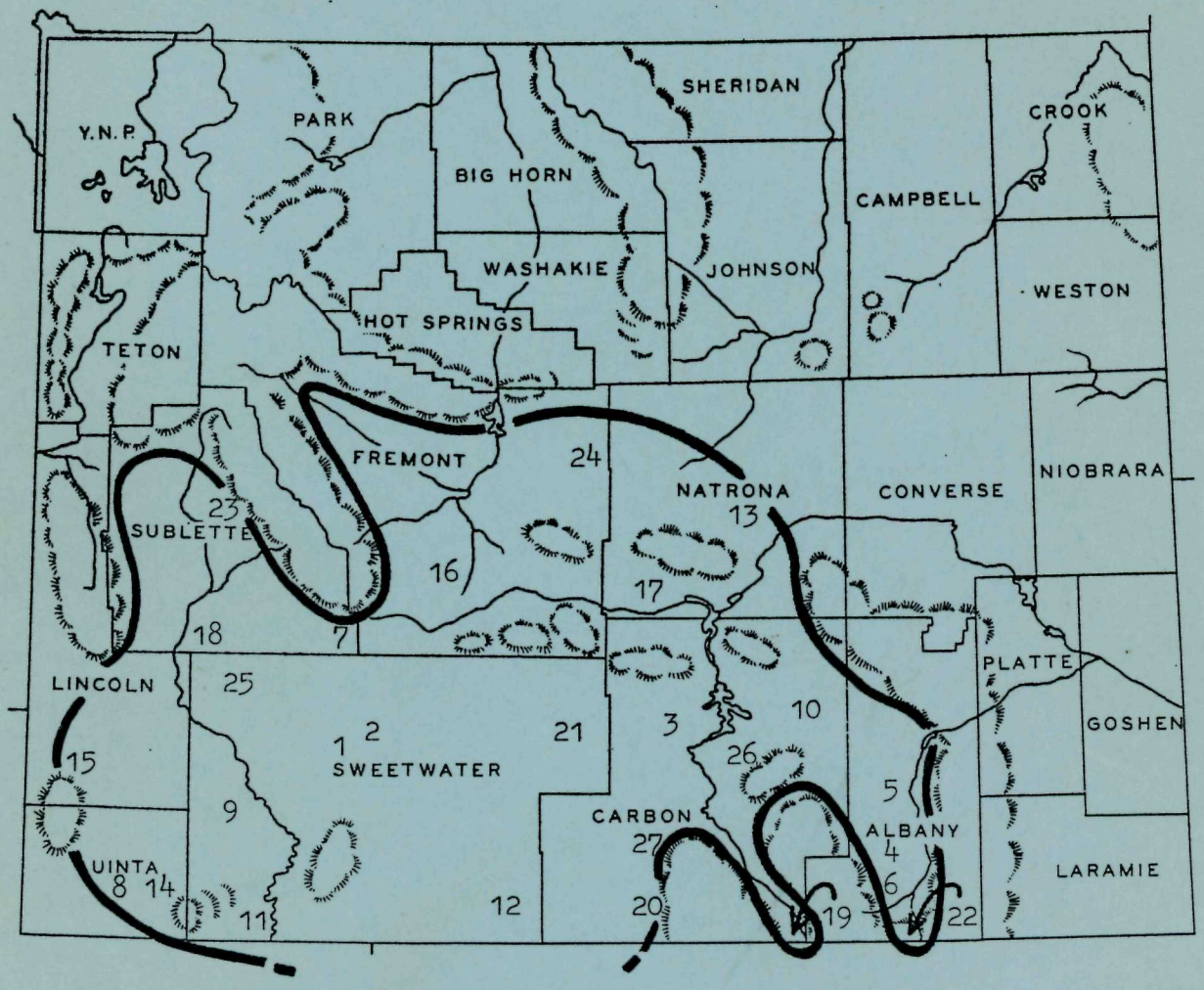
POTENTIAL NATURAL LANDMARKS IN THE WYOMING BASIN

Terrestrial and Aquatic Ecosystems



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University of Wyoming

1976

A county map of Wyoming showing the approximate location of the Wyoming Basin and areas of special biological value. The numbers on the map identify the following areas (relevant page number in parentheses):

1. Killpecker Sand Dunes (p. 93)
   Boar's Tusk Sand Dune Natural Area (p. 97)
2. Steamboat Mountain (p. 99)
3. Sand Dune Natural Area (p. 98)
4. Big Hollow (p. 106)
5. Laramie High Plains Natural Area (p. 113)
6. Laramie Plains Natural Area (p. 114)
7. Oregon Trail Sagebrush-grassland (p. 115)
8. Alkali Desert Shrub Natural Area (p. 119)
9. Northern Desert Shrub-Sagebrush Natural Area (p. 120)
10. Bates Hole - Shirley Basin Petrified Forest (p. 121)
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11. Henry's Fork Fault Juniper Woodland (p. 130)
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13. Hell's Half-acre Badlands (p. 142)
14. Grizzly Buttes Badlands (p. 146)
15. Fossil Fish Quarries Natural Area (p. 152)
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17. Sweetwater River Complex (p. 158)
18. Green River (p. 164)
19. North Platte River (p. 165)
20. Muddy Creek (p. 166)
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22. Sand Creek & Camel Rock (p. 171)
23. Pinedale Glacial Fields and Fremont Lake (p. 175)
24. Moneta Phragmites Marsh (p. 180)
    Castle Gardens (p. 183)
25. Little Colorado Desert (p. 186)
26. Rattlesnake Creek Oak Woodland (p. 189)
27. Twin Groves Aspen Atoll (p. 190)

POTENTIAL NATURAL LANDMARKS IN THE WYOMING BASIN

Terrestrial and Aquatic Ecosystems[1]

by

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[1] Consult McGrew, et al. (1974) for an inventory of significant geological areas in the Wyoming Basin. Areas recommended in both this report and the geological report are identified on page 218.

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ACKNOWLEDGMENTS

Many individuals have provided information and suggestions that we have incorporated in this report. Dr. Paul McGrew's familiarity with the Basin was especially helpful at the beginning, and he recommended some of the sites we have included. Dr. Martha Christensen and Jerry Uhlrich provided information on the Shirley Basin fossil wood deposits, and Drs. Kenneth Diem and Reed Fautin prepared the faunal lists included as Tables 4 and 5, and Dr. George Baxter advised us on rare fish and aquatic habitats. Many M.S. and Ph.D. theses were helpful, especially the dissertation by Robert Gibbens (Ph.D. in Range Management at the University of Wyoming). Charlotte Reeder provided a very useful review of the Wyoming endangered species list prepared by the Smithsonian Institution (Table 50), and Dr. John Reeder provided space and assistance in the Rocky Mountain Herbarium for our work. Ernest Nelson, Robert Dorn, and Gary Pierce helped with identifications, and Dr. Marvin Maxell provided information on the faunistic characteristics of the Basin. Ramona Wilson, Cynda Gibson, and Kayleen Evans typed and/or proof read the report; and Frank Ugolini and Craig Schaeffer of the National Park Service provided helpful suggestions. To all of these individuals we express our sincere thanks. We hope that they and others will continue to help preserve areas with special natural history values in the Wyoming Basin and elsewhere.

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INTRODUCTION

Straddling the Continental Divide, the Wyoming Basin is a unique feature of the Rocky Mountain Cordillera (Fig. 1). Although more rugged than Nebraska to the east, the sagebrush-dominated grasslands provided a route westward for wagon trains searching to avoid the mountains to the north and south. Even at the Divide the landscape is treeless and less difficult to cross. Isolated mountains, buttes, river valleys, and badlands are interspersed with the sagebrush-grasslands and greasewood flats, adding scenic and biotic diversity to the area.

With the exception of a rather small percentage of land in cultivation along floodplains, most of the terrestrial habitats in the Wyoming Basin are still dominated by the native flora and fauna (except for buffalo). Cattle and sheep grazing have caused shifts in the relative abundance of the different species, but this has not changed the character of the ecosystems. Some argue that sagebrush became more abundant with domestic grazing pressure, which may be true on some sites, but Vale (1975) documents the abundance of sagebrush-grasslands in the 1800's by quoting some of the first explorers. For example, Fremont (1845) wrote, "One of the prominent characteristics in the face of the country is the extraordinary abundance of the 'artemisias.' They grow everywhere -- on the hills, and over the river bottoms, in tough, twisted, wiry clumps; and, wherever the beaten tract was left, they rendered the progress of the carts rough and slow. As the country increased in elevation on our advance to the west, they increased in size; and the whole air is strongly impregnated and saturated with the odor of camphor and spirits of turpentine which belongs to this plant. This climate has been found very favorable to the restoration of health, particularly in cases of consumption; and possibly the respiration of air so highly impregnated by aromatic plants may have some influence." Platt and Slater (1852) noted, "Along the Sweet Water, most of the way, are narrow bottoms of good grass. Adjacent to these bottoms are large, arid, wild-sage plains, extending to the mountains."

Because of a limited water supply in the Basin, the aquatic habitats have been heavily affected by man. Most floodplains have been cultivated or are regularly cropped for hay, intense land use near the banks has led

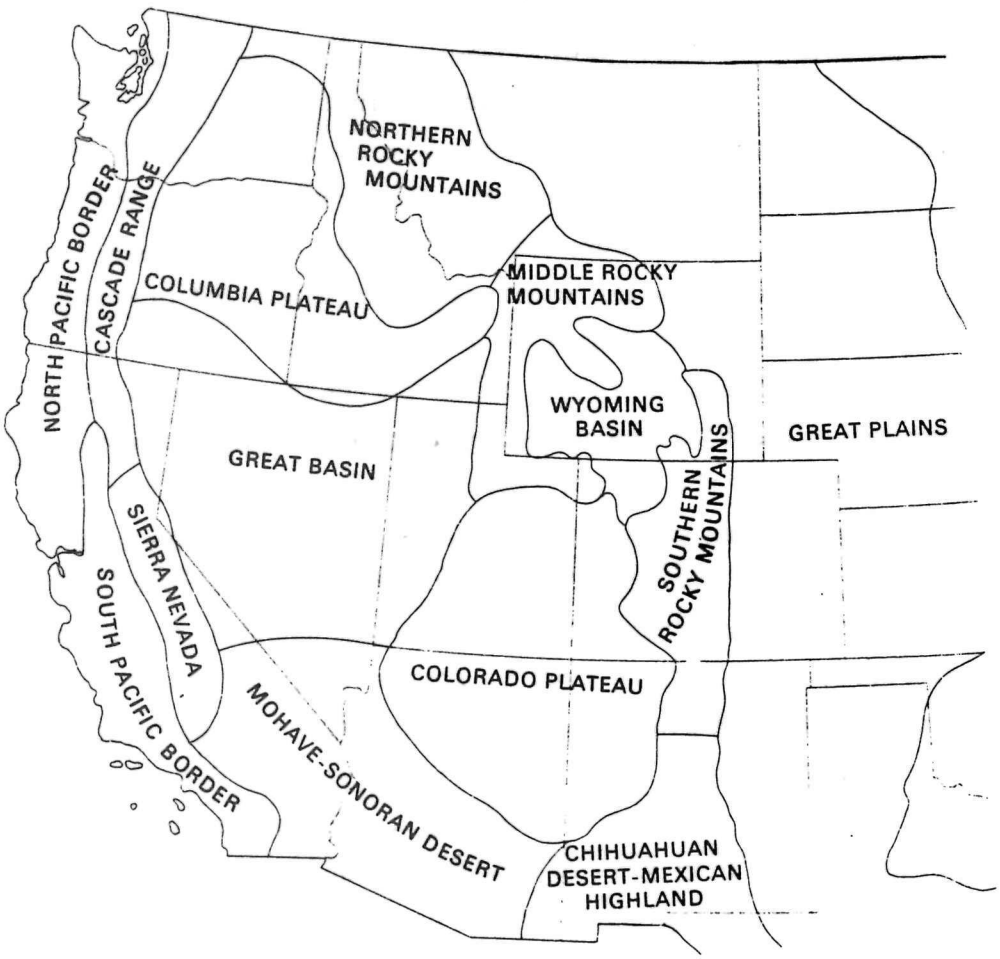


Fig. 1. Natural physiographic regions of the conterminous western United States, showing the location of the Wyoming Basin (after Fenneman, 1931).

to modification of the aquatic and riparian habitat, and the reservoirs for irrigation projects have innundated large areas. As a general rule, the farther away from open water, the more natural is the ecosystem.

For approximately two and one-half summers we have explored the Wyoming Basin in search of potential Natural Landmarks, travelling thousands of miles by car and hiking long distances in and around areas of interest. We have actively sought and obtained recommendations from people familiar with the area. Our focus has been largely botanical, but we have consulted with zoologists in order to learn about the fauna of most areas. For a variety of reasons, both the flora and fauna of the Basin are not well-known, in contrast to the geological features.

In addition to studying potential Natural Landmarks we have tried to provide a useful classification of the different ecosystem types and natural history themes in the Basin, and have identified those themes and natural areas that should be studied first, in our opinion, for possible designation as Natural Landmarks. A report already has been submitted to the National Park Service in which similar information is provided for significant geological areas in the Wyoming Basin (McGrew, Brown, Hager, and Mears 1974). In many cases, areas of geological interest are also of biological interest, in part because the unique geological situation provides a unique habitat for plants and animals.

Although our attention has naturally drifted to areas which appear rare, endangered, or unique, we have also attempted to include natural areas that represent common and typical ecosystems in the Basin. Doing so has not been easy. Unlike the midwest where a farmer's woodlot or a railroad right-of-way may be the only natural areas available, in Wyoming one can drive for a hundred miles and have difficulty deciding which area is more natural or more typical. In such cases we have chosen areas that, in addition to being biologically valuable, are also of interest for geological or historical reasons, or because one area includes several different habitat types. The latter criterion is important because some ecological studies are easier done where boundaries exist and because greater plant and animal species diversity can be expected in such an area.

The Wyoming Basin is large (approximately 440 km east-west and 300 km north-south) and we have not been able to explore all possible Landmarks in

the time available. We trust that readers of this document will draw our attention to omissions, and we expect to submit additional recommendations as we become more familiar with the Wyoming Basin.

THE WYOMING BASIN: PHYSIOGRAPHY, CLIMATE, AND SOILS

Although a natural physiographic unit according to Fenneman (1931), the Wyoming Basin can be subdivided into several geomorphic units (Figs. 2 and 3), including at least 7 smaller basins and several small mountain ranges. The geological characteristics of the various units have been described by McGrew et al. (1974, pp. 1-10). Elevations in the Basin average between 6700 and 7000 ft. (2030 - 2121 m), with the lowest point being 4725 ft. (1,432 m) at Boysen Reservoir and the highest at the top of the Ferris Mountain Range, 10,037 ft. (3,042 m). As a general but arbitrary guideline we have used the 7500 ft. (2,273 m) contour as the exterior edge of the Basin.

The climate of the Basin is variable, depending largely on the elevation, but is characterized throughout by cold, windy winters and warm, dry summers. Temperatures above 95°F (35°C) are exceptional. Annual precipitation (Fig. 4) is between 6 and 12 inches (15 - 30 cm) throughout most of the Basin (Rechard 1967), excluding the mountain ranges which receive more due largely to heavier snowfall. One-half to two-thirds of the precipitation occurs in the winter and spring; the summers are dry. The average number of days without a hard frost ranges from 80 to 140 (USDA 1941). Figs. 4-6 illustrate temperature and rainfall patterns in the Basin (excluding the Colorado portion). Becker and Alyea (1964a, 1964b) and Becker, Alyea, and Eppson (1961) provide information on temperature and precipitation probabilities at various times during the year, and Rechard (1967) summarizes the water resources of Wyoming with data on precipitation, evapotranspiration, streamflow, and groundwater. Fig. 7 shows the distribution of the major rivers of Wyoming.

The soils of the Wyoming Basin have not been intensively studied and the maps that exist are very general, with the exception of those done for specific areas by the Soil Conservation Service. The Wyoming Soils Map (Dunnewald 1957) is most detailed and shows the distribution of the following

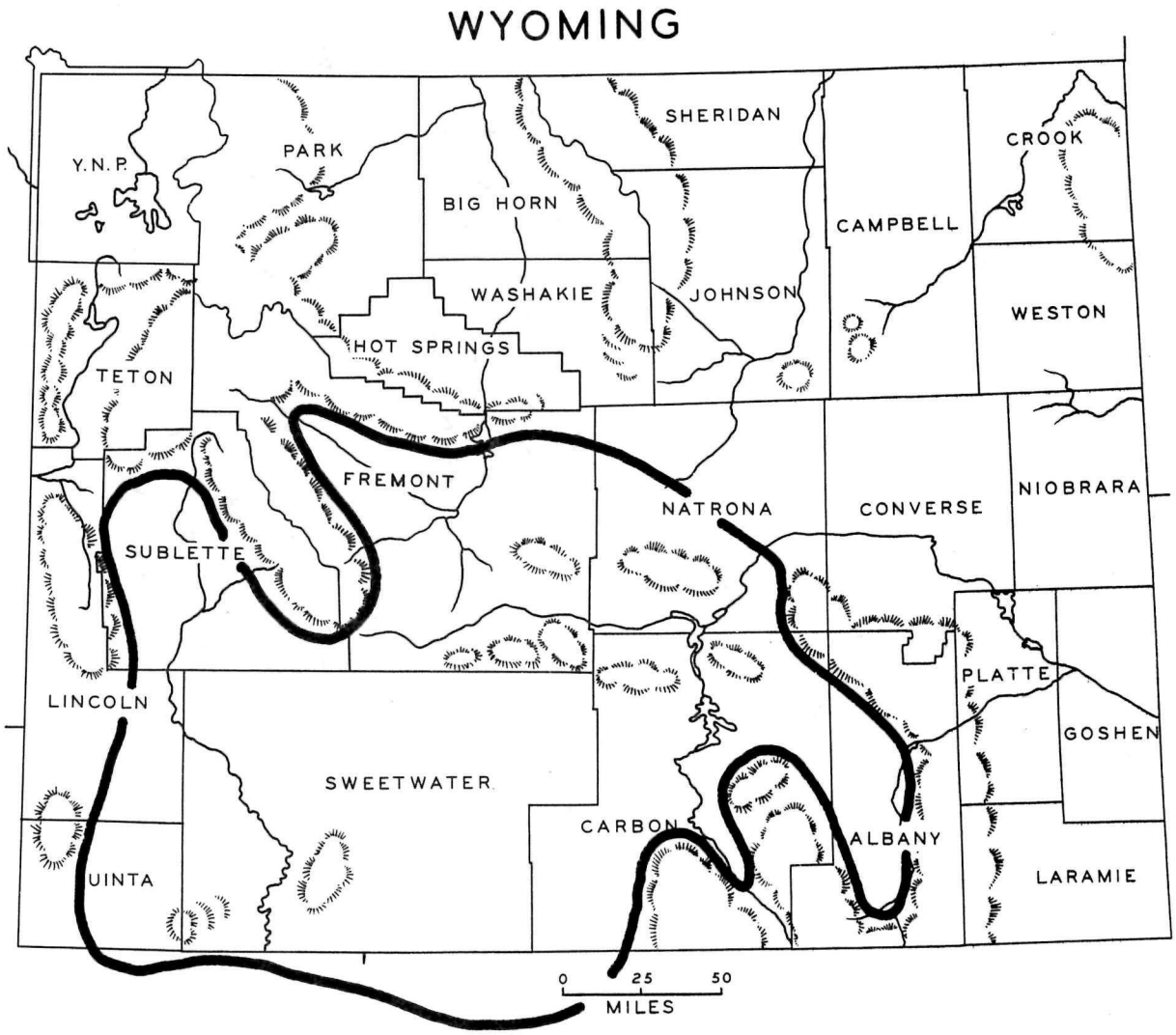


Fig. 2. County map of Wyoming showing the location of the Wyoming Basin.

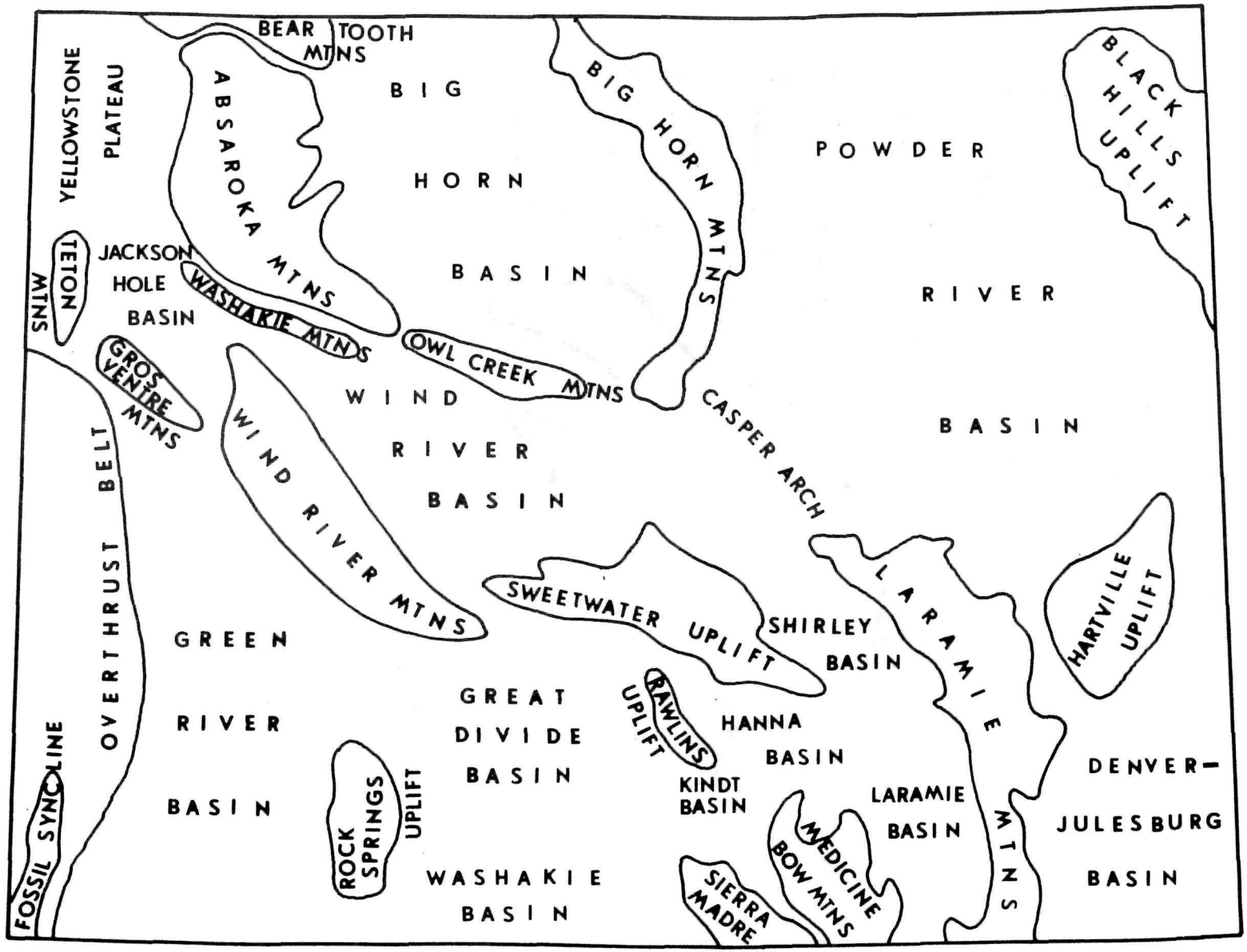
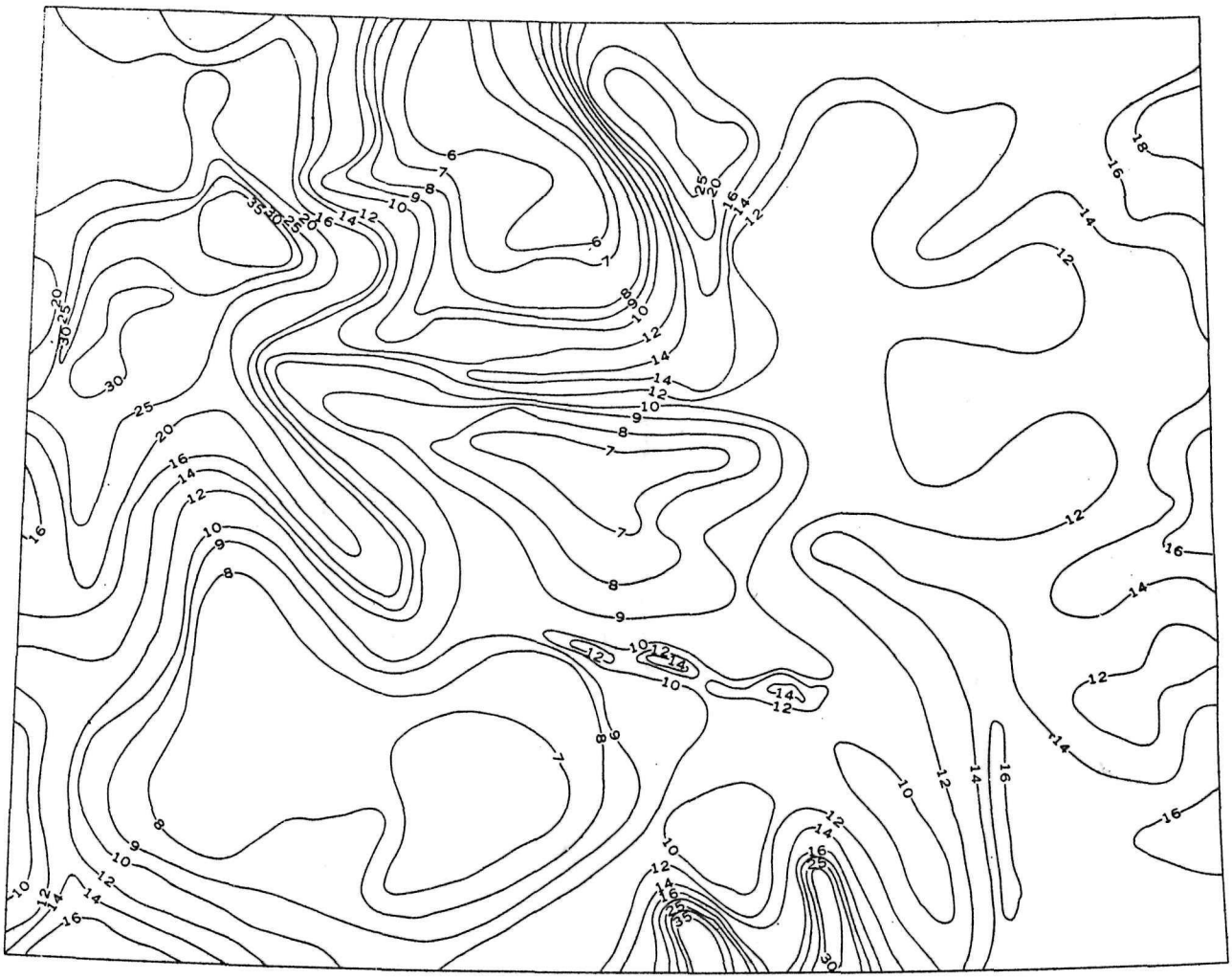
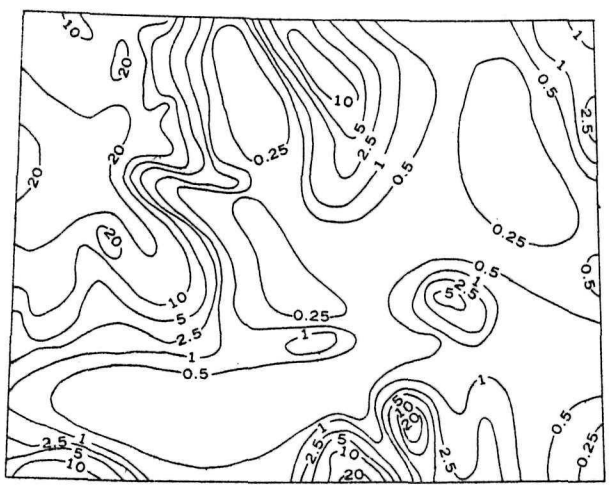


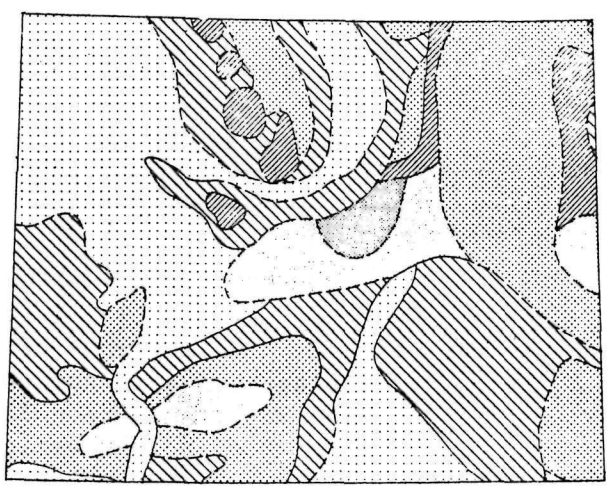
Fig. 3. Map of Wyoming showing the major physiographic regions within the State and the various sub-divisions of the Wyoming Basin (after a map prepared by the Wyoming State Geological Survey).



MEAN ANNUAL PRECIPITATION, IN INCHES, AS OF 1965
(Adapted from National Weather Service—NOAA)



AVERAGE ANNUAL RUNOFF, IN INCHES



200 300 500 1000 2000 5000 10,000 20,000 50,000
Milligrams per liter
SEDIMENT CONCENTRATION OF RIVERS

Fig. 4. Three diagrams showing the distribution of mean annual precipitation, average annual runoff, and river sediment concentration in Wyoming (from the U. S. Geological Survey, 1974).

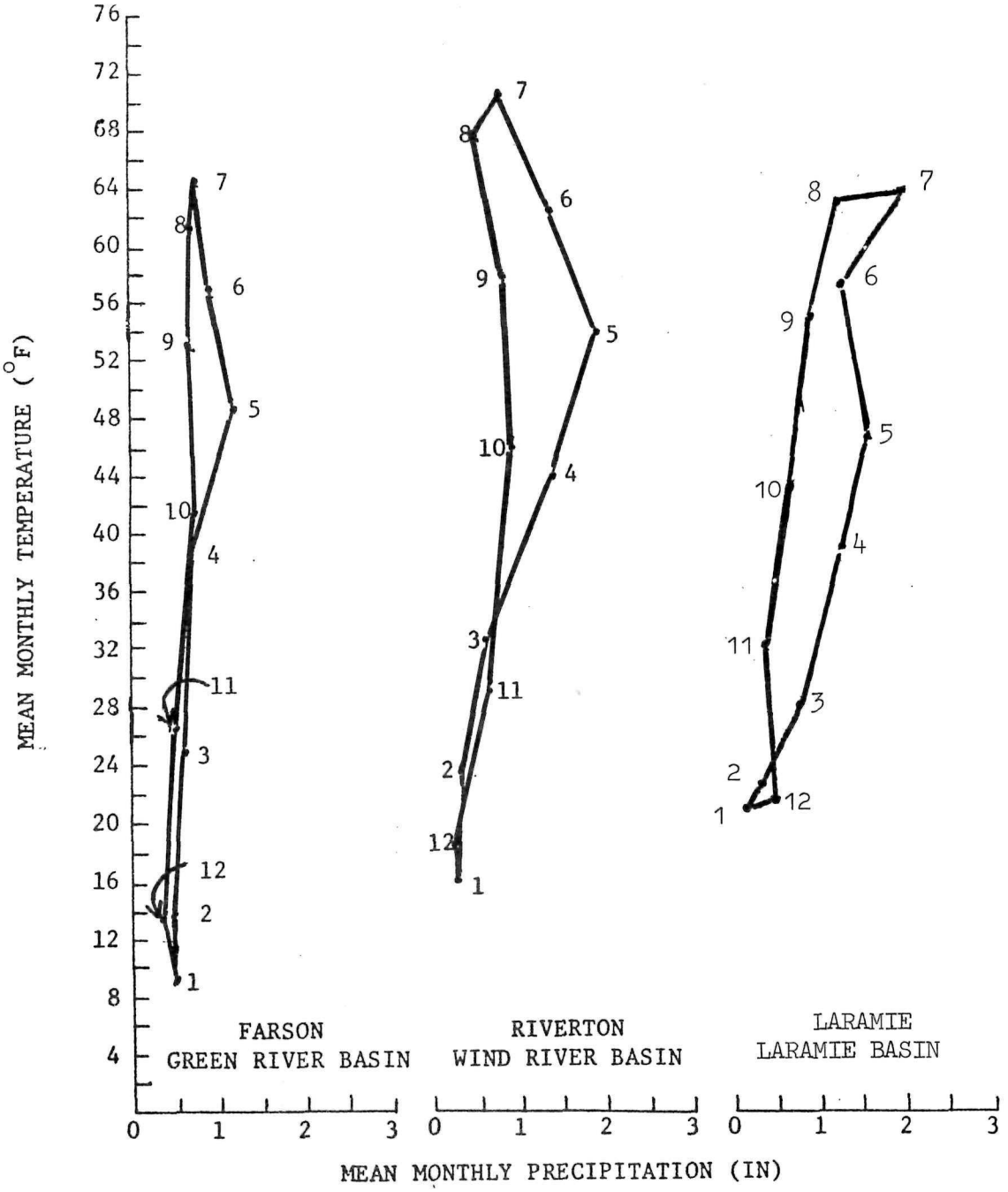


Fig. 5. Climographs of three locations depicting the average moisture and temperature regimes of the Wind River and Green River basins. Numbers along margins of polygones indicate months of year.

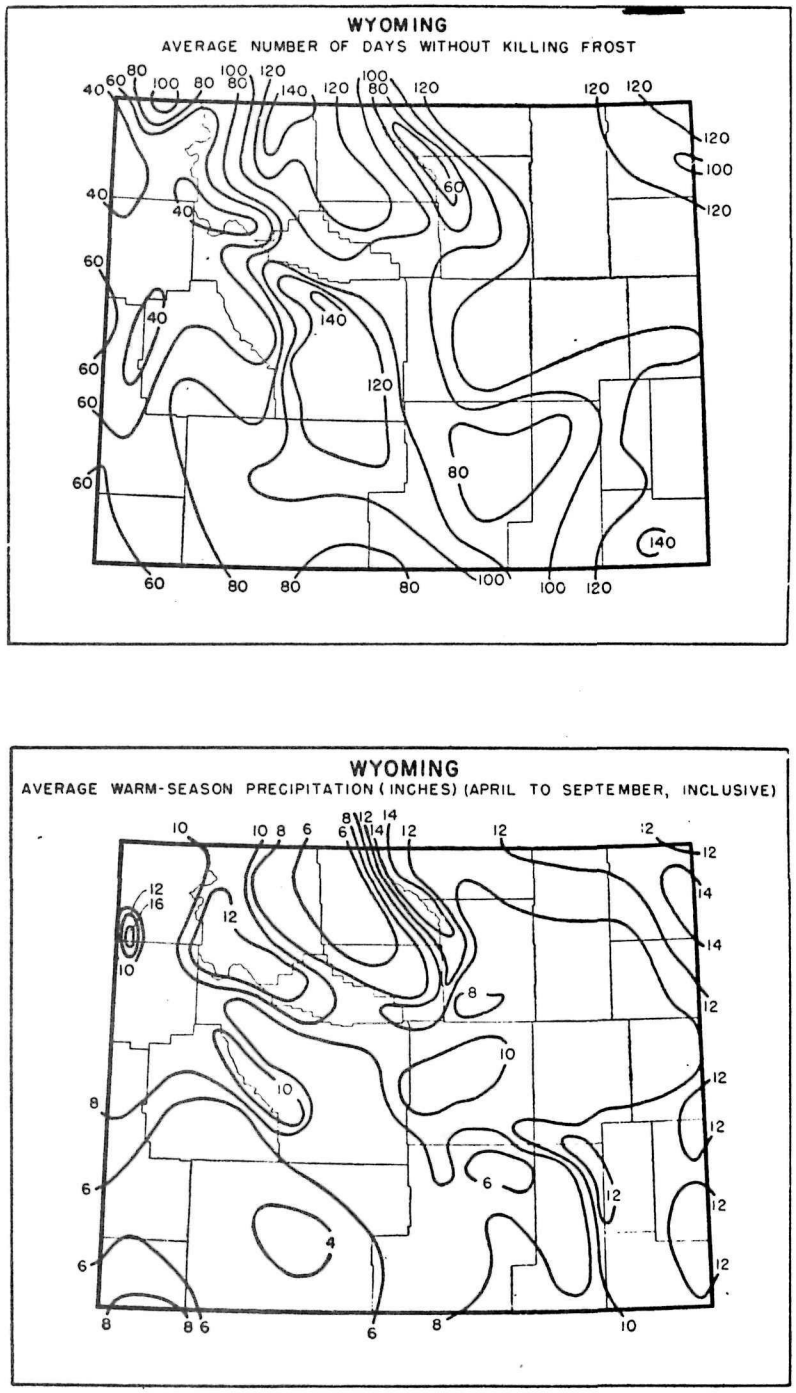
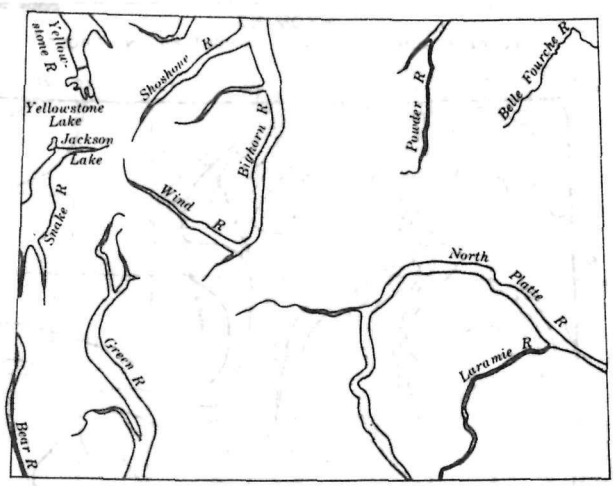
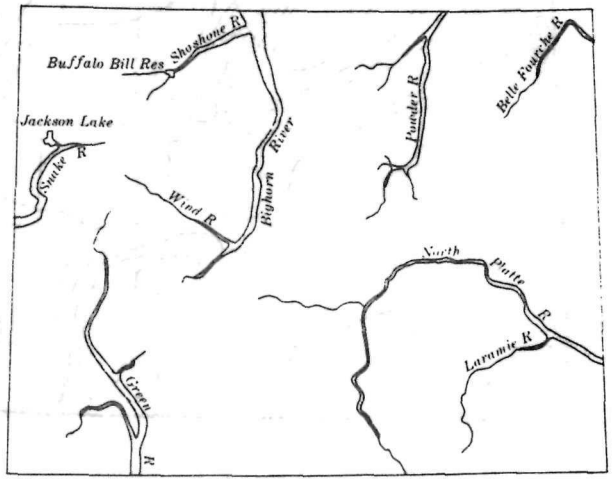


Fig. 6. Two maps showing the distribution of the average warm-season precipitation (April to September, inclusive) and the average number of days without killing frost in Wyoming (from Climate and Man, 1941, USDA).



AVERAGE DISCHARGE OF THE PRINCIPAL RIVERS



DISSOLVED SOLIDS RELATIVE ANNUAL LOADS
TRANSPORTED BY THE MAJOR STREAMS (GENERALIZED)

Fig. 7. Two maps showing the average discharge of the principal rivers and and dissolved solids transported by the major streams (from the Wyoming State Engineer's office).

soil types in the Basin:

Friable loams on limey shale, marl, and ash

Valley soils on limey alluvium and till

Tight clays and loams on salty shales

Reddish brown soils

Brown sandy loams on sandstone and limestone

Dune sands (see Fig. 8)

Mountain soils on acidic rocks and granite

Dunnewald describes the known series of each soil type in Bulletin 349 (Wyoming Agric. Exp. Station) which accompanies the map. Another soils map (Soils of the Western U. S.[1]) shows most of the Wyoming Basin covered with "light colored soils of arid regions (desert, sierozem, lithosol, alluvial, brown, regosol, solonetz, humic gley)". According to the Bulletin with this map, these soils are in general not leached below 1 to 2 feet (30 - 60 cm) and plant productivity is low. Organic matter content of the soil is usually less than 1.5 percent and a gravelly surface mantle is characteristic over thin A and B horizons. Horizons of carbonate accumulation occur in the lower B or upper C horizon, commonly within 20 inches (50 cm) of the surface.

Gibbens (1972) studied soil-vegetation interactions in the Washakie Basin west of Baggs, and provides quantitative data on the characteristics of several soil types.

The edaphic characteristics of the Basin are by no means uniform. As they vary, so do characteristics of the ecosystems. Travelling across the basin one is most impressed with the coarse upland soils which support the sagebrush-dominated grasslands; the fine-textured alluvial soils along rivers and streams which support meadows; the fine-textured alkaline soils which support greasewood and saltbush in poorly drained depressions; the rocky lithosols and regosols which support stands of mountain mahogany, juniper, and in some localities, ponderosa and limber pine; and the sand dunes (Fig. 8) which support a variety of dune species. These are the

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[1] Consult document libraries of the Soil Conservation Service for copies of this bulletin and map, published by Washington State University. No author is named.

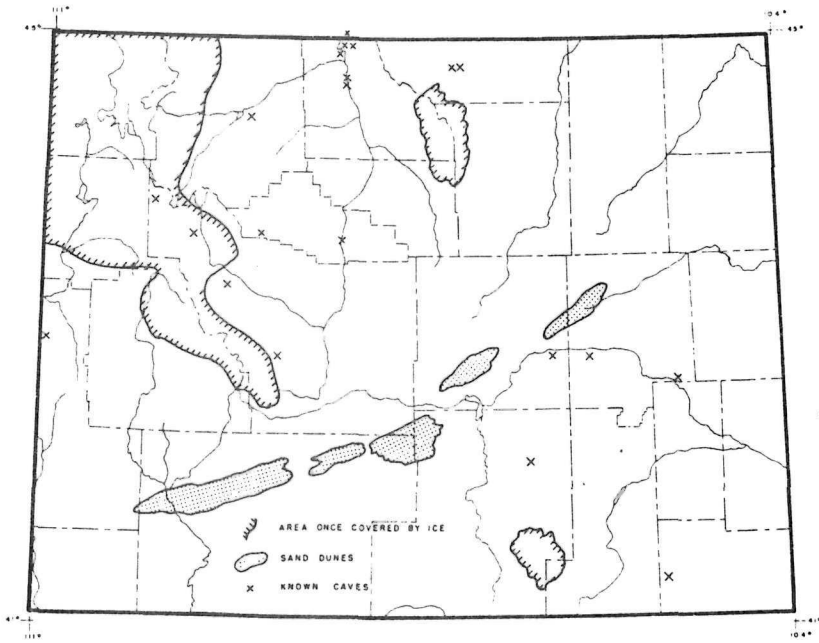

Fig. 8. Map of Wyoming showing areas occupied by glaciers during the Pleistocene Ice Age, and the location of dune sands and caverns probably developed during the same period (from Blackstone 1971).

obvious terrestrial patterns, caused by varying edaphic features, but the variation in ecosystem types is continuous and much greater than this as illustrated in the next section. Also, the relationships between ecosystem type and environment often are not so apparent.

THE FAUNAL AREAS OF THE WYOMING BASIN

The faunal areas in the Wyoming Basin, described by Long (1965) and based on the geographic distribution of the mammals, are as follows (see Fig. 9):

1. The Great Plains Faunal Area. This area covers the Laramie Basin and the eastern portion of the Shirley and Wind River Basins. Two characteristic species of mammals in this area are the prairie vole (Microtus ochrogaster) and the western harvest mouse (Reithrodontomys megalotis).
2. The Central Portal Faunal Area. This area includes species from the Great Plains Faunal Area and the Rocky Mountain Faunal Area. No species of mammals are unique to this area.
3. The Rocky Mountain Faunal Area. Two divisions are represented in the Wyoming Basin, the Upper and Lower Green River Divisions.
   a. Upper Green River Division. This division covers the Washakie Basin, the southwestern two-thirds of the Great Divide Basin, and the Upper Green River Drainage including the Uinta Badlands. Of the four subspecies of golden-mantled ground squirrels in Wyoming, one (Spermophilus lateralis wortmani) is endemic to the Red Desert Faunal Subdivision. This ground squirrel is restricted to the western border of the Great Divide Basin in the Upper Transition Life Zone and is usually associated with stands of limber pine (Pinus flexilis).

b. Lower Green River Division. This division covers the Flaming Gorge northward to the town of Green River, Wyoming. Three species of mammals which are unique to the Wyoming Basin, as well as the State of Wyoming occur in this division. They are the cliff chipmunk (Eutamias dorsalis), canyon mouse (Peromyscus crinitus), and piñon mouse (P. truei). All three species enter the Wyoming Basin from the south through the Green River Drainage.

Potential Natural Landmarks are recommended in this Report that are representative of each of the above faunal areas.

Baxter (1946) provides information on the amphibians and reptiles of Wyoming, and Long (1965) surveyed the mammals of the State. Many other studies have been done on the animals of specific areas, and some are referred to in this Report.

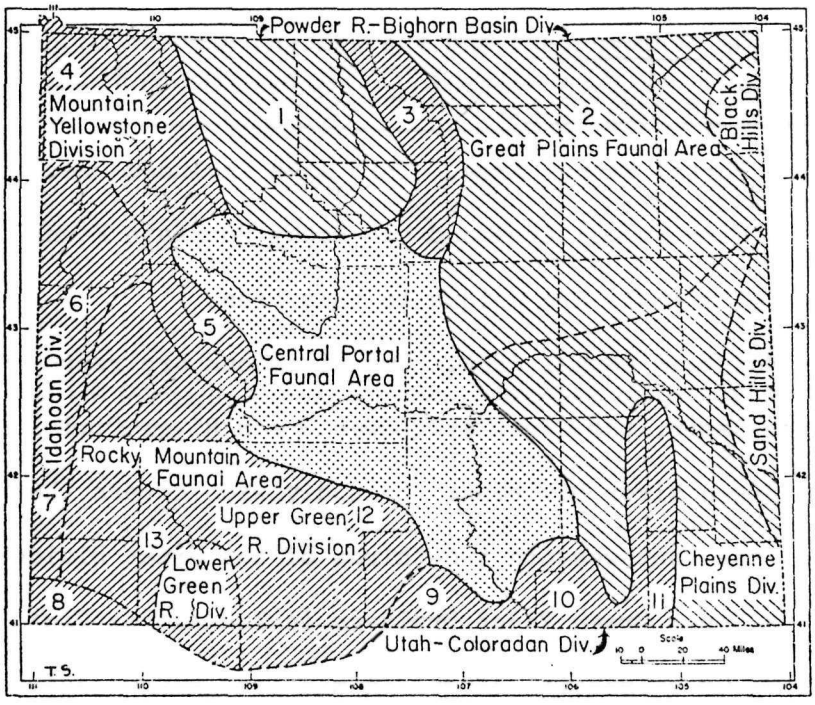

Fig. 9. Faunal Areas (names on map), Faunal Divisions (names on map), and Faunal Subdivisions (numerals on map refer to numerals in this legend). 1. Bighorn Basin Faunal Subdivision 2. Powder River Faunal Subdivision 3. Bighorn Mountain Faunal Subdivision (part of Mountain-Yellowstone Plateau Faunal Division) 4. Yellowstone Plateau Faunal Subdivision 5. Wind River Mountains Faunal Subdivision 6. Snake River Faunal Subdivision 7. Bear River Faunal Subdivision 8. Uinta Mountains Faunal Subdivision 9. Sierra Madre Mountains Faunal Subdivision 10. Medicine Bow Mountains Faunal Subdivision 11. Laramie Mountains Faunal Subdivision 12. Red Desert Faunal Subdivision 13. Upper Green River Faunal Subdivision (from Long, 1965).

NATURAL HISTORY THEMES AND ECOSYSTEM TYPES IN THE WYOMING BASIN

One of our objectives has been to identify the major natural history themes and ecosystem types in the Wyoming Basin. Doing so provides a basis for systematically deciding on the desirability of natural area preservation. The meaning of the terms "natural history themes" and "ecosystem type" is not obvious, however, and should be defined.

According to a National Park Service (NPS) Bulletin[1], the natural history themes are a series of categories encompassing essentially all the natural phenomena of the U. S. Some of the themes can be grouped, e.g. into the category "Terrestrial Ecosystems" which includes such themes as tundra, boreal forest, eastern deciduous forest, etc. The NPS has defined the various groups and themes. Natural Landmarks are areas that may range in size from a few hectares to several hundred square kilometers, and which are designated as being of value in their natural condition. A change in ownership is not necessarily involved, and existing uses of the land may continue. Designation as a Natural Landmark, however, formally recognizes the value of an area and, hopefully, will prevent its destruction in the future.

An ecosystem is an area where plants, animals, microbes, and the physical environment interact as a portion of the biosphere. Since one ecosystem grades into another, boundaries are arbitrary. Nevertheless it is useful for inventory purposes to classify ecosystems, and usually such a classification provides for sub-divisions of a natural history theme. Table 1 lists the Ecological Groups, Natural History Themes, and Ecosystem Types that we have identified in the Wyoming Basin[2]. As is commonly done, the ecosystem types are classified on the basis of dominant vegetation and

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[1] Part Two of the National Park System Plan: Natural History, 1972, U. S. Government Printing Office, $1.25.

[2] According to Cary (1917), the Wyoming Basin has the following life zones represented: Upper Sonoran Zone (Great Plains Division and the Great Basin Division), Transition Zone, and the Canadian Zone.

are synonymous with vegetation types in this report.

The vegetation of the Wyoming Basin has been partially classified by Nelson (1927) and Vass and Lang (1938), who studied the "Red Desert" region around the Great Divide Basin[1] and Sweetwater County. Nelson recognized 3 major types, namely the saltbush type (Atriplex gardneri and A. confertifolia), the sagebrush type (Artemisia tridentata, A. cana, A. spinescens, and A. pedatifida), and the wheatgrass type (Agropyron trachycaulum and A. smithii). These can obviously be further subdivided, as we have done in this report. Vass and Lang (1938) recognized twelve major vegetation types, compared to Nelson's three, and divided these into a total of 45 subtypes (Table 2). Our classification is not that detailed. Küchler (1964) recognized 8 vegetation types in the Wyoming Basin (Fig. 10), with the sagebrush-steppe (sagebrush-grassland) and saltbush-greasewood types being by far the most common.

Big sagebrush-grassland, the most common vegetation type in the Basin, forms an interesting pattern that can be characterized as follows: At the higher elevations, in the foothills, big sagebrush is common and vigorous on the upland but cannot compete with the aspen and other taller shrubs that occur on the deeper, more mesic soils in the ravines. At lower elevations and in the more arid portions of the Basin, however, sagebrush can only survive in the ravines, appearing from a distance as dark fingers of vegetation that gradually fade away near the bottom of the basin (Fig. 11), e.g., in the Great Divide Basin. In between these two extreme habitats big sage is generally common, being uniformly distributed on the favorable upland sites but sometimes only in patches on what we presume to be the more favorable edaphic sites. Shrubs that occur in the ravines are usually taller than those on the adjacent upland.

Although many view the sagebrush-grasslands as being dominated by big sage, Artemisia tridentata, it is useful ecologically to recognize at least 3 subspecies (Beetle 1960, Beetle and Young 1967). Wyoming big sagebrush (A. tridentata ssp wyomingensis) does not usually reach heights

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[1] Appendix A is a list of plant species found in the Great Divide Basin by Maxell (1973).

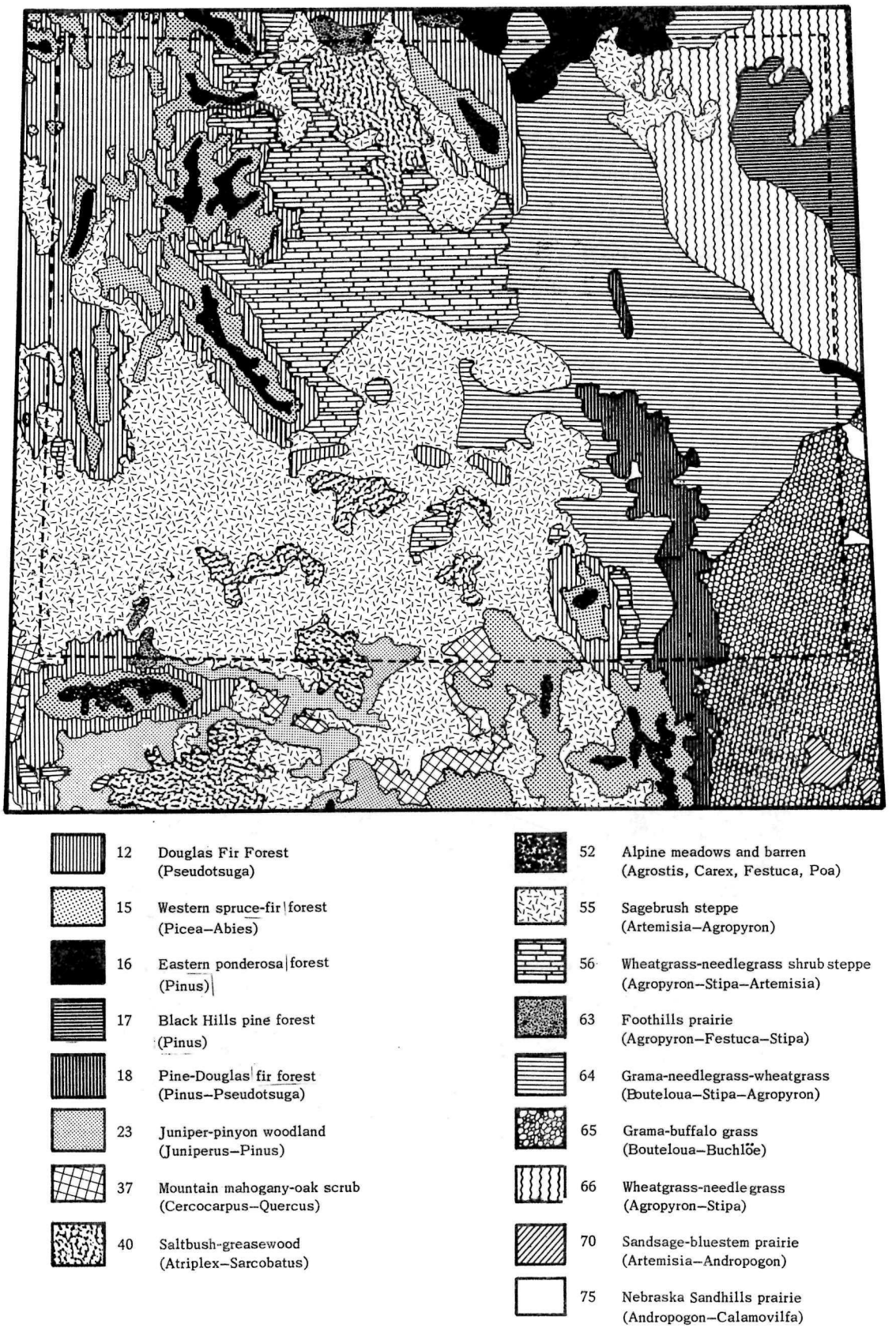


Fig. 10. The vegetation of Wyoming, redrawn from Küchler (1964).

of more than 0.3 m and grows on the drier, windswept shallow soils between about 5,000 and 8,000 feet elevation (1,515 to 2,424 m)[1]. Basin big sagebrush (A. tridentata ssp. tridentata) is much taller, reaching heights of 1 to 2 m, and is usually found below 5,500 ft., while Mountain big sagebrush (A. tridentata ssp vaseyana) is intermediate in height and is generally restricted to areas above 7,000 ft.

Another vegetation pattern can be easily recognized, namely greasewood domination on the lower slopes and depressions, various species of sagebrush dominating on the upper slopes, and sagebrush plus Grayia spinosa on the more windswept knolls and/or ridges.

Grazing pressure has also had a noticeable effect on the vegetation in some areas, leading to an increase in rabbitbrush, cheatgrass, and other species while causing the decline of still others. The Soil Conservation Service has considerable information on the increaser and decreaser species of each habitat type (defined by soil and precipitation).

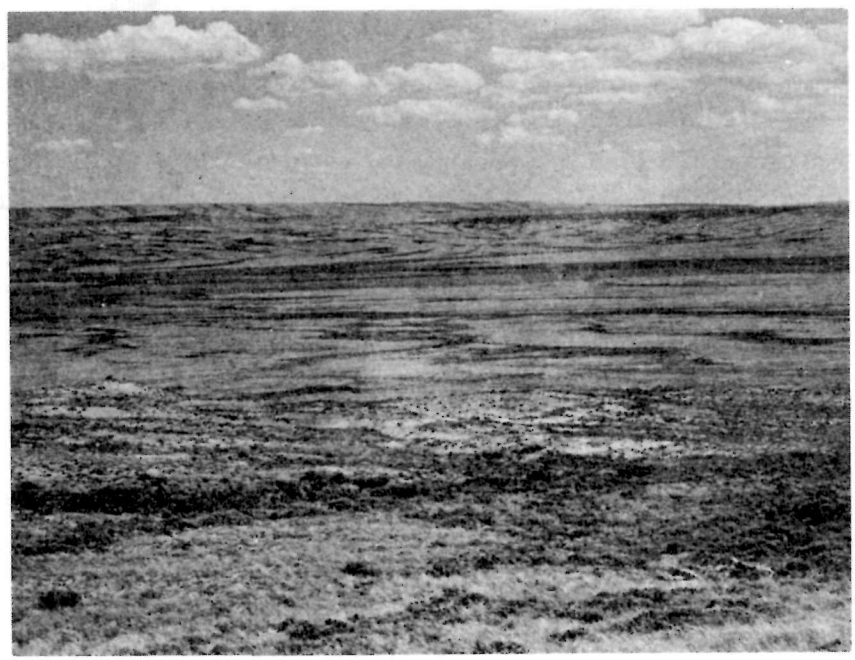


Fig. 11. View in the Wyoming Basin, showing the inter-digitation of the vegetation.

[1] The elevational limits of these subspecies have not been determined precisely.

TABLE 1. A classification of the natural history themes and ecosystem types identified in the Wyoming Basin.

Group[1]	Natural History Theme	Ecosystem Type
Terrestrial Ecosystems	Boreal Coniferous Forest	Engelmann Spruce-Subalpine Fir Forest
		Lodgepole Pine Forest
	Dry coniferous Forest and woodland	Ponderosa pine-Douglas fir savanna or woodland
		Ponderosa pine woodland or forest
		Limber pine savanna or woodland
		Juniper woodland
		Pinyon pine-juniper woodland
	Deciduous Forest	Aspen groves
	Floodplain Ecosystems[2]	
		Cottonwood floodplain woodland
		Floodplain willow thickets
		Floodplain meadows
		Blue spruce-alder-cottonwood-willow floodplain woodland

[1] The geological groups and themes in the Wyoming Basin have been identified, with potential natural landmarks, by McGrew, Brown, Hager, and Mears (1974).

[2] This theme is not listed by the National Park Service.

TABLE 1. (Continued)

Group	Natural History Theme	Ecosystem Type
	Upland Shrub Steppe[1]	Big sagebrush-grassland (tall and low variations)
		Sagebrush-bitterbrush grassland
		Sagebrush-shadscale-grassland
		Low sagebrush-grassland
		Birdfoot sagewort-grassland
		Bud sagewort-grassland
		Woody aster-sagebrush-grassland
	Alkali Depressions[1]	Greasewood-grassland
		Greasewood-sagebrush-grassland
		Shadscale-sagebrush-greasewood community
		Alkaline meadows
		Saltbush community (*Atriplex gardneri*)
		Playa - flooded in spring (*Agropyron smithii*)
	Grassland	Grassland-dwarf shrub community (short-grass prairie)
		Great Basin wild-rye mesic grassland
		Alkaline meadows
		Non-alkaline meadows

[1] This theme is not listed by the National Park Service.

TABLE 1. (Continued)

Group	Natural History Theme	Ecosystem Type
		Playas
		Stabilized Dune grasslands
	Sand Dunes[1]	Stable sand dunes
		Unstable sand dunes
	Foothills Shrub Community	Mountain mahogany community
		Mountain mahogany-skunkbush-bitterbrush community
		Serviceberry-big sagebrush-bitterbrush community
		Gambel's oak woodland
Aquatic Ecosystems	Lakes	Reservoirs
		Alkaline lakes
		Glacially-formed foothill lakes
	Ponds & marshes	Dune ponds
		Oxbow ponds
		Alkaline ponds
		Ephemeral Ponds
		Phragmites marsh
	Springs[1]	(not yet classified by type)
	Bogs[2]	Sedge bogs

[1] Listed only as a geological theme by the National Park Service.

[2] Not listed as a theme by the National Park Service.

TABLE 1. (Continued)

Group	Natural History Theme	Ecosystem Type
	Rivers	Large
		Small
	Streams	Rapid, clearwater, gravel bottom
		Slow, meandering mud bottom
		Ephemeral streams

TABLE 2. A list of the 45 vegetation subtypes identified by Vass and Lang (1938) in the Red Desert portion of the Wyoming Basin.

Dominant	Sub-dominant
Artemisia tridentata	Agropyron
" "	Atriplex confertifolia
" "	Chrysothamnus
" "	(nearly pure stand)
" "	Eurotia lanata
" "	Atriplex gardneri[1]
" "	Oryzopsis hymenoides
" "	Poa
" "	Artemisia pedatifida
" "	Kochia americana
" "	Stipa
" "	Sitanion hystrix
" "	Grayia spinosa
" "	Sarcobatus vermiculatus
Atriplex gardneri[1]	(pure stand)
" "	Sarcobatus vermiculatus
" "	Artemisia tridentata
" "	Artemisia pedatifida
" "	Eurotia lanata
" "	Atriplex confertifolia
" "	Agropyron
" "	Kochia americana
Sarcobatus vermiculatus	(pure stand)
" "	Atriplex gardneri[1]
" "	Atriplex gardneri ssp. tridentata[2]
" "	Distichlis stricta
" "	Artemisia tridentata
Chrysothamnus	Artemisia tridentata
"	Grayia spinosa
"	Distichlis stricta
"	Atriplex gardneri[1]
Eurotia lanata	(pure stand)
" "	Artemisia tridentata
Artemisia pedatifida	Agropyron
" "	Atriplex gardneri[1]

[1] Known as Atriplex Nuttallii when Vass and Lang (1938) wrote their paper.

[2] Known as Atriplex pabularis when Vass and Lang (1938) wrote their paper.

TABLE 2. (Continued)

Dominant	Sub-dominant
Atriplex confertifolia	Tetradymia
" "	Kochia americana
" "	Atriplex gardneri[1]
" "	(nearly pure stand)
Atriplex philonitra	(pure stand)
Grayia spinosa	Atriplex confertifolia
" "	Chrysothamnus
Iva axillaris	Agropyron
Atriplex canescens	Artemisia tridentata
Carex stenophylla	Artemisia tridentata

[1] Known as Atriplex Nuttallii when Vass and Lang (1938) wrote their paper.

Engelmann Spruce - Subalpine Fir Forest[1]

Although spruce-fir forests are very common in the adjacent Rocky Mountains, both to the north and south, they are found in the Wyoming Basin only in a few localities near the top of the Ferris Mountains, Elk Mountain, and the Shirley Mountains. We did not study these forests, but they are probably similar in species composition to those on the adjacent cordillera. The "island" nature of these mountains causes a different environment, however, and their relatively small size could prevent the persistence of some plant and animal species. The presence of these montane forests in the Basin could be significant for the survival of some Basin species; more thorough biological inventories need to be conducted to identify such potential values. A Management Plan for some of these mountain areas has been outlined by the BLM in "The Red Desert Study -- Final Report", 1972, but does not include such biological assessments.

Information on the plant species composition of this ecosystem type is available in Oosting and Reed (1952), Gartner (1967), Jacoby (1971) and Wirsing (1973). Tables 3, 4, and 5 list some of the major plants, birds, and mammals, respectively, that can be found in the coniferous forests of the cordillera adjacent to the Wyoming Basin. Nelson (1974) has recently documented the vascular flora of the Medicine Bow Mountains.

Potential Natural Landmarks:

None described in this Report, but Elk Mountain, the Ferris Mountains, and mountain ranges adjacent to the Wyoming Basin have potential that should be studied.

[1] We include little specific information on the coniferous forests because most of our attention was focused on the lowland vegetation.

Lodgepole Pine Forest[1]

Occurring at lower elevations than the spruce-fir forests (Fig. 12), the lodgepole pine forest ecosystem is somewhat more common on the mountain ranges in the Basin but still occurs primarily as "islands", e.g. the Ferris Mountains, Shirley Mountains, Green Mountains, Crooks Mountain, and Elk Mountain. The BLM (1972) has identified significant elk usage of these areas. The plant species composition of the lodgepole pine forests is probably very similar to those on the adjacent Cordillera, which have been described by Gartner (1967), Jacoby (1971), Wirsing (1973), and Rogers (1974).

Tables 3, 4, and 5 list the major plants, birds, and mammals, respectively, that could be expected in the boreal coniferous forests of the Basin.

Potential Natural Landmarks:

None described in this Report, but Elk Mountain, Ferris Mountains, or mountain ranges adjacent to the Wyoming Basin have potential that should be studied.

[1] We include little specific information on the coniferous forests because most of our attention was focused on the lowland vegetation.

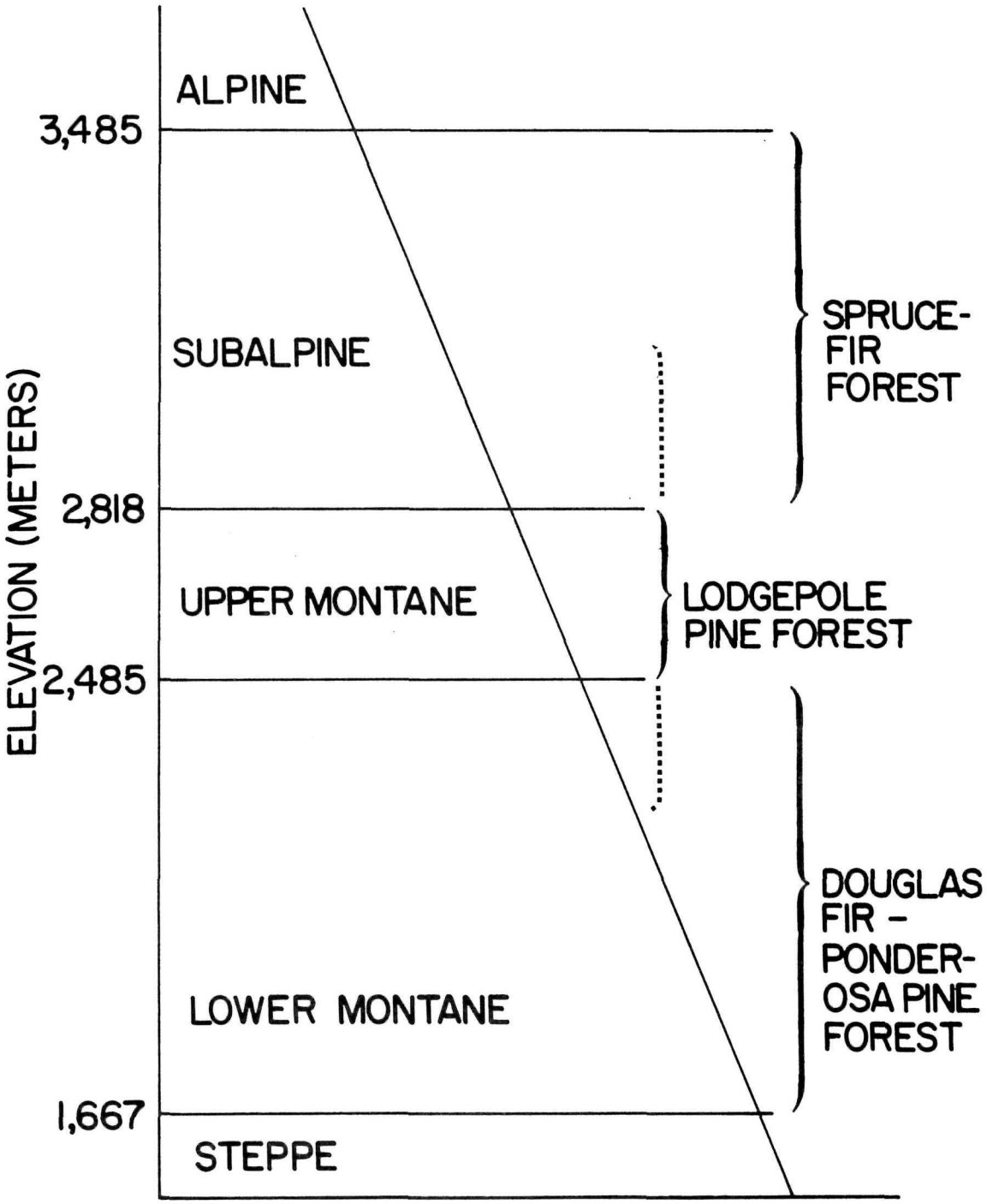


Fig. 12. Vegetation zonation in the Wyoming-Colorado area of the Rocky Mountains (after Moir 1969).

TABLE 3. Some of the major plant species found in boreal coniferous forests of the Wyoming Basin.

TREES

Abies lasiocarpa
Picea engelmanni
Pinus contorta
Populus tremuloides

SHRUBS

Juniperus communis
Ribes lacustre
Rosa woodsii
Shepherdia canadensis

GRASSES AND SEDGES

Calamagrostis purpuracens
Calamagrostis rubescens
Carex geyeri
Carex rossii
Luzula spicata
Poa cusickii
Poa nervosa
Poa reflexa
Trisetum spicatum

FORBS

Achillea millefolium
Androsace septentrionalis var. *puberulenta*
Aquilegia caerulea
Arnica cordifolia
Arnica latifolia
Arnica mollis
Astragalus miser
Castilleja rhexifolia
Castilleja septentrionalis
Chimaphila umbellata
Claytonia lanceolata
Draba stenoloba var. *nana*
Epilobium angustifolium
Epilobium hornemanni
Epilobium saximontanum

FORBS (Continued)

Erigeron melanocephalus
Erigeron peregrinus ssp. *callianthus*
Erythronium grandiflorum
Fragaria ovalis
Gentiana amarella
Hieracium albiflorum
Hieracium gracile
Lewisia pygmaea
Ligusticum filicinum
Ligusticum porteri
Listera cordata
Lupinus argenteus
Lupinus rubricaulis
Mahonia repens
Mertensia ciliata
Mitella pentandra
Monotropa hypopitys var. *latisquama*
Osmorhiza obtusa
Pedicularis parryi
Pedicularis racemosa
Penstemon whippleanus
Polygonum bistortoides
Potentilla glaucophylla
Pyrola secunda
Ranunculus alismaefolius
Ranunculus eschscholtzii
Sagina saginoides
Senecio cymbalarioides
Sibbaldia procumbens
Solidago spathulata
Stellaria umbellata
Thlaspi alpestre
Thlaspi glaucum
Trifolium parryi
Zigadenus elegans

TABLE 4. Species and estimated abundance of birds found in the Medicine Bow Mountains.[1]

Common Name*	Scientific Name*	Estimated Abundance
Mallard	Anas platyrhynchos	Locally common along streams and rivers
American Green-winged Teal	Anas crecca carolinensis	Locally common along streams and rivers
Common Goldeneye	Bucephala clangula	Uncommon on rivers
Common Merganser	Mergus merganser	Fairly common on rivers
Turkey Vulture	Cathartes aura	Locally uncommon
Goshawk	Accipiter gentilis	Uncommon in coniferous forests
Sharp-shinned Hawk	Accipiter striatus	Uncommon
Cooper's Hawk	Accipiter cooperii	Uncommon
Red-tailed Hawk	Buteo jamaicensis	Fairly common
Swainson's Hawk	Buteo swainsoni	Fairly common
Rough-legged Hawk	Buteo lagopus	Fairly common along open foothills
Ferruginous Hawk	Buteo regalis	Uncommon along open foothills
Golden Eagle	Aquila chrysaetos	Uncommon
Bald Eagle	Haliaeetus leucocephalus	Rare along rivers
Marsh Hawk	Circus cyaneus	Fairly common
Prairie Falcon	Falco mexicanus	Uncommon around rocky cliffs
Peregrine Falcon	Falco peregrinus	Very rare
American Kestrel	Falco sparverius	Fairly common
Blue Grouse	Dendragapus obscurus	Common in forested areas
White-tailed Ptarmigan	Lagopus leucurus	Rare on Brooklyn Ridge
Sage Grouse	Centrocercus urophasianus	Uncommon in sagebrush foothills

*Check-List of North American Birds, Committee of the American Ornithologists' Union. Fifth Edition, Baltimore, Maryland. 1957.

Thirty-Second Supplement to the American Ornithologists' Union Check-List of North American Birds. A.O.U. Committee on Classification and Nomenclature, The Auk, Vol. 90, No. 2, pp. 411-419. April 1973.

Corrections and Additions to the Thirty-Second Supplement to the Check-List of North American Birds. A.O.U. Committee on Classification and Nomenclature, The Auk, Vol. 90, No. 4, p. 887. October 1973.

[1]Prepared by Dr. Kenneth Diem and Dr. Reed Fautin, Department of Zoology, University of Wyoming.

TABLE 4. (continued)

Common Name	Scientific Name	Estimated Abundance
Killdeer	Charadrius vociferus	Uncommon in wet areas of foothills
Common Snipe	Capella gallinago	Uncommon in wet areas
Spotted Sandpiper	Actitis macularia	Fairly common along streams and rivers
Lesser Yellowlegs	Tringa flavipes	Uncommon along streams, rivers and on ponds at lower elevations
California Gull	Larus californicus	Fairly common on lakes and along rivers
Ring-billed Gull	Larus delawarensis	Uncommon on lakes and along rivers
Mourning Dove	Zenaida macroura	Common along foothills
Great Horned Owl	Bubo virginianus	Fairly common
Long-eared Owl	Asio otus	Uncommon along Platte River in willows
Common Nighthawk	Chordeiles minor	Fairly common
White-throated Swift	Aeronautes saxatalis	Uncommon around rocky cliffs
Broad-tailed Hummingbird	Selasphorus platycercus	Common
Rufous Hummingbird	Selasphorus rufus	Uncommon
Belted Kingfisher	Megaceryle alcyon	Fairly common along rivers and streams
Common Flicker	Colaptes auratus	Common
Yellow-bellied Sapsucker	Sphyrapicus varius	Common
Hairy Woodpecker	Dendrocopos villosus	Common
Downy Woodpecker	Dendrocopos pubescens	Common
Northern Three-toed Woodpecker	Picoides tridactylus	Uncommon
Eastern Kingbird	Tyrannus tyrannus	Fairly common at lower elevations
Western Kingbird	Tyrannus verticalis	Uncommon at lower elevations
Say's Phoebe	Sayornis saya	Uncommon at lower elevations
Willow Flycatcher	Empidonax traillii	Common in willows & alders below 9,000 ft.
Gray Flycatcher	Empidonax wrightii	Fairly common
Western Flycatcher	Empidonax difficulis	Fairly common
Western Wood Pewee	Contopus sordidulus	Fairly common
Horned Lark	Eremophila alpestris	Common along foothills and fairly common on Libby Flats

TABLE 4. (continued)

Common Name	Scientific Name	Estimated Abundance
Violet-green Swallow	Tachycineta thalassina	Uncommon around cliffs
Tree Swallow	Iridoprocne bicolor	Fairly common in aspen & cottonwood stands
Bank Swallow	Riparia riparia	Fairly common along rivers
Barn Swallow	Hirundo rustica	Uncommon
Cliff Swallow	Petrochelidon pyrrhonota	Common locally
Gray Jay	Perisoreus canadensis	Common
Steller's Jay	Cyanocitta stelleri	Fairly common
Black-billed Magpie	Pica pica	Common
Common Raven	Corvus corax	Common
Common Crow	Corvus brachyrhynchos	Fairly common at lower elevations
Piñon Jay	Gymnorhinus cyanocephalus	Uncommon at lower elevations
Clark's Nutcracker	Nucifraga columbiana	Common at higher forested elevations
Black-capped Chickadee	Parus atricapillus	Fairly common at lower elevations
Mountain Chickadee	Parus gambeli	Abundant
White-breasted Nuthatch	Sitta carolinensis	Rare
Red-breasted Nuthatch	Sitta canadensis	Fairly common
Pygmy Nuthatch	Sitta pygmaea	Uncommon
Brown Creeper	Certhia familiaris	Fairly common
Dipper	Cinclus mexicanus	Fairly common along streams and rivers
House Wren	Troglodytes aedon	Fairly common
Cañon Wren	Catherpes mexicanus	Rare in river canyons
Rock Wren	Salpinctes obsoletus	Fairly common in rocky areas at lower elevations
Gray Catbird	Dumetella carolinensis	Fairly common in willows and alders
American Robin	Turdus migratorius	Abundant
Hermit Thrush	Catharus guttata	Common locally
Swainson's Thrush	Catharus ustulata	Fairly common
Veery	Catharus fuscescens	Uncommon in willow thickets of lower elevations
Mountain Bluebird	Sialia currucoides	Fairly common
Townsend's Solitaire	Myadestes townsendi	Fairly common locally

TABLE 4. (continued)

Common Name	Scientific Name	Estimated Abundance
Golden-crowned Kinglet	Regulus satrapa	Rare
Ruby-crowned Kinglet	Regulus calendula	Common in coniferous forests
Water Pipit	Anthus spinoletta	Fairly common above timberline
Loggerhead Shrike	Lanius ludovicianus	Fairly common locally
Starling	Sturnus vulgaris	Common locally at lower elevations
Solitary Vireo	Vireo solitarius	Rare
Warbling Vireo	Vireo gilvus	Common in aspens and cottonwoods at lower elevations
Yellow Warbler	Dendroica petechia	Abundant in willow-alder habitat
Yellow-rumped Warbler	Dendroica coronata	Common locally in coniferous forests
MacGillivray's Warbler	Oporornis tolmiei	Fairly common in riparian thickets
Common Yellowthroat	Geothlypis trichas	Fairly common in riparian thickets
Wilson's Warbler	Wilsonia pusilla	Fairly common in riparian thickets at higher elevations
Western Meadowlark	Sturnella neglecta	Common along open foothills
Northern Oriole	Icterus galbula	Fairly common along rivers at lower elevations
Brewer's Blackbird	Euphagus cyanocephalus	Common in wet areas of lower elevations
Brown-headed Cowbird	Molothrus ater	Fairly common at lower elevations
Western Tanager	Piranga ludoviciana	Fairly common in coniferous areas
Black-headed Grosbeak	Pheucticus melanocephalus	Uncommon along Platte River
Lazuli Bunting	Passerina amoena	Uncommon along streams & rivers at lower elevations
Evening Grosbeak	Hesperiphona vespertina	Uncommon
Cassin's Finch	Carpodacus cassinii	Fairly common in conifers
Pine Grosbeak	Pinicola enucleator	Fairly common in conifers
Brown-capped Rosy Finch	Leucosticte australis	Uncommon in alpine or artic zones
Pine Siskin	Spinus pinus	Abundant in coniferous forest
American Goldfinch	Spinus tristis	Common in weedy and forested foothills

TABLE 4. (continued)

Common Name	Scientific Name	Estimated Abundance
Red Crossbill	Loxia curvirostra	Fairly common locally
Green-tailed Towhee	Chlorura chlorura	Fairly common in foothill shrub habitat
Lark Bunting	Calamospiza melanocorys	Uncommon along open foothills
Vesper Sparrow	Pooecetes gramineus	Common in shrub-steppe
Gray-headed Junco	Junco caniceps	Common
Chipping Sparrow	Spizella passerina	Common
Brewer's Sparrow	Spizella breweri	Abundant in shrub zone of foothills
White-crowned Sparrow	Zonotrichia leucophrys	Common at higher elevations
Lincoln's Sparrow	Melospiza lincolnii	Common in shrubs at higher elevations
Song Sparrow	Melospiza melodia	Common in willow & alder habitat

TABLE 5. Species and estimated abundance of mammals found in the Medicine Bow Mountains.*[1]

Common Name*	Scientific Name*	Estimated Abundance
Masked Shrew	Sorex cinereus cinereus	Most common in coniferous forests
Vagrant Shrew	Sorex vagrans obscurus	Most widely distributed shrew in Wyoming
Dwarf Shrew	Sorex nanus	Rare
Water Shrew	Sorex palustris navigator	Common along streams in dense herbaceous vegetation
Little Brown Myotis	Myotis lucifugus carissima	Rare even at lower elevations
Long-legged Myotis	Myotis volans interior	Fairly common at lower elevations
Big Brown Bat	Eptesicus fuscus pallidus	Uncommon
Pika	Ochotona princeps saxatilis	Fairly common talus slopes and rock piles
Nuttall's Cottontail	Sylvilagus nuttallii grangeri	Rare in forested area
Snowshoe Rabbit	Lepus americanus bairdii	Fairly common in forested area
White-tailed Jack-rabbit	Lepus townsendii campanius	Uncommon on Libby Flats, but common on plains
Black-tailed Jack-rabbit	Lepus californicus melanotis	Rare even on plains
Least Chipmunk	Eutamias minimus operarius	Common at all elevations
Uinta Chipmunk	Eutamias umbrinus montanus	Rare in Albany County
Yellow-bellied Marmot	Marmota flaviventris luteola	Common
Richardson's Ground Squirrel	Spermophilus richardsonii elegans	Common in brush of foothills; present on Libby Flats
Thirteen-lined Ground Squirrel	Spermophilus tridecemlineatus pallidus	Common on Laramie plains
Golden-mantled Ground Squirrel	Spermophilus lateralis lateralis	Common
White-tailed Prairie Dog	Cynomys leucurus	Locally uncommon on Laramie plains area
Red Squirrel	Tamiasciurus hudsonicus fremonti	Common
Northern Pocket Gopher	Thomomys talpoides rostralis	Common in non-forested area at all elevations
Beaver	Castor canadensis missouriensis	Fairly common along rivers and streams
Western Harvest Mouse	Reithrodontomys megalotis dychei	Fairly common in non-forested area at lower elevations

*Nomenclature follows that of Long (1965).
Long, Charles A. 1965. The Mammals of Wyoming, Univ. of Kan. Pub. 14(18):493-758.

[1]Prepared by Dr. Kenneth Diem and Dr. Reed Fautin, Department of Zoology, University of Wyoming.

TABLE 5. (continued)

Common Name	Scientific Name	Estimated Abundance
Deer Mouse	Peromyscus maniculatus nebrascensis	Very abundance
Northern Grasshopper Mouse	Onychomys leucogaster arcticeps	Fairly common in grassland
Bushy-tailed Wood Rat	Neotoma cinerea orolestes	Uncommon
Red-backed Vole	Clethrionomys gapperi galei	Common in lodgepole pine and spruce-fir forests
Heather Vole	Phenacomys intermedius intermedius	Uncommon
Montane Vole	Microtus montanus nanus	Abundant
Long-tailed Vole	Microtus longicaudus longicaudus	Rare
Sagebrush Vole	Lagurus curtatus levidensis	Rare
Muskrat	Undatra zibethicus cinnamominus	Common along streams
Western Jumping Mouse	Zapus princeps princeps	Common along streams with dense herbaceous vegetation
Porcupine	Erethizon dorsatum bruneri	Common in coniferous forests
Coyote	Canis latrans latrans	Common
Red Fox	Vulpes vulpes regalis	Common
Swift Fox	Vulpes velox velox	Very rare
Black Bear	Ursus americanus cinnamomum	Locally fairly common
Raccoon	Procyon lotor hirtus	Common along North Platte with ranges extending to about 8,300 along Big and Little Laramie Rivers
Marten	Martes americana origenes	Common in coniferous forests but not readily seen
Ermine	Mustela erminea muricus	Rare -- above 10,000 feet
Long-tailed Weasel	Mustela frenata nevadensis	Common
Mink	Mustela vison letifera	Fairly common along rivers and streams of lower elevations
Badger	Taxidea taxus taxus	Common
Striped Skunk	Mephitis mephitis hudsonica	Common

TABLE 5. (continued)

Common Name	Scientific Name	Estimated Abundance
Mountain Lion	Felis concolor hippolestes	Rare
Lynx	Lynx canadensis canadensis	Rare
Bobcat	Lynx rufus pallescens	Locally common
Wapiti	Cervus canadensis nelsoni	Common
Mule Deer	Odocoileus hemionus hemionus	Common
White-tailed Deer	Odocoileus virginianus dacotensis	Uncommon, along flood plains at lower elevations
Pronghorn	Antilocapra americana americana	Locally common along foothill region
Mountain Sheep	Ovis canadensis canadensis	Fairly common along Platte River Canyon around Douglas Creek

Ponderosa pine - Douglas fir savanna or woodland
Ponderosa pine woodland or forest
Douglas fir woodland

Ponderosa pine and Douglas fir are found in the foothills of the mountains, and Ponderosa pine in particular is found occasionally on hogback ridges well separated from the mountains. Three localities where this type is well represented include the western foothills of the Shirley Mountains near Alcova and Pathfinder Reservoirs, around Laramie Peak, and in the foothills of the Uinta Mountains south of Flaming Gorge Reservoir. Moisture is more limited in this ecosystem type than those higher on the mountains. These foothill woodlands often are interspersed with sagebrush-grasslands.

Perhaps the largest Douglas fir in the Basin occur on the lateral glacial moraines on the east side of Fremont Lake and along the North Platte River south of Saratoga. Douglas fir woodlands are also found in the foothills of the Salt River and Wyoming Mountain Ranges, along Beaver Rim, and on ridges overlooking the Green River, for example near LaBarge. Douglas fir is often found where ponderosa pine does not grow.

Table 6 is a list of plant species known to occur in this ecosystem type.

States (1968) has discussed the occurrence of ponderosa pine and limber pine on isolated hogback ridges in the eastern part of the Wyoming Basin.

Potential Natural Landmarks:

None described in this report, but the Ferris Mountains and mountain ranges adjacent to the Basin have potential that should be studied.

Limber Pine Woodland or Savanna

Limber pine predominates in some foothill environments, as well as on the top and slopes of some of the mountains of the Basin, e.g. Steamboat Mountain, Crooks Mountain, and Green Mountain. Usually the trees do not form a closed canopy and a variety of sun-loving shrubs, forbs and grasses exist in the community. This type is more common in the Basin and more characteristic of the Basin than the Ponderosa pine - Douglas fir type. In all cases it is associated with the mountain ranges, with hogback ridges, or with escarpments such as the Beaver Rim.

Table 6 lists the plant species that we have observed in this ecosystem type. Deer, elk, coyote, fox, and a variety of other animals frequent this ecosystem type.

Distribution in the Wyoming Basin:

Beaver Rim, Crooks and Green Mountains, near South Pass City, Steamboat Mountain, Green River Rim near LaBarge (limber pine - douglas fir), Separation Peak, Rim of Bates Hole, Granitic outcrop near the Sweetwater River, and Castle Gardens.

Potential Natural Landmarks:

Steamboat Mountain
Beaver Rim
Sweetwater River Complex
Castle Gardens

TABLE 6. Some plant species found in the Ponderosa pine-Douglas fir-limber pine-savanna, woodland, or forest.

TREES

Juniperus osteosperma
Juniperus scopulorum
Pinus flexilis
Pinus ponderosa
Pseudotsuga menziesii

SHRUBS

Amelanchier alnifolia
Arctostaphylos uva-ursi
Artemisia arbuscula
Artemisia frigida
Artemisia tridentata
Artemisia tripartita
Brickelia grandiflora
Cercocarpus montanus
Chrysothamnus nauseosus
Chrysothamnus viscidiflorus
Juniperus communis
Mahonia repens
Prunus virginiana
Purshia tridentata
Rhus trilobata
Ribes cereum
Rosa woodsii
Shepherdia canadensis
Symphoricarpos oreophilus
Yucca glauca

GRASSES

Agropyron spicatum
Bromus japonicus
Bromus tectorum
Elymus cinereus
Festuca idahoensis
Koeleria cristata
Oryzopsis hymenoides
Stipa comata

FORBS

Achillea millefolia
Apocynum medium
Arenaria hookeri
Artemisia ludoviciana
Balsamorrhiza sagittata
Calochortus nuttallii
Chenopodium berlandieri
Chenopodium fremontii
Delphinium geyeri
Eriogonum brevicaule
Eriogonum sp.
Geranium sp.
Heuchera parvifolia
Hymenoxys acaulis
Ivesia gordonii
Lewisia rediviva
Lupinus humicola
Opuntia polyacantha
Physaria australis
Potentilla sp.
Psoralla sp.
Ribes saxosum
Thermopsis rhombifolia

Juniper Woodland

Pinyon Pine - Juniper Woodland

These ecosystem types occur in still dryer, warmer environments in the foothills of some mountains, and usually merge into the sagebrush-grasslands which predominate over most of the Basin. Juniper is far more common, with pinyon pine (Pinus edulis) being restricted to the area around Flaming Gorge Reservoir. Mountain mahogany and big sagebrush are frequently associated with these small tree species. Both J. scopulorum and J. osteosperma occur in the Basin, and have been observed invading the adjacent sagebrush-grassland (Wight and Fisser 1968). Usually the junipers are restricted to shallower, less developed soils. Table 7, from Wight and Fisser (1968), is a comparison of the juniper woodland soils with those of adjacent sagebrush-grassland in the Big Horn Basin.

Table 8 is a list of the plants known to occur in this type. Wight and Fisser (1968) and Hanson (1974) summarize some of the ecological characteristics of this ecosystem type.

Distribution in the Basin:

Flaming Gorge Reservoir, Owl Creek Mountains, Wind River Mountain foothills, Castle Gardens, Bull Lake, South of Rock Springs, and Southwest of Baggs.

Potential Natural Landmarks:

Rattlesnake Creek Oak Woodland

Henry's Fork Fault Juniper Woodland

Castle Gardens

TABLE 7. Comparison of some soil characteristics of juniper woodlands with those of adjacent sagebrush-grasslands in northwestern Wyoming. Data from Wight and Fisser (1968).

Soil Characteristic	Average of juniper community	Average of Sagebrush-grassland
Available Moisture (inches)	0.31	2.04
Soil Depth (inches)	6.3	18.6
Soluble salts (mmhos/cm)	5.82	5.90
Soil pH	7.10	7.12
Soil Organic Matter (%)	2.01	2.27

TABLE 8. Some plants known to occur in the juniper woodlands of the Wyoming Basin.

TREES

Juniperus communis
Juniperus osteosperma
Juniperus scopulorum
Pinus edulis
Pinus flexilis
Pinus ponderosa

SHRUBS

Artemisia arbuscula
Artemisia tridentata
Atriplex confertifolia
Cercocarpus ledifolius
Cercocarpus montanus
Chrysothamnus nauseosus
Gutierrezia sarothrae
Purshia tridentata

GRASSES AND SEDGES

Agropyron spicatum
Bouteloua gracilis
Bromus tectorum
Carex filifolia
Oryzopsis hymenoides
Poa secunda
Stipa comata

FORBS

Allium textile
Calochortus nuttallii
Descurainia pinnata
Lappula texana
Opuntia polyacantha
Phlox hoodii
Plantago purshii
Sphaeralcea coccinea

Aspen Groves

Aspen groves are not common in the Wyoming Basin, occurring only on more mesic sites on the slopes of the mountains. These groves are small, but have a very distinctive flora (Table 9) and are important food sources for deer and elk in the winter. The aspen groves at Twin Groves, Crooks Mountain, and probably elsewhere are of special interest because they sometimes have the form of an "atoll", apparently due to heavy snow accumulation within the grove. This phenomenon is described further on page 190 . Beetle (1974) reviews what is known about the taxonomy, autecology, and synecology of aspen in Wyoming.

Cottonwoods (Populus angustifolium) are common along the floodplains of all the rivers, but in addition form distinctive groves in the vicinity east of Farson. We have not determined whether these are natural or planted, nor have we found them elsewhere.

Distribution of aspen groves in the Wyoming Basin:

Slopes of mountains near Atlantic City, top of Steamboat Mountain, Slopes of Separation Peak, Twin Groves, and Crooks Mountain.

Potential Natural Landmarks:

Twin Groves Aspen Atoll

Steamboat Mountain

TABLE 9. Some plant species known to occur in the aspen groves of Teton County, Wyoming (from Beetle 1974).

SHRUBS

Amelanchier alnifolia
Berberis aquifolium
Ceanothus velutinus
Juniperus communis
Pachistima myrsinites
Prunus melanocarpa
Rosa woodsii
Salix scouleriana
Sambucus racemosus
Shepherdia canadensis
Symphoricarpos albus

GRASSES AND SEDGES

Agropyron trachycaylum
Agropyron trachycaylum var. unilaterale
Agrostis scabra
Bromus anomalus
Bromus kalmii
Bromus margniatus
Calamagrostis rubescens
Carex geyeri
Carex hoodii
Carex raynoldsii
Elymus glaucus
Muhlenbergia glomerata
Oryzopis pungens
Phleum alpinum
Poa nervosa
Schizachne purpurascens
Stipa columbiana
Stipa lettermanii
Trisetum wolfii

FORBS

Achillea lanulosa or A. millifolium
Actea rubra
Agastache urticifolia
Agoseris glauca
Angelica pinnata
Aquilegia caerulea

FORBS (Continued)

Aster engelmannii
Aster integrifolius
Balsamorhiza sagittata
Campanula rotundifolia
Cirsium centaureae
Collomia linearis
Delphinium barbeyi
Delphinium occidentale
Epilobium angustifolium
Erigeron speciosus
Fragaria glauca
Galium boreale
Gayophytum ramosissimum
Geranium fremontii
Geranium richardsonii
Geranium viscossissimum
Hackelia diffusa
Hackelia floribunda
Helianthella quinquenervis
Heracleum lanatum
Lathyrus leucanthus
Lathyrus pauciflorus
Ligusticum filicinum
Ligusticum porteri
Linum lewisii
Lupinus parviflorus
Mertensia arizonica
Nemophila breviflora
Osmorhiza depauperata
Pedicularis paysoniana
Penstemon rydbergii
Perideridia gairdneri
Polygonum douglasii
Potentilla gracilis
Pseudocymopterus montanus
Rudbeckia hirta
Rudbeckia occidentalis
Senecio serra
Smilacina racemosa
Smilacina stellata
Thalictrum fendleri
Thalictrum occidentalis
Valeriana obovata
Valeriana occidentals
Vicia americana
Viguiera multiflora

Cottonwood Floodplain Woodland
Willow Thickets
Floodplain Meadows
Blue Spruce - alder - willow floodplain woodland

Except for blue spruce, which occurs in the floodplains only at higher elevations (e.g. just above Dubois on the Wind River and near Lake Fremont), and lodgepole pine, which occurs on the Pine Creek floodplain near Pinedale, narrowleaf cottonwood is the only tree found on the floodplains of the Wyoming Basin. Ribbon forests of cottonwood are common along the rivers, intermingling with willow thickets and meadows. Many of the meadows are very extensive, are used for hayland, and are irrigated (Fig. 13). Various species of willows occur on the floodplains (Dorn 1974), and alder is found at the higher elevations. Like the ecosystem types of a mountain, those on the floodplain are not isolated from each other and together could just as appropriately be referred to as one ecosystem type, dominated by the river and valley in the case of the floodplain and by the abrupt relief and topography in the mountains.

Tables 10 and 11 provide a list of floodplain plant species. These areas have not been well studied for either the flora or fauna, and often have been heavily influenced by man.

Distribution of floodplain ecosystems in the Wyoming Basin:

See Fig. 13

Potential Natural Landmarks:

Sweetwater River Natural History Complex
Muddy Creek
Sand Creek and Camel Rock

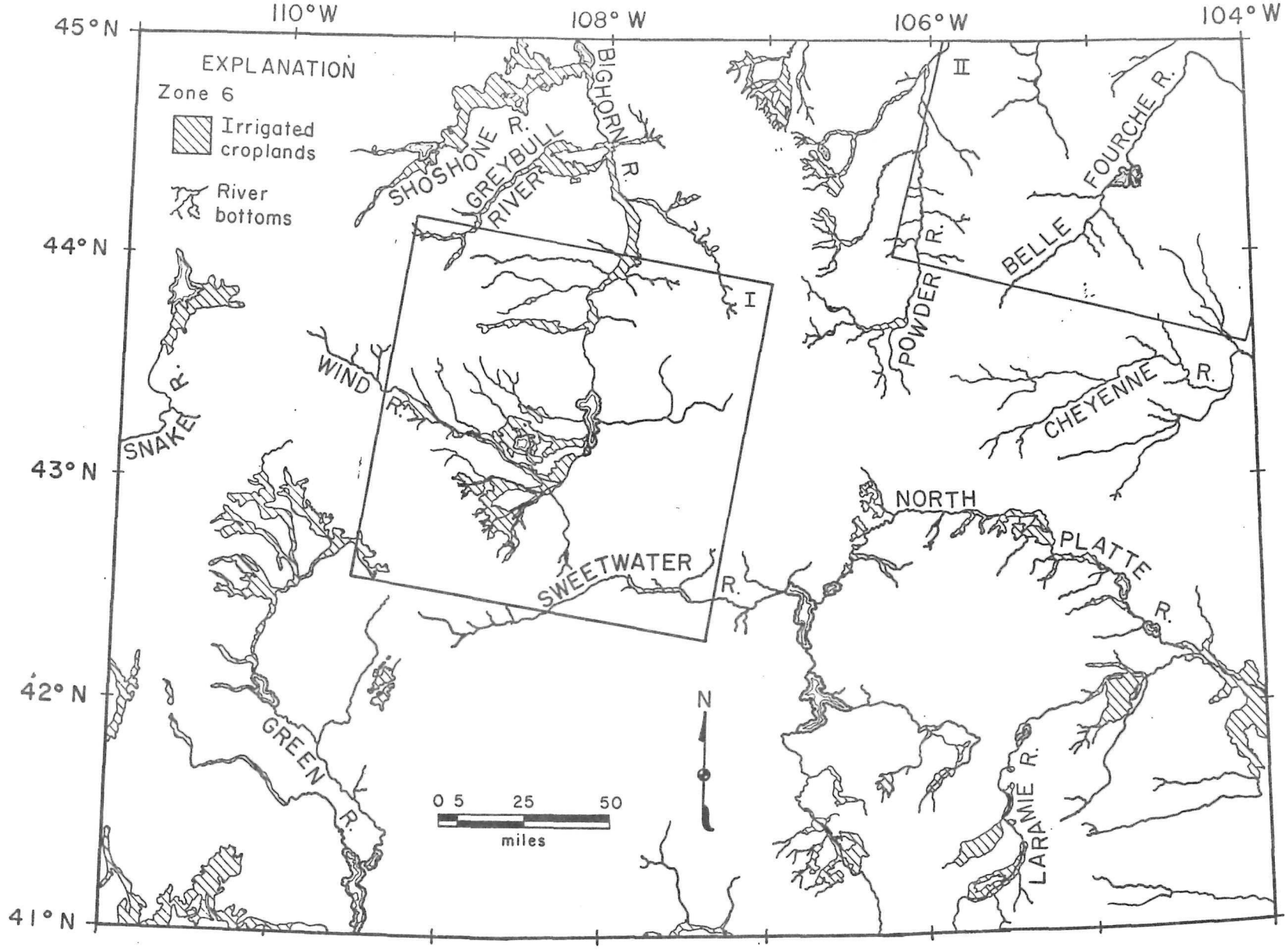


Fig. 13. Map of the major floodplains and irrigated land in Wyoming, prepared by Mike Evans in the Remote Sensing Laboratory, Department of Geology, University of Wyoming.

TABLE 10. Some plants found along the flood plains of the Wyoming Basin.

TREES

Alnus tenuifolia
Betula occidentalis
Crataegus sp.
Juniperus osteosperma
Picea pungens
Populus angustifolia

SHRUBS

Cornus stolonifera
Elaeagnus commutata
Prunus virginiana var. melanocarpa
Ribes spp.
Salix spp.
Salix drummundiana
Salix exigua
Salix geyeriana
Salix monticola
Tamarix (invading Carbon Co.; probably T. gallica)

GRASSES AND SEDGES

Agropyron sp.
Agrostis scabra
Alopecurus sp.
Hordeum sp.
Hordeum jubatum
Juncus balticus
Oryzopsis hymenoides
Sporobolus airoides

FORBS

Artemisia ludoviciana
Asparagus officinalis
Aster spp.
Glycyrrhiza lepidota
Lactuca sp.
Mentha arvensis
Plantago sp.
Polygonum sp.
Rumex crispus
Rumex maritinus
Senecio sp.
Solidago sp.
Tragopogon dubius or porrifolius

FORBS (Continued

Xanthium sp.

TABLE 11. Checklist of plants of moist bottomland (Meadow), Eagle Rock Area, Laramie Range, Wyoming. (Prepared by Jay N. Holliday 1964, Univ. of Wyoming)

TREES

Alnus tenuifolia
Populus tremuloides

SHRUBS

Arctostaphylos uva-ursi
Cercocarpus montanus
Potentilla fruticosa
Rosa acicularis
Salix bebbiana
Salix monticola
Salix planifolia
Salix pseudocordata

GRASSES, SEDGES AND RUSHES

Agropyron smithii var. molle
Agropyron subsecundum
Agropyron trachycaulum
Agrostis scabra
Alopecurus aequalis
Beckmannia syzigachne
Bromus marginatus
Carex aquatilis
Carex aurea
Carex canescens
Carex festivella
Carex lanuginosa
Carex nebraskensis
Carex rostrata
Carex simulata
Danthonia parryi
Deschampsia caespitosa
Eleocharis acicularis
Eleocharis macrostachya
Glyceria grandis
Glyceria pauciflora
Glyceria striata
Hesperochloa kingii
Hordeum brachyantherum
Juncus alpinus

GRASSES, SEDGES AND RUSHES

Juncus balticus var. montanus
Juncus longistylis
Juncus saximontanus f. saximontanus
Koeleria cristata
Phleum alpinum
Phleum pratense
Poa compressa
Scirpus microcarpus
Stipa comata
Stipa richardsonii

FORBS

Achillea millefolium ssp. lanulosa var. lanulosa
Aconitum columbianum
Allium cernuum
Allium geyeri var. geyeri
Anaphalis margaritacea var. subalpina
Androsace septentrionalis var. subumbellata
Anemone patens
Antennaria parvifolia
Antennaria rosea
Apocynum androsaemifolium
Arabis holboellii Hornem. var. retrofracta
Arenaria fendleri
Arnica cordifolia
Artemisia campestris ssp. borealis var. scouleriana
Artemisia dracunculus
Artemisia frigida
Artemisia ludoviciana
Artemisia tridentata
Artemisia tripartita
Aster occidentalis
Astragalus alpinus
Astragalus dasyglottis

TABLE 11. (Continued)

FORBS (Continued)

Astragalus eucosmus
Astragalus gracilis
Astragalus parryi
Astragalus pectinatus
Astragalus striatus
Besseya wyomingensis
Calochortus gunnisonii
Campanula rotundifolia
Castilleja chromosa
Castilleja flava
Cerastium arvense
Chrysopsis villosa var. hispida
Chrysothamnus viscidiflorus ssp. lanceolatus
Collinsia parviflora
Collomia linearis
Corallorhiza maculata
Crepis atrabarba
Crepis modocensis
Cryptantha virgata
Cystopteris fragilis
Delphinium nelsonii
Epilobium angustifolium
Equisetum arvense
Equisetum hyemale var. pseudo-hyemale
Equisetum laevigatum
Erigeron caespitosus
Erigeron compositus
Erigeron eatoni
Erigeron pumilus
Eriogonum flavum
Eriogonum subalpinum
Erigonum umbellatum
Eriophorum angustifolium
Erysimum capitatum
Fragaris ovalis
Frasera speciosa
Gaillardia aristata
Galium boreale
Gayophytum ramosissimum
Geranium parryi
Grindelia squarrosa
Gutierrezia sarothrae
Habenaria hyperborea

FORBS (Continued)

Harbouria trachypleura
Heuchera parvifolia
Hymenoxys acaulis
Iris missouriensis
Juniperus communis
Lesquerella montana
Lewisia pygmaea
Lilium philadelphicum var. andinum
Lomatium orientale
Lupinus argenteus
Lupinus sericeus
Lychnis drummondii
Mertensia lanceolata
Microseris nutans
Montia chamissoi
Oenothera caespitosa
Oenothera coronopifolia
Orthocarpus luteus
Osmorhiza depauperata
Oxytropis lambertii
Oxytropis sericea
Oxytropis splendens
Paronychia sessiliflora
Penstemon rydbergii
Penstemon secundiflorus
Penstemon virens
Phlox hoodii
Potamogeton alpinus
Potamogeton foliosus
Potentilla arguta
Potentilla effusa
Potentilla pennsylvanica var. strigosa
Potentilla pulcherrima
Polygonum amphibium var. amphibium
Polygonum aviculare var. littorale
Polygonum bistortoides
Polygonum sawatchense
Ranunculus aquatilis var. capillaceus
Ranunculus cardiophyllus var. cardiophyllus
Ranunculus glaberrimus

TABLE 11. (Continued)

FORBS (Continued)

Ranunculus ranunculinus
Ribes cereum
Rumex crispus
Saxifraga rhomboidea
Sedum stenopetalum
Senecio integerrimus
Sisyrinchium montanum
Smilacina stellata
Solidago spathulata
Sparganium multipedunculatum
Stellaria longifolia
Taraxacum officinale
Thermopsis divaricarpa
Thlaspi alpestre
Townsendia hookeri
Tragopogon sp.
Triglochin maritima
Triglochin palustris
Zigadenus elegans

Big sagebrush-grassland

Unlike the previously described ecosystems which are found intermittently in the Wyoming Basin, sagebrush-grassland is often visible for many miles in all directions. Although some believe that big sagebrush has become much more abundant due to the grazing of domestic livestock, Vale (1974) reviews historical evidence that suggests this is probably not true (see p. 1). Big sagebrush covers about 36,100 square miles in Wyoming, which is an estimated 62 percent of all the sagebrush-dominated vegetation in the State (Beetle 1960). Vass and Lang (1938) estimated that big sagebrush-grassland covered over 25 percent of Sweetwater County, which is entirely within the Wyoming Basin.

Big sagebrush-grassland is usually dominated by Artemisia tridentata, but the vegetation is far from uniform. On some sites sagebrush is rather sparse, with grasses and forbs being more conspicuous. Equally apparent is the variation in sagebrush height, the drier sites having very stunted shrubs (A. tridentata var. wyomingensis), some higher elevation sites having moderately tall shrubs (0.5 - 1 m, usually A. tridentata var. vaseyana), and some more mesic sites at lower elevations having very tall sagebrush (A. tridentata var. tridentata). It is logical to classify the big sagebrush-grasslands into 1) sparse low big-sagebrush-grassland, 2) sparse tall big-sagebrush-grassland, 3) dense low big-sagebrush-grassland, and 4) dense tall big-sagebrush-grassland. The variation in physiognomy and species composition between these various subtypes is continuous, however, and the causes of the variation are not well understood. It is known that the early settlers learned that land with the taller sagebrush had the best agricultural potential, and it is this subtype that is hardest to find in the Wyoming Basin. Vass and Lang (1938) identify 14 subtypes of vegetation dominated by A. tridentata (see Table 2).

In general, the soils of big sagebrush-grassland are relatively deep and well-aerated, and in some places the type is found only in the more mesic ravines, e.g. on the slopes of the desert-like Great Divide Basin. Several investigators have noted that A. tridentata occurs on soils with relatively low salt content (Gibbens 1973, Nelson 1898, Shantz and Piemeisel 1940, Nichols 1964). One-half to two-thirds of the annual precipitation

comes as snow, and this comprises most of the water available to the vegetation.

Tables 12 and 13 are lists of the plants and animals, respectively, that are known to occur in big sagebrush-grassland.

Distribution in the Wyoming Basin:

Widespread throughout the Wyoming Basin

Potential Natural Landmarks:

Washakie Basin

Oregon Trail Exclosure--Sagebrush-grassland

Beaver Rim

Sweetwater River Natural History Complex

Little Colorado Desert

Pinedale Glacial Fields

TABLE 12. Some plant species known to occur in the sagebrush-grasslands of the Wyoming Basin.

SHRUBS

Amelanchier alnifolia
Artemisia arbuscula
Artemisia cana
Artemisia frigida
Artemisia nova
Artemisia petatifida
Artemisia spinescens
Artemisia tridentata ssp. tridentata
Artemisia tripartita
Atriplex canescens
Atriplex confertifolia
Atriplex gardneri
Atriplex pabularis (gardneri)
Chrysothamnus nauseosus ssp. speciosus
Chrysothamnus stenophyllus
Chrysothamnus viscidiflorus ssp. pumilis
Eurotia lanata
Grayia spinosa
Gutierrezia sarothrae
Leptodactylon pungens
Sarcobatus vermiculatus
Symphoricarpos sp.
Tetradymia canescens
Tetradymia inermis
Tetradymia spinosa

GRASSES, SEDGES AND RUSHES

Agropyron dasystachyum
Agropyron smithii
Agropyron spicatum
Agropyron trachycaulum
Astragalus spatulatus
Bromus tectorum
Carex eleocharis
Carex filifolia
Carex obtusata
Carex stenophylla
Distichilis stricta
Elymus cinereus
Festuca idahoensis
Festuca octoflora

GRASSES, SEDGES AND RUSHES (Continued)

Hilaria jamesii
Hordeum jubatum
Juncus balticus
Koeleria cristata
Oryzopsis hymenoides
Poa fendleriana
Poa sandbergii
Poa secunda
Sitanion hystrix
Stipa columbiana
Stipa comata
Stipa lettermani

FORBS

Agoseris glauca
Allium acuminatum
Allium textile
Alyssum desertorum
Antennaria dimorpha
Antennaria rosea
Arabis holboellii
Arabis lingifera
Arabis sparsiflora var. subvillosa
Arenaria hookeri
Artemisia ludoviciana
Astragalus miser
Astragalus pectinatus var. pectinatus
Astragalus purshii
Astragalus spatulatus
Atriplex philonitra
Balsamorhiza incana
Balsamorhiza sagittata
Calochortus nuttallii
Castilleja chromosa
Chenopodium album
Chenopodium leptophyllum
Commandra umbellata
Cordylanthus ramosus
Crepis mococensus
Cryptantha watsonii
Delphinium bicolor
Delphinium geyeri

TABLE 12. (Continued)

FORBS (Continued)

Descurainia richardsonii
Erigeron caespitosum
Erigeron engelmanni
Eriogonum caespitosum
Eriogonum cernum
Eriogonum compositus
Eriogonum microthecum
Eriogonum ovalifolium
Gayophytum ramosissimum
Gilia sp.
Halogeton glomeratus
Haplopappus acaulis
Hymenoxys richardsonii
Iva axillaris
Lappula redowskii
Lesquerella ludoviciana
Lithospermum incisum
Lomatium foeniculaceum
Lupinus argenteus
Machaeranthera canescens
Machaeranthera glabriuscula
Mertensia oblongifolia
Monolepis nuttalliana
Musineon divaricatum
Opuntia polyacantha
Oxytropis sp.
Pastinaea sativa
Penstemon arenicola
Penstemon fremontii
Phlox hoodii
Phlox longifolia
Phlox multiflora
Polygonum sawatchense
Pseudocymopterus montanus
Psoralea sp.
Salsola kali
Sisymbrium elegans
Sphaeralcea coccinea
Thermopsis rhombifolia
Trifolium gymnocarpon
Zygadenus paniculatus
Zygadenus venosus

TABLE 13. Some animal species that could be expected in the sagebrush-grassland ecosystem.

MAMMALS[1]

badger
bats
beaver
black footed ferret?
blacktailed jackrabbit
white-tailed jackrabbit
bobcat
coyote
deer mouse
desert cottontail
least chipmunk
longtail weasel
masked shrew
montane vole
mule deer
muskrat
northern grasshopper mouse
northern pocket gopher
olive-backed pocket mouse
Ord's kangaroo rat
pronghorn
Richardson's ground squirrel
sagebrush vole
thirteen-lined ground squirrel
vagrant shrew
white-tailed prairie dog

BIRDS

bald eagle
golden eagle
ferruginous hawk
marsh hawk
red-tailed hawk
roughlegged hawk
sparrow hawk
prairie falcon
burrowing owl
horned lark
lark bunting

BIRDS (Continued)

magpie
McCown's longspur
sage grouse
sage thrasher
vesper sparrow
Brewer's blackbird
Killdeer
mountain plover
mourning dove
common nighthawk
loggerhead shrike
western meadowlark

REPTILES AND AMPHIBIANS[1]

gopher snake
green garter snake
horned toad
leopard frog
sagebrush lizard
short-horned lizard
spadefoot toad
tiger salamander
western rattlesnake
western garter snake

[1]Consult Long (1965) and Baxter (1946) for surveys of the mammals and reptiles and amphibians, respectively, found in Wyoming.

Big sagebrush - bitterbrush - grassland
Big sagebrush - shadscale - grassland
Woody aster - sagebrush - grassland

These ecosystem types are further variations of big sagebrush-grassland, but the causes of the variation are only partly known. Bitterbrush is a common associate only in a few localities, sometimes at higher elevations and/or on sites that appear to have a more favorable moisture balance, such as around large snow banks. Shadscale (Atriplex confertifolia) and other species with halophytic tendencies are more commonly found with big sagebrush as the soil becomes more alkaline, and woody aster, along with prince's plume and other species, becomes more abundant where soils have higher amounts of selenium. Sometimes the seleniferous species predominate to the exclusion of big sagebrush. Tables 11, 12, and 13 list species found in these variations of big sagebrush-grassland.

Bitterbrush variant:

Distribution of Big sagebrush - bitterbrush grassland in the Wyoming Basin:

Fremont Lake Moraines, west side of the Saratoga Valley, near Kemmerer, and in the foothills of several mountain ranges.

Potential Natural Landmarks:

Pinedale Glacial Fields near Fremont Lake
Steamboat Mountain

Shadscale variant:

Distribution of big sagebrush-shadscale grassland in the Wyoming Basin:

Little Colorado Desert, Washakie Basin, Colorado portion of the Basin west of Baggs, Southwest of Baggs, and scattered throughout the Basin.

Potential Natural Landmarks:

Bates Hole

Washakie Basin

Grizzly Buttes

Muddy Creek

Little Colorado Desert

Woody aster variant:

Distribution in the Wyoming Basin:

Between Fort Steele and Sinclair, and elsewhere.

Potential Natural Landmark:

Bates Hole

Washakie Basin

Low Sagebrush-Grassland

Dominated by a different species of sagebrush, Artemisia arbuscula, this ecosystem type is less common and more scattered geographically. Some research suggests that the low sagebrush is restricted to soils with shallow hard pans, but it is also found on coarse soils with no hard pan (Sabinske 1973). Both situations would produce a drier environment than is normal for the big sagebrush-grasslands. Approximately 2,100 square miles are dominated by low sagebrush in Wyoming, which is equal to about 4 percent of the sagebrush land in the State (Beetle 1960).

Table 14 lists species known to occur in the low sagebrush-grassland just east of Laramie.

Distribution in the Wyoming Basin:

East flank of the Laramie Basin, west of LaBarge, the Little Colorado Desert, and parts of the Saratoga Valley and Bates Hole.

Potential Natural Landmarks:

To our knowledge, none described in this Report but some representative areas could be located.

TABLE 14. Some plant species known to occur in the low sagebrush-grassland of the Laramie Basin.

SHRUBS

Artemisia arbuscula ssp. nova
Gutierrezia sarothrae
Ribes cereum

GRASSES AND SEDGES

Agropyron smithii
Bouteloua gracilis
Calamovilfa longifolia
Elymus sp.
Eragrostis diffusa ?
Koeleria cristata
Oryzopsis hymenoides
Stipa comata

FORBS

Allium textile
Amaranthus sp.
Artemisia frigida
Astragalus flexuosus ?
Astragalus missouriensis ?
Astragalus shortianus
Chenopodium berlanderi
Chenopodium desiccatum
Cirsium sp.
Colomia linearis
Cryptantha kelseyana ?
Delphinium geyeri
Descurainia pinnata
Descurainia sophia
Erigeron engelmannii
Erigeron pumilus
Eriogonum effusum
Eriogonum ochroleucum ?
Eriogonum sp. (small)
Euphorbia robusta ?
Gaura coccinea
Geranium caespitosum or fremontii
Helianthus annuus
Helianthus petiolaris
Heterotheca horrida

FORBS (Continued)

Lappula sp.
Lepidium densiflorum
Leptodactylon pungens
Lesquerella ludoviciana
Leucocrinum montanum
Linum lewisii
Lygodesmia juncea
Machaeranthera canescens
Mertensia lanceolata
Oenothera sp.
Opuntia polyacantha
Oxytropis sericea
Pediocactus simpsonii
Penstemon angustifolius
Phlox hoodii
Rumex venosus
Salsola kali
Scuttelaria sp.
Sedum lanceolatum
Solanum triflorum ?
Sphaeralcea coccinea
Sysymbrium linifolium
Tetradymia canescens
Zygadenus venenosus

Birdfoot Sagewort Community

Artemisia pedatifida is occasionally the characteristic species of still another type of sagebrush-grassland. We have observed the community southeast of Riverton on the Gas Hills Road, near North Table Mountain and Steamboat Mountain, and northeast of Bosler in the Laramie Basin, and Gibbens (1973) studied the community west of Baggs. Gibbens found that the soil pH of this community was between 8.0 to 8.1 in the top 15 cm, and that salinity increased with depth to about 3 mmhos/cm at 45 to 60 cm. He found that below 15 cm the soils exhibited a very strong columnar structure that parted to a coarse, angular, blocky structure. White flecks and nodules of calcareous material were apparent in the profile.

Table 15 lists the species that Gibbens found in this community type.

Potential Natural Landmarks:

Washakie Basin

Steamboat Mountain

Bud Sagewort Community

Dominated by Artemisia spinescens, this community type apparently is not well known. A. spinescens is frequently encountered in some variations of sagebrush-grassland, but Gibbens (1973) recognized an identifiable community-type characterized by this species. The 2 stands he studied were located on alluvial soils that were deep and well-drained. Table 16 lists the plant species that Gibbens found with A. spinescens.

Distribution in the Wyoming Basin:

In the Red Desert area on the slopes of North Table Mountain, South Table Mountain, and on Black Rock, and in the Washakie Basin.

Potential Natural Landmarks:

Washakie Basin

Steamboat Mountain

TABLE 15. Some plant species found in the Artemisia pedatifida (Birdfoot Sagewort) community. From Gibbens (1972).

SHRUBS

Artemisia pedatifida
Artemisia spinescens
Atriplex gardneri
Chrysothamnus viscidiflorus
Eurotia lanata

GRASSES

Agropyron spp.
Oryzopsis hymenoides
Poa secunda
Sitanion hystrix
Stipa comata

FORBS

Arabis holboellii
Astragalus purshii
Chenopodium atrovirens
Crepis modocensus
Cymopterus bulbosus
Descurania pinnata
Erigeron engelmanni
Eriogonum cernuum
Eriogonum ovalifolium
Kochia americana
Lappula redowskii
Machaeranthera canescens
Penstemon fremontii
Phlox hoodii
Salsola kali
Sisymbrium elegans
Sphaeralcea coccinea
Townsendia incana
Trifolium gymnocarpon

TABLE 16. Some plant species known to occur in the Bud Sagewort Community (*Artemisia spinescens*) in the Wyoming Basin. From Gibbens (1972).

SHRUBS

Artemisia pedatifida
Artemisia spinescens
Artemisia tridentata
Atriplex gardneri
Chrysothamnus viscidiflorus

GRASSES

Agropyron spp.
Oryzopsis hymenoides
Poa secunda
Sitanion hystrix

FORBS

Allium textile
Arabis holboellii
Cymopterus bulbosus
Lappula redowskii
Penstemon fremontii
Phlox hoodii
Salsola kali
Sisymbrium elegans
Sphaeralcea coccinea
Townsendia incana

Woody aster - prince's plume - grassland

Seleniferous soils are the characteristic habitat for this community, which is dominated by small shrubs and forbs that are tolerant to the alkalinity and selenium. Some species are selenium accumulators and are toxic to livestock. On extreme sites only the woody aster and a few other species are found, but sagebrush, rabbitbrush, and others occur with these species where the selenium concentration is lower. Table 17 is a list of the plant species that are characteristic of this type.

Gibbens (1972) found this ecosystem type on clayey soils (49-56% clay), with a pH between 7.8 and 8.0 and a conductivity of only 0.70 to 1.00 mmhos/cm in the top 15 cm but 5.00 to 6.40 mmhos/cm below that depth. Generally, the soils were quite shallow, i.e. less than 0.6 m.

Because of livestock poisoning, the seleniferous vegetation has been the subject of considerable research (Beath, Eppson, and Gilbert 1935; Beath 1937; Beath, Gilbert, and Eppson 1939). Although of considerable interest, soils and vegetation with toxic levels of selenium occupy only a small area in the State.

Distribution in the Wyoming Basin:

The Shirley Basin and Bates Hole, with 3 species of Prince's Plume (Stanleya pinnata var. bipinnata, S. pinnata var. pinnata and S. viridiflora); the Big Hollow; and elsewhere.

Potential Natural Landmarks:

Big Hollow
Bates Hole
Washakie Basin

TABLE 17. Some plant species known to occur on soils relatively high in selenium and which are characteristic of the woody aster-prince's plume-grassland in the Wyoming Basin.

SHRUBS

Artemisia pedatifida
Artemisia tridentata
Atriplex confertifolia
Atriplex gardneri
Chrysothamnus viscidiflorus
Eurotia lanata
Tetradymia nuttallii

GRASSES

Poa secunda
Agropyron spp.
Agropyron smithii
Oryzopsis hymenoides
Sitanion hystrix

FORBS

Allium textile
Arenaria hookeri
Astragalus bisulcatus
Astragalus confertiflorus
Astragalus diholcos
Astragalus haydenianus
Astragalus racemosus
Cymopterus bulbosus
Erigeron engelmanni
Kochia americana
Lappula redowskii
Machaeranthera glabriuscula
Opuntia polyacantha
Phlox hoodii
Salsola kali
Sisymbrium elegans
Sphaeralcea coccinea
Stanleya pinnata
Trifolium gymnocarpon

Greasewood - Grassland
Greasewood - Sagebrush - Grassland
Greasewood - Saltbush - Grassland
Shadscale - Sagebrush - Greasewood Community

Depressions and flatlands with poor drainage and salt accumulations are found throughout the Wyoming Basin, and provide a special environment for plant growth. Only halophytes are sufficiently adapted to these alkaline soils to become dominant. Of course there are varying degrees of soil alkalinity, and often the species composition of these ecosystems includes species more typical of the sagebrush-grassland.

Greasewood is a widespread shrub and is most characteristic of this ecosystem type. Table 18 lists other plant species that are commonly associated with Greasewood. Except for waterfowl, which occur when open water is found in the area, the characteristic animals are to the best of our knowledge about the same as for the sagebrush-grassland. There are very few studies of this ecosystem type that have been done in the Basin.

Greasewood is thought to require considerable water in order to survive and has a long tap root for utilizing groundwater. Hence, it is usually found on low floodplains or near ponds where the water table is relatively shallow. As water becomes more limiting, greasewood becomes less abundant and shadscale, saltbush, winterfat or even big sagebrush are more characteristic.

Although classified separately from alkaline ponds as a separate ecosystem type, the greasewood flats and ponds interact and are properly considered as one ecosystem. We have considered this when recommending potential natural landmarks. Often the greasewood-dominated ecosystems have been modified by livestock as they trail toward their few water supplies; windmills and stock tanks are often placed within this ecosystem type.

Distribution in the Wyoming Basin:

Chain-of-Lakes, Battle Spring Flat, Circle Bar Lake, Mud Springs, Sublette Flats near Farson, and generally throughout the Wyoming Basin.

Potential Natural Landmarks:

Chain-of-Lakes

Bates Hole

Washakie Basin

Grizzly Buttes Badlands

Alkaline Meadows

Some meadows occur in depressions or on floodplains where salt accumulation has been high. The sparcity or absence of greasewood and other halophytic shrubs from such sites is not understood. Alkali sacaton, alkali grass, salt grass and other halophytic forbs, grasses, and sedges are common. The species composition is different from other meadows and grasslands.

Distribution in the Wyoming Basin:

Interspersed with other floodplain communities, along the Little Snake River floodplain, Mud Springs, and Chain-of-Lakes.

Potential Natural Landmarks:

Chain-of-Lakes

Sweetwater River Natural History Complex

Washakie Basin

Muddy Creek

Non-alkaline Meadows - see page 74.

TABLE 18. Some plant species known to occur in the Greasewood-dominated ecosystems of the Wyoming Basin.

SHRUBS

Artemisia spinescens
Artemisia tridentata
Atriplex confertifolia
Atriplex gardneri
Chrysothamnus nauseosus
Eurotia lanata
Grayia spinosa
Sarcobatus vermiculatus
Suaeda fruticosa
Tetradymia spinosa

GRASSES, SEDGES AND RUSHES

Agropyron smithii
Bouteloua gracilis
Bromus tectorum
Distichlis stricta
Elymus cinereus
Festuca octoflora
Hordeum jubatum
Hordeum pusillum
Juncus spp.
Juncus balticus
Munroa squarrosa
Poa nevadensis
Poa secunda
Puccinellia airoides
Scirpus sp.
Scirpus acutis
Sitanion hystrix
Spartina gracilis
Sporobolus airoides
Stipa viridula
Triglochin maritima
Triglochin palustris

FORBS

Allium textile
Aster canescens
Atriplex patula
Atriplex argentea
Chenopodium dessicatum
Crepis occidentalis

FORBS (Continued)

Descurainia pinnata
Dodecatheon pulchellum
Erigeron pumila
Euphorbia serphyllifolia
Gilia pumila
Halogeton glomeratus
Helianthus petiolaris
Hymenoxys richardsonii
Iris missouriensis
Iva axillaris
Kochia scoparia
Lappula texana
Lepidium densiflorum
Lepidium perfoliatum
Lupinus sp.
Machaeranthera tanacetifolia
Monolepis nuttalliana
Oenothera trichocalyx
Opuntia polyacantha
Oxytropis sp.
Plantago eriopoda
Plantago patagonica
Salicornia rubra
Salsola kali
Sisymbrium altissimum
Sisymbrium linifolium
Taraxacum officinale
Thlaspe arvense
Tragopogon dubius

Saltbush community (A. gardneri)

Playas

These communities occur sporadically in the drier parts of the Basin, and are perhaps the most desert-like of all the ecosystem types. The soils, in addition to being dry, are also alkaline and only a few other species are found (Table 19). The vegetation is of considerable value for winter forage.

Sometimes this vegetation type is found on playas -- flat lake beds that have water only in the spring. A salt-tolerant species of Agropyron Smithii occurs on such sites, almost to the exclusion of other plants (even saltbush). Gibbens (1972), Vosler (1962), Russey (1967), and Steger (1970) found the saltbush community type on rather deep, calcareous, clayey soils. According to Gibbens, surface pH ranged from 7.8 to 8.1, but decreased consistently with depth. Gibbens noted a definite increase in soluble salt content (0.73 to 3.08 mmhos/cm) of the surface soil under the saltbush plants.

Distribution in the Wyoming Basin:

South of Rawlins, Southwest of Baggs, near Mud Springs, the Washakie Basin, and elsewhere.

Potential Natural Landmarks:

Washakie Basin
Bates Hole
Little Colorado Desert
Near Steamboat Mountain

TABLE 19. Some plant species found in the saltbush communities of the Wyoming Basin.

SHRUBS

Artemisia spinescens
Atriplex confertifolia
Atriplex gardneri
Sarcobatus vermiculatus

GRASSES AND SEDGES

Agropyron smithii
Hordeum jubatum
Oryzopsis hymenoides
Poa secunda
Sitanion hystrix

FORBS

Chenopodium atrovirens
Cymopteris bulbosus
Eriogonum cernuum
Halogeton glomeratus
Lappula redowskii
Machaeranthera glabriuscula
Opuntia polyacantha
Salsola kali
Sisymbrium elegans

Grassland - dwarf shrub ecosystem
Bluebunch Wheatgrass Community

Upland grasslands without conspicuous shrubs occur in only a few places in the Wyoming Basin, for example in the Laramie Basin and just south of Crooks and Green Mountains. These grasslands have been observed only above 7,000 ft. (2,121 m), but no systematic study of their distribution has been made. Unlike the short-grass and mixed prairies of eastern Wyoming, dwarf shrubs appear to be in greater abundance, e.g. Phlox hoodii, Artemisia frigida, and Arenaria hookeri. Like the sagebrush-grasslands, these grasslands are important to the livestock industry. Table 20 is a plant species list for this ecosystem type; the animals are about the same as in the sagebrush-grassland with some exceptions. Wenzel (1949) and Finzel (1962) provide data on the mammals and birds of the Laramie Basin.

In some foothill areas around 7,000 feet (2,121 m) there is a community dominated by Agropyron spicatum, bluebunch wheatgrass. Gibbens (1973) found this community on relatively more mesic north slopes and on rather rocky soils. Table 21 lists the other plant species found associated with this community type.

Distribution in the Wyoming Basin:

Laramie Basin, approaching Chain-of-Lakes rim, approaching Crooks Mountain from the south, and the Saratoga Valley.

Potential Natural Landmarks:

Big Hollow
Sand Creek and Camel Rock

TABLE 20. Some plant species found in the grassland-dwarf shrub community of the Laramie Basin.

SHRUBS

Arenaria hookeri
Artemisia frigida
Atriplex gardneri
Chrysothamnus vaseyi
Chrysothamnus viscidiflorus
Chrysothamnus viscidiflorus ssp. *lanceolatus*
Eurotia lanata
Gutierrezia sarothrae
Tetradymia canescens

GRASSES AND SEDGES

Agropyron smithii
Agropyron spicatum
Bouteloua gracilis
Calamovilfa longifolia
Carex eleocharis
Carex filifolia
Koeleria cristata
Oryzopsis hymenoides
Poa spp.
Poa sandbergii
Stipa spp.
Stipa comata

FORBS

Allium textile
Arabis holboellii var. *retrofracta*
Aster canescens
Astragalus purshii
Astragalus shortianus
Astragalus spatulatus
Astragalus striatus
Cymopterus montanus
Echinocactus simpsonii
Erigeron nematophyllus
Eriogonum flavum ssp. *crassifolium*
Eriogonum ovalifolium
Eriogonum ovalifolium var. *purpureum*
Gilia spicata

FORBS (Continued)

Haplopappus acaulis
Lesquerella condensata var. *laevis*
Lesquerella ludoviciana
Lygodesmia juncea
Opuntia polyacantha
Orobanche fasciculata
Oxytropis lagopus
Paronychia sessiliflora
Penstemon angustifolius
Phlox hoodii
Polygonum sawatchense
Salsola kali var. *tenuifolia*
Senecio canus
Sisymbrium altissimum
Sphaeralcea coccinea
Trifolium gymnocarpon

TABLE 21. Some plant species known to occur in the bluebunch wheatgrass community in the Wyoming Basin (from Gibbens 1972).

SHRUBS
Artemisia tridentata
Atriplex confertifolia
Chrysothamnus viscidiflorus
Eurotia lanata
GRASSES AND SEDGES
Agropyron spp.
Agropyron spicatum
Carex filifolia
Koeleria cristata
Oryzopsis hymenoides
Poa fendleriana
Poa secunda
FORBS
Arabis lignifera
Astragalus purshii
Astragalus spatulatus
Erigeron engelmanni
Eriogonum microthecum
Eriogonum ovalifolium
Haplopappus acaulis
Penstemon fremontii
Phlox hoodii
Sphaeralcea coccinea

Great Basin Wild-rye mesic grassland

This type occurs throughout the Basin, but is usually restricted to foothill ravines with a finer-textured soil and more favorable moisture balance than the adjacent upland. The dominant, Elymus cinereus, is the tallest grass in the Basin, growing up to 1.5 m, and is conspicuous from a distance. Litter tends to accumulate. In some places patches of cherry or snowberry are conspicuous, and Castilleja sp., Aquilegia sp., Ribes sp., Mahonia repens, Rosa sp., Frasera speciosa, Achillea lanulosa and Acer glabrum may also be found in some of these oases in what is usually sagebrush-grassland.

Distribution in the Wyoming Basin:

Slopes (draws) of Separation Peak, along the rim of Bates Hole in the Shirley Basin, Steamboat Mountain, Washakie Basin, near the Sweetwater River, and elsewhere.

Potential Natural Landmarks:

Bates Hole
Washakie Basin
Steamboat Mountain
Sweetwater River Natural History Complex

Alkaline Meadows

See page 66.

Non-Alkaline Meadows

Where drainage is good, e. g. fresh water springs and along the floodplains of swift rivers that are submerged in the spring, salts do not accumulate to the same degree and lush meadows are found that are quite different than the alkaline meadows. Willow thickets and cattail marshes often adjoin, with red-winged blackbirds being conspicuous. These meadows are harvested for hay, and are often irrigated well into the summer in order to increase production. Irrigation and the seeding of non-native species has modified the original ecosystem in many places, and natural meadows are hard to find. See Table 10 for a plant species list of non-alkaline meadows.

Distribution in the Wyoming Basin:

Steamboat Mountain, along the Sweetwater River, Sand Creek, and elsewhere along free-flowing streams or springs.

Potential Natural Landmarks:

Steamboat Mountain
Sweetwater River Natural History Complex
Sand Creek

Playas

See page 68.

Stable Sand Dunes
Unstable Sand Dunes

Unknown to many in the State, an extensive dune system extends across the central part of the Basin (Fig. 14). Both stable and unstable dunes can be found, and some dune ponds also occur. The Killpecker Dunes is the best known active system, just west, south, and east of Steamboat Mountain. The area is not protected currently from dune buggy racing. In extensive areas the dunes have been stabilized with the plant species listed in Table 22. Calamovilfa longifolia, a common dune-stabilizing grass in the western Great Plains, is not found on the major dune system of the Basin (i.e. Killpecker Dunes), but does occur elsewhere, e.g. in the Laramie Basin. The reason for this is not known.

Distribution in the Basin:

See Fig. 14.

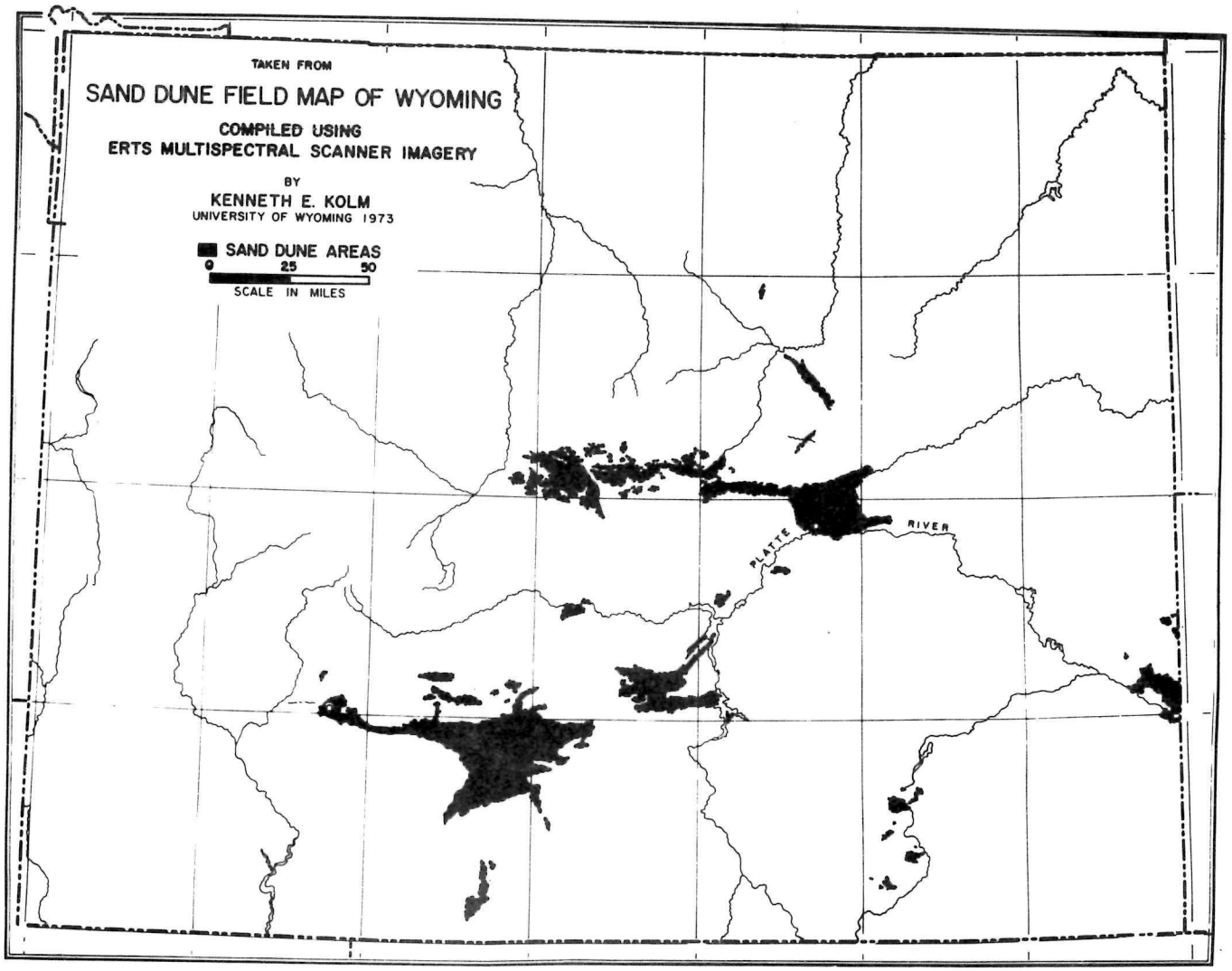


Fig. 14. Map of the active and stabilized sand dunes in Wyoming (from Kolm, 1973).

TABLE 22. Some plant species known to occur on the sand dunes of the Wyoming Basin.

SHRUBS

Artemisia tridentata
Chrysothamnus nauseosus
Chrysothamnus vaseyi
Chrysothamnus viscidiflorus
Eurotia lanata
Grayia spinosa
Leptodactylon pungens
Tetradymia nuttallii

GRASSES, SEDGES AND RUSHES

Agropyron desertorum
Agropyron smithii
Agropyron spicatum
Calamovilfa longifolia
Carex filifolia
Elymus simplex
Juncus balticus
Oryzopsis contracta
Oryzopsis hymenoides
Puccinellia siroides
Scirpus americanus var. polyphyllus
Sitanion hystrix
Spartina gracilis

FORBS

Allium textile
Arenaria hookerii
Artemisia biennis
Astragalus kentrophyta
Astragalus oreganus
Castilleja linariaefolia
Chaenactis douglasii
Chenopodium berlandieri
Chenopodium dessicatum var. leptophylloides
Cirsium pulcherrimum
Cleome lutea
Coldenia nuttallis
Commandra pallida
Cordylanthus ramosus
Cryptantha fendleri
Cryptantha flava
Cryptantha kelseyana

FORBS (Continued)

Descurainia pinnata
Eriogonum brevicaule
Eriogonum cernum
Eriogonum flavum
Eriogonum microthecum
Eriogonum ovalifolium
Euphorbia robusta
Gaura coccinea
Lesquerella ludoviciana
Lupinus pusillus
Lygodesmia juncea
Machaeranthera canexens
Machaeranthera grindeliodes
Oenothera nuttallii
Oenothera pallida var. trichocalyx
Oryzopsis hymenoides
Oxytropis sericea
Penstemon arenicola
Penstemon laricifolius var. exilifolius
Phacelia ivesiana
Psoralea lanceolata
Rumex hymenosepalus
Rumex venosus
Salsola kali var. tenuifolia
Streptanthella longirostris
Townsendia incana
Tragopogon dubius

Potential Natural Landmarks:

Killpecker Sand Dunes

Mountain mahogany foothills shrub community
Mountain mahogany - skunkbush - bitterbrush community

Mountain mahogany (Cercocarpus spp.) is found in the foothills of various mountain ranges, almost always on soils that are very rocky (lithosols, regosols). In some areas bitterbrush is associated with the mountain mahogany, and near Flaming Gorge both Cercocarpus montanus and C. ledifolius occur together. Skunkbush (Rhus trilobata) is not abundant in the Basin, but may be found at the lower elevations. These foothill shrub communities have not been greatly disturbed, although the mountain mahogany may be heavily browsed in the winter by mule deer. See Table 23 for a list of characteristic plant species.

Distribution in the Wyoming Basin:

Foothills toward the north end of the Medicine Bow Mountains, Henry's Fork Fault, and on shallow soils in the foothills of most mountain ranges in and adjacent to the Wyoming Basin.

Potential Natural Landmarks:

Steamboat Mountain
Henry's Fork Fault Juniper Woodland
Beaver Rim

TABLE 23. Some plant species known to occur in mountain mahogany-dominated communities in the Wyoming Basin.

TREES

Juniperus osteosperma
Juniperus scopulorum

SHRUBS

Amelanchier alnifolia
Artemisia frigida
Artemisia tridentata
Cercocarpus montanus
Chrysothamnus nauseosus
Chrysothamnus parryi
Chrysothamnus pumilis
Chrysothamnus viscidiflorus
Eurotia lanata
Gutierrezia sarothrae
Purshia tridentata
Symphoriocarpos racemosa

GRASSES AND SEDGES

Agropyron dasystachyum
Agropyron smithii
Agropyron spicatum
Agropyron subsecunda
Bromus tectorum
Carex eleocharis
Festuca idahoensis
Koeleria cristata
Leucopoa kingi (Hesperochloa kingii)
Muhlenbergia filiculmis
Oryzopsis hymenoides
Stipa comata

FORBS

Agoseris spp.
Allium spp.
Antennaria scariosa
Besseya wyomingensis
Cerastium arvense
Chenopodium leptophyllum
Delphinium nelsoni
Descurainia pinnata
Erigeron poliospermum

FORBS (Continued)

Eriogonum umbellatum
Galium boreale
Gilia spp.
Grindelia squarrosa
Harbouria trachypleura
Hedeoma drummondi
Heuchera parvifolia
Lappula spp.
Lesquerella argentea
Linum lewisii
Mertensia lanceolata
Orobanche ludoviciana
Oxytropis spp.
Penstemon spp.
Phlox multiflora
Senecio spp.

Serviceberry - big sagebrush - bitterbrush foothill shrub community

In some foothill localities serviceberry (Amelanchier alnifolia and A. utahensis) is a conspicuous associate of big sagebrush. The soils are much more developed than on the mountain mahogany sites, and a better moisture balance may prevail. Table 24 is a list of the major plant species found in this community. White (1968) studied the ecology of Amelanchier in western Wyoming.

Distribution in the Basin:

Steamboat Mountain, Separation Peak, and other foothill areas.

Potential Natural Landmarks:

Steamboat Mountain

Sand Creek and Camel Rock

Beaver Rim

TABLE 24. Some plant species found in areas characterized by serviceberry (*Amelanchier*) in the Wyoming Basin.

TREES

Acer glabrum
Betula occidentalis
Crataegus sp.
Juniperus scopulorum
Picea pungens
Pinus contorta
Pinus flexilis
Populus tremuloides
Pseudotsuga menziesii
Sorbus scopulina

SHRUBS

Arctostaphylos uva-ursis
Artemisia cana
Artemisia frigida
Artemisia longiloba
Artemisia nova
Artemisia tridentata
Artemisia tripartita
Cercocarpus montanus
Chrysothamnus sp.
Chrysothamnus parryi
Chrysothamnus viscidiflorus
Cornus stolonifera
Juniperus communis
Mahonia repens
Prunus virginiana
Purshia tridentata
Rhus trilobata
Ribes sp.
Rosa sp.
Salix sp.
Shepherdia canadensis
Symphoricarpos albus
Tetradymia sp.

FORBS

Eriogonum sp.
Phlox sp.
Phlox hoodii
Potentilla hippiana

Gambel's Oak Woodland

Gambel's oak forms a distinctive foothills shrub community only in the southern part of the Basin near the Sierra Madre Mountains and the Colorado-Wyoming border. This ecosystem type is much more abundant farther south, especially west of the Continental Divide, although Jacoby (1971) reports the association of Gambel's oak with Douglas fir on the northwest side of Elk Mountain. The cause of this restricted distribution in the Basin is not known to our knowledge, but this occurrence is an important northern distributional limit for the species. As Cottam has pointed out (Cottam et al. 1959) in Utah, Gambel's oak may be limited in its northward range by the occurrence of late spring frosts. Hence this oak has important biogeographic questions associated with its present and past distribution. More information on its ecology in the Wyoming Basin should be gathered.

Distribution in the Wyoming Basin:

Western foothills of the Sierra Madre Mountains, and the Rattlesnake Creek watershed on Elk Mountain.

Potential Natural Landmarks:

Rattlesnake Creek Oak Woodland

Description of Aquatic Ecosystems

Lakes

The most conspicuous and frequent lakes in the Wyoming Basin are those resulting from the impoundments constructed on the North Platte, Wind, and Green Rivers. These reservoir lakes are large, support a variety of freshwater fish including trout, and are used regularly for recreational purposes. The canyons in which some of these lakes exist are often very scenic with multi-colored escarpments, and rival some of the National Parks for beauty. We have not studied these reservoirs for natural landmark status because of their man-made nature, but the National Park Service may wish to study them for other purposes.

Two major kinds of natural lakes exist in the Basin, but neither is common. One type includes glacially-formed foothill lakes, perhaps the best example being Lake Fremont (see page 175). These lakes are large and deep, and also are located in scenic valleys. The flora and fauna of these lakes are believed to be quite unique for the Wyoming Basin, and they are interesting geologically as well. Thus, we recommend that these lakes be studied in order to locate one or two good examples for possible designation as a Natural Landmark.

The other kind of lake is much different, being smaller, more shallow, and having water of greater alkalinity. Greasewood and other halophytes are found near the shoreline. These alkaline lakes, like the alkaline ponds, are of considerable biological interest because of their unique flora and fauna, and the rather adverse environment to which the organisms have adapted. The distinction between alkaline lakes and alkaline ponds is not obvious, but together they represent a natural history theme that should be studied further to select the best and least disturbed examples for natural landmark status. Unfortunately, livestock grazing and/or fish introduction may have modified these aquatic habitats considerably. Examples of these lakes associated with wildlife refuges already exist in the Laramie Area and may need to be considered for landmark status. These include Bamforth and Hutton Lake National Wildlife Refuges in Albany County,

with Hutton Lake already on the federal research natural area list (Federal Committee on Research Natural Areas, 1968). Since some of these areas have already been designated, further information was not collected for them. Nevertheless important botanical and ecological information is lacking for most of these lake ecosystems in the Wyoming Basin. Serdink (1965) has provided lists of aquatic plants and waterfowl which appear to be typical of the region (Tables 25 and 26).

Distribution of Lakes in the Wyoming Basin:

Chain-of-Lakes area of the Red Desert, lakes around Sand Creek and others in Albany County, and others scattered throughout the Basin.

Potential Natural Landmarks:

Fremont Lake

Chain-of-Lakes

Sand Creek

TABLE 25. Common plant species characteristic of alkaline lakes and ponds in the Wyoming Basin (from Serdink, 1965)

SHRUBS

Salix spp.

GRASSES AND SEDGES

Carex sp.
Distichlis stricta
Eleocharis palustris
Hordeum jubatum
Juncus balticus
Phalaris arundinacea
Polypogon monspeliensis
Scirpus americanus
Scirpus paludosus
Scirpus acutus

FORBS
Asclepias speciosa
Cirsium arvense
Kochia scoparia
Polygonum lapathifolium
Rumex crispis
Rumex maritimus
Salicornia rubra

Trifolium repens
Typha latifolia

TABLE 26. Waterfowl characteristic of alkaline lakes and ponds (from Serdink, 1965 and Maxell, 1973).

Anas acuta (pintails)
Anas carolinensis (green-winged teal)
Anas cyanoptera (cinnamon teal)
Anas discors (blue-winged teal)
Anas platyrhynchos (mallards)
Anas strepera (gadwalls)
Aythya affinis (lesser scaup)
Aythya americana (red-heads)
Bucephala albeola (bufflehead)
Fulica americana (American coots)
Mareca americana (American widgeons)
Mergus serrator (red-breasted mergansers)
Oxyura jamaicensis (ruddy ducks)
Spatula clypeata (shovellers)
Recurvirostra americana (American avocet)
Larus californicus (California gull)
Sterna hirundo (common tern)
Agelaius phoeniceus (red-winged blackbird)

Ponds and marshes

The most frequent type of pond in the Basin are the alkaline ponds. Usually small, shallow, and devoid of fish, these ponds are an important natural history theme in the Basin and are believed to be of considerable ecological significance to the adjacent greasewood-dominated communities. Clearly the terrestrial and aquatic habitats interact in these alkaline basins, and together form one ecosystem, not two. Ponds that are ephemeral are, of course, distinctive from those that are not.

The other ponds in the Basin are fresher, i.e. less alkaline, and include sand dune ponds and oxbow ponds. These ponds are also integral parts of the adjacent terrestrial habitats, and should be included in any natural landmark that focuses on the sand dune or floodplain natural history theme.

Marshes dominated by phragmites are rare in the Basin, and represent a unique habitat that must be preserved. Sometimes occurring in the center of a vast expanse of dry sagebrush-grassland, these marshes are virtual oases for some organisms. The Moneta Phragmites Marsh that we have observed is spring fed, and is thus of both biological and geological interest.

Distribution of ponds and marshes in the Wyoming Basin:

Widely scattered, but found particularly in depressions, near springs, or on floodplains.

Potential Natural Landmarks:

Moneta Phragmites Marsh
Big Hollow
Chain-of-Lakes
Killpecker Sand Dunes

Springs
Sedge Bogs

Both springs and sedge bogs occur in the Basin, but only sporadically and we have not been able to study them sufficiently for a natural landmark recommendation. Steamboat Mountain, the Moneta Phragmites Marsh, and various other localities include springs. Juncus balticus is characteristic of the springs in the Washakie Basin and elsewhere, and Scirpus nevadensis characterizes the Steamboat Mountain Springs. Bogs in the Basin are probably even more rare, having formed by the filling in of ponds with sedge peat. We now know of only one, the historically famous Ice Slough which has been heavily grazed, but others probably exist.

Warm or hot springs are known to occur in the Basin, for example in the Saratoga Valley. To our knowledge all of these have been tapped or commercialized, but the possibility of a natural warm spring should be determined. Kendall Warm Springs in the western part of the Basin is known to have a rare dace.

Rivers and Streams

Centering on the Continental Divide, the Wyoming Basin is drained by 4 major river systems -- The North Platte River system to the east, the Wind River system to the north, and the Green River and Little Snake River systems to the south (Fig. 7, 13). These rivers are fed mainly by snow melt in the mountains adjacent to the Basin, and flow is greatest in the spring. Smaller rivers and streams contribute to the flow, but are usually ephemeral unless their headwaters are located in the mountains. As noted previously, floodplain grazing and impoundments are frequent and both the flow and the floodplains have been consequently modified. Only a few stretches of these waterways can be considered natural. Another disrupting factor has been the introduction of exotic fish to the larger steams and rivers.

In addition to size, the waterways can be distinguished on the basis of stream velocity and bottom-type, and on whether or not water flows all year. Although a useful classification for certain portions of a river, in fact a single river may be fast and stony in one area and slow and muddy farther downstream.

Desert streams, such as Muddy Creek, provide a special habitat for certain fish, in particular the now rare bluehead sucker and roundtail chub which could become extinct (Baxter, George; personal comm.).

Occurring only in the Sierra Madre Mountains and in montane streams west of Big Piney, the Colorado cut-throat trout also is considered a rare and endangered species for Wyoming. A rare dace is known to occur in Kendall Warm Springs.

Distribution of rivers and streams in the Wyoming Basin:

See Fig. 13

Potential Natural Landmarks:

Muddy Creek (T 15-16 N, R 91W) (lower 10-15 miles of Muddy Creek)

Sweetwater River

Sand Creek

Portions of the Green and North Platte Rivers.

DESCRIPTION OF POTENTIAL NATURAL LANDMARKS

As we understand, the principal objectives of our contract have been to 1) identify the major natural history themes and ecosystem types in the Wyoming Basin, 2) make preliminary studies of specific areas in the Basin that are potential landmarks, and 3) establish priorities on which themes and specific areas should be considered first for landmark status. In this section we briefly describe those specific areas we have studied, but in some cases we may not have discovered the best example of a particular theme. Future studies in the Basin could focus on a specific area, e.g. the Killpecker Sand Dunes, but could as appropriately focus on the sand dune natural history theme, the objective being to determine which part of the dunes would be best as a landmark. As emphasized earlier, we are sure that some valuable natural areas have been inadvertently ignored in this report. Additional recommendations will be made in the future.

The initial contract between the University of Wyoming and the National Park Service called for a joint biological-geological effort. The geological part of our final report has been submitted by McGrew, Brown, Hager, and Mears (1974). In several cases we have studied the same landmarks. When this is the case we have referred to specific pages in the report of McGrew, et al. Both reports should be used concurrently, if possible, when studying the Wyoming Basin for natural landmarks.

A total of 1,556 plant voucher specimens were collected during the course of this study and were identified at the Rocky Mountain Herbarium. Lists of these identified vouchers are given in appropriate tables with each site description.

Many of the areas we describe in this report are very large, too large in fact to expect them to either qualify for natural landmark status or be acceptable as landmarks to the people in the area. The Washakie Basin and Little Colorado Desert are examples. We include these large areas, however, because we consider them of special biological value and believe that they should be studied further in order to identify the smaller tracts that would be reasonable as natural landmarks.

In order to focus attention on those areas which we believe should be established first as natural landmarks, we have used the following priority rating system recommended by the National Park Service:

Priority 1: High degree of national significance, recommended without reservation.

Priority 2: Appears to be nationally significant.

Priority 3: Information lacking for confident recommendation, but may prove nationally significant upon further investigation.

Priority 4: Not recommended.

Protection A: Site is in serious impending danger.

Protection B: Site is in some jeopardy.

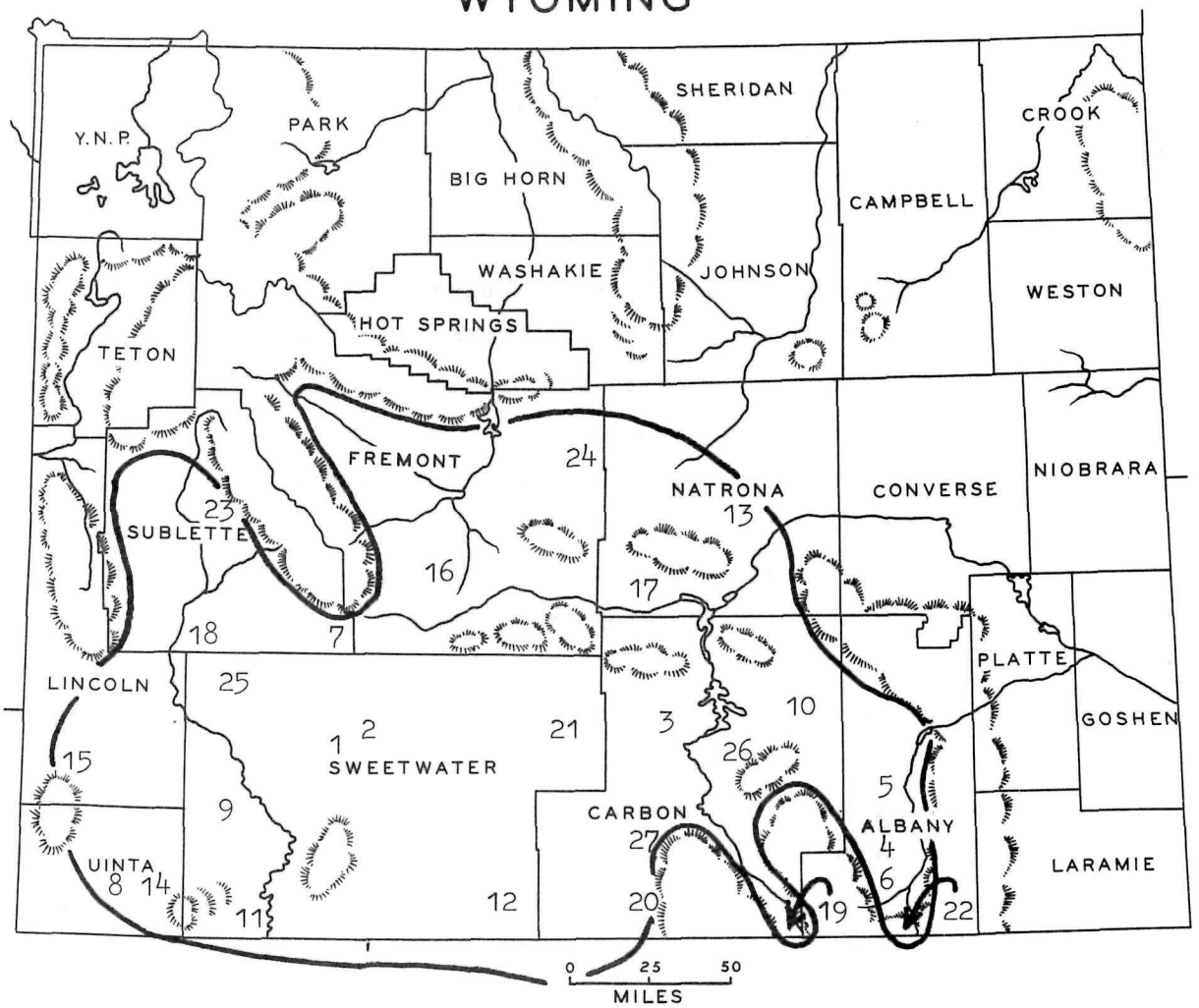
Protection C: Site is in no apparent jeopardy.

Protection D: Relative jeopardy is unknown.

The rankings are obviously subjective, but provide a partial basis for recommending a course of action. Those areas ranked 1A in Table 51 should be established first as natural landmarks.

McGrew et al. (1974) also ranked many of the same potential natural landmarks, but we have done our evaluation independently. Their ranking is also shown in Table 51. An area ranked 1A by both us and McGrew et al. deserves special attention. However, merely because we have not listed an area included by the geologists does not mean it has no ecological value.

Land ownership in the Wyoming Basin is over half public (federal), with some state and private lands. The Bureau of Land Management controls nearly all of the public lands, with the U. S. Forest Service supervising a much smaller amount. In most cases BLM should be contacted first for inquiries about potential natural landmarks on public land (State BLM Office, Cheyenne, Wyoming). State lands are administered by the Wyoming State Land Commissioner, Cheyenne, Wyoming. The Union Pacific Railroad is probably the largest owner of private land in the Wyoming Basin.



A county map of Wyoming showing the approximate location of the Wyoming Basin and areas of special biological value. The numbers on the map identify the following areas (relevant page number in parentheses):

1. Killpecker Sand Dunes (p. 93)
   Boar's Tusk Sand Dune Natural Area (p. 97)
2. Steamboat Mountain (p. 99)
3. Sand Dune Natural Area (p. 98)
4. Big Hollow (p. 106)
5. Laramie High Plains Natural Area (p. 113)
6. Laramie Plains Natural Area (p. 114)
7. Oregon Trail Sagebrush-grassland (p. 115)
8. Alkali Desert Shrub Natural Area (p. 119)
9. Northern Desert Shrub-Sagebrush Natural Area (p. 120)
10. Bates Hole - Shirley Basin Petrified Forest (p. 121)
    Petrified Forest Natural Area (p. 129)
11. Henry's Fork Fault Juniper Woodland (p. 130)
12. Washakie Basin (p. 136)
13. Hell's Half-acre Badlands (p. 142)
14. Grizzly Buttes Badlands (p. 146)
15. Fossil Fish Quarries Natural Area (p. 152)
16. Beaver Rim (p. 153)
17. Sweetwater River Complex (p. 158)
18. Green River (p. 164)
19. North Platte River (p. 165)
20. Muddy Creek (p. 166)
21. Chain-of-Lakes (p. 167)
22. Sand Creek & Camel Rock (p. 171)
23. Pinedale Glacial Fields and Fremont Lake (p. 175)
24. Moneta Phragmites Marsh (p. 180)
    Castle Gardens (p. 183)
25. Little Colorado Desert (p. 186)
26. Rattlesnake Creek Oak Woodland (p. 189)
27. Twin Groves Aspen Atoll (p. 190)

The Killpecker Sand Dunes

The Killpecker Sand Dunes are composed of both stable and unstable dunes. The dunes are quite extensive, traversing the Basin from west to east (Fig. 15) and encompassing about 170 square miles. Gravel roads provide access to the area.

The dunes are very unique for the Wyoming Basin, and are aesthetically and biologically interesting. Dune ponds exist in some places. See Table 22 for a list of plants known to occur in the Killpecker Dunes.

Although most of the plants and animals found on the dunes are also found on the adjacent sagebrush-grassland, the dune habitat has led to the development of a unique community dominated by plant species capable of survival in shifting dune sand. Such plants include Psoralea lanceolata and Lupinus pusillus which may "fix" nitrogen in a nutrient deficient situation. Plants tolerant of being buried by sand such as Oxyzopsis hymenoides (Indian Rice grass) and Psoralea, with long creeping rhizomes, survive in this unique habitat. Dune buggies are a regular disturbing factor. We consider this area and adjacent Steamboat Mountain to have top priority for landmark status. BLM has outlined a potential natural area in the dunes, but no official action has been taken.

The most common animals associated with these dunes are Ord's kangaroo rat, several species of pocket mice, and the short-horned lizard. While the western rattlesnake (Crotalus viridus) occurs commonly on the dunes in eastern Wyoming, it is absent or rare in the Killpecker Dunes.

Location:

See Fig. 16; Sweetwater Co., T. 23 N., R. 102-103 W.

Ownership:

Mostly public land, administered by BLM

Land Usage:

Recreation with dune buggies; some grazing.

Additional Information:

See McGrew et al. (1974), pp. 222-225; and Ahlbrandt (1972).

Approximate Acreage:

About 50 square miles, depending on how the dunes are defined.

Ecosystem Types Represented:

Inland sand dunes, stable and unstable; sagebrush-grassland.

Vulnerability:

Very high, due to excessive use by dune buggies in some areas, and some portions probably are underlain by strippable coal. Several federal coal leases have been approved that are located in the dune area.

Other Knowledgeable Persons:

Dr. Thomas Ahlbrandt
Esso Production Research Laboratory
Houston, Texas

BLM Office
P. O. Box 1088
Rock Springs, Wyo.

References:

See McGrew et al. (1974).

Public Sensitivity

Low

Priority:

1A

Other Sand Dune Natural Areas in the Basin:

Two sand dune natural areas are listed in Research Natural Areas (1968) that occur in the Wyoming Basin. Number 273, known as the Boar's Tusk Sand Dune Natural Area, is part of the Killpecker Sand Dunes, is 41,700 acres in size (6,700-7,800 ft. elevation), and is administered by The Rock Springs District Office of the Bureau of Land Management (BLM). This area is used regularly, however, for dune buggy races. Number 280, Sand Dune Natural Area, is administered by the Rawlins District Office of BLM and is located in Carbon County in the Wyoming Basin. It occupies 960 acres at 7,000 ft. elevation.

Fig. 15. Photograph of Boar's Tusk, an old volcanic neck with the white sand of the Killpecker Dunes in the background.

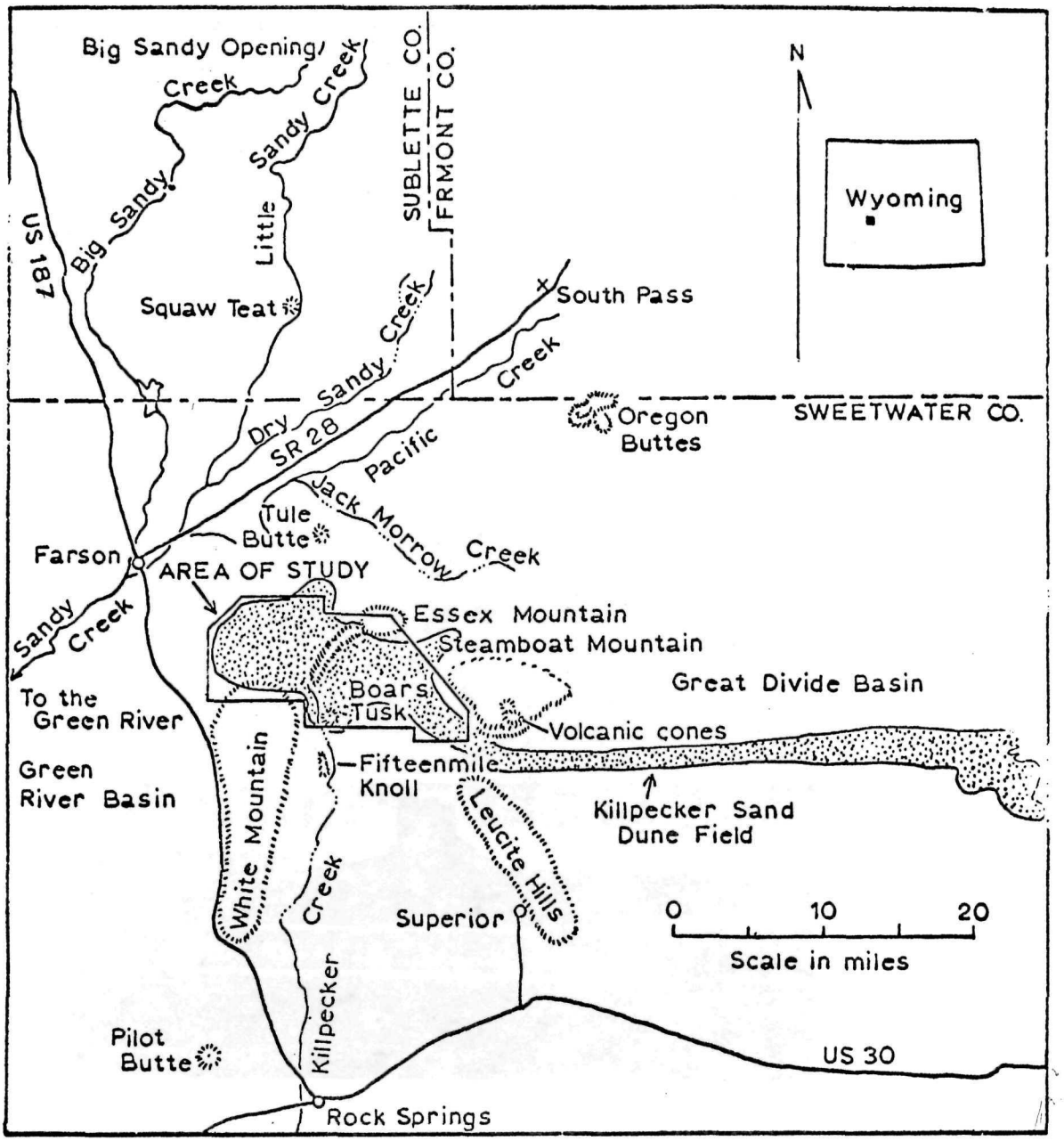


Figure 1 Location of the study area.

Fig. 16. Map showing the Killpecker Sand Dunes, Steamboat Mountain, and Leucite Hills (from McGrew et al., 1974).

Boar's Tusk Sand Dune Natural Area
(Federal Research Natural Area No. 273)

Location:

Sweetwater Co. See Fig. 16 and the description of the Killpecker Dunes.

Approximate Acreage:

61,700 acres

Ownership:

Public, administered by BLM (Rock Springs District Office, Box 1088, Rock Springs, Wyoming 82901).

Ecosystem Type:

Active dunes

Elevation:

6,700-7,800 feet

The Bureau of Land Management recognizes this area, at least informally, as a natural area. It lies on the western end of what is known as the Killpecker Sand Dunes (see p. 93). Although already recognized as a natural area, we firmly believe that natural landmark status also is highly desirable for this unique area. It is quite possible that strippable coal will be discovered under these dunes. There is considerable interest in leasing federal coal in the area, and the dunes lie on the fringes of a Known Coal Leasing Area.

Vulnerability:

High

Priority:

1A

Sand Dune Natural Area
(Federal Research Natural Area No. 280)

Location:

Carbon Co. Contact BLM for precise location, near Seminoe Reservoir.

Approximate Acreage:

960 acres

Ownership:

Public, administered by BLM (Rawlins District Office, Rawlins, Wyoming 82301).

Ecosystem Type:

Active dunes

Elevation:

7,000 feet

These dunes are an eastward extension of the central Wyoming sand dune system (Fig. 14); This natural area lies just west of the Seminoe Reservoir on the North Platte River. We do not know the vulnerability of this area, but coal is being strip mined in the county just to the south.

Priority:

1B

Steamboat Mountain

Steamboat Mountain, with the nearby buttes and mesas, old volcanic necks, e.g. Boar's Tuck, and sand dunes, is one of the more unique and scenic areas in the Wyoming Basin. It seems to us imperative that some portion of this area be recognized as a natural landmark, though the exact boundaries are yet to be determined. The Mountain itself covers about 3 sections, is of volcanic origin, rises to an elevation of 8,693 ft., and is part of the Continental Divide on the western side of the Great Divide Basin. It is truly an oasis in the middle of the Red Desert.

A total of 119 plant species were collected from Steamboat Mountain alone (Tables 27, 28, 29). The top of the mountain is a sagebrush-grassland with scattered groves of aspen in depressions. Elk and mule deer have been observed here. On the slopes limber pine predominates with some taller aspen groves and taller big sagebrush. Springs and seeps are common, creating very special microhabitats for some species like wild iris (Iris missouriensis), blue-eyed grass (Sisyrinchium sarmentosum), and shooting star (Dodecatheon pulchellum). A diversity of vegetation types is represented, especially considering that the Killpecker Sand Dunes are at the base of the Mountain. Herds of wild horses occur in the area together with a large resident elk herd which also utilizes the Killpecker Sand Dune area. On the west side of Steamboat Mountain in moister areas where sand dunes abut the base of the mountain, mesic shrubs such as chokecherry (Prunus virginiana), serviceberry (Amelanchier alnifolia), and buffalo berry (Shepherdia canadensis) have been observed. Also at the relatively level crest of the mountain, montane-subalpine species such as Ivesia gordonii, Geum triflorum, and Holodiscus microphyllus occur together with the relatively undisturbed bluebunch wheatgrass - Idaho fescue grasslands, adding biogeographic importance to this isolated mountain within the Wyoming Basin. Important outcrops of Eocene plant fossils were observed on the west face of Steamboat Mountain under a dateable basaltic flow.

The Leucite Hills area, of which Steamboat Mountain and the Killpecker Dunes are a part, is internationally known for its geological characteristics and is a very diverse and interesting area ecologically because of the dunes,

the isolated desert mountain, the seeps along the mountain sides, and the high abrupt cliffs which provide nesting sites for birds of prey, including prairie falcons, golden eagles, and redtailed hawks. Other birds in the area include the great horned owl, poor wills, nighthawks, Clark's nutcracker, several wrens and hummingbirds, red-shafted flickers, and swallows

Two unique species of rodents are found on Steamboat Mountain -- the yellow-bellied marmot (Marmota flaviventris) and Wortman's golden-mantled ground squirrel (Spermophilus lateralis wortmani). The latter is endemic to the Red Desert countryof Wyoming, and is found in the boulder fields of Steamboat Mountain, usually in association with limber pine.

A special historical marker, the Tri-Territorial Monument, is located near Steamboat Mountain. This monument is located on the intersection of the old Louisiana Purchase, Oregon Territory, and Texas Territory, and is maintained by a group of Lander citizens. The monument is surrounded by low sagebrush-saltbush vegetation, which is typical of the bench tops in the area.

Black Rock is also located near Steamboat Mountain, a few miles to the southeast. It is a volcanic neck that rises from the basin floor some 300 feet to an elevation of 7,201 feet. Black Rock was a conspicuous landmark along the old stage trail north from Point of Rocks to Atlantic City. The ruins of the old Black Rock Stage Station have been seriously pirated, but are still visible west of Black Rock along the road from Point of Rocks. The base of Black Rock covers about 3/4 section. Vegetation on the saddle-back top of Black Rock is dominated by low sagebrush, shadscale saltbush, bottlebrush squirreltail, and Indian ricegrass. Vegetation growth is limited by moisture, low precipitation and high soil percolation due to the porous condition of the volcanic substrate. Steep sides prevent the occurrence of large grazing herbivores on the top. The sides of Black Rock provide numerous locations for falcon nests, which have been observed there.

We urge that the Steamboat Mountain area be studied further for land-mark status.

Location:

Northeast of Rock Springs; see Fig. 16; Sweetwater Co., Sec. 8, 9, 10, 15, 16, 17, T. 23 N., R. 102 W.

Ownership:

Mixed private, federal, and State.

Additional Information:

See McGrew et al. (1974), who recommend the same area under the name "Leucite Hills - Boar's Tusk Area."

Fig. 17. Photograph of limber pine - sagebrush savanna on Steamboat Mountain.

Approximate Acreage:

3 square miles

Land Use:

Hunting; some grazing.

Ecosystem Types Represented:

Limber pine - sagebrush savanna

Sagebrush-grassland

Sand dunes

Springs and non-alkaline meadows

Aspen groves

Vulnerability:

Low

Other Knowledgeable Persons:

Dr. Marvin Maxell
Utah Department of Environmental Quality
Salt Lake City, Utah

Public Sensitivity:

Low

Priority:

1B

TABLE 27. Plant voucher specimens collected from Steamboat Mountain Non-Alkali Sloughs and Springs.[1]

TREES

Populus tremuloides #387

SHRUBS

Salix bebbiana #386

GRASSES

Elymus cinereus #414

FORBS

Achillea millefolium #1046
Collinsia parviflora #422
Dodecatheon pulchellum #378
Epilobium ciliatum #1041
Epilobium saximontanus #395
Eriogonum lonchophyllus #1032
Frasera speciosa #404
Galium boreale #400
Gilia aggregata #362
Glycyrrhiza lepidota #1031
Hackelia floribunda #1035
Iris missouriensis #379
Juncus balticus #383
Juncus longistylis #384
Juncus tracyi #1047
Mentha arvensis #1040
Mertensia lanceolata var. *fendleri* #396
Osmorhiza depauperata #408
Penstemon angustifolius #410
Penstemon humilis #368
Penstemon strictus #410
Phlox andicola #419
Potentilla anserina #374
Potentilla fruticosa #1463
Potentilla gracilis var. *nuttallii* #1034, #389
Ranunculus glaberrimus #382
Rumex triangulivalvis #402
Senecio integerrimus #399
Sisyrinchium sarmentosum #398
Smilacina stellata #438
Taraxacum laevigatum #388
Viola adunca #392

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[1]The voucher numbers refer to the collections of Robert J. Hill, all specimens are deposited in the Rocky Mountain Herbarium, Laramie, Wyoming 82071.

TABLE 28. Plant voucher specimens collected from Steamboat Mountain Short Big Sage-Grassland Association.

TREES

Pinus flexilis #365

SHRUBS

Artemisia pedatifida #451
Artemisia tridentata var. arbuscula #440
Artemisia tridentata var. tridentata #282
Atriplex gardneri #452
Chrysothamnus nauseosus #447
Leptodactylon pungens #420
Purshia tridentata #436
Ribes cereum var. inebrians #428
Sarcobatus vermiculatus #445
Tetradymia canescens #381

GRASSES AND SEDGES

Bromus tectorum #411
Koeleria cristata #358
Oryzopsis hymenoides #448
Sitanion hystrix #415

FORBS

Allium textile #394
Arenaria hookerii #450
Artemisia frigida #1045
Astragalus agrestis #430
Astragalus diversifolius #409
Astragalus miser var. decumbens #433
Astragalus purshii #434
Astragalus spatulatus #374
Calochortus nuttallii #1037
Castilleja chromosa #427
Comandra pallida #443
Crepis modocensis #372
Cryptantha bradburiana #449
Cryptantha flava #370
Cryptantha flavoculata #247

FORBS (Continued)

Cymopterus acaulis #397
Descurainia sophia #375
Erigeron compositus #426
Erigeron ochroleucus #425
Eriogonum caespitosum #393
Eriogonum flavum var. crassifolium #1048
Eriogonum ovalifolium #444
Erysimum cheiranthoides #376
Erysimum unconspicuum #1039
Euphorbia robusta #437
Fritillaria atropurpurea #357
Haplopappus acaulis #373
Ivesia gordonii #354
Lappula fremontii #364
Lesquerella ludoviciana #406
Linanthus septentrionales #423A
Linum lewisii #446
Lupinus argenteus #380
Opuntia polyacantha
Penstemon angustifolius #410
Penstemon laricifolius #1043
Phlox hoodii #417
Phlox multiflora var. depressa #418
Physaria australis #1044
Psoralea lanceolata #350
Stanleya viridiflora #1042
Stellaria longipes #431
Symphoricarpos oreophilus #442
Thlapsi arvense #377
Trifolium symnocarpon #435
Viola nuttallii var. vallicola #421
Zygadenus paniculatus #366

TABLE 29. Plant voucher specimens collected from Steamboat Mountain Forest Scrub Complex.

TREES

Pinus flexilis
Populus tremuloides

SHRUBS

Amelanchier utahensis #1033
Ceanothus velutinus #1036
Chrysothamnus viscidiflorus #439
Holodiscus discolor (ATH south rim of mtn. 9/30/74)
Prunus virginiana var.
melanocarpa #429

GRASSES AND SEDGES

Carex gynocrates #360

FORBS

Agoseris glauca #391
Antennaria rosea #424
Arabis hirsuta var.
globrata #355, #356
Arenaria fendleri var.
eastwoodia #454
Arenaria fendleri var.
fendleri #432
Delphinium geyeri #279
Delphinium nelsonii #369
Geum triflorum var.
ciliatum #401
Lithospermum ruderale #403
Potentilla ovina #390

The Big Hollow

Located in the Laramie Basin and crossed by the old Overland Trail, the Big Hollow is an area of great historical, geological, and biological interest. This large elongated depression covers about 40 square miles (14 miles long and 2-4 miles wide), and it seems incredible that such a feature in the landscape was caused by wind erosion (McGrew, et al. 1974). The Big Hollow is a conspicuous landscape feature along heavily-travelled Highway 130 west of Laramie, and many people inquire about its origin.

Biologically, the flora and fauna of the Big Hollow are not particularly unique or rare. The area is valuable, however, because of the complex of native vegetation that exists in close proximity. The bottom has several alkali depressions, where a variety of salt-tolerant halophytes occur and several ponds offer a rigorous habitat for some aquatic organisms. The ponds are frequented by killdeer, avocets , blackbirds, gulls, and several species of ducks.

Some areas are high in selenium and provide an opportunity to study a variety of plant species that are tolerant of this often toxic element.

The slopes and tops of Big Hollow are dominated by grasslands that are typical throughout the Laramie Basin. Herds of sheep, often the first seen by tourists from the east, and horses graze these areas, but antelope are common and at least one prairie dog town has been located. The crest of Big Hollow is rockier and provides a habitat for a different set of plant species. A variety of hawks glide near the crest in search of ground squirrels and other prey, taking advantage of the up-drafts that occur there.

Historically, the Big Hollow is especially interesting because it was traversed by the Overland Trail and the Ben Holliday Stage Coach Line. The Wyoming State Historical Society has marked the place where this trail crosses Highway 130, and the location of two stage stations to the north and south of Big Hollow are known. The physiography of Big Hollow, with many overlooks along the margin, easily allows for visions of Indians watching as the stagecoach moves across the Hollow, trailing a cloud of dust.

Of all the areas we have studied, the Big Hollow seems most deserving of an interpretive turnout sponsored by the State of Wyoming. Heavy traffic along Highway 130 provides the opportunity for a very meaningful education program of a geological, biological, and historical nature. Such an interpretive center in this area would reflect well, we believe, on the sponsoring agency, and would be appreciated by many as a rest area.

Table 30 is a list of the plant species that we collected in the Big Hollow, and Tables 31 and 32 list birds and mammals, respectively, that are known to occur there.

Location:

The east end of Big Hollow is about 2.5 miles west of Laramie, Wyoming. See Fig. 18. Albany Co., T. 15-16 N., R. 74-75 W.

Elevation:

6,500 to 7,500 feet.

Ownership:

Private except for 2 State sections and 1 BLM section.

Land Use:

Grazing of livestock, in places rather heavily. The area that would be appropriate for an interpretive turnout is in better condition, due perhaps to a greater distance from water which reduces the grazing intensity. Several oil wells.

Other Natural Areas in the Basin of the Grassland Type:

Federal Research Natural Areas 207 and 208 are located in the same county as the Big Hollow (Albany County), and, like Big Hollow, are dominated by western wheat grass, blue grama, needle grass, and a variety of other grasses, sedges, forbs, and prominent small shrubs, e.g. fringed sage. They lack, however, the geologic and historic interest of Big Hollow. Number 207 is known as the Laramie High Plains Natural Area, covers 640 acres at 7,000 ft., and is administered by the Rawlins District Office of BLM. Number 208 is known as the Laramie Plains Natural Area, covers 27 acres at 7,150 ft. in Hutton Lake National Wildlife Refuge,

Approximate Acreage:

40 square miles

Ecosystem Types Represented:

Grassland - dwarf shrub community

Greasewood flats

Alkaline ponds

Vulnerability:

Low

Other Knowledgeable Persons:

Geology Department
University of Wyoming

References:

See McGrew, et al. (1974)

Montagne, John. 1953. Geomorphology of the Centennial-Big Hollow area, southeastern Wyoming. Wyo. Geol. Assoc. Guidebook, 8th Ann. Field Conf., Laramie Basin and North Park, p. 77-80.

Public Sensitivity:

Low

Priority:

1B

and is administered by the Bureau of Sport Fisheries and Wildlife. Both areas are listed in Research Natural Areas (1968).

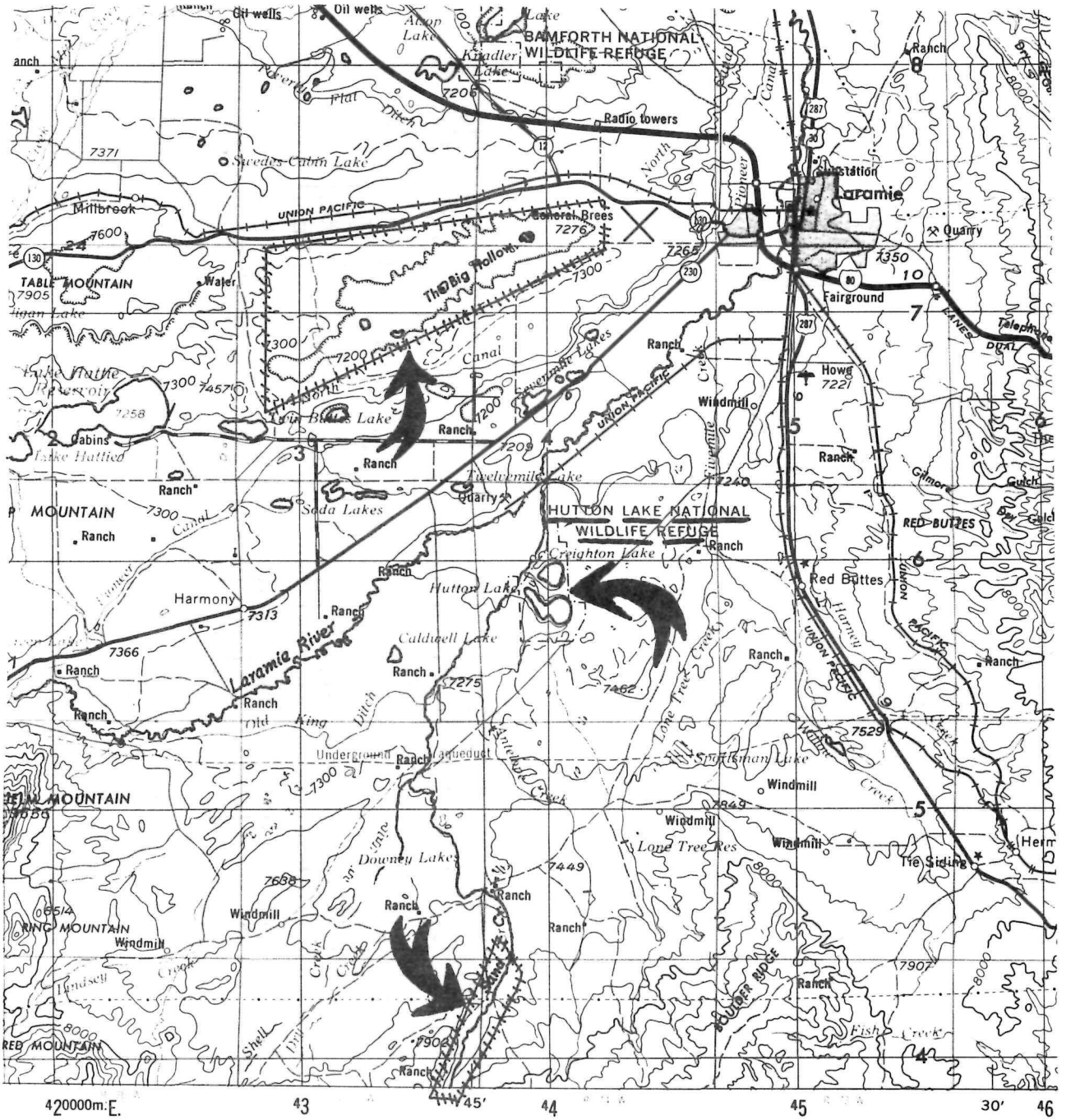


Fig. 18. Map showing the Big Hollow and Sand Creek potential natural landmarks. Cheyenne Quadrangle (NK 13-8), 1:250,000.

TABLE 30. Plant species collected in the Big Hollow.

ALKALINE DEPRESSIONS AND SLOUGHS

TREES

Populus angustifolia #33

SHRUBS

Atriplex gardneri #15, #23, #1131
Salix monticola #32
Sarcobatus vermiculatus #31
Suaeda fruticosa #1113

GRASSES, SEDGES, AND RUSHES

Carex aquatilis #1101
Distichlis stricta #1168
Eleocharis macrostachya #1100
Juncus balticus #1112, #39
Scirpus americanus var.
polyphyllus #1111

FORBS

Atriplex argentea #1117
Chenopodium berlandieri #1115
Glaux maritima #1103
Hutchinsia procumbens #43
Pedicularis crenulata #1106
Plantago eriopoda #40
Ranunculus cymbalaria #37, #1118
Salicornia rubra #1102
Triglochon maritima #1170
Triglochon palustris #44

GRASSLANDS

SHRUBS

Chrysothamnus nauseosus #41
Chrysothamnus viscidiflorus #1129
Eurotia lanata #1139
Tetradymia canescens #1156

GRASSES, SEDGES, AND RUSHES

Agropyron desertorum #1166, #1172
Agropyron smithii #1165

GRASSLANDS (Continued)

GRASSES, SEDGES, AND RUSHES (Continued)

Agrostis alba #1114
Bromus commutatus #1163
Bromus inermis #1146
Bromus tectorum #22
Hordeum jubatum #1164
Koeleria cristata #1138, #1141
Oryzopsis contracta #1167
Oryzopsis hymenoides #1144
Phleum pratense #1171

FORBS

Abronia fragrans var.
elliptica #1120
Achillea millefolium #1119
Allium textile #1126
Artemisia frigida #1162
Astragalus drummondii #1159
Astragalus pectinatus #1124
Astragalus shortianus #10
Astragalus spatulatus #14
Camelina microcarpa #1154
Cirsium arvense #1127, #1128
Cleome serrulata #1136
Coryphantha vivipara #35
Crepis runcinatus #1108
Cryptantha bradburiana #1104
Delphinium bicolor #1142
Descurainia sophia #7, #1151
Draba oligosperma #8
Erigeron nematophyllus #16
Eriogonum acaule #36
Erysimum argillosum #26
Gaura coccinea #1135
Gilia spicata #1152
Grindelia squarrosa #1143
Hymenoxys acaulis #6
Hyoscyamus niger #1107
Lappula redowskii #4, #18, #1155
Lepidium montanum #1125
Lepidium ramosissimum #1116
Lesquerella alpina #13
Lesquerella ludoviciana #1161
Linum lewisii #1123

TABLE 30. (Continued)

GRASSLANDS (Continued)

FORBS (Continued)

Lithospermum incisum #1
Lupinus argenteus #1140
Machaeranthera grindeliodes #1105
Melilotus officinalis #1150
Mirabilis linearis #1133
Oenothera caespitosa var.
montana #9
Oenothera coronopifolia #1134
Opuntia polyacantha #34
Oxytropis sericea #19
Penstemon angustifolius #3
Penstemon laricifolius var.
exilifolius #1160
Phlox bryoides #11
Phlox hoodii #29
Polygonum aviculare #1153
Rorippa sinuata #28, #30
Rumex crispis #1109
Salsola kali var.
tenuifolia #1121
Senecio canus #38
Senecio integerrimus #24
Sisymbrium altissimum #1137
Sphaeralcea coccinea #1158
Tanacetum capitatum #20
Taraxacum officinale #21
Tragopogon dubius #1149
Verbena bracteata #1148
Vicia americana var.
minor #25
Viola nuttallii var.
vallicola #12
Zygadenus venosus #5

SELENIFEROUS SOIL

FORBS

Astragalus bisulcatus
Astragalus pectinatus #17
Haplopappus fremontii #1122
Machaeranthera glabriuscula #141
Picradeniopsis oppositifolia #1130
Stanleya pinnata var.
pinnata #1132

TABLE 31. Some birds known to occur in the vicinity of Big Hollow, based in part on Finzel (1962).

Turkey vulture	Cathartes aura (Linnaeus)
Red-tailed hawk	Buteo jamaicensis (Gmelin)
Rough-legged hawk	Buteo lagopus (Pontoppidan)
Ferruginous hawk	Buteo regalis (Gray)
Golden eagle	Aquila chrysaetos (Linnaeus)
Marsh hawk	Circus cyaneus (Linnaeus)
Sparrow hawk	Falco sparverius (Linnaeus)
Killdeer	Charadrius vociferus (Linnaeus)
Mountain plover	Eupoda montana (Townsend)
California gull	Larus californicus (Lawrence)
Common nighthawk	Chordeiles minor (Forster)
Horned lark	Eremophila alpestris (Linnaeus)
Barn swallow	Hirundo rustica (Linnaeus)
Cliff swallow	Petrochelidon pyrrhonota (Vieillot)
Western meadowlark	Sturnella neglecta (Audubon)
Vesper sparrow	Pooecetes gramineus (Gmelin)
McCown's longspur	Rhynchophanes mccownii (Lawrence)

TABLE 32. Some mammals known to occur in the vicinity of Big Hollow, based in part on Finzel (1962).

White-tailed jackrabbit	Lepus townsendii (Bachman)
Desert cottontail	Sylvilagus audubonii (Baird)
Richardson ground squirrel	Citellus richardsonii (Sabine)
Thirteen-lined ground squirrel	Citellus tridecemlineatus (Mitchill)
Deer mouse	Peromyscus maniculatus (Wagner)
Northern grasshopper mouse	Onychomys leucogaster (Wied-Neuwied)
Coyote	Canis latrans (Say)
Badger	Taxidea taxus (Schreber)
Striped skunk	Mephitis mephitis
Mule deer	Odocoileus hemionus (Rafinesque)
Pronghorn	Antilocapra americana (Ord)

Laramie High Plains Natural Area
(Federal Research Natural Area No. 207)

Location:

Albany Co., near Bamforth National Wildlife Refuge.

Approximate Acreage:

640 acres

Ownership:

Public, administered by BLM, Rawlins District Office.

Ecosystem Types Represented:

Grassland

Elevation:

7,000 feet

Little is known about this natural area. BLM should be contacted.

Priority:

2C

Laramie Plains Natural Area
(Federal Research Natural Area No. 208)

Location:

Albany Co., Hutton Lake National Wildlife Refuge. See Fig. 18.

Approximate Acreage:

27 acres

Ownership:

Public, administered by the Bureau of Sport Fisheries and Wildlife.

Ecosystem Type:

Grassland

Greasewood-grassland

Marsh

Elevation:

7,150 feet

Knowledgeable Persons:

Refuge Manager, Hutton Lake National Wildlife Refuge
Bureau of Sport Fisheries and Wildlife
Walden, Colorado

Vulnerability:

Low

Priority:

2C

Oregon Trail Sagebrush-Grassland

The Oregon Trail traverses the Wyoming Basin, crossing the Continental Divide near South Pass City. In some areas the trail is still quite visible, winding its way through broad expanses of big sagebrush-grassland. The Secretary of Interior has already designated South Pass as an Historic Landmark, the ghost town of South Pass City is being restored by the Wyoming State Historical Commission, and nearby a fenced exclosure has been erected by the Historical Landmark Commission of Wyoming that includes a major fork in the Oregon Trail. It is said that here, within this exclosure, wagon trains divided depending on whether the destination was Oregon or California (Fig. 19).

The area is obviously of great historic significance, and appropriate attention has been given to it. Our interest in the area is in the fine big sagebrush-grassland that can be found in the area. The exclosure, unfortunately, is rather small and the vegetation within is heavily trampled by visitors. We believe, however, that the adjacent area is of sufficient importance to merit natural landmark status, and the historical value of the area would add to its value. Thus, we propose that further ecological studies be made of this historic area in order to find an appropriate example of the undistrubed big sagebrush-grassland through which the first wagon trains travelled.

Many of the plants and animals listed in Tables 12 and 13 could be found in this area. The big sagebrush that dominates here is probably subspecies vaseyiana. Plant species collected here include Antennaria rosea (#1515), Stipa pinetorum (#1518), Astragalus kentrophyta (#1513), Leptodactylon pungens (#1516), and Eriogonum caespitosum (#1517).

Location:

Along U. S. Highway 28, west of South Pass City. See Fig. 20.

Ownership: Sublette Co., T. 27 N., R 103 W., Sec. 24, 25.

All public land - BLM.

Additional Information:

See McGrew et al. (1974), p. 345-352, who recommend the nearby Atlantic City Goldfield.

Approximate Acreage:

100 acres

Land Use:

Grazing

Ecosystem Types Represented:

Sagebrush-grassland

Vulnerability:

Low

Public Sensitivity:

Moderate due to the remnants of the Oregon Trail.

Priority:

1B

Other Natural Areas of the Sagebrush-Grassland Type:

Federal Research Natural Area 162, known as the Alkali Desert Shrub Natural Area, is located in Uinta County in the Wyoming Basin, is 40 acres in size, ranges from 6,500 to 6,600 ft. in elevation, and is administered by the Rock Springs District Office of the Bureau of Land Management. Federal Research Natural Area 167, known as the Northern Desert Shrub-Sagebrush Natural Area, is also of the sagebrush-grassland type. It is located in Sweetwater County in the Wyoming Basin, covers 640 acres at 6,800 ft., and is administered by the Rawlins District Office of BLM. Both of the above areas are in the K-38 Great Basin Sagebrush type, and are listed in Research Natural Areas (1968).

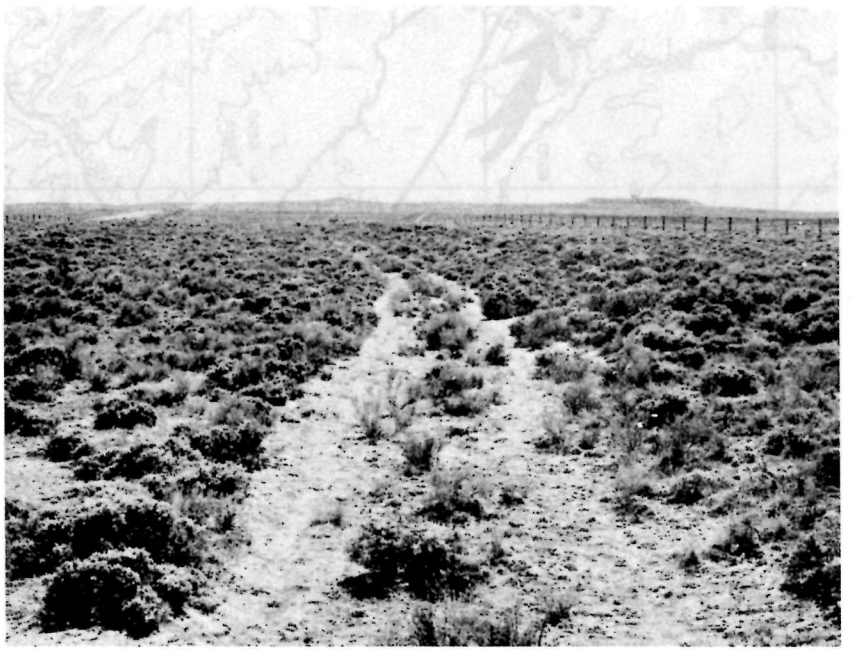


Fig. 19. Photograph of the Oregon Trail sagebrush - grassland potential natural landmark.

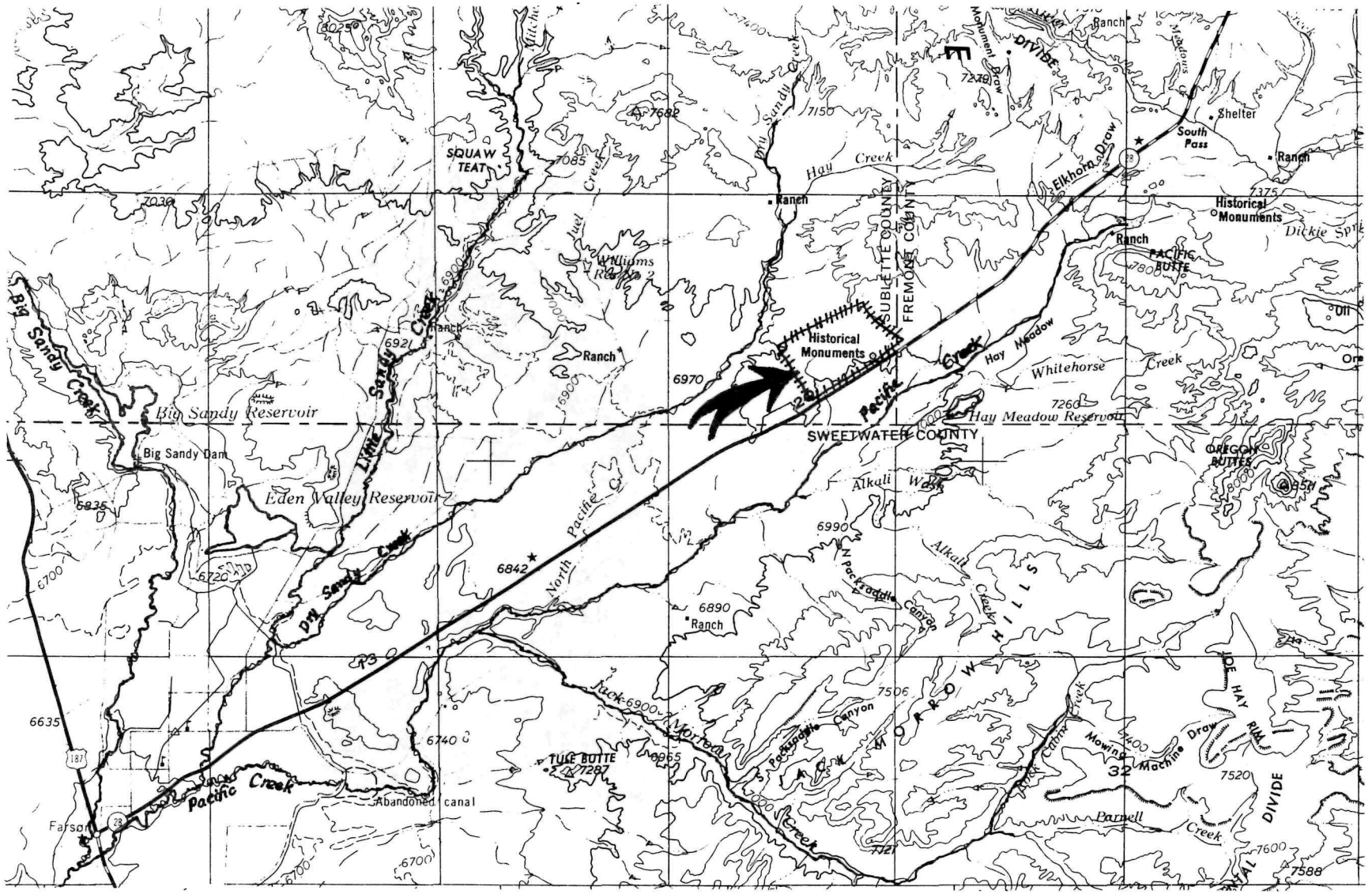


Fig. 20. Map showing the Oregon Trail sagebrush-grassland potential natural landmark. Lander Quadrangle (NK 12-6), 1:250,000.

Alkali Desert Shrub Natural Area
(Federal Research Natural Area No. 162)

Location:

Uinta Co.

Ownership:

Public, administered by the BLM (Rock Springs District Office, Rock Springs, Wyoming 82901).

Approximate Acreage:

40 acres

Ecosystem Type:

Sagebrush-grassland

Elevation:

6,500 feet

Priority:

2B

BLM should be contacted for further information on this area.

Northern Desert Shrub-Sagebrush Natural Area
(Federal Research Natural Area No. 167)

Location:

Sweetwater Co.

Ownership:

Public, administered by BLM (Rawlins District Office, Box 670 Rawlins, Wyoming 82301).

Approximate Acreage:

640 acres

Ecosystem Type:

Sagebrush-grassland

Elevation:

6,800 feet

Priority:

2B

BLM should be contacted for further information on this area.

Bates Hole and Shirley Basin Petrified Forest

Portions of the Shirley Basin, Bates Hole in particular, have been recommended by McGrew et al. (1974, pp. 110-114) for Natural Landmark Status, primarily for the fossiliferous sediments and spectacular views of heavily dissected monuments, pillars, and turretted castles around the edges. The rim of Bates Hole offers one of the more spectacular views in the whole Wyoming Basin, a consequence of headward erosion by Stinking Creek.

The area recommended by McGrew et al.(1974) includes the spectacular south rim of Bates Hole, which we also believe is meritorious of Natural Landmark status. The vegetation above and below the rim is typical of the area and is quite diverse. On the slopes we observed several small plant species that are usually found as forest understory plants, e.g. Mahonia repens. The presence of these plants suggests that this area might have been forested in recent time, a prospect that lends biogeographic interest to the area. Further study is necessary. No rare or endangered species were encountered but the area has good examples of the vegetation found throughout the Shirley Basin, a large and significant component of the Wyoming Basin. Table 33 lists plants that we collected in the Shirley Basin area, and McGrew et al.(1974) provide further information. Most of the area is owned by either the State of Wyoming or the BLM.

Of special interest in the Shirley Basin are the petrified remnants of an Eocene forest. G. W. Ullrich and M. Christensen have described the value and location of the area as follows:

"A spectacular display of petrified logs -- relics of a Wyoming Eocene forest - recently was brought to the attention of the authors by Mr. Paul Turley. Petrified intact logs and an abundance of fragments, on the surface and partially embedded in crumbling sandstone, impressively remind the onlooker that a swamp forest dominated by trees of tremendous size must once have grown in or near the new arid Shirley Basin in southcentral Wyoming. To the best of our knowledge, however, the petrifactions have not been studied by a paleobotanist, and thus composition, structure, and extent of the forest are essentially unknown.

"Although the area is relatively remote, there is evidence that rock hunters already have pilfered material, and the popularity of that activity is increasing at an alarming rate. A huge, open-pit uranium mine extends to within approximately one-half mile of the principal exposure of logs. There are test holes in and beyond the area in question. Thus it is apparent to us that unless the Wyoming Congressional delegation and the Bureau of Land Management act quickly, the Nation will have lost, forever, that which merits protection for its scientific value and its potential in contributing to Public enjoyment and education.

"The two land Sections known to contain concentrations of logs are located about 30 miles north of Medicine Bow, Wyoming in Carbon County. An area of principal exposure (S13, T27N - R78W, see Fig. 21) can be reached by travelling paved State Highway 487 and about 15 to 18 miles of graded earth road. The site is an eroded embankment in an eastern section of the Shirley Basin.

"According to Riedl (1959) who has studied and described the geology of the eastern portion of the Shirley Basin, fossil wood occurs in Sections 11, 12, and 13 of T27N - R78W (see map) and the area is known locally as the 'Petrified Forest'.

"The petrifactions are embedded in '...gray to yellow arkosic sandstones' near the top of the Wind River formation. The beds which comprise that formation are listed as deposits of the 'late Early Eocene'. Toppling and fossilization of that dawn age swamp forest, then, may have occurred 40 to 50 million years ago.

"An impression of the general appearance of the log-strewn landscape can be obtained through examination of the accompanying photographs. Riedl reported that some of the logs reach lengths '...of nearly 30 feet.' In the area of Section 13 shown to us by Mr. Turley, one log is nearly 90 feet long and several have intact lengths exceeding 60 feet. The trunk diameters measured by us ranged from about 14 to 66 inches (several were 60-65 inches) at 4 feet above the base. The log which was 66 inches across at 4 feet still had a diameter of 42 inches at 60 feet; assuming uniform taper, total tree height may have been 420-500 feet, which is considerably higher than the tallest-growing extant species of hardwood tree. We could see no regularity in position of the logs, i.e., in one area seven intact

petrifactions 30-88 feet long lie crossed over one another. Most of the trunks are branched. Growth rate, as evidenced by clearly visible rings 1/8-1/4 inch wide, apparently was rapid. One of the unique features may be the interesting and beautiful log surfaces, with well-preserved wood grain and knots underlying a colorful growth of lichens.

"Dr. T. Delevoryas, Yale University Department of Biology, has identified a section from one of the large trees as the wood of a dicot (Angiospermae, Dicotyledoneae), but because of poor cell preservation in the specimen which we sent, he was not able to identify it to genus. An extinct sycamore (Platanus) is the most abundant hardwood in the Yellowstone Park Eocene forest petrifactions.

"The famous petrified forests of Yellowstone Park have been intensively studied by Dr. Erling Dorf and his students at Princeton University since about 1954 (Dorf 1964). Those forests also date from late Early Eocene or early Middle Eocene. More than 100 different plant species occur in the 27 layers of petrified trees which have been exposed on Amethyst Mountain in northeastern Yellowstone Park. According to Dorf, 'The most numerous hardwood species in the Eocene forests were apparently large-leaved sycamores, walnuts, magnolias, chestnuts, oaks, redwoods, maples and dogwoods.'

"A careful study of the Shirley Basin petrified forest can be expected to yield new information on composition in those Eocene forests and species' distribution patterns.

"There are two threats to preservation of the fossil trees in the Shirley Basin: vandalism is the chronic threat, and in our estimation could totally destroy the area even before it is affected by uranium mining, the catastrophic threat.

"Rock hunters apparently have known of the 'Petrified Forest' for many years and no doubt already have carried away literally tons of petrified wood. Areas at one time protected by their remoteness, however, now are accessible by 4-wheel drive vehicles, and it is for this reason particularly that we are urging immediate protection in Sections 12 and 13.

"A large Kerr-McGee uranium mine is in operation about one-half mile from the site shown to us by Mr. Turley. There are test holes in the immediate area, but the Section 12 and 13 ridges may not be prime uranium

mining areas - the intensive mining sites are in Sections 10, 14, 15 and 11, T27N - R78W, closely adjacent to the Little Medicine Bow River.

"All of the land in Sections 12 and 13, T27N - R78W, is public land administered by the Bureau of Land Management. The two sections have been staked for mining claims, however. We had expected to submit the mining claims record, but found the cost to be prohibitive. The records are on file in the office of the County Clerk, Carbon County, Rawlins, Wyoming 82301. They are in book 552 (327-354, 28 pages), book 519 (497-559, 63 pages), and book 519 (560-625, 65 pages).

"We urge 1) immediate protection of all surface and subsurface fossils in Sections 12 and 13, T27N - R78W, and 2) careful study of the area for possible reclassification as a National Monument."

Other Fossil Natural Areas:

Two fossil natural areas are listed in Research Natural Areas (1968) for the Wyoming Basin. One, Number 313, is known as the Fossil Fish Quarries Natural Area, is located in Lincoln County, is 120 acres in size, and is administered by the Rock Springs District Office of BLM. In addition to preserving fish and other vertebrate and invertebrate fossils, this area has 120 acres of sagebrush grassland. The other area, No. 316, is known as the Petrified Forest Natural Area, is located in Carbon County, is 1,280 acres in size, and is administered by the Rawlins District Office of BLM. The fossils there are botanical, and the area is covered by grassland.

Location:

Carbon Co., T. 27-28 N., R. 78-80 W.

The petrified wood deposits are at T. 27 N., R. 77-78 W.; see Fig. 21.

Ownership:

Mostly public and state

Land Use:

Uranium mining and grazing

Ecosystem Types Represented:

Sagebrush-grassland

Escarpments with limber pine and juniper

Greasewood flats

Vulnerability:

High due to scavenging and mining.

Other Knowledgeable Persons:

BLM - Rawlins Office

BLM - State Archeologist, Cheyenne

U. S. Geological Survey - Denver

Public Sensitivity:

High due to fossils

Priority:

1B

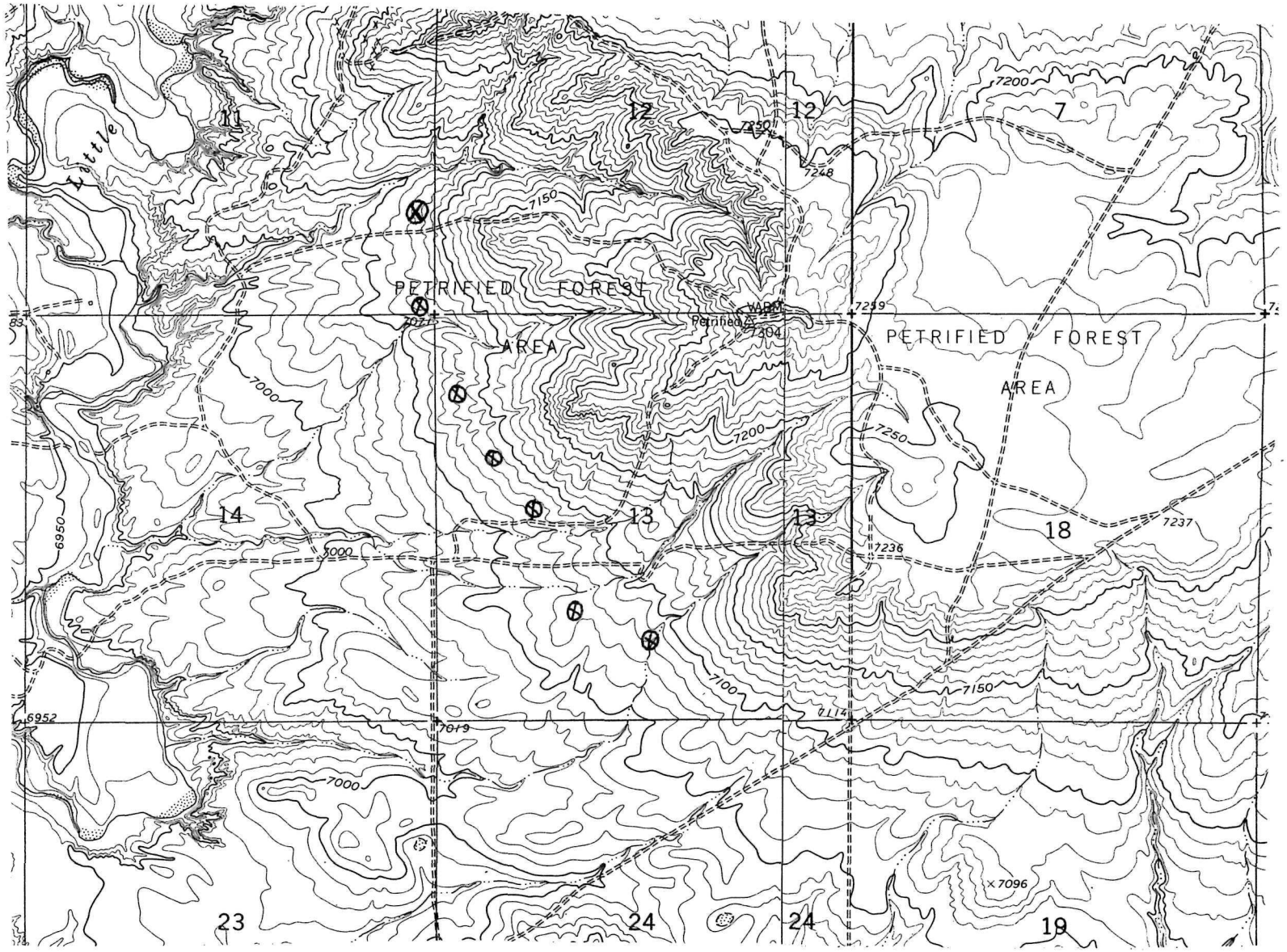


Fig. 21. Map showing the location of known or reported fossil wood in Bates Hole. Moss Agate Reservoir Quadrangle (west) and Chalk Hills, Wyo. Quadrangle (east), 1:24,000.

TABLE 33. Some plant species collected in the Shirley Basin of Wyoming.

TREES

Populus tremuloides #127

SHRUBS

Artemisia tridentata var. nova #1268
Artemisia tridentata var. speciformis #176
Atriplex gardneri #1223
Chrysothamnus parryi #1194
Chrysothamnus viscidiflorus #1265
Eurotia lanata #1256
Gutierrezia sarothrae #1199
Prunus virginiana var. melanocarpa #142
Purshia tridentata #1257
Ribes cereum var. inebrians #128
Rosa woodsii #1266
Salix exiqua #156
Salix lutea #135
Sarcobatus vermiculatus #154, #1202
Symphoricarpos oreophilus #129

GRASSES AND SEDGES

Agropyron desertorum #149
Agropyron smithii #1217
Agropyron spicatum #1257
Agropyron trachycaulum #1197
Agrostis scabra #1259
Bromus inermis #1215, #147
Bromus tectorum #170
Calamovilfa longifolia #1254, #1258
Hordeum jubatum #1219
Koelaria cristata #1260, #1196
Oryzopsis hymenoides #1213

FORBS

Achillea millefolium #1221, #1264
Allium cernuum #1236
Allium textile #161, #168
Antennaria rosea #167
Artemisia biennis #1211
Artemisia frigida #1212, #1267

FORBS (Continued)

Aster adscendens #1204, #1351
Astragalus bisculcatus #143, #1209
Astragalus miser var. decumbens #139
Astragalus pectinatus #157
Astragalus spatulatus #172
Besseya wyomingensis #181
Castilleja chromosa #183
Castilleja linariaefolia #1186
Chenopodium berlandieri #1210
Chrysopsis villosa #1205, #1252
Cirsium arvense #1206
Cleome serrulata #1191
Comandra pallida #126
Crepis atrabarba #150
Cryptantha bradburiana #155
Delphinium nelsonii #125
Descurainia sophia #165, #1195
Erigeron nematophyllus #180, #1198, #1262
Eriogonum flavum #1270
Eriogonum ovalifolium #185
Erysimum cheiranthoides #160
Fritillaria atropurpurea #136
Gaura coccinea #152
Gilia spicata #137
Grindelia squarrosa #1218
Haploppapus acaulis #179
Helianthus petiolaris #1200
Hymenopappus filifolius var. luteus #1269
Iris missouriensis #159
Kochia scoparia #1203
Lappula redowskii #163
Lepidium campestre #162
Lesquerella alpina #187A
Linum kingii #1271
Linum lewisii #164, #1253
Lomatium simplex #131
Lupinus argenteus #1201
Machaeranthera canescens #1261
Machaeranthera glabriuscula #141
Melilotus alba #151, #1189
Melilotus officinalis #145, #1208
Oenothera caespitosa var. montana #175
Opuntia polyacantha #178

TABLE 33. (Continued)

FORBS (Continued)

Oxytropis besseyi #153, #169
Oxytropis sericea #158
Penstemon eriantherus #138
Penstemon humilis #184
Phlox andicola #182
Phlox bryoides #186
Phlox hoodii #133
Plantago eriopoda #1214
Rorippa sinuata #160, #1190
Rumex triangulivolvis #1216
Sedum lanceolatum #171
Sphaeralcea coccinea #144
Stanleya pinnata var. *bipinnata* #140
Stanleya pinnata var. *pinnata* #1187
Stanleya viridiflora #1192
Thermopsis rhombifolia #177
Thlapsi arvense #1207
Tragopogon dubius #1193
Viola nuttallii var. *vallicola* #134
Zygadenus pediculatus #166

Petrified Forest Natural Area
(Federal Research Natural Area No. 316)

Location:

Carbon Co. See Fig. 21.

Ownership:

Public, administered by BLM (Rawlins District Office, P. O. Box 670, Rawlins, Wyoming 82301).

Approximate Acreage:

1,280 acres

Ecosystem Type:

Sagebrush-grassland

Elevation:

7,300 feet

This area is apparently the same area we recommend on p. 121. BLM should be contacted for further information.

Priority:

1B

Henry's Fork Fault Juniper Woodland

Located on the west side of Flaming Gorge Reservoir, this area is of considerable interest biologically as well as scenically and geologically. Here floristic elements of the Great Basin intermix with elements of the Rocky Mountain foothills. For example, Juniperus osteosperma and Juniperus scopulorum occur together, as do Cercocarpus montanus and Cercocarpus ledifolius. Table 34 lists the plant species we have observed growing at this potential natural landmark; a variety of reptiles and cliff-dwelling birds were common.

The vegetation here is very representative of the juniper woodland and foothills shrub (mountain mahogany) natural history themes. Farther south are areas dominated by pinyon pine, ponderosa pine, and douglas fir, with some aspen and thickets of Symphoricarpos sp. on north-facing slopes. The whole area surrounding the south end of Flaming Gorge Reservoir is of interest biologically, and probably should be studied along with the Henry Fork Fault area.

Three species of mammals, unique to Wyoming, occur in the rocky outcroppings and cliffs of the area. The cliff chipmunk, canyon mouse, and piñon mouse established residence in Henry's Fork Fault and the Green River Canyon prior to the filling of Flaming Gorge Reservoir. As the reservoir filled, the species moved to habitat higher in the canyon adjacent to the shoreline. Prairie dogs (Cynomys leucurus) are common in the table-land saltbush communities along the western portion of the Recreation Area from the Utah border to the town of Green River. This would be one prime location to search for the black-footed ferret (Mustela nigripes) and/or a potential site for reintroduction or re-establishment of the species.

Location:

Along the Lucern Valley access road to Flaming Gorge Reservoir, about 4 miles northeast of Manila, Utah. See Figs. 22, 23, 24. Sec. 19, T. 12 N., R. 108 N. and Sec. 24, T. 12 N., R. 109 W., Sweetwater Co.

Ownership:

All of the Henry's Fork Fault area lies within the Flaming Gorge Recreation Area of Ashley National Forest.

Additional Information:

See McGrew et al. (1974), p. 162-165.

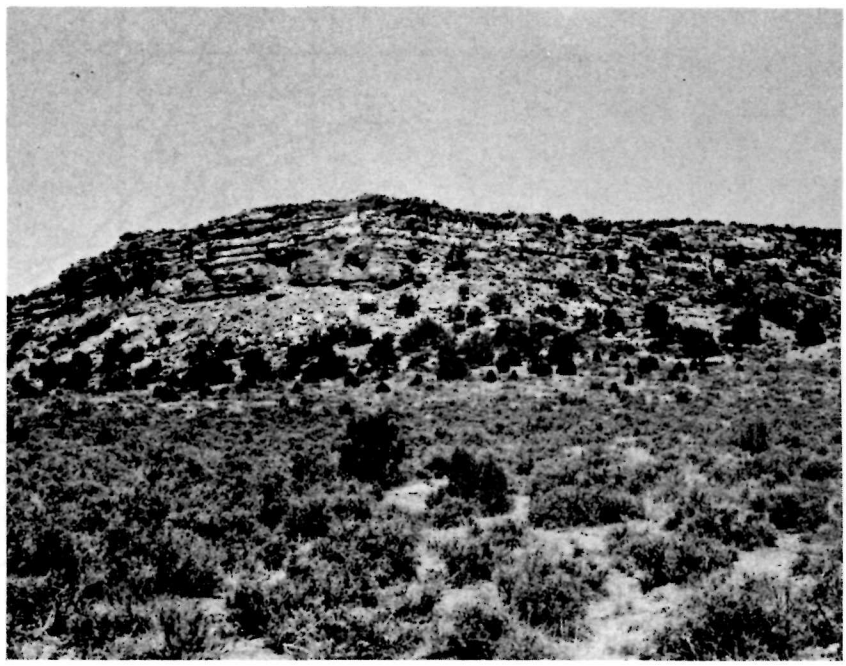


Fig. 22. Photograph of the sagebrush - grassland and juniper woodland at Henry's Fork Fault.

Approximate Acreage:

1,280 acres

Land Use:

Flaming Gorge National Recreation Area.

Ecosystem Types:

Juniper woodland

Mountain mahogany shrub community

Sagebrush-grassland

Vulnerability:

Low

Other Knowledgeable Persons:

Supervisor
Ashley National Forest
437 East Main Street
Vernal, Utah 84078

Public Sensitivity:

Low

Priority:

2C

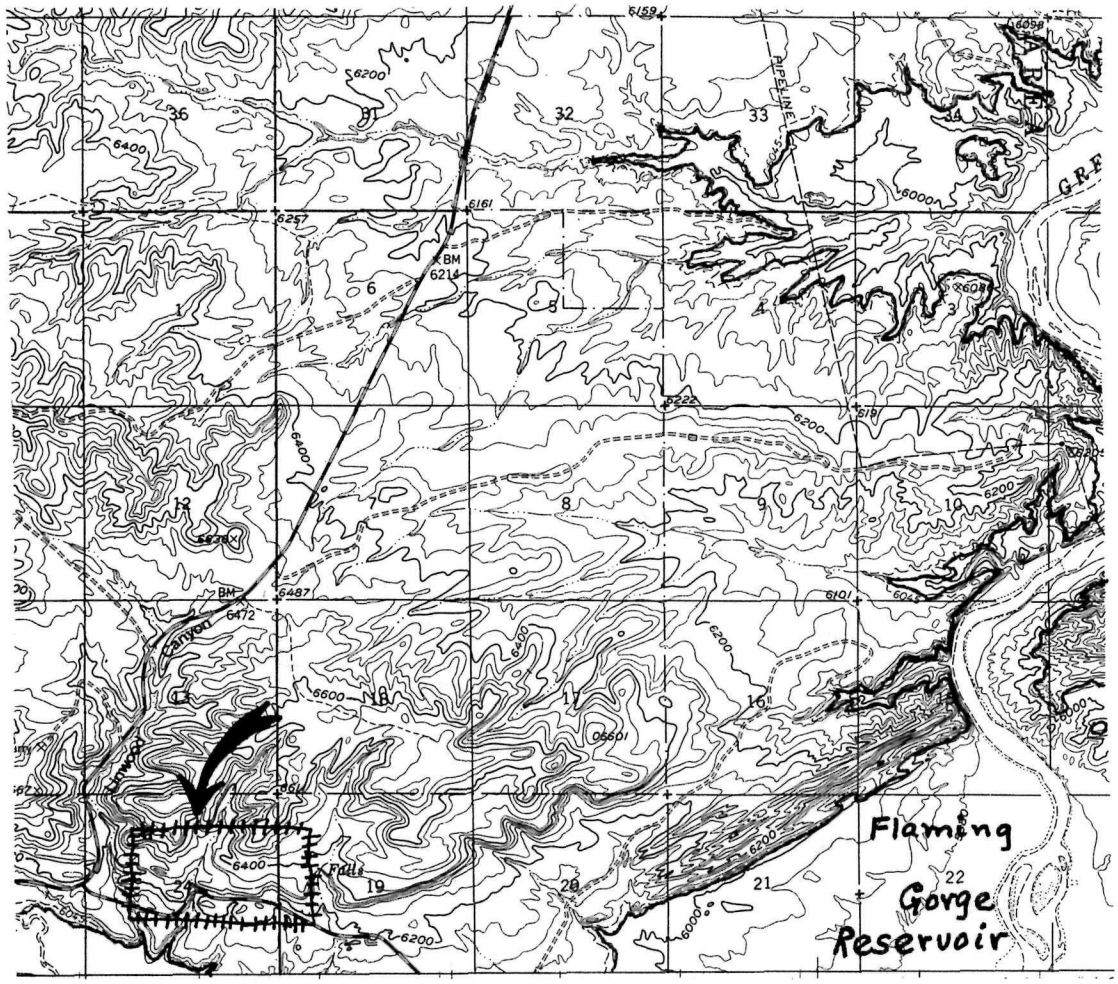


Fig. 23. Map showing the location of the Henry's Fork Fault juniper woodland (Buckboard Crossing Quadrandle). Buckboard Crossing Quadrangle, 15 minute series.

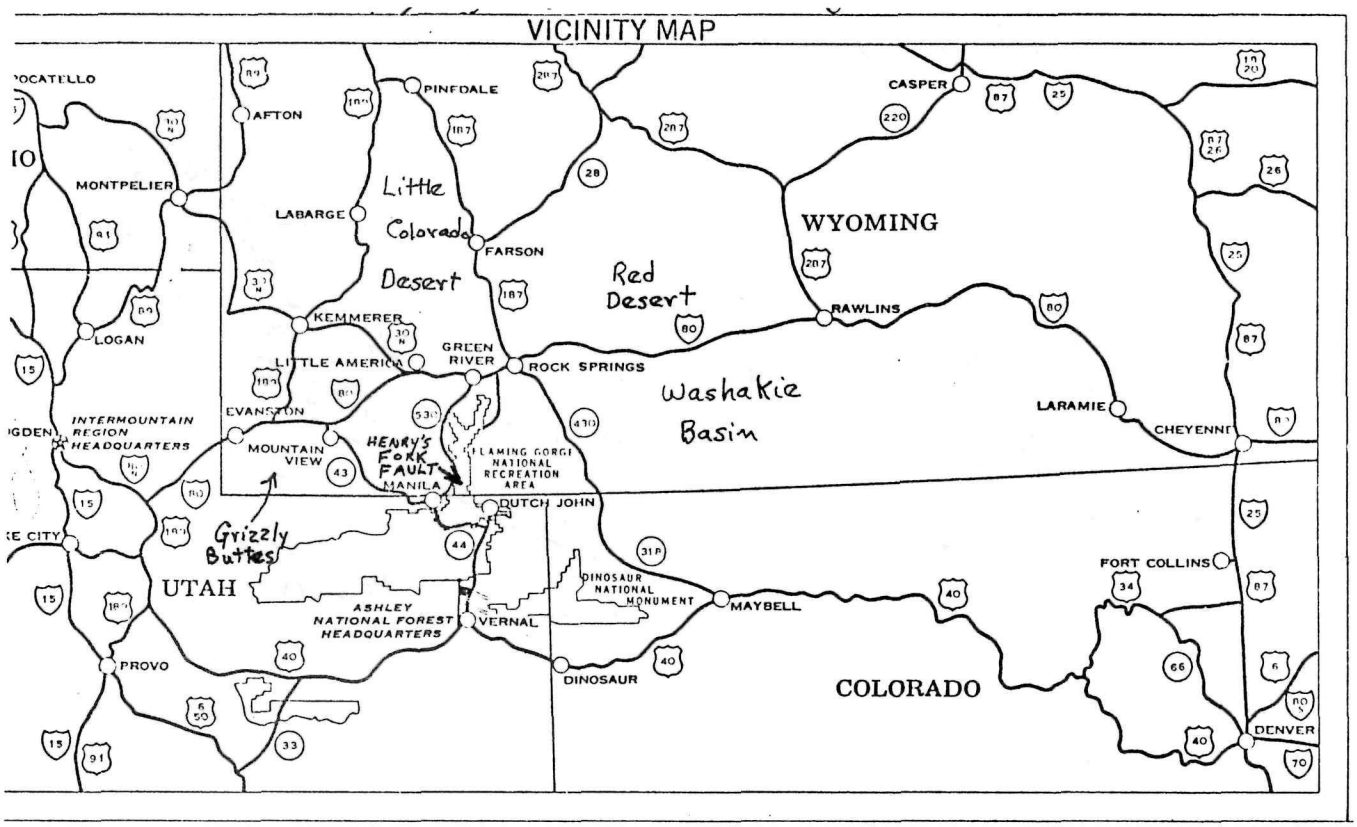


Fig. 24. Map showing the location of Henry's Fork Fault, Grizzly Buttes, Washakie Basin, Red Desert, and the Little Colorado Desert.

TABLE 34. Plant voucher specimens collected from Henry's Fork Fault Foothills Scrub Community.

TREES

Juniperus osteosperma #935
Juniperus scopulorum #1557

SHRUBS

Artemisia tridentata #954
Atriplex canescens #946
Atriplex confertifolia #956
Cercocarpus ledifolius #966
Cercocarpus montanus #965
Chrysothamnus parryi #962
Chrysothamnus vaseyi #955
Eurotia lanata #936
Grayia spinosa #929
Sarcobatus vermiculatus #952
Shepherdia argentea #1556
Symphoricarpos oreophilus #1563

GRASSES AND SEDGES

Agropyron spicatum #951
Bromus inermis #931
Bromus tectorum #958
Oryzopsis hymenoides #959
Phleum pratense #930
Sitanion hystrix #961
Stipa comata #948

FORBS

Arabis holboellii #945
Arenaria hookerii #957
Artemisia frigida #950
Astragalus agrestis #944
Astragalus bisulcatus #1554
Caulanthus crassicaulis #1555
Chenopodium dessicatum var. leptophylloides #949
Cryptantha flava #943
Cryptantha kelseyana #938
Delphinium bicolor #947
Eriogonum cernuum #939
Hymenoxys richardsonii #933
Machaeranthera canescens #934
Melilotus alba #927

FORBS (Continued)

Melilotus officinalis #928
Mentzelia albicaulis #937
Mirabilis linearis #963
Opuntia polyacantha #967
Paronychia sessiliflora #953
Sphaeralcea coccinea #960
Townsendia incana #964
Tragopogon dubius #942

Washakie Basin

This is a very large area that is as yet relatively free from the influence of man. Livestock grazing does occur, but for many the area represents a dry sagebrush-grassland-greasewood wilderness. As McGrew et al. (1974) note, the area includes buttes, badlands, springs, old forts (100 years old) along the historic Overland Trail, and fossil beds of great significance. The vegetation is quite diverse as are the geological characteristics. The Washakie Basin is large (525 square miles) and we have not been able to study it adequately to recommend specific sites or to recommend the whole area as a landmark. It is a very special area in the Wyoming Basin, however, and we believe the NPS should study it further.

Being semi-arid, the vegetation of the Washakie Basin is characterized by sagebrush-grassland with frequent occurrence of communities dominated by greasewood and saltbush species. Several springs and alkaline lakes occur in the area, lending aquatic diversity, and wild horse herds have been observed as well as antelope and mule deer. Escarpments, alkali flats, and badlands can be found, which undoubtedly provide habitat for additional species of animals, especially birds. Prairie dog towns have been observed.

Table 35 is a list of the plant species collected in the Washakie Basin. We found what may be a new species of Grayia (hopsage) in the Washakie Basin. The area is very poorly known botanically.

A number of historical sites occur on the Overland Trail route in the northern part of the Basin. Among these are the Boy Pit (NE¼, NE¼, Sec. 6, R 95 W, T 17 N), Barrel Springs Crossing (SW¼, NW¼ Sec. 30, R 90 W, T 17 N), Tadpole Springs Stage Station, Fort LaClede, and LaClede Stage Station (See Figure 27). The latter ruins are better preserved than those to the East. One station on the Overland Trail at Point of Rocks is being restored. The LaClede sites should be considered for restoration and the other sites along the way should be protected.

Location:

See Fig. 26 and McGrew et al. (1974), p. 186. Washakie Basin occurs in the south-central portion of Wyoming. It is the southern portion of the Red Desert and includes the eastern portion of Sweetwater County and the southwestern portion of Carbon County. It is bordered on the north by the Continental Divide which separates it from the Great Divide Basin on the north. The Basin is bordered on the east by the Sierra Madre Range and on the west by the Aspen Mountains. Sweetwater Co., T. 13-17 N., R. 94-98 W.

Fig. 25. Photograph of old Fort LaClede in the Washakie Basin, along the Overland Trail. Several Similar structures still remain in the Washakie Basin.

Ownership:

Mostly public land administered by BLM, with considerable holdings by the Union Pacific Railroad.

Approximate Acreage:

525 square miles, but only portions would probably be potential natural landmarks.

Land Use:

Grazing, oil wells, and mineral exploration

Vulnerability:

Moderate to high, due to oil and mineral exploration and the potential for oil shale development.

Other Knowledgeable Persons

Mr. Henry Roehler
U. S. Geological Survey
Denver, Colorado

See McGrew, et al. (1974).

Public Sensitivity:

Moderate, due to the historic sites.

Priority:

1B

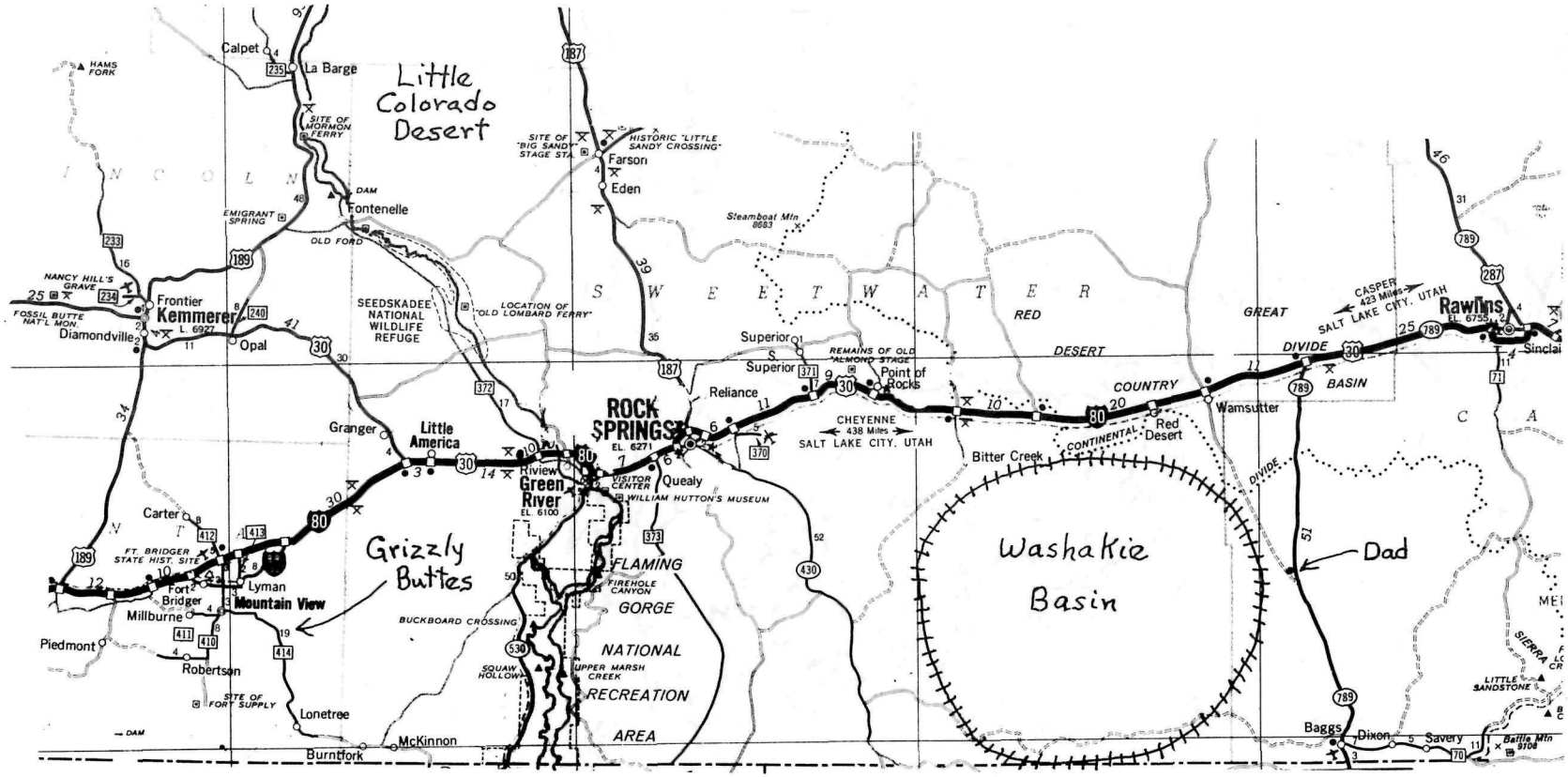


Fig. 26. Map showing the general location of the Washakie Basin, Red Desert, Little Colorado Desert, and Grizzly Buttes.

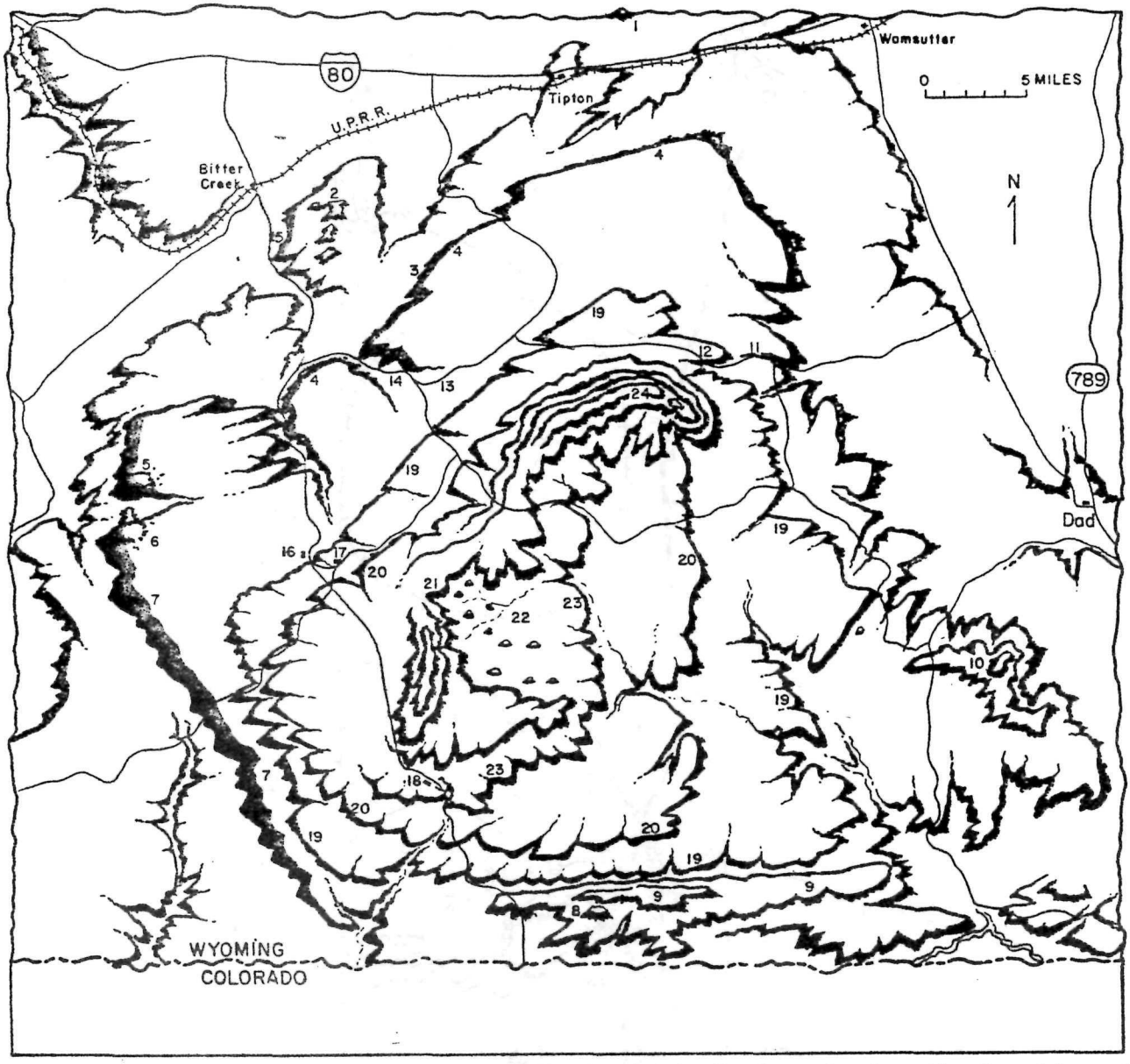


Fig. 27. Physiographic diagram of the Washakie Basin, showing the location of special land form and cultural features (from McGrew et al. 1974).

1. Tipton Butte (Eagle's Nest)
2. Table Rock
3. Cathedral Bluffs
4. Laney Rim
5. Sand Butte
6. Pine Butte (Pine Bluffs)
7. Kinney Rim
8. Powder Mountain
9. Cherokee Ridge (Cedar breaks)
10. Flat Top Mountain (Washakie Mountain)
11. Barrel Springs
12. Tadpole or Dug Springs Stage Station (ruins)
13. Fort LaClede (ruins)
14. LaClede Stage Station (ruins)
15. Big Pond Stage Station (ruins)
16. Eversole Ranch
17. Kinney Springs and Kinney Ranch (abandoned)
18. Cow Creek Ranch (abandoned)
19. Lower brown sandstone rim
20. Rim below Adobe Town rim
21. Adobe Town rim
22. Adobe Town
23. Rose-red marker rim
24. Haystack Mountain

TABLE 35. Plant voucher specimens collected in the Washakie Basin and deposited in the University of Wyoming Rocky Mountain Herbarium, Laramie, Wyoming.

SHRUBS

Artemisia pedatifida #1022
Artemisia spinescens #1024
Artemisia tridentata #1023
Atriplex confertifolia #1245
Atriplex gardneri #1021
Chrysothamnus viscidiflorus #992
Grayia spinosa #982
Kochia americana #1025
Leptodactylon pungens #979
Sarcobatus vermiculatus #1246, #974

GRASSES AND SEDGES

Agropyron desertorum #971
Agropyron smithii #1009
Bromus inermis #970
Bromus tectorum #1004
Eleocharis macrostachya #1000
Elymus cinereus #977
Hordeum brachyantherum #905
Koeleria cristata #1010, #984
Oryzopsis hymenoides #1008
Phleum pratense #972
Sitanion hystrix #1007
Spartina gracilis #1560
Stipa comata #1147, #980

FORBS

Achillea millefolium #990
Antennaria rosea
Arenaria hookerii #1003
Aster adscendens #978
Astragalus agrestis #993
Atriplex argentea #1002
Atriplex rosea #1243
Calochortus nuttallii #988
Cardaria pubescens #975
Castilleja linariaefolia #1238
Chenopodium dessicatum var. leptophylloides #1016
Chenopodium leptophyllum #1239
Cirsium pulcherrimum #1001

FORBS (Continued)

Cleome serrulata #973
Cordylanthus ramosus #1006
Cryptantha flava #986
Cryptantha kelseyana #1017
Descurainia sophia #1237
Erigeron ochroleucus #1013
Eriogonum brevicaule #983, #1233
Eriogonum cernuum #1019, #1247
Eriogonum salsuginosum #981
Eriogonum umbellatum #987
Gayophytum ramosissimum #1018
Gilia aggregata #1240
Helianthus annus #1236
Juncus balticus #998
Lepidium montanum #1244
Lupinus argenteus #968
Lupinus plattensis #1234
Machaeranthera canescens #989, #1242
Machaeranthera grindeliodes #976
Melilotus officinalis #969
Opuntia polyacantha #1026
Orobanche ludoviciana var. ludoviciana #1249
Plagiobothrys scouleri var. penicillatus #1005
Polygonum sawatchense #1020
Potamogeton pectinatus #1027
Rumex paucifolius #1449
Rumex triangulivalvis #991
Salsolia kali var. tenuifolia #1015, #1235
Sphaeralcea coccinea #994
Taraxacum laevigatum #1011
Townsendia incana #1241
Veronica peregrine var. xalapensis #997

Hell's Half-Acre Badlands

This area is a fine example of badlands that have been carved into the Wind River Formation near the headwaters of the South Fork of the Powder River. The vegetation is predominantly a sparse greasewood-shadescale community with a more mesic variant near the bottom drainageway. The plant species we collected here are listed in Table 36. The area is a major scenic attraction, and a specialized fauna is expected to exist here.

Hell's Half-Acre is but one of several badland regions in the Wyoming Basin, and is perhaps the best preserved example. We believe the badlands natural history theme should be studied further in the Basin in order to select the best example as a natural landmark. This theme should definitely be represented in the Registry. Being very colorful, they also represent an exceptional scenic attraction.

Indians used the badlands as a hunting trap and death fall for large herbivores. Consequently a number of skeletons of buffalo (Bison bison) as well as other petrified skeletons are buried in the eroded clays. Petrified wood is very common.

Location:

West of Casper; see Fig. 28. This section of badlands is located on the eastern border of the Wind River Basin, about 4 miles southeast of Waltman, Natrona County, Wyoming. The badlands cover about 960 acres of which 320 acres were given to Natrona County by the Federal Government. A portion of this acreage has been leased to a private concern for tourist concessions. T. 35-36 N., R. 85-86 W.

Ownership:

Private

Additional Information:

See McGrew et al. (1974)

Land Use:

Tourist attraction

Vulnerability:

Moderate due to fossil hunters.

Public Sensitivity:

Low

Priority:

1B

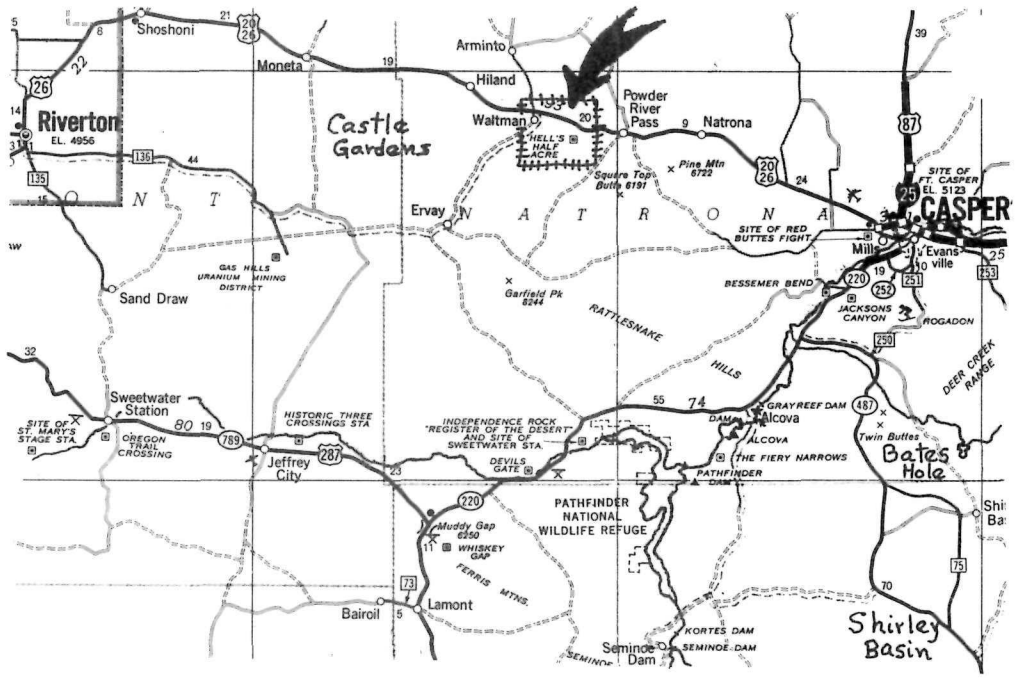


Fig. 28. Map showing the location of Hell's Half-acre, Castle Gardens, Bates Hole, and the Shirley Basin.

TABLE 36. Plant vouchers collected from Hell's Half Acre, Greasewood-saltbush complex.

SHRUBS

Artemisia cana #1311
Artemisia longifolia #579
Artemisia tridentata #618
Atriplex confertifolia #584, #1314
Leptodactylon pungens #592
Rosa woodsii #571
Sarcobatus vermiculatus #599

GRASSES AND SEDGES

Bromus tectorum #619
Distichlis stricta #1316
Koeleria cristata #1309, #620
Oryzopsis hymenoides #600
Sitanion hystrix #611
Spartina gracilis #1308
Sporobolis airoides #1302
Sporobolis cryptandrus #1301
Stipa comata #612

FORBS

Allium textile #593
Arabis cobrensis #582
Arenaria hookerii #564, #610
Artemisia frigida #617
Astragalus flexuosus #602
Atriplex dioeca #574
Calochortus nuttallii #601
Castilleja chromosa #594
Chaenactis douglasii #605
Cirsium Flodmanii #589
Comandra pallida #624
Crepis acuminata #604
Cryptantha bradburiana #603
Delphinium nelsonii #615
Descurainia richardsonii #590
Erigeron caespitosus #588
Erigeron pumilus #614
Eriogonum brevicaule #1307
Eriogonum cernuum #1310
Eriogonum salsuginosum #598, #1305
Gaura coccinea #570
Gilia congesta #616, #1306

FORBS (Continued)

Glycyrrhiza lepidota #1305
Grindelia squarrosa #1312, #578
Halogeton glomeratus #1304
Haplopappus multicaulis #607
Hymenopappus filifolius var. filifolius #586
Lappula fremontii #591
Lappula texana #625
Lepidium perfoliatum #595
Lewisia redivivia #565
Lupinus pusillus #622
Machaeranthera canescens #1313
Machaeranthera grindeliodes #575
Melilotus officinalis #580
Oenothera caespitosa var. montana #566
Oenothera pallida var. trichocalyx #567
Opuntia polyacantha #626
Phlox hoodii #627
Plantago patagonica #623
Platyschuria integrifolia #606
Psoralea lanceolata #596
Rumex triangularivalvis #573
Sedum lanceolatum #609
Sphaeralcea coccinea #569
Stephanomeria runcinata #576
Thermopsis rhombifolia #597
Trifolium gymnocarpon #577
Xanthium strumarium #1315
Zagadenus venosus #568

Grizzly Buttes Badlands

Badlands are found in only a few localities in the Wyoming Basin, including Grizzly Buttes. The badland natural history theme is very interesting, both geologically and biologically, and at least one badland natural landmark should be established in the Basin. Grizzly Buttes is a good candidate, but Hell's Half-Acre and the Washakie Basin badlands are also good possibilities.

McGrew et al. (1974) describe the geological features of Grizzly Buttes. Biologically the Buttes are characterized by sagebrush-grassland back from the badlands rim, with some spiny hop-sage (Grayia spinosa), shadscale, (Atriplex confertifolia) and woody aster (Machaerantha sp.). Near the eroding rim the habitat is very dry, with Nuttall's saltbush (Atriplex gardneri), cheatgrass, and various species of cushion plants predominating on a rather bare-clay soil surface.

The badlands proper are not characterized by plants, although a fair number of species were encountered (Table 37). Swallows, desert cottontails, ground squirrels, chipmunks, and horned toads were seen.

The vegetation was more dense in the flatter valley of the Buttes, greasewood, shadscale, and sagebrush being the more conspicuous species (see Table 37 for other plant species). Narrowleaf cottonwood (with Rosa woodsii growing underneath), Basin wildrye (Elymus cinereus), and 2 species of willow (Salix exigula and S. amygdaloides) were observed along the ephemeral stream. We have not observed Salix amygdaloides anywhere else in the Wyoming Basin, and the same can be said about the milkweed, Asclepias cryptoceras.

It should be noted that these extensive high elevation badlands in the Green River drainage of the western Wyoming Basin present a very specialized habitat for plants. Peculiar toxic metals and compounds which weather from these geologic eocene strata may contribute to the paucity of plant species. Nevertheless such plants which survive here may possess specialized physiological tolerance mechanisms. Much more botanical work needs to be pursued here and the area deserves special consideration.

Location:

About 3 miles southeast of Mountain View in Uinta County along State Highway 414 in the southwest part of the Basin. See Figs. 26, 30.

Ownership:

Mostly private, though BLM has established a picnic area on the east end.

Additional Information:

See McGrew et al. (1974), p. 283-291, who regard the area very highly for the Eocene fossils that have been found there.

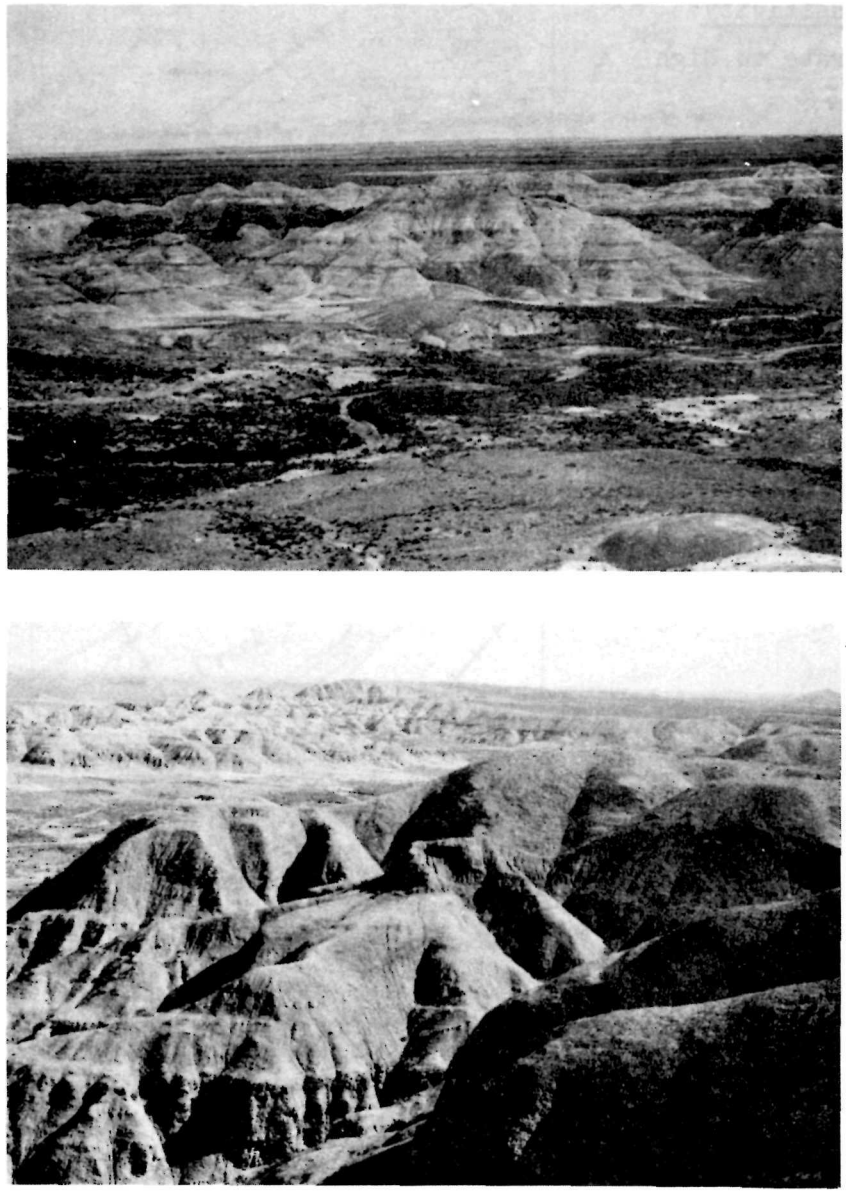


Fig. 29. Two photographs of the Grizzly Buttes Badlands.

Approximate Acreage:

4 square miles

Land Use:

Grazing; fossil hunting

Ecosystem Types Represented:

Greasewood community

Badlands

Grassland

Vulnerability:

Moderate due to fossils

Public Sensitivity:

Moderate to High

Priority:

2C

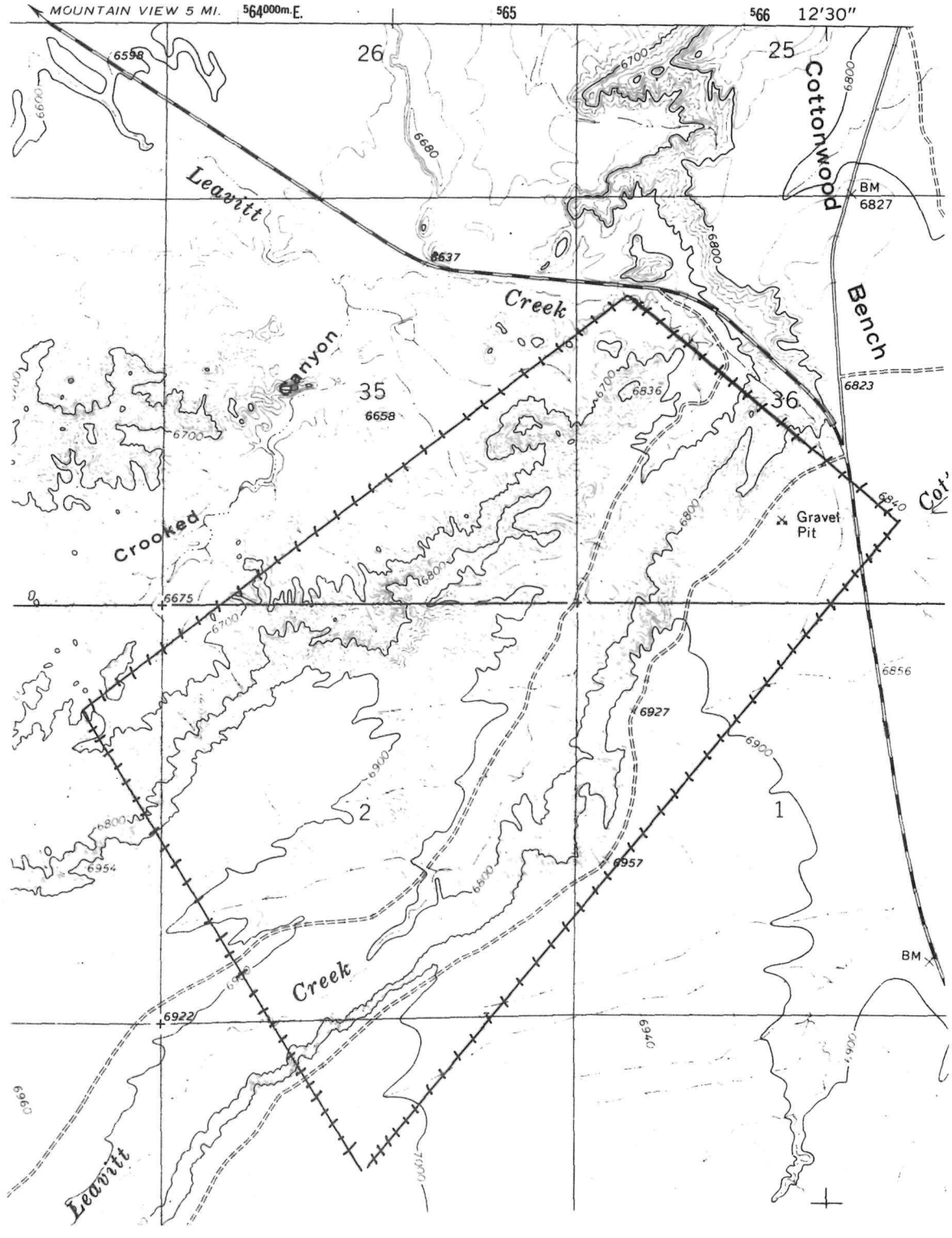


Fig. 30. Map showing the general location of the Grizzly Buttes Badlands, near Mountain View, Wyoming. Reed Reservoir Quadrangle, 1:24,000. Sections 35-36, T. 15N., R. 114W., and sections 1-2, T. 14N., R. 114W.

TABLE 37. Voucher specimens collected at Grizzly Buttes. Greasewood-Shadscale- Saltbush-Badlands Complex.

TREES

Populus angustifolia #887
Salix amygdaloides

SHRUBS

Artemisia tridentata #896
Atriplex confertifolia #917
Atriplex gardneri #916
Chrysothamnus viscidiflorus #877
Grayia spinosa
Salix exigua #891
Salix lutea #893
Sarcobatus vermiculatus #909
Tetradymia canescens #922

GRASSES AND SEDGES

Agropyron desertorum #878
Agropyron dasystachyum #882, #904, #1559
Agrostis alba #1558
Distichlis stricta
Elymus cinereus #892
Oryzopsis hymenoides #908
Sitanion hystrix #911
Spartina gracilis
Stipa comata #875

FORBS

Allium textile #920
Arenaria hookerii #923
Artemisia frigida #873
Asclepias cryptoceras #872
Castilleja flava #879
Chaenactis douglasii #912
Comandra pallida #874
Cordylanthus ramosus #907
Cryptantha flavoculata #894
Eriogonum brevicaule #921
Eriogonum cernuum #889
Eriogonum salsuginosum #906
Gilia aggregata #888
Glaux maritima #899
Glycyrrhiza lepidota #900
Halogeton glomeratus #1561

FORBS (Continued)

Hymenopappus filifolius var. luteus #876
Hymenoxys richardsonii #884
Iva axillaris #898
Juncus balticus #897
Kochia americana #915
Lupinus argenteus #885
Machaeranthera grindeliodes #925, #1562
Mentha arvense #901
Mentzelia laevicaulis #871
Opuntia polyacantha #926
Oxytropus sericea #924
Phlox multiflora var. depressa #913
Physaria australis #881
Potentilla anserina #902
Ranunculus cymbalaria #903
Stanleya viridiflora #910
Stephanomeria runcinata #918
Tanacetum nuttallii #914
Thermopsis rhombifolia #985
Veronica americana #1038
Xanthium strumarium #890
Zygadenus paniculatus #880

Fossil Fish Quarries Natural Area
(Federal Research Natural Area No. 313)

Location:

Lincoln Co.

Approximate Acreage:

120 acres

Ownership:

Public, administered by BLM (Rock Springs District Office, P. O. Box 1088, Rock Springs, Wyoming 82901).

Ecosystem Type:

Sagebrush-grassland

Elevation:

6,800-7,200 feet

Priority:

1C

This general area has now been established as a National Monument.

Beaver Rim

After travelling westward for many miles across the rolling sagebrush-grasslands of the Sweetwater Plateau, the Beaver Rim southeast of Lander provides an abrupt and spectacular change in scenery and an equally great change in flora and fauna. The escarpment complex is characterized by limber pine, mountain mahogany-douglas fir woodland, but an occasional seep from the sedimentary formations provides a special microenvironment near which we observed hummingbirds, a small mint (Mentha arvense), and goldenrod (Solidago sp.),none of which are common in the vicinity. Other plant species observed are listed in Table 38. Mule deer undoubtedly find the Rim a choice habitat in both summer and winter and the tree-dotted escarpments are the home of a variety of hawks, swallows (e.g. the violet-green swallow), falcons, and other birds. Some of the north-facing slopes are covered with a dense woodland of large Douglas fir, and ravines sometimes have patches of Basin wildrye (Elymus cinereus), cherry thickets, or even small aspen groves. Skunkbush (Rhus trilobata) is common, perhaps because of the lower elevation.

The top of Beaver Rim is a very wind-swept pebbly surface characterized by a variety of cushion plants, whereas the base is more sagebrush-grassland. Thus a diversity of habitats exists from top to bottom. The whole area presents an excellent opportunity for studies on the relationship between plant and animal species composition and geological substrata in an area of uniform precipitation.

Beaver Rim is but one of many escarpments in the Wyoming Basin, and is representative of what probably should be designated as an "escarpment (or breaks) natural history theme." These escarpments are unique habitats in the Basin,probably due to more favorable water relations for various plant species,and are undoubtedly important to the survival of some otherwise uncommon species. A separate study on the escarpments (breaks) of the Wyoming Basin is recommended.

Location:

About 30.5 miles southeast of Lander on U. S. Highway 287. See Fig. 32. Fremont Co., T. 30 N., R. 96 W.

Ownership:

Public land administered by BLM

Additional Information:

See McGrew et al. (1974), p. 325-330.

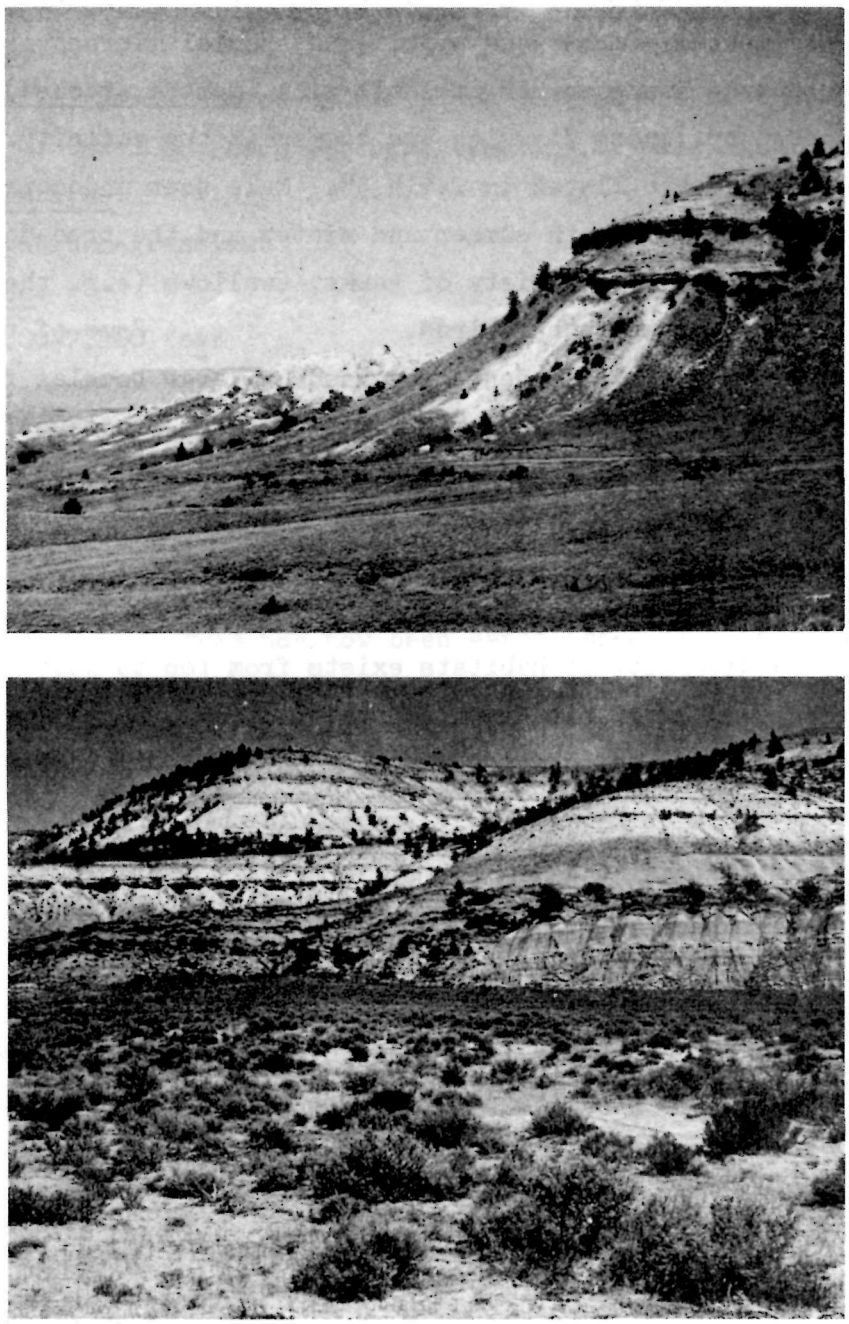


Fig. 31. Two photographs of the Beaver Rim potential natural landmark.

Approximate Acreage:

1,120 acres

Land Use:

Grazing, hunting

Ecosystem Types Represented:

Sagebrush-grassland

Limber pine - Douglas fir savanna

Badlands, escarpments

Vulnerability:

Low

Other Knowledgeable Persons:

Department of Geology
University of Wyoming

Public Sensitivity:

Low

Priority:

2C

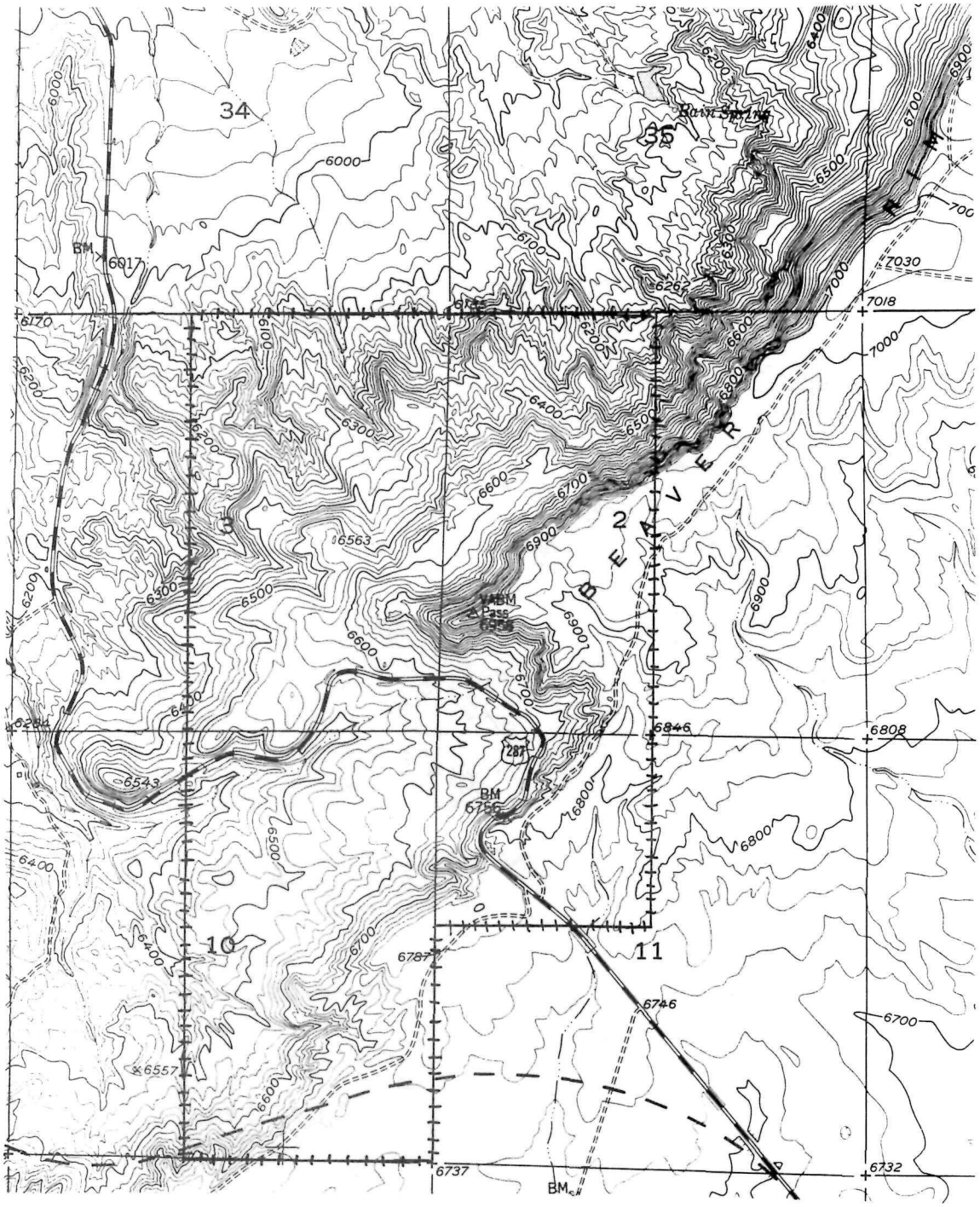


Fig. 32. Map of the Beaver Rim potential natural landmark. Red Canyon Quadrangle, 1:24,000.

TABLE 38. Plant species observed at Beaver Rim.

TREES

Juniperus osteosperma
Pinus flexilis
Populus tremuloides
Pseudotsuga menziesii

SHRUBS

Amelanchier alnifolia
Artemisia arbuscula
Artemisia cana
Artemisia tridentata
Cerococarpus montanus
Chrysothamnus sp.
Cornus stolonifera
Mahonia repens
Prunus virginiana var. melanocarpa
Rhus trilobata
Ribes cereum
Rosa woodsii
Symphoricarpos sp.

GRASSES AND SEDGES

Agropyron smithii
Agropyron spicatum
Bromus tectorum
Carex aurea
Elymus cinereus
Koeleria cristata
Oryzopsis hymenoides
Stipa comata

FORBS

Artemisia frigida
Artemisia ludoviciana
Astragalus sericoleucus
Calochortus nuttallii
Delphinium geyeri
Hymenoxys acaulis
Ivesia gordonii
Lupinus sp.
Lygodesmia
Mentha arvense
Physaria australis

FORBS (Continued)

Psoralea lanceolata
Smilacina stellata
Solidago sp.

The Sweetwater River Natural History Complex
(Split Rock, Devil's Gate, Independence Rock, and the Rattlesnake Hills)

In addition to the great historical interest of this area along the Oregon Trail, the area includes fine examples of 3 ecological natural history themes - floodplain meadows, big sagebrush-grassland, and dry conifer woodland - and several geological themes (McGrew et al. 1974). Although geologically distinct (McGrew et al. 1974), we treat the three areas together because of their proximity and ecological similarity.

Tables 39, 40, and 41 list the plant species that we collected in the sagebrush-grasslands, floodplain meadows, and limber pine woodlands, respectively, along this portion of the Sweetwater River. The vegetation of this region is a rather unique complex, mainly because of the fresh water meadows and limber pine-juniper dominated granitic mountains. Some portion of this area should definitely become a natural landmark, perhaps in the historically famous Devil's Gate area, but further study is necessary to determine the proper location.

Breeding waterfowl are common in the wet meadows of the Sweetwater, which itself has good trout populations and, according to some, the clearest, finest water in the Wyoming Basin. Transbasin diversion of water is being contemplated in Wyoming, which could adversely modify the Sweetwater River for the native flora and fauna.

Bobcats, mountain lions, golden eagles, elk, and mule deer, among other animals, have been seen in the pine-juniper woodlands nearby.

Location:

See Fig. 33. Natrona Co., T. 29 N., R. 86-87 W.

Ownership:

A mix of public and private land. Access to Split Rock is across the privately owned Split Rock Ranch.

Additional Information:

See McGrew et al. (1974), pp. 93-96 (Split Rock), pp. 85-89 (Rattlesnake Hills), and pp. 134-136 (Devil's Gate).

Land Use:

Grazing; hunting; possible State Park near Independence Rock in the future.

Ecosystem Types Represented:

Sagebrush-Grassland

Juniper Woodland

Limber pine savanna

River

Vulnerability:

Moderate to High

Public Sensitivity:

Low

Priority:

1B

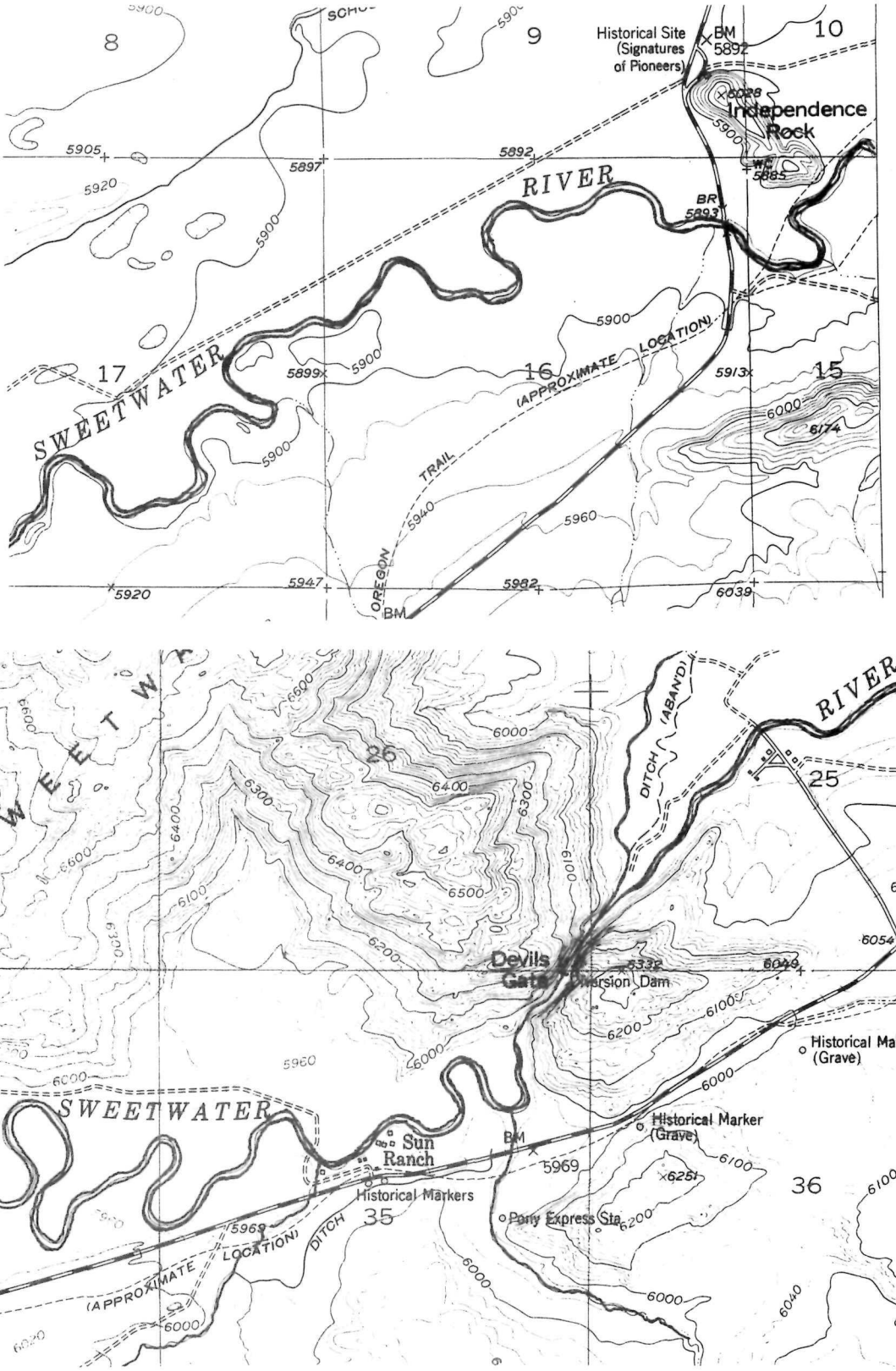


Fig. 33. Two maps of the Sweetwater River natural history complex. Independence Rock Quadrangle, 1:24,000.

TABLE 39. Vouchers collected from Rattlesnake Hills and Split Rock Big Sagebrush Grassland Association.

SHRUBS

Artemisia tridentata var. nova #545
Cercocarpus montanus #528
Leptodactylon pungens #1426

GRASSES AND SEDGES

Agropyron dasystachum #563
Agropyron spicatum #534, #1382
Bouteloua gracilis #1365
Elymus triticoides #1384
Koeleria cristata #1387, #547
Oryzopsis hymenoides #551
Sitanion longifolium #1386
Stipa comata #555

FORBS

Achillea millefolium #1329
Allium cernuum #1400
Antennaria rosea #536
Arenaria hookerii #1429
Artemisia frigida #546
Artemisia ludoviciana #1342
Aster adscendens #1393, #1398A
Aster ericoides #1360
Astragalus bisulcatus #1421
Astragalus spatulatus #544
Castilleja pallescens #553
Chaenactis douglasii #537
Chrysopsis villosa #1401
Cirsium pulcherrimum #556
Cryptantha bradburiana #559
Descurainia sophia #1423
Erigeron caespitosus #1398B
Erigeron ochroleucus #539
Eriogonum subalpinum #543, #1396
Haplopappus amerioides #550
Hymenopappus filifolius var. filifolius #535
Lappula fremontii #562
Lappula redowskii #1425
Linum lewisii #549
Lithospermum incisum #1428

FORBS (Continued)

Lithospermum ruderale #839
Lupinus argenteus #1392
Machaeranthera grindeliodes #560A
Paronychia sessiliflora #548
Penstemon laricifolius #524
Phlox multiflora var. depressa #541
Plantago patagonica #1432
Potentilla biennis #1333
Potentilla fissa #1327
Potentilla fissa #13
Potentilla hippiana #526
Sedum lanceolatum #531
Sphaeralcea coccinea #554
Woodsia scopulina #1337

TABLE 40. Vouchers collected from Split Rock and Devil's Gate Floodplain Association.

SHRUBS

Artemisia cana #1375, #630
Prunus virginiana melanocarpa #651
Rosa woodsii #662
Salix exigua #1417
Salix lutea #629
Sarcobatus vermiculatus #1419

GRASSES AND SEDGES

Bromus inermis #633
Bromus tectorum #678
Spartina pectinata #1320

FORBS

Achillea millefolium #640
Apocynum cannabinum #654
Cirsium undulatum #641
Descurainia sophia #675
Equisetum laevigatum #1341
Glycyrrhiza lepidota #1359
Heuchera parvifolia #649
Iva axillaris #631
Iva xanthifolia #1367
Juncus confusus #1324
Lactuca pulchella #1346
Lactuca scariola #1376
Lepidium densiflorum var. *macrocarpum* #661
Melilotus alba #1358
Plantago eriopoda #625A
Senecio rapifolius #1371
Smilacina stellata
Sphaeralcea coccinea #674
Tragopogon dubius #635
Trifolium hybridum #626A
Veronica peregrina var. *xalapensis* #1433

TABLE 41. Vouchers collected from Rattlesnake Hills and Split Rock and Devil's Gate Forest Communities.

TREES

Juniperus scopulorum #648
Pinus flexilis #636

SHRUBS

Artemisia cana #1352
Artemisia tridentata #672, #1378
Cercocarpus montanus #644
Chrysothamnus nauseosus #1349
Chrysothamnus viscidiflorus #1366, 638
Juniperus communis #542
Leptodactylon pungens #1437
Prunus virginiana var. melanocarpa #1323
Rhus trilobata #1319
Ribes cereum var. inebrians #655, #1328
Ribes inerme #527
Rosa woodsii #1354
Symphoricarpos oreophilus #1418, #525

GRASSES AND SEDGES

Agropyron desertorum #634
Agropyron smithii #664
Agropyron spicatum #1381
Agrostis scabra #1389
Bouteloua gracilis #1368
Carex foenea #1332
Deschampsia caespitosa #1388
Distichlis stricta #669
Elymus cinereus #628
Koeleria cristata #1369, #652
Oryzopsis hymenoides #643
Phleum alpinum #1383
Phleum pratense #1340
Stipa comata #627A
Stipa occidentalis #1385
Sporobolus cryptandrus #1380

FORBS

Achillea millefolium #538
Antennaria rosea #637
Arenaria congesta #1399

FORBS (Continued)

Artemisia frigida #1361
Artemisia ludoviciana #1379
Astragalus pectinatus var. platyphyllus #1439
Astragalus succulentus #645
Calochortus nuttallii #659
Campanula rotundifolia #1330, #658
Cardaria pubescens #1357
Castilleja chromosa var. dubia #530
Cerastium arvense #653, #1438
Chrysopsis villosa #670, #1343
Cirsium undulatum
Crepis acuminata #642
Epilobium paniculatum #1334
Erigeron divergens #1377
Erigeron pumilus #658
Erigeron ochroleucus #1431
Gaillardia aristata #1391
Grindelia squarrosa #1345
Helianthus nuttallii #1362
Heuchera parvifolia #1435
Iva axillaris #1339
Lappula redowskii #673
Lewisia redivivia #646, #1442
Lithospermum incisum #1434
Lygodesmia grandiflora #558, #639
Opuntia polyacantha
Orthocarpus luteus #1390
Potentilla fissa #650
Sisymbrium altissimum #1321
Solidago canadensis #1372
Solidago nana #1336, #1232
Taraxacum laevigatum #1395
Woodsia scopulina #657, #1374

Green River

The Green River currently has two major reservoirs (Fontenelle and Flaming Gorge), but there are still portions of the River that are candidates for wild or scenic river classification and which are relatively free from human disturbance. The River is considered one of the best trout streams in the west.

With rapid industrial development and continued agricultural needs, there is great pressure being applied to construct another reservoir and to divert some Green River water to the Powder River Basin in northeast Wyoming. The State has appropriated a large amount of Green River water that still flows out of the State. In-stream flows are not generally considered as a beneficial use in Wyoming, so any wild river is endangered.

Thus, we recommend that the Green River be studied to determine what portion might be best considered for Natural Landmark status. There is considerable sentiment for preserving that portion of the River above Fontenelle Reservoir, but that is also considered to be the best location for a trans-basin diversion project.

Location:

Sweetwater, Lincoln, and Sublette Counties in southwestern Wyoming.

Ownership:

State, public, and private

Other Knowledgeable Persons:

Dr. George Baxter
Department of Zoology
University of Wyoming
Laramie, Wyo. 82071

Wyoming Game and Fish Department
Cheyenne, Wyoming 82002

Vulnerability:

High

Public Sensitivity:

Moderate, due to conflicting interests on the desirability of wild rivers.

Priority:

1A

North Platte River

The upper North Platte River in Carbon County is one of the finest wild rivers in the west, with an excellent trout fishery and exceptional scenery. These values should be protected, but it has not yet been classified. A de facto wilderness (over 5,000 acres) exists along the River where it passes through the Medicine Bow National Forest (south of Saratoga, Wyo.).

Location:

Southeast Carbon County

Ownership:

Public (administered by the Supervisor, Medicine Bow National Forest, Laramie, Wyoming 82070), and private.

Ecosystem Types Represented:

Swift river

Douglas fir-ponderosa pine woodland

Sagebrush grassland

Willow thickets

Cottonwood woodland along river

Other Knowledgeable Persons:

Mr. James Richards
Sherman Hill Estates
Laramie, Wyoming 82070

Supervisor
Medicine Bow National Forest
Skyline Drive
Laramie, Wyoming 82070

Vulnerability:

Moderate, due to water demands for agriculture and industry.

Public Sensitivity:

Low

Priority:

1B

Muddy Creek

Located just west of the Sierra Madre Mountain Range and near the town of Baggs, this small desert stream has 2 species of uncommon fish -- the bluehead sucker and the roundtail chub. These populations are isolated and because of the demands for water, are believed to be endangered. They are both common in the Green River, but populations in small streams are a rare occurrence. Neither species is widely distributed.

Location:

About 18 miles north of Baggs in T15-16N, R91W-92W; Carbon Co.

Ownership and Water Rights:

Mostly private and State.

Additional Information:

Consult Dr. George Baxter, Department of Zoology, University of Wyoming.

Approximate Acreage:

20 miles of stream

Adjacent Land Use:

Grazing

Ecosystem Types Represented:

Greasewood - grassland

Sagebrush - grassland

Stream and adjacent wetlands

Shadscale - greasewood community

Vulnerability:

High

Public Sensitivity:

Moderate

Priority:

1B

Chain-of-Lakes

Chain-of-Lakes is a unique series of alkaline ponds that provide a fresh change in the semi-arid sagebrush-grasslands nearby. Greasewood-dominated vegetation is interspersed with the ponds, the whole area covering several square miles. The greasewood communities are as diverse in species composition as we've seen for this vegetation type, and the ponds provide a rare habitat in the area for avocets, ducks, killdeer, willets, and other waterfowl. Red-wing blackbirds were seen in the rushes, and gray-fish were observed in the water. This whole area is truly unique and should be studied as a possible representative of the alkaline depression -- alkaline pond natural history theme. Circle Bar Lake and Battle Springs Flat to the west should also be studied. Battle Spring Flats, like Separation Flats, is a huge alkaline playa dominated by greasewood.

Table 42 lists the major plant species that we collected in this area.

Location:

See Fig. 34. Sweetwater Co., T. 23 N., R. 92-93 W.

Ownership:

Private and State land mixed with Public Land administered by BLM. The Wyoming Department of Game and Fish maintains a winter range for deer and elk in the area.

Approximate Acreage:

24 square miles

Land Use:

Grazing; waterfowl habitat; deer and elk winter range.

Ecosystem Types Represented:

Greasewood-grassland

Marsh

Ephemeral ponds

Sagebrush-grassland

Vulnerability:

High due to potential for strip mining of coal.

Other Knowledgeable Persons:

Wyoming Game and Fish Department
Cheyenne or/and Rawlins

Public Sensitivity:

Low

Priority:

2A

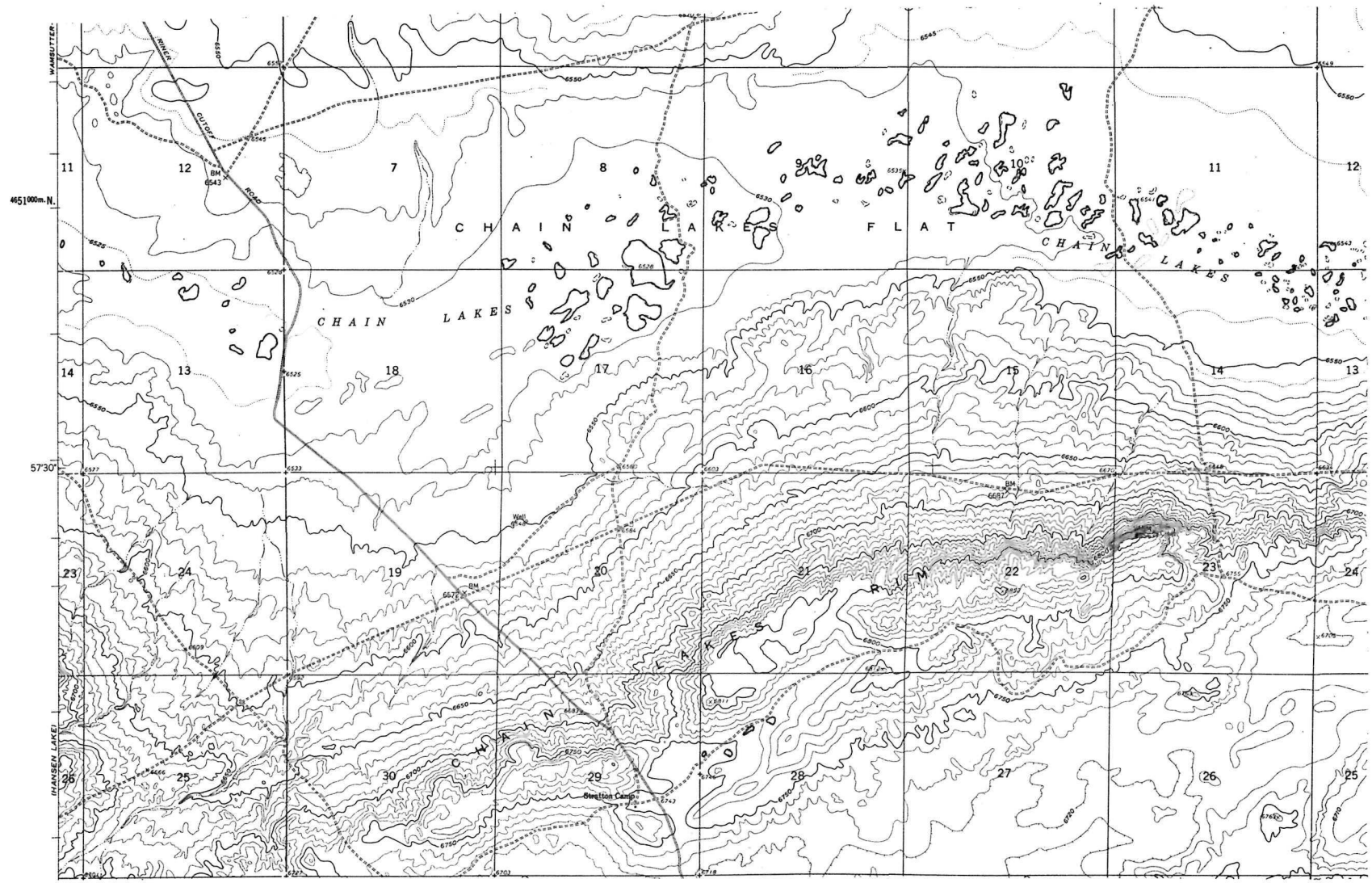


Fig. 34. Map of the Chain-of-Lakes area (Battle Spring and Hansen Lake NE Quadrangle, 1:24,000).

TABLE 42. Plant voucher specimens collected at Chain-of-Lakes: Alkali Lake

SHRUBS

Sarcobatus vermiculatus

GRASSES AND SEDGES

Agropyron smithii #1502
Distichlis stricta #1505
Hordeum brachyantherum #1506
Puccinellia airoides
Spartina gracilis

FORBS

Dodecatheon pulchellum
Eleocharis macrostachya #1504
Juncus balticus #1508
Plantago eriopoda #1507
Scirpus americanus var.
polyphyllus #1503
Scirpus nevadensis #1512
Sueda erecta
Triglochin maritima #1510

Sand Creek and Camel Rock

Located about 30 miles southwest of Laramie, this area affords a diverse range of ecosystems, including colorful sandstone cliffs, sand dunes, interesting scenic features such as Camel Rock, sagebrush-grassland, and a fresh, clear stream with relatively luxuriant floodplain vegetation. Indian petroliths have been observed.

A total of 147 plant species were collected in the area (Table 43). *Acer negundo*, *Populus angustifolium*, *Betula occidentalis*, *Cornus stolonifera*, *Acer glabrum*, and several species of willows were found along the stream. *Downingia laeta* is a very rare plant in the State, but is found along the margins of the small lakes in this area.

This area, along with Boulder Ridge, should be studied soon, since developers are sub-dividing the land for vacation homes.

Location:

See Fig. 18. Albany Co., T. 12-13 N., R. 74-75 W.

Ownership:

Mostly private

Additional Information:

See McGrew et al. (1974), p. 338-341.

Approximate Acreage:

8 square miles

Land Use:

Grazing, summer homes

Ecosystem Types Represented:

Grassland

Willow thickets

Stream

Escarpments

Vulnerability:

Moderate due to summer home construction.

Other Knowledgeable Persons:

Dr. James Steidtman
Department of Geology
University of Wyoming

Public Sensitivity:

Low

Priority:

2B

TABLE 43. Plant voucher specimens collected from Sand Creek.

TREES

Acer glabrum #726
Betula occidentalis #64
Juniperus scopulorum #63, #83
Pinus flexilis #724
Populus angustifolia #94
Populus tremuloides #45

SHRUBS

Amelanchier alnifolia #103
Amelanchier utahensis #725
Artemisia cana #100, #647
Berberis repens #48
Cercocarpus montanus #123
Chrysothamnus viscidiflorus #114
Cornus stolonifera #42
Juniperus communis #87
Leptodactylon pungens #706
Prunus virginiana var. melanocarpa #86
Purshia tridentata #79
Rhus trilobata #72, #729
Ribes aurem #80, #727
Ribes cereum var. inebrians #85
Ribes inerme #61
Symphoricarpos oreophilus #713

GRASSES AND SEDGES

Agropyron dasystachum #734
Agropyron spicatum #711
Aristida fendleriana #694
Bromus tectorum #90
Carex oreocharis #47
Carex scopulorum #102
Oryzopsis hymenoides #731, #686
Stipa comata #685, #733

FORBS

Alisma geyeri #1181
Antennaria parviflora #108
Antennaria rosea #689
Arenaria hookerii #75, #705
Artemisia frigida #104

FORBS (Continued)

Astragalus agrestis #75
Astragalus drummondii #84
Astragalus shortianus #112
Astragalus spatulatus #49, #710
Balsamorhiza sagittata #118
Besseya wyomingensis #98
Castilleja flava #714, #69
Cerastium arvense #107
Chaenactis douglasii #697
Cheilanthes feei #65, #716
Chenopodium atrovirens #741
Cirsium canescens #701
Comandra pallida #57, #684, #740
Cryptantha bradburiana #122, #721
Cystopteris fragilis #66
Delphinium geyeri #700
Delphinium nelsonii #106
Descurainia richardsonii #82
Descurainia sophia #738, #742
Downingia laeta #1178
Epilobium ciliatum #735
Equisetum arvense #76
Erigeron nematophyllus #105, #720
Eriogonum alatum #687
Eriogonum cernuum #715
Eriogonum flavum #690
Erysimum asperum #115
Euphorbia robusta #117, #704
Franseria acanthicarpa #1180
Gaura coccinea #683
Gilia spicata #120
Haplopappus amerioides #709
Heuchera parvifolia #52, #703
Hydrophyllum fendleri #53
Hymenoxys acaulis #692
Iris missouriensis #111
Juncus balticus #67
Lappula fremontii #688
Lappula redowskii #92
Lesquerella ludoviciana #702
Linum australe #1176
Linum lewisii #51
Lithophragma bulbifera #50
Lithospermum incisum #1428
Mentzelia multiflora #1173

TABLE 43. (Continued)

FORBS (Continued)

Mentzelia speciosa #1174, #736
Mertensia humilis #109, #739
Opuntia polyacantha
Paronychia sessiliflora #691
Penstemon humilis #730
Penstemon laricifolius var. *exilifolius* #699
Penstemon nitidus #73
Penstemon strictus #719, #693
Phacelia denticulata #732, #93
Phlox hoodii #695
Phlox multiflora var. *depressa* #95
Physaria australis #78
Plantago eriopoda #81
Polygonum amphibium #1177
Potentilla fissa #68
Potentilla hippiana #687
Ranunculus cymbalaria #54
Ranunculus ranunculinus #89, #70
Rorippa sinuata #1179
Rumex venosus #46
Scutellaria brittonii #119
Sedum lanceolatum #77
Senecio canus #110, #718
Smilacina stellata #61, #698
Stephanomeria runcinata #707
Viola adunca #58
Viola nuttallii var. *vallicola* #89
Zygadenus venosus #728

Pinedale Glacial Fields and Fremont Lake

Characterized by big sagebrush-bitterbrush-grasslands and ravines and upper slopes wooded with limber pine, aspen, douglas fir and some blue spruce, the Pinedale Glacial Fields provide a range of habitats for many plants and animals. The area, including Fremont Lake, is a classical example of land sculpturing by glaciers, and the moraines provide a habitat for several species not commonly encountered in the Wyoming Basin, e.g. blue spruce, Betula occidentalis, Rubus deliciosus, and Actea rubra. We observed more different species of birds here than at any other locality.

The Pinedale Glacial Fields encompass a very large area, and we have had time to study primarily that area near Fremont Lake. Although this is an exceptionally fine area, other parts of the Fields should be studied also before deciding on a natural landmark. Bogs and marshes also exist in the area.

Tables 44 and 45 list the plant species that we have collected on the moraines near Fremont Lake.

Location:

Just northeast of the town of Pinedale, Wyoming; see Fig. 37.
Sublette Co., T. 34-35 N., R. 108-109 W.

Ownership:

Mostly on the public lands of the Bridger National Forest and the Bureau of Land Management.

Additional Information:

See McGrew et al. (1974); Supervisor, Wind River National Forest, Pinedale.

Approximate Acreage:

20 square miles

Current Land Use:

Grazing, recreation.

Ecosystem Types Represented:

Sagebrush-bitterbrush-grassland
Limber pine savanna
Douglas fir forest
Deep, freshwater lake

Vulnerability:

Low

Public Sensitivity:

Low

Priority:

2C

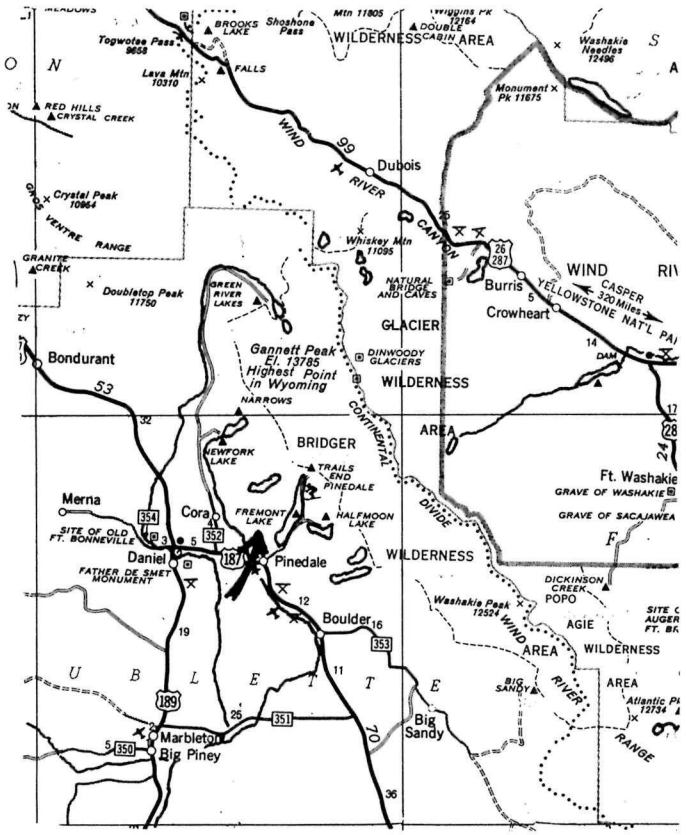


Fig. 37. Map showing Fremont Lake

Fig. 38. Photograph of Fremont Lake with glacial moraine in foreground.

TABLE 44. Plant voucher specimens collected from the Pine Forests of the Pinedale Glacial Fields.

TREES

Abies lasiocarpa #1549
Betula occidentalis #1531
Juniperus scopulorum #811, #1546
Picea pungens #1547
Pinus contorta #823
Populus tremuloides #822

SHRUBS

Cornus stolonifera #1549
Eleagnus commutata #818
Lonicera involucrata #1539
Salix scouleriana #1541
Shepherdia canadensis #1543
Prunus virginiana var. *melanocarpa* #845

GRASSES AND SEDGES

Phleum alpinum #864

FORBS

Actaea rubra #1544
Aquillegia caerulea #859
Arnica sororia #834
Epilobium angustifolium #1542
Eriophyllum lanatum #869
Helenium hoopesii #868
Heuchera parvifolia #1519
Lomatium dissectum var. *multifidum* #808
Lomatium simplex #806
Melilotus officinalis #817
Pedicularis groenlandica #803
Penstemon strictus #851
Polygonum bistortoides #862
Smilacina stellata #825
Thalictrum sparsiflorum #866
Trollius laxus #861
Veronica americana #865

TABLE 45. Plant voucher specimens collected from the Big Sage-Bitterbrush-Grasslands Association of the Pinedale Glacial fields.

SHRUBS

Artemisia tridentata #843
Berberis repens #824
Chrysothamnus viscidiflorus #850
Leptodactylon pungens #812
Purshia tridentata #849
Rosa woodsii #831
Symphoricarpos oreophilus #841

GRASSES AND SEDGES

Agropyron desertorum #844
Agropyron spicatum #854, #1533
Agrostis alba #810
Bromus inermis #1535, #847
Bromus tectorum #809
Carex athrostachya #813
Elymus cinereus #848
Koeleria cristata #846
Oryzopsis hymenoides #819
Phleum pratense #814
Sitanion longifolium #816
Stipa comata #845

FORBS

Achillea millefolium #826
Antennaria rosea #830
Arabis drummondi #833
Arenaria congesta #821
Berteroa incana #807
Calochortus nuttallii #1538
Castilleja flava #820
Comandra pallida #837
Crepis acuminata #805
Crepis runcinatus #1537
Erigeron caespitosus #821
Erigeron ochroleucus #853
Eriogonum subalpinum #842
Geum triflorum var. ciliatum #836
Gilia aggregata #804
Helianthella quinquenerius #1540
Lappula redowskii #852

FORBS (Continued)

Lupinus argenteus #835
Opuntia polyacantha #856
Orobanche fasciculata #1545
Phlox longifolia #832
Potentilla arguta var. convallaria #838
Sedum lanceolatum #857
Selaginella densa #1534
Zygadenus paniculatus #828

Moneta Phragmites Marsh

Fed by springs, this marsh is dominated by Phragmites communis, a tall grass that has been collected only a few times in the Wyoming Basin. This was the only phragmites marsh we observed during the course of travelling several thousand miles in the Basin. Similar to the Chain-of-Lakes, the Moneta marsh is a rare oasis in an otherwise semi-arid sagebrush grassland. Yellow-headed and red-winged blackbirds were observed, along with killdeer and mule deer. Although the marsh itself has quite fresh water from the springs, and is not as alkaline as the Chain-of-lakes, the adjacent area is a good example of greasewood-sagebrush-grassland. In addition to these species, silver sage and Basin-wildrye are common.

Location:

See Fig. 36. Fremont Co., T. 35 N., R. 91 W., Sec. 35.

Ownership:

Unknown, possibly private. The area is fenced.

Fig. 35. The Moneta Phragmites Marsh, also known as the Buffalo Wallows.

Approximate Acreage:

100 acres

Land Use:

Grazing, waterfowl, source of water.

Ecosystem Types Represented:

Spring

Phragmites marsh

Greasewood-grassland

Sagebrush-grassland

Alkaline meadow

Vulnerability:

High

Public Sensitivity:

Low

Priority:

2A

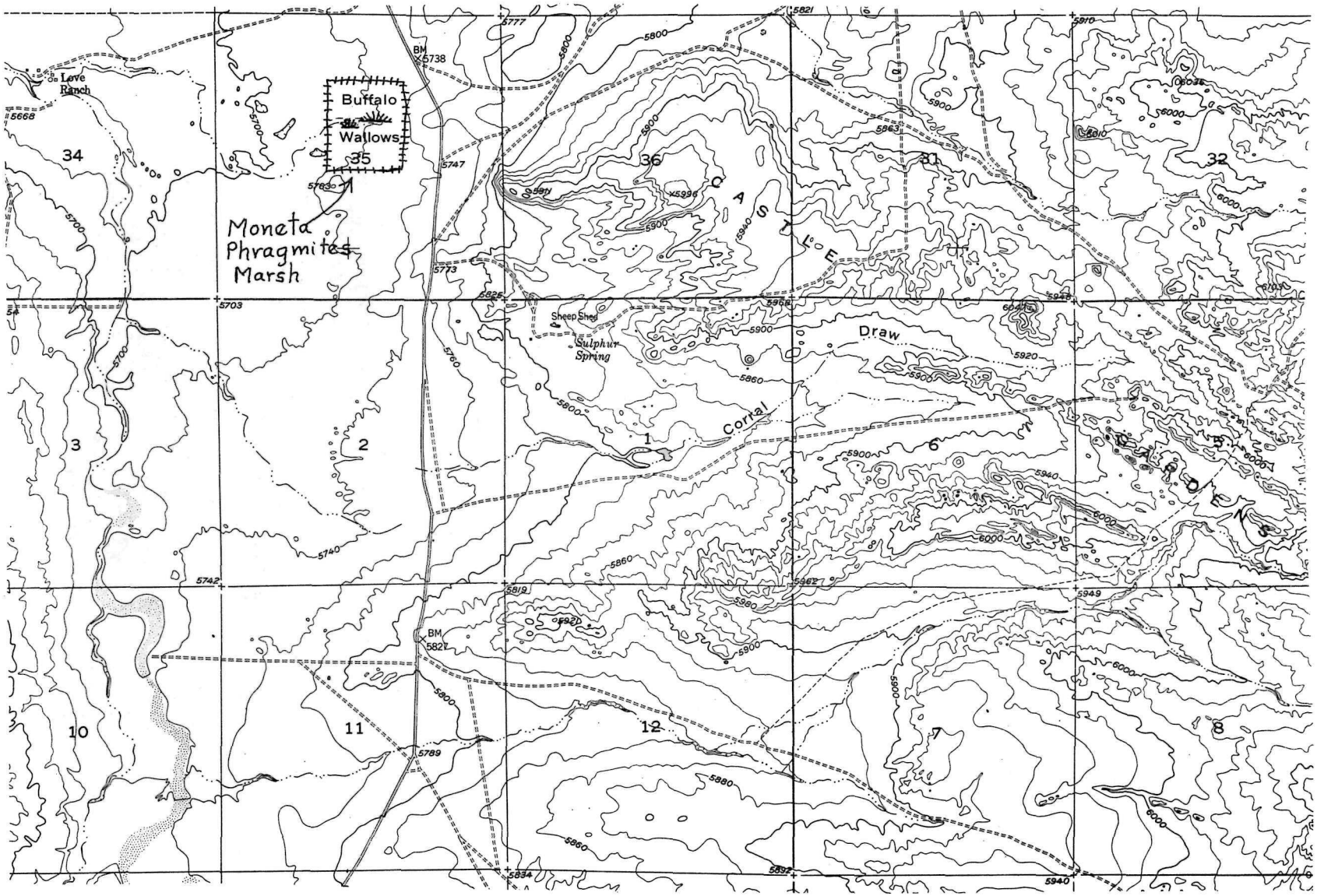


Fig. 36. Map of the Castle Gardens and Moneta Phragmites Marsh potential natural landmarks. The Marsh is also known as the Buffalo Wallows. (Moneta and 71 Reservoir Quadrangles, 1:24,000)

Castle Gardens

Castle Gardens is a heavily dissected hogback ridge located east of Riverton and south of Moneta. Though not large, the area is a scenic attraction for picnickers today,as it was for the Indians prior to settlement. Petroglyphs are common on the rocks.

The unique topography has created a unique environment, and consequently some of the plants and animals found here are uncommon for many miles in all directions. Characteristic plant species include limber pine, Rocky Mountain juniper, ground juniper, silver sage, and golden banner. Chipmunks and flycatchers were seen that are essentially non-existant in the adjacent sagebrush-grasslands. As with some other special geologic formations, Castle Gardens is a biological island in the Basin.

Table 46 lists the species we observed in Castle Gardens. A rattlesnake was observed.

Location:

See Fig. 36. Fremont Co., T. 34-35 N., R. 89-90 W. and adjacent Natrona Co.

Ownership and land usage:

Public, administered as an archeological site and recreational area by BLM.

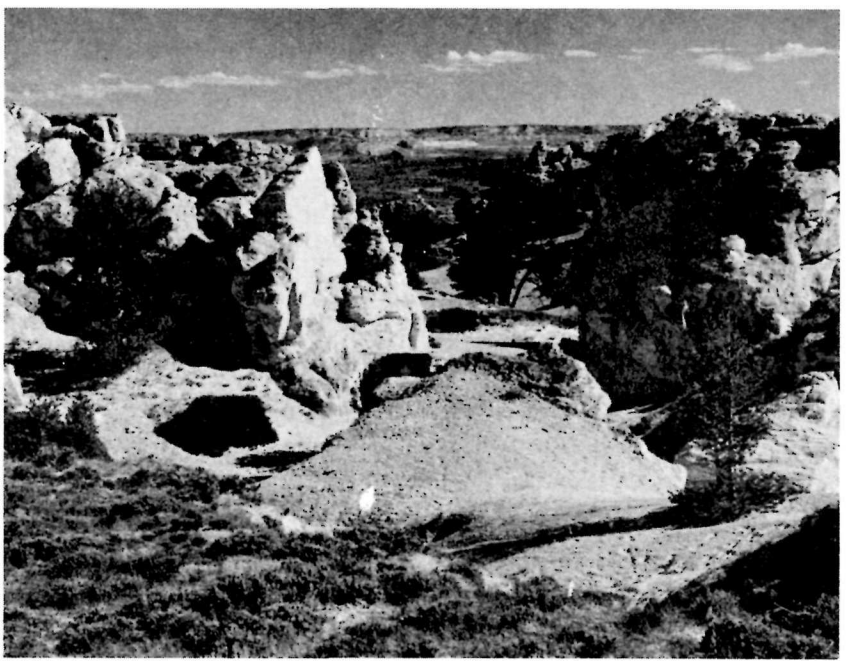


Fig. 39. Photograph of the Castle Gardens area.

Approximate Acreage:

200 acres

Land Use:

Grazing, archeological site

Ecosystem Types Represented:

Limber pine-juniper-savanna

Sagebrush-grassland

Escarpements

Vulnerability:

Moderate

Other Knowledgeable Persons:

State Archeologist
University of Wyoming, Laramie

Archeologist
State BLM Office, Cheyenne

Public Sensitivity:

High, due to petroglyphs

Priority:

1A

TABLE 46. Common plants observed at Castle Gardens

TREES

Juniperus scopulorum
Pinus flexilis

SHRUBS

Artemisia cana
Artemisia tridentata
Chrysothamnus nauseosus
Chrysothamnus viscidiflorus
Juniperus communis
Leptodactylon pungens

GRASSES

Bromus tectorum

FORBS

Achillea millifolium
Allium textile
Antennaria sp.
Arenaria hookeri
Astragalus sp.
Commandra pallida
Descurainia sophia
Erysimum asperum
Lapula redowski
Machaeranthera sp.
Penstemon linearis
Psoralea sp.
Zygadenus venosus

Little Colorado Desert

The Little Colorado Desert is an area comprising approximately 200 square miles of desert-like vegetation and interesting erosional features. Saltbush (Atriplex gardneri), and two species of sagebrush (Artemisia pedatifida and Artemisia tridenta) are found commonly. This whole area probably cannot be designated as a natural landmark, but we believe that portions of it are sufficiently well-preserved ecologically to be so designated. Further studies are required. Its major values are in its desert-like characteristics which are found only in a few other areas of the Basin.

Table 47 lists plant species that we have collected or seen in the area. The plant Eriastrum wilcoxii was found here, which was a new record for the State.

Location:

See Fig. 24. Northwest Sweetwater Co. and Southcentral Sublette Co.

Ownership:

Mostly public land administered by BLM

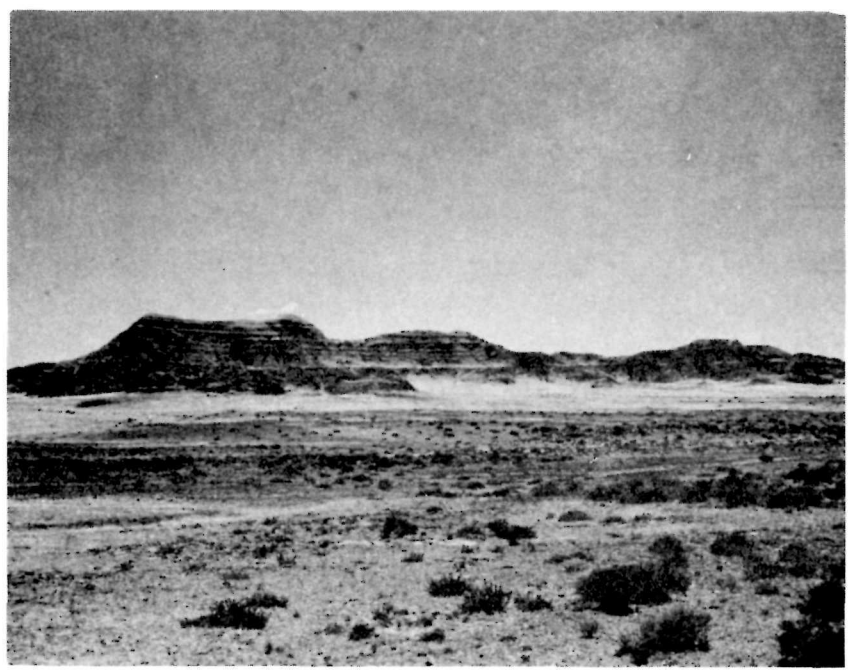


Fig. 40. The Little Colorado Desert.

Approximate Acreage:

100 square miles

Land Use:

Grazing

Ecosystem Types Represented:

Sagebrush-grassland

Greasewood-grassland

Escarpments

Shadscale shrubland

Other non-forest desert associations

Vulnerability:

Low

Public sensitivity:

Low

Priority:

3B

TABLE 47. Plant voucher specimens collected from the Little Colorado Desert Badlands Association.

SHRUBS

Artemisia pedatifida #787
Artemisia tridentata var. arbuscula #792, #1529
Artemisia tridentata var. nova #1530
Atriplex confertifolia #793
Atriplex gardneri #800
Chrysothamnus viscidiflorus #795
Eurotia lanata
Grayia spinosa #790
Leptodactylon pungens #776
Sarcobatus vermiculatus #789
Tetradymia nuttallii #791

GRASSES AND SEDGES

Agropyron dasystachyum #797
Agropyron desertorum #749, #757
Agropyron smithii #767
Bromus inermis #761
Elymus triticoides #755
Hordeum jubatum #766
Koeleria cristata #774
Oryzopsis hymenoides #794
Sitanion hystrix #748, #798
Stipa comata #796

FORBS

Allium textile #772
Arenaria hookerii #788
Astragalus flavus #775
Camissonia scapoidea #778
Cardaria pubescens #765
Chenopodium berlandieri #763
Cleome serrulata #762
Cryptantha kelseyana #773
Eriastrum wilcoxii #752 - state record
Eriogonum cernuum #782
Eriogonum ovalifolium #780
Eriogonum salsuginosum #770
Erysimum argillosum #779
Gilia leptomeria #781
Lappula redowskii #756

FORBS (Continued)

Lupinus argenteus #769
Medicago falcata #753
Medicago sativa #760
Melilotus officinalis #754
Mentzelia pumila #750
Opuntia polyacantha #801
Phlox sp.
Salsola kali var. tenuifolia #764, #784
Sisymbrium altissimum #759
Sphaeralcea coccinea #768
Stephanomeria runcinata #771
Tanacetum capitatum #785
Townsendia incana #799
Tragopogon dubius #758

Rattlesnake Creek Oak Woodland

Location:

Rattlesnake Creek watershed on the northwest side of Elk Mountain, Carbon Co., sections 6 and 7, T. 19 N., R. 81 W. and sections 1, 11, and 12, T. 19 N., R. 82 W.

Ownership:

Private (including the Union Pacific Railroad) and public, administered by BLM.

Approximate Acreage:

1,000 acres

Land Use:

Grazing, hunting

Ecosystem Types Represented:

Gambel's oak woodland

Stream

References:

Jacoby, Pete W. 1971. Interrelationships of vegetation and environmental factors on a mountain watershed in southeastern Wyoming. Ph.D. dissertation (Plant Science Division), University of Wyoming. 125 p.

Vulnerability:

Low

Public Sensitivity:

Low

Priority:

1C

Twin Groves Aspen Atoll

On some of the mountain foothills scattered aspen groves are characteristic. Such is the case with Twin Groves, located on the northern end of the Sierra Madre Mountain Range. These groves provide a special habitat for a diversity of species (See Table 48), and are unique ecological phenomena for several reasons. They are known to occur on more mesic sites, and thus represent a special environment in the foothills.

One ecological feature of special interest is the "atoll" appearance of some groves caused by the accumulation of drifting snow in the center. Being located in the open, wind-swept foothills, the windward edge of the groves sometimes acts as a snowfence and causes snow to accumulate in the center of the "aspen atoll". Such large amounts of snow accumulate in these open centers that the growing season is shortened sufficiently to prevent tree establishment or re-establishment. Thus a donut-shaped aspen grove is created. Between the opening and the taller trees on the edge is a band of stunted, twisted aspen. The explanation for this middle band is presently not known. This question and others, plus the unique island habitats created by the groves, has led us to recommend the inclusion of a representative example such as Twin Groves in the Natural Landmark Registry. The groves are currently grazed lightly by cattle, but they could be cut or burned at anytime. Their scientific value should be formally recognized.

Location:

See Fig. 41. Carbon Co., T. 16 N., R. 87 W., Sec. 10 & 15.

Ownership:

Not now known, but probably either USFS or private.

Approximate Acreage:

2 square miles

Land Use:

Grazing, hunting

Ecosystem Types Represented:

Aspen groves

Sagebrush-grassland

Non-alkaline meadow

Vulnerability:

Low

Public Sensitivity:

Low

Priority:

2C

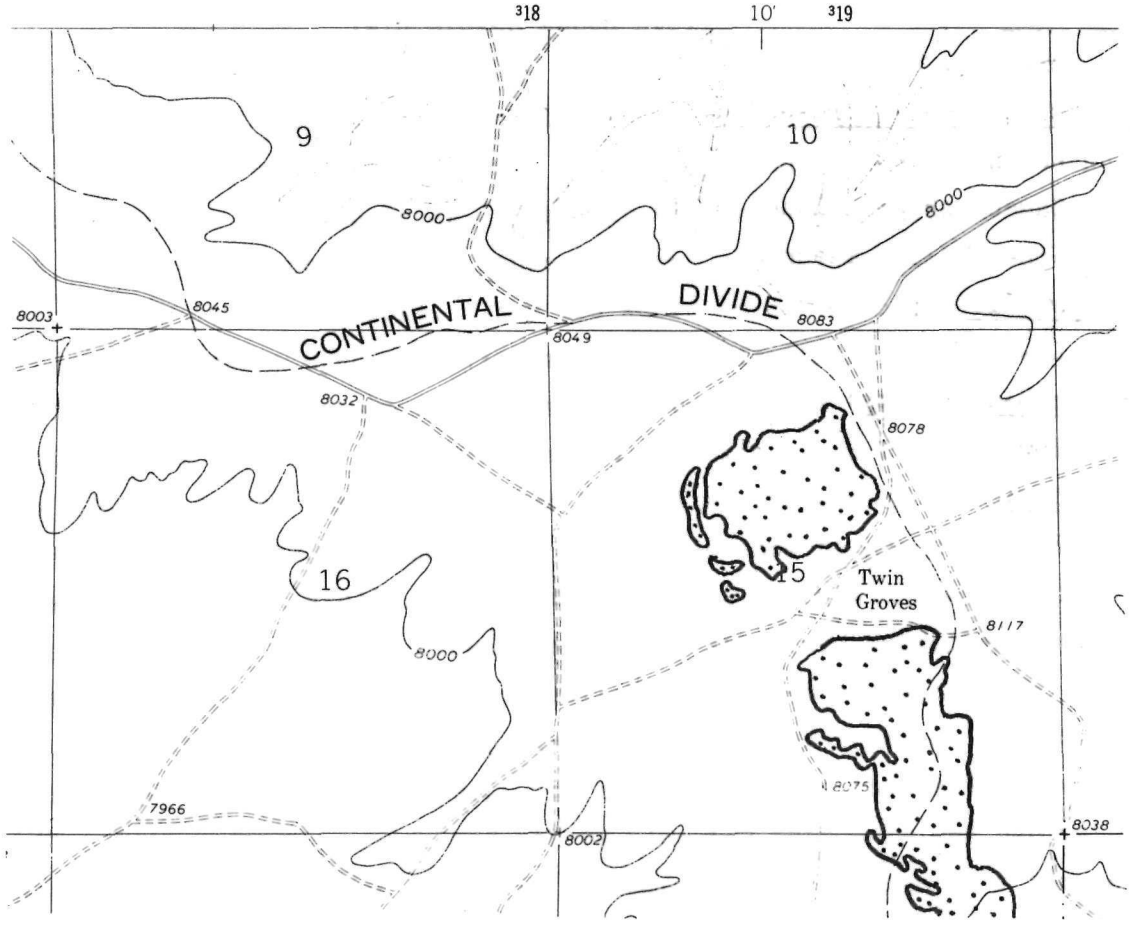


Fig. 41. Map showing the location of the Twin Groves potential natural landmark (Divide Peak Quadrangle, 1:24,000).

TABLE 48. Plant vouchers specimens collected from Twin Groves Aspen Atolls.

TREES

Pinus contorta #1450
Populus tremuloides #1485

SHRUBS

Artemisia cana #1464
Juniperus communis #1451
Salix scouleriana #1452
Symphoricarpos oreophilus #1482

GRASSES AND SEDGES

Agropyron dasystachyum #1475
Bromus breviaristatus #1477
Festuca idahoensis
Leucopoa (Hesperochloa) kingii #1477
Phleum pratense #1478
Stipa comata #1471
Juncus balticus #1465

FORBS
Achillea millefolium #1480
Alyssum alyssoides #1468
Antennaria rosea #1489
Arenaria congesta #1479
Arnica fulgens #1462
Astragalus agrestis #1492
Daucus carota #1473
Delphinium bicolor #1484
Epilobium adenocaulon #1453
Erigeron eatoni #1483
Eriogonum subalpinum #1490
Galium boreale #1486
Geranium richardsonii #1491
Geum triflorum var.
ciliatum #1460
Iris missouriensis #1454

Lewisia rediviva #1487
Lupinus argenteus #1470
Oxytropis sericea #1461
Penstemon confertus #1459
Phlox multiflora var.
depressa #1472

FORBS (Continued)

Polygonum bistortoides #1458
Potentilla pulcherrima #1467
Tragopogon dubius #1469

ANALYSIS OF THE POTENTIAL NATURAL LANDMARKS

The establishment of natural areas is an activity that has been highly recommended by scientists, educators, and conservationists (Moir 1972, Franklin et al. 1972, Schmidt and Dufour 1975, and others), but nevertheless has not kept pace with rural development. Consequently, natural areas are becoming not only more difficult to find but also more difficult to maintain. Furthermore there is the problem of convincing land developers and politicians that natural area values offset the economic losses that may result, at least temporarily, from natural area establishment. By in large, the American public has not come to recognize natural areas as a reservoir of information, much like the books in a library. While even the illiterate would not normally promote the destruction of our libraries, the information reservoir in natural areas is constantly threatened, even in relatively less developed regions such as the Wyoming Basin.

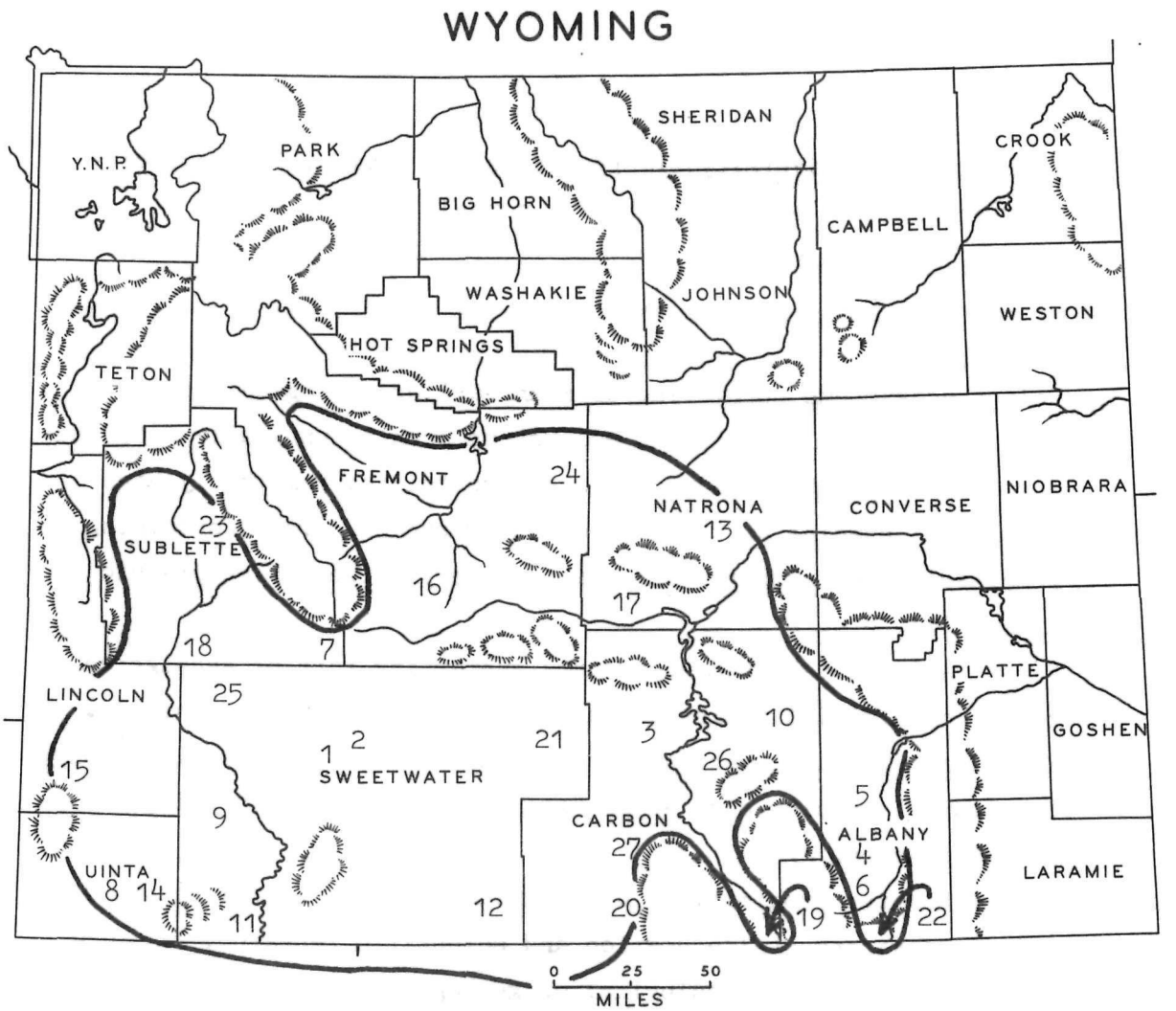
During the last 3 years we have studied a variety of natural areas in the Wyoming Basin. We could easily argue that all of these areas should be protected immediately, primarily because all have value and combined they occupy a small percentage of the Basin. However, the mechanics of natural area establishment dictate that priorities be established. In this section we provide a series of recommendations, based on our analysis of 1) the representation of natural history themes in the Wyoming Basin, 2) the threats to these potential natural landmarks, 3) rare or endangered species, and 4) the potential national significance of each area. National significance is not easily defined, but the National Park Service has listed the following as examples of areas that would be appropriate ecological Natural Landmarks:

1. Remnants of vanishing ecosystem types maintaining a degree of integrity.
2. Best representative examples of more common ecosystems, associations or biomes found in the country, physiographic province, State or other geographically defined areas other than strictly local. Best could reflect such factors as basic integrity relative to other representative examples; size; successional maturity or age; lack of appreciable past disturbances, cultural intrusions or human

manipulations; diversity of species and/or communities; capacity as a protectable ecosystem (buffer zones); etc.

3. Relict ecosystems persisting from an earlier geological time.
4. Distributionally significant ecosystems such as unusually outstanding major ecosystem disjuncts, areas containing remarkably high numbers of species at the edge of their ranges, areas containing remarkably high numbers of species of very different geographic affinities, etc.
5. Essentially undisturbed ecosystems supporting rare or endangered plants or officially listed "threatened" and endangered animals.
6. Essential natural habitats or seasonal havens of great importance to a faunal species such as an essential breeding, wintering or migration area.
7. Scenic beauty; proximity to urban areas as a factor reflecting its role in environmental education and scientific research; sites of important documented ecological or geological research and discovery; etc., are important factors to be considered in conjunction with, but not in lieu of, the previous examples of significance.[1]

[1] Long distance vistas are a special feature of the wide-open spaces of the Wyoming Basin and provide a special opportunity and challenge, i.e. even though industrial developments do not occur directly on a natural landmark they may lead to its degradation because of scenic intrusions.



A county map of Wyoming showing the approximate location of the Wyoming Basin and areas of special biological value. The numbers on the map identify the following areas (relevant page number in parentheses):

1. Killpecker Sand Dunes (p. 93)
   Boar's Tusk Sand Dune Natural Area (p. 97)
2. Steamboat Mountain (p. 99)
3. Sand Dune Natural Area (p. 98)
4. Big Hollow (p. 106)
5. Laramie High Plains Natural Area (p. 113)
6. Laramie Plains Natural Area (p. 114)
7. Oregon Trail Sagebrush-grassland (p. 115)
8. Alkali Desert Shrub Natural Area (p. 119)
9. Northern Desert Shrub-Sagebrush Natural Area (p. 120)
10. Bates Hole - Shirley Basin Petrified Forest (p. 121)
    Petrified Forest Natural Area (p. 129)
11. Henry's Fork Fault Juniper Woodland (p. 130)
12. Washakie Basin (p. 136)
13. Hell's Half-acre Badlands (p. 142)
14. Grizzly Buttes Badlands (p. 146)
15. Fossil Fish Quarries Natural Area (p. 152)
16. Beaver Rim (p. 153)
17. Sweetwater River Complex (p. 158)
18. Green River (p. 164)
19. North Platte River (p. 165)
20. Muddy Creek (p. 166)
21. Chain-of-Lakes (p. 167)
22. Sand Creek & Camel Rock (p. 171)
23. Pinedale Glacial Fields and Fremont Lake (p. 175)
24. Moneta Phragmites Marsh (p. 180)
    Castle Gardens (p. 183)
25. Little Colorado Desert (p. 186)
26. Rattlesnake Creek Oak Woodland (p. 189)
27. Twin Groves Aspen Atoll (p. 190)

Figure 42

Representation of Natural History Themes

In Table 1 (p.19) we presented our classification of the natural history themes and ecosystem types that occur in the Wyoming Basin. We believe that a primary goal should be to have at least one natural area of each ecosystem type. A more immediate goal, however, is to 1) establish natural areas with themes that are unusual and 2) locate natural areas that include themes not represented in those areas we have studied.

With regard to the first task, we believe that the following themes or ecosystem types are relatively unique in the Wyoming Basin and merit special attention:

1. Isolated desert mountains
2. Sand dunes
3. Sedge bogs
4. Phragmites marshes
5. Pinyon pine - juniper woodland
6. Gambel's oak woodland
7. Non-alkaline meadows
8. Rapid, clearwater, gravel bottom streams and rivers
9. Springs

The above are not ranked in order of importance. Any potential Natural Landmark with one of the above should be given special attention.

The second task is to identify themes not represented in the potential natural landmarks that we have listed. To the best of our knowledge the following are not represented:

1. The montane coniferous forests (Engelmann spruce, subalpine fir, and lodgepole pine), and associated mountain meadows and grasslands. The Ferris Mountains, Green Mountains, Shirley Mountains, and Elk Mountain have these vegetation types.
2. Ponderosa pine woodland. Areas near Laramie Peak, the North Platte River above Saratoga, and south of Flaming Gorge Reservoir have potential.
3. Blue spruce-alder-cottonwood-willow floodplain woodland. The Wind River above Dubois has potential.
4. Low sagebrush grassland (see p. 58).

5. Bluebunch wheatgrass grassland; this would be found on the desert mountains.
6. Gambel's Oak Woodland. The Rattlesnake Creek watershed on Elk Mountain has potential; see Jacoby (1971) and p. 189.
7. Lakes, streams, and rivers are not well represented and should be studied further.
8. Sedge bogs. Ice Slough, now identified with an historical marker near Sweetwater Crossing, is a possibility.

Efforts should be made soon to locate good natural areas that have these ecosystem types. Some of the areas we have recommended are large and may contain one or more of the above, e.g. The Washakie Basin or Bates Hole.

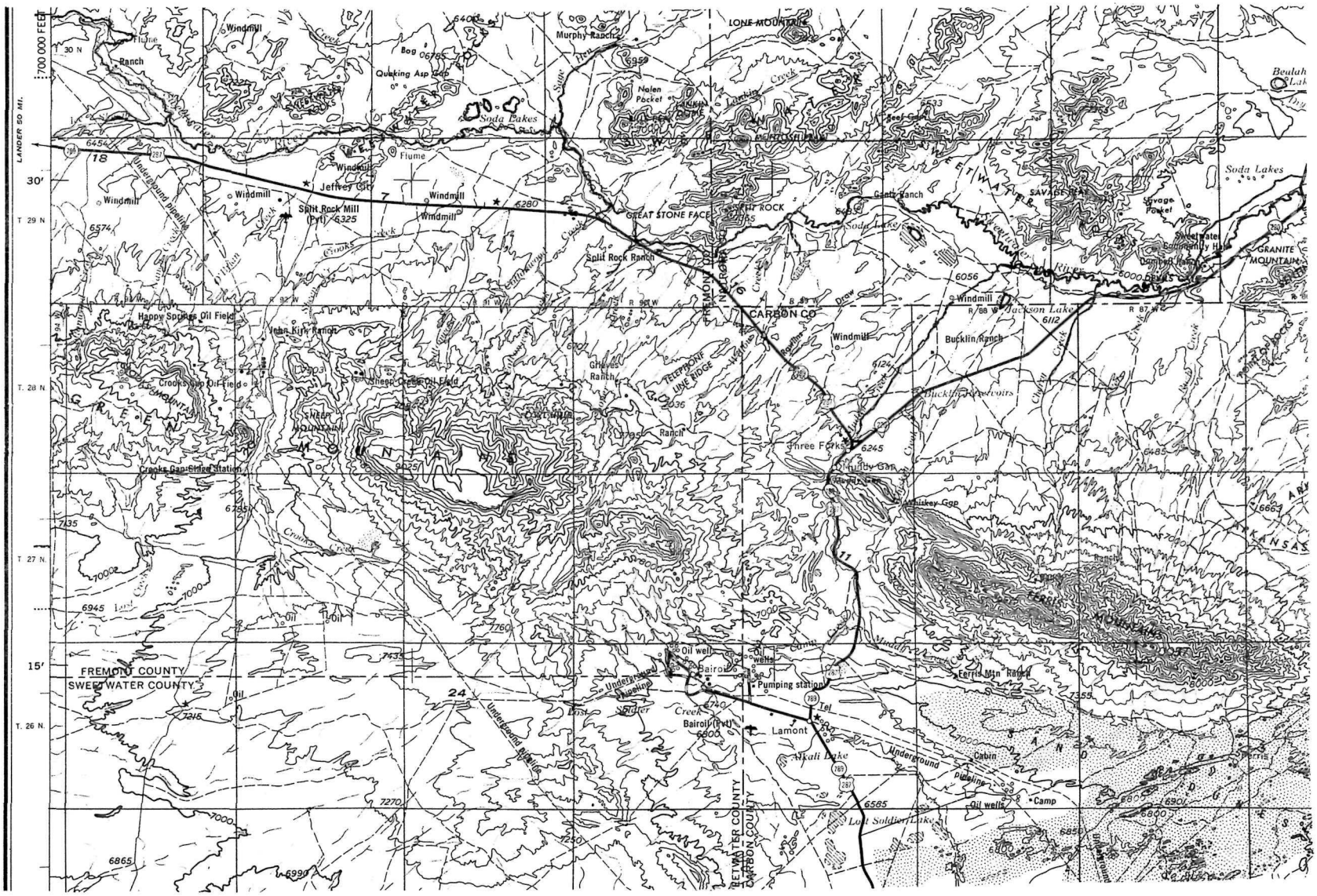


Fig. 43. Map showing the Ferris Mountains, Green Mountains, and Sweetwater Rocks. (Casper Quadrangle, 1:250,000)

Endangered Natural History Themes

Another criterion for deciding which potential natural landmarks should be established first is the degree to which the area is threatened by new developments. In the Wyoming Basin these developments include surface mining for coal and uranium; spraying of sagebrush with herbicides; new roads associated with oil and gas drilling, recreational developments, and mineral exploration; land sub-divisions for new settlements, power plants, and industrial facilities; new impoundments which create reservoirs and obliterate floodplain ecosystems; pipelines and powerlines; and the conversion of native rangeland to irrigated agricultural land. All of these types of activities are threats to natural areas in general, but some are more likely to happen soon than others. Thus, again we must evaluate the situation in order to establish priorities. To do this we briefly discuss each of these developments and, where possible, we indicate where the developments are likely to occur first and what potential natural areas could be affected.

Surface Mining. National attention has been focused on Wyoming because of the huge deposits of coal and oil shale that can be surface mined. Most of the strippable coal deposits are outside the Wyoming Basin, in the Powder River Basin, but 3 smaller strippable deposits do exist in the Basin (Fig. 44). The Hanna and Jim Bridger Coalfields are currently being mined, but none of our proposed natural landmarks are in either area. That is not to say, however, that natural areas do not occur there.

If the Red Desert Coalfield is opened (Fig. 44.), then the proposed Chain-of-Lakes Natural Landmark and nearby Battle Creek Flat (Greasewoood Ecosystem) could be destroyed. Exploitation of the Black Butte Coalfield, and the large oil shale deposits in that area, would have an adverse effect on the proposed Washakie Basin Natural Landmark. Due to mining and industrial activity in Sweetwater County, more people are using the Steamboat Mountain and Killpecker dunes area for recreation, and in particular, more dune buggy racing is occurring.

Thus, surface mining is now resulting in greater pressure on the Killpecker Sand Dunes and Steamboat Mountain potential natural landmarks, and poses a future threat to the Washakie Basin and Chain-of-

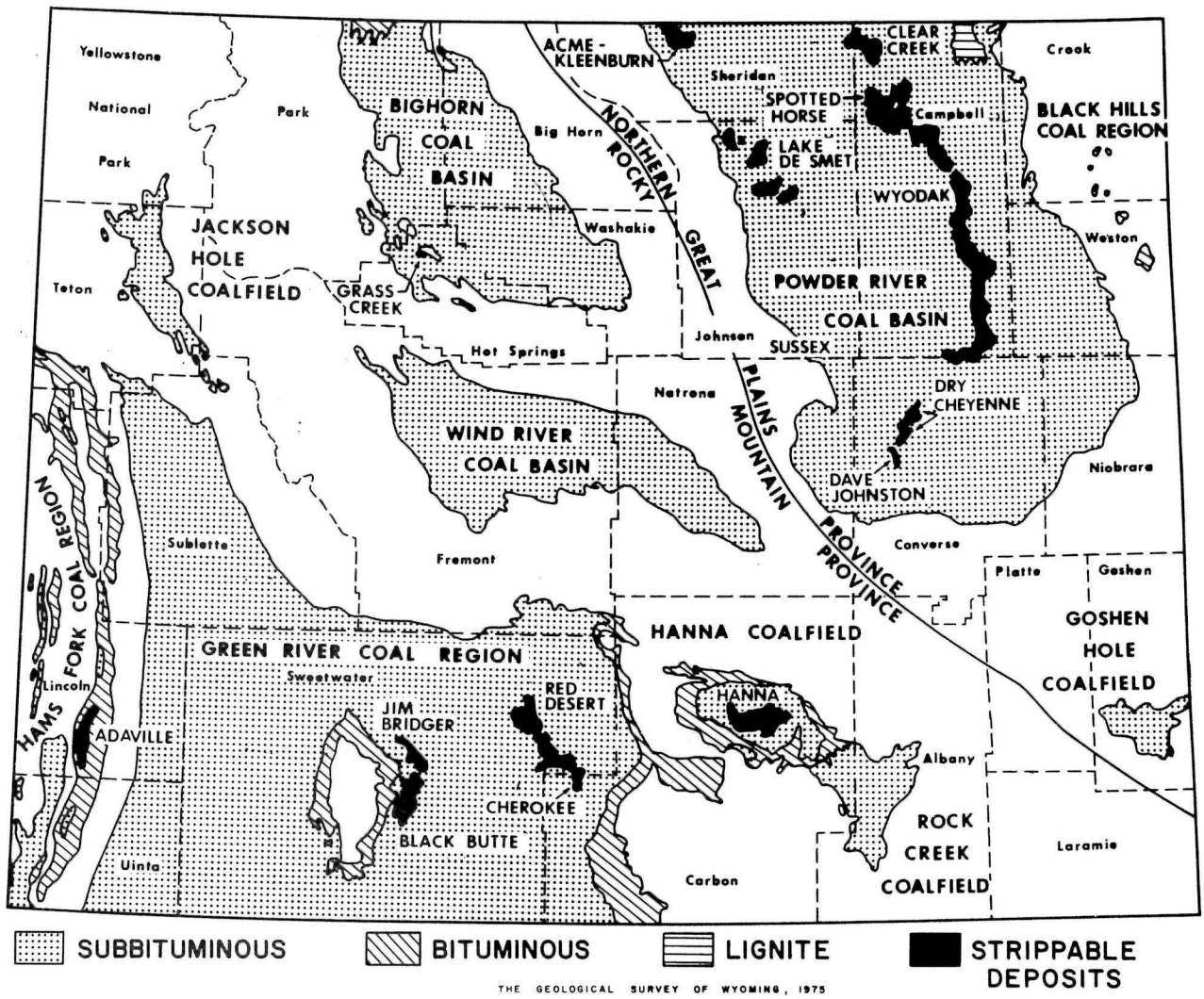


Fig. 44. Map of coal bearing regions in Wyoming (from Glass, 1975).

Lakes potential natural landmarks. Because the exploitation of fossil fuels is likely to occur at a quickened pace in Wyoming, we recommend a special program to evaluate what natural landmarks will be lost due to this mining activity.

Sagebrush Spraying. Thousands of acres of sagebrush-dominated grassland are sprayed with herbicides each year, but we have no information on where the spraying will be done in the future. The spraying is most likely to occur on private land. Although we would not like to see the Oregon Trail Sagebrush-Grassland sprayed, other sagebrush-grassland natural landmarks could be found.

New Roads, Powerlines, and Pipelines. Although sparsely populated, the Wyoming Basin is threaded with rough mineral exploration roads, powerlines, and pipelines which can greatly degrade the value of a natural area. Unfortunately, the location of these developments is hard to predict, and unless some formal recognition of all the natural areas in the Basin is accomplished, industrial easements are likely to be granted. None of our potential natural landmarks are free of this threatened disturbance unless they have been formally recognized as natural areas by other state or federal agencies.

Land Sub-division. Many of our proposed natural landmarks are also aesthetically pleasing, and some have scenic vistas which rival our National Parks and Monuments. For this reason, they are desirable sites for second homes and other recreational developments, and sub-division could occur, especially on privately owned land. Areas that are threatened in this way, to our knowledge, include the Sand Creek-Camel Rock area and the Sweetwater River Natural History Complex.

Sub-division may also occur to meet industrial needs, e.g. power plants. In this case the development will probably be near mines or near rivers where water is available. Wyoming now has an Industrial Plant Siting law which should force consideration of natural area values before a construction permit is granted.

New Impoundments and Irrigation. Water is a critical limiting factor for agricultural and industrial development in the Wyoming Basin. Actually there is a large amount of water in the area, due to runoff from the adjacent high mountains, but it is not evenly distributed in a geographic and temporal sense. Thus there are always developers discussing the construction of new reservoirs and transbasin diversion aquaducts. At the present time no construction is being done of which we are aware, but water is critical for industrial development in the State. Industry is paying exorbitant prices for water rights, and new impoundments no doubt will be attempted in the future.

Areas of particular concern in this regard would be the Green River, Wind River, Sweetwater River, and North Platte River which are of Wild or Scenic River caliber in some places. We are not categorically against all impoundments, although the long term value of some may be questionable in arid lands, but potential natural landmarks on the floodplain may be destroyed by the reservoir and this possibility must be recognized.

With all the fossil fuels in Wyoming and the industrial demand for water, it is not likely that much native rangeland or potential natural landmarks will be lost due to irrigation. The water could become too expensive for new agricultural purposes. In addition, the growing season length is another limiting factor at the higher elevations. Fig. 45 shows the location of cultivated land in Wyoming.

The pumping of groundwater could affect the distribution of major developments in the future. Fig. 46. shows the approximate location of major groundwater reservoirs in Wyoming.

Fossil Scavengers. Hunting for fossils is a popular activity for many people, and consequently we are concerned for the future of this valuable educational and scientific resource. Four of our potential natural landmarks are especially threatened by this activity -- the Shirley Basin Petrified Forest, the Grizzly Buttes Badlands, Hell's Half Acre, and Beaver Rim. McGrew et al. (1974) should be consulted for other areas endangered by fossil hunters. Unfortunately, any publicity given on the designation of fossil-rich areas as natural landmarks may encourage even more scavanging.

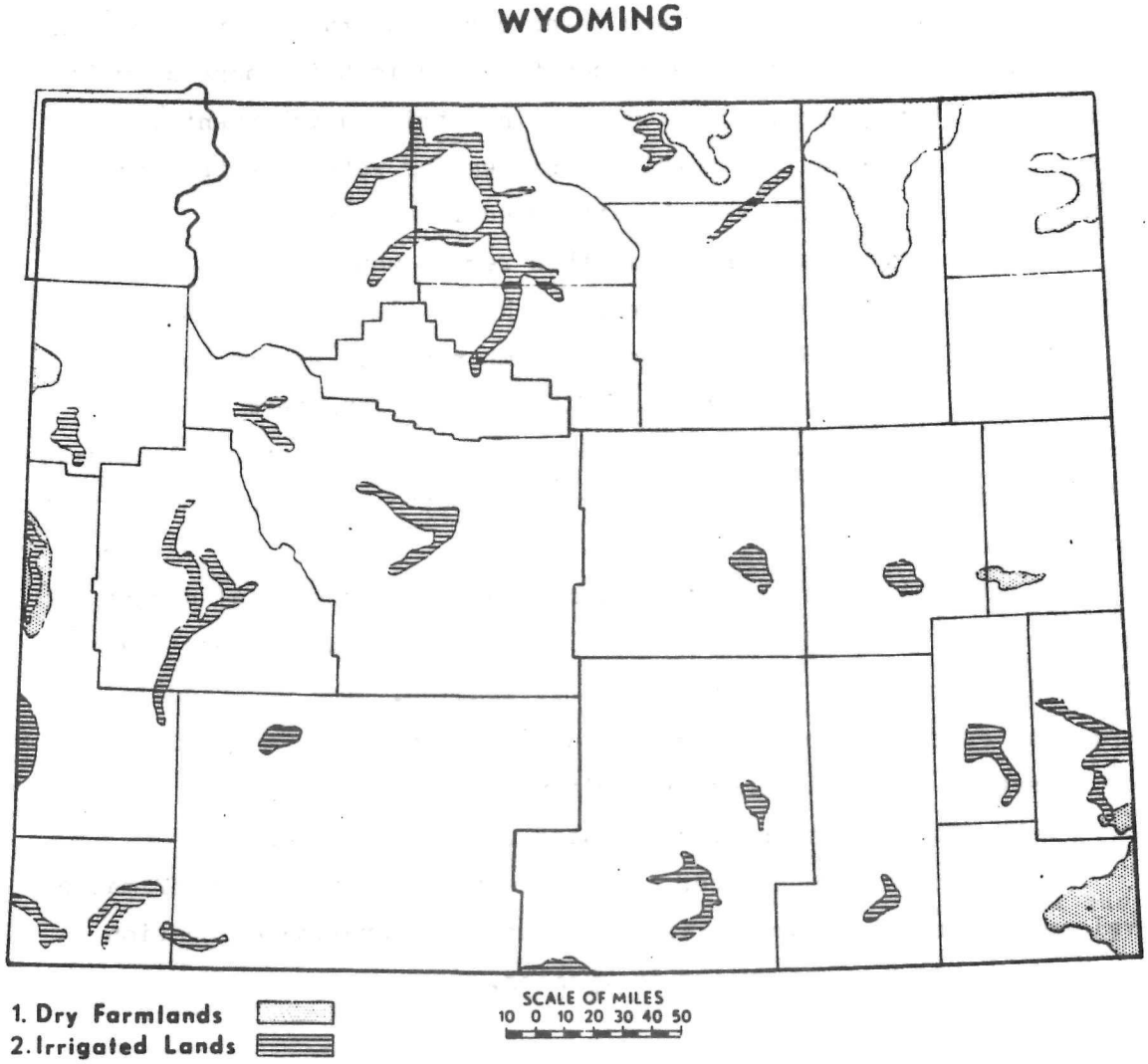


Fig. 45. Map of principal cultivated lands in Wyoming (from Bartruff, 1967).

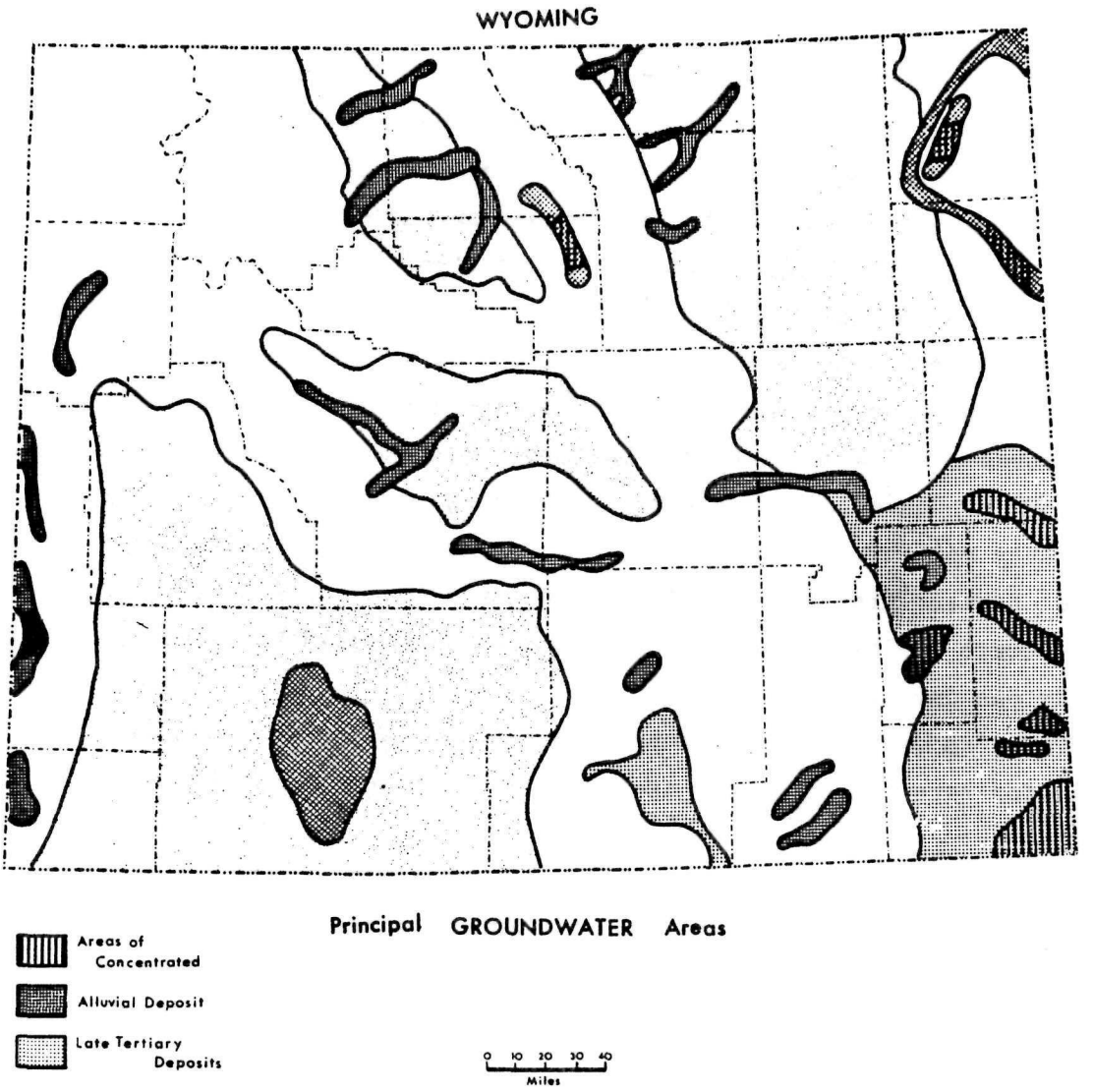


Fig. 46. Map of major groundwater sources in Wyoming (from Rechard 1967).

Rare or Endangered Species

We adopt the contention that man should not willfully or knowingly cause the extinction of any plant or animal species. Thus, we have endeavored to determine whether or not rare or endangered species exist in the Wyoming Basin. In order to make such a determination, however, an area must be very well studied. That is not the case for the Basin. Despite our extensive collections during the course of this study, and the valuable collections in the Rocky Mountain Herbarium at the University of Wyoming, we still have inadequate information for judging which species are rare and endangered. We may have found a species only once, but it could easily occur in other areas that we have not yet explored. Only one specimen may exist in the University collections, but many areas have never been visited by a botanist or zoologist. This lack of information could lend a false sense of security. Rare species are by definition hard to find, and could be driven to extinction by only one development.

Thus, as far as we know none of our potential natural landmarks are havens for rare or endangered species. A few observations are noteworthy, however.

1. The following animal species are generally recognized as being rare and endangered in the region: American peregrine falcon, black-footed ferret, humpback chub, Kendall warm springs dace, the greenback cutthroat trout, bluehead sucker, and roundtail chub.
2. Wortman's golden-mantled ground squirrel (Spermophilus lateralis wortmani) is endemic to the Red Desert Country of Wyoming, and, because it seems to be associated with Limber Pine, one of the few available habitats for the species would be Steamboat Mountain. The yellow-bellied marmot (Marmota flaviventris) is also uncommon in the area except on Steamboat Mountain.
3. Mahonia repens, commonly known as Oregon Grape, is usually associated with the understory vegetation of lower montane pine forests, however, we observed it growing far removed from trees on the south rim of Bates Hole. It is not a rare species, but this distribution pattern has biogeographic implications and lends support to our Bates Hole recommendation.

4. At Henry's Fork Fault two species of mountain mahogany grow side by side (Cercocarpus montanus and C. ledifolius), and this is unusual.
5. The black-footed ferret (Mustela nigripes) is near extinction, if not extinct. Its native range includes the Wyoming Basin.
6. At Beaver Rim we observed seeps that provide a very special microhabitat and in which we observed a small mint (Mentha arvense) and a goldenrod (Solidago sp.), neither of which we found elsewhere.
7. The Moneta Phragmites Marsh is dominated by Phragmites communis, which has been collected several times in the Basin but which was observed by us only at this spring-fed marsh. Because such marshes may be converted to stock ponds, they are endangered.
8. Downingia laeta is considered to be a rare plant in Wyoming, but we found it along the margins of the small lakes near Sand Creek and Camel Rock.

Table 49 lists plant species thought to be endemic to Wyoming, and Table 50 lists plant species that are thought by some to be rare and endangered in Wyoming.

TABLE 49. Plant species believed to be endemic to Wyoming as of October, 1967.

List prepared by C. L. Porter.

POACEAE (GRAMINEAE)

Agrostis rossae Vasey, near hot springs and geysers, Yellowstone Park.

POLYGONACEAE

Eriogonum acaule Nutt. Southern Wyoming

RANUNCULACEAE

Aquilegia laramiensis A. Nels. Laramie Range, southeastern Wyoming.

BRASSICACEAE (CRUCIFERAE)

Physaria condensata Rollins, southwestern Wyoming near Ft. Bridger.
Physaria didymocarpa (Hook.) A. Gray, var. *integrifolia* Rollins, Lincoln and Teton counties, Wyoming.
Stanleya pinnata (Pursh) Britt., var. *gibberosa* Rollins, Uinta County, Wyo.
Stanleya tomentosa Parry, var. tomentosa Big Horn Basin area, Shell Creek Canyon, northern Wyoming.

FABACEAE (LEGUMINOSAE)

Astragalus drabelliformis Barneby, upper Green River Basin, Sublette County.
Astragalus grayi Parry, Shirley Basin, Carbon County, and northwestward to Park County.
Astragalus jejunus S. Wats., southwestern Wyoming.
Astragalus oreganus Nutt. ex T. & G., Wind River Basin and adjacent area, Fremont County.
Astragalus proimanthus Barneby, southern Sweetwater County.
Oxytropis besseyi (Rydb.) Blank., var. *ventosa* (Greene) Barneby, drainages of the Wind, North Platte, and Green Rivers in central and southern Wyoming.
Oxytropis nana Nutt., drainages of the North Platte, Sweetwater, and Cheyenne rivers.

BORAGINACEAE

Cryptantha caespitosa (A. Nels.) Payson, southern and south-central Wyoming.

SCROPHULARIACEAE

Pedicularis pulchella Pennell, the type from south of Anaconda, Montana, and also known from Sheep Mt.,14 miles northeast of Jackson, Teton County, Wyo.
Penstemon acaulis L. Williams, southwestern Wyoming and adjacent Daggett County, Utah.
Penstemon arenicola A. Nels., central and western Wyoming.
Penstemon caryi Pennell, west slope of the Big Horn Range, Big Horn County.
Penstemon cleburnei Jones, from northern to southern central Wyoming and adjacent Daggett County, Utah.
Penstemon paysoniorum Keck, central and southwestern Wyoming.

ASTERACEAE (COMPOSITAE)

Artemisia porteri Cronquist, eastern Fremont County.
Erigeron allocotus Blake, Shell Creek Canyon, Big Horn County.

TABLE 49. (Continued)

ASTERACEAE (COMPOSITAE) (Continued)

Haplopappus multicaulis (Nutt.) A. Gray, east of the Wind River Range, Wyoming, and near Bellefouche, S. D.

Parthenium alpinum (Nutt.) T. & G., var. *alpinum*, central Wyoming.

Townsendia spathulata Nutt., Natrona and Fremont counties, Wyoming.

TABLE 50. A list of possibly rare and endangered plant species in Wyoming. The species were originally suggested by the Smithsonian Institution (1975); comments were prepared by Charlotte Reeder, Rocky Mountain Herbarium.

Species	Described (date)	Type Locality	Remarks
CRUCIFERAE			
* Lesquerella fremontii Rollins & Shaw	1973	Wyoming: Fremont Co. Wind River Mountains, 5 miles E of Atlantic City 8200 ft. (1947)	Known only from the type series (none in RM)
Arabis demissa Greene var. languida Rollins	1941	Wyoming: Albany County: near City Springs, east of Laramie (1936)	Known from Albany County (1896, 1935, 1937); Sweetwater County (2 miles SE of Green River, 1938); and Utah: Daggett County (1938).
Arabis demissa Greene var. russeola Rollins	1941	Utah: Uintah County: 18 miles north of Vernal (1937)	Specimens from Wyoming: Albany County, Laramie Hills (1899); and Utah: Daggett County (1932, 1938)
Draba nivalis Lilj. var. brevicula Rollins	1953	Wyoming: northwest Park Co. in crevices on vertical cliffs on the western edge of Clay Butte (1951) (RM)	Another specimen cited: Wyoming: Park County: Beartooth Park.

* = endangered on list;
without a mark = threatened
(compiled October, 1975

TABLE 50. (Continued)

Species	Described (date)	Type Locality	Remarks
CRUCIFERAE (Continued)			
Lesquerella carinata Rollins	1950	Idaho: Lemhi County: Birch Creek	Specimens cited in the original description from Wyoming: Teton County: Lower Devil's Staircase and Teton Pass, also several others from Idaho.
Physaria condensata Rollins	1939	Wyoming: Uinta County: 3 miles west of Ft. Bridger, on Bridger Butte (1938)	Two other collections, both from the same area. ("unprotected knoll-crests in Upper Sonoran zone") (RM)
* Lesquerella macrocarpa A. Nels. (probably extinct)	1902	Wyoming: Sweetwater County: near Bush Ranch, Red Desert (1900)	Additional specimen: Wyoming: Sweetwater County: 45 miles north of Point of Rocks, on naked clay flats and ridges near Steamboat Mt. (RM) "This is a quite distinct species apparently of restricted range..."
ONAGRACEAE			
* Gaura neomexicana Wooton var. coloradensis (Rydb.) Munz	1958	Colorado: Larimer County: Fort Collins (1895)	"Apparently limited to northcentral Colorado..." Only 1 doubtful specimen in RM from Colorado

TABLE 50. (Continued)

Species	Described (date)	Type Locality	Remarks
LEGUMINOSAE			
* Astragalus proimanthus Barneby	1964	Wyoming: Sweetwater County: 3 miles north of McKinnon, 7100 ft. (1961) (RM)	"..forming colonies but apparently local, known only from the valley of Henry's Fork on the Green River, near McKinnon." Only 1 other collection cited.
COMPOSITAE			
Artemisia Porteri Cronquist	1951	Wyoming: Fremont County: in desert ca.10 miles east of Sand Draw Oil Field, 40 miles southeast of Riverton. 6000 ft. (RM)	Two other collections in RM from Wyoming: Fremont County: 15 miles NE of Shoshoni (1961) near Lysite (1963)
Erigeron allocotus Blake	1937	Wyoming: Bighorn County: near Grouse Creek, Shell Creek Canyon. 7500 ft. (1936) (RM)	No other collections in RM.
Tanacetum simplex A. Nels.	1899	Wyoming: Albany County: near Laramie, on a stony slope in foothills. (1898) (RM)	"Certainly rare and far from abundant even in type locality." RM has four other collections all from Albany County: Laramie Hills from 1899, 1901, and 1907.
Townsendia spathulata Nutt.	1840	"On the Black Hills" (an alpine chain toward the sources of the Platte.) Nuttall in 1834.	Cited specimens (in monograph of Townsendia) include 5 from Fremont County, 3 from Natrona County, and 1 from Sweetwater County (near Steamboat Mountain), all these from Wyoming.

TABLE 50. (Continued)

Species	Described (date)	Type Locality	Remarks
COMPOSITAE (Continued)			
Haplopappus contractus Hall (probably extinct)	1928	Substitute name for *Pyrrocoma acuminata* Rydb. (1900) From Wyoming: Uinta County: Fort Bridger, 1873. (NY)	Known only from a very fragmentary type specimen. Attempts to recollect have been fruitless. To be considered as a synonym of *Haplopappus uniflorus* (Hook.) Torrey & Gray by Texas monographer.
BORAGINACEAE			
Cryptantha stricta (Osterh.) Payson	1927	Colorado: Moffat County: some distance south of the Yampa or Bear River, along the "Victory Highway." (1922)	"Upper Sonoran Zone, northwestern Colorado." There are two other collections in RM; another from the type locality (in 1925), and the other from Utah: Uintah County.
Mertensia viridis A. Nels. var. *dilatata* (A. Nelson) L. O. Williams	1937	Wyoming: Albany County: Medicine Bow Mountains, rock slides. (1900)	"In the mountains of southeastern Wyoming, adjacent Colorado, and Uinta Mountains, Utah." "Similar to the species except the leaves are glabrous on both sides." RM has a number of specimens from Albany County: Medicine Bow Mountains.
CYPERACEAE			
Carex microptera Mack. var. *crassinervia* F. J. Hermann	1968	Colorado: Ouray County: below Engineer Pass. 11,000 ft. (US)	One other specimen cited in the original description, Wyoming: Natrona County: summit of Casper Mountain. (RM)

TABLE 50. (Continued)

Species	Described (date)	Type Locality	Remarks
GRAMINEAE			
Agrostis Rossae Vasey	1892	Wyoming: Yellowstone Nat. Park. from hot springs. (1890).	RM has several recent collections (1955, 1957) all from Yellowstone National Park hot springs of Fire Hole River, Whistle Geyser, & Punch Bowl Geyser. Abundant in these spots. "One of Wyoming's few endemic grasses."
Oryzopsis hymenoides (Roem. & Schult.) Ricker var. *contracta* B. L. Johnson	1945	Wyoming: Carbon County: Freezeout Hills. (RM)	A 1966 paper cites populations from Bosler, Big Hollow, Shirley Basin, Delaney Rim, Rawlins, Wamsutter, and Hart Mts. RM has specimens from Albany County, Carbon County, and Sweetwater County, + 1 from Colorado.
PORTULACACEAE			
Claytonia bellidifolia Rydb. = *Claytonia megarhiza* var. bellidifolia (Rydb.) C. L. Mitchc. (1964)	1932	Type from eastern Oregon, 1897	Distribution: Wallowa and Blue Mountains of Oregon, Jarbidge Mts., Nevada, and possibly Wenatchee Mts., Washington.
RANUNCULACEAE			
Aquilegia laramiensis A. Nels.	1896	Wyoming: Albany County: Cottonwood Canyon, base of Laramie Peak. (1895)	"An endemic that is apparently confined to shaded places among granitic rocks at about 8300 feet, in Laramie Range, northeast of Laramie." RM has five collections other than the type, including one (1973) from just over the line in Converse County.

TABLE 50. (Continued)

Species	Described (date)	Type Locality	Remarks
SCROPHULARIACEAE			
Penstemon Caryi Pennell	1920	Wyoming: Big Horn County: Bighorn Mountains, 2400 m. (1910)	"A local endemic known only from Big Horn County, Wyoming." Six collections in RM -- all from Big Horn County (1896, 1928, 1932, 1935, and 1936).
Penstemon Paysoniorum Keck	1947	Wyoming: Lincoln County: dry hills between Opal and Kemmerer (1923)	"This plant grows in southwestern Wyoming on sandy creek bottoms, alkaline shale bluffs, and dry hills, 6500--7500 ft." In the original description eight different collections are cited from Sublette and Uinta Counties. RM has a series of specimens of later dates from Fremont County: Beaver Hill. "A Wyoming endemic, limited to the southwestern part of the State, extending only as far east as Fremont County."

RECOMMENDED COURSE OF ACTION

In order to focus attention on those areas which we believe should be established first as natural landmarks, we have used the following priority rating system recommended by the National Park Service:

Priority 1: High degree of national significance, recommended without reservation.

Priority 2: Appears to be nationally significant.

Priority 3: Information lacking for confident recommendation, but may prove nationally significant upon further investigation.

Priority 4: Not recommended.

Protection A: Site is in serious impending danger.

Protection B: Site is in some jeopardy.

Protection C: Site is in no apparent jeopardy.

Protection D: Relative jeopardy is unknown.

The rankings are obviously subjective, but provide a partial basis for recommending a course of action. Those areas ranked 1A in Table 51 should be established first as natural landmarks.

McGrew et al. (1974) also ranked many of the same potential natural landmarks, but we have done our evaluation independently. Their ranking is also shown in Table 51. An area ranked 1A by both us and McGrew et al. deserves special attention. However, merely because we have not listed an area included by the geologists does not mean it has no ecological value.

It seems obvious to us from the priority ranking and our analysis of the potential natural landmarks (pp 194 to 215) that the following course of action should be taken if possible:

1. Establish a natural landmark in the Killpecker Sand Dunes -- Steamboat Mountain -- Leucite Hills area. Such action could help preserve the dunes, and would protect the flora and fauna on a fine example of a desert mountain.
2. Because ponds and floodplains have already been heavily disturbed, and because they are likely to be utilized even more in the future, initiate a study to locate the few remaining natural areas along

streams and rivers, and the few areas, if any, around lakes and ponds that have escaped impoundments, heavy grazing by domestic livestock, or settlements.

3. Locate natural landmarks in areas most threatened by impending developments, in particular the Chain-of-Lakes, the Washakie Basin, the Sweetwater River Natural History Complex, the Shirley Basin Fossil Forest, and the Killpecker Sand Dunes.
4. Establish natural landmarks and education displays at Big Hollow and the Oregon Trail Sagebrush-Grassland. The three most common ecosystem types in the Wyoming Basin should be represented in one or more of these areas, namely grassland, sagebrush-grassland, and greasewood.
5. Initiate landmark studies in the larger, isolated, desert mountain ranges in the Wyoming Basin, e.g. the Green Mountains or the Ferris Mountains. The ecosystem types found in these Basin mountains are not represented in the areas we recommend in this Report and they are not likely to be included in NPS surveys of the Rocky Mountains. These isolated mountains maintain biota which are important in interpreting the biogeography of the region.
6. Follow the above with efforts to balance the representation of natural history themes in the Natural Landmarks Registry, recognizing that the goal should be the representation of each ecosystem type in at least one natural landmark in each major physiographic region.

Again we wish to point out that some of the areas selected for this report are too large for natural landmarks. Further study is necessary to locate the best tracts that would qualify and which should be protected from non-traditional land use for the area.

TABLE 51. Ranking of the potential natural landmarks included in this Report, using the ranking system described on page 216. The ranking of McGrew et al. (1974) for the same areas is shown.

Potential Natural Landmark	Our Ecological Rating	McGrew Geological Rating
Castle Gardens	1A	--
Note: Indian petroglyphs are the major value for this area, and they are being rapidly destroyed. BLM has put up fences, but the remote location of the area makes surveillance nearly impossible.		
Boar's Tusk Sand Dunes	1A	1A
Killpecker Sand Dunes	1A	1A
Sand Dune Natural Area	1B	--
Steamboat Mountain	1B	1C
Note: The Killpecker Dunes and Steamboat Mountain should be considered together as one natural landmark.		
Green River	1A	--
North Platte River	1B	--
Washakie Basin	1B	1A
Note: The old stage stations and forts lend special significance to the Washakie Basin; oil shale mining may occur there in the future.		
The Big Hollow	1B	2C
Note: Provides an exceptional educational opportunity in a scenic setting.		
Shirley Basin Fossil Forest	1B	--
Petrified Forest Natural Area	1B	--
Oregon Trail Sagebrush-Grassland	1B	--
Hell's Half-acre Badlands	1B	1C
Note: The threat is mainly fossil hunters who could destroy a valuable archeological site.		
Sweetwater River Complex	1B	1C
Rattlesnake Creek Oak Woodland	1C	--
Pinedale Glacial Fields and Fremont Lake	2C	1C

TABLE 51 (Continued)

Potential Natural Landmark	Our Ecological Rating	McGrew Geological Rating
Fossil Fish Quarries Natural Area	1C	--
Muddy Creek	1B	--
Note: Desert creeks are always threatened due to the demand for water which may adversely affect streamflow characteristics and consequently the biota.		
Chain-of-Lakes	2A	--
Note: The vegetation adjacent to lakes such as these is often heavily grazed.		
Moneta Phragmites Marsh	2A	--
Northern Desert Shrub - Sagebrush Natural Area	2B	--
Sand Creek and Camel Rock	2B	1C
Alkali Desert Shrub Natural Area	2B	--
Henry's Fork Fault Juniper Woodland	2C	1C
Grizzly Buttes Badlands	2C	1C
Beaver Rim	2C	1C
Laramie Plains Natural Area	2C	--
Bates Hole	2C	1C
Laramie High Plains Natural Area	2C	--
Twin Groves Aspen Atoll	2C	--
Little Colorado Desert	3B	--

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APPENDIX A. List of plant species collected in the Great Divide Basin of Wyoming from 1967 to 1970 by Maxell (1973). The classification scheme for families and species is that of Harrington (1954) and Porter (1962, 1963, 1964, 1965, 1967, 1968, 1972a, and 1972b). Common names are from Beetle (1970).

PINACEAE	Pine Family	
Pinus flexilis James		Limber pine
CYPRESSACEAE	Juniper Family	
Juniperus scopulorum Sarg.		Rockymountain juniper
POACEAE (GRAMINEAE)	Grass Family	
Bromus tectorum L.		Cheatgrass brome
Hesperochloa kingii (S. Wats.) Rydb.		King spikefescue
Poa sp.		Bluegrass
Poa compressa L.		Canadian bluegrass
Poa sandbergii Vasey		Sandberg bluegrass
Poa ampla Merr.		Big bluegrass
Distichlis stricta (Torr.) Rydb.		Inland saltgrass
Deschampia caespitosa (L.) Beauv.		Tufted hairgrass
Koeleria cristata (L.) Pers.		Prairie junegrass
Agropyron spicatum (Pursh) Scribn. & Smith		Bluebunch wheatgrass
Agropyron subsecundum (Link) Hitchc.		Bearded wheatgrass
Agropyron smithii Rydb.		Western wheatgrass
Agropyron trachycaulum (Link) Malte		Slender wheatgrass
Elymus cinereus Scribn. & Merr.		Basin wildrye
Elymus simplex Scribn. & Williams		Alkali wildrye
Hordeum jubatum L.		Foxtail barley
Sitanion hystrix (Nutt.) J. G. Smith		Bottlebrush squirreltail
Oryxopsis hymenoides (Roem. & Schult.) Richer		Indian ricegrass
Stipa comata Trin. & Rupr.		Needle and thread
Stipa pinetorum Jones		Pinewood needlegrass
Stipa columbiana Macoun		Subalpine needlegrass
Spartina gracilis Trin.		Alkali cordgrass
CYPERACEAE	Sedge Family	
Carex eleocharis Bailey		Needleleaf sedge
Carex praegracilis W. Boott.		Fieldclustered sedge
Carex filifolia Nutt.		Threadleaf sedge
Carex nebraskensis Dewey		Nebraska sedge
Scirpus validus Vahl		Softstem bulrush
Scirpus americanus Pers.		American bulrush

APPENDIX A. (Continued)

JUNCACEAE	Rush Family	
Juncus balticus Willd.		Baltic rush
LILIACEAE	Lily Family	
Calochortus nuttallii Torr.		Sego mariposalily
Allium textile Nels. & Macbr.		Textile onion
IRIDACEAE	Iris Family	
Iris missouriensis Nutt.		Rockymountain iris
SALICACEAE	Willow Family	
Salix spp.		Willows
Populus tremuloides Michx.		Quaking aspen
POLYGONACEAE	Buckwheat Family	
Eriogonum cernuum Nutt.		Nodding wildbuckwheat
Eriogonum ovalifolium Nutt.		Cushion wildbuckwheat
Eriogonum brevicaule Nutt.		Shortstem wildbuckwheat
Rumex venosus Pursh		Vein dock
Rumex hymenosepalous Torr.		Canaigre dock
Rumex crispus L.		Curly dock
CHENOPODIACEAE	Goosefoot Family	
Sarcobatus vermiculatus (Hook.) Torr.		Black greasewood
Grayia spinosa (Hook.) Moq.		Spiny hopsage
Atriplex confertifolia (Torr. & Frem.) S.Wats.		Shadscale saltbush
Atriplex canescens (Pursh) Nutt.		Fourwing saltbush
Atriplex gardneri (Moq.) D. Dietr.		Nuttall saltbush
Eurotia lanata (Pursh) Moq.		Common winterfat
Kochia americana S. Wats.		Greenmolly summercypress
Kochia scoparia (L.) Shrad.		Fireweed summercypress
Halogeton glomeratus (M.Bied.) C.A.Meyer in Ledeb.		Common halogeton
Suckleya suckleyana (Torr.) Rydb.		Poison suckleya
Salsola kali L.		Common russianthistle
Corispermum hyssopifolium L.		Hyssopleaf bugseed
Chenopodium berlandieri Moq.		Pitseed goosefoot
NYCTAGINACEAE	Four-o'clock Family	
Tripterocalyx micranthus (Torr.) Hook.		Wingfruited sandverbena
PORTULACACEAE	Purslane Family	
Lewisia rediviva Pursh		Bitterroot lewisia

APPENDIX A. (Continued)

CARYOPHYLLACEAE	Pink Family	
Arenaria hookeri Nutt.		Hooker sandwort
RANUNCULACEAE	Crowfoot Family	
Delphinium bicolor Nutt.		Little larkspur
CAPPARIDACEAE	Capper Family	
Cleome serrulata Pursh		Rockymountain beeplant
CRUCIFERAE	Mustard Family	
Stanleya pinnata (Pursh) Britton		Desert princesplume
Cardaria pubescens (Meyer) Rollins		Hairy whitetop
Lesquerella ludoviciana (Nutt.) S.Wats.		Foothill bladderpod
Arabis cobrensis M.E.Jones		Silver rockcress
Arabis lignifera A. Nels.		Woody rockcress
Descurainia richardsonii (Sweet) O.E.Schulz		Richardson tansymustard
Erysimum asperum (Nutt.) DC		Plains wallflower
Erysimum capitatum (Doug.) Greene		Coast wallflower
Streptanthella longirostris (S. Wats.) Rydb.		Beakpod nippletwist
Sisymbrium linifolium Nutt.		Flaxleaf hedgemustard
SAXIFRAGACEAE	Saxifrage Family	
Ribes cereum Dougl.		Wax currant
ROSACEAE	Rose Family	
Amelanchier alnifolia Nutt.		Saskatoon serviceberry
Cercocarpus montanus Raf.		True mountainmahogany
Potentilla anserina L.		Silverweed cinquefoil
Potentilla pulcherrima Lehm.		Showy cinquefoil
Potentilla pennsylvanica L.		Pennsylvaniz cinquefoil
Purshia tridentata (Pursh) DC		Antelope bitterbrush
LEGUMINOSAE	Legume Family	
Thermopsis rhombifolia Nutt. ex. Rich.		Prairie thermopsis
Lupinus pusillus Pursh		Rusty lupine
Lupinus greenei A. Nels.		Greene lupine
Psoralea lanceolata Pursh		Lemon scurfpea
Oxytropis sericea Nutt.		Silky loco
Astragalus kentrophyta A. Gray		Nuttall kentrophyta milkvetch
Astragalus bisulcatus (Hook.) A. Gray		Twogrooved milkvetch
Astragalus oreganus Nutt. ex. T.&G.		Windriver milkvetch
Astragalus purshii Doug. ex. Hook.		Pursh milkvetch
Astragalus spatulatus Sheld.		spoonleaf milkvetch
Astragalus lentiginosus Doug. ex. Hook.		Freckled milkvetch
Astragalus striatus Nutt. ex. T.&G.		Standing milkvetch

APPENDIX A. (Continued)

CACTACEAE	Cactus Family	
Opuntia polyacantha Haw.		Plains pricklypear
ONAGRACEAE	Evening Primrose Family	
Oenothera nuttallii Sweet		Nuttall eveningprimrose
UMBELLIFERAE	Carrot Family	
Pteryxia terebinthina (Hook.) Coult. & Rose		Fernyparsley
Cymopterus acaulis (Pursh) Raf.		Stemless springparsley
Lomatium macdougallii Coult. & Rose		MacDougal lomatium
PRIMULACEAE	Primrose Family	
Dodecatheon pulchellum (Raf.) Merr.		Darkthroated shootingstar
POLEMONIACEAE	Phlox Family	
Phlox hoodii Rich. in Frankl.		Hoods phlox
Gilia aggregata (Pursh) Spreng.		Skyrocket gilia
BORAGINACEAE	Borage Family	
Lappula redowskii (Horneum.) Greene		Bluebur stickseed
Mertensia sp.		Bluebell
Cryptantha fendleri (Gray) Greene		Fendler cryptantha
Cryptantha flava (A.Nels.) Payson		Yellow cryptantha
Cryptantha flavoculata (A. Nels.) Payson		Roughseed cryptantha
SCROPHULARIACEAE	Figwort Family	
Penstemon strictus Benth. in DC		Rockymountain penstemon
Penstemon laricifolius Hook. et Arn.		Larchleaf penstemon
Penstemon arenicola A. Nels.		Sand penstemon
Castilleja linariaefolia Benth. in DC		Wyoming Indianpaintbrush
Castilleja chromosa A. Nels.		Desert Indianpaintbrush
Cordylanthus ramosus Nutt. ex. Benth. in DC		Bushy birdbeak
RUBIACEAE	Madder Family	
Galium boreale L.		Northern bedstraw
PLANTAGINACEAE	Plantain Family	
Plantago eriopoda Torr.		Redwool plantain
CAPRIFOLIACEAE	Honeysuckle Family	
Symphoricarpus albus (L.) Blake		Common snowberry

APPENDIX A. (Continued)

COMPOSITAE	Composite Family
Chrysothamnus nauseosus (Pallas) Britt. in Britt. & Brown	Rubber rabbitbrush
Chrysothamnus viscidiflorus (Hook.) Nutt.	Douglas rabbitbrush
Erigeron spp.	Fleabane
Aster adscendens Lindl.	Longleaf aster
Machaeranthera canescens (Pursh) A. Gray	Hoary tansyaster
Machaeranthera glabriuscula (Nutt.) Cronq.& Keck	Alkali aster
Achillea lanulosa Nutt.	Western yarrow
Artemisia spinescens D.C.Eaton	Bud sagewort
Artemisia cana Pursh	Silver sagebrush
Artemisia pedatifida Nutt.	Birdfoot sagebrush
Artemisia tridentata Nutt.	Basin big sagebrush
Artemisia arbuscula Nutt.	Low sagebrush
Artemisia nova A. Nels.	Black sagebrush
Chaenactis douglasii (Hook.) H.&A.	Douglas dustymaiden
Hymenoxys acaulis (Pursh) Parker	Stemless actinea
Tetradymia spinosa Hook. & Arn.	Cottonthorn horsebrush
Tetradymia nuttallii T.&G.	Nuttall horsebrush
Tetradymia canescens DC	Gray horsebrush
Xanthium strumarium L.	Heartleaf cocklebur
Antennaria rosea (D.C.Eaton) Greene	Rose pussytoes
Cirsium ochrocentrum A. Gray	Yellow thistle
Crepis acuminata Nutt.	Tapertip hawksbeard
Taraxacum officinale Wiggars	Common dandelion
Lygodesmia juncea (Pursh) D.Don.	Rush skeletonplant