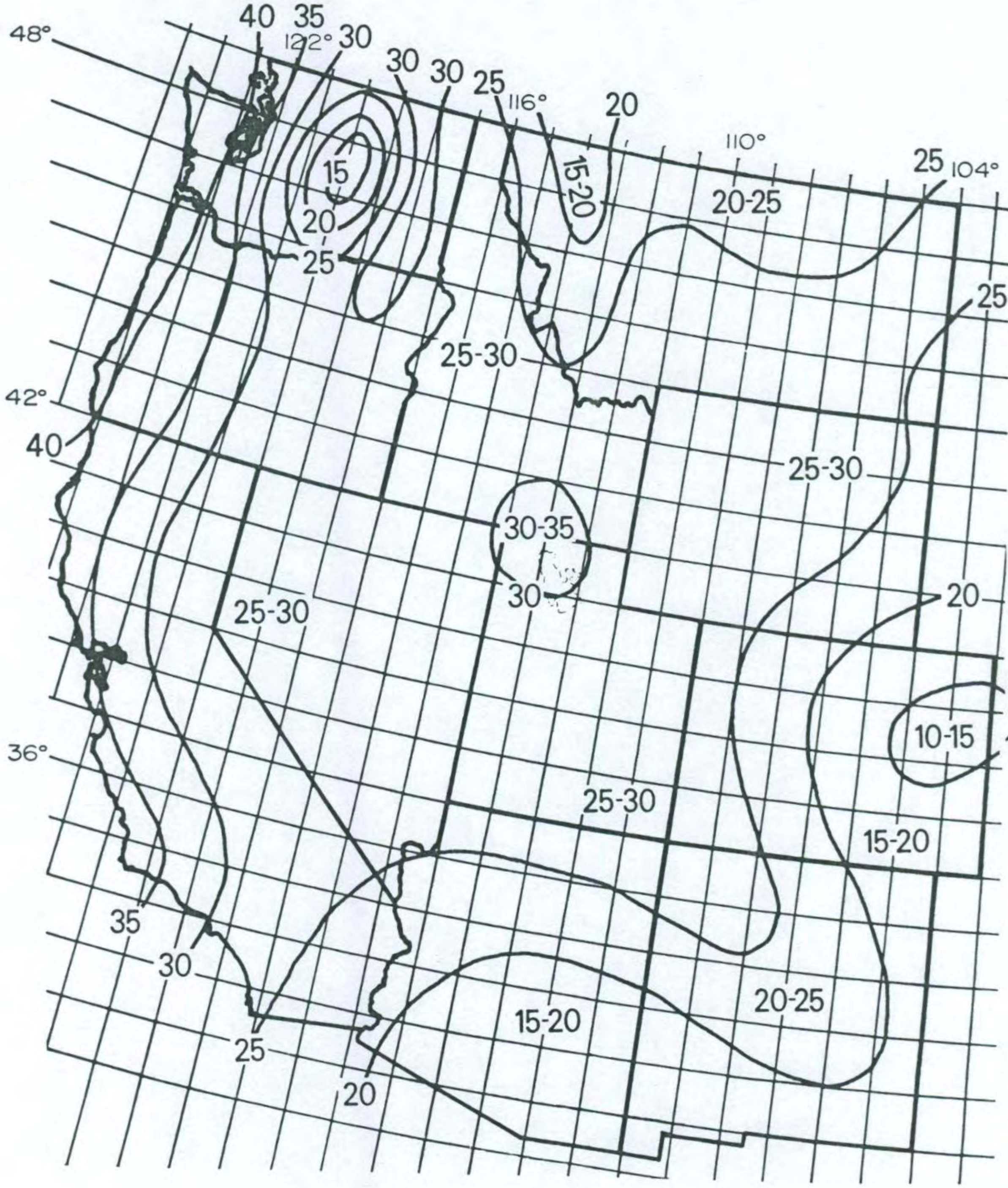
Varieties Earlier than Kharkof		Varieties the	Varieties Later than Kharkof	
Variety	Days Earlier	Same as Kharkof	Variety	Days Later
Blackhull	2	Cheyenne	Brevor	1
Westmont	3	Columbia	Burt	1
Federation	3	Elmar	Cache	1
Onas	4	Itana	Fortyfold	1
Newturk	4	Karmont	Golden	1
Lemhi	4	Omar	Pacific Bluestem	1
Baart	4	Oro	Yogo	1
Ramona	5	Rio	Elgin	2
Marfed	5		Orfed	2
White Federation	8		Red Russian	6

A possible explanation for some of the observed differences between lilac bloom and wheat headed date may relate to soil moisture conditions. After wheat has made some initial growth, which depends on available soil moisture, further development tends to be more rapid under relatively dry soil moisture conditions. The time of bloom of deep-rooted lilacs, on the other hand, tends to be relatively unaffected by springtime variations in soil moisture. When such a differential response to soil moisture is operative, the interval between begin lilac bloom and 10% wheat headed date would tend to be shorter in drier areas of the Western Region. The date of end lilac bloom corresponds more closely to the wheat headed date, and a map is being developed showing this comparison.

Linking the phenology of important commercial crops to indicator plants such as lilac and honeysuckle could play an important role in advancing our understanding of how the climatic environment controls the seasonal development of crops, and could assist in the interpretation of crop inventories made by satellite remote sensing.

Further work is being undertaken to compare the phenology of agricultural crops with lilac and honeysuckle phenology.

Preliminary Map



J. M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, Montana, Dec. 1979

Average Interval (Days) From Date of Begin Lilac Bloom to Date When Dryland Winter Wheat is Ten Percent Headed

The Western Phenological Survey is being conducted in conjunction with Regional Project W-148 of the western agricultural experiment stations. Committee representatives for this project are as follows:

A. Administrative Advisor, Montana Agri. Exp. Sta.	Johan A. Asleson	Plant & Soil Science
B. Agricultural Experiment Stations		
Arizona	Richard K. Frevert Roger Huber	Soil, Water, & Engineering Entomology
California	Joe McBride Jerry Hatfield Harry P. Bailey	Forestry & Conservation Land, Air, & Water Resources Earth Science
Colorado	Thomas B. McKee	Atmospheric Science
Idaho	Dale O. Everson Myron Molnau	Station Statistician Agricultural Engineering
Montana	Joseph M. Caprio	Plant & Soil Science
New Mexico	Morris D. Finkner	Experimental Statistics
Nevada	Richard O. Gifford	Plant, Soil, & Water
Utah	E. Arlo Richardson	Soils & Biometeorology
Washington	Gaylen Campbell	Agronomy and Soils
Wyoming	Larry O. Pochop	Agricultural Engineering
C. Agencies		
USDA, Forest Service, Missoula	Robert G. Baughman	Forestry
USDA, Agricultural Research Service	Dale Heerman	Agricultural Engineering
USDA, Cooperative State Research Service	Wayne L. Decker	Atmospheric Science
NOAA-EDS Columbia, MO	Clarence M. Sakomoto	Agricultural Meterology

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
December 22, 1980

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1980 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom Date Anomaly Map

In the spring of 1980, honeysuckle begin bloom date anomalies varied widely throughout the Western Region, however, earlier than normal conditions generally prevailed in northern sections and later than normal conditions were more common in central and southern parts of the Region (Figure 1). The normal base period for honeysuckle is 1969 to 1975.

Bloom was mostly earlier than normal in Idaho, Montana, Oregon, and Washington with largest earlier than normal anomalies prevailing in northeastern Montana where the season was more than 20 days earlier than normal. Several reports of more than 20 days earlier than normal were also received from an area of northern California near the Oregon border. The season was more than 10 days earlier than normal over most of Montana, Idaho, central and eastern Oregon, northern Wyoming, parts of northern California and north-central Utah. An area of greater than 10 days earlier than normal is also indicated on the map in southeastern Arizona and western New Mexico.

Largest late bloom date anomalies (more than 10 days late) occurred in east-central Colorado and in an area near the California-Nevada border. Most of the eastern half of Colorado was more than five days later than normal, while bloom was generally near five days later than normal in most coastal areas of Oregon. Honeysuckle bloomed about a week later than normal over much of northern Texas.

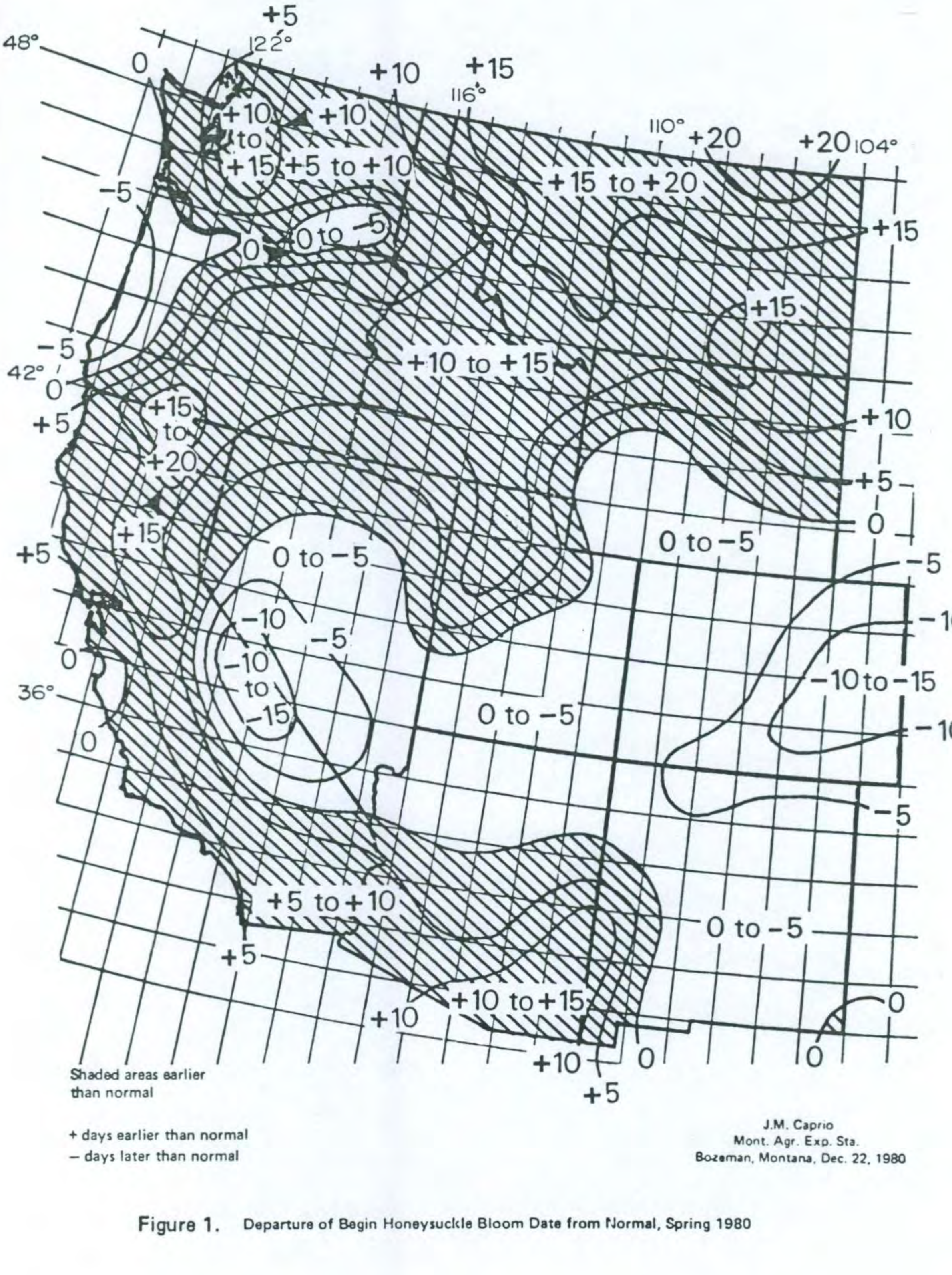


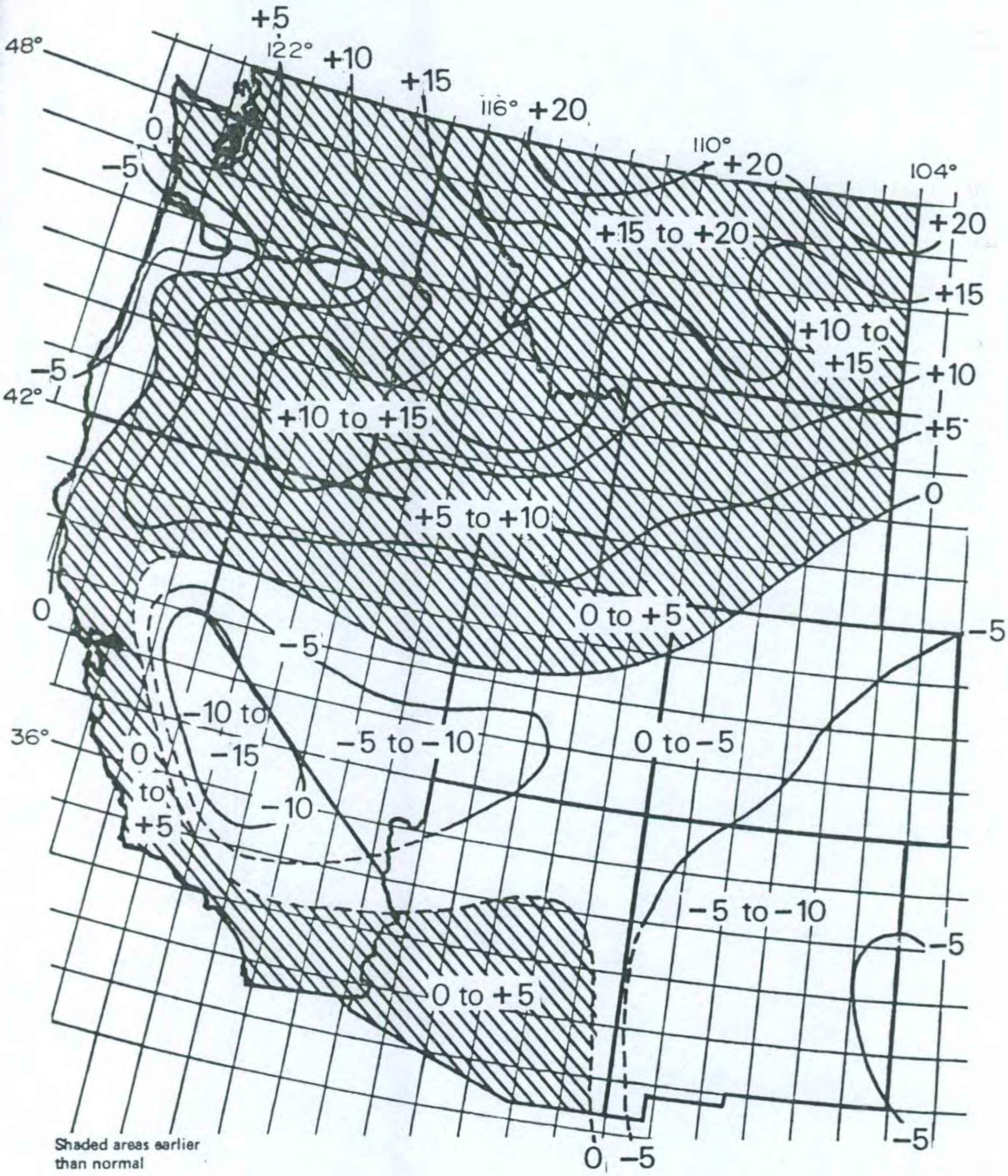
Figure 1. Departure of Begin Honeysuckle Bloom Date from Normal, Spring 1980

Lilac Bloom Date Anomaly Map

A map of begin bloom date anomaly for the Western Region was also developed for the common purple lilac (Figure 2). The normal base period for the common purple lilac is 1957 to 1966. The isophanes in southwestern areas are dashed in because of the low density of reporting stations.

Some similarities between the honeysuckle map and the lilac map might be expected since both are perennial woody species and their normal dates of begin bloom generally occur within 10 days of each other over most of the Western Region. As indicated in a previous report, however, average lilac bloom precedes average honeysuckle bloom by more than 10 days in parts of Montana and Wyoming and average honeysuckle bloom precedes average lilac bloom by more than 10 days in southern and southwestern parts of the region. Honeysuckle bloom averages about 30 days earlier than lilac bloom along a narrow coastal strip of southern California.

Lilac bloom was generally earlier than normal in northern sections of the Western Region and later than normal in the southern parts of the Region. Largest earlier than normal anomalies occurred in northern Montana where extensive areas are indicated as coming into bloom more than 20 days earlier than normal. Bloom was more than 10 days earlier than normal over most of Montana and over large parts of Wyoming, Idaho, Oregon and Washington. Bloom was nearly five days later than normal near the Oregon Coast. Lilac bloom was 10 to 15 days later than normal in parts of central California and about a week later than normal over much of northern Texas.



Shaded areas earlier than normal

+ days earlier than normal
– days later than normal

J.M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, Montana, Dec. 20, 1980

Figure 2. Departure of Begin Lilac Bloom Date from Normal, Spring 1980

Comparison of Spring Temperature and Bloom Date Anomolies

An examination of a map of temperature departures from normal for the spring of 1980 (March through May) indicates a striking parallel with the honeysuckle and lilac bloom date anomaly maps. Temperatures averaged mostly warmer than normal over northern portions of the Region and colder than normal over the southern parts of the Region during this 3-month period. Exceptions are along the Oregon coast where it was somewhat colder than normal and along the California coast where it was somewhat warmer than normal. A plot of the departure from normal of honeysuckle 95% redberry phase in 1980 indicated that this phase, too, occurred about 20 days earlier than normal in eastern Montana in the summer of 1980.

The earlier than normal plant bloom in Montana of about 18 days was associated with temperatures which averaged 6°F warmer than normal for the entire 3-month period. Let us assume that only temperatures from mid-March to mid-May were effective in advancing plant development in Montana. Then, to interpret these relations quantitatively, we can state that roughly every 1°F temperature anomaly above normal for the 2-month period mid-March through mid-May corresponds to an earlier than normal plant development of about 3 days (18 days divided by 6 degrees). The time of occurrence of large temperature anomalies within the 2-month period could have an important impact on the time of bloom, but during this season temperatures were running quite consistently above normal. Stated in other terms, a 1-degree warmer than normal single month during this period tends to be associated with about a 1.5 day earlier than normal bloom (3 days divided by 2 months).

It is interesting to consider what temperature anomaly for the critical 2-month pre-bloom period could result in a 30-day earlier than normal bloom. Using the rough model suggested above, we would conclude that the 2-month temperature anomaly would have to be about 10° warmer than normal, which is undoubtedly a very rare occurrence in meteorological records for a 2-month period in the Western Region. Anomalies of near 1 month in plant development have been observed at some locations during the course of these phenological studies. When they do occur they tend to be very disruptive to agriculture.

Considered in terms of keeping a rough daily log over the 2-month pre-bloom period, each day of a 1-degree above normal temperature could be counted as advancing bloom by .05 day (1.5 divided by 30 days) and each day of a 1-degree cooler than normal temperature could be counted as delaying bloom by .05 day. A single day that is 10°F warmer than normal would thus advance bloom one-half day (10 times .05) from its normal time of occurrence.

Such a rough "rule of thumb" daily log would no doubt have some validity for estimating departure from normals of early season phenological events for many other species of plants. To apply such a log one would have to begin the accumulation of daily effects roughly 2-months prior to the <u>normal date</u> of the phenological event.

More precise models of this general nature should be developed as statistical analyses are conducted on a wider range of historical data from throughout the Western Phenological Network.

The Western Phenological Survey is being conducted in conjunction with Regional Project W-148 of the western agricultural experiment stations. Committee representatives for this project are as follows:

A. Administrative Advisor, Colorado State Univ.	Jay M. Hughes	Forestry
B. Agricultural Experiment Stations		
Arizona	Richard K. Frevert Roger Huber	Soil, Water & Engineering Entomology
California	Joe McBride Jerry Hatfield	Forestry & Conservation Land, Air & Water Resources
Colorado	Thomas B. McKee	Atmospheric Science
Idaho	Dale O. Everson Myron Molnau	Station Statistician Agricultural Engineering
Montana	Joseph M. Caprio	Plant & Soil Science
New Mexico	Morris D. Finkner	Experimental Statistics
Nevada	Richard O. Gifford	Plant, Soil & Water
Utah	E. Arlo Richardson	Soils & Biometeorology
Washington	Gaylen Campbell	Agronomy & Soils
Wyoming	Larry O. Pochop	Agricultural Engineering
C. Agencies		
USDA, Forest Service, Missoula	Robert G. Baughman	Forestry
USDA, Agricultural Research Service	Dale Heerman	Agricultural Engineering
USDA, Cooperative State Research Service	Wayne L. Decker	Atmospheric Science
NOAA-EDS Columbia, MO	Clarence M. Sakomoto	Agricultural Meteorology

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
December 18, 1981

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1981 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom Date Anomaly Map

The normal base period for honeysuckle is 1969 to 1975. In the spring of 1981, honeysuckle bloomed earlier than normal over almost the entire Western Region (Figure 1). The isophanes in southwestern areas and the northern Idaho area are dashed in because of the low density of reporting stations.

In general, anomalies were more extreme in northern and central areas than in southern areas. The only place on the map showing later than normal bloom is an area of coastal southern California. Largest earlier than normal anomalies prevailed in the Puget Sound area of western Washington where bloom was more than 35 days earlier than normal. This area experienced warmer than normal temperature anomalies of about 4°F in December, 7°F in January, 3°F in February, 5°F in March, 1°F in April, and 1°F in May. Honeysuckle usually blooms during late April in the Seattle area but this year they bloomed during late March.

Earlier than normal anomalies exceeding 20 days were common in central Oregon, western Washington, eastern Montana, and eastern Wyoming. Most of the northern half of the Western Region was more than 10 days earlier than normal. A notable exception was in northeastern Washington, northern Idaho, and parts of western Montana where bloom varied from near normal to less than 10 days earlier than normal. With the exception of

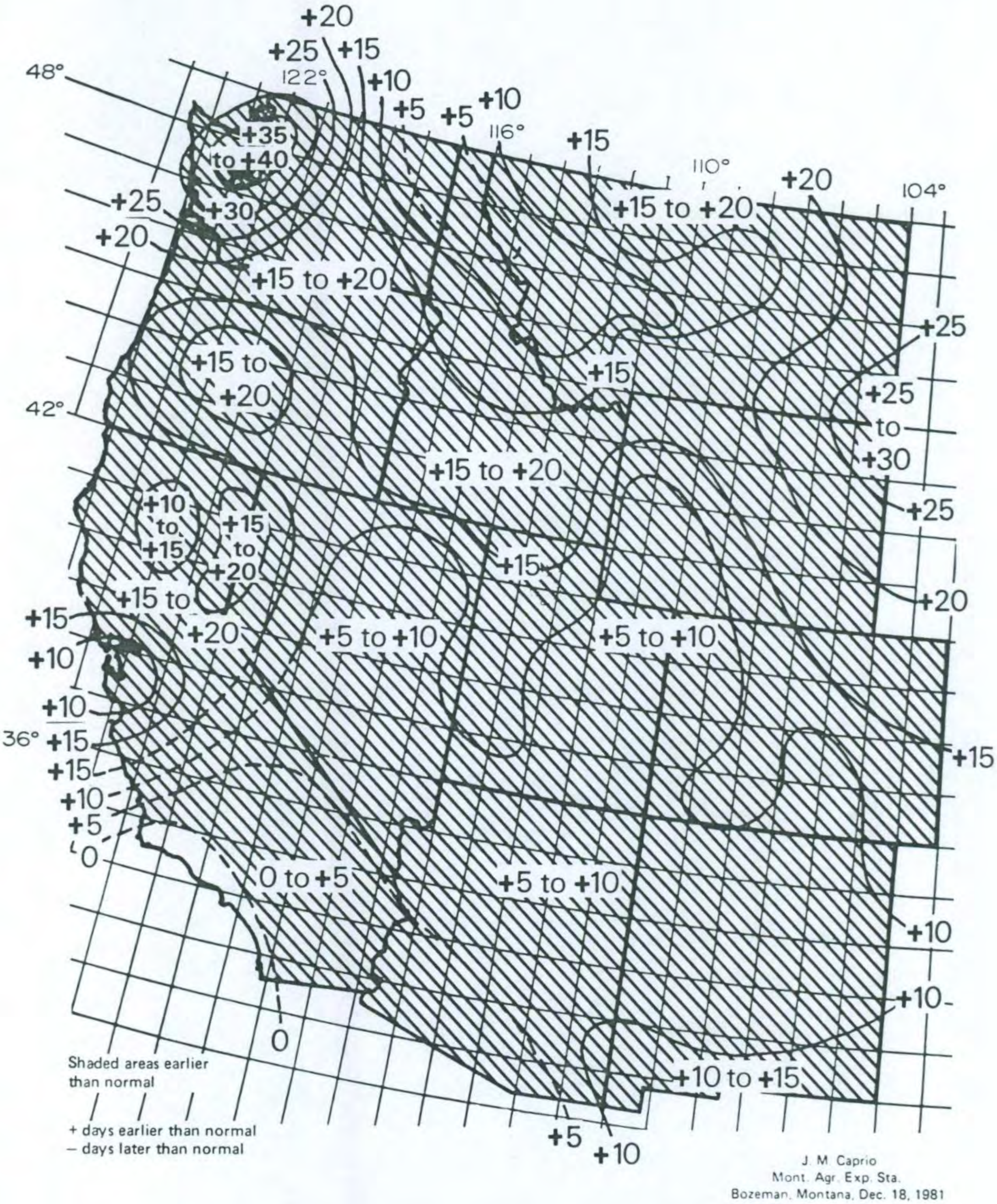


Figure 1. Departure of Begin Honeysuckle Bloom Date from Normal, Spring 1981.

California where anomalies varied from later than normal to more than 20 days earlier than normal, bloom over most of the southern half of the Western Region was mostly 5 to 10 days earlier than normal.

The earlier than normal honeysuckle bloom over most of the Western Region in the spring of 1981 was associated with almost region-wide and warmer than normal temperatures during December, January, February, March, and April. By May, the warmer than normal pattern changed to cooler than normal in parts of the Region including much of Oregon, Idaho, Wyoming, Utah, and Colorado. Other areas tended to be somewhat warmer than normal in May. A much warmer than normal May, however, occurred in northeastern Montana and parts of California and Arizona.

Lilac Bloom Date Anomaly Map

A map of begin bloom date anomaly for the Western Region was also developed for the common purple lilac (Figure 2). The normal base period for the common purple lilac is 1957 to 1966. The isophanes in southwestern areas are dashed in because of the low density of reporting stations.

Some similarities between the honeysuckle map and the lilac map might be expected since both are perennial woody species and their normal dates of begin bloom generally occur within 10 days of each other over most of the Western Region. As indicated in a previous report, however, average lilac bloom precedes average honeysuckle bloom by more than 10 days in parts of Montana and Wyoming and average honeysuckle bloom precedes average lilac bloom by more than 10 days in southern and southwestern parts of the Region. Honeysuckle bloom averages about 30 days earlier than lilac bloom along a narrow coastal strip of southern California.

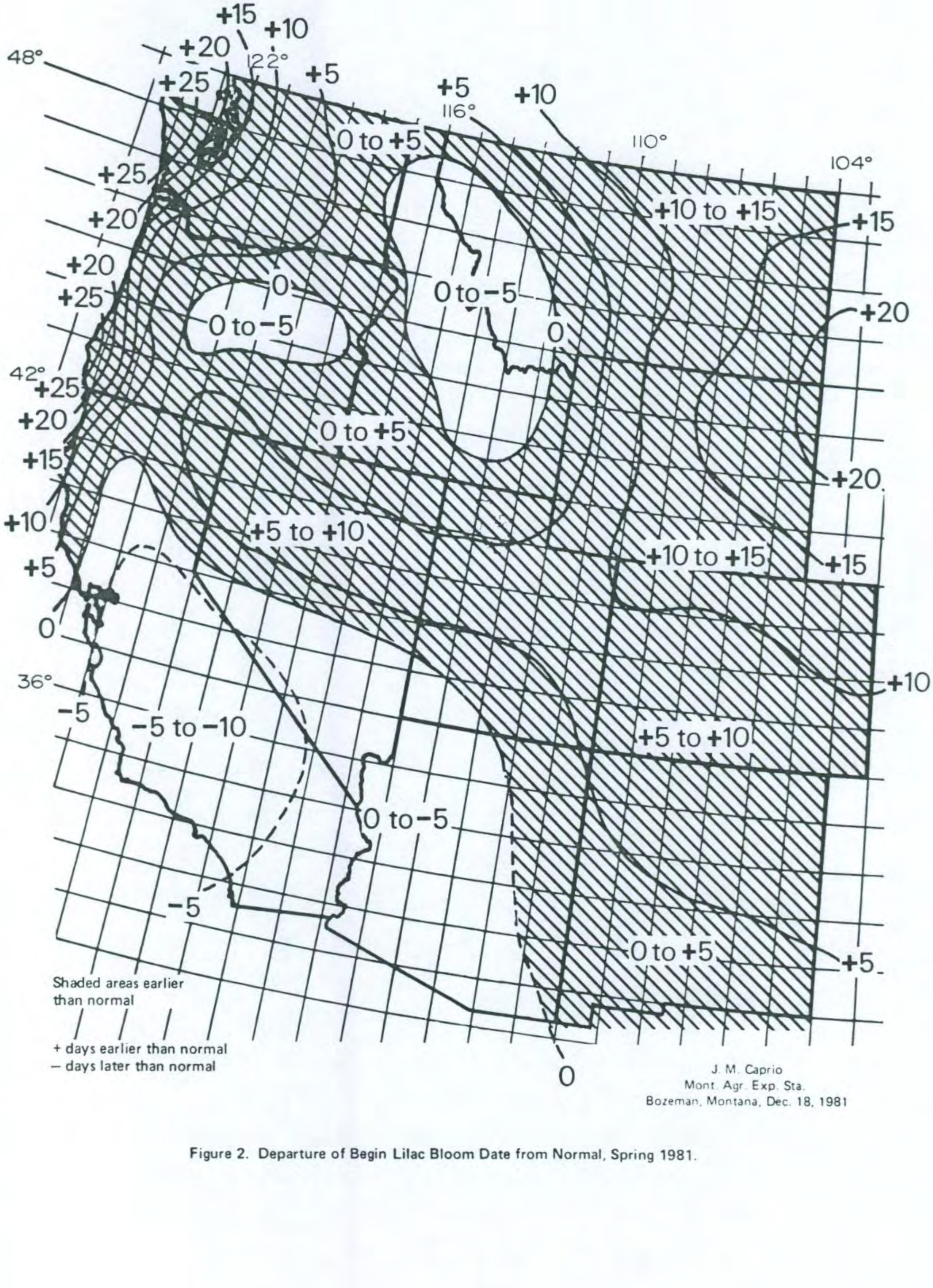


Figure 2. Departure of Begin Lilac Bloom Date from Normal, Spring 1981.

Lilac bloom was generally earlier than normal over most of central, northern, and southeastern areas. Lilacs generally bloomed from near normal to less than 10 days later than normal in southwestern areas. Later than normal bloom is also indicated on the map as having occurred in central Oregon and over extensive areas of Idaho and western Montana.

An unusually early bloom is indicated along coastal areas of Washington, Oregon, and northwestern California where bloom was more than 20 days earlier than normal. This early season pattern is associated with warmer than normal winter and spring temperatures in the area, particularly during January when temperatures generally were about 7°F warmer than normal in coastal areas where these very early blooms were reported.

Lilacs also bloomed more than 20 days earlier than normal in parts of southeastern Montana and northeastern Wyoming. This area experienced warmer than normal temperature anomalies of about 3°F in December, 14°F in January, 3°F in February, 10°F in March, and 7°F in April. Temperatures were near normal in this area during May.

Extensive portions of central and southeastern areas were from about 5 to 10 days earlier than normal. Information from Texas on honeysuckle and lilac also indicates that bloom was earlier than normal in northern and northwestern parts of the state.

The Western Phenological Survey is being conducted in conjunction with Regional Project W-148 of the western agricultural experiment stations. Committee representatives for this project are as follows:

A. Administrative Advisor, Colorado State Univ.	Jay M. Hughes	Forestry
B. Agricultural Experiment Stations		
Alaska	Lee D. Allen	Agricultural Engineering
Arizona	Roger T. Huber Allen D. Matthias	Entomology Biometeorology
California	Joe R. McBride Jerry L. Hatfield Terry A. Howell Robert W. Pease	Forestry & Conservation Land, Air & Water Resources Irrigation Engineering Earth Sciences
Colorado	Thomas B. McKee	Atmospheric Science
Idaho	Dale O. Everson Myron Molnau	Station Statistician Agricultural Engineering
Montana	Joseph M. Caprio	Plant & Soil Science
New Mexico	Morris D. Finkner	Experimental Statistics
Nevada	Richard O. Gifford	Plant, Soil & Water
Texas	M. Joe McFarland Gerald F. Arkin	Agricultural Engineering Soil-Water-Atmosphere
Utah	E. Arlo Richardson	Soils & Biometeorology
Washington	Gaylen S. Campbell	Agronomy & Soils
Wyoming	Larry O. Pochop	Agricultural Engineering
C. Agencies		
USDA, Forest Service, Missoula	Robert G. Baughman	Forestry
USDA, Agricultural Research Service	Dale F. Heerman	Agricultural Engineering
USDA, Cooperative State Research Service	Wayne L. Decker	Atmospheric Science
NOAA-EDS Columbia, MO	Clarence M. Sakomoto	Agricultural Meteorology

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Montana Agricultural Experiment Station
Bozeman, Montana
November 15, 1982

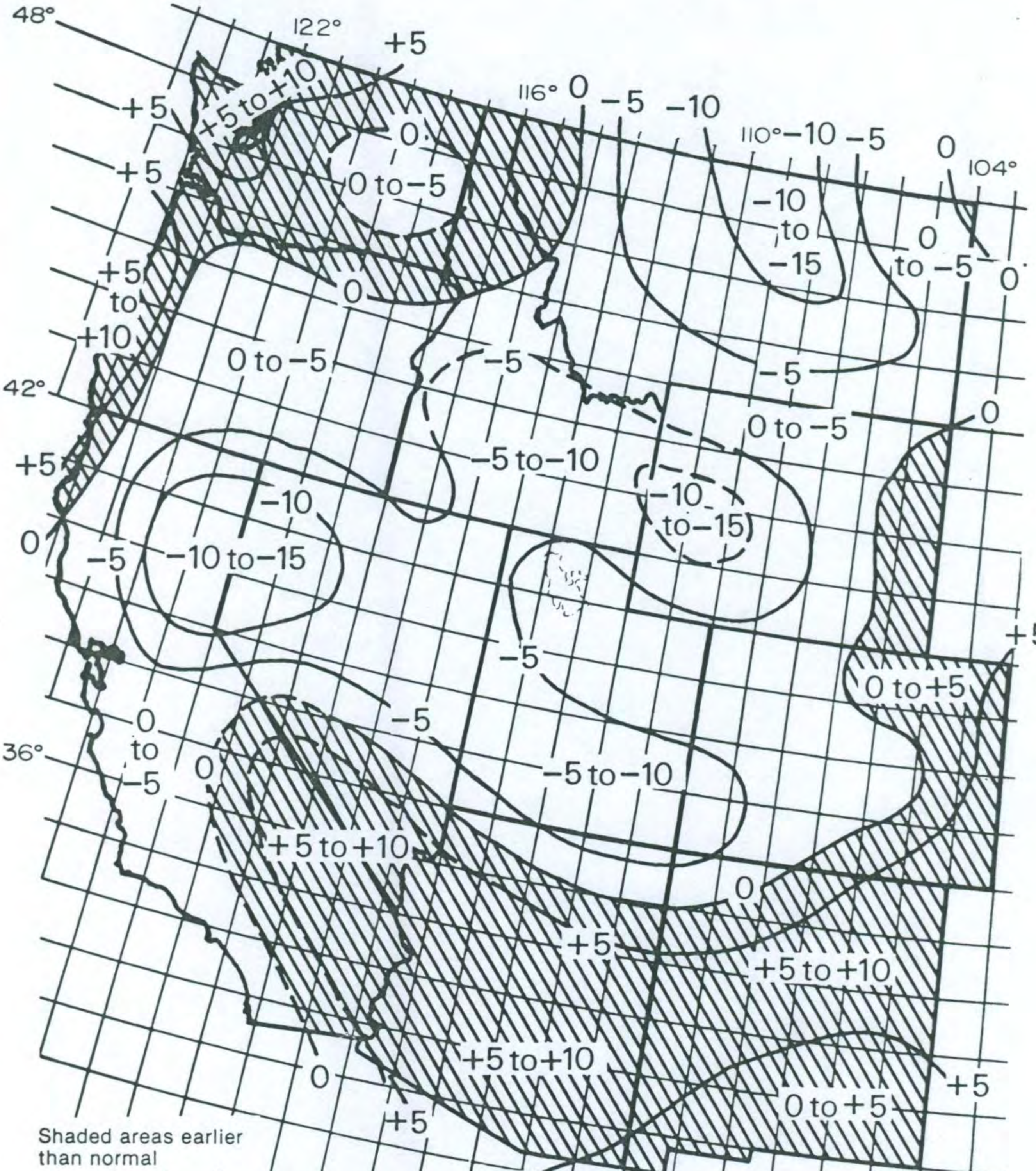
DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1982 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Begin Bloom Date Anomaly Map

The normal base period for honeysuckle is 1969 to 1975. In the spring of 1982, honeysuckle bloomed later than normal over the greater portion of the Western Region (Figure 1). The isophanes in Washington and southwestern areas are dashed in because of the low density of reporting stations. Areas that were particularly late were northeastern California, northwestern Nevada and northcentral Montana where bloom was 10 to 15 days later than normal.

Parts of northwestern California, and western Oregon and Washington were more than 5 days earlier than normal this spring. Eastern parts of Colorado, Montana, Wyoming and southeastern California were earlier than normal as were also most of Arizona and New Mecico. A 5 to 10 days earlier than normal section is shown on the map extending from southern California and Nevada through Arizona, central New Mexico and eastern Colorado.

The 10 to 15 days later than normal zones in California, Nevada and Montana were associated with lower than normal temperatures in these areas during April and May. Temperatures averaged more than $4^{o}F$ cooler than normal in north central Montana during both April and May.



+days earlier than normal
−days later than normal

J.M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, Montana Nov. 15, 1982

FIGURE 1. Departure of Begin Honeysuckle Bloom Date from Normal, Spring 1982.

The large section of earlier than normal bloom in the eastern and southern tier of states was associated with warmer than normal January and February temperatures in the extreme southwestern portion of the region and a warmer than normal March throughout most of this earlier than normal area. Some of this area experienced temperatures more than 6°F above normal for the month of March. Higher than normal temperatures persisted in this southwestern area during the months of April and May.

Lilac Begin Bloom Date Anomaly Map

A map of begin bloom anomaly for the Western Region for the common purple lilac is shown in Figure 2. The normal base period for the lilac is 1957-1966. The isophanes in some areas in the south are dashed in because of the low density of reporting stations. Central and northern parts of the region were generally later than normal while southern areas tended to be earlier than normal. The season was delayed most (15 to 20 days late) in an area extending from east-central Oregon through central Idaho and southwestern Montana. Smaller zones of 10 to 15 days later than normal bloom also appear in northern Montana, central Wyoming and the northern California-Nevada border area.

Bloom was more than 10 days earlier than normal in parts of southern and eastern New Mexico. The season was slightly earlier than normal in a small area along the Oregon-Washington border.

Later than normal bloom in central and northern sections was associated with lower than normal temperatures during both April and May. Temperatures were more than 4°F below normal in central Montana for both of these months. The earlier than normal bloom in southern areas were generally associated with higher than normal temperatures in January,

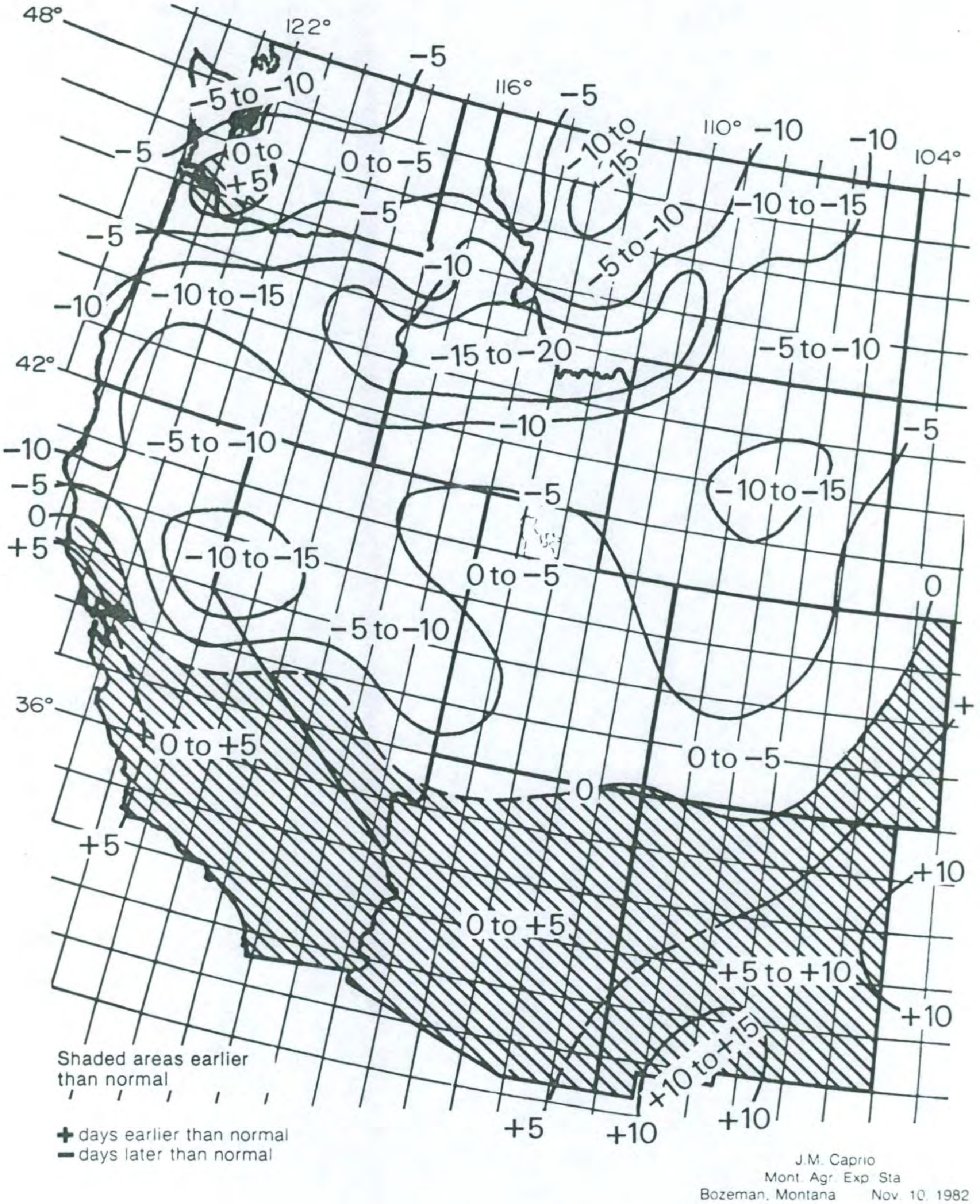


FIGURE 2. Departure of Begin Lilac Bloom Date from Normal, Spring 1982.

February, March and April. The very early bloom in parts of New Mexico was associated with March temperatures of more than $4^{o}F$ above normal.

The geographical patterns of lilac and honeysuckle begin bloom date anomalies are rather similar this year. A notable exception is in northwestern coastal areas where lilacs tended to come in later than normal whereas honeysuckle were generally earlier than normal.

New Observers Join Phenological Network

Last spring about 600 new Arnold Red honeysuckle plants were distributed for phenological observation throughout the West. Observations on these plants will begin this coming spring. These are mostly located near Weather Service climatological stations and are observed by weather station attendants. About two hundred additional common purple lilac observers were also added to the phenological network last spring.

Observers of common purple lilac do not receive plants via United
5 Parcel Service as do honeysuckle observers. Instead they report on
common purple lilac plants that are already established near-by in an
open unshaded location away from trees and buildings. Many phenological
observers report on both lilac and honeysuckle.

More observers for common purple lilac are needed. Only the first 5 phases are observed for the lilac. Perhaps some phenological observers who now report only on the honeysuckle would like to report also on a conveniently located and suitably exposed common purple lilac bush. A lilac reporting card is enclosed for this purpose. Discard the lilac card if you will not be observing a lilac.

A picture of a common purple lilac slightly beyond begin bloom phase is enclosed.

Phenological Survey
Montana State University
Bozeman, MT 59717

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Phenological Survey
Montana Agricultural Experiment Station
Bozeman, Montana 59717

November 28, 1983

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1983 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

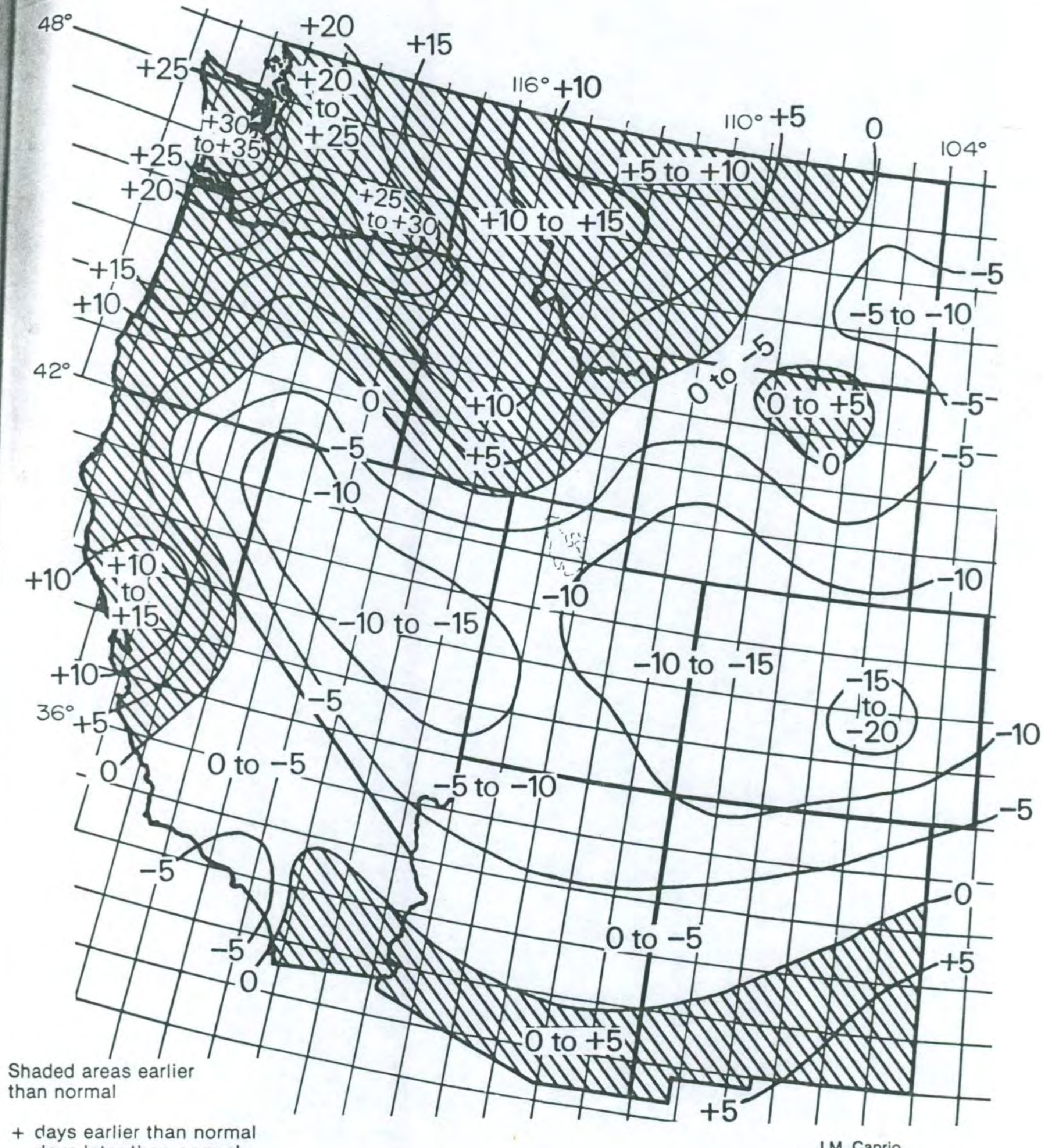
Honeysuckle Bloom

A map of begin bloom date anomaly for the Western Region for honeysuckle (i.e., the number of days difference between the begin bloom date and the normal begin bloom date) is shown in Figure 1. The average date at each location for the 7-year period, 1969-1975, when the honeysuckle begins to bloom, is considered to be the normal date of begin bloom. At least portions of all states except Washington experienced later than normal honeysuckle bloom in the spring of 1983. Honeysuckle bloom occurred more than 10 days later than normal in areas extending from northwestern California to western Utah and from central and eastern Utah to eastern Colorado. This later than normal zone included parts of southern Wyoming and northwestern New Mexico. Latest anomalies of 15 to 20 days were reported in Colorado in an area extending southward from about Denver to south of Colorado Springs. Parts of southwestern California and eastern Montana were 5 to 10 days later than normal.

Honeysuckle bloom began earlier than normal in the Pacific Northwest and Northern Rocky Mountain areas and in some coastal and extreme southern locations. Bloom was more than 20 days earlier than normal over most of Washington and parts of northern Oregon. Anomalies of more than 30 days are a rare occurrence, and this spring some areas in southwestern Washington were more than 30 days earlier than normal. Honeysuckle bloom generally occurred from 10 to 15 days earlier than normal in central and northern Idaho as well as in western Montana. An areas in central California was 10 to 15 days earlier than normal.

Lilac Bloom

A map of begin bloom date anomaly for the Western Region for the common purple lilac (i.e., the number of days difference between the begin bloom date and the normal begin bloom date) is shown in Figure 2.



J.M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, Montana Nov. 28, 1983

FIGURE 1. Departure of Begin Honeysuckle Bloom Date from Normal, Spring 1983.

The average date at each location for the 7-year period, 1957-1966, when the lilac begins to bloom, is considered to be the normal date of begin bloom. Most of the West was later than normal in the spring of 1983 with many areas experiencing bloom of more than 10 days later than normal. Bloom was more than 10 days later than normal in parts of California, Oregon, Nevada, Idaho, Utah, Montana, Wyoming, and Colorado. Most extreme lateness, exceeding 15 days later than normal, occurred in two areas: (1) northwestern California and western Nevada and (2) northern Colorado and southeastern Wyoming. Included in the first zone are Susanville and Bridgeport, California and Reno and Lovelock, Nevada. Included in the second zone are Fort Collins, Boulder and Steamboat Springs, Colorado and Wheatland, Laramie and Cheyenne, Wyoming.

Lilacs bloomed earlier than normal in the Pacific Northwest and southwestern and southern areas. Bloom was more than 10 days earlier than normal in western Washington and the northwestern corner of Oregon, in a section of southeastern Washington and northeastern Oregon and parts of coastal California. Parts of western Washington were more than 20 days earlier than normal.

Monthly Temperature Anomalies

The months of January, February and March were much warmer than normal over nearly the entire Western Region. Most extreme temperature anomalies generally occurred in Montana where temperatures were warmer than normal by +14°F, +12°F and +8°F in January, February and March, respectively. The areas in Washington and surrounding states which experienced a very early season also had a warmer than normal April. A warm winter in the interior-north does not necessarily mean an early phenological season as evidenced this spring when lilacs bloomed later than normal over the entire state of Montana and adjoining areas.

The areas of later than normal honeysuckle and lilac bloom in the central portion of the Western Region were colder than normal in April, May and June. Temperature anomalies in this area were commonly more than 4°F lower than normal in both April and May with extremes of more than 6°F below normal in parts of Colorado and Wyoming.

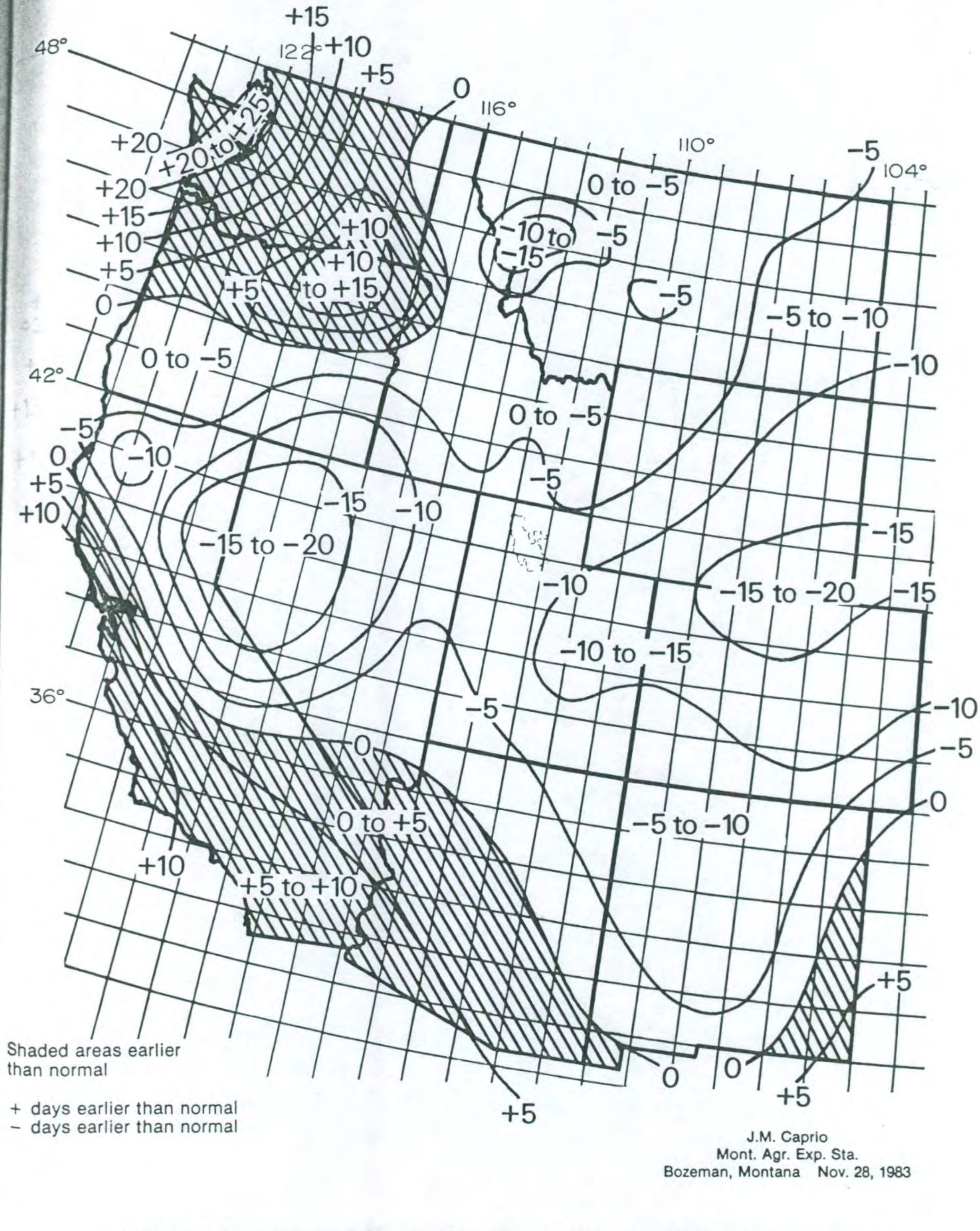


FIGURE 2. Departure of Begin Lilac Bloom Date from Normal, Spring 1983.

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio

Phenological Survey
Montana Agricultural Experiment Station

Bozeman, Montana 59717

December 14, 1984

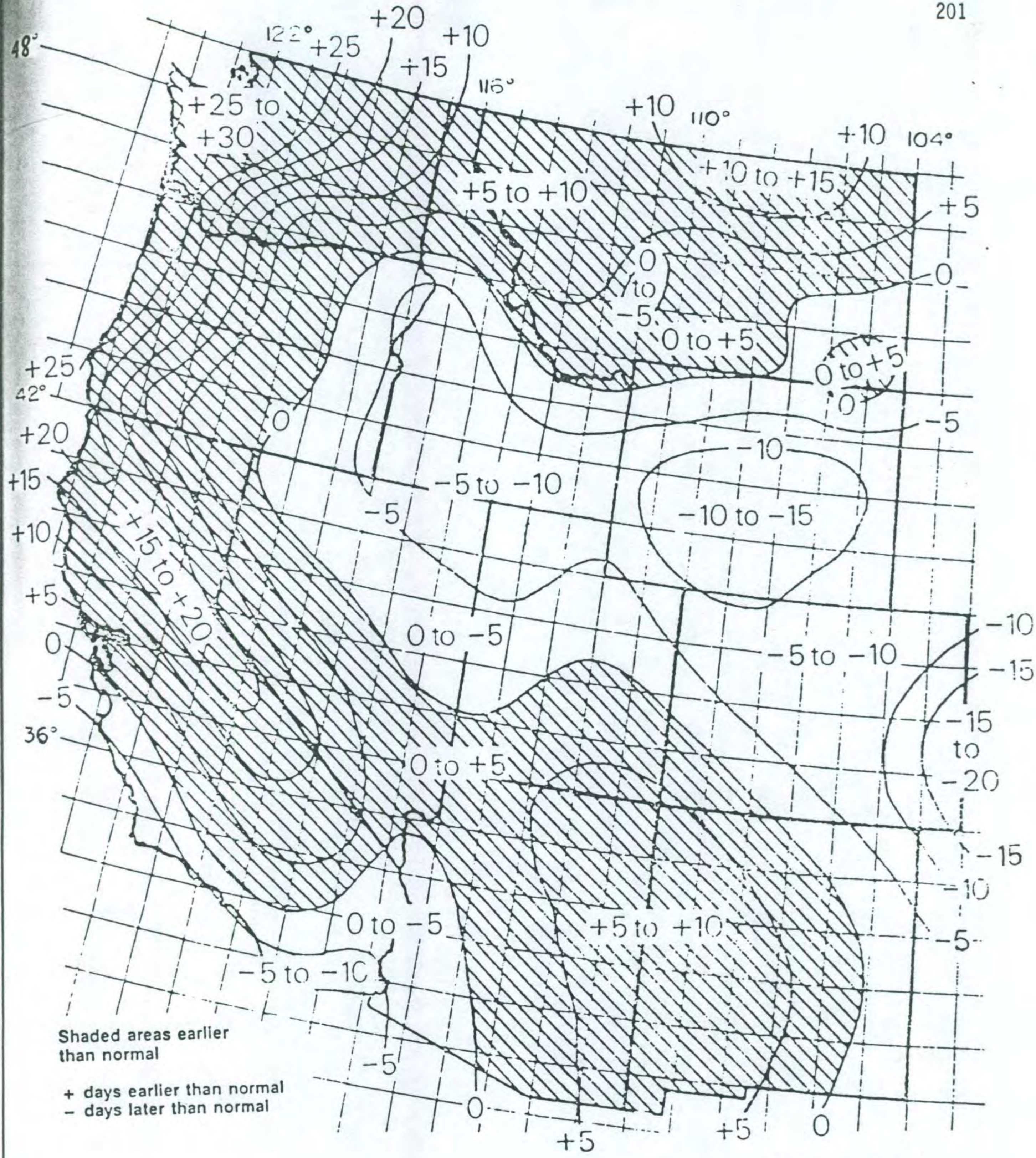
DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1984 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom

The time of begin bloom for honeysuckles was generally earlier than normal in northern, western, and southern areas of the western states, while central and eastern parts of the Western Region were mostly later than normal. Honeysuckle begin bloom dates were earlier than normal over most of western New Mexico, Arizona, California, Oregon, and Washington. These areas of earlier than normal bloom were generally characterized by higher than normal temperatures from December 1983 through March 1984. Honeysuckles also bloomed earlier than normal over most of Montana.

Earliest anomalies occurred in western parts of Oregon and Washington where bloom was more than 25 days earlier than normal. Most of Washington, as well as parts of California, Nevada, Oregon, and Montana were more than 10 days earlier than normal.

Bloom mostly occurred later than normal in Colorado, Wyoming, Idaho and Utah. These areas of later than normal bloom were associated with lower than normal temperatures for the month of April. Temperatures in the eastern Colorado area where the bloom was later than normal averaged colder than normal in March. Later than normal bloom areas in Washington,



J M Caprio
Mont Agr Exp Sta
Bozeman Montana Dec 14 1984

Figure 1 Departure of Honeysuckle Begin Bloom Date from Normal Spring 1984 central and northern Idaho, and western Montana also experienced a colder than normal May. Latest departures from normal occurred in eastern Colorado and central Wyoming, where plant development was more than 10 days later than normal.

Lilac Bloom

The time of begin bloom for lilacs was generally earlier than normal in southern and extreme western areas of the West and was later than normal in central, eastern, and northern parts of the region. Lilacs began to bloom earlier than normal over parts of Arizona and nearly all of California as well as in the western parts of Oregon and Washington and most of New Mexico. Most other areas of the Western Region experienced later than normal bloom.

Earliest anomalies were reported from locations near the Pacific Ocean, extending along much of the California coastal area where plant development was more than 25 days earlier than normal. The season was more than 10 days earlier than normal in a large area, including southwestern Arizona, most of California, and western parts of Oregon and Washington.

The latest anomalies occurred in southeastern Colorado and northeastern New Mexico where the season was more than 15 days later than normal. The season was more than 10 days later than normal in eastern parts of Washington and Oregon and in parts of Idaho, Montana, Wyoming, Nevada, Utah, Colorado, and New Mexico. Only Arizona and California did not have some areas where the season was more than 10 days later than normal.

Sometimes the departures from normal are reversed for the honeysuckle and the lilac. This happened in the spring of 1984. Bloom was generally later than normal for lilacs in eastern Washington, northern

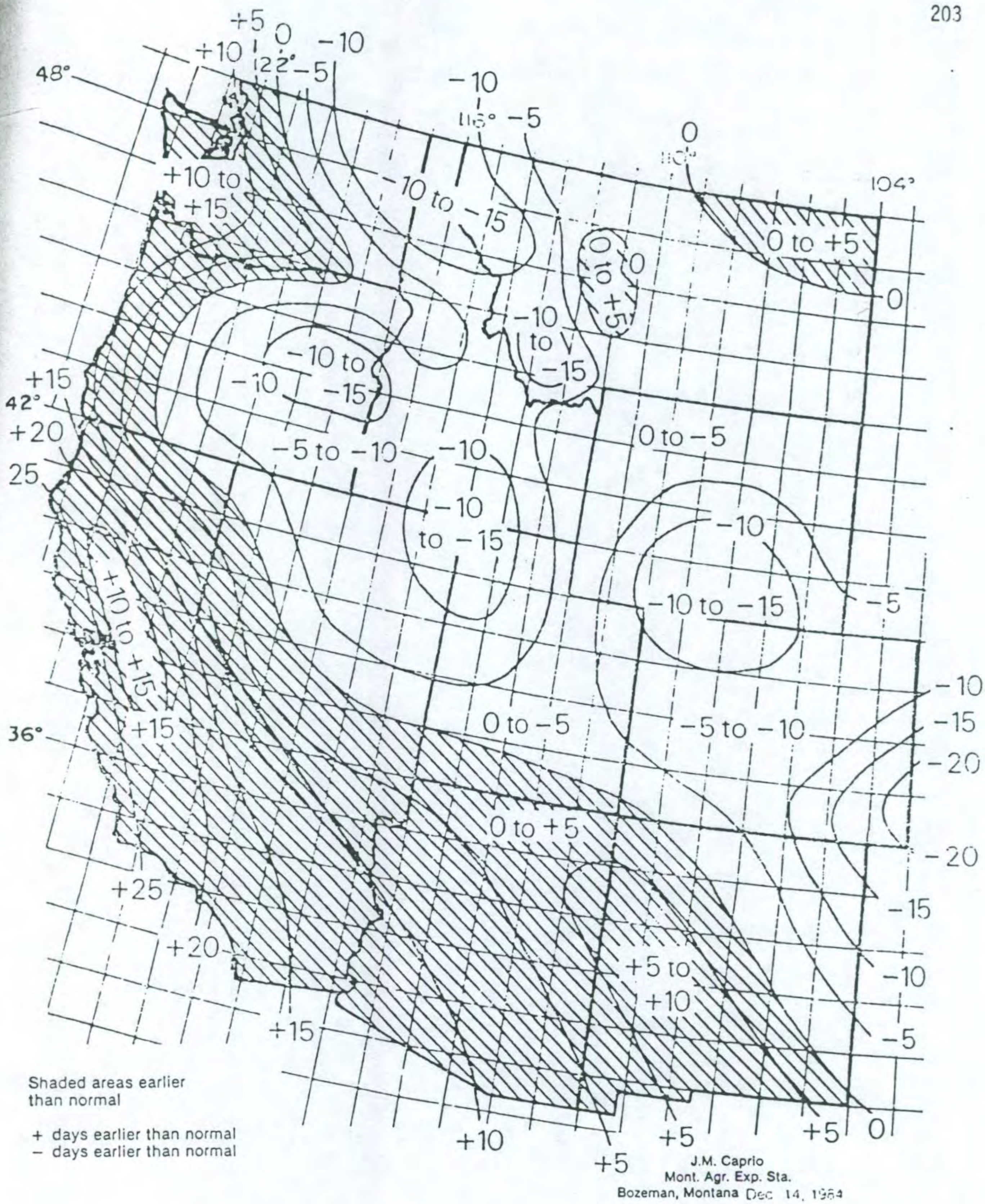


FIGURE 2. Departure of Begin Lilac Bloom Date from Normal, Spring 1984.

Idaho, and Montana, but earlier than normal for honeysuckle over this same area.

Monthly Temperature Anomalies

December of 1983 was an extremely cold month over most of Idaho, Montana, Wyoming, and Colorado. Parts of north-central Montana averaged more than 22°F colder than normal in December 1983. Lower than normal, but less extreme temperatures, also occurred over Washington, Oregon, and eastern New Mexico. The extreme ice-age-like cold had dire impacts upon vegetation as far south as Texas and Louisiana. At the same time, southwestern areas were warmer than normal in December, even exceeding 6°F warmer than normal in parts of Arizona, California, and Nevada.

January and February were colder than normal in central parts of the Western Region. Some of these areas experienced anomalies exceeding 10°F colder than normal during both January and February. Other areas of the Region were generally warmer than normal.

March was mostly warmer than normal over most of the region. Exceptions were in south-central Colorado and northern New Mexico where it was colder than normal in March by as much as 4°F.

April averaged colder than normal over most of the Western Region. Exceptions occurred in southwestern and northeastern areas of the Region.

May averaged warmer than normal, especially in southwestern areas where anomalies exceeding 6°F occurred over an extensive six-state area. Exceptions occurred in northwestern and extreme northeastern areas where it was cooler than normal.

June tended to be colder than normal over most of the Western Region. A notable exception occurred over part of Arizona and most of California where temperatures averaged warmer than normal in June.

The Variation of Spring Since the Mid-50's at Two Locations

Phenological observations on the common purple lilac were started in Montana in 1956 and throughout the Western Region in 1957. Normal dates of begin bloom have been determined based on the average date of begin bloom for the 10-year period 1957-1966. It is of interest to know whether there has been a tendency for spring to begin earlier or later than normal over the years as indicated by the time of begin bloom of the lilac, since such information may be indicative of climatic change or cyclic tendencies. Annual dates of begin bloom have been determined for two locations, Seattle-Tacoma, Washington and Glasgow, Montana, from yearly anomaly maps that were drawn each year since the survey began. These annual dates of begin bloom are shown in Figures 3 and 4. Also shown in the figures is a 7-year running average.

For Glasgow the 1960's and early 1970's were characterized by somewhat later than normal springs. Since the mid-1970's, bloom has tended to be earlier than normal, but the last 3 years have averaged later than normal. The 7-year average reached a minimum in 1968 and a maximum in 1979, 11 years later.

For Seattle-Tacoma the bloom tended to be later than normal from about the mid-1960's until the late 1970's. Since the late 1970's, bloom has tended to be earlier than normal. The 7-year running average reached a minimum in 1973 and now appears to be at or approaching a maximum.

Figure 3. DATES WHEN COMMON PURPLE LILAC BEGAN TO BLOOM

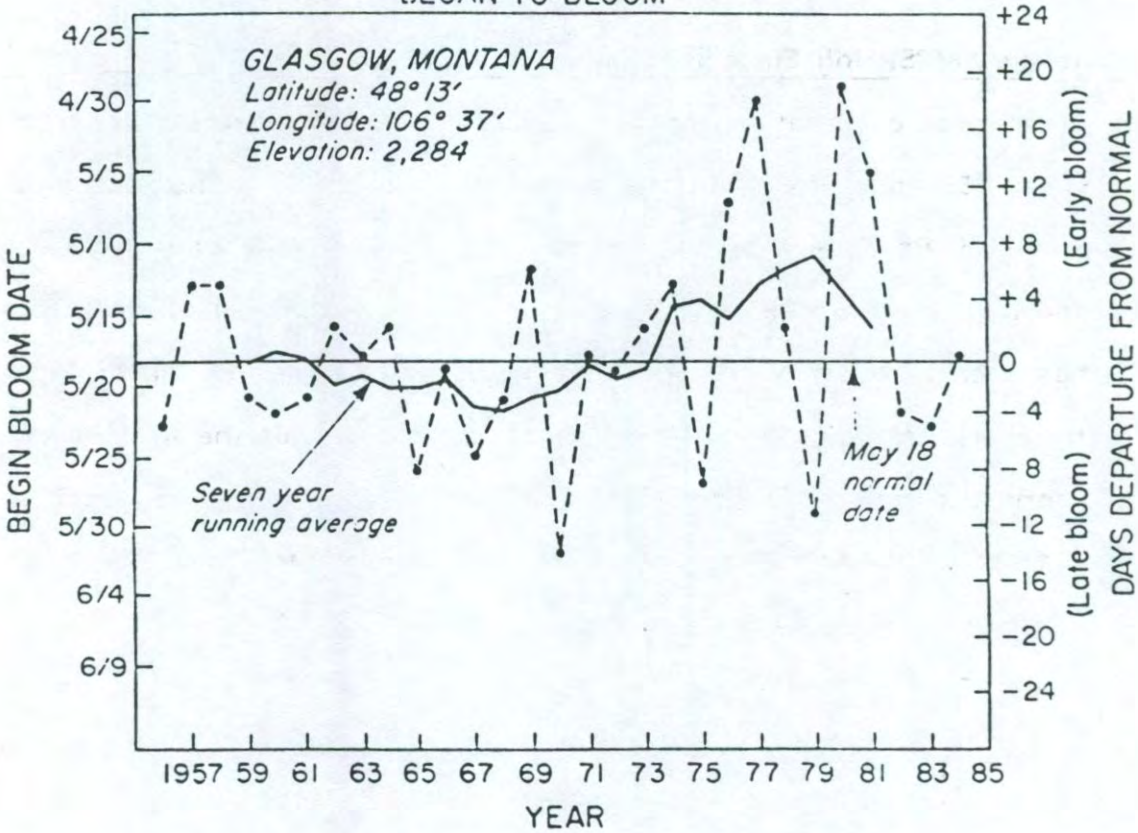
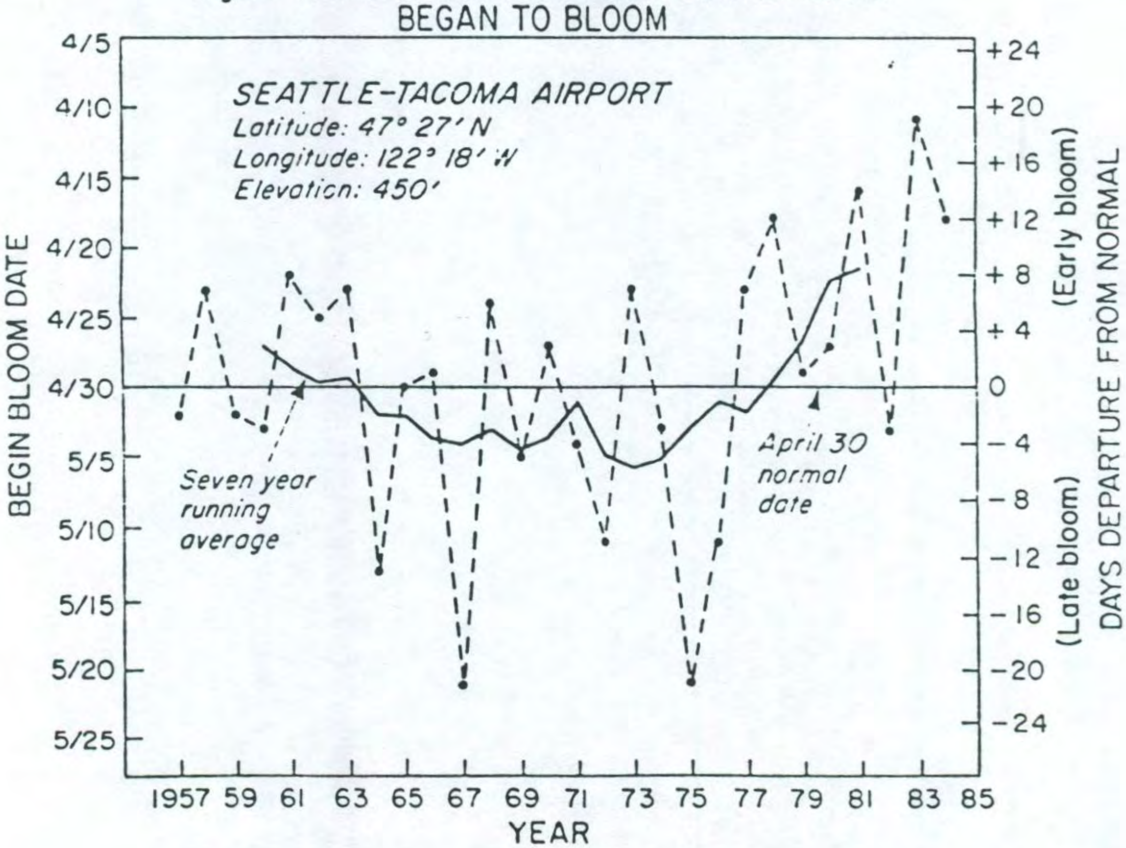


Figure 4. DATES WHEN COMMON PURPLE LILAC BEGAN TO BLOOM



A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio

Phenological Survey
Montana Agricultural Experiment Station

Bozeman, Montana 59717

November 25, 1985

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1985 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

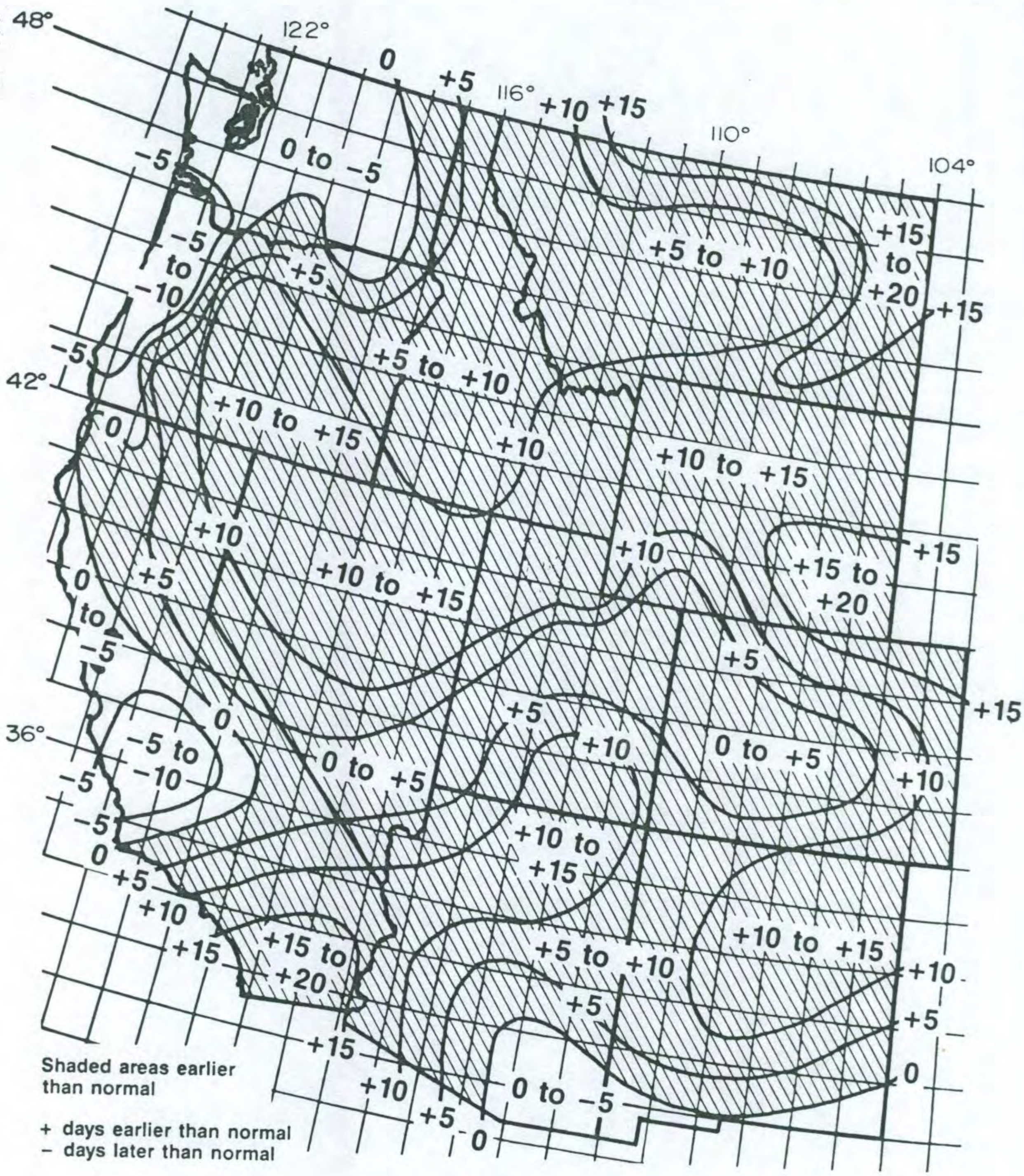
Honeysuckle Bloom

A map of begin bloom date anomaly for the Western Region for honeysuckle (i.e., the number of days difference between the begin bloom data in 1985 and the normal begin bloom date) is shown in Figure 1. The time of begin bloom for honeysuckles was earlier than normal over most of the Western Region. Earliest anomalies, ranging from 15 to 20 days earlier than normal, occurred in southern California, northern and eastern parts of Montana, northeastern Colorado, and southeastern Wyoming. Extensive areas of the West had begin bloom date occurrences between 10 and 15 days earlier than normal.

Honeysuckle begin bloom phase occurred later than normal in parts of California, Oregon, and Washington, as well as southeastern Arizona and extreme southern New Mexico. Most extreme late anomalies were in the 5 to 10 days later than normal range.

Lilac Bloom

A map of begin bloom date anomaly for the Western Region for the common purple lilac (i.e., the number of days difference between the



J.M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, Montana, Nov. 1985

Figure 1. Departure of Begin Honeysuckle Bloom Date from Normal, Spring 1985

begin bloom data in 1985 and the normal begin bloom date) is shown in Figure 2. The time of begin bloom for lilacs was earlier than normal over most of the Western Region. Earliest anomalies, exceeding 20 days earlier than normal, occurred in coastal areas of central and southern California. Anomalies exceeding 15 days earlier than normal occurred over an extensive area of the Southwest that included parts of 5 states (Arizona, California, New Mexico, Nevada, and Utah) and smaller areas in northern Montana and north-central Colorado.

Lilac begin bloom phase occurred later than normal only in two small areas, one along a narrow coastal strip of northern California and Oregon and the other in central Washington. Most extreme late anomalies occurred along coastal area of Oregon and were in the 5 to 10 days later than normal range.

Only once during the 1957-1985 period of lilac phenology recordings did the early anomaly area cover nearly as extensive an area of the West and that was 19 years ago in the spring of 1966.

Monthly Temperature Anomalies

December of 1984 was an extremely cold month over the northern third of the Western Region. Many locations in this area were more than 10 degrees Fahrenheit colder than normal. Temperature anomalies elsewhere in the West were mostly within 4 degrees (above or below) of normal.

The pattern of January and February 1985 temperature anomalies were surprisingly similar with an extreme colder than normal area extending from eastern Oregon and Idaho and covering western parts of Montana, northern Nevada, northern Utah, and parts of Wyoming. Elsewhere, temperatures tended to be within 2 degrees (above or below) of normal.

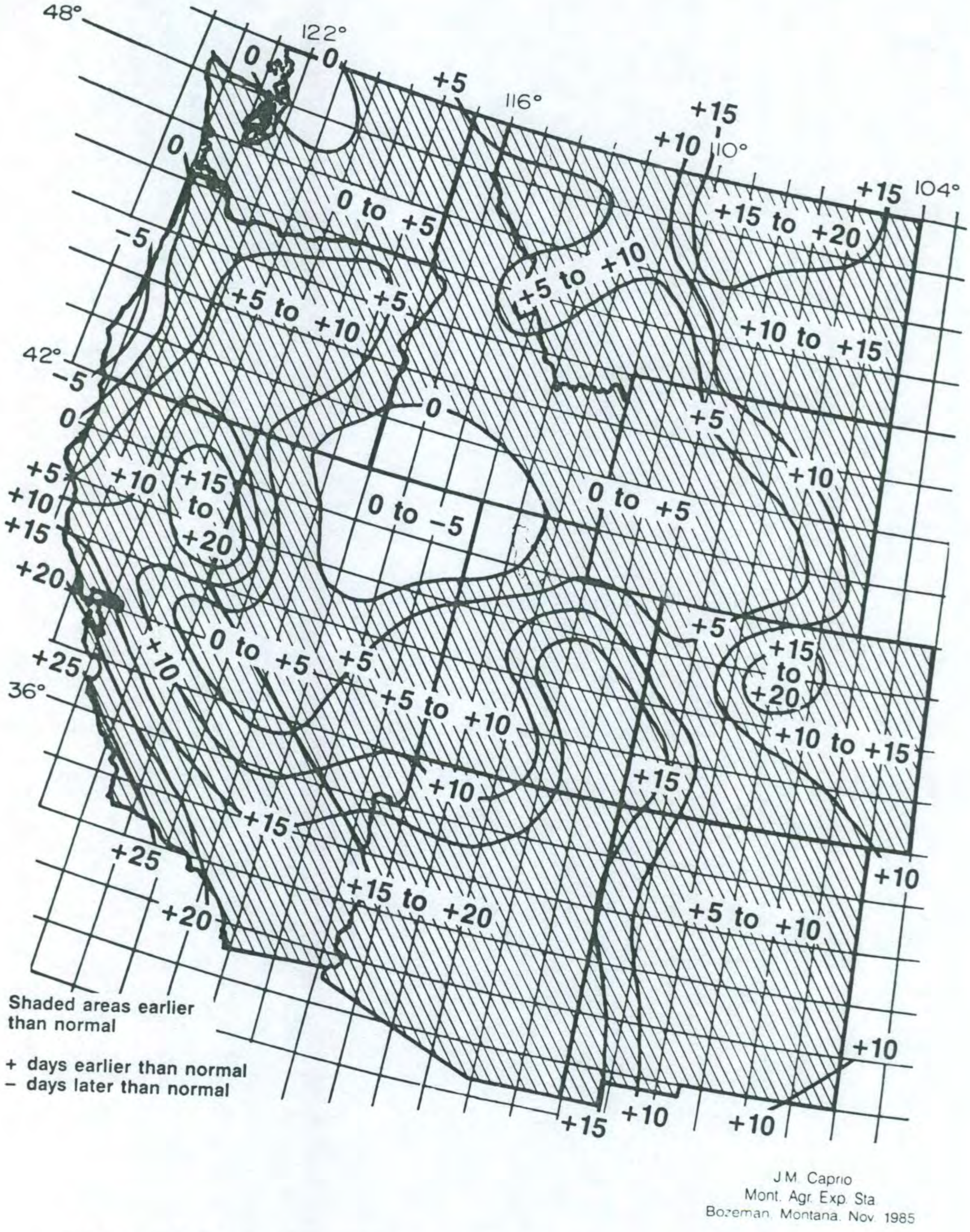


Figure 2. Departure of Begin Lilac Bloom Date from Normal, Spring 1985

The lower than normal temperature anomalies, noted in January and February over much of eastern Oregon and most of Idaho continued during March. Much of California and southern Nevada were more than 2 degrees colder than normal. Coastal areas of Oregon and Washington were a degree or two cooler than normal. About the eastern third of the region was warmer than normal by at least 2 degrees in March. In northeastern Montana temperatures averaged from 4 to more than 8 degrees warmer than normal.

April was warmer than normal over almost the entire Western Region. Anomalies exceeding 4 degrees extended over more than half of the region and large areas were from 6 to 8 degrees warmer than normal. Only in extreme northwestern Washington was it somewhat cooler than normal in April.

The warmer than normal anomaly pattern over most of the Western Region continued during May. Temperatures were more than 4 degrees warmer than normal in western Arizona, and over much of Montana and Wyoming. It was somewhat cooler than normal only in parts of California, Oregon, northwestern Nevada, and extreme northwestern Washington.

The higher than normal temperatures of April and May continued during June over most of the Western Region. In parts of California and Nevada anomalies exceeding 4 degrees were common. Eastern parts of the region as well as eastern Oregon and northwestern Washington were somewhat cooler than normal.

Phenological observers of 25 years or more are listed on the following page.

Listed below are the names of phenological observers who have provided data for the Western Phenological Survey on the common purple lilac for at least 25 years.

Allredge, M. J.
Barclay, L.
Beatty Weather Bureau
Big Bar Ranger Station
Birtic, Frank
Bowes, Robert
Brown, M. J.
Bushby, L. F.
Cady, L. C.
Cameron, Ruth
Copley, C. B.
Craig, Betty
Draper, E. & J.
Eggenberger, G.
Eugene Weather Bureau
Fairbanks, L. & C.
Fey, Anthony
Flynn, William
Harker, Mary
Hennes, Bertha
Hensley, W.
Hubbard, M.S.
Huntley Experiment Station
Jennings, Walt
Johnson, Evelyn
Joiner, Mary
King, Etta
Kronebusch, D. A.
McAtee, L. & E.
McKenna, Ross
Medicine Lake Wildlife
Montana State University
Monte Vista Bur. of Land Reclamation
Moore, Delmar
Parsons, Lloyd
Payton, Everett
Peterson, W. J.
Philipsburg Ranger Station
Plog, Harry
Plymale, Laird
Richland Atomic Energy
Rocky Ford Experiment Station
Rogers, F. A.
St. Ignatius Flathead Irrigation
Saltmarsh, V. E.
Schoenradt, Roy
Shaw, J. & G.
Staats, R. E.
Sunnyside Bur. of Land Reclamation
Turner, Frank
Ukiah Fire Department
Vaught, Merrill
Wall, J. F.
Wall, O. J.
Warnock, Hazel
Wheeler, Soper
Wiggins, S. & W.
Wilson, M.
Wood, James
Worland Holly Sugar Company
Wright, Lida

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Phenological Survey
Montana Agricultural Experiment Station
Bozeman, Montana 59717

December 10, 1986

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1986 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom

A map of begin bloom date anomaly for the Western Region for honeysuckle (i.e., the number of days difference between the begin bloom date in 1986 and the normal begin bloom date) is shown in Figure 1. Bloom occurred earlier than normal in 1986 over most of the Western Region. Only portions of Idaho, Montana, and Wyoming were later than normal. Most extreme early anomalies of 25 to 30 days are indicated in two areas, eastern Colorado and in a larger area extending from northeastern California to southern Nevada. Bloom was 20 to 25 days earlier than normal in large areas centered in central New Mexico and northwestern Washington. Coastal areas of Oregon were 10 to 15 days earlier than normal.

Honeysuckle bloomed up to 5 days later than normal in parts of northern Idaho, northeastern Washington, and both northwestern and northeastern Montana.

Lilac Bloom

Since the normal times of honeysuckle and lilac bloom differ, anomaly patterns of the two plant species might be expected to differ significantly in some years. Lilac bloom, on an average, tends to occur later than honeysuckle bloom in much of the central portion of the Western Region as well as in the western portions of Washington, and later than honeysuckle over most of the southern and western portions of the Western Region. Greatest differences in normal bloom dates between the two species occur in southwestern California where lilacs normally bloom more than three weeks later than honeysuckle.

Most of the Western Region experienced earlier than normal lilac bloom in the spring of 1986 (Figure 2). Only portions of Idaho, Montana, and Wyoming were later than normal. Most extreme early anomalies of 35 to 40 days are indicated in parts of southern California. Bloom was more than 25 days earlier than normal in southeastern Colorado, over an extensive

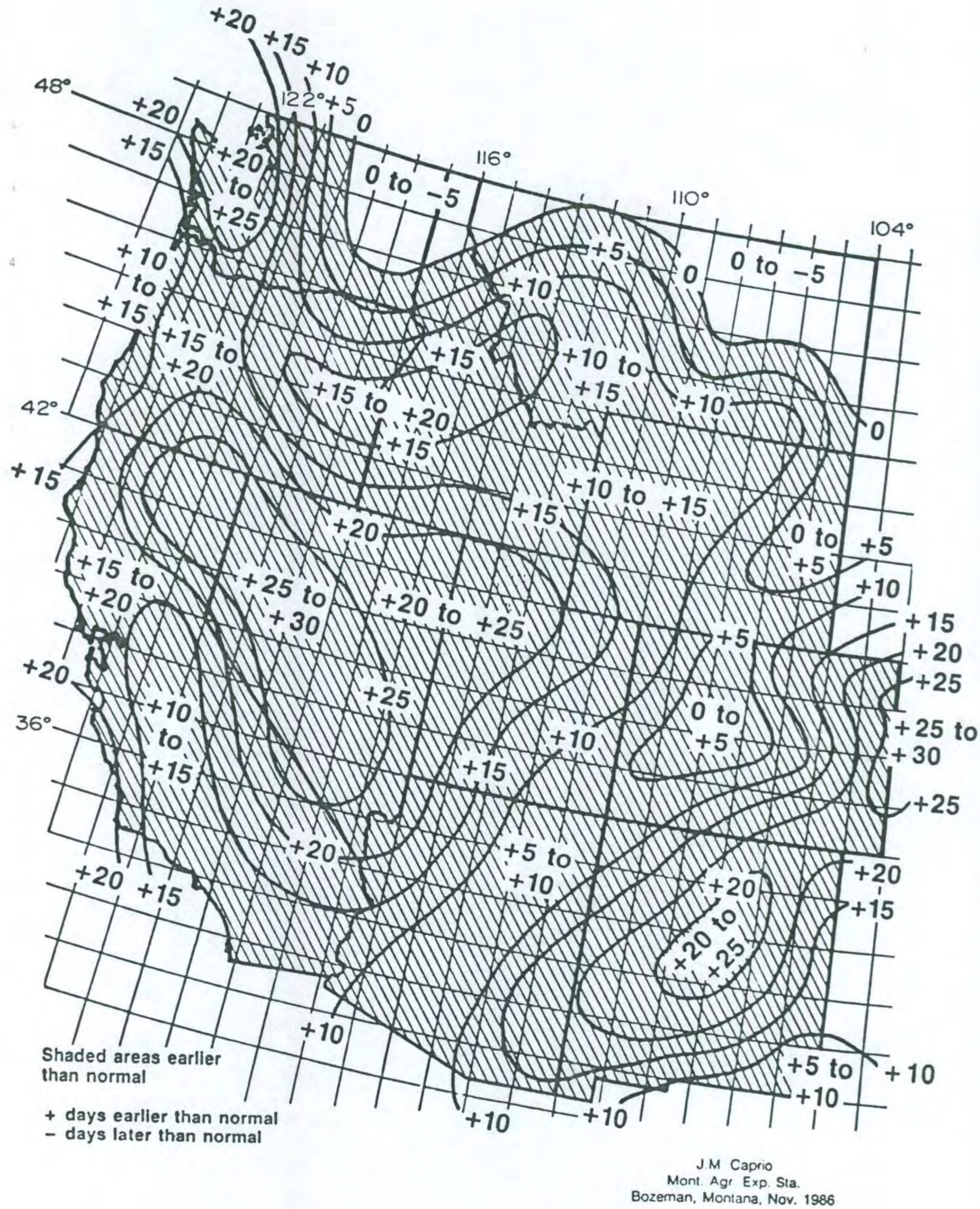


Figure 1. Departure of Begin Honeysuckle Bloom Date from Normal, Spring 1986

area of the southwest covering a large area of central and southern California, and parts of southern Nevada and western Arizona. Lilac bloom was only 1 to 5 days earlier than normal over an extensive area of northern Nevada, southeastern Oregon, and southwestern Idaho. Honeysuckle bloom, in contrast, was generally near 20 days earlier than normal in this same general area. Lilacs in Coastal areas of Oregon and Washington were 10 to 15 days earlier than normal.

Lilac bloom was up to 5 days later than normal in northern portions of Idaho, Montana, and Washington.

Monthly Temperature Anomalies

December 1985 was much colder than normal in Idaho, Washington, western Montana, and most of Oregon, Utah, and Nevada. Temperatures in central Idaho averaged more than 18°F colder than normal in December. December temperatures elsewhere in the Western Region were mostly near or above normal. Thereafter, from January 1986 through June 1986, monthly temperatures mostly averaged above normal.

January temperature anomalies exceeding 8°F warmer than normal were experienced over much of the Western Region. January temperatures averaged more than 15°F above normal over much of Montana. Only a small area extending from eastern Oregon to northern Utah and western Wyoming had lower than normal temperatures in January.

February temperatures averaged mostly colder than normal in Montana and Washington and warmer than normal in all other areas except parts of northern and eastern Wyoming. Anomalies exceeding 4°F warmer than normal were widespread over the southern half of the Western Region.

March averaged warmer than normal over the entire Western Region. Anomalies exceeding 6°F were recorded in most areas, with extreme anomalies of 10 to 14°F occurring over most of Montana.

With the exception of Washington, nearly all areas averaged warmer than normal in April. Anomalies of 1 to 2°F were most extensive, while southeastern locations averaged mostly 2 to 5°F warmer than normal. A mid-April cold outbreak caught vegetation in an unusually advanced stage of development in Colorado, Montana, Utah, and Wyoming, causing much freeze damage. Some locations in Montana and Wyoming recorded below zero temperatures during that cold snap with an extreme of -12°F registered at Denton and Culbertson, Montana.

Temperatures in May averaged near normal ($\pm$ 2°F) in all areas except southwestern locations where temperatures averaged more than 4°F warmer than normal in some locations.

June was warmer than normal except over most of New Mexico and parts of adjoining states. Many areas were more than 4°F warmer than normal.

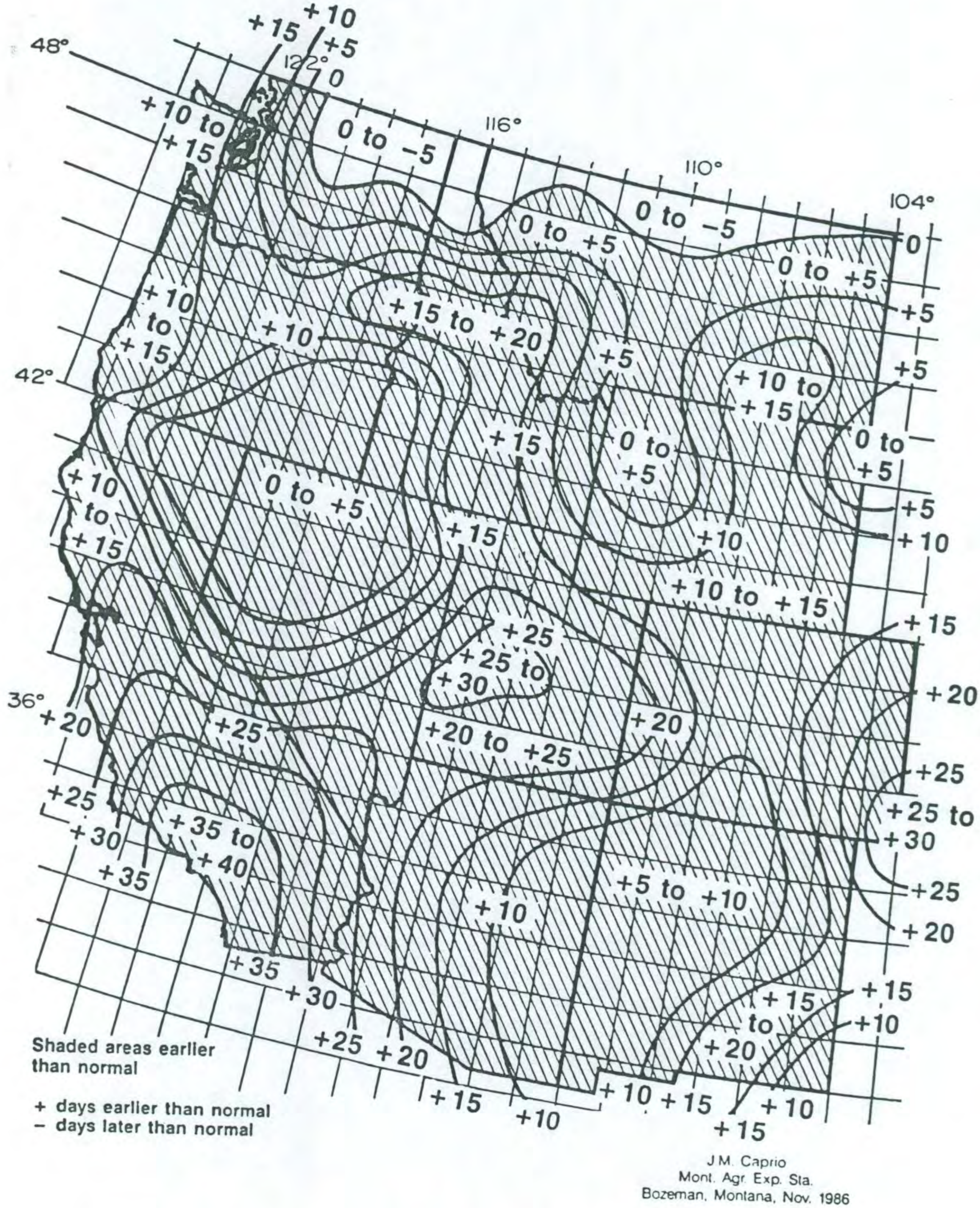


Figure 2. Departure of Begin Lilac Bloom Date from Normal, Spring 1986

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Phenological Survey
Montana Agricultural Experiment Station
Bozeman, Montana 59717

December 8, 1987

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1987 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom

A map of begin bloom date anomaly for the Western Region for honeysuckle (i.e., the number of days difference between the begin bloom date in 1987 and the normal begin bloom date) is shown in Figure 1.

Honeysuckle bloom over most of the Western Region occurred earlier than normal in the spring of 1987 while most of Arizona and New Mexico as well as western portions of Oregon and California were later than normal (Figure 1). Spring was also earlier than normal over most of the Western Region last year. This spring the most extreme early anomalies of more than 25 days occurred in an oval area extending from northwestern Wyoming and adjacent areas of Idaho, northeastward into central Montana. Much of the northern half of the Western Region was more than ten days earlier than normal. Most extreme later than normal anomalies of more than ten days are indicated in southeastern New Mexico.

Lilac Bloom

Since the normal times of honeysuckle and lilac bloom differ, anomaly patterns of the two plant species might be expected to differ significantly in some years. Lilac bloom, on an average, tends to occur later than honeysuckle bloom in much of the central portion of the Western Region as well as in the western portions of Washington, and later than honeysuckle over most of the southern and western portions of the Western Region. Greatest differences in normal bloom dates between the two species occur in southwestern California where lilacs normally bloom more than three weeks later than honeysuckle.

Most of the Western Region experienced earlier than normal lilac bloom in the spring of 1987 (Figure 2). Southern California and nearly all of Arizona and New Mexico were later than normal. Extreme early anomalies of more than 25 days are indicated in an oval area extending from northwestern Wyoming and adjacent areas of Idaho, northwestward into central Montana. Two smaller areas of more than 25 days earlier than normal are indicated in the Bitterroot Valley area of western Montana and in the extreme northeastern corner of Montana. Much of the northern half of the Western Region was more than 15 days earlier than normal. Most

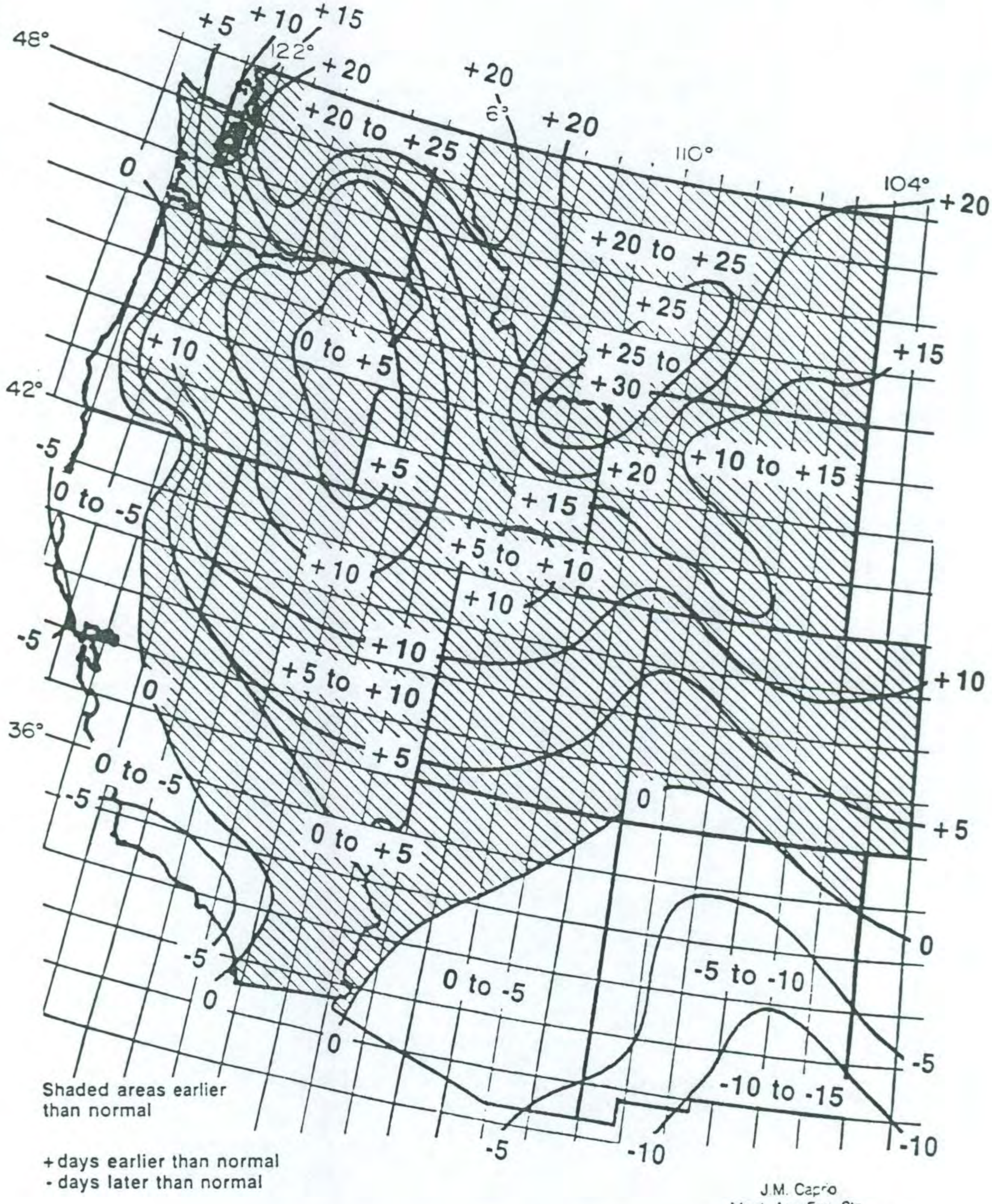


Figure 1. Departure of Honeysuckle Begin Bloom Date from Normal, Spring 1987.

extreme later than normal anomalies are indicated in portions of western New Mexico and eastern Arizona where bloom was more than ten days later than normal.

Monthly Temperature Anomalies

December 1986 temperatures were mostly near normal throughout the Western Region except in northern, central, and eastern parts of Montana where it was 4°F to 10°F warmer than normal. January temperatures were generally near normal but an area that extended over most of Montana and portions of Wyoming and Colorado was more than 4°F warmer than normal. Extreme anomalies of more than 16°F warmer than normal occurred near the Canadian border in northern Montana. February temperatures were mostly above normal over most of the Western Region. Montana experienced a very warm February with more than half of the state at least 6°F above normal and anomalies of more than 16°F were reported from the northeast corner of the state. Temperatures in March were mostly warmer than normal in the north and somewhat cooler than normal in southern areas. Most extreme warm anomalies in March of more than 6°F occurred in Montana and parts of adjacent states. Except for portions of New Mexico and adjacent states, the entire Western Region was warmer than normal during April, May, and June.

Western Regional Research and Phenological Observations

There are at least two Western Regional committees (listed below) that have utilized phenological information to assist in their research studies. Listed below are the names of one member of these two committees at each Agricultural Experiment Station location. More persons at these institutions and in other states and Canada as well as participating federal agencies are also active members of these committees.

W-130 "FREEZING DAMAGE AND PROTECTION OF DECIDUOUS FRUIT AND NUT CROPS"

AZ	John Moon	Tucson
CA	Vito Polito	Davis
	Steve Lindow	Berkeley
CO	Steve Wallner	Fort Collins
	Rocky Renquist	Grand Junction
MT	Nancy Callan	Corvallis
	Joseph Caprio	Bozeman
OR	Les Fuchigami	Corvallis
WA	Del Ketchie	Wenatchee
	Ed Proebsting	Prosser
	Rita Hummel	Puyallup
UT	Schuyler Seeley	Logan

WRCC-47 "CLIMATIC INFORMATION FOR AGRICULTURE AND NATURAL RESOURCES"

AZ	Allan Mathias	Tucson
CA	James Bradley	Berkeley
	Joyce Fox	Davis
CO	Thomas McKee	Ft. Collins
ID	Myron Molnau	Moscow
MT	Joseph Caprio	Bozeman
NM	Kenneth Kunkel	Las Cruces
OR	Kelly Redmond	Corvallis
TX	Marshall McFarland	College Stn.
UT	Gaylen Ashcroft	Logan
WY	Larry Pochop	Laramie

Your assistance in reporting phenological observations on honeysuckle and lilac is making an important contribution and is much appreciated.

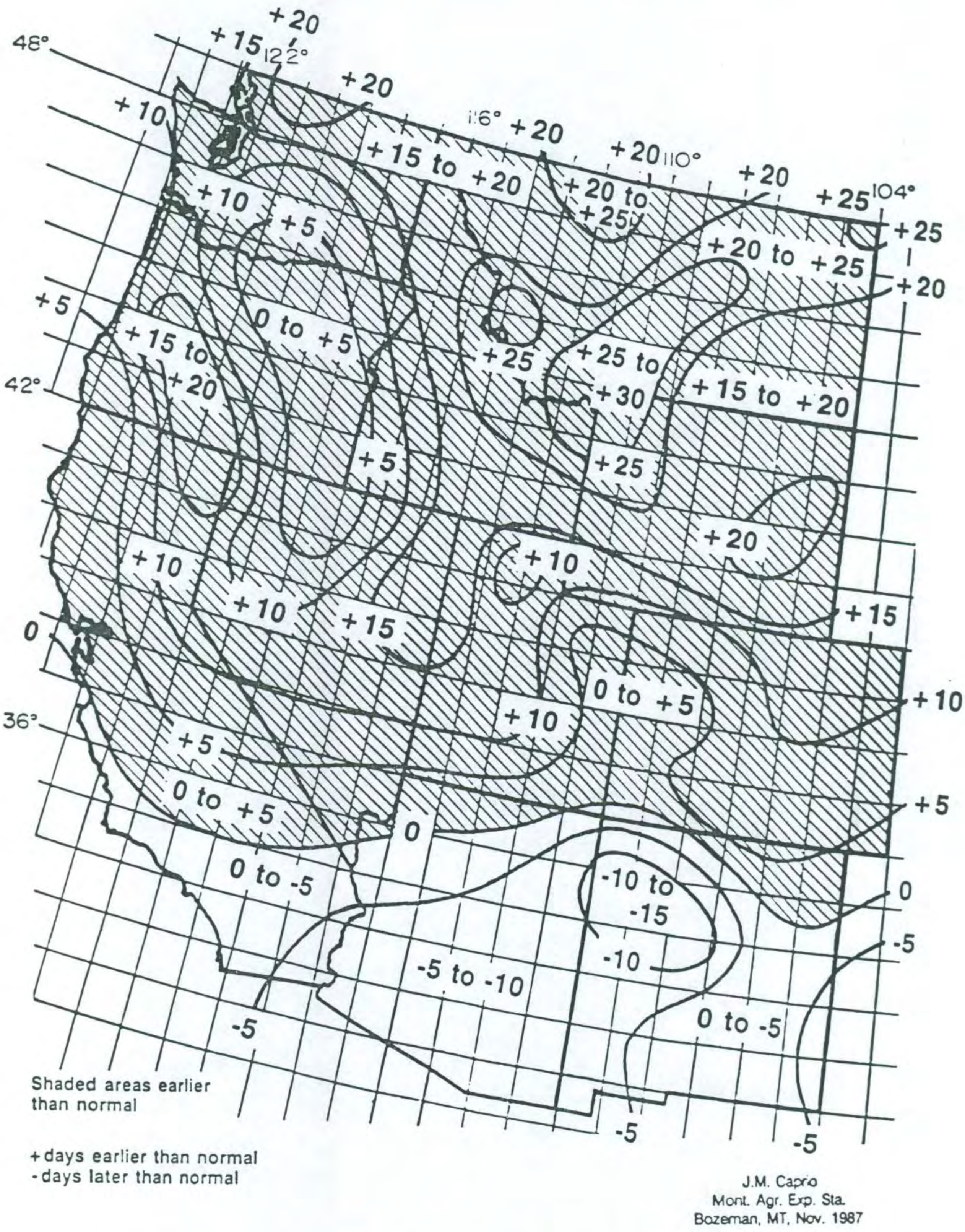


Figure 2. Departure of Lilac Begin Bloom Date from Normal, Spring 1987.

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Phenological Survey
Montana Agricultural Experiment Station
Bozeman, Montana 59717

December 28, 1988

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1988 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom

The Honeysuckle begin-bloom-phase occurred earlier than normal over most of the Western Region in the spring of 1988 (Figure 1). This is the fourth consecutive year that the greater portion of the Western Region was earlier than normal.

The major area of earlier than normal bloom extended from central California northeastward across the central Great Basin and into northern Idaho and Montana. Areas in southeastern Oregon, northern Nevada, and southwestern Idaho are indicated as 15 to 20 days earlier than normal. Many locations where bloom was earlier than normal experienced severe drought and forest fires during 1988.

Bloom was 1 to 5 days later than normal in coastal portions of extreme northern California, Oregon, and extreme southern Washington as well as in portions of Arizona, Colorado, Nevada, New Mexico, and Utah.

Lilac Bloom

The Lilac begin-bloom-phase was earlier than normal over almost the entire region in the spring of 1988 (Figure 2). This is also the fourth consecutive year that the lilac was earlier than normal over the greater portion of the Western Region. The most extreme earlier-than-normal area extended from California northeastward and included most of Nevada, Idaho, and Montana. Anomalies in most of this area were 10 to 15 days earlier than normal. The only later-than-normal area is indicated in the east-central part of New Mexico. Bloom was near normal over most of Oregon and Utah.

Monthly Temperature Anomalies

December 1987 temperatures were mostly colder than normal over most of the Western Region. A noted exception was the northeastern half of Montana where temperatures were 2 to 9°F warmer than normal. January 1988 temperatures were colder than normal in most central portions of the Region and warmer than normal in most of Arizona, California, and Montana, and in eastern Oregon and Washington. Parts of Colorado and Utah were more than 6°F colder than normal in January. February averaged warmer than normal over nearly all of the Western Region with

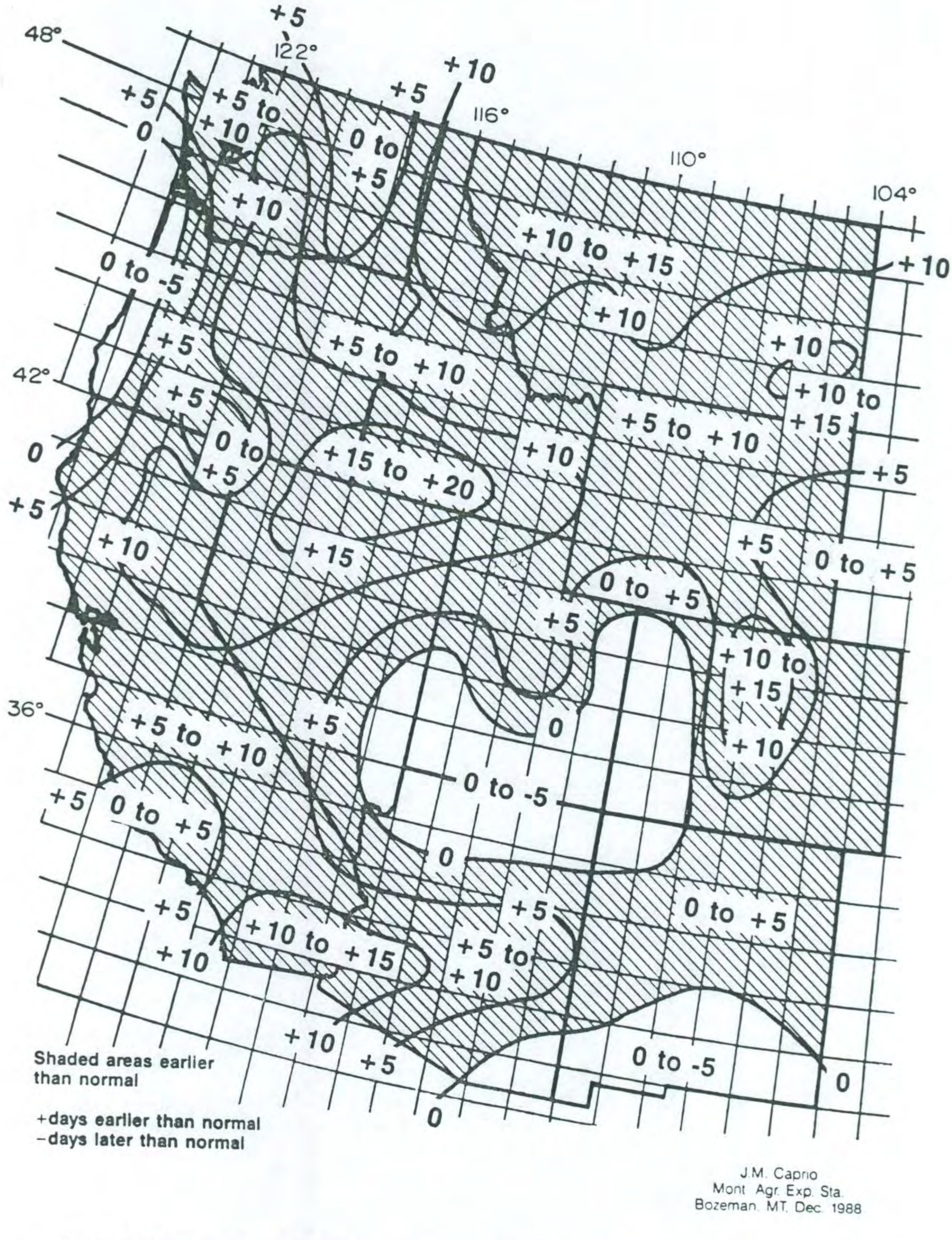


Figure 1. Departure of Honeysuckle Begin Bloom Date from Normal, Spring 1988.

the exception of most of Colorado and Utah, which was colder than normal. March averaged warmer than normal over most of the Region with extreme anomalies in Montana of more than 6°F warmer than normal over most of the State. March was cooler than normal over adjoining portions of Colorado, Utah, and Wyoming. Virtually the entire Region was warmer than normal in April except for southern New Mexico, where temperatures were 1 to 2°F below normal. May was warmer than normal except for southern California and a band extending from eastern New Mexico through southwestern Colorado, Utah, northern Nevada, Oregon, and central Washington, May anomalies in eastern Montana were more than 4°F to 7°F warmer than normal. Most of the region was warmer than normal in June with extreme anomalies exceeding 12°F above normal in eastern Montana and northeastern Wyoming. June was cooler than normal in Washington, northern Oregon, southern California, and much of New Mexico.

Western Regional Research and Phenological Observations

There are at least two Western Regional committees (listed below) that have utilized phenological information to assist in their research studies. Listed below are the names of one member of these two committees at each Agricultural Experiment Station location. More persons at these institutions and in other states and Canada as well as participating federal agencies are also active members of these committees.

W-130 "FREEZING DAMAGE AND PROTECTION OF DECIDUOUS FRUIT AND NUT CROPS"

AZ	John Moon	Tucson
CA	Vito Polito	Davis
	Steve Lindow	Berkeley
CO	Steve Wallner	Ft. Collins
	Rocky Renquist	Grand Junction
MT	Nancy Callan	Corvallis
	Joseph Caprio	Bozeman
OR	Les Fuchigami	Corvallis
WA	Del Ketchie	Wenatchee
	Ed Proebsting	Prosser
	Rita Hummel	Puyallup
UT	Schuyler Seeley	Logan

WRCC-47 "CLIMATIC INFORMATION FOR AGRICULTURE AND NATURAL RESOURCES"

AZ	Allan Mathias	Tucson
CA	James Bradley	Berkeley
	Joyce Fox	Davis
CO	Thomas McKee	Ft. Collins
ID	Myron Molnau	Moscow
MT	Joseph Caprio	Bozeman
NM	Kenneth Kunkel	Las Cruces
OR	Kelly Redmond	Corvallis
TX	Marshall McFarland	College Stn.
UT	Gaylen Ashcroft	Logan
WY	Larry Pochop	Laramie

Your assistance in reporting phenological observations on honeysuckle and lilac is making an important contribution and is much appreciated.

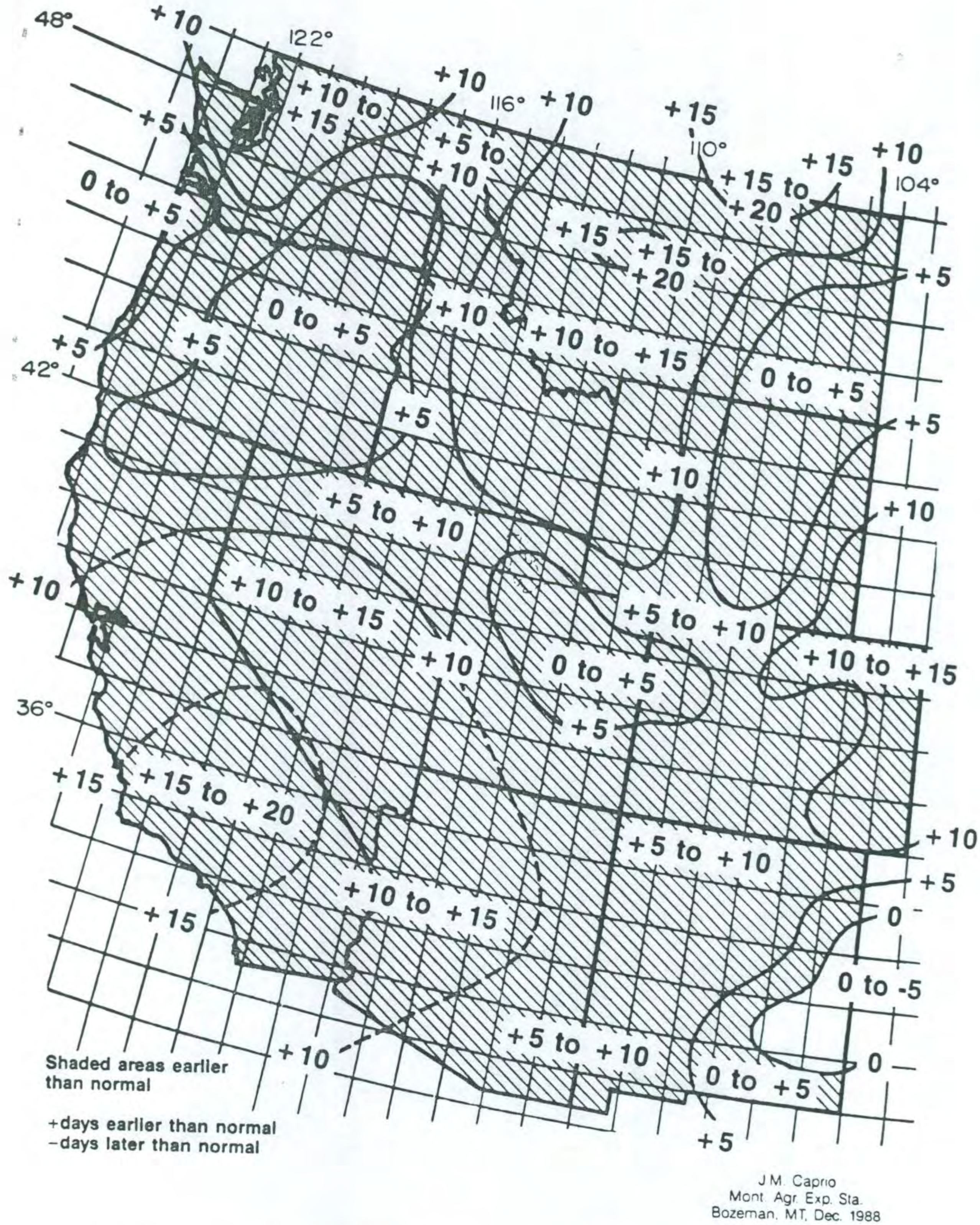


Figure 2. Departure of Lilac Begin Bloom Date from Normal, Spring 1988.

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Phenological Survey
Montana Agricultural Experiment Station
Bozeman, Montana 59717

December 28, 1989

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1989 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom

Honeysuckle bloomed earlier than normal over most of the Western Region in the spring of 1989. A particularly large very early area extended from central Nevada into central New Mexico. Extreme earliness of more than 25 days is indicated in southern Utah and northeastern Arizona. Bloom was later than normal in western parts of the region with anomalies of more than ten days later than normal along much of the Pacific Coast. Extreme late anomalies of more than 25 days are indicated in northwestern Washington. Honeysuckle was more than 10 days later than normal in an area of northwestern Montana and northern Idaho.

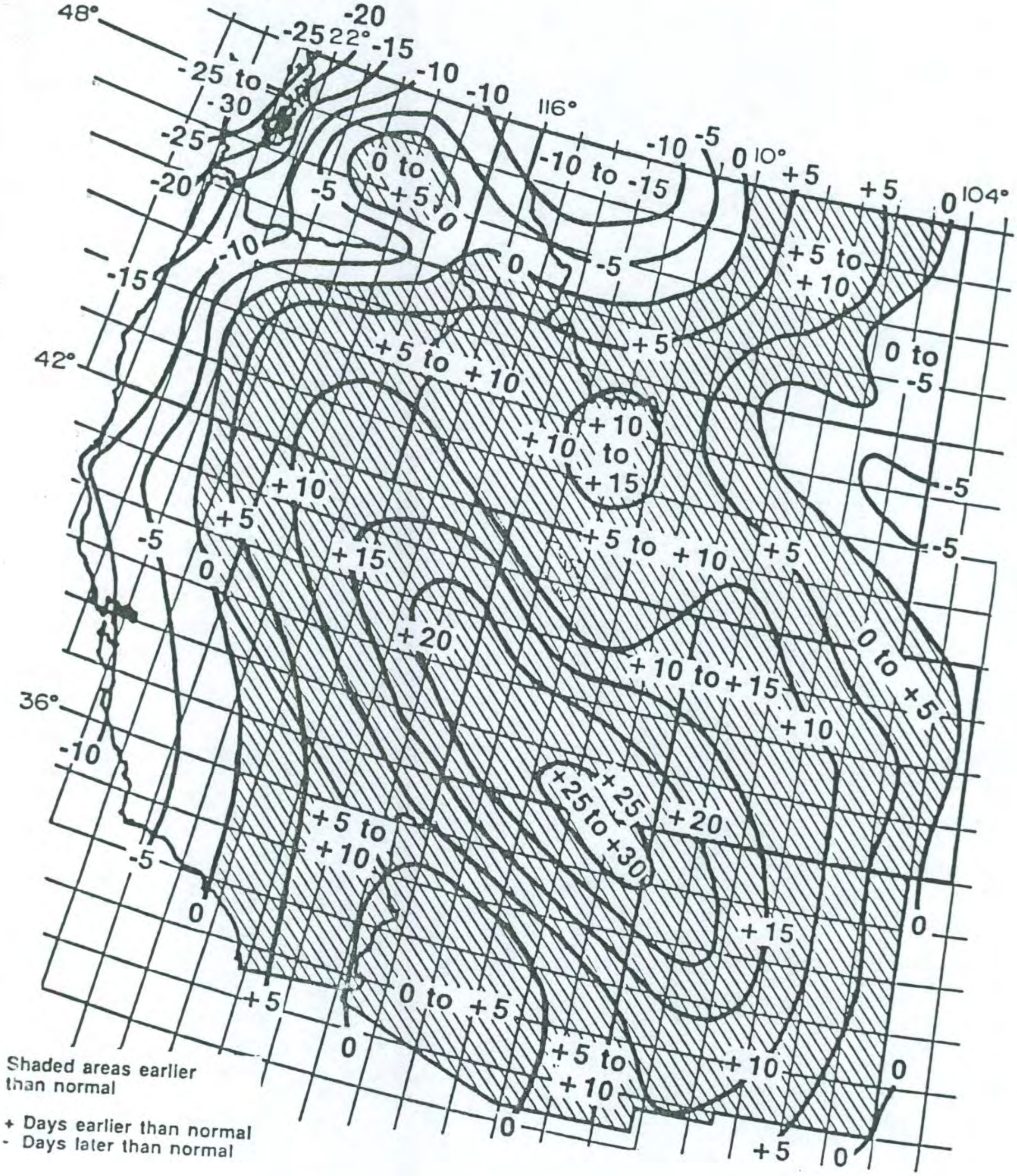
Lilac Bloom

Lilacs bloomed earlier than normal over most of the Western Region in the spring of 1989. A particularly large very early area extended from central Nevada southeastward into central New Mexico. In the center of this early zone, in the vicinity of the Nevada-Utah border, lilacs were more than 25 days earlier than normal. Lilacs were later than normal in extreme western parts of the region, particularly in areas near the Pacific Coast. Most extreme late anomalies were reported near the mouth of the Columbia River where the season was more than 10 days later than normal. An area in northwestern Montana was more than 5 days later than normal. The isophanes in southwestern areas of the Western Region are dashed in because of the low density of reporting stations.

Monthly Temperature Anomalies

December 1988 was colder than normal over most of the Western Region with anomalies of more than 4°F reported in some central areas. Exceptions were most coastal areas and large portions of the Great Plains where it was as much as 2°F warmer than normal.

January 1989 was generally warmer than normal in the northern and eastern tier of states of the region and colder than normal elsewhere. Anomalies of more than 8°F warmer than normal occurred in the Chinook Belt of Montana. January temperatures in parts of Nevada and Utah averaged more than 10°F colder than normal.



Shaded areas earlier than normal

+ Days earlier than normal
- Days later than normal

J.M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, MT, Dec. 1989

Figure 1. Departure of Honeysuckle Begin Bloom Date from Normal, Spring 1989.

February was an extremely cold month over nearly all areas of the Western Region except Arizona and New Mexico. Anomalies of more than 14°F colder than normal were experienced over large portions of Montana, Oregon, and Wyoming. Extreme anomalies of more than 18°F colder than normal were experienced in central Montana.

March was mostly warmer than normal with temperatures more than 8°F above normal in some areas in the southern half of the region. Lower than normal temperatures were recorded over most of Montana and Washington.

April was warmer than normal in all areas except portions of eastern Montana. Temperatures averaged more than 10°F above normal over a large portion of Arizona.

May generally averaged warmer than normal except for eastern Oregon and Washington and most of Idaho and Montana. Extreme anomalies of more than 6°F above normal were reported from parts of Arizona.

June was mostly warmer than normal with cooler than normal weather the general pattern over the eastern one-third of the Western Region. Southeastern Colorado and northeastern New Mexico averaged more than 4°F cooler than normal.

Western Regional Research and Phenological Observations

There are at least two Western Regional committees (listed below) that have utilized phenological information to assist in their research studies. Listed below are the names of one member of these two committees at each Agricultural Experiment Station location. More persons at these institutions and in other states and Canada as well as participating federal agencies are also active members of these committees.

W-130 "FREEZING DAMAGE AND PROTECTION OF DECIDUOUS FRUIT AND NUT CROPS"

AZ	John Moon	Tucson
CA	Vito Polito	Davis
	Steve Lindow	Berkeley
CO	Steve Wallner	Ft. Collins
	Rocky Renquist	Grand Junction
MT	Nancy Callan	Corvallis
	Joseph Caprio	Bozeman
OR	Les Fuchigami	Corvallis
WA	Del Ketchie	Wenatchee
	Ed Proebsting	Prosser
	Rita Hummel	Puyallup
UT	Schuyler Seeley	Logan

WRCC-47 "CLIMATIC INFORMATION FOR AGRICULTURE AND NATURAL RESOURCES"

AZ	Allan Mathias	Tucson
CA	James Bradley	Berkeley
	Joyce Fox	Davis
CO	Thomas McKee	Ft. Collins
ID	Myron Molnau	Moscow
MT	Joseph Caprio	Bozeman
NM	Kenneth Kunkel	Las Cruces
OR	Kelly Redmond	Corvallis
TX	Marshall McFarland	College Stn.
UT	Gaylen Ashcroft	Logan
WY	Larry Pochop	Laramie

Your assistance in reporting phenological observations on honeysuckle and lilac is making an important contribution and is much appreciated.

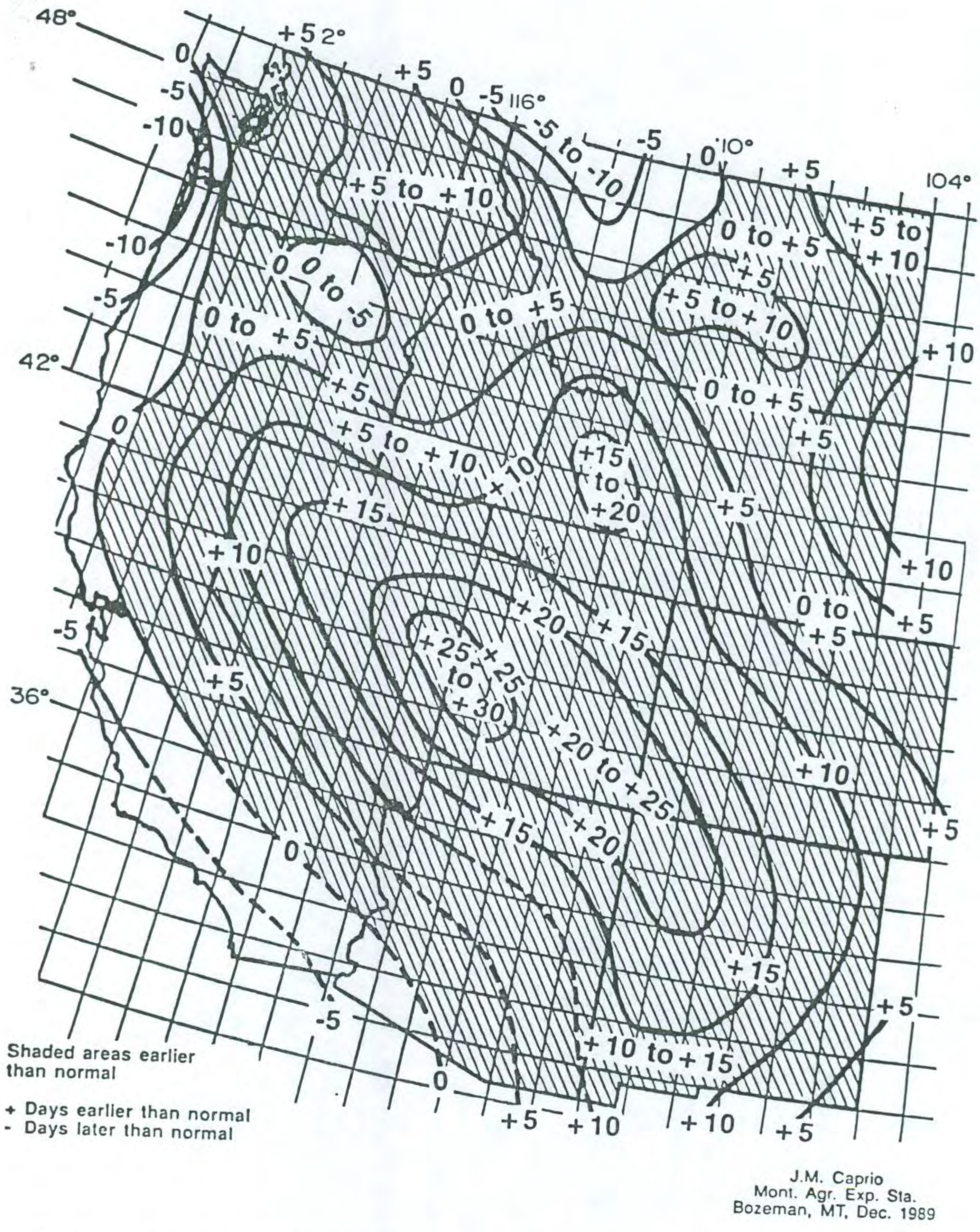


Figure 2. Departure of Lilac Begin Bloom Date from Normal, Spring 1989.

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Phenological Survey
Montana Agricultural Experiment Station
Bozeman, Montana 59717

December 21, 1990

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1990 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom

Honeysuckle flowered earlier than normal in a large area of the Western Region. Extensive portions of Idaho, Nevada, and eastern Oregon were more than 20 days earlier than normal. Bloom was later than normal in nearly all border areas of the Western Region. Anomalies of more than 10 days later than normal are indicated in northwestern Washington, northcentral Montana and coastal areas of California. Most of western California, southern Arizona, southern New Mexico, central Montana, northern Washington, and northern Wyoming were later than normal. Earlier than normal conditions were the rule in the other five states of the Western Region.

Lilac Bloom:

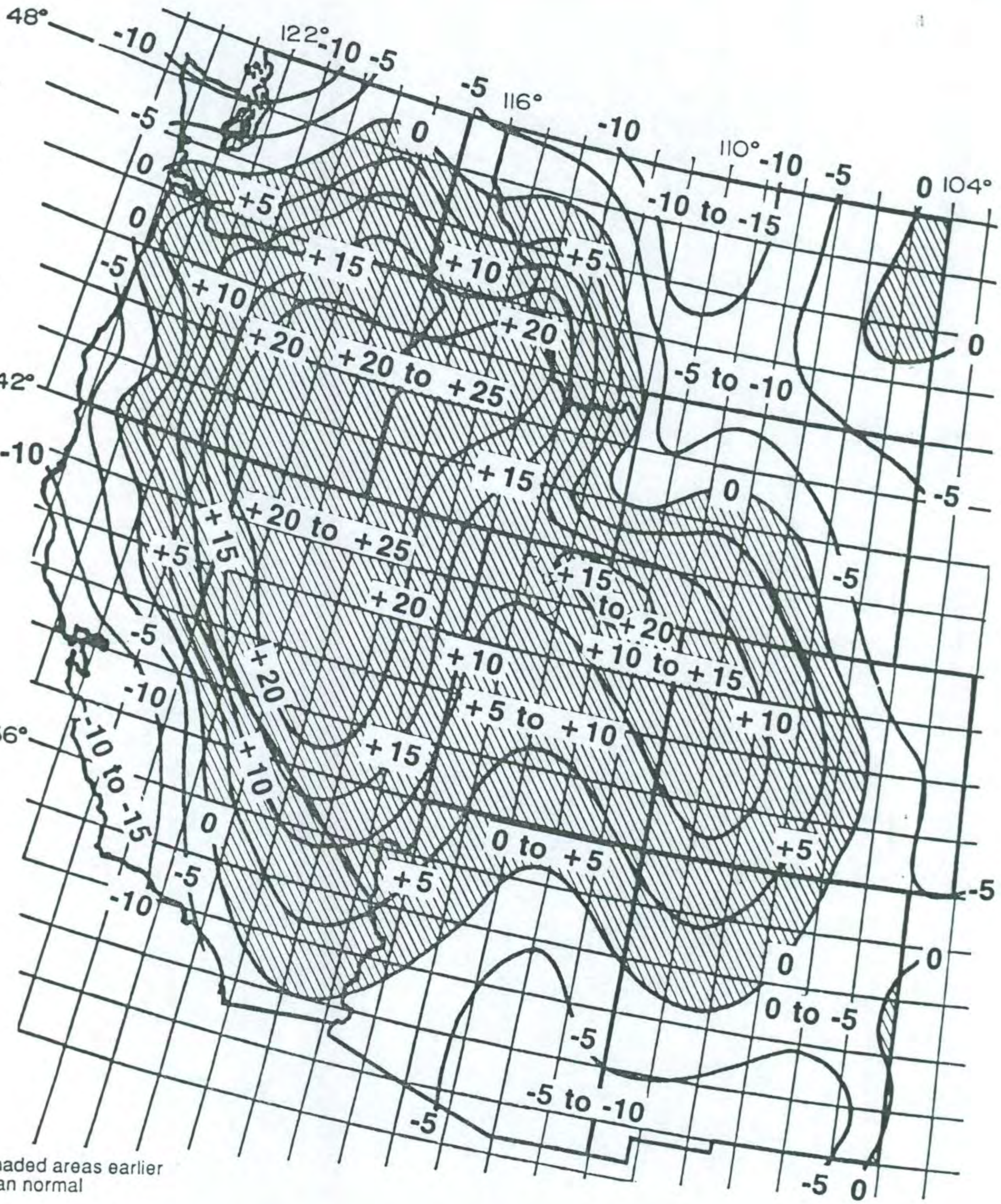
For the sixth consecutive year, the major portion of the Western Region was earlier than normal. Extreme early anomalies of more than 30 days were reported over most of Nevada. Portions of Arizona, California, Idaho, Nevada, Oregon and Utah are indicated as more than 20 days earlier than normal. Later than normal bloom was reported from large areas of Colorado, Montana, and Wyoming where some extreme late anomalies of 5 to 10 days were reported.

What is striking about both the 1990 lilac and honeysuckle phenology anomaly maps is their similarity to the 1989 phenology anomaly maps. Both years were characterized by very large early anomalies in the Nevada-Utah area.

Monthly Temperature Anomalies

December 1989 was generally cooler than normal in the eastern one-third of the region and warmer than normal elsewhere. The weather was also cooler than normal in central California and the Columbia River area. Anomalies of more than 4°F cooler than normal were reported along the entire eastern border of the Western Region.

January was warmer than normal over nearly the entire Western Region. Most of western Washington, Montana, northern Idaho and northern Wyoming ere more than 8°F warmer than normal. Extreme anomalies of more than 14°F warmer than normal were recorded in northeastern Montana.



Shaded areas earlier than normal

+ Days earlier than normal
- Days later than normal

J M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, MT, Dec. 1990

Figure 1. Departure of Honeysuckle Begin Bloom Date from Normal, Spring 1990.

February was mostly colder than normal with the general exception of Montana, Wyoming, Colorado, and New Mexico which were mostly warmer than normal. Extreme anomalies of more than 4°F colder than normal occurred over most of Nevada and portions of northeastern California, southeastern Oregon, southwestern Idaho and western Utah. Temperatures were more than 4°F warmer than normal in eastern Montana and northwestern Colorado.

March was warmer than normal over the entire Western Region. Large areas were more than 4°F warmer than normal and some central areas as well as northeastern Montana reported anomalies exceeding 6°F.

April was warmer than normal except for a small portion of eastern New Mexico. A large area including most of Nevada, Utah, Idaho and Oregon experienced anomalies of 6°F warmer than normal. Anomalies exceeding 8°F were reported in northern Nevada, northeastern California and portions of southern Oregon and Idaho. These very warm temperatures in March and April were undoubtedly responsible for the very early flowering of the honeysuckle and lilac in these areas.

May was somewhat cooler than normal over most northern and eastern areas. This is reflected in later than normal flowering of honeysuckle and lilac over much of Montana, Wyoming and parts of Colorado. Temperatures were within two degrees of normal in most areas.

June returned to the pattern of March and April with nearly the entire region being warmer than normal. Major exceptions were central and eastern Washington, northwestern Montana, and eastern Oregon which were cooler than normal. Large portions of central and southern areas were more than 4°F warmer than normal with some areas of Arizona and New Mexico reporting extreme anomalies greater than 6°F warmer than normal.

Western Regional Research and Phenological Observations

There are at least two Western Regional committees (listed below) that have utilized phenological information to assist in their research studies. Listed below are the names of members of these two committees at each Agricultural Experiment Station location. More persons at these institutions and in other states and Canada as well as participating federal agencies are also active members of these committees.

W-130 "FREEZING DAMAGE AND PROTECTION OF DECIDUOUS FRUIT AND NUT CROPS"

AZ	John Moon	Tucson
CA	Vito Polito	Davis
	Steve Lindow	Berkeley
CO	Steve Wallner	Ft. Collins
	Rocky Renquist	Grand Junction
MT	Nancy Callan	Corvallis
	Joseph Caprio	Bozeman
OR	Les Fuchigami	Corvallis
	Porter Lombard	Corvallis
WA	Del Ketchie	Wenatchee
	Ed Proebsting	Prosser
	Rita Hummel	Puyallup
UT	Schuyler Seeley	Logan

WRCC-47 "CLIMATIC INFORMATION FOR AGRICULTURE AND NATURAL RESOURCES"

AZ	Allan Mathias	Tucson
CA	James Bradley	Berkeley
	Joyce Strand	Davis
CO	Thomas McKee	Ft. Collins
ID	Myron Molnau	Moscow
MT	Joseph Caprio	Bozeman
TX	Marshall McFarland	College Stn.
UT	Gaylen Ashcroft	Logan
WY	Larry Pochop	Laramie

Your assistance in reporting phenological observations on honeysuckle and lilac is making an important contribution and is much appreciated.

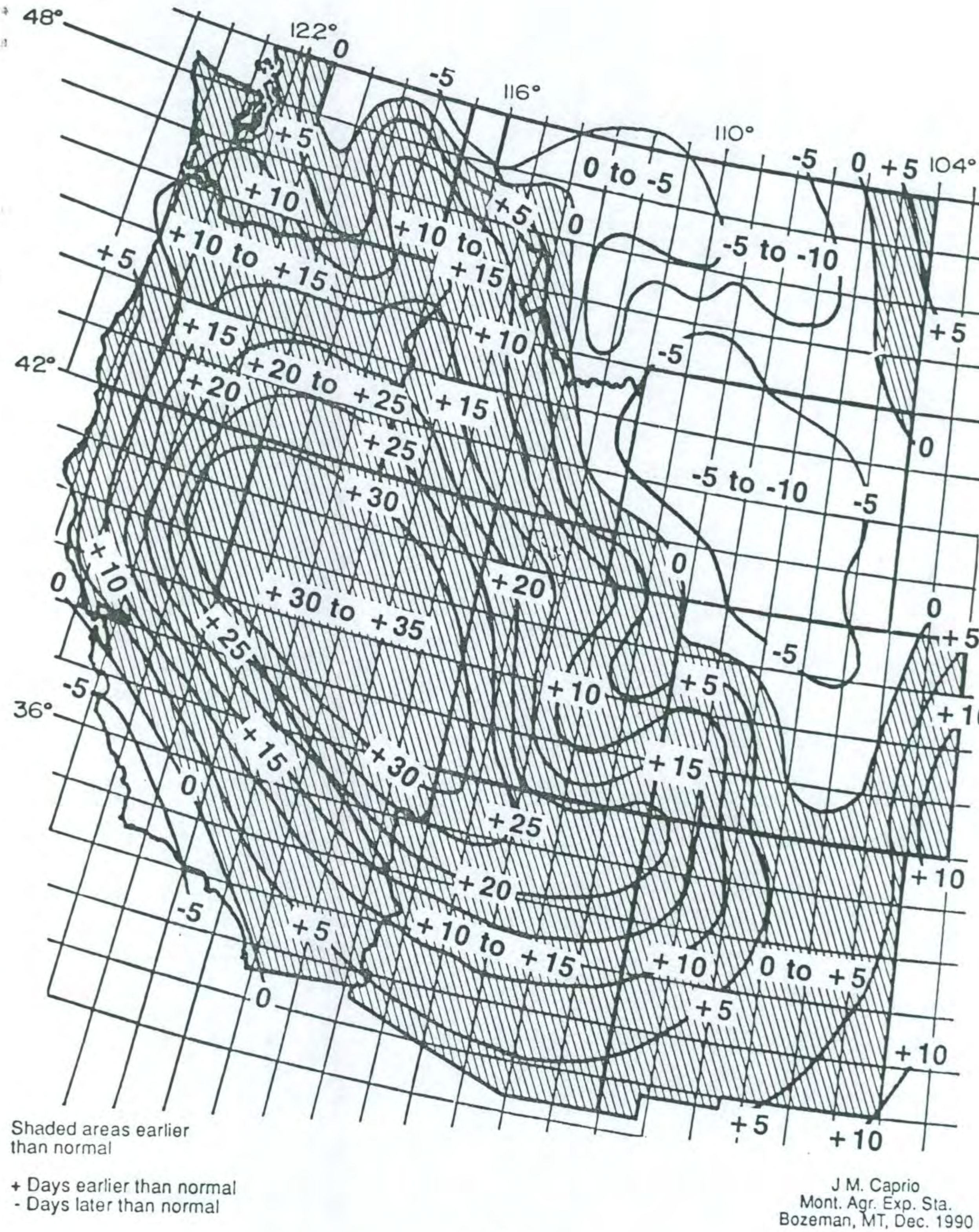


Figure 2. Departure of Lilac Begin Bloom Date from Normal, Spring 1990.

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Phenological Survey
Montana Agricultural Experiment Station
Bozeman, Montana 59717

December 20, 1991

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1991 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom

Honeysuckle flowered later than normal over the greater part of the Western Region. The most extreme anomaly of 15 to 20 days later than normal occurred over most of Nevada, Utah and adjacent areas Arizona, California, Idaho and Oregon (Figure 1). Four zones of earlier than normal bloom are indicated on the map. Two of these are located in the western parts of California, Oregon and Washington. One zone includes most of eastern Montana and the other covers much of eastern Colorado and eastern New Mexico. Each of these areas includes an extreme earliness zone where bloom occurred 5 to 10 days earlier than normal.

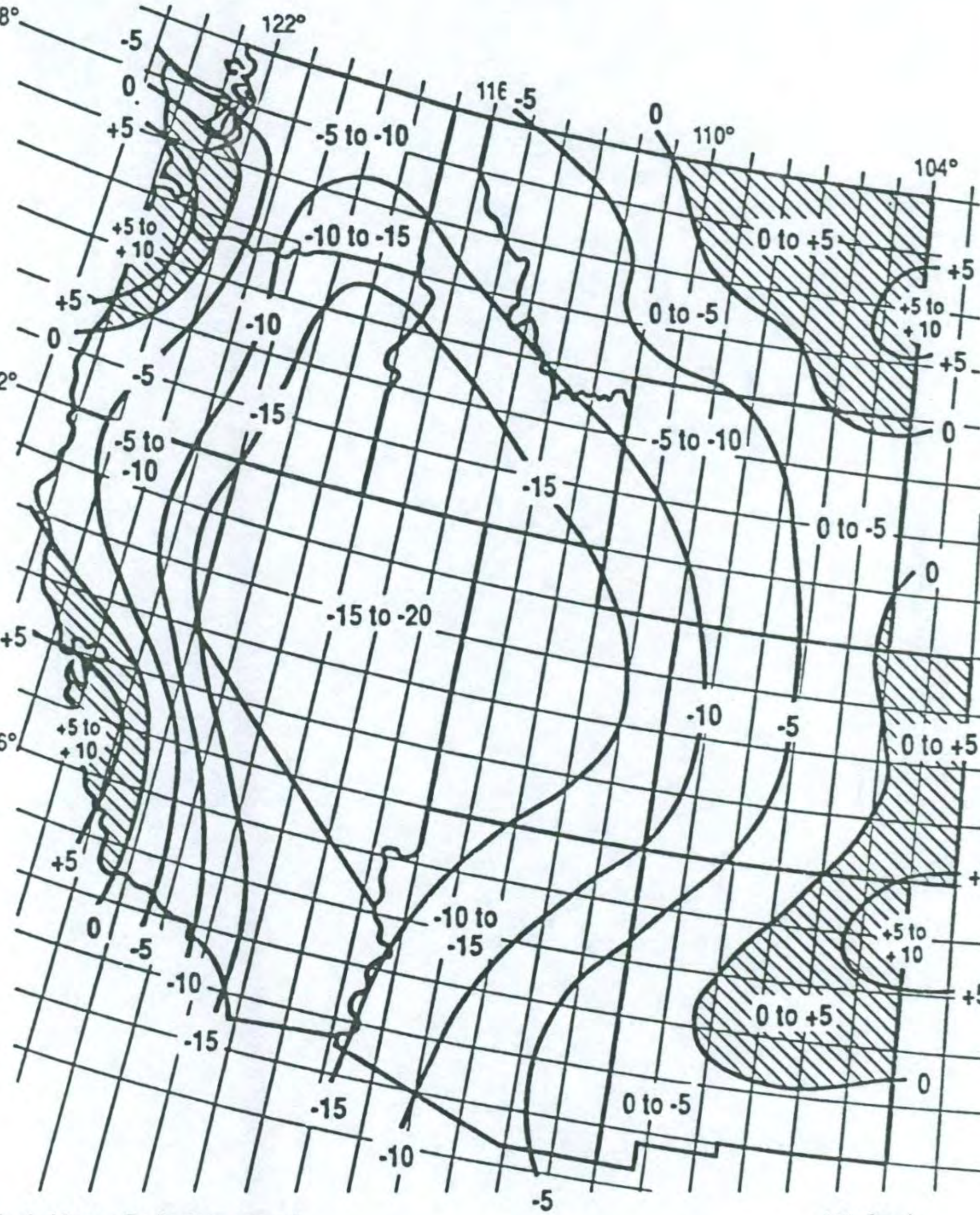
Lilac Bloom:

The spring of 1991 was the first year since 1984 that the begin bloom phase of both the honeysuckle and lilac occurred later than normal over the greater portion of the Western Region. Lilac bloom in 1991 was more than 15 days later than normal over most of Nevada, central and western Utah and adjacent areas of Arizona, California, Idaho and Oregon (Figure 2). Extreme late anomalies occurred in west-central Utah where bloom was 20 to 25 days later than normal. Areas of earlier than normal bloom were largely located in north-eastern Montana, eastern Colorado and New Mexico and western portions of California, Oregon and Washington.

Monthly Temperature Anomalies

December 1990 averaged much colder than normal over the entire Western Region except for parts of southern Arizona and New Mexico. Extreme anomalies of more than 12°F below normal were recorded in parts of southeastern Oregon, southwestern Idaho and northern Nevada. The more tender fruit plants in the Northwest were decimated by the extreme cold of later December. Figure 3, produced by the U.S. Climate Analysis Center, shows the lowest temperatures recorded in the U.S. during 1990. The indicated values over the Western Region occurred during the late December 1990 Arctic cold wave.

January 1991 was mostly colder than normal in central parts of the region and warmer than normal elsewhere. Extreme cold anomalies of -6°F were



Shaded Areas: Earlier than normal
+: Days earlier than normal
–: Days later than normal

J.M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, MT Dec. 1991

Figure 1. Departure of Honeysuckle Begin Bloom Date from Normal, Spring 1991

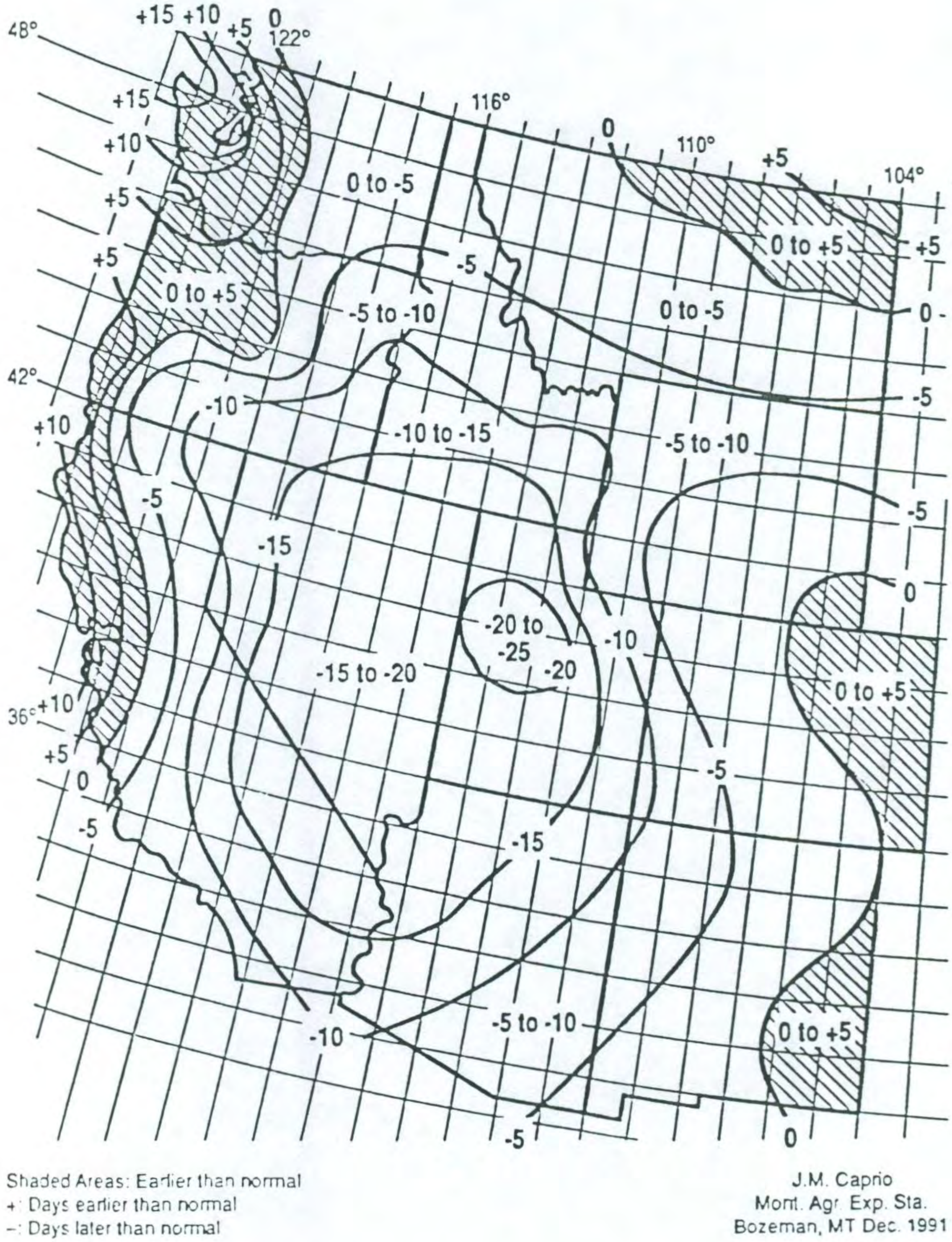
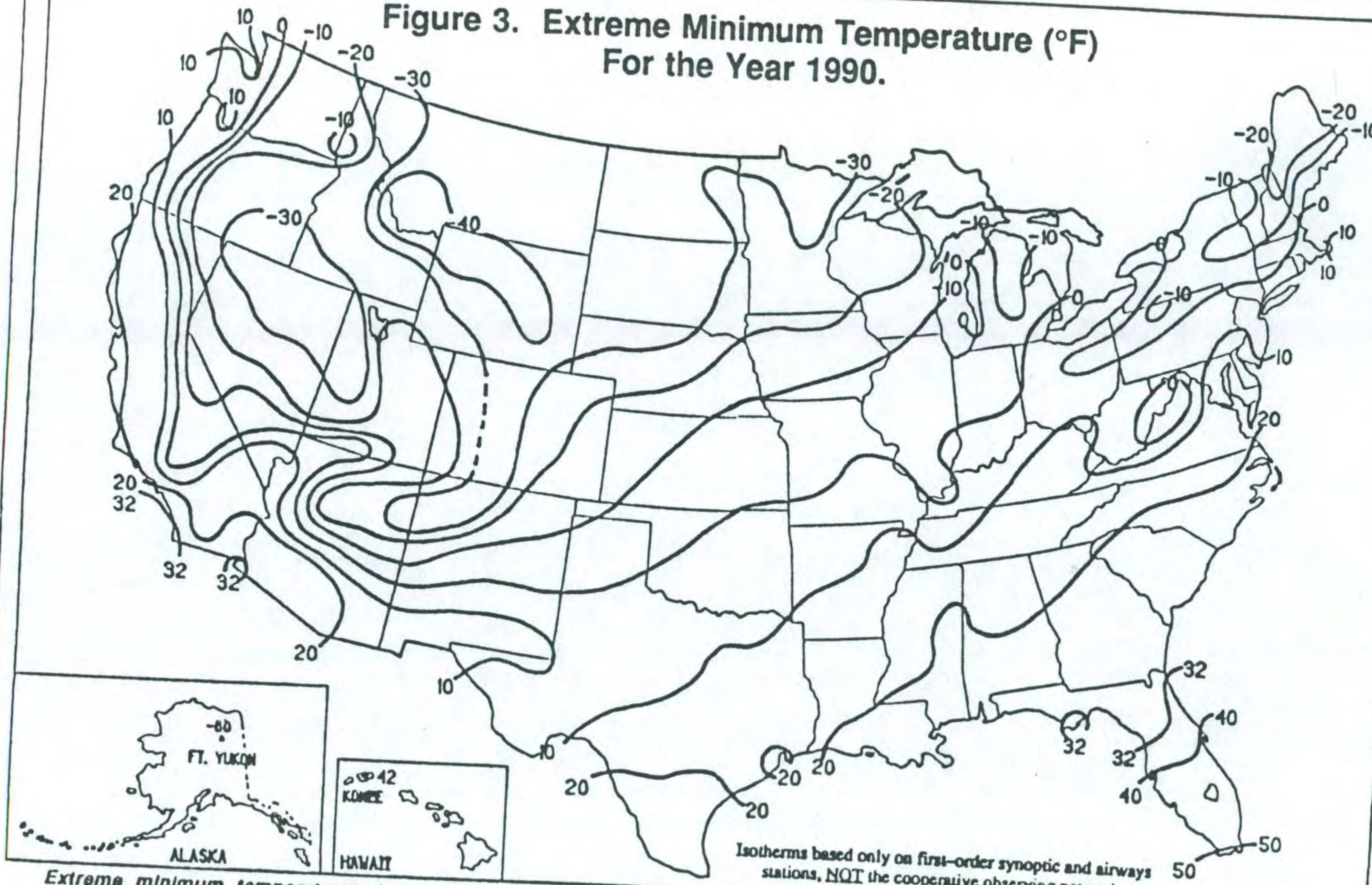


Figure 2. Departure of Lilac Bloom Date from Normal, Spring, 1991

Figure 3. Extreme Minimum Temperature (°F) For the Year 1990.



Isotherms based only on first-order synoptic and airways stations, NOT the cooperative observing network.

Extreme minimum temperatures (F) during 1990. *Isotherms were drawn from a network of several hundred stations consisting of first-order synoptic and airways stations (NOT cooperative stations). Isotherms are only analyzed for -40°F, -30°F, -20°F, -10°F, 0°F, 10°F, 20°F, 32°F, 40°F, and 50°F. Unlike last year when bitterly cold Arctic air covered the eastern half of the country during December, extreme lows were relatively high as the southern two-thirds of Florida failed to drop below freezing, and readings in the teens failed to penetrate into the southeastern U.S. In sharp contrast, frigid conditions during December 1990 sent temperatures into the teens throughout much of California, including the major agricultural valleys. Sub-zero readings were common in the Great Basin and Rockies, and a few stations set all-time record lows.*

recorded in eastern Utah and western Colorado. Warm anomalies were mostly less than +2°F and were mostly concentrated in coastal areas and in southwestern portions of the region.

February was warmer than normal throughout the entire Western Region with the exception of a small area in east-central Utah and west-central Colorado. Most extreme warm anomalies occurred mostly in the northern half of the region. The most extreme anomalies were reported from Montana where most of the state was in the +12 to +16°F anomaly range.

March was mostly warmer than normal in the northeastern half of the region and colder than normal in the southwestern half of the region. Anomalies mostly varied from +6°F above normal to -4°F below normal.

April tended to be colder than normal in the central part of the region and warmer than normal in other areas of the region. Most extreme cold anomalies of more than -2°F were reported in two areas, one centered in southeastern Oregon and another centered in northern Utah. Extreme warm anomalies exceeding +4°F were reported in southeastern New Mexico and northeastern Montana.

May was mostly colder than normal in the western two-thirds of the region and warmer than normal in the eastern one-third. Most extreme cold anomalies of more than -4°F occurred in parts of northern California, Nevada, and Oregon. Most extreme warm anomalies of more than +4°F were reported in eastern New Mexico.

June was mostly warmer than normal in the northeastern quarter of the region and cooler than normal elsewhere. Warm anomalies were mostly less than +2°F. Most extreme cold anomalies of more than -4°F occurred in eastern Oregon, southeastern Washington and northern Idaho

Progress in Phenological Modeling

Phenological observations made throughout the western United States have contributed to our understanding of the pattern of plant development throughout the Western Region. Estimates were made of developmental unit (DU) requirements of first flower phase for the two indicator species, honeysuckle and lilac, as well as for several fruit cultivars for each of three models. These are listed in Table 1. The chill unit (CU) requirements (Utah method[1]) for honeysuckle and lilac are also presented in Table 1 along with the requirements for several fruit cultivars that were previously determined by Lombard and Richardson[2]. According to the Utah model instrument shelter temperatures at and below 32°F are not effective in satisfying the chilling requirement. Most effective are instrument shelter temperatures in the 36°F to 49°F range. The Solar Thermal Unit

---

[1] Ashcroft, G.L., E.A. Richardson and S.D. Seeley. 1977. A statistical method of determining chill unit and growing degree hour requirements for deciduous fruit trees. Hort. Science 12:347-348.

[2] Lombard, P. and E.A. Richardson. 1979. Physical principles involved in controlling phenological development. *In*: Modification of the areal environmental of plants. pp 429-440. Edited by: B.J. Barfield and J.F. Gerber. An American Society of Agricultural Engineers (ASAE) Monograph Number 2 in a series published by ASAE. 538 pages.

6

Table 1. Chill Unit and Developmental Unit Requirements for Selected Species.

		Developmental Unit Models		
	Chill Units	$(T-41)^{1.0}$ daylight hours only	$(T-41)^{1.0}$ 24-hours per day	$(T-41)^{1.0}R^{0.27}$ STU*
Bartlett pear	1,210	6,432	8,676	14,825
Honeysuckle	535	9,055	12,215	20,872
Italian prune	788	7,246	9,775	16,703
Lilac	1,049	8,136	10,976	18,755
Red Delicious Apple	1,234	7,870	10,617	18,141
Redhaven Peach	870	5,322	7,179	12,267

* STU = Solar Thermal Unit

Table 2. Elevation Efficiency for Plant Development (EE_{PD})

FEET	0	100	200	300	400	500	600	700	800	900
2,000	0.997	0.992	0.986	0.981	0.975	0.970	0.964	0.958	0.953	0.947
3,000	0.941	0.935	0.929	0.923	0.916	0.910	0.904	0.897	0.891	0.885
4,000	0.878	0.872	0.865	0.858	0.852	0.845	0.839	0.832	0.825	0.819
5,000	0.812	0.805	0.799	0.792	0.786	0.779	0.772	0.766	0.759	0.753
6,000	0.746	0.740	0.733	0.727	0.720	0.714	0.707	0.701	0.695	0.689
7,000	0.682	0.676	0.670	0.664	0.658	0.652	0.646	0.640	0.634	0.628
8,000	0.622	0.616	0.611	0.605	0.599	0.594	0.588	0.583	0.577	0.572
9,000	0.566	0.561	0.556	0.551	0.545	0.540	0.535	0.530	0.525	0.520
10,000	0.515	0.511	0.506	0.501	0.496	0.492	0.487	0.483	0.478	0.474

(STU) model, which considers hourly temperatures only during daylight hours and requires an adjustment for elevation efficiency for plant development (EE_{PD}), appears to be more accurate than the other two models. T in the models is hourly temperature in °F and R is global solar radiation in langleys per hour. Hourly temperatures above 77°F are taken as 77°F. No elevation adjustment is made for elevations below 1,939 feet. Table 2 gives EE_{PD} for different elevations. For example, first flower phase of lilac requires 18,755 DU (Model $(T-41)^{1.0}$ $R^{0.27}$) atelevations below 1,939 feet. At 4,000 feet elevation the 18,755 DU is divided by 0.878 to yield 21,361 DU required for first flower phase at 4,000 feet elevation. The study also suggests that water-use-efficiency of crops grown under the same conditions of daytime temperature and solar radiation is less at higher elevations. Further study is recommended to confirm the relations suggested by this study.

Phenological Interception

Schnelle[3], noted that the sequence of flowering of deciduous woody species varies from place to place. He refers to this phenomenon as "phenological

---

[3] Schnelle, F. 1955. Pflanzen Phanologie. Akademische Verlagsgesellschaft, Leipzig. 299 p.

interception." He presented a map of Europe that shows the following bloom sequence:

Southern Europe: lilac (*Syringa vulgaris*), horse chestnut (*Castanea sativa*), mountain ash (*Sorbus aucuparia*)
Central Europe: horse chestnut, lilac, mountain ash
Northern Europe: mountain ash, lilac

He also lists examples of phenological interception of other phenological phases for some deciduous woody species. Reversals of phenological events of deciduous woody plants in different years in the area are also noted by Schnelle. For example, there is a saying in Europe that "when the ash tree greens before the oak there will be a dry summer, when the oak greens before the ash there will be much moisture."

Schnelle wrote about changes in the sequence of the opening of blossoms and leaf buds on the same tree from year to year and refers to this phenomenon as "phenological inversion." Robinia, the locust tree, blooms without leaves in southern Europe but with leaves in central Europe, and Schnelle gives a rule that "blossoming is more advanced than leafing the earlier the development begins."

At any given location the relative timing of the honeysuckle and lilac will differ from year to year. The average difference in bloom dates of these two species, however, shows a distinct pattern over the Western Region. A map (Figure 4) shows the general pattern of interception of first flower phase of honeysuckle and lilac in the western United States. Honeysuckle flowers more than 15 days earlier than the lilac in western parts of California while it blooms as many as 4 days later than the lilac over parts of Montana and Wyoming. In general, honeysuckle bloom occurs prior to lilac bloom in the southern and western parts of the region and later than the lilac in the central and northeastern areas of the region. There appears to be a tendency for honeysuckle bloom to precede lilac bloom in northeastern Montana, suggesting that honeysuckle bloom precedes lilac bloom farther north into Canada.

The observed interception of the honeysuckle and lilac is in conformity with our honeysuckle and lilac models that designate CU and DU requirements. Winters in the southern and western areas tend to be warmer than other parts of the region. Mid-winter temperatures in these warmer areas are generally high enough to allow plants to develop, i.e., daytime temperatures exceeding the threshold temperature of 41° F in our models. In these areas honeysuckle completes its chill requirement (535 CU) before lilac (1,049 CU) and the honeysuckle initiates development while the lilac does not initiate development until some time later, only after it has received its larger CU requirement. Thus, the honeysuckle in these areas progresses in development ahead of the lilac and initiates bloom before the lilac, even though its DU requirement is greater than that of the lilac (20,872 DU for the honeysuckle vs. 18,755 DU for the lilac).

In areas where the lilac flowers before the honeysuckle, the honeysuckle completes its chilling requirements before the lilac but upon completion of its chilling requirement, usually in the late autumn, temperatures have dropped to such a low level that further development is stopped or is insignificant until spring warm-up. Chilling of the lilac continues after the time that the honeysuckle completes its chilling requirement and fulfillment of the rest requirement for the lilac may continue into the late winter or early spring. By the time spring warm-up begins both the honeysuckle and lilac are ready to initiate development at about

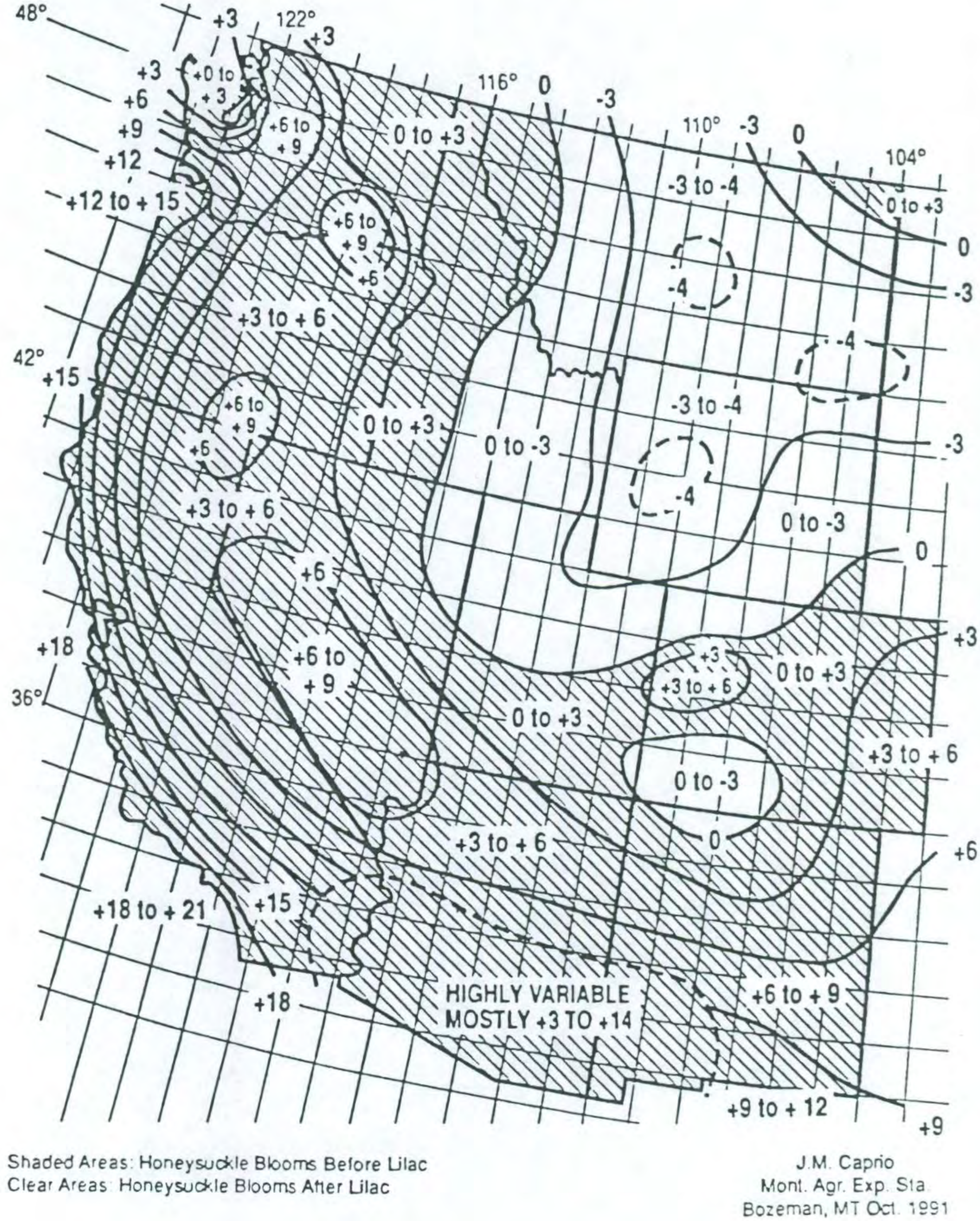


Figure 4. Difference in days between the average dates when lilac and honeysuckle reach first flower phase

the same time. With the advancing warmth of spring, the lilac, requiring fewer development units, flowers before the honeysuckle which has a greater DU requirement.

In extreme northeastern Montana and likely into southern Canada the honeysuckle bloom again precedes that of the lilac. This may be explained as follows. Temperatures in the autumn drop very rapidly there. This drop intemperature is so rapid through the "temperature window" for chilling that an average of only 559 CU accumulate at Glasgow, for example, before the mean daily maximum temperature falls below 35°F on November 20. The chill unit requirement of only the honeysuckle is satisfied before chilling usually ends on November 20. With spring warming in March, chilling of the lilac resumes but the honeysuckle, which has already had its chilling satisfied, begins its development. The lilac meanwhile does not begin to develop until about April 8, only after its chilling is finally satisfied. Thus, the honeysuckle gets enough of a head start in the spring to bloom before the lilac even though its DU requirement is greater.

Effects of Climatic Warming

We can speculate about the effect that climatic warming would have on the flowering dates of the lilac and honeysuckle. In areas where chilling is much more than satisfied before the onset of spring warming, climatic warming is likely to lead to earlier flowering. This could be expected in most central and northeastern areas.

In warm southern areas where chilling is often not satisfied, climatic warming is likely to lead to the absence of or delayed flowering due to inadequate chilling to complete the rest. Some warm southern areas where lilacs now flower might not flower at all due to insufficient chilling. Places between the above two areas will either flower earlier or later depending upon the balance between the chill unit and developmental unit requirements of the plants.

The general pattern of interception described in Figure 4 is likely to undergo change with climatic warming. The extensive area in the south and west where honeysuckle flowers before the lilac is expected to extend further toward the center of the western region. This would be attributable to the incursion of more mild winters allowing the honeysuckle to develop before lilac rest has been satisfied. These findings on the honeysuckle and lilac provides a basis for estimating the likely impact on western deciduous fruit production in the event of significant climatic warming. It is clear that with climatic warming there would be a northward displacement of the southern limit of some fruit varieties due to the lack of adequate chilling. It is also possible that another problem might surface. The fruit industry depends on the simultaneous flowering of pollinator and primary production trees. Climatic change may result in altering the relative timing of pollinator and primary trees which may necessitate the planting of different pollinator species. An understanding of the causes underlying the relative timing of the flowering sequence of deciduous perennial plants could help anticipate pollination problems caused by future climatic warming.

PHENOLOGICAL OBSERVERS WHO HAVE CONTRIBUTED INFORMATION FOR 20 OR MORE YEARS*

ARIZONA::

CRAIG	002	JOAN ANDERSON	003	UNIV ARIZONA	005	MR. FRED NOON	010

CALIFORNIA::

VMP CORDINATOR	009	KERN CO. FORST	015	E A EBERLE	019	A. BECHTAL	023	R.M. TIMM SUPT	023
MERCED IRRIGAT	024	R. KEN. SMITH	025	WALT HENNES	027	HUNT, RUSTY	029	WALL, JOHN F.	031
RAY JOHNSON	031	TAYLOR, O. C.	033	HELII WTR DIST	037	US BUROFRECLAM	045	MRS. BERTAGNA	045
PACIFIC GAS CO	045	U.S. FOREST SE	047	DIST. RANGER	047	CARL CRAMER	047	BIG BAR RGR ST	053
JOHN DAYBELL	054								

COLORADO::

ARMILDA BURHEN	005	ROBERT BOWES	007	GEORGE MACKEEN	008	JAMES ROBERTS	011	U. S. SCS	020
LELAND OLKJER	020	ERNA T. MASS	020	YOUNGER	021	CARLA G. NASH	022	BRD WATER COMM	030
DR T. E. MAUS	035	SHANNON, CECIL	036	FILGHT SER STA	036	MRS R CHAMBERS	037	ROSEMARY CASTO	039
JOHN BARCUS	039	SUPERINTENDENT	042	COL EIP STAT	045				

IDAHO::

SWAN FALLS PP	001	FOREST SERVICE	004	US FOREST SERV	005	BRANCH EI. STA	006	PROFFER	008
FOREST SERVICE	008	MARY CUDDEBACK	014	CLYDE COOK	020	MRS. M WILSON	025	EDWARD T GILRO	025
DAVID J ESCHEN	029	LESLIE BUSHBY	032	DOROTHY CHENEY	033	GENA NEWPORT	039	AMALGAMATED CO	042

MONTANA::

JAMES SHAW	002	MRS M J BROWN	002	VIOLET ENGLERT	002	MRS. L PLYMALE	004	MRS M. VAUGHT	004
WOODRO HENSLEY	004	MRS. W. FLYNN	004	ERWIN DRAPER	005	MRS. W. SHOOP	005	L. FAIRBANKS	005
HAZEL PATEK	005	E.R. SOMERFELD	007	CULLA KELSON	007	J SILVAN	008	MRS.G. DIELMAN	008
JAMES WOOD	008	IRA VINION	008	MR. JOHN PFAFF	009	FRANK BIRTIC	013	ALEI COLLIE	013
VICTORIA FARR	014	MILTON URSE	014	GLENN JOHNSTON	015	J. KINSHELLA	015	ROD BOZARTH	015
WALLACE MECOI	016	LLOYD OTT	016	MSU	016	MOORE, DELMER	016	L. BARCLAY	016
MARGRET WATSON	016	MRS R. MCKENNA	017	FRANK WITT	017	E. CHRISTENSEN	020	US FOREST SERV	020
DON ANDERSON	021	D. WICHMAN	023	FIAT HT IRR PJ	024	BUR. OF REC.	026	LEN MC ATEE	029
MRS P. ROSTAD	030	RUTH CAMERON	030	PHILLIP ROSTAD	030	DIST RANGER	032	L. PARSONS	033
STAN WIGGINS	035	KRONEBUSCH	037	MRS. P. HANSEN	039	RICHARD CREEK	040	US FRST SERVCE	041
AIEL LARSEN	043	KUN KOPPERMAN	043	ARTHUR HAGEN	044	N CHEYENNE	044	MARY HARKER	045
DIST. RANGER	045	MR H. CRAWFORD	045	KNUD KAAE	046	MEDICINE LAKE	046	CLAYTON WRIGHT	048
VINA UELAND	049	GREENSFIELDS	050	ANTHONY FEY JR	051	U S CUSTOM SER	051	D. J. WALL	053
EGGENBERGER	054	JACK BREHM	056	BILLINGS WEA.	056	HUNTLEY BRANCH	056		

NEVADA::

LOUISE LEAR	004	LIDA WRIGHT	005	ED ROBINSON	012	WEA BUR OFFICE	017

NEW MEIICO::

DAWSON CAMBELL	009	FRANK TURNER	013	KENNETH WALKER	013	MARY JOINER	014	NELSON McBRIDE	016
J. CADWALLADER	018	ROY SCHOENRADT	026	ROBERT SANCHEZ	029				

OREGON::

MR. PAYTON	001	DOUGLAS CO WAT	006	POST MASTER	006	PAT CHOCHRAN	009	WETHER BUR	013
PM HARNEY CNTY	013	MRS D COWAN	013	MRS HARRY PLUG	014	SALTMARSH, VIE	015	MR. LAMBRECHT	015
DAVID HENDRII	015	GRANTS PASS	017	GLENN TYLER	019	ROBERT COONROD	020	NAT'L WEATHER	020
US FOREST SERV	021	E.L. KING	022	RES. ENG.	026	PENDLETON BR E	030	WEATHER SERV.	030
CROW, JOHN	030	JOHN WAELTY	031	MEYERS, INEI	032	HAZEL WARNOCK	032	ROBERT W. FORD	036

TEIAS::

WILLIAM WARREN	048	SAMUEL HERREN	104	JOHN TREADWELL	164

UTAH::

WEATHER BUREAU	001	WALT JENNINGS	006	DUCHESNE R ST	007	MERVN ALLREDGE	014	CHARLES COPLEY	022
U.S. NAT PARK	027	US NAT'L PARK	028						

WASINGTON::

LAMPTON, A. W.	003	E L PROEBSTING	003	ERNEST CLARK	004	MRS. R. HILT	005	R L OLMSTEAD	006
RICHARD SLAGLE	010	L GRASSL	011	NORMA BOOHER	013	EVE. JOHNSON	015	DAVE THOMAS	015
SEATLE WATER	017	WILLAM MEYER	020	E. CRONRATH	022	TACOMA CTY LGH	027	NW WASH EIPER.	029
KENNETH CURTIS	034	POST OFFICE	039						

WYOMING::

MANKIN	003	CHARLES PEITON	005	ROSS MCKENNA	010	VERE DUNCAN	010	MARTHA NEILSON	014
R.L. STAATS	016	EDMOND C TODD	018	LANNY FRITZ	022	HOLLY SUGAR CO	022	W. J. PETERSON	023

*NUMBERS ARE COUNTY IDENTIFIERS

A REPORT TO COOPERATORS OF THE PHENOLOGICAL SURVEY IN THE WESTERN REGION OF THE UNITED STATES

Joseph M. Caprio
Phenological Survey
Montana Agricultural Experiment Station
Bozeman, Montana 59717

December 30, 1992

DEPARTURE OF HONEYSUCKLE AND LILAC BEGIN BLOOM DATES FROM NORMAL IN 1992 THROUGHOUT THE WESTERN REGION OF THE UNITED STATES

Honeysuckle Bloom

The first flower phase of honeysuckle occurred earlier than normal throughout most of the Western Region in the spring of 1992. Earliest flowering anomalies occurred in the northwest portion of Washington where flowering was more than 30 days earlier than normal. Large portions of Idaho, Montana, Oregon and Washington flowered more than 20 days earlier than normal. Flowering over most of the Great Plains was in the 5 to 15 days earlier than normal range.

The only areas reporting later than normal honeysuckle bloom in 1992 were southern Arizona and New Mexico and some locations in California -- mostly near the Pacific ocean. Later than normal areas were mostly within the range of one to five days later than normal.

Honeysuckle bloomed earlier than normal over the greater portion of the Western Region in all years since 1984 with the exception of 1991 which was generally later than normal.

Lilac Bloom:

The first flower phase of the lilac occurred earlier than normal throughout most of the Western Region in 1992. The only areas where flowering occurred later than normal were in near coast areas of central and southern California and in extreme southern Arizona. Earliest anomalies occurred in the northwest tip of Washington where flowering occurred more than 30 days earlier than normal. Parts of Washington, Oregon, Idaho, Montana, Nevada and Utah were more than 20 days earlier than normal. Flowering over most of the Great Plains was in the 10 to 15 days earlier than normal range.

Lilacs bloomed earlier than normal over the greater portion in all years since 1984 with the exception of 1991 which was generally later than normal.

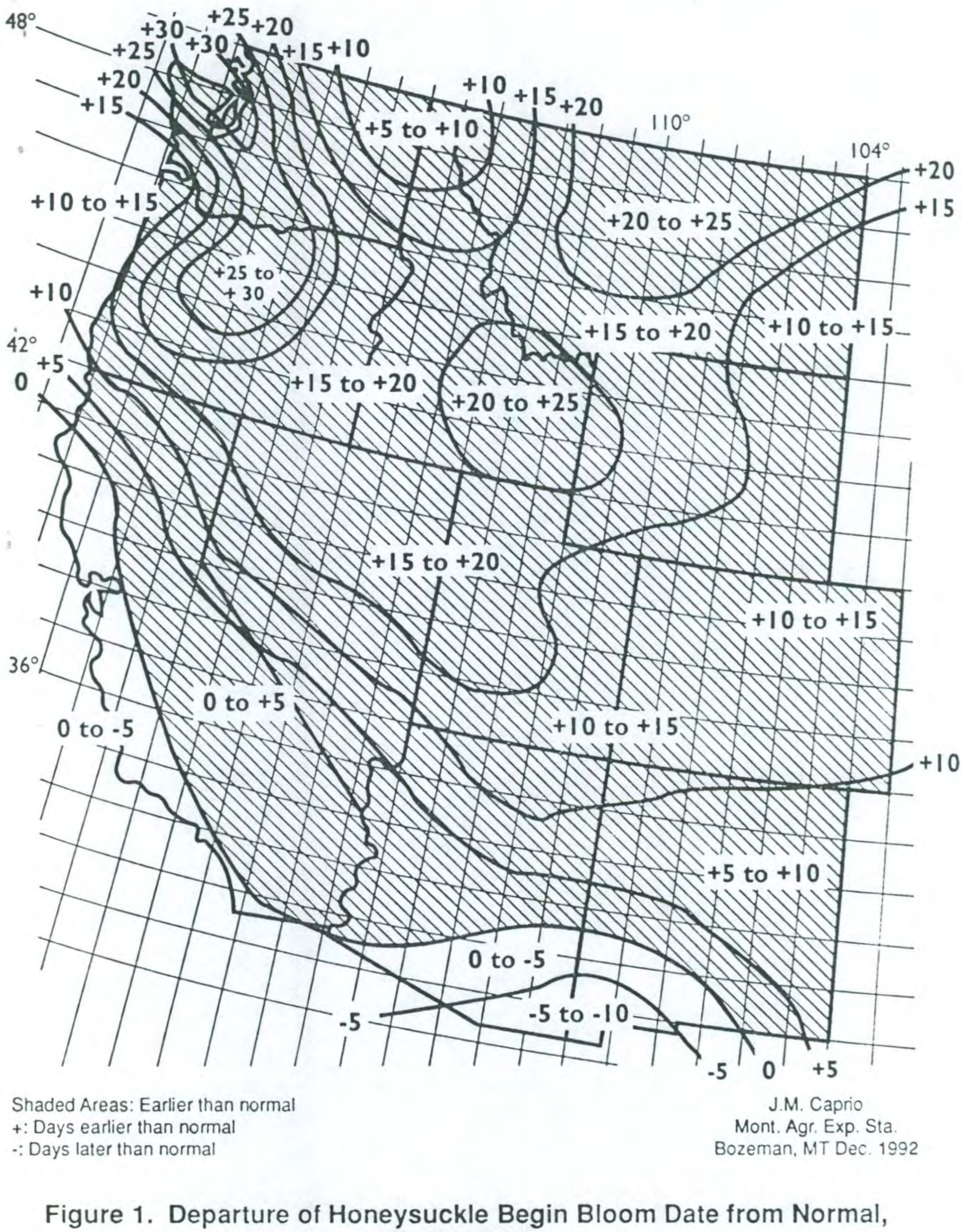


Figure 1. Departure of Honeysuckle Begin Bloom Date from Normal, Spring 1992

Modelling of the Honeysuckle:

Continued studies of the first flower phase of the honeysuckle indicated that developmental unit requirements for the honeysuckle increase with elevation, which is in agreement with the findings for the lilac. Studies on honeysuckle also indicted that more developmental units are required for the honeysuckle than the lilac and that the chill unit requirement of the honeysuckle is considerably less than that of the lilac.

Monthly Temperature Anomalies

December 1991 was warmer than normal throughout the greater portion of the Western Region with the greatest anomalies exceeding 8°F occurring in Montana. Temperatures in December were more than 2°F lower than normal in an area centered at the junction of Wyoming, Utah and Colorado.

January 1992 was much warmer than normal over the northern third of the Region with greatest warmer than normal anomalies exceeding 18°F located in Montana. Most of Utah, western Colorado and parts of adjacent states were cooler than normal in January. The interior valley of California was also mostly cooler than normal in January.

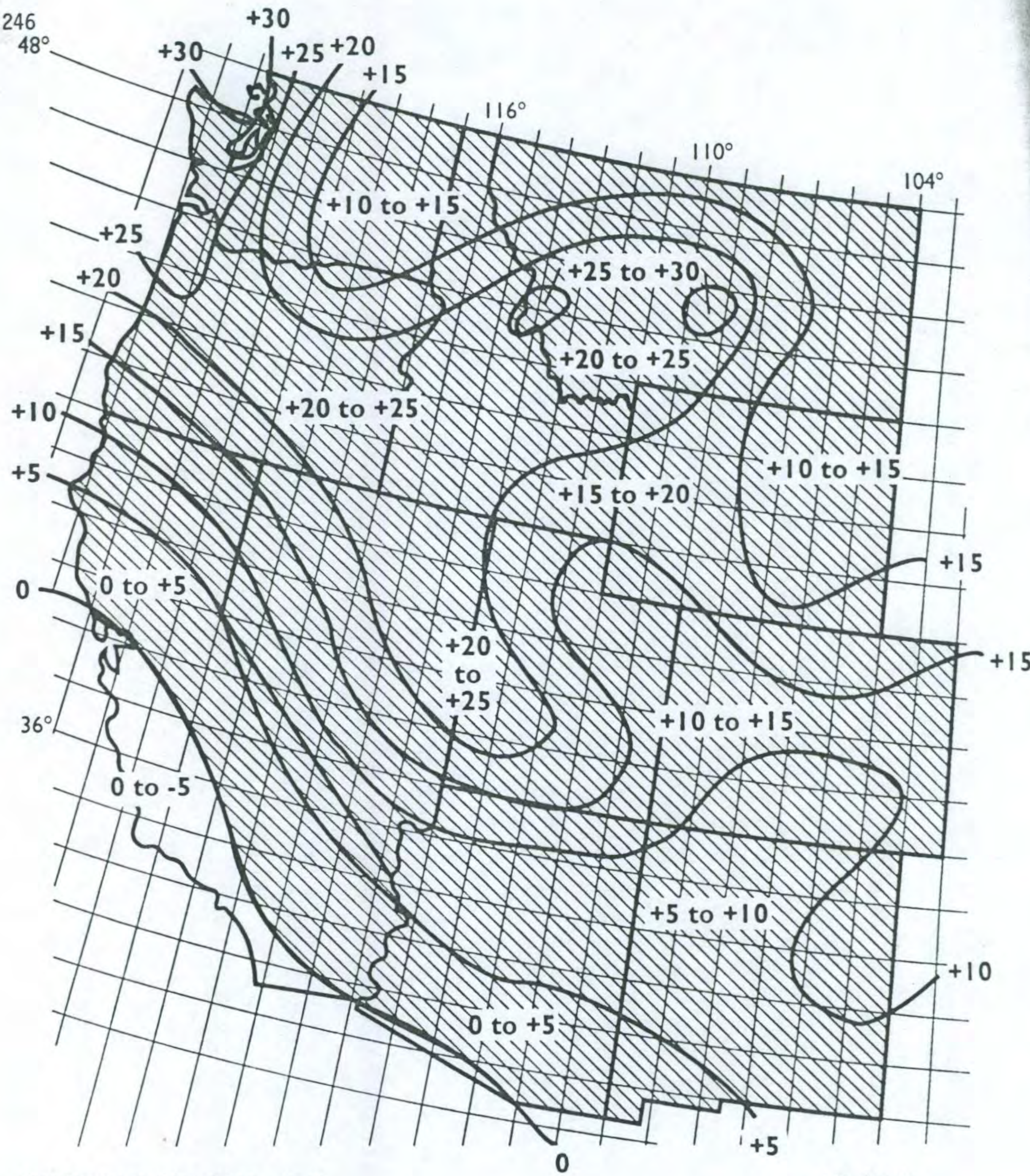
The entire Western Region was warmer than normal in February. Greatest positive anomalies of more than 14°F were located in eastern Montana. Most areas were at least 4°F warmer than normal in February.

Except for a small area in the vicinity of the Salton Sea in southern California the entire Western Region was warmer than normal in March. Greatest positive anomalies exceeding 12°F were again located in Montana. Except for extreme southern areas the entire Region was a least 4°F warmer than normal in March.

The entire Western Region was warmer than normal in April. Greatest positive anomalies exceeding 8°F were located largely in central parts of the Region. Most areas were at least 4°F warmer than normal in April.

All parts of the Region were warmer than normal in May except for an area of southeastern New Mexico and the southeastern tip of Colorado. Greatest positive temperature anomalies exceeding 8°F were mostly confined to the northern border junction area of California and Nevada. Temperatures were mostly greater than 4°F warmer than normal in May throughout the eastern half of the Region.

The great predominance of warmer than normal temperatures that occurred from December 1991 through May 1992 finally terminated in June of 1992. Nearly half of the Region was cooler than normal in June 1992. Much of New Mexico and Colorado were 2 to 4°F cooler than normal. Temperatures greater than 4°F warmer than normal, however, were recorded over much of the northwestern quarter of the Region.



Shaded Areas: Earlier than normal
+: Days earlier than normal
-: Days later than normal

J.M. Caprio
Mont. Agr. Exp. Sta.
Bozeman, MT Dec. 1992

Figure 2. Departure of Lilac Begin Bloom Date from Normal, Spring 1992

ARIZCNA 2

1. Apache
2. Cochise
3. Coconino
4. Gila
5. Graham
6. Greenlee
7. Maricopa
8. Mohave
9. Navajo
10. Pima
11. Pinal
12. Santa Cruz
13. Yavapai
14. Yuma

CALIFCRNIA 4

1. Alameda
2. Alpine
3. Amador
4. Butte
5. Calaveras
6. Colusa
7. Contra Costa
8. Del Norte
9. Eldorado
10. Fresno
11. Glenn
12. Humboldt
13. Imperial
14. Inyo
15. Kern
16. Kings
17. Lake
18. Lassen
19. Los Angeles
20. Madera
21. Marin
22. Mariposa
23. Mendocino
24. Merced
25. Modoc
26. Mono
27. Monterey
28. Napa
29. Nevada
30. Orange
31. Placer
32. Plumas
33. Riverside
34. Sacramento
35. San Benito
36. San Bernardino
37. San Diego
38. San Francisco
39. San Joaquin
40. San Luis Obispo
41. San Mateo
42. Santa Barbara
43. Santa Clara
44. Santa Cruz
45. Shasta
46. Sierra
47. Siskiyou
48. Solano
49. Sonoma
50. Stanislaus
51. Sutter
52. Tehama
53. Trinity
54. Tulare
55. Tuopumme
56. Ventura
57. Yolo
58. Yuba

COLCRADO 5

1. Adams
2. Alamosa
3. Arapahoe
4. Archuleta
5. Baca
6. Bent
7. Boulder
8. Chaffee
9. Cheyenne
10. Clear Creek
11. Conejos
12. Costilla
13. Crowley
14. Custer
15. Delta
16. Denver
17. Dolores
18. Douglas
19. Eagle
20. Elbert
21. El Paso
22. Fremont
23. Garfield
24. Gilpin
25. Grand
26. Gunnison
27. Hinsdale
28. Huerfano
29. Jackson
30. Jefferson
31. Kiowa
32. Kit Carson
33. Lake
34. La Plata
35. Larimer
36. Las Animas
37. Lincoln
38. Logan
39. Mesa
40. Mineral
41. Moffat
42. Montezuma
43. Montrose
44. Morgan
45. Otero
46. Ouray
47. Park
48. Phillips
49. Pitkin
50. Prowers
51. Pueblo
52. Rio Blanca
53. Rio Grande
54. Routt
55. Saguache
56. San Juan
57. San Miguel
58. Sedgwick
59. Summit
60. Teller
61. Washington
62. Weld
63. Yuma

IDAHO 10

1. Ada
2. Adams
3. Bannock
4. Bear Lake
5. Benewah
6. Bingham
7. Blaine
8. Boise
9. Bonner
10. Bonneville
11. Boundary
12. Butte
13. Camas
14. Canyon
15. Caribou
16. Cassia
17. Clark
18. Clearwater
19. Custer
20. Elmore
21. Franklin
22. Fremont

IDAHO 10

23. Gem
24. Gooding
25. Idaho
26. Jefferson
27. Jerome
28. Kootenai
29. Latah
30. Lemhi
31. Lewis
32. Lincoln
33. Madison
34. Minidoka
35. Nez Perce
36. Oneida
37. Owyhee
38. Payette
39. Power
40. Shoshone
41. Teton
42. Twin Falls
43. Valley
44. Washington

MONTANA 24

1. Beaverhead
2. Big Horn
3. Blaine
4. Broadwater
5. Carbon
6. Carter
7. Cascade
8. Chouteau
9. Custer
10. Daniels
11. Dawson
12. Deer Lodge
13. Fallon
14. Fergus
15. Flathead
16. Gallatin
17. Garfield
18. Glacier
19. Golden Valley
20. Granite
21. Hill
22. Jefferson
23. Judith Basin
24. Lake
25. Lewis and Clark
26. Liberty
27. Lincoln
28. McCone
29. Madison
30. Meagher
31. Mineral
32. Missoula
33. Musselshell
34. Park
35. Petroleum
36. Phillips
37. Pondera
38. Powder River
39. Powell
40. Prairie
41. Ravalli
42. Richland
43. Roosevelt
44. Rosebud
45. Sanders
46. Sheridan
47. Silver Bow
48. Stillwater
49. Sweetgrass
50. Teton
51. Toole
52. Treasure
53. Valley
54. Wheatland
55. Wibaux
56. Yellowstone

NEVADA 26

1. Churchill
2. Clark
3. Douglas
4. Elko
5. Esmeralda
6. Eureka
7. Humboldt
8. Lander
9. Lincoln
10. Lyons
11. Mineral
12. Nye
13. Ormsby
14. Pershing
15. Storey
16. Washoe
17. White Pine

NEW MEXICO 29

1. Bernalillo
2. Catron
3. Chaves
4. Colfax
5. Curry
6. De Baca

NEW MEXICO 29

7. Don Ana
8. Eddy
9. Grant
10. Guadalupe
11. Harding
12. Hidalgo
13. Lea
14. Lincoln
15. Luna
16. McKinley
17. Mora
18. Otero
19. Quay
20. Rio Arriba
21. Roosevelt
22. Sandoval
23. San Juan
24. San Miguel
25. Santa Fe
26. Sierra
27. Socorro
28. Taos
29. Torrance
30. Union
31. Valencia
32. Los Alamos

OREGON 35

1. Baker
2. Benton
3. Clackamas
4. Clatsop
5. Columbia
6. Coos
7. Crook
8. Curry
9. Deschutes
10. Douglas
11. Gilliam
12. Grant
13. Harney
14. Hood River
15. Jackson
16. Jefferson
17. Josephine
18. Klamath
19. Lake
20. Lane
21. Lincoln
22. Linn
23. Malheur
24. Marion

CCUNTIES

OREGON 35

25. Morrow
26. Multnomah
27. Polk
28. Sherman
29. Tillamook
30. Umatilla
31. Unicn
32. Wallowa
33. Wasco
34. Washington
35. Wheeler
36. Yamhill

UTAH 42

1. Beaver
2. Box Elder
3. Cache
4. Carbon
5. Daggett
6. Davis
7. Duchesne
8. Emery
9. Garfield
10. Grand
11. Iron
12. Juab
13. Kane
14. Millard
15. Morgan
16. Piute
17. Rich
18. Salt Lake
19. San Juan
20. Sanpete
21. Sevier
22. Summit
23. Tooele
24. Uintah
25. Utah
26. Wasatch
27. Washington
28. Wayne
29. Weber

WASHINGTCN 45

1. Adams
2. Asotin
3. Benton
4. Chelan
5. Clallam
6. Clark
7. Columbia
8. Cowlitz
9. Douglas
10. Ferry
11. Franklin
12. Garfield
13. Grant
14. Grays Harbor
15. Island
16. Jefferson
17. King
18. Kitsap
19. Kittitas
20. Klickitat
21. Lewis
22. Lincoln
23. Mason
24. Ckanogan
25. Pacific
26. Pend Creille
27. Pierce
28. San Juan
29. Skagit
30. Skamania
31. Snohomish
32. Spokane
33. Stevens
34. Thurstcn
35. Wahkiakum
36. Walla Walla
37. Whatcom
38. Whitman
39. Yakima

WYOMING 48

1. Albany
2. Big Horn
3. Campbell
4. Carbon
5. Converse
6. Crook
7. Fremont
8. Goshen
9. Hot Springs
10. Johnson
11. Laramie
12. Lincoln
13. Natrona
14. Niobrara
15. Park
16. Platte
17. Sheridan
18. Sublette
19. Sweetwater
20. Teton
21. Uinta
22. Washakie
23. Weston
24. Yellowstone National Park

PLANTS

L - LILAC
A - ARNOLD RED
Z - ZABEL

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
915	US BUR OF RECL	Z	NM	027	34° 26'	106° 49'	4	114	111	10.99
7094	E.DE VANEY	A	NM	029	34° 25'	105° 51'	6	109	107	8.24
5583	ELLEN DAVIS	A	NM	029	34° 55'	106° 05'	4	108	114	21.37
7094	E.DE VANEY	Z	NM	029	34° 25'	105° 51'	5	112	109	6.06
5583	ELLEN DAVIS	Z	NM	029	34° 55'	106° 05'	6	114	121	16.29
3060	ROBERT SANCHEZ	Z	NM	029	34° 45'	106° 04'	21	113	114	11.36
1887	NAT'L WEATHER	A	NM	030	36° 27'	103° 09'	18	104	106	9.91
1887	NAT'L WEATHER	Z	NM	030	36° 27'	103° 09'	18	105	108	11.17
6619	SAM BRITT	Z	NM	030	36° 18'	103° 44'	4	127	122	13.28
4719	GRACE RILEY	A	NM	031	35° 02'	107° 24'	16	101	104	12.28
2785	NAT PARK SERV	A	NM	031	35° 03'	108° 21'	4	114	114	10.80
5084	ATOMIC LAB	A	NM	032	35° 52'	106° 19'	4	112	112	12.01
4349	NEVADA ST PARK	A	NV	001	39° 28'	119° 04'	4	98	99	9.71
1071	US BUR RECL	A	NV	002	35° 59'	114° 51'	9	69	70	6.07
1071	US BUR RECL	Z	NV	002	35° 59'	114° 51'	9	70	70	7.47
5191	D. ELLIS	Z	NV	003	38° 57'	119° 46'	8	115	118	13.45
1905	NEVADA ST HWY	A	NV	004	41° 47'	114° 45'	4	137	138	6.85
8988	WELLS ELECTRIC	A	NV	004	41° 07'	114° 58'	9	142	141	5.84
8988	WELLS ELECTRIC	Z	NV	004	41° 07'	114° 58'	9	143	143	4.39
2431	LIDABEL WRIGHT	A	NV	005	37° 37'	118° 01'	19	112	114	10.97
9171	NAT WEATHER SV	A	NV	007	39° 00'	119° 10'	5	100	104	19.87
1630	CENTRL NEVADA	A	NV	008	39° 23'	117° 19'	8	141	139	13.55
507	EDNAV. COOLEY	A	NV	008	39° 30'	117° 05'	13	139	139	9.86
1630	CENTRL NEVADA	Z	NV	008	39° 23'	117° 19'	8	140	135	14.14
507	EDNAV COOLEY	Z	NV	008	39° 30'	117° 05'	5	144	138	9.59
2562	BRADSHAW J W	A	NV	009	37° 19'	114° 30'	4	87	90	6.73
5880	US FISH WILDLF	A	NV	009	37° 16'	115° 07'	4	87	87	10.21
1358	US SOIL CON	A	NV	009	37° 37'	114° 31'	4	100	104	22.91
2562	BRADSHAW J W	Z	NV	009	37° 19'	114° 30'	4	83	84	4.55
1358	US SOIL CON	Z	NV	009	37° 37'	114° 31'	4	100	105	23.93
8822	NV FISH & GAME	A	NV	010	39° 05'	119° 07'	4	105	107	14.45
7620	C.H. CECCHINI	A	NV	012	38° 47'	117° 10'	8	121	124	12.50
46	SIMPSON ILLIE	A	NV	012	38° 07'	115° 35'	4	128	128	6.08
7620	H. WILLIAMS	Z	NV	012	38° 47'	117° 10'	5	125	123	8.93

2562	BRADSHAW J W	Z	NV	009	37° 19'	114° 30'	4	83	84	4.55
1358	US SOIL CON	Z	NV	009	37° 37'	114° 31'	4	100	105	23.93
8822	NV FISH & GAME	A	NV	010	39° 05'	119° 07'	4	105	107	14.45
7620	C.H. CECCHINI	A	NV	012	38° 47'	117° 10'	8	121	124	12.50
46	SIMPSON ILLIE	A	NV	012	38° 07'	115° 35'	4	128	128	6.08
7620	H. WILLIAMS	Z	NV	012	38° 47'	117° 10'	5	125	123	8.93
46	SIMPSON ILLIE	Z	NV	012	38° 07'	115° 35'	4	129	130	7.54

DURING THE PERIOD 1968 - 1991
BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
1485	NEV ST HIGHWAY	Z	NV	013	39° 09'	119° 46'	5	120	123	9.18
8761	PAUL MEINECKE	A	NV	015	39° 18'	119° 38'	5	129	130	7.33
8761	PAUL MEINECKE	Z	NV	015	39° 18'	119° 38'	5	129	129	9.13
8838	.UNIV NEVADA	A	NV	016	39° 42'	119° 17'	5	104	107	10.53
4745	C.GARDNER	A	NV	017	38° 51'	115° 00'	7	124	124	8.42
4745	C.GARDNER	Z	NV	017	38° 51'	115° 00'	7	123	122	6.99
2482	EDITH JOHNSON	A	OR	001	44° 37'	117° 29'	4	129	128	4.27
3604	EVERETT PAYTON	A	OR	001	44° 53'	117° 07'	7	125	125	11.44
8780	US FOREST SERV	A	OR	001	44° 26'	118° 14'	8	134	132	19.41
2482	EDITH JOHNSON	Z	OR	001	44° 37'	117° 29'	5	129	129	2.12
3770	BUR.WAT.WORKS	A	OR	003	45° 27'	122° 09'	4	109	112	10.44
1329	CANBY	A	OR	003	45° 17'	122° 40'	13	83	86	10.22
5880	CLACKAMAS CONT	A	OR	003	45° 21'	122° 35'	7	94	95	8.56
3402	G. BECKMAN	A	OR	003	45° 18'	121° 45'	11	176	176	12.71
1329	CITY OF CANBY	Z	OR	003	45° 17'	122° 40'	12	87	87	12.08
5880	CLACKAMAS CONT	Z	OR	003	45° 21'	122° 35'	7	98	93	10.48
3402	G H ECKMAN	Z	OR	003	45° 18'	121° 45'	10	185	182	10.26
3180	ASTER EXP STA	A	OR	004	46° 09'	123° 49'	7	108	125	33.10
3180	ASTER EXP STA	Z	OR	004	46° 09'	123° 49'	11	104	107	19.65
9051	SAM DAHLGREN	A	OR	005	45° 49'	122° 51'	6	97	98	7.58
1643	RALPH KLEGER	Z	OR	005	46° 06'	123° 17'	4	108	110	9.80
9051	SAM DAHLGREN	Z	OR	005	45° 49'	122° 51'	7	94	97	14.99
5217	DOUGLAS CO.	A	OR	006	42° 49'	123° 51'	9	92	99	13.75
5217	DOUGLAS CO.	Z	OR	006	42° 49'	123° 51'	9	92	96	9.83
7866	E. STINSON	Z	OR	006	43° 09'	123° 52'	9	77	74	15.86
6238	OCHOCO IRR DIS	A	OR	007	44° 18'	120° 44'	4	123	122	10.97
9316	RAYMOND AMES	A	OR	009	43° 41'	121° 41'	9	141	144	10.98
2406	CITY DRAIN	A	OR	010	43° 41'	123° 18'	4	94	97	15.84
7112	J W GURNEY	A	OR	010	43° 08'	123° 37'	4	90	84	21.52
3305	MRS. H. MEAD	A	OR	010	42° 44'	123° 26'	9	92	92	8.23
4939	RUSSEL NELSON	A	OR	010	43° 14'	122° 56'	5	100	105	16.65
2633	ST FOR NURSERY	A	OR	010	43° 36'	123° 35'	12	85	81	12.13
8536	TOKETEE FALLS	A	OR	010	43° 17'	122° 27'	6	114	117	9.20
2406	CITY DRAIN	Z	OR	010	43° 41'	123° 18'	5	94	88	12.58
7112	J.GURNEY	Z	OR	010	43° 08'	123° 37'	6	96	97	11.90

HONEYSUCKLE WEATHER BUREAU OBSERVERS DURING THE PERIOD 1968 - 1991 BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
2633	ORE. STATE FOR	Z	OR	010	43° 36'	123° 35'	5	86	83	15.64
4939	RUSSEL NELSON	Z	OR	010	43° 14'	122° 56'	5	96	94	14.05
265	HAROLD BLANK	Z	OR	011	45° 43'	120° 12'	5	100	99	6.14
5715	OREGON ST F DE	A	OR	012	44° 49'	119° 25'	5	111	112	10.46
541	US FOREST SERV	A	OR	012	44° 32'	118° 36'	8	126	126	5.67
541	FOREST SERVICE	Z	OR	012	44° 32'	118° 36'	8	133	132	6.30
5020	M. GIBBS	Z	OR	012	44° 43'	119° 06'	13	138	136	12.17
5715	OREGON ST F DE	Z	OR	012	44° 49'	119° 25'	8	113	112	9.44
2308	M.SMITH	A	OR	015	43° 11'	122° 08'	6	96	96	9.15
5424	MEDFORD EXP ST	A	OR	015	42° 18'	122° 52'	28	95	95	9.61
738	MEDFORD WAT.	A	OR	015	42° 30'	122° 28'	6	129	128	6.65
1207	OLSEN, J.H.	A	OR	015	42° 32'	122° 33'	18	129	128	9.45
7391	ROSALIE CULY	A	OR	015	42° 14'	123° 02'	9	96	92	8.92
1149	SALTMARSH, VIE	A	OR	015	42° 09'	122° 58'	14	106	106	10.69
760	DAVID HENDRIX	Z	OR	015	42° 18'	122° 56'	22	98	98	10.06
2308	M.SMITH	Z	OR	015	43° 11'	122° 08'	7	94	92	11.44
738	MEDFORD WAT.	Z	OR	015	42° 30'	122° 28'	7	125	122	7.04
1207	OLSEN, J. H.	Z	OR	015	42° 32'	122° 33'	17	129	129	9.77
1149	SALTMARSH, VIE	Z	OR	015	42° 09'	122° 58'	13	106	104	12.55
3542	GEORG RUFENER	A	OR	016	44° 29'	120° 58'	4	130	130	0.50
6532	PORTLAND ELECT	A	OR	016	44° 44'	121° 14'	8	105	103	8.07
3542	GEORG RUFENER	Z	OR	016	44° 29'	120° 58'	4	135	135	2.08
118	MR CURTIS	A	OR	019	42° 58'	120° 00'	8	128	128	14.50
3095	MRS. BRANCH	A	OR	019	43° 20'	121° 10'	8	138	138	14.65
4670	GLENN TYLER	Z	OR	019	42° 11'	120° 21'	19	131	130	10.58
3095	MRS. BRANCH	Z	OR	019	43° 20'	121° 10'	7	137	140	13.72
781	ROBERT COONROD	A	OR	020	43° 36'	123° 05'	21	90	93	16.00
781	ROBERT COONROD	Z	OR	020	43° 36'	123° 05'	18	101	104	11.19
6366	CASCADE EXP FO	A	OR	021	45° 02'	123° 56'	8	94	89	14.49
82	C.SPENCER	A	OR	022	44° 37'	123° 07'	4	92	91	13.92
3971	E.L. KING	A	OR	022	44° 21'	122° 47'	18	93	95	9.76
652	EUGENE WAT&POW	A	OR	022	44° 18'	122° 02'	6	133	137	9.91
7559	SANTIAM LC	A	OR	022	44° 25'	121° 52'	10	103	85	40.46
82	C.SPENCER	Z	OR	022	44° 37'	123° 07'	5	88	89	7.81

3095	MRS. BRANCH	Z	OR	019	43° 20'	121° 1[illegible]'	[illegible]	[illegible]	93	16.00
781	ROBERT COONROD	A	OR	020	43° 36'	123° 05'	21	90	93	16.00
781	ROBERT COONROD	Z	OR	020	43° 36'	123° 05'	18	101	104	11.19
6366	CASCADE EXP FO	A	OR	021	45° 02'	123° 56'	8	94	89	14.49
82	C.SPENCER	A	OR	022	44° 37'	123° 07'	4	92	91	13.92
3971	E.L. KING	A	OR	022	44° 21'	122° 47'	18	93	95	9.76
652	EUGENE WAT&POW	A	OR	022	44° 18'	122° 02'	6	133	137	9.91
7559	SANTIAM LC	A	OR	022	44° 25'	121° 52'	10	103	85	40.46
82	C.SPENCER	Z	OR	022	44° 37'	123° 07'	5	88	89	7.81

DURING THE PERIOD 1968 – 1991
BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
7500	NAT'L WX SERVI	A	OR	024	44° 55'	123° 01'	9	87	88	11.58
2112	STATE BOARD	A	OR	027	44° 56'	123° 19'	4	102	102	6.46
2805	K RICHARDSON	Z	OR	027	44° 51'	123° 26'	4	112	112	11.15
6540	PENDLETON BR S	A	OR	030	45° 43'	118° 38'	17	102	103	10.64
8726	UKIAH RANG STA	A	OR	030	45° 08'	118° 56'	13	138	140	6.34
3847	UMUTILLA STAT.	A	OR	030	45° 49'	119° 17'	11	98	98	6.99
6540	PENDLETON BR S	Z	OR	030	45° 43'	118° 38'	17	104	104	11.37
8726	UKIAH RANG STA	Z	OR	030	45° 08'	118° 56'	14	141	143	4.65
3847	UMUTILLA	Z	OR	030	45° 49'	119° 17'	11	100	99	7.64
2564	YOUNG JOHN I.	Z	OR	030	45° 45'	119° 11'	4	103	103	11.34
2675	ASCHENBRENNER	Z	OR	032	45° 24'	117° 15'	4	145	146	4.11
1227	EDNA BELLER	A	OR	034	45° 41'	123° 04'	6	108	108	7.08
2325	JOSEPH BRIDGES	A	OR	034	45° 29'	123° 07'	9	86	80	10.02
2348	NORMA JACOBER	A	OR	034	45° 42'	122° 56'	7	105	108	10.13
2997	CITY FOREST GR	Z	OR	034	45° 32'	123° 06'	7	89	92	17.79
1227	EDNA BELLER	Z	OR	034	45° 41'	123° 04'	8	106	106	8.95
8009	JOHN BUTLER	Z	OR	035	44° 50'	119° 47'	9	103	106	12.57
9298	D. SCHAEFFER	A	OR	036	45° 10'	123° 12'	8	95	96	11.75
7127	C A SCHAAD	Z	OR	036	45° 18'	122° 55'	8	95	97	10.11
9298	D. SCHAEFFER	Z	OR	036	45° 10'	123° 12'	8	98	96	10.04
7361	MARY PITTMAN	A	TX	023	34° 21'	101° 02'	4	75	75	6.65
7361	MARY PITTMAN	Z	TX	023	34° 21'	101° 02'	4	76	77	9.57
1068	C.STEWART	Z	TX	027	30° 53'	97° 56'	4	66	66	4.97
408	MR BILL LOVIL	A	TX	034	33° 07'	94° 11'	7	73	75	10.98
408	MR. LOVIL	Z	TX	034	33° 07'	94° 11'	9	69	67	12.30
4278	HORDS CREEK	A	TX	042	31° 51'	99° 34'	6	68	67	4.50
4278	HORDS CREEK	Z	TX	042	31° 51'	99° 34'	6	73	71	6.94
3080	MR C J RIKE	A	TX	043	33° 10'	96° 22'	6	76	72	14.41
3080	MR C J RIKE	Z	TX	043	33° 10'	96° 22'	5	64	62	5.12
3156	MR. FISCHER	A	TX	046	29° 59'	98° 16'	5	67	64	8.02
3156	MR. FISCHER	Z	TX	046	29° 59'	98° 16'	5	72	74	6.19
1429	US COPRS ENG	Z	TX	046	29° 52'	98° 12'	4	47	50	17.69
7495	MR. BROWN	Z	TX	070	32° 31'	96° 48'	8	70	70	8.38
8877	MRS TEAGUE	Z	TX	086	30° 26'	98° 49'	4	67	64	11.15
7081	MR H SMITH	A	TX	095	34° 12'	101° 43'	5	88	92	10.07

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
7081	MR H SMITH	Z	TX	095	34° 12'	101° 43'	5	85	89	10.83
1800	OLIN SMYTH JR.	A	TX	126	32° 20'	97° 24'	4	72	71	2.71
1800	OLIN SMYTH JR.	Z	TX	126	32° 20'	97° 24'	4	73	72	3.32
4670	H.COLEMAN	A	TX	134	30° 30'	99° 47'	4	76	76	2.38
4670	H.COLEMAN	Z	TX	134	30° 30'	99° 47'	4	74	73	9.29
3225	KEN SHARPE	A	TX	148	36° 26'	100° 08'	10	96	100	9.90
3225	KEN SHARPE	Z	TX	148	36° 26'	100° 08'	10	94	93	10.62
7243	J.RUSCHE	Z	TX	150	30° 35'	98° 53'	4	81	83	13.39
9593	LEDNICKY	Z	TX	155	31° 48'	97° 06'	9	76	75	6.46
5158	GROVER SPRINGE	Z	TX	159	32° 18'	101° 53'	16	73	74	6.93
3247	MR. FOSTER	A	TX	169	33° 29'	97° 34'	8	74	71	12.05
3247	MR. FOSTER	Z	TX	169	33° 29'	97° 34'	7	67	74	13.28
8761	SOUTH.PUB.SER.	A	TX	171	35° 58'	101° 52'	4	97	92	21.30
8761	SOUTH.PUB.SER.	Z	TX	171	35° 58'	101° 52'	4	97	91	24.07
3196	GEORGE POPE	A	TX	173	34° 14'	100° 59'	5	72	71	8.79
3196	G.POPE	Z	TX	173	34° 14'	100° 59'	4	77	77	5.75
6893	TRANSPECOS EXP	Z	TX	195	31° 25'	103° 30'	8	71	70	7.64
691	US CORPS ENG	A	TX	220	32° 39'	97° 27'	8	78	79	5.73
691	US CORPS ENG	Z	TX	220	32° 39'	97° 27'	8	77	78	9.32
9499	C.G. PARSONS	A	TX	224	31° 40'	100° 43'	7	75	74	7.87
9499	MR C G PARSONS	Z	TX	226	31° 40'	100° 43'	11	67	67	4.55
852	MS. KIRKPATRIC	A	TX	232	29° 14'	100° 06'	5	64	66	3.63
852	MS. KIRKPATRIC	Z	TX	232	29° 14'	100° 06'	5	67	65	6.02
3199	B.LEFNER	Z	TX	246	30° 48'	97° 46'	4	68	69	4.24
5723	DARWIN MARSHAL	A	UT	001	38° 13'	112° 55'	6	107	107	8.47
5654	WEATH. BUREAU	A	UT	001	38° 26'	113° 01'	16	128	128	8.62
5654	WEATHER BUREAU	Z	UT	001	38° 26'	113° 01'	13	130	130	9.22
5186	G.ASHCROFT	A	UT	003	41° 44'	111° 49'	6	129	128	5.66
5186	G.ASHCROFT	Z	UT	003	41° 44'	111° 49'	6	131	130	6.59
8474	KAISER STEEL C	A	UT	004	39° 34'	110° 22'	5	145	144	12.44
2726	RULON DRAPER	A	UT	006	40° 59'	111° 53'	6	119	118	15.41
9346	WEBER BASIN	A	UT	006	41° 07'	111° 55'	17	124	123	9.09
9346	WEBER BASIN	Z	UT	006	41° 07'	111° 55'	17	122	125	8.59
[illegible]								[illegible]	[illegible]	[illegible]

5654	WEATH. BUREAU									
5654	WEATHER BUREAU	Z	UT	Ø01	38° 26'	113° Ø1'	[illegible]			
5186	G.ASHCROFT	A	UT	Ø03	41° 44'	111° 49'	6	129	128	5.66
5186	G.ASHCROFT	Z	UT	Ø03	41° 44'	111° 49'	6	131	13Ø	6.59
8474	KAISER STEEL C	A	UT	Ø04	39° 34'	11Ø° 22'	5	145	144	12.44
2726	RULON DRAPER	A	UT	Ø06	4Ø° 59'	111° 53'	6	119	118	15.41
9346	WEBER BASIN	A	UT	Ø06	41° Ø7'	111° 55'	17	124	123	9.Ø9
9346	WEBER BASIN	Z	UT	Ø06	41° Ø7'	111° 55'	17	122	125	8.59
5507	US FOR SERV	A	UT	Ø07	4Ø° 1Ø'	11Ø° 24'	8	125	129	11.24
								124	128	14.52

DURING THE PERIOD 1968 - 1991
BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
2798	D. CHRISTENSEN	A	UT	ØØ8	39° Ø6'	111° Ø8'	12	126	128	8.43
2798	D. CHRISTENSEN	Z	UT	ØØ8	39° Ø6'	111° Ø8'	13	127	129	9.93
1ØØ2	FAA FLIGHT ST.	A	UT	ØØ9	37° 42'	112° Ø9'	5	142	142	14.54
1ØØ2	FAA FLIGHT ST.	Z	UT	ØØ9	37° 42'	112° Ø9'	5	149	159	15.73
2561	MABEL NIELSEN	A	UT	Ø11	37° 45'	113° 39'	8	125	124	1Ø.Ø8
2561	MABEL NIELSEN	Z	UT	Ø11	37° 45'	113° 39'	9	127	126	8.14
1144	D. BAGLEY	A	UT	Ø12	39° 54'	113° 43'	7	123	124	6.Ø5
5138	J W WOODBURY	A	UT	Ø12	39° 44'	112° 18'	7	118	119	6.76
1144	C N BAGLEY	Z	UT	Ø12	39° 54'	113° 43'	7	123	123	6.57
5Ø65	JOHN SHEPHERD	Z	UT	Ø12	39° 33'	111° 57'	5	127	127	7.66
26Ø7	MR. CHILDS	A	UT	Ø14	39° Ø7'	113° 57'	9	122	12Ø	8.15
26Ø7	DOUGLAS CHILDS	Z	UT	Ø14	39° Ø7'	113° 57'	11	122	121	6.56
4856	MONTY KEARL	A	UT	Ø17	41° 49'	111° 19'	4	146	145	9.87
7343	CHARLES TEA	Z	UT	Ø18	4Ø° 31'	111° 59'	6	123	122	7.84
4542	SALT LAKE CO	Z	UT	Ø18	4Ø° 39'	111° 49'	5	118	122	11.9Ø
4947	ROBERTA WILCOX	A	UT	Ø19	38° 18'	1Ø9° 13'	9	13Ø	13Ø	9.Ø9
4764	GEORGE HATCH	A	UT	Ø21	38° 31'	111° 53'	16	144	143	9.61
2847	FOREST RANGER	Z	UT	Ø21	38° 33'	111° 43'	5	168	175	14.31
4764	GEORGE HATCH	Z	UT	Ø21	38° 31'	111° 53'	18	146	146	7.82
1411	SALLY LINDGREN	A	UT	Ø22	4Ø° 49'	11Ø° 48'	7	115	111	15.44
1588	CHARLES COPLEY	Z	UT	Ø22	4Ø° 55'	111° 24'	21	136	135	9.36
326Ø	CECIL WOODMAN	A	UT	Ø23	4Ø° 1Ø'	113° 5Ø'	4	124	126	6.99
2173	NATL PARK SER	A	UT	Ø24	4Ø° 26'	1Ø9° 18'	4	128	128	4.65
6568	OURAY NWR	A	UT	Ø24	4Ø° Ø8'	1Ø9° 38'	6	129	128	6.51
2173	NATL PARK SER	Z	UT	Ø24	4Ø° 26'	1Ø9° 18'	5	144	128	32.35
2996	US DP INTERIOR	Z	UT	Ø24	4Ø° 17'	1Ø9° 51'	5	129	134	9.18
7Ø61	CHRISTOPHERSON	A	UT	Ø25	4Ø° 14'	111° 4Ø'	6	124	124	1Ø.58
7Ø64	DALE STEVENS	A	UT	Ø25	4Ø° 15'	111° 39'	7	112	112	13.38
6724	LESLIE BARNETT	A	UT	Ø25	4Ø° Ø3'	111° 46'	4	115	117	1Ø.4Ø
2696	ROLAND HANSEN	A	UT	Ø25	4Ø° 16'	112° Ø5'	8	134	132	8.99
7Ø61	CHRISTOPHERSON	Z	UT	Ø25	4Ø° 14'	111° 4Ø'	7	126	129	12.74
6724	LESLIE BARNETT	Z	UT	Ø25	4Ø° Ø3'	111° 46'	5	118	122	1Ø.64
4968	VERNON CHURCH	Z	UT	Ø27	37° 12'	113° 16'	5	92	88	14.82
3Ø46	CAPITOL REEF	A	UT	Ø28	38° 17'	111° 16'	15	11Ø	11Ø	13.68
3Ø46	CAPITOL REEF	Z	UT	Ø28	38° 17'	111° 16'	15	1Ø9	112	15.16

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
4135	F BARTHOLOWMEW	A	UT	029	41° 14'	111° 43'	9	139	135	9.55
3546	W. ASHCRAFT	A	WA	001	46° 46'	118° 40'	9	115	114	8.22
3546	W. ASHCRAFT	Z	WA	001	46° 46'	118° 40'	10	118	119	8.59
5231	CORPS OF ENGIN	A	WA	003	45° 57'	119° 18'	5	95	93	8.09
6768	E L PROEBSTING	A	WA	003	46° 15'	119° 45'	18	103	102	6.38
5231	CORPS OF ENGIN	Z	WA	003	45° 57'	119° 18'	6	96	95	6.78
6768	E. PROEBSTING	Z	WA	003	46° 15'	119° 45'	10	104	103	6.87
4572	FISH WILD SERV	A	WA	004	47° 34'	120° 40'	5	127	125	3.74
6534	MRS TROY MOORE	A	WA	004	47° 47'	120° 39'	6	129	133	9.51
4572	FISH WILD SERV	Z	WA	004	47° 34'	120° 40'	4	128	128	5.85
1350	GEORGE PENNELL	Z	WA	004	47° 50'	120° 02'	7	128	116	20.38
7544	CITY OF SEQUIM	A	WA	005	48° 05'	123° 03'	6	100	100	23.26
4438	MAPLE GROVE R	Z	WA	005	48° 05'	123° 42'	7	127	128	9.27
4769	CITY LONGVIEW	A	WA	008	46° 10'	122° 55'	7	97	98	7.73
4084	KALAMA HATCHRY	A	WA	008	46° 01'	122° 43'	7	99	94	9.59
4769	CITY LONGVIEW	Z	WA	008	46° 10'	122° 55'	8	98	101	9.27
1690	MRS FINKBEINER	A	WA	011	46° 40'	118° 53'	6	105	102	8.80
6610	US FORSET SERV	Z	WA	012	46° 28'	117° 37'	14	104	106	9.29
7727	NORMA BOOHER	A	WA	013	46° 50'	119° 40'	8	97	101	8.86
6011	EVA GRISWOLD	A	WA	014	46° 50'	123° 13'	5	105	102	15.61
6864	FOREST SERVICE	A	WA	014	47° 30'	123° 49'	6	129	130	11.81
9112	JOSEPHINE DYAS	A	WA	014	46° 52'	124° 06'	7	71	64	19.37
13	WYNOOCHE	A	WA	014	47° 16'	123° 42'	11	100	103	15.83
6011	EVA GRISWOLD	Z	WA	014	46° 50'	123° 13'	4	112	109	19.91
1064	SIMPSON LOGGIN	Z	WA	014	47° 22'	123° 36'	4	132	132	8.43
13	WYNOOCHE	Z	WA	014	47° 16'	123° 42'	14	102	107	12.33
324	CITY AUBURN	A	WA	017	47° 19'	122° 14'	5	95	97	12.01
5704	CORPS OF ENGIN	A	WA	017	47° 09'	121° 56'	5	111	110	5.26
4169	KENT WAT. DPT.	A	WA	017	47° 22'	122° 14'	8	90	92	17.14
1233	SEATLE WATER	A	WA	017	47° 25'	121° 44'	22	126	128	18.70
6295	TACOMA WAT.DPT	A	WA	017	47° 18'	121° 51'	6	114	121	10.99
324	CITY AUBURN	Z	WA	017	47° 19'	122° 14'	7	92	92	9.83
5704	CORPS OF ENGIN	Z	WA	017	47° 09'	121° 56'	6	121	125	10.73
1233	SEATLE WATER	Z	WA	017	47° 25'	121° 44'	23	126	125	17.46
[illegible]	[illegible]	Z	WA	017	47° 18'	121° 51'	10	103	112	20.65

DURING THE PERIOD 1968 - 1991

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
324	CITY AUBURN	A	WA	Ø17	47° 19'	122° 14'	[illegible]	[illegible]	[illegible]	[illegible]
5704	CORPS OF ENGIN	A	WA	Ø17	47° Ø9'	121° 56'	5	111	11Ø	5.26
4169	KENT WAT. DPT.	A	WA	Ø17	47° 22'	122° 14'	8	9Ø	92	17.14
1233	SEATLE WATER	A	WA	Ø17	47° 25'	121° 44'	22	126	128	18.7Ø
6295	TACOMA WAT.DPT	A	WA	Ø17	47° 18'	121° 51'	6	114	121	1Ø.99
324	CITY AUBURN	Z	WA	Ø17	47° 19'	122° 14'	7	92	92	9.83
5704	CORPS OF ENGIN	Z	WA	Ø17	47° Ø9'	121° 56'	6	121	125	1Ø.73
1233	SEATLE WATER	Z	WA	Ø17	47° 25'	121° 44'	23	126	125	17.46
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1Ø2	112	2Ø.65

DURING THE PERIOD 1968 – 1991
BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
217	GREEN, PATRICI	A	WA	Ø2Ø	45° 49'	121° 16'	1Ø	138	137	5.95
668	MEYER WILLIAM	A	WA	Ø2Ø	46° ØØ'	12Ø° 18'	15	133	134	7.49
3183	CHARLES HAIGHT	Z	WA	Ø2Ø	46° Ø1'	121° 17'	4	131	131	2.22
217	GREEN, PATRICI	Z	WA	Ø2Ø	45° 49'	121° 16'	12	136	134	5.79
668	WILLIAM MEYER	Z	WA	Ø2Ø	46° ØØ'	12Ø° 18'	21	13Ø	131	9.21
2253	DANIEL WOOSTER	A	WA	Ø21	46° 38'	123° 15'	5	11Ø	114	11.69
3177	MARGIE GOODWIN	A	WA	Ø21	46° 31'	122° 1Ø'	8	95	95	8.93
6909	US FOREST SERV	A	WA	Ø21	46° 32'	121° 56'	6	99	96	6.91
6262	USF PACKWOOD	A	WA	Ø21	46° 37'	121° 4Ø'	1Ø	114	116	11.Ø9
5425	VICTOR ROWE	A	WA	Ø21	46° 43'	122° 11'	4	122	126	9.22
2253	DANIEL WOOSTER	Z	WA	Ø21	46° 38'	123° 15'	6	111	113	8.97
6262	USF PACKWOOD	Z	WA	Ø21	46° 37'	121° 4Ø'	1Ø	117	12Ø	12.15
5425	VICTOR ROWE	Z	WA	Ø21	46° 43'	122° 11'	5	123	122	8.33
3515	GENE CRONRATH	A	WA	Ø22	47° 29'	118° 11'	16	129	13Ø	7.94
3515	CRONRATH EUGEN	Z	WA	Ø22	47° 29'	118° 11'	12	128	127	8.9Ø
5832	BUREAU INDIAN	Z	WA	Ø24	48° Ø8'	118° 59'	8	132	134	6.Ø7
5128	ROY KUMM	Z	WA	Ø24	48° 32'	12Ø° 2Ø'	4	143	144	3.74
3333	WA DEPT FISHER	A	WA	Ø25	46° 23'	123° 34'	1Ø	89	87	9.Ø4
436Ø	TACOMA CITY LI	A	WA	Ø27	46° 5Ø'	122° 19'	1Ø	1Ø5	11Ø	17.71
436Ø	TACOMA CITY LI	Z	WA	Ø27	46° 5Ø'	122° 19'	11	1Ø6	1Ø8	19.67
4999	CASCADES NAT P	A	WA	Ø29	48° 32'	121° 27'	8	114	118	18.45
5678	NW WASH. EXPER	A	WA	Ø29	48° 26'	122° 23'	5	84	85	14.91
4999	CASCADES NAT P	Z	WA	Ø29	48° 32'	121° 27'	8	117	119	14.77
5678	SUPERVISOR	Z	WA	Ø29	48° 26'	122° 23'	9	1Ø5	1Ø5	9.84
257	BARNEY BRENNE	A	WA	Ø31	48° 12'	122° Ø8'	4	99	98	4.24
7657	IDA TURNER	A	WA	Ø31	48° Ø4'	121° 34'	8	152	154	8.54
1992	US FOREST RNGR	A	WA	Ø31	48° 15'	121° 36'	4	131	131	11.61
5525	WA STATE REFOR	A	WA	Ø31	47° 51'	121° 59'	1Ø	95	98	1Ø.4Ø
7657	IDA TURNER	Z	WA	Ø31	48° Ø4'	121° 34'	6	154	154	1Ø.95
8034	ST SALMON HAT	Z	WA	Ø31	47° 52'	121° 43'	4	99	99	15.22
1992	US FOREST RNGR	Z	WA	Ø31	48° 15'	121° 36'	5	129	131	6.63
5525	WA STATE REFOR	Z	WA	Ø31	47° 51'	121° 59'	9	1Ø3	1Ø3	1Ø.73
7933	FINCH ARBORETM	A	WA	Ø32	47° 4Ø'	117° 25'	5	131	132	5.13
7933	FINCH ARBORETM	Z	WA	Ø32	47° 4Ø'	117° 25'	7	132	13Ø	5.99
5954	HARRY VAUGHAN	Z	WA	Ø32	47° 41'	117° 26'	5	122	121	8.35

HONEYSUCKLE WEATHER BUREAU OBSERVERS DURING THE PERIOD 1968 - 1991 BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
1650	WILMA CAMERON	A	WA	033	48° 33'	117° 53'	6	131	132	9.56
1205	DEPT FISH CATH	A	WA	035	46° 16'	123° 18'	8	109	112	10.68
1205	DEPT FISH CATH	Z	WA	035	46° 16'	123° 18'	11	100	96	11.97
5387	FRANCIS HARRIS	A	WA	036	46° 05'	118° 16'	5	100	99	6.80
9200	NAT'L PARK SER	A	WA	036	46° 03'	118° 27'	12	95	92	9.86
3883	PROJ ENG ICE H	A	WA	036	46° 15'	118° 51'	6	101	103	5.19
5387	FRANCIS HARRIS	Z	WA	036	46° 05'	118° 16'	4	103	100	7.94
3883	PROJ ENG ICE H	Z	WA	036	46° 15'	118° 51'	7	103	102	5.13
729	MRS. VAN LUVEN	A	WA	037	49° 00'	122° 45'	9	92	95	14.39
564	WASH ST. NURSE	A	WA	037	48° 47'	122° 29'	10	94	95	15.86
564	WASH ST. NURSE	Z	WA	037	48° 47'	122° 29'	6	91	96	16.50
6789	FRANK H WEBB	A	WA	038	46° 46'	117° 12'	5	136	136	4.97
6789	FRANK H WEBB	Z	WA	038	46° 46'	117° 12'	5	138	141	7.02
8442	YAKIMA TIETON	Z	WA	039	46° 40'	121° 00'	4	131	130	4.24
5435	WATER RES.	A	WY	001	41° 21'	105° 37'	13	149	149	6.49
5435	WATER RES.	Z	WY	001	41° 21'	105° 37'	14	151	153	6.31
4080	MRS WL MAXWELL	A	WY	002	44° 29'	108° 03'	8	135	131	14.43
3865	C. MANKIN	A	WY	003	44° 05'	105° 43'	10	145	149	11.90
7548	E. OEDEKOVEN	A	WY	003	44° 56'	105° 48'	5	144	145	6.39
3865	C. MANKIN	Z	WY	003	44° 05'	105° 43'	11	143	145	9.97
2580	DILLINGER	Z	WY	003	44° 07'	105° 07'	8	144	146	8.48
2610	B. HENDERSON	A	WY	004	41° 02'	107° 32'	12	150	149	12.62
2610	B. HENDERSON	Z	WY	004	41° 02'	107° 32'	10	144	141	7.68
5525	KORTES JOHN	Z	WY	004	42° 11'	106° 50'	4	155	159	9.25
2725	VIC NACHTMAN	A	WY	005	43° 25'	104° 57'	6	141	140	8.60
2725	NACHTMAN MARY	Z	WY	005	43° 25'	104° 57'	18	136	138	11.04
8705	CROOK SHERIFFS	A	WY	006	44° 24'	104° 21'	4	139	141	7.14
8647	F. JENKINS	A	WY	006	44° 47'	105° 05'	10	148	148	6.02
8647	F. JENKINS	Z	WY	006	44° 47'	105° 05'	9	148	148	7.46
7115	MIDVALE IRRIG.	A	WY	007	43° 15'	108° 41'	8	137	138	10.12
3490	CAROL KAPUS	A	WY	008	42° 23'	104° 32'	7	139	139	9.21
5260	CLIFFORD NOYES	A	WY	008	41° 38'	104° 10'	6	136	137	7.93
9000	HOLLY SUGAR CO	A	WY	008	42° 03'	104° 11'	8	129	130	6.67
8995	UNIV.WYOMING	A	WY	008	42° 05'	104° 13'	6	127	130	10.37

8647	F. JENKINS	A	WY	006	44° 47'	105° 05'	9	148	148	7.46
8647	F. JENKINS	Z	WY	006	43° 15'	108° 41'	8	137	138	10.12
7115	MIDVALE IRRIG.	A	WY	007	42° 23'	104° 32'	7	139	139	9.21
3490	CAROL KAPUS	A	WY	008	41° 38'	104° 10'	6	136	137	7.93
5260	CLIFFORD NOYES	A	WY	008	42° 03'	104° 11'	8	129	130	6.67
9000	HOLLY SUGAR CO	A	WY	008	42° 05'	104° 13'	6	127	130	10.37
8995	UNIV.WYOMING	A	WY	008	[illegible]	[illegible]	10	139	138	6.21

DURING THE PERIOD 1968 – 1991
BY STATE AND COUNTY

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
5612	CHARLEY CARROL	Z	WY	008	42° 05'	104° 20'	6	131	130	5.29
5260	CLIFFORD NOYES	Z	WY	008	41° 38'	104° 10'	13	135	134	8.89
740	E W SNIDER	A	WY	010	44° 08'	106° 44'	10	143	141	7.31
5055	ROSS MCKENNA	A	WY	010	43° 43'	106° 38'	13	133	133	8.33
740	EW. SNIDER	Z	WY	010	44° 08'	106° 44'	4	148	148	3.56
5055	ROSS MCKENNA	Z	WY	010	43° 43'	106° 38'	15	134	135	8.05
7240	ED PROSSER	A	WY	011	41° 11'	104° 09'	10	133	134	5.32
270	UNI OF WYOMING	A	WY	011	41° 09'	104° 39'	16	143	143	9.44
7240	ED PROSSER	Z	WY	011	41° 11'	104° 09'	11	134	135	5.85
4440	HARRY FERGUSON	Z	WY	011	41° 09'	105° 11'	6	148	150	9.27
1547	R PEERY	Z	WY	011	41° 02'	104° 18'	15	136	139	6.56
7955	MARIE WESTON	A	WY	012	41° 52'	111° 00'	10	153	145	14.96
915	ETCHEVERRY JON	Z	WY	012	42° 15'	111° 02'	17	158	160	9.58
552	MRS E S MARTIN	A	WY	013	42° 38'	106° 23'	9	138	137	9.66
5085	FRANK MAHNKE	A	WY	014	42° 46'	104° 47'	4	147	150	14.89
8475	FRED WILSON	Z	WY	014	43° 26'	104° 10'	5	139	137	5.72
4411	MR W L JACKSON	A	WY	015	44° 42'	108° 57'	8	135	135	7.45
7388	U OF WY EXP ST	A	WY	015	44° 47'	108° 45'	11	136	138	7.49
7388	WYOMING	Z	WY	015	44° 47'	108° 45'	10	134	133	8.17
5506	J.CHASE	Z	WY	017	44° 51'	106° 17'	7	141	143	7.50
6165	EDMOND C TODD	A	WY	018	42° 57'	110° 22'	20	174	175	6.03
695	US WEA BUR	A	WY	018	42° 32'	110° 07'	7	164	166	9.27
6165	EDMOND C TODD	Z	WY	018	42° 57'	110° 22'	21	174	174	7.73
695	US WEA BUR	Z	WY	018	42° 32'	110° 07'	8	164	164	8.30
7840	ROB. LARSON	A	WY	019	41° 35'	109° 13'	6	144	145	4.79
7840	ROB. LARSON	Z	WY	019	41° 35'	109° 13'	7	146	146	5.08
6440	BUR OF RECLAMA	A	WY	020	43° 51'	110° 35'	13	168	170	8.94
6440	BUR. OF RECLAM	Z	WY	020	43° 51'	110° 35'	14	173	175	8.20
7473	LANNY FRITZ	Z	WY	022	44° 11'	107° 57'	23	132	133	7.60
6660	JAMES PARRISH	A	WY	023	43° 51'	104° 13'	7	129	130	13.07
6450	KEN WHITNEY	A	WY	023	43° 31'	104° 20'	9	130	132	6.65
6935	ROSE MCMEEKIN	A	WY	023	43° 59'	104° 25'	8	135	136	8.40

HONEYSUCKLE WEATHER BUREAU OBSERVERS DURING THE PERIOD 1968 - 1991 BY STATE AND BUREAU

First Flower Phase
Julian Date

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
380	MR. FRED NOON	Z	AZ	010	31° 35'	111° 19'	21	71	71	6.15
690	PETER KELLY	Z	AZ	002	32° 18'	110° 23'	4	70	71	5.19
871	BLUERIDGE RAN	A	AZ	003	34° 37'	111° 07'	4	124	126	18.30
1101	ERNEST BURRUS	A	AZ	003	35° 16'	111° 32'	13	154	156	10.00
1101	ERNEST BURRUS	Z	AZ	003	35° 16'	111° 32'	18	146	149	11.32
1514	MRS. T. BINNER	A	AZ	007	33° 13'	111° 41'	8	55	61	21.76
1920	EVELYN RICHTER	A	AZ	008	37° 00'	112° 59'	14	105	107	10.40
1920	EVELYN RICHTER	Z	AZ	008	37° 00'	112° 59'	14	105	104	11.75
2140	1SNPS CORONADO	A	AZ	002	31° 21'	110° 15'	5	83	82	8.93
2140	1SNPS CORONADO	Z	AZ	002	31° 21'	110° 15'	4	85	86	11.53
2439	US BUR OF REC	A	AZ	008	35° 12'	114° 34'	5	64	66	10.50
2545	BUR INDIAN AFF	A	AZ	001	36° 51'	109° 51'	5	105	107	10.69
2545	BUR INDIAN AFF	Z	AZ	001	36° 51'	109° 51'	4	105	106	11.59
2781	MRS D SWAFFORD	A	AZ	006	33° 21'	109° 29'	8	90	92	7.95
3120	FORT HUACHUCA	A	AZ	002	31° 34'	110° 20'	6	79	80	9.73
3448	MRS. HALE	Z	AZ	004	34° 07'	111° 17'	9	73	73	9.51
3852	BIG HORN RANCH	A	AZ	007	33° 30'	113° 04'	7	69	69	4.20
3852	BIG HORN RNACH	Z	AZ	007	33° 30'	113° 04'	9	66	66	4.88
4053	MR W SATATHITE	A	AZ	013	34° 29'	112° 53'	8	85	87	8.40
4453	ARIZ STATE PAR	Z	AZ	013	34° 45'	112° 07'	10	82	83	11.36
4508	40AN ANDERSON	Z	AZ	003	34° 58'	111° 45'	7	103	102	15.97
5412	FIRECHIEF	A	AZ	001	34° 04'	109° 51'	6	119	123	19.72
5412	FIRECHIEF	Z	AZ	001	34° 04'	109° 51'	4	117	112	24.50
5908	MARGURETTE SHO	A	AZ	010	32° 07'	110° 41'	11	77	74	16.35
5908	MARGURETTE SHO	Z	AZ	010	32° 07'	110° 41'	11	76	74	17.10
5921	M L NOON	A	AZ	012	31° 21'	110° 55'	7	78	78	9.58
5921	M L NOON	Z	AZ	012	31° 21'	110° 55'	5	76	79	7.79
6597	PHILIP BOUCHER	A	AZ	009	34° 07'	109° 56'	6	109	111	13.43
6601	AZ FISH & GAME	A	AZ	009	34° 7.'	109° 55'	5	116	117	4.04
6653	US FOREST SERV	A	AZ	004	34° 06'	110° 56'	9	97	100	12.54
7355	WALTER ORMSBY	A	AZ	010	32° 18'	110° 49'	4	69	69	10.89
7390	U OF ARIZONA	Z	AZ	005	32° 49'	109° 41'	18	71	71	5.24
7708	US FRST SER	A	AZ	003	34° 52'	111° 46'	4	128	131	22.29
7716	AGENT A.T. S.F	A	AZ	013	35° 19'	112° 53'	4	105	108	9.57

5921	M L NOON	Z	AZ	012	31° 21'	110° [illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6597	PHILIP BOUCHER	A	AZ	009	34° 07'	109° 56'	6	109	111	13.43
6601	AZ FISH & GAME	A	AZ	009	34° 7.'	109° 55'	5	116	117	4.04
6653	US FOREST SERV	A	AZ	004	34° 06'	110° 56'	9	97	100	12.54
7355	WALTER ORMSBY	A	AZ	010	32° 18'	110° 49'	4	69	69	10.89
7390	U OF ARIZONA	Z	AZ	005	32° 49'	109° 41'	18	71	71	5.24
7708	US FRST SER	A	AZ	003	34° 52'	111° 46'	4	128	131	22.29
7716	AGENT A.T. S.F	A	AZ	013	35° 19'	112° 53'	4	105	108	9.57

DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
8112	HL ORCUTT	A	AZ	007	33° 23'	112° 04'	7	58	55	8.02
8112	H. L. ORCUTT	Z	AZ	007	33° 23'	112° 04'	12	57	60	13.61
9211	R P MCELHANEY	Z	AZ	014	32° 40'	114° 08'	4	63	64	4.66
9271	INDIAN AFFAIRS	A	AZ	009	33° 50'	109° 58'	5	103	100	13.61
9271	INDIAN AFFAIRS	Z	AZ	009	33° 50'	109° 58'	7	98	97	13.69
9334	FRED BUCK	A	AZ	002	32° 18'	109° 51'	10	73	74	8.30
9652	UA YUMA MESA	A	AZ	014	32° 37'	114° 39'	5	59	63	5.72
9652	U. OF ARIZ.	Z	AZ	014	32° 37'	114° 39'	13	74	74	11.39
29	ADIN RANGER ST	A	CA	025	41° 12'	120° 57'	32	125	124	9.95
29	USFS ADIN RS	Z	CA	025	41° 12'	120° 57'	26	127	128	10.21
161	R. KEN. SMITH	A	CA	025	41° 29'	120° 32'	20	126	127	8.62
161	KEN SMITH	Z	CA	025	41° 29'	120° 32'	7	137	135	6.28
442	WBAP BAKERSFLD	A	CA	015	35° 25'	119° 03'	12	64	65	7.97
442	WBAP BAKERFLD	Z	CA	015	35° 25'	119° 03'	12	64	65	7.72
617	HETCHY HETCH	Z	CA	055	38° 00'	119° 47'	4	73	74	10.40
684	EXCLU & DETEN	A	CA	026	37° 51'	118° 29'	7	111	106	12.46
731	CA DIV FORESTR	A	CA	018	41° 07'	121° 08'	5	125	129	15.44
1010	MEYER'S RANCH	A	CA	037	32° 40'	116° 18'	9	78	79	11.34
1060	VERNON CAKEBRE	Z	CA	007	37° 53'	121° 47'	18	66	67	6.01
1076	FOREST SERVICE	A	CA	026	38° 17'	119° 17'	4	145	148	12.79
1076	FOREST SERVICE	Z	CA	026	38° 17'	119° 17'	4	145	144	9.20
1112	JOYCE FARNHAM	Z	CA	057	38° 46'	122° 09'	6	73	73	9.75
1250	HAGER WILLARD	A	CA	033	33° 55'	116° 47'	4	65	67	8.88
1250	HAGER WILLARD	Z	CA	033	33° 55'	116° 47'	4	64	66	10.28
1280	CALAERAS	A	CA	005	38° 12'	120° 22'	13	119	122	10.89
1280	CALACERAS	Z	CA	005	38° 12'	120° 22'	11	120	123	9.37
1316	MARIAN HAYDEN	A	CA	047	41° 19'	122° 48'	6	105	105	5.80
1476	US FOREST SERV	A	CA	025	41° 27'	120° 52'	4	128	123	13.92
1534	A A COLLINS JR	Z	CA	027	36° 29'	121° 44'	5	54	56	9.02
1653	USFS CHALLENGE	A	CA	058	39° 29'	121° 13'	8	97	98	9.64
1653	USFS CHALLENGE	Z	CA	058	39° 29'	121° 13'	8	95	94	11.06
1700	NED EARL	Z	CA	032	40° 18'	121° 14'	5	141	140	6.19
1739	VICTOR HASKIN	Z	CA	035	36° 54'	121° 36'	5	66	63	12.22
1754	DISTRCT RANGER	Z	CA	056	34° 48'	119° 01'	5	118	118	18.58
1785	DICK MUDD	A	CA	011	39° 33'	122° 24'	5	76	76	7.92

HONEYSUCKLE WEATHER BUREAU OBSERVERS DURING THE PERIOD 1968 - 1991 BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
1785	DICK MUDD	Z	CA	Ø11	39° 33'	122° 24'	5	72	71	1Ø.92
1948	I.STEPHENS	A	CA	ØØ6	39° 12'	122° Ø1'	5	67	63	6.35
1948	I.STEPHENS	Z	CA	ØØ6	39° 12'	122° Ø1'	7	69	67	8.95
2Ø84	MENOCINO FOR	Z	CA	Ø23	39° 5Ø'	123° Ø5'	5	96	91	17.25
2236	ROWELL JOHN	Z	CA	Ø42	34° 56'	119° 37'	4	84	83	7.5Ø
2239	HELIX WTR DIST	A	CA	Ø37	32° 59'	116° 35'	22	1Ø3	1ØØ	11.86
2239	HELIX WTR DIST	Z	CA	Ø37	32° 59'	116° 35'	22	1Ø8	11Ø	12.5Ø
229Ø	PACIFIC CEMENT	Z	CA	Ø44	37° Ø1'	122° 12'	13	51	49	11.23
2294	KAY RYUGO	Z	CA	Ø57	38° 32'	121° 46'	4	75	75	8.83
23Ø6	HERMAN LORENZE	Z	CA	Ø25	41° 13'	121° 23'	4	12Ø	12Ø	7.87
25ØØ	DIST RANGER	A	CA	Ø46	39° 34'	12Ø° 5Ø'	5	1Ø6	11Ø	12.3Ø
25ØØ	DIST RANGER	Z	CA	Ø46	39° 34'	12Ø° 5Ø'	5	11Ø	113	13.7Ø
2572	WALL MARSHALL	A	CA	Ø47	41° 13'	122° 16'	4	1Ø7	1Ø7	11.59
2572	WALL MARSHALL	Z	CA	Ø47	41° 13'	122° 16'	5	113	1Ø8	16.33
258Ø	LESLIE SALT CO	A	CA	Ø28	38° 12'	122° 18'	5	62	59	1Ø.14
258Ø	LESLIE SALT CO	Z	CA	Ø28	38° 12'	122° 18'	7	62	6Ø	15.58
3113	FOLSAM DAM WEA	A	CA	Ø34	38° 42'	121° Ø9'	6	75	74	5.99
3113	FOLSAM DAM WEA	Z	CA	Ø34	38° 42'	121° Ø9'	8	76	79	13.33
3118	R.GETCHELL	A	CA	Ø36	34° 11'	117° 27'	4	62	61	13.18
3118	R.GETCHELL	Z	CA	Ø36	34° 11'	117° 27'	6	53	53	26.78
3134	US FOREST SERV	A	CA	Ø31	39° Ø1'	12Ø° 5Ø'	6	92	9Ø	12.66
3134	US FOREST SERV	Z	CA	Ø31	39° Ø1'	12Ø° 5Ø'	6	9Ø	88	1Ø.46
3176	CARL CRAMER	A	CA	Ø47	41° 35'	122° 43'	8	127	129	4.57
3176	CARL CRAMER	Z	CA	Ø47	41° 35'	122° 43'	9	125	124	5.62
3242	JONES CLARA	Z	CA	Ø45	4Ø° 42'	122° 38'	4	92	91	1Ø.28
3338	ROBERT C KYLE	A	CA	ØØ9	38° 5Ø'	12Ø° 51'	6	89	91	14.72
3338	ROBERT C KYLE	Z	CA	ØØ9	38° 5Ø'	12Ø° 51'	4	98	96	6.55
3357	US FOREST SERV	A	CA	ØØ8	41° 52'	123° 58'	16	75	75	1Ø.19
3357	US FOREST SERV	Z	CA	ØØ8	41° 52'	123° 58'	16	74	74	1Ø.2Ø
34Ø2	SANTA BARB WAT	A	CA	Ø42	34° 31'	119° 41'	6	66	66	7.45
34Ø2	SANTA BARB WAT	Z	CA	Ø42	34° 31'	119° 41'	6	66	65	8.98
3491	JOHN F WALL	Z	CA	Ø31	39° 1Ø'	12Ø° 52'	17	82	82	14.77
3578	L. B. HALLBERG	A	CA	Ø49	38° 26'	122° 52'	8	63	61	7.8Ø

3338	ROBERT C KYLE	Z	CA	Ø09	38° 50'	120° 31'	[illegible]	[illegible]	[illegible]	[illegible]
3357	US FOREST SERV	A	CA	ØØ8	41° 52'	123° 58'	16	75	75	10.19
3357	US FOREST SERV	Z	CA	ØØ8	41° 52'	123° 58'	16	74	74	10.2Ø
3402	SANTA BARB WAT	A	CA	Ø42	34° 31'	119° 41'	6	66	66	7.45
3402	SANTA BARB WAT	Z	CA	Ø42	34° 31'	119° 41'	6	66	65	8.98
3491	JOHN F WALL	Z	CA	Ø31	39° 1Ø'	120° 52'	17	82	82	14.77
3578	L. B. HALLBERG	A	CA	Ø49	38° 26'	122° 52'	8	63	61	7.98
[illegible]	[illegible]	A	CA	Ø14	34° Ø8'	117° 57'	5	90	85	10.46

DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
3761	FOREST SERVICE	A	CA	Ø47	41° 48'	123° 23'	6	85	92	15.89
3928	C.AKERS	Z	CA	Ø35	36° 18'	120° 42'	5	94	99	11.26
4082	BUR.IND.AFF.HO	A	CA	Ø12	41° Ø3'	123° 40'	7	77	76	8.22
4082	BUR.IND.AFF.HO	Z	CA	Ø12	41° Ø3'	123° 40'	7	76	77	9.27
4144	LURLINE BROWN	Z	CA	Ø4Ø	35° Ø6'	120° 23'	4	66	67	1Ø.15
4232	LA DEPT W&P	A	CA	Ø14	36° 48'	118° 12'	5	81	81	1Ø.Ø5
4232	LA DEPT W&P	Z	CA	Ø14	36° 48'	118° 12'	4	81	79	11.27
4418	CHARL VILINEK	Z	CA	Ø37	33° Ø6'	116° 39'	6	78	78	15.15
4536	K. FOSTER	A	CA	Ø16	36° Ø4'	12Ø° Ø5'	9	64	66	7.75
4536	K. FOSTER	Z	CA	Ø16	36° Ø4'	12Ø° Ø5'	9	61	6Ø	9.75
4544	PACIFIC GAS CO	A	CA	Ø45	4Ø° 41'	121° 52'	23	98	98	1Ø.73
4544	PACIFIC GAS CO	Z	CA	Ø45	4Ø° 41'	121° 52'	25	94	95	12.56
4587	EDRA MOORE	A	CA	Ø12	4Ø° 38'	123° 54'	9	65	73	3Ø.77
4587	EDRA L MOORE	Z	CA	Ø12	4Ø° 38'	123° 54'	7	94	95	16.89
4711	HELIX IRRIGA.	A	CA	Ø37	32° 52'	116° 53'	4	6Ø	58	15.5Ø
4886	IVAN LEHMAN	A	CA	ØØ9	38° 36'	121° Ø1'	5	77	76	4.49
4886	I.LEHMAN	Z	CA	ØØ9	38° 36'	121° Ø1'	4	75	76	6.56
4957	FRANK DE CHAIN	A	CA	Ø54	36° 11'	119° Ø4'	5	7Ø	68	6.73
4957	FRANK DE CHAIN	Z	CA	Ø54	36° 11'	119° Ø4'	5	69	63	9.4Ø
5ØØ2	E.A. EBERLE	A	CA	Ø19	34° 28'	117° 45'	12	81	78	7.86
5ØØ2	E.A. EBERLE	Z	CA	Ø19	34° 28'	117° 45'	13	8Ø	81	8.43
5147	FOR.SER.LOS PR	A	CA	Ø42	34° 33'	119° 47'	4	55	55	13.25
5258	LIZ MAHNKE	Z	CA	Ø17	38° 51'	122° 47'	5	95	92	6.58
5284	LA.WA.&POWER	A	CA	Ø26	37° 37'	119° Ø2'	11	141	139	8.63
5284	LA.WA.&POWER	Z	CA	Ø26	37° 37'	119° Ø2'	11	141	14Ø	9.Ø3
5372	BENSON ERIC	Z	CA	ØØ7	37° 58'	122° Ø6'	7	83	83	5.16
5532	MERCED CNTY FI	Z	CA	Ø24	37° 18'	12Ø° 29'	4	77	78	1Ø.78
5535	MERCED IRRIGAT	Z	CA	Ø24	37° 19'	12Ø° 29'	21	63	64	7.52
5623	DISTRICT RANGE	A	CA	Ø18	4Ø° Ø8'	12Ø° 21'	12	13Ø	129	6.96
5679	NAT.PARK LASS.	A	CA	Ø52	4Ø° 21'	121° 36'	5	143	14Ø	14.52
5741	E AMES	A	CA	Ø5Ø	37° 38'	121° ØØ'	11	7Ø	71	6.94
5741	E AMES	Z	CA	Ø5Ø	37° 38'	121° ØØ'	11	7Ø	7Ø	6.47
5853	L. COATES	A	CA	Ø43	37° Ø8'	121° 39'	21	63	65	1Ø.74
5853	L. COATES	Z	CA	Ø43	37° Ø8'	121° 39'	27	63	65	11.4Ø
5941	USF HEBRON	A	CA	Ø47	41° 47'	122° ØØ'	7	133	129	12.Ø9

HONEYSUCKLE WEATHER BUREAU OBSERVERS DURING THE PERIOD 1968 - 1991 BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
5941	USF HEBRON	Z	CA	047	41° 47'	122° 00'	7	138	138	10.94
6136	CARETAKER P PK	A	CA	029	39° 16'	121° 01'	4	96	94	8.52
6136	CARETAKER P PK	Z	CA	029	39° 16'	121° 01'	4	95	92	10.68
6164	US FOREST SERV	A	CA	019	34° 22'	118° 31'	4	72	74	4.19
6164	US FOREST SERV	Z	CA	019	34° 22'	118° 31'	4	74	74	6.73
6379	OCEANSIDE WD	Z	CA	037	33° 13'	117° 21'	8	64	69	12.23
6597	POOLE FLOYD	A	CA	009	38° 45'	120° 30'	10	105	107	13.43
6597	FLOYD POOLE	Z	CA	009	38° 45'	120° 30'	13	105	103	10.75
6675	MARG. STROHM	A	CA	035	36° 36'	120° 52'	8	68	69	7.18
6699	E.DUSSAMAN	A	CA	036	34° 17'	114° 10'	4	63	63	2.22
6699	E.DUSSAMAN	Z	CA	036	34° 17'	114° 10'	5	64	61	9.94
6726	RANGER	Z	CA	052	39° 53'	122° 32'	9	70	72	10.36
6761	N. THOMPSON	A	CA	052	40° 20'	121° 54'	5	90	91	7.58
6962	WEATHER OBSERV	A	CA	009	38° 44'	120° 44'	5	78	78	7.96
6962	WEATHER OBSERV	Z	CA	009	38° 44'	120° 44'	5	79	79	8.96
6998	PLUMAS EUREKA	A	CA	032	39° 45'	120° 42'	4	150	151	2.50
7077	4OHN DAYBELL	Z	CA	054	36° 04'	119° 01'	11	64	65	9.71
7096	PANORAMA HTS	A	CA	054	35° 48'	118° 38'	4	114	115	13.82
7096	PANORAMA HTS	Z	CA	054	35° 48'	118° 38'	4	113	107	15.14
7108	COYOTE DAM	Z	CA	023	39° 18'	123° 04'	4	65	67	15.86
7195	US FOREST SERV	A	CA	032	39° 56'	120° 57'	6	114	116	9.03
7195	US FOREST SERV	Z	CA	032	39° 56'	120° 57'	6	116	114	6.25
7231	LOUIS SPAULDIN	A	CA	037	33° 04'	116° 51'	6	66	65	8.49
7292	WM A CUPPLES	A	CA	052	40° 09'	122° 15'	5	75	72	7.66
7292	WM A CUPPLES	Z	CA	052	40° 09'	122° 15'	7	75	74	7.53
7339	REDWOOD FIRE	A	CA	041	37° 29'	122° 14'	7	59	58	6.74
7339	REDWOOD FIRE	Z	CA	041	37° 29'	122° 14'	7	56	59	13.84
7580	MRS. BERTAGNA	A	CA	045	40° 49'	121° 56'	22	96	98	11.84
7580	MRS. BERTAGNA	Z	CA	045	40° 49'	121° 56'	24	96	97	10.46
7641	UNI OF CALIF	A	CA	029	39° 26'	120° 14'	7	160	159	6.09
7646	E.LEARNED	A	CA	028	38° 30'	122° 32'	5	74	74	3.78
7646	E.LEARNED	Z	CA	028	38° 30'	122° 32'	6	77	76	5.82
7661	SAINT MARY'S	Z	CA	007	37° 50'	122° 06'	5	71	68	9.27
7668	US AGRICULTURE	A	CA	027	36° 40'	121° 36'	6	48	52	12.76

7339	REDWOOD FIRE	Z	CA	041						
7580	MRS. BERTAGNA	A	CA	045	40° 49'	121° 56'	22	96	98	11.84
7580	MRS. BERTAGNA	Z	CA	045	40° 49'	121° 56'	24	96	97	10.46
7641	UNI OF CALIF	A	CA	029	39° 26'	120° 14'	7	160	159	6.09
7646	E.LEARNED	A	CA	028	38° 30'	122° 32'	5	74	74	3.78
7646	E.LEARNED	Z	CA	028	38° 30'	122° 32'	6	77	76	5.82
7661	SAINT MARY'S	Z	CA	007	37° 50'	122° 06'	5	71	68	9.27
7668	US AGRICULTURE	A	CA	027	36° 40'	121° 36'	6	48	52	12.76

DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
7807	GARY ARATA	Z	CA	041	37° 18'	122° 22'	5	46	54	17.01
7810	BYRON JOHANSEN	A	CA	033	33° 47'	116° 58'	7	67	68	4.54
7810	BYRON JOHANSEN	Z	CA	033	33° 47'	116° 58'	10	71	67	12.80
7817	USF JOAQUIN	A	CA	020	37° 06'	119° 44'	11	77	74	7.72
7817	SAN JOAQUIN ER	Z	CA	020	37° 06'	119° 44'	12	75	73	7.25
7897	LOUIS LUEBKERT	A	CA	019	34° 13'	118° 01'	7	67	67	8.24
7897	LOUIS LUEBKERT	Z	CA	019	34° 13'	118° 01'	8	71	72	9.67
7916	ROBERT BURTON	A	CA	044	36° 59'	122° 01'	4	48	51	10.49
7916	ROBERT BURTON	Z	CA	044	36° 59'	122° 01'	6	57	62	10.30
7933	TOM BROWN	A	CA	040	35° 22'	120° 38'	6	68	68	4.56
7933	TOM BROWN	Z	CA	040	35° 22'	120° 38'	8	71	68	8.84
7965	JOE SHOEMAKER	A	CA	049	38° 27'	122° 42'	8	60	60	6.97
8014	L A WATER PLAN	A	CA	019	34° 35'	118° 27'	9	73	74	6.50
8045	PAC. LUMBER CO	A	CA	012	40° 29'	124° 06'	4	49	52	8.37
8218	U.S.F.S.	A	CA	046	39° 35'	120° 22'	11	130	131	10.26
8218	U.S.F.S.	Z	CA	046	39° 35'	120° 22'	11	131	132	9.75
8446	WALTER HENNES	Z	CA	027	36° 36'	121° 41'	26	53	52	9.27
8479	LEROY KEMP	A	CA	036	34° 14'	117° 14'	4	112	108	13.09
8479	LEROY KEMP	Z	CA	036	34° 14'	117° 14'	6	86	93	48.89
8627	SUEY RANCH	A	CA	040	35° 00'	120° 23'	4	50	53	12.23
8703	CAL. DEPT FORS	A	CA	018	40° 26'	120° 40'	9	114	110	11.17
9122	A.T. BECHTAL	A	CA	023	39° 09'	123° 12'	17	72	73	6.59
9122	A.T. BECHTAL	Z	CA	023	39° 09'	123° 12'	19	69	69	8.24
9124	MARJ. DORY	Z	CA	023	39° 08'	123° 16'	5	70	70	19.38
9167	E J SCHUETTE	Z	CA	017	39° 11'	123° 02'	13	78	75	15.96
9390	PACIFIC GAS EL	A	CA	045	40° 28'	121° 52'	4	86	85	4.50
9490	FOREST SERVICE	Z	CA	053	40° 44'	122° 56'	6	110	110	15.27
214	ORV. ALTENBERN	A	CO	023	39° 30'	108° 23'	18	125	125	7.57
214	ORV. ALTENBERN	Z	CO	023	39° 30'	108° 23'	17	127	130	8.68
370	MARTHA MADSEN	A	CO	049	39° 11'	106° 50'	6	158	158	6.83
454	MRS R KINGERY	A	CO	047	39° 24'	105° 29'	8	154	155	13.66
454	U S FOREST SER	Z	CO	047	39° 24'	105° 29'	4	154	155	9.07
1017	BROWNS REFUGE	A	CO	041	40° 48'	108° 55'	7	129	124	15.51
1121	BURLINGTON POL	A	CO	032	39° 19'	102° 16'	5	112	106	18.19
1564	CARL A. LOVELL	Z	CO	009	38° 49'	102° 21'	9	117	119	13.79

HONEYSUCKLE WEATHER BUREAU OBSERVERS DURING THE PERIOD 1968 - 1991 BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
1660	HIGH ALT OBSER	A	CO	019	39° 23'	106° 12'	4	184	184	4.35
1741	JAMES HAWKINS	A	CO	039	39° 15'	107° 58'	9	124	127	12.22
1928	MRS O J SMITH	A	CO	041	40° 31'	107° 33'	7	147	149	6.95
1928	MRS O J SMITH	Z	CO	041	40° 31'	107° 33'	9	147	148	7.96
2184	LYNN WOODS	A	CO	053	37° 40'	106° 21'	4	148	149	15.90
2184	LYNN WOODS	Z	CO	053	37° 40'	106° 21'	7	143	140	13.00
2192	W D PRESTON	A	CO	015	38° 45'	108° 03'	4	117	120	11.79
2192	W D PRESTON	Z	CO	015	38° 45'	108° 03'	6	117	119	10.50
2281	TERRY MAST	A	CO	059	39° 38'	106° 02'	8	172	173	11.99
2281	MAST TERRY	Z	CO	059	39° 38'	106° 02'	15	168	171	9.57
2326	V O HODGES	Z	CO	042	37° 28'	108° 30'	10	137	136	9.16
2494	CARL GUY	A	CO	021	39° 05'	104° 34'	5	148	155	11.07
2535	ROBERTA MAY	A	CO	063	40° 07'	102° 29'	8	116	121	10.07
2535	ROBERTA MAY	Z	CO	063	40° 07'	102° 29'	9	118	119	8.02
3027	L. MOODY	Z	CO	062	40° 06'	104° 49'	10	123	124	10.23
3038	GREAT WEST.SU.	Z	CO	044	40° 15'	103° 48'	4	119	119	12.28
3146	JOHN BARCUS	Z	CO	039	39° 10'	108° 44'	10	117	118	7.69
3489	CSU MESA RESRC	A	CO	039	39° 03'	108° 27'	8	106	109	11.67
3500	USBR	Z	CO	025	40° 11'	105° 52'	11	173	173	6.32
3553	DR. TROWBRIDGE	A	CO	062	40° 25'	104° 42'	6	123	124	10.46
3553	DR. TROWBRIDGE	Z	CO	062	40° 25'	104° 42'	7	124	126	9.56
3579	NORMAN YOUNGER	A	CO	021	39° 06'	104° 44'	14	150	150	8.73
3579	NORMAN YOUNGER	Z	CO	021	39° 06'	104° 44'	13	156	154	10.12
3584	NORMA BAIN	A	CO	018	39° 14'	104° 45'	6	142	141	5.61
3584	BAIN, NORMA	Z	CO	018	39° 14'	104° 45'	4	149	151	5.80
3656	CARLA G. NASH	A	CO	022	38° 41'	104° 23'	22	157	159	9.18
3656	CLARA NASH	Z	CO	022	38° 41'	104° 23'	22	160	162	10.94
4076	W.R. DAVIS	A	CO	050	38° 03'	102° 07'	4	112	115	10.05
4172	B.MATTIX	Z	CO	037	39° 08'	103° 28'	4	128	128	3.42
4388	CORPS OF ENGR	A	CO	006	38° 04'	102° 56'	5	109	105	10.11
4388	CORPS OF ENGR	Z	CO	006	38° 04'	102° 56'	7	111	114	7.63
4603	E.LAFFERTY	A	CO	009	38° 46'	102° 47'	5	117	117	6.88
4603	E.LAFFERTY	Z	CO	009	38° 46'	102° 47'	5	117	117	[illegible]

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
3656	CLARA NASH	Z	CO	022	38° 41'	104° 23'	[illegible]	[illegible]	[illegible]	[illegible]
4076	W.R. DAVIS	A	CO	050	38° 03'	102° 07'	4	112	115	10.05
4172	B.MATTIX	Z	CO	037	39° 08'	103° 28'	4	128	128	3.42
4388	CORPS OF ENGR	A	CO	006	38° 04'	102° 56'	5	109	105	10.11
4388	CORPS OF ENGR	Z	CO	006	38° 04'	102° 56'	7	111	114	7.63
4603	E.LAFFERTY	A	CO	009	38° 46'	102° 47'	5	117	117	6.88
4603	E.LAFFERTY	Z	CO	009	38° 46'	102° 47'	5	117	117	4.78
5048	LITTLE HILL EX	A	CO	052	40° 00'	108° 12'	13	142	143	8.10
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	107	106	14.94

DURING THE PERIOD 1968 – 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
5327	EDGAR NOLAND	Z	CO	042	37° 21'	108° 18'	11	130	130	10.28
5507	HOWARD DEAKHMR	A	CO	049	39° 22'	106° 45'	5	161	161	11.71
5507	HOWARD DEAKHMR	Z	CO	049	39° 22'	106° 45'	5	162	162	11.68
5695	GEORGE MACKEEN	Z	CO	008	38° 30'	106° 20'	20	170	171	7.67
5706	MR BRYNING	Z	CO	053	37° 35'	106° 09'	6	138	139	8.41
5717	COL.WA.CON.	Z	CO	043	38° 29'	107° 53'	13	121	121	8.30
5922	K.D. THOMPSON	A	CO	062	40° 36'	103° 51'	14	133	134	10.96
5922	K.D. THOMPSON	Z	CO	062	40° 36'	103° 51'	13	134	136	8.11
6315	GARBER CHAL.	Z	CO	043	38° 22'	108° 58'	4	119	119	10.21
6318	WYONNA IRISH	A	CO	043	38° 23'	108° 59'	8	114	115	10.06
6326	MRS E EVERITT	A	CO	020	39° 32'	104° 39'	5	140	140	19.27
7017	CHARLES ENGEL	A	CO	017	37° 41'	108° 02'	9	155	152	11.63
7017	CHARLES ENGEL	Z	CO	017	37° 41'	108° 02'	8	164	162	7.76
7031	MAXINE MYSER	A	CO	023	39° 32'	107° 48'	15	127	125	7.82
7031	MAXINE MYSER	Z	CO	023	39° 32'	107° 48'	12	133	132	7.59
7510	B. BIANFORD	A	CO	018	39° 23'	104° 58'	7	130	128	10.29
7510	GWEN NICHOLS	Z	CO	018	39° 23'	104° 58'	4	134	135	10.86
7618	JOHN W DAVIS	A	CO	023	39° 34'	107° 14'	5	146	146	5.34
7866	MANN, HERBERT	A	CO	005	37° 24'	102° 37'	18	113	114	11.42
7866	MANN, HERBERT	Z	CO	005	37° 24'	102° 37'	17	112	114	10.38
7992	ARMILDA BURHEN	A	CO	005	37° 17'	102° 11'	19	107	106	10.34
7992	ARMILDA BURHEN	Z	CO	005	37° 17'	102° 11'	18	101	99	10.70
8434	FILGHT SER STA	A	CO	036	37° 15'	104° 20'	21	114	116	9.85
8434	FLIGHT SER STA	Z	CO	036	37° 15'	104° 20'	22	113	114	10.80
8468	C SHANNON	A	CO	036	37° 08'	103° 19'	8	107	109	14.98
8468	SHANNON, CECIL	Z	CO	036	37° 08'	103° 19'	8	111	111	8.91
8722	R. FORD	Z	CO	032	39° 18'	102° 44'	17	118	121	12.20
9045	RALPH CLINE	A	CO	015	38° 55'	107° 31'	4	124	123	6.61
9045	RALPH CLINE	Z	CO	015	38° 55'	107° 31'	5	127	126	7.82
1363	WA H20 POWER C	A	ID	009	48° 05'	116° 04'	5	132	137	12.50
1422	LYDIA WISNER	A	ID	043	45° 28'	115° 19'	5	134	134	1.64
1422	LYDIA WISNER	Z	ID	043	45° 28'	115° 19'	5	131	130	2.97
1551	EARL HEIDEL	A	ID	042	42° 33'	114° 52'	14	126	127	11.06
1636	XINIA JONES	A	ID	008	43° 58'	115° 51'	5	155	155	12.04
1636	XINIA JONES	Z	ID	008	43° 58'	115° 51'	9	154	156	9.16

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
1932	E SCHMUCK	A	ID	030	45° 05'	114° 14'	5	150	153	20.44
1932	ELSIE SCHMUCK	Z	ID	030	45° 05'	114° 14'	5	162	161	6.62
2159	WEATHER OBSERV	A	ID	025	46° 02'	116° 23'	8	144	141	8.47
2845	CORPS ENGR.	Z	ID	018	46° 30'	116° 18'	4	119	118	2.52
2875	DREISBACH CHAR	A	ID	025	45° 49'	115° 26'	5	148	146	13.72
2904	LIL. MINNICH	A	ID	009	48° 29'	116° 27'	6	140	140	5.49
2904	LIL. MINNICH	Z	ID	009	48° 29'	116° 27'	6	141	140	3.56
3143	US FOREST SER.	Z	ID	025	46° 06'	115° 33'	5	125	126	4.74
3554	LES USHER	A	ID	030	45° 33'	113° 57'	4	150	149	5.44
3554	LES USHER	Z	ID	030	45° 33'	113° 57'	5	154	154	4.98
3677	IDAHO STATE DE	A	ID	024	42° 55'	114° 42'	4	126	128	13.33
3780	SCHWARTX AL	Z	ID	025	45° 40'	115° 56'	4	131	129	4.76
3811	DAVID TINDALL	Z	ID	037	42° 16'	115° 53'	8	133	137	11.01
3835	FRNK UHLENKOTT	A	ID	025	46° 09'	116° 16'	6	146	146	6.92
3835	FRNK UHLENKOTT	Z	ID	025	46° 09'	116° 16'	7	143	145	5.53
3942	MARTINDALE, ED	A	ID	007	43° 31'	114° 19'	4	153	153	2.99
3942	US FOREST SER.	Z	ID	007	43° 31'	114° 19'	4	153	154	6.83
4140	N SIDE CANAL C	A	ID	027	42° 36'	114° 08'	7	132	131	7.47
4140	N SIDE CANAL C	Z	ID	027	42° 36'	114° 08'	8	130	129	7.68
4150	POTLATCH FORES	A	ID	018	46° 38'	115° 48'	4	146	144	7.59
4150	POTLATCH FORST	Z	ID	018	46° 38'	115° 48'	5	141	145	11.97
4230	T. CHRISTENSEN	A	ID	015	42° 54'	111° 30'	6	151	152	11.84
4268	CARROLL DAMMEN	A	ID	013	43° 18'	115° 03'	4	150	150	3.16
4268	CARROLL DAMMEN	Z	ID	013	43° 18'	115° 03'	5	148	147	5.03
4475	CHRIS CALLEN	A	ID	037	42° 01'	115° 19'	5	134	134	4.38
4475	CHRIS CALLEN	Z	ID	037	42° 01'	115° 19'	6	138	139	6.66
5426	FRONIA FARBER	A	ID	008	44° 05'	115° 34'	4	147	149	5.91
5426	FRONIA FARBER	Z	ID	008	44° 05'	115° 34'	4	148	148	5.32
5567	USFS MALTA	A	ID	016	42° 19'	113° 21'	4	140	141	7.94
5567	USFS MALTA	Z	ID	016	42° 19'	113° 21'	5	137	136	4.47
5685	IDAHO FISH BME	A	ID	030	44° 36'	113° 55'	4	148	150	16.25
6388	US FRST SRVC	A	ID	002	44° 58'	116° 17'	6	145	146	4.15
6388	FOR. SERVICE	Z	ID	002	44° 58'	116° 17'	6	148	148	3.87
[illegible]	NORTH STAR	A	ID	025	45° 55'	114° 50'	24	131	132	6.97

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
5426	FRONIA FARBER	A	ID	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5426	FRONIA FARBER	Z	ID	008	44° 05'	115° 34'	4	148	148	5.32
5567	USFS MALTA	A	ID	016	42° 19'	113° 21'	4	140	141	7.94
5567	USFS MALTA	Z	ID	016	42° 19'	113° 21'	5	137	136	4.47
5685	IDAHO FISH BME	A	ID	030	44° 36'	113° 55'	4	148	150	16.25
6388	US FRST SRVC	A	ID	002	44° 58'	116° 17'	6	145	146	4.15
6388	FOR. SERVICE	Z	ID	002	44° 58'	116° 17'	6	148	148	3.87
6493	NORTH STAR	A	ID	025	45° 55'	114° 50'	24	131	132	6.97

DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
6542	HERBERT HARDY	Z	ID	016	42° 15'	113° 53'	5	132	130	6.66
6764	WEATHER OBSERV	A	ID	010	43° 21'	111° 13'	4	153	152	7.42
6764	US BUR RECL.	Z	ID	010	43° 21'	111° 13'	10	154	154	7.45
6891	JOSEPH LOWE	Z	ID	038	44° 05'	116° 56'	5	117	116	5.98
7040	LEONARD PURDY	Z	ID	007	43° 18'	114° 04'	4	153	152	5.85
7046	US FOREST SERV	A	ID	018	46° 30'	115° 48'	7	137	120	23.71
7301	POTLATCH FORST	A	ID	029	46° 58'	116° 53'	7	133	136	13.87
7327	CLYDE COOK	Z	ID	020	43° 30'	115° 35'	11	146	146	5.48
8475	US FOREST SER.	Z	ID	025	45° 38'	116° 17'	4	94	99	10.31
8548	US FOREST SERV	A	ID	013	43° 30'	114° 50'	5	148	145	5.05
8548	US FOREST SERV	Z	ID	013	43° 30'	114° 50'	5	147	147	3.70
9119	GEORGE CLARK	A	ID	037	42° 05'	115° 09'	5	157	158	3.90
9119	GEORGE CLARK	Z	ID	037	42° 05'	115° 09'	4	155	155	0.82
9293	COLL. S. IDAHO	A	ID	042	42° 35'	114° 28'	9	113	108	11.97
9299	AMALGAMATED CO	A	ID	042	42° 32'	114° 25'	22	118	118	10.94
9299	AMALGAMATED CO	Z	ID	042	42° 32'	114° 25'	24	119	119	9.36
9846	H. HUMPHREY	A	ID	031	46° 13'	116° 38'	12	147	149	11.51
9846	H. HUMPHREY	Z	ID	031	46° 13'	116° 38'	13	154	152	10.48
330	DISTRICT RANGE	Z	MT	044	45° 36'	106° 16'	16	136	136	10.33
636	A E TAYLOR	A	MT	006	45° 39'	104° 23'	5	153	152	5.72
636	A E TAYLOR	Z	MT	006	45° 39'	104° 23'	5	147	152	17.49
743	MRS MADER	A	MT	038	45° 03'	105° 28'	6	141	140	6.63
755	UNIV. OF MONT.	A	MT	024	47° 53'	114° 02'	6	135	134	8.50
1044	MSU	A	MT	016	45° 40'	111° 03'	22	146	147	10.69
1044	MSU	Z	MT	016	45° 40'	111° 03'	21	146	147	9.13
1047	AGRIC. CLIMATO	A	MT	016	45° 41'	111° 09'	10	145	144	9.40
1047	ARGIC CLIMATOL	Z	MT	016	45° 41'	111° 09'	10	148	149	10.40
1050	J FORSYTHE	A	MT	016	45° 49'	110° 53'	13	174	173	10.35
1050	JANE FORSYTHE	Z	MT	016	45° 49'	110° 53'	9	176	179	9.33
1080	CHARLES AZNOE	Z	MT	008	47° 57'	111° 20'	4	145	145	6.27
1088	AXEL LARSEN	Z	MT	043	48° 33'	105° 16'	22	141	141	9.59
1127	H LA FLAME	A	MT	038	45° 26'	105° 24'	5	142	144	6.66
1127	MRS. H LA FLAM	Z	MT	038	45° 26'	105° 24'	8	141	141	6.47
1309	R. SETTERSTROM	A	MT	047	45° 54'	112° 33'	4	167	169	9.43
1470	BUREAU OF RECL	A	MT	025	46° 39'	111° 44'	5	137	134	13.48

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
1758	H R REINEMER	Z	MT	Ø28	47° 26'	105° 35'	4	144	145	7.83
1984	FLORENCE MILK	A	MT	Ø36	47° 59'	107° 34'	9	14Ø	138	8.63
1984	FLORENCE MILK	Z	MT	Ø36	47° 59'	1Ø7° 34'	1Ø	143	14Ø	9.45
2104	TODD KEENER	A	MT	Ø15	48° 11'	114° Ø8'	16	137	138	8.68
2122	ALEX LUFT	Z	MT	Ø43	48° Ø9'	104° 31'	6	143	141	6.52
2317	L. PARSONS	A	MT	Ø33	46° 29'	108° 24'	13	136	135	8.74
2317	L. PARSONS	Z	MT	Ø33	46° 29'	108° 24'	13	137	135	9.18
2404	FED AVIATION	Z	MT	ØØ1	45° 15'	112° 33'	5	153	154	3.78
2421	M. TUTTLE	Z	MT	Ø47	45° 46'	112° 47'	9	153	153	6.69
2827	1S FOREST SERV	A	MT	Ø27	48° 54'	115° Ø4'	9	141	138	5.27
2827	US FOREST SER.	Z	MT	Ø27	48° 54'	115° Ø4'	5	143	143	6.Ø3
3Ø89	OTTO JOHNSON	A	MT	Ø36	48° 47'	1Ø7° 28'	9	144	144	9.77
3Ø89	OTTO JOHNSON	Z	MT	Ø36	48° 47'	1Ø7° 28'	9	147	148	7.92
311Ø	DON. ANDERSON	Z	MT	Ø21	48° 3Ø'	1Ø9° 48'	6	136	14Ø	12.53
3113	IRA VINION	A	MT	ØØ8	47° 49'	11Ø° 4Ø'	19	127	126	9.54
3113	IRA VINION	Z	MT	ØØ8	47° 49'	11Ø° 4Ø'	2Ø	128	129	1Ø.Ø4
3119	MRS B COLWELL	Z	MT	ØØ8	48° Ø2'	11Ø° 59'	6	14Ø	143	6.44
3139	D R WEYDEMEYER	A	MT	Ø27	48° 47'	114° 54'	7	139	138	6.53
3139	D R WEYDEMEYER	Z	MT	Ø27	48° 47'	114° 54'	8	144	144	3.96
3176	CORP OF ENGR	A	MT	Ø28	48° Ø1'	1Ø6° 24'	9	141	143	9.77
3176	CORPS OF ENGR	Z	MT	Ø28	48° Ø1'	1Ø6° 24'	9	139	14Ø	8.63
3489	GREENFLD IRR.	Z	MT	Ø25	47° 36'	112° 46'	4	163	165	3.86
353Ø	J. SWINNEY	A	MT	Ø21	48° 35'	11Ø° 18'	1Ø	14Ø	138	13.59
353Ø	J. SWINNEY	Z	MT	Ø21	48° 35'	11Ø° 18'	11	142	141	11.23
3581	RONEY, ROY	A	MT	Ø11	47° Ø6'	1Ø4° 43'	16	132	132	1Ø.69
3581	RONEY, ROY	Z	MT	Ø11	47° Ø6'	1Ø4° 43'	16	133	134	9.65
37Ø7	HELEN WELLBORN	A	MT	ØØ1	45° ØØ'	113° Ø4'	9	156	154	6.71
37Ø7	HELEN WELLBORN	Z	MT	ØØ1	45° ØØ'	113° Ø4'	1Ø	159	159	6.36
4Ø55	A B AIR STA	A	MT	Ø25	46° 36'	112° ØØ'	8	142	141	8.54
4Ø55	A B AIR STA	Z	MT	Ø25	46° 36'	112° ØØ'	8	138	137	7.94
412Ø	BERTHA WALKER	A	MT	ØØ8	47° 33'	11Ø° 47'	1Ø	133	134	11.69
412Ø	BERTHA WALKER	Z	MT	ØØ8	47° 33'	11Ø° 47'	1Ø	137	134	11.14
4217	MRS. JOHNSON	Z	MT	ØØ3	48° 49'	1Ø8° 48'	4	15Ø	15Ø	8.54
[illegible]	[illegible]	[illegible]	MT	Ø15	[illegible]	[illegible]	5	[illegible]	[illegible]	[illegible]

3707	HELEN WELLBORN	A	MT	001	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
3707	HELEN WELLBORN	Z	MT	001	45° 00'	113° 04'	10	159	159	6.36
4055	A B AIR STA	A	MT	025	46° 36'	112° 00'	8	142	141	8.54
4055	A B AIR STA	Z	MT	025	46° 36'	112° 00'	8	138	137	7.94
4120	BERTHA WALKER	A	MT	008	47° 33'	110° 47'	10	133	134	11.69
4120	BERTHA WALKER	Z	MT	008	47° 33'	110° 47'	10	137	134	11.14
			MT		48° 49'	108° 48'	4	150	150	8.54
4217	MRS. JOHNSON	Z	MT	003	48° 21'	114° 00'	5	146	147	3.70
4328	US BUR RECLAMA	A	MT	015	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
4345	HUNTLEY BRANCH	A	MT	056	45° 55'	108° 15'	6	127	130	12.24
4386	ARTHUR HAGEN	A	MT	044	46° 42'	107° 13'	23	135	135	8.48
4386	ARTHUR HAGEN	Z	MT	044	46° 42'	107° 13'	23	136	136	7.85
4442	J. T. RUGG	Z	MT	009	46° 31'	104° 47'	5	142	143	5.07
4506	L. FAIRBANKS	A	MT	005	45° 29'	108° 58'	18	130	129	12.07
4506	L. FAIRBANKS	Z	MT	005	45° 29'	108° 58'	19	132	134	11.26
4512	M. ANDERSON	A	MT	026	48° 35'	110° 47'	4	137	137	5.26
4512	M. ANDERSON	Z	MT	026	48° 35'	110° 47'	4	140	141	4.90
4522	LLOYD COX	A	MT	017	47° 19'	106° 54'	9	140	142	8.38
4522	LLOUD COX	Z	MT	017	47° 19'	106° 54'	9	137	137	7.35
4545	GRACE MEYERS	A	MT	054	46° 41'	109° 29'	9	158	154	10.48
4545	GRACE MEYERS	Z	MT	054	46° 41'	109° 29'	8	158	159	4.36
4701	D FERGUSON	A	MT	002	45° 19'	106° 59'	7	153	151	9.38
4701	D FERGUSON	Z	MT	002	45° 19'	106° 59'	8	154	154	4.60
4715	FRANK BIRTIC	A	MT	013	45° 55'	104° 05'	22	141	143	9.71
4715	FRANK BIRTIC	Z	MT	013	45° 55'	104° 05'	22	142	144	9.83
4820	RED RK LK NWR	A	MT	001	44° 36'	111° 48'	8	173	174	7.17
4820	RED RK LK NWR	Z	MT	001	44° 36'	111° 48'	9	175	176	7.08
4954	MRS P. ROSTAD	A	MT	030	46° 22'	110° 36'	10	167	165	8.26
4954	PHIL ROSTAD	Z	MT	030	46° 22'	110° 36'	11	170	171	8.36
5106	JAMES SHAW	Z	MT	002	45° 18'	107° 22'	19	137	137	9.39
5146	KEN HERMAN	A	MT	032	46° 45'	114° 31'	5	152	154	4.83
5146	KEN HERMAN	Z	MT	032	46° 45'	114° 31'	6	157	158	6.65
5285	WALL OJ	A	MT	053	48° 27'	105° 56'	15	143	148	12.02
5285	WALL OJ	Z	MT	053	48° 27'	105° 56'	15	145	147	11.05
5303	ALEX COLLIE	A	MT	013	46° 09'	104° 44'	17	138	139	12.46
5303	ALEX COLLIE	Z	MT	013	46° 09'	104° 44'	21	135	140	13.41
5387	RUTH CAMERON	A	MT	030	46° 30'	110° 20'	22	152	154	8.88
5387	RUTH CAMERON	Z	MT	030	46° 30'	110° 20'	23	155	156	9.54
5572	MED LAKE REFUG	A	MT	046	48° 29'	104° 27'	18	142	143	7.55
5572	MEDICINE LAKE	Z	MT	046	48° 29'	104° 27'	15	143	145	7.06
5596	JOHN BALOCK	A	MT	033	46° 36'	107° 52'	4	133	131	7.62
5761	ARTHUR DUBBS	Z	MT	023	47° 03'	109° 57'	6	149	155	11.08
5791	ROY LINGER	A	MT	048	45° 46'	108° 58'	4	149	152	7.54
5791	ROY LINGER	Z	MT	048	45° 46'	108° 58'	6	146	147	7.31

HONEYSUCKLE WEATHER BUREAU OBSERVERS DURING THE PERIOD 1968 - 1991 BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
5873	CARL KEITH	A	MT	017	47° 15'	107° 57'	12	136	136	9.75
5873	C. KEITH	Z	MT	017	47° 15'	107° 57'	11	137	138	7.24
6008	EDWINA KNOWLES	A	MT	007	47° 03'	110° 47'	8	159	160	9.16
6287	MARY LLOYD	A	MT	038	45° 06'	106° 15'	16	134	135	8.97
6287	MARY LLOYD	Z	MT	038	45° 06'	106° 15'	13	135	134	8.70
6364	LOREN MINEAR	A	MT	045	47° 23'	114° 48'	4	135	135	8.17
6472	FOREST SERVICE	Z	MT	020	46° 19'	113° 18'	13	160	158	8.57
6562	USFS PLAINS	Z	MT	045	47° 28'	114° 53'	10	133	133	7.66
6576	GUY NICKLE	A	MT	015	48° 08'	114° 55'	4	148	148	4.66
6576	GUY NICKLE	Z	MT	015	48° 08'	114° 55'	5	151	152	6.66
6615	KAREN FEATHER	A	MT	015	48° 46'	114° 16'	4	160	157	7.19
6923	U S FOR SER	A	MT	005	45° 01'	109° 32'	7	154	150	17.03
6923	U S FOR SER	Z	MT	005	45° 01'	109° 32'	6	158	162	15.68
6927	MARTIN, ALVIN	A	MT	046	48° 50'	104° 57'	16	145	144	10.77
6927	MARTIN, ALVIN	Z	MT	046	48° 50'	104° 57'	16	148	146	8.78
6946	MJ VAN CAMPEN	A	MT	048	45° 43'	109° 33'	7	143	149	20.65
6946	MJ VAN CAMPEN	Z	MT	048	45° 43'	109° 33'	5	130	130	14.05
6983	MARTHA PARRISH	A	MT	027	48° 52'	115° 13'	7	136	141	14.69
6983	MARTHA PARRISH	Z	MT	027	48° 52'	115° 13'	8	139	138	5.54
7034	MRS G RICHARDS	A	MT	006	45° 30'	104° 26'	7	142	139	13.55
7034	G. RICHARDS	Z	MT	006	45° 30'	104° 26'	7	137	131	11.67
7204	FLTD IRR PROJ	A	MT	024	47° 32'	114° 17'	6	137	134	9.81
7204	FLTD IRR PROJ	Z	MT	024	47° 32'	114° 17'	6	140	139	8.14
7265	FLORIAN ROCK	A	MT	036	48° 28'	107° 21'	6	141	137	7.97
7265	FLORIAN ROCK	Z	MT	036	48° 28'	107° 21'	4	146	144	7.51
7286	FLATHEAD IRR	A	MT	024	47° 19'	114° 06'	13	134	133	5.61
7286	FLATHEAD IRR	Z	MT	024	47° 19'	114° 06'	13	137	137	5.32
7501	DONALD COONS	A	MT	051	48° 33'	111° 52'	5	145	145	6.12
7501	DONALD COONS	Z	MT	051	48° 33'	111° 52'	17	145	146	8.43
8043	HARRY SHRYOCK	A	MT	031	47° 12'	114° 53'	5	137	135	9.02
8043	HARRY SHRYOCK	Z	MT	031	47° 12'	114° 53'	4	137	136	3.11
8093	US CUSTOMS	A	MT	051	49° 00'	111° 57'	9	142	145	10.56
8093	US CUSTOMS	Z	MT	051	49° 00'	111° 57'	9	143	145	10.14
8211	HAROLD CRAWFOR	A	MT	045	47° 36'	115° [illegible]	[illegible]	[illegible]	[illegible]	[illegible]

7286	FLATHEAD IRR	Z	MT	024	47° 19'	114° 06'	13	137	137	5.32
7501	DONALD COONS	A	MT	051	48° 33'	111° 52'	5	145	145	6.12
7501	DONALD COONS	Z	MT	051	48° 33'	111° 52'	17	145	146	8.43
8043	HARRY SHRYOCK	A	MT	031	47° 12'	114° 53'	5	137	135	9.02
8043	HARRY SHRYOCK	Z	MT	031	47° 12'	114° 53'	4	137	136	3.11
8093	US CUSTOMS	A	MT	051	49° 00'	111° 57'	9	142	145	10.56
8093	US CUSTOMS	Z	MT	051	49° 00'	111° 57'	9	143	145	10.14
8211	HAROLD CRAWFOR	A	MT	045	47° 36'	115° 22'	15	137	136	5.96

DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
8390	US FOREST SERV	A	MT	027	48° 29'	115° 55'	4	134	135	6.25
8390	US FOREST SERV	Z	MT	027	48° 29'	115° 55'	6	136	136	3.43
8395	US FOR SERV	A	MT	027	48° 44'	115° 53'	7	151	154	14.65
8395	US FOR SERV	Z	MT	027	48° 44'	115° 53'	8	147	157	22.48
8495	STATE FISH & G	A	MT	023	46° 53'	110° 18'	11	160	163	14.84
8495	STATE FISH & G	Z	MT	023	46° 53'	110° 18'	13	161	164	14.12
8783	WEST MT BR STA	A	MT	041	46° 20'	114° 04'	14	129	130	15.25
8783	WEST MONT BRAN	Z	MT	041	46° 20'	114° 04'	11	137	139	13.98
8857	AIRWAY OB.	A	MT	016	44° 39'	111° 06'	11	168	168	6.81
8857	AIRWAY OBS	Z	MT	016	44° 39'	111° 06'	8	170	171	7.13
8933	MRS. F. WISDOM	A	MT	030	46° 41'	110° 52'	14	173	176	12.15
8933	MRS. F. WISDOM	Z	MT	030	46° 41'	110° 52'	13	173	174	10.09
9067	GEORGE HELMING	A	MT	001	45° 37'	113° 27'	4	182	181	8.77
9175	MRS V ENGLERT	A	MT	002	45° 08'	107° 23'	9	138	139	8.79
9175	MRS V ENGLERT	Z	MT	002	45° 08'	107° 23'	10	139	141	13.39
41	CORPS OF ENGIN	A	NM	020	36° 14'	106° 26'	6	118	122	10.82
41	RES.ENGINEER	Z	NM	020	36° 14'	106° 26'	5	117	114	13.99
692	US NAT PARK	Z	NM	023	36° 50'	108° 00'	18	118	118	8.47
818	US FOREST SERV	Z	NM	002	33° 25'	108° 07'	13	118	121	8.15
903	C. BANKS	A	NM	022	35° 19'	106° 33'	9	100	103	14.24
903	MRS C F BANKS	Z	NM	022	35° 19'	106° 33'	10	104	107	15.10
915	SALAS, ALBINO	A	NM	027	34° 26'	106° 49'	7	109	108	9.65
915	US BUR OF RECL	Z	NM	027	34° 26'	106° 49'	4	114	111	10.99
992	USFWS ROSWELL	A	NM	003	33° 29'	104° 24'	6	85	87	8.57
1252	MRS F DRUMMOND	A	NM	009	33° 02'	108° 43'	8	88	90	7.43
1480	US NATL PARK	Z	NM	008	32° 11'	104° 27'	4	69	71	9.61
1887	NAT'L WEATHER	A	NM	030	36° 27'	103° 09'	18	104	106	9.91
1887	NAT'L WEATHER	Z	NM	030	36° 27'	103° 09'	18	105	108	11.17
1963	PLAINS STATION	A	NM	005	34° 36'	103° 13'	10	96	98	11.28
2024	HARRY RHIZOR	A	NM	015	31° 50'	107° 39'	4	72	75	7.77
2785	NAT PARK SERV	A	NM	031	35° 03'	108° 21'	4	114	114	10.80
2837	RIO GRND CON	A	NM	020	36° 36'	106° 44'	7	140	141	9.85
3060	ROBERT SANCHEZ	Z	NM	029	34° 45'	106° 04'	21	113	114	11.36
3225	BRC BROWNFIELD	A	NM	015	32° 26'	107° 29'	5	82	84	7.86
3225	BRC BROWNFIELD	Z	NM	015	32° 26'	107° 29'	6	87	89	10.13

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
3294	MR DALE DUNLAP	A	NM	006	34° 28'	104° 15'	8	98	98	5.60
3296	VAUGHN C NEAL	Z	NM	006	34° 22'	104° 15'	15	90	91	9.76
3340	MONROE WOOTEN	A	NM	023	36° 44'	108° 24'	16	111	111	6.09
3340	MONROE WOOTEN	Z	NM	023	36° 44'	108° 24'	14	111	112	6.59
3530	DAWSON CAMBELL	A	NM	009	33° 12'	108° 13'	19	103	104	7.81
3530	DAWSON CAMBELL	Z	NM	009	33° 12'	108° 13'	19	103	104	8.81
3649	SUP.GRAN QUIVI	Z	NM	027	34° 16'	106° 05'	4	110	116	24.23
4009	ROY SCHOENRADT	A	NM	026	32° 56'	107° 34'	22	83	84	8.98
4009	ROY SCHOENRADT	Z	NM	026	32° 56'	107° 34'	23	85	85	8.55
4346	EARL G. SMITH	A	NM	013	32° 06'	103° 12'	9	72	73	4.55
4375	US FOREST SERV	A	NM	002	33° 59'	108° 38'	5	132	132	8.84
4375	US FOREST SERV	Z	NM	002	33° 59'	108° 38'	5	131	131	8.56
4719	GRACE RILEY	A	NM	031	35° 02'	107° 24'	16	101	104	12.28
5084	ATOMIC LAB	A	NM	032	35° 52'	106° 19'	4	112	112	12.01
5273	US FOREST SERV	A	NM	002	33° 50'	108° 56'	5	125	131	9.61
5583	ELLEN DAVIS	A	NM	029	34° 55'	106° 05'	4	108	114	21.37
5583	ELLEN DAVIS	Z	NM	029	34° 55'	106° 05'	6	114	121	16.29
5617	MR. BRIGHT	A	NM	005	34° 26'	103° 38'	5	88	90	13.77
5617	MR. BRIGHT	Z	NM	005	34° 26'	103° 38'	5	88	93	15.43
5754	MIMBRES RANG.	A	NM	009	32° 56'	108° 01'	7	108	108	12.99
5754	MIMBRES RANG.	Z	NM	009	32° 56'	108° 01'	7	109	109	12.41
5834	WATERSHED	A	NM	001	35° 10'	107° 01'	9	73	74	7.50
5834	WATERSHED	Z	NM	001	35° 10'	107° 01'	11	73	74	9.44
6619	SAM BRITT	Z	NM	030	36° 18'	103° 44'	4	127	122	13.28
6659	FRAMK K TURNER	A	NM	013	32° 39'	103° 23'	15	84	81	11.19
6659	FRANK TURNER	Z	NM	013	32° 39'	103° 23'	14	83	82	10.74
6676	US FOREST SERV	A	NM	024	35° 35'	105° 41'	4	121	123	16.05
6676	US FOREST SERV	Z	NM	024	35° 35'	105° 41'	4	121	125	15.59
7094	E.DE VANEY	A	NM	029	34° 25'	105° 51'	6	109	107	8.24
7094	E.DE VANEY	Z	NM	029	34° 25'	105° 51'	5	112	109	6.06
7254	ILENE WALL	Z	NM	014	34° 16'	104° 57'	6	98	101	10.42
7340	RALPH WRIGHT	A	NM	009	32° 42'	108° 44'	6	88	87	5.67
7340	RALPH WRIGHT	Z	NM	009	32° 42'	108° 44'	11	84	84	7.06
7384	US FRST SERVIC	A	NM	002	33° 43'	108° 47'	7	119	117	5.80
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71	75	8.26

HONEYSUCKLE WEATHER BUREAU OBSERVERS

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
6676	US FOREST SERV	A	NM	[illegible]	[illegible]	[illegible]	4	121	125	15.59
6676	US FOREST SERV	Z	NM	Ø24	35° 35'	105° 41'	6	109	107	8.24
7094	E.DE VANEY	A	NM	Ø29	34° 25'	105° 51'	5	112	109	6.06
7094	E.DE VANEY	Z	NM	Ø29	34° 25'	105° 51'	6	98	101	10.42
7254	ILENE WALL	Z	NM	Ø14	34° 16'	104° 57'	6	88	87	5.67
7340	RALPH WRIGHT	A	NM	ØØ9	32° 42'	108° 44'	11	84	84	7.06
7340	RALPH WRIGHT	Z	NM	ØØ9	32° 42'	108° 44'	7	119	117	5.8Ø
7386	US FRST SERVIC	A	NM	ØØ2	33° 43'	108° 47'	[illegible]	[illegible]	[illegible]	8.26

HONEYSUCKLE WEATHER BUREAU-OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
7534	ADE. MILLER	Z	NM	Ø12	31° 51'	109° Ø2'	4	76	77	8.89
7867	CLARK WHITE	A	NM	Ø19	35° Ø7'	103° 2Ø'	13	84	85	8.99
7867	CLARK WHITE	Z	NM	Ø19	35° Ø7'	103° 2Ø'	19	84	85	1Ø.34
8Ø72	PUB SERV CO NM	A	NM	Ø25	35° 41'	105° 54'	4	125	124	7.27
8Ø72	PUB SERV CO NM	Z	NM	Ø25	35° 41'	105° 54'	4	131	132	4.27
883Ø	NELSON McBRIDE	A	NM	Ø16	35° 26'	108° Ø9'	12	118	119	9.59
883Ø	NELSON McBRIDE	Z	NM	Ø16	35° 26'	108° Ø9'	17	118	12Ø	1Ø.75
8845	DEPT OF FOREST	A	NM	Ø2Ø	36° 45'	106° 34'	6	144	142	1Ø.54
9Ø31	NAVAJO MISSION	A	NM	Ø22	35° 48'	107° 11'	5	116	118	12.59
9Ø31	NAVAJO MISSION	Z	NM	Ø22	35° 48'	107° 11'	5	121	12Ø	11.69
933Ø	VAL SANATORIUM	Z	NM	Ø17	35° 49'	104° 56'	6	115	121	17.77
9448	CURTIS DRAKE	Z	NM	ØØ4	36° 53'	104° 57'	5	141	136	13.99
46	SIMPSON ILLIE	A	NV	Ø12	38° Ø7'	115° 35'	4	128	128	6.Ø8
46	SIMPSON ILLIE	Z	NV	Ø12	38° Ø7'	115° 35'	4	129	13Ø	7.54
5Ø7	EDNAV. COOLEY	A	NV	ØØ8	39° 3Ø'	117° Ø5'	13	139	139	9.86
5Ø7	EDNAV COOLEY	Z	NV	ØØ8	39° 3Ø'	117° Ø5'	5	144	138	9.59
1Ø71	US BUR RECL	A	NV	ØØ2	35° 59'	114° 51'	9	69	7Ø	6.Ø7
1Ø71	US BUR RECL	Z	NV	ØØ2	35° 59'	114° 51'	9	7Ø	7Ø	7.47
1358	US SOIL CON	A	NV	ØØ9	37° 37'	114° 31'	4	1ØØ	1Ø4	22.91
1358	US SOIL CON	Z	NV	ØØ9	37° 37'	114° 31'	4	1ØØ	1Ø5	23.93
1485	NEV ST HIGHWAY	Z	NV	Ø13	39° Ø9'	119° 46'	5	12Ø	123	9.18
163Ø	CENTRL NEVADA	A	NV	ØØ8	39° 23'	117° 19'	8	141	139	13.55
163Ø	CENTRL NEVADA	Z	NV	ØØ8	39° 23'	117° 19'	8	14Ø	135	14.14
19Ø5	NEVADA ST HWY	A	NV	ØØ4	41° 47'	114° 45'	4	137	138	6.85
2431	LIDABEL WRIGHT	A	NV	ØØ5	37° 37'	118° Ø1'	19	112	114	1Ø.97
2562	BRADSHAW J W	A	NV	ØØ9	37° 19'	114° 3Ø'	4	87	9Ø	6.73
2562	BRADSHAW J W	Z	NV	ØØ9	37° 19'	114° 3Ø'	4	83	84	4.55
4349	NEVADA ST PARK	A	NV	ØØ1	39° 28'	119° Ø4'	4	98	99	9.71
4745	C.GARDNER	A	NV	Ø17	38° 51'	115° ØØ'	7	124	124	8.42
4745	C.GARDNER	Z	NV	Ø17	38° 51'	115° ØØ'	7	123	122	6.99
5191	D. ELLIS	Z	NV	ØØ3	38° 57'	119° 46'	8	115	118	13.45
588Ø	US FISH WILDLF	A	NV	ØØ9	37° 16'	115° Ø7'	4	87	87	1Ø.21
762Ø	C.H. CECCHINI	A	NV	Ø12	38° 47'	117° 1Ø'	8	121	124	12.5Ø
762Ø	H. WILLIAMS	Z	NV	Ø12	38° 47'	117° 1Ø'	5	125	123	8.93
8761	PAUL MEINECKE	A	NV	Ø15	39° 18'	119° 38'	5	129	13Ø	7.33

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
8761	PAUL MEINECKE	Z	NV	015	39° 18'	119° 38'	5	129	129	9.13
8822	NV FISH & GAME	A	NV	010	39° 05'	119° 07'	4	105	107	14.45
8838	.UNIV NEVADA	A	NV	016	39° 42'	119° 17'	5	104	107	10.53
8988	WELLS ELECTRIC	A	NV	004	41° 07'	114° 58'	9	142	141	5.84
8988	WELLS ELECTRIC	Z	NV	004	41° 07'	114° 58'	9	143	143	4.39
9171	NAT WEATHER SV	A	NV	007	39° 00'	119° 10'	5	100	104	19.87
82	C.SPENCER	A	OR	022	44° 37'	123° 07'	4	92	91	13.92
82	C.SPENCER	Z	OR	022	44° 37'	123° 07'	5	88	89	7.81
118	MR CURTIS	A	OR	019	42° 58'	120° 00'	8	128	128	14.50
265	HAROLD BLANK	Z	OR	011	45° 43'	120° 12'	5	100	99	6.14
541	US FOREST SERV	A	OR	012	44° 32'	118° 36'	8	126	126	5.67
541	FOREST SERVICE	Z	OR	012	44° 32'	118° 36'	8	133	132	6.30
652	EUGENE WAT&POW	A	OR	022	44° 18'	122° 02'	6	133	137	9.91
738	MEDFORD WAT.	A	OR	015	42° 30'	122° 28'	6	129	128	6.65
738	MEDFORD WAT.	Z	OR	015	42° 30'	122° 28'	7	125	122	7.04
760	DAVID HENDRIX	Z	OR	015	42° 18'	122° 56'	22	98	98	10.06
781	ROBERT COONROD	A	OR	020	43° 36'	123° 05'	21	90	93	16.00
781	ROBERT COONROD	Z	OR	020	43° 36'	123° 05'	18	101	104	11.19
1149	SALTMARSH, VIE	A	OR	015	42° 09'	122° 58'	14	106	106	10.69
1149	SALTMARSH, VIE	Z	OR	015	42° 09'	122° 58'	13	106	104	12.55
1207	OLSEN, J.H.	A	OR	015	42° 32'	122° 33'	18	129	128	9.45
1207	OLSEN, J. H.	Z	OR	015	42° 32'	122° 33'	17	129	129	9.77
1227	EDNA BELLER	A	OR	034	45° 41'	123° 04'	6	108	108	7.08
1227	EDNA BELLER	Z	OR	034	45° 41'	123° 04'	8	106	106	8.95
1329	CANBY	A	OR	003	45° 17'	122° 40'	13	83	86	10.22
1329	CITY OF CANBY	Z	OR	003	45° 17'	122° 40'	12	87	87	12.08
1643	RALPH KLEGER	Z	OR	005	46° 06'	123° 17'	4	108	110	9.80
2112	STATE BOARD	A	OR	027	44° 56'	123° 19'	4	102	102	6.46
2308	M.SMITH	A	OR	015	43° 11'	122° 08'	6	96	96	9.15
2308	M.SMITH	Z	OR	015	43° 11'	122° 08'	7	94	92	11.44
2325	JOSEPH BRIDGES	A	OR	034	45° 29'	123° 07'	9	86	80	10.02
2348	NORMA JACOBER	A	OR	034	45° 42'	122° 56'	7	105	108	10.13
2406	CITY DRAIN	A	OR	010	43° 41'	123° 18'	4	94	97	15.84
2406	CITY DRAIN	Z	OR	010	43° 41'	123° 18'	5	94	88	12.58

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991

1643	RALPH KLEGER	Z	OR	[illegible]	[illegible]	123° 19'	4	102	102	6.46
2112	STATE BOARD	A	OR	027	44° 56'	122° 08'	6	96	96	9.15
2308	M.SMITH	A	OR	015	43° 11'	122° 08'	7	94	92	11.44
2308	M.SMITH	Z	OR	015	43° 11'	123° 07'	9	86	80	10.02
2325	JOSEPH BRIDGES	A	OR	034	45° 29'	122° 56'	7	105	108	10.13
2348	NORMA JACOBER	A	OR	034	45° 42'	123° 18'	4	94	97	15.84
2406	CITY DRAIN	A	OR	010	43° 41'	123° 18'	5	94	88	12.58
2406	CITY DRAIN	Z	OR	010	43° 41'	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
2482	EDITH JOHNSON	Z	OR	001	44° 37'	117° 29'	5	129	129	2.12
2564	YOUNG JOHN I.	Z	OR	030	45° 45'	119° 11'	4	103	103	11.34
2633	ST FOR NURSERY	A	OR	010	43° 36'	123° 35'	12	85	81	12.13
2633	ORE. STATE FOR	Z	OR	010	43° 36'	123° 35'	5	86	83	15.64
2675	ASCHENBRENNER	Z	OR	032	45° 24'	117° 15'	4	145	146	4.11
2805	K RICHARDSON	Z	OR	027	44° 51'	123° 26'	4	112	112	11.15
2997	CITY FOREST GR	Z	OR	034	45° 32'	123° 06'	7	89	92	17.79
3095	MRS. BRANCH	A	OR	019	43° 20'	121° 10'	8	138	138	14.65
3095	MRS. BRANCH	Z	OR	019	43° 20'	121° 10'	7	137	140	13.72
3180	ASTER EXP STA	A	OR	004	46° 09'	123° 49'	7	108	125	33.10
3180	ASTER EXP STA	Z	OR	004	46° 09'	123° 49'	11	104	107	19.65
3305	MRS. H. MEAD	A	OR	010	42° 44'	123° 26'	9	92	92	8.23
3402	G. BECKMAN	A	OR	003	45° 18'	121° 45'	11	176	176	12.71
3402	G H ECKMAN	Z	OR	003	45° 18'	121° 45'	10	185	182	10.26
3542	GEORG RUFENER	A	OR	016	44° 29'	120° 58'	4	130	130	0.50
3542	GEORG RUFENER	Z	OR	016	44° 29'	120° 58'	4	135	135	2.08
3604	EVERETT PAYTON	A	OR	001	44° 53'	117° 07'	7	125	125	11.44
3770	BUR.WAT.WORKS	A	OR	003	45° 27'	122° 09'	4	109	112	10.44
3847	UMUTILLA STAT.	A	OR	030	45° 49'	119° 17'	11	98	98	6.99
3847	UMUTILLA	Z	OR	030	45° 49'	119° 17'	11	100	99	7.64
3971	E.L. KING	A	OR	022	44° 21'	122° 47'	18	93	95	9.76
3971	E.L. KING	Z	OR	022	44° 21'	122° 47'	19	94	97	9.78
4670	GLENN TYLER	Z	OR	019	42° 11'	120° 21'	19	131	130	10.58
4939	RUSSEL NELSON	A	OR	010	43° 14'	122° 56'	5	100	105	16.65
4939	RUSSEL NELSON	Z	OR	010	43° 14'	122° 56'	5	96	94	14.05
5020	M. GIBBS	Z	OR	012	44° 43'	119° 06'	13	138	136	12.17
5217	DOUGLAS CO.	A	OR	006	42° 49'	123° 51'	9	92	99	13.75
5217	DOUGLAS CO.	Z	OR	006	42° 49'	123° 51'	9	92	96	9.83
5424	MEDFORD EXP ST	A	OR	015	42° 18'	122° 52'	28	95	95	9.61
5715	OREGON ST F DE	A	OR	012	44° 49'	119° 25'	5	111	112	10.46
5715	OREGON ST F DE	Z	OR	012	44° 49'	119° 25'	8	113	112	9.44
5880	CLACKAMAS CONT	A	OR	003	45° 21'	122° 35'	7	94	95	8.56
5880	CLACKAMAS CONT	Z	OR	003	45° 21'	122° 35'	7	98	93	10.48
6238	OCHOCO IRR DIS	A	OR	007	44° 18'	120° 44'	4	123	122	10.97
6366	CASCADE EXP FO	A	OR	021	45° 02'	123° 56'	8	94	89	14.49

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
6532	PORTLAND ELECT	A	OR	016	44° 44'	121° 14'	8	105	103	8.07
6540	PENDLETON BR S	A	OR	030	45° 43'	118° 38'	17	102	103	10.64
6540	PENDLETON BR S	Z	OR	030	45° 43'	118° 38'	17	104	104	11.37
7112	J W GURNEY	A	OR	010	43° 08'	123° 37'	4	90	84	21.52
7112	J.GURNEY	Z	OR	010	43° 08'	123° 37'	6	96	97	11.90
7127	C A SCHAAD	Z	OR	036	45° 18'	122° 55'	8	95	97	10.11
7391	ROSALIE CULY	A	OR	015	42° 14'	123° 02'	9	96	92	8.92
7500	NAT'L WX SERVI	A	OR	024	44° 55'	123° 01'	9	87	88	11.58
7559	SANTIAM LC	A	OR	022	44° 25'	121° 52'	10	103	85	40.46
7866	E. STINSON	Z	OR	006	43° 09'	123° 52'	9	77	74	15.86
8009	JOHN BUTLER	Z	OR	035	44° 50'	119° 47'	9	103	106	12.57
8536	TOKETEE FALLS	A	OR	010	43° 17'	122° 27'	6	114	117	9.20
8726	UKIAH RANG STA	A	OR	030	45° 08'	118° 56'	13	138	140	6.34
8726	UKIAH RANG STA	Z	OR	030	45° 08'	118° 56'	14	141	143	4.65
8780	US FOREST SERV	A	OR	001	44° 26'	118° 14'	8	134	132	19.41
9051	SAM DAHLGREN	A	OR	005	45° 49'	122° 51'	6	97	98	7.58
9051	SAM DAHLGREN	Z	OR	005	45° 49'	122° 51'	7	94	97	14.99
9298	D. SCHAEFFER	A	OR	036	45° 10'	123° 12'	8	95	96	11.75
9298	D. SCHAEFFER	Z	OR	036	45° 10'	123° 12'	8	98	96	10.04
9316	RAYMOND AMES	A	OR	009	43° 41'	121° 41'	9	141	144	10.98
408	MR BILL LOVIL	A	TX	034	33° 07'	94° 11'	7	73	75	10.98
408	MR. LOVIL	Z	TX	034	33° 07'	94° 11'	9	69	67	12.30
691	US CORPS ENG	A	TX	220	32° 39'	97° 27'	8	78	79	5.73
691	US CORPS ENG	Z	TX	220	32° 39'	97° 27'	8	77	78	9.32
852	MS. KIRKPATRIC	A	TX	232	29° 14'	100° 06'	5	64	66	3.63
852	MS. KIRKPATRIC	Z	TX	232	29° 14'	100° 06'	5	67	65	6.02
1068	C.STEWART	Z	TX	027	30° 53'	97° 56'	4	66	66	4.97
1429	US COPRS ENG	Z	TX	046	29° 52'	98° 12'	4	47	50	17.69
1800	OLIN SMYTH JR.	A	TX	126	32° 20'	97° 24'	4	72	71	2.71
1800	OLIN SMYTH JR.	Z	TX	126	32° 20'	97° 24'	4	73	72	3.32
3080	MR C J RIKE	A	TX	043	33° 10'	96° 22'	6	76	72	14.41
3080	MR C J RIKE	Z	TX	043	33° 10'	96° 22'	5	64	62	5.12
3156	MR. FISCHER	A	TX	046	29° 59'	98° 16'	5	67	64	8.02
3156	MR. FISCHER	Z	TX	046	29° 59'	98° 16'	5	72	74	6.19

HONEYSUCKLE WEATHER BUREAU OBSERVERS

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
1068	C.STEWART	Z	TX	027	30° 53'	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1429	US COPRS ENG	Z	TX	046	29° 52'	98° 12'	4	47	50	17.69
1800	OLIN SMYTH JR.	A	TX	126	32° 20'	97° 24'	4	72	71	2.71
1800	OLIN SMYTH JR.	Z	TX	126	32° 20'	97° 24'	4	73	72	3.32
3080	MR C J RIKE	A	TX	043	33° 10'	96° 22'	6	76	72	14.41
3080	MR C J RIKE	Z	TX	043	33° 10'	96° 22'	5	64	62	5.12
3156	MR. FISCHER	A	TX	046	29° 59'	98° 16'	5	67	64	8.02
3156	MR. FISCHER	Z	TX	046	29° 59'	98° 16'	5	72	74	6.19

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
3196	G.POPE	Z	TX	173	34° 14'	100° 59'	4	77	77	5.75
3199	B.LEFNER	Z	TX	246	30° 48'	97° 46'	4	68	69	4.24
3225	KEN SHARPE	A	TX	148	36° 26'	100° 08'	10	96	100	9.90
3225	KEN SHARPE	Z	TX	148	36° 26'	100° 08'	10	94	93	10.62
3247	MR. FOSTER	A	TX	169	33° 29'	97° 34'	8	74	71	12.05
3247	MR. FOSTER	Z	TX	169	33° 29'	97° 34'	7	67	74	13.28
4278	HORDS CREEK	A	TX	042	31° 51'	99° 34'	6	68	67	4.50
4278	HORDS CREEK	Z	TX	042	31° 51'	99° 34'	6	73	71	6.94
4670	H.COLEMAN	A	TX	134	30° 30'	99° 47'	4	76	76	2.38
4670	H.COLEMAN	Z	TX	134	30° 30'	99° 47'	4	74	73	9.29
5158	GROVER SPRINGE	Z	TX	159	32° 18'	101° 53'	16	73	74	6.93
6893	TRANSPECOS EXP	Z	TX	195	31° 25'	103° 30'	8	71	70	7.64
7081	MR H SMITH	A	TX	095	34° 12'	101° 43'	5	88	92	10.07
7081	MR H SMITH	Z	TX	095	34° 12'	101° 43'	5	85	89	10.83
7243	J.RUSCHE	Z	TX	150	30° 35'	98° 53'	4	81	83	13.39
7361	MARY PITTMAN	A	TX	023	34° 21'	101° 02'	4	75	75	6.65
7361	MARY PITTMAN	Z	TX	023	34° 21'	101° 02'	4	76	77	9.57
7495	MR. BROWN	Z	TX	070	32° 31'	96° 48'	8	70	70	8.38
8761	SOUTH.PUB.SER.	A	TX	171	35° 58'	101° 52'	4	97	92	21.30
8761	SOUTH.PUB.SER.	Z	TX	171	35° 58'	101° 52'	4	97	91	24.07
8877	MRS TEAGUE	Z	TX	086	30° 26'	98° 49'	4	67	64	11.15
9499	C.G. PARSONS	A	TX	224	31° 40'	100° 43'	7	75	74	7.87
9499	MR C G PARSONS	Z	TX	226	31° 40'	100° 43'	11	67	67	4.55
9593	LEDNICKY	Z	TX	155	31° 48'	97° 06'	9	76	75	6.46
1002	FAA FLIGHT ST.	A	UT	009	37° 42'	112° 09'	5	142	142	14.54
1002	FAA FLIGHT ST.	Z	UT	009	37° 42'	112° 09'	5	149	159	15.73
1144	D. BAGLEY	A	UT	012	39° 54'	113° 43'	7	123	124	6.05
1144	C N BAGLEY	Z	UT	012	39° 54'	113° 43'	7	123	123	6.57
1411	SALLY LINDGREN	A	UT	022	40° 49'	110° 48'	7	115	111	15.44
1588	CHARLES COPLEY	Z	UT	022	40° 55'	111° 24'	21	136	135	9.36
2173	NATL PARK SER	A	UT	024	40° 26'	109° 18'	4	128	128	4.65
2173	NATL PARK SER	Z	UT	024	40° 26'	109° 18'	5	144	128	32.35
2561	MABEL NIELSEN	A	UT	011	37° 45'	113° 39'	8	125	124	10.08
2561	MABEL NIELSEN	Z	UT	011	37° 45'	113° 39'	9	127	126	8.14
2607	MR. CHILDS	A	UT	014	39° 07'	113° 57'	9	122	120	8.15

HONEYSUCKLE WEATHER BUREAU OBSERVERS DURING THE PERIOD 1968 - 1991 BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
2607	DOUGLAS CHILDS	Z	UT	014	39° 07'	113° 57'	11	122	121	6.56
2696	ROLAND HANSEN	A	UT	025	40° 16'	112° 05'	8	134	132	8.99
2726	RULON DRAPER	A	UT	006	40° 59'	111° 53'	6	119	118	15.41
2798	D. CHRISTENSEN	A	UT	008	39° 06'	111° 08'	12	126	128	8.43
2798	D. CHRISTENSEN	Z	UT	008	39° 06'	111° 08'	13	127	129	9.93
2847	FOREST RANGER	Z	UT	021	38° 33'	111° 43'	5	168	175	14.31
2996	US DP INTERIOR	Z	UT	024	40° 17'	109° 51'	5	129	134	9.18
3046	CAPITOL REEF	A	UT	028	38° 17'	111° 16'	15	110	110	13.68
3046	CAPITOL REEF	Z	UT	028	38° 17'	111° 16'	15	109	112	15.16
3260	CECIL WOODMAN	A	UT	023	40° 10'	113° 50'	4	124	126	6.99
4135	F BARTHOLOWMEW	A	UT	029	41° 14'	111° 43'	9	139	135	9.55
4542	SALT LAKE CO	Z	UT	018	40° 39'	111° 49'	5	118	122	11.90
4764	GEORGE HATCH	A	UT	021	38° 31'	111° 53'	16	144	143	9.61
4764	GEORGE HATCH	Z	UT	021	38° 31'	111° 53'	18	146	146	7.82
4856	MONTY KEARL	A	UT	017	41° 49'	111° 19'	4	146	145	9.87
4947	ROBERTA WILCOX	A	UT	019	38° 18'	109° 13'	9	130	130	9.09
4968	VERNON CHURCH	Z	UT	027	37° 12'	113° 16'	5	92	88	14.82
5065	JOHN SHEPHERD	Z	UT	012	39° 33'	111° 57'	5	127	127	7.66
5138	J W WOODBURY	A	UT	012	39° 44'	112° 18'	7	118	119	6.76
5186	G.ASHCROFT	A	UT	003	41° 44'	111° 49'	6	129	128	5.66
5186	G.ASHCROFT	Z	UT	003	41° 44'	111° 49'	6	131	130	6.59
5507	US FOR SERV	A	UT	007	40° 10'	110° 24'	8	125	129	11.24
5507	US FOREST SERV	Z	UT	007	40° 10'	110° 24'	4	124	128	14.52
5654	WEATH. BUREAU	A	UT	001	38° 26'	113° 01'	16	128	128	8.62
5654	WEATHER BUREAU	Z	UT	001	38° 26'	113° 01'	13	130	130	9.22
5723	DARWIN MARSHAL	A	UT	001	38° 13'	112° 55'	6	107	107	8.47
6568	OURAY NWR	A	UT	024	40° 08'	109° 38'	6	129	128	6.51
6724	LESLIE BARNETT	A	UT	025	40° 03'	111° 46'	4	115	117	10.40
6724	LESLIE BARNETT	Z	UT	025	40° 03'	111° 46'	5	118	122	10.64
7061	CHRISTOPHERSON	A	UT	025	40° 14'	111° 40'	6	124	124	10.58
7061	CHRISTOPHERSON	Z	UT	025	40° 14'	111° 40'	7	126	129	12.74
7064	DALE STEVENS	A	UT	025	40° 15'	111° 39'	7	112	112	13.38
7343	CHARLES TEA	Z	UT	018	40° 31'	111° 59'	6	123	122	7.84
[illegible]	KAISER STEEL C	A	UT	004	39° 34'	110° 22'	5	145	144	12.44

7061	CHRISTOPHERSON	A	UT	025	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7061	CHRISTOPHERSON	Z	UT	025	40° 14'	111° 40'	7	126	129	12.74
7064	DALE STEVENS	A	UT	025	40° 15'	111° 39'	7	112	112	13.38
7343	CHARLES TEA	Z	UT	018	40° 31'	111° 59'	6	123	122	7.84
[illegible]	KAISER STEEL C	A	UT	004	39° 34'	110° 22'	5	145	144	12.44

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
9346	WEBER BASIN	Z	UT	006	41° 07'	111° 55'	17	122	125	8.59
13	WYNOOCHE	A	WA	014	47° 16'	123° 42'	11	100	103	15.83
13	WYNOOCHE	Z	WA	014	47° 16'	123° 42'	14	102	107	12.33
217	GREEN, PATRICI	A	WA	020	45° 49'	121° 16'	10	138	137	5.95
217	GREEN, PATRICI	Z	WA	020	45° 49'	121° 16'	12	136	134	5.79
257	BARNEY BRENNE	A	WA	031	48° 12'	122° 08'	4	99	98	4.24
324	CITY AUBURN	A	WA	017	47° 19'	122° 14'	5	95	97	12.01
324	CITY AUBURN	Z	WA	017	47° 19'	122° 14'	7	92	92	9.83
564	WASH ST. NURSE	A	WA	037	48° 47'	122° 29'	10	94	95	15.86
564	WASH ST. NURSE	Z	WA	037	48° 47'	122° 29'	6	91	96	16.50
668	MEYER WILLIAM	A	WA	020	46° 00'	120° 18'	15	133	134	7.49
668	WILLIAM MEYER	Z	WA	020	46° 00'	120° 18'	21	130	131	9.21
729	MRS. VAN LUVEN	A	WA	037	49° 00'	122° 45'	9	92	95	14.39
1064	SIMPSON LOGGIN	Z	WA	014	47° 22'	123° 36'	4	132	132	8.43
1205	DEPT FISH CATH	A	WA	035	46° 16'	123° 18'	8	109	112	10.68
1205	DEPT FISH CATH	Z	WA	035	46° 16'	123° 18'	11	100	96	11.97
1233	SEATLE WATER	A	WA	017	47° 25'	121° 44'	22	126	128	18.70
1233	SEATLE WATER	Z	WA	017	47° 25'	121° 44'	23	126	125	17.46
1350	GFORGE PENNELL	Z	WA	004	47° 50'	120° 02'	7	128	116	20.38
1650	WILMA CAMERON	A	WA	033	48° 33'	117° 53'	6	131	132	9.56
1690	MRS FINKBEINER	A	WA	011	46° 40'	118° 53'	6	105	102	8.80
1992	US FOREST RNGR	A	WA	031	48° 15'	121° 36'	4	131	131	11.61
1992	US FOREST RNGR	Z	WA	031	48° 15'	121° 36'	5	129	131	6.63
2253	DANIEL WOOSTER	A	WA	021	46° 38'	123° 15'	5	110	114	11.69
2253	DANIEL WOOSTER	Z	WA	021	46° 38'	123° 15'	6	111	113	8.97
3177	MARGIE GOODWIN	A	WA	021	46° 31'	122° 10'	8	95	95	8.93
3183	CHARLES HAIGHT	Z	WA	020	46° 01'	121° 17'	4	131	131	2.22
3333	WA DEPT FISHER	A	WA	025	46° 23'	123° 34'	10	89	87	9.04
3515	GENE CRONRATH	A	WA	022	47° 29'	118° 11'	16	129	130	7.94
3515	CRONRATH EUGEN	Z	WA	022	47° 29'	118° 11'	12	128	127	8.90
3546	W. ASHCRAFT	A	WA	001	46° 46'	118° 40'	9	115	114	8.22
3546	W. ASHCRAFT	Z	WA	001	46° 46'	118° 40'	10	118	119	8.59
3883	PROJ ENG ICE H	A	WA	036	46° 15'	118° 51'	6	101	103	5.19
3883	PROJ ENG ICE H	Z	WA	036	46° 15'	118° 51'	7	103	102	5.13
4084	KALAMA HATCHRY	A	WA	008	46° 01'	122° 43'	7	99	94	9.59

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
4169	KENT WAT. DPT.	A	WA	Ø17	47° 22'	122° 14'	8	9Ø	92	17.14
436Ø	TACOMA CITY LI	A	WA	Ø27	46° 5Ø'	122° 19'	1Ø	1Ø5	11Ø	17.71
436Ø	TACOMA CITY LI	Z	WA	Ø27	46° 5Ø'	122° 19'	11	1Ø6	1Ø8	19.67
4438	MAPLE GROVE R	Z	WA	ØØ5	48° Ø5'	123° 42'	7	127	128	9.27
4572	FISH WILD SERV	A	WA	ØØ4	47° 34'	12Ø° 4Ø'	5	127	125	3.74
4572	FISH WILD SERV	Z	WA	ØØ4	47° 34'	12Ø° 4Ø'	4	128	128	5.85
4769	CITY LONGVIEW	A	WA	ØØ8	46° 1Ø'	122° 55'	7	97	98	7.73
4769	CITY LONGVIEW	Z	WA	ØØ8	46° 1Ø'	122° 55'	8	98	1Ø1	9.27
4999	CASCADES NAT P	A	WA	Ø29	48° 32'	121° 27'	8	114	118	18.45
4999	CASCADES NAT P	Z	WA	Ø29	48° 32'	121° 27'	8	117	119	14.77
5128	ROY KUMM	Z	WA	Ø24	48° 32'	12Ø° 2Ø'	4	143	144	3.74
5231	CORPS OF ENGIN	A	WA	ØØ3	45° 57'	119° 18'	5	95	93	8.Ø9
5231	CORPS OF ENGIN	Z	WA	ØØ3	45° 57'	119° 18'	6	96	95	6.78
5387	FRANCIS HARRIS	A	WA	Ø36	46° Ø5'	118° 16'	5	1ØØ	99	6.8Ø
5387	FRANCIS HARRIS	Z	WA	Ø36	46° Ø5'	118° 16'	4	1Ø3	1ØØ	7.94
5425	VICTOR ROWE	A	WA	Ø21	46° 43'	122° 11'	4	122	126	9.22
5425	VICTOR ROWE	Z	WA	Ø21	46° 43'	122° 11'	5	123	122	8.33
5525	WA STATE REFOR	A	WA	Ø31	47° 51'	121° 59'	1Ø	95	98	1Ø.4Ø
5525	WA STATE REFOR	Z	WA	Ø31	47° 51'	121° 59'	9	1Ø3	1Ø3	1Ø.73
5678	NW WASH. EXPER	A	WA	Ø29	48° 26'	122° 23'	5	84	85	14.91
5678	SUPERVISOR	Z	WA	Ø29	48° 26'	122° 23'	9	1Ø5	1Ø5	9.84
57Ø4	CORPS OF ENGIN	A	WA	Ø17	47° Ø9'	121° 56'	5	111	11Ø	5.26
57Ø4	CORPS OF ENGIN	Z	WA	Ø17	47° Ø9'	121° 56'	6	121	125	1Ø.73
5832	BUREAU INDIAN	Z	WA	Ø24	48° Ø8'	118° 59'	8	132	134	6.Ø7
5954	HARRY VAUGHAN	Z	WA	Ø32	47° 41'	117° 26'	5	122	121	8.35
6Ø11	EVA GRISWOLD	A	WA	Ø14	46° 5Ø'	123° 13'	5	1Ø5	1Ø2	15.61
6Ø11	EVA GRISWOLD	Z	WA	Ø14	46° 5Ø'	123° 13'	4	112	1Ø9	19.91
6262	USF PACKWOOD	A	WA	Ø21	46° 37'	121° 4Ø'	1Ø	114	116	11.Ø9
6262	USF PACKWOOD	Z	WA	Ø21	46° 37'	121° 4Ø'	1Ø	117	12Ø	12.15
6295	TACOMA WAT.DPT	A	WA	Ø17	47° 18'	121° 51'	6	114	121	1Ø.99
6295	V VESEY	Z	WA	Ø17	47° 18'	121° 51'	1Ø	1Ø3	112	2Ø.65
6534	MRS TROY MOORE	A	WA	ØØ4	47° 47'	12Ø° 39'	6	129	133	9.51
661Ø	US FORSET SERV	Z	WA	Ø12	46° 28'	117° 37'	14	1Ø4	1Ø6	9.29
[illegible]	F. I. PROFESTING	A	WA	ØØ3	46° 15'	119° 45'	18	1Ø3	1Ø2	6.38
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.87

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991

6295	TACOMA WAT.DPT	A	WA	Ø17	47° 18'	121° 51'	1Ø	1Ø3	112	[illegible]
6295	V VESEY	Z	WA	Ø17	47° 47'	120° 39'	6	129	133	9.51
6534	MRS TROY MOORE	A	WA	ØØ4	46° 28'	117° 37'	14	1Ø4	1Ø6	9.29
661Ø	US FORSET SERV	Z	WA	Ø12	46° 15'	119° 45'	18	1Ø3	1Ø2	6.38
[illegible]	[illegible]	A	WA	ØØ3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
6789	FRANK H WEBB	A	WA	Ø38	46° 46'	117° 12'	5	136	136	4.97
6789	FRANK H WEBB	Z	WA	Ø38	46° 46'	117° 12'	5	138	141	7.Ø2
6864	FOREST SERVICE	A	WA	Ø14	47° 3Ø'	123° 49'	6	129	13Ø	11.81
69Ø9	US FOREST SERV	A	WA	Ø21	46° 32'	121° 56'	6	99	96	6.91
7544	CITY OF SEQUIM	A	WA	ØØ5	48° Ø5'	123° Ø3'	6	1ØØ	1ØØ	23.26
7657	IDA TURNER	A	WA	Ø31	48° Ø4'	121° 34'	8	152	154	8.54
7657	IDA TURNER	Z	WA	Ø31	48° Ø4'	121° 34'	6	154	154	1Ø.95
7727	NORMA BOOHER	A	WA	Ø13	46° 5Ø'	119° 4Ø'	8	97	1Ø1	8.86
7933	FINCH ARBORETM	A	WA	Ø32	47° 4Ø'	117° 25'	5	131	132	5.13
7933	FINCH ARBORETM	Z	WA	Ø32	47° 4Ø'	117° 25'	7	132	13Ø	5.99
8Ø34	ST SALMON HAT	Z	WA	Ø31	47° 52'	121° 43'	4	99	99	15.22
8442	YAKIMA TIETON	Z	WA	Ø39	46° 4Ø'	121° ØØ'	4	131	13Ø	4.24
9112	JOSEPHINE DYAS	A	WA	Ø14	46° 52'	124° Ø6'	7	71	64	19.37
92ØØ	NAT'L PARK SER	A	WA	Ø36	46° Ø3'	118° 27'	12	95	92	9.86
27Ø	UNI OF WYOMING	A	WY	Ø11	41° Ø9'	1Ø4° 39'	16	143	143	9.44
552	MRS E S MARTIN	A	WY	Ø13	42° 38'	1Ø6° 23'	9	138	137	9.66
695	US WEA BUR	A	WY	Ø18	42° 32'	11Ø° Ø7'	7	164	166	9.27
695	US WEA BUR	Z	WY	Ø18	42° 32'	11Ø° Ø7'	8	164	164	8.3Ø
74Ø	E W SNIDER	A	WY	Ø1Ø	44° Ø8'	1Ø6° 44'	1Ø	143	141	7.31
74Ø	EW. SNIDER	Z	WY	Ø1Ø	44° Ø8'	1Ø6° 44'	4	148	148	3.56
915	ETCHEVERRY JON	Z	WY	Ø12	42° 15'	111° Ø2'	17	158	16Ø	9.58
1547	R PEERY	Z	WY	Ø11	41° Ø2'	1Ø4° 18'	15	136	139	6.56
258Ø	DILLINGER	Z	WY	ØØ3	44° Ø7'	1Ø5° Ø7'	8	144	146	8.48
261Ø	B. HENDERSON	A	WY	ØØ4	41° Ø2'	1Ø7° 32'	12	15Ø	149	12.62
261Ø	B. HENDERSON	Z	WY	ØØ4	41° Ø2'	1Ø7° 32'	1Ø	144	141	7.68
2725	VIC NACHTMAN	A	WY	ØØ5	43° 25'	1Ø4° 57'	6	141	14Ø	8.6Ø
2725	NACHTMAN MARY	Z	WY	ØØ5	43° 25'	1Ø4° 57'	18	136	138	11.Ø4
349Ø	CAROL KAPUS	A	WY	ØØ8	42° 23'	1Ø4° 32'	7	139	139	9.21
349Ø	CAROLINE KAPUS	Z	WY	ØØ8	42° 23'	1Ø4° 32'	1Ø	139	138	6.21
3865	C. MANKIN	A	WY	ØØ3	44° Ø5'	1Ø5° 43'	1Ø	145	149	11.9Ø
3865	C. MANKIN	Z	WY	ØØ3	44° Ø5'	1Ø5° 43'	11	143	145	9.97
4Ø8Ø	MRS WL MAXWELL	A	WY	ØØ2	44° 29'	1Ø8° Ø3'	8	135	131	14.43
4411	MR W L JACKSON	A	WY	Ø15	44° 42'	1Ø8° 57'	8	135	135	7.45
444Ø	HARRY FERGUSON	Z	WY	Ø11	41° Ø9'	1Ø5° 11'	6	148	15Ø	9.27
5Ø55	ROSS MCKENNA	A	WY	Ø1Ø	43° 43'	1Ø6° 38'	13	133	133	8.33

HONEYSUCKLE WEATHER BUREAU OBSERVERS
DURING THE PERIOD 1968 - 1991
BY STATE AND BUREAU

Bureau	Name	Plant	State	County	Latitude	Longitude	Years of Data	Mean	Median	Standard Dev.
5055	ROSS MCKENNA	Z	WY	010	43° 43'	106° 38'	15	134	135	8.05
5085	FRANK MAHNKE	A	WY	014	42° 46'	104° 47'	4	147	150	14.89
5260	CLIFFORD NOYES	A	WY	008	41° 38'	104° 10'	6	136	137	7.93
5260	CLIFFORD NOYES	Z	WY	008	41° 38'	104° 10'	13	135	134	8.89
5435	WATER RES.	A	WY	001	41° 21'	105° 37'	13	149	149	6.49
5435	WATER RES.	Z	WY	001	41° 21'	105° 37'	14	151	153	6.31
5506	J.CHASE	Z	WY	017	44° 51'	106° 17'	7	141	143	7.50
5525	KORTES JOHN	Z	WY	004	42° 11'	106° 50'	4	155	159	9.25
5612	CHARLEY CARROL	Z	WY	008	42° 05'	104° 20'	6	131	130	5.29
6165	EDMOND C TODD	A	WY	018	42° 57'	110° 22'	20	174	175	6.03
6165	EDMOND C TODD	Z	WY	018	42° 57'	110° 22'	21	174	174	7.73
6440	BUR OF RECLAMA	A	WY	020	43° 51'	110° 35'	13	168	170	8.94
6440	BUR. OF RECLAM	Z	WY	020	43° 51'	110° 35'	14	173	175	8.20
6450	KEN WHITNEY	A	WY	023	43° 31'	104° 20'	9	130	132	6.65
6660	JAMES PARRISH	A	WY	023	43° 51'	104° 13'	7	129	130	13.07
6935	ROSE MCMEEKIN	A	WY	023	43° 59'	104° 25'	8	135	136	8.40
7115	MIDVALE IRRIG.	A	WY	007	43° 15'	108° 41'	8	137	138	10.12
7240	ED PROSSER	A	WY	011	41° 11'	104° 09'	10	133	134	5.32
7240	ED PROSSER	Z	WY	011	41° 11'	104° 09'	11	134	135	5.85
7388	U OF WY EXP ST	A	WY	015	44° 47'	108° 45'	11	136	138	7.49
7388	WYOMING	Z	WY	015	44° 47'	108° 45'	10	134	133	8.17
7473	LANNY FRITZ	Z	WY	022	44° 11'	107° 57'	23	132	133	7.60
7548	E. OEDEKOVEN	A	WY	003	44° 56'	105° 48'	5	144	145	6.39
7840	ROB. LARSON	A	WY	019	41° 35'	109° 13'	6	144	145	4.79
7840	ROB. LARSON	Z	WY	019	41° 35'	109° 13'	7	146	146	5.08
7955	MARIE WESTON	A	WY	012	41° 52'	111° 00'	10	153	145	14.96
8475	FRED WILSON	Z	WY	014	43° 26'	104° 10'	5	139	137	5.72
8647	F. JENKINS	A	WY	006	44° 47'	105° 05'	10	148	148	6.02
8647	F. JENKINS	Z	WY	006	44° 47'	105° 05'	9	148	148	7.46
8705	CROOK SHERIFFS	A	WY	006	44° 24'	104° 21'	4	139	141	7.14
8995	UNIV.WYOMING	A	WY	008	42° 05'	104° 13'	6	127	130	10.37
9000	HOLLY SUGAR CO	A	WY	008	42° 03'	104° 11'	8	129	130	6.67