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Research Study Report

RER-6

THREE MOUNTAIN AREAS IN SOUTHWESTERN WYOMING

by

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FOREWORD

The importance of mountainous terrain in military operations has long been recognized. Cities and defenses have been built and military campaigns planned taking advantage of natural mountain barriers. The experiences in the mountains of Italy during World War II forcefully emphasized the requirements for more information on the nature of mountains and the capabilities of man and equipment to perform under such conditions. In order to strengthen the ability to operate in the mountains it was decided to establish a mountain training site. The then Environmental Protection Section was requested to study and evaluate several potential site areas. An interim report was submitted and one of the sites studied was selected for the training site of the Mountain and Cold Weather Training Command. The present report is an expansion and revision of the interim report, and with this report the assignment is considered completed.

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Abstract

In Southwestern Wyoming the three major mountain areas present marked contrasts in environmental characteristics.

The Wind River Range Area contains rugged isolated peaks with alpine glaciers and elevations from 12,000 to 13,700 feet above sea level. The upper slopes are covered with subalpine forest, except for the high meadows, and below the 7,000 foot elevation sagebrush and grass are predominant. Much of this range has been classified as a wilderness area by the United States Forest Service.

The Wyoming-Salt River Range Area consists of several parallel ranges with elevations up to 11,000 feet above sea level. These ranges contain scattered areas of alpine meadow, but most of the slopes are in coniferous forests with aspen groves and grassy areas at lower elevations. This area has a relatively high amount of cultivated land in Star Valley and South Piney Creek Valley, but sagebrush predominates in all other parts of the lower foothills.

The Uinta Range Area is a sinuous plateau remnant. Elevations of the highest portions of the Uinta Range are 13,400 feet, only slightly lower than in the Wind River Range. In contrast with the other areas having a general northwest-southeast trend to their ranges, the Uintas have a unique east-west trend. The vegetative cover is much like that of the other two areas except that much of the middle and lower slopes are in mountain brush and scrub woodland. In addition, large areas of the Bridger Basin are in badland and waste land. This area has the greatest number of mines of the three areas, and is crossed by the densest network of transport lines.

A. INTRODUCTION

1. Purpose of Study

This report describes environmental conditions affecting military operations in the mountains of southwestern Wyoming. Originally prepared for limited distribution in 1951 as Environmental Protection Section Special Report No. 53, the material in this report has been slightly expanded and revised, and supersedes SR No. 53 which should be destroyed. The original report was intended to evaluate the suitability of the three major mountainous areas in southwestern Wyoming as military training sites. A locality in one of these areas, Gannett Peak in the Wind River Range, was subsequently selected by the Army Ground Forces Mountain and Cold Weather Training Command as a training site. This revised report is intended to be utilized in planning training operations by Army units in southwestern Wyoming.

2. Location of Areas

The report discusses three predominantly mountainous areas in southwestern Wyoming and northeastern Utah between 40°30' and 43°30' north latitude and 109°00' and 111°30' west longitude. For the purpose of this report the areas are called the Wyoming-Salt River Range Area, the Wind River Range Area, and the Uinta Range Area. These mountain ranges enclose the Upper Green River and Bridger Basins, high plateau basins with a general elevation of 6,500 to 7,500 feet. The location and delimitation of the areas is shown on the Location Map, Figure 1.

3. History

Southwestern Wyoming played a prominent part in the early development of the West due to its position athwart the principal routes of travel to Salt Lake and the Pacific Coast. Both the Oregon Trail and the Overland Trail to California entered the Bridger basin at what is now the town of Granger, continuing together through Fort Bridger, the trading post established in 1843 by James Bridger and Louis Vasquez, where they turned to the northwest to follow the Bear River Valley into Idaho. The numerous expeditions and emigrant trains that stopped at Fort Bridger on their westward journeys included Fremont's expedition of 1843-44 and the first Mormon train in 1847. When the Union Pacific Railroad was built in 1868-69 it followed the emigrant route to Utah, taking advantage of the coal supplies near Evanston to establish its shops and division point there. In 1881-82 the Oregon Short Line was built, leaving the main track at Granger and following the route of the Oregon Trail down the Bear River.

During the period of westward expansion there was sporadic Indian fighting in this region but no major campaigns. There was also some conflict between Federal authorities and Mormon settlers in 1857, resulting in the establishment of an Army post at Fort Bridger. Troops were maintained here for a number of years, but were finally withdrawn and the Military Reservation passed into private hands again. The fort and its buildings are now maintained as a State Park.

For the past seventy years the region has been utilized for grazing, supplemented by irrigation agriculture on the bottomlands along the river. The mountainous areas have become important as centers of recreation and forest reserves.

B. PHYSICAL FEATURES

1. Topography

Although all three areas are predominantly mountainous they exhibit three different types of mountain topography. The mountains of the Wyoming-Salt River Range Area are characterized by extensive ridge development, those of the Wind River Range Area by individual peaks, and those of the Uinta Range Area by a plateau remnant crestline which has been extensively eroded into cirques. A general topographic description for each area follows.

a. Wyoming-Salt River Range Area

This area is dominated by the Salt River Range in the west and the Wyoming Range in the east central section. These two ranges traverse the area in a north-northwest to south-southeast direction forming a succession of rugged ridges and peaks.

Throughout most of its length the Salt River Range forms the divide between the Salt River and Greys River. Many of its peaks are over 10,000 feet in elevation and it reaches a maximum elevation of 10,900 feet in an unnamed peak eight miles east of Afton, Wyoming. The northern terminus of the range is the canyon of the Snake River. In the northern portion it is predominantly a single range. South of Mt. Wagner, however, it branches into two ranges, the Tump Range on the west and Commissary and Absaroka Ridges on the east.

East of, and parallel to, the Salt River Range is the Wyoming Range which occupies the middle part of the area. This range also terminates at the Snake River in the north. It is characterized in the north by a single distinct ridge (Grayback Ridge). In its central portion it widens into two parallel ridges which are connected by spurs. These two ridges join again in the vicinity of South Piney Creek. The crest of Grayback Ridge varies slightly in elevation from 9,500 feet in the north to 9,700 feet in the south. Many peaks in the central part of the range have ele-

THREE MOUNTAIN AREAS IN SOUTHWESTERN WYOMING

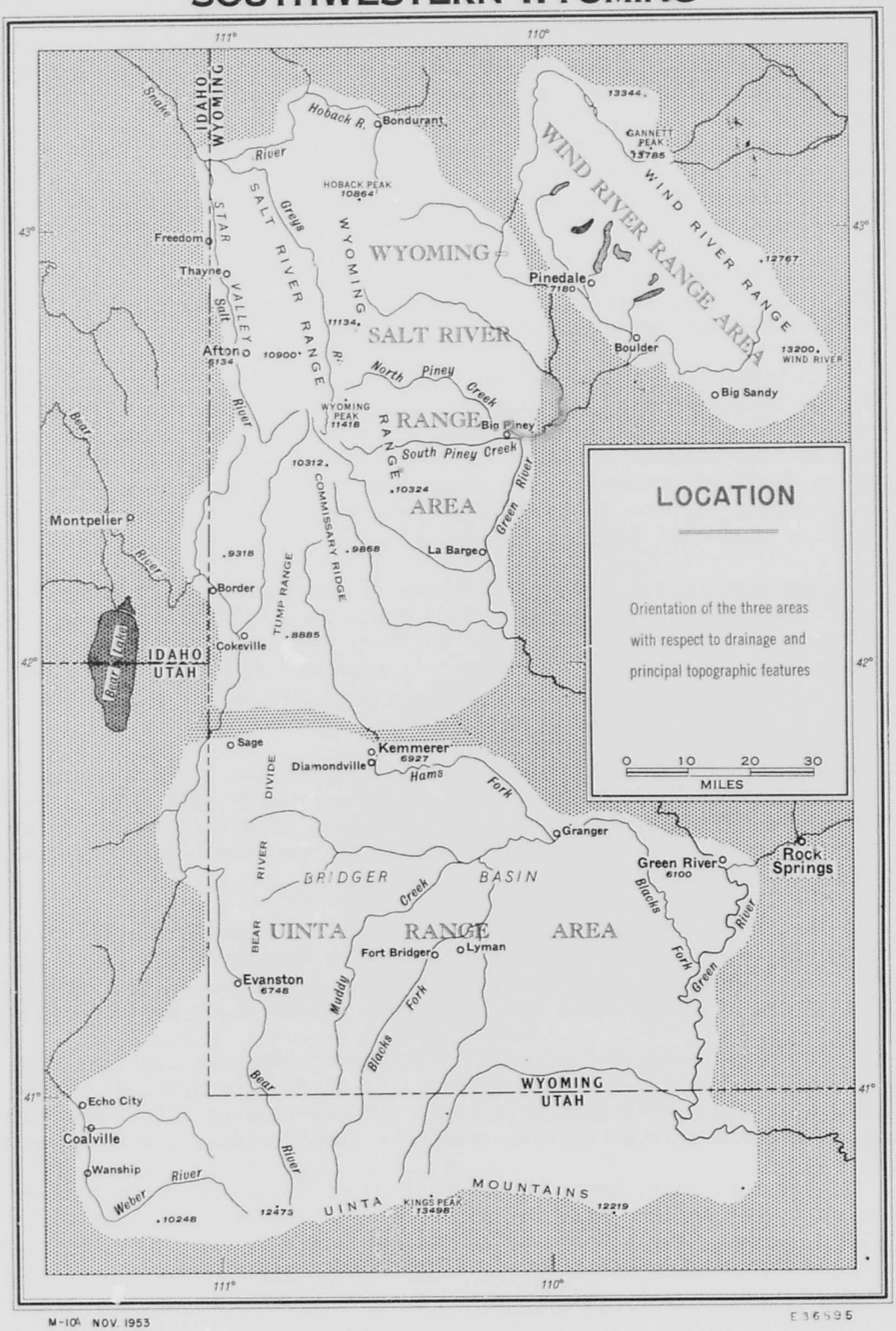

Figure 1.

vations over 10,000 feet, and Wyoming Peak, the highest, has an elevation of 11,418 feet. South of Wyoming Peak the Wyoming Range continues in the form of a broad tableland (Thompson Plateau), which ranges in elevation from 10,000 to 10,300 feet. The western edge of the plateau forms steep cliffs, but on the east there are gentle slopes.

In the south this plateau passes into Meridian Ridge whose elevation decreases from 10,000 feet in the north to 8,000 feet in the south, where it approaches the level of the surrounding plains and loses its topographic identity.

West of the Thompson Plateau and Meridian Ridge a series of hogbacks forms the eastern margin of a broad valley (Mammoth Hollow). Absaroka Ridge forms the western border of this valley.

In the northeastern part of the Wyoming-Salt River Range Area the Hoback Range extends from the Hoback River Canyon southward to the vicinity of Horse Creek. The range gradually rises toward the south, culminating in Hoback Peak with an elevation of 10,864 feet. South of Hoback Peak the range is less prominent. The range south of Hoback Canyon has a double crest. The eastern ridge is the more prominent with the western ridge forming a spur of it.

The eastern and southern portions of the Wyoming-Salt River Range Area are in the Green River Basin. This basin is a high plain broken by scattered, relatively flat hills and by long, low hogback ridges. On the west the area is bounded by the valleys of the Salt River and Bear River.

b. Wind River Range Area

The Wind River Range forms the backbone of the Rocky Mountain system for approximately 85 miles through west-central Wyoming. The Wind River Range Area of this report, however, includes only the western flank of the range from the crest line southwestward to the eastern edge of the Green River Basin.

The Wind River Range is characterized by a heavily glaciated crest line composed of prominent individual peaks and sharp crested ridges. The major peaks may be divided into two groups, the southern group dominated by Wind River Peak and the northern by Fremont and Gannett Peaks.

The elevations of the peaks in the northern group are very high with Gannett Peak, elevation 13,785 feet, the highest in Wyoming. There are many mountain glaciers in this group and practically all of the surface at higher elevations has been eroded to narrow ridges and sharp peaks.

In the southern group the elevations of the peaks are not as great as those in the north. Existing glaciers are small and are limited to individual peaks. These southern mountains, however, still retain a very rugged topography. The western side of the range contains many cliff-

walled cirques and canyons.

e. Uinta Range Area

The southern portion of the Uinta Range Area consists of the northern flank of the Uinta Mountains from the crestline northward. The Uinta Mountains have a plateau-like crest which has been dissected into a series of peaks, many rising 12,000 to 13,000 feet in elevation with spurs which project into the basin to the north, dividing the range into a large number of cirques. The basins formed by these cirques vary from one to twelve square miles in area and are characterized by precipitous enclosing walls.

In the western part of the range the nearly horizontal beds of rock composing the crest of the mountains are sufficiently varied in hardness to give rise to minor cliffs and benches on the peaks. In the east the underlying rock is softer and the crest line and associated peaks have a more rounded character. At places along the edge of the range it is flanked by hogback ridges.

North of the Uinta Range is Bridger Basin. This basin area has been extensively eroded and its main topographic features consist of eroded ridges and deep cut valleys. The largest ridge, known as the Bear River Divide, runs generally northward forming the western border of the Basin. Elevations above 8,000 feet are numerous. The slopes of the southern part of the ridge vary from gentle to steeply rolling. In the northern part the ridge is eroded into much rougher topography. In the eastern part of the Basin the topography consists of dissected remnants of the plain which once formed the basin floor, with steeply eroded escarpments leading down to the present stream channels. In the eastern part of the basin there is an area of "badlands" (indicated on the Vegetation Map, Figure 2). This consists of a heavily eroded clay formation forming innumerable small steep-sided gullies separated by sharply crested ridges. Though the over-all relief in this area is not great, the terrain is extremely rugged.

2. Drainage

a. Wyoming-Salt River Range Area

In the Wyoming-Salt River Range Area the major rivers are the Snake and Hoback Rivers which form the northern boundary of the area, the Bear and Salt Rivers which form the western boundary, and Greys River which flows through the valley that separates the Wyoming and Salt River Ranges. The eastern portion of the area is drained by tributary streams which rise in the mountains and flow eastward to Green River. In the south the streams of the western portion drain into the Bear River.

Within the mountainous portions of the area, streams flow through three principal types of valleys: (1) precipitous walled canyons; (2) steep-sided, V-shaped valleys; and (3) valleys with terraced floors, these ter-

races frequently being wide enough to form small parks between the stream bed and the base of the enclosing slopes. Streams which flow across the Green River and Bridger Basins have broader floored valleys and generally flow in steep-walled channels. Larger streams furnish water for irrigation along their middle and lower courses.

The Bear and Salt River Valleys have relatively broad, flat floors, and irrigation is used extensively. The Star Valley of the Salt River is a highly productive dairy region.

b. Wind River Range Area

In the highest levels of the Wind River Range, glaciers produce small, steeply graded, fast flowing streams, which empty into high basin lakes. Many of these high lakes occupy the basins of cirques, and their outlet streams flow through U-shaped valleys where frequently, due to irregularities in the valley floor or damming by morainal deposits, "chain" lakes are formed. From this zone of chain lakes streams flow either southwestward into tributaries of the Green River or, in the north central part of the area, into a group of large "finger" lakes of which Fremont Lake is the largest.

c. Uinta Range Area

The majority of streams in the Uinta Range Area rise in cirque basins near the crest of the range and flow northward through Bridger Basin. All larger valleys have the U-shape characteristic of glaciated valleys. In their upper portions these valleys are floored by bedrock, but in their lower portions they are floored with glacial deposits. However, there is not the extensive development of "chain" lakes in the middle and lower portions of these valleys that is found in the Wind River Range Area. The streams in their upper courses are swift flowing and turbulent, and most flow northward into the Bridger Basin where they join tributaries of the Green River or turn eastward and empty directly into the Green River.

In the south central part of Bridger Basin aprons of outwash material extend several miles northward from the foot of the mountains. As the streams flow past these aprons their valley walls consist of a succession of alluvial terraces separated by steeply eroded escarpments. These terraces, composed mainly of coarse mountain debris, gradually diminish in width toward the north.

Throughout the basin area there are many intermittent streams which occupy steep-sided gullies. The Green River and its major tributaries are often bordered by cliffs, some of which are considerably over a hundred feet high.

3. Surface Conditions

a. Wyoming-Salt River Range Area

At the highest elevations in this area the surface consists of bare rock on the steep slopes and peaks, interspersed with mountain meadows having a thin soil cover. On ridges and slopes at lower elevations there is a thin, boulder-strewn soil cover that supports extensive coniferous forests. Valley bottoms contain terraces and parks with a soil composed of rock debris and alluvium, and a vegetation cover of sage and bunchgrass. Steep slopes and cones of rock debris occur at the base of cliffs at all levels.

b. Wind River Range Area

The crest area of the Wind River Range is composed of peaks and sharp ridges of bare rock. Many of the high peaks are accompanied by glaciers. Steep slopes and cones of glacial debris occur at the bases of cliffs throughout the area. The flanks of many of the crests and peaks form the walls of cirques and gorges, the floors of which are often occupied by lakes. The valleys that lead from these cirques and gorges trend generally southwest with a floor covering of coarse glacial debris which has dammed up numerous lakes. This zone of glacial deposits also contains small swamps and areas of wet ground.

c. Uinta Range Area

In the crest area of the Uinta Range the surface consists of bare rock or thinly covered rock surfaces with steep slopes, and cones of detritus at the base of the cirque walls which are so characteristic of this range. The floors of the upper portion of the valleys leading from these cirques are also predominantly bare rock. In the middle and lower portions of these valleys there is a cover of glacial debris in the form of moraines and glacial outwash deposits.

The Bridger Basin to the north is a semi-arid plateau with areas of heavily eroded "badlands" in its southern portion. These are shown on the vegetation map as "waste lands", south and southeast of Granger. Throughout most of the basin the main obstacles to surface travel are the abrupt though relatively low escarpments that generally border the elevated parts of the basin and the terraces that border the streams. Passage across the "badland" areas is nearly impossible for vehicles and difficult on foot because of the extremely narrow valley bottoms, the steep, smooth slopes, and the sharp crests.

Persons interested in the detailed hypsometry of these areas will find useful information on U.S.G.S. topographic sheets indexed in Figure 8.

4. Climate

a. General

Located over 700 miles inland, and surrounded and divided by mountain ranges of varying size and orientation, southwestern Wyoming has a dry, "continental" climate. The region is semiarid at lower elevations and moderately humid in the mountains, with temperatures ranging from well below freezing in winter to pleasantly warm in summer. Winters are long and summers short, due in great part to the altitude.

b. Temperature

On the whole, in both winter and summer, temperatures are more affected by local topography than by elevation. This is indicated by the mean monthly temperatures shown in Table I, in which the stations are arranged according to their elevations. Since there are no climatic data available for the mountain areas proper, the temperature figures given are representative only of the marginal areas and cannot be construed as indicative of conditions in the mountains, except in a general way. Certain generalizations can be made, however, concerning the temperatures in this region. Variation in temperature, both diurnal and seasonal, is large; at Rock Springs, for example, there is an average range of 26F° daily and 77F° annually. The warmest month of the year is July, the coldest, January. The periods of warm weather are never of sustained duration and the nights are comfortably cool and pleasant during the summer. Freezing temperatures are possible at any time during the summer months, and average temperatures are below freezing for about five months each year, from November through March.

Some of the coldest temperatures ever recorded in the United States were observed in this general region. Five of the ten places which have reported temperatures of -60° or lower, during the 80 years for which there are official weather records, are located within 25 miles of the western boundary of Wyoming, and one of them, Border, is on the western margin of the Wyoming-Salt River Range Area. On 8 February 1929, Border recorded a temperature of -60°, which is only six degrees above the present United States record of -66° recorded at the Riverside Ranger Station in Yellowstone Park. According to the statistical theory of extreme values, temperatures of -60° or colder should occur about 16 times in 1,000 years at Border— if general climatic conditions do not change. Expressed in another way, the chances that the temperature will go as low as -60° in any one winter at Border are 16 in 1,000, and there is an even chance that in any winter the temperature will drop to at least -34°.

However, very low temperatures do not occur over a very wide area. Occurrence of temperatures below -40°depends primarily on the relation of the local topography to the general weather situation. In each of the three mountain areas, there are probably many locations where local topography,

Table I: MEAN MONTHLY TEMPERATURES AT SELECTED POINTS IN SOUTHWEST WYOMING - (°F)

Location	Elev (ft)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Coalville (Utah)	5642	21.4	27.0	33.8	43.6	51.3	58.3	66.3	64.4	55.7	46.0	33.1	23.9	43.7
Border	6085	11.9	15.6	24.8	38.6	48.1	56.0	63.5	61.1	52.1	41.8	28.4	15.2	38.1
Green River	6109	18.5	23.3	32.7	42.9	52.5	61.5	69.2	67.0	56.7	44.8	32.1	20.7	43.5
Rock Springs	6271	18.7	23.7	32.0	42.1	52.0	60.1	68.2	66.4	56.7	45.4	31.0	20.9	43.4
Sage	6331	14.2	19.2	23.2	39.5	48.2	56.5	64.6	61.7	52.3	41.4	27.5	17.5	38.8
Big Piney	6820	10.2	12.0	23.1	36.3	45.0	51.9	58.9	55.1	47.8	38.2	22.8	15.2	34.8
Kemmerer	6954	17.4	20.7	27.6	39.4	49.0	55.9	63.4	61.6	52.9	42.9	28.5	22.6	40.2
Evanston	7009	18.9	21.2	28.0	38.6	46.8	53.9	62.2	60.7	52.4	42.0	30.6	20.8	39.7
Pinedale	7180	9.6	15.2	22.8	34.7	44.5	52.8	60.3	57.4	48.9	38.7	23.1	14.4	35.4

combined with the general weather situation, can produce such low temperatures. These temperatures are most likely between mid-January and mid-February; it is unlikely that they would occur before Christmas or after early March.

In contrast to these low winter temperatures, one or more hot days (over 90°F) may be expected during each of the summer months. Two of the stations shown on Table I, Border and Green River, have experienced absolute maximum temperatures of 100°F. The highest temperatures reported at the other stations on Table I have been over 95°F. Average maximum temperatures for the warmest months at these stations, however, are in the middle 80's except for Evanston and Pinedale, each with 79°F. The average daily maximum temperatures for June, July, and August are above 70°F at each of these stations. At all stations except Green River, however, the average daily minimum temperature for June, July and August is below 50°F. Each of these stations has experienced absolute minimum temperatures between 20° and 30°F during each of the summer months. On the other hand, absolute maximum temperatures between 50° and 60°F for each of the winter months, December, January and February, have been recorded at these stations.

c. Precipitation

The amounts and seasons of rainfall and snowfall vary markedly with the topography. In and near the mountains, more than half the total yearly precipitation comes during the colder half of the year, chiefly in the form of snow; in the larger intermontane basins summer showers account for most of the precipitation, which is much less than at higher elevations. Summer rainfall usually occurs in the form of thunderstorms which are intense but of short duration. They are often accompanied by hail and electrical storms, especially in the mountains. Lives have sometimes been lost from cloudburst floods in canyons or deep draws. The amount and monthly distribution of precipitation in southwestern Wyoming are indicated in Table II.

The annual snowfall varies from 40 inches at the lower elevations such as the Bridger Basin to 100 inches in the higher mountains. The number of days each year with one inch or more of snow on the ground varies from 60 to 100. No data are available for actual snow accumulation in the area.

d. Wind

The prevailing wind direction is west in the vicinity of Rock Springs and Green River, but local topography may cause considerable variation in wind directions in various other parts of the region, especially in the mountains. In the lower elevations the average wind velocity is high and the maximum generally occurs during the hours of greatest heating, causing dust storms and considerable discomfort during protracted dry spells. No tornadoes have been reported in this region.

Table II: MEAN PRECIPITATION BY MONTHS, SELECTED POINTS IN SOUTHWEST WYOMING (inches)

Location	Elev (ft)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Coalville (Utah)	5642	1.11	1.36	1.39	1.15	1.23	1.11	.82	1.21	.75	1.29	1.14	1.03	13.59
Border	6085	1.19	1.15	1.15	1.19	1.31	1.02	.72	.84	1.15	1.28	.91	.99	11.98
Green River	6109	.38	.51	.58	.91	1.04	.58	.53	.72	.82	.84	.43	.34	7.68
Rock Springs	6271	.43	.72	.66	1.24	1.02	.78	.98	.80	.63	.98	.54	.35	9.13
Sage	6331	.45	.61	.67	.88	.96	.68	.86	.88	.96	1.11	.67	.48	9.21
Big Piney	6820	.32	.32	.45	.83	1.30	1.26	.75	.96	1.18	1.19	.39	.29	9.24
Kemmerer	6954	.61	.66	.73	.81	.90	1.01	.75	.89	.64	.84	.65	.63	9.12
Evanston	7009	1.00	1.19	1.28	1.25	1.36	1.00	.96	1.10	1.01	1.22	.89	.82	13.08
Pinedale	7180	.83	.79	.73	.81	1.12	1.16	1.02	1.05	1.10	.89	.68	.86	11.04

5. Vegetation

The vegetation of the three areas under study has been divided into five general types for representation on the Vegetation map, Figure 2. These are (1) cultivated land, (2) sagebrush and grass, (3) mountain brush and woodland, (4) subalpine forest, and (5) alpine meadows and barren peaks. The altitudinal level of each is generally in the order given, from the lowest to the highest. This classification represents a considerable simplification of the actual conditions, particularly with respect to the sagebrush and subalpine forest types, but within each there is a good deal of uniformity of general aspect and density of the vegetation. Following is a brief description of the vegetation within each of the types shown on the map.

a. Cultivated Land

Cultivated land in this region is mostly irrigated, though some of it is dry-farmed. It is located in the land bordering the rivers and streams, most of which was covered originally with grass or sagebrush. The principal crops raised are oats, barley, alfalfa, and various other hay plants.

b. Sagebrush and Grass

The type designated Sagebrush and Grass includes all of the open, sparse vegetation of the valleys and lower foothills, in which the plants grow separately as shrubs or clumps with more or less bare soil between. Its presence indicates a desert or semi-desert climate, where the annual rainfall is less than 15 inches. Included in this type are several distinct vegetative associations, the difference in distribution being due in most cases to soil conditions and degree of alkalinity rather than to difference in rainfall. The most common plant of the sagebrush type is the "big sage" which covers large areas throughout the Great Basin Region; it is also referred to as "black sage" during the fall and winter months when it has lost its silvery leaves. Over most of its range in southwestern Wyoming its height is commonly 2 or 3 feet and the plants are several feet apart, but in especially favorable sites this plant may reach a height of 6 feet or more and take on the aspect of an open miniature forest. During spring, annual flowering plants and native grasses grow between the sagebrush plants. Other types of sagebrush which are found in the less favorable areas are the small sage, forming clumps about 18 inches, silver sagebrush, and rabbit brush. At its upper limits, between 7,500 and 8,500 feet elevation in this area, the sagebrush type merges into the subalpine forest or mountain brush.

At lower elevations where the soil tends to be somewhat alkaline, the "big sagebrush" gives way to a species known as shadscale, which grows in widely spaced clumps about one foot high. There are considerable areas of shadscale in the eastern part of the Bridger Basin, in the Uinta Range Area. On still more alkaline soils there grows a very sparse vegetation cover that is called mat salt bush, in which the widely spaced plants are only a few inches high. Other plants found on the more saline soils are cactus (prickly

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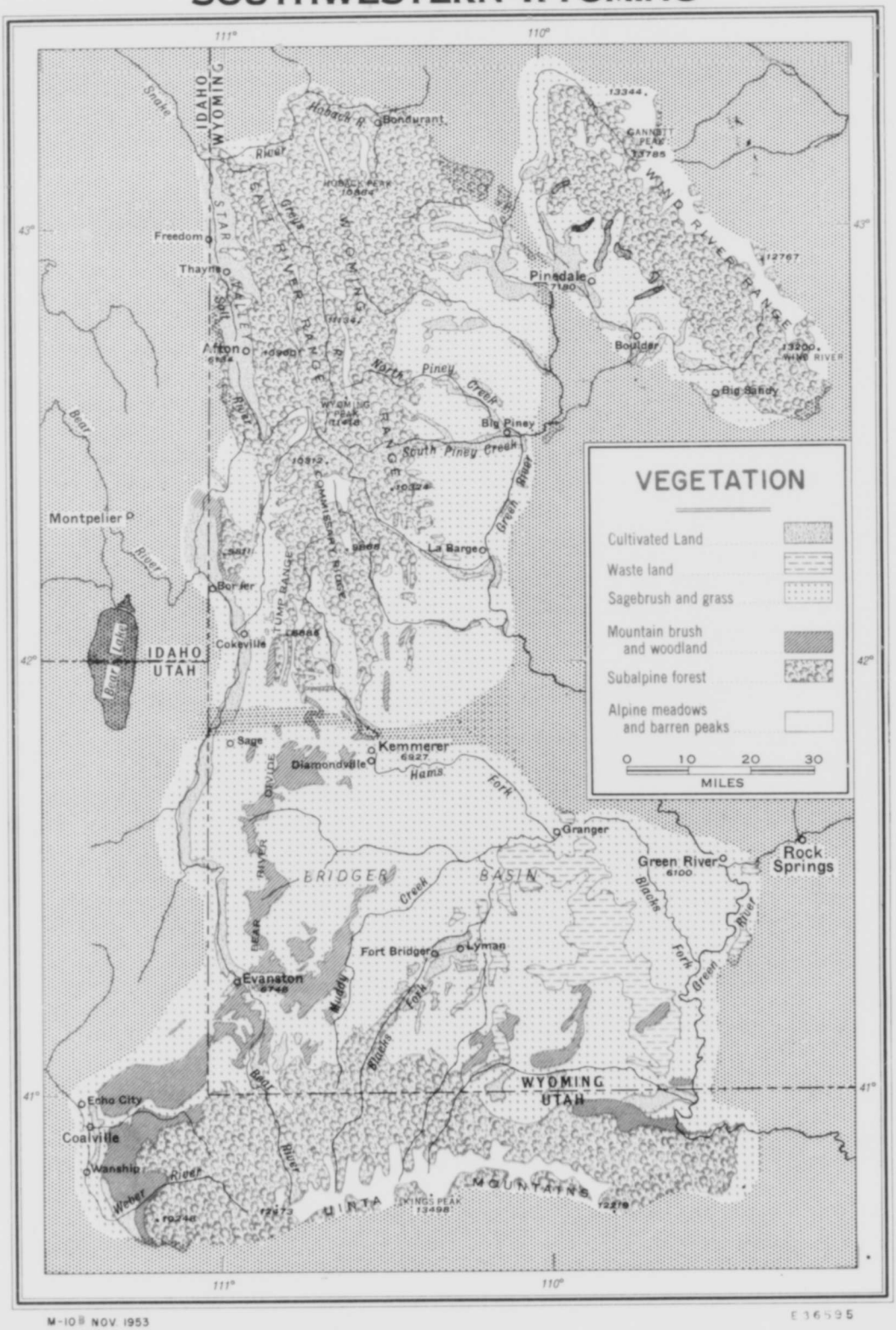

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Figure 2.

pear), greasewood, alkali spikegrass, and salt sage.

Several small areas of bunch grass, especially in the northeastern and southwestern portions of the Wyoming-Salt River Range Area, have also been included with the sagebrush type. Though botanically it is quite distinct from sagebrush, bunch grass resembles the smaller species of sage in its open "clumpy" habit of growth, and has been included with it because of this open character.

Within the area generally covered by sagebrush there are some fairly extensive "waste lands" where there is practically no vegetation. These have been indicated on the map, and are found mainly in the Bridger Basin south of Granger. The lack of vegetation is due not to climatic conditions but to the local topography, which consists of heavily eroded badlands where there is insufficient soil and soil moisture to support plant growth.

Along stream courses in many parts of the sagebrush and bunchgrass type there are growths of willows, sometimes extending into the subapline forest. These are not of sufficient width to be indicated on the map; consequently they are included here with the sagebrush though actually they are distinct from it.

From the foregoing discussion it may be concluded that within the sagebrush type as a whole the vegetation presents only a slight to moderate obstacle to surface movement. In other words, a vehicle could be driven through most of it with little or no hindrance from the vegetation.

c. Mountain Brush and Woodland

This mountain brush type occurs mainly within the Uinta Range Area, and includes some of the lower mountain lands where either the soil is too shallow or the rainfall is insufficient to support forests. It is a shrubby woodland varying in density from open to moderately dense. The principal plants are scrub oak, mountain mahogany, serviceberry, and other evergreen shrubs. It is possible for men to walk through such vegetation, though occasionally with difficulty; vehicles, however, would encounter a considerable obstacle.

In a few places juniper trees (locally called "cedars") are found on the higher ridges, forming an open woodland, but since they are of such small extent they have been included with mountain brush on the map.

d. Subalpine Forest

At its lower altitudinal limits, usually between 8,000 and 8,500 feet, the subalpine forest is an open type with many groves of quaking aspen, open stands of lodgepole pine or Douglas fir, and occasional grassy areas. The forest becomes more dense at higher altitudes, forming heavy stands of timber on the more favorable slopes. The trees comprising this forest are

almost entirely coniferous, except for the aspens which occur at the lower elevations and in areas where the conifers have been destroyed by fire. At the lower altitudes the principal species are lodgepole pine and Douglas fir; Rocky Mountain white pine (limber pine) often grows with them in patches or scattered stands, especially along the ridges and dry slopes. There are also some scattered stands of ponderosa pine, especially in the Wind River Range Area and on the northeastern slopes of the Uinta Mountains. At the higher altitudes (above 9,500 feet) there is a forest of Englemann spruce and alpine fir, which extends up protected valleys to the timber line between 11,000 and 11,500 feet.

The lodgepole pine forests are economically the most important, and account for the majority of all timber produced in southwestern Wyoming. They grow where the average annual precipitation is 18 inches or more, and can endure great extremes of temperature for short periods. Due to its ability to reproduce readily following fires, this tree has extended its range in burned-over areas at the expense of the Douglas fir in the lower mountains and the spruce-fir forests of the higher slopes; it may be found as high as 10,000 feet.

The subalpine forest is not as uniform in density as might be inferred from the vegetation map. There is considerable variation in density depending upon slope, exposure, soil, and local moisture conditions. On favorable sites there are dense stands that can be traversed only with difficulty, except on the trails; other areas, such as rocky talus slopes and moraines, have few trees but rugged terrain. In many places the forest encloses grassy meadows which offer no obstacle to surface movement, while the average condition within this type permits fairly easy movement for persons on foot but is impassable for vehicles except on roads.

e. Alpine Meadows and Barren Peaks

Above the tree line vegetation is limited to meadows of sedge, grass, and annual flowers in favorable spots, alternating with barren mountain peaks where only hardy mosses and lichens survive. In the zone of transition from the forest to the alpine type, the trees take on a stunted and prostrate form, with occasional willow thickets, dwarfed pines, and shrubby cinquefoil, but these disappear altogether above 11,500 feet. Even at lower altitudes, as in the Salt River and Wyoming Ranges, the crests of the ridges may be practically barren due to the lack of soil in which plants can grow. In the Wind River Range all peaks are barren, and vegetation within this type offers no obstacle to surface movement, but difficulties are likely to be encountered from snow, ice, and the ruggedness of the terrain.

6. Harmful Animals, Insects, and Plants

a. Large Animals

There is an abundance of wildlife in the mountains of southwestern Wyoming, but few animals are likely to be dangerous to human beings. The shooting of game animals and birds is closely regulated by State laws. Black bear are fairly numerous in the Wind River and Wyoming-Salt River Range Areas, and range widely in the mountains. They are harmless except when wounded or defending their young, but food supplies must be protected from them. Grizzly bears are very rare, inhabiting only the high mountains of the Wind River Range Area. The Forest Service estimates that there are a total of ten grizzlies in the Bridger National Forest, and none in the Uinta Range Area. Like the black bear, the grizzly is harmless except when wounded or cornered or when someone interferes with his taking food supplies, in which case he may be dangerous. Mountain lions are found only in the northwestern part of Wyoming and are unlikely to be encountered in any of the areas of this study.

b. Reptiles

The only dangerous reptile of southwestern Wyoming is the "faded " or yellow rattlesnake. The principal range of this species is in Utah, but it might be encountered in rocky places at lower elevations (below 7,000 feet) in the Uinta Range Area. This snake is pale brownish gray, cream, or straw color, with an unpronounced pattern. No poisonous snakes are reported from the Wind River or the Wyoming-Salt River Range Areas.

c. Insects and Arachnids

The woodtick which carries the organism causing Rocky Mountain spotted fever, a sometimes fatal disease, is found from March until late May or early June, especially in the sagebrush areas frequented by livestock. Since the Uinta Range Area has the largest amount of such lands, it is most likely to occur there, but it can be expected at lower elevations in all three of the areas. Other less serious tick-borne diseases which have been reported from this general region are relapsing fever and Colorado tick fever, which somewhat resembles dengue. Tularemia is carried by wild rabbits, antelope, sage chickens, coyotes, and deer, and can be contracted not only by contact with infected animals but also by bites from infected ticks or deer flies. Mosquitoes are not known to carry disease in this region, but they cause considerable annoyance in the summer in many mountain areas, especially along streams. They disappear at the higher altitudes about the middle of August. Deer flies and gnats are prevalent in mid-summer in the rural regions at lower elevations, and their stings may require treatment with baking soda.

d. Plants

While there are a number of stock-poisoning plants in southwestern Wyoming, there are few plants which are likely to be dangerous to men. The water hemlock which grows in marshes and swamps has a root which is poisonous when eaten. Contact with nettles, tall green plants which grow in moist places, will produce a stinging skin irritation. Poison oak and poison ivy do not grow in the areas under study.

THREE MOUNTAIN AREAS IN SOUTHWESTERN WYOMING

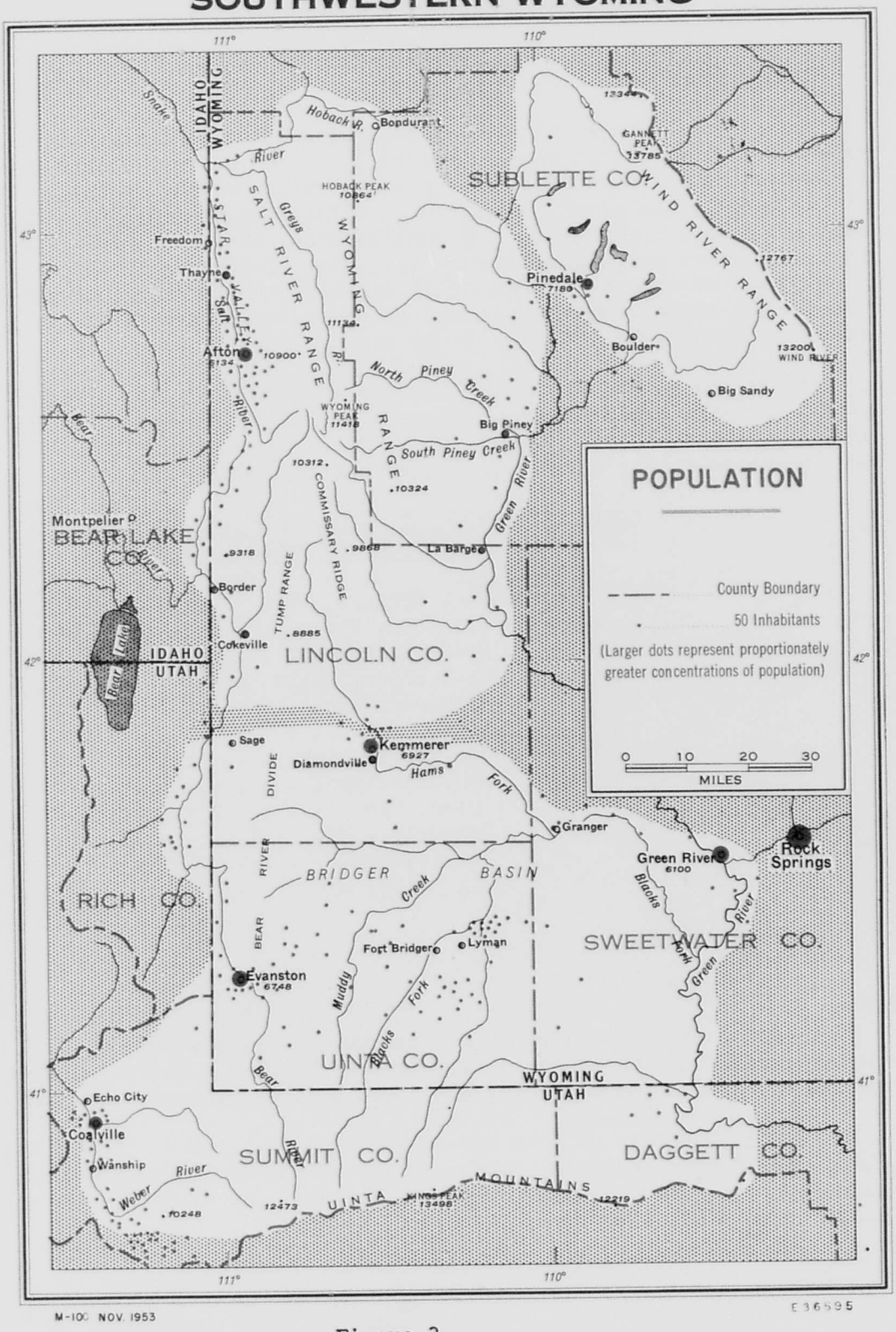

Figure 3.

C. CULTURAL FEATURES

1. Population

The general pattern of population distribution in the areas of this study, as shown in the Population map, Figure 3, is one of very sparse population in the mountains and sagebrush country and a rather dense population in the agricultural areas along the streams. Within the National Forests almost the only permanent inhabitants are Forest Service personnel and some sawmill workers in places where logging is carried on. Most of the sagebrush zone is practically uninhabited except for occasional ranches. Mining accounts for some population in the region centering around Kemmerer, which like Evanston owes its existence largely to its position on the railroad line.

All of the principal towns in this region are thus found around the margins of the mountain areas proper, either in agricultural areas like the Star Valley or along communication routes like the Union Pacific Railroad. This is indicated in the following table of populated places (Table III).

Table III: POPULATION OF PRINCIPAL PLACES IN SOUTHWEST WYOMING AREA -1950

Rock Springs, Wyo.	10,857
Evanston, Wyo.	3,863
Green River, Wyo	3,187
Montpelier, Idaho.	2,824
Kemmerer, Wyo.	1,667
Afton, Wyo.	1,319
Coalville, Utah.	850
Pinedale, Wyo.	770
Lyman, Wyo.	483
Cokeville, Wyo.	440
Thayne, Wyo.	229
Big Piney, Wyo	206

2. Transportation

a. Railroads

The Union Pacific Railroad and its subsidiary, the Oregon Short Line, are the only railroads which serve this part of Wyoming. These railroads, with siding capacities (as of 1940), are shown on the Transportation Map (Figure 4).

The Wind River Range Area has no railroad facilities. The closest rail points are Lander, Wyoming, which is east of the Range and approximately 80 miles by road from Big Sandy, and Rock Springs, approximately the same distance to the south.

THREE MOUNTAIN AREAS IN SOUTHWESTERN WYOMING

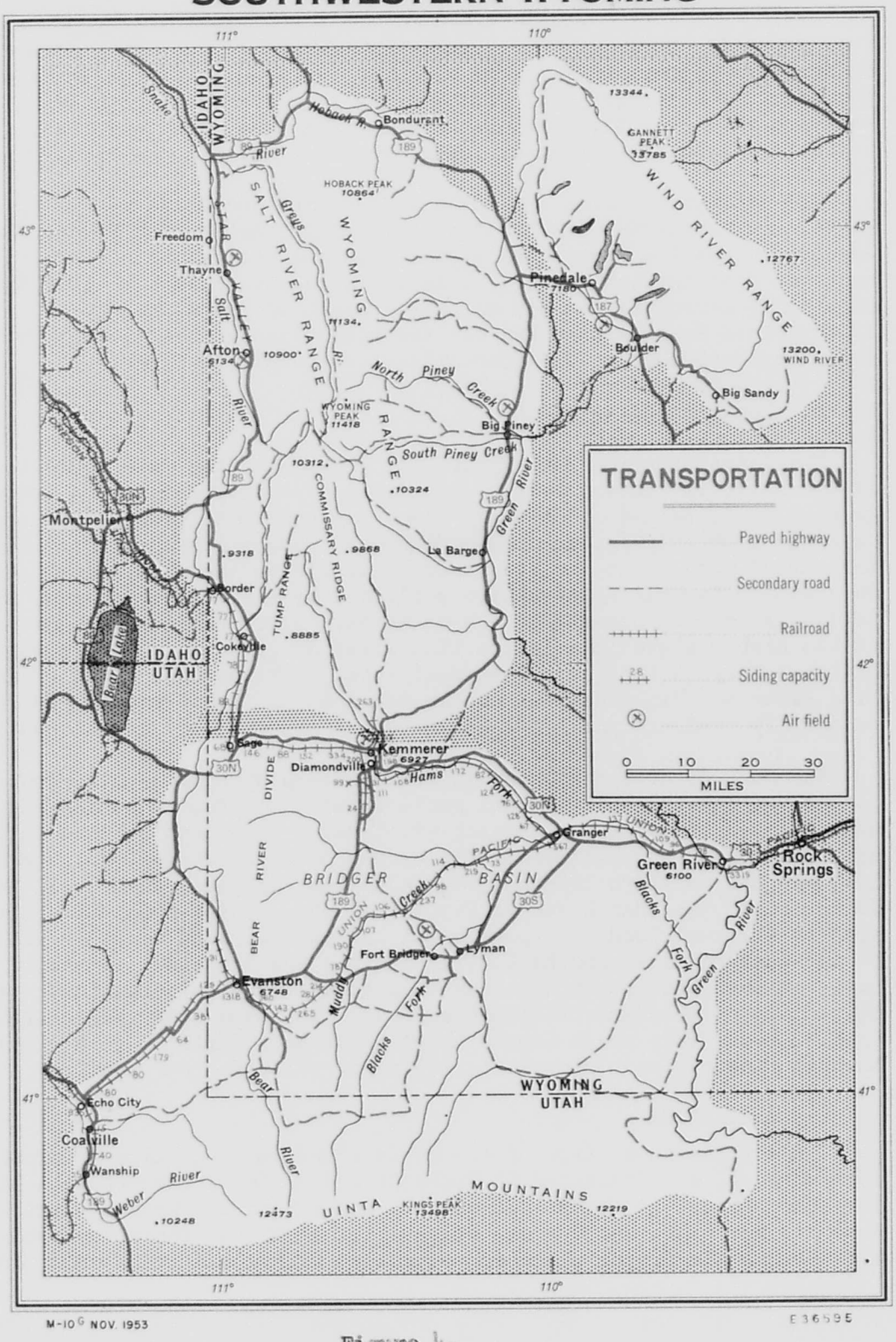

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Figure 4.

The Wyoming-Salt River Range Area is better served by rail facilities. The Oregon Short Line skirts the southern and southwestern edge of the area. This is mostly a single-track line, and there is a spur to a mine 8 miles north of Kemmerer; other spurs run to mines in the area south and southwest of Kemmerer. The largest siding capacities are in the vicinity of Kemmerer and westward to Sage. The northern part of this area has no rail facilities; the nearest rail point is Victor, Idaho, which is west of the Teton Pass.

The Uinta Range Area is served by the Overland Route of the Union Pacific, which is a standard-gauge, double track line crossing the Bridger Basin from Granger, where the Oregon Short Line branches off to the northwest, to Evanston, near the Wyoming-Utah border. This track passes closest to the Uinta Mountains at a point approximately ten miles southeast of Evanston. In the extreme west of the Uinta Range Area there are two spur lines in the vicinity of Coalville, extending eastward two and four miles toward the mountains.

b. Roads and Trails

The Transportation Map (Figure 4), shows both the main roads that are part of the National Highway system, and those secondary roads that are paved or are regularly maintained. There are also numerous "poor roads" that are unimproved or subject to only infrequent maintenance. Space does not allow inclusion on the map of such roads, or the numerous trails in the mountains; however, this information is available on maps published by the Forest Service. The network of trails is most dense in the Wyoming-Salt River Range Area, and least dense at the higher elevations in the Wind River Range Area. Those portions of the National Forests that have been designated as Wilderness Areas (found in the Wind River and Uinta Range Areas as shown on the Land Tenure Map Figure 7) are completely roadless and are restricted against the building of roads.

The most important highway in southwestern Wyoming is U.S. Route 30, which is part of the transcontinental route between the East and the West. It forks near Granger, the southern branch (designated 30S) passing through the Bridger Basin and thence to Salt Lake City by way of Evanston and the Weber River Valley, and the northern branch (30N) following the old Oregon Trail through Kemmerer and the Bear River Valley into Idaho. The Wyoming-Salt River Range Area is circumscribed by a portion of the latter route together with U.S. 89 on the western side, and by U.S. 189 on the eastern side. These highways unite at the junction of the Snake and Hoback Rivers to continue northward to the Grand Teton and Yellowstone Parks. The Wind River Range Area is served by U.S. Route 187, which leaves Route 30 at Rock Springs, goes northwestward through Pinedale and joins Route 189 a few miles farther west.

c. Air fields

The air fields in each of the three areas, with pertinent information concerning each, are indicated in Table IV and on the Transportation Map (Fig. 4). Kemmerer Airport is shown in the table under both the Wyoming-Salt River Range Area and the Uinta Range Area, since it lies between these two areas. In addition to the air fields which are actually within the areas under investigation,

THREE MOUNTAIN AREAS IN SOUTHWESTERN WYOMING

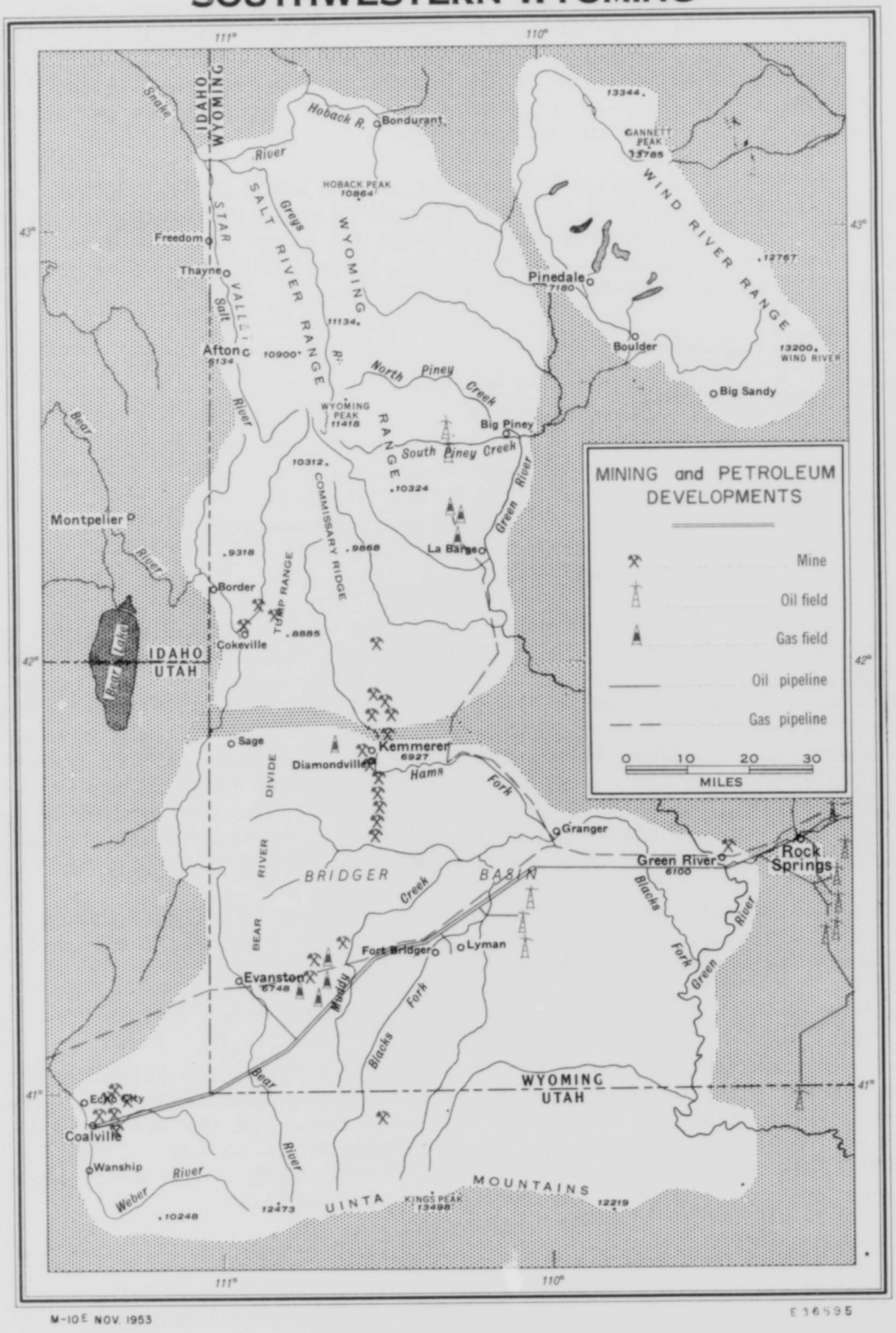

Figure 6.

there is a well-developed municipal airport at Rock Springs, a short distance east of the Uinta Range Area and south of the Wind River Range Area. This field has three paved runways, of which the longest is 6,700 feet, taxiways now under construction, boundary and runway lights, and storage facilities. Of the air fields mentioned here, the only ones which USAF aircraft are permitted to use are those at Fort Bridger and Rock Springs.

Commercial scheduled air service is available at Rock Springs by Frontier Airlines, which connects with the transcontinental routes of United Air Lines at Salt Lake City and Cheyenne. Western Air Lines also has scheduled service to Salt Lake City, as well as to Ogden, Idaho Falls, and other points west of the Uinta and Wyoming-Salt River Range Areas.

3. Public Utilities

a. Telephone

Telephone facilities are shown on the Utility Map (Figure 5). This map simply shows the location of telephone lines but does not indicate whether they are private or public. Most of the lines extending into the mountains are maintained by the Forest Service for fire control.

b. Electric Power

There are no electric power facilities in the Wind River Range Area. At Freedom in the Wyoming-Salt River Range Area, there is a publicly owned combination hydroelectric and internal combustion generating plant with a combined capacity of 1,100 kilowatts. At Frontier (near Kemmerer) there is a privately owned steam generating plant with a capacity of 5,500 kilowatts, with transmission lines leading southward into the Uinta Range Area. In the western part of the area there are two 44,000-volt transmission lines of the Utah Power and Light Company, one leading to Leefe (near Sage), and one leading to Evanston. The Utah Power and Light Company also has a 44,000-volt transmission line bordering the Uinta Range Area on the southeast between Echo City and Wanship, Utah.

East of the Bridger Basin, the town of Green River is served by a 33,000-volt transmission line from the 25,000-kilowatt steam plant of the Southern Wyoming Utilities Company at Rock Springs.

4. Mines, Oil and Gas Fields and Pipelines

The locations of the mines, oil and gas fields, and pipelines are shown on the map entitled Mining and Petroleum Developments (Figure 6). None of these features are found in the Wind River Range Area. In the Wyoming-Salt River Range Area there are small gas fields about ten miles west of Big Piney and oil fields four to eight miles northwest of La Barge. There are numerous coal mines in the vicinity of Kemmerer and near cokeville.

THREE MOUNTAIN AREAS IN SOUTHWESTERN WYOMING

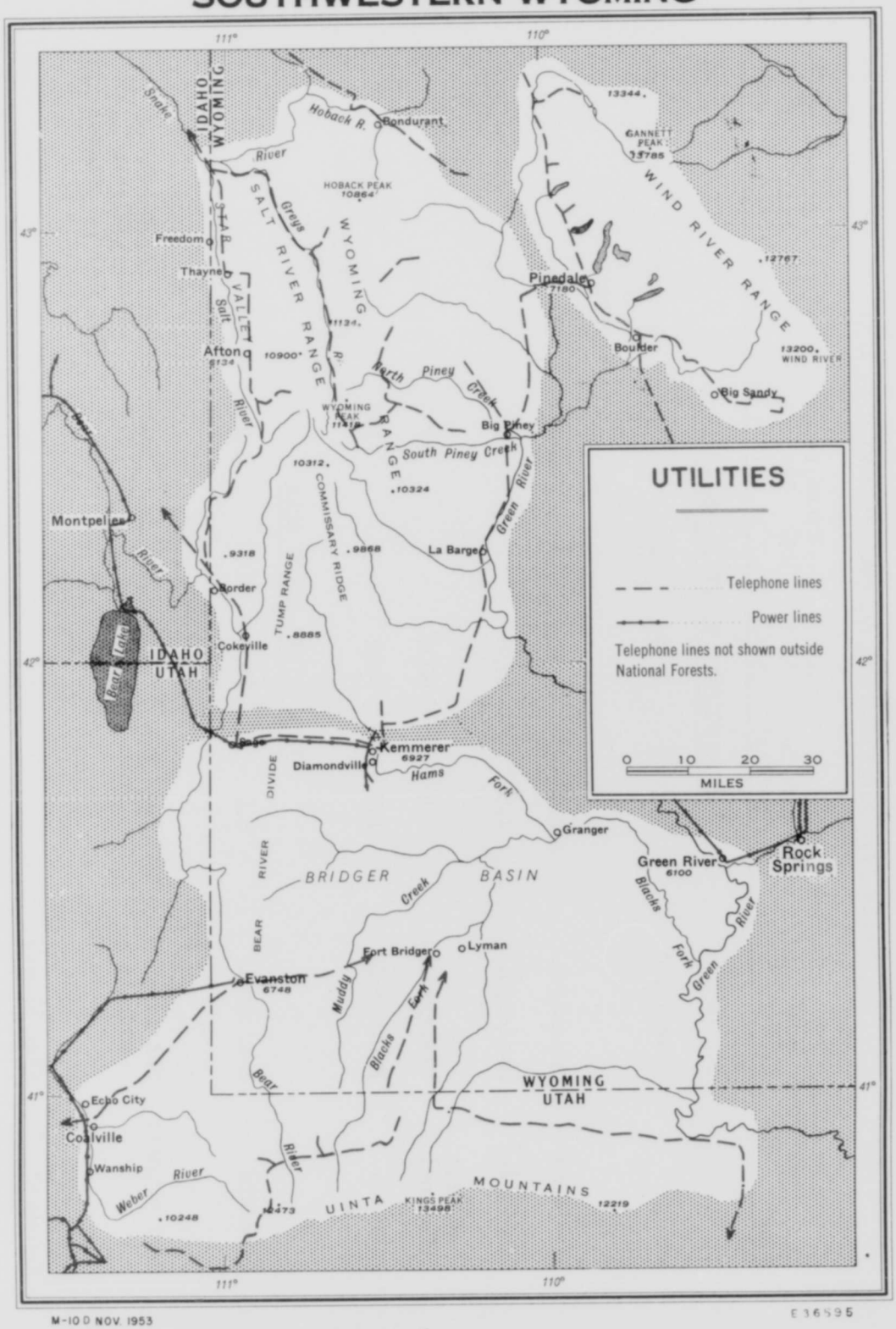

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Figure 5

Table IV: AIR FIELDS IN SOUTHWESTERN WYOMING AREA

Name	Type	Distance to town (miles)	Elevation (ft)	Runways* No.	Runways* Longest (ft)	Special facilities
WYOMING-SALT RIVER RANGE AREA						
Afton	Commercial	0.3	6239	1	4000	Storage, major aircraft; major engine repairs
Big Piney	Municipal	2.7	6900	2	6400	Storage
Cokeville	Municipal	2.5	6250	2	4500	Storage
Humphreys (Thayne)	Commercial	2.5	6000	1	2900	Storage
Kemmerer	Municipal	1.5	7282	3	7100	Rotating beacon Boundary lights Storage
WIND RIVER RANGE AREA						
Pinedale	Municipal	6.0	7200	3	4000	None
UINTA RANGE AREA						
Fort Bridger	CAA Intermediate	5.0	7016	2	5100	Rotating beacon Boundary lights Weather reports available
Kemmerer	(See above)					

*All runways are unpaved.

Source: Airman's Guide, v. 6, no. 7 (June 19, 1951)

In the Uinta Range Area there is a large oil field twelve miles east-northeast of Lyman and a group of gas fields about fifteen miles east of Evanston. There are some coal mines in this same locality and another group of mines near Coalville. Near the Bear River, in the Uinta Range, there is an abandoned sulfur mine.

c. Reservoirs, Dams, and Canals

Since irrigation is practiced on all of the agricultural lands within the areas, minor diversion dams and irrigation canals are found on the principal streams in all three of the areas. The only major dam is Echo Dam on the Weber River, on the western edge of the Uinta Range Area. This dam, 158 feet high and 1,887 feet long, impounds a reservoir which extends from Echo City to Coalville and has a capacity of 73,900 acre-feet of water. The project was built by the Bureau of Reclamation in 1931. There are three other reservoirs of considerably smaller capacity within the Uinta Range Area, all within the drainage area of the Upper Green River. These are the Uinta No. 3 and Patterson Lake Reservoirs, both on Black's Creek northeast of Fort Bridger, and Van Tassel Lake on the same stream but higher in the mountains. Their capacities range from 850 to 4,000 acre-feet.

On the eastern side of the Wyoming-Salt River Range Area is the Sixty Seven Reservoir, about six miles northwest of Big Piney on North Piney Creek. Its capacity is 4,300 acre-feet.

The only reservoir within the Wind River Range Area is the Elkhorn Reservoir, located in the upper part of Little Sandy Creek at the southern end of the area, which has a capacity of 1,450 acre-feet.

A number of other dam and reservoir sites are available within the Green River drainage basin, and it is likely that some of them have been used for additional projects since the above information was compiled.

5. Land Tenure

The type of ownership of land in the three areas is shown on the Land Tenure Map (Figure 7). As the Federal Government is the largest land owner here, the map is concerned mainly with showing the different types of Federal ownership and the distinction between Federal and non-Federal lands. In general, the pattern of land ownership shows considerable correlation with the natural vegetation. The forest lands are for the most part included in National Forests which are managed by the Forest Service. The sagebrush lands are largely public domain under control of the Bureau of Land Management, whereas the cultivated lands bordering the streams are privately owned.

Most of the National Forest land in the Wind River Range and Salt River-Wyoming Range Areas is in the Bridger National Forest. It consists of two separate divisions; the Bridger Division comprises the "east arm" of the Forest which is on the west slope of the Wind River Range, while the Wyoming Division includes the Wyoming and Salt River Ranges. The total area of the

National Forest is 1,710,220 acres, including 11,122 acres not under Forest Service administration, and its administrative headquarters is at Kemmerer, Wyoming. In addition to the Bridger National Forest, the areas under consideration include portions of three other National Forests: the Teton, Wasatch, and Ashley. A very small part of the Teton National Forest is included in the northern end of the Wyoming-Salt River Range Area, between the Hoback River and Grayback Ridge. The Wasatch and Ashley National Forests, which are adjacent to each other, lie almost entirely in Utah and have their headquarters at Salt Lake City and Vernal, respectively. They comprise most of the forested part of the Uinta Mountains and thus include roughly the southern quarter of the Uinta Range Area.

Included in the National Forest lands are two Wilderness Areas, which are roadless areas that have been set aside to be kept in the primitive state with no improvements other than trails. The High Uintas Wilderness Area, lying in the Uinta Mountains in Utah, is mainly south of the mountain divide but extends north of it for a distance of about 5 miles along a 30-mile portion of the mountain range. In the Wind River Range the Bridger Wilderness Area includes 383,000 acres of the Bridger National Forest. This comprises about half of the Wind Range Area and all of the land at the higher elevations. No land has been disignated as Wilderness Area within the Wyoming-Salt River Range Area.

Outside of the National Forests, all of the federally-owned land in the three areas of this study is under the jurisdiction of the Bureau of Land Management, which manages the lands principally for grazing use. For this purpose the lands have been organized into grazing districts, those in southwestern Wyoming being managed from the District Grazing Offices at Rock Springs (District No. 4) and Pinedale (District No. 5). There is a small area of public grazing lands in the Wind River Range Area and a fairly large amount in the Wyoming-Salt River Range Area, with the blocks of public land interrupted in many places by private land holdings along the streams.

In the Uinta Range Area the ownership pattern is somewhat different; here the "alternate section" pattern is found in most of a strip 40 miles wide where the Union Pacific Railroad passes through the Bridger Basin. Within this zone the railroad company received a grant of all odd-numbered sections for a width of 20 miles on either side of the track, at the time the track was first laid. The even-numbered sections, except sections 16 and 36, were retained by the Federal Government for sale or homesteading, and most of such lands are still under Federal ownership. Sections 16 and 36 of each township were granted to the state for the purpose of providing aid to public schools; some of these were sold and others are still owned by the state. For the purpose of this map state-owned land, which is of small extent except for the so-called "school sections", is included with that which is privately owned. While the original "checkerboard" pattern of tenure has been changed somewhat through private acquisition of public lands, through sale of "school sections," and through tax reversion to the state, the alternation of private and federally-owned sections is still the basic pattern through most of the Bridger Basin. Only in the northwestern corner and in the southeastern portion are there extensive unbroken blocks of public lands.

THREE MOUNTAIN AREAS IN SOUTHWESTERN WYOMING

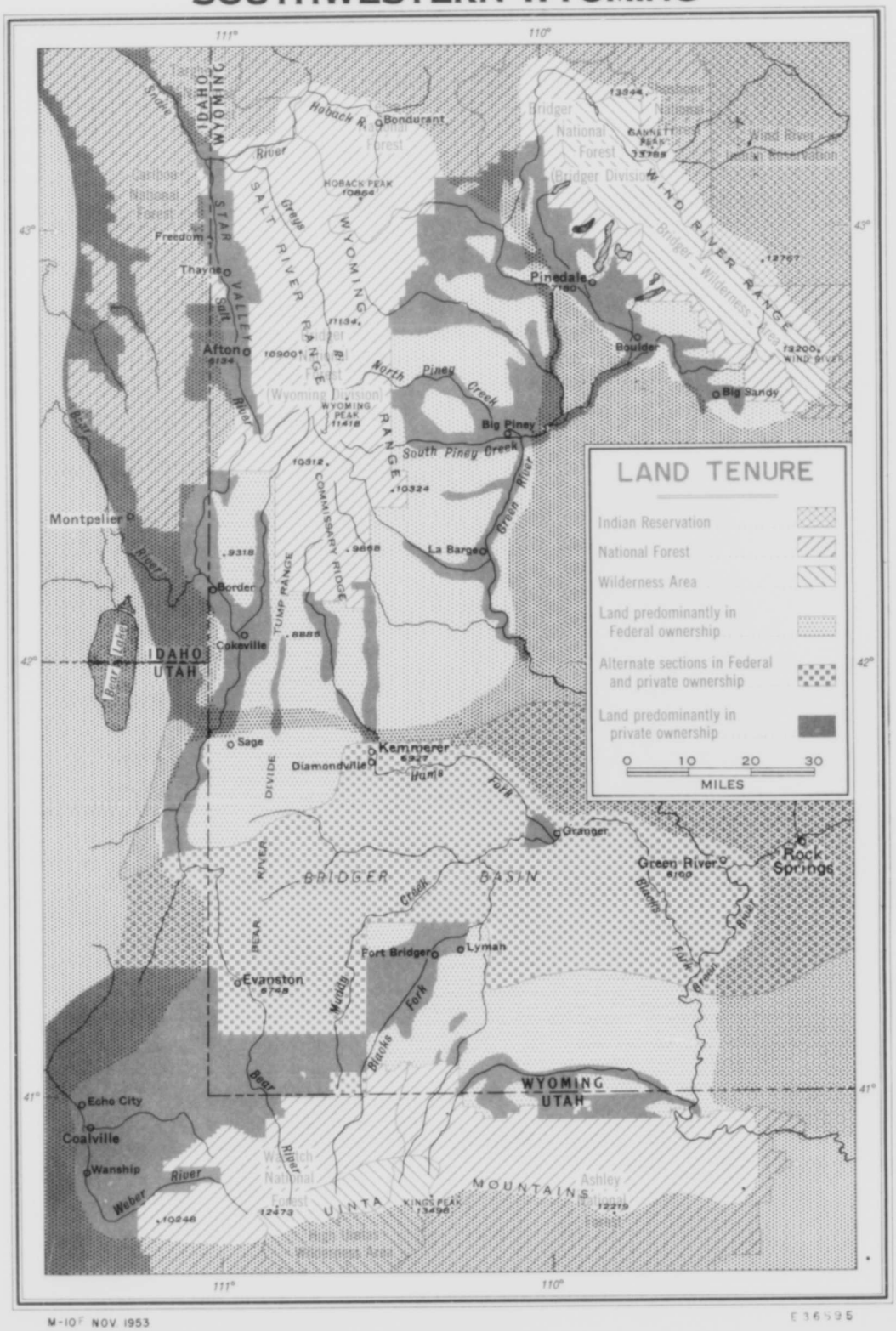

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Figure 7.

The Wind River Indian Reservation lies to the east of the Wind River Range Area and adjoins it along the crest of the range for a distance of about ten miles.

The Bureau of Reclamation has one project which borders the Uinta Range Area. This is the Echo Dam project on the Weber River, forming a lake between Echo City and Coalville on the western edge of the Area. As the lands that are irrigated by the project are all outside of the Area, it is not of direct importance to this discussion. Other Bureau of Reclamation projects have been recommended for construction in the Weber River Basin and the upper Star Valley, but they have not reached the stage of actual field construction.

The Grand Teton National Park is about 50 miles to the north of the Wyoming-Salt River Range Area, but there are no lands controlled by the National Park Service actually within any of the areas of this study, practically all federally -owned land being under the jurisdiction of either the Forest Service or the Bureau of Land Management.

THREE MOUNTAIN AREAS IN SOUTHWESTERN WYOMING

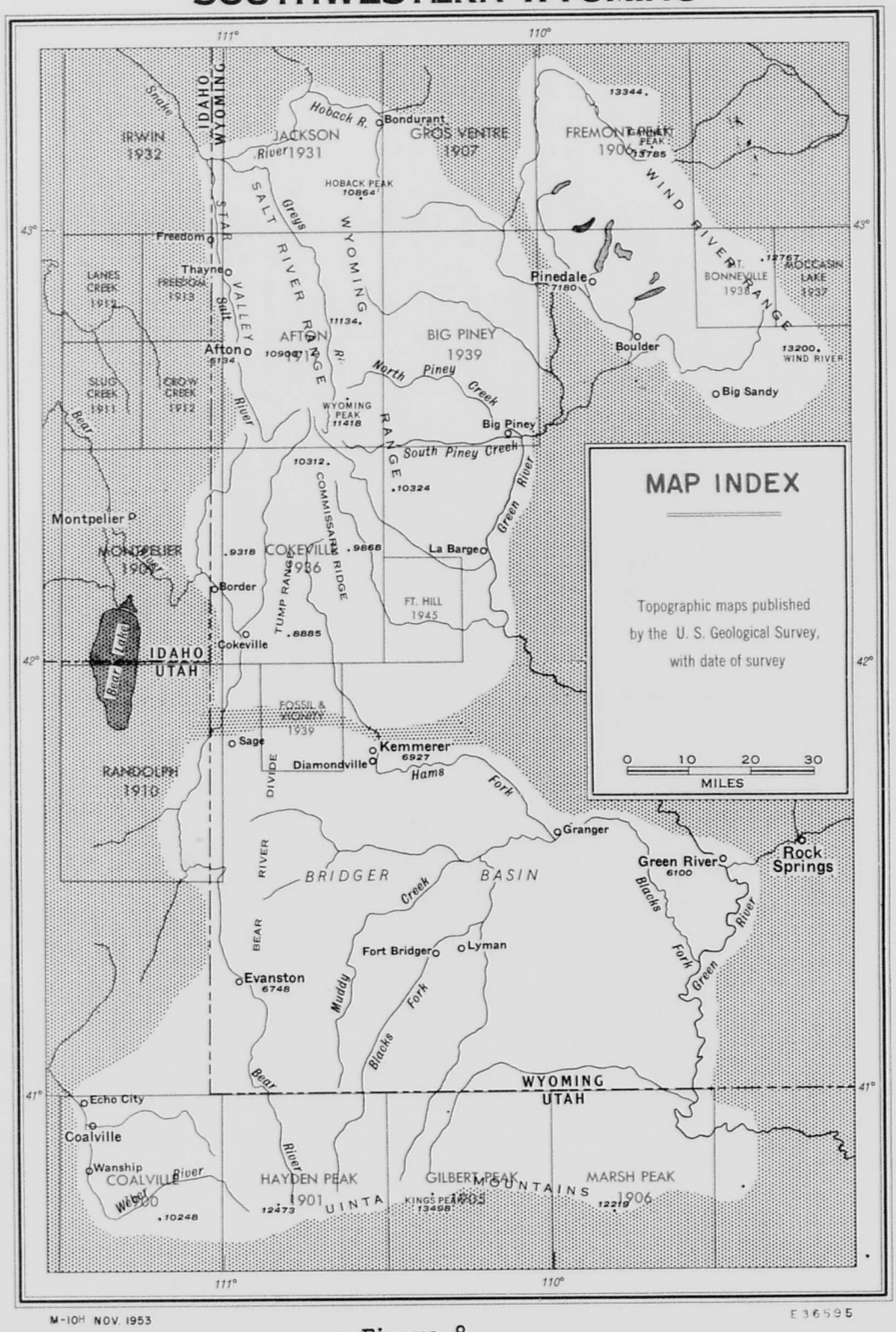

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Figure 8.

D. COMPARISON TABLE

Item	WYOMING-SALT RIVER RANGE AREA	WIND RIVER RANGE AREA	UINTA RANGE AREA
Topography			
Topographic Form	NNW-SSE trending, parallel, inter-locking ranges, with prominent ridges.	High, individual peaks with mountain glaciers. Peak line trending generally NW-SE.	Sinuous, plateau remnant crest line trending generally E-W.
Peak Elevations	9,000 to 11,000 ft, peaks highest in middle section.	12,000 to 13,500 ft, highest in northern group of peaks.	10,000 to 13,400 ft, highest in central section of range.
General Relief	2,500 to 3,000 ft in north and central section. 1,500 ft in southern section.	3,000 to 3,500 ft in northern group.	1,500 ft, relief is accentuated by the precipitous side and head walls of the valleys flanking the crest.
Vegetation			
Valleys and Lower Foothills	Sagebrush and bunch grass. Upper elevation limit: 7,500 to 8,500 ft.	Sagebrush. Upper elevation limit: 7,500 to 8,500 ft.	Sagebrush, shadscale, saltbush and wasteland. Upper elevation limit: 7,500 to 8,500 ft.
Mountain Slopes	Coniferous forest with aspen groves and grassy areas at lower elevations. Lower elevation limit: 8,000 ft. Upper elevation limit: 10,000 ft.	Same as Wyoming-Salt River Range Area. Lower elevation limit: 8,000 ft. Upper elevation limit: 11,000 ft.	Same as Wyoming-Salt River Range Area with brush on lower ridges. Lower elevation limit: 8,000 ft. Upper elevation limit: 11,000 ft.
High Ridges and Peaks	No vegetation except alpine meadows in favorable spots. Lower elevation limit: above 10,000 ft.	Same as Wyoming-Salt River Range Area. Lower elevation limit: above 11,000 ft.	Same as Wyoming-Salt River Range Area. Lower elevation limit: above 11,000 ft.

Climate	There are not enough data available to contrast the individual areas. Southwestern Wyoming, in general, has very cold winters, heavy annual snowfall and snow accumulation, and relatively cool summers with large daily ranges of temperature. The climate varies from semiarid in the basin areas to moderately humid in the mountains.		
Transportation			
Rail	Served by Oregon Short Line along southern and southwestern border. No rail service in north and central section.	No rail service in area. Closest rail points, Lander and Rock Springs, Approx. 75 road miles away.	Bridger Basin crossed by Overland Rte of UPRR. Oregon Short Line crosses Basin in north. Extreme western part of area served by branch of UPRR running south from Echo City to Coalville, Utah.
Roads and Trails	US hwy 30N parallels Oregon Short Line in south. US hwy 189 skirts area in east. Secondary road net at lower elevations fairly dense. Trail net at higher elevations densest of the three areas.	US hwy 187 runs through Boulder and Pinedale in west. Secondary road net at lower elevations not as dense as that of Wyoming-Salt River Range Area. Trail net at higher elevations very sparse.	Bridger Basin crossed by US Hwy 30S and US Hwy 189. Secondary road net fairly dense in central part of Basin but absent in "badlands" area in east and Bear River Divide Area in northwest. Roads lead into lower elevations of Uinta Mts. Trail net at higher elevations sparse.
Land tenure	Most of mountain area included in Wyoming Division of Bridger National Forest. Private ownership along streams. Sagebrush areas controlled by Bureau of Land Management.	Mostly included in Bridger Division of Bridger Nat'l Forest, about half of which is Bridger Wilderness Area. Private ownership along streams at lower elevations.	Federal and private ownership of alternate sections in much of Bridger Basin reflecting railroad land grant to UPRR. Private ownership along streams, especially in Fort Bridger area. Ashley and Wasatch Nat'l Forests include most of the Uinta Wilderness Area in crest portion.

E. ACKNOWLEDGMENTS

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