1959

Polyploidy in relation to vegetational zonation in the western United States

Kozo Funabiki
The University of Montana

POLYPLOIDY IN RELATION TO VEGETATIONAL ZONATION

IN

THE WESTERN UNITED STATES

by

KOZO FUNABIKI

Bachelor of Agriculture, Tokyo University, 1943

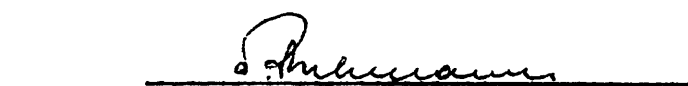
Presented in partial fulfillment of the requirement of the degree of

Master of Forestry

Montana State University

1959

Approved by:



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ACKNOWLEDGEMENT

I would like to express my appreciation to Dean Ross Williams of the School of Forestry for giving me the opportunity to study at Montana State University; and to Dr. Vollrat V. Deichmann under whose direction the work was done. I should also like to express my thanks to Dr. and Mrs Otto Steom and Dr. Sherman Preece of the Department of Botany whose advice on advanced cytological and cytotaxonominal problems were particularly helpful. I am also indebted to Professor Gene Cox who helped me in writing the thesis.

INTRODUCTION

Each plant has a particular number of chromosomes in its cells which may be counted and observations made of their shapes and behavior during division in the mitotic and meiotic stages. These features are generally considered to be characteristic for each species.

The number of chromosomes varies among the families, genera and species as a result of different habitat or life-form characteristics and their ecological and geographical distribution.

In this paper, the chromosome number of some plants of the western United States has been listed; vegetation study areas were selected in Oregon, Washington, Wyoming, Colorado and California.

The data obtained were analysed with special reference to vegetation life-zones; comparisons were made between the five areas in the western United States, as well as between these areas and life-zones in Europe and Japan.

Chapter 1. REVIEW OF LITERATURE

According to Stebbins (1947), approximately half of the species of angiosperms have chromosome numbers that clearly indicate polyploid origin, and in some families, such as Gramineae, three-fourths of the species are polyploids.

The percentage of polyploids in many families can not be given accurately. It is rather difficult to determine the basic chromosome numbers of the genera. Some authors report that 30 -35 per cent of all angiosperms are polyploids (Stebbins, 1947, 1950; Tischler 1950; Darlington and Janaki-Ammal (1945).

The variation in the number of polyploid species is in part a result of uncertainty as to the correct basic chromosome number. However, recent counts of chromosome numbers indicate that a larger proportion of genera may be polyploids, and therefore principally of hybrid origin.

The majority of woody plants have basic numbers of chromosomes of 10, 11, 12, 15, 19 and 23; on the other hand there are number in which x = 7, 8, and 9. The genus Quercus has a basic chromosome number of 12 instead of 6. Why is it not x = 6? Sakisaka (1951) explained reduced numbers of many genera from the revolutional point of view. From this point of view, the genus Quercus may have originated through polyploidization from some unknown plants which had x = 6 or 3. However, the basic number of Quercus is estimated to be 12, because those ancestral plants are no longer living and their basic number is unknown.

All the bamboo genera have basic chromosome numbers of 12, and all the species are polyploids having somatic chromosome numbers of 2n = 48 and 72 (Darlington and Wylie, 1955). There is no literature describing the diploid plants although presumably they originated from some heraceous plants of x = 6, probably having life-forms similar to other members of the Gramineae.

Some species which have haploid chromosome numbers of n = 23 are said to have been derived from hybridization between (n = 11) X (n = 12); those of n = 15 from (n = 7) X (n = 8), and n = 13 from (n = 6) X 2 + 1 (Tischler, 1951).

If further evidence should prove the hypothesis that basic numbers of 10 and higher in the woody angiosperms originated from polyploid derivation, many species and genera as well as families may have to be reclassified on a cytogenetic and systemetic basis.

In the case of the Hammamelidacea, chromosome numbers of the genera are:

Corylopsis	n: 12 and 36	(Anderson and Sax, 1935)
Distylium	n: 12	(Sugiura, 1936)
Hammamelis	n: 12	(Anderson and Sax, 1935)
Forthergilla	n: 24 and 36	(" " " ")
Parrotiopsis	n: 12	(" " " ")
Sinowilleonia	n: 12	(" " " ")
Liquidambar	n: 15	(" " " ")

This chromosome list shows that Liquidambar is the only genus of the family with a base number other than 12. Harms (1935?) transferred the genus Liquidambar from the Hammamelidaceae on the basis of studies of the wood anatomy of this family.

The major aim of this paper is not to solve these questions of basic chromosome numbers, but to compare the chromosomal features of vegetation

from different life-zones at various locations in the western United States with each other and with those of Europe and Japan.

Tischler (1955) cited many chromosome data of European floras, in which the listed basic chromosome numbers of some genera varied. In Japan, the author employed the method used by Darlington and Wylie (1955), Haskel (1952), and Loeve and Loeve (1943). In some cases, for instance, a genus in which 2n = 36 and whose basic number was listed as 18 by Darlington, might be said to have x = 9 if there are no other genera which have such a high basic number among the same family.

In Japan, it was rather easy for the author to check the plants whose chromosome numbers were unknown and to estimate the numbers from other closely related species whose chromosome numbers have been counted previously. However, in the United States the number of species whose chromosome numbers are listed in this paper may not be sufficient to treat statistically.

In cyto-taxonomic studies, conclusions are drawn from a comparison of the morphology and ecology of the plants as well as from chromosomal evidences.

Polyploidy in nature is almost always associated with hybridization, either intervarietal or interspecific, which has far-reaching significance. Polyploid plants simply have more genetic possibilities of including allopolyploids and auto-allopolyploids with high potentials of adaption to the environment of the given area or newly openend area or habitats for colonization. These polyploids may be successful at the expense of the diploids which have a simpler genetic structure.

There are many facts which verify this hypothesis of correlation between polyploidy and environment among the angiosperms, ferns, and mosses, while among both genera and species of coniferous plants, chromosome variation is rare.

There are only four basic numbers within the coniferous genera, some rare exceptions excluded (Darlington and Wylie, 1955).

x = 10 : Sciadopitys, Podocarpus

x = 11 : Torreya, Taxodiaceae (Athrotaxis, Cryptomeria, Cunninghamia, Taiwania, Taxodium, Sequoiadendron, Sequoia.), Cupressaceae (Callistris, Chamaecyparis, Cupressus, Libocedrus, Thuja, Juniperus.)

x = 12 : Ginkgo, Taxus, Cephalotaxus, Pinaceae (Tsuga, Abies, Cedrus, Keteleeria, Larix, Picea, Pinus), Gnetum.

x = 13 : Araucariaceae (Araucaria, Agathis).

All these conifers are considered as diploids.

As can be seen from the foregoing list, the majority of coniferous genera have basic numbers of x = 11 and 12; whereas, all the genera of Pinaceae have just 12 as a basic number with no polyploids, and all the genera of Cupressaceae and Taxodiaceae have 11. One exceptional polyploid species among conifers is Sequoia sempervirens which has 66 as a somatic chromosome number (Hirayoshi, 1943; Stebbins, 1948).

In spite of a large number of species and varieties, coniferous plants have no variations in chromosome numbers although there is a great diversity of environmental factors in their widespread range in the northern hemisphere.

According to Swanson (1957), any conclusion drawn as to the extensive-

ness and geographical distribution of polyploids as compared to diploids must be considered tentative at the present time. Since the flora of temperate, north-temperate and boreal zones have been investigated cytologically much more than those of tropical and subtropical zones.

Chromosome numbers of some genera are completely known, or in some cases it is quite clear that homoploidy exists, i.e., there is no variation of chromosome numbers among numbers of a genus.

As a result of studies in the last half century, the following criteria may be studied as a basis for correlation with chromosome numbers:

1) life-forms of plants : woody - herbaceus
annual - perennial
deciduous - evergreen
sterile - fertile
entomophilous - anemophilous

2) ecological situation of plants :
terrestrial - aquatic
desert - savannah - moderate - marshes
different light conditions

3) altitudinal zonation : plain plants - alpine plants

4) geographical distribution :
tropical to boreal flora
coastal to inland flora

5) plants growing under unusual environment

The influence of altitudinal zonation and geographical distribution on the occurrence polyploidy is discussed in this paper.

Before discussing the data obtained on the flora of the five regions of the western United States, some studies will be cited to clarify the background of this study.

Loeve and Loeve (1945) demonstrated that from Schleswig-Holstein in Germany to Spitzbergen in the north of Norway, there is a progressively greater proportion of polyploids encountered in the various floras. They concluded that polyploids are more resistant to cold and consequently there is a larger proportion of polyploids among the northern floras, although there are some who may not agree with the interpretation of the correlation (Swanson, 1957).

Manton (1952) estimated that 52 per cent of the British (50° - 59°N.) ferns are polyploids, while the island of Madeira (33°N.) has 42 per cent polyploids among its fern population. The difference in percent is probably without significance, but there remains a marked difference in degree of polyploidy.

The British ferns are predominantly tetraploid, and there still is geographical contact with their diploid ancestors, which results in a more active evolutional change than can be recognized in Madeira, about 20° south of the British Islands.

Hurst (1926, 1927, 1928) showed that in North America, diploid species of Rosa (x = 7) are dominant on mountains of subtropic zones, tetraploids in temperate zones, hexaploids in northern temperate zones while octaploids are found only in boreal or subarctic zones.

Rosa is said to be a genus troublesome to classify morpho-taxonomically because of the tremendous number of species and varieties and the numberous hybrids which are known among these species and varieties. Erlanson (1934) concluded that wild roses of North America should be classified into six groups according to the polyploidy as follows:

Diploid species and varieties	(2n:14)	25 spp., 1 var.
Triploid hybrids	(2n:21)	13 var's.
Tetraploid species	(2n:28)	38 spp.
Pentaploid hybrids	(2n:35	17 var's.
Hexaploid species	(2n:42)	14 spp.
Septaploid	(2n:49)	none
Octaploid species and varieties	(2n:56)	3 spp., 1 var.

In the same family Rosaceae, Jinno (1952, 1953, 1954, 1955) found some relation between polyploidy, geographical distribution and altitudinal ranges of Rubus species. In Japan, out of 14 diploid species of Rubus, 13 are found on mountains and northern areas where the temperature in winter is low, while 11 of those diploids also range into southern Japan where the climate is milder in winter. On the other hand, out of five polyploid species, four are found only in the lowlands and the southern part of central Japan. Diploid species of this genus are deciduous, while tetraploid species are evergreen other than a few exceptional deciduous species. Hexaploid species are all evergreen and are considered to have lost winter hardiness. This is an instance of "southern type" polyploidy.

Tradescantia of North America show characteristic features in its distribution correlated with polyploidy variation (Anderson, 1935; Anderson and Sax, 1936). The tetraploid species Tradescantia occidentalis (2n = (12), 24) colonizes and spreads along railway embankments and is widespread throughout the mid-western region. Similarly, T. virginiana (2n = 24) is widespread also. T. subaspera (2n = 24) has a smaller range, while other diploid forms are largely concentrated in the southern United States and the plateau region of Texas. The only species which spreads beyond the limit of the diploid range is T. bracteata

(2n= 12, 18).

The average area occupied by each diploid species is 83,475 square miles, while the nine tetraplid species occupy an average area of 376,300 square miles. The spreading power, favoring the tetraploids, can be expressed by ratio of 2 to 1 (Anderson, 1935).

The following general conclusion may be drawn from the investigations on Crepis by Babcock and Stebbins (1938):

1) Natural range of auto-polyploids is limited to the same area as the diploid types from which those auto-polyploids have been derived. In general, diploid plants occupy a little larger area than auto-polyploids.
2) Allo-polyploids are distributed over a much larger area compared to diploids and auto-polyploids as a result of having different genomes, and they maintain their dominancy by parthenogenesis.

From his studies of Orchis in Denmark, Hagerup (1938) concluded that polyploid species have:

1) a larger area of distribution
2) a bigger population
3) are hardy to drought, high humidity, and low temperature.

Shimotamai (1947) made a large scale study of the relationships between polyploidy (n = 9, 18, 27, 36, 45) and distribution of the genus Chrysanthemum. The conclusions may be summarized as follows:

1) The statistical analysis of the chromosomal data of the plants on poor sites compared with those on average sites show a comparatively large number of polyploid individuals.
2) Diploid species, which are considered to be original forms from which some polyploid individuals have been derived, normally occupy the

plains while polyploids are restricted to the mountains and sea-coast regions; in some cases, however, these relationships are reversed.

Tischler (1937, 1955) checked the chromosome numbers of the plants of Sicily. Chromosome numbers of 689 of the 2,345 angiosperm species growing on the island were counted, of these 216 or 31.3 per cent were polyploids. In contrast, chromosome numbers of 192 angiosperm species in Iceland were determined, of which 54.5 per cent were polyploids, a much higher percentage than those of the flora of Sicily in the Mediterranean. Also in the Faeroes (62° N.) , of 162 of the 267 species of angiosperms studied, 49.4 per cent were polyploids.

Loeve (1948) gave data on chromosome numbers of angiosperms showing that in Iceland, 65.8 per cent are polyploids, among which 90 per cent of the monocotyledons are polyploids and 60.3 per cent of the dicotyledons are polyploids; 58 per cent of all the flora of Norway, and about 74 per cent of that of Spitzbergen are polyploids.

The family Gramineae shows another characteristic distribution in the southern United State (Church 1941) : the hexaploid type of *Andropogon saccharum* (2n = 60) occupies rather dry sites in Louisiana, Missouri and Colorado where environmental conditions are most favorable for this species, while the 12-ploid type of this species (2n = 120) is found on the less favorable humid soils along the coast region of Texas and Mexico.

According to Standt (1951), *Fragaria* species are widely distributed over the Northern Hemisphere, although chromosome numbers of the ranges are quite characteristic:

	Asia	Europe	North America	South America
2x-type	X	X	X	-
4x-type	X	-	-	-
6x-type	-	X	-	-
8x-type	-	-	X	X

Original diploid forms are found in Asia, Europe and North America; tetraploids occur only in Asia; hexaploids only in Europe; and octaploids are found only in both North and South America.

All the bamboo species are polyploid (Darlington, 1955) and no diploid forms have ever been found. Among bamboo genera (x = 12), tetraploids are widespread throughout southern Asia northward to Japan, but hexaploids occur only in certain tropical countries of Asia, e.g. Java and India while there are almost none in Japan since it is beyond the northern limit of these genera.

According to Stern (1949), 14-ploid forms of Primula (x = 9) species are widespread in arctic zones. The original diploid forms cover a wide area over the Old World. In contrast, populations having a basic number of eight are concentrated in limited areas of western China.

Studies on desert plants also show some characteristic features of polyploidy. In the Sahara, Hagerup (1932) has shown that in the vicinity of Timbuktu, eight species out of 29 (14 families, 29 genera) were polyploid, two of these were octaploid. Among these plants, Fragrostis of the Gramineae shows a characteristic adaptations to various sites. The species encountered in the area were:

Fragrostis cambessedian	(n : 10)	diploid
F. albida	(n : 20)	tetraploid
F. pallescens	(n : 40)	octaploid

Diploid populations were found at the edge of poinds while tetraploids were at the foot of sand dunes where the moisture content of the soil was suitable. Octaploids were found only on sand dunes where there was almost no soil moisture present. Soil temperatures of 80° C. were attained on the sand dunes.

Tischler (1937) noticed that 95 per cent of the humid area flora of Hasseldorf, Germany were polyploids in the area where lime water along Elbe River seems to be disadvantageous to plant growth. He also reported that the flora growing in peat deposits on the humid plains included 79 per cent polyploid species.

On Hallingen - small islands in the North Sea - Tischler (1934, 1937) found that 52 species out of 80 or approximately 65 per cent were polyploid. However, in Schleswig-Holstein on the mainland which is located close to Hallingen, polyploidy occurs in 45 per cent of the species, and in 100 per cent of those on sand dunes.

Chapter 2. DESCRIPTION OF THE STUDY AREAS

A. Iron Mountain, Oregon

1) Location and topography [1/]

Iron Mountain is located in the Rogue River Range of Oregon, 15 miles east of the Pacific Ocean and 10 miles north of the Rogue River. It is the highest peak in the area, reaching an elevation of 4,000 feet. The latitude is about 43° N.

The steep terrain of the north slope is bordered by canyons, other gentle slopes are interrupted by creeks and rivers. The topography of this region is broken and rugged, due to excessive dissection and the nature of formations which are apparently old and heavily metamorphosed. The whole pattern is a maze of ridges and valleys giving it a very confusing topographic picture.

2) Climate and growing season [2/]

Iron Mountain is located in a region which has a marine climate, a relatively high winter precipitation in the form of rain and snow, a high summer temperature, fairly moderate winter temperature, low summer precipitation, and a long growing season.

The nearest weather stations are located at Port Orford and Gold Beach on the Pacific Ocean. There were no weather records available for Iron Mountain. The prevailing winds are westerly, blowing from the ocean. The annual precipitation of the area is approximately 70 inches, but may

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1/, 2/ : Baker, W.H., 1956

be higher on Iron Mountain because of the higher elevation. Most of it occurs from October to May. The summer precipitation during the three months of June, July and August averages three inches.

The growing season is comparatively long, ranging from 238 days at Gold Beach to 286 at Port Orford. It is estimated (John, 1937) that Iron Mountain has a growing season from 160 to 180 days.

The snowfall during the winter months is usually quite heavy with the result that some years deep drifts are present until the middle of June.

B. Southeastern Washington

1) Location and topography 3/

This plot includes the counties of Spokane, Whitman, Asotin, Garfield, and Columbia and a part of Walla Walla County in Washington, and a strip about 15 miles wide in the adjacent areas of Idaho.

The area is one of intermontane plateaus and low mountains. They are mostly made up by old crystalline metamorphic rocks, granite, or quartzite.

The plateau is deeply trenched by the major streams. Most spectacular of all is the canyon of the Snake River, which is cut to a depth from 1,000 to 3,000 feet, and at Granite Point exposes the underlying granite rocks.

The elevation varies from 523 feet at Perry to 6,370 feet at Table Rock in the Blue Mountains. The southernmost parts are the Blue Mount-

3/ : St John, H. S.

ains., a great dome of basalt, with its highest peak, the Table Peak, in Washington reaching an elevation of 6,370 feet. From the Snake River to the west is a lower narrow basaltic ridge, the Craig Mountains. Northward along the Idaho is a series of low, wooded mountains, culminating in Moscow Mountain 5,000 feet high, Mica Peak 5,250 feet high, Rathdrum Peak 4,970 feet high, and Mt. Spokane 5,208 feet high. Outlying peaks to the east of the Snake River are Kamiak Butte 3,650 feet, and Steptone Butte 3,614 feet in height.

The southern limit of this region is the Oregon border located at 46° N., the northern limit is approximately 48° N.

2) Climate and growing season 4/

The climate is rather severe and of the continental type. The precipitation increases from the low regions near the Snake River to the higher areas in the northeast and south. At Hooper, the annual rainfall is 13 inches, as it is at Lewiston. At Dayton, it is 24 inches, at Pullman 22 inches, and doubtless it is much higher on the forested mountain peaks to the south and east.

A distinct dry season prevails in the summer, most of the precipitation coming during the remainder of the year. The winter is cold and the summer hot. The extremes are for Pullman a minimum of -18° F., a maximum of 104° F.

The growing season of southeastern Washington is much shorter than the coast region of the same latitude in Washington and Oregon. It may be estimated at 120 to 150 days in the Upper Sonoran zone of the lowest

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4/ : St John H. S.

level, shortening to less than 120 days in the higher elevations and dropping below 90 days on the Hudsonian zones of the peaks.

C. Yellowstone National Park

1) Location and topography 5/

The Yellowstone National Park lies in the extreme northwest corner of Wyoming with a narrow strip two miles wide on the north and northwest in Montana and in the west in Idaho. The park is 62 miles in length from north to south and is 54 miles in breadth and comprises an area of about 3,350 square miles.

The plateaus are dissected by deep canyons, lakes and poinds. The central and southern portion of the park is, for the most part, with the exception of the isolated Red Mountain Range in the extreme south, a high rolling, heavily timbered country, mainly plateau-shaped ranging from 7,500 to 10,000 feet in altitude, the latter height being reached only on the volcanic plateau in the extreme southeast. In the northwest rises the Gallatin Range which culminates in Electric Park, 11,000 feet above sea level.

The rugged volcanic peaks of the Abseroka or Yellowstone Range are located on the eastern border reaching elevations of 10,000 feet on the southeast. The continental divide crosses the Park. Along the divide the mountains are heavily timbered. It has an elevation of 8,000 feet.

2) Climate and growing season 6/

Yellowstone National Park, like most mountain regions, where

5/ : McDougal, W.E.
Bevan, A.

6/ : Harrington, H. D. 1954
The U.S.A. (Compton, Chicago.)

terrestrial radiation is great shows extremes of diurnal temperature during the summer months, however, the day temperature is low, generally not above 75° F. Frequent summer frosts are a characteristic feature. This coolness of climate in conjunction with a high comparative humidity, accounts in part for the fact that this area of the Rocky Mountains is densely timbered.

The growing season over the main area of the park is from early May to late August or early September or approximately 90 to 120 days.

D. Colorado

1) Location and topography 7/

The biggest plot of this study is the state of Colorado which covers an area of 104,247 square miles. Its topography is quite variable ranging from semi-desert to plains and steep mountains. Some peaks are higher than 14,000 feet. Approximately two-fifths of Colorado is level and rolling plains, while the western three-fifths is a mixture of mountains, high mesas, narrow valleys, and large upland areas. The San Inis Valley, in the south-central portion of the state, is an extensive level basin once covered by an inland sea.

The elevation in Colorado varies from 3,286 feet at the lowest point in the southeastern plains to 14,431 feet at the top of Mt. Elbert in the Rockies.

In north-central Colorado, mountains and plateaus occupy an area 5,500 to 7,000 feet high, while in the southern and western parts

7/ : Harrington, H.D. 1954
: The U.S.A. (Compton, Chicago)

elevations range up to 8,500 feet above sea level. In this paper, the state is divided into two elevational zones:

1) Lower zone : below 8,500 feet
2) Upper zone : above 8,500 feet. This zone may be classified as the upper-transition timbered and the Canadian zones.

2) Climate and growing season. 8/

Mean temperature and precipitation within the state differ greatly, comparable to the climatic differences between southern Florida and Greenland. Annual precipitation varies from less than eight inches in the low western valleys to more than 40 inches in the higher mountains.

The growing season shrinks from 120 days in the lower areas to a few days at the high elevations. It averages about 90 days at 7,000 to 8,000 feet and seldom reaches five months even at 5,000 feet. The climate is typically continental.

The upper zone as classified in this paper has a growing season of 90 days or less. Precipitation and relative humidity are rather high in the eastern part.

E. Mount Diablo, California 9/

1) Location and topography

Mt. Diablo is an isolated peak of the Central Coast Range located thirty miles east-northeast of San Francisco at latitude 37°53'. The main peak rises to a height of 3,849 feet; the summit is 3,749 above the floor of Ygnacis Valley.

The central mass, which is roughly circular and four to five miles

8/: See 7 9/ : Bowerman, M. L. 1944
The U.S.A. (Compton, Chicago), 1956

in diameter, is composed of Franciscan rocks of the Jurassic period. The central mass is surrounded by rocks of Cretaceous age. Carry Canyon is eroded in soft Cretaceous shales.

2) Climate and growing season[10/]

Mt. Diablo has a cool summer mediterranean type climate (Russel, 1926). This climate is characterized by the average temperature of its coolest month being 32°F., and reaching sometimes 66.4°F., and the average temperature of its warmest month being below 71°F. When the mean annual temperature approximates 55°F., the precipitation is 14 inches or more.

The precipitation varies with altitude :

Year of record	Elevation:	Lathrop 15 ft	Diablo 500 ft	Summit Mt. Diablo 3,847 ft
1917-1939		10.38 in.	17.54 in.	(No record)
1932-1939		11.03 in.	19.48 in.	22.32 in.

The growing season at Mt. Diablo which lasts more than 240 days, is the longest of the five plots.

10/ : Bowerman, M. L. 1944
The U.S.A. (Compton, Chicago), 1956

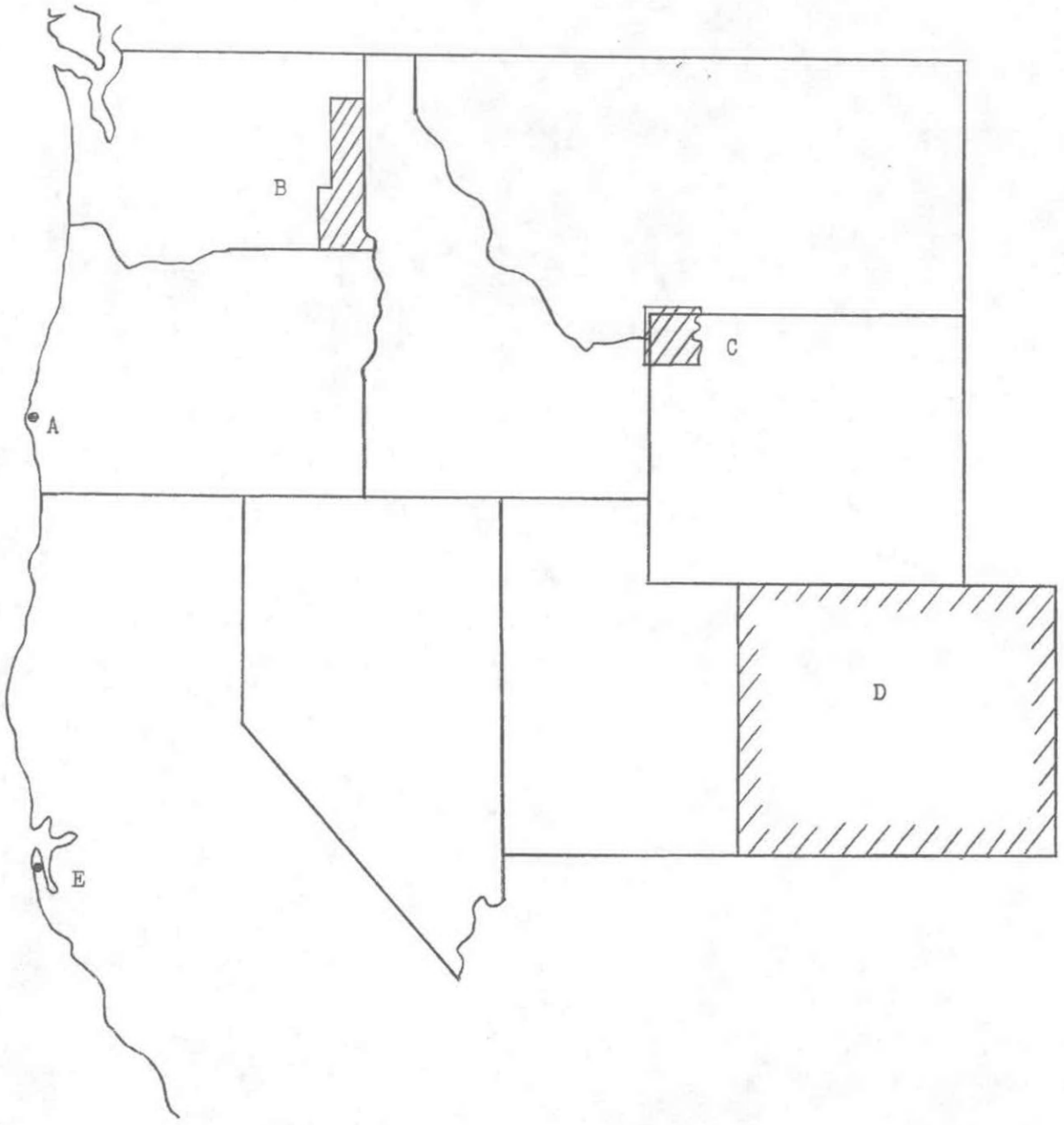

Fig. 1. Location of the study area. A: Iron Mountain, Oregon; B: Southeastern Washington; C: Yellowstone National Park; D: Colorado; E: Mt. Diablo, California

Chapter 3. BRIEF DESCRIPTION OF THE VEGETATION TYPES AND LIFE ZONES

Forest types of the United States were first classified by Gray (1878): "We have two forest regions in North America - an Atlantic and Pacific, intersected by a traverse belt of arid and alkaline plateau, or eastward of grassy plain - a hundred miles wide from north to south - through which passes the Union Pacific Railroad. This divides the Rocky Mountain forest into southern and northern portions. The Pacific forest is made of conifers," and so on.

Later divisions were made by many foresters and botanists in the early Twentieth Century among whom were : Graves (1899), Zon (1906), Dana (1913), Munger (1913), Woodward (1913), Moore (1913), Greeley (1913), Pearson (1913), Rockwell (1913), Mason (1913), Tillotson (1913), Zon (1913).

They laid the foundations of classification of North American forest types.

In addition to these authors, many other different classifications have been made of the vegetation types of North America. The following two by Merriam and by Clements show the characteristics of the zones considered in this paper.

1. Typical Vegetation of Merriam's Zones in the Western United States 11/

Zones	Typical Vegetation
Lower Sonoran	Desert
Upper Sonoran	Sagebrush (Wyo., Colo., Utah, Nev.) Pinyon pine (Colo.,Utah, Nev., N.M., Ariz.) Desert junipers (Colo., Utah, Nev., Ariz., N.M.) Blue oak, valley oak, evergreen white oak, chaparral Digger pine (Calif.)
Transition Arid	Ponderosa pine (throughout the zone) Rocky Mountain juniper (Mont., Wyo.) Rocky Mountain white oak (Utah) Douglas fir (throughout the Rocky Mountains) White fir, incense cedar, sugar pine (Calif.)
Transition Humid	Douglas fir, western red cedar, western hemlock (Ore., Wash.) Redwood (Calif.)
Canadian	Western white pine, silver fir (Ore., Wash., Ida.) Engelmann spruce (Wyo., Colo., N.M., Mont., Ida.) Aspen, Douglas fir (throughout the Rocky Mountains) Sitka spruce (Ore., Wash., Calif.) Lodgepole pine (throughout the zone) California red fir, Jefferey pine, western white pine (Calif.) Blue spruce (Colo., Wyo., Utah) White fir (Colo., Utah)
Hudsonian	Alpine fir, whitebark pine (throughout the zone) Alpine larch (Ida., Mont.) Engelmann spruce (Colo., Utah, N.M.) Bristlecone spruce (Colo., N.M.) Alaska cedar, mountain hemlock (Oreg., Wash., Calif.) Western juniper (Calif.)
Arctic alpine	Above timberline vegetation.

11/ Merriam, C.H.

2. Clements' Classification of the Climax Types of North America[12/]

Woodland: Pinus - Juniperus Formation
1) Pinion - juniper woodland: Pinus - Juniperus Association
2) Oak - juniper woodland: Quercus - Juniperus Association
3) Pine - oak woodland: Pinus - Quercus Association

Montane Forest: Pinus - Pseudotsuga Formation
1) Petran Montane Forest: Pinus - Pseudotsuga Association
2) Sierran Montane Forest: Pinus - Abies Association

Coast Forest: Tsuga Formation
1) Cedar - hemlock Forest: Thuja - Tsuga Association
Douglas fir subclimax: Pseudotsuga consocies
2) Larch - pine Forest: Larix - Pinus Association

Subalpine Forest: Picea - Abies Formation
1) Petran subalpine Forest: Picea - Abies Association
Lodgepole subclimax: Pinus consocies
2) Sierran subalpine Forest: Pinus - Tsuga Association

Boreal Forest: Picea - Larix Formation
1) Spruce - Larch Forest: Picea - Larix Association
Birch - aspen subclimax: Betula - Populus consocies

Lake Forest: Pinus - Tsuga Formation
1) Pine - hemlock Forest: Abies - Tsuga Association
Jack pine subclimax: Pinus consocies

Deciduous Forest: Quercus - Fagus Formation
1) Maple - beech Forest: Acer - Fagus Association
2) Oak - chestnut Forest: Quercus - Castanea Association
3) Oak - hickory Forest: Quercus - Hickoria Association
Pine subclimax: Pinus consocies

12/ : Clement, F.F.

In this study, life zones and vegetation types can also be recognized as follows :

A. Iron Mountain, Oregon[13/]

The plants of the area are made up for the most part of species coming from two different floral provinces, the Alaskan or northern element which extends southward along the chain of coastal mountains, and the Californian or southern element which extends northward from California. Another small but interesting segment of the flora is made up of the narrow endemics which consist of a moderately high percentage of the plants in this region.

The northern element includes many species that are common on Iron Mountain and grow principally northward to Alaska. Nine species reach their southern limit in this region or at least are not known to occur beyond northern California at the present time. These species are: Erythronium oregonum, Montia flagellaria, Angelica arguta, Ligusticum spifolium, Pyrola bracteata, Hypopitys lanuginosa, Caultheria ovatifolia, Trientalis arctica, and Phlox diffusa var. longistylis.

The southern element is by far the most important and largest element in the flora of Iron Mountain. The parts of this element are more widely distributed to the south of the area and appear to be predominantly of Californian region. The Rogue River, situated 10 miles south of the region, forms an effective barrier to the plants of the southern element.

B. Southeastern Washington[14/]

13/ : Baker, W.H. 1956
14/ : St. John, H.S. 1937

1) The Upper Sonoran Zone is arid. The vegetation is sparse and mainly shrubby. The dominant species and indicator plants of this area are:

Artemisia rigida, Opuntia polyacantha, Chrysothamnus nauseosus, Chaenactis douglasii, Penstemon triphyllus, Rumex venosus, and Sphaeralcea munroana.

2) The Arid Transition Timbered Zone is the zone of grass lands or prairies, locally known as the "Bunch Grass Prairies". They are nearly treeless, except for the thickets along streams.

3) The Arid Transition Timbered Zone is the zone of the open ponderosa pine forests. Indicator species are : Pinus ponderosa, Ceanothus sanguineus, Vaccinium membranaceum, and Physocarpus malvaceus.

4) The Canadian Zone is the zone of moist dense forest on the middle slopes of the mountains. Indicator plants are: Abies grandis, Larix occidentalis, Picea engelmannii, Thuja plicata, Menziesia ferruginea, Pachystima myrsinites, and Cornus canadensis.

5) The Hudsonian Zone is the highest zone in which trees grow in the mountains. It is not well developed in this area, but is recognizable on the peaks of the highest mountains. Indicator species are: Abies lasiocarpa, Phyllodoce empetriformis, Senecio triangularis, and Valeriana sitchensis.

C. Yellowstone National Park [15/]

1) Sagebrush Desert Type. This type occupies the great central plateau of the park at elevations between 7,000 to 8,500 feet but small parts of the northern end extend somewhat below 6,000 feet. Between Mammoth and

15/ McDougall, W.B., and H.A. Baggley, 1936

and the North Entrance of the park, two other typical desert plants Sarcobatus vermiculatus and Opuntia polyacantha are found with the sage-brush. The climate of the park, however, is not a typical desert climate, therefore these deserts may be very slowly and gradually being replaced by forests.

2) Lodgepole Pine Type. This is the most extensive type of the plant community in the park covering nearly three-fourths of its area, mostly between 7,000 to 8,000 feet altitude. Lodgepole pine trees often grow in very dense stands, but they seem to be adapted to a shallow soil. The fire hazard in this forest is very great during the dry season. If fire is kept out of the area, the type would be eventually replaced by spruce and Douglas fir.

3) Douglas-fir Type. This type of forest occurs below 7,000 feet and is very limited in the park.

4) Aspen Type. The aspen is the only common broad-leaved tree in the park. Aspen forests are scattered over the whole are but are usually restricted to valley bottoms and river banks.

5) Spruce - Fir Type. Where the sites are more favorable for Engelmann spruce and alpine fir, these species have already replaced lodgepole pine, especially in higher elevations, because the spruce-fir forest extends to timberline.

6) Alpine and Subalpine Meadow Type. This zone is characterized by grasses, sedges and many different flowers. The timberline in the park likes at approximately 10,000 feet. The alpine meadows are located above timberline, while the subalpine meadows are those below timberline. The

chief difference in the vegetation of the two meadow types is due to the dwarf condition of all alpine plants.

D. Colorado[16/]

Because of the extreme topographic relief of Colorado, vegetation zones are sharply delimited and easily recognized. The eastern plains are characterized in general by short grasses, but are interrupted by extensive sand hills in which Artemisia filifolia is dominant. The foothills at the western edge of the plains support a shrubby mixture, predominantly Cercocarpus montanus. Coniferous forests occur generally between 6,500 to 11,000 feet. Above timberline, bluegrass, sedges, and various depauperate willows give aspect to the alpine flora. Between the lowest elevations and the tops, the following plant communities can be observed:

(1) Plain Area: Mixed prairies
Sand sagebrush

(2) Semi-desert Area: Elevation below 7,000 feet, mostly in western Colorado
Greasewood
Saltbush
Sagebrush

(3) Mountain and Plateau Area: 5,500 - 7,000 feet in the south-central area up to 8,500 feet in the southern and western parts.

a) Pinion-juniper
Quercus gambelli in upper edge.
b) Mountain shrub (Quercus-Cercovarpus-Amelanchier.)
Quercus gambelli, Prunus virginiana var., Crataegus spp. Rhus triloba, Rosa woodsii.
c) Ponderosa pine - Douglas fir.
6,000 ft. to 8,500 ft., and to 9,500 ft. in San Luis Valley.
d) Spruce-fir
This is the broad zone of coniferous forest that extends from the ponderose pine - Douglas fir forest to the upper timber limit.

16/ Harrington, H.D. 1954

Coniferous species which extend to above 8,500 feet (upper zone) are:

Species	Elevation (ft.)
Abies concolor	7,500 - 10,000
A. lasiocarpa	8,500 - 12,000
Juniperus utahensis	4,000 - 9,000
Picea engelmannii	8,500 - 12,000
P. pungens	7,000 - 9,500
Pinus aristata	7,000 - 13,000
P. contorta and two varieties	6,000 - 11,000
P. edulis	4,000 - 9,000
P. flexilis	5,000 - 11,000
P. ponderosa	5,000 - 9,000

E. Mount Diablo, California [17/]

Mount Diablo belongs to the Upper Sonoran Zone. Of the twenty-nine herbaceous index species listed by Jepson (1925), twenty-six might be expected to be present on Mount Diablo, of these twenty-three were actually found. The question may be raised as to whether the summit of the mountain should be included in the Transition life zone. The conifers which are typical to the Transition life zone are absent among the summit plants.

Grinnel (1935) has suggested that the summit area should be classified as in the upper Sonoran life zone. He subdivided the plant communities as follows:

(1) Quercus chrysolepis Association
(2) Q. agrifolia - Aesculus Association
(3) Q. douglasii - Pinus sabiniana Association
(4) Pinus coulteri Association
(5) Alnus - Platanus Association
(6) Stipa - Sitanion Association
(7) Adenostema - Arctostaphylos Association
(8) Quercus durata - Arctophylos Association
(9) Q. (frutex) - Cerocarpus Association

17/Bowerman, M.L. 1944

Chapter 4. METHOD AND RESULTS

Chromosome numbers of plants occuring at 1) Iron Mountain, Oregon, 2) Southeastern Washington, 3) Yellowstone National Park in Wyoming, 4) Colorado, and 5) Mount Diablo, California have been listed from the literature. For the reasons discussed in Cahpter one, [18] only angiosperm species are considered in this paper

There is some doubt as to the correctness of these chromosome lists. It is known that the chromosome numbers of each individual plant may not be representative of the whole population of one species. Several investigations have given different chromosome numbers for a single species. Even though the chromosome number of a certain species has been ascertained, it is not certain that the same species growing in another location under different climatic, topographic, and soil conditions, or within a different plant community, has the same chromosome number or not. Future counts may solve this problem.

Since chromosome numbers of the entire flora of a given plot can not be drawn from field survey, approximate quantities may be obtained by checking the literature.

These chromosome lists may not show the exact chromosome numbers of the plants, but if the same method is applied to each flora, the data obtained permits some comparison of genetical and ecological characteristics of different floras. This is the reason why both Tischler and the present author employed this method instead of field or microscopic

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[18] : See p. 5-6

observation.

Some genera are difficult to study by this method. As mentioned before, the chromosome numbers of the United States of which no former studies of this type are reported could not be assumed.

In particular among the monocotyledons, there are many genera which have aneuploidy, in fact, have both aneuploidy and euploidy. Furthermore, a single species in certain genera may have various basic numbers. Numerous discussions of this problem from both the cytogenetical and evolutional points of view have been reviewed. In this paper, aneuploids, which can be considered to have been derived from polyploids having comparatively large chromosome numbers, are listed as polyploids.

Carex is a very complicated genus because of its genetical structure and it is difficult to treat in this study. This genus has numerous species, varieties and subspecies including many aneuploids. For this reason taxonomic classifications differ with the individual taxonomist's viewpoint of the problem. Ninety per cent of the Carex species of Japan are polyploids with polyploidy increasing gradually with latitude from south to north; however, fewer data for this genus in the United States were obtained.

Polyploid frequency and percentage can be expressed by the formula (Darlington 1951, Haskel 1952):

$$\text{Polyploid frequency} = \frac{p + p'}{(p + p') + (d + d')}$$

Polyploid degree in percent = (Polyploid frequency) X 100

p = number of polyploid species
p' = number of species which give both polyploid and diploid numbers.
d = number of diploid species
d' = p'

Table. Polyploidy and diploidy percent of the eight plots, subdivided by life zones.

Dicotyledons

Regions		Number of species, chromosome numbers decided	Number of diploid species	Diploid %	Number of polyploid species	Polyploid %
Iron Mountain Oregon (42°N.)	(A)	70	46	66.2	24	33.8
Southeastern Washington All zones (46-48°N.)	(B)	190	181	61.6	113	34.4
Transition timbered and Canadian zones	(B")	78	49	58.3	35	41.7
Transition timberless and Sonoran zones	(B')	168	132	62.9	78	37.1
Yellowstone National Park, Wyoming (44-45°N.)	(C)	112	55	43.0	73	57.0
Colorado All zones (37-41°N.)	(D)	417	262	56.6	220	43.4
Upper zone Above 8,500 feet	(D')	169	96	53.3	84	46.7
Mt. Diablo, California (38°N.)	(E)	171	121	67.6	58	32.4

Table. Polyploidy and Diploidy Percent of the Five Plots.

Monocotyledons

Regions		Number of Species, chromosome Numbers decided	Number of Diploid Species	Diploid %	Number of Polyploid Species	Polyploid %
Iron Mountain Oregon	(a)	38	19	47.5	21	52.5
Southeast Washington	(b)	150	45	36.6	78	63.4
Yellowstone National Park	(c)	87	31	31.0	69	69.0
Colorado	(d)	224	101	36.7	174	63.3
Mt.Diablo California	(e)	61	29	42.0	40	58.0

Table. Percent of Polyploids in Europe (Tischler, 1955)

Region	Dicots	Monocots	Angiosperms
Cyclades	32.4	53.2	37.0
Rumania	42.4	62.4	46.8
Hungary	44.6	62.4	48.5
Central Europe	47.3	64.2	50.9
Schleswig-Holstein	48.1	72.4	54.5
Sweden	49.3	72.7	56.9
Northern Europe	51.1	78.0	59.2
British Isles	47.9	68.5	53.3
Faeroes	59.3	83.5	68.3
Iceland	56.8	86.0	65.9
Southwest Greenland	60.9	87.5	71.0
Spitzbergen	65.0	97.6	76.2

Table. Polyploidy-degree in percent in Japan. (Funabiki,1958)

Region	Polyploid %		Average (2n)		Latitude
	Dicots	Monocots	Dicots	Monocots	°N
Sakhalin	40.7	79.4	33.4	46.2	50.0
Ishikari(Hokkaido Island)	33.8	88.9	34.4	43.9	43.7
Kushiro (Hokkaido Island)	38.5	74.3	-	-	43.4
Nopporo (Hokkaido Island)	36.4	68.0	-	-	43.0
Shimokita	38.5	65.9	-	-	41.3
Hakkoda	28.1	72.2	34.5	46.8	40.7
Awashima Islan (Japan Sea)	33.5	73.6	-	-	38.4
Niigata	25.4	63.1	35.3	46.9	37.5
Shimane	26.1	55.3	-	-	35.2
Kyoto	30.3	54.8	30.8	39.9	35.0
Yamaguchi	24.4	51.6	32.1	39.4	34.0
Fukuoka	25.4	63.8	-	-	33.7

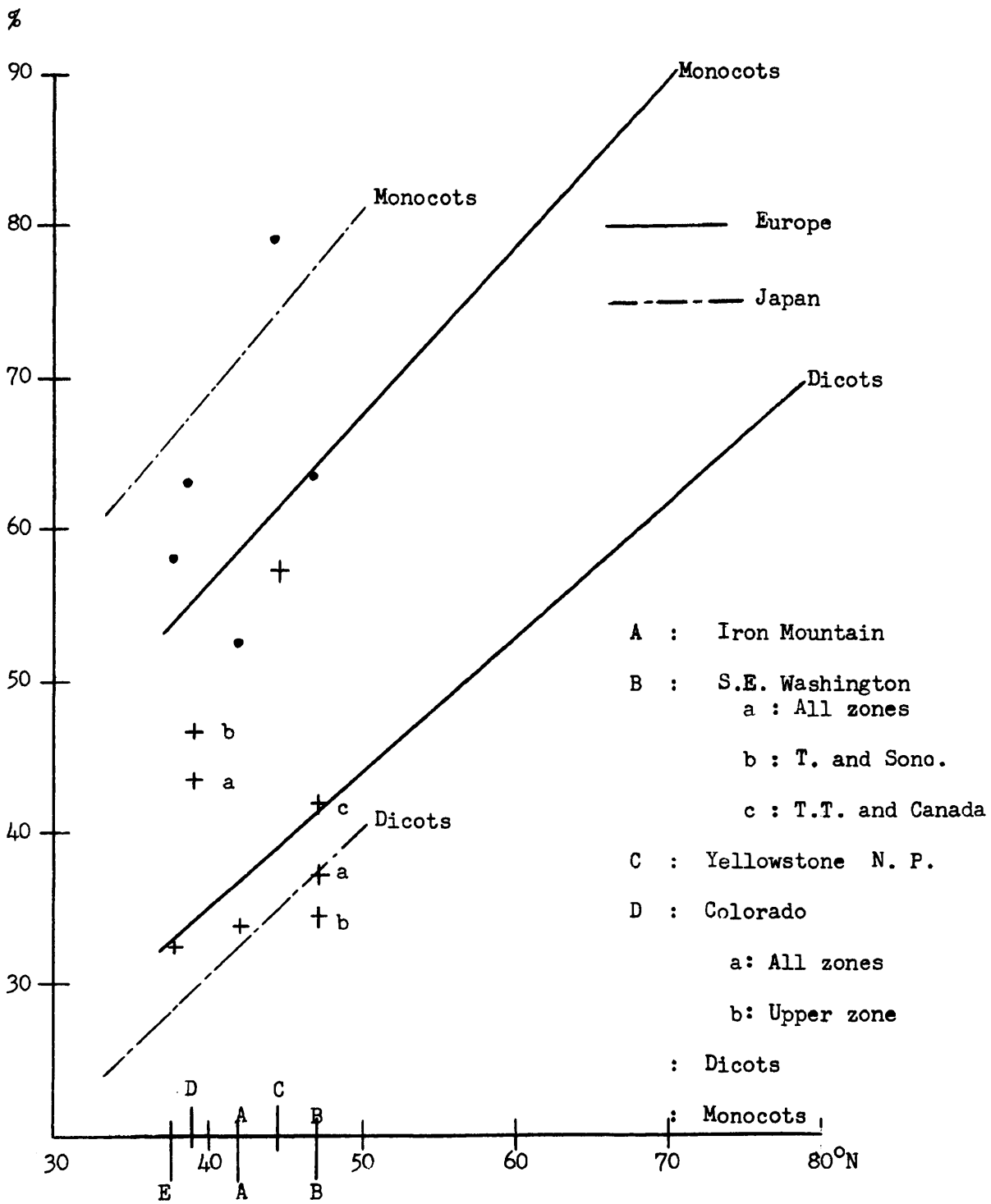

Figure 2. Representatives of the polyploidy-percent of the Western United States, compared with those of Europe and Japan.

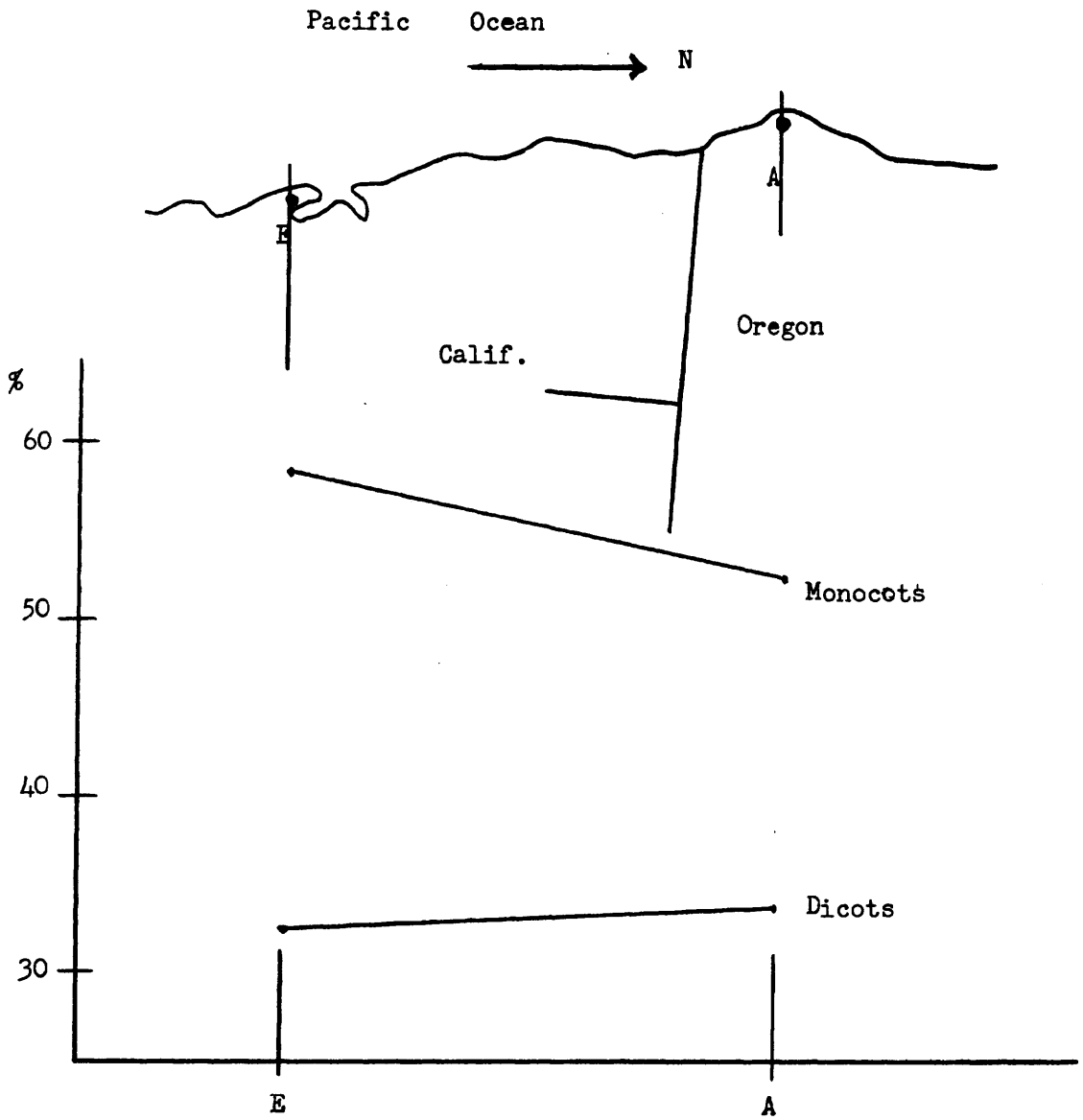

Figure 3. Representatives of the polyploidy-percent of the Pacific plots, showing the chromosomal features of the two plots.

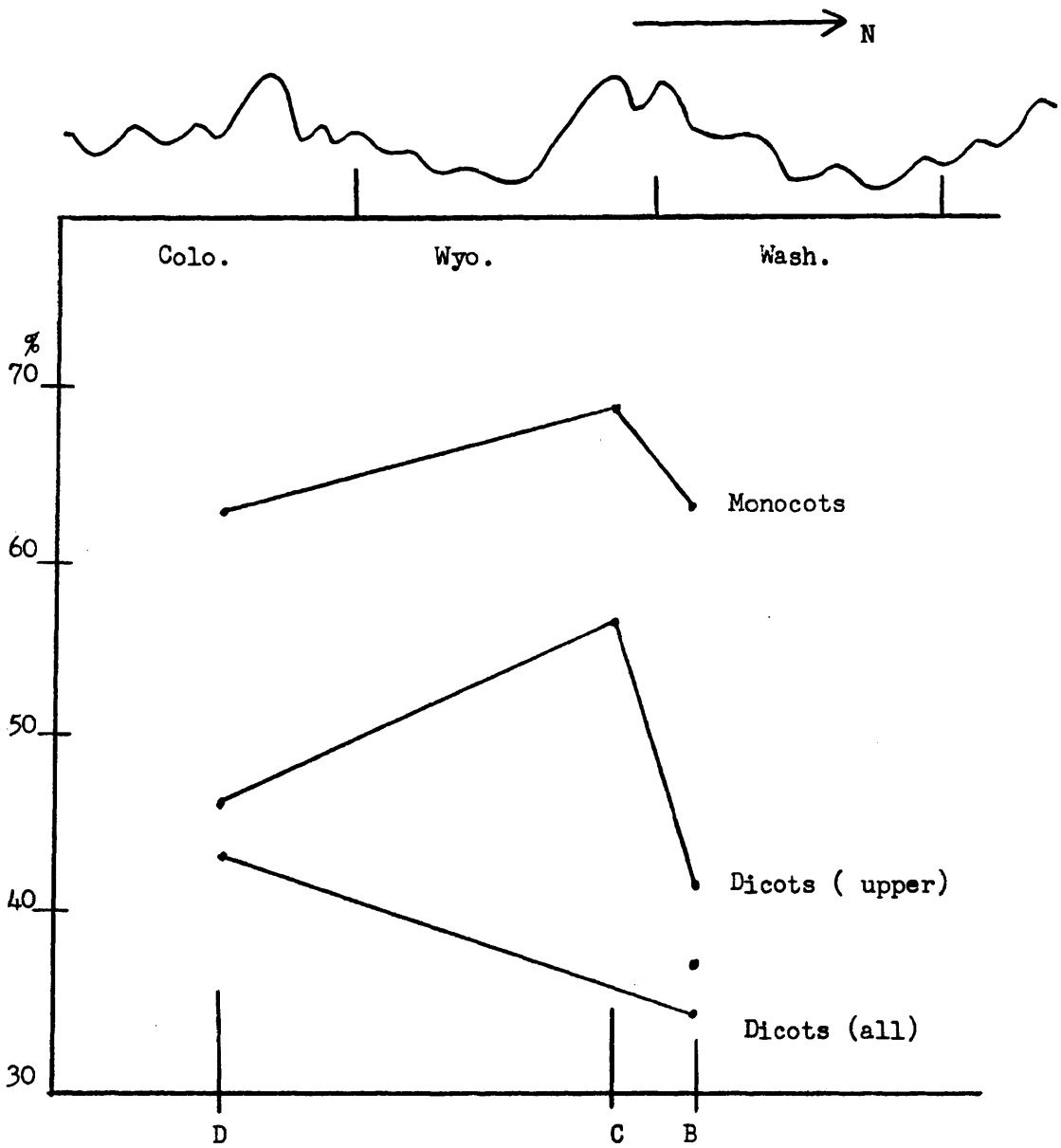

Figure 4. Representatives of the polyploidy-percent of the eastern three plots, showing the chromosomal features of these plots.

Chapter 5. DISCUSSION OF RESULTS

1. Mount Diablo, California - Iron Mountain, Oregon

Chromosome features of the vegetation do not vary remarkably between these two areas in the Pacific Coast Range. The degree of polyploidy of the dicotyledons increases slightly with the latitude, and that of the monocotyledons decreases a few per cent.

In these two areas, the life zones vary from upper Sonoran, which lacks coniferous species, to Transition and Canadian zones. The annual precipitation of Mt. Diablo is only 11 inches at 15 feet above sea level, 18 to 19 inches at 500 feet, and about 22 inches at the summit of Mt. Diablo, which is 3,849 feet high, while it reaches more than 70 inches at Iron Mountain, in Oregon.

In both areas, the growing seasons are 160 to 180 days in length, the season at Mt. Diablo may be slightly longer.

The Iron Mountain are represents the Canadian zone, the Transition Arid zone with Pinus ponderosa, P. jeffreyi and Libocedrus decurrens, and the Transition Humid zone with Pseudotsuga menziesii and Tsuga heterophylla.

The Mt. Diablo plot lacks the Transition zone having no coniferous forest. The major factor responsible for the present difference between the vegetation types of the two areas seems to be precipitation.

The degree of polyploidy of Mt. Diablo is similar to that of the same latitude in Europe, particularly on the Cyclades Islands in the Mediterranean. That of Iron Mountain is almost the same as in Japan, which

is somewhat less than that of Europe. All of these plots are islands or are in coastal areas where they are influenced by a marine climate.

2. Upper zone of Colorado - Yellowstone National Park

In the Rocky Mountains, the percentage of polyploid species increases from the mountain flora of Colorado to the flora of Yellowstone National Park. From the graph (Figure 2), it can be presumed that the mountain flora of Colorado is similar to that of southern or central Germany, 53°N., as far as the chromosomal features concern.

The yellowstone flora is of the far northern type and includes a larger amount of polyploid species. The degree of polyploidy is almost the same as that of central Scandinavia or the alpine type of Central Europe.

The percentage of polyploids among monocotyledons increases with latitude, the slope of the curve parallels that for Europe but is approximately nine percent higher.

3. Upper southeastern Washington - Yellowstone National Park

The area in southeastern Washington is only four degrees north of Yellowstone National Park area.

The upper southeastern zones, including a small part of the Hudsonian, Canadian and Transition Humid zones, do not show the northern types in their chromosomal characters. The number of polyploid species, both dicotyledons and monocotyledons, is just the same as that of Europe. The environmental conditions of these widely separated areas in North America and Europe have influenced similarly the present vegetation by repeated natural selection and adaptation by hybridization and chromosome duplica-

tion, and by colonization or introgressive hybridization of the plants.

The greatest environmental difference between these two plots is the temperature or the length of growing season.

The vegetation of Yellowstone National Park is typical alpine or boreal, while southeastern Washington has, as a whole, a typically northern temperate vegetation, and should not be included in the Northern Rocky Mountain coniferous zone, except for some limited areas.

4) Iron Mountain - Southeastern Washington

The vegetation of Iron Mountain area lacks both the upper Sonoran and Transition Timberless zones. The forests of the area show a more humid character than that of southeastern Washington. Therefore, the flora of the upper Columbia Plateau along the Snake River as a whole includes more grassland species than that of Iron Mountain. The latter is almost completely covered by forest, and receives as much as 70 inches precipitation, while in southeastern Washington the precipitation is approximately 13 to 24 inches.

The number of polyploid species varies markedly between the zones of Southeastern Washington area, though increasing from the sea coast to the inland region, and from the humid to the arid zones.

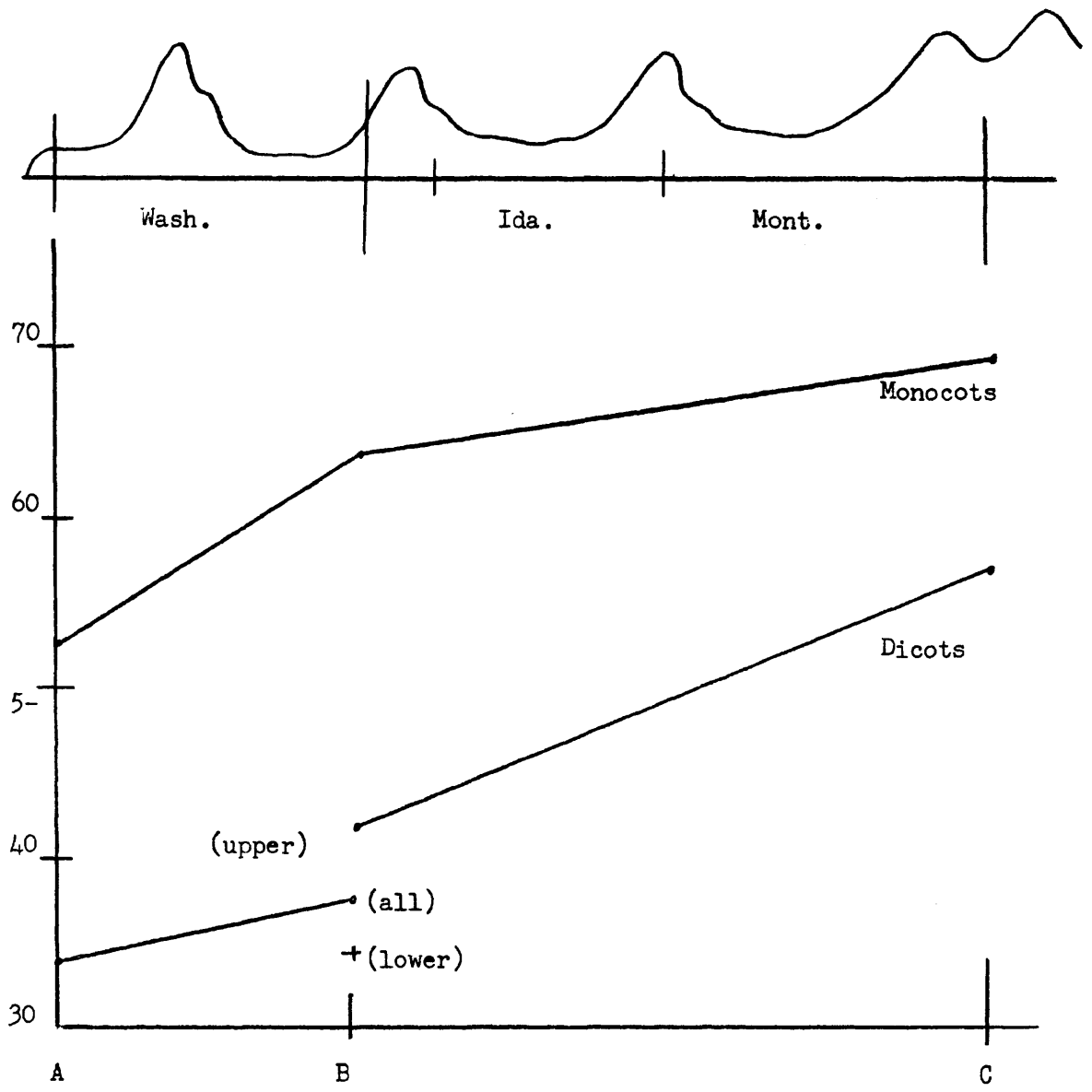

Figure 5. Representatives of the polyploidy-percent of the northern three plots, showing the variation of chromosomal features of these three floras.

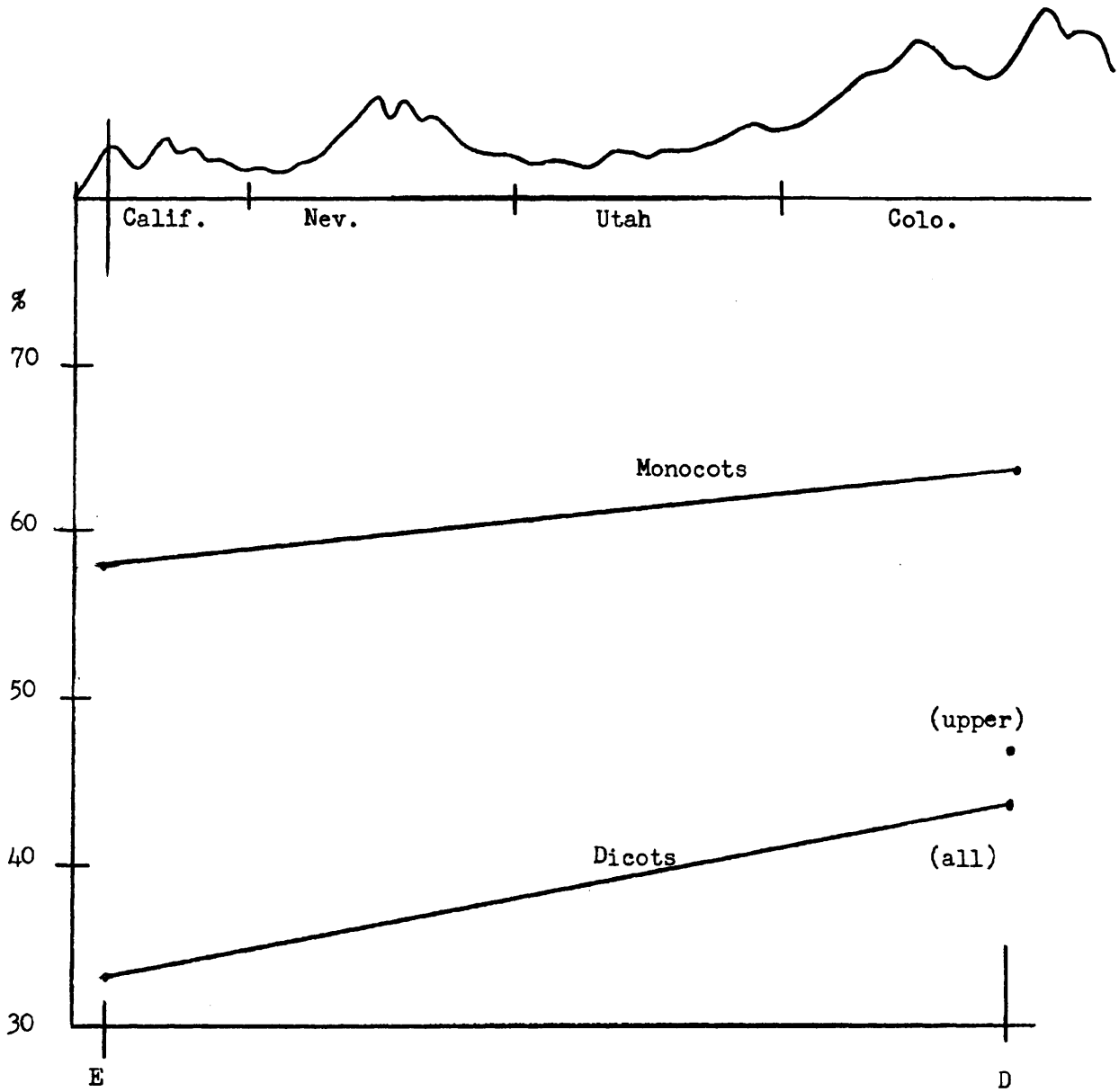

Figure 6. Representatives of the polyploidy-percent of the southern two plots, showing the variation of chromosomal features of the floras from Coastal Range to Rocky Mountain Range.

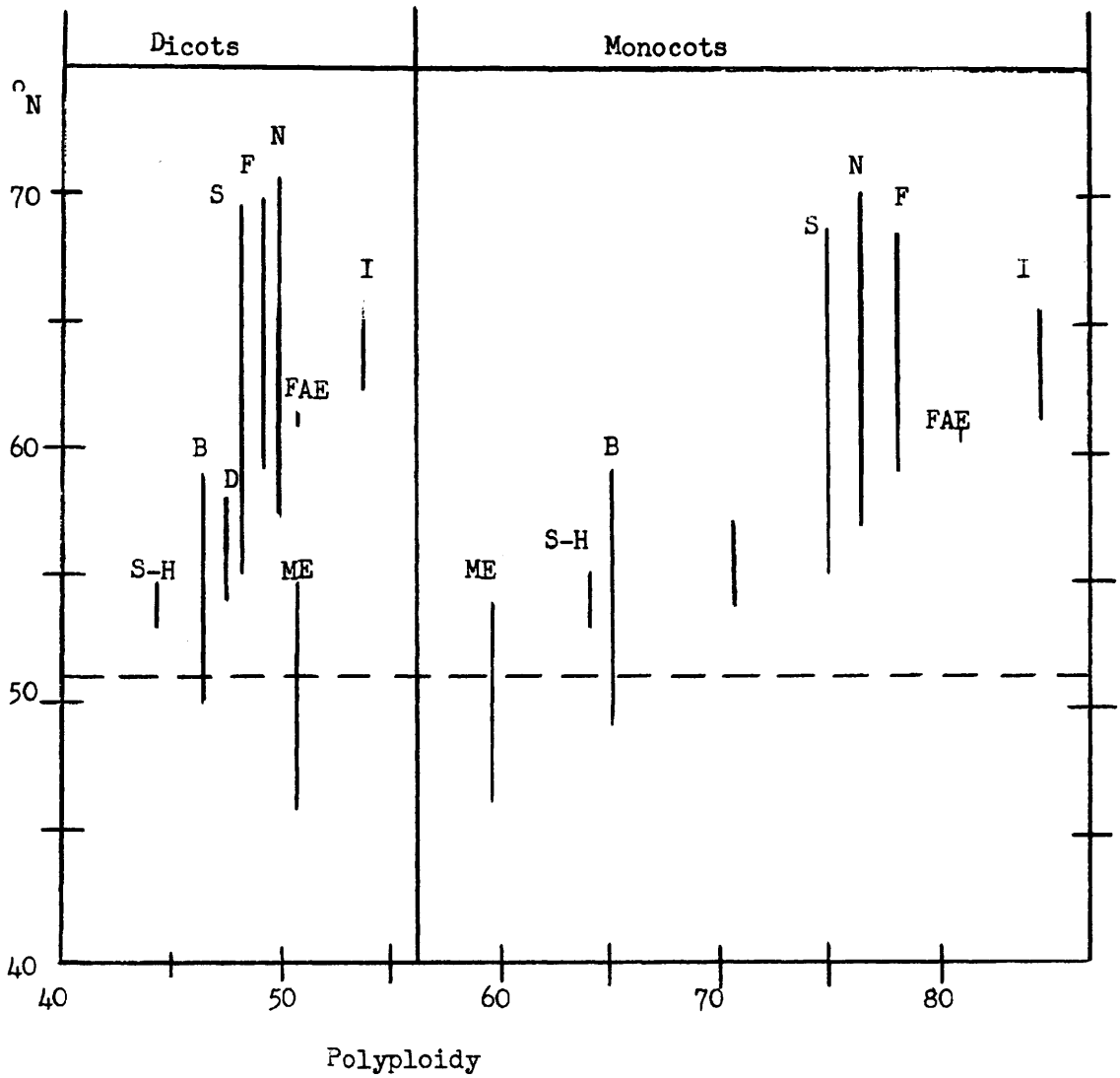

Figure 7. Relation of polyploidy frequencies of British monocots and dicots to those in other European countries, calculated from Loeve and Loeve (1943) and Tischler (1950).
B: British Isles: D: Denmark; F: Finland; FAE: Faeroes; I: Iceland; ME: Middle European Countries; N: Norway; S: Sweden: S-H: Sleswick-Holstein.

(Haskell, 1952)

Table. Typical vegetation forms of the northern three plots.

Life-zones	Iron Mountain, Oregon Pacific Coast Range) Species	S.E.Washington (Columbia Plateau) Species	Yellowstone N.P. (N.Rocky Mountains) Species
Hudsonian	Penstemon rupicola Lomatium martindalei Phleum alpinum		Picea engelmannii Pinus albicaulis Juniperus sibirica Lloydia serotina
Canadian	Pinus monticola P. contorta Juniperus communis var.montana Clintonia uniflora Xerophyllym tenax Acer glabrum	Abies lasiocarpa Phyllodoce emptriformis Senecio triangularis Valeriana sitchensis	Pinus contorta P. flexilis Juniperus scopulorum Agrostis rosae Crepis acuminata Acer glabrum
Transition Timber, humid	Pseudotsuga menziesii Tsuga heterophylla	Pseudotsuga menziesii Tsuga heterophylla	Pseudotsuga menziesii
Transition Timber, arid	Libocedrus decurrens Pinus ponderosa P. jeffereyi Chamaecyparis lawsoniana Rhododendron occidentalis Sambucus coerulea	Pinus ponderosa Ceanothus sanguineus Vaccinium membranaceum Physocarpus malvaceus	
Transition Timberless		Agropyron inerme Poa sandbergii Germanium viscosissimum Balsamorhiza sagittate Wyethia amplexicaulis	
Upper Sonoran		Artemisia rigida Opuntia polyacantha Crysothammus nauseosus Chaenactis douglasii Penstemon triphyllus Rumex venosus Sphaeralcea nunroana	

Chapter 6. CONCLUSIONS

Investigations in Europe and Japan indicate that in the Northern Hemisphere, the number of polyploid species among the angiosperms increases with latitude. This also seems to be true in the United States.

The topography of the western United States is quite variable. Climatic differences between the coastal range, plateaus and the Rocky Mountains are also pronounced.

The most important factors affecting chromosomal characteristics are temperature or the length of growing season, and precipitation.

The percentage of polyploids on Mt. Diablo is higher in comparison with that of Iron Mountain than would be expected from the polyploid hypothesis,[19] especially among the monocotyledons. This seems to be due to low precipitation.

Mountain flora of both Colorado and Yellowstone National Park have a large number of polyploid species chiefly because of the short growing season in the high altitude, furthermore these areas have been vegetated for a comparatively short time following recent glaciation; and may be more unfavorable for the diploid plants.

The flora of southeastern Washington, especially of the lower Snake

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19/ : 1) The number of polyploids increase with latitude under normal conditions. (Tischler, 1955).
2) Polyploids occupy different habitats than the related diploid species; they are tolerant of a wider range of conditions which permits them to occupy ecological habitats unsuitable to the diploids. (Stebbins, 1950)

River, shows only a small number of polyploid species, probably because of the milder climate and longer growing season.

Further collection and analysis of data is necessary to ascertain the evolutionary characteristics of the vegetation in life zones of the New World, but it can be ascertained from the data already collected that the percentage of polyploid species varies as widely from the Pacific coast to the Rocky Mountains as from the Mediterranean islands to Central Scandinavia.

SUMMARY

The percentage of polyploid species in five areas in the western United States were studied. The number of polyploid species varies markedly between these regions depending on the topography, climate, and evolutionary history of each zone.

The Pacific Coast Range flora shows the same degree of polyploidy as Mediterranean islands and Japan of the same latitude.

The vegetation of the Rocky Mountains, however, has a much higher percentage of polyploid species among dicotyledons as well as among monocotyledons, far in excess of the European vegetation at the same latitude. The alpine flora of Europe may have similar characteristics.

Some correlation was obtained between life zones and chromosomal features, however, further study collecting the evidences of these phenomenon is necessary to ascertain the hypothesis of the relation between polyploidy and distribution of plants, given by Loeve and Tischler.

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APPENDIX

CHROMOSOME LIST

PART 1. DICOTYLEDONS

Iron Mountain, Oregon: Dicotyledons

Species	Basic number (x)	Chromosome number (2n)	Polyploidy	Author*
Acer circinatum	13	26	D	Foster 1933
Alnus rubra	14	28	D	Wetzel 1929
Anaphalis margaritacea	7	28	P	Maude 1939
Angelica arguta	11	22	D(Homopl.)	Many authors
Apecynum androsaefolium	8	16	D	Shirhoff et al.1944
Aquilegia formosa	7	14	D	Skalinska 1931
Aralia californica	12	48	P	Bowden 1945
Berberis nervos	14	28	D	Bermen 1931
B. piperiana	14	28	D	" "
Brassica campestris	10	20	D	Karpechenko 1924
Camelina microcarpa	10	40	P	Manton 1932
Capsella bursa-pastoris	8	32	P	Vaarama 1943
Ceenothus velutinus var.	12	24	D	Nobs 1942
C. integcrrimus	12	24	D	" "
C. pumilus	12	24	D	" "
Chimaphila umbellata	13	c.26	D	Hagerup 1941
Chrysanthemem leucanthemem	9	36,54	P	Dowrick 1952
Chrysamphora californica	15	30	D	Bell 1949
Cirsium vulgare	17	68	P	Podbuaja 1931
Collomia heterophylla	8	16	D	Flory 1934
Cornus nuttallii	11	22	D	Dermen 1932
Descurariana pinnata	7	14,28,42	D,P	Baldwin & C. 1940
Epilobium angustifolium	9	36	P	Bicher & L. 1950
Gautheria shallon	11	88	P	Callen 1941
Heuchera micrantha	7	14	D	Skovsted 1934
Hypericum perforatum	8	32	P	Noack 1939
Hypochaeris radicata	4	8	D	Stebbins et. al. 1953
Lathyrus vestitus	7	14	D	Senn 1938
Ledum columbianum	13	26	D	Callen 1941
Linnaea borealis var.	9	36	P(Homopl.)	Many authors
Nuphar polysetarum	17	34	D(Homopl.)	Many authors
Orobanche uniflora	9	36,72	P	Jensen 1951
Penstemon rattanii	8	16	D	Clausen et. al.1946
Phlox difusa var.	7	28	P	Flory 1934
Plantago lanceolata	6	12,13	D	Bicher et.al.1953
		24,96	P	Flory 1934
P. major	6	12	D	Turesson 1938
Prunnela vulgaris	7	28	P	Bicher 1949
	8	32		Hruby 1932
Pyrola secunda	19	38	D	Hagerup 1941

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Quercus chrysolepis	12	24	D	Duffield 1940
Q. sadleriana	12	24	D	" "
Q. vaccinifolia	12	24	D	" "
Rhamnus californica	12	24	D	Bowden 1945
Rhus diversiloba	15	30	D(Homopl.)	Many authors
Ribes bracteosum	8	16	D	Zielenski 1953
R. crunentum	8	16	D	" "
R. glutinosum	8	16	D	" "
Rosa gymnocarpa	7	14	D	Tackholm 1922
Rubus laciniatus	7	14	D	Vaarama 1954
R. leucodermis	7	14	D	Darrow & L. 1933
Rumex acetocella	12	24	D	Loeve 1944
R. conglomeratus	10	20	D	" "
R. obtusifolius	10	40	P	" "
Sedum spathulifolium	5	30	P	Clausen & U. 1944
Senecio vulgaris	5	40	P	Afzelius 1924
Silene campanulata	12	48	P	Kruckeberg 1955
Spergularia rubra	9	36	P	Loeve & L.1942
Synthris reniformis	12	24	D	MacMillan 1949
Tellima grandiflora	7	14	D	Skovated 1934
Tolmiea menziesii	7	28	P	" "
Trichostema lanceolatum	7	14	D	Lewis 1945
Trifolium microcephalum	8	16	D	Wexelsen 1928
Umbellularia californica	12	24	D	Banbacioni 1941
Vaccinium ovatum	12	24	D	Darrow et.al.1944
V. parvifolium	12	24	D	" " " "
Vancouveria hexandra	6	12	D	Langlet 1928
Verbascum blattaria	8	32	P	Hakanson 1926
Veronica americana	9	36	P	Schleuker 1936
Viola sempervirens	6	24	P	Clausen 1929
		48		Gershoy 1934
Wyethia angustifolia	19	38	D	Weber 1946

Southeastern Washington: Dicotyledons

Species	Basic Chromosome number (x)	Chromosome number (2n)	Polyploidy	Author
Acer negundo var.	13	26	D	Foster 1933
*Achillea millefolium var.	9	18	D	Harling 1950
		36,54	P	Turesson 1938
Agroseris glauca	9	18,36	D,P	Stebbins et.al.1953
A.heterophylla	9	18,36	D,P	" " " "
A. grandiflora	9	18	D	" " " "
Agrostemma githago	12	24	D	Rohweder 1939
		48	P	Favarger 1946
*Alnus tenuifolia	14	28	D	Gram et.al.1941
Ameranthus graecizans	8	32	P	Heiser & W. 1948
*A. retroflexa	8	32	P	" " " "
Ambrosia psilostachya	12-18	100-104	P	" " " "
A. trifida	12	24	D	Cooper & M. 1935
Amsinkia lycopsoides	5	30	P	Ray 1954
*Anaphalis margaritacea var.	7	28	P	Maude 1939
Anchusa azurea	8	32	P	Britton 1951
A. officinalis	8	16	D	" "
Anthemis arvensis	9	18	D	Harling 1950
A. cotula	9	18	D	" "
Apocynum cannabium	11	22	D	Breslawetz et al 1934
*Aquilegia formosa	7	14	D	Skalinska 1931
*Arabis hirsuta	8	32	P	Jaretzky 1928
Aralia nudicaulis	12	24	D	Bowden 1945
Arctium minus	8	32	P	Wulff 1937
*Arctostaphylos uva-ursi var.	13	52	P	Hagerup 1928
*Arenaria serphyllifolia	10	20,40	D,P	Woess 1941
Armoracia lapathifolia	8	32	P	Manton 1932
Artemisia absinthum	9	18	D	Weinedel 1928
A. draucunculoides	9	18	D	" "
A. tridentata	9	18,36	D,P	Ward 1953
A. vulgaris var.	9	18	D	Weinedel 1928
Asclepias speciosa	11	22	D	Moore 1945
Asperugo procumbens	6	48	P	Reese 1953
*Aster laevis	9	54	P	Revel 1945
Atriplex patula	9	18	D	Witte 1947
Balsamorhiza careyana	19	38	D	Weber 1946
B. incana	19	38	D	" "
B. sagittata	19	38	D	" "
B. serrata	19	38	D	" "
Berberis vulgaris	14	28	D	Langlet 1928
*Berula erecta	9	18	D	Scheerer 1940
*Betula papyrifera-occidentalis	14	84	P	Woodworth 1929
Bidens cernua	12	24	D	Lewitzky 1937

*Upper (Canadian and Transition Timbered) Zone.

Brassica campestris	10	20	D	Karpechenko 1924
B. nigra (cult. esc?)	8	16	D	Nagai 1930
Camelina microcarpa	10	40	P	Manton 1932
Capsella bursa-pastoris	8	32	P	Vaarana 1943
*Collomia heterophylla	8	16	D	Flory 1937
*C. linearis	8	16	D	" "
Conium macratum	11	22	D	Garde & G. 1949
Conringia orientalis	7	14	D	Jaretzky 1929
*Convolvulus arvensis	10	50	P	Wolcott 1937
*Cardamine pennsylvanica	8	64	P	Smith 1938
*Ceanothus sanguineus	12	24	D	Nobs 1942
*C. veltinus	12	24	D	" "
Celtis douglasii	10	20	D	Bowden 1945
Centaurea cyanus	12	24	D	Fritsch 1935
C. jacea	11	44	P	Roy 1937
C. repens	13	26	D	Morore & P. 1954
Centunculus minimus	11	22	D	Hagerup 1941
	9	36,72	P	Söller 1952
Ceratophyllum demersum	12	24	D	Langlet & S. 1927
Chenopodium album	9	36	P	Witte 1947
		54		Kjellmark 1934
C. botrys	8?	16?	D	Kawatani & O. 1950
C. murale	9	18	D	Winge 1917
C. virgatum	9	18	D	Wulff 1936
Chorispora tenella	7	14	D	Manton 1932
Chrysanthemum balsamita	9	18,54	D,P	Harling 1951
C. leucanthemum	9	36,54	P	Dowrick 1952
C. parthenium	9	18	D	" "
Cichorum intybus	9	18	D	Stebbins et al. 1953
*Circaea alpina	11	22	D	Loeve & L. 1944
*Cirsium arvense	17	34	D	Wulff 1937
*C. lanceolatum	17	68	P	Puddubnaja 1931
*Claytonia sarifolia	6	24	P	Blackburn 1937
*C. perifoliata	6	36	P	Rutland 1941
Clematis liguisticifolia	8	16	D	Meurman & T. 1939
Cleone lutea	8	32	P	Rollins 1939
C. cerrulata	8	32	P	" "
Cnicus benedictus	11	22	D	Vaarama 1947
*Collomia grandiflora	8	16	D	Flory 1937
*C.heterophylla	8	16	D	" "
*C. linearis	8	16	D	" "
Conium maculatum	11	22	D	Grade & G. 1949
Conringia orientalis	7	14	D	Jaretzky 1929
Coreopais atkinsoniana	12	24?	D	Bilquets 1951
Corispermum hyssopifolium	9	18	D	Reese 1952
Crydalis aurea	8	16	D	Ownby 1951
Crataegus douglasii	17	51	P	Longley 1924
Crepis barbigera	11	44-88	P	Babcock 1947
C. intermedia	11	33-88	P	" "
Cuscuta campestris	7	56	P	Fogelberg 1938
Datura stramonium	12	24	D	Staina et al. 1941
Daucus carota(escaped carrot)	9	18	D	Thompson 1933

*Erigeron acris	9	18	D	Loeve & L. 1942
E. annus	9	27	P	Okabe 1934
E. compositus	9	54,63	P	Bøcher & L. 1950
E. canadensis	9	18	D	Harling 1951
*E. macranthus	9	18	D	Bergman 1942
Erysium cheirantheoides	8	16	D	Manton 1932
*Erodium cicutarum	10	40	P	Andreas 1947
Eupatrium occidentalis	17	34	D	Grant 1943
Euphorbia cyparissias	10	20,40	D,P	Moore & L. 1953
*Fragaria cuneifolia	7	56	P	Ichijima 1926
F. helleri	7	14	D	" "
*Fragaria bracteata	9	36	P	Cooper & M. 1935
		72		Atwood 1937
Galium aparine	11	22,44	D,P	Pauques 1949
		c.66,c.88		Fagerlind 1937
G. boreale	11	44	P	Loeve & L. 1954
G. trifidum	12	24	D	Fagerlind 1937
*G. vailantii	10	20	D	" "
*Gayophytum ramosissimum	11	22	D	Johansen 1933
Geranium pusillum	13	26	D	Jackson 1951
*geum macrophyllum	7	42	P	Gajevski 1949
*Gillia aggregata	7	14	D	Flory 1937
G. capitata	9	18	D	Grant 1953
Glycyrrhiza lepidota	8	16	D	Heiser & W. 1948
Gymnosteris nudicaulis	6	12	D	McMillan 1949
*Habenaria dilatata	7	42	P	Humphrey 1934
Helenium autumnale	17	34	D	E. K. J.
Helianthus annuus	17	34	D	Geisler 1931
Heliotropium curassavium	7-13	26	D	Britton 1951
Hemizonia pungens	9	18	D	Clausen 1951
Heuchera cylindrica	7	14	D	Skovsted 1934
Holosteum umbelatum	10	20	D	Rohweder 1939
Huchinsia procunbens	6	12,24	D,P	Manton 1932
*Hydrophyllum albifrous	9	18	D	Cave & C. 1942
*H. capitatum	9	18	D	" " " "
*Hypericum perforatum	8	32	P	Noak 1939
*Lactuca spicata (8+9)	17	34	P	Thompson et al. 1941
Lagophylla ramosissima	7	14	D	Johansen 1933
Lamium amplexicaulis	9	18	D	Berström 1944
Lathyrus latifolius	7	14	D	Senn 1938
Lepidium densiflorum	8	24	P	Manton 1932
Limosella aquatica	10	40	P	Vachell & B. 1939
Linaria dalmatica	6	12	D	Matsuura & S. 1935
L. vulgaris	6	12	D	Heitz 1927
Linum usitatissimum(esc.)	10	30	P	Ray 1944
	8	32		Kostoff 1932
*Linnaea borealis	8	32	P	Ehrenberg 1945
Lithospermum arvense	7	28	P	Britton 1951
*Lonicera involucrata	9	18	D	Janaki-Ammal & S. 1952
Lychnis coronaria	12	24	D	Rehweder 1939
Lycopus americanus	11	22	D	Ruttle 1939

Madia citriodora	8	16	D	Clausen 1951
M. exigua	8	32	P	" "
M. gromerata	7	28	P	" "
M. sativa	8	32	P	" "
Malva rotundifolia	7	42	P	Skovsted 1935
Marrubium vulgare	9	36	P	Wulff 1939
Matricaria matricarioides	9	18	D	Rutland 1941
Medicago hispida	7	14	D	Fryer 1930
M. lupulina	8	16,32	D,P	Tschechow 1933
M. sativa (esc.)	8	16	D	Bolton & G. 1950
		32	P	Fryer 1930
Melilotus officinalis	8	16	D	Tschechow 1933
*Mentha arvensis	6	12,60,70	D,P	Loeve & L. 1942
		54		Wolf 1929
		72		Ruttle 1931
		64,92		Nagao 1941
M. piperita	6	36,64	P	Glotov 1940
		36,68,70		Ruttle 1931
M. spicata		36,48	P	Loeve & L. 1942
M. varidis	6	36	P	Nagao 1941
Menyanthes trifoliata	9	54	P	Pork 1949
*Mimulus guttatus	7	28	P	Clausen et al. 1950
	8	48		Maude 1940
Mollugo verticilata	8	64	P	Sugiura 1936
Morus alba (intro.)	14	28	D	Osawa 1920
Myosotis scorpioides (esc.)	8	64	P	Loeve & L. 1942
Myriophyllum exalbescens	7	14	D	Loeve 1954
Natsurtium officinale	8	32	P	Howard & M. 1946
Nepeta cataria	9	36	P	Sugiura 1940
Nicotiana attenuata	12	24	D	Goodspeed 1945
Oenothera andina	7	14	D	Darlington 1931
O. caespitosa	7	14	D	" "
O. contorta	7	14	D	" "
O. heterantha	7	14	D	" "
O. hookeri	7	14	D	" "
O. pallida	7	14	D	" "
*O. strigosa	7	14	D	" "
O. tancetifolia	7	14	D	" "
Opuntia polyacantha	11	22	D	Matsuura & S. 1935
		44,66	P	Stockwell 1935
Orobanche uniflora	12	36,72	P	Jensen 1951
*Paeonia brownii	5	10	D	Stebbins 1938
Papaver argemone	6	12	D	Beale 1939
		42	P	Sugiura 1940
Papaver rhoeas	7	14	D	Lawrence 1930
*Penstemon attenuatus	8	48	P	Keck 1945
*P. confertus	8	32	P	" "
*Phacelia linearis	11	22	D	Cave & C. 1944
*Philaderphus leirisii	13	26	D(Homopl)	Many authors
Physalis pruinosa	12	24	D	Menzel 1951

Physaria geyeri	4	8	D	Jakowska 1949
Physocarpus capitatus	9	18	D	Sax 1931
Plantago lanceolata	6	12	D	Nakajima 1930
		12,13		Bøcher et al. 1953
		24,96		MacCullagh 1934
*P. major	6	12	D	Turesson 1938
Polygonum aviculare	10	40,60	P	Loeve & L. 1948
*P. convolvulus	10	20	D	Jaretzky 1928
		40	P	Loeve, A. 1942
P. hydropiper	10	20	D	Jaretzky 1928
	11	22		Sax and S. 1938
P. lapathifolium	11	22	D	Loeve & L. 1948
P. persicaria	11	44	P	Jaretzky 1928
*Populus balsamifera	19	38	D	Smith 1943
		76	P	Blackburn & H. 1924
Portulaca oleacea	9	54	P	Steiner 1944
*Potentilla grandulosa	7	14	D	Clausen et al. 1937
P. novagica	7	70	P	Gentcheff 1938
Prunella vurgaris	7	28	P	Bøcher 1949
	8	32		Hruby 1922
*Prunus virginiana	8	32	P	Sax 1931
*Pyrola chlorantha	23	46	D	Hagerup 1941
*P. minor	23	46	D	" 1928
*Pyrus dumosa	17	34	D(Homopl.)	Many authors
Ranunculus cymbalaria var.	8	16	D	Bøcher & L. 1950
*R. reptans	8	32	P	" 1938
Rhus taxicodendron	15	30	D	Grimm 1912
Ribes aureum	8	16	D	Zielenski 1953
R. cerum	8	16	D	" "
R. congatum	8	16	D	" "
R. goodingoo	8	16	D	" "
R. inerme	8	16	D	" "
*R. irrigum	8	16	D	" "
*R. lacustre	8	16	D	" "
R. niveum	8	16	D	" "
*R. petiolare	8	16	D	" "
R. reniforme	8	16	D	" "
*R. viscosissimum	8	16	D	" "
Robinia pseudoacacia(esc.)	10	20	D	Kreuter 1930
*Rosa gymnocarpa	7	14	D	Erlanson 1934
*R. ultramontana	7	14,21	D,P	" 1933
Rubus idaeus	7	14,21,28	D,P	Clane 1936
*R. leucodermis	7	14	D	Darrow & L. 1933
Rumex acetosella	7	42	P	Loeve, A. 1944
R. crispus	10	60	P	" 1942
R. martimus	10	40	P	" "
R. patientia (intro.)	10	60	P	Kihara 1927
Sagina procumbens	11	22	D	Rohweder 1939
*S. saginoides	11	22	D	Blackburn 1938
Salix lasiandra	19	76	P	Wilkinson 1944
Salsola kali	9	36	P	Wulff 1936

Salvia carnosa	11	22	D	Stewart 1939
*Sanicula nevadensis	8	16	D	Bell 1954
Saponaria officinalis	14	28	D	Favarger 1946
*Sedum stenopetalum	8	14,48	D,P	Clausen & U. 1943
*Senecio vulgaris	5	40	P	Afzelius 1924
*Sibbaldia procumbens	7	14	D	Bøcher 1938
Solanum dulcamera	12	24	D	Vilmorin & S. 1928
S. nigrum	12	24,48,72	D,P	Bhaduri 1933
Spergula arvensis	9	18	D	Rohweder 1939
*Spergularia rubra	9	36	P	Loeve & L. 1942
*Sphaeralcea rivularis	11	66	P	Webber 1936
Stellaria longipes	13	52	P	Bøcher & L. 1950
S. media	10	40	P	Negodi & L. 1950
	11?	42,44		Peterson 1936
Stephanomeria paniculata	8	16	D	Stebbins et al. 1953
*Symphoricarpos albus	9	c.54	P	Sax & K. 1930
Taraxacum laevigatum	8	24	P	Poddubnaja & D.1934
*T. vulgare	8	16,24,48	D,P	Woess 1949
Thermopsis montana	9	18	D	Tschechow 1931
Thapsi arvense	7	14	D	Manton 1932
T. perofliatum(intro.)	7	70	P	Jaretzky 1932
Thysanocarpus curvipes	7	28	P	Manton 1932
Tragopogon major	6	12	D	Poddubnaja et al.1935
T. porrifolius	6	12	D	" " " "
T. pratensis	6	12	D	Winge 1926
Tribulus terrestris	12	24	D	Negodi 1939
		48	P	Schnack & C. 1947
*Trichostema oblangum	7	14	D	Lewis 1945
Trifolium arvense	7	14	D	Karpechenko 1925
T. agarium	7	14	D	Wulff 1939
T. hybridum	8	16	D	Kawakami 1930
T. microcephalum	8	16	D	Wexelson 1928
T. repens	8	32	P	Atwood & H. 1940
		32,48		Moriya & K. 1949
T. respinatum	8	16	D	Karpechenko 1925
T. variegatum	8	16	D	Wexelsen 1928
Utricularia vulgaris	(?)	36-40	P	Reese 1952
Vergasecum blattaria	15,16	30,32	D	Hakansson 1926
*V. thapsus	17.18	34,36	D	" "
*Viola adunca	10	20	D	Gershoy 1934
*V. palustris	6	48	P	Clausen 1926
*V. sempervirens	6	24	P	" 1931
		48		Gershoy 1931
Wyethia amplexicaulis	19	38	D	Webber 1946
Xanthium italicum	9	36	P	Symons 1926
X. spinosum	9	36	P	Heiser & W. 1948

Yellowstone National Park: Dicotyledons

Species	Basic number (x)	Chromosome number (2n)	Poly-ploidy	Author
Adoxa moschatellina	9	36	P	Pouques 1949
		54		Oikawa 1942
Alnus tenuifolia	14	28	D	Gram et al. 1941
Anaphalis margaritacea	7	28	P	Maude 1939
Androsace septentrinalis	10	20	D	Dahlgren 1916
Apocynum androsaenifolium	11	22	D	Schürhoff et al.1937
A. cannabium	11	22	D	Breslawetz et al.1934
Aquilegia caerulea	7	14	D	Winge 1925
Arabis hirsuta	8	32	P	Jaretzky 1928
Arctostaphylos uva-ursi	13	52	P	Hagerup 1941
Aster adescendens	8	16,32	D,P	Clausen et al.1940
Balsamorrhiza incana	19	38	D	Webber 1946
B. sagittata	19	38	D	" "
Camelina microcarpa	10	40	P	Manton 1932
Campanula rotundifolia	17	34,68	D,P	Bøcher 1936
Cerastium arvense	9	36,72	P	Söller 1952
		36,38,72		Brett 1955
Chenopodium album	9	36	P	Witte 1947
C. murale	9	54	P	Kjelmark 1934
Chimaphylla umbellata	13	c.26	D	Hagerup 1941
Chrysanthemum leucanthemum	9	36,54	P	Dowrick 1945
Circium arvense	17	34	D	Ehrenberg 1945
Clematis ligusticifolia	8	16	D	Meurman & T. 1939
Collinsia tennela	8	32	P	Bollins 1939
Corylus aurea	8	16	D	Ownberg 1951
Dodecantheon conjungens	11	44	P	Thompson 1953
D. cusickii	11	44	P	" "
Draba crassifolia	8	40	P	Heilborn 1941
Dryas octopetala	9	18	D	Maude 1940
Epilobium alpinum	9	36	P	Bøcher & L. 1950
E. anagallidifolum	9	36	P	" " " "
Erigeron acris	9	18	D	Loeve & L. 1942
E. compositus	9	54,63	P	Bøcher & L. 1950
E. macranthus	9	18	D	Bergman 1942
E. uniforus	9	18	D	Bøcher & L. 1950
Erodium cicutarium	10	40	P	Andreas 1947
Erysium cheiranthoides	8	16	D	Manton 1932
Fragaria americana	7	14	D	Ichijima 1926
F. ovalis	7	56	P	Powers 1944
F. platypetala	7	56	P	Yarnell 1931
Gaillardia aristata	9	36	P	Cooper & M. 1935
		72		Atwood 1937

Galium boreale	11	44	P	Loeve & L. 1953
G. trifidum	12	24	D	Fagerlind 1937
Gayophytum ramosissimum	11	22	D	Johansen 1933
Glycyrrhiza lepidota	8	16	D	Heisen & W. 1948
Grindelia subalpina	6	24	P	" " " "
Helianthus annuus	17	34	D	Geisler 1931
		68	P	Rybin 1939
Hippuris vulgaris	8	32	P	Winge 1917
Hutchinsia procumbens	6	12,24	D,P	Manton 1932
Hydrophyllum capitatum	9	18	D	Cave & C. 1942
Hymenophysa pubescens	12	24	D	Manton 1932
Kalmia polifolia	11	44	P	Callan 1941
Lactuca pulchella	(8+9)17	34	P	Stebbins et al.1953
Lepidium apetalum	8	32	P	Smith, F.H.1938
Linnaea americana	8	32	P	Loeve & L. 1944
Madia glomerata	7	28	P	Clausen 1951
Matricaria matricarioides	9	18	D	Rutland 1941
Melilotus alba	8	16,24,32	D,P	Atwood 1933
M. officinalis	8	16	D	Tschechow 1933
Mentha spicata	9	36	P	Schürhoff 1929
		c.96		Ruttle 1931
Mentzelia decapitale	11	22	D	Hamel 1938
Mertensia ciliata	12	24,48	D,P	Britton 1951
Mimulus guttatus	7	28	P	Clausen et al. 1950
	6 or 8	48		Maude 1940
M. langsdorfii	7	28	P	Clausen et al. 1950
Myosotis alpestris	6-9	24,28,c.72	P	Geitler 1936
Navarretia intertexta	7	28	P	Loeve 1954
Opuntia polyacantha	11	22	D	Matsuura & S. 1935
		44,c.66	P	Stockwell 1935
Oxyria dignya	7	14	D	Loeve & L. 1948
Parnassia palustris	9	18,27,36,54	D,P	Erlandsson 1942
Penstemon cyanthus	8	16	D	Clausen et al. 1940
P. rydbergii	8	32	P	Koch 1945
Phlox douglasii	7	28	P	Flory 1934
P. hoodi	7	28	P	" "
Polygonum amphibium	11	c.66	P	Jaretzky 1928
P. aviculare	10	40,60	P	Loeve & L. 1948
P. convolvulus	10	20	D	Jaretzky 1928
		40	P	Loeve 1942
P. vipiparum	10,11	c.88	P	Sos 1938
		c.100		Flovik 1940
		c.110		Loeve & L. 1948
		c.132		Kalinska 1950
Populus angustifolia	19	38	D	Smith, E.D.1943
P. balsamifera	19	38	D	" " "
		76	P	Blackburn &H. 1924
P. tremuloides	19	38	D	Smith 1943
Potentilla gracilis	7	52-109	P	Clausen et al.1940
Prunella vulgaris	7	28	P	Bøcher 1949
	8	32		Hruby 1932

Pyrola chlorantha	(11+12)23	46	P	Hagerup 1941
P. minor	(")23	46	P	" "
Ros' bourgeauiana	7	42	P	Erlanson 1933
R. woodsii	7	14,21	D,P	" "
R. strigosus	7	14	D	Longley & D. 1924
		21	P	Einset 1947
Rumex acetosella	7	14	D	Ono 1928
		21,22,29	P	Yamamoto 1934
R. brittanicus	10	160	P	Jensen 1936
Sagina saginoides	11	22	D	Blackburn & W. 1938
Salix cordata	22?	44	D	Wilkinson 1944
	19	152	P	Holmberg 1931
		172		Wilkinson 1944
S. lasiandra	19	76	P	" "
Saxifraga caespitosa	8	64	P	Harmsen 1939
		56-65		Skovsted 1934
		80		Loeve & L. 1951
S. sivularia	13	26	D	Flovik 1940
		52	P	Loeve & L. 1948
	7	56		Bøcher 1938
Sedum rhodanthum	7	14	D	Uhl 1952
S. stenopetalum	8	16,48	D,P	Clausen & U. 1943
Sibbaldia procumbens	7	14	D	Bøcher 1938
Silene acaulis	12	24	D	Loeve & L. 1944
Solidago canadensis	9	18	D	Brock (1955?)
S. elongata	9	18	D	Clausen et al.1953
Sonchus asper	9	18	D	Stebbins et al.1953
Sphaeralcea coccinea	5	10	D	Webber 1936
S. sivularis	11	66	P	" "
Thalictrum diocium	7	28	P	Jensen 1944
		42		Kuhn 1928
Urticularia minor	5-6	36-40	P	Reese 1952
U. vulgaris	5-6	36-40	P	" "
Veronica americana	9	36	P	Schlenker 1936
V. peregrina	9	52	P	Hofelich 1935
V. sculellata	9	18	D	Hagerup 1944
V. warmskjordii	9	36	P	Bøcher & L. 1950
Viola adunca	10	20	D	Gershoy 1934
V. canadensis	6	24	P	" "
V. nuttallii	6	48	P	Clausen 1936
V. palustris	6	48	P	" "

Species	Basic number (x)	Chromosome number (2n)	Polyploidy	Author
Acer negundo	13	26	D	Foster 1933
*Achillea lanulosa	9	36	P	Lawrence 1947
A. millefolium	9	18	D	Harling 1950
		36,54	P	Turesson 1938
		54		Ehrendorfer 1952
*Adoxa moshatellina	9	36	P	Pouques 1949
		54		Oikawa 1942
		56		Matsuura & S. 1935
Agrostemma githago	12	24	D	Rohweder 1939
		48	P	Favarger 1946
*Alnus temuifolia	14	28	D	Gram et al. 1941
Alyssum alyssoides	8	32	P	Manton 1932
Amalanthus albus	8	32	P	Heiser & W. 1948
*A. graecizans	8	32	P	" " " "
Ambrosia trifida	12	24	D	Cooper & M. 1935
Amorpha canescens	10	20	D	Tschechow 1935
A. nana	10	20	D	" "
*Anaphalis margaritacea	7	28	P	Maude 1939
Anagallis arvensis	10	40	P	Wulff 1937
Anchusa officinalis	8	16	D	Britton 1951
*Androsace septentrinalis	10	20	D	Dahlgren 1916
Anethum graveolens	11	22	D	Tamamschjan 1933
*Antennaria neglecta	7	28	P	Stebbins 1932
*Anthemis cotula	9	18	D	Harling 1950
A. arvensis	9	18	D	" "
*Apocynum androsaefolium	8(?)	16(?)	D	Schürhoff et al.1937
A. cannabium	11	22	D	Breslawetz et al.1934
*Aquilegia caerulea	7	14	D	Winge 1925
Arabis hirsuta	8	32	P	Jaretzky 1928
Aralia rudicaulis	12	24	D	Bowden 1945
Arctium minus	8	32	P	Wulff 1937
*Arctostaphylos uva-ursi	13	52	P	Hagerup 1928
Arenaria serphyllifolia	10	20,40	D,P	Woess 1941
Argemone mexicana	7	28	P	Sugiura 1936
Artemisia borealis	9	18,36	D,P	Erlanson 1939
*A. ludoviciana	9	36,c.54	P	Clausen et al.1940
Asclepias incarnata	11	22	D	Moore 1946
A latifolia	11	22	D	" 1936
A. speciosa	11	22	D	" 1946
A. tuberosa	11	22	D	" "
Asperugo procumbens	6 or 8	48	P	Reese 1953
*Aster adescendens	8	16,32	D,P	Clausen et al. 1940
*A. alpinus	9	18	D	Sakai 1935

Atriplex hortensis	9	18	D	LaCour 1931
A. patula	9	18	D	Witte 1947
*Balsamorhiza sagittata	19	38	D	Webber 1946
Berberis vulgaris	14	28	D	Langlet 1928
*Berula erecta	9	18	D	Scheerer 1940
*Betula grandulosa	14	28	D	Pouques 1949
*Betula occidentalis	14	84	P	Woodworth 1929
B. papyrifera	14	84	P	" "
Bidens cernua	12	24	D	Lewitzky 1937
B. heterosperma	12	48	P	Gelin 1934
Brassica campestris	10	20	D	Karpechenko 1924
B. juncea	9(?)	36	P	Alam 1936
B. nigra	8	16	D	Nagai 1930
Callirhoe involucrata	12	24	D	Kesseler 1932
*Callistriche hermaphroditica	3	6	D	Jorgensen 1923
*Caltha leptosepala	8	48	P	Langlet 1932
Camelina microcarpa	10	40	P	Manton 1932
*Campanula rotundifolia	17	34,68	D,P	Bøcher 1936
Cannabis sativa	10	20	D	Medvedeva 1935
*Cardamine pennsylvanica	8	64	P	Smith 1939
*Cardaria draba	8	64	P	Manton 1932
Carthamus tinctorius (esc.)	8	32	P	Poddubnaja 1927
Caulanthus crassicaulis	12	24	D	Rollins 1939
*Ceanothus fendleri	12	24	D	Nobs 1942
C. martinii	12	24	D	" "
C. ovatus	12	24	D	" "
*C. veltinus	12	24	D	" "
Celtis occidentalis	10	20	D	Bowden 1945
	14	28		Sax 1933
Centaurea solatitialis	8	16	D	Heiser & W. 1948
Centunculus minimus	11	22	D	Hagerup 1941
Cerastium arvense	9	36,72	P	Söller 1952
Ceratophyllum demersum	12(?)	24(?)	D	Langlet & S. 1927
Chenopodium ambrosioides	8	16,32,48	D,P	Kawatani & O. 1950
		32		Suzuka 1950
		64		Suzuka & K. 1949
		36		Kjellmark 1934
*Chimaphilla umbellata	13	c.26	D	Hagerup 1928
*Chorispora tenella	7	14	D	Manton 1932
Chrysanthemum balsamita	9	18,54	D,P	Dowrick 1952
C. coronasium	9	18,36	D,P	Shimotomai & H.1935
C. leucanthemum	9	36,54	P	Dowrick 1952
Cichorium intybus	9	18	D	Stebbins et al.1952
Circaea alpina	11	22	D	Loeve & L. 1944
*Cirsium arvense	17	34	D	Ehrenberg 1945
*Clematis columbiana	8	16	D	Gregory 1941
*C.hirsutissima	8	16	D	" "
*C. ligusticifolia	8	16	D	" "
C. orientalis	8	16	D	" "
*C. pseudoalpina	8	16	D	" "

Cleone lutea	8	32	P	Rollins 1939
*C. serrulata	8	32	P	" "
Clinopodium vulgare	10	20	D	Scheerer 1939
Collomia grandiflora	8	16	D	Flory 1937
*C. linearis	8	16	D	" "
Conringia orientalis	7	14	D	Jaretzky 1929
Convolvulus arvensis	10	50	P	Wolcott 1937
Coeropsis lanceolata	12	24,48	D,P	Bilquez 1951
C. tinctoria	12	24	D	Gelin 1934
*Cornus canadensis	11	22	D	Dermen 1932
*C. stronifera	11	22	D	" "
*Colydalis aurea	8	16	D	Ownbey 1951
Cosmos bipinnatus	12	24	D	Sugiura 1936
Crepis acuminata	11	22-88	D,P	Babcock 1947
*C. intermedia	11	33-88	D,P	" "
Cucurbita foetidissima	10	40	P	McKay 1931
Cuscuta approximata	7	28	P	Finn 1937
C. campestris	7	56	P	Fogelberg 1938
C. cephalanthi	15	60	P	" "
C. gronovii	15	60	P	" "
C. pentagona	7	c.56	P	" "
Datula metaloides	12	24	D	Satina 1953
D. stramonium	12	24	D	" "
Daucus carota	9	18	D	Garde & G. 1951
Descrinia obtusa	7	14,42	D,P	Baldwin & C. 1940
D. pinnata	7	14,28,42	D,P	" " " "
*D, richardsonii	7	14,28,42	D,P	" " " "
D. sophia	7	28,56	P	Manton 1932
Desmanthus cooleyi	14	28	D	Turner & B. 1953
D. illinoensis	14	28	D	" " " "
Dipsacus sylvestris	8	16	D	Pouques 1949
	9	18		Kachidze 1929
*Draba aurea	8	64	P	Bøcher 1938
*D. crassifolia	8	40	P	Heilborn 1941
*D. fladnizensis	8	16	D	Loeve & L. 1948
*Dryas octopetala	9	18	D	Maude 1940
Echinocereus rechenbachii	11	22	D	Beard 1937
Echinops sphaerocephalus	8	32	P	Poddubnaja 1927
Echium vulgare	8	16,32	D,P	Litardiere 1943
		32		Britton 1951
Elaeagnus angustifolia	14	28	D	Fyfe 1945
Elatine triandra	10(?)	40(?)	P	Frisendahl 1940
*Ellisia nyctelea	5	20	P	Cave & C. 1950
*Epilobium alpinum	9	36	P	Bøcher 1950
*E. palustre	9	36	P	Loeve & L. 1942
*Erigeron compositus	9	54,63	P	Bøcher & L. 1950
Erodium cicutarium	10	40	P	Andreas 1947
*Erysimum cheiranthoides	8	16	D	Manton 1932
Eschscholzia californica	6	12	D	Lawrence 1930
Eupatrium herbaceum	10	20	D	Grant 1953
Euphorbia cyparissias	10	20,40	D,P	Moore & L. 1953

E. dentata	7	14,28,56	D,P	Perry 1943
E. esula	8	64	P	Reese 1952
E. marginata	7	56	P	Perry 1943
Eustema russelianum	9	72	P	Pork 1943
Fagopyrum esculatum	8	16	D	Jaretzky 1927
Foeniculum volgare	11	22	D	Garde & G. 1949
Foestiera neomexicana	23	46	D	Taylor 1945
*Fagaria ovalis	7	56	P	Powers 1944
*Gaillardia aristata	9	36	P	Cooper & M. 1935
		72		Atwood 1937
G. pulchella	9	36	P	Morinaga et al.1929
	?	34		Schnack 1940
*Galeopsis tetrahit	8	32	P	Müntzing 1932
Galinsoga cilliata	8	32	P	Haskell & H. 1952
*Galium aparine	11	22,44	D,P	Pouques 1949
		c.66,c.88		Fagerlind 1934
*G. boreale	11	44	P	Loeve & L 1934
*G. trifidum	12	24	D	Fagerlind 1937
Gaura coccinea	7	14	D	Johansen 1933
G. ramosissimum	11	22	D	" "
Gentiana andrewsii	6	36	P	Pork 1949
G. prostrata	6	36	P	Favarger 1952
G. tenella	5	10	D	" "
G. termalis	13	26	D	Pork 1949
Geranium pusillum	13	26	D	Jackson 1951
*Geum macrophyllum	7	42	P	Gajewski 1949
*G. rivale	7	42	P	Raynor 1952
*Gilia aggregata	7	14	D	Flory 1937
G. sinuata	15	30	D	Grant 1950
*Glaux maritima	15	30	D	Wulff 1937
Glechoma hederacea	9	18	D	Scheerer & L. 1942
	6	24	P	Loeve & L. 1942
		36		Felfoldy 1947
*Glycyrrhiza lepidota	8	16	D	Tschechow 1930
*Gnaphalium uliginosum	7	14	D	Wulff 1937
*Helenium autumnale	17	34	D	E.K.J.
*Helianthus annuus	17	34	D	Geisler 1931
H. grosse-serratus	17	32(?)	D	Cooper & M. 1932
H. maximiliana	17	34	D	Geisler 1931
H. rigidus	17	102	P	Wagner 1932
H. petiolaris	17	34	D	Heiser 1948
H. salicifolius	17	34	D	Geisler 1931
H. tuberosus	17	102	P	Wagner 1932
Hibiscus trionum	7	28	P	Medvedeva 1936
		56		Skovsted 1935
*Hippuris vulgaris	8	32	P	Loeve & L. 1948
Hutchinsia procumbens	6	12,24	D,P	Manton 1932
*Hydrophyllum fendleri	9	18	D	Cave & C. 1950
*Hymenoxys acaulis	15	30,60	D,P	Speese & B. 1952
*H. brandegi	15	30	D	" " " "
*H. grandiflora	15	30	D	" " " "

*H. helenioides	15	30	D	Speese & B. 1952
H. odorata	11	22	D	" " " "
*H. richardsonii	15	30	D	" " " "
H. scaposa	15	30	D	" " " "
*Hyoscyamus niger	17	34	D	Vaarama 1950
Hypericum perforatum	8	32	P	Noak 1939
*Jamesia americana	16	32	D	Sax, I. 1931
Kalmia polifolia	11	44	P	Callan 1941
*Kochia scoparia	9	18	D	Wulff 1936
Lactuca canadensis	17	34	D	Stebbins et al. 1953
L. ludviciana	17	34	D	" " " "
L. spicata	17	34	D	Thompson et al.1941
Lamium amplexicaule	9	18	D	Bernstrom 1944
L. purpureum	9	18	D	" "
Lapsana communis	6	12	D	Loeve & L. 1948
	7	14		Stebbins et al. 1953
*Leonurus cardiaca	10	20	D	Suzuka 1950
*Lepidium campestre	8	16	D	Wulff 1939
L. latifolium	8	24	P	Heiser & W. 1948
*Lesquerella alpina	5	10	D	Rollins 1939
L. calcicola	5	c.20	P	" "
L. ludviciana	5	10,30	D,P	" "
L. fendleri	6	12	D	" "
L. intermedia	8	16	D	" "
*L. montana	5	10	D	" "
Liatris punctata	10	20,30,40	D,P	Geiser 1950
Limosella aquatica	10	40	P	Vachell & B. 1939
Linaria delmatica	6	12	D	Matsuura & S.1935
*L. vulgaris	6	12	D	Vaarama 1948
*Linnaea borealis	8 or 9	36	P	Ehrenberg 1945
Linum compactum	15	30	D	Ray 1944
L. usitatissinum(esc.?)	8-15	30	D	" "
		32		Kostoff 1940
Lithospermum arvense	7	28	P	Britton 1951
*L. incisum	7	28	P	" "
L. cardinalis	7	14	D	Vilmorin & S.1927
L. siphilitica	7	14	D	Okuno 1937
*Lonicera involucrata	9	18	D	Janaki-Ammal & S.1952
Lycopus americanus	11	22	D	Ruttle 1932
Lygodesmia rostrata	6	12	D	Stebbins et al.1953
malacothrix sonchoides	7	14	D	Stebbins 1953
Malcolmia africana	7	14	D	Jaretzky 1928
		28	P	Manton 1932
Malus pumila	17	34	D	Einset & I. 1951
Malva crispa	7	c.112	P	Skovsted 1935
M. neglecta	7	42	P	" "
Marrubium vulgare	6-7	36(?)	P	Wulff 1939
*Matricaria inodora	9	18	D	Hüser 1930
		36	P	Harling 1951
Medicago hispida	7	14	D	Fryer 1930

M. lupulina	8	16,32	D,P	Tschechow 1933
M. sativa	8	16	D	Bolton & G. 1950
		32	P	Fryer 1930
		32,63		Tome 1930
Mentzelia decapetala	11	22	D	Hamel 1938
M. humilis	9	18	D	" "
*Meltensia ciliata	6	24,48	P	Britton 1951
*Meyanthes trifoliata	9	54	P	Pork 1949
*Mimulus guttatus	7	28	P	Clausen et al. 1950
	8	48		Maude 1940
Mirabilis multiflora	29	58	D	Showalter 1935
*Monandra fistulosa	8	32	P	Rushnell 1936
	9	36		Suzuka & K. 1949
M. punctata	6 or 8	24	P	Rushnell 1936
*Mollugo verticilata	8	64	P	Sugiura 1936
Monotropa hypopitys	8	48	P	Loeve & L. 1944
*Myosotis alpestris	7,8,9	24,48,C.72	P	Geitler 1936
*Myosurus minimus	7	c.28	P	Ehrenberg 1945
*Hyriophyllum verticilatum	7	28	P	Scheerer 1940
*Nemophila brevifolia	9	18	D	Cave & C. 1950
Nepta cataria	9	36	P	Sugiura 1940
Nicandra physalodes	9-10	19,20	D	Darlington & J. 1945
Nicotiana attenuata	12	24	D	Goodspeed 1933
N. trigonophylla	12	24	D	" 1945
Opuntia fragilis	11	66	P	Bowden 1945
O. phaecantha	11	c.66	P	Stockwell 1935
O. polycantha	11	22	D	Matsuura & S. 1935
		44,C.66	P	Stockwell 1935
Orobanche uniflora	6	36,72	P	Jensen 1951
Osmorhiza longistylis	11	22	D	Wansher 1932
Oxalis stricta	6	24	P	Wulff 1937
*O. violacea	7	28	P	Yamashita 1935
*Oxyria digyna	7	14	D	Loeve & L. 1948
*Oxytropis campestris	9	36	P	Jalas, L. & L. 1948
Paeonia brownii	5	10	D	Stebbins 1938
*Papaver nudicaule	7	14	D	Faberge 1944
		28	P	Horn 1938
Pastinaca sativa	11	22	D	Ogawa 1929
*Penstemon barbatus	8	16	D	Sugiura 1936
P cobaea	8	64	P	Pictrowska 1937
*P. procerus	8	16,32	D,P	Keck 1932
*P. rydbergii	8	32	P	" 1945
Philadelphus microphyllus	13	26	D	Bangham 1939
*Phlox hoodii	7	28	P	Flory 1934
Physalis pruinosa	12	24	D	Menzel 1951
P. pubescens	12	24	D	" "
*Physaria vitulifera	4	16	P	Weber & B. 1950
Physocarpus intermedius	9	18	D	Sax 1931
*P. monognus	9	18	D	" "
Plantago aristata(exp.)	5	20	P	Heitz 1927

P. lanceolata	6	12,13	D	Bøcher et al. 1953
		12		Nakajima 1930
		24,96	P	MacCullagh 1934
Polamisia trachysperma	10	20	D	Raghavan 1938
*Polemonium delicatum	9	18	D	Flory 1937
*Polemonium foliosissimum	9	18	D	" "
*P. occidentale	9	18	D	" "
*P. viscosum	9	18	D	" "
Polygonum amphibium	11	c.66	P	Jaretzky 1928
*P. aviculare	10	40,60	P	Loeve & L. 1948
*P. convolvulus	10	20	D	Jaretzky 1928
		40	P	Loeve, A. 1942
P. hydropiper	10	20	D	Jaretzky 1928
	11	22		Sax and Sax 1938
P. lapathifolium	11	22	D	Loeve & L. 1948
P. persicaria	11	44	P	Jaretzky 1928
*P. viviparum	10-11	c.88	P	Sax & S. 1938
		c.100		Flovik 1940
		c.110		Loeve & L. 1948
		c.132		Skalinska 1950
*Portulaca oleracea	9	54	P	Steiner 1944
*Potentilla anserina	7	28,42	P	Erlandson 1942
*P. arguta	7	14	D	Popoff 1935
*P. fruticosa	7	14	D	Shimotomai 1929
		28	P	Wulff 1939
*P. glandulosa	7	14	D	Clausen et al. 1937
P. monspeliensis	7	56	P	Loeve 1954
*P. nivea	7	56	P	Erlandson 1942
		63		Bøcher & L. 1950
		70		Sakai 1934
Premanthus racemosa	8	16	D	Babcock et al. 1937
*Primula parryi	11	44	P	Bruun 1932
Prunus americana	8	16	D	Sax 1931
*P. virginiana	8	32	P	" "
*Pyrola minor	23	46	D	Hagerup 1928
Quercus fendleri	23	46	D(Homopl.)	Sax 1930 & many othe
*Q. gambellii	12	24	D	" " " " "
Q. turbinella	12	24	D	" " " " "
Q. undulata	12	24	D	" " " " "
Q. verlandii	12	24	D	" " " " "
Ranunculus acris	7	14	D	Langlet 1936
		42	P	Larter 1932
*R. aquatilis	8	32	P	Bøcher 1932
R. circinatus	8	16	D	Scheerer 1939
*R. cymbalaria	8	16	D	Bøcher & L. 1950
R. flammula	8	32	P	Neves 1944
R. repens	8	16,32	D,P	Matsuura & S. 1935
		32		Naves 1944
*R. sceleratus	8	32	P	Gregory 1941
Raphnus raphnistrum	9	18	D	Karpechenko 1928
Reseda lutea	6	48	P	Eigsti 1936

Rhamnus cathartica(esc.?)	12	24	D	Wulff 1939
Ribes americanum	8	16	D	Zielenski 1953
R. aureum	8	16	D	" "
*R. cereum	8	16	D	" "
*R. coloradense	8	16	D	" "
*R. inerme	8	16	D	" "
*Ribes lacustre	8	16	D	" "
*R. leptanthum	8	16	D	Meurman 1928
*R. montigenum	8	16	D	Zielenski 1953
R. setosum	8	16	D	" "
R. viscosissimum	8	16	D	" "
*R. wolfii	8	16	D	" "
*Sagina saginoides	11	22	D	Blackburn 1938
*Salix glauca	19	152	P	Holmberg 1931
		176		Wilkinson 1944
S. fregilis	19	76	P	Blackburn & H. 1924
		114		Loeve & L. 1942
S. lucida	19	76	P	Harrison 1926
*Salsola kali	9	36	P	Wulff 1937
Salvis sylvestris	8	16	D	Hruby 1941
Sambucus canadensis	9	36	P	Sax, K. 1930
*S. pubescens	9	36	P	Bowden 1940
Sanicula canadensis	8	16	D	Bell 1954
S. marilandica	8	16	D	" "
Saponaria officinalis	14	28	D	Favarger 1946
*Sausurea alpina	9	54	P	Loeve & L. 1944
*Saxifraga adscendens	11	22	D	Melchers 1935
*S. bronchialis	8	48	P	Sakai 1935
		48,49		Philip 1934
		c.150		Skovsted 1934
*S. caespitosa	8	64	P	Harmsen 1939
		56-65		Skovsted 1934
		80		Loeve & L. 1951
*S. cernua	8-10	50	P	Chiarugi 1950
		60		Loeve & L. 1940
		64		" " " 1951
*S. flagellaris	8	32	P	Flovik 1940
*S. hirculus	8	32	P	Loeve & L. 1951
Schrankia occidentalis	8	24	P	Turner & B. 1953
Scutellaria galericulata	8	32	P	Scheel 1931
Sedum acre	4	16,48	P	Wulff 1937
S. cockerellii	4	32	P	Clausen & U. 1943
*S rhodanthum	7	14	D	Uhl 1952
*S. stenopetalum	4	16,48	P	Clausen & U. 1943
Senecio vulgaris	5	40	P	Afzelius 1924
*Sibbaldia procumbens	7	14	D	Sax & S. 1941
Sida hederacea	11	22	D	Heiser & W. 1948
*Silene acaulis	12	24	D	Loeve & L. 1944
*S. cucubalis	12	24	D	Blackburn 1928
*Sisymbium altissimum	7	14	D	Smith,F.H. 1938
Solanum jamesii	12	24	D	" " " 1927
S. nigrum	12	24,48,72	D,P	Bhadwri 1933

Solidago canadensis	9	18	D	Brock (1955?)
Sonchus arvensis	8	64	P	Wulff 1937
S. asper	9	18	D	Stebbins et al. 1953
S. pleraceus	8	32	P	" " " "
Spergula arvensis	9	18	D	Rohweder 1939
Spergularia rubra	9	36	P	Loeve & L. 1942
*Sphepherdia argentea	13	26	D	Fyfe 1945
S. canadensis	11	22	D	Cooper 1932
Sphaeralcea angustifolia	5	10,20	D,P	Webber 1936
*S. occinea	5	10	D	" "
S. fendleri	5	10,20	D,P	" "
		15		EKJ.
S. incana	5	10,20	D,P	Webber 1936
*Stachys palustris	8	c.64	P	Wulff 1938
		102		Lang 1940
Stanleya albescens	12	24	D	Rollins 1939
S. pinnata	12	24	D	" "
S. viridiflora	12	24	D	" "
*Stellaria longipes	13	52	P	Bøcher & L. 1950
S. media	10-11	40	P	Negodi 1935
		42,44		Peterson 1936
		28		Pal 1952
Stephanomeria virgata	8	16,32	D,P	Stebbins et al. 1953
Saueda fruticosa	9	36	P	Joshi 1935
*Swertia perennis	9	18	D	Sakai 1940
	8(?)	24	P	Woyciki 1937
	7	28		Favarger 1952
Symphoricarpos albus	9	c.54	P	Sax & K. 1930
S. orbiculatus	9	18	D	" " " "
*Talinum parviflorum	6	48	P	Steiner 1944
Tamarix gallica	12	24	D	Bowden 1940
Tanacetum vulgare	9	18	D	Shimotomai 1937
*Thalictnum alpinum	7	14	D	Loeve & L. 1944
T. dasycarpum	7	28	P	Gregory 1941
		42		Langlet 1927
*T. fendleri	7	28,56,c.70	P	Clausen et al. 1940
Thelesperma negapotamicum	11	22	D	Schnack & C. 1947
*Thermospis montana	9	18	D	Tschechow 1931
*Thlapsi arvense	7	14	D	Manton 1932
*Tillaea aquatica	7	42	P	Hagerup 1941
Tragopogon porrifolius	6	12	D	Poddubnaja et al.1935
T. pratensis	6	12	D	Winge 1926
*Trautvetteria carolinensis	8	16	D	Langlet 1932
Trilubus terrestris	12	24	D	Negodi 1939
		48	P	Schnack & C. 1947
*Trollius laxus	8	32	P	Langlet 1932
Urtica dioica	12	48	P	Loeve & L. 1942
	13	52		Fothergill 1936
*Utricularia vulgaris	5-6	36-40	P	Reese 1952
*U. minor	5-6	36-40	P	" "
*Vaccinium myrtillus	12	24	D	Darrow et al.1944

*Valeriana capitata	7	56	P	Sax & S. 1941
Verbascum blattaria	15,16	30,32	D	Hakansson 1926
*V. thapsus	17,18	34,36	D	" "
Verbena ambrosifolia	5	30	P	Dermen 1936
V. canadensis	5	30	P	" "
*Verbesina encelioides	17	34	D	Covas & S. 1946
Veronica anagallis-aquatica	9	36	P	Ehrenberg 1945
V. persica	7	28	P	Beatus 1936
*V. scutellata	9	18	D	Hagerup 1944
*V. wormskjoldii	9	36	P	Bøcher & L. 1950
Vicia cracca	6,7	12,14,28	D,P	Sweschnikova 1927
V. volosa	7	14	D	Senn 1938
*Viola adunca	10	20	D	Gershoy 1934
*V. biflora	6	12	D	Miyaji 1929
*V. palustris	6	48	P	Clausen 1931
V. pedata (6+11+11)	28	56	P	Gershoy 1934
Vitis arizonica	19	38	D	Christoff 1929
V. donoana	19	38	D	Nebel 1929
V. longii	19	38	D	Sax 1929
V. vulpina	19	38	D	Nebel 1929
*Wyethia amplexicaulis	19	38	D	Weber 1946
Xanthium italicum	9	36	P	Symons 1926
X. spinosum	9	36	P	Heiser & W. 1948
Zygophyllum fabago	11	22	D	Warburg 1938

Mount Diablo, California: Dicotyledons

Species	Basic number (x)	Chromosome number (2n)	Polyploidy	Author
Acer negundo	13	26	D	Foster 1933
Achillea millefolium	9	18	D	Rutland 1941
Amsinckia intermedia	4-7	30,34,38	P	Ray 1954
Anagallis arvensis	10	40	P	Wulff 1937
Anthemis cotula	9	18	D	Harting 1950
Apocynum androsaemifolium	11	16(?)	D	Schürhoff et al.1937
A. cannabium	11	22	D	Breslawetz et al. 1934
Aquilegia truncata	7	14	D	Skalinska 1931
Aralia californica	12	48	P	Bowden 1945
Artemisia douglasiana	9	54	P	Clausen et al. 1940
Astragalus gambelianus	11	22	D	James 1951
Berberis pinnata	14	28	D	Dermen 1941
Berula erecta	9	18	D	Scheerer 1940
Blennosperma californicum	7	14	D	Heiser 1947
Calandriana ciliata	8	24	P	Heiser & W. 1948
		46		Blackburn 1937
		48		Sugiura 1940
Capsella bursa-oastirus	8	32	P	Vaarama 1943
Ceanosus cuneatus	12	24	D	Nobos 1942
C. sorediatus	12	24	D	" "
Centaurea melitensis	11	22	D	Covas & S. 1947
C. solstitialis	8	16	D	Heiser & W. 1948
Cercocarpos betuloides	9	18	D	Morley 1949
Chenopodium album	9	36	P	White 1947
		54		Kjellmark 1934
Clarkia concinna	7	14	D	Lewis 1953
C. elegans	9	18	D	" "
Clematis lasiantha	8	16	D	Meurman & T. 1939
C. ligusticifolia	8	16	D	" " " "
Collinsia bicolor	7	14	D	Hiorth 1933
Conium macratum	11	22	D	Garde & G. 1949
Convolvulus arvensis	10	50	P	Wolcott 1937
Cornus glabrata	11	22	D	Dermen 1932
Corylus rostrata	14	28	D	Woodworth 1929
Cotula coronopfolia	10	20	D	Castro & F. 1946
Delphinium decoram	8	16	D	Lewis et al.1951
D. mudicaule	8	16	D	Lawrence 1936
D. variegatum	8	16,32	D,P	Lewis et al.1951
Diplacius auranticus	10	20	D	McMinn 1951
Dodecantheon hendersonii	11	44,66,132	P	Thompson 1953
Echinocystis favacea	8	32	P	MacKay 1931
Emmenanthe penduliflora	9	36	P	Cave & C. 1944

Emenocarpus setigerus	10	20	D	Heiser & W. 1947
Erigeron canadensis	9	18	D	Hartung 1951
Erodium botrys	10	40	P	Heiser & W. 1948
E. cicutarium	10	40	P	Andreas 1947
E. moschatum	10	20	D	Gauger 1937
Eschscholtzia californica	6	12	D	Lawrence 1930
Eucrypta chrysanthmopholia	5	20	P	Cave & C. 1950
Forestiera neomexicana	23	46	D	Taylor 1945
Fragaria californica	7	14	D	Ichijima 1930
Fraxinus dipetala	23	46	D	Sax 1932
Galium aparine	11	22,44	D,P	Pouques 1949
		c.66,c.88		Fagerlind 1934
Garrya elliptica	11	22	D	Meurman 1930
Geranium dissectum	11	22	D	Loeve & L. 1944
Gilla achilleaefolia	9	18	D	Grant 1953
G. capitata	9	18	D	" "
G. giloides	9	18	D	" "
G. millefoliata	9	18	D	" "
G. tricolor	9	18	D	" "
Godetia amoena	7	14	D	Lewis 1953
G. purpurea	13(?)	52	P	" "
G. biloba	8	16	D	" "
Grindelina camporum	6	24	P	Heiser & W. 1948
Gutierrezia californica	12	24	D	Caves & S.1947
Helianthus annuus	17	34	D	Geisler 1931
Hemizonia congesta	7	28	P	Clausen 1951
Heuchera micrantha	7	14	D	Skovsted 1934
Hydrophyllum occidentale	9	18	D	Cave & C. 1950
Hypochoeris glabra	8	16	D	Stebbins et al. 1953
Lactuca saligna	9	18	D	Thompson et al.1941
L. virosa	9	18	D	" " " "
Lagophylla ramosissima	7	14	D	Johansen 1933
Layia gaillardioides	8	16	D	Clausen 1951
L. hieracioides	8	16	D	" "
L. platyglossa	7	14	D	" "
Lythrum hyssopifolia	15	20(?),30(?)	D	Tischler 1929
Madia elegans	8	16	D	Clausen 1951
M. exigua	8	32	P	" "
M. gracilis	8	16,48	P	" "
Malacothrix clevelandii	7	14,28	D,P	" "
Marrubium vulgare	9(?)	34,36	P	Rutland 1941
Medicago hispida	7	14	D	Fryer 1930
M. sativa	8	16	D	Bolton & G. 1950
		32,64	P	Tome 1947
Mentha spicata	6	36,48	P	Loeve & L. 1942
Mimulus cardinalis	8	16	D	Sugiura 1940
M. guttatus	7	28	P	Clausen et al.1950
	8	48		Maude 1940
Microseris attenuata	9	18	D	Stebbins et al. 1953
Nemophila heterophylla	9	18	D	Cave & C. 1942
N. menziesii	9	18	D	" " " "

N. pedunculata	9	18	D	Cave & C. 1942
Oenothera graciliflora	7	14	D	Cleland et al.1950
O. hookeri	7	14	D	" " " "
O. micrantha	7	14	D	" " " "
Osmaronia cerasiformis	8	16	D	Moffett 1931
Penstemon corymbosus	8	16	D	Clausen et al.1940
Phacelina californica	11	22,44	D,P	Cave & C. 1944
P. divaricata	5	20	P	" " " "
P. suaveolens	12	24	D	" " " "
P. tanacetifolia	11	22	D	" " " 1942
Pholistoma membranaceum	9	18	D	" " " 1950
Picris echioides	5	10	D	Schnack & C. 1947
Platystemon californicus	6	12	D	Sugiura 1937
Plantago major-asiatica	6	24	P	Ikeno 1929
Polygonum amphibium	11	c.66	P	Jaretzky 1928
P. aviculare	10	40,60	P	Loeve & L. 1948
Potentilla glandulosa	7	14	D	Clausen et al.1937
Prunus virginiana	8	32	P	Sax 1931
Quercus agrifolia	12	24	D	Duffield & many others
Q. chrysolepis	12	24	D	" " " "
Q. douglasii	12	24	D	" " " "
Q. dumosa	12	24	D	" " " "
Q. durata	12	24	D	" " " "
Q. garryana	12	24	D	" " " "
Q. kelloggii	12	24	D	" " " "
Q. morehus	12	24	D	" " " "
Q. wislizenii	12	24	D	" " " "
Rafinesquia californica	8	16	D	Stebbins et al. 1953
Ranunculus aquatilis	8	32	P	Bøcher 1932
R. californicus	7	28	P	Coonen 1939
R. muricatus	8	48	P	Neves 1944
Rhamnus californica	12	24	D	Bowden 1945
Ribes californicum	8	16	D	Skovsted 1934
R. malvaceum	8	16	D	Zielenski 1953
R. menziesii	8	16	D	" "
Rosa californica	7	28	P	Erlanson 1933
R. gymnocarpa	7	14	D	Tächholm 1922
Romanzoffia californica	11	22	D	Cave & C. 1947
Rumex acetocella	7	42	P	Loeve, A. 1944
R. conglomeratus	10	20	D	" " "
R. crispus	10	60	P	" " 1942
R. pulcher	10	20	D	Heiser & W. 1948
Salsola kali	9	36	P	Wulff 1937
Salvia columbariae	8	16	D	Stewart 1939
		32	P	Carlson 1939
S. mellifera	8	32	P	Stewart 1939
S. spathacea	13	26	D	" "
Sanicula crassicaulis	8	32,48,64	P	Bell 1954
S. bipinnatifida	8	16	D	" "
S. saxatilis	8	16	D	" "
S. tuberosa	8	16	D	" "

Scandix pectenveneris	8	16	D	Wanscher 1931
Scutellaria tuberosa	8	c.32	P	Scheel 1931
Sedella pentandra	9	18	D	Baldwin 1940
Sedum spathulifolium	5	30	P	Clausen & U. 1944
Silene californica	12	96	P	Kruckeberg 1955
S. gallica	12	48	P	Blackburn 1928
Silybum marianum	17	34	D	Heiser & W
Sisymbrium officinale	7	14	D	Wulff 1937
Solanum nigrum	12	24,48,72	D,P	Bhaduri 1933
Sonchus asper	8	16	D	Stebbins et al.1955
S. oleraceus	8	32	P	" " " "
Sphaeralcea fasciculata	5	10	D	Webber 1936
S. fremontii	5	10	D	" "
Stellaria media	10-14	40	P	Negodi 1935
		42,44		Peterson 1936
		28		Pal 1952
Stephanomeria virgata	8	16,32	D,P	Stebbins et al.1953
Synphoricarpos albus	9	c.54	P	Sax 1930
Thysanocarpus curvipes	7	28	P	Manton 1932
Tillaea aquatica	7	42	P	Hagerup 1941
Torrilis nodosa	11	22	D	Garde & C. 1949
Trichostema lanceolatum	7	14	D	Lewis 1945
Trifolium albopurpureum	8	16	D	Wexelsen 1928
T. fucatum	8	16	D	" "
T. microcephalum	8	16	D	" "
T. obtusiflorum	8	16	D	" "
T. variegatum	8	16	D	" "
T. wormskjordii	8	c.48	P	" "
Umbellularia californicus	12	24	D	Bambacione 1941
Veronica americana	9	36	P	Schlenker 1936
V. peregrina (8*9*9)	26	52	P	Hofelich 1935
Vitis californica	19	38	D	Kobel 1929
Wyethia helenioides	19	38	D	Webber 1946
Xanthium spinosum	9	36	P	Heiser & W. 1948
Zauschneria californica	15	60	P	Clausen et al. 1940

PART 2. MONOCOTYLEDONS

Iron Mountain, Oregon: Monocotyledons

Species	Basic number (x)	Chromosome number (2n)	Polyploidy	Author
Agrostis exarata	7	42	P	Stebbins et al.1941
A. hallii	7	42	P	" " " "
A. tenuis	7	28	P	Stuckey & B. 1946
Aira caryophyllea	7	14	D	Wulff 1937
Alopecuris genicalatus	7	28	P	Avdulov 1928
Anthoxanthum odoratum	5	10	D	Ostergren 1947
Brodiae coronaria	7	42	P	Burbank 1941
Bromus mollis	7	28	P	Knowles 1944
B. tectorum	7	14	D	" "
B. vulgaris	7	14	D	Stebbins & T. 1944
Calochortus tolmei	10	20	D	Beal & O. 1943
Calypso bulbosa	14	28	D	Hagerup 1944
Clintonia uniflora	7	28	P	Walker 1944
Dactylis glomerata	7	27-30	P	Myers & H. 1940
		42		Hanson & H. 1953
Disporum hookeri	9	18	D	Jones 1951
D. smithii	8	16	D	" "
Elymus glaucus	7	28	P	Stebbins & L. 1941
Erithronium oregonum	12	24	D	Smith 1955
Festuca occidentalis	7	28	P	Stebbins & L. 1941
Glyceria elata	5	20	P	Church 1949
Hierochloe occidentalis	7	42	P	Church & M. 1941
Holcus lanatus	7	14	D	Litardiere 1949
Iris innominata	10	40	P	Lenzz 1955 (?)
Juncus effusus	10	40	P	Loeve & L. 1944
Lillium columbianum	12	24	D	Sansome & C. 1934
L. pardalium	12	24	D	" " " "
Lolium perene	7	14,21	D,P	Muntzing 1937
Melica geyeri	9	18	D	Stebbins & L. 1941
M. subulata	9	18	D	" " " "
Poa pratensis	7	28,56,70	P	Avdulov 1931
		49-84		Hartung 1946
Phleum alpinum	7	14,28	D,P	Litardiere 1949
Polygonum monspeliensis	7	28	P	Avdulov 1928
Smilacina sessilifolia	9	36	P	Cave 1948
Streptopus amplexifolius	8	32	P	Matsuura & S. 1935
Trillium ovatum	5	10	D	Warmke 1937
T. rivale	5	10	D	" "
Trisetum canescens	7	42	P	Stebbins & L. 1941
Zigadenus fremontii	11	22	D	Miller 1930

*Darlington, C. D. and A. P. Wylie: Chromosome Atlas of Flowering Plants (1955)

Species	Basic number (x)	Chromosome number (2n)	Polyploidy	Author
Aegilops (esc.)	7	28	P	Kihara 1954
Agrophyron repens (esc.)	7	28,42	P	Avdulov 1931
A. spicatum	7	14,28	D,P	Hartung 1946
Alisma gramineum	7	14	D	Castro & W. 1948
		10,14,16,28	P	Wulff 1950
Alopecurus sequalis	7	14	D	Johnsson 1941
A. geniculatus (intro.)	7	28	P	Avdulov 1928
A. myosuroides (intro.)	7	14	D	Kaltermann 1930
A. pratensis(intro.)	7	42	P	Johnsson 1941
Arrhentherum elatius (esc.)	7	28	P	Avdulov 1931
Avena fatua (intro.)	7	42	P	Philip 1933
Beckmannia syzigachne	7	14	D	Nielsen & H.1937
Brodiaea lactea	6	42-48	P	Smith 1933
Bromus brizaeformis(intro.)	7	14	D	Avdulov 1928
Calamagrostis canadensis	7	42-46	P	Nygren 1946
C. inexpansa var.	7	28,56,58,84-105	P	" 1954
C. neglecta	7	28	P	" 1946
C. rubescens	7	28,42,56	P	" 1954
Calochortus apiculatus	10	20	D	Beal & O. 1943
C. elegans	10	20	D	" " " "
C. longeberbatus	10	20,30	D,P	" " " "
C. pavonaceus	10	40	P	" " " "
Calypso bulbosa	7	28	P	Hagerup 1944
Clintonia uniflora	7	28	P	Wulff 1944
Corallorrhiza trifida	7	42	P	Loeve & L. 1948
Cyperus esculentus	9	108(?)	P	Hicks 1929
Cypripidium parviflorum	10	20	D	Carlson 1945
Dactylis glomerata (esc.)	7	27-30	P	Myers & H. 1940
		42(38-39)		Hanson & H. 1953
Danthonia unispicata	6	36	P	deWet 1954
Deschampsia danthonioides	13	26	D	Myers 1947
D. elongata	13	26	D	" "
Digitaria sanquinalis(intro.)	17	34	D	Thomas 1955(?)
	9	36-48	P	Brown 1948
		54	P	Covas 1948
Disporum trachycarpum	11	22	D	Jones 1951
Distichlis stricta	5	40	P	Stebbins & L. 1941
Echinochloa crusgalli(intro.)	9	36	P	Brown 1948
	7	42		Church 1929
	8	48		Rau 1929
	9	54		Tateoka 1954
Elodea canadensis	8	24	P	Heppel 1945
Elymus caput-medusae(intro.)	7	14	D	Griffee 1927

E. glaucus	7	28	P	Stebbins & L. 1941
E. triticoides	7	28,42	P	" " " "
Erithronium grandiflorum	12	24	D	Sato 1942
Festuca elatior(esc.)	7	14	D	Bosemark 1954
F. idahoensis	7	48	P	Stebbins & L. 1941
F. occidentalis	7	28	P	" " " "
F. rubra	7	14,28,56,70	D,P	Loeve & L. 1942
		28,42		Brandberg 1948
		42,46,53,64		Juhl 1952
F. viridula	7	28	P	Stebbins 1947
Glyceria borealis	5	20	P	Church 1949
G. elata	5	20	P	" "
G. striata	5	20	P	" "
Heteranthera dubia	15	30	D	Bowden 1945
Holcus lanatus	7	14	D	Litardiere 1948
Hordeum jubatum	7	28	P	Aase & P. 1926
		14	D	Tanzi 1925
Hordeum murinum	7	14	D	Stolze 1925
		28	P	Aase & P. 1925
H. nodosum	7	14,28	D,P	Chin 1941
		42		Griffee 1927
Iris missouriensis	11	88	P	Snoad 1952
Juncus bufonius	10	c.60,c.120	P	Wulff 1937
J. effusus	10	40	P	Loeve & L. 1944
J. filiformis	10	c.40,c.80	P	" " " 1948
J. macer	10	30	P	" " " "
Koeleria cristata	7	14	D	Tateoka 1954
		28	P	Stebbins & L. 1941
Lemna minor	10	40	P	Blackburn 1933
L. trisulca	11	44	P	" "
Lilium columbianum	12	24	D	Sansome & L.C.1934
Lolium perene (intro.)	7	14	D	Müntzing 1939
Luzula campestris	6	12,36	D,P	Nordenskiöld 1951
Melica bulbosa	9	18	D	Boyle 1945
Muhlenbergia squarrosa	10	40	P	Stebbins & L. 1941
Panicum brodiei	9	18	D	Brown 1948
P. capillare	9	18	D	Avdulov 1928
P. scribnerianum	9	18	D	Brown 1948
Phalaris arundinacea	7	14,28	D,P	Church 1929
		27-31,35		Hansen & H. 1953
Phleum alpinum	7	14,28	D,P	Litardiere 1949
P. pratense	7	42	P	Myers 1944
Poa ampla	7	62-100	P	Hartung 1946
P. annua (intro.)	7	28	P	Litardiere 1938
P. bulbosa (intro.)	7	14	D	Guinochet 1943
		28,45	P	Akerberg 1942
		42		Hartung 1946
P. compressa (intro.)	7	35,42,49	P	Akerberg 1942
		45,49,56		Loeve & L. 1948
P. cusickii	7	28	P	Stebbins & L. 1941
		42		Hartung 1946

P. gracillima	7	81-86	P	Hartung 1946
P. nemoralis (intro.)	7	28-38,42,43	P	Loeve & L. 1941
		47-49		Bøcher & L. 1950
		70		Kato 1951
Poa pratensis	7	28,56,70	P	Avdulov 1931
Potamogeton gramineus	13	52	P	Palmgren 1939
P. parnormitanus	13	26	D	Harada 1942
P. pectinatus	13	78	P	" "
Phragmites communis	12	36	P	Tischler 1942
Puccinellia rupestris(intro.)	7	42	P	Rutland 1941
Sagittaria cuneata	11	22	D	Brown 1946
S. latofolia	11	22	D	Oleson 1941
Sclerochloa dura (intro.)	7	14	D	Avdulov 1931
Setaria viridis	9	18	D	Tateoka 1954
Sitanion hanseni	7	28	P	Stebbins & L. 1941
S. hystrix	7	28	P	" " " "
S. jubatum	7	28	P	" " " "
Smilacina stellata	9	36	P	Stenar 1935
Spartina gracilis	7	42	P	Church 1940
S. spectinata	7	28	P	" "
Sphenopholis obtusata	7	14	D	Brown 1950
Spirodela polyrhiza	10	40	P	Blackburn 1933
Stipa californica	9	36	P	Stebbins & L. 1941
S. columbiana	11	44	P	Nielsen 1939
S. comata	11	44,66	P	Stebbins & L. 1941
S. elmeri	9	36	P	" " " "
S. lemmoni (8•9)	17	34,36	P	" " " "
S. turberiana (8•9)	17	34	P	" " " "
Streptopus amplexifolius	8	32	P	Matsuura & S. 1935
Trillium ovatum	5	10	D	Warmke 1937
T. petiolatum	5	10	D	" "
Trisetum canescens	7	42	P	Stebbins & L,1941
T. cernuum	7	42	P	Myers 1947
T. spicatum	7	28	P	Frovik 1938
Typha latifolia	15	30	D	Harada 1947
Zanichellia palustris	7	28	P	Scheerer 1937

Yellowstone National Park: Monocotyledons

Species	Basic Number (x)	Chromosome Number (2n)	Polyploidy	Author
Agropyron smithii	7	28,56	P	Hartung 1946
		42		Stebbins 1947
A. spicata	7	28	P	Hartung 1946
Agrostis exarata	7	42	P	Stebbins & L. 1941
A. rossaea	7	28	P	Myers 1947
Allium cernuum	7	14	D	Levan 1935
Alopecurus aequalis	7	14	D	Johnsson 1941
A. alpinus	7	119-122	P	" "
		112-130		Flovik 1940
Andropogon halii	10	60,70	P	Nielsen 1939
		60,100		Brown 1950
Avena fatua	7	42	P	Philip 1933
Beckmannia syzigache	14	28	D	Woodworth 1931
B. glandulosa	14	28	D	Pouques 1949
Bromus anomalus	7	14	D	Nielsen 1939
		28	P	Nielsen & H. 1937
B. ciliatus	7	14,28	D,P	Elliot 1949
B. pumpellianus	7	42	P	Stählin 1929
		56		Elliot 1949
B. tectorum	7	14	D	Knowles 1944
Calamagrostis canadensis	7	42-66	P	Nygren 1954
C. inexpansa	7	28,56,58,84-105	P	" "
C. neglecta	7	28	P	" "
C. purpureascens	7	40-57	P	" "
C. pubescens	7	28,42,56	P	" "
Calypso balbosa	7	28	P	Hagerup 1944
Cammasia esculenta	15	30	D	Nakajima 1936
Catabrosa aquatica	5	20	P	Avdulov 1931
Cinna latifolia	7	28	P	Ehrenberg 1945
Collinia linearis	7	28	P	" "
Corallorhiza innata	21	42	D	Miduno 1940
Deschampsia caespitosa	13	26	D	Lawrence 1945
	7	28	P	Hagerup 1939
D. elongata	13	26	D	Myers 1947
Distichlis stricta	5	20	P	Church 1949
Eleocharis acicularis	5	20	P	Tanaka 1939
		c.56		Hichs 1929
E. palustris	5,8	10,16	D	Lewitzky 1940
Elymus canadensis	7	28	P	Brown 1948,1950
E. glaucus	7	28	P	Stebbins & L. 1941
Erthronium grandiflorum	12	24	D	Sato 1942
Festuca idahoensis	7	28	P	Stebbins & L. 1941

F. kingii	7	56	P	Boyle 1950
F. occidentalis	7	28	P	Stebbins & L. 1941
Festuca ovina	7	14,21,28,42	D,P	Loeve & L. 1942
		28,35		Skalinska 1950
		56		Church 1929
		70		Thuresson 1930
F. rubra	7	14,28,42,56,70	D,P	Loeve & L. 1942
		28,42		Brandberg 1948
		42,46,53,64		Juhl 1952
Glyceria borealis	5	20	P	Church 1949
Hordeum jubatum	7	14	D	Tanzi 1925
		28	P	Aase & P. 1926
H. nodosum	7	14,28	D,P	Chin 1941
		42	P	Griffee 1927
Iris missouriensis	11	88	P	Snoad 1952
Koeleria cristata	7	14	D	Tatsoka 1954
Lemna gibba	10-11	64	P	Blackburn 1933
L. minor	10	40	P	" "
L. trisulca	11	44	P	" "
Lloydia serotina	12	24	D	Brown 1927
Lolium perenne	7	14,21	D,P	Müntzing 1937
		28		Myers 1939
Luzula campestris	6	12,36	D,P	Nordenskiöld 1951
L. spicata	6,7	12,14,24	D,P	" "
Melica bulbosa	9	18	D	Boyle 1945
Muhlenbergia andina	10	40	P	Stebbins 1947
Oryzopsis asperifolia	11-12	46	P	Johnsson 1945
Panicum capilare	9	18	D	Avdulov 1928
Phalaris arundinacea	7	14,28	D,P	Church 1929
		27-31,35		Hansen & H. 1953
		42		Brock 1955 (?)
Poa alpina	7	14,28-74	D,P	Müntzing 1948
P. ampla	7	62-100	P	Hartung 1946
P. arctica	7	72,84,c.100	P	Loeve & L. 1948
		38,56,c.68,76		Nanfeldt 1940
P. arida	7	63-103	P	Hartung 1946
P. canbyi	7	72-106	P	" "
P. compressa		35,42,49		Loeve & L. 1942
P. cusickii	7	28	P	Stebbins & L. 1941
		42		Hartung 1946
P. epilis	7	56	P	Armstrong 1937
		c.84	P	Hartung 1946
P. gracillima	7	81-86	P	" "
P. nervosa	7	62-70	P	" "
P. nevadensis	7	62-70	P	" "
P. palustris	7	28,30,42	P	Loeve & L. 1942
P. oratensis	7	28,56,70	P	Avdulov 1931
		49-84		Hartung 1946
		36-123		Nissen 1950
		38-96		Juhl 1952

P. secunda	7	74-87	P	Hartung 1946
Potamogeton filiformis	13,14	c.78	P	Loeve & L. 1942
Puccinalia nuttaliana	7	56	P	Church 1949
Sisyrinchium augustifolium	8	96	P	Bowden 1945
Sitantion hystrix	7	28	P	Stebbins & L. 1941
Streptopus amplexifolius	8	32	P	Matsuura & S.
Smilacina amplexicaulis	9	36	P	Stenar 1935
S. sessilifolia	9	36	P	Cave 1948
S. stellata	9	36	P	Stenar 1935
Sparganium angustifolium	15	30	D	Loeve & L. 1942
S. simplex	15	30	D	Hagerup 1941
Spartina gracilis	7	42	P	Church 1940
Stripa columbiana	11	44	P	Nielsen 1939
Triglochin maritina	6	12	D	Loeve & L. 1944
Trillium albifolius	8	16	D	Langlet 1932
Trisetum psicatum	7	28	P	Flovik 1938
Typha angustifolia	15	30	D	Loeve & L. 1942
Zygadenus elegans	8	32	P	Miller 1930

Colorado: Monocotyledons

Species	Basic number (x)	Chromosome number (2n)	Polyploidy	Author
Acolus calamus	9	18	D	Budley 1951
Agropyron latiglume	7	28	P	Senn et al. 1949
A. repens	7	28,42	P	Avdulov 1931
A. smithii	7	28,56	P	Hartung 1946
		42		Stebbins 1947
A. spicatum	7	14,28	D,P	Hartung 1946
Agrostis borealis	7	56	P	Björkman 1954
A. exarata	7	42	P	Stebbins et al. 1941
Alisma plantago-aquatica	5,6,7	10,14,16,28	D,P	Wulff 1950
		12		Palmgren 1943
		14		Castro & W. 1950
Allium cernuum	7	14	D	Levan 1935
A. schoenoprasum	8	16,24,32	D,P	" 1936
Alopecurus aequalis	7	14	D	Johnsson 1941
A. alpinus	7	119-122	P	" "
		112-130		Flovik 1940
Andropogon gerardi	10	60,70	P	Nielsen 1939
		60,100		Brown 1950
A. scoparius	10	40	P	Hunter 1934
Anthoxanthum odoratum	5	10	D	Ostergren 1947
Aristata adscensioides	11	22	D	Covas & B. 1945
Arrhenatherum elatius	7	28	P	Avdulov 1931
Asparagus officinalis	10	20	D	Nagao 1938
Beckemannia syzigachne	7	14	D	Nielsen & H. 1937
Bouteloua courtipendula	7-10	28,35,40,56,70	P	Fults 1942
E. eriopoda	7	21	P	" "
		28		Brown 1950
B. gracilis	7	28,35,42,61,77	P	Fults 1942
	7-10	20,40,42,60,84		Snydei & H.
B. hirsuta	7	21,37,42	P	Fults 1942
		28		Brown 1951
Bromus anomalus	7	14	D	Elliott 1949
		28	P	Nielsen & H. 1937
B. brizaeformis	7	14	D	Avdulov 1928
B. carinatus	7	56	P	Stebbins & T. 1944
B. catharticus	7	28	P	Moriya & K. 1949
		42		Stebbins & T. 1944
B. ciliatus	7	14,28	D,P	Elliott 1949
B. commutatus	7	14	D	Felfoldy 1947
		28	P	Litardiere 1950
		56		Nielsen 1939
B. inermis	7	28	P	Knoblock 1953
		42,56		" 1943
		56,70		Nielsen 1939

B. japonicus	7	14	D	Moriya & K. 1949
B. margaritus	7	42	P	Nielsen & H. 1937
		56		Stebbins & T. 1944
B. pumpelianus	7	42	P	Stählin 1929
		56		Elliott 1949
B. purgans	7	14,28	D,P	" "
B. racemosus	7	28	P	Knowles 1944
B. secalinus	7	14	D	Nielsen 1939
		28	P	Knowles 1944
B. tectorum	7	14	D	" "
B. trinii	7	42	P	" "
Buchloë dactyloides	6-7	56	P	Nielsen 1939
		60		Avdulov 1931
Calamagrostis canadensis	7	42-66	P	Nygren 1954
C. inexpansa	7	28,56,58,84-105	P	" "
C. montanensis	7	28	P	" "
C. neglecta	7	28	P	" 1946
C. purpurescens	7	40-57	P	" 1954
C. rubescens	7	28,42,56	P	" "
Calochortus flexiosus	7	14	D	Beal & O. 1943
C. gunnisonii	9	18	D	" " " "
C. macrocarpa	7	14	D	" " " "
C. nuttallii	8	16	D	" " " "
Calypso bulbosa	7	28	P	Hagerup 1944
Catabrosa aquatica	5	20	P	Avdulov 1931
Cenchus pauciflorus	9	36	P	Brown 1948
Chloris verticillata	10	40	P	" 1950
C. virgata	10	20	D	Moffett & H. 1949
		40	P	Krishaswamy 1940
Cinna latifolia	7	28	P	Ehrenberg 1945
Corallorhiza trifida	21	42	D	Loeve & L. 1948
Cynodon dactylon	9	36	P	Brown 1950
	10	40		Moffett & H. 1949
Cynosurus cristatus	7	14	D	Avdulov 1931
Cyperus esculatus	9	108	P	Hicks 1929
Dactylis glomerata	7	27-30	P	Myers & H. 1940
		42		Hansen & H. 1953
Danthonia californica	6	36	P	deWet 1954
D. intermedia	6	36	P	" "
D. spicata	6	36	P	" "
D. unispicata	6	36	P	" "
Deschampsia atropurpurea	7	14	D	Loeve & L. 1948
D. caespitosa	7	26	P	Lawrence 1945
		28		Hagerup 1939
Digitaria ischaemum	9	36	P	Brown 1948
D. sanguinalis	9-?	34	P	Thomas,P.T.(1959?)
		36-48		Brown 1948
		54		Covas & S. 1947
Disporum trachycarpus	11	22	D	Jones 1951
Dischilis stricta	5	40	P	Stebbins & L 1941

Echinochloa crusgalli	9	36	P	Brown 1948
		42		Church 1948
		48		Rau 1929
		54		Tateoka 1954
Eleocharis acicularis	5	20	P	" 1937
Eleusine indica	9	18	D	Avdulov 1931
		36	P	Moffett & H. 1949
Elodea canadensis	8	24	P	Heppell 1945
		48		Santas 1924
Elymus canadensis	7	28	P	Brown 1948,1950
E. cinereus	7	28,56	P	Stebbins & L. 1941
E. glaucus	7	28	P	" " " "
E. triticoides	7	28,42	P	" " " "
Eragrostis barrelieri	10	60	P	Moffett & H. 1949
E. cillianensis	10	20	D	" " " "
E. curtipedicellata	10	40	P	Brown 1951
E. pilosa	10	40	P	Ono & T. 1953
E. spectabilis	10	40	P	Nielsen 1939
		42		Nielsen & H. 1949
Erianthus ravennae	10	20	D	Janaki-Ammal 1941
Reichloa contracta	9	36	P	Brown 1948
Erithronium grandiflorum	12	24	D	Sato 1942
Festuca arizonica	7	42	P	Brown 1951
F. elatior	7	28	P	Stahlin 1929
		42		Myers & H. 1947
		70		Lewitzky & K. 1927
F. idahoensis	7	28	P	Stebbins & L. 1941
F. ovina	7	14,21,28,42	D,P	Loeve & L. 1942
		28,35		Skalinska 1950
		56		Church 1929
F. rubra	7	14,28,42,56,70	D,P	Loeve & L. 1942
		28,42		Brandberg 1948
		42,46,53,64		Juhl 1952
Fritillaria pudica	13	26,39	P	Darlington 1936
Glyceria borealis	5	20	P	Church 1949
G. elata	5	20	P	" "
G. grandis	5	20	P	" "
G. striata	5	20	P	" "
Goodyera repens	15	30	D	Richardson 1935
Habenaria dilatata	7	42	P	Humphrey 1934
Heteranthera dubia	15	30	D	Bowden 1945
Hierochloe dactyloides	6-7	56	P	Nielsen 1939
		60		Avdulov 1931
Hordeum brachyantherum	7	28	P	Covas 1952
H. jubatum	7	14	D	Tanzi 1925
		28	P	Aase & P. 1926
H. pusillum	7	14	D	Kihara 1924
		28	P	Stahlin 1929
Iris missouriensis	11	88	P	Snoad 1952
Juncus alpinus	10	40	P	Loeve & L. 1944

J. bufonius	10	c.70,c.120	P	Wulff 1937
J. castaneus	10	40	P	Loeve & L. 1948
J. tenuis	10	30	P	" " " "
Kobresia bellardi	13	52	P	Bøcher 1938
Koeleria cristata	7	14	D	Tateoka 1954
		28	P	Stebbins & L. 1941
Leersia oryzoides	12	48	P	Tateoka 1954
Lemna gibba	8	64	P	Blackburn 1933
L. minor	10	40	P	" "
L. trisulca	11	44	P	" "
Leucocrinum montanum	7	28	P	Cave 1948
Lloydia serotina	12	24	D	Bianchi 1946
Lolium multiflorum	7	14	D	Peto 1933
L. perenne	7	14	D	Müntzing 1937
Luzula multiflora	6	12	D	Malheiros & G. 1947
		24,36,48	P	Garde & G. 1952
Lycurus phleoides	7	28	P	Brown 1951
	10	40		Avdulov 1931
Malaxis monophyllos	15	c.30	D	Hagerup 1944
Melica bulbosa	9	18	D	Boyle 1945
M. porteri	9	18	D	Stebbins 1941
M. spectabilis	9	18	D	Boyle 1945
Miscanthus sinensis	7-8	28	P	Moriya & K. 1949
		38		Leung & L. 1949
		40		Tateoka 1954
Muhlenbergia andina	10	20	D	Stebbins 1947
M. asperifolia	10	20	D	" "
M. cuspidata	9	18	D	" "
M. filiformis	9	18	D	" "
M. mexicana	10	40	P	Avdulov 1931
M. porteri	10	20	D	Brown 1951
M. pungens	7	28	P	Nielsen & H. 1937
	10	60	P	Nielsen 1939
M. racemosa	10	40	P	Avdulov 1931
Najas guadalupensis	6	12,36,42,54,60	D,P	Chase 1947
N. flexilis	6	12,24	D,P	" "
Oryzopsis asperifolia	(11+12)23	46	P	Johnson 1945
O. hymenoides	12	48	P	" "
O. micrantha	11	22	D	" "
O. pungens	11	22	D	" "
Panicum capillare	9	18	D	Avdulov 1928
P. miliaceum	9	36	P	" 1931
P. obtusum	10	20,40	D,P	Brown 1941
P. screbrerianum	9	18	D	" 1948
P. virgatum	9	18,36,54,72,90,108	D,P	Nielsen 1944
		21-36		Brown 1948
Paspalum dilatatum	10	40	P	" "
P. racemosum	10	20	D	Avdulov & T. 1933
Pennisetum setaceum	9	27	P	Hrishi 1952
P. villosum	9	45	P	Krishnaswamy 1940

Phalaris arundinaceae	7	14,28	D,P	Church 1929
		27-31,35		Hansen & H. 1935
		42		Brook 1955 (?)
P. caroliniana	7	14	D	Brown 1942
P. minor	7	28,29	P	Hansen & H. 1935
Phippsia algida	7	28	P	Flovik 1940
Phleum alpinum	7	14,28	D,P	Litardiere 1949
Phragmites communis	12	36	P	Tischler 1942
		48,c.96		Avdulov 1931
Piptochaetium fimbriatum	11	44	P	Brown 1951
Poa alpina	7	14	D	Müntzing 1948
		28-74	P	" 1940,1954
P. ampla	7	62-100	P	Hartung 1946
P. annua	7	28	P	Litardiere 1938
P. arctica	7	56	P	Flovik 1940
		72-84,c.100		Loeve & L. 1948
		38,56,c.68,75		Nannfeldt 1940
P. arida	7	63-103	P	Hartung 1946
P. bulbosa	7	14	D	Guinochet 1943
		28,45		Akerberg 1942
		42		Hartung 1946
P. compressa	7	35,42,49	P	Akerberg 1942
		45,49,56		Loeve & L. 1948
P. cusickii	7	28	P	Stebbins & L. 1941
		42		Hartung 1946
P. epilis	7	56	P	Armstrong 1937
		c.84		Hartung 1946
P. glaucifolia	7	50,56	P	" "
P. gracillima	7	81-96	P	Müntzing 1946
P. junifolia	7	62-84	P	Hartung 1946
P. nervosa	7	62-70	P	" "
P. nevadensis	7	62-70	P	" "
P. palustris	7	28-30,42	P	Loeve & L. 1942
P. scabrella	7	44-104	P	Hartung 1946
P. secunda	7	74-87	P	" "
P. trivialis	7	14,27,28	D,P	Guinochet 1943
Polygonatum commutatum	10	20,40,60	D,P	Therman 1950
Polypogon monspeliensis	7	28	P	Avdulov 1931
Potamogeton liliformis	13	c.78	P	Loeve & L. 1942
Puccinellia distans	7	14	D	Avdulov 1931
		28	P	Polya 1948
		42		Loeve & L. 1948
Puppia maritima	8	16	D	Wulff 1937
Sagittaria calycina	11	22	D	Brown 1946
S. cuneata	11	22	D	" "
S. latifolia	11	22	D	Oleson 1941
Schedonnardus paniculatus	10	30	P	Brown 1950
Schizachne purpurascens	5	20	P	Boyle 1944
Setaria italica	9	18	D	Avdulov 1928
S. lutescens	9	36	P	" "
		72		Brown 1948

S. macrostachya	9	72	P	Brown 1950
S. verticillata	9	18	D	deWet 1954
		36	P	Avdulov 1931
S. viridis	9	18	D	Tateoka 1954
Sisyrinchium montanum	8	32,c.96	P	Bøcher & L. 1950
Smilax hervacea	13	26	D	Lindsey 1930
Sorghastrum nutans	10	20	D	Saura 1948
		40	P	Brown 1950
Sorghum helepense	5	20,40	D,P	E.K.J.
Spartina gracillis	7	42	P	Church 1940
Sphenopholis intermedia	7	14	D	Nielsen & H. 1937
Sporobulus airoides	9	108	P	Brown 1951
		126		Stebbins & L. 1941
S. asper	9	54	P	Brown 1950
S. cryptandrus	9	18	D	Nielsen 1939
		36	P	Brown 1950
S. heterolepis	9	72	P	Nielsen 1939
S. pyramidalis	6,10	24,30	P	Moffett & H. 1949
S. neglectus	9	36	P	Brown 1950
Stipa columbiana	11	44	P	Nielsen 1939
S. comata	11-12	44-46	P	Stebbins & L. 1941
S. lettermani	11	66	P	" " " "
S. neomexicana	11	44	P	Loeve & M. 1947
S. pinectorum	7	32	P	Myers 1947
S. speciosa	11	66	P	Covas & B. 1947
S. viridula	12-13	82	P	Johnson & B. 1945
Streptopus amplexifolius	8	32	P	Matsuura & S. 1935
Tradescantia canaliculata	6	12,24	D,P	Anderson & S. 1936
T. occidentalis	6	12,24	D,P	" " " "
Trichachne californica	9	18	D	Krishnaswamy 1940
		36	P	Brown 1951
Triclens elongatus	8	32	P	Brown 1950
T. pilosus	8	16	D	" "
Triglochin palustris	6	24	P	Loeve & L. 1944
Trillium ovatum	5	10	D	Warmke 1937
Trisetum flavescens	6-7	24	P	Avdulov 1931
		28		Nakajima 1930
T. spicatum	7	28	P	Flovik 1938
Yucca angustissima	15	60	P	Watkins 1936
Y. baccata	15	60	P	" & McKelvey & S. 1933
Y. glauca	15	60	P	" " " " " "
Y. harrimaniae	15	60	P	" " " " " "
Y. standleyi	15	60	P	" " " " " "
Zizania aquatica	15	30	D	Brown 1948
Zygadenus elegans	8	32	P	Miller 1930

Mount Diablo, California: Monocotyledons

Species	Basic number (x)	Chromosome number (2n)	Polyploidy	Author
Agrostis verticilata	7	14	D	Brown 1950
Aira caryophyllea	7	14	D	Wulff 1937
Avena fatua(intro.esc.)	7	42	P	Philip 1933
A. barbata (" ")	7	28	P	Huskins 1927
Briza minor	5	10	D	Avdulov 1931
Brodiaea elegans	8	32	P	Burbanck 1941
B. hyacinthina	7	28	P	" "
B. laxa	7,8,9	18,28,42,48	D,P	" 1941,1944
Bromus carinatus	7	56	P	Stebbins & T. 1944
B. laevipes	7	14	D	" " " 1941
B. madritensis	7	28	P	Knowles 1944
B. mollis	7	28	P	" "
B. racemosus	7	28	P	" "
B. rigidus	7	42	P	Cugnac & S. 1941
		56,70		Beck & H. 1932
B. rubens	7	28	P	Knowles 1944
B. trinii	7	42	P	" "
Calamagrostos rubescens	7	28,42,56	P	Nygren 1954
Calochortus luteus	6-10	17,20,21	D,P	Beal & O. 1943
C. pulchellus	10	20	D	" " " "
C. splendens	7	14	D	" " " "
C. umbellatus	10	20	D	" " " "
C. venustus	7	14	D	" " " "
Chlorogalum poeridianum	9	36	P	Cave 1949
Cynodon dactylon	9	36	P	Brown 1950
	10	40		Hurcombe 1947
Deschampsia danthonioides	13	26	D	Myers 1947
Disporum hookeri	9	18	D	Jones 1951
Echinochloa crusgalli	7-9	36	P	Brown 1948
		42		Church 1939
		48		Rau 1929
		54		Tateoka 1954
Eleocharis palustris	5-9	10,16	D	Levisky 1940
		36	P	Hicks 1929
		38		Hakanson 1954
Elymus glauca	7	28	P	Stebbins & L. 1941
E . triticoides	7	28,42	P	" " " "
Festuca californica	7	56	P	" " " "
Fritillaria lanceolata var.	12	24,36	D,P	Darlington 1936
		24,36,48		Beetle 1944
Hordeum gussoneanum	7	28	P	Chin 1941
H. murium	7	14	D	Stolze 1925
		28	P	Aase & P. 1926

H. nodosum	7	14,28	D,P	Chin 1941
		42		Griffee 1927
Juncus bufonius	10	c.60,c.120	P	Wulff 1937
J. effusus	10	40	P	Loeve & L. 1944
Koeleria cristata	7	14	D	Tateoka 1954
		28	P	Stebbins & C. 1941
Lemna minor	10	40	P	Blackburn 1933
Lilium pardalium	12	24	D	Sansome & L.C.1943
Lolium multiflorum	7	14	D	Shalygin 1941
L. perenne	7	14	D	Müntzing 1937
L. tenulentum	7	14	D	Jnekin & T. 1938
Luzula campestris	6	12,36	D,P	Nordenskiöld 1951
Melica bulbosa	9	18	D	Boyle 1945
M. californica	9	18	D	" "
M. imperfecta	9	18	D	Stebbins 1941
M. torreyana	9	18	D	" "
Poa annua	7	28	P	Litardiere 1938
P. scabrella	7	44-104	P	Hartung 1946
Polypogon lutosus	7	28,42	P	Heiser & W. 1948
Sisyrinchium bellum	8	32	P	Bowden 1945
Sitanion hanseni	7	28	P	Stebbins & L. 1941
S. hystrix	7	28	P	" " " "
S. jubatum	7	28	P	" " " "
Smilacina stellata	9	36	P	Stenar 1935
Stipa lepida (8+9)	17	34	P	Loeve 1954
S. pulchra	8	64	P	" "
		66		Nielsen 1939
Trillium sessile	5	10	D	Darlington & L.C. 1940
Typha latifolia	15	30	D	Harada 1947
Zygadenus fremontii	11	22	D	Miller 1930