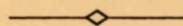


UNIVERSITY OF UTAH

Department of Anthropology



ANTHROPOLOGICAL PAPERS

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(Upper Colorado Series Number 8)

Ecological Studies of the Flora and Fauna of the Curecanti Reservoir Basins, Western Colorado

By ANGUS M. WOODBURY; SEVILLE FLOWERS; HEBER H. HALL
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ANTHROPOLOGICAL PAPERS

The University of Utah Anthropological Papers are a medium for reporting to interested scholars and to the people of Utah research in anthropology and allied sciences bearing upon the peoples and cultures of the Great Basin and the West. They include, first, specialized and technical record reports on Great Basin archeology, ethnology, linguistics, and physical anthropology, and second, more general articles on anthropological discoveries, problems and interpretations bearing upon the western regions, from the High Plains to the Pacific Coast, insofar as they are relevant to human and cultural relations in the Great Basin and surrounding areas.

For the duration of the archeological salvage project for the Upper Colorado River Basin which the University has undertaken by contract agreement with the National Park Service, reports relating to that research program are being published as series within a series, bearing numbers in the general sequence of the Papers as well as their own identifying numbers.

The Upper Colorado and Glen Canyon subseries will represent a wider range of the sciences and humanities than the parent series itself. The project provides for studies of the natural history of the Glen Canyon area and its inhabitants so that the relationships of the prehistoric cultures and their settings will be understood in depth. As contact with Western peoples and cultures has had a varying effect upon the native Americans and the land, some papers will be concerned with the Colorado in the more recent past.

UNIVERSITY OF UTAH
DEPARTMENT OF ANTHROPOLOGY

ECOLOGICAL STUDIES
of the
FLORA AND FAUNA OF THE CURECANTI RESERVOIR BASINS
WESTERN COLORADO

Articles by

Angus M. Woodbury; Seville Flowers; Heber H. Hall and
Seville Flowers; Robert Newel Reynolds; R. Bruce Walker;
Calvin Ray Lamborn; Allen W. Knight and Delbert W. Argyle;
Jay W. Richardson, Jr.; A. Dean Stock; Delbert W. Argyle
and George F. Edmunds; Ronald W. Olson; and Stephen D.
Durrant and Elroy B. Robinson.

ANGUS M. WOODBURY, Biological Editor

Number 59 (Upper Colorado Series Number 8) November, 1962

A N T H R O P O L O G I C A L P A P E R S

Department of Anthropology

A C K N O W L E D G M E N T

The courtesy of the Division of Biological Sciences,
University of Utah, in releasing these papers for publication
in the Anthropological Series, instead of the Divisional
Biology Series, is acknowledged with appreciation.

UNIVERSITY OF UTAH
DIVISION OF BIOLOGICAL SCIENCES

ECOLOGICAL STUDIES

of the

FLORA AND FAUNA OF THE CURECANTI RESERVOIR BASINS
WESTERN COLORADO

A by-product of the cooperative agreement dated 28 April 1961

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Articles by

Angus M. Woodbury; Seville Flowers, Heber H. Hall and Seville Flowers; Robert Newell Reynolds; R. Bruce Walker; Calvin Ray Lamborn; Allen W. Knight and Delbert W. Argyle; Jay W. Richardson, Jr.; A. Dean Stock; Delbert W. Argyle and George F. Edmunds; Ronald W. Olson; and Stephen D. Durrant and Elroy B. Robinson.

ANGUS M. WOODBURY, Biological Editor

FOREWORD

This publication, containing a series of papers dealing with the flora and fauna along the Gunnison River in western Colorado, is one of a series that deals with investigations of the Colorado River System arising out of the water storage program provided by Congress for development of the Upper Colorado River Basin to conserve water and regulate stream flow (Act of 11 April 1956, 70 Stat. 105). The papers in this publication deal with ecological studies of the flora and fauna made as by-products of an expedition conducted by the University of Utah under my direction to survey the flora and fauna that will be inundated when the Curecanti reservoirs are filled.

Primary support for the expedition came from the U. S. Bureau of Reclamation, Region 4 Office at Salt Lake City which had need for a quantitative survey of the vegetation that will be lost by inundation. Auxiliary support was provided by the University Research Fund and the Division of Biological Sciences, Don M. Rees, Chairman. Further support came from the National Science Foundation in the form of a grant to permit four students to join the expedition for training with scientists engaged in ecological research.

Reports of previous ecological investigations in the Upper Colorado Basin by University personnel were published in University of Utah Anthropological Papers, numbers 31, 36, 40, 45, 48, 51, 55 and 56. Numbers 36, 45, 51 and 56 dealt with quantitative surveys of the vegetation in Glen Canyon, Flaming Gorge, Navajo and Curecanti reservoirs, respectively, prepared for the Bureau of Reclamation. The balance dealt with ecological studies of the floras and faunas of general scientific interest.

Angus M. Woodbury, Director

ECOLOGICAL STUDIES OF THE
FLORA AND FAUNA OF THE CURECANTI RESERVOIR BASINS
WESTERN COLORADO

CONTENTS

Foreword	iv
Contents	v
Biota of the basins; an introduction and summary	1
Vegetation of the basins	12
Annotated list of plants found	47
Comparison of south-facing and north-facing canyons	103
Theoretical cross-section transect	120
Limnological studies	135
A stream survey of East Elk Creek	151
Invertebrates	161
Endoparasites of mammals	161
General list of insects and ticks	167
Mayflies	178
Bat flies	190
Vertebrates	191
Amphibians and reptiles	191
Birds	195
Mammals of subaquatic habitats	222
Mammals	233
Index	264



Fig. 1. The Curecanti Needle, from which the project was named. Photo by Gerald R. Groves.

BIOTA OF THE CURECANTI RESERVOIR BASINS

WESTERN COLORADO

AN INTRODUCTION AND SUMMARY

Angus M. Woodbury

CONTENTS

Introduction	3
Ecological background	3
Vegetation of the basins	7
Ecology of Gunnison River	8
Invertebrate fauna	8
Vertebrate fauna	9
Effects of the reservoir	10

ILLUSTRATIONS

Figures

1. The Curecanti Needle	vi
2. The field crew	2
3. A view of the Blue Mesa reservoir basin	2
4. Black Canyon, a mile below Curecanti Needle	4
5. Black Canyon about three miles below Cimarron Cr.	4
6. Sagebrush dominates most of the hillsides	6
7. Meadows develop from irrigation or seepage	6

Table

1. Status of specimen identification	9
--	---

University of Utah
Anthropological Papers, No. 59, 1962
Upper Colorado Series, No. 8



Fig. 2. The field crew, from left, stooping: H. H. Hall, E. B. Robinson, R. B. Walker, G. R. Groves, R. N. Reynolds; standing: S. D. Durrant, P. C. Mountford, R. W. Olson, Seville Flowers, A. D. Stock, E. R. Riley, Delbert Argyle, A. W. Knight; on fence: C. R. Lamborn, G. L. Ranck, and J. W. Richardson, Jr. Photo by Gerald R. Groves.



Fig. 3. A view of part of the Blue Mesa Reservoir Basin. Photo by Gerald R. Groves.

INTRODUCTION

The papers in this publication are mainly products of an expedition to the Curecanti Unit reservoirs (Blue Mesa, Morrow Point, Crystal), conducted by the University of Utah from June 26 to July 23, 1961, under support from the U. S. Bureau of Reclamation, the University Research Fund, the University Division of Biological Sciences, and the National Science Foundation. The primary objective was a quantitative survey of the vegetation for the Bureau and all other studies were subordinate and geared to its progress. A report of the quantitative survey appeared in University of Utah Anthropological Papers, No. 56. This issue, No. , in the same series deals with ecological studies of the limnology of the river and the flora and fauna of the reservoir basins.

The expedition organized under the writer's direction had the following scientific personnel: Dr. Stephen D. Durrant, field director; Dr. Seville Flowers, field chief of vegetation survey; Gerald T. Groves, assistant to Dr. Flowers; Delbert W. Argyle, Heber H. Hall, Calvin R. Lamborn, Gary L. Ranck, Robert N. Reynolds, and A. Dean Stock, members of the vegetation survey crews; Allen W. Knight and Elroy B. Robinson, faunal study team; Paul C. Mountford, camp manager; Ronald W. Olson, Jay W. Richardson, Ernest R. Riley, and R. Bruce Walker, National Science Foundation students, assigned to participate in research with scientists of the expedition. In addition, Don M. Rees, Arden R. Gaufin, and I, each spent a day with the expedition in consultation with the personnel. The field crew is shown in Fig. 2.

Headquarters of the expedition were maintained at a vacant ranch home on Dry Gulch about 20 mi. downstream from the city of Gunnison, Colorado by permission from the Colorado State Game and Fish Department. From this place, the vegetation survey was started at the upper end and worked downstream successively through two and part of the third reservoirs. Faunal and limnological studies were geared to match.

ECOLOGICAL BACKGROUND

The Gunnison River, draining the west slopes of the high continental divide of the Rocky Mountains is an important contributing branch of the Colorado River. The high mountains where the tributaries arise are heavily forested, except where high peaks rise above timberline. The tributary creeks descend the steep mountain slopes rapidly, many of them through deep canyons, and coalesce with Gunnison River at lower altitudes. The main stem of the river rises near a 14,000 ft. peak and descends rapidly within the next 50 to 60 mi. past Gunnison City to about 7500 ft. at the upper end of the Blue Mesa Reservoir. A view within the reservoir basin is shown in Fig. 3.

Within the next 22 mi. through an open valley to the damsite of this reservoir, the river drops about 300 ft., approximately 15 ft. per mi. Within the next 20 mi. along the upper reaches of Black Canyon through Morrow Point



Fig. 4. Black Canyon, a mile below Curecanti Needle.
Photo by Heber H. Hall.

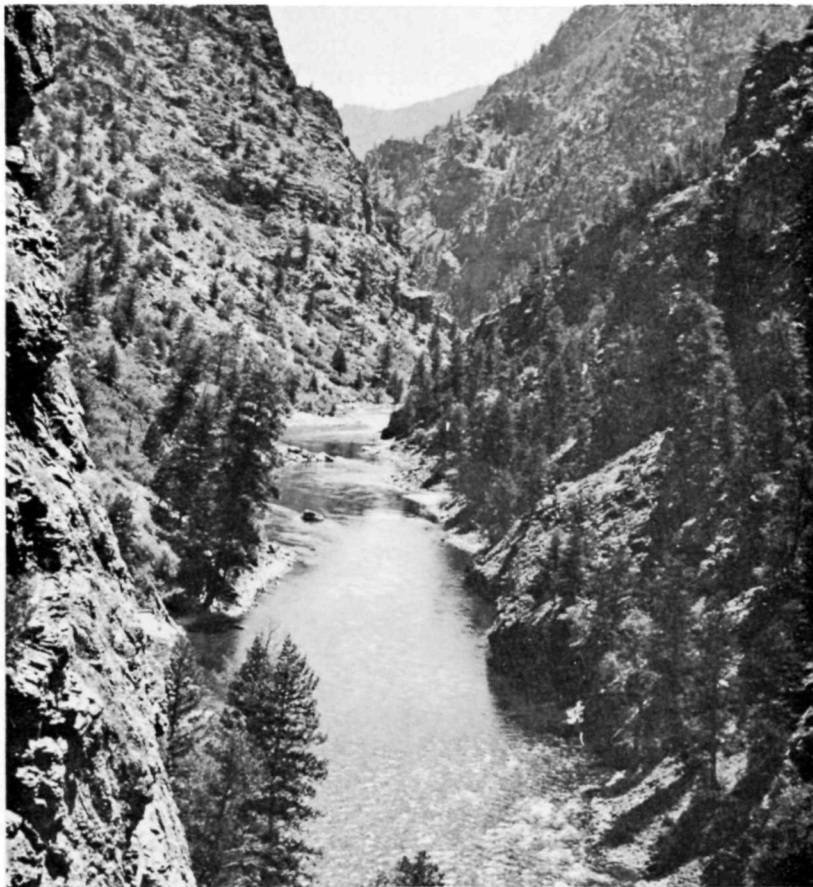


Fig. 5. Black Canyon about three miles
below Cimarron Creek. Photo by
Gerald R. Groves.

and Crystal reservoirs, it drops about 650 ft. averaging more than 30 ft. per mi. Here the river is swift and has a rocky bed with many riffles, rapids, cascades and pools. The canyon is narrow with steep hillsides of cliffs, rocks and talus. Soil is sparse and shallow, held in place mainly by plant roots anchored to the rocks, Figs. 4 and 5.

Above the Blue Mesa Dam in the upper narrows of Black Canyon, the canyon widens into a valley that extends upstream about 18 mi. to a smaller and less confining canyon about 4 mi. in length where the reservoir will end. Above this constriction is the larger and wider valley in which the city of Gunnison is located. The lower valley will be inundated by the water of the reservoir. The small village of Sapinero, the deluxe Moncrief Ranch and many of the farms, ranches, and resorts of the valley will be covered.

Black Canyon is cut through an uplift of Precambrian rocks of gneiss, schist and granite, above which the sedimentary rocks of later ages, encountered in surrounding areas, are here largely missing. The resistance and strength of these Precambrian rocks has enabled the walls to stand in cliffs and steep slopes while the river has cut its deep narrow channel in the hard rock. Above Black Canyon, the less resistant sedimentary rocks have permitted erosional widening into a valley. Into this valley, tributary streams enter from both sides, some of them through relatively shallow side canyons in comparison with the deep side canyon through which Cimarron Creek enters Black Canyon.

Lake Fork, entering the valley from the southeast (left bank) just above Black Canyon will produce a narrow embayment in the reservoir about 8 mi. in length. Cebolla Creek, next on the south side, will have an embayment more than half that length and South Willow Creek will make only a small indentation in the shoreline. On the north side (right bank), Soap Creek, West and East Elk creeks will make embayments of about 4, 2.5 and 1 mi., respectively. Several other side canyons will make small indentations.

The headwaters mountains, lying mainly in the Gunnison and Uncompahgre national forests, bear heavy spruce-fir forests. The precipitation in these mountains is more than adequate to saturate the deep litter and soil of the forests. The surplus either runs off at snow melting time or seeps downward through subterranean routes and emerges as springs. These springs feeding into the Gunnison River form an important source of water for the Colorado River.

Below the timbered zone, the precipitation rate falls off rapidly until, upon the main slopes leading into the valley within the reservoir site, the precipitation is inadequate to permit a complete ground cover of vegetation. On these lower slopes, the roots of perennial plants usually occupy more ground area under the surface than the foliage does above. This is interpreted to mean that the roots must extend farther over a larger area in proportion to the foliage volume as precipitation water becomes less adequate to fill the soil.

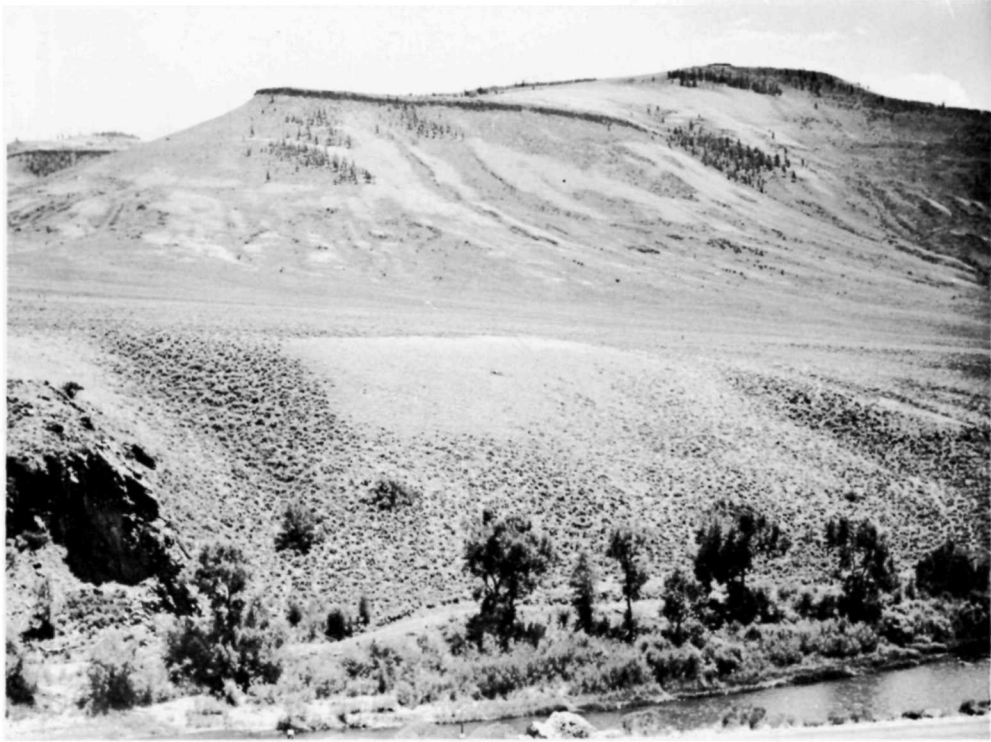


Fig. 6. Sagebrush dominates most of the hillsides but is often displaced by other plants where more soil moisture is available. Photo by Gerald R. Groves.



Fig. 7. Meadows develop from irrigation or seepage. Photo by Gerald R. Groves.

As plant foliage shrinks in volume, more of the bare soil surface is exposed to sunshine and more of the water in the soil evaporates directly from the soil surface. As more of the water is lost from the surface, less water is available for plant use. Plants that live in such areas must be adapted to subsist upon the scanty water supply available to them.

Fine-grained clay soils use more of the soil water by adsorption around the fine particles than do coarser soils. Rocks and cliffs do not usually absorb as much of the water as soil does and part of it may run off or be absorbed in adjacent soil. Where water is supplied by streams or seepage beyond that available from precipitation, plants that use water lavishly usually take possession. The contrast between the phreatophytes of the streamsides and the parsimonious shrubs of the hillsides is usually striking.

In canyons, where the cliffs or canyon walls shut out part of the daily sunshine and a canyon effect is produced, the modified habitat conditions usually provide more of the precipitation water for plant use than would be the case otherwise. The same is true for north-facing slopes where a given quantity of sunshine is distributed over much greater land surface than on south-facing slopes.

VEGETATION OF THE RESERVOIR BASINS

The vegetation of these reservoir basins and adjacent gentle slopes is dominated by the ubiquitous sagebrush, Artemisia tridentata, except where extra water supplied by streams is available or where physiographic features or soil types interfere or yield greater proportions of the precipitation water for plant use. The sagebrush is widespread over gentle slopes containing adequate fine loamy soils but is usually missing on coarse or rocky soils and on areas where additional soil moisture gives an advantage to plants requiring more water. Where sagebrush occurs, it has many associated plants, including more than 20 shrubs and over 100 herbs and grasses, Fig. 6.

The streamsides where adequate water is available to the roots of plants, are usually dominated by the narrowleaf cottonwood, often with an understory of willows (4 species), alder, hawthorn, river birch, or shrubs of smaller size, usually including dogwood, currant, wild rose, service berry, and several others. Where this dominant cover has not been developed on flood plains or gravel bars, less permanent herbaceous cover often occurs, including both annual and perennial plants. In some places where ponds occur, communities of rushes have developed in the shallow water or around its edge, Fig. 7.

Many of the terraces, benches, and gentle slopes of the valley have been transformed into farms, fields, pastures, or ranches where domesticated plants and weeds have replaced the native vegetation. These plants consist mainly of hay and pasture grasses, sedges and rushes; alfalfa and clovers; and many kinds of weeds.

On mountain slopes and in canyons where the exposures are exaggerated, a different flora usually occurs, including Gambel oak, mountain red juniper, choke cherry, alder, birch, hawthorn, and in special favorable nooks, even Douglas fir and blue spruce. Many of the rough rocky slopes are nearly bare of vascular plants but the rocks and cliff faces are often coated with lichens and moss.

ECOLOGY OF THE GUNNISON RIVER

The steep grades of the river and its tributaries assure rapid flowage of the water. In the Blue Mesa Reservoir, with a fall of about 15 ft. per mi. there is considerable meandering but in the other two reservoirs with double that fall, the stream follows the bottom of the canyon where there is practically no opportunity for deviation. The grades, however, are by no means regular. Rapids, riffles and pools break the regularity of flow, especially in Black Canyon. Most of the riffles and rapids occur below some blockade in the stream such as large rock falls from the cliffs or at the mouth of incoming tributaries that bring extra sediments into the main stream and build up the bed. Pools are generally found where stream currents gouge depressions in the streambed, Figs. 4 and 5.

INVERTEBRATE FAUNA

In collecting invertebrates, emphasis was placed upon both terrestrial and aquatic insects with minor emphasis on arachnids, mainly ticks. Special studies of the mayflies and bat flies are reported in special articles. Others identified sufficiently to be listed are given in general lists.

The streams were very productive of mayflies. Six families, 11 genera and 20 species were represented by the specimens collected. Of the bat flies, only one species, Basilia forcipata Ferris, was found. It occurred on five specimens of four species of Myotis but no flies were found on seven specimens of Myotis and one specimen of Eptesicus.

The specimens of arthropods collected far outnumbered those identified sufficiently to be included in the general lists. Those included in the lists represent nine orders of insects and one of arachnids. Of these, four orders, Collembola, Thysanura, Hemiptera, and Acarina are represented in the collections only by one family each; Siphonaptera by two; Neuroptera by three; Diptera by four; Lepidoptera and Hymenoptera by five; and Coleoptera by 28. The beetles received more attention in identification than other groups. Most of the specimens were sorted to orders and families. Some specimens were sorted to genus and in five orders some of the specimens were carried to species. A summary of those identified is given in Table 1.

Table 1. Status of Specimen Identification.

Orders	No. Families	No. Genera	No. Species
INSECTS			
Collembola Springtails	1		
Thysanura Bristle-tails	1	1	
Neuroptera Lacewings	3	2	
Hemiptera Bugs	1	11	10
Coleoptera Beetles	28	48	15
Lepidoptera . . Butterflies, moths	5	7	
Diptera 2-winged flies	4	7	12
Siphonaptera Fleas	2	5	4
Hymenoptera Bees, etc.	5	9	
ARACHNIDS			
Acarina Ticks	1	3	4

While collecting vertebrates, the carcasses of 107 specimens of mammals were preserved in formalin in the field and later examined in the laboratory for endoparasites. Of these, 72 specimens were negative and 37 contained parasites of nematodes, cestodes, or acanthocephalans.

VERTEBRATE FAUNA

Among the vertebrates, only one amphibian, the leopard frog, was found although others may be present. It was commonly observed along the river and its numerous tributaries, in beaver ponds and in marshy areas. Reptiles were represented in the collections only by two lizards of the genus *Sceloporus* and one snake of the genus *Thamnophis*, the widespread wandering garter snake. This mountainous region lying on the western slope of the high Rocky Mountains has little precipitation and lies at a high altitude that most amphibians and reptiles of Western Colorado do not reach.

Birds form the bulk of the vertebrate population of this study area. The list of birds include 165 species, of which, 63 are considered as permanent residents, 71 as summer residents and 31 as winter residents, migrants or casuals. They are associated with a variety of habitats, ranging from open water of streams and ponds through marshy meadowlands, gravel banks and shores to terrestrial vegetation of streamsides, terraces, farmlands and hillsides represented by grasses, shrubs, willows, scrubby trees and taller trees, mainly of cottonwoods and conifers. These habitats are not always sharply defined and birds that might otherwise be widely separated ecologically may be found close together.

The mammalian fauna found here includes 36 species of 26 genera in 13 families belonging to 6 orders. These include 2 species of shrews, 6 bats, 2 rabbits, 18 rodents, 6 carnivores and 2 ungulates. The ecological conditions that make it difficult to segregate birds by habitat also apply to the mammals and many of those that would otherwise be widely separated ecologically are in some cases found in close proximity to each other.

Durrant suggests from his knowledge of surrounding fauna that an additional 53 species of 37 genera in 14 families belonging to the same 6 orders are likely to occur in the Colorado Basin.

A special study of the mammals of subaquatic habits revealed that 9 species were found in meadow, streamside or pond edges but 3 of these were extensions from adjacent terrestrial habitats, leaving 6 species that appear to be obligate inhabitants of moist or subaquatic habitats.

EFFECTS OF THE RESERVOIRS

When the reservoirs are filled, the rapid water streams will be transformed into still water lakes that will fluctuate in level from season to season and from year to year. This will transform terrestrial habitats of the basins into aquatic environment. The inundated vegetation and most of the associated animals will perish. Even the swift stream flora and fauna may be similarly affected. Most of the species will be replaced by still water forms.

All three reservoirs will be deep enough so that the cold water of winter will be trapped in the bottom when the surface water is warmed in the summertime. Since the three reservoirs are close together in succession, cold water drawn from the upper basin below the thermocline will flow into the second and thence into the third with little chance for warming. A cold water stream would leave the lower reservoir and flow down through Black Canyon National Monument unless diverted before it reaches that place.

The continual fluctuation of water levels in the reservoirs will effectively prevent establishment of wateredge vegetation along the shore and it can confidently be expected that there will be barren areas along the shore below the high water mark when the reservoirs are not full.

It is expected that the plankton of the lake will flourish since it would not, as in a river, continually be washed downstream. The changes in volume of the aquatic habitat produced by the fluctuations will affect the the productivity by alternate contractions and expansions of the environment. The rapid stream insects such as mayflies, dragonflies, stoneflies, and caddisflies, would be much reduced or excluded from the still water of the reservoirs although they might be continually carried into the still water from the mouths of incoming streams. The rapid stream fishes will no doubt be affected by the

changed food supply, the lack of current, temperature, and other factors. If they cannot adjust to the new conditions and compete with still water fish, they will be replaced by lake inhabiting species.

The great expansion in lake surface will be especially inviting to certain kinds of water birds, especially to migrating waterfowl that can rest on the surface and feed in the water, and to wading birds that can live along the shores. It will not be so inviting to breeding water birds where barren shores do not provide suitable nesting sites.

With the filling of the reservoirs, most of the lizards, snakes, rodents and other sedentary animals will be driven upward by the rising water, exposing them to greater predation or to competition on ranges already occupied. Some of the larger or more active mammals such as beavers, carnivores and deer might move upward above the lake water but they would find similar problems of competition on ranges already occupied.

Since the natural habitat of the animals of the basins will be destroyed, any temporary increase in numbers above the rising waters would soon be reduced to normal levels by natural processes of predation and competition. Much of the resulting decimation resulting from the rising waters would be produced by driving the animals out of their established shelters and out of their home ranges, exposing them to weather and greater chance of predation in unfamiliar surroundings.

The Blue Mesa Basin is now known to be a wintering ground for big game (elk and deer) that descend into the valley from the mountains to the north, and possibly from those to the south. Some of them are known to cross the valley in their migration. The reservoir will not only cover part of their winter range but will also interpose a hurdle in their migration path. It is expected that this interference will be detrimental to the big game herds.

VEGETATION OF MORROW POINT AND BLUE MESA RESERVOIR BASINS
of the
UPPER GUNNISON RIVER, COLORADO
Seville Flowers

CONTENTS

Introduction	13
Location and extent of the area	13
Geology and topography	13
Blue Mesa Basin	13
Morrow Point Basin	14
Climate	14
The vegetation	15
Streamside communities	15
Herbaceous communities	17
Mixed herbaceous communities	17
Rush communities	20
Ponds and wet meadows	22
Tree and shrub communities	23
Narrowleaf cottonwoods	23
Small tree and shrub communities	29
Terrace communities	30
Hay fields and weed communities	32
Farmlands	32
Weed communities	32
Hillside and upland communities	35
Big sagebrush communities	35
Uplands of the canyons	40
Mosses and liverwort	43
Algae	44

ILLUSTRATIONS

Figure

1. Sharp contrasts shown between streamside and hillside	16
2. Streamside communities showing wide gravel bar	16
3. Big sagebrush dominating hillside	36
4. Spruce and Douglas Fir dominate streamside	36

INTRODUCTION

The present article deals with a survey of the vegetation of the basins of the Gunnison River expected to be flooded by the Morrow Point and Blue Mesa reservoirs in central western Colorado. A reconnaissance trip was made June 7 to 9 followed by an expedition June 26 to July 23. During these periods, notes were taken on the floristics and ecological plant communities of the region. Specimens of plants collected are deposited in the herbarium of the University of Utah. Results of the observations are presented here.

LOCATION AND EXTENT OF THE AREA

The overall area embraces about 40 river miles extending from a point about 6 mi. west of the town of Gunnison westward to a point near the junction of Cimarron Creek with the Gunnison River. The lowest elevation at the base of the Morrow Point Dam site is 6,780 ft. and the highest level of the Blue Mesa Reservoir will reach 7,320 ft., a range of 740 ft. While the survey of the vegetation was limited to the areas which will be inundated, this general study includes the lower slopes of the mountains above the levels of the reservoirs. The Blue Mesa basin includes several side canyons which will be inundated. At the highest level, the water will extend 8 mi. into Lake Canyon, $4\frac{1}{2}$ mi. into Cebolla Canyon, these entering from the south, and 4 mi. into Soap Creek Canyon entering from the north.

GEOLOGY AND TOPOGRAPHY

The greater part of the basin lies in an area of igneous rocks consisting of pre-Cambrium gneiss, schist and granitic rocks with a few exposures of Cretaceous shales and sandstones in the Blue Mesa basin. The igneous rocks are variable in character ranging from fine grained to extremely coarse porphyritic granite and gneiss some of which are composed of extremely large pheocrysts of feldspar and mica in a matrix of quartz. The predominating color is reddish with local areas of gray or dark rocks. The upper Blue Mesa basin consists mainly of open valleys while the lower Morrow Point basin occupies the narrow gorge of the upper part of Black Canyon.

Blue Mesa Basin

The Blue Mesa basin begins at its upper extremity in Eagle Rock Canyon, a short section about 3 mi. long, followed by Iola and Sapinero valleys, 4 and 8 mi. long respectively, and about 1 mi. in width. These valleys are separated by a higher terrace-like traverse, about 4 mi. long, through which the river passes in a little gorge about 200 ft. in depth.

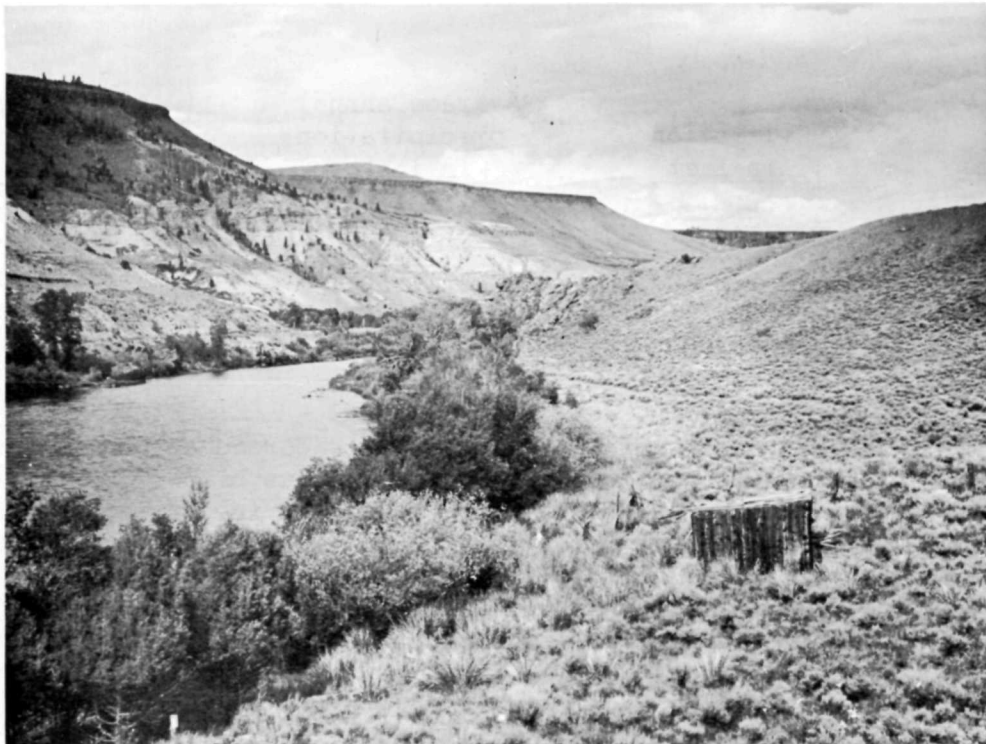


Fig. 1. Sharp contrasts sometimes occur between the phreatophytes of the streamside and the vegetation of the hillside. Photo by Gerald R. Groves.



Fig. 2. Streamside communities showing wide gravel bar in foreground and cottonwoods beyond. Photo by Gerald R. Groves.

Herbaceous Communities

With the exception of low lying flood plains and vertical banks scoured by flood waters, most of the stream banks harbour herbaceous plants, disposed according to the nature and extent of the habitats. On the depositing sides of the streams gently rising or nearly level flood plains may be as much as 50 or 60 ft. wide in the broader parts of the valleys but in most areas, they are narrow zones ranging from a few feet to about 20 ft. wide. The length varies according to the course of the stream, being short in the more sinuous parts and upwards to nearly 1 mi. long in the straighter parts. Along quieter waters the deposits are mainly brown mud, often sandy in quality, and sometimes strewn with cobbles or large boulders. On areas along swifter currents the deposits are usually sandy or gravelly, sometimes with numerous cobbles forming a sort of shingle.

There is great diversity in the density and composition of herbaceous communities on the riverbanks. A few of the more prominent situations will serve to give an epitome of these communities throughout the region.

Mixed herbaceous communities

Widely spaced small herbs occur on some flood plains, although some species aggregate in small local stands. The variable composition is due mainly to the nature of the substrate and degree of flooding. The following three communities are representative:

1. Wet muddy flood plains along the Gunnison River bear a few widely scattered species. The waterstarwort, Calitriche, grows in little puddles of water and small lagoons and extends outward prostrate on the wet mud, the small slender stems and widely spaced narrow opposite leaves giving it a spindly appearance. The speedwell, Veronica wormskjoldii R. & S., is a small erect annual, often quite abundant but well spaced. The arrowgrasses, Triglochin maritima L. and T. palustris L., have short tuberous stems bearing dense clusters of dark green grass-like leaves with single tall naked flowering stalks bearing a dense spike of small greenish flowers at the summit. They occur isolated or sometimes in small clumps. The ever present horsetails, Equisetum arvense L. and E. kansanum Schaffn., with their leafless jointed stems lend a paler shade of green among the darker plants. Here and there the trailing buttercup, Ranunculus cymbalaria Pursh, and the silverweed, Potentilla anserina L., with bright yellow flowers spread their stems and leaves closely over the brown mud. Macoun's buttercup, Ranunculus macounii Britt., stands out more conspicuously by virtue of its taller dark green ample foliage. In some instances the rushes, particularly Juncus balticus L. and Eleocharis palustris (L.) R. & S., have begun to invade these situations. Rows of well spaced individuals arising from underground rhizomes creep outward from the distal margins of the flood plains. More advanced stages show a procession of plants following the rushes depending upon the contour and pitch of the outer banks.

2. Narrower flood plains with a steeper pitch, range upwards to 15 or 20 ft. wide and as much as 300 yds. long. The soils are basically muddy but often contain sand, numerous pebbles, and small cobbles. Narrow flood plains occur sparingly along the Gunnison River but are frequent in the mouths of side canyons. The scattered growths of low herbs range upward to as much as 20 per cent density with vague traces of zonation toward the distal margins of the banks where they often give way suddenly to dense growths of willows, alder and birch with dense grass and herbage beneath. A wide variety of herbs and grasses occurs here while the rushes are generally scarce or lacking. Typical of these situations are the following:

<u>Equisetum arvense</u> L.	Meadow horsetail
<u>Alopecurus aequalis</u> Sobol	Marsh foxtail
<u>Agrostis palustris</u> L.	Marsh redtop
<u>Beckmannia syzigachne</u> (Steud.) Fernald .	Sloughgrass
<u>Bromus ciliatus</u> L.	Fringed brome
<u>Catabrosa aquatica</u> (L.) Beauv.	Brookgrass
<u>Phleum pratense</u> L.	Timothy
<u>Poa palustris</u> L.	Fowl bluegrass
<u>Ranunculus cymbalaria</u> Pursh.	Trailing buttercup
<u>Radicula lyrata</u> (Nutt.) Greene	Yellow watercress
<u>Potentilla anserina</u> L.	Silverweed
<u>Trifolium repens</u> L.	White clover
<u>Trifolium hybridum</u> L.	Alsike clover
<u>Epilobium adenocaulon</u> Hausskn.	Willowherb
<u>Veronica americana</u> Schwein.	American speedwell
<u>Veronica worms kjoldii</u> R. & S.	Speedwell
<u>Mentha penardi</u> (Briq.) Rydb.	Mint
<u>Scutellaria galericulata</u> L.	Skullcap
<u>Stachys palustris</u> L.	Hedge nettle
<u>Plantago major</u> L.	Big plantain

Toward the outer limits of the flood plains the following appear:

<u>Ranunculus macounii</u> Britt.	Macoun's buttercup
<u>Thermopsis montana</u> Nutt.	Yellow mountain thermopsis
<u>Glycyrrhiza lepidota</u> Nutt.	Wild licorice
<u>Hypericum formosum</u> H.B.K.	St. Johnswort
<u>Arnica fulgens</u> Pursh.	Black-eyed Susan

The extremities of these flood plains often give way to steeper slopes, sometimes with boulders, or to low vertical soil banks above the edge of the water. Here tall grasses and sedges occasionally form dense clumps of one species, or sometimes two or three in various combinations. Notable examples are seen in tall tussocks of the gracefully drooping American manna grass, Glyceria grandis S. Wats., or the strict erect sloughgrass, Beckmannia syzigachne (Steud.) Fernald. The tall coarse Nebraska sedge,

Carex nebraskensis Dewey and the smaller slender species, Carex foenea Willd., C. microptera Mack. and C. praeegracilis W. Booth, also assume this habit.

3. Wide gravel bars, often quite rocky and sometimes watered by seepage springs along the outer margins, usually display a pleasant aspect especially typical along the side streams. Against a background of lighter colored sandy gravel interspersed with cobbles most of the plants are low and widely dispersed with a few taller ones here and there, sometimes in small clumps. The liverwort, Marchantia polymorpha L., spread its flat thallus over wet gravel and rocks while a few mosses, notably Funaria hygrometrica and Bryum cuspidatum (B.S.G.) Schimp. form bright green cushions set off by rich yellowish-brown capsules. Clumps of the bitter cress, Cardamine cordifolia A. Gray, with its ample foliage and clusters of white flowers grow in shallow water along the brooks and in springs contrasting with the yellow monkey flower, Mimulus guttatus DC., with which it shares the watery habitat. Among the rocks the plants are generally scattered, none particularly dominant, but several are especially characteristic of this type of habitat. Among the latter are the cudweed, Gnaphalium palustre Nutt., a rather small herb densely covered with tangled white hairs; avens, Geum macrophyllum Willd., a close relative of the cinquefoils, which grows quite tall and spindly; golden dock, Rumex persicarioides L., curly dock, R. crispus L., and selfheal, Prunella vulgaris L. The tall evening primrose, Oenothera hookeri T. & G., with its large yellow flowers; and lovely pearly everlasting, Anaphalis margaritacea subalpina A. Gray with its clusters of small intensely white flowers add a special accent to the general color aspect. Tall tufts of the fowl manna grass, Glyceria striata (Lam.) Hitchc., with gracefully drooping slender and diffusely branched flower clusters add a pleasing contrast to the dominantly erect herbs. Most of the other species of this type of community are those common to the river banks of the region and include the following: (Fig. 2).

<u>Equisetum arvense</u> L.	Meadow horsetail
<u>Alopecurus aequalis</u> Sobol.	Marsh foxtail
<u>Hordeum nodosum</u> L.	Meadow barley
<u>Panicum capillare</u> L.	Witchgrass
<u>Phleum pratense</u> L.	Timothy
<u>Juncus saximontanus</u> A. Nels.	Rocky Mt. rush
<u>Urtica gracilentia</u> Greene	Stinging nettle
<u>Ranunculus cymbalaria</u> Pursh.	Trailing buttercup
<u>Ranunculus macounii</u> Britt.	Macoun's buttercup
<u>Trifolium repens</u> L.	White clover
<u>Potentilla anserina</u> L.	Silverweed
<u>Epilobium adenocaulon</u> Haussk.	Willowherb
<u>Erigeron canadensis</u> L.	Canadian fleabane
<u>Taraxacum officinale</u> Wiggers	Common dandelion

Rush Communities

The baltic rush, Juncus balticus L., locally called wiregrass, and the spike rush, Eleocharis palustris L., are the commonest species invading the banks of the Gunnison River and are also prominent on the banks of side streams. The baltic rush is an erect dark green leafless herb with cylindrical or somewhat flattened stems, often twisted slightly, arising from creeping underground rhizomes either widely spaced in rows or in dense clusters, and range from 1 to 3 ft. in height. Small reddish-green flowers are borne in what appears to be a lateral subterminal panicle, but actually are terminal with a cylindrical slenderly tapering bract extending vertically and continuous with the stem. Each flower is made up of three sepals, three petals, six stamens and a three-celled ovary maturing as a small brown capsule.

The spike rush also spreads by rhizomes and is strict and erect with leafless cylindrical stems but is much more slender and paler green. It ranges from 6 to 18 ins. tall and bears a small terminal grass-like spike of light brownish-green flowers.

Less frequent but locally dominant are several sedges, Carex spp. These are grass-like herbs with triangular stems bearing the leaves in three rows in contrast with true grasses which have cylindrical stems with the leaves alternate in two rows. The flowers are in terminal and lateral spikes. Carex nebraskensis Dewey is a tall coarse species reaching nearly 3 ft. tall, the stems usually growing in dense tufts with the long bright green keeled leaves arching outward. Two other less conspicuous species are Carex foenea Willd. and C. praegracilis W. Booth, both of which are much more slender.

Communities dominated by the rushes are variable in aspect and range from practically bare muddy flood plains with only a few pioneers sending out long rows of widely spaced stems toward the river through various intermediate successional stages to dense growths completely obscuring the riverbanks. On low vertical banks on the cutting sides of the river, these plants usually form a narrow zone giving way abruptly to thickets of willow, alder and dogwood or to open meadows or farmland. Broad open muddy flood plains, often strewn with rocks, usually show irregular successional zones of diverse character depending upon the nature and extent of the banks, and to a great extent, upon which species gets there first in sufficient numbers to establish a zone. In general, the meadow horsetail, Equisetum arvense L. and Kansas horsetail, Equisetum kansanum Schaffn. usually appear following the pioneer rushes but evidence of a definite zone is vague. Several low herbs usually follow in similar manner, some of them becoming locally aggregated. Among the conspicuous ones are the following: The silverweed, Potentilla anserina L. has a rosette of compound pinnate leaves spreading closely to the soil, the lower and sometimes the upper surface clothed with dense silvery white appressed hairs. It bears bright yellow flowers and spreads by long slender stolons. The willowherb, Epilobium adenocaulon Haussk., is a slender erect plant with small white or pink flowers in narrow racemes. Seasonal flooding restricts its growth to 4 to 6 ins. tall.

The speedwell, Veronica americana Schwein. is a spreading perennial and V. wormskjoldii R. & S., an erect annual. Brookgrass, Catabrosa aquatica (L.) Beauv. and water foxtail, Alopecurus aequalis Sobol are especially typical and general on many flood plains.

The rushes and sedges are sturdy plants and strong competitors tending to aggregate in dense colonies and force out the plants less well adapted to the changing situations. Older stabilized flood plains show dense fields of the dark green baltic rush along the outer portions of the flood plains and sometimes extending to the margin of the river where the current washes against the stiff stems. The smaller spike rush and the slender species of sedges generally persist in reduced numbers against the pressure of the stouter baltic rush and in many instances they become completely eliminated. Ordinarily the sedges tend to aggregate themselves and when in sufficient numbers resist the invasion of rushes. Thus, it is not uncommon for them to form dense clumps of lighter green spreading foliage in contrast with the strict dark green rushes. In a few instances the sedges and rushes occur in separate parallel zones, particularly on older slightly terraced flood plains where stabilization has reached a maximum.

The following is a generalized list of plants of the rush communities:

<u>Triglochin maritima</u> L.	Seaside arrowgrass
<u>Triglochin palustris</u> L.	Podgrass
<u>Agrostis palustris</u> Huds.	Marsh reedtop
<u>Beckmannia syzigachne</u> (Stued.) Fernald	Sloughgrass
<u>Hordeum jubatum</u> L.	Foxtail barley
<u>Poa palustris</u> L.	Marsh bluegrass
<u>Poa pratensis</u> L.	Kentucky bluegrass
<u>Polypogon monspeliensis</u> (L.) Desf.	Beardgrass
<u>Carex microptera</u> Mack.	Sedge
<u>Carex rostrata</u> Stokes	Beaked sedge
<u>Juncus longistylis</u> Torr.	Meadow wiregrass
<u>Juncus saximontanus</u> A. Nels.	Rocky Mt. wiregrass
<u>Luzula parviflora</u> Desv.	Woodrush
<u>Polygonum amphibium</u> L.	Water smartweed
<u>Rumex crispus</u> L.	Curly dock
<u>Rumex mexicanus</u> Meisn.	Mexican dock
<u>Rumex persicarioides</u> L.	Golden dock
<u>Ranunculus cymbalaria</u> Pursh.	Trailing buttercup
<u>Ranunculus macounii</u> Britt.	Macoun's buttercup
<u>Radicula lyrata</u> (Nutt.) Greene	Yellow watercress
<u>Prunella vulgaris</u> L.	Selfheal
<u>Veronica anagallis-aquatica</u> L.	Speedwell
<u>Plantago eriopoda</u> Torr.	Plantain
<u>Plantago major</u> L.	Big plantain
<u>Solidago sparsiflora</u> L.	Goldenrod
<u>Taraxacum officinale</u> L.	Dandelion

Ponds and Wet Meadows

In the wider valleys, small lagoons, ponds and wet meadows are watered by springs arising along the bases of the bordering hills, while in the narrower canyons beaver ponds are frequent. Seepage from irrigation ditches often augments the source of water and extends the area of aquatic habitats. The wet meadows are often continuous with the flood plains of the rivers and generally are continuous with the ponds. Some of the larger irrigation ditches accumulate seepage water which stands most of the year.

Most of the ponds are small and while variable individually, collectively they present a highly typical hydrophytic vegetation. Many of them harbour a rich algal growth (treated separately later) and submerged vascular plants including the pondweed, Potamogeton pectinatus L., water buttercup, Batrachium trichophyllum (Chaix) Bossch., water milfoil, Myriophyllum exalbesces Fern. and the bladderwort, Utricularia vulgaris L. All of these plants have very slender or narrowly divided leaves. Conspicuous emergent types include the mare's tail, Hippuris vulgaris L., an erect dark green herb with spreading verticillate leaves, the bulrushes, Scirpus americanus Pers., S. microcarpus Presl. and S. rubrotinctus Fern. In a few instances the narrowleaf cattail, Typha angustifolia L. is present. The water smartweed, Polygonum amphibium L. occurs both in the ponds where the leaves are floating and on the wet banks where it becomes more or less erect. On open muddy banks the little mudwort, Limosella aquatica L., spreads by slender stolons and sends up clusters of narrowly spatulate leaves at points where the nodes take root. The rushes and sedges usually crowd in closely on the muddy borders and are sometimes partially emergent where they have extended into the water. The baltic rush and tall Nebraska sedge are usually abundant together with a number of grasses some of which are common hay grasses cultivated in the region. These include redtop, marsh redtop, American and fowl manna grasses, Kentucky blue grass, marsh blue grass, slough-grass, smooth brome and timothy. Dropseed muhly occasionally forms dense stands along wet borders and in drier willow thickets. The tall reed, Phragmites communis Trin., occurs sparingly around some swampy situations and toward the drier borders the stout Canadian ryegrass and giant ryegrass stand out in tall clumps. The baltic rush has invaded some of the damp hay field adjacent to ponds and marshy ground forming irregular dark green patterns against the lighter green of the grasses.

In more open situations, where the grasses are not quite so dense and especially where cattle graze, a number of colorful flowers are found. Among the prominent ones are the blue-eyed grass, Sisyrinchium montanum Greene, red clover, Trifolium pratense L., the tall pink fireweed, Epilobium angustifolium, L., the lousewort, Pedicularis crenulata Benth. and yellow-flowered species including the tall evening primrose, Oenothera hookeri T. & G., monkey flower, Mimulus guttatus DC., Arnica fulgens Pursh., Canadian goldenrod, Solidago canadensis L., the black-eyed Susan, Rudbeckia hirta L., and the coneflower R. laciniata L.

Other frequent species include the following:

<u>Smilacina stellata</u> (L.) Desf.	False Solom seal
<u>Urtica gracilentia</u> Greene	Stinging nettle
<u>Ranunculus sceleratus</u> L.	Cursed crowfoot
<u>Choriospora tenella</u> DC.	Choriospora
<u>Stellaria longipes</u> Goldie	Bedstraw
<u>Trifolium pratense</u> L.	Red clover
<u>Melilotus alba</u> Desr.	White sweetclover
<u>Thermopsis montana</u> Nutt.	Yellow Mt. thermopsis
<u>Sidalcea candida</u> A. Gray	White prairie mallow
<u>Sidalcea neomexicana</u> A. Gray	False mallow
<u>Hypericum formosum</u> H.B.K.	St. Johnswort
<u>Epilobium adenocaulon</u> Haussk.	Willowherb
<u>Cicuta douglasii</u> (DC.) Coult.	Water hemlock
<u>Heracleum lanatum</u> Michx.	Cow parsnip
<u>Sium suave</u> Walt.	Water parsnip
<u>Apocynum cannabinum</u> L.	Indian hemp
<u>Asclepias speciosa</u> Torr.	Milkweed
<u>Mentha penardi</u> (Briq.) Rydb.	Mint
<u>Stachys palustris</u> L.	Hedge nettle
<u>Veronica americana</u> Schwein.	American speedwell
<u>Veronica anagallis-aquatica</u> L.	Speedwell
<u>Valeriana edulis</u> Nutt.	Western valerian
<u>Taraxacum officinale</u> Wiggers	Dandelion
<u>Xanthium saccharatum</u> Wallr.	Cocklebur

In a few local areas where sandstone rocks are exposed, seepage springs have leached out soluble salts, principally sodium sulphate, creating marshy situations. Here a number of salt-loving plants occur including the arrowgrass, Triglochin maritima L.; salt grass, Distichlis stricta (Torr.) Rydb.; the alkali grass, Puccinellia distans (L.) Parl.; beardgrass, Polypogon monspeliensis (L.) Desf.; alkali sacaton, Sporobolus airoides Torr.; dropseed muhly, Muhlenbergia asperifolia (N. & M.) Parodi; squirreltail barley, Hordeum jubatum L.; annual atriplex, Atriplex hastata L.; and annual inkweed, Suaeda depressa (Pursh.) S. Wats.

Tree and Shrub Communities

Narrowleaf Cottonwood Communities (Fig. 2)

The narrowleaf cottonwood, Populus angustifolia James, is the most conspicuous tree along the water courses, reaching 50 to 60 ft. in height, with pale whitish-green branches and twigs bearing dark green lanceolate leaves on short petioles while the older trunks become gray and deeply furrowed, sometimes becoming as much as 2 or 3 ft. in dia. at the base. Many trees have the habit of forming a skirt of small branches and suckers around the base and lower

trunks. Frequently two to four trunks arise in juxtaposition from the ground, diverging upwards with coalescing crowns which are generally broadly lobed in outline.

The cottonwood communities are variable in distribution and extent. Along the Gunnison River in Eagle Rock Canyon and in Iola and Sapinero valleys the communities may extend along one or both sides more or less continuously for as much as 3 or 4 mi. The width varies from narrow open fringes 30 to 60 ft. wide to groves on some terraces as much as 100 yds. wide. In the narrower parts of the Gunnison valley and particularly in Black Canyon and the side canyons, the cottonwood communities become discontinuous and often spotty, single trees, clumps, or small groves occurring here and there depending upon the varying width of the banks and terraces. The trees are usually restricted to the outer limits of broad flood plains but on cutting banks or in narrow canyons where the current is swift, they frequently grow close to the water's edge.

Undisturbed communities generally have one or more understories of lower plants which vary considerably in density and composition from place to place. The principal understory is composed of small trees 10 to 15 ft. tall and include willows, birch, alder, hawthorn and red osier dogwood which generally occur close to the streams and frequently extend along the banks and terraces beyond the limits of the dominating cottonwood whence they become the dominant types. In the latter areas, they are treated as separate communities. A second shrubby story, reaching upwards to about 8 ft. tall, includes wild rose, wild currants and twinberry, and also on the drier parts of terraces, Oregon grape, snowberries and occasionally red elderberry. Here and there vines of the hop and virgin bower clamber upward among the branches of the shrubs or trees. In some places where the small trees are lacking, the shrubs form the principal understory. A third understory of herbaceous plants of wide variety is generally present in places where the shrubs and trees are well spaced and not too dense. The composition is usually mixed although grasses are frequently dominant, especially where they crowd closely along the stream sides or the outer limits of flood plains.

Some plants typical of the drier terraces or adjacent steeper slopes extend into the cottonwood communities to variable degrees. Gambel oak, choke-cherry, service berry, squawbush, shrubby cinquefoil and even the mountain red juniper are notable in this respect. In Eagle Rock Canyon and high up in Soap Creek Canyon, Douglas fir and blue spruce also enter the community.

In open park-like groves, grasses and other herbs carpet the ground beneath the cottonwoods and often extend to the open terraces where they constitute the dominant flora in these areas. The dominant grasses include Kentucky and Canadian bluegrasses, smooth brome, hairy chess, redtop, western bluestem and slender wheatgrass. These occur in various combinations according to the situation; sometime one species or two or three together dominate the others. Tall clumps of the giant ryegrass scattered here and there are conspicuous by their size and are a constant feature in the various aspects of stream side and terrace communities.

Many frequent or locally abundant herbs are conspicuous by their numbers, or size, ample foliage, or by colorful flowers. While general in distribution the false Solomon seal, stinging nettle, tall stickseed, and northern bedstraw have the habit of aggregating in dense colonies, especially around the perimeter of dense clumps of wild rose or willow, birch and hawthorn thickets. In more open places the plains mustard, Schoenocrambe linifolia (Nutt.) Greene occurs in colonies, spreading by underground stems, while weedy species like the poverty weed, Monolepis nuttalliana, blite, Blitum capitatum, the tansy mustard, peppergrass and penny cress colonize areas of disturbed soil.

The more conspicuously colored wild flowers are more or less scattered but some of them tend to form colonies in certain favorable spots. Notable red or pink-flowered plants are scarlet gilia, Indian paintbrush, Rocky Mountain beeweed, collomia and wild sweet William. Purple and blue species include wild sweetpea, the locoweed, Astragalus agrestis, lupine, Fendler's clover, mountain hollyhock, tall stickseeds, Mertensia ciliata, two species of bluebell and the tall handsome Pentstemon comarrhenus. Yellow sweet clover, wall flower, false dandelions and senecios are the principal yellow species while the white ones are white sweet clover, penny cress, tall locoweed, white-flowered mountain hollyhock and yarrow.

The generalized composition of the narrowleaf cottonwood communities is as follows:

Dominant:

Populus angustifolia James Narrowleaf cottonwood

Subdominant:

Salix bebbiana Sarg. Bebb willow
Salix caudata (Nutt.) Heller Whiplash willow
Salix exigua Nutt. Sandbar willow
Salix geyeriana (Andrs.) Rydb. Geyer willow
Alnus tenuifolia Nutt. Alder
Crataegus saligna Greene Hawthorn
Betula fontinalis Sarg. Red river birch

Frequent or occasional trees or large shrubs:

Amelanchier alnifolia Nutt. Service berry
Prunus virginiana L. Chokecherry
Quercus gambelii Nutt. Gambel oak

Frequent shrubs, sometimes subdominant:

Cornus stolonifera Michx. Red osier dogwood
Rosa woodsii Lindl. Wild rose
Ribes aureum Pursh. Golden currant
Ribes inerme Rydb. Wild black currant

Occasional trees:

<u>Salix lutea watsoni</u> (Bebb) Jepson	Yellow willow
<u>Crataegus rivularis</u> Nutt.	River hawthorn
<u>Tamarix pentandra</u> Pall.	Tamarix
<u>Elaeagnus commutata</u> Benth.	Bull berry

Occasional shrubs:

<u>Clematis ligusticifolia</u> Nutt.	Western virgin bower
<u>Berberis repens</u> Lindl.	Oregon grape
<u>Potentilla fruticosa</u> L.	Shrubby cinquefoil
<u>Rhus trilobata</u> Nutt.	Squawbush
<u>Symphoricarpos longiflorus</u> A. Gray	Snowberry
<u>Symphoricarpos oreophilus</u> A. Gray	Snowberry

Dominant grasses:

<u>Agrostis alba</u> L.	Redtop
<u>Bromus inermis</u> Leyss.	Smooth brome
<u>Bromus tectorum</u> L.	Downy chess
<u>Elymus condensatus</u> Presl.	Giant ryegrass
<u>Poa pratensis</u> L.	Kentucky bluegrass

Frequent or locally dominant herbs:

<u>Agropyron smithii</u> Rydb.	Western wheatgrass
<u>Agropyron trachycaulum</u> (Link) Malte	Slender wheatgrass
<u>Smilacina stellata</u> (L.) Desf.	False Solomon seal
<u>Monolepis nuttalliana</u> (Schult.) Greene	Poverty weed
<u>Urtica gracilenta</u> Greene	Stinging nettle
<u>Thalictrum fendleri</u> Engelm.	Meadow rue
<u>Cleome serrulata</u> Pursh.	Rocky Mt. beeflower
<u>Descurainia pinnata</u> (Walt.) Britt.	Tansy mustard
<u>Descurainia sophia</u> (L.) Webb. ex Pratl.	Tansy mustard
<u>Lepidium virginicum</u> L.	Peppergrass
<u>Schoenocrambe linifolia</u> (Nutt.) Greene	Plains mustard
<u>Thlaspi arvense</u> L.	Penny cress
<u>Potentilla diversifolia</u> Lehm.	Cinquefoil
<u>Astragalus agrestis</u> Dougl.	Loco
<u>Glycyrrhiza lepidota</u> Nutt.	Wild licorice
<u>Lathyrus brachycalyx</u> Rydb.	Wild sweetpea
<u>Lupinus greenei</u> A. Nels.	Lupine
<u>Melilotus alba</u> Desr.	White sweet clover
<u>Melilotus officinalis</u> (L.) Lam.	Yellow sweet clover
<u>Oxytropus albiflora</u> (Nutt.) Schum.	Tall loco
<u>Trifolium fendleri</u> Greene	Fendler clover
<u>Trifolium hybridum</u> L.	Alsike clover
<u>Sidalcea neomexicana</u> A. Gray	False mallow
<u>Gayophytum ramosissimum</u> T. & G.	Gayophytum

Frequent or locally dominant herbs (continued)

<u>Collomia linearis</u> Nutt.	Collomia
<u>Gilia aggregata</u> (Pursh) Spreng.	Scarlet gilia
<u>Phlox longifolia</u> Nutt.	Wild sweet William
<u>Lappula florabunda</u> (Lehm.) Greene	Stickseed
<u>Mertensia ciliata</u> (James) G. Don	Bluebell
<u>Castilleja linariaefolia</u> Benth.	Indian paintbrush
<u>Pentstemon comarrhenus</u> A. Gray	Beardtongue
<u>Campanula rotundifolia</u> L.	Bellflower
<u>Achillea lanulosa</u> Nutt.	Purple yarrow
<u>Agoseris glauca</u> (Pursh) Dietr.	False dandelion
<u>Artemisia ludoviciana</u> Nutt.	Herbaceous sagebrush
<u>Senecio cymbalarioides</u> Nutt.	Senecio
<u>Senecio integerrimus</u> Nutt.	Senecio

Occasional herbs:

<u>Bromus anomalus</u> Rupr.	Nodding brome
<u>Bromus ciliatus</u> L.	Fringed brome
<u>Dactylis glomerata</u> L.	Orchard grass
<u>Elymus canadensis</u> L.	Canada ryegrass
<u>Festuca ovina</u> L.	Sheep fescue
<u>Festuca rubra</u> L.	Red fescue
<u>Melica bulbosa</u> Geyer	Onion grass
<u>Muhlenbergia filiformis</u> (Thurb.) Rydb.	Pull-up muhly
<u>Phleum pratense</u> L.	Timothy
<u>Poa compressa</u> L.	Canadian bluegrass
<u>Poa nevadensis</u> Vasey	Nevada bluegrass
<u>Stipa lettermani</u> Vasey	Letterman needle grass
<u>Stipa pinetorum</u> M. E. Jones	Needle and thread grass
<u>Allium macropetalum</u> Rydb.	Wild onion
<u>Smilacina racemosa</u> (L.) Desf.	False Solomon seal
<u>Humulus lupulus neomexicanus</u> Nels. & Ckll.	New Mexican hop
<u>Comandra pallida</u> A. DC.	False toadflax
<u>Eriogonum racemosum</u> Nutt.	Wild buckwheat
<u>Polygonum aviculare</u> L.	Doormat weed
<u>Rumex mexicanus</u> Meisn.	Mexican dock
<u>Blitum capitatum</u> L.	Blite
<u>Chenopodium album</u> L.	Lambsquarter
<u>Chenopodium glaucum</u> L.	Pigweed
<u>Chenopodium leptophyllum</u> Nutt.	Narrowleaf goosefoot
<u>Kochia scoparia</u> (L.) Schrad.	Summer cypress
<u>Salsola kali tenuifolia</u> Tausch.	Russian thistle
<u>Silene noctiflora</u> L.	Catchfly
<u>Stellaria longipes</u> Goldie	Starwort
<u>Corydalis aurea</u> Willd.	Golden corydal
<u>Erysimum capitatum</u> (Dougl.) Greene	Wallflower
<u>Lepidium densiflorum</u> Schrad.	Peppergrass

Occasional herbs (continued)

<u>Thlaspi alpestre</u> L.	Penny cress
<u>Fragaria bracteata</u> Heller	Wild strawberry
<u>Potentilla glandulosa</u> Lindl.	Shrubby cinquefoil
<u>Potentilla pectinisecta</u> Rydb.	Cinquefoil
<u>Astragalus diversifolius</u> A. Gray	Loco
<u>Lotus wrightii</u> (A. Gray) Greene	Deervetch
<u>Trifolium pratense</u> L.	Red clover
<u>Vicia americana</u> Muhl.	American vetch
<u>Geranium fremontii</u> T. & G.	Fremont geranium
<u>Geranium parryi</u> (Engelm.) Heller	Parry geranium
<u>Linum lewisii</u> Pursh.	Blue flax
<u>Euphorbia glyptosperma</u> Engelm.	Little spurge
<u>Euphorbia robusta</u> (Engelm.) Small	Robust spurge
<u>Gaura coccinea glabra</u> (Lehm.) T. & G.	Gaura
<u>Gayophytum ramosissimum</u> T. & G.	Gayophytum
<u>Androsace septentrionalis</u> L.	Rockjasmine
<u>Swertia radicum</u> (Kell.) Kuntze	Green gentian
<u>Asclepias speciosa</u> Torr.	Milkweed
<u>Phacelia heterophylla</u> Pursh.	Hairy waterleaf
<u>Lappula redowskii</u> (Hornm.) Greene	Western stickseed
<u>Physalis longifolia</u> Nutt.	Ground cherry
<u>Solanum triflorum</u> Nutt.	Nightshade
<u>Collinsia parviflora</u> Dougl.	Blue-eyed Mary
<u>Castilleja sulphurea</u> Rydb.	Sulphur paintbrush
<u>Linaria vulgaris</u> Mill.	Butter and eggs
<u>Scrophularia occidentalis</u> (Rydb.) Bickn.	Scrophularia
<u>Galium boreale</u> L.	Northern bedstraw
<u>Campanula parryi</u> A. Gray	Parry bellflower
<u>Valeriana edulis</u> Nutt.	Edible valerian
<u>Agoseris glauca parviflora</u> (Nutt.) Rydb.	False dandelion
<u>Antennaria parvifolia</u> Nutt.	Pussytoes
<u>Antennaria microphylla</u> Rydb.	Everlasting
<u>Aster adscendens</u> Lindl.	Aster
<u>Centaurea picris</u> Pall.	Russian knapweed
<u>Chrysopsis villosa</u> (Pursh.) Nutt.	Golden aster
<u>Erigeron speciosus speciosus</u> Cronq.	Fleabane
<u>Erigeron speciosus macranthus</u> (Nutt.) Cronq.	Wild fleabane
<u>Iva axillaris</u> Pursh.	Poverty weed
<u>Lactuca pulchella</u> (Pursh) DC.	Blue lettuce
<u>Lactuca scariola</u> L.	Prickly lettuce
<u>Senecio ambrosioides</u> Rydb.	Groundsel
<u>Senecio crassulus</u> A. Gray	Groundsel
<u>Senecio mutabilis</u> Greene	Groundsel
<u>Senecio platylobus</u> Rydb.	Senecio
<u>Tanacetum vulgare</u> L.	Tansy
<u>Taraxacum officinale</u> Wiggers	Common dandelion
<u>Tragopogon dubius</u> Scop.	Goatsbeard

Small Tree and Shrub Communities

Along certain portions of the stream banks, especially in the narrower parts of the Gunnison River valley and in the side canyons, small trees and shrubs grow in dense communities which may be more or less continuous for considerable distance but often in smaller clumps variously spaced. Sandbar, Geyer, Bebb, yellow and whiplash willows are the dominant species occurring in various combinations. Of these, the whiplash willow, Salix caudata, is the largest, sometime reaching 20 ft. in height, and is characterized by bright green, lanceolate and slenderly acuminate leaves 4 to 6 in. long. The other species are usually shrubs seldom exceeding 15 ft. tall and usually ranging from 6 to 10 ft. The sandbar willow, Salix exigua Nutt., is commoner along the Gunnison River and has a more bushy habit with numerous slender erect stems with pale linear leaves tapered at both ends, 2.5 to 4.5 in. long with a very short petiole. The Geyer willow, Salix geyeriana (Anders) Rydb., has rather small leaves mostly 1 to 2.5 in. long, dark green above and pale or glaucous beneath, tapering at the base and acute or shortly acuminate at the apex. The leaves of the Bebb willow, Salix bebbiana Sarg., are also rather small and about the same length as the last, but they are variable in shape, ranging from narrowly elliptical and acute at both ends to broadly oblanceolate or obovate-oval and abruptly shortly acuminate, smooth and dull green above but veiny and pale beneath. The yellow willow, Salix lutea Nutt., is noted for its yellow twigs which become reddish-brown on the sunny side. The leaves are bright green, mostly 2.5 to 4 in. long, ovate-lanceolate to lanceolate from a rounded cordate base and rather broadly acute to shortly acuminate at the apex. Associated species in fewer numbers, but sometime locally dominant, include river birch, alder, wild rose, hawthorn, chokecherry and red osier dogwood. Of these, the small hawthorn, Crataegus saligna, Greene, is notable because it is endemic to the canyons of west central Colorado. It is a small tree, rarely over 15 ft. tall, with slender somewhat drooping branchlets bearing small dark green leathery rhombic-oblanceolate leaves 1.5 to 2 in. long, acute to obtuse at the apex and tapering to a slender petiole. The river hawthorn, Crataegus rivularis Nutt., has less slender branchlets and the leaves are larger and slightly broader in proportion. It is much less frequent in this region.

Less frequent shrubs are golden currant, wild black currant and twinberry. Among the larger and more conspicuous herbs, Indian hemp and wild licorice may be scattered among the trees or around the margins of dense clumps, sometimes becoming densely aggregated in local open places. Very often the trees grow so close together as to exclude other plants. Dense growths of grasses, rushes and sedges together with horsetails and a variety of other herbs in fewer numbers, crowd closely around the margins and occupy the open areas where the continuity of the trees is interrupted. In some broader areas where adjacent low terraces are continuous with the riverbanks the willows and some times the birch, hawthorn and wild rose are disposed in thickets with grasses and herbs occupying the intervening areas, frequently with widely scattered shrubs like snowberry, shrubby cinquefoil

and the wild currants. Here also the buffalo berry, Shepherdia argentea Nutt., occasionally appears. It is a small tree with silvery-gray leaves standing out conspicuously in the midst of the prevailing green background.

In Black Canyon and parts of Cebolla and Lake canyons where steep slopes arise abruptly from the stream banks, the communities become narrow often thinning out at the extremities to a discontinuous fringe and are interrupted at intervals by cliffs and talus slopes descending to the water's edge. Plants of the drier hillsides, like Gambel oak, squawbush, rabbitbrush, big sagebrush, crowd downward closely to the riverbank trees, often mingling with them and occasionally single trees or small groups of Douglas fir or blue spruce tower above them.

TERRACE COMMUNITIES

The vegetation of terrace areas and adjacent stream banks are usually so mixed and diffused one with the other that no distinct zonation is evident. However, there are a few distinct terraces, the largest about three acres in extent, where rabbitbrush, typical of such areas, grows in stands of 40 to 60 per cent density. Several species grow here all of which are similar in habit and have strict slender stems growing in dense tufts 3 to 4 ft. tall and about the same distance across the crowns. The leaves are slender, mostly 2 to 3 in. long, and the small composite heads of yellow flowers are borne in dense clusters at the summits of the stems in late summer and fall, very showy. Usually the bushes are quite evenly spaced with a limited number of associated plants crowded around their bases and dispersed in the intervening spaces.

The tall rabbitbrush, Chrysothamnus nauseosus, is the dominant species, the stems and narrowly linear leaves of which are matted with tangled white hairs giving the plant a decidedly pale grayish-green appearance. In contrast, the varnishleaf rabbitbrush, Chrysothamnus viscidiflorus, and its variety tortifolius, have green narrowly lanceolate leaves devoid of hairs, in the latter variety spirally twisted. The aromatic sagebrush, Artemisia dracunculoides, appears here occasionally. It is a shrub of about the same size but with a rounded crown and has very slender dark green stems and narrow leaves.

The soil in these areas is usually mildly saline as reflected by the presence of several halophytic plants including the annual inkweed, Suaeda depressa; annual atriplex, Atriplex hastata; fireball, Kochia scoparia; and the grasses, alkali sacaton, Sporobolus airoides; Alkali grass, Puccinellia distans; dropseed muhly, Muhlenbergia asperifolia; and saltgrass, Distichlis stricta.

The general composition of several communities include the following:

Dominant shrub:

Chrysothamnus nauseosus (Pall.) Britt. Big rabbitbrush

Frequent shrubs:

Chrysothamnus viscidiflorus (Hook.) Nutt. Varnishleaf rabbitbrush

Chrysothamnus viscidiflorus tortifolius(Gray)Greene . . Twistedleaf rabbitbrush

Artemisia dracunculoides Pursh. Aromatic sagebrush

Occasional shrubs:

Chrysothamnus parryi (A. Gray) Greene Parry rabbitbrush

Atriplex canescens (Pursh) Nutt. Four-wing saltbush

Frequent grasses:

Bromus tectorum L. Downy chess

Distichlis stricta (Torr.) Rydb. Saltgrass

Elymus condensatus Presl. Giant ryegrass

Hilaria jamesii (Torr.) Benth. Galleta grass

Hordeum jubatum L. Foxtail barley

Muhlenbergia asperifolia (N. & M.) Parodi Dropseed muhly

Puccinellia distans (L.) Parl. Alkali grass

Sitanion hystrix (Nutt.) J. G. Smith Squirreltail

Sporobolus airoides Torr. Alkali sacaton

Frequent herbs:

Polygonum aviculare L. Doormat weed

Chenopodium album L. Lambsquarter

Chenopodium leptophyllum Nutt. Narrowleaf goosefoot

Kochia scoparia (L.) Schrad. Fireball

Salsola kali tenuifolia Tausch Russian thistle

Atriplex hastata L. Annual atriplex

Atriplex rosea L. Rose atriplex

Lepidium densiflorum Schrad. Peppergrass

Descurainia pinnata (Walt.) Britt. Tansy mustard

Cleome serrulata Pursh. Rocky Mt. beeflower

Asclepias speciosa Torr. Milkweed

Centaurea picris Pall. Russian knapweed

Cirsium undulatum (Nutt.) Spreng. Thistle

Erigeron flagellaris Gray Fleabane

Helianthus annuus L. Sunflower

Iva axillaris Pursh Poverty weed

HAY FIELDS AND WEED COMMUNITIES

Rich agricultural and mineral resources of central western Colorado have been exploited during the last hundred years and a network of roads to service both ranch and mining properties has cut swaths through the native vegetation. A narrow gage railroad formerly wound through the gorge of Black Canyon, entering by way of Cimarron Canyon, and followed the Gunnison River to the town of Gunnison with a branch line through Lake Canyon to Lake City. About 16 years ago the service was discontinued and the tracks taken up. The old roadbed is now a dirt highway through Black Canyon but elsewhere it is a weed-grown foot trail. U. S. Highway 50 descends from the east end of Blue Mesa and passes through the Gunnison River valley. Extensive operations in rerouting parts of the Highway above the reservoir level are in progress at the present time.

Farmlands

Farmlands occupy nearly all of the flatter parts of Iola and Sapinero valleys and extend to some of the gentler foothills where canals furnish water. Hay is practically the only crop, except for small vegetable gardens and a few fruit trees. Smooth brome grass and alsike clover are the dominant hay plants while timothy, redtop, red clover and alfalfa are grown in lesser quantity.

Weed Communities

In natural communities, weeds usually assume a minor role, but when the native vegetation is removed, and especially when the soil is disturbed, they become the first pioneers to invade the bare soil. They compete with farm crops and flourish along ditch banks, fence rows, roadsides and around dwellings.

Two outstanding traits of weeds are their adaptation to a wide range of environmental conditions and to their great tenacity of life. Kochia scoparia often becomes robust and reaches 6 ft. or more tall when growing on canal banks but become progressively smaller in drier upland soils where it is a foot or less in height. Lambsquarter and the maple-leaved goosefoot show similar extremes while many smaller herbs show a wide range of size on a smaller scale, as in the Russian thistle, tansy mustards, gold of pleasure, tumbling mustard, peppergrass and the western stickseed. Along ditch banks, fence rows and some low lying roadsides these and many other weeds thrive, their ample foliage forming tall lush borders. Here the hay plants extending from the fields together with baltic rush, sedges, western bluestem, Kentucky bluegrass, orchard grass, redtop, soft chess, cheat grass and foxtail barley crowd among the taller herbs. More sporadic or in local stands are redroot, pigweed, choriospora, wild licorice, white sweet clover, milkweed, ground cherry, prickly lettuce, sunflower, burdock and cocklebur. In some of the more open places low growing species like the common mallow, wild morning glory, nightshade, plantain and dandelion are conspicuous.

The general composition is as follows:

<u>Agropyron smithii</u> Rydb.	Western bluestem
<u>Bromus inermis</u> Leyss.	Smooth brome
<u>Bromus racemosus</u> L.	Soft chess
<u>Bromus tectorum</u> L.	Cheat grass
<u>Dactylis glomerata</u> L.	Orchard grass
<u>Echinochloa crus-galli</u> (L.) Beauv.	Barnyard grass
<u>Elymus canadensis</u> L.	Canadian ryegrass
<u>Elymus condensatus</u> Presl.	Giant ryegrass
<u>Glyceria striata</u> (Lam.) Hitchc.	Fowl mannagrass
<u>Hordeum jubatum</u> L.	Foxtail barley
<u>Panicum capillare</u> L.	Witchgrass
<u>Phleum pratense</u> L.	Timothy
<u>Poa pratensis</u> L.	Kentucky bluegrass
<u>Carex nebraskensis</u> Dewey	Nebraska sedge
<u>Carex rostrata</u> Stokes	Beaked sedge
<u>Juncus balticus montanus</u> Engelm.	Baltic rush
<u>Juncus longistylis</u> Torr.	Meadow wiregrass
<u>Urtica gracilenta</u> Greene	Stinging nettle
<u>Rumex crispus</u> L.	Curly dock
<u>Amaranthus retroflexus</u> L.	Redroot
<u>Chenopodium album</u> L.	Lambsquarter
<u>Chenopodium glaucum</u> L.	Pigweed
<u>Kochia scoparia</u> (L.) Schrad.	Fireball
<u>Camelina microcarpa</u> Andrz.	Gold of pleasure
<u>Chorispora tenella</u> DC.	Chorispora
<u>Brassica nigra</u> (L.) Koch.	Black mustard
<u>Descurainia pinnata</u> (Walt.) Britt.	Tansy mustard
<u>Descurainia sophia</u> (L.) Webb.	Tansy mustard
<u>Lepidium draba</u> (L.) Desv.	White top
<u>Lepidium virginicum</u> L.	Peppergrass
<u>Sisymbrium altissimum</u> L.	Tumbling mustard
<u>Thlaspi arvense</u> L.	Penny cress
<u>Glycyrrhiza lepidota</u> Nutt.	Wild licorice
<u>Melilotus alba</u> Desr.	White sweet clover
<u>Melilotus officinalis</u> (L.) Lam.	Yellow sweet clover
<u>Medicago sativa</u> L.	Alfalfa
<u>Trifolium hybridum</u> L.	Alsike clover
<u>Trifolium repens</u> L.	White clover
<u>Trifolium pratense</u> L.	Red clover
<u>Malva rotundifolia</u> L.	Common mallow
<u>Cicuta douglasii</u> (DC.) Coult.	Water hemlock
<u>Sium suave</u> Walt.	Water parsnip
<u>Asclepias speciosa</u> Torr.	Milkweed
<u>Convolvulus arvense</u> L.	Wild morning-glory
<u>Physalis longifolia</u> Nutt.	Ground cherry
<u>Solanum nigrum</u> L.	Black nightshade
<u>Plantago major</u> L.	Plantain

General composition (continued)

<u>Arctium minus</u> (Hill.) Bernh.	Burdock
<u>Erigeron canadensis</u> L.	Canadian fleabane
<u>Helianthus annuus</u> L.	Sunflower
<u>Iva axillaris</u> Pursh.	Poverty weed
<u>Lactuca scariola</u> L.	Prickly lettuce
<u>Solidago canadensis</u> L.	Canadian goldenrod
<u>Taraxacum officinale</u> Wiggers	Dandelion
<u>Xanthium saccharatum</u> Wallr.	Cocklebur

In some of these communities the sandbar willow, Salix exigua; wild rose, Rosa woodsii; and some rabbitbrushes, Chrysothamnus spp. have become established in small clumps. In some areas just outside fences that surround hay fields, the hay plants have volunteered and are dominant.

Many of these plants occur around dwellings and farm buildings in dry soil, certain ones frequently becoming conspicuous. Poverty weed grows in rather open stands on otherwise bare ground; the doormat weed, Polygonum aviculare, spreads out here and there in little round mats; cheat grass and the tansy mustards commonly crowd close to the bases of farm buildings where rainwater drips. Similarly some taller herbs have the same habit, rose atriplex, lambsquarter, redroot, the common pigweed, barnyard grass, witchgrass, and orchard grass are notable in this respect. Patches of white top mustard are often dense while penny cress becomes more openly aggregated.

On dry upland ground, particularly along graded roadsides, many of the same species cited above are scattered and show less vigorous growth, often with considerable bare soil between them. Some species are xerophytes peculiar to these habitats. Of this sort are desert wheatgrass, Agropyron desertorum; squirreltail grass, Sitanion hystrix; false buffalo grass, Munroa squarrosa; Russian thistle, Salsola kali tenuifolia; Monolepis nuttalliana; some peppergrass, Lepidium spp.; Malcolmia africana; western stickseed, Lappula occidentalis; and the matchweed, Gutierrezia microcephala. Others of characteristic habit are the prostrate pigweed, Amaranthus blitoides; doormat weed, Polygonum aviculare; the puncture vine with its spiny fruits, Tribulus terrestris; little spurge, Euphorbia glyptosperma; and the trailing verbena, Verbena bracteata, which spread out flat on the ground in circular mats widely dispersed on bare soil.

Around the drip zone of roadside trees, particularly in the canyons, or at the bases of large rocks or cliffs where rainwater drains, cheat grass, Bromus tectorum; soft chess, Bromus racemosus; tansy mustards, Descurainia pinnata and D. sophia; gold of pleasure, Camelina microcarpa; peppergrass, Lepidium virginicum and Monolepis nuttalliana are often densely aggregated. Similar dense growths border some ungraded upland roadsides where the soil is loose.

HILLSIDE AND UPLAND COMMUNITIES

The hillsides and uplands embracing the open valleys of the Blue Mesa basin mostly rise rather gently and increase in steepness as the elevation increases upwards. Steep slopes also occur at points where the river flows close to the bases of high mesa-like terraces and where it cuts through the terrace-like traverse separating Iola and Sapinero valleys. Most of the hills are more or less regularly rounded with a few rocky outcrops and ledges.

Big Sagebrush Communities

Extensive light gray communities of the big sagebrush are more or less continuous over most of these areas, often extending high up over the crest of the hills.

The big sagebrush, Artemisia tridentata Nutt., is a silvery-gray shrub of erect-spreading habit, mostly 1 to 2 ft. tall but becoming upwards to 10 ft. in local stands where favorable environmental conditions reach a maximum. The main trunk is short and thick with gray shreddy bark extending upwards on the somewhat abruptly narrowing branches and slender terminal twigs. The leaves are more or less erect, wedge-shaped with three teeth at the truncated apex, 1 to 1.5 in. long and covered with white appressed hairs. The plant is primarily a surface-water feeder, usually with widely spreading roots but in deep loose soil they may descend as much as 15 ft. Extensive communities are more or less continuous over the lower mountain slopes often extending high up over the crests of the hills. On open slopes the shrubs are low and more or less evenly spaced, the density ranging from about 15 to 35 per cent with considerable bare soil between the bushes which is often augmented by numerous stock trails. In the bottom of ravines and along the bases of the steeper slopes the growths are more robust and taller, the density ranging upwards to as much as 60 to 75 per cent.

In shallow gullies and open ravines where precipitation water drains or where the slope exposure receives less direct sunlight the continuity of the cover is interrupted by the darker green of the Gambel oak and by mixed growths including chokecherry, service berry and the mountain red juniper. These plants may occur in local clumps, scattered or occasionally single ones isolated. In other instances local dense growths of rabbitbrush occur, particularly along the drainage ways. Outcropping rocks and ledges provide a contrasting type of environment where the associated plants are more varied. Here the narrowleaf yucca, wax currant, bitterbrush, Holodiscus, and silver sagebrush occur, occasionally with aggregations of prickly pear cacti, snowberry or the horsebrush. In these and similar places certain herbaceous plants are more concentrated. Fendler's cloakfern, brittle fern, stonecrop, rockcress, alumroot and the Colorado bedstraw are notable crevice plants. The four-o'clock, clammyweed, Eriogonum campanulatum, Fendler's sandwort, bladder pod, Fendler's spurge, pale evening primrose, Leptodactylon pungens,



Fig. 3. Big sagebrush dominating a hillside but giving way at top and bottom to other shrubs and trees. Photo by Gerald Groves.



Fig. 4. Stands of spruce and Douglas Fir dominate the streamside in sheltered stretches of Soap Creek. Photo by Gerald R. Groves.

Phlox caespitosa, hairy waterleaf, Pentstemon coloradensis, P. barbatus, Artemisia ludoviciana, Aplopappus acaulis, A. amerioides, Senecio ambrosioides, S. crassulus, S. cymbalarioides, Coleosanthus grandiflorus and Chrysopsis villosa are especially conspicuous among the rocks and on ledges.

Herbs of general distribution are numerous. Cheat grass is prevalent everywhere and dominates the spring aspect but perishes early in July. Perennial grasses and herbs are frequent on less exposed slopes and high mesa-like terraces but scanty on the open hillsides. Among the conspicuous ones are slender wheatgrass, bunch wheatgrass, Canadian bluegrass, Indian ricegrass, needle and thread grass, Stipa pinetorum, Letterman stipa, and the squirrel-tail grass; wild onion, false toadflax, Eriogonum campanulatum, E. racemosum, E. umbellatum, the rockcress, Arabis demissa, wallflower, mountain peppergrass, blue flax, globe mallow, Androsace septentrionalis, scarlet gilia, Phlox caespitosa, the paint brushes, Castilleja hispida and C. linariaefolia, Pentstemon comarrhenus, yarrow, Agoseris glauca, A. parviflora, Antennaria parviflora, A. microphylla, the fleabanes, Erigeron divergens cinereus, E. flagellaris, and E. concinnus and the western thistle.

The general composition is as follows:

Dominant:

Artemisia tridentata Nutt. Big sagebrush

Frequent shrubs and small trees (locally dominant):

Quercus gambelii Nutt. Gambel oak
Amelanchier alnifolia Nutt. Service berry
Cercocarpus montanus Raf. Mountain mahogany
Prunus virginiana L. Chokecherry
Purshia tridentata (Pursh) DC. Bitter brush
Ribes cereum Dougl. Red wax currant
Opuntia hystricina Engelm. Yellow prickly pear
Chrysothamnus nauseosus (Pall.) Britt. Big rabbitbrush
Chrysothamnus nauseosus graveolens (Nutt.) DC. Tall rabbitbrush
Chrysothamnus viscidiflorus (Hook.) Nutt. Varnishleaf rabbitbrush

Occasional shrubs, (locally frequent):

Yucca angustissima Engelm. Narrowleaf yucca
Atriplex canescens (Pursh) Nutt. Four-wing saltbush
Berberis repens Lindl. Oregon grape
Eurotia lanata (Pursh) Moq. Winterfat
Holodiscus dumosus (Nutt.) Heller Ocean spray
Symphoricarpos longiflorus A. Gray Snowberry
Symphoricarpos oreophilus A. Gray Snowberry
Artemisia dracunculoides Pursh. Aromatic sagebrush
Artemisia frigida Willd. Silver sagebrush
Artemisia nova (A. Nels.) H. & C. Black sagebrush

Occasional shrubs (continued)

<u>Chrysothamnus depressus</u> Nutt.	Dwarf rabbitbrush
<u>Chrysothamnus viscidiflorus stenophyllus</u> (Gray) H. & C.	Little rabbitbrush
<u>Tetradymia canescens</u> DC.	Spineless horsebush

Frequent herbs:

<u>Cystopteris fragilis</u> (L.) Bernh.	Brittle fern
<u>Notholaena fendleri</u> Kuntze	Fendler cloakfern
<u>Agropyron desertorum</u> (Fisch.) Schult	Desert wheatgrass
<u>Agropyron smithii</u> Rydb.	Western bluestem
<u>Agropyron spicatum</u> (Pursh) Rydb.	Bunch wheatgrass
<u>Agropyron trachycaulum</u> (Link) Malte	Slender wheatgrass
<u>Aristida fendleriana</u> Steud.	Three-awn grass
<u>Bouteloua gracilis</u> (H.B.K.) Lag.	Slender grammagrass
<u>Bromus tectorum</u> L.	Cheat grass
<u>Festuca ovina</u> L.	Sheep fescue
<u>Festuca rubra</u> L.	Red fescue
<u>Hilaria jamesii</u> (Torr.) Benth.	Galleta grass
<u>Koeleria cristata</u> (L.) Pers.	Junegrass
<u>Melica bulbosa</u> Geyer	Oniongrass
<u>Oryzopsis hymenoides</u> (R. & S.) Riker	Indian ricegrass
<u>Poa compressa</u> L.	Canadian bluegrass
<u>Sitanion hystrix</u> (Nutt.) J. G. Smith	Squirreltail grass
<u>Sporobolus cryptandrus</u> (Torr.) A. Gray	Sand dropseed
<u>Stipa comata</u> Trin. & Rupr.	Needle-and-thread grass
<u>Stipa lettermanii</u> Vasey	Letterman stipa
<u>Stipa pinetorum</u> M. E. Jones	Needle-and-thread grass
<u>Allium macropetalum</u> Rydb.	Wild onion
<u>Calochortus gunnisonii</u> S. Wats.	Mariposa lily
<u>Calochortus nuttallii</u> Torr.	Sego lily
<u>Comandra pallida</u> A. DC.	False toadflax
<u>Eriogonum campanulatum</u> Nutt.	Campanulated eriogonum
<u>Eriogonum cernuum</u> Nutt.	Slender eriogonum
<u>Eriogonum ovalifolium</u> Nutt.	Silver plant
<u>Eriogonum racemosum</u> Nutt.	Wild buckwheat
<u>Eriogonum tristichum</u> Small	Eriogonum
<u>Eriogonum umbellatum</u> Torr.	Sulphur eriogonum
<u>Chenopodium album</u> L.	Lambsquarter
<u>Chenopodium leptophyllum</u> Nutt.	Narrowleaf chenopodium
<u>Monolepis nuttalliana</u> (Schult.) Greene	Schard
<u>Salsola kali tenuifolia</u> Tausch.	Russian thistle
<u>Mirabilis linearis</u> Pursh.	Four-o'clock
<u>Arenaria fendleri</u> A. Gray	Sandwort
<u>Clematis hirsutissima</u> Pursh.	Virginbower
<u>Argemone intermedia</u> Sweet	Prickly poppy
<u>Cleome serrulata</u> Pursh.	Rocky Mt. beeflower
<u>Polanisia trachysperma</u> T. & G.	Clammy weed

Frequent herbs (continued)

<u>Arabis demissa</u> Greene	Rockcress
<u>Descurainia pinnata</u> (Walt.) Britt.	Tansy mustard
<u>Erysimum capitatum</u> (Dougl.) Greene	Wallflower
<u>Lepidium montanum</u> Nutt.	Mt. peppergrass
<u>Physaria floribunda</u> Rydb.	Bladderpod
<u>Streptanthus cordatus</u> Nutt.	Twistflower
<u>Thlaspi alpestre</u> L.	Pennycrass
<u>Sedum stenopetalum</u> Pursh	Stonecrop
<u>Heuchera parviflora</u> Nutt.	Alumroot
<u>Astragalus</u> spp. (3-4 sp. undertermined)	Locoweed
<u>Lotus wrightii</u> (A. Gray) Greene	Deervetch
<u>Lupinus greenei</u> A. Nels.	Lupine
<u>Lupinus kingii</u> S. Wats.	King lupine
<u>Oxytropis albiflora</u> (A. Nels.) Schum.	Loco
<u>Linum lewisii</u> Pursh	Blue flax
<u>Euphorbia fendleri</u> (Torr.) Gray	Fendler spurge
<u>Euphorbia robusta</u> (Engelm.) Small	Mountain spurge
<u>Sphaeralcea coccinea</u> (Pursh) Rydb.	Globe mallow
<u>Sphaeralcea coccinea elata</u> (Baker) Kerney	Scarlet globe mallow
<u>Mentzelia dispersa</u> S. Wats.	Blazing star
<u>Gayophytum ramosissimum</u> T. & G.	Gayophytum
<u>Oenothera caespitosa marginata</u> (Nutt.) Munz.	Evening primrose
<u>Oenothera pallida</u> Lindl.	Pale evening primrose
<u>Androsace septentrionalis</u> L.	Rockjasmine
<u>Collomia linearis</u> Nutt.	Collomia
<u>Gilia aggregata</u> (Pursh) Spreng	Scarlet gilia
<u>Gilia aggregata attenuata</u> Gray	Scarlet gilia
<u>Gilia sinuata</u> Dougl.	Gilia
<u>Leptodactylon pungens</u> (Torr.) Rydb.	Spiny phlox
<u>Phlox caespitosa</u> Nutt.	Caespitose phlox
<u>Phlox longifolia</u> Nutt.	Wild sweet William
<u>Phacelia heterophylla</u> Pursh.	Hairy waterleaf
<u>Amsinckia rugosa</u> Rydb.	Fiddleneck
<u>Cryptantha crassisejala</u> (T. & G.) Greene	Cryptantha
<u>Cryptantha flaviculata</u> (A. Nels) Payson	Cat eye
<u>Cryptantha gracilis</u> Osterh.	Cryptantha
<u>Cryptantha jamesii</u> (Torr.) Payson	Cryptantha
<u>Lappula occidentalis</u> (S. Wats.) Greene	Western stickseed
<u>Lithospermum multiflorum</u> Torr.	Gromwell
<u>Castilleja hispida</u> Benth.	Paintbrush
<u>Castilleja linariaefolia</u> Benth.	Indian paintbrush
<u>Collinsia parviflora</u> Dougl.	Blue-eyed Mary
<u>Pentstemon barbatus arizonica</u>	Red pentstemon
<u>Pentstemon coloradensis</u> A. Nels.	Colorado pentstemon
<u>Pentstemon comarrhenus</u> A. Gray	Blue pentstemon
<u>Pentstemon crandallii</u> A. Nels.	Beardtongue

Frequent herbs (continued)

<u>Pentstemon watsonii</u> A. Gray	Watson pentstemon
<u>Galium coloradoense</u> Wright	Colorado bedstraw
<u>Achillea lanulosa</u> Nutt.	Purple yarrow
<u>Agoseris glauca</u> (Pursh) Dietr.	False dandelion
<u>Agoseris glauca parviflora</u> (Nutt.) Rydb.	False dandelion
<u>Antennaria anaphaloides</u> Rydb.	Pussytoes
<u>Antennaria microphylla</u> Rydb.	Everlasting
<u>Antennaria parvifolia</u> Nutt.	Pussytoes
<u>Aplopappus acaulis</u> (Nutt.) Gray	Aplopappus
<u>Aplopappus amerioides</u> (Nutt.) Gray	Goldenweed
<u>Artemisia ludoviciana</u> Nutt.	Herbaceous sagebrush
<u>Artemisia michauxiana</u> Bess.	Herbaceous sagebrush
<u>Chaenactis douglasii</u> (Hook.) H. & A.	False yarrow
<u>Chrysopsis villosa</u> (Pursh) Nutt.	Golden aster
<u>Cirsium undulatum</u> (Nutt.) Spreng.	Western thistle
<u>Crepis occidentalis</u> Nutt.	Hawksbeard
<u>Crepis occidentalis costata</u> (Gray) Babco. & Stebb.	Hawksbeard
<u>Erigeron concinnus</u> T. & G.	Fleabane
<u>Erigeron divergens</u> T. & G.	Fleabane
<u>Erigeron flagellaris</u> A. Gray	Fleabane
<u>Helianthus annuus</u> L.	Common sunflower
<u>Helianthus petiolaris</u> Nutt.	Utah sunflower
<u>Ptiloria pauciflora</u> (Torr.) A. Nels.	Wire lettuce
<u>Senecio ambrosioides</u> Rydb.	Groundsel
<u>Senecio crassulus</u> A. Gray	Groundsel
<u>Senecio cymbalarioides</u> Nutt.	Senecio
<u>Senecio mutabilis</u> Greene	Groundsel
<u>Senecio platylobus</u> Rydb.	Senecio
<u>Townsendia exscapa</u> (Rich.) Porter	Townsendia
<u>Viguiera multiflora</u> (Nutt.) Blake	Golden ray
<u>Wyethia amplexicaulis</u> Nutt.	Mule-ear

Uplands of the Canyons

The deep narrow canyons present varied aspects according to the slope exposures and rough contours. Black Canyon cleaves the high Blue Mesa, and both sides are cut at right angles by numerous steep side ravines. Great masses of native rock stand out in bold cliffs and ledges, mounting upwards 1500 ft. or more to lend a predominating reddish hue splashed with blackish streaks, in contrast with green foliage which partially clothes the less forbidding areas.

In the canyon bottoms, smaller willows occur in discontinuous fringes along the river banks, with narrowleaf cottonwoods isolated or in small clumps. In the mouths of larger side canyons like Blue Creek, Curecanti Creek and

Meyers Fork, they grow in small groves with understories of the usual stream-side plants. On the steep slopes immediately above the stream banks birch, alder, hawthorn and chokecherry tend to form irregular clumps while the bright green foliage of the taller boxelder stands out against the darker green background.

The north-facing slopes of the canyon harbor a denser vegetation than the exposed south-facing slope. Gambel oak is frequent everywhere, becoming dominant in irregular stands lower down and extending high up in the side ravines, while the mountain red juniper is more widely dispersed but conspicuous by its larger size. Douglas fir and blue spruce stand out here and there above the smaller trees and shrubs in the bottoms and scatteringly high up among the cliffs where they cling on ledges and in crevices. On some steep open slopes they grow in small dense forests.

At frequent intervals along the bases of shady cliffs the soil and rocks are kept damp by seepage water from seams in the rocks which maintains a highly mesophytic vegetation consisting of willows, dogwood, wild rose, chokecherry, wild raspberry, black currant, red and blue elderberry, snowberries and the twinberry with a dense undergrowth of grasses and herbs. Horsetails, Kentucky bluegrass, redtop, marsh muhly and fowl mannagrass are most abundant around wet places while fringed brome, California brome, orchard grass, pull-up muhly, ticklegrass and slender wheatgrass are more conspicuous in drier situations. Frequent flowering herbs include stinging nettle, wild strawberry, meadow rue, American vetch and dogbane while others in fewer numbers, such as red baneberry, mountain hollyhock, fireweed, yellow evening primrose, cow parsnip, the tall green gentian and Canadian goldenrod are conspicuous by their larger size. Hop vines often grow tangled among shrubbery and herbage and occasionally the Columbian virginbower climbs upward among the branches of shrubs and trees. The starworts, blue-eyed Mary and androsace are small slender herbs commonly growing in open soil and around the edges of denser vegetation.

In drier areas the mountain red maple appears together with squawbush, Oregon grape, wax currant, mountain red currant, holodiscus, western ninebark and the western mock oranges. Most of these plants crowd into the bottoms of gullies and ravines but thin out among the cliffs and ledges where the more xerophytic ones like wax currant, western ninebark, holodiscus and the mock oranges stand out against the bare rocks. Big sagebrush and the silver sagebrush are also frequent in these places while poison ivy is less common but grows in dense colonies at the bases of some cliffs. Brickellia grandiflora is especially characteristic on dry ledges and rocky places. It is a rather large tufted herb, about 2 ft. tall, with numerous straight stems spreading out from the crown and bearing rather widely spaced triangular-ovate leaves. Smaller herbs are of wide variety, none particularly abundant, but more or less scattered or in small colonies. Rockcress, bladder pod, sandwort, stonecrop, red pentstemon, chaenactis, pale aster, golden aster, golden ray, herbaceous sages and certain species of senecio and aplopappus are the more prominent kinds. Typical plants of dry crevices are Fendler's cloak fern, slender lipfern,

American parsley fern, alum roots, spiny phlox, Colorado bedstraw and the little clubmoss. The curious rock-lover, Saxifraga bronchialis, roots in crevices and spreads its closely and irregularly branched stems with numerous small rosettes of slender leaves over considerable areas of bare shaded rocks.

In seepage areas and wet crevices of cliffs the white saxifrage, bittercress, willowherb and yellow monkey flower are conspicuous. Here also the brittle fern attains considerable size but persists in a dwarfed state among dry shaded rocks.

The dry south-facing side of the canyon shows more exposed rock and soil with less dense vegetation. Gambel oak grows in compact colonies on local open slopes while the mountain red juniper is more or less evenly scattered everywhere and, on the whole, the dominant tree. Blue spruce and Douglas fir are fewer and more widely dispersed although grouped in small stands low down close to the river and in steep gullies and ravines. Ponderosa pine is sporadic and pinyon pine very sparse. Big sagebrush and rabbitbrush are more in evidence on this side, especially low down where they show unusually tall and vigorous growths. Squawbush is also conspicuous low down but holodiscus, broadleaf mountain mahogany, bitterbrush extend upwards everywhere among rocks and cliffs. Chokecherry, serviceberry, wax currant and snowberries are much less vigorous and largely confined to ravines and protected places. Among the smaller shrubs yucca, cacti, silver sagebrush and low scrubby growths of Oregon grape are occasional and more local. The conspicuous grasses include slender wheatgrass, Indian ricegrass, galleta grass, slender gramma grass side-oats gramma, cheat grass, closed dropseed and needle-and-thread grass.

The xerophytic herbs are mostly the same species named on the north-facing side but some of them like brickellia, western thistle, herbaceous sagebrush, golden aster, golden ray and aplopappus stand out more conspicuously. Here also are some plants peculiar to this side such as monardella, a densely tufted fragrant mint which grows in open rocky places, a slender species of milkweed, golden corydal, Mentzelia pumila and two very slender and diffusely branched annuals, Eriogonum cernuum and Gayophytum ramosissimum. Infrequent seepage water occurs under overhanging cliffs and generally supports dense colonies of false Solomon seal, horsetails and several grasses.

Within the limits of the present studies, Cebolla and Lake canyons are narrow and extend in a north-south direction. The sides are steep with numerous outcrops of rocks and a few low cliffs. On the whole, the west-facing slope is drier and presents a xerophytic vegetation much like that described for the south-facing side of Black Canyon, except that big sagebrush is more predominant although the communities are mixed. In contrast, Gambel oak is more prevalent on the somewhat less xerophytic east-facing slope. Some steep side ravines harbour spruce and fir on the more protected north-facing slopes while mesophytic types, like chokecherry, service berry and snowberry occupy the bottoms. Springs and seepage areas and their attendant vegetation are lacking but otherwise the plants are much the same as those found in Black Canyon.

Soap Creek Canyon is wider and more open with soil covered slopes where considerable areas are dominated either by communities of Gambel oak or by serviceberry while at higher elevations yellow pine occurs on the southern exposures and woods of aspen, spruce and Douglas fir occupy the northern exposures. High up in the canyon the latter descend to the canyon bottom. The associated plants are much the same as those occurring elsewhere except that certain ones like grasses, wild geranium, lupine, scarlet gilia, pentstemons, shrubby cinquefoil, mertensia and the snowberries are much more abundant. The common Siberian juniper and bearberry make their appearance here.

MOSSES AND LIVERWORT

Relatively few kinds of mosses are abundant in the reservoir basins while the majority are infrequent or scanty, and often sporadic in distribution. In wet or moist habitats hydrophytic and mesophytic species are locally abundant, especially on shaded banks along the quieter waters of the Gunnison River and the side streams above the high water levels. Vertical soil banks along the outer margins of flood plains are particularly favorable to a few of the commoner species, especially where overhanging trees and shrubbery provide more or less constant shade. Here Leptobryum pyriforme, Bryum cuspidatum, B. pseudotriquetrum and B. angustirete grow in dense green cushions, sometimes forming extensive sods all over the banks and extending for as much as 8 or 10 ft. laterally. Usually they are richly fruited with bright reddish-brown capsules making a pleasant contrast against the green background of the vegetative parts. Less common species are Funaria hygrometrica, Pohlia wahlenbergii and Amblystegium serpens with a variety of occasional species occurring here and there. During July and August the little annual liverwort, Riccia frostii, appears in open wet flood plains where it forms small circular rosettes $\frac{1}{4}$ to $\frac{1}{2}$ in. across and closely appressed on the damp soil.

Brook banks and seepage areas of the side canyons harbour a more varied bryophyte flora. Here Marchantia polymorpha is the commonest liverwort. In wetter situations Philonotis fontana, Bryum turbinatum, Mnium serratum, Brachythecium salebrosum, B. albicans, B. rivulare, Amblystegium serpens, A. trichopodium kochii, Campylium radicale and Hypnum patientiae elatum appear while on damp banks and gravelly flood plains Distichium capillaceum, Pottia heimii, Pohlia cruda, Bryum pallescens, B. cuspidatum, B. cirratum are frequent.

Submerged or emergent hydrophytic mosses are occasionally encountered in a variety of habitats. Fontinalis duriaei occurs attached to rocks in the Gunnison River and especially in the lower reaches of side streams near their mouths. Wet meadows and slow brooklets occasionally harbour dense patches of Amblystegium riparium, Cratoneuron filicinum and Drepanocladus aduncus while Hygrohypnum ochraceum, H. palustre and H. cochlearifolium grow in local patches and dense mats on wet or submerged rocks in swifter brooks and around small shaded waterfalls of the side streams, especially in Black Canyon.

In wet crevices where seepage water emerges from under overhanging cliffs and on the subtending rocks where water trickles downward, tufts and cushions of Distichium capillaceum, Didymodon trifarius, D. mexicanus subulatus, Pottia heimii, Funaria hygrometrica, Pohlia cruda, Bryum pallescens, B. cuspidatum and Mnium serratum are typical of such habitats. In deep shaded crevices and under strongly overhanging rocks where precipitation water lingers longest Timmia barvarica, Tortella fragilis, Brachythecium utahensis, B. collinum and Hypnum revolutum are found, the latter two being among the commoner species of the region. Encalypta vulgaris and its variety mutica are typical in dry crevices and also among the commoner mosses. Clevea hyalina and Asterella ludwigii, characteristic liverworts, grow on shaded ledges and in crevices where the soil remains moist most of the year. Several species of Bryum mentioned above are abundant on steep soil banks of the north-facing slopes of Black Canyon but their numerous young capsules fail to reach maturity before drouth conditions set in during early summer.

Tortula ruralis is the most common moss of the region and grows on dry soil in many different situations, in communities of big sagebrush, oak, under various bushes, among rocks, in dry crevices and on open soil. While it is typically a xerophyte, it also grows vigorously in damp shaded places where it most frequently fruits. It is especially abundant in Black Canyon.

Among the rock mosses, Grimmia ovalis is the most conspicuous as well as one of the most common species of the entire region. It forms black convex cushions upward to 5 in. across on dry rocks and on vertical cliffs. Grimmia calyptrata is frequent and forms strongly convex cushions with a hoary surface of white hairs, while G. anodon, G. plagiopodia and G. alpestris occur only occasionally. Orthotrichum hallii is frequent throughout the region and locally abundant in Black Canyon. It forms compact tufts on bare rock surfaces, usually in shaded places. Other associated species include Orthotrichum alpestre, O. texanum and O. jamesianum. Leskea tectorum is a very small slender moss forming thin olivaceous mats on dry rock and bases of trees.

ALGAE

Algae are distributed according to the nature and extent of the aquatic habitats which range from the large volume of the Gunnison River through a variety of smaller side streams and ditches to relatively still water of small side pools, beaver ponds and shallow seepage areas. The main factors in the distribution of the various populations are the velocity of the water and aeration, the nature of the substrata and the degree of light or shade present. Chemically the area is mainly ferro-magnesian and this is reflected in the clean, bright colors of the algae and lack of calcium deposits on the substrata and around attached plants. A few very local exposures of shale and sandstones carry calcium sulfate and calcium carbonate and the water in these limited areas harbour some algae but they are the common forms throughout the area and are not restricted to calcic conditions.

In some parts of the Gunnison River, particularly where the velocity of the water is moderate, the rocks are densely covered with Cladophora kuetzingiana a rather coarse branched filamentous form, the fronds of which become upward to 12 in. long and often give the stream bed a distinctly dark green color. Long strings of the algae extend in the direction of the current and wave gently in the passing water. In other parts of the river it is either scattered in isolated tufts or in smaller local aggregations while in swifter currents it becomes progressively shorter and often ragged.

Second in abundance is Ulothrix zonata which forms shorter darker green silky tufts attached to rocks. Ulothrix tenuissima is commonly associated with it and differs in being much more slender. Both are unbranched filamentous forms commonly rising in dense tufts from an expanded basal palmelloid thallus spreading over the substata.

Locally the rocks are densely studded with the more or less globular, dark olivaceous gelatinous colonies of Nostoc sp. ranging upwards to 1/2 in. or more in diameter. Older masses become yellowish-brown and it is third in abundance. Long strings of Stigeoclonium stagnatile are also attached to rocks and is of a brighter green than the other species. It is a slender filamentous form with short, widely-spaced attenuated branches and from the limited observation it appears to be fourth in abundance.

Diatomes vary in abundance according to seasonal fluxes in populations and are more or less general in nearly all aquatic habitats. The ubiquitous Tabellaria flocculosa, Fragilaria sp., Synedra ulna, Diatoma hiemale, Cocconeis pediculus, and Amorpha ovalis are the most common kinds while a number of species of Navicula, Gomphonema and Cymbella together with Rhopalodia gibba, Epithemia argus, Ceratoneis arcus and Melosira sp. are frequent.

Botrydium granulotum and Vaucheria borealis occur as subaerial forms on wet mud of banks and flood plains, usually in partial shade. Botrydium is a curious globular sessile alga with a branched rhizoid penetrating the muddy substratum.

Algae of the side streams, ditches and seepage areas. The larger side streams, such as Lake, Cebolla and Soap creeks, are much alike and harbor about the same algal communities as the Gunnison River with some variation in density of populations and composition. A number of smaller brooks on the whole show the greatest variety of algae although the populations are usually less and more spotty in distribution. Usually there is more shade and the influx from springs and seepage areas contribute algae particularly adapted to these latter habitats. In the swifter currents Monostroma quaternarium is conspicuous by its ruffled, dark green laminate fronds which become as much as 2 in. long. It is generally aggregated in dense colonies in certain places and more or less scattered elsewhere. It appears to be more tolerant of shade than other associated forms. It is frequent in the Gunnison River, particularly at the mouths of side streams.

In quieter water of side pools and especially in beaver ponds dense populations of Spirogyra and Zygnema with less Tribonema, Oedogonium and Mougeotia float freely on the surface while Vaucheria, Ulothrix, Stigioclonium and Cladophora are attached forms in less abundance. Less frequent species include Tetraspora gelatinosa, Chaetophora piciformis, Ch. incrassata, Drepanaldia acuta and Rhizoclonium hieroglyphicum. Desmids are frequent but not as abundant in the early part of the summer as might be expected in a ferro-magnesian region. Closterium acerosum and C. cucumis appeared in the collections most frequently with Cosmarium crenulatum, C. ovale and C. tetraphthalmum in fewer numbers. Melosira sp. is a filamentous diatom often appearing among the free floating forms.

Shallow seepage areas, pools and small brooklets draining from them are especially rich in blue-green algae. The dominant species include Anabaena variabilis, A. inaequalis, A. oscillarioides, Nodularia spumigena and N. sphaerocarpa, all of which occur in soft, yellowish-green or brownish gelatinous colonies sometimes aggregated in dense masses on the bottoms and occasionally extending to the wet banks exposed to the air. Oscillatoria limosa is the dominant member of this genus and it commonly forms thin, slimy, dark bluish-blackish-green sheets on submerged muddy bottoms, wood and rocks. Less frequent Oscillatorias include O. angustissima, O. tenuis, and O. animalis all of which form brighter bluish-green sheets. Phormidium retzii and Ph. autumnale occasionally appear in dark blue-green sheets on submerged rocks and wood. Cylindrospermum comatum and Rivularia borealis occur in pale soft gelatinous masses while Calothrix parietina forms firm gelatinous yellowish crusts on rocks and wood. Filaments of nearly all of these species become separated from their gelatinous colonies and appear scattered among other algae in many communities. In midsummer and autumn the gelatinous masses of many of them become detached and float to the surface of ponds and quiet pools.

PLANTS FOUND IN CURECANTI RESERVOIR BASINS, 1961

Non-vascular Plants by

Seville Flowers

Vascular Plants (except grasses) by

Heber H. Hall
Seville Flowers

Grasses by

Robert Newell Reynolds

CONTENTS

Introduction	48
Non-vascular plants	49
Vascular plants	52
Grasses	92
Discussion	101
References	102

University of Utah
Anthropological Papers, No. 59, 1962
Upper Colorado Series, No. 8

INTRODUCTION

This is a list of plants collected or observed in the Curecanti Reservoir basins by the University of Utah Ecological Research Expedition conducted during June and July, 1961 under the direction of Angus M. Woodbury. The principal objective of the expedition was a vegetation survey for the Bureau of Reclamation; however, additional plant data were collected for other purposes of the University.

The vegetation studies were made under the direction of Seville Flowers who checked the identification of all specimens both in the field and in the herbarium. He collected most of the non-vascular plants (algae and mosses) and prepared the list of specimens. Robert N. Reynolds concentrated on the grasses and prepared the annotated check list. Heber H. Hall emphasized the collection of other vascular plants and provided the annotated list of specimens. In addition to the specimens listed, other vascular plants recognized and recorded in the field by Dr. Flowers have been incorporated in the list.

The Curecanti Reservoir basins extend in elevation from 6700 to 7500 ft. At this high elevation the spring growing season is retarded and early flowering plants were in full bloom when the survey began June 26, 1961, but many of the late summer flowering plants had not reached a maturity suitable for herbarium use when it terminated July 22. Some of these plants were recognizable and have been included in the check list. Since the reservoir basin will soon be inundated and further collections from the basin improbable, this collection of plants will be placed on deposit in the University of Utah herbarium and will be available for further study.

A total of 752 specimens were prepared for herbarium reference. These included most of the spring and early summer flowering plants, trees and shrubs. The collection includes 68 families, 191 genera and 372 species, exclusive of 18 specimens identified to genera only.

All dates are of the year 1961 and all plants were collected within the three reservoir basin sites, Blue Mesa, Morrow Point and Crystal, extending from river mile (RM) 62.7 at the upper end to 20.7 at the Crystal damsite, all in the Gunnison River drainage, Gunnison and Montrose Counties, Colorado.

These reservoirs are considerably higher in elevation than the Flaming Gorge Basin surveyed in 1959 or the Navajo Basin surveyed in 1960 and contain many different species in the flora. The great variety of physiographic aspects and forms found in the open basin of Blue Mesa, its side canyon tributaries and the deep and rugged Black Canyon, creates many environmental niches for a large variety of plants.

The assistance of F. T. Hermann, Washington, D. C., who identified the *Carex* specimens; H. D. Harrington of Colorado State University, who identified 31 specimens from the collection; and herbarium personnel who helped with the specimens is gratefully acknowledged.

PLANTS

Many of the expedition crew members gathered specimens in the field and brought them to Hall for pressing and recording of data. The initials of the person making the collection or identifying the plant in the field without taking a specimen are given in parenthesis after each record. These names are as follows: (SDD) S. D. Durrant; (SF) Seville Flowers; (GTG) Gerald T. Groves; (HHH) Heber H. Hall; (AWK) Allen W. Knight; (CRL) Calvin R. Lamborn; (GLR) Gary L. Ranck; (RNR) R. Newell Reynolds; (EBR) Elroy B. Robinson; (ADS) A. Dean Stock; and (RBW) R. Bruce Walker.

NON-VASCULAR PLANTS

Seville Flowers

Estimated extra abundance indicated by asterisks

CYANOPHYTA (phylum) Blue-green algae

ALGAE (class) Algae

- | | |
|---|--|
| <p>*<u>Oscillatoria angustissima</u> W. & W.</p> <p>***<u>Oscillatoria limosa</u> Agard</p> <p>*<u>Oscillatoria tenuis</u> Agard</p> <p><u>Oscillatoria animalis</u> Agard</p> <p><u>Phormidium autumnale</u> (Agard) Gomont</p> <p><u>Phormidium retzii</u> (Agard) Gomont</p> <p>***<u>Nostoc</u> spp. (all sterile)</p> <p>**<u>Anabaena inaequalis</u> (Ktz.) Born. & Flan.</p> <p>**<u>Anabaena oscillarioides</u> Bory</p> <p><u>Anabaena torulosa</u> (Carmichael) Langer.</p> | <p>**<u>Anabaena variabilis</u> Ktz.</p> <p>*<u>Nodularia amonica</u> Thuret</p> <p>**<u>Nodularia sphaerocarpa</u> Born. & Flan.</p> <p>***<u>Nodularia spumigena</u></p> <p>*<u>Cylindrospermum comatum</u> Wood.</p> <p><u>Calothrix parietina</u> (Naeg.) Thuret</p> <p><u>Rivularia borealis</u> R. Richter</p> <p><u>Rivularia</u> sp.</p> |
|---|--|

CHRYSOTHYTA (phylum) Yellow-green algae

- | | |
|---|---|
| <p><u>Botridium granulatatum</u> (L.) Greville</p> <p>***<u>Tribonema bombycina</u> (Agard) Hazen</p> <p>**<u>Tribonema minor</u> Klebs</p> <p>**<u>Vaucheria geminata</u> (Vauch.) DC.</p> | <p><u>Vaucheria longipes</u> Collins</p> <p><u>Vaucheria pachyderma</u> Walz.</p> <p><u>Vaucheria sessilis</u> (Vauch.)</p> |
|---|---|

CHLOROPHYTA (phylum)

Bacillarieae (family) . . . Diatoms

- | | |
|---|--|
| <p><u>Amorpha ovalis</u> Kuetz.</p> <p><u>Ceratoneis arcus</u> (Ehr.) Kuetz.</p> <p><u>Cocconeis pediculus</u> Ehr.</p> | <p><u>Cymbella</u> spp.</p> <p><u>Diatima hiemale</u> (Lyngb.) Heib.</p> <p><u>Epithemia argus</u> (Ehr.) Kuetz.</p> |
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PLANTS

Bacillarieae (family) continued

Fragilaria spp.
Gomphonema spp.
Navicula spp.
Melosira spp.
Rhopalodia gibba (Ehr.) O. Mull.
Synedra ulna (Nitz.) Ehr.
Gloeocystis gigas (Ktz.) Lagern.
Tetraspora gelatinosa (Vauch.)
 Desv.
Ulothrix tenuissima Ktz.
 ***Ulothrix zonata (Web. & Mohr.)
 Ktz.
Stigioclonium attenuatum (Hazen)
 Collins
 ***Stigioclonium stagnatile (Hazen)
 Collins
Chaetophora elegans (Roth) Agard
 *Chaetophora piciformis (Roth)
 Agard
Chaetophora incrassata (Huds)
 Hazen
Drepanaldia acuta (Agard) Ktz.

Drepanaldia acuta (Agard) Ktz.
 ***Cladophora kuetzingiana Grunow
Rhizoclonium hieroglyphicum
 (Agard) Ktz.
 **Oedogonium spp. (sterile)
Monostroma quaternarium (Ktz.)
 Desmaz.
 **Spirogyra inflata (Vauch.) Ktz.
Spirogyra longata (Vauch.) Ktz.
 ***Spirogyra porticalis (Mull.)
 Cleve
 ***Spirogyra varians (Hass.) Ktz.
 **Spirogyra weberi Ktz.
 **Zygnema insigne (Hass.) Ktz.
 **Mougeotia spp. (sterile)
 **Closterium acerosum (Schrank)
Closterium cucumis Ehrenb.
 *Cosmarium crenatum Ralfs
Cosmarium ovale Ralfs
Cosmarium tetraphthalmum
 (Ktz.) Breb.

BRYOPHYTA (phylum) Mosses and liverworts

HEPATICAEE (class) Liverworts

Ricciaceae (family)

Riccia frostii Austin

Marchantiaceae (family)

Asterella ludwigii (Schwaegr.) Underw.
Clevea hyalina Lindb.
Marchantia polymorpha L.

MUSCI (class) Mosses

Ditrichaceae (family)

Ceratodon purpureus Brid.
Distichium capillaceum (Hedw.)
 B. S. G.

Encalyptaceae (family)

Encalypta rhabdocarpa Schwaegr.
Encalypta vulgaris Hedw.
Encalypta vulgaris mutica Brid.

Pottiaceae (family)

Didymodon mexicanus subulatus
 Thér. & Bart.
Didymodon trifarius (Hedw.) Brid.
Pottia heimii Furnr.
Tortula mucronifolia Schwaegr.
Tortula papillosissima (Coppey)
 Broth.
Tortula ruralis (Hedw.) Smith

PLANTS

Grimmiaceae (family) . . Rock mosses

- Grimmia alpestris Nees
- Grimmia anodon B. S. G.
- Grimmia ovalis (Hedw.) Lindb.

Funariaceae (family)

- Funaria hygrometrica Hedw.

Orthotrichaceae (family)

- Orthotrichum alpestre Hornsch.
- Orthotrichum hallii Sulliv.
- Orthotrichum jamesianum Sulliv.
- Orthotrichum texanum Sulliv.

Timmiaceae (family)

- Timmia bavarica Hessel.

Bartramiaceae (family)

- Philonotis fontana (Hedw.) Brid.

Bryaceae (family)

- Bryum angustirete Lindb.
- Bryum argenteum Hedw.
- Bryum caespiticiu (L.) Hedw.
- Bryum cirratu Hoppe & Hornsch.
- Bryum cuspidatu (B. S. G.) Schimp.
- Bryum pallescens Schleich.
- Bryum pseudotriquetru (Hedw.) Schwaegr.
- Bryum turbinatu (Hedw.) Schwaegr.
- Leptobryum pyriforme (Hedw.) Schimp.
- Mnium serratu Brid.
- Pohlia cruda (Hedw.) Lindb.
- Pohlia gracilis (Schleich.) Lindb.
- Pohlia wahlenbergii (W. & M.) Andrews

Hypnaceae (family)

- Amblystegium orthocladon P. Beauv.
- Amblystegium riparium (L.) Hedw.
- Amblystegium serpens (Hedw.) B.S.G.
- Amblystegium trichopodium kochii Lindb.
- Brachythecium albicans (Neck.) B. S. G.
- Brachythecium collinum (Schleich.) B. S. G.
- Brachythecium collinum idahense (R. & C.) Grout
- Brachythecium rivulare B. S. G.
- Brachythecium salebrosum (W. & M.) B. S. G.
- Brachythecium utahense James
- Campylium radicale (P. Beauv.) Grout
- Cratoneuron filicinum (Hedw.) Roth
- Drepanocladus aduncus (Hedw.) Warnst.
- Eurhynchium strigosum (Hoffm.) B. S. G.
- Hygrohypnum cochlearifolium (Vent.) Broth.
- Hygrohypnum ochraceum (Turn.) Loeske
- Hygrohypnum palustre (Hedw.) Loeske
- Hypnum patientiae elatu Schimp.
- Hypnum revolutu (Mitt.) Lindb.

Neckeraceae (family)

- Neckera pennata oligocarpa (Bruch) Grout

Leskeaceae (family)

- Leskea tectorum (Braun) Lindb.
- Thuidium abietinum (Brid.) B.S.G.

Fontinalaceae (family) . . Water moss

- Fontinalis duriaei Schimp.

VASCULAR PLANTS

Heber H. Hall and Seville Flowers

PTERIDOPHYTA (phylum) Ferns and allies

Polypodiaceae (family) Ferns

Cheilanthes feei Moore Lipfern

Black Canyon: dry schistose crevices, shady area, June 9, 7600 ft. (SF); RM 37, dry rocky soil, roadside and near riverbank, July 15, 7200 ft. (HHH); RM 36, moist crevice of large ledge associated with rich green moss and liverworts, July 18, 6950 ft. (ADS); and Cimarron Creek, rocky cliffs, frequent in ledges, July 21, 6900 ft. (HHH).

Cryptogramma acrostichoides (R.Br.) Clark Parsley fern

Black Canyon, dry schistose crevices along north face, July 9, 7600 ft. (SF).

Notholaena fendleri Kunze Cloakfern

Dry Gulch, RM 50, face of rock crevice, dry soil, very rare, June 28, 8300 ft. (EBR); Red Creek, RM 47, dry rock crevice above river at confluence, June 29, 7460 ft. (RNR); Blue Mesa damsite, RM 41, rare, rocky soil under high incline of rock wall above river, July 14, 7460 ft. (SF); and Black Canyon, RM 26, 3 mi. down Crystal Res., rocky crevice in shady canyon, frequent, July 21, 7400 ft. (HHH).

Equisetaceae (family) Horsetails

Equisetum arvense L. Meadow horsetail

Upper limits of Reservoir, RM 63, emergent in margin of meadow stream, wet soil of meadow and fields, June 30, 7500 ft. (HHH); and Beaver Creek, RM 62, damp to wet soil, emergent, common, July 3, 7500 ft. (SF).

Equisetum kansanum Schaffn. Kansas horsetail

East Elk Creek, among wet meadow types, common, June 8, 7500 ft. (SF); Dry Gulch, RM 50, common on ditch banks and streamsides in wet gravelly soil, June 28, 7460 ft. (HHH); and upper limits of Reservoir, RM 63, wet meadow and roadside, deep soil, plants robust, July 1, 7500 ft. (HHH).

Equisetum prealtum Raf. Tall horsetail

Soap Creek, RM 43, common in wet gravel soil along canal bank and wet mud of river, July 12, 7490 ft. (HHH).

PLANTS

SPERMATOPHYTA (phylum) Seed plants

GYMNOSPERMAE (class) Cone-bearing plants

Pinaceae (family) Pines

Juniperus communis L. Mountain juniper

West of Cebolla Creek, RM 48, only two well shaded plants observed associated with aspen in rocky soil, July 8, 7520 ft. (HHH); Soap Creek, RM 43, growing in spruce, fir forest at upper limits of reservoir, July 12, 7460 ft. (SF).

Juniperus scopulorum Sarg. Mountain red juniper

Dry Gulch, RM 50, rare in lower extension of this drainage, in cottonwood stand in deep clay soil, June 30, 7485 ft. (HHH).

Picea pungens Engelm. Blue spruce

Cebolla Creek, RM 50, common on north face slope or river drainage, but rare in stream bottom, July 7, 7500 ft. (GTG); Willow Creek, RM 60, common on steep dry gulch on north face, July 1, 7500 ft. (HHH).

Pinus edulis Engelm. Doubleleaf pinyon pine

Black Canyon, RM 29, dominant stand at lower end of Morrow Point Reservoir on south facing slope, July 19, 7100 ft. (HHH).

Pinus ponderosa Laws. Ponderosa pine

Elk Horn Lodge up Willow Creek, RM 60, dry hillside in narrow draw, July 1, 7500 ft. (HHH); and Cebolla Creek, RM 50, dry hillside, rare in this drainage, only these mature trees observed, July 8, 7560 ft. (HHH).

Pseudotsuga menziesii (Mirb.) Franco Douglas fir

South Elk Horn, RM 60, common on rocky north facing slope, very handsome fully mature, July 1, 7560 ft. (HHH).

ANGIOSPERMAE (class) Flowering plants

MONOCOTYLEDONES (subclass) Monocots

Typhaceae (family) Cattail

Typha angustifolia L. Narrowleaf cattail

Upper limits of Res., RM 63, emergent at margin of stream in wet meadow, rare, very deep wet swamp, 7 mi. west Gunnison on Highway 9, July 1, 7520 ft. (HHH).

Najadaceae (family) Pondweed

Potamogeton pectinatus L. Pondweed

Soap Creek, RM 43, common in small backwaters near confluence, July 13, 7460 ft. (AWK).

PLANTS

Juncaginaceae (family) Arrowgrass

Triglochin maritima L. Seaside arrowgrass

West Iola, RM 58, dry granite and quartz, very heavily grazed and depressed, small per cent of cover, July 5, 7500 ft. (HHH); and West Elk Creek, RM 44, common in wet clay soil in meadows, July 11, 7460 ft. (HHH).

Triglochin palustris L. Podgrass

East Elk Creek, RM 58, common in streamside community and open meadow grass field, July 6, 7460 ft. (HHH).

Gramineae (family) Grasses

See separate treatment by R. N. Reynolds, page 92.

Cyperaceae (family) Sedges

Carex sp. Sedge

River bridge, Cimarron, RM 29, rare, hillside, north facing slope, dry soil, July 19, 6940 ft. (HHH).

Carex foenea Willd. Sedge

Moncrief Ranch, RM 50, rare, along old abandoned canal, soil rocky and dry, July 21, 7480 ft. (HHH).

Carex microptera Mack. Sedge

Five miles west of Gunnison, upper reaches of Res., RM 63, emergent in canal at large meadow, common, July 1, 7520 ft. (HHH); and Dry Gulch, RM 50, wet streamside just below beaver dams in canyon, July 21, 7500 ft. (HHH).

Carex nebraskensis Dewey Nebraska sedge

Upper limits of Res., RM 63, large plant, common emergent in meadow water drainage, July 1, 7520 ft. (HHH); and Moncrief Ranch, RM 50, common, old ranch meadow, July 9, 7460 ft. (HHH).

Carex praegracilis W. Booth Sedge

Upper limits of Res., RM 63, semi-submerged, common in canal at bend of river, July 2, 7500 ft. (HHH).

Carex rostrata Stokes Beaked sedge

Aswald Ranch, RM 58, common in meadow and in swamp area near stream, July 4, 7500 ft. (HHH).

Carex sartwellii Dewey Sedge

Iola: RM 58, common in fields, July 4, 7500 ft. (HHH); and RM 57, common in wet meadow, July 4, 7460 ft. (HHH).

PLANTS

- Eleocharis macrostachya Britt. Spikerush
Iola, RM 58, common in wet meadows of cultivated field, July 4, 7460 ft. (HHH).
- Eleocharis palustris (L.) R. & S. Spikerush
Upper limits of Res., RM 63, emergent margins of stream, very abundant in much of meadow fields, July 1, 7520 ft. (HHH).
- Eleocharis sp. Spikerush
Dry Gulch, RM 50, common in streamside, wet sandy soil, July 6, 7500 ft. (HHH); and Stevens Creek, RM 56, common in cultivated meadows, July 3, 7520 ft. (HHH).
- Scirpus americanus Pers. American bulrush
Mouth of East Elk Creek and in meadow near Coullintine Ranch (SF).
- Scirpus microcarpus Presl. Torrey bulrush
Dry Gulch, RM 50.5, common on streamside and riverbanks, wet clay, sandy soil, June 28, 7460 ft. (HHH); and upper reaches of Res., RM 63, emergent margin of stream in wet meadow, rare, July 1, 7210 ft. (HHH).
- Scirpus rubrotinctus Fernald Bulrush
Cebolla Creek, RM 50, common in wet mud soil in willow and alder association, July 6, 7520 ft. (CRL).
- Juncaceae (family) Rush
- Juncus balticus montanus Engelm. Baltic wiregrass
Dry Gulch, RM 50, common along the ditch bank and streamside, June 28, 7500 ft. (HHH); Tex Lodge, RM 51, common in deep swamp, wet soil and deep clay, July 6, 7500 ft. (HHH); Moncrief Ranch, RM 49, common in meadows and streamside areas, July 9, 7460 ft. (HHH); and East Elk Creek, RM 51, common, streamside and meadow, July 21, 7500 ft. (HHH).
- Juncus longistylis Torr. Meadow rush
East Elk Creek, RM 50, common, streamside, handsome, July 6, 7500 ft. (HHH).
- Juncus saximontanus A. Nels. Rocky Mt. rush
Cebolla, RM 50, common, streamside, from Aswald Ranch to Moncrief Ranch, July 6, 7500 ft. (HHH); Black Canyon, RM 36, wet seepage under large gneiss rock overhang, rare, July 18, 7100 ft. (HHH); and East Elk Creek, RM 49, common in wet meadow and farmland, rich humic clay soil, July 21, 7500 ft. (HHH).
- Luzula parviflora Desv. Woodrush
In rush communities (SF).

PLANTS

Liliaceae (family) Lily

Allium macropetalum Rydb. Wild onion

Beaver Creek, RM 52, common in meadow uplands and damp soil along canal and roadside, July 3, 7500 ft. (SF); and Stevens Creek, RM 58, common on streamside and among meadow, July 3, 7500 ft. (HHH).

Calochortus gunnisonii Watson Mariposa lily

Dry Gulch, RM 50, rare, had passed its flowering stage, July 2, 7500 ft. (HHH); and Upper Red Creek, RM 48, rocky outcrop in sagebrush and grass, July 8, 8700 ft. (HHH).

Calochortus nuttallii Torr. Sego lily

Dry Gulch, RM 50, associated with populus and oak, dry roadside, July 7, 7500 ft. (HHH); and Soap Creek, RM 43, common, deep soil of semi-sand and clay among large sagebrush, July 12, 7500 ft. (HHH).

Smilacina racemosa (L.) Desf. False Solomon seal

Black Canyon, RM 38, sandy soil, rocky overhang south shady wet area, July 15, 7200 ft. (HHH); and Black Canyon, RM 33, common in narrows associated with willows of wet sandy soil, July 18, 7100 ft. (HHH).

Smilacina stellata (L.) Desf. False Solomon seal

East Elk Creek, RM 50, common, associated with willows in wet streamside, June 8, 7500 ft. (SF); and Dry Gulch, RM 50.5, abundant along dry gulches and sandy washes and semi-wet terrace, June 28, 7500 ft. (HHH).

Yucca angustissima Engelm. Narrowleaf yucca

Dry Gulch, RM 50, dry hills along ridge near ranch house, June 8, 7500 ft. (SF); and South Elk Horn, RM 61, common, full flowers, dry open sagebrush flat sandy soil, July 1, 7500 ft. (HHH).

Iridaceae (family) Iris

Iris missouriensis Nutt. Blue iris

Upper limits of Reservoir, RM 63, wet meadow along stream, common, deep in bog soil, June 8 and 30, 7500 ft. (HHH) (SF).

Sisyrinchium montanum Greene Blue-eyed grass

Beaver Creek, wet soil among willows near upper damsite, June 8, 6700 ft. (SF).

Sisyrinchium demissum Greene Blue-eyed grass

Willow Creek, RM 60, streamside was dry but much cottonwood, sandy soil, July 1, 7500 ft. (HHH).

PLANTS

DICOTYLEDONES (subclass) Dicots

Salicaceae (family)Willows and cottonwoods

Populus angustifolia James Narrowleaf cottonwood

Cimarron Creek, RM 29, river edge near bridge, July 19, 6900 ft. (HHH); and Dry Gulch, large stands along stream and field of canyons, huge trees in upper Soap Creek standing 85-100 ft., July 28, 7500 ft. (HHH).

Populus tremuloides Michx. Quaking aspen

Haystack Gulch, RM 53, common on hillside and at rock outcrops, July 8, 7500 ft. (HHH); and West of Cebolla Creek, RM 47, rare at this elevation, found in deep north facing gullies and at break of ridges, July 8, 7500 ft. (HHH).

Salix sp. Willow

Beaver Creek, common, damp soil, river bottom and streamside, June 8, 7500 ft. (SF); and Cebolla Creek, RM 50, common, wet streamside soil, July 8, 7500 ft. (HHH) (SF).

Salix amygdaloides Anders. Peachleaf willow

Dry Gulch, RM 50.5, common where water streams out of side canyons and canyon bottoms, June 28, 7500 ft. (HHH).

Salix bebbiana Sarg. Bebb willow

Dry Gulch, RM 50, common on streamside, wet soil, very tall robust, June 28, 7500 ft. (HHH).

Salix caudata (Nutt.) Heller Whiplash willow

Dry Gulch, RM 50, common along stream and near valley wash in deep soil, June 28, 7500 ft. (HHH); Willow Creek, RM 60, streamside, July 1, (SF); and West Elk Creek, RM 44, common, streamside, wet mud, July 10, 7480 ft. (HHH).

Salix exigua Nutt. Sandbar willow

Willow Creek, RM 60, streamside, common along old railroad bed, July 1, 7500 ft. (HHH); and Lake Fork, RM 41, common streamside vegetation from Gunnison, Colo. to the walled cliffs below Cimarron Creek, July 15, 7000 ft. (HHH).

Salix geyeriana (Anders.) Rydb. Geyer willow

Dry Gulch, RM 50, common in stream just north of canyon in damp sandy soil, June 28, 7460 ft. (HHH).

Salix lutea Nutt. var. watsoni (Bebb.) Jepson Yellow willow

Dry Gulch, RM 50.5, common, wet streamside and canyon bottom, very handsome tree like, June 28, 7500 ft. (HHH).

PLANTS

Salicaceae (family) continued

Salix watsonii Rydb.

Dry Gulch, RM 50.5, common along streamside and riverbanks in most drainages, June 28, 7460 ft. (HHH).

Betulaceae (family) Birch

Alnus tenuifolia Nutt. Thinleaf alder

Dry Gulch, RM 50, common along wet streams along river and just north of camp, June 28, 7500 ft. (HHH).

Betula fontinalis Sarg. Red riverbirch

Henderson Place, RM 50, hillside, rocky soil near old abandoned stock yard, July 7, 7500 ft. (HHH); and mouth of Cebolla Creek, RM 50, not common, some mature trees, wet soil, July 9, 7460 ft. (HHH).

Betula occidentalis Hook. Western riverbirch

Red Creek, RM 47, common on rocky banks east of new bridge, June 29, 7500 ft. (RBW).

Fagaceae (family) Beech

Quercus gambelii Nutt. Gambel oak

Dry Gulch, RM 50, common at breaks of hills in rocky soil, June 30, 7500 ft. (HHH); West of Cebolla Creek, RM 48, common on north face above river, 15% to 20% total cover, July 8, 7500 ft. (HHH); and Soap Creek, RM 43, common in rocky, shale soil on dry west facing slope, July 12, 7500 ft. (HHH).

Quercus gambelii x turbinella Nutt. Hybrid Gambel oak

West Elk Creek, RM 44, hillside, common in sandy soil near outcrops and steep dry sandstone walls, July 10, 7500 ft. (HHH).

Cannabinaceae (family) Hemp

Humulus lupulus var. neomexicanus Nels. & Ckll. New Mexican Hop

Willow Creek, RM 60, streamside, common along creek and canal, July 1, 7500 ft. (HHH); and Dry Gulch, RM 50, rare, found in deep wet sandy clay soil, climbing on willows, June 28, 7500 ft. (HHH).

Urticaceae (family) Nettle

Urtica gracilenta Greene Stinging nettle

Dry Gulch, RM 50, dry waste soil in fields and pasture, June 28, 7500 ft. (HHH).

PLANTS

Santalaceae (family) Sandalwood

Comandra pallida A. DC. False toadflax

Near upper damsite, dry soil near river bank, June 8, 7600 ft. (SF).

Polygonaceae (family) Buckwheat

Eriogonum sp.

Red Creek Rim, RM 48, common in large park area of sagebrush and grass, deep clay loam soil, July 8, 8700 ft. (HHH).

Eriogonum sp.

Cebolla Creek, RM 50, common, dry sandy clay soil in abandoned farmland, July 7, 7460 ft. (HHH).

Eriogonum spp.

South of West Elk Creek, RM 44, dry fir forest north slope just above river near confluence, July 10, 7500 ft. (HHH); and Morrow Point damsite, RM 29, dry hillside, shallow soil, shady north side, July 18, 6860 ft. (HHH).

Eriogonum campanulatum Nutt. Campanulated eriogonum

Red Creek, RM 47.5, frequent on hills of rock and gravel soil of sagebrush belt and up steep canyons, June 28, 7460 ft. (HHH); and RM 47, dry rock hillside, common, mature plants, June 30, 7500 ft. (HHH).

Eriogonum cernuum Nutt. Slender eriogonum

Black Canyon, RM 33, common, rocky soil along roadside of canyon, July 18, 6940 ft. (HHH).

Eriogonum ovalifolium Nutt. Silver plant

Among sagebrush (SF).

Eriogonum racemosum Nutt. Wild buckwheat

South Iola, RM 59, rare on dry rocky escarpment just out of reservoir area, July 5, 7500 ft. (HHH); and Black Canyon, RM 32, rare to common in open sandy soil along railroad bed, July 21, 6950 ft. (HHH).

Eriogonum tristichum Small Eriogonum

Among sagebrush (SF).

Eriogonum umbellatum Torr. Sulphur eriogonum

Beaver Creek, dry hillside near bottom, June 8, 7500 ft. (SF); Dry Gulch, RM 50.5, rare, dry rocky hillside, plants in seed, June 28, 7500 ft. (HHH); Dry Gulch, RM 50, common in hillsides of sagebrush and oak, June 30, 7500 ft. (HHH); south of Steuben Creek, RM 60, common on dry hillside beneath large ledge and in shade of crevice, July 1, 7460 ft. (HHH); Red Creek rim, RM 48, common among sagebrush in rocky soil of coarse texture, July 8, 8700 ft. (HHH); and West Elk Creek, RM 44, common, steep hillside among rocks, (HHH).

PLANTS

Polygonum spp.

Soap Creek, RM 43, semi-dry soil associated with sagebrush and *Chrysothamnus*, rare on east face hillside, July 12, 7500 ft. (HHH).

Polygonum amphibium L. Water smartweed

Upper limits of Res., RM 63, submergent in large canal just east of river, common, June 30, 7520 ft. (HHH); and wet meadow, submergent in canal, 7 mi. west of Gunnison, Colo., July 1, 7500 ft. (HHH); and Stevens Creek, RM 58, rare, semi-submerged in some river back water, July 3, 7520 ft. (HHH).

Polygonum aviculare L. Doormat weed

Lake Fork, RM 41-6, dry gravel soil along roadside and in waste place of lower Lake Fork, July 15, 7500 ft. (HHH).

Rheum rhaponticum L. Rhubarb

Moncrief Ranch, RM 49, rare, open abandoned farmland, escaped cultivation, July 10, 7500 ft. (EBR).

Rumex crispus L. Curly dock

Dry Gulch, RM 50, common, along roadside and in waste places at fringes of fields, coarse gravel soil, June 28, 7460 ft. (HHH).

Rumex mexicanus Meisn. Mexican dock

Dry Gulch, RM 50, rare, deep clay soil, along road and abandoned ditches, June 28, 7460 ft. (HHH).

Rumex persicarioides L. Golden dock

East Elk Creek, RM 51, common, rocky hillside, damp edge of small canyon stream, July 10, 7500 ft. (HHH).

Chenopodiaceae (family) Goosefoot

Atriplex canescens (Pursh.) Nutt. Four-wing saltbrush

Dry Gulch, RM 50, rare, abused by grazing, dry rock hill 1 mi. up canyon from ranch house, July 2, 7500 ft. (HHH); and Moncrief Ranch, RM 44, rare, few plants taken, badly hedged, July 10, 7500 ft. (HHH).

Atriplex hastata L. Annual atriplex

Alkaline terraces, dry road side in Black Canyon Gorge (SF).

Blitum capitatum L. Blite

Soap Creek, RM 43, terrace, semi-dry, just above main streamside, July 12, 7460 ft. (SF).

Chenopodium album L. Lambsquarter

Dry Gulch, RM 50, common in waste areas and old corrals, June 30, 7460 ft. (HHH); and Lake Fork, RM 41-6, common roadside, dry hillside in rocky soil, July 15, 7690 ft. (HHH).

PLANTS

Chenopodium glaucum L. Pigweed

Dry Gulch, RM 50.5, common, roadside and open waste fields in dry gravel rocky soil, June 28, 7500 ft. (HHH); Dry Creek, RM 50, rare, dry rocky soil along old railroad bed, July 6, 7500 ft. (HHH).

Chenopodium leptophyllum Nutt. Narrowleaf chenopodium

Dry Gulch, RM 50, dry soil along roadside, field fringe deep sandy clay loam, June 28, 7460 ft. (HHH).

Eurotia lanata (Pursh.) Moq. Winterfat

Red Creek, RM 47, east of new bridge construction, much grazing, June 29, 7500 ft. (HHH).

Kochia scoparia (L.) Schrad. Fireball

Dry Gulch, RM 50, poor competitor, abandoned fields and dry gravel along the roadside, June 28, 7500 ft. (HHH).

Monolepis nuttalliana (Schult.) Greene Schard

Black Canyon, dry rocky soil along road bank, June 9, 7200 ft. (SF).

Salsola kali tenuifolia Tausch Russian thistle

Henderson Ranch, RM 50, common in dry soil in abandoned field, July 7, 7460 ft. (HHH).

Suaeda depressa (Pursh.) S. Wats. Annual inkweed

Stevens Creek, RM 58, damp clay soil at river's edge, rare, July 4, 7500 ft. (HHH).

Amaranthaceae (family) Amaranths

Amaranthus blitoides S. Wats. Prostrate pigweed

Dry sandy soil of Black Canyon (SF).

Amaranthus graecizans L. Tumbleweed redroot

Willow Creek, RM 60, rare, streamside, July 1, 7500 ft. (SF); and Lake Fork, RM 41-4, dry roadside, sandy soil, rare, July 16, 7495 ft. (HHH).

Amaranthus retroflexus L. Redroot pigweed

Black Canyon, RM 34, rare, dry rocky soil embankment of road, July 18, 6940 ft. (HHH).

Nyctaginaceae (family) Four-o'clock

Mirabilis linearis (Pursh) Heimerl. Four-o'clock

Cebolla Creek, RM 49, common on hillside near recent seep and moist soil, July 8, 7500 ft. (HHH); upper Red Creek, RM 48, common on steep rocky outcrops in dry sandy aggregate soil, July 8, 8700 ft. (HHH); Red Creek, RM 47, common, red sandy clay on rock ledge, trail from confluence,

PLANTS

Nyctaginaceae (family) continued

Mirabilis linearis (continued)

July 10, 7600 ft. (EBR); Red Creek, RM 43, dry rocky soil along road embankment, July 10, 7500 ft. (EBR); and Lake Fork, RM 41-4, common, dry rocky gneiss outcrop, July 15, 7500 ft. (HHH).

Caryophyllaceae (family) Pinks

Arenaria congesta Nutt. Sandwort

Black Canyon, RM 37, common associated with oak and sagebrush near old roadbed rocky soil, July 15, 7200 ft. (HHH).

Arenaria fendleri A. Gray Fendler sandwort

Willow Creek, RM 60, not common, dry crevices and rock on hillside, July 1, 7500 ft. (HHH).

Silene noctiflora L. Catchfly

Dry Gulch, RM 50, rare, one specimen observed, in shade and dry sandy soil, July 5, 7460 ft. (SF).

Stellaria jamesiana Torr. Starwort

East Elk Creek, dry soil in willow thicket, June 8, 7500 ft. (SF); and Beaver Creek, wet soil at bottom of creek, June 8, 7600 ft. (SF).

Stellaria longipes Goldie Starwort

Upper limits of Res., RM 63, common, dry to damp soil of roadbed, 7520 ft. (HHH); Black Canyon, dry soil, shady, June 9, 7600 ft. (SF); mouth of Willow Creek, RM 59, common in meadow of fields, streamside, wet soil, July 2, 7500 ft. (HHH); and West Elk Creek, RM 44, common, wet soil along streamside, July 11, 7460 ft. (SF).

Stellaria longipes laeta (Richard) Wats Starwort

Upper limits of Res., RM 63, common, full maturity, meadow stream, along roadside, 6 mi. west of Gunnison, Colo., June 30, 7520 ft. (HHH).

Ranunculaceae (family) Buttercups and allies

Actaea arguta Nutt. ex. T. & G. Baneberry

Black Canyon, dry soil shady ravine, June 9, 7600 ft. (SF); RM 36, damp soil, shady soil under large cliff overhang, plant bore red or rubra colored fruit, July 16, 6940 ft. (HHH); and RM 36, common, rich damp soil of the narrow area, plant bore white or alba colored fruit, July 16, 6940 ft. (HHH).

Batrachium trichophyllum (Chaix) Bossch. Water buttercup

North and east of Iola, Colo., submerged in swamp stream (SF).

Clematis hirsutissima Pursh. Virginbower

Beaver Creek, common, dry hillside near bottom, June 8, 7400 ft. (SF); Aswalt Ranch, RM 59, common, terrace in deep soil, July 4, 7560 ft. (ADS); and Soap Creek, RM 43, common, wet deep river mud soil, July 12, 7500 ft. (HHH).

PLANTS

Ranunculaceae (family) continued

Clematis ligusticifolia Nutt. Western virginbower

Black Canyon, RM 38, common in willow and alnus near road and riverbank, sandy soil, July 15, 7200 ft. (HHH); and Lake Fork, RM 41-5, rare, climbing in rubis and willows, July 16, 7490 ft. (HHH).

Clematis pseudoalpina (Kuntze) A. Nels. Virginbower

Black Canyon, dry soil in shady ravine, June 9, 7600 ft. (SF).

Ranunculus sp.

Cebolla Creek, RM 50, common in damp sandy soil under large alder tree, July 3, 7420 ft. (SF); and Black Canyon, dry soil, near river edge but above water level, common, June 9, 7600 ft. (SF).

Ranunculus aquatilis L. Water buttercup

West Elk Creek, RM 43, wet sandy soil near streamside at upper limits of Res., July 13, 7500 ft. (HHH).

Ranunculus circinatus Sibth. Water buttercup

Stevens Creek, RM 59, submerged and semi-submerged at the bow of small stream, July 3, 7500 ft. (HHH).

Ranunculus cymbalaria Pursh. Trailing buttercup

East Elk Creek, RM 51, common in mud and stream debris and in riverbanks along Res., July 6, 7460 ft. (HHH); West Elk Creek, RM 42-4, common in meadow and wet streamside, July 11, 7460 ft. (SF); and Soap Creek, RM 43, rare, wet mud and rocky soil near stream, July 12, 7480 ft. (SF).

Ranunculus macounii Britt. Macoun buttercup

East Elk Creek, moist soil, June 8, 7500 ft. (SF); Dry Gulch, RM 50, rare, wet soil along stream and in sagebrush near stream, June 28, 7500 ft. (HHH); and upper limits of Res., RM 63, common, roadside, rocky soil, nice robust plants, June 30, 7520 ft. (HHH).

Ranunculus sceleratus L. Cursed crowfoot

Beaver Creek, near mouth, semi-submerged (SF).

Thalictrum fendleri Engelm. Meadow rue

Elk Horn Ranch, RM 62, streamside in meadow type habitat under large Populus angustifolia, July 3, 7500 ft. (SF); and west of Cebolla Creek, RM 48, rare, not mature, in aspen forest, July 8, 7520 ft. (HHH).

Berberidaceae (family) Barberry

Berberis repens Lindl. Oregon grape

Henderson Ranch, RM 50, rare, dry gully in rock soil, July 7, 7540 ft. (HHH).

PLANTS

Papaveraceae (family) Poppy

Argemone intermedia Sweet Prickly poppy

Lake Fork, RM 41-5, semi-wet terrace associated with sagebrush and rabbit-brush, July 16, 7500 ft. (HHH).

Fumariaceae (family) Fumitory

Corydalis aurea Willd. Golden corydalis

Jointed Rod Ranch, RM 63, wet soil and rocky terrace on north side of river, 7520 ft. (SF).

Corydalis caseana A. Gray Corydalis

Coal Creek, RM 41-5, common along streamside and as a subordinate to spruce, and fir forest, July 15, 7500 ft. (HHH).

Capparidaceae (family) Caper

Cleome serrulata Pursh. Rocky Mt. beeflower

Dry Gulch, RM 50, common in dry gravelly soil along roadside and in fringe of cultivated grain and alfalfa fields, June 29, 7460 ft. (HHH); and Jointed Rod Ranch, RM 63, common in some of fields near ranch, dry soil above stream bank, July 3, 7500 ft. (SF).

Polanisia trachysperma T. & G. Clammy weed

Black Canyon, RM 30, rare, one specimen taken in dry rocky soil, July 18, 7100 ft. (HHH).

Cruciferae (family) Mustard

Arabis demissa Greene Rockcress

Beaver Creek, dry hillside near bottom of creek, June 8, 7600 ft. (SF).

Arabis sp.

Black Canyon, RM 36, dry soil, common, June 9, 7200 ft. (SF).

Camelina microcarpa Andr. Gold of pleasure

Waste places near Mancreif Ranch and Dry Gulch (SF).

Cardamine cordifolia A. Gray Bitter cress

East Elk Creek, wet soil along rivulets of cold mountain stream, June 8, 7500 ft. (SF); and Dry Gulch, RM 50, rare at this time, flowers have fruited, dry road bed near beaver ponds, July 7, 7500 ft. (HHH).

Chorispora tenella DC. Chorispora

Dry Gulch, RM 50, common above ranch house, sandy damp soil, June 9, 7500 ft. (SF); Lake Fork Creek, RM 41-3, streamside, north facing slope, common, July 3, 7520 ft. (SF); and Cebolla Creek, RM 50, common in streamside soil, July 9, 7440 ft. (HHH).

Descurainia pinnata (Walt.) Britt. Tansy mustard

Elk Horn Lodge, RM 61, common in rocky soil, dry hillside at bend of river July 1, 7500 ft. (HHH).

PLANTS

Cruciferae (family) continued

Descurainia sophia (L.) Webb ex Prantl. Tansy mustard

Dry Gulch, RM 50, common in dry gravelly soil, dry road sides and waste areas, June 28, 7500 ft. (HHH); Dry Gulch, RM 50, common in cottonwood community north of ranch house, deep moist soil and shade, June 30, 7460 ft. (HHH); and Morrow Point damsite, RM 29, rare, dry roadside and in open areas near road grade, July 19, 6900 ft. (HHH).

Erysimum capitatum (Dougl.) Greene Wallflower

Upper damsite, dry soil and hillside, June 8, 6700 ft. (SF).

Lepidium densiflorum Schrad. Peppergrass

Red Creek, RM 47, burrow pit of road just east of new bridge, June 29, 7500 ft. (HHH); and upper limits of Res., RM 63, roadside, rocky soil, common in all drainages, July 1, 7520 ft. (HHH).

Lepidium draba (L.) Desv. Journ. White top

Dry Gulch, RM 50, common in field in dry soil south of ranch house, June 28, 7500 ft. (HHH).

Lepidium montanum Nutt. Mt. peppergrass

Red Creek, RM 47, near road on dry gravel soil, June 29, 7500 ft. (SF); and Dry Gulch, RM 50, common in field just south of ranch house, June 30, 7500 ft. (SF).

Lepidium virginicum L. Peppergrass

Black Canyon, dry soil, canyon bottoms, June 9, 7600 ft. (SF); and Red Creek, RM 47, not too common, dry gravel bench north of road at new bridge, June 29, 7480 ft. (HHH).

Physaria floribunda Rydb. Bladderpod

Upper limits of Res., RM 63, common, dry soil, gravel texture, June 6, 7500 ft. (SF); and Soap Creek, RM 43, common in lower areas where more water collected and soil less rocky, dry hillside, July 12, 7500 ft. (HHH).

Radicula lyrata (Nutt.) Greene Yellow watercress

Common in the rush communities of the drainage (SF).

Schoenocrambe linifolia (Nutt.) Greene Plains mustard

Beaver Creek, dry soil, shady part of canyon, June 8, 7400 ft. (SF).

Sisymbrium altissimum L. Tumbling mustard

Dry Gulch, RM 50, common in fallow fields of Henderson Place and Moncrief Ranch, dry soil on roadside and waste areas, June 28, 7500 ft. (HHH); and Black Canyon, RM 30, roadside rare, in canyon dry rocky soil, July 11, 7100 ft. (HHH).

PLANTS

Cruciferae (family) continued

Streptanthus cordatus Nutt. ex. T. & G. Twistflower

Upper damsite, dry hillsides, June 8, 7600 ft. (SF).

Thlaspi alpestre L. Penny cress

Beaver Creek, dry soil of fields and hillsides, June 8, 7600 ft. (SF).

Thlaspi arvense L. Penny cress

Sapinero, RM 41, common along old dry road bed and open foothills, July 12, 7500 ft. (HHH); and Dry Gulch, RM 50, rare, dry gravel bed along roadside, June 28, 7500 ft. (HHH).

Crassulaceae (family) Stonecrop

Sedum stenopetalum Pursh. Stonecrop

Dry Gulch, RM 50, rocky soil and open sagebrush in north face of area above ranch house, June 28, 7500 ft. (SF); and Jointed Rod Ranch, RM 63, those with flowers rare, dry rock soil, July 8, 7520 ft. (HHH).

Saxifragaceae (family) Alumroot

Heuchera parvifolia Nutt. Alumroot

Beaver Creek, common, dry hillside at base of rocks, June 8, 7500 ft., (SF).

Heuchera spp.

Upper limits of Res., RM 63, emergent in wet marsh, rare in this meadow, heavy clay soil and very wet area, June 30, 7520 ft. (HHH).

Philadelphus microphyllus microphyllus Gray Mockorange

Rim of Red Creek, RM 47, frequent, rocky soil, open sagebrush and oak association, July 8, 8700 ft. (HHH); Black Canyon, RM 36, large mature, rare, rocky schistose black-soil, July 15, 7200 ft. (HHH); and Black Canyon, dry rocky slope, common, 7600 ft. (SF).

Philadelphus microphyllus occidentalis (Nels.) Hitchc. . . Western mockorange

Lake Fork Creek, RM 41-3, common on steep north face slope just above stream, July 8, 7500 ft. (GTG); and Lake Fork near Sapinero, RM 41, common near bridge, July 14, 7520 ft. (HHH).

Saxifraga arguta D. Don Saxifrage

Black Canyon: RM 38, wet seepage, bank of large overhang, wet soil and shady area, July 15, 7200 ft. (HHH); RM 37, rocky soil, shade of crevice and large cliffs associated with spruce and fir, common, July 15, 7200 ft. (HHH); and RM 36, dry rocky overhang, common in wet seepage, July 16, 7120 ft. (HHH).

PLANTS

Saxifragaceae (family) continued

Saxifraga bronchialis L. Rock lover

Black Canyon: dry schistose crevices and on rocks as a subordinate to the conifer forest, June 9, 7500 ft. (SF); and RM 36, very abundant in many crags and crevices of steep walls on both sides of stream, July 15, 7190 ft. (HHH).

Rosaceae (family) Rose

Amelanchier alnifolia Nutt. Service berry

Red Creek, RM 47, rare in dry rocky ravine of this elevation, more common in ledges and rocky soil above reservoir, June 30, 7460 ft. (HHH).

Cercocarpus montanus Raf. Mountain mahogany

Iola, RM 59, abundant steep rocky soil, south and west of Iola, July 4, 7600 ft. (HHH).

Crataegus rivularis Nutt. River hawthorn

Along streamside and hills down stream from Mancreif Ranch along the Gunnison River (SF).

Crataegus saligna Greene Hawthorn

East Elk Creek, common along stream banks in wet soil, June 8, 7600 ft. (SF); and Dry Gulch, RM 50, streamside and valley drainage east of ranch house at camp, common throughout reservoir, June 28, 7460 ft. (HHH).

Fragaria bracteata Heller Wild strawberry

Willow Creek, RM 60, rare, damp rocky outcrop just above river, July 2, 7500 ft. (HHH).

Geum macrophyllum Willd. Avens

Soap Creek, RM 43, rare, wet soil in very shady spruce area of small side canyons, July 12, 7480 ft. (SF).

Holodiscus dumosus (Nutt.) Heller Ocean spray

Red Creek, RM 47, common on steep rocky banks near river, common at Morrow and Crystal reservoirs, June 28, 7480 ft. (HHH).

Physocarpus alternans (Jones) J. T. Howell Ninebark

Black Canyon, dry soil along riverbanks and canyon ravines, June 7, 7600 ft. (SF).

Physocarpus malvaceus (Greene) Kuntze Ninebark

Black Canyon, RM 32, dry hillside, rare, rocky outcrops and steep hills, July 18, 6940 ft. (HHH); and dry soil above riverbanks (SF).

Potentilla sp.

West Elk Creek, RM 44, damp sandy soil associated with willow and near stream bank, common, June 11, 7500 ft. (SF); and Black Canyon, dry soil, rare, June 9, 7600 ft. (SF).

PLANTS

Rosaceae (family) continued

Potentilla anserina L. Silver weed

Upper limits of Res., RM 63, common in streamside, deep clay soil and in meadow, June 30, 7520 ft. (HHH).

Potentilla diversifolia Lehm. Cinquefoil

Dry Gulch, RM 50.5, rare, along ditch bank associated with willow and alder, June 28, 7500 ft. (HHH).

Potentilla fruticosa L. Shrubby cinquefoil

Dry Gulch, RM 50, rare, found in damp soil or lower fringe of sagebrush belt, June 28, 7460 ft. (HHH).

Potentilla glandulosa Lindl. Shrubby cinquefoil

Dry Gulch, RM 50, rare, dry soil and along wash bottom, June 28, 7460 ft. (HHH).

Potentilla monspeliensis L. Cinquefoil

Upper limits of Res., RM 63, common, deep meadow and as emergent in wet, clay soil, 7520 ft. (HHH).

Potentilla pectinisecta Rydb. Cinquefoil

Upper limits of Res., RM 63, common in stream and meadow, wet soil near large drainage canal, June 30 and July 2, 7520 ft. (HHH).

Potentilla plattensis Nutt. Cinquefoil

Beaver Creek, RM 62, near stream growing very prostrately in wet muddy environment, July 2, 7500 ft. (SF).

Prunus virginiana L. Chokecherry

Willow Creek, RM 60, streamside, common along canyon wet sand, rocky mud, shady, July 1, 7500 ft. (HHH); and RM 59, streamside, rare, July 1, 7500 ft. (HHH).

Purshia tridentata Nutt. Bitterbrush

Beaver Creek, dry hillside, June 8, 7500 ft. (SF); and Dry Gulch, RM 50.5, common on hillsides, badly hedged by grazing animals, June 28, 7500 ft. (HHH).

Ribes aureum Pursh. Golden currant

Red Creek, RM 47, rare, full mature, very dry gully leading into river, June 30, 7525 ft. (HHH); and south Steuben Creek, RM 60, rare on hillside, common along streamside, dry rocky hillside, July 1, 7560 ft. (HHH).

Ribes cereum Dougl. Red currant

Near upper damsite, dry soil, cliffs and hillsides, June 8, 7500 ft. (SF).

PLANTS

Rosaceae (family) continued

Ribes inerme Rydb. Wine gooseberry

Dry Gulch, RM 50, common along stream in deep soil, bore mature fruit, June 28, 7500 ft. (HHH).

Ribes leptanthum A. Gray Gooseberry

Black Canyon, RM 37, rocky hills and shoulder of road, damp soil near water seepage, July 14, 7200 ft. (HHH).

Ribes montigenum McClatchie Mt. red currant

Black Canyon, dry soil, canyon bottoms and ravines, June 9, 7600 ft. (SF); and RM 36, common with full mature fruit, rocky soil along streamside and road bed, July 15, 7190 ft. (HHH).

Rosa woodsii Lindl. Wild rose

Dry Gulch, RM 50, most handsome of roses in full bloom, very common, June 28, 7500 ft. (HHH).

Rubus strigosus Michx. Red raspberry

Black Canyon, dry soil in shady canyon at bottom, June 9, 7000 ft. (SF); South Elk Horn, RM 60, common streamside, in fruit, July 1, 7520 ft. (HHH); and Lake Fork, RM 41-4, abundant in wet to semi-wet sandy soil, streamside, July 15, 7490 ft. (HHH).

Leguminosae (family) Pea

Astragalus sp.

East Elk Creek, dry soil in bottom of stream, June 3, 7600 ft. (SF); Beaver Creek, RM 62, dry soil near upper limits of Res., June 8, 7500 ft. (SF); Black Canyon, RM 35, rare, dry soil, June 9, 7500 ft., (SF); Dry Gulch, RM 50, dry soil, frequent associated with sagebrush, June 28, 7500 ft. (SF); Dry Gulch, common in dry soil associated with sagebrush, June 9, 7500 ft. (SF); common in dry soil associated with sagebrush and rabbitbrush, June 10, 7500 ft. (SF); and Soap Creek, RM 43, semi-dry soil, east slope, deep sandy soil, July 12, 7500 ft. (HHH).

Astragalus spp.

Dry Gulch, RM 50, rare in rock soil of hillsides in sagebrush belt, June 30, 7500 ft. (HHH).

Astragalus agrestis Dougl. Loco

Dry Gulch, RM 50, common on streamside at fringes of meadows, June 28, 7470 ft. (HHH).

Astragalus diversifolius A. Gray Locoweed

West of Cebolla Creek, RM 48, rare in small gully, semi-damp soil and in sagebrush, July 8, 7500 ft. (HHH).

PLANTS

Leguminosae (family) continued

Astragalus iodopetalus Greene Astragalus

Beaver Creek, RM 62, rare, damp soil near river, July 3, 7500 ft. (SF).

Glycyrrhiza lepidota Nutt. Wild licorice

Elk Horn, RM 60, common in terrace meadow, deep rocky soil, July 1, 7460 ft. (HHH).

Lathyrus brachycalyx Rydb. Wild sweet pea

Willow Creek, RM 60, common associated with willow and streamside vegetation, July 2, 7500 ft. (SF).

Lathyrus eucosmus Butters & St. John Peavine

Dry Gulch, RM 50, common in good sandy clay soil, along ditch banks and associated with salix, July 4, 7460 ft. (SF).

Lotus wrightii (A. Gray) Greene Deervetch

Dry Gulch, RM 50, common at ranch house, riverbank terrace, July 2, 7500 ft. (HHH); East Elks Creek, RM 54, dry sagebrush hillside, rocky sandy soil, July 5, 7460 ft. (HHH); and West Elk Creek, RM 44, rare in this dry hillside, but on north face in small gully, very common, July 10, 7500 ft. (HHH).

Lupinus caespitosus Nutt. Lupine

Cebolla Creek, RM 49, common, streamside in deep canyon, July 8, 7500 ft. (HHH).

Lupinus greenei A. Nels. Lupine

Beaver Creek, common, dry soil and rocky areas, June 8, 6700 ft. (SF); Dry Gulch, RM 50.5, common throughout entire area, both streamside and sagebrush hillsides, common in upper limits of reservoir, June 28, 7500 ft. (HHH); and Soap Creek, RM 43, common in sagebrush terrace and hillside, handsome, July 12, 7500 ft. (SF).

Lupinus kingii Wats. King lupine

Reeses Ranch, RM 58, common, dry railroad bed associated with sagebrush, July 5, 7460 ft. (SF); and Dry Gulch, RM 50, rare, in open spaces between sagebrush, July 20, 7500 ft. (SF).

Medicago sativa L. Alfalfa

Dry Gulch, RM 50, cultivated in fields of sandy clay loam, very good stands, June 28, 7500 ft. (HHH); Sapinero, RM 41, rare, pure white flowered sativa, only one plant in field, July 14, 7520 ft. (HHH); and Henderson Place, RM 50, rare (albino plants, hillside north face of steep cliff on south side of river, July 16, 7500 ft. (HHH).

PLANTS

Leguminosae (family) continued

Melilotus alba Desr. White sweetclover

Black Canyon, RM 33, rare, two observed in canyon, July 18, 7200 ft. (HHH).

Melilotus officinalis (L.) Lam. Yellow sweetclover

Dry Gulch, RM 50.5, common in cultivated fields and ditch banks, some fields total cover, June 28, 7460 ft. (HHH).

Oxytropis albiflora (Nels.) Schum. Tall loco

Dry Gulch, RM 50.5, hillside, gravelly soil, common among sagebrush and rabbitbrush, June 28, 7500 ft. (HHH).

Thermopsis montana Nutt. Yellow Mt. thermopsis

Upper limits of Res.: dry soil and meadows, June 8, 7500 ft. (SF); and RM 63, rare in wet soil at fringe of large meadow and riverbank, June 30, 7520 ft. (HHH); and Stevens Creek, RM 55, common on streamside and meadow, wet deep clay soil, July 1, 7560 ft. (HHH).

Trifolium fendleri Greene Fendler clover

West Elk Creek, RM 44, common in cultivated field pastures, July 11, 7460 ft. (HHH); Soap Creek, RM 43, wet mud along streamside, July 12, 7500 ft. (SF) (HHH); and RM 41, common, rocky streamside and meadows, July 14, 7500 ft. (HHH).

Trifolium hybridum L. Alsike clover

Dry Gulch, RM 50, cultivated fields and along ditch bank, common in meadow and pastures, June 28, 7500 ft. (HHH).

Trifolium pratense L. Red clover

Jointed Rod Ranch, RM 63, rare in meadow, June 3, 7500 ft. (SF); and upper limits of Res., common in wet soil, streamside and meadows, July 2, 7520 ft. (HHH).

Trifolium repens L. White clover

Common in swamp and pasture land of this drainage (SF).

Vicia americana Muhl. American vetch

Beaver Creek, RM 62, common, wet soil associated with willow, July 3, 7500 ft. (SF); and Beaver Creek, dry soil, shaded, willow thickets, 7500 ft. (SF).

Geraniaceae (family) Geranium

Geranium fremontii Torr. & Gray Fremont geranium

Dry Gulch, RM 50, common in drainage in and near stream and among large cottonwood north of ranch house, June 30, 7580 ft. (HHH).

Geranium parryi (Engelm.) Heller Parry geranium

South Steuben Creek, RM 60, dry hillside, north face of large rock cliff up from streamside, July 1, 7560 ft. (HHH); Willow Creek, RM 60, rare, dry crevice hillside, July 1, 7500 ft. (HHH); and Red Creek Rim, RM 48, common in deep fir and spruce litter, damp soil, July 8, 8700 ft. (HHH).

PLANTS

Linaceae (family) Flax

Linum lewisii Pursh. Blue flax

Willow Creek, RM 60, dry hillside, July 2, 7500 ft. (SF).

Zygophyllaceae (family) Caltrop

Tribulus terrestris L. Puncture vine

Black Canyon, RM 30, common, dry rocky soil, side of roadbed, July 19, 7121 ft. (HHH).

Euphorbiaceae (family) Spurge

Euphorbia fendleri (Torr.) Gray Fendler spurge

Black Canyon, RM 30, rare, dry rocky cliff, July 21, 7400 ft. (HHH).

Euphorbia glyptosperma Engelm. Little spurge

Black Canyon, RM 33, roadside, waste fields and near sandy beaches, July 18, 7200 ft. (HHH).

Euphorbia robusta (Engelm.) Small Robust spurge

Red Creek, RM 47, common in sagebrush and hillside, dry soil, June 30, 7500 ft. (HHH); and Black Canyon, RM 30, rare, dry rocky hillside, July 19, 7120 ft. (HHH).

Anacardiaceae (family) Sumac

Rhus radicans L. Poison ivy

Cebolla Creek, RM 50, scarce in this drainage, 1 ft. tall average in rocky area near riverbank. Common, Black Canyon, Morrow Point Dam, July 7, 7500 ft. (GTG).

Rhus trilobata Nutt. Squawbush

Dry Gulch, RM 50, hillsides and steep rocky slopes, common in drainages of deep sandy soil, not common in valley floor of meadows, June 28, 7500 ft. (HHH); and Tex Lodge, RM 60, dry hillside, common in gully and north slope drainage, rare on south facing slope, July 6, 7500 ft. (HHH).

Aceraceae (family) Maple

Acer glabrum Torr. Mountain red maple

Lake Fork, RM 41-5, streamside, common, July 16, 7500 ft. (HHH); Black Canyon, RM 36, common on both slopes of hillside, more abundant on north facing slopes in damp soil, July 16, 6740 ft. (HHH); and Black Canyon, canyon bottoms, riverbanks and ravines of side canyons, 7600 ft. (SF).

PLANTS

Aceraceae (family) continued

Acer negundo interius (Britt.) Say Boxelder

Black Canyon, RM 38, rare, becomes common in deep canyon of Morrow Point Reservoir, July 14, 7120 ft. (HHH).

Malvaceae (family) Mallow

Iliamna rivularis (Doug.) Greene Wild hollyhock

Dry Gulch and upper reaches of West Elk Creek drainage (SF).

Malva rotundifolia L. Common mallow

Common along old roadbeds near Mancreif Ranch (SF).

Sidalcea candida (Gray) White prairie mallow

Cebolla Creek: RM 54, rare, wet streamside, July 5, 7560 ft. (CRL); RM 50, common 2 mi. upstream, July 8, 7460 ft. (HHH); and RM 48, common in sagebrush community in dry sandy soil, July 8, 7500 ft. (HHH).

Sidalcea neomexicana A. Gray False mallow

Dry Gulch, RM 50, dry sandy soil on riverbank and streamside, common in open fields and rabbitbrush association, June 28, 7500 ft. (HHH); mouth of Cebolla Creek, RM 50, common from riverbank to upper hillside, July 10, 7460 ft. (HHH); and Cebolla Creek, RM 4, common, deep clay soil near stream, July 6, 7460 ft. (CRL).

Sphaeralcea coccinea (Pursh) Rydb. Globe mallow

Beaver Creek, common associated with sagebrush and dry rocky soil, June 8, 7600 ft. (SF).

Sphaeralcea coccinea elata (Baker) Kearney Scarlet globe mallow

Dry Gulch, RM 50, common in sagebrush east of ranch house and along dry roadbeds, July 21, 7500 ft. (HHH).

Tamaricaceae (family) Tamarix

Tamarix pentandra Pall. Tamarix, salt cedar

Black Canyon, RM 30, rare, semi-damp sand along road fill, July 19, 6900 ft. (HHH).

Hypericaceae (family) St. Johnswort

Hypericum formosum H.B.K. St. Johnswort

Mouth of Cebolla Creek, RM 49, rare, one specimen taken, 7460 ft. (SF).

Loasaceae (family) Loasa

Mentzelia albicaulis Dougl. Blazing star

Morrow Point damsite, dry soil, road bank and side, June 8, 7500 ft. (SF).

PLANTS

Loasaceae (family) continued

Mentzelia dispersa Wats. Blazing star

Dry Gulch, RM 50, dry sandy soil, common just south of ranch house, July 22, 7480 ft. (HHH).

Mentzelia dispersa compacta (A. Nels.) Macbride Stick leaf

Black Canyon, RM 30, rare, dry rocky hillside among pinyon forest, July 19, 7120 ft. (HHH).

Mentzelia pumila (Nutt.) Torr. & Gray Blazing star

Dry Gulch, RM 50, common, dry stream bed and roadside, in fruit, June 28, 7500 ft. (HHH).

Mentzelia rusbyi Wooton Blazing star

Dry Gulch, RM 50, common in rocky soil along fringes of farmland and old abandoned railroad, July 21, 7480 ft. (HHH).

Cactaceae (family) Cactus

Opuntia sp.

Lake Fork, RM 41-4, dry, rocky gneiss soil, rare, in full flower, July 15, 7495 ft. (HHH).

Opuntia hystricina Engelm. Yellow prickly pear

Dry Gulch, RM 50, common in upper reaches, many in full flower, June 30, 7500 ft. (HHH).

Elaeagnaceae (family) Oleaster

Elaeagnus angustifolia L. Silverberry

Confluence of Cimarron Creek, RM 29, wet sandy soil near bridge, 6900 ft. (HHH).

Elaeagnus commutata Bernh. Bull berry

Aswalds Ranch, RM 59, common, streamside, large full mature stand at north end of Aswald field, July 1, 7500 ft. (HHH).

Shepherdia argentea (Nutt.) Greene Buffaloberry

Found in upper reaches of Lake Fork and Cimarron Creek (SF).

Onagraceae (family) Evening primrose

Epilobium adenocaulon Haussken Willowherb

Beaver Creek, RM 62, wet soil, wash and riverbanks, July 3, 7500 ft. (SF); and West Elk Creek, RM 44, common, wet soil along streambank and in wet muddy aggregate, July 10 and 11, 7460 ft. (HHH).

PLANTS

Onagraceae (family) continued

Epilobium angustifolium L. Fireweed

Willow Creek, RM 59, streamside, common in wet meadow soil, July 1, 7500 ft. (HHH); and West Elk Creek, RM 44, common in streamside wet muddy soil, July 10, 7500 ft. (HHH).

Gaura coccinea glabra (Lehm.) T. & G. Gaura

Beaver Creek, RM 61, common, dry open field, July 4, 7460 ft. (SF).

Gayophytum ramosissimum T. & G. Gayophytum

Upper limits of Res., RM 63, common in dry sagebrush and rocky soil, June 30, 7520 ft. (EBR); and Soap Creek, RM 43, deep clay loam soil in shade of sagebrush and rabbitbrush, July 12, 7500 ft. (HHH).

Oenothera caespitosa (Nutt.) Roem. Evening primrose

Upper damsite, common, dry hillside soil, June 8, 6700 ft. (SF); Elk Horn Lodge, RM 61, rare, dry hillside, north face rocky outcrop, July 1, 7500 ft. (HHH); Aswald Ranch, RM 60, common, streamside, very wet soil along canal, July 1, 7500 ft. (HHH); and Lake Fork, RM 41-5, rare to frequent along cut of road, dry soil, shady overhang, July 16, 7500 ft. (HHH).

Oenothera hookeri T. & G. Evening primrose

Upper limits of Res., RM 63, common throughout the upper drainage from Sapinero to Eagles Park, roadside in gravelly outwash, July 1, 7520 ft. (HHH).

Oenothera marginata (Nutt.) Munz. Evening primrose

Waste area in East Elk Creek (SF).

Oenothera pallida Lindl. Pale evening primrose

Willow Creek, RM 59, streamside and in shady rocky hillsides, July 1, 7500 ft. (HHH); and Black Canyon, RM 32, common, dry hillside, near the axis of Morrow Point Dam, July 18, 7100 ft. (HHH).

Oenothera strigosa (Rydb.) Mack. Evening primrose

Black Canyon, RM 33, rare, sandy dry soil, south face, July 18, 6945 ft. (HHH).

Haloragidaceae (family) Watermilfoil

Hippuris vulgaris L. Maretail

Sapinero, RM 41, shallow water of river backwash and very wet meadow drainage, July 14, 7460 ft. (SF); and Stevens Creek, RM 58, rare in old slew and semi-drained swamp at mouth of creek, July 3, 7500 ft. (HHH).

Myriophyllum exalbescens Fern. Watermilfoil

Dry Gulch, RM 50, rare, wet pond in stream, July 4, 7500 ft. (SF).

PLANTS

Umbelliferae (family) Carrot and parsnip

Cicuta douglasii (DC.) Coult. Water hemlock

Upper limits of Res., RM 63, common in meadows and streamside, roadside and riverbank, July 1, 7460 ft. (HHH).

Heracleum lanatum Michx. Cow parsnip

Dry Gulch, RM 50, frequent in wet soil of side canyon stream, infected with insect gaul, June 28, 7460 ft. (HHH); and mouth of Cebolla Creek, RM 50, common in wet mud and riverbank willow, July 10, 7460 ft. (HHH).

Sium suave Walt. Water parsnip

Upper limits of Res., RM 63, submergent, common in large canal and in mud and clay at Colenirie Ranch, 7520 ft. (HHH).

Cornaceae (family) Dogwood

Cornus stolonifera Michx. Red osier dogwood

Black Canyon, riverbanks and shady bottom, June 9, 7100 ft. (SF); and Willow Creek, RM 60, streamside, common in wet mud of meadow north of Aswald Ranch, July 1, 7500 ft. (HHH).

Ericaceae (family) Heath

Arctostaphylos uva-ursi (L.) Spreng. Bearberry

Cebolla Creek, RM 50, dry sand and rock hillside north face and in conifer forests, July 6, 7540 ft. (HHH); and Red Creek Rim, RM 48, common, abundant growing very tight to soil, rocky soil, shade of spruce and fir, July 8, 8700 ft. (HHH).

Primulaceae (family) Primrose

Androsace septentrionalis L. Rockjasmine

Black Canyon, dry soil partly shaded and under cliffs, June 9, 7600 ft. (SF).

Dodecatheon pulchellum (Raf.) Merr. Shooting star

Jointed Rod Ranch, RM 63, restricted to meadow habitat and canyon bottoms of deep dry soil, July 3, 7500 ft. (SF); and Beaver Creek, RM 62, common at side of stream associated with cottonwood in wet clay soil, July 3, 7500 ft. (SF).

Dodecatheon radicans Greene Shooting star

Willow Creek, RM 59, wet canyon in crevice of old road cut, July 1, 7560 ft. (HHH); and East Tex Lodge, RM 55, common in canyon bottom damp soil in abandoned pasture land, July 1, 7500 ft. (HHH).

Gentianaceae (family) Gentian

Swertia radiata (Kell.) Kuntze Green gentian

Cebolla Creek, RM 59, rare, stream and terrace, damp soil, July 6, 7460 ft. (CRL); and Soap Creek, RM 43, common in sagebrush and spruce, July 12, 7500 ft. (RNR).

PLANTS

Apocynaceae (family) Dogbane

Apocynum cannabinum L. Indian hemp

Red Creek, RM 47, common, river bank and streamside, frequent along main drainage, June 28, 7460 ft. (HHH).

Apocynum medium floribundum (Greene) Woodson Dogbane

Willow Creek, RM 60, streamside, common along ditches, July 2, 7500 ft. (SF); and Black Canyon, RM 30, rare, sandy soil, common in shady side of canyon and among willows, July 19, 7120 ft. (HHH).

Asclepiadaceae (family) Milkweed

Asclepias speciosa Torr. Milkweed

Soap Creek, RM 43, hillside just above streamside in sagebrush belt, sandy soil near mouth of creek, July 10, 7500 ft. (HHH).

Asclepias subverticillata (Gray) Vail. Bull. Milkweed

Black Canyon, RM 33, common, semi-wet soil of gravelly and sandy texture, roadbed, July 18, 6940 ft. (HHH).

Convolvulaceae (family) Morning-glory

Convolvulus arvensis L. Wild morning-glory

Jointed Rod Ranch, RM 63, semi-dry roadside and outskirts of fields, July 1, 7520 ft. (SF); and Sapinero, RM 41, dry clay soil near old abandoned stock yard and corral, July 14, 7440 ft. (HHH).

Polemoniaceae (family) Phlox

Collomia linearis Nutt. Collomia

Dry Gulch, RM 50, common in foothill region and dry soil at roadside, June 28, 7500 ft. (HHH).

Gilia sp.

Black Canyon, RM 35, common in crevices of cliffs on damp rocky soil, June 12, 7200 ft. (SF); Black Canyon, RM 37, dry rocky soil, hills, common, July 15, 7200 ft. (HHH); and Black Canyon, RM 36, rare, dry rocky overhang, dry soil, July 18, 7100 ft. (HHH).

Gilia aggregata (Pursh.) Spreng. Scarlet gilia

Beaver Creek, dry soil of hillside, June 8, 7500 ft. (SF); and Upper limits of Res., RM 63, roadside in gravel soil, locally common, one large patch at this collection site, June 30, 7500 ft. (HHH).

Gilia aggregata var. attenuata Gray Scarlet gilia

Dry Gulch: RM 50.5, common at margins of reservoir area of all three sites, June 28, 7500 ft. (HHH); and RM 50, full flower, common in sagebrush and along foothills beneath the river, June 28, 7500 ft. (HHH).

PLANTS

Polemoniaceae (family) continued

Gilia sinuata Dougl. Gilia

Beaver Creek, dry soil, hillsides near bottoms of creek, June 8, 7600 ft. (SF); and Cebolla Creek, RM 50, common, riverbank, wet soil, July 10, 7480 ft. (CRL).

Leptodactylon pungens (Torr.) Rydb. Spiny phlox

Beaver Creek, dry hillside among rocks, June 8, 6000 ft. (SF); South Elk Horn Lodge, RM 60, hillside very rocky, in shade of large ledge, July 1, 7520 ft. (HHH); and Red Creek Rim, RM 48, common in fir, spruce forest semi-wet soil in much litter accumulation, July 8, 8700 ft. (HHH).

Phlox caespitosa Nutt. Caespitose phlox

Dry Creek, RM 50, common in sagebrush in dry soil and steep drainages, very caespitose matting to soil, June 28, 7460 ft. (HHH); and Willow Creek, RM 60, dry hillside, common in sagebrush, rocky soil, some pack very large, July 2, 7500 ft. (HHH).

Phlox longifolia Nutt. Wild sweet William

Beaver Creek, dry hillsides near bottom at creek, June 8, 7500 ft. (SF); and Upper dam site, dry soil in rocky area, 7600 ft. (SF).

Hydrophyllaceae (family) Waterleaf

Phacelia heterophylla Pursh. Hairy waterleaf

Dry Gulch: RM 50, rare, open cultivated fields, dry soil along ditch banks, June 28, 7500 ft. (HHH); and RM 50, west of ranch upstream by beaver dam in willow cottonwood, common, deep soil, July 2, 7200 ft. (HHH); and Black Canyon, RM 30, steep rocky talus, common on north slope, July 18, (HHH).

Boraginaceae (family) Borage

Amsinckia rugosa Rydb. Fiddleneck

Dry Gulch, RM 50.5, dry hillside, waste fields and open roadside along the ranch driveway, June 28, 7510 ft. (HHH).

Cryptantha crassiseppala (Torr. & Gray) Greene Cryptantha

East Elk Creek, dry soil bottom of creek, associated with sagebrush, June 8, 7600 ft. (SF).

Cryptantha flaviculata (A. Nels.) Payson Cat-eye

Dry Gulch, RM 50, dry sandy soil in sagebrush and rabbitbrush, July 21, 7500 ft. (HHH).

Cryptantha gracilis Osterhout. Cryptantha

Upper dam site, dry soil near river edge, June 8, 7600 ft. (SF).

PLANTS

Boraginaceae (family) continued

Cryptantha jamesii (Torr.) Payson *Cryptantha*

Beaver Creek, dry hillside, June 8, 7600 ft. (SF); South Steuben Creek, RM 60, dry hillside, north facing slope at mouth of small canyon associated with sagebrush, July 1, 7560 ft. (HHH); South Iola, RM 59, rare in rocky soil just beyond its limits, July 5, 7500 ft. (HHH); and Mouth of Cebolla Creek, RM 49, common on road at bridge in mouth of stream, July 8, 7460 ft. (SF).

Lappula florabunda (Lehm.) Greene *Stickseed*

Black Canyon, dry soil, partial shade, June 9, 7600 ft. (SF); Dry Gulch, RM 50, dry gravelly soil along roadside, upper limits of reservoir site, June 30, 7500 ft. (HHH); and Soap Creek, RM 43, common, dry steep hills just above a large irrigation canal, July 12, 7500 ft. (HHH).

Lappula redowskii (Hornem.) Greene *Western stickseed*

Upper dam site, dry hillside, rocky soil among sagebrush, June 8, 6700 ft. (SF).

Lithospermum multiflorum Torr. *Gromwell*

Soap Creek: RM 43, shady spruce fir hillside just below irrigation canal diversion gate, July 12, 7500 ft. (SF); and RM 43, common in wet soil and deep mud in spruce, cottonwood groves of streamside, July 12, 7460 ft. (SF).

Mertensia ciliata (James) G. Don *Bluebells*

Black Canyon, dry soil, shady places base of cliffs, June 9, 7600 ft. (SF); Jointed Rod Ranch, RM 63, common at limits of reservoir site in wet soil of meadow, July 3, 7520 ft. (SF); Dry Gulch, RM 50, common in streamside, upstream from cabin, July 5, 7600 ft. (HHH); and Cebolla Creek, RM 50, common on streambank in very wet soil, July 7, 7520 ft. (GTG).

Verbenaceae (family) *Vervain*

Verbena bracteata Lag. & Rodr. *Blue verbena*

Red Creek, RM 47, common in wet meadows and open fields, soil wet of heavy clay loam, waste places in fields, June 30, 7460 ft. (SF); West Elk Creek, RM 44, common, wet soil, in shady willow patches, June 10, 7460 ft. (HHH); Black Canyon, RM 36, dry roadside, common in sandy, gravelly aggregated soil, July 18, 7000 ft. (HHH); and Black Canyon, RM 32, dry roadside, rocky talus and gravel shoulder on road grade, July 18, (HHH).

Labiatae (family) *Mint*

Mentha penardi (Briq.) Rydb. *Mint*

Common in cultivated fields along semi-moist streambank (SF).

Monardella odoratissima Benth. *Monardella*

Black Canyon, RM 38, dry north face, common growing in deep sandy soil, July 15, 7200 ft. (HHH).

PLANTS

Labiatae (family) continued

Prunella vulgaris L. Selfheal

Soap Creek, RM 43, common, streamside, rocky sandy soil, July 12, 7480 ft. (SF).

Scutellaria galericulata L. Skullcap

Willow Creek, RM 60, riverside, common in damp to semi-damp sandy soil, July 2, 7500 ft. (SF); Cebolla Creek, RM 50, wet, clay soil and streamside in creek and rock beds, July 6, 7520 ft. (CRL); East Elk Creek, RM 50, damp soil near streambank, shady area of cottonwood forest, July 6, 7500 ft. (HHH); Dry Gulch, RM 50, wet soil along old railroad bed near river, July 7, 7400 ft. (HHH); Mouth of Cebolla Creek, RM 49, common in mouth of creek, July 8, 7460 ft. (SF); and Black Canyon, RM 30, streamside damp, soil of willow humic, July 17, 7460 ft. (HHH).

Stachys palustris L. Hedge nettle

Jointed Rod Ranch, RM 63, streamside, common on riverbanks soil and meadow, July 3, 7520 ft. (SF); Cebolla Creek, RM 50, rare, streamside wet soil, July 6, 7460 ft. (CRL); and West Elk Creek, RM 42-4, common at streams edge in wet gravel aggregate soil, July 11, 7460 ft. (SF).

Solanaceae (family) Potato

Physalis longifolia Nutt. Ground cherry

Black Canyon, RM 33, common at bases of south facing talus and on rocky dry soil along road grade; 6840 ft.; and RM 33, common in roadbed, rocky and gravel soil, July 18, 7200 ft. (HHH).

Solanum trifolium Nutt. Nightshade

Dry Gulch, RM 50.5, streamside just above corral from ranch house, common, June 28, 7460 ft. (HHH); and Lake Fork, RM 41-4, dry sagebrush flat, common, also along the roadbed, July 16, 7495 ft. (HHH).

Scrophulariaceae (family) Figwort

Castilleja hispida Benth. Indian paintbrush

Beaver Creek, dry hillsides, June 8, 7600 ft. (SF).

Castilleja linariaefolia Benth. Indian paintbrush

Dry Gulch, RM 50.5, dry sandy, gravelly hills, common, mature, June 28, 7500 ft. (HHH); Red Creek Rim, RM 48, dry rocky soil, in small craig near rim, 8700 ft.; Red Creek Rim, RM 48, semi-wet soil in small swale under large rock slope, 8700 ft.; Red Creek Rim, RM 48, common in open sagebrush flat in park area near steep cliff, 7460 ft., July 8 (HHH); Henderson Ranch, RM 50, common in sagebrush, July 17, 7500 ft. (HHH); and Soap Creek, RM 43, common on south face in sagebrush belt at upper limits of the reservoir site, July 12, 7500 ft. (HHH).

PLANTS

Scrophulariaceae (family) Figwort

Castilleja lineata Greene Paintbrush
 Jointed Rod Ranch, RM 63, common in dry soil, along streamside associated with cottonwood, July 3, 7520 ft. (SF); and Aswald Ranch, RM 58, rare along terrace just south of bridge, July 5, 7460 ft. (HHH).

Castilleja sulphurea Rydb. Sulphur paintbrush
 Black Canyon, RM 29, streamside, wet sandy soil, July 18, 7100 ft. (HHH).

Collinsia parviflora Dougl. Blue-eyed Mary
 East Elk Creek, dry soil in willow thicket, June 8, 7500 ft. (SF).

Epilobium latifolium L. Willowweed
 Soap Creek, RM 43, wet mud, gravelly soil, common, not in flower, July 12, 7480 ft. (HHH).

Limosella aquatica L. Mudwort
 Muddy flats of Soap Creek and West Elk Creek drainage (SF).

Linaria vulgaris Mill. Butter and eggs
 Willow Creek, RM 60, riverside, common in deep wet mud soil, July 2, 7500 ft. (SF); and Cebolla Creek, RM 50, common in terrace and streamside, July 8, 7500 ft. (HHH).

Mimulus guttatus DC. Yellow monkey flower
 Soap Creek, RM 43, wet soil, widely distributed, July 12, 7480 ft. (HHH); Coal Creek, RM 41, abundant, wet streamside, deep shady canyon associated with fir, July 16, 7500 ft. (HHH); and Black Canyon, RM 30, stream and wet seepage at Curecanti Creek, July 18, 7130 ft. (HHH).

Pedicularis crenulata Benth. Lousewort
 Near upper dam site, dry soil, banks of river, June 8, 7600 ft. (SF); Upper limits of Res., RM 63, wet meadow and soil along road, July 1, 7520 ft. (HHH); Steven Creek, RM 58, common at the margin of meadow and among willows, July 3, 7560 ft. (HHH).

Pentstemon barbatus (Cov.) Roth. Red pentstemon
 Upper dam site, dry soil among sagebrush and rabbitbrush, June 9, 7500 ft. (SF); RM 60, rare, rocky bank in Holodiscus dumosus, July 1, 7500 ft. (HHH); Cebolla Creek, RM 49, common upstream along roadbed, July 8, 7560 ft. (SF); Lake Fork Creek, RM 41-3, common on terrace and streamside near head of fork, July 8, 7500 ft. (SF); and Lake Fork, RM 41-5, common dry rocky hillside in sagebrush, July 16, 7500 ft. (HHH).

Pentstemon colorandensis Nels. Colorado pentstemon
 Beaver Creek, dry hillside near bottom of creek, June 8, 7500 ft. (SF).

PLANTS

Scrophulariaceae (family) continued

Pentstemon comarrhenus A. Gray Beardtongue

Henderson Place, RM 50, common, dry soil abandoned field, July 8, 7500 ft. (HHH); Lake Fork, RM 41-4, common along foothills in rocky soil, among sagebrush and rabbitbrush belt, July 15, 7500 ft. (HHH); and Dry Gulch, RM 50.5, common on hills and among sagebrush and cottonwoods, very attractive, June 28, 7500 ft. (HHH).

Pentstemon crandallii A. Nels., Bull. & Torr. Beardtongue

Dry Gulch, RM 50.5, roadside above camp, sandy soil, common in dry fields, June 28, 7500 ft. (HHH).

Pentstemon watsonii A. Gray Watson pentstemon

Beaver Creek, RM 62, semi-dry soil, common associated with cottonwood, July 3, 7500 ft. (SF); and West Elk Creek, common in streamside, associated with alder, birch and willow, July 12, 7460 ft. (SF).

Scrophularia lanceolata Pursh. Scrophularia

Dry Gulch, RM 50, dry sandy soil along drainage, a subarcanant of the cottonwood trees, July 9, 7500 ft. (SF).

Scrophularia occidentalis (Rydb.) Bickn. Scrophularia

Dry Gulch, RM 50, associated with sagebrush at base of small hill, rare in this creek drainage, sandy soil, June 28, 7460 ft. (HHH).

Veronica americana Schwein. American speedwell

Soap Creek, RM 43, hillside, rare in rocky soil and very dry area steep gradient, 7500 ft. (HHH); and wet meadow, rare, muddy rocky soil, 7460 ft., July 12 (ADS).

Veronica anagallis-aquatica L. Speedwell

Willow Creek, RM 59, streamside, common in meadow and farmland, July 1, 7500 ft. (HHH).

Veronica wormskjoldii Roem. & Schultz. Speedwell

Mouth of Cebolla Creek, RM 49, common in wet riverbank soil at mouth of creek, July 8, 7460 ft. (SF).

Lentibulariaceae (family) Bladderwort

Utricularia vulgaris L. Bladderwort

Beaver Creek, RM 62, small shallow stream, rare, few plants in flower, July 4, 7460 ft. (HHH).

Rubiaceae (family) Madder

Galium boreale L. Northern bedstraw

Dry Gulch, RM 50, common in dry sandy, rocky soil at foothill, near the cliff rock of the sagebrush belt, June 28, 7500 ft. (HHH); and Lake Fork, RM 41-4, upper reaches of streamside, north face of slope, deep black soil aggregate, July 13, 7460 ft. (HHH).

PLANTS

Rubiaceae (family) continued

- Galium coloradoense W. F. Wright Colorado bedstraw
Beaver Creek, at base of rocks and cliffs, dry soil, June 8, 7600 ft.
(SF); and Black Canyon, RM 33, dry rock talus, common on south face of
hillside, July 18, 6945 ft. (HHH).

Plantaginaceae (family) Plantain

- Plantago eriopoda Torr. Plantain
Sapinero, RM 41, open brome meadow, semi-wet soil, common, July 14,
7460 ft. (HHH).

Plantago major L. Big plantain

- Willow Creek, RM 60, common in wet soil near large meadow, July 1, 7500
ft. (HHH); Willow Creek, RM 59, streamside, common in river drainage and
meadows, very large, July 1, 7400 ft. (HHH); Blackstock Ranch, RM 59,
streamside, common in meadow, July 1, 7400 ft. (HHH); East Iola, RM 58,
common in large meadow just east of bridge, wet soil, July 5, 7500 ft.
(HHH); and West Elk Creek, RM 50, streamside, common in wet meadow,
July 18, 7500 ft. (HHH).

Caprifoliaceae (family) Honeysuckle

- Lonicera fragrantissima Lindl. & Part. Winter honeysuckle
Willow Creek, riverside, very common in damp soil, July 2, 7500 ft. (SF).

Lonicera involucrata Banks Bearberry honeysuckle

- Near upper dam site, damp soil banks of river, June 8, 7600 ft. (SF); and
Stevens Creek, RM 58, common in stream soil and deep clay soil, July 3,
7480 ft. (HHH).

Sambucus pubens Michx. Red elderberry

- Black Canyon, dry soil shady ravines, June 9, 7600 ft. (SF); Black Canyon,
RM 36, common in dry to semi-dry sandy soil, July 14, 4950 ft. (HHH); and
stream and hillside, common especially on north face of hillside, July 18,
6948 ft. (HHH).

Symphoricarpos albus (L.) Blake Snowberry

- Elk Horn Lodge, RM 60, streamside, common in meadow and fields, July 1,
7500 ft. (HHH).

Symphoricarpos longiflorus Gray Snowberry

- Black Canyon, dry soil, canyon bottoms and ravines, June 9, 7600 ft. (SF).

Symphoricarpos oreophilus Gray Snowberry

- So. Tex Lodge, RM 60, dry rock escarpment growing in small crevice and at
full exposure to sun, July 6, 7460 ft. (HHH).

PLANTS

Campanulaceae (family) Bellflower

Campanula parryi Gray Parry bellflower

Dry Gulch, RM 50.5, streamside, common to frequent, found in meadows and seepage along small drainage, June 28, 7500 ft. (HHH); Black Canyon, RM 36, common, dry rock outcrop, shady environment, July 14, 7120 ft. (HHH); and Black Canyon, RM 36, rare in rocky soil at base of large cliff wall in west seepage soil, July 21, 6950 ft. (HHH).

Campanula rotundifolia L. Bellflower

Dry Gulch, RM 50.5, streamside, common, in meadows and among willows, June 28, 7500 ft. (HHH); RM 50, common in meadows, wet sands, soil and streamside and along main river, June 28, 7500 ft. (HHH); and RM 50, very common in clay soil and associated with grass, full flower, June 30, 7500 ft. (HHH); Black Canyon, RM 36, dry rocky overhang, damp shady crevice, rare, July 16, 6950 ft. (HHH); and RM 34, dry rocky overhang, shaded from sunlight by extensive ledge, July 18, 6950 ft. (HHH).

Valerianaceae (family) Valerian

Valeriana edulis Nutt. Edible valerian

Mouth of Willow Creek, RM 59, wet soil, streamside, deep meadow clay mud, July 2, 7500 ft. (HHH); and West Elk Creek, RM 44, common in wet sandy soil near streamside, July 11, 7460 ft. (SF).

Compositae (family) Thistle

Achillea lanulosa Nutt. Purple yarrow

Dry Gulch, RM 50, common in clay soil at field margins and on shoulders of road, gravel soil, June 28, 7500 ft. (HHH); and West Elk Creek, RM 44, meadow, streamside, rare, July 10, 7460 ft. (SF).

Agoseris glauca (Pursh.) D. Dietr. False dandelion

East Elk Creek, RM 51, dry soil, June 6, 7500 ft. (SF); and Stevens Creek, RM 59, common in meadow and streamside, very abundant in some meadow fringes, July 3, 7500 ft. (HHH).

Agoseris glauca dasycephala (T. & G.) Jepson Mt. dandelion

Dry Gulch, RM 50, common along roadsides and at fringes of fields, June 28, 7650 ft. (HHH).

Agoseris glauca parviflora Nutt. False dandelion

Dry Gulch, RM 50, common in upper elevation areas of meadows, associated with dry rabbitbrush, July 4, 7500 ft. (SF); and Soap Creek, RM 43, roadside, common just beyond cultivated meadow, gravelly road embankments, July 12, 7460 ft. (HHH).

Anaphalis margaritacea subalpina A. Gray Pearly everlasting

Soap Creek, RM 43, common in wet shady areas along streamside, 7460 ft. (SF); dry terrace habitat just above streamside among cottonwood trees, 7460 ft. (HHH); common in sagebrush and rabbitbrush, 7500 ft. (SF); and Black Canyon, RM 36, dry sandy soil, rare but more common downstream, July 16, 7190 ft. (HHH).

PLANTS

Compositae (family) continued

Antennaria anaphaloides Rydb. Pussytoes

Soap Creek, RM 43, common in sagebrush flat at bend of river near steep rocky hillside, July 12, 7500 ft. (HHH).

Antennaria microphylla Rydb. Everlasting

Upper dam site, dry rocky soil in ravines, June 8, 6700 ft. (SF).

Antennaria parvifolia Nutt. Pussytoes

Beaver Creek, RM 63, wet riverbank, above water level in cottonwood stand, July 3, 7500 ft. (SF).

Aplopappus acaulis (Nutt.) Gray Aplopappus

South of Steuben Creek, RM 60, dry hillside, rare, July 1, 7520 ft. (HHH); South Iola, RM 59, very dry sagebrush and shrubs on dry rocky soil, common July 5, 7500 ft. (HHH); Soap Creek, RM 43, streamside, rocky muddy soil, common, July 10, 7500 ft. (HHH); and Soap Creek, RM 43, dry hillside, rare, but common on east hillside slopes, July 12, 7460 ft. (HHH); and Upper dam site, RM 40.6, dry rocky soil associated with sagebrush and Tetradychia, June 9, 7500 ft. (SF).

Aplopappus amerioides (Nutt.) Gray Goldenweed

Mouth of Willow Creek, RM 59, dry hillside, rare, most plants immature, July 2, 7500 ft. (HHH); and Upper dam site, RM 40.6, dry soil of hillside, June 8, 6700 ft. (SF).

Arnica fulgens Pursh. Black-eyed Susan

Henderson Place, RM 50, rare, dry sage and sandy soil at old stockyard near derrick, July 7, 7500 ft. (HHH); and mouth of Cebolla Creek, RM 49, streamside in damp mud soil, rare, July 8, 7480 ft. (SF).

Artemisia dracunculus glauca (Pallas) H. & C. Aromatic sagebrush

Dry Gulch, RM 50, rare, along roadside and fringes of cultivated farmland, in dry to semi-dry soil, June 28, 7500 ft. (HHH).

Artemisia frigida Willd. Silver sagebrush

Upper limits of Res., RM 63, roadside, rocky shallow soil, common in reservoir basin in big sagebrush belt, July 2, 7520 ft. (HHH); and Dry Gulch, RM 50, rare in valley floor and common in steep sagebrush hillsides, June 28, 7460 ft. (HHH).

Artemisia ludoviciana Nutt. Herbaceous sagebrush

Dry Gulch, RM 50, common along road leading up canyon on dry soil and associated with Agropyron smithii, June 30, 7480 ft. (HHH).

Artemisia michauxiana Bess. Herbaceous sagebrush

East Elk Creek, RM 43, dry soil along old roadside, sagebrush and horsebrush community, July 16, 7500 ft. (HHH).

PLANTS

Compositae (family) continued

- Artemisia nova (A. Nels.) H. & C. Black sagebrush
Sapinero, RM 41, dry soil, one large acreage of black sagebrush covering hillside just south of Sapinero, July 14, 7500 ft. (HHH).
- Artemisia tridentata Nutt. Big sagebrush
Dry Gulch, RM 50, most dominant plant in reservoir, open fields, flats, gullies and dry hills to river, June 28, 7500 ft. (HHH); and West Elk Creek, RM 44, common in sagebrush belt and in canyon valleys, dry clay loam, July 10, 7500 ft. (HHH).
- Aster adscendens Lindl. Aster
Black Canyon, RM 32, most abundant along lower part of hillside near stream and road, July 18, 7000 ft. (HHH).
- Aster arenosus Blake Aster
Black Canyon near Curecanti Needle (SF).
- Aster foliaceus Lindl. Aster
Black Canyon near Curecanti Needle (SF).
- Aster foliaceus frondeus A. Gray Aster
Upper reaches of Soap Creek area (SF).
- Centaurea picris Pall. Russian knapweed
Henderson Ranch, RM 51, common in abandoned farmland, dry soil near old stockyard, July 7, 7500 ft. (HHH); and Upper limits of West Elk, RM 44, common on well shaded slope soil deep, sagebrush, July 10, 7500 ft. (HHH).
- Chaenactis douglasii (Hook) H. & A.) False yarrow
South of Elk Horn, RM 61, dry sagebrush flat, sandy soil on south side of river, very common, July 1, 7500 ft. (HHH); and Soap Creek, RM 43, dry hillside, associated among sagebrush and oak of steep drainage, July 12, 7520 ft. (HHH).
- Chrysanthemum leucanthemum pinnatifidum Lecoq. & Lam. Shasta daisy
Jointed Rod Ranch, RM 63, common on dry terrace in deep, sandy clay soil, July 3, 7520 ft. (SF); and Stevens Creek, RM 56, common, associated with narrowleaf cottonwood and on sandy soil, July 3, 7520 ft. (HHH).
- Chrysopsis villosa (Pursh.) Nutt. Golden aster
One mile upstream from new bridge, RM 47, on dry steep rocky slope, common, associated with sagebrush and oak north of bridge, June 28, 7400 ft. (HHH); South Iola, RM 59, dry sagebrush, rare, very gravelly, rocky aggregated soil, July 5, 7400 ft. (HHH); and West Elk Creek, RM 44, hillside sagebrush belt, dry rocky soil, July 11, 7460 ft. (ADS).

PLANTS

Compositae (family) continued

Chrysothamnus depressus Nutt. Dwarf rabbitbrush

Dry Creek, RM 50, in dry gravel, rock soil and at face of small gully just south of ranch house, June 28, 7460 ft. (HHH); Dry Gulch, RM 50, very common just south of ranch and dry rocky soil of sagebrush belt, June 28, 7560 ft. (HHH); Red Creek, RM 47, dry rocky slopes on north side, generally hedged and in retarded growth, June 30, 7500 ft. (HHH); and Henderson Ranch, RM 50, very common in upper limits, rocky outcrop and talus outbreak, July 7, 7500 ft. (HHH).

Chrysothamnus nauseosus (Pall.) Britt. Big rabbitbrush

Red Creek, RM 47, very common in abandoned fields and on valley floors of both Red Creek and Dry Gulch drainage, June 30, 7460 ft. (HHH).

Chrysothamnus nauseosus graveolens (Nutt.) DC. Tall rabbitbrush

Dry Gulch, RM 50, common in deep sandy soil near streamside, soil water table high, near old well, July 21, 7500 ft. (HHH).

Chrysothamnus parryi (A. Gray) Greene Parry rabbitbrush

Soap Creek, RM 43, dry hillside, good deep soil in areas where water was more abundant, July 12, 7500 ft. (HHH).

Chrysothamnus vaseyi (A. Gray) Greene Vasey rabbitbrush

Sapinero, RM 41, dry hillsides, rare, sagebrush and juniper scopulorum community, dry sandy soil, July 14, 7500 ft. (HHH).

Chrysothamnus viscidiflorus (Hook.) Nutt. Varnishleaf rabbitbrush

Dry Gulch, RM 50.5, very common in rocky soil of sagebrush belt in old cultivated fields and along abandoned canals, June 28, 7500 ft. (HHH); and West Elk Creek, RM 44, common in drainage near fields and of low hills and adjacent uplands, July 10, 7500 ft. (HHH).

Chrysothamnus viscidiflorus stenophyllus (A. Gray) H. & C. . . Little rabbitbrush

West Elk Creek, RM 44, very common on hillsides, composing a large per cent of cover, July 10, 7500 ft. (HHH).

Chrysothamnus viscidiflorus tortifolius Hook & Nutt. . Twistedleaf rabbitbrush

Dry Gulch, RM 50.5, very common in farmland and valley floor along reservoir drainages, June 28, 7460 ft. (HHH).

Cirsium undulatum (Nutt.) Spreng. Western thistle

Dry Gulch, RM 50, rare, sagebrush and rabbitbrush community, dry gravel soil, June 30, 7500 ft. (SF); Red Creek, RM 47, frequent in large patches in fields and meadows near old fence line, June 30, 7500 ft. (SF); and West Elk Creek, upper limits, RM 44, common along canal of west side of canyon, dry soil in sagebrush, July 10, 7500 ft. (HHH).

PLANTS

Compositae (family) continued

Crepis occidentalis Nutt. Hawksbeard

Sapinero, RM 41, dry hillside, sagebrush community, soil deep of sandy texture, July 12, 7500 ft. (HHH).

Crepis occidentalis costata (Gray) Babco. & Stebb. Hawksbeard

Mouth of Willow Creek, RM 59, dry hillside, rare, sagebrush, rocky soil, much rock pavement, July 2, 7500 ft. (HHH); and Soap Creek, RM 43, rare, steep hillside on shale and clay soil, west facing slope, July 12.

Erigeron concinnus T. & G. Fleabane

Beaver Creek, RM 62, dry hillside, June 8, 7600 ft. (SF); Dry Gulch, RM 50, dry hillside east of ranch house in rocky soil of sagebrush belt, June 30, 7500 ft. (HHH); Dry Gulch, RM 50, very rare most have passed flowering age, dry rocky outcrop sagebrush belt, June 30, 7460 ft. (HHH); Elk Horn Lodge, RM 61, dry hillside, steep rocky slope on north shady face, common, July 1, 7500 ft. (HHH); South of Steuben Creek, RM 60, dry hillside, beneath large cliff, common, plants gone to seed, July 1, 7470 ft. (HHH); and Willow Creek, RM 60, dry hillside, very common, soil deep and gullied, July 2, 7500 ft. (HHH).

Erigeron divergens T. & G. Fleabane

Upper dam site, RM 40.6, dry soil of hillside near upper dam site, June 8, 6700 ft. (SF); and Beaver Creek, dry hillside, June 8, 7450 ft. (SF).

Erigeron divergens cinereus A. Gray Wild fleabane

Soap Creek, RM 43, streamside meadow, common, July 12, 7480 ft. (SF).

Erigeron flagellaris Gray Fleabane

Upper dam site, dry soil along Gunnison River, June 8, 7600 ft. (SF).

Erigeron philadelphicus L. Fleabane

Upper limits of reservoir, RM 63, wet meadows, open field, roadside, very deep bog soil, dry gravelly soil and waste areas in meadow, common, June 30, 7520 ft. (HHH).

Erigeron speciosus macranthus (Nutt.) Cong. Wild fleabane

Dry Gulch, RM 50, common in dry soil associated with sagebrush and rabbitbrush from valley floor, June 30, 7500 ft. (HHH); and Beaver Creek, RM 62, upland, semi-dry soil, near hillside climax, common, July 2, 7500 ft. (SF).

Erigeron speciosus speciosus Cong. Wild fleabane

Henderson Ranch, RM 50, hillside in upper part of old abandoned farmland, July 7, 7500 ft. (HHH); and Cebolla Creek, mouth, RM 50, common in streamside, alnus and salix community, July 8, 7500 ft. (SF).

Gnaphalium palustre Nutt. Cudweed

West Elk Creek, RM 44, riverbank soil, rare, July 10, 7500 ft. (SF).

PLANTS

Compositae (family) continued

Gutierrezia sarothrae microcephala (DC) Benson Matchweed
In drainage of Red Creek (SF).

Helianthus annuus L. Common sunflower
Soap Creek, RM 43, streamside, roadside, dry gravel soil, common, associated with Populus angustifolia, July 12, 7460 ft. (HHH); Black Canyon, RM 34, rare, roadside, dry sandy soil, very few encountered within this basin, July 18, 6950 ft. (HHH); and Black Canyon, RM 30, dry roadside, rare, sandy soil, July 19, 7140 ft. (HHH).

Helianthus petiolaris Nutt. Utah sunflower
Jointed Rod Ranch, RM 63: common in meadow of streamside near house, July 3, 7500 ft. (SF); and rare, growing near road in sandy soil, July 3, 7520 ft. (SF).

Hymenoxys acaulis (Pursh.) K. F. Parker Hymenoxys
Upper limits of Res., RM 63, dry gravel soil in road bank, rare to common, very beautiful, June 30, 7522 ft. (HHH).

Iva axillaris Pursh. Poverty weed
Mouth of Cebolla Creek, RM 49, terrace, dry waste field, abundant, July 8, 7460 ft. (SF).

Iva xanthiifolia Nutt. Poverty weed
Moncrief Ranch in the waste fields near stockyard (SF).

Lactuca pulchella (Pursh.) DC. Blue lettuce
Black Canyon, RM 34, roadside, dry soil aggregate, common, July 18, 7400 ft. (HHH).

Lactuca scariola L. Prickly lettuce
Black Canyon, RM 33, rare, roadside, gravel soil of clay, July 18, 6940 ft. (HHH).

Ptiloria pauciflora (Torr.) A. Nels. Wirelettuce
West of Cebolla Creek, RM 48, common in sagebrush flat and deep red soil, dry area, July 8, 7500 ft. (HHH); and West Elk Creek, RM 44, very common on hillside in rocky soil and valley floor of canyon, July 10, 7500 ft. (HHH).

Ptiloria tenuifolia L. Tiloría
Willow Creek, RM 60, dry roadside, common, July 2, 7500 ft. (SF).

Rudbeckia hirta L. Black-eyed Susan
Dry Gulch, RM 50, dry rocky soil, open field and in sagebrush community, June 29, 7460 ft. (HHH); South of Elk Horn, RM 61, streamside, common, very wet mud soil, July 1, 7465 ft. (HHH); Willow Creek, RM 60, common,

PLANTS

Compositae (family) continued

Rudbeckia hirta (continued)

near ranch house at Aswald Place, July 2, 7500 ft. (HHH); mouth of Cebolla Creek, RM 50, common in streamside and terrace, July 8, 7460 ft. (SF); and Soap Creek, RM 43, common in wet soil associated with willows, July 10, 7500 ft. (HHH).

Rudbeckia laciniata L. Coneflower

Cebolla Creek, RM 50, rare, terrace, deep sandy soil, July 7, 7460 ft. (HHH); and Black Canyon, RM 37, rocky steep walls, common along road shoulder west of Sapinero, July 14, 7200 ft. (HHH).

Senecio ambrosioides Rydb. Groundsel

Beaver Creek, RM 62, dry soil, hillside, June 8, 7600 ft. (SF); Dry Gulch, RM 58, wet soil by beaver dam upstream from ranch house, July 6, 7500 ft., (HHH); West Elk Creek, RM 44, wet streamside, July 10, 7460 ft. (SF); Soap Creek, RM 43, wet soil along canal at upper limits of reservoir site, July 12, 7500 ft. (SF); and Black Canyon, RM 33, gravel soil, dry hillside, common, July 18, 7000 ft. (HHH).

Senecio atratus Greene Groundsel

Soap Creek, RM 43: common on steep rocky hillside associated with sagebrush and oak, July 12, 7460 ft. (HHH); and dry soil, sagebrush hillside, west facing slope near upper limits of reservoir site, July 12, 7500 ft. (SF).

Senecio crassulus A. Gray Groundsel

Red Creek, RM 47, common, hillside just out of riverbank, June 30, 7500 ft. (HHH).

Senecio cymbalarioides Nutt. Senecio

Upper dam site, rare in dry soil, June 8, 7500 ft. (SF).

Senecio integerrimus Nutt. Senecio

Upper limits of Res., RM 63, roadside and meadow fringes, 7 mi. west of Gunnison, Colo., July 1, 7520 ft. (HHH).

Senecio mutabilis Greene Groundsel

West Elk Creek, RM 44, common in fields and outskirts of meadow in damp soil, July 11, 7460 ft. (SF).

Senecio platylobus Rydb. Senecio

South Steuben Creek, RM 60, dry hillside, common in hillside throughout reservoir basin, July 1, 7520 ft. (HHH).

Solidago canadensis L. Goldenrod

Soap Creek, RM 43, common at west slope and in sagebrush and oak, July 12, 7500 ft. (SF); Morrow Point dam site, RM 30, dry rocky soil, rare, very tall, July 18, 6890 ft. (HHH); and Black Canyon, RM 51, dry roadbed, rocky soil, some near rivers edge, July 21, 6900 ft. (HHH).

PLANTS

Compositae (family) continued

Solidago sparsiflora L. Goldenrod

South Elk Horn, RM 61, terrace in small stream drainage associated with old cottonwoods, July 1, 7460 ft. (HHH); and Black Canyon, RM 33, common along stream banks and roadbed, dry soil, July 15, 7100 ft. (HHH).

Stephanomeria tenuifolia (Torr.) Hall. Desert pink

Willow Creek, RM 59, streamside, common in and about old railroad bed near culvert of canal, July 1, 7500 ft. (HHH).

Tanacetum vulgare L. Tansy

West Elk Creek, RM 60, streamside, upper limits, common, wet soil, July 2, 7500 ft. (HHH).

Tetradymia canescens DC. Spineless horsebrush

Red Creek, RM 47, rare, hedged and indicates over use, dry steep hillside and rocky soil, June 29, 7500 ft. (HHH); West Elk Creek, RM 60, dry hillside, rocky cliff and poor shallow soil, July 2, 7500 ft. (HHH); Soap Creek, RM 43, rare, dry sandy soil, rocky soil of upland in sagebrush belt, July 12, 7500 ft. (HHH); and East Elk Creek, RM 51, dry rocky soil, hillside, rare, heavily hedged from grazing, common on road grade at bend crossing creek, July 21, 7500 ft. (HHH).

Taraxacum officinale Wiggers Common dandelion

Dry Gulch, RM 50, common throughout in both fields, streamside and open sagebrush and grass, June 30, 7460 ft. (HHH).

Tragopogon dubius Scop. Goatsbeard

Dry Gulch, RM 50, rare, roadside and at shoulder of some arroyos, June 28, 7500 ft. (HHH).

Townsendia exscapa (Rich) Porter Townsendia

Upper dam site, RM 40.6, dry soil associated with sagebrush, June 8, 7600 ft. (SF).

Viguiera multiflora (Nutt.) Blake Goldenray

Stevens Creek, RM 58, meadow, good wet soil, rich meadow, July 3, 7500 ft. (HHH); Soap Creek, RM 43, July 12: very common at upper limits of reservoir site, semi-dry sandy soil, (SF); common in wet soil along stream and wet meadow (HHH); big sagebrush, common, sandy clay soil, semi-damp (HHH); and Black Canyon, RM 32, dry sandy soil, common near stream bank, July 18, 7000 ft. (HHH).

Wyethia amplexicaulis Nutt. Mule ears

West of Cebolla Creek, RM 48, rocky soil in aspen grove, some 100 yds. above stream on hillside, rare, July 8, 7520 ft. (HHH); and Soap Creek, RM 43, meadow, wet soil, rare, July 12, 7460 ft. (ADS).

Xanthium saccharatum Wallr. Cocklebur

Black Canyon, RM 34, roadside, common on sandy beaches of stream sediment, July 18, 6950 ft. (HHH).

THE GRASS FLORA

Robert Newel Reynolds

Gramineae (family) Grasses

Agropyron desertorum (Fisch.) Schult. Desert wheatgrass

This valuable introduced forage grass, found occasionally throughout the reservoir basin, was collected only from Dry Gulch where it was fairly abundant in the dry clay, loam type soils of the terrace and streamside habitats. Stock and Lamborn reported it reaching a significant density in the farmland near Moncrief Ranch.

Records - Dry Gulch, RM 50, dry, rocky and loamy soil of terrace, July 17, 7460 ft. (RNR); and dry soil of sagebrush community, June 28, 7500 ft. (HHH).

Agropyron saundersii (Vasey) Hitchc. Saunders wheatgrass

This infrequent species, collected only once in the entire reservoir basin, was found in a moist habitat near the streamside.

Record - Mouth of Cebolla Creek, RM 49, damp, rocky soil of streamside, July 9, 7460 ft. (RNR).

Agropyron smithii Rydb. Western bluestem wheatgrass

This widely distributed species was observed to have a very wide adaptation to soil and water conditions. It was found growing in streamside, terrace, farmland and hillside habitats, but seemed to do best in the heavy soil along intermittent swales and water courses that receive excess surface drainage waters.

Records - Moncrief Ranch, RM 49, rocky hillsides, July 9, 7460 ft. (HHH); Dry Gulch, RM 50, dry soil of roadbed through terrace in bottom of canyon, July 10, 7460 ft. (SF); Soap Creek, RM 43, moist meadow, July 12, 7350 ft. (RNR); and Black Canyon, moist soil at edge of meadow on rim of canyon 1/4 mi. west of Sapinero, July 21, 7300 ft. (RNR).

Agropyron smithii var. molle (Scribn. and Smith) Jones . . Western wheatgrass

Differing from the species in having lemmas and sometimes the glumes pubescent, this grass was uncommon in the area.

Record - Dry Gulch, 1/4 mi. west, RM 50, very wet and rich soil of seepage area, July 18, 7500 ft. (RNR).

Agropyron subsecundum (Link) Hitchc. Bearded wheatgrass

Found occasionally in the moist meadows and open woods of the river drainage.

Record - West Elk Creek, moist soil of meadow, July 11, 7300 ft. (SF).

Agropyron trachycaulum (Link) Malte Slender wheatgrass

This species was found growing in a number of different habitats from the moist irrigated meadowlands to the dry open fields and roadsides. It favored the sandy, loamy soils that receive water frequently where it was observed in dense leafy bunches 1 ft. in dia. and 3 ft. high.

PLANTS

Gramineae (family) continued

Agropyron trachycaulum (continued)

Records - Dry Gulch, RM 50, dry soil of open field, June 28, 7460 ft. (HHH); dry fringe of alfalfa field in dry, loamy soil, July 2, 7400 ft. (RNR); moist, loamy soil in canyon bottom at edge of shrub community, July 10, 7460 ft. (SF); 1/4 mi. west, rich moist soil along water seepage area, July 18, 7500 ft. (RNR); Moncrief Ranch, RM 49, common in meadow near canal and streamside of wet clay soil, July 9, 7500 ft. (SF); and West Elk Creek, moist soil of meadow, July 11, 7300 ft. (RNR).

Agrostis alba L. Redtop

This species was observed frequently in moist soils where it was cultivated as a hay grass and as a soil binder because of the rhizomatous character of the roots. It was most always found as a mixture among other hay grasses and often escaping wherever there was moist, loamy, sandy soil conditions to accomodate it.

Record - Soap Creek, RM 43, wet sandy soil along stream running through hay meadow, July 12, 7300 ft. (SF).

Agrostis exarata Trin. Spike bent

Observed occasionally in the wet seepage areas of the streamside and in the moist meadows.

Record - Dry Gulch, 1/4 mi. west, RM 50, wet rich soil of seepage area, July 18, 7500 ft. (RNR).

Agrostis palustris Huds. Creeping bent

Found occasionally in the streamside and moist meadows abut never in abundance.

Record - West Elk Creek, RM 44, sandy soil along creek and moist, rich soil in meadow, July 11, 7300 ft. (RNR).

Agrostis scabra Willd. Ticklegrass

Occurring throughout the reservoir basin, this species was restricted to the moist, sandy areas along the stream.

Records - Mouth of Cebolla Creek, RM 49, wet soil in shade of large populus grove, July 9, 7460 ft. (RNR); West Elk Creek, RM 44, moist, sandy area along stream, July 10, 7300 ft. (SF); and wet sandy soil near stream, July 10, 7460 ft. (RNR).

Alopecurus aequalis Sobol. Short-awn foxtail

This long-lived perennial resembles timothy so much that it was often mistaken for it. It was found throughout the reservoir basin in the wet streamside and moist meadow habitats, but never occurred in rich enough abundance to be used as a hay grass.

Records - One-half mile east of new bridge on Highway 50, meadow and streamside, June 30, 7460 ft. (HHH); Cebolla Creek, RM 50, wet streamside, July 6, 7500 ft. (RNR); East Elk Creek, RM 50, wet drainage in meadow, July 9, 7560 ft. (RNR); and West Elk Creek, RM 44, wet meadow of canyon bottom, 7500 ft., and 7300 ft., July 11 (RNR).

PLANTS

Gramineae (family) continued

Aristida fendleriana Steud. Fendler three-awn

This species was unevenly distributed throughout the reservoir basin. It occurred rarely in significant amounts and was always confined to the dry soils of the hillside.

Records - South Beaver Creek, RM 60, dry hillside, July 1, 7460 ft. (RNR); Iola, RM 58, common but heavily grazed, only few in fruit, July 5, 7500 ft. (HHH); and Henderson Ranch, RM 50, north slope of hillside, July 7, 7520 ft. (RNR).

Beckmannia syzigachne (Steud.) Fernald American sloughgrass

Observed occasionally throughout the meadows in ditches and marshy areas.

Records - Upper limits of Blue Mesa Reservoir, RM 63, submerged in meadow stream, common, deep wet soil, June 30, 7520 ft. (HHH); 1/4 mi. west of Dry Gulch, RM 50, wet rich soil of seepage area, July 18, 7500 ft. (RNR); and West Elk Creek, RM 44, wet, marshy area of meadow, July 11, 7300 ft. (RNR).

Bouteloua gracilis (H.B.K.) Lag. Blue grama

This low-growing, long-lived, native perennial is considered to be a valuable range species due to its wide distribution, high quality, hardiness and growth habits, but in this area it was very rare.

Record - West Elk Creek, RM 43, upper edge of meadow in dry, rocky soil adjacent to cliffs, rare, July 11, 7300 ft. (GLR) (RNR).

Bromus anomalus Rupr. Nodding brome

Found only occasionally, but in a variety of habitats from the waste places of an abandoned railroad track to the moist and rich soils of the streamside.

Records - Soap Creek, RM 43, wet soil of streamside, July 12, 7480 ft. (RNR); Lake Fork, dry soil of roadbed, July 14, 7450 ft. (RNR); and Black Canyon, RM 41, dry soil, rocky cliffs near brink of the canyon, July 21, 7500 ft. (RNR).

Bromus ciliatus L. Fringed brome

Appearing occasionally in the moist woods and on the rocky slopes.

Records - Dry Gulch, RM 50, dry, loamy soil in bottom of dry wash leading through terrace, July 10, 7460 ft. (SF); and Black Canyon, RM 36, wet soil near streamside, July 16, 7190 ft. (HHH).

Bromus commutatus Schrad. Hairy chess

This introduced grass from Europe has become a weed of fields and waste places. It was observed occasionally growing in the waste soil of an abandoned railroad bed.

Record - Black Canyon, dry, sandy soil along abandoned railroad track, July 18, 6900 ft. (SF).

PLANTS

Gramineae (family) continued

Bromus inermis Leyss. Smooth brome

This long-lived, perennial sod grass with strong creeping rhizomes, was introduced into the United States in 1884 and has now become very widely spread. In the reservoir basins it is used both as a pasture and a hay grass and has escaped cultivation and spread throughout the canyon bottoms and open woods, occasionally appearing in stands of leafy forage up to 4 ft. in height.

Records - Dry Gulch, RM 50: loamy soil of terrace, July 10, 7460 ft. (RNR); and open field and mouth of canyon June 28, 7500 ft. (HHH); and Soap Creek, RM 43, moist rich soil of meadow, July 12, 7450 ft. (RNR).

Bromus polyanthus Scribn.

Observed occasionally in the open woods, along the roadside and in moist soil of the canyon bottom.

Record - Soap Creek, RM 43, hillside terrace 15 ft. above stream in dry soil of open woods, July 12, 7400 ft. (RNR).

Bromus tectorum L. Downy chess, cheatgrass

As a wide-spread species, it occurs throughout the entire reservoir basins along the roadsides, banks, waste places and hillsides.

Records - Dry Gulch, RM 50, sidehill and open field, June 28, 7500 ft. (HHH); Dry Gulch, RM 50, along dry ditchbank in dark, loamy soil and rocks, July 10, 7460 ft. (RNR); and Henderson Ranch, RM 50, common on hillsides and abandoned fields, July 7, 7560 ft. (HHH).

Calamagrostis canadensis (Michx.) Beauv. Bluejoint

Specimen taken, but not recognized in the field.

Record - One-fourth mile east of West Elk Creek, RM 44, sandy open ground along river, July 11, 7250 ft. (RNR).

Calamagrostis inexpansa A. Gray Northern reedgrass

Specimen taken, but not recognized in the field.

Record - Soap Creek, RM 43, rich, moist soil of meadow, July 12, 7300 ft. (RNR).

Calamagrostis neglecta (Ehrh.) Gaertn. Mey. & Schreb.

Specimen taken, but not recognized in the field.

Record - Soap Creek, RM 43, rich, moist soil of meadow, July 12, 7300 ft. (RNR).

Catabrosa aquatica (L.) Beauv. Brookgrass

Found frequently in the meadows along the ditches and in the wet seepage areas.

Records - Dry Gulch, RM 50, emerged in beaver dam, common in area of Iola meadows, July 7, 7500 ft. (RNR); Soap Creek, RM 43, rocky, sandy soil in very wet seepage area, July 12, 7300 ft. (SF); and 1/4 mi. west of Dry Gulch, wet, rich, soil in water seep, July 18, 7500 ft. (SF).

PLANTS

Gramineae (family) continued

Dactylis glomerata L. Orchard grass

This distinctive bunch-type grass, cultivated in many of the meadows for hay, was usually mixed with alfalfa and red clover. It has frequently escaped into the shady woodlands where it is often the dominant grass.

Records - West Elk Creek, RM 44, full field of orchard grass mixed with timothy and red clover, wet soil, very tall plants, July 10 and 11, 7460 ft. (RNR).

Distichlis stricta (Torr.) Rydb. Desert saltgrass

This species, usually restricted to alkaline soils, was observed only on the abandoned railroad bed in the Black Canyon.

Records - Black Canyon, RM 31, dry soil at edge of abandoned railroad bed, July 18, 6935 ft. (SF) and July 19, 7200 ft. (RNR).

Elymus canadensis L. Canada wild rye

This vigorous, widely distributed, perennial bunchgrass is quite common in the Rocky Mountain states but appeared only occasionally in the reservoir basins.

Record - Black Canyon, RM 29, dry, sandy soil at edge of road, July 19, 7200 ft. (SF).

Elymus condensatus Presl. Giant ryegrass

This coarse, robust, perennial with thick short rootstocks occurs in all the western states and is the largest of the native ryegrasses. One individual bunch, in Dry Gulch, measured over 7 ft. high and 3 ft. in dia. It was found particularly abundant on moderately dry fertile soils of the terrace but was also observed in the streamside, farmland, and hillside habitats.

Records - Dry Gulch, RM 50, robust plants, common in valley floors growing in deep sandy soil of terrace association, June 28, 7500 ft. (HHH); West Elk Creek, RM 44, common in cultivated fields, 5 ft. high, July 10, 7500 ft. (HHH); and Dry Gulch, RM 50, dry, rocky and loamy soil of terrace, July 17, 7460 ft. (RNR).

Festuca elatior L. Meadow fescue

This hardy perennial, native to Europe, is used in pasture and hay mixtures, but in the reservoir basin was found in only one area.

Record - Sapinero, moist rich soil at edge of hay meadow, 1/4 mi. west on Highway 50, July 21, 7300 ft. (RNR).

Festuca ovina L. Sheep fescue

This bunchgrass succeeded better than most grasses on sandy or gravelly soils. It was observed only in open woods and rocky slopes at elevations above the reservoir basin.

Records - Rim of Red Creek, RM 48, open woodland of aspen and fir, 8460 ft., and on south facing slope of fir association, 8700 ft., July 8, (RNR).

PLANTS

Gramineae (family) continued

Festuca rubra L. Red fescue

Like sheep fescue, red fescue is a hardy, robust plant adapted well to shaded, dry sites.

Record - Soap Creek, RM 43, dry west-facing slope, July 12, 8460 ft. (RNR).

Glyceria grandis S. Wats. American mannagrass

This grass, of common occurrence throughout the reservoir basin, was always found in extremely wet places, streamsides and marshes.

Records - East Elk Creek, RM 51, deep soil of wet meadow, July 6, 7500 ft. (RNR); West Elk Creek, RM 44, wet marshy meadows, July 9, 7460 ft. (RNR), and July 11, 7300 ft. (SF).

Glyceria striata (Lam.) Hitchc. Fowl mannagrass

Commonly observed in the wet seepages, marshes and ditchbanks.

Records - West Elk Creek, RM 44, rich black soil of seepage, July 11, 7300 ft. (SF); and Cebolla Creek, wet, rich soil of seepage on east-facing slope, July 21, 7400 ft. (RNR).

Hilaria jamesii (Torr.) Benth. Galleta grass

Generally distributed throughout the reservoir basin but usually restricted to the hillside habitat where it flourished in the dry sandy soils.

Records - Beaver Creek, RM 61, gravelly soil of dry hillside, July 4, 7460 ft. (HHH); and south of Iola, RM 58, rare, heavily grazed, dry hillside, July 5, 7500 ft. (HHH).

Hordeum brachyantherum Nevski Meadow barley

Specimen collected, but not recognized in the field.

Record - Soap Creek, RM 43, dry soil of hillside, July 12, 7300 ft. (RNR).

Hordeum jubatum L. Foxtail barley

This grass, widely spread throughout the reservoir basin, has invaded the irrigated meadows and become a troublesome weed. It was observed in streamside, terrace, farmland and hillside habitats and was extremely prevalent in waste places.

Records - Moncrief Ranch, RM 49, wet meadow, July 9, 7480 ft. (HHH); Dry Gulch, RM 50, abandoned field, June 28, 7500 ft. (HHH); West Elk Creek, RM 44, moist meadowland, July 11, 7300 ft. (RNR); and edge of Black Canyon, dry aggregate soil of roadside, July 21, 7300 ft. (RNR).

Koeleria cristata (L.) Pers. Junegrass

Specimen taken but not identified in the field.

Record - Cebolla Creek, RM 49, dry side canyon at bend of main river drainage, July 8, 7500 ft. (RNR).

Melica bulbosa Geyer, Porter & Coult. Oniongrass

Specimen taken but not identified in the field.

Record - Lake Fork, RM 41-3, common in dry sandy soil along stream, July 15, 7500 ft. (RNR).

PLANTS

Gramineae (family) continued

Melica porteri Scribn. Porter melica

This grass, mistaken in the field for Bouteloua curtipendula because of the one-sided, contracted panicle, was observed in open woods and moist places.

Records - Black Canyon, RM 36, semi-wet soil, south side of river, common, handsome, July 16, 7200 ft. (HHH); and RM 49, wet sandy soil at mouth of small side canyon, frequent, July 21, 7500 ft. (HHH).

Muhlenbergia asperifolia (Nees. & Mey.) Parodi Scratchgrass

Commonly occurring in wet soil along ditchbanks and streams.

Record - West Elk Creek, RM 44, streamside soil, July 11, 7460 ft. (RNR).

Muhlenbergia filiformis (Thurb.) Rydb. Pull-up muhly

This low growing annual was found occasionally in wet sandy soil in seepage areas or along streams.

Records - West Elk Creek, RM 44, sany soil along stream, 7300 ft. (SF); and damp soil of streamside, 7460 ft. (RNR), July 11; and Soap Creek, RM 43, sandy soil of seepage area, July 12, 7400 ft. (RNR).

Muhlenbergia racemosa (Michx.) B.S.P. Marsh muhly

This perennial grass, found in a wide range of habitats, was observed throughout the reservoir basin growing on rocky hillsides, moist meadows, sandy alluvial soil along the river, and in waste places along the roadside.

Records - Black Canyon, RM 33, dry aggregate soil along roadbed, July 18, 6950 ft. (RNR); RM 33, moist, sandy soil along river, July 18, 6900 ft. (SF); and RM 30, dry, sandy soil near streamside, July 19, 6940 ft. (RNR).

Muhlenbergia richardsonia (Trin.) Rydb. Mat muhly

Specimen taken, but not identified in the field.

Record - Lake Fork, dry soil on open terrace, July 15, 7400 ft. (RNR).

Munroa squarrosa (Nutt.) Torr. False buffalo grass

Black Canyon, RM 33, rare, only specimen taken from oak cluster in dry soil, July 18, 6940 ft. (SF).

Oryzopsis bloomeri (Boland) Ricker Bloomer ricegrass

Found to be rare in the reservoir basin.

Record - Black Canyon, dry soil at edge of Highway, July 21, 7350 ft. (RNR).

Oryzopsis hymenoides (R. & S.) Ricker Indian ricegrass

This densely tufted, native, perennial bunchgrass is widely distributed over the western states, and once served as a food staple for the Indians. It is drought resistant and was most always found growing in the dry sandy soils of the hillside and terrace habitat. It was particularly abundant along the highway and the abandoned railroad in the dry, rocky and sandy soils and banks.

Records - Dry Gulch, RM 50, dry soil of sagebrush community, June 28, 7460 ft. (HHH); and dry soil at edge of beaver dam, July 5, 7520 ft. (HHH); $\frac{1}{2}$ mi. east of West Elk Creek, RM 44, dry, rocky soil on abandoned railroad track, July 11, 7250 ft. (RNR); and Soap Creek, RM 43, dry, rocky hillside, July 12, 7520 ft. (RNR).

PLANTS

Gramineae (family) continued

Oryzopsis micrantha (Trin. & Rupr.) Thurb. Littleseed ricegrass

Fairly common on the dry hillsides and occasionally in moist streamside habitat.

Records - Elk Horn Lodge, RM 61, dry hillside, July 1, 7500 ft. (RNR); Soap Creek, RM 43, wet soil in salix community and meadows, July 12, 7480 ft. (HHH); Lake Fork, dry terrace above creek, July 15, 7450 ft. (RNR); and Black Canyon, dry, sandy aggregated soil on roadbed, July 18, 6950 ft. (RNR).

Panicum capillare L. Witchgrass

This species, rare to the reservoir basin, was found in only one location, along an abandoned railroad bed (now roadway) in the Black Canyon.

Record - Black Canyon, RM 33, dry, sandy aggregate soil of roadbed, July 18, 6950 ft. (SF).

Panicum virgatum L. Switchgrass

This vigorous, native, perennial, sod-forming grass occurs throughout most of the United States, but is most abundant in the central and southern parts of the Great Plains where it is used as a forage and pasture grass. In the reservoir basin, it was very rare. The only specimens found were in one small stand at the edge of the roadway in the Black Canyon.

Record - Morrow Point dam site, RM 30, dry sandy soil along road and waste area, July 19, 7200 ft. (SF).

Phleum pratense L. Timothy

Timothy, an introduced grass from Europe, was brought to the United States in the early 18th century and its cultivation then begun. By the beginning of the 19th century, it was the most important hay grass in the United States. It is now well adapted to the valleys of the Rocky Mountains, of which the Gunnison River valley is a good example. There it is widely used as a hay grass and was often found mixed with Dactylis glomerata, Poa pratensis, Bromus inermis, and Trifolium pratense (red clover). In the West Elk Creek drainage a pure stand of Timothy (about 20 acres) was observed.

Records - Dry Gulch, RM 50, cultivated field, June 28, 7500 ft. (HHH); Dry Gulch, RM 50, dark loamy soil of moist canyon bottom, July 10, 7460 ft. (RNR); West Elk Creek, RM 44, moist soil of meadow, July 11, 7300 ft. (RNR); Soap Creek, RM 43, wet, sandy soil in shaded area along stream, July 12, 7300 ft. (RNR).

Poa compressa L. Canada bluegrass

This native grass of Europe was occasionally found in open, rather poor, dry soils. It was also found in rich, moist soils of meadows.

Records - Cebolla Creek, RM 49, wet meadow, July 9, 7460 ft. (HHH); Dry Gulch, RM 50, along ditch in moist, loamy soil, July 10, 7460 ft. (SF).

Poa nevadensis Vasey Nevada bluegrass

Found on the dry, rocky hillsides as well as the moist meadows.

PLANTS

Gramineae (family) continued

Poa nevadensis (continued)

Records - Dry Gulch, RM 50, dry, rocky hillside and ditchbank in dark, loamy soil mixed with rocks, July 10, 7460 ft. (RNR); and Willow Creek, RM 60, common, streamside, wet gravelly, July 1, 7500 ft. (RNR).

Poa palustris L. Fowl bluegrass

Observed occasionally in moist soil of canyon bottoms and meadows.

Records - Dry Gulch, RM 50, wet soil of canyon bottom, July 10, 7460 ft. (RNR); West Elk Creek, RM 44, moist soil of woodland, July 11, 7250 ft. (RNR); and Black Canyon, moist sandy soil along river, July 18, 6950 ft. (RNR).

Poa pratensis L. Kentucky bluegrass

Commonly cultivated throughout the basin as a pasture and hay grass, and was often found spreading through the canyon bottoms and streamsides. In the meadows it was most always found as a mixture with Dactylis glomerata, Bromus inermis, Phleum pratense and Trifolium pratense (red clover).

Records - Dry Gulch, RM 50, 7500 ft.: common in ditch bank and dry soil, meadows heavily covered, June 28, (HHH); streamside and meadows, deep clay soil in a cottonwood association, June 30, (HHH); and along dried-up stream, July 10, (SF); South Steuben Creek, RM 60, dry crevice on hillside at face of large sandstone ledge, July 1, 7560 ft. (HHH); Willow Creek, RM 60, wet streamside, July 2, 7500 ft. (HHH); and West Elk Creek, RM 44, moist, loamy soil of canyon bottom, July 11, 7250 ft. (RNR).

Puccinellia distans (L.) Parl. Alkali grass

Specimen collected, but not recognized in the field.

Record - West Elk Creek, RM 44, wet meadow, lush mountain meadow, cultivated for stock feed, July 11, 7460 ft. (RNR).

Sitanion hystrix (Nutt.) J.G.Smith Squirreltail

Widely distributed in the dry soils of the terrace and hillside.

Records - Beaver Creek, RM 62, dry soil of sandy aggregate, June 8, 7460 ft. (SF); Dry Gulch, RM 50, situations common but this species was rare, dry hillside among sagebrush near ranch house, June 28, 7500 ft. (HHH); Dry Gulch, dry soil of terrace among open woods, July 10, 7460 ft. (RNR); and Soap Creek, RM 43, dry rocky and clay soil above stream, July 12, 7300 ft. (SF).

Sporobolus airoides (Torr.) Torr. Alkali sacaton

This native bunchgrass occurs generally throughout the western United States and is commonly found on moist alkaline soils but it does occur also on other types of soil. In the river basin it was found in the moist meadow as well as the dry terrace.

Records - Oswald Ranch, RM 59, frequent in terrace areas near stream in dry sandy and clay soil, July 4, 7460 ft. (RNR); south Iola, RM 59, rare, dry rocky soil near old pasture, over grazed, July 5, 7500 ft. (HHH); Henderson Ranch, RM 50, dry terrace, July 8, 7500 ft. (HHH); and Soap Creek RM 43, moist soil at edge of meadow, July 12, 7450 ft. (SF).

PLANTS

Gramineae (family) continued

Sporobolus cryptandrus (Torr.) A. Gray Sand dropseed

This native grass is a pioneer or invader species on raw, denuded soil and is most prevalent on sandy soil. It was found abundant throughout the basin in dry meadows, sandy open ground and particularly on the dry sandy soil along the abandoned railroad bed.

Records - Eagle Rock, RM 60, dry meadow, south side of river across canyon July 3, 7600 ft. (RNR); 1/4 mi. west of East Elk Creek, sandy open ground, July 11, 7250 ft. (SF); Lake Fork, RM 41-6, common, stream and terrace, July 15, 7690 ft. (RNR); and Black Canyon, RM 33, occasional on roadside sandy soil and at base of talus slopes, July 18, 6940 ft. (HHH) (RNR).

Stipa columbiana Macoun. Columbia needlegrass

Common throughout the reservoir basins in the dry soil of terraces, along the roads, in the open woods and on the hillsides.

Records - Soap Creek, RM 43, dry clay bank above creek, July 11, 7400 ft. (RNR); West Elk Creek, RM 44, dry, rocky hillside, July 15, 7520 ft. (SF); and Black Canyon, dry, loamy soil at edge of meadow, July 21, 7300 ft. (RNR).

Stipa comata Trin. & Rupr. Needle and thread grass

This deep-rooted, long-lived, native bunchgrass, occurs generally on the western ranges. It occurred periodically throughout the basins and was usually in abundant stands when found. It favored areas that had previously been cultivated.

Records - Beaver Creek, RM 62, dry soil among the sagebrush, June 8, 7460 ft. (SF); Eagle Rock, RM 60, cultivated in field, lush tall in deep sandy clay loam soil, July 1, 7420 ft. (HHH); and Dry Gulch, RM 50, loamy soil of terrace, July 10, 7460 ft. (SF).

Stipa lettermani Vasey Letterman needlegrass

Fairly common on the dry terraces and hillsides.

Records - Cebolla Creek, RM 49, dry, rocky north-facing slope, July 8, 7450 ft. (HHH); and Soap Creek, RM 43, dry clay-type soil of hillside, July 12, 7520 ft. (SF).

Stipa pinetorum Jones Needle and thread grass

This species was mistaken for Stipa lettermani in the field.

Records - Dry Gulch, RM 50, along roadway and open sagebrush flat, June 28, 7500 ft. (HHH); and Henderson Ranch, RM 50, rocky soil of hillside July 7, 7500 ft. (HHH).

DISCUSSION

A total of 61 species belonging to 27 genera, 7 tribes and both sub-families of the Gramineae (grass) family were collected from the Curecanti Reservoir basins during the 1961 ecological survey. Of these, Calamagrostis neglecta, Bromus commutatus, Festuca elatior, Oryzopsis bloomeri, Panicum virgatum and Stipa pinetorum are reported by Harrington (1954, pp. 45-110) as being uncommon in this area.

PLANTS

Agrostis alba, Bromus inermis, Dactylis glomerata, Phleum pratense and Poa pratensis are of tremendous economic importance to the ranchers and farmers of the area as they are important pasture and hay grasses. All have been introduced from Europe.

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COMPARISON OF A WIDE SOUTH-FACING

and a

NARROW NORTH-FACING CANYON

R. Bruce Walker

CONTENTS

Introduction	105
The study area	105
Methods of study	105
Results	105
Discussion	110
Conclusions	119
Literature cited	119

ILLUSTRATIONS

<u>Figures</u>		<u>Page</u>
1-5	Transects from bottom of Dry Gulch	104
6	Dry Gulch, south-facing wide canyon	109
7	Cebolla Creek in north facing narrow canyon. .	109
8-13	Transects from Cebolla Creek	111
<u>Table</u>		
1	Plants found in Dry Gulch and Cebolla	116

University of Utah
Anthropological Papers, No. 59, 1962
Upper Colorado Series, No. 8

SHORT TRANSECT

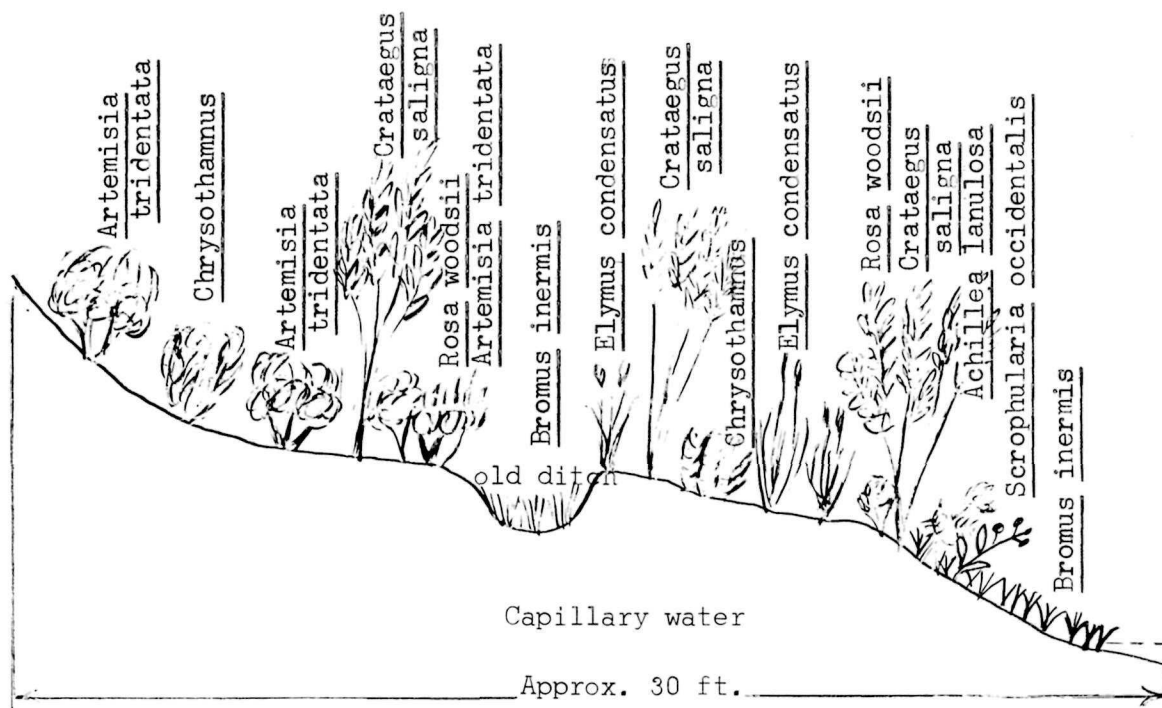


Fig. 1. Transect from bottom of Dry Gulch to hillside about 2800 ft. above junction.

WIDE UNIFORM TERRACE

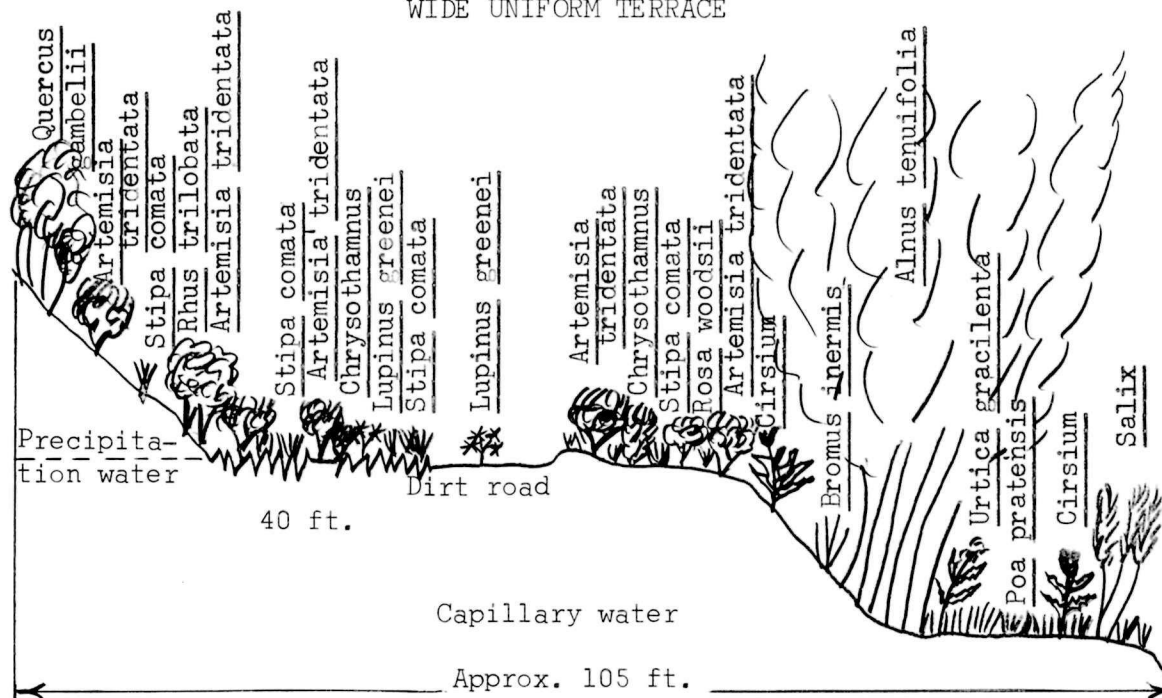


Fig. 4. Transect from bottom of Dry Gulch to hillside about 4100 ft. above junction.

INTRODUCTION

As a National Science Foundation student during the summer of 1961, I accompanied the University of Utah Ecological Research Expedition on a study of the area to be inundated by the reservoirs of the Curecanti project. The expedition was under the direction of Angus M. Woodbury, Stephen D. Durrant and Seville Flowers. This study was made in the basin of the Blue Mesa Reservoir and this paper is written for the purpose of comparing the vegetation in a wide dry south-facing canyon with that of a deep narrow north-facing canyon containing a permanent stream.

THE STUDY AREA

The two canyons studied are Dry Gulch and Cebolla Creek; both flow into the Gunnison River about 12 mi. upstream from the town of Sapinero, Colorado. Dry Gulch joins the river in section 28, Cebolla Creek in section 29, township 49 north, range 3 west. Dry Gulch is about 5 mi. in length and when there is water in the streambed, it flows south through a south-facing canyon. The headwater of Cebolla Creek is in the Gunnison National Forest, along the Continental Divide, in the Rocky Mountains, some 37 mi. to the south. The water in the stream was cold and clear and flows north through a north-facing canyon. The average rainfall in the lowlands of this region is about 10 in. but at higher elevations the rainfall is much greater.

METHODS OF STUDY

The study was made by walking through the area, listing the plants, and taking specimens for identification. Also, I made 11 transect drawings showing the succession of vegetation from streamside to hillside. All the work was done on the east side of both canyons and extended from the mouths of the canyons to the upper limits of the proposed Blue Mesa Reservoir.

RESULTS

Dry Gulch is a broad dry canyon. The sides of the canyon have an average slope of about 20 degrees. The underlying rock is a yellow sandstone mixed with clay. The streambed has water in it only occasionally, generally in the spring and early summer. The streambed is badly eroded. In some places, it is 8 to 10 ft. wide, and 4 to 5 ft. deep and very rocky. The water table must be relatively high because there was water in one part of the streambed for a distance of about 50 ft. Above and below this stretch, the water disappeared and seemed to run in subterranean channels (Fig. 3). The density of the vegetation near the streamside was estimated at 100 per cent and gradually thinned to 18 per cent on the hillsides. Table 1 shows the plants found and their distribution. Figures 1, 2, 3, 4, and 5 show sample plant transects in the canyon shown in Fig. 6.

TRANSECT OF SMALL TERRACE

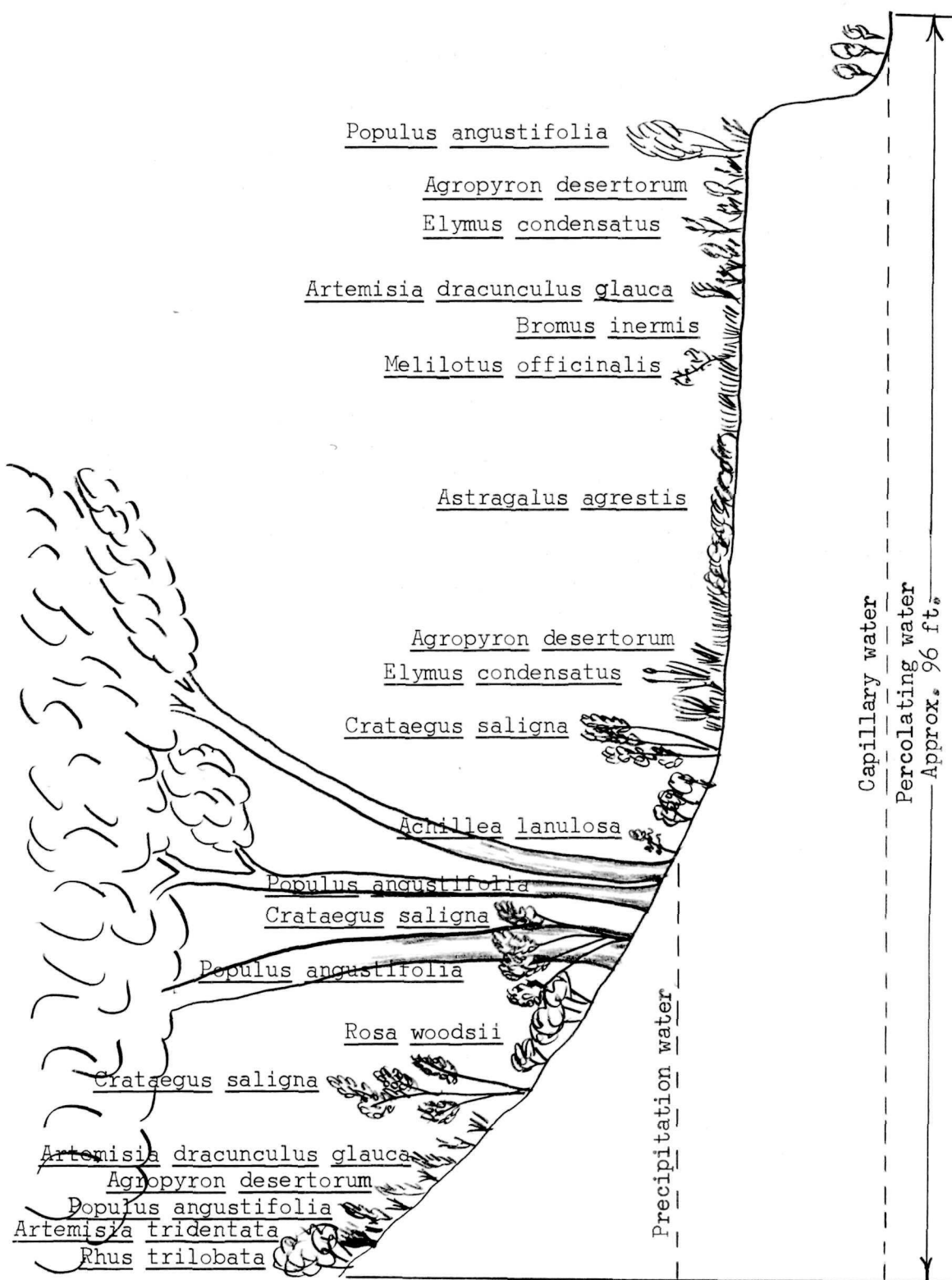


Fig. 2. Transect from bottom of Dry Gulch to hillside about 3,100 ft. above junction.

TRANSECT OF WIDE TERRACE

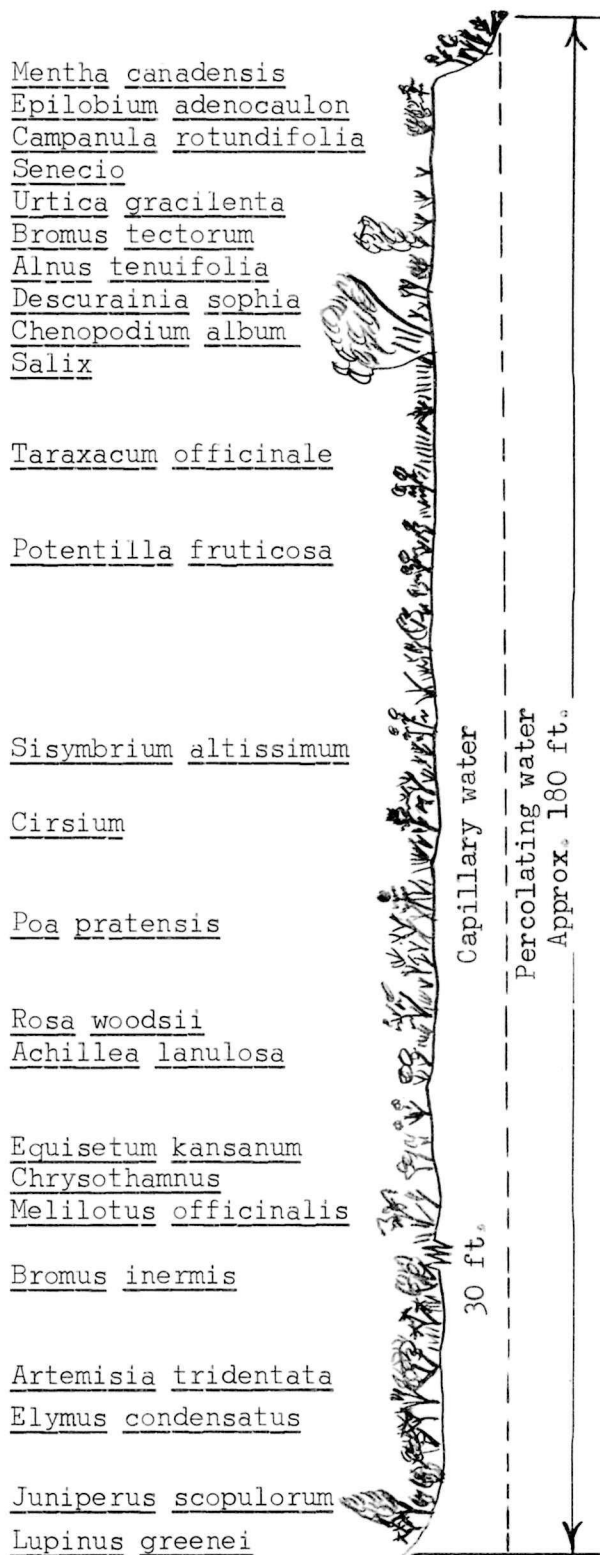


Fig. 3. Transect from bottom of Dry Gulch to hillside about 3600 ft. above junction.

TRANSECT THRU GROVE

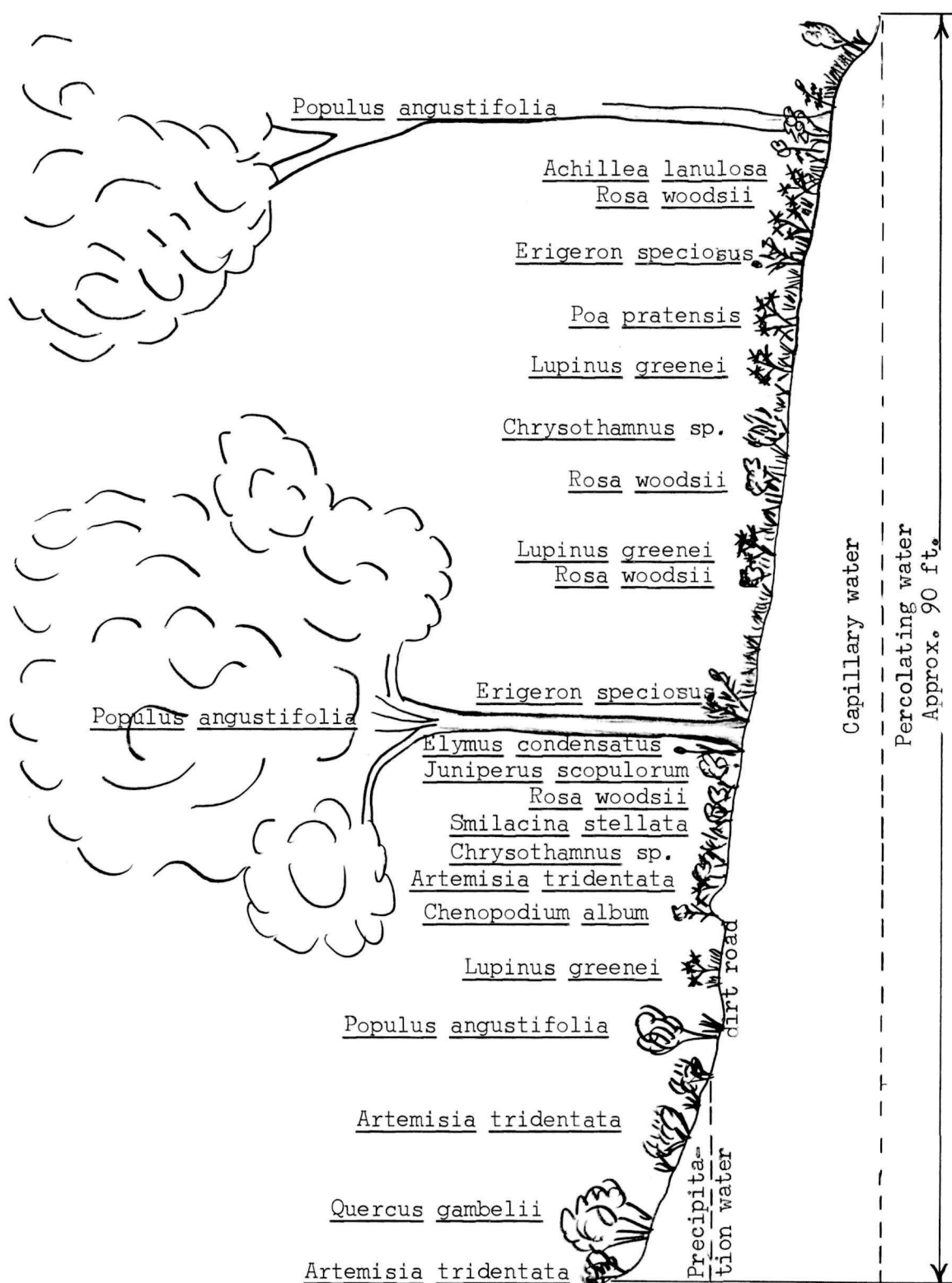


Fig. 5, Transect from bottom of Dry Gulch to hillside about 5100 ft. above junction.



Fig. 6. Dry Gulch, a south-facing wide canyon.
Photo by Gerald R. Groves.



Fig. 7. Cebolla Creek in a north-facing narrow canyon. Photo by Gerald R. Groves.

Cebolla Creek is a narrow and deep canyon, Fig. 7. About 2 mi. above the mouth, the stream has cut into Precambrian rock and in this area a gorge has been formed with many perpendicular cliffs. Near the mouth of the gorge, it is nearly 100 ft. deep and around 200 ft. wide. Above this Precambrian layer, the same sandstone clay formation, as in Dry Gulch, is found. The vegetation is estimated at 100 per cent along the streamside thinning to 20 per cent on the hillside. Table 1 shows the observed plants and their distribution. Figures 8, 9, 10, 11, 12 and 13 show sample plant transects.

DISCUSSION

Cebolla Creek and Dry Gulch have a few similarities. Geologically they have the sandstone clay formation and each has a large terrace about 1 mi. above their junctions with the Gunnison River. The terrace in Dry Gulch has true terrace type vegetation, Figs. 3 and 4. The terrace in Cebolla Creek has a great deal of streamside vegetation growing on it, indicating the presence of percolating water near the surface, Figs. 8 and 9. About 3 mi. up Cebolla Creek there is a small terrace with true terrace type vegetation, Fig. 13.

The most common plant in both canyons is big sagebrush. It is the dominant plant on the hillsides and a fair amount is growing on the terraces. Golden currant is found in small numbers along the streamside where the wild rose is an abundant understory plant. Yarrow, although not very abundant, is evenly distributed throughout the canyons on both terraces and stream-sides. Giant wild rye is found growing mostly on the terraces, Fig. 13. Kentucky blue grass, where present along the streamside, grows very dense, but it becomes sparse farther away from a source of water.

The canyons have a few distinct differences. There are some plants growing in both canyons with a great difference in quantity. Table 1 shows the following plants to be more abundant in Cebolla Creek than in Dry Gulch: false Solomon seal (2% vs. trace) and alder (29% vs. 8%). The following plants were more numerous in Dry Gulch: willow (30% vs. 5%), narrowleaf cottonwood (7% vs. trace), and hawthorn (15% vs. 2%). The table shows that conifers, red birch and dogwood are found in Cebolla and smooth brome grass and yellow sweet clover in Dry Gulch and not in the other.

The amount of sunshine affected by exposure is the big factor causing the differences in the two canyons. Because the two canyons do not face the same direction, the sun's energy is not equally dispersed in them. A diagram of this condition is found in Woodbury's Principles of General Ecology (1954:214). This diagram shows how a given unit of the sun's energy is concentrated in a smaller area on a south-facing slope than on a north-facing slope. This concentration will raise the temperature more than in the north-facing aspect. On the hillsides in Dry Gulch and Cebolla Creek, the vegetation depends on precipitation water. The sun shining on the soil of the hillsides evaporates the water out of the ground for several inches in depth.

TRANSECT OF WIDE WILLOW COVERED TERRACE

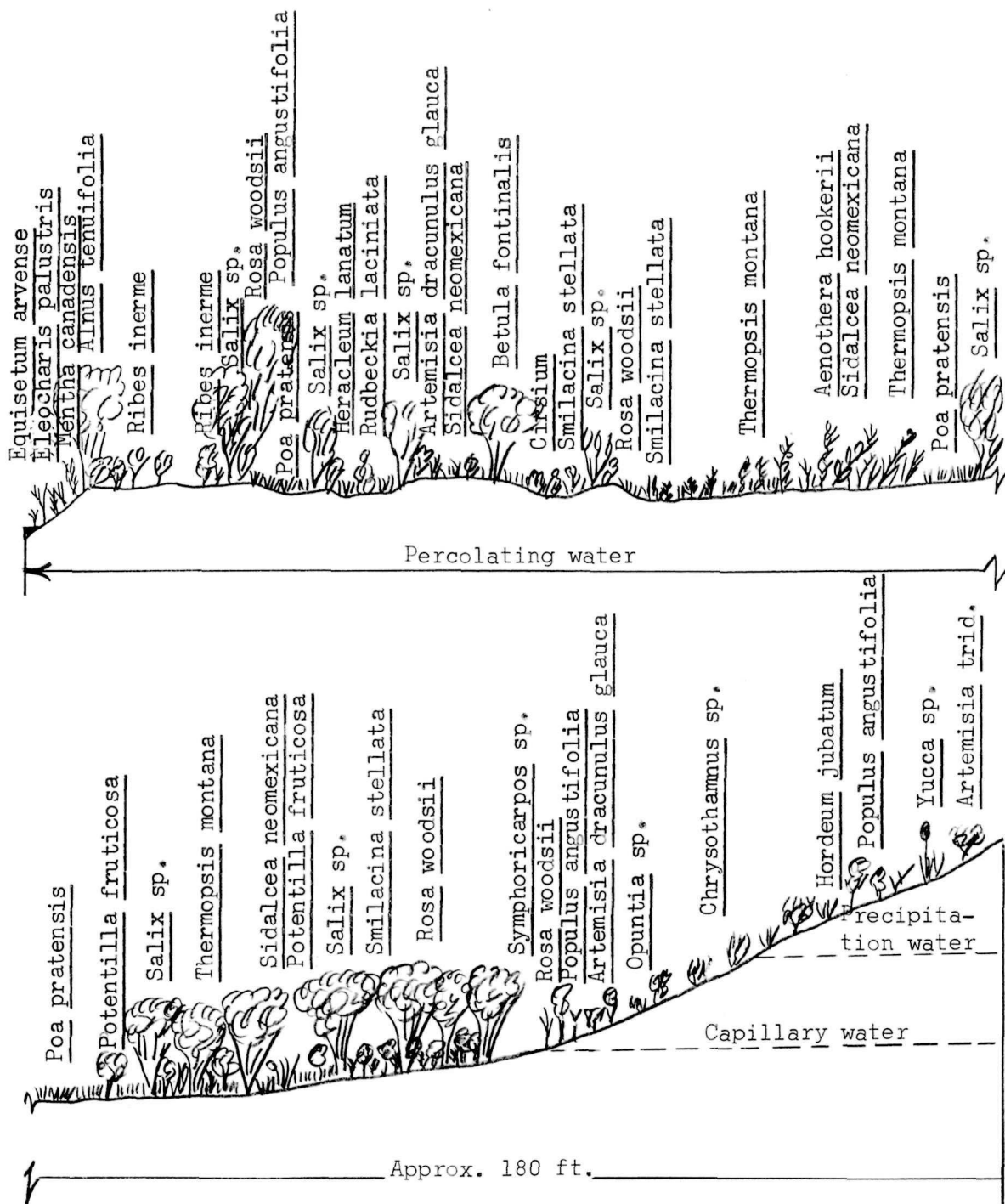


Fig. 8. Transect from Cebolla Creek to hillside about 7300 ft. above junction with Gunnison River.

SURVEY OF WIDE TERRACE

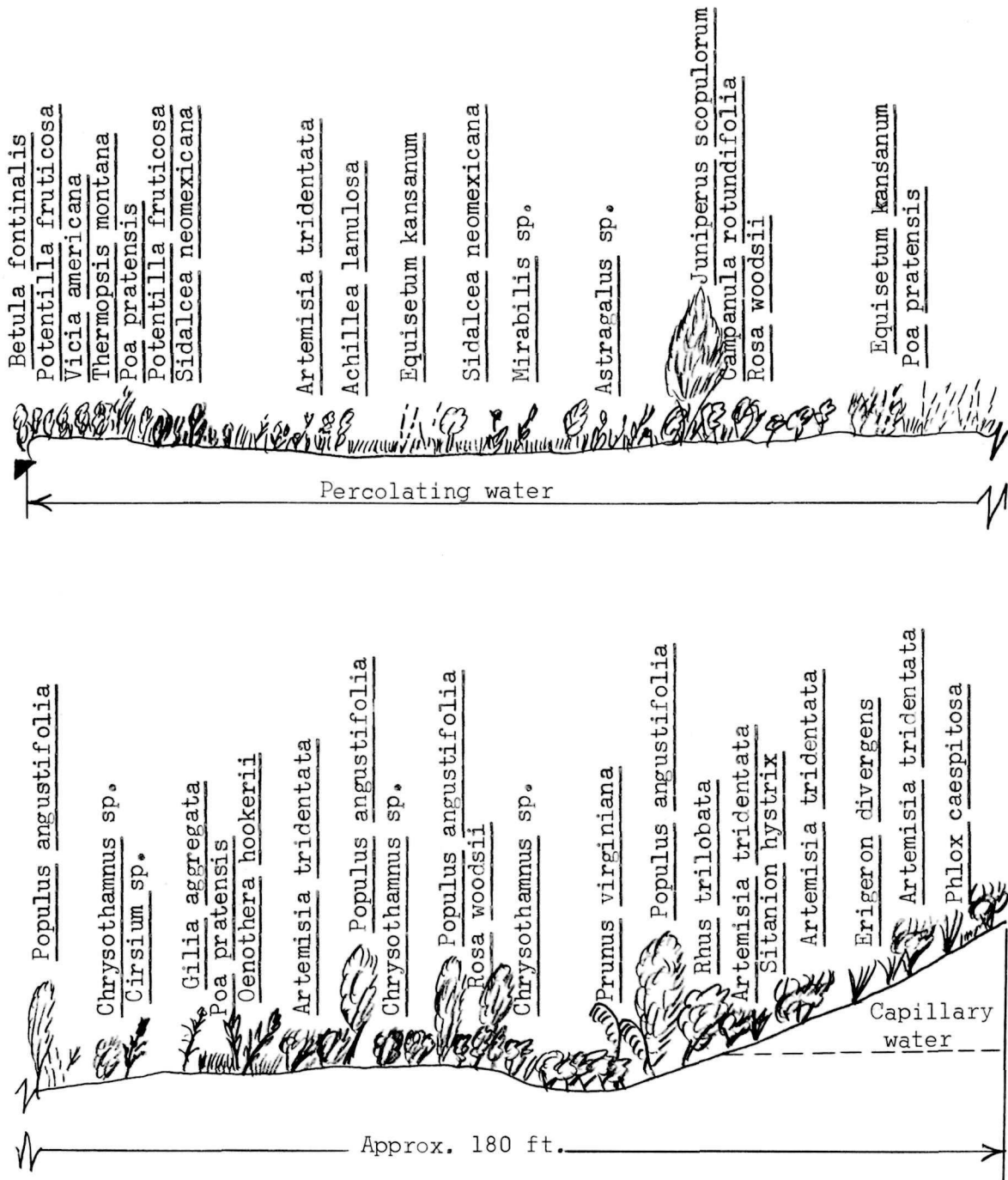


Fig. 9. Transect from Cebolla Creek to hillside about 7600 ft. above junction.

TRANSECT OF STREAMSIDE

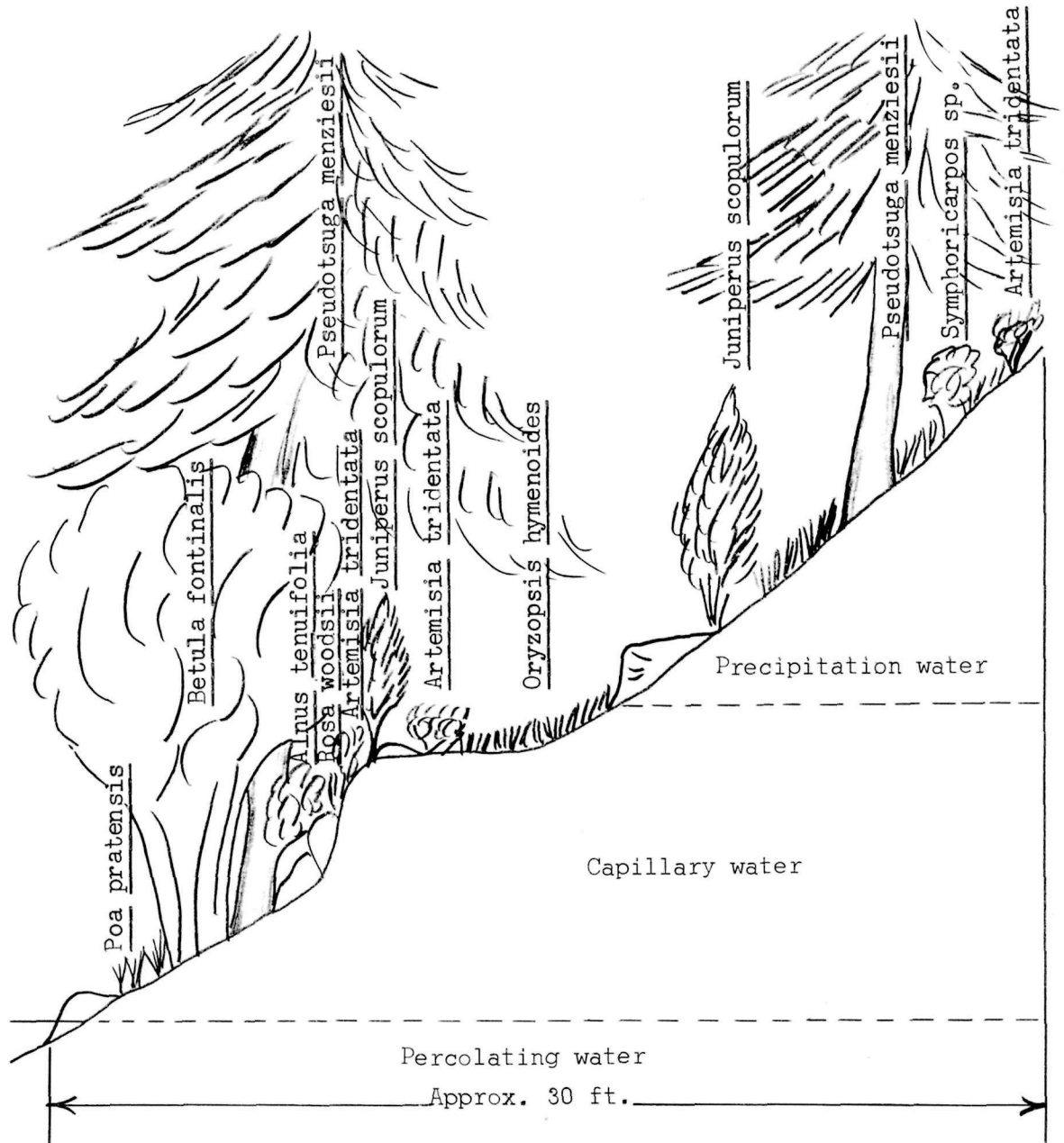


Fig. 10. Transect from Cebolla Creek to hillside about 9920 ft. above junction.

TRANSECT THROUGH SPRUCE GROVE

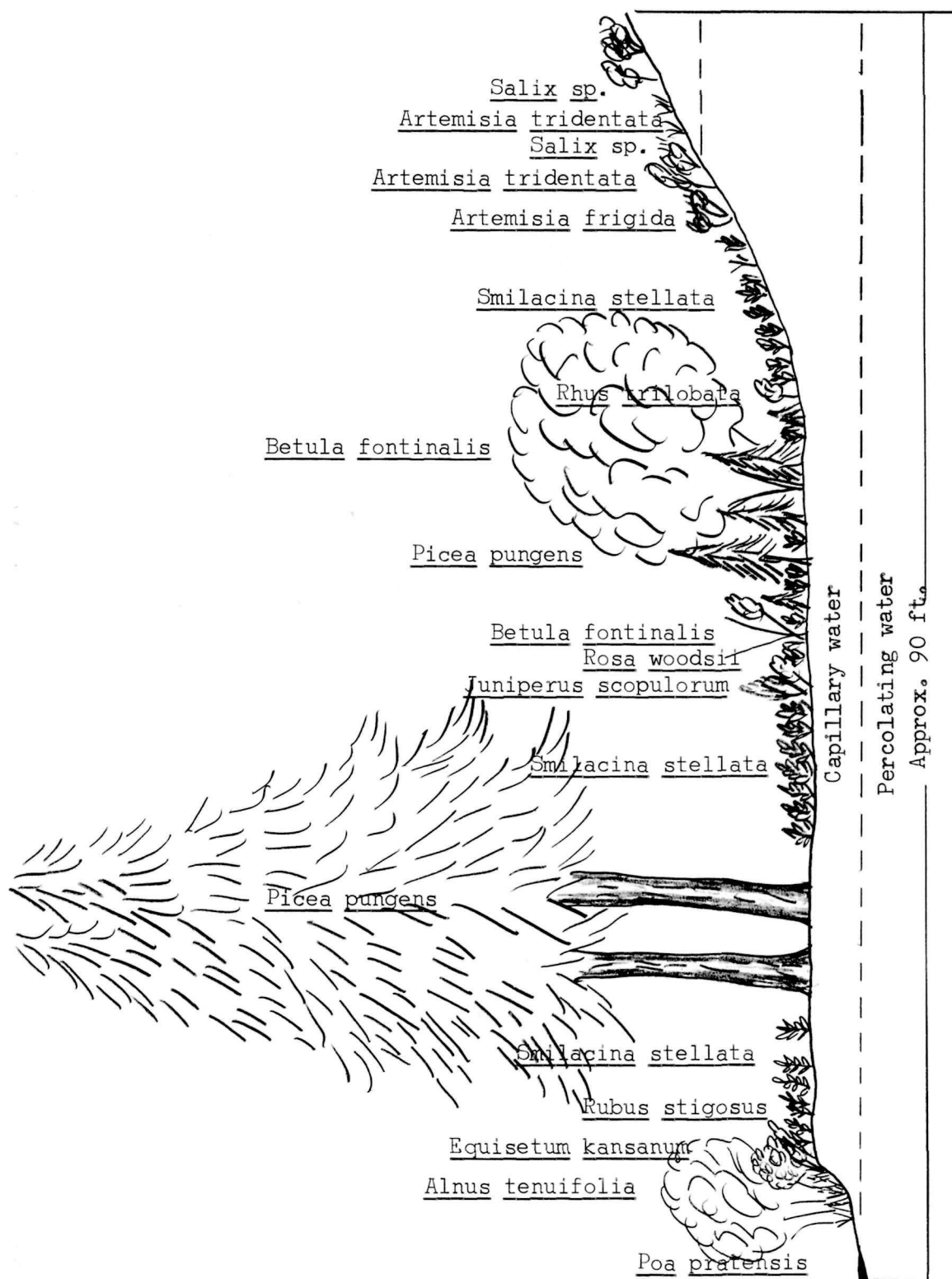


Fig. 11. Transect from Cebolla Creek to hillside about 12,560 ft. above junction.

TRANSECT OF THICK SPRUCE GROVE

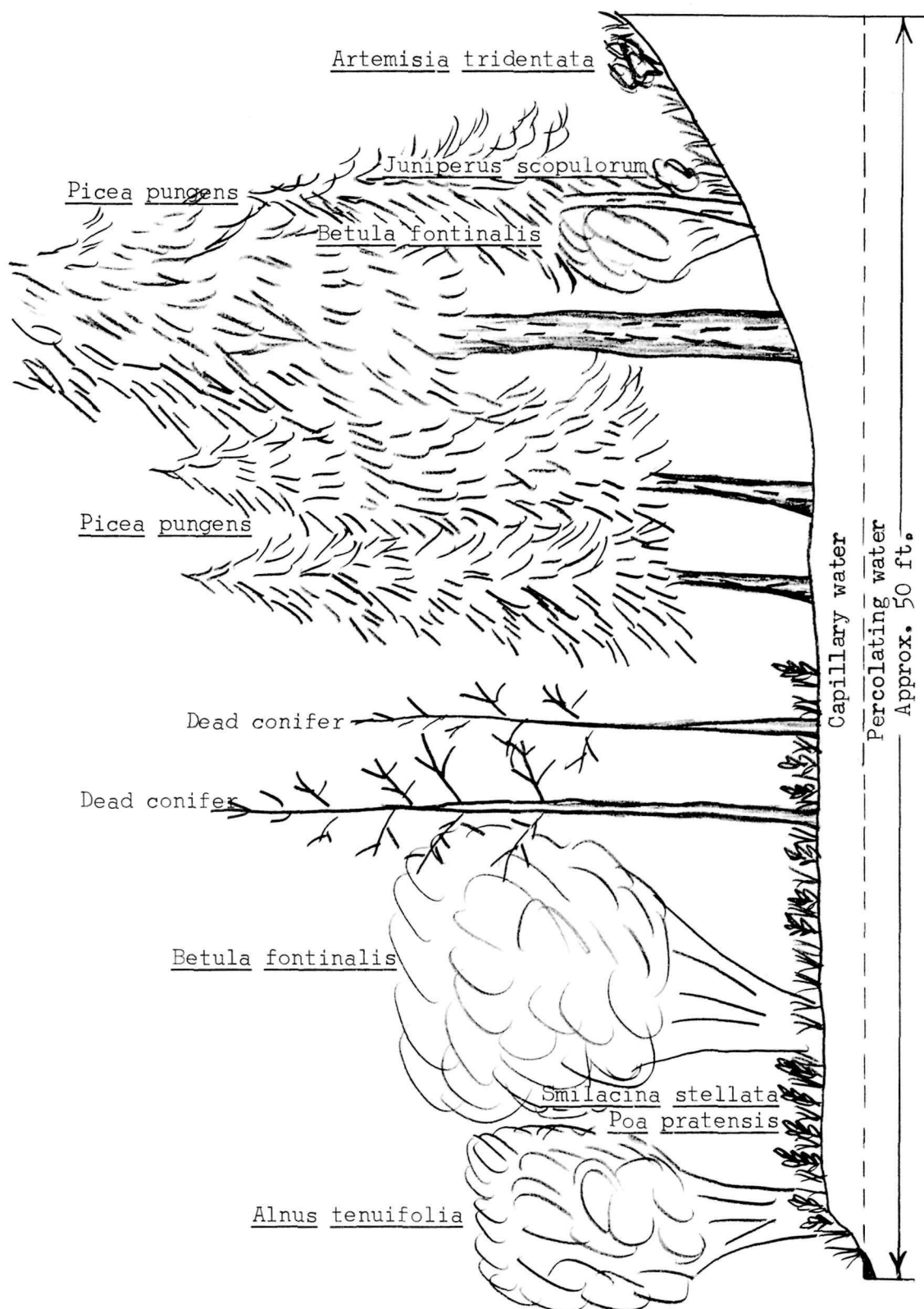


Fig. 12. Transect from Cebolla Creek to hillside about 15,600 ft. above junction.

DISTRIBUTION OF PLANTS

Table 1. Observed distribution of plants found in Dry Gulch and Cebolla canyons.
Percentages show total ground covered by plants in the respective habitats.
1- = trace, less than 1%.

Plants	Cebolla Creek			Dry Gulch		
	Stream- side %	Ter- race %	Hill- side %	Stream- side %	Ter- race %	Hill- side %
Length of canyon	8500 ft.			2300 ft.		
Total acreage	35	5	225	5	4	11
Plant cover, %	100	41	21	100	80	16
TREES						
<i>Picea pungens</i> Blue spruce	1-	1-	1-			
<i>Pinus ponderosa</i> Ponderosa pine			1-			
<i>Populus angustifolia</i> Narrowleaf cottonwood	1-	1-		7	1-	10
<i>Populus tremuloides</i> Quaking aspen			1-			
<i>Pseudotsuga menziesii</i> Douglas fir			1			
SHRUBS						
<i>Alnus tenuifolia</i> Thinleaf alder	29			8		
<i>Amelanchier alnifolia</i> Service berry	1-	1-				
<i>Apocynum cannabinum</i> Dogbane	1-					
<i>Artemisia dracunculus glauca</i> Aromatic sagebr.	1	2		1-	1-	
<i>Artemisia frigida</i> Silver sagebrush		1-	1-	1-	1-	
<i>Artemisia tridentata</i> Big sagebrush	2	8	14	1-	20	13
<i>Betula fontinalis</i> Red river birch	20					
<i>Berberis repens</i> Oregon grape	1-					
<i>Cercocarpus montanus</i> Mt. mahogany			1-			
<i>Chrysothamnus</i> sp. Rabbitbrush	1-	1-	1	2	24	1
<i>Clematis ligusticifolia</i> Western virgin bower	1-			1-		
<i>Cornus stolonifera</i> Redosier dogwood	3					
<i>Crataegus saligna</i> Hawthorn	2			15		
<i>Holodiscus dumosus</i> Ocean spray			1-			
<i>Juniperus scopulorum</i> Mt. red juniper	1-	1-	1-	1-	1-	
<i>Purshia tridentata</i> Bitter brush			1-			
<i>Potentilla fruticosa</i> Shrubby cinquefoil	5	3		2		
<i>Prunus virginiana</i> Chokecherry		1-				
<i>Quercus gambelii</i> Gambel oak			1			1-
<i>Rhus radicans</i> Poison ivy	1-					
<i>Rhus trilobata</i> Squaw bush	2	1	1			1-
<i>Ribes aureum</i> Golden currant	3			2		
<i>Ribes inerme</i> Wine gooseberry	1-					
<i>Rosa woodsii</i> Wildrose	15	7		10		
<i>Rubus strigosus</i> Red raspberry	1-					
<i>Salix</i> sp. Willow	5	5		30		
<i>Symphoricarpos albus</i> Snowberry			1-			
HERBS						
<i>Achillea lanulosa</i> Yarrow	1	1		1		
<i>Agropyron desertorum</i> Desert wheatgrass				1-		
<i>Agropyron smithii</i> Bluestem wheatgrass	1-	1-		3	4	1-
<i>Antennaria parvifolia</i> Pussytoes	1-					
<i>Arctostaphylos uva-ursi</i> Bearberry	1-					
<i>Bromus inermis</i> Smooth brome				4	8	
<i>Bromus tectorum</i> Cheatgrass						1-
<i>Calochortus gunnisonii</i> Sego lily	1-					
<i>Campanula rotundifolia</i> Bellflowers				1-		
<i>Carex nebraskensis</i> Sedge	1-					
<i>Cicuta douglasii</i> Water hemlock	1-					

DISTRIBUTION OF PLANTS

Plants	Cebolla Creek			Dry Gulch		
	Stream-side %	Ter- race %	Hill- side %	Stream-side %	Ter- race %	Hill- side %
HERBS (continued)						
<u>Cirsium</u> sp.	1-	1-		1-	1-	
<u>Cryptantha fendleri</u>						1-
<u>Eleocharis palustris</u>	1-					
<u>Elymus condensatus</u>	1	10	1	3	12	
<u>Equisetum arvense</u>	1-			1		
<u>Equisetum kansanum</u>	1-	1-		1-	1-	
<u>Erigeron speciosus</u>	1-					
<u>Erigeron concinnus</u>	1-					
<u>Eriogonum umbellatum</u>	1-			1-		
<u>Geranium fremontii</u>	1-					
<u>Gilia aggregata</u>	1-	1-	1-	1-	1-	
<u>Glycyria grandis</u>	1-					
<u>Heracleum lanatum</u>	1-					
<u>Hordeum jubatum</u>	1-					
<u>Humulus lupulus</u>	1-					
<u>Iris missouriensis</u>	1-					
<u>Iva axillaris</u>	1-					
<u>Juncus balticus</u>	1-			2		
<u>Lappula florabunda</u>	1-					
<u>Lepidium draba</u>						1-
<u>Linaria vulgaris</u>	1-					
<u>Linum lewisii</u>	1-					
<u>Lupinus greenei</u>	1-	1-	1-	1-	1-	1-
<u>Melilotus officinalis</u>				3	1	1-
<u>Mentha canadensis</u>	1-			1-		
<u>Oenothera hookeri</u>	1-			1-		
<u>Oenothera strigosa</u>	1-					
<u>Opuntia hystrix</u>			1-			1-
<u>Oryzopsis hymenoides</u>			1-			1
<u>Pentstemon comarrhenus</u>	1-				1-	
<u>Phlox caespitosa</u>			1-			1
<u>Poa pratensis</u>	3	1-		3	1-	
<u>Rudbeckia hirta</u>	1-					
<u>Salsola kali</u>	1-					1
<u>Scrophularia occidentalis</u>	1-			1-		
<u>Scutellaria galericulata</u>	1-					
<u>Senecio</u> sp.				1-		
<u>Sidalcea neomexicana</u>	1-			1-		
<u>Sisymbrium altissimum</u>				1		1-
<u>Sitanion hystrix</u>	2	2	1			1-
<u>Smilacina stellata</u>	2	1-		1-	1-	
<u>Solidago canadensis</u>	1-			1-		
<u>Stachys palustris</u>	1-					
<u>Stipa comata</u>			1-			2
<u>Taraxacum officinale</u>				1	1-	
<u>Thermopsis montana</u>	1-					
<u>Trifolium repens</u>				1		
<u>Urtica gracilentia</u>	1-			1		
<u>Vicia americana</u>	1-					
<u>Yucca angustissima</u>			1-			3

TRANSECT OF ELMUS COVERED TERRACE

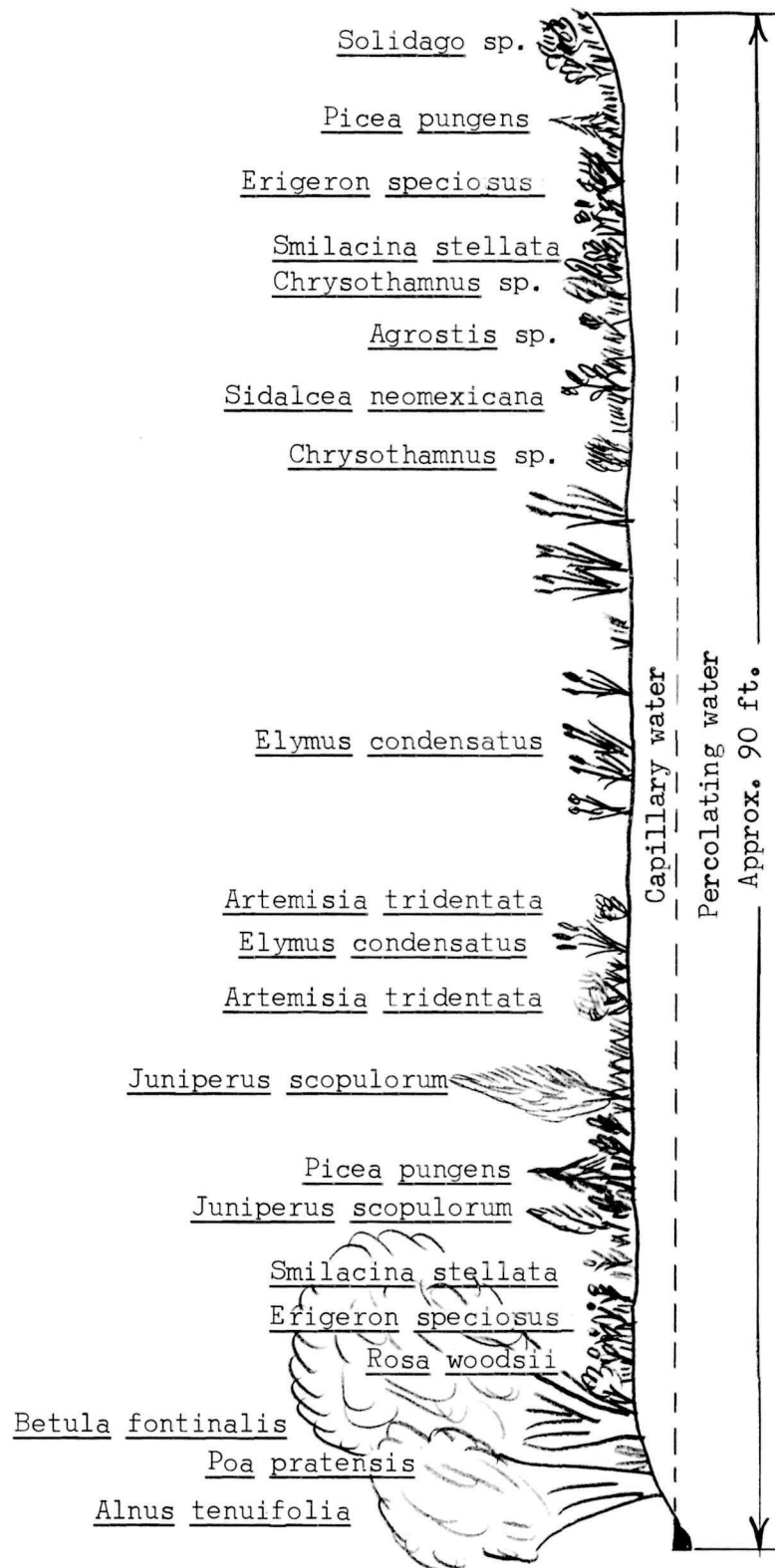


Fig. 13. Transect from Cebolla Creek to hillside about 15,840 ft. above junction.

One reason why Dry Gulch does not have as many plants as Cebolla Creek may be because it receives a greater amount of the sun's energy and therefore loses much more of its precipitation water through evaporation from the soil without passing through the plants than occurs in the latter creek. Where the ground is shaded, however, less water is lost by evaporation and more is available for plant use.

The plants growing on the terraces and streamsides have the advantage of obtaining capillary or percolating water. Some of the small herbs require a percolating habitat. An example of this is Mentha canadensis, it was growing in both canyons but in Dry Gulch it was growing in that part of the streambed where there was a small trickle of water, Fig. 3.

CONCLUSIONS

The two main factors contributing to the difference in the vegetation in Cebolla Creek and Dry Gulch appear to be the amount of sunlight energy and availability of water. The direction and angle of exposure to the sunshine, both are important in determining the proportion of precipitation water that evaporates, runs off, or becomes available for plant use. Because Dry Gulch faces south and receives a greater amount of sunlight per unit area, its warm and dry habitat makes it difficult for plants to obtain adequate moisture for thrifty growth. This accounts for the greater emphasis on desert types of vegetation found there. Because Cebolla Creek is a north-facing canyon, receives less sunlight and has a more moist habitat, it is easier for the plants to obtain adequate moisture for thrifty growth. This helps to account for the emphasis on canyon type vegetation found there.

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THEORETICAL CROSS-SECTION TRANSECT
of the
BLUE MESA RESERVOIR BASIN IN COLORADO

Calvin Ray Lamborn

CONTENTS

Introduction	121
General description	121
Distribution factors	123
Major habitats	123
Introduction to diagrams	124
Descriptions of transects	124
Descriptions of transects	127
Description of theoretical transect and conclusion . . .	134

ILLUSTRATIONS

Figures

1. Portion of Blue Mesa Reservoir Site	122
2. Vegetation on wide streamside	122
3. Streamside vegetation	125
4. Vegetation on steep hillside	126
5. Hillside of Fig. 4	128
6. Vegetation of riverbank and cottonwood grove . . .	128
7. Cross-section showing limited streamside habitat. .	129
8. Cross-section beyond reservoir level south	130
9. Cross-section beyond reservoir level north	131
10. Cross-section shows major habitat	132

Table

1. Area covered by dominant plants	133
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University of Utah
Anthropological Papers, No. 59, 1962
Upper Colorado Series, No. 8

INTRODUCTION

During the summer of 1961, the University of Utah conducted an ecological expedition into the Curecanti Reservoir Basins. The principal objective of the expedition was to survey the vegetation of the three reservoir sites for the U. S. Bureau of Reclamation. It was my pleasure to be a member of the vegetation survey crew. Along with the floral survey, crew members were given secondary duties or personal projects. These projects were to be of interest to each of us and also of ecological importance.

With the advice and direction of Dr. Angus M. Woodbury and assistance from Dr. Seville Flowers, I undertook the project of producing a theoretical cross-section transect of the Blue Mesa Reservoir. The transect was to be based upon extensive study and to show the overall relative position and relationship of the major plants of the area.

I chose to study four sites selected as typical of the area but having different topographic expressions. At each site, a profile sketch was made showing the relative position of the major dominant plants. In addition to these sketches, I gained a mental picture or general feeling of the overall relationship of the major plants in the reservoir basin as the vegetation survey proceeded. On the basis of my sketches and mental picture, I was able to predict, with some degree of accuracy, which plants would be found in each habitat. With this information, it was possible to make a theoretical transect diagram showing the overall relationships of the major dominant plants of the reservoir.

GENERAL DESCRIPTION

The three reservoirs are going to be constructed at narrow points in Black Canyon through which the Gunnison River flows. Blue Mesa Reservoir will be the largest of the three and will be constructed where the river enters the narrows of Black Canyon. At this point, cliffs rise 500 ft. or more directly above the river. Upstream, the valley opens out into meadow land and sagebrush slopes. The upper end of the reservoir will be within a few miles of the town of Gunnison, Colorado. Here the valley closes in again to form a narrow gorge. When the reservoir is filled, several deeply cut side canyons will also be inundated.

Figure 1 shows the general appearance of a portion of the reservoir site. Narrow strips of dense green vegetation border the river and side streams. Streamside vegetation abuts steep hillside and cliffs along much of the river. Sagebrush slopes are extensive and reach upwards beyond the reservoir level to the tops of the mountains. In the gullies and at the base of the cliffs, clumps of oak and other green plants are common.

Igneous rocks predominate in the region together with some horizontal beds of sedimentary rocks that produce a mesa effect with exposed cliffs and



Fig. 1. The general appearance of a portion of the Blue Mesa Reservoir Site. Photo by Calvin Lamborn.



Fig. 2. Streamside vegetation having a growth form of three zones. Photo by Calvin Lamborn.

steep slopes on both sides of the valley. In higher parts of the mountains, clumps of conifers begin to appear and on top, conifer and aspen forests are common.

DISTRIBUTION FACTORS

Environmental conditions such as average precipitation, temperature, soil, soil moisture, light, topography, slope exposure and other factors are important in determining the distribution of plants. Each plant species is adapted to a specific range of environmental factors. The interaction of the factors in varying degrees presents a very complex problem. Any one factor may determine the limits of each plant species if it is strong enough. For example, the Gunnison River area receives a low annual rainfall of about 10 ins. This does not give enough soil moisture for many plant species; so they are limited to areas that have an added source of water. The type of vegetation growing is a very good indication of how much water is available. This information has been used to divide the area into different habitats.

MAJOR HABITATS

The streamside habitat borders the river, sidestreams and springs. Those plants using the greatest amount of water will occupy this habitat. These phreatophyte plants form a dense growth which often covers 100 percent of the ground surface. Their major water supply percolates from the streams.

The terrace habitat is usually an old flood plain adjacent to and at a higher level than the streamside habitat. The common plants growing on the terrace are intermediate users of water and need more than what precipitation will provide. Their roots are beyond the percolating zone but additional water, through capillary action, reaches them.

The hillside habitat has to depend almost entirely upon precipitation for water. In this habitat, there are variations in soil moisture content. Higher elevation receives more precipitation and the water is not equally absorbed into the soil. Water shed from rock and bare surfaces collects at the base of cliffs and in gullies. These areas have a higher soil moisture content than the open hillside and will support a different type of vegetation.

In the vegetation survey farmland was also classed as a separate habitat. Farmland was present on what was once streamside, terrace and hillside habitats. Because the farmland did not represent the natural vegetation of the basin, it will receive little attention in this report.

INTRODUCTION TO DIAGRAMS

The cross-section transects studied had similarities and differences. In the description of each transect, emphasis will be placed upon the habitats that are typical of the reservoir site. Differences and points of interest will also be mentioned. Because the water plant relationship was used to divide the area into habitats, the source of water will be listed at the base of each transect diagram. All diagrams are drawn facing downstream and this portion of the river flows from east to west.

DESCRIPTION OF TRANSECT OPPOSITE SOAP CREEK

The general aspect of the streamside vegetation in this picture shows three zones bordering the river, Fig. 2. The first zone averages 1 ft. high and about 5 ft. wide. It is composed of Eleocharis palustris; meadow horse-tail, Equisetum arvense; American manna grass, Glyceria grandis; and Baltic wiregrass, Juncus balticus. A dense growth of young whiplash willows, Salix caudata; and sandbar willows, Salix exigua; invade the first zone where they compete sharply with the pioneers. On the other side of them, they are crowding older and larger willows of the same species forming a second zone that may be 8 to 12 ft. high. Following closely on the upper part of the stream-bank, thinleaf alder, Alnus tenuifolia, is commonly found mixed with the willows and maybe even a few feet taller. When western riverbirch, Betula occidentalis, is present, it is associated with the alder, Fig. 3.

The taller narrowleaf cottonwood, Populus angustifolia, forms the third zone, which has two stories. The narrowleaf cottonwood is the upper story and the lower story is composed of several herbs and small shrubs. The most common herbs are false Solomon seal, Smilacina stellata; Kentucky bluegrass, Poa pratensis; and Kansas horsetail, Equisetum kansanum. The common shrubs are wild rose, Rosa woodsii and redosier dogwood, Cornus stolonifera.

In this transect, several young mountain red junipers, Juniperus scopulorum, were associated with the narrowleaf cottonwoods. There were only a few young junipers in the basin and those observed were among the streamside and terrace vegetation. This would indicate that perhaps the hillsides are too dry for the young juniper to get started.

This streamside area was unusually wide. Two old stream channels with an abundant willow growth along them indicate that the river has changed its course.

The terrace habitat was more distinct than the typical. Vanishleaf rabbitbrush, Chrysothamnus viscidiflorus, and rye grass, Elymus condensatus were the dominant plants.

TRANSECT OPPOSITE SOAP CREEK

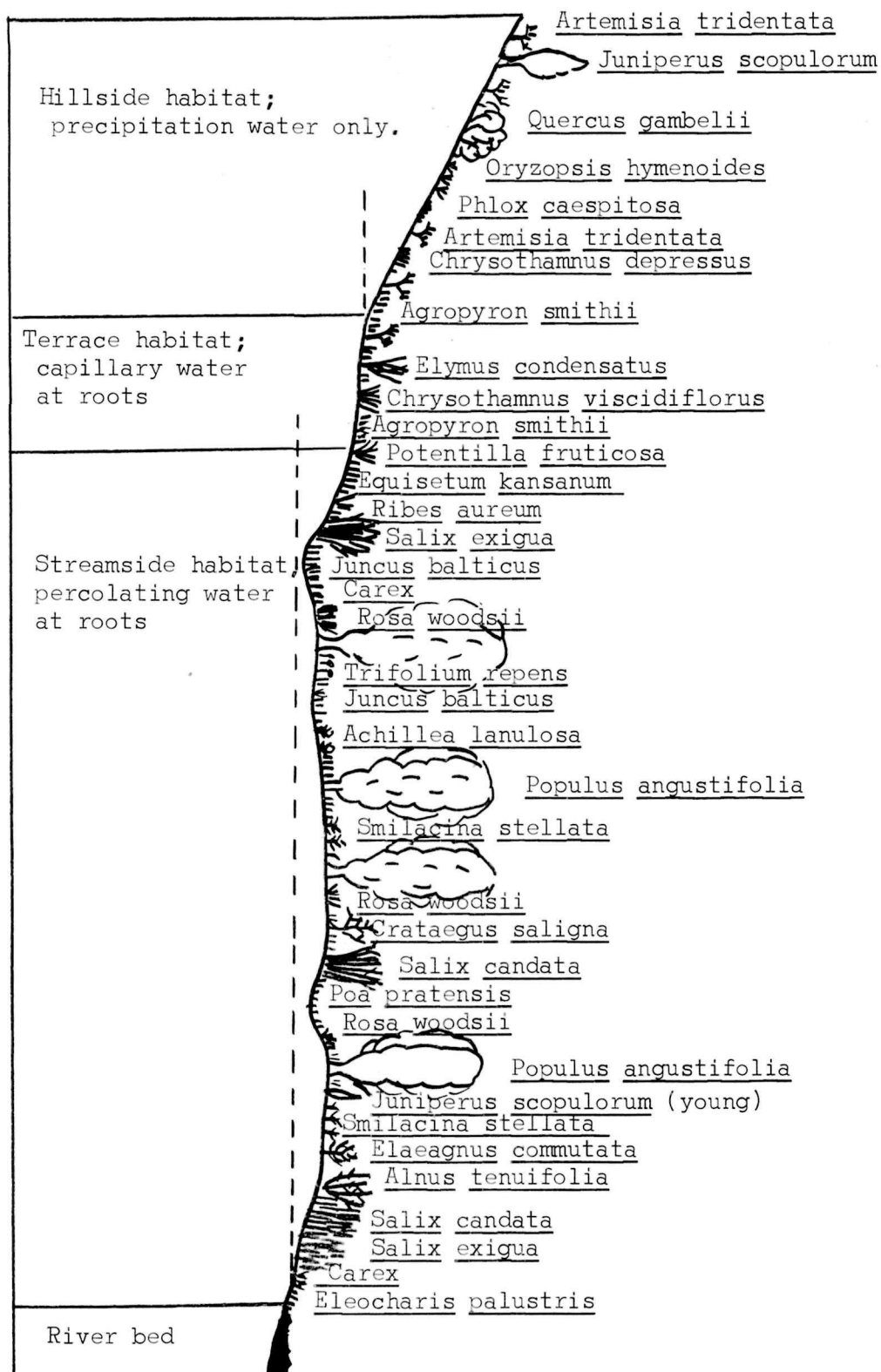


Fig. 3. Cross-section showing vegetation on a wide streamside, former flood plain between river and hillside.

TRANSECT SOUTH OF SAPINERO

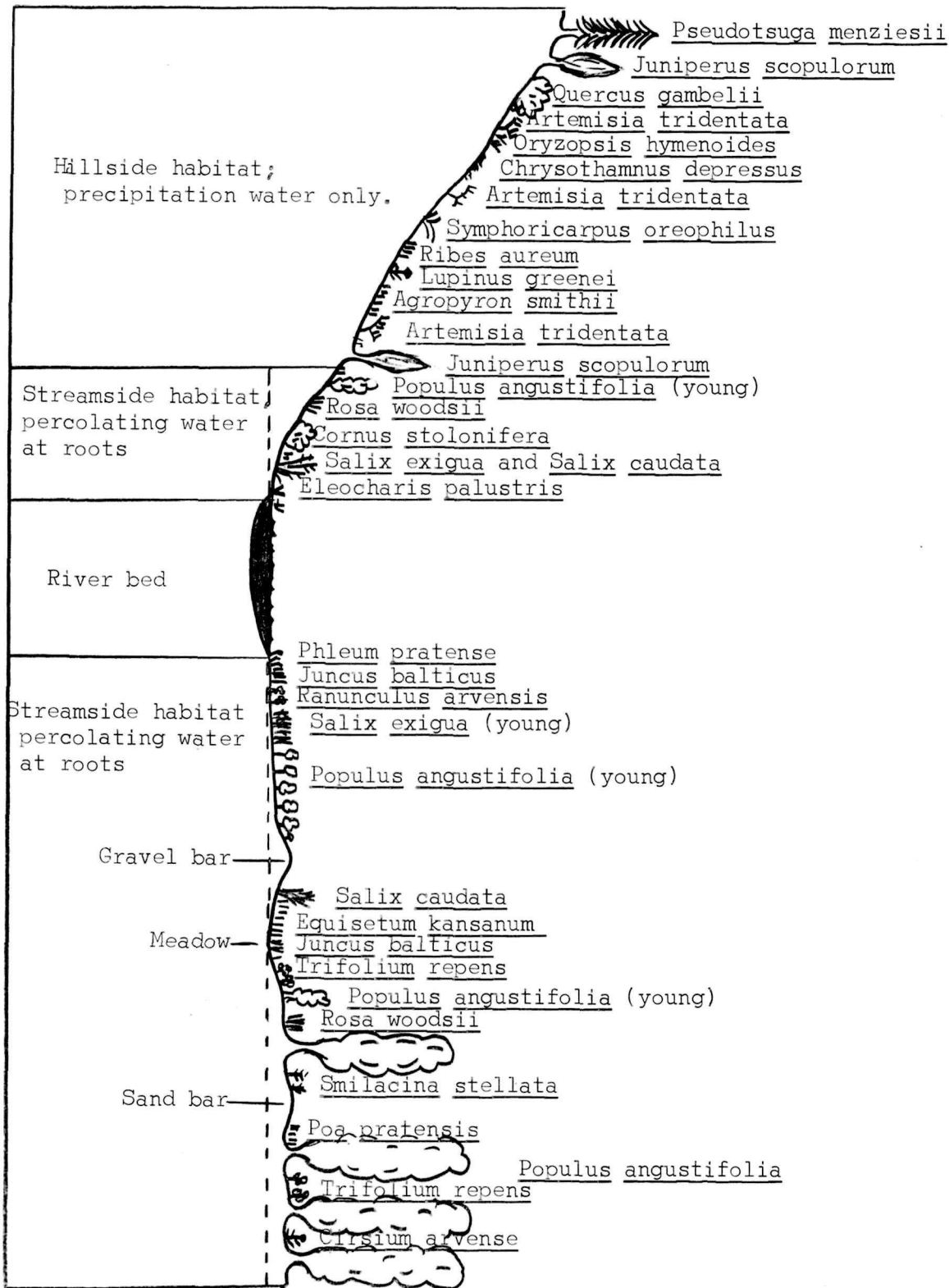


Fig. 4. Cross-section showing vegetation on a steep hillside, a new riverbank, an old river channel and an old flood plain.

The hillside, as usual, was dominated by big sagebrush. Some of the other plants of significance were depressed rabbitbrush, Chrysothamnus depressus, Indian ricegrass, Oryzopsis hymenoides, squirreltail grass, Sitanion hystrix, Caespitose phlox, Phlox caespitosa, Gambel oak, Quercus gambelii and mountain red juniper, Juniperus scopulorum.

DESCRIPTION OF TRANSECT SOUTH OF SAPINERO

The hillside in Fig. 4 is also shown in Fig. 5. Here the steep slope continues right down to the river's edge leaving a poor habitat for streamside vegetation and no terrace. The hillside is dominated by sagebrush and has a higher percent of oak, juniper and Douglas fir than average.

The photo in Fig. 6 shows the streamside habitat on the right side of the river of Fig. 4, opposite Fig. 5. Evidence indicates that the broad rocky riverbank was once an island. The old river channel has been blocked by stream action with sand and gravel. Water seeping into the old channel supports a meadow type vegetation. Several plants are becoming established on this new riverbank. Of special interest is the dense stand of young cottonwoods that occupies an area about 50 ft. wide and 400 ft. long.

On the old riverbank, the cottonwoods were so dense that only a sparse understory was present. Beyond the cottonwood grove, farmland extended nearly to the reservoir level.

The topography in Fig. 4 was not typical of the basin but most plants appeared in the expected order.

DESCRIPTION OF TRANSECT ABOVE JUNCTION OF GUNNISON RIVER AND DRY GULCH

At this point, on the south side of the river, there is a limited streamside habitat, no terrace and a typical hillside. Beyond the transect, hillside vegetation abuts a large abandoned farm. Secondary succession on this land is well underway. Tumbling mustard is the major plant. Big sagebrush, depressed rabbitbrush, Indian ricegrass and squirreltail grass are moving into the area. The only remaining farm type plant is smooth brome grass which represents about one per cent of the plant cover, Fig. 7.

The typical streamside vegetation north of the river is densely compacted between the river and an old railroad bed, which has been abandoned for about 20 years. Terrace type plants have moved into this area with squawbush being the most common.

Above the cliff, there is an area where terrace and hillside types are mixed. Bluestem wheatgrass forms a border on both sides of a small meadow and is present in the narrow terrace. Hillside vegetation extends to the reservoir level.



Fig. 5. Hillside of Fig. 4. Photo by Calvin Lamborn.



Fig. 6. Vegetation of new riverbank and dense narrowleaf cottonwood grove of Fig. 4. Photo by Calvin Lamborn.

TRANSECT ABOVE JUNCTION OF GUNNISON RIVER AND DRY GULCH

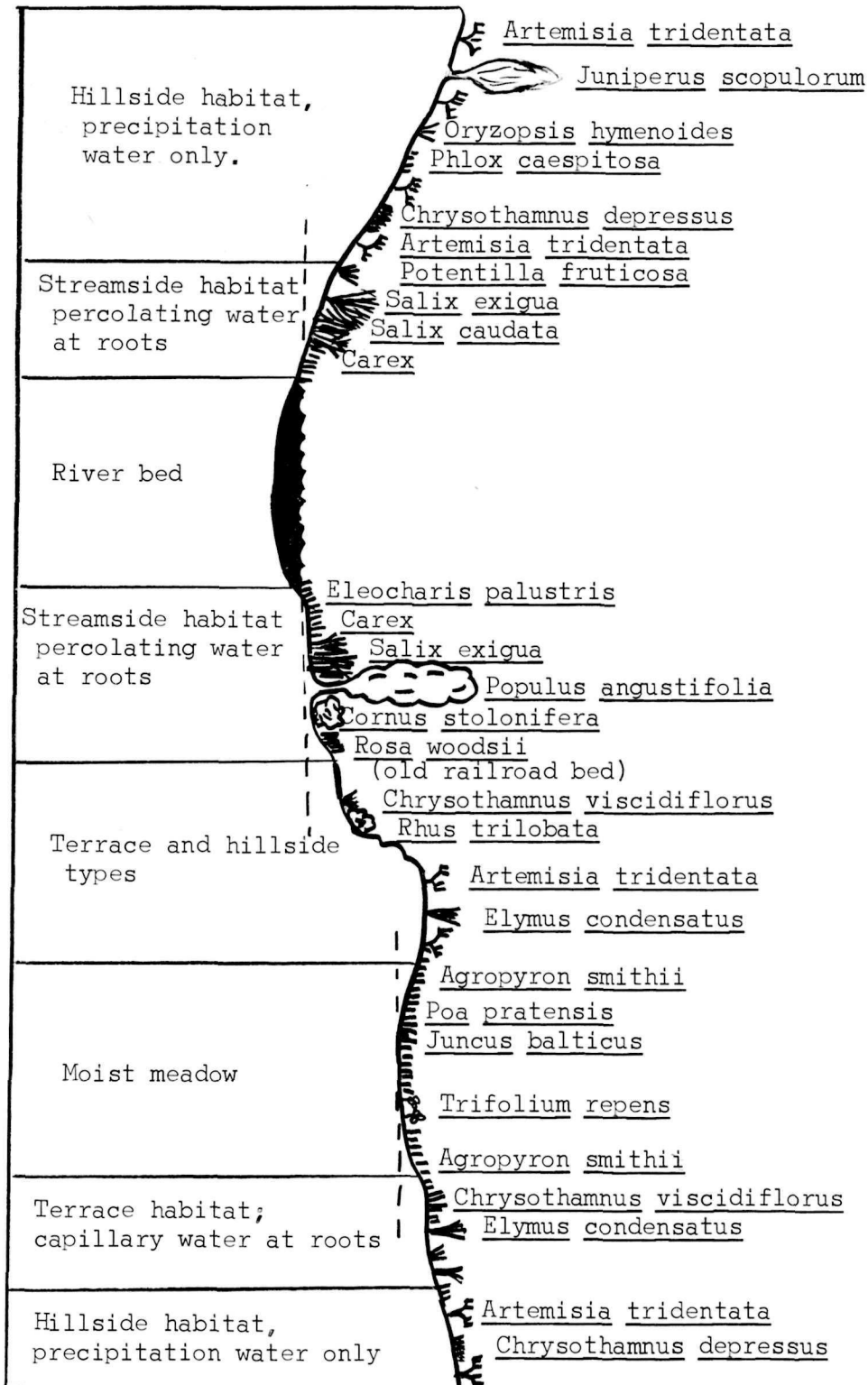


Fig. 7. Cross-section shows a limited streamside habitat, an old rail-road bed and a meadow above the level of the river.

TRANSECT FROM JUNCTION OF GUNNISON RIVER TO CARPENTER RIDGE

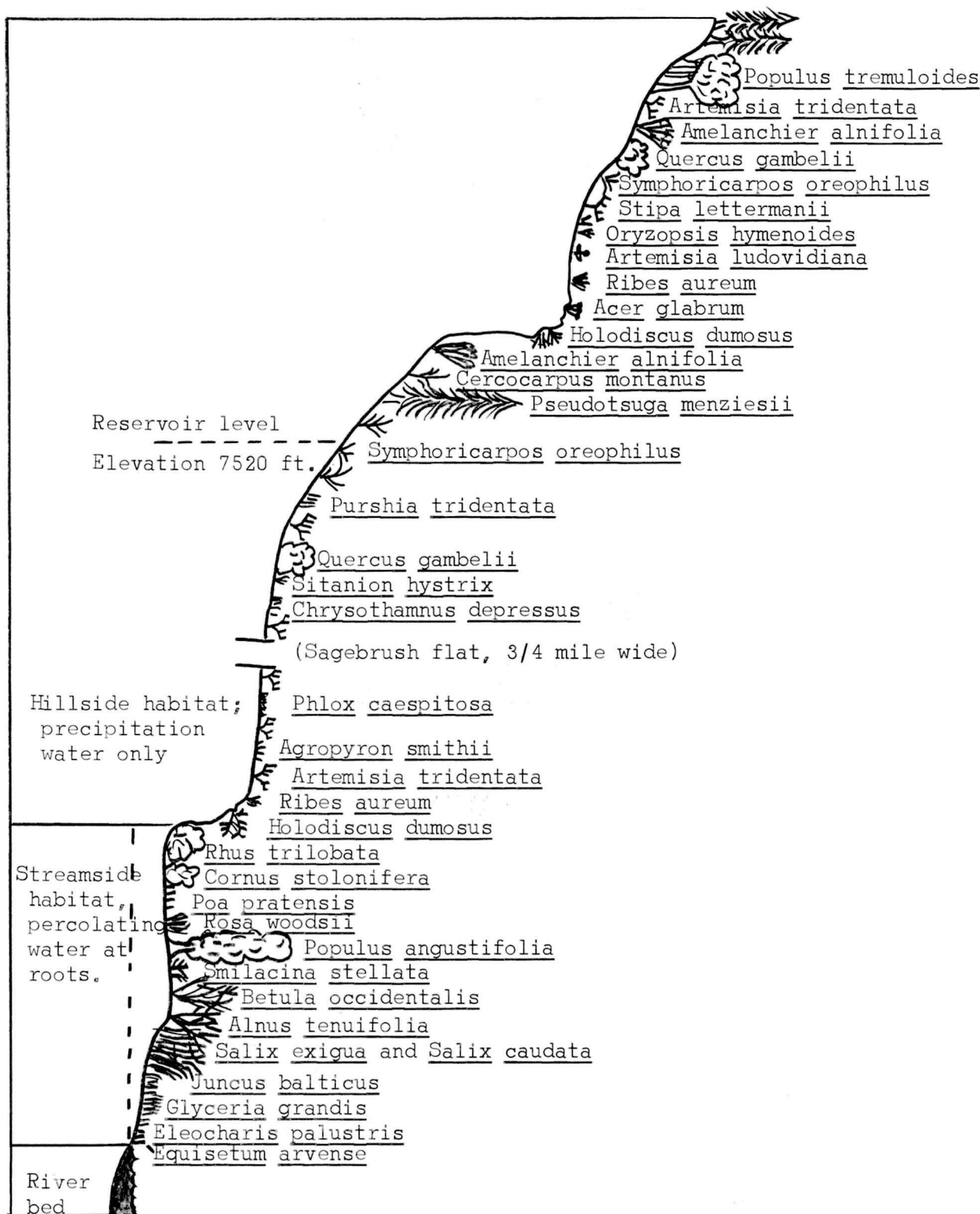


Fig. 8. Cross-section extends beyond reservoir level south of river.

TRANSECT FROM JUNCTION OF GUNNISON RIVER TO TENDERFOOT HILL

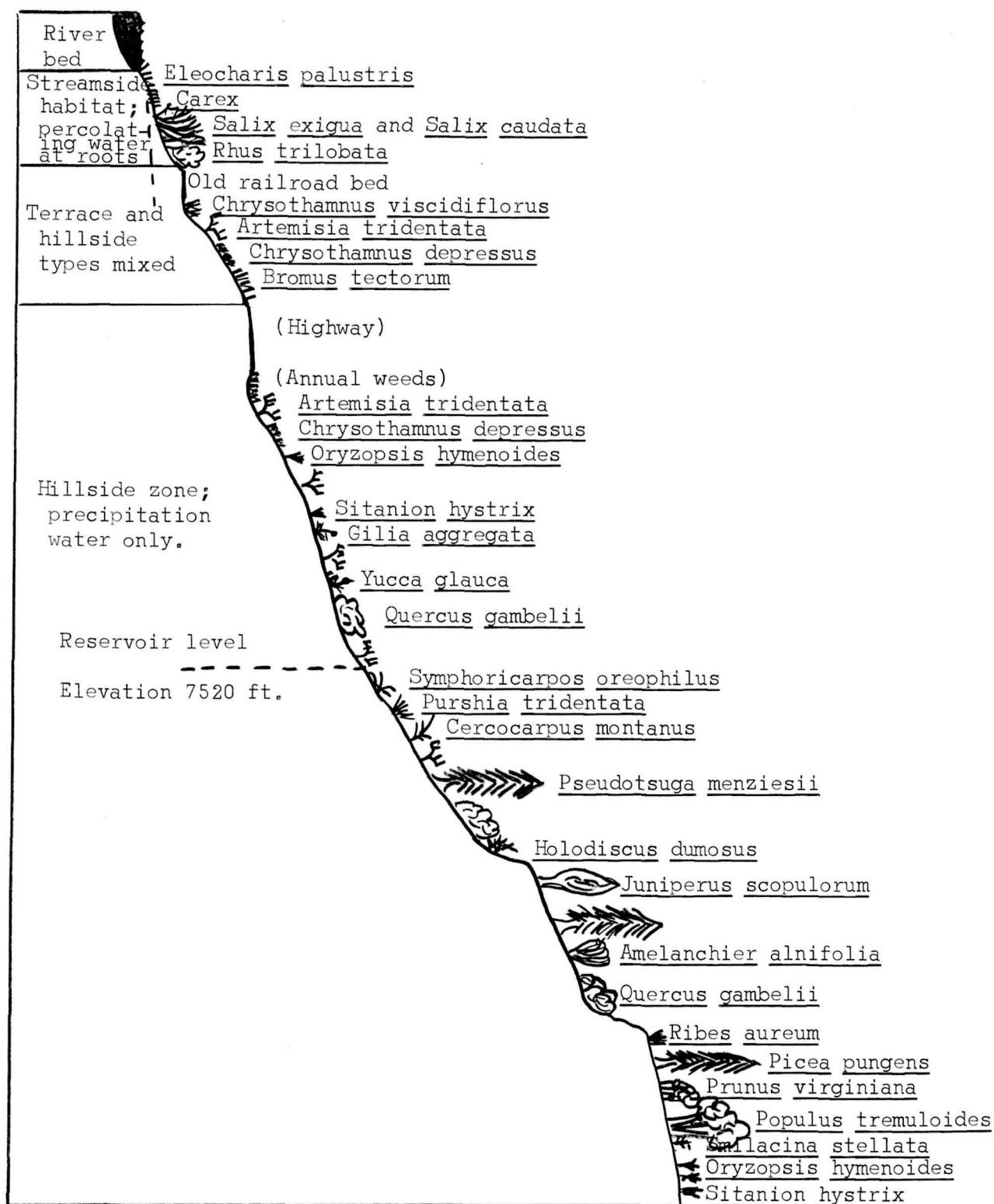


Fig. 9. Cross-section extends beyond reservoir level north of river.

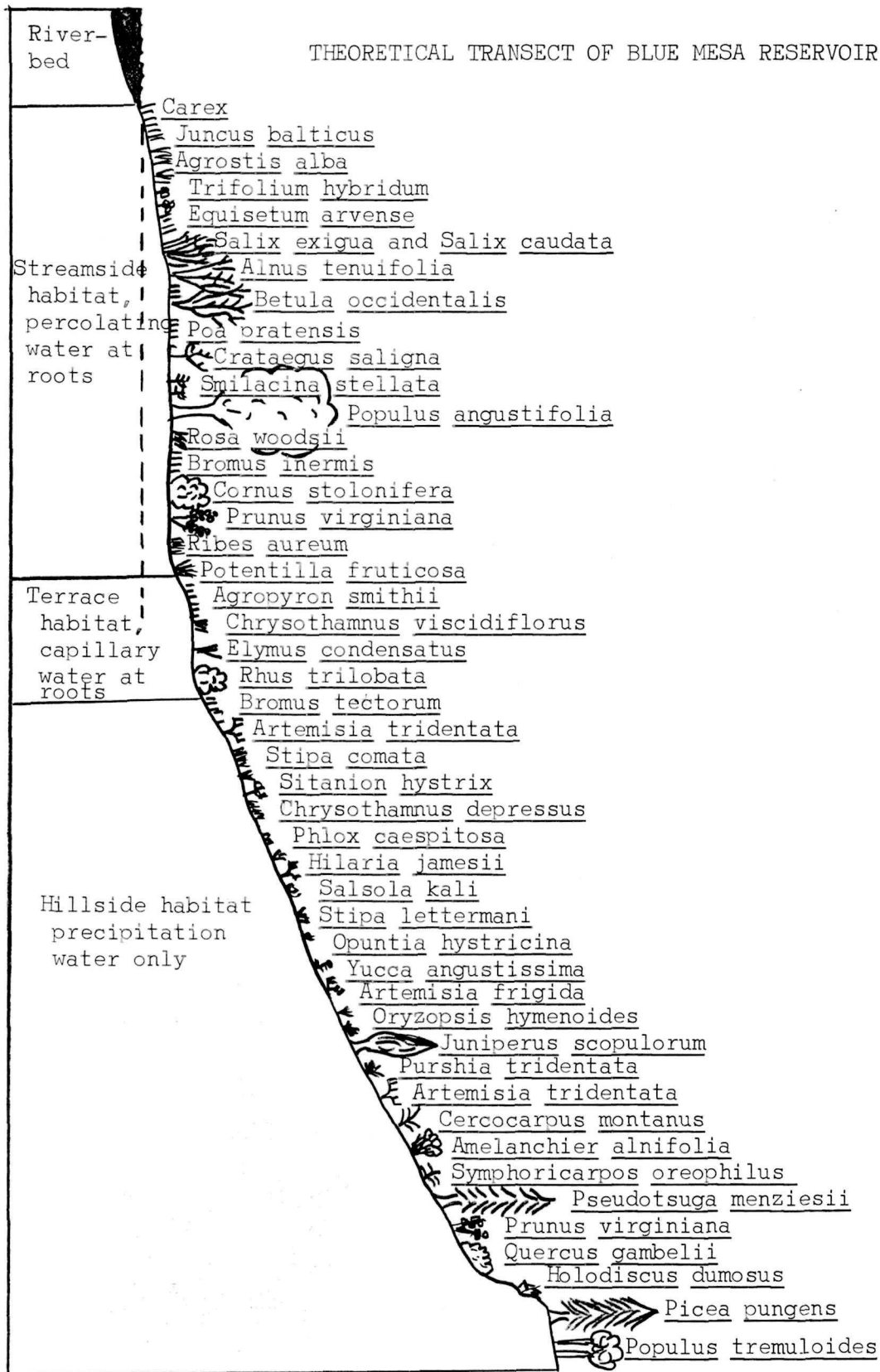


Fig. 10. Cross-section shows a theoretical interpretation of the major habitats each plant was found in and a general idea of their order of appearance.

Table 1. Area covered by dominant plants in Blue Mesa Reservoir.

Scientific name	Common name	Area covered				Total
		Stream side	Ter- race	Hill side	Farm- land	
<u>Equisetum arvense</u>	Meadow horsetail	5	--	--	6	11
<u>Juniperus scopulorum</u>	Mt. red juniper	6	--	29	--	35
<u>Picea pungens</u>	Blue spruce	18	--	10	5	33
<u>Pseudotsuga menziesii</u>	Douglas fir	1	1	27	--	29
<u>Agropyron smithii</u>	Western bluestem wheatgrass	6	8	18	22	54
<u>Agrostis alba</u> *	Redtop	8	--	--	48	56
<u>Bromus inermis</u>	Smooth brome	13	4	2	389	408
<u>Bromus tectorum</u>	Cheat grass	3	2	9	5	19
<u>Elymus condensatus</u>	Giant ryegrass	19	15	8	8	50
<u>Hilaria jamesii</u>	Galleta grass	--	--	20	--	20
<u>Oryzopsis hymenoides</u>	Indian ricegrass	1	--	73	--	74
<u>Poa pratensis</u>	Kentucky bluegrass	32	1	--	130	163
<u>Sitanion hystrix</u>	Squirreltail	1	1	38	2	42
<u>Stipa lettermani</u>	Letterman needle grass	--	1	55	--	56
<u>Stipa comata</u>	Needle and thread grass	--	--	11	14	25
<u>Carex nebraskensis</u> *	Sedge	32	1	--	258	291
<u>Juncus balticus montanus</u> *	Wiregrass	29	5	--	180	214
<u>Smilacina stellata</u>	False Solomon seal	4	1	1	--	6
<u>Yucca angustissima</u>	Narrowleaf yucca	--	--	4	--	4
<u>Populus angustifolia</u>	Narrowleaf cottonwood	206	13	5	15	239
<u>Populus tremuloides</u>	Quaking aspen	1	--	9	--	10
<u>Salix caudata</u>	Whiplash willow	69	1	1	10	81
<u>Salix exigua</u>	Sandbar willow	133	--	2	2	137
<u>Alnus tenuifolia</u>	Thinleaf alder	70	--	2	--	72
<u>Betula occidentalis</u>	Western riverbirch	10	--	--	--	10
<u>Quercus gambelii</u>	Gambel oak	2	--	99	3	104
<u>Salsola kali</u>	Russian thistle	--	--	9	4	13
<u>Amelanchier alnifolia</u>	Service berry	3	--	18	--	21
<u>Cercocarpus montanus</u>	Mt. mahogany	--	--	30	--	30
<u>Crataegus saligna</u>	Hawthorn	27	--	--	1	28
<u>Holodiscus dumosus</u>	Ocean spray	2	1	27	--	30
<u>Potentilla fruticosa</u> *	Shrubby cinquefoil	5	1	3	7	16
<u>Prunus virginiana</u>	Chokecherry	12	--	5	--	17
<u>Purshia tridentata</u>	Bitterbrush	--	--	34	--	34
<u>Ribes aureum</u>	Golden currant	5	--	4	--	9
<u>Rosa woodsii</u>	Wild rose	43	2	6	6	57
<u>Trifolium hybridum</u>	Alsike clover	13	--	--	147	160
<u>Rhus trilobata</u>	Squaw bush	15	--	15	--	30
<u>Opuntia hystricina</u>	Yellow prickly pear	--	--	3	--	3
<u>Cornus stolonifera</u>	Red osier dogwood	23	--	1	--	24
<u>Phlox caespitosa</u>	Caespitose phlox	--	--	38	--	38
<u>Symphoricarpos oreophilus</u>	Snowberry	--	--	8	--	8
<u>Artemisia frigida</u>	Silver sagebrush	--	1	6	1	8
<u>Artemisia tridentata</u>	Big sagebrush	3	20	808	3	834
<u>Chrysothamnus depressus</u>	Dwarf rabbitbrush	--	--	62	1	63
<u>Chrysothamnus viscid.tort.</u>	Varnishleaf "	13	31	36	21	101
Others	Others	58	8	63	623	752
TOTAL COVER AREA		891	118	1599	1911	4519

* and related species

DESCRIPTION OF TRANSECT ACROSS THE GUNNISON RIVER NEAR THE MOUTH OF CEBOLLA
CREEK FROM CARPENTER RIDGE TO TENDERFOOT HILL

Figures 8 and 9 show a complete cross-section of the Gunnison River Basin at this location. This site shows typical streamside and hillside vegetation with an abrupt rise in elevation from 7300 ft. to about 8800 ft. within a mile and a half from the river.

In Fig. 8, the streamside habitat abuts a cliff leaving little room for terrace. Above this, an extensive sagebrush slope reaches up to the reservoir level. Further up the mountain, patches of Douglas fir become common. Mountain mahogany is the major plant on the slope below the cliffs, a zone usually occupied by Gambel oak in most areas in the valley. On the flat mountain, top grassy flats covered most of the area with dense stands of aspen and Douglas fir standing out in strong contrast, especially at the higher levels.

In Fig. 9, the streamside had a limited area. The highway and old railroad bed have modified the plant life near them. The rest of the hillside is largely similar to the other side of the valley. On this side, Gambel oak is the major plant growing at the base of the cliffs.

DESCRIPTION OF THEORETICAL TRANSECT OF BLUE MESA RESERVOIR AND CONCLUSION

Figure 10 is my interpretation of a theoretical transect of the Blue Mesa Reservoir. Information gained during the vegetation survey of the reservoir basin was used to select typical habitats and the typical order of plants in each transect.

The relative sizes of habitats in the diagram have been changed. Streamside area had to be expanded to include the common plants and the hillside was contracted to fit on one page.

The total acreage and density (per cent of plant cover), differed greatly among the different habitats. These figures are listed below.

<u>Habitat</u>	<u>Total Acreage</u>	<u>Average Density</u>
Streamside	900	99%
Terrace	187	63%
Hillside	6151	26%
Farmland	2055	93%

Only the 46 most dominant plants of streamside, terrace and hillside habitats have been illustrated. Table 1 also lists these major plants, giving their scientific name, common name, amount of cover in each habitat and total cover. The plant species listed in Fig. 10 and Table 1 represent 94% of the total vegetation cover of streamside, terrace and hillside habitats.

LIMITED LIMNOLOGICAL STUDIES
OF THE GUNNISON RIVER, COLORADO

Allen W. Knight

Delbert W. Argyle

CONTENTS

General description	136
Summary	138
Methods and procedures	138
Results	140
Discussion	145
Literature cited	149

ILLUSTRATIONS

Fig. 1. Hydrogen-ion	142
Fig. 2. Collecting in Soap Creek	144
Fig. 3. Collecting invertebrates	144
Fig. 4. Alkalinity present	148
Table 1. Chemical and physical analysis	146

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GENERAL DESCRIPTION

The area covered by the present study comprises a great portion of the South Fork of the Gunnison River system, one of the largest tributaries of the Colorado River. The South Fork of the Gunnison River basin is bounded by the West Elk Mountains on the north, Elk Mountains on the northeast, the Sawatch Mountains on the east, the Cochetopa Hills on the east and the Uncompahgre Mountains on the west. The headwaters of the entire basin arise within the Gunnison National Forest.

The area is filled with considerable recreation and camping facilities as well as fishing resorts. The portion of the Gunnison River delimited by the study area has enjoyed the reputation of being one of the finest and most productive trout waters in Western United States. The river basin is predominantly ranch land with inhabitants located along the river where physical conditions have favored such establishment. The drainage area under consideration covers a total area of approximately 1500 sq. mi. lying, for the most part, in Gunnison County, Colorado. The South Fork of the Gunnison River has its origin above the town of Gunnison, Colorado, at the confluence of the Taylor and East Rivers.

The geological strata of an area have a profound effect upon the chemical and physical constituents of the water flowing over the strata. For this reason, the following general discussion of the geology of the Curecanti region is presented.

The material contained in this discussion represents a compilation of the known geology of the Curecanti region. The information was gathered mainly from the more general geological works which have been published for the entire San Juan region, of which the Curecanti is but a small portion. The work from which the authors have drawn are: Hunter, 1925; Atwood and Mather, 1932; Cross and Larsen, 1935; Larsen and Cross, 1956 and Clark and Stearn, 1960.

The earliest rock of record in the study area is a Pre-Cambrian metamorphic complex of biotite mica and amphibole schists and gneisses of Archean Age. This rock forms the majority of the Black Canyon (future site of Crystal and Morrow Point dams). The Gunnison River is bedded in this rock in most of the area studied. Extensive areas have been exposed in the canyons of Lake Fork and Cebolla Creek. Lesser exposures are found in Blue Creek and Curecanti Creek. Large flat areas are exposed because of erosion at the mouth of Cebolla Creek and in the Kezar basin, 4 mi. east southeast of the mouth of Cebolla. Broad areas are also exposed in the region of Elkhorn (Steuben Creek), on both sides of the river. Dikes and small bodies of Pre-Cambrian intrusive pegmatite and coarse granite are found in the main canyon and some of the tributary canyons. The Black Canyon schists and gneisses are heavily intruded in the region of Curecanti and Blue creeks by the Curecanti granite, a very fine grained biotite granite which is exposed for 3 mi. as the bed of the river. One and 2 mi. of these formations are respectively exposed in the two tributary canyons.

The area was heavily eroded during the Cambrian period following uplifts which occurred during Pre-Cambrian intrusive activity. A peneplain of nearly continental extent was developed. This flat peneplain persisted and the area was an erosional surface of a low relief through most of the Paleozoic. Marine limestone and dolomite of the Arbuckle formation were deposited during the upper Cambrian and lower Ordovician periods.

During the upper Ordovician and Silurian periods this area consisted of a surface of low relief from which the earlier limestones were eroded away. Ingressions of the Epeiric seas may have deposited some marine formations which were later eroded away. Various formations were deposited and eroded during the balance of the Paleozoic.

Triassic and Lower Jurassic rocks are located near but are not present in the area. Long periods of erosion took place during the Paleozoic and early Mesozoic, removing all beds which had been deposited over the Pre-Cambrian base.

During the upper Jurassic, the Entrada sandstone and the Morrison formation were deposited directly on the very smooth and flat surface of Pre-Cambrian rocks. The Entrada sandstone, probably non-marine, is a massive crossbedded quartzose sandstone of a pink to white color. The Gunnison Valley is the north edge of the formation and where it is found, it is extremely thin.

The Morrison formation in this area ranges in thickness from about 300 ft. to 400 ft. It is composed mainly of alternating beds of sandstone and green shale. These are non-marine sediments.

A few Upper Cretaceous beds appear to be uniformly deposited upon the Morrison. They are exposed in a few narrow areas along the east side of the river at Curecanti, and on the high slopes at the mouths of Soap Creek and West Elk.

The San Juan tuff of early Miocene is deposited upon the Upper Cretaceous beds. This is a very thick formation, commonly over 1,000 ft. thick. It is a very widespread Andesitic tuff-breccia, the vast bulk of which was transported only a short distance from its volcanic source. It was derived from explosive vents which probably were southwest of the study area. The tuff is well bedded by water deposition.

During the middle Miocene time a formation was laid down in the area by the Potosi Volcanic Epoch, the Aliberto quartz latite. This formation in the Gunnison area consists of thin flows of tridymite rhyolite (lavas) alternating with layers of tuff.

Volcanic activity in the Pliocene produced widespread lava beds over the area. At the beginning of the Pleistocene there was a general uplift of the San Juan peneplain with the development of a syncline in which the Gunnison River runs today. Extensive erosion followed the uplift with cycles of glaciation. In a few places in the area there are deposits, river terrace gravels, glacial

till, landslides and alluvium of the Quaternary. With this exception the erosion since the uplift has left the Alborto as the youngest bedded formation exposed in the Curecanti region.

SUMMARY

The Gunnison River and its tributaries in this area have cut through to the Archean base. Formations deposited throughout the Paleozoic and Triassic have been eroded away so that the Jurassic Morrison formation and Entrada sandstone rest directly upon the Archean with an immense temporal unconformity. Various Upper Cretaceous formations are present but intermittently exposed. A very thick series of volcanics was deposited in the Tertiary. The area was uplifted at the beginning of the Pleistocene and was eroded, glaciated and faulted. A few Quaternary deposits are present.

METHODS AND PROCEDURES

TEMPERATURE

Temperature of the air was taken, at each station, standing in the stream, back to the sun, while holding an ordinary mercury thermometer at forearm's length at the level of the waist with the bulb in the shade of the body. Water temperature was taken by inserting the bulb of the thermometer below the water surface. The water temperature reading was taken while the thermometer was in the above position. The thermometer used in the present study was calibrated in the Fahrenheit scale.

HYDROGEN-ION CONCENTRATION (pH)

The hydrogen-ion concentration was determined using a Hellige glass pocket comparator. The appropriate indicator solutions and corresponding comparator disks were used according to the manufacture instructions.

ALKALINITY

Phenolphthalein alkalinity was determined by titrating with 0.02 N H_2SO_4 , using phenolphthalein as an indicator (Ellis, Westfall and Ellis, 1948). Methyl orange alkalinity was determined by titrating with 0.02N H_2SO_4 , using methyl orange as an indicator (Ellis, et al., ibid.). Total alkalinity was obtained by adding the results obtained for the phenolphthalein and methyl orange alkalinities, when both had values to contribute to the sum. Total alkalinity is expressed as milligrams of $CaCO_3$ per liter. Samples taken for the determination of total alkalinity were obtained with a standard B.O.D. bottle at a depth of 12 in. wherever possible.

DISSOLVED OXYGEN

The dissolved oxygen content of the water was determined using the unmodified Winkler method (Ellis, et al., ibid.). Water samples obtained for dissolved oxygen determination were obtained at a depth of 12 in. wherever possible, using a standard B.O.D. bottle. Results were reported as amount of dissolved oxygen in ppm.

FREE CARBON DIOXIDE (CO₂)

The amount of carbon dioxide which was free in the water was approximated by titrating with N/44 sodium hydroxide, using phenolphthalein as an indicator, until a weak pink color remained for at least 30 seconds. The results were reported as carbon dioxide content in ppm.

SURFACE VELOCITY

Surface velocity of the streams was obtained wherever possible by timing a float over a measured 100 ft. of a straight section of the stream. The average of three trials was reported as velocity in feet per second.

LOCATION OF SAMPLING STATIONS

Station refers to the exact points on the stream where readings were taken. Stations were selected so as to best obtain the greatest possible estimate of the total diverse invertebrate populations of the main river, as well as each tributary studied.

AVERAGE WIDTH

Average width was determined by a series of measurements at the widest and narrowest points of the stream where practical. When it was impossible to measure the width of the stream the width was estimated and reported in yards.

AVERAGE DEPTH

Depth was determined where practical by averaging a series of measurements reported in feet.

COLOR

The term, water color, as used in the present paper, refers to those hues which are inherent within the water itself, resulting from colloidal substances or substances in solution (Welch, 1952). Color of the water was estimated by visual inspection.

TURBIDITY

Turbidity is a condition of water resulting from the presence of suspended matters (Welch, ibid.). Turbidity was described in accordance with values given by Lagler (1959): clear, if bottom is distinctly seen through 4 or more feet of water; slightly turbid, if the bottom is indistinct 1 to 4 feet; and turbid, if the bottom is visible only at less than 1 foot.

BOTTOM TYPE

The bottom type and size were estimated after a careful evaluation was made of the stream bottom material at each station.

RESULTS

TEMPERATURE

The water temperature in the Gunnison River proper during the study period ranged from a high of 63° Fahrenheit on June 28, 1961 near the junction of Dry Gulch to a low of 51° Fahrenheit near the junction of Steuben Creek on July 5, 1961. The maximum water temperature of the tributaries recorded during the study period was 68° Fahrenheit, recorded for Tomichi Creek on July 10, 1961. The minimum water temperature was 45° Fahrenheit, recorded for East Elk Creek on July 20, 1961. Water temperatures taken only once at each sampling station have little meaning inasmuch as the water temperatures vary to some degree in response to the daily cycle of air temperature. Such temperatures, however, give an indication of the extremes that may be found and provides valuable information as to temperature trends and extremes that were present during the study period. Extremes of temperature are manifested in at least two ways. Temperature has a profound effect on the progressive exclusion of species, genera and entire families, as well as on the occurrence of specific thermal forms.

Air temperatures are given in Table 1 and are important only indirectly by influencing water temperatures.

HYDROGEN-ION CONCENTRATION (pH)

The hydrogen-ion concentration recorded in the experimental area ranged from a high of 8.5, recorded for Cimarron Creek to a low of 7.0, recorded for Steuben Creek, both just prior to confluence with the Gunnison River.

Hydrogen-ion concentration is of considerable limnological interest because it may be a limiting factor. Each organism has its toleration range of pH (terminated by a maximum and a minimum) and possesses a definite optimum at some intermediate position. In ordinary unpolluted waters the normal pH varies from approximately 6.5 to 8.5. Inasmuch as all the pH values reported throughout the entire sampling period did not exceed the expected value of normal streams, it can be stated, with some reservation (Ellis, et al., ibid.), that data from the present study do not indicate any limitation by pH of the waters of the Gunnison River system upon the fauna and flora. Determinations of pH are most valuable for detecting certain types of pollution. It should be kept in mind that the pH values indicated in this study represent an overall balance of a series of equilibria existing in solution and the authors recognize the fact that such data only indicate the equilibria existing at the exact time of sampling.

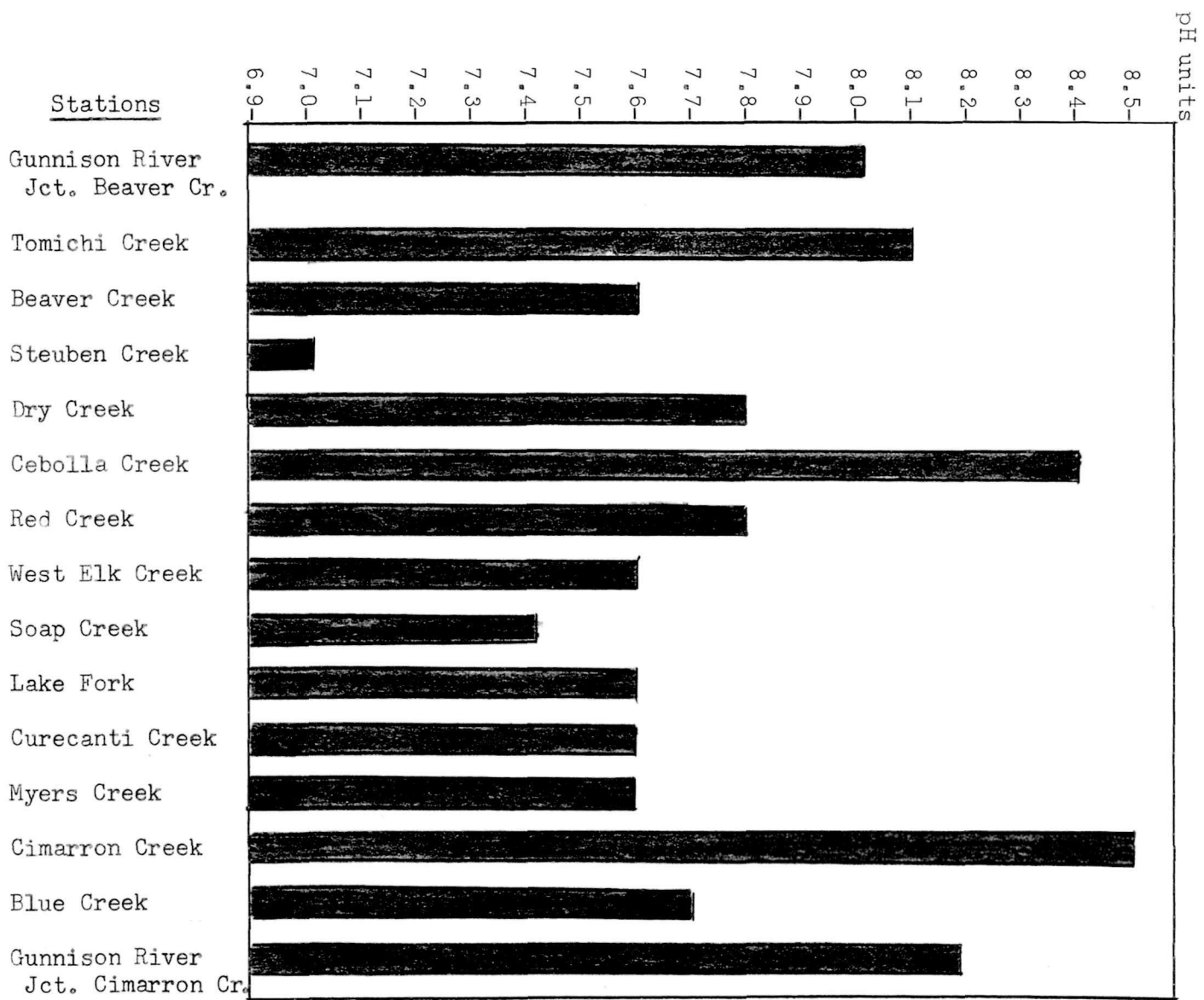
ALKALINITY

The total alkalinity recorded for the Gunnison River ranged from a high of 166.0 ppm, as CaCO_3 , in which carbonate plus some bicarbonate were present, at the junction of Beaver Creek, to a low of 99.6 ppm just below the entrance of Myers Gulch into the Gunnison River. In the latter determination the total alkalinity was also predominantly carbonate plus some bicarbonate, Fig. 2. The total alkalinity determinations of the tributaries ranged from a high in East Elk Creek of 222.0 ppm as CaCO_3 , in which carbonates plus some bicarbonates were present, to a low in Blue Creek of 32.1 ppm as CaCO_3 . The latter was only bicarbonate. According to Ellis, et al., (ibid.), the usually expected values for total alkalinity (expressed as calcium carbonate) range between 45 and 200 ppm. and unpolluted waters supporting good fish fauna range from 0 to 350 ppm. All of the total alkalinity determinations in the present study fall within such expected values.

DISSOLVED OXYGEN

The dissolved oxygen concentration in the water of the Gunnison River ranged from a high of 8.8 ppm reported on July 4 at 0905 and 0930, 40 yds. above and below the junction of Beaver Creek into the Gunnison River, to a low of 7.3 ppm on June 30 at 0830 and 0930, recorded at 40 yds. above and below the junction of Red Creek and the main river. The highest dissolved oxygen determination recorded for the tributaries was 8.6 ppm, recorded for Curecanti Creek on July 19 at 0910. The lowest dissolved oxygen determination was 6.3 ppm, reported for Steuben Creek on July 5 at 0830.

Fig. 1. Hydrogen-ion Concentration present in the Gunnison River and tributaries of the study area.



The amount of dissolved oxygen in the main river and the tributaries showed values very near to saturation in every case. Sampling each station only once does not indicate the extremes in the daily oxygen cycle of a stream. A series of chemical analyses run on a diurnal basis may illustrate crises and catastrophies that may be present in the diurnal cycle. The lethal limit of dissolved oxygen for fresh water invertebrates and fish is subject to some individual and species variation and to the modifying action of numerous physical and chemical factors. Because of the relatively small depth and large surface exposure, constant motion and turbulence, streams generally contain an abundant supply of oxygen and the organisms therein are not likely to be subjected to as variable an oxygen supply as those in other aquatic situations.

CARBON DIOXIDE CONCENTRATION

A concentration of carbon dioxide in the Gunnison River was limited to only one occurrence of 2.0 ppm at the junction of Curecanti Creek, Fig. 1. The carbon dioxide concentration in the tributaries ranged from a high of 4.0 ppm, recorded for Steuben Creek, to a complete absence in many of the streams. The presence of dissolved carbon dioxide in natural waters is common but, due to its reaction with other compounds in solution and to constant aeration, it is seldom present in larger quantities.

The free carbon dioxide present in the waters under investigation was the result of water filtered through the rocks and soil, ultimately entering the streams from inflowing ground water.

TURBIDITY

Turbidity, according to Welch (ibid.) is a condition of water resulting from the presence of suspended matter. Water, in the general term, is turbid only when its load of suspended matter is conspicuous, but it should be pointed out that all natural waters contain suspended materials and are therefore turbid. The turbidity reported in the present study was only of transitory nature and, in many cases, could be attributed to the effects of a run-off of rainfall. The sources of substances producing turbidity are innumerable, but the authors feel that it was largely due to silt, detritus and other nonliving materials.

Extreme turbidity in the Gunnison River, in many instances, was correlated with the release of greater quantities of water from the Taylor Dam which is located relatively close to the head waters of the Gunnison River. The occurrence of extreme turbidity in some of the tributary streams, Soap Creek for example, could be attributed to the use of large quantities of the stream water for irrigation with the ultimate return of much of the water loaded with silt and other nonliving materials. In still other cases severe turbidity could be traced to construction work being conducted upstream.

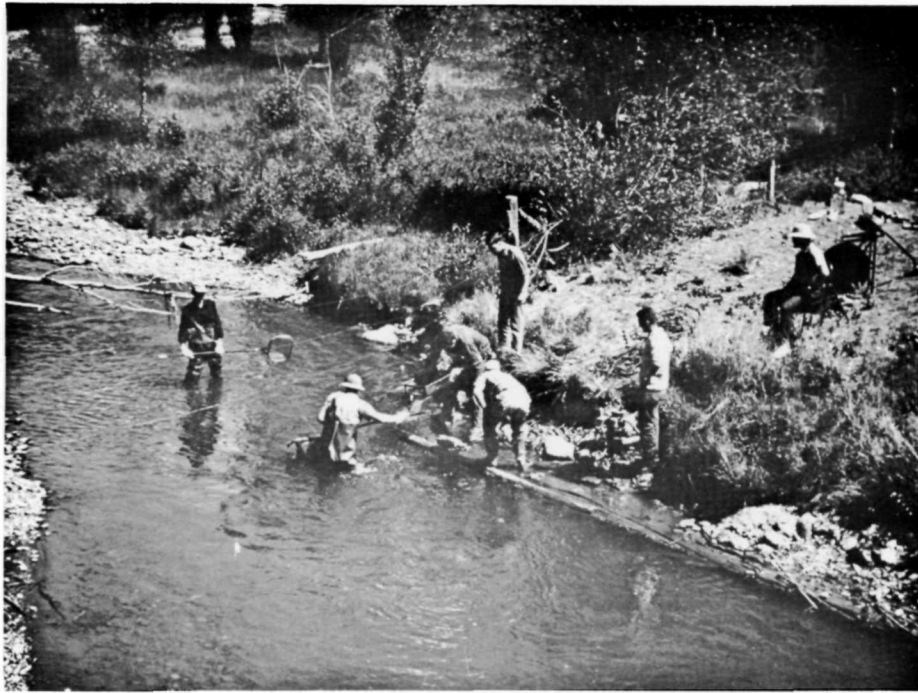


Fig. 2. Limnological collecting in Soap Creek above junction with river. Photo by Gerald R. Groves.

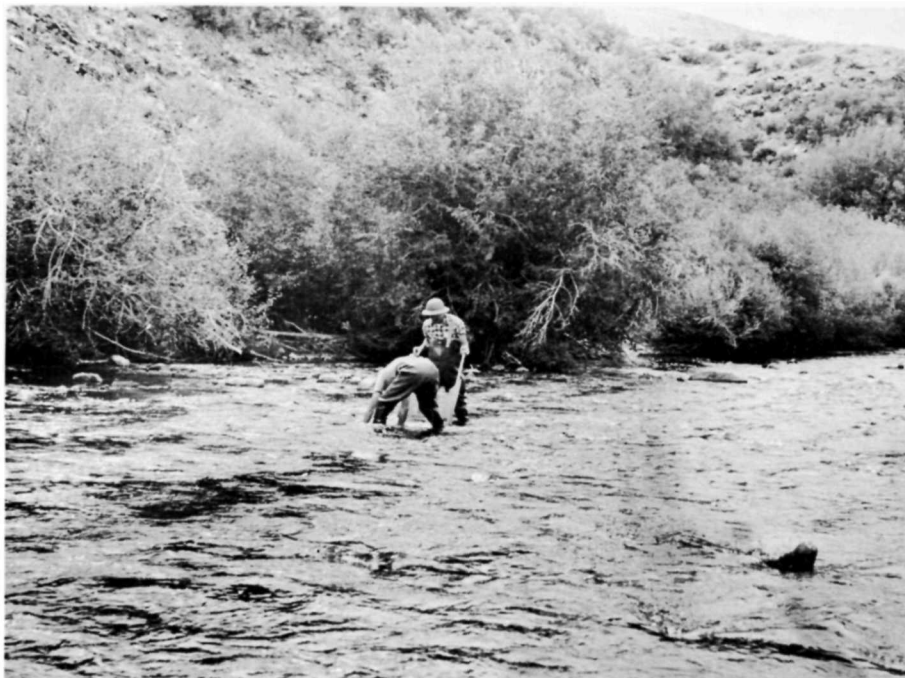


Fig. 3. Collecting invertebrates in edge of Gunnison River. Jay Richardson and Allen W. Knight. Photo by Gerald R. Groves.

WATER COLOR

Water color was reported for only one station in the entire study area. Tomichi Creek was observed to be slightly stained. The authors feel that the whole matter of color production in water is very complex and little actual information was recorded in the study at hand. It is felt that a more critical study would be required before valid reasons for water stain of this stream could be determined.

The remainder of the physical characteristics not specifically discussed are found in Table 1. The authors feel that these data are self-explanatory and do not need further explanation, a view of limnology operations shown in Figs. 2 and 3.

DISCUSSION

The streams and river in the study area, for the most part, run over bed rock formations which are fairly resistant to erosion. It is because of this resistance to erosion that the majority of the tributaries studied carried a lesser load of substances that would raise the total alkalinity, and, therefore, the water chemistries reported for the tributaries were somewhat lower than that reported for the Gunnison River (see Chart 1). Because of the dilution effect as one proceeds downstream the Gunnison showed a reduced water chemistry value, for the most part, from the upper end of the study area to the lower limits of same. However, the carbonates do not follow this trend and do not decrease in a like ratio as the bicarbonates, as one could normally expect. This it is hypothesized, is due to a very substantial amount of carbonate introduced into the Gunnison River by way of the Cebolla Creek, Fig. 1.

The carbonates in the amount of 102.0 ppm carbonate (51.0 ppm phenolphthalein alkalinity), introduced by way of the Cebolla Creek, is in an excess of normal expectations. However, unlikely this reading may appear, the authors advance the following explanation. The geologic maps of the area indicate, near Powderhorn, the presence of an extensive exposure of a hydro-thermal marble. Cebolla Creek flows directly over this highly soluble rock for about 3 mi. Because of this the authors believe that large quantities of carbonate ions are entering the system from this source.

The reported total alkalinity values for the Cimarron Creek appeared somewhat out of order until the geology of the upper stretches of this Creek were investigated. Stevens (1934) indicates that silicate minerals may be an important source of alkalinity in natural waters. The silica content of the rocks in the entire study area is quite high but, in the Big Cimarron drainage, the exposed silicon source is the San Juan tuff (Larsen - Cross, 1956, op. cit.). This formation is not highly indurated, and consequently is of a porous nature with a greater surface area exposed to chemical erosive processes which contribute silica to the water.

Table 1. Results of chemical and physical analysis from indicated locations in the Curecanti study area.

Sampling range	Date	Time	Shore cover	Shore type	Bottom type	Size of bottom materials	Max. width yds.
Tomichi Creek*	7/10	1530	Willow	Rock/gravel	Ro/Gr/Sn	4" dia.	30
Beaver Creek	7/4	0835	Ct/Bir/Haw	Rubble/rock	Rocks	1-3"	6
GR.40 yds above jct.		0505	Sage/willow	Rubble/rock	Rock/silt	2-8"	60
GR.40 yds below jct.		0930	None	Gravel/sand	Rubble	2-6"	80
Steuben Creek	7/5	0830		Sand/rock	Rock/rubble	4-8"	4.5
GR.40 yds above jct.		0815	Willow/Ct	Rock/rubble	Rock/rubble	4-8"	40
GR.40 yds below jct.		0850	Willow/Ct	Rock/rubble	Rock/gravel	1-3"	65
East Elk Creek	7/20	0830	Willow/grass	Meadow	Rock/gravel	1-5"	3
Dry Gulch	6/28	1500	Willow	Grass	Sand/gravel	1-4"	4.5
GR.40 yds above jct.		1430	Willow	Steep rocky	Gravel/rock	1-24"	60
GR.40 yds below jct.		1515	Willow	Steep rocky	Gravel/rock	1-24"	60
Cebolla Creek	7/7	0915	Rock wall	Rock wall	Sand/gravel	--	20
GR.40 yds above jct.		0845	None	Rock wall	Silt/sand	--	70
GR.40 yds below jct.		0930	Willow/Ct	Sand	Sand/gravel	--	65
Red Creek	6/30	0900	Rock			4"-6"	4-6
GR.40 yds above jct.		0830	Willow/oak	Steep rocky	Rock	6-12"	70
GR.40 yds below jct.		0930	Willow	Steep rocky	Sand/gravel	2"	70
West Elk Creek	7/3	0830	Willow	Gravel/rock	Gravel/rock	1-4"	10
GR.40 yds above jct.		0800	Willow	Sandy	Mud/rock	1-4"	40
GR.40 yds below jct.		0900	Bir/Wil/Rose	Gravel/rock	Mud/rock	1-6"	30
Soap Creek	7/1	0800	Grass/willow	Rock/rubble	Rock/sand	1-3"	7.4
GR.40 yds above jct.		0745	Bir/Wil/Rose	Roc/rub/sand	Rock/silt	1-12"	40
GR.40 yds below jct.		0845	Willow	Rock/silt	Rock/silt	1-12"	40
Lake Fork	7/8	1000	Wil/Sage/Ct	Sheer rock	Bou/gr/sand	4'	25
GR.40 yds above jct.		0945	Willow/sage	Boulder/rock	Boulder/sand	3'	40
Curecanti Creek	7/19	0910	Steep cliff	Cur/ras/Ct	Boulder	3-5'	3-4
GR.40 yds above jct.		0845	Steep cliff	Haw/Ct	Silt/sand		40
GR.40 yds below jct.		0930	Steep cliff		Silt/sand		35
Myers Gulch Creek	7/19	1300	Steep walls	Rock/boulder	Rock/boulder	1-10"	3
GR.40 yds above jct.		1315	Con/P.Ivy	Boulder/sand	Sand/silt		30-40
GR.40 yds below jct.		1330	Willow/P.Ivy	Boulder/sand	Sand/silt		35-40
Cimarron Creek	7/13	1115	Cliffs	Boulder/rock	Rock/mud	1-4"	20
GR.40 yds above jct.		1100	Cliffs	Boulder/rock	Sand/silt	1"	40
GR.40 yds below jct.		1130	Cliffs	Boulder/rock	Rock	1-5"	80
Blue Creek	7/10						
1 mi.above hwy 50		1030	Willow/grass	Meadow	Rock/rubble	1-4"	5-7
100 yds below "		0845	Grass	Steep bank	Rubble/gr	1-8"	7-8

* Water color was slightly stained, all others colorless

GR = Sampling range on Gunnison River

Ct=Cottonwood, Bir=Birch, Haw=Hawthorn, Rose=Wild rose, P.Ivy=Poison Ivy
 Roc=Rock, Rub=rubble, Gr=gravel
 Cur=Currant, ras=rasberry, Con=conifer

Results of chemical and physical analysis (continued)

Ave. Depth ft.	Turbidity	Apparent water color	Water veloc. ft/sec	Temperature F.		pH	DO ₂	CO ₂	Alkalinity (ppm)		
				Air	Water				Phenol	MO	Total
2-3	Slight	Brownish		77°	68°	8.1	7.6	1.0	0.0	176.0	176.0
.6	None	Brownish	2.0	76°	63°	7.6	7.5	3.6	0.0	96.0	96.0
3-4	None	Brown/green	1.8	76°	61°	8.0	8.8	0.0	4.4	147.0	151.4
2	None	Green	1.9	76°	61°	8.2	8.8	0.0	30.0	136.0	166.0
2-3"	None	Slight green		64°	52°	7.0	6.3	4.0	0.0	54.0	54.0
3-4	Slight	Green/brown		63°	51°	7.8	8.2	0.0	1.0	134.8	135.8
2-3	Slight	Green/brown		63°	51°	7.7	8.5	0.0	1.0	120.0	121.0
$\frac{1}{2}$ -3/4	None	Brownish	0.6	47°	45°	8.0	8.2	0.0	1.0	221.0	222.0
1-2"	None	Brown		82°	46°	7.8	8.0	0.0	2.0	121.0	123.0
2.5	None	Green/brown		87°	63°	8.4	8.1	0.0	5.0	147.0	152.0
2.5	None	Green/brown		87°	63°	8.4	8.2	0.0	4.0	153.0	157.0
$\frac{1}{2}$ -1	None	Brownish		76°	60°	8.4	7.7	0.0	51.0	104.0	159.0
4-5	Slight	Very brown		76°	58°	7.9	7.7	0.0	1.2	129.0	130.2
2-4	Slight	Very brown		76°	58°	8.1	8.2	0.0	3.9	126.0	129.9
.4-.5	None	Brownish		58°	52°	7.8	8.0	3.0	0.0	96.0	96.0
2	None	Brown/green		72°	62°	8.0	7.3	0.0	2.0	145.0	147.0
2	None	Brown/green		72°	62°	8.3	7.3	0.0	2.8	142.2	145.0
.5-.7	None	Brown/green	2.3	58°	52°	7.6	8.3	2.7	0.0	68.0	68.0
3	Consider.	Brown	1.25	64°	58°	7.8	8.1	0.0	4.0	140.0	144.0
2	Consider.	Brown	2.6	63°	57°	8.1	7.8	0.0	3.1	142.0	145.1
1-2	Extreme	Green/gray	3.4	63°	53°	7.4	7.6	3.0	0.0	64.5	64.5
2.5	None	Brown/green	4.3	62°	52°	7.9	7.5	0.0	2.0	138.0	140.0
2	Jct. only	Brown/green	4.2	62°	52°	8.1	7.4	0.0	1.0	128.5	129.5
4	None	Blue/green	3.8	73°	58°	7.6	7.4	1.4	0.0	39.0	39.0
Unk.	Slight	Brownish	2.7	73°	58°	7.9	7.5	0.0	20.0	131.0	151.0
1-2	None	Greenish		71°	54°	7.6	8.6	0.0	0.0	52.0	52.0
Unk.	Slight	Brown	2.5	71°	59°	7.8	8.3	0.0	1.6	86.0	87.6
Unk.	Slight	Brown	2.5	71°	59°	7.7	8.4	2.0	0.0	91.0	91.0
$\frac{1}{2}$ -1	Clear	Brownish		85°	59°	7.6	8.6	1.1	0.0	42.3	42.3
Unk.	Slight	Brown/green	2.4	85°	61°	8.3	8.2	0.0	3.4	96.6	100.0
Unk.	Slight	Brown/green	1.5	85°	61°	8.1	8.4	0.0	3.2	96.4	99.6
$\frac{1}{2}$ -1	Consider.	Gray/brown		86°	59°	8.5	7.9	0.0	11.2	174.6	185.8
Unk.	Slight	Brownish		86°	62°	8.1	7.9	0.0	2.6	104.2	106.8
1	Slight	Brownish		86°	62°	8.2	7.7	0.0	4.0	106.0	110.0
$\frac{1}{2}$ -1	None	Blue/green	2.2	70°	56°	7.4	8.5	0.5	0.0	32.1	32.1
$\frac{1}{2}$ -1	None	Blue/green		58°	51°	7.7	8.8	1.0	0.0	35.3	35.3

Unk.=Unknown, pH=hydrogen ion concentration, DO₂=dissolved oxygen,
CO₂=carbon dioxide, Phenol=phenolphthalein indicator, MO=methol orange indicator

Parts per
million

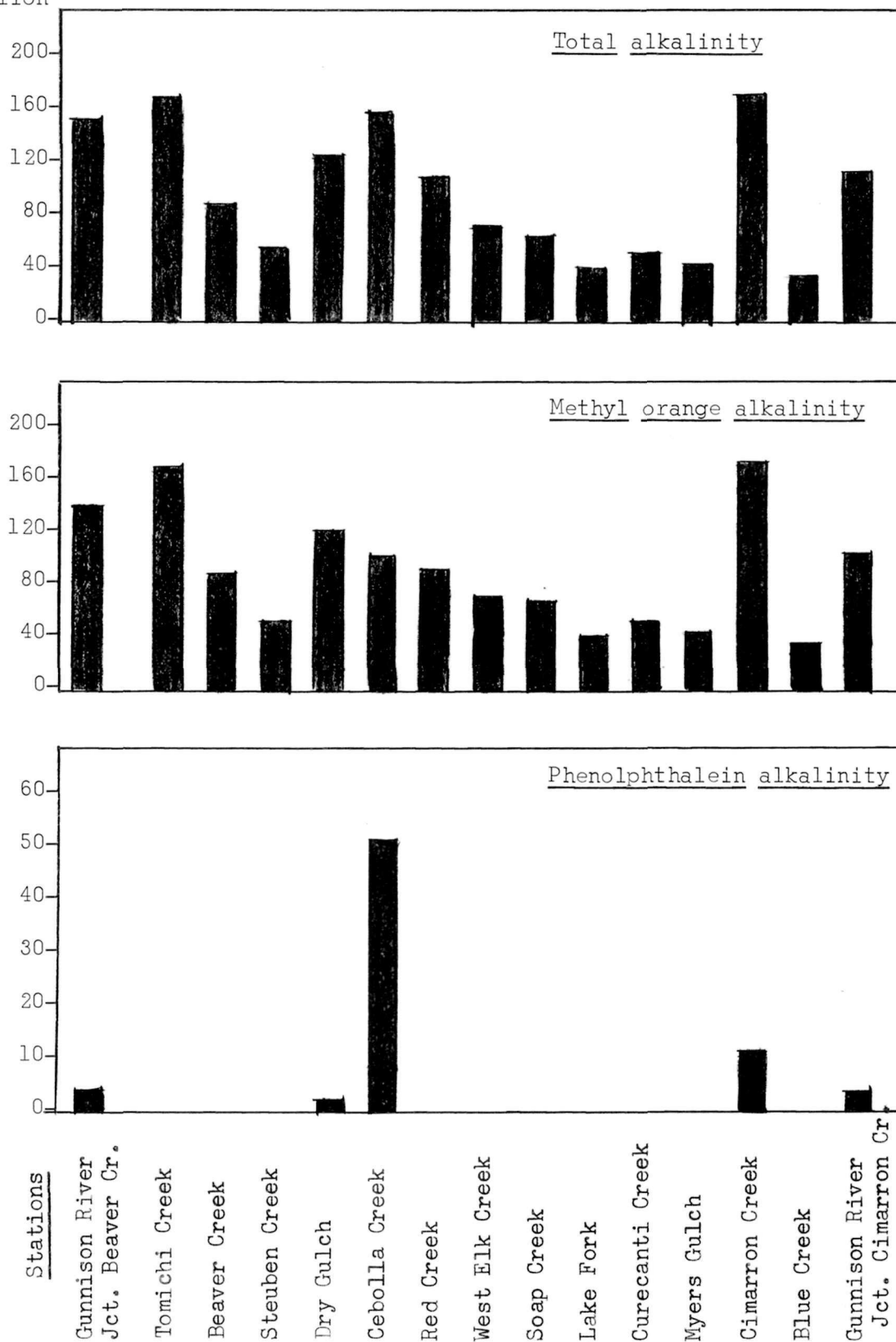


Fig. 4. Alkalinity present in the Gunnison River and tributaries of the study area.

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A STREAM SURVEY OF EAST ELK CREEK,

GUNNISON RIVER, COLORADO

Jay W. Richardson, Jr.

CONTENTS

Introduction	152
Objectives of the study	152
Methods and procedures	153
Physical-chemical sampling	153
Bottom fauna sampling	154
Results	154
Physical-chemical data	154
Productivity	155
Organisms found	156
Discussion	157
Summary	158
References	158

TABLES

1. List of common plants alongside East Elk Creek	153
2. Analysis of water of East Elk Creek	154
3. Productivity of the stream	155
4. List of biota found in East Elk Creek	156

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INTRODUCTION

During the summer of 1961 from June 26 to July 23, I accompanied the University of Utah Ecological Research Expedition studying the flora and fauna of the Gunnison River Valley within the basins of the proposed Curecanti reservoirs, working in close association with Angus M. Woodbury, Stephen D. Durrant, Arden R. Gaufin, and Allen W. Knight.

My project was a limited survey of East Elk Creek, an unusual stream located in Gunnison County, Colorado conducted between July 10 and 23, 1961. East Elk Creek originated from a spring which emerges approximately 4 mi. above the study area. It flows southwesterly through a steep ravine for about 4 mi. and then passes through a meadow before entering a narrow gulch that leads it to Gunnison River.

Just above the study area, much of the water is diverted for irrigation so that the size of the stream in the study area is much reduced. The volume fluctuates throughout the season. While the study was in progress, the stream was relatively small. The stream drops about 345 ft. in less than 6 mi. from the spring at elevation 7700 ft. to its mouth at 7355 ft. The water is clear as it flows from the spring and remains so through its journey to the river. Many people use the meadow and stream for recreational purposes, especially fishing and camping.

The study area extends from the Colorado Game and Fish Management Ranch to U. S. Highway 50. The stream flows through a rather flat meadow bordered on each side by low rolling foothills. The streamside vegetation, composed primarily of narrowleaf cottonwoods and willows, is extremely dense and makes the stream at some points impassable by foot. In contrast, the foothills and some parts of the meadow are cleared for farm and grazing land. The dominant plants in this area are assorted grasses and herbs, while the uncleared land is occupied by dense growths of grayish green rabbitbrush and silver sage. The main plants here are listed in Table 1.

OBJECTIVES OF THE STUDY

1. To assess the potential value of the stream for production of bottom fauna as a source of food for vertebrate animals, mainly fish.
2. To ascertain what ecological factors might be significant to the bottom invertebrates as a potential source of food for fish populations.

Table 1. List of common plants alongside East Elk Creek.

Species	Height ft.	Dens. %
<u>Populus angustifolia</u>	50.0	40
<u>Salix caudata</u>	12.0	20
<u>Alnus tenuifolia</u>	14.0	5
<u>Rosa woodsii</u>	5.0	3
<u>Juncus balticus</u>	.8	4
<u>Carex</u>	1.3	4
<u>Crataegus saligna</u>	1.0	5
<u>Chrysothamnus viscidiflorus</u>	2.5	5
<u>Rhus trilobata</u>	.7	3
<u>Elymus condensatus</u>	2.5	3
<u>Bromus inermis</u>	1.4	4
<u>Poa pratensis</u>	1.2	4
<u>Trifolium repens</u>	.8	5
<u>Taraxacum officinale</u>	.8	5
<u>Bromus tectorum</u>	.8	5

METHODS AND PROCEDURES

An area, about 4000 yd. in length, extending from the meadow downward through a narrow gulch to the highway, was selected for study. Four stations were selected for sampling physical and chemical data and 15 for quantitative sampling of the bottom fauna.

PHYSICAL-CHEMICAL SAMPLING

At each of the four stations, samples of water were taken directly from the stream in standard 250 cubic centimeter sampling bottles in accordance with standard practice. With the aid of a portable chemical kit, each sample was immediately analyzed for oxygen content, free carbon dioxide, alkalinity and pH (Welch, 1948:207). Water and air temperatures were taken with a Fahrenheit pocket thermometer. The width and depth were measured with a standard folding ruler. The depth was recorded as an average of several measurements in the cross-section. The bottom types were classified as rubble, sand, gravel or silt, according to standard methods. The rate of flow was obtained by placing three equal sized sticks or floats in the stream and clocking them over a 100 ft. course. The resulting figures were used to calculate the mean rate of flow in cubic feet per second.

BOTTOM FAUNA SAMPLING

The bottom fauna was sampled qualitatively by use of a handscreen, consisting of a fine mesh wire stretched between two poles, approximately 4 ft. in length. The handscreen was unrolled and placed in a slanting position crosswise of the stream so as to catch any insects dislodged from the rocks, debris, gravel and silt above by scraping the bottom of the stream bed, using the feet or hands. The handscreen was then placed on the bank and the specimens picked off the screen and placed in 70 per cent alcohol for later identification. Hand picking was also employed as a qualitative method for collection of bottom fauna (Welch, 1948:299).

On July 19 and 20, a quantitative study was made of the bottom fauna at 15 stations selected at random, using the Table of Random Numbers (Hodgman, 1960:237).

At each of these 15 stations, a point in the cross-stream transect was randomly selected at which to take a 144 square-inch sample of bottom surface. The point at which the sample was taken was indicated in percentage of distance across the stream beginning at the right bank.

The device used in sampling the bottom was essentially like the well-known Surber square foot sampler, (Welch, 1948:321) modified to cover an area 10 x 14.4 in. instead of 12 x 12. The mouth of the sampler was faced upstream so that the conical net ballooned downstream. This caught the organisms dislodged when the gravel, debris, rubble, sand or silt within the frame were worked over thoroughly with the fingers. The net was then emptied into a collecting jar for later counting in the laboratory.

RESULTS

PHYSICAL-CHEMICAL DATA

Limnological data taken on July 24, 1961, a clear windless day, are given in the table below. At the time of the study, the stream was at its low stage during midsummer when temperatures were high, hence data will not apply at other times.

Table 2. Analysis of the water of East Elk Creek.

Station	Location ft.	Time	Temperature F.		pH	Chemical Data, ppm			
			Air	Water		CO ₂	-HCO ₂	-CO ₃	O ₂
1	0	8:30	47°	45°	7.8	2	157.0	0	7.9
2	2000	9:30	59.5°	54°	8.1	0	216.5	1	8.6
3	2900	10:00	61°	54°	8.0	0	217.2	1	8.5
4	4000	10:45	67.8°	56°	8.0	0	221.0	1	8.2

Changes in the chemical data within the study area were not great during the time it was studied. The air temperature ranged from 47° at station one to 67.8° F. at station four. The water temperature ranged from 45° to 56° F. The variation in pH was slight, ranging from 7.8 to 8.1. This increase in pH may be related to the increased amount of half-bound CO₂ in the water. The decline in CO₂ concentration below station one may also be related to pH since free CO₂ does not usually exist at a pH higher than 8.0. Carbonates seem to increase as the stream flows toward the river. This is the most likely cause of the high pH which is well above neutrality and very alkaline.

The increase in dissolved oxygen between stations one and two was probably due to increased photosynthetic activity while the decrease at stations three and four may be attributed to warming of the water and decomposition of organic material picked up as the stream ran through a heavily grazed pasture.

PRODUCTIVITY

Invertebrates collected from square foot samples at 15 stations on July 19 and 20 were taken from 15 stations spaced downstream from the upper end of the study area as shown in the second column of Table 3. The samples were taken at randomly calculated points in the stream transect measured from the right bank and shown in the third column of the same table. The total volume and the number of organisms of each sample are also given in that table. These data apply only to the summer season when stream flow is low, temperatures are relatively high and organic matter is accumulated in the bottom.

Table 3. Productivity of the stream.

Stations No.	Feet	Sample Location	Samples	
			Volume CC	Number of organisms
1	365	85	.60	81
2	480	11	1.90	51
3	582	56	.52	52
4	725	11	3.00	54
5	742	93	.85	107
6	1011	92	.60	69
7	1085	1	1.80	89
8	1525	62	1.40	41
9	1567	24	.60	77
10	1921	44	2.20	94
11	2157	16	1.00	143
12	2162	21	1.40	86
13	2167	59	2.10	48
14	2368	87	1.61	163
15	2488	35	2.00	132
Total			20.98	1290
Average			1.39	86

The deposition of organic matter appears to be more pronounced in the upper end of the study area. This may interfere with attachment of certain invertebrates to solid places of support and may have a smothering effect on others. A general decrease in organic matter and a general increase in hardness may help to account for the increase in productivity in the lower end. Based on Welch's (1960:305) scale, this stream is approximately average in productivity.

ORGANISMS FOUND

From the collections made for qualitative studies and from other records, it was determined that the following plants and animals occurred in the stream:

Table 4. LIST OF THE BIOTA FOUND IN EAST ELK CREEK

Myxophyceae (family) . . Blue green algae	Bacillarieae (family) . . Diatoms
<u>Anabaena</u> sp.	<u>Synedra ulna</u> (Nitzsch.) Ehren.
<u>Nostoc</u> sp.	<u>Navicula</u> spp.
Chrysophyceae (family) . . . Yellow green algae	Chlorophyceae (family) .Green algae
<u>Vaucheria</u> sp.	<u>Chaetophora</u> sp.
<u>Tribonema minor</u>	<u>Monostroma</u> sp.
	<u>Closterium acerosum</u> (Schrank) Ehrb.
	<u>Oedogonium</u> sp.

MOSS

Hygrohypnum palustre

INVERTEBRATES

INSECTS

Ephemeroptera . . . Mayflies
 Heptageniidae (family)
Heptagenia sp.
Cinygmula sp.
Epeorus sp.
 Baetidae (family)
Baetis sp.
 Ephemerellidae (family)
Ephemerella sp.
 Leptophlebiidae (family)
 Paraleptophlebia sp.

Plecoptera

Pteronarcidae (family)
Pteronarcella badia (Hagen)
 Perlodidae (family)
Isoperla sp.
Isogenus sp.
 Perlidae (family)
Acroneura sp.
 Chloroperlidae (family)
Alloperla sp.

INSECTS (continued)

Hemiptera

Gerridae (family)
Gerris sp.
Trepobates sp.

Coleoptera

Dytiscidae (family)
Agabus sp.
Dryopidae (family)
Helichus sp.

Elmidae (family)
Zaitzevia sp.

Psephenidae (family)
Psephenus sp.

Hydrophilidae (family)
Tropisternus sp.
Paracynus sp.

Tricoptera

Rhyacophilidae (family)
Rhyacophila sp.

Hydropsychidae (family)
Hydropsyche sp.
Cheumatopsyche sp.

Limnephilidae (family)
Limnephilus sp.
Platycentropus sp.

Lepidostomatidae (family)
Lepidostoma sp.

Diptera

Simuliidae (family)
Simulium sp.

Tipulidae (family)
Hexatoma sp.
Holorusia sp.

VERTEBRATES

FISHES

Salvelinus fontinalis . . Brook trout
Salmo gairdneri (Richardson)

MAMMALS

Castor canadensis Beaver

DISCUSSION

The limnological data taken between 8:30 and 10:45 a.m. indicated a much slower rise in water temperature from 45° to 56° F. (8° to 13° C.), than the rise in air temperature from 47° to 68° F. (9° to 20° C.). The two were very close together in the early morning but diverged rapidly as the sunshine warmed the air faster than it affected the water. The difference in pH (7.8 to 8.1) may have little significance for interpretation of the overall picture. The amount of free CO₂ and carbonates in the stream at that time is negligible but the amount of bicarbonate and available O₂ indicates favorable conditions for use by stream inhabitants.

If the productivity of a stream is an expression of the relationship between the organisms and their environment, East Elk Creek may be considered as a normally productive stream according to the standards of Lagler (1956). The average of 1.39 cc and 86 organisms per square foot sample falls well within the limits of average productivity.

SUMMARY

From July 10 to 28, 1961, a limited stream survey was made of East Elk Creek, Gunnison County, Colorado. This stream originates in a bed of springs approximately 2 mi. above the study area.

The streamside vegetation of East Elk Creek includes the sandbar willow, Salix exigua; narrowleaf cottonwood, Populus angustifolia; wild rose, Rosa woodsii; and alder, Alnus tenuifolia. Beyond the streamside, the dominant vegetation includes the big rabbitbrush, Chrysothamnus nauseosus; big sagebrush, Artemisia tridentata (Nutt.); and some assorted grasses of which most were Poa spp. In addition there was a meadow in a wide part of the canyon enclosed for a pasture.

From data of 15 random sampling stations, productivity was calculated at 1.39 cc containing 86 megascopic organisms per square foot bottom sample, approximately average in productivity. Aquatic organisms found in the stream included among the algae, 4 families and 10 genera; moss, 1 species of Hygrohypnum; among the insects, 6 orders; among the mayflies, 4 families and 6 genera; stoneflies, 4 families and 5 genera; bugs, 1 family and 2 genera; beetles, 5 families and 6 genera; caddisflies, 4 families and 6 genera; diptera, 2 families and 3 genera. From other sources, it was found that beaver and at least two species of trout were found in the stream.

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INVERTEBRATES

ENDOPARASITES OF MAMMALS

FOUND IN THE CURECANTI AREA

OF

GUNNISON COUNTY, COLORADO

A. Dean Stock

CONTENTS

Introduction	162
List of endoparasites of mammals	162
References	166

TABLE

1. Parasites found in mammalian hosts	165
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University of Utah
Anthropological Papers, No. 59, 1962
Upper Colorado Series, No. 8

INTRODUCTION

During the summer of 1961, from June 26 to July 22, a crew of biologists from the University of Utah made an ecological survey of the Curecanti Reservoirs Basins in Gunnison County, Colorado. As a part of the survey, a total of 107 carcasses of mammals were preserved in the field and later examined for their endoparasites in the laboratory at the University. The carcasses were preserved by slitting or injecting the abdomen and immersing in formalin. These specimens slit and placed in formalin yielded better specimens of endoparasites than those injected. In the laboratory the carcasses were cut open and the body cavity and the viscera removed from the body cavity. This was checked for possible encysted parasites and the viscera examined section by section under a binocular dissecting scope for its endoparasites. Nematodes were cleared with lactophenol and mounts made for identification. The cestodes and acanthocephalans were immersed in distilled water to remove formaldehyde, stained, and mounted for identification. Identification of cestodes was made by Albert W. Grundmann; mammals by Stephen D. Durrant and Elroy B. Robinson.

LIST OF MAMMALS EXAMINED AND PARASITES FOUND

CHIROPTERA (order) Bats

Vespertilionidae (family) Vespertilionid bats

Myotis subulatus melanorhinus (Merriam) 1890 . . . Small footed myotis
Junction of Dry Gulch and Gunnison River, 7400 ft., July 7, 1 specimen,
negative.

Myotis volans interior Miller 1914 Long-legged myotis
Junction of Dry Gulch and Gunnison River, 7400 ft., July 7, 1 specimen,
negative.

Eptesicus fuscus pallidus Young 1908 Big brown bat
Junction of Dry Gulch and Gunnison River, 7400 ft., July 7, 1 specimen,
negative.

LAGOMORPHA (order) Hares, rabbits and pikas

Leporidae (family) Hares and rabbits

Lepus townsendi townsendi Backman 1839 White tailed jackrabbit
Three miles east of Dry Gulch near Gunnison River, 7460 ft., June 30,
1 specimen, nematodes in caecum, Trichurus sp., 2♂ 1♀.

Sylvilagus nuttalli pinetis (J. A. Allen) 1894 . . . Nuttall cottontail
Dry Gulch, 3/4 mi. north junction with Gunnison River, 7460 ft., July 2,
2 specimens with nematodes in caecum, of which one had Dermatoxys
veligera (Rudolphi) 1819, 1♀, and Trichurus sp. 4♂ 5♀; the other had
Dermatoxys veligera 2♂ 4♀; both had cestodes, Cittotaenia variabilis

Sylvilagus nuttalli pinetis (continued)

Stiles 1895, in small intestine. July 9, 1 specimen, cestodes in small intestine, Raillietina retractilis Stiles 1925. July 13, 1 specimen, nematodes in caecum, Dermatoxys veligera, 1♂, nematodes in large intestines below caecum, trichurus sp., 1♂, cestodes in small intestine, Cittotaenia variabilis.

RODENTIA (order) Rodents

Sciuridae (family) Squirrels

Marmota flaviventris luteola A. H. Howell 1914 . . . Yellow-bellied marmot
Junction of Dry Gulch and Gunnison River, 7400 ft., June 29; 1 specimen with nematodes in large intestine, Citellina sp.

Citellus lateralis lateralis (Say) 1823 Golden mantled ground squirrel
Junction of Beaver Creek and Gunnison River, 7600 ft., July 6; 1 specimen, negative. Junction of Dry Gulch and Gunnison River, 7400 ft., July 6; 2 specimen, negative; July 20, 1 specimen, negative; July 20, 1 specimen, negative; July 21, 1 specimen, negative.

Citellus variegatus grammurus (Say) 1823 Rock squirrel
Dry Gulch, $\frac{1}{2}$ mi. north junction with Gunnison River, June 29, 1 specimen, negative.

Eutamias minimus operarius Merriam 1905 Least chipmunk
Junction of Beaver Creek and Gunnison River, 7600 ft., July 6, 7 specimens, 6 negative, 1 with nematodes in caecum, Syphatineria eutamii (Tiner 1948), 10♂ 16♀, and Heteroxynema cucullatum Hall 1916, 3♂ 7♀; July 7, 2 specimens, 1 negative, 1 with nematodes in caecum, Aspicularis sp., 9♀. Dry Gulch, 1 mi. north of Gunnison River, 8000 ft., July 4, 3 specimens, 1 negative, 1 with nematodes in caecum, Syphatineria eutamii, 3♀, 1 with nematodes in small intestine, Rictularia coloradensis Hall 1916, 1♀, and nematodes in caecum, Syphatineria eutamii, 2♀.

Eutamias quadrivittatus quadrivittatus (Say) 1825 . . . Colorado chipmunk
Junction of Pine Creek and Gunnison River, 7260 ft., July 21, 1 specimen, negative.

Cynomys gunnisoni gunnisoni (Baird) 1855 Gunnison's prairie dog
Near Gunnison River, $\frac{1}{2}$ mi. east of Eagle Rock, 7500 ft., June 30 1 specimen, negative; 1 mi. west Steuben Creek, 7460 ft., July 14, 3 specimens, negative.

Castoridae (family) Beaver

Castor canadensis concisor Warren and Hall 1939 Beaver
East Elk Creek, 1 mi. north Gunnison River, 7500 ft., July 21, 1 specimen with nematodes in caecum, Castorstrongylus castoris Chapin 1905, 12♂ 8♀.

Geomyidae (family) Gophers

Thomomys talpoides fossor J. A. Allen 1893 Northern pocket gopher
Junction Dry Gulch and Gunnison River, 7400 ft., July 21, 2 specimens
with nematodes in caecum, Ransomus rodentorum Hall 1916, 3♂ 3♀ and 1♀.

Cricetidae (family) New World rats and mice

Peromyscus maniculatus rufinus (Merriam) 1890 Deer mouse
Dry Gulch, $\frac{1}{2}$ mi. north of Gunnison River, 7450 ft., June 30, 14 specimens,
6 negative; 1 with nematodes in small intestines Rictularia coloradensis
Hall 1916, 1♀, 1 with nematodes in caecum, Trichurus stansburyi Grundmann
and Frandsen 1961, 5♂ 8♀ and numerous eggs of nematode in liver, Capillaria
hepatica (Bancroft, 1893); 1 with Trichurus stansburyi, 1♂ 1♀, in caecum,
eggs in liver, Capillaria hepatica, and acanthocephalam in small intestine,
Moniliformis clarkii (Ward 1917); 1 with Moniliformis clarkii in small in-
testine; 1 with Trichurus stansburyi in caecum, 1♂, and Moniliformis clarkii,
in small intestine; 2 with Trichurus stansburyi in caecum, 1♀ and 2♂ 1♀;
1 with Moniliformis clarkii in small intestine. Dry Gulch, 1 mi. north of
Gunnison River, 8300 ft., July 4, 24 specimens, 21 negative, 1 with
nematodes in caecum, Trichurus stansburyi, 1♀; 1 with nematodes in caecum,
Syphacia peromysci Harkema 1936, 20♂ 40♀; 1 with nematodes in caecum,
Aspicularis sp., 1♂ 4♀, and nematodes in small intestine, Rictularia
coloradensis Hall 1916, 2♂ 1♀. Near Gunnison River, $\frac{1}{2}$ mi. west of Pine
Creek, 7200 ft., July 21, 16 specimens, 14 negative, 1 with nematodes in
caecum, Syphacia peromysci, 7♀, 1 with nematode in small intestine,
Rictularia coloradensis, 1♂.

Neotoma cinerea orolestes Merriam 1894 Bushy-tailed wood rat
One mile northwest of junction of Dry Gulch and Gunnison River, 8300 ft.,
July 4; 4 specimens, 3 negative, 1 with nematodes in caecum, Aspicularis
sp., 1♂ 1♀. cestodes in small intestine, Raillietina sp. (probably
retractilis unidentified, cestode cysti in liver.

Ondatra zibethica osoyoosensis (Word) 1863 Muskrat
One mile south Iola Bridge, 7600 ft., July 4, 1 specimen, negative.

Microtus montanus fusus Hall 1938 Montane vole
Willow Creek, $\frac{1}{2}$ mi. north Gunnison River, 7600 ft., July 4, 9 specimens,
3 negative, 6 specimens with nematodes in caecum, Syphacia obvelata
(Rudolphi) 1902, 17♀, 45♀, 18♀, 14♀, 11♀, and 13♀.

Zapodidae (family) Jumping mice

Zapus princeps princeps J. A. Allen 1893 Western jumping mouse
Junction Dry Gulch and Gunnison River, 7400 ft., June 30, 3 specimens,
1 negative, 2 with nematodes in small intestine, Rictularia coloradensis
Hall 1916, 5♂ 6♀ and 1♂.

These relationships of host and endoparasites are arranged in a chart
form in Table 1.

Table 1. Parasites found in mammalian hosts.

SPECIES	Number examined	Number infected	Parasites found																				
			Acanthocephala Moniliformis clarkii	Cestoda	Cittotaenia variabilis	Raillietina	retractilis	Nematodes	Aspiculurus sp.	Capillaria hepatica	Citellina sp.	Castorstrongylus	castoris	Dermatoxys veligera	Heteroxynema	cucullatum	Ransomus rodentorum	Rictularia	coloradensis	Syphacia obvelata	Syphacia peromysci	Syphatineria eutamii	Trichurus stansburyi
<u>Myotis subulatus melanorhinus</u> Small footed myotis	1	0																					
<u>Myotis volans interior</u> Long-legged myotis	1	0																					
<u>Eptesicus fuscus pallidus</u> Big brown bat	1	0																					
<u>Lepus townsendi townsendi</u> White tailed jack rabbit	1	1																					3
<u>Sylvilagus nuttalli pinetis</u> Nuttall cottontail	4	4		3	?	1	?						7										10
<u>Marmota flaviventris luteola</u> Yellow-bellied marmot	1	1								?	1												2
<u>Citellus lateralis lateralis</u> Golden mantleground squirrel	6	0																					
<u>Citellus variegatus grammurus</u> Rock squirrel	1	0																					
<u>Eutamias minimus operarius</u> Least chipmunk	12	4						9	1					10			1	1			31		
<u>Eutamias g. quadrivittatus</u> Colorado chipmunk	1	0																					
<u>Cynomys gunnisoni</u> Gunnison's prairie dog	4	0																					
<u>Castor canadensis concisor</u> Beaver	1	1										20	1										
<u>Thomomys talpoides fossor</u> Northern pocket gopher	2	2														7	2						
<u>Peromyscus maniculatus rufinus</u> Deer mouse	54	13	4	4				5	1	N								5	3	67	2		20
<u>Neotoma cinerea orolestes</u> Bushy-tailed wood rat	4	1				?	1	2	1														
<u>Ondatra zibethica osoyoosensis</u> Muskrat	1	0																					
<u>Microtus montanus fusus</u> Montane vole	9	6																		118	6		
<u>Zapus princeps princeps</u> Western jumping mouse	3	2																12	2				
TOTAL	107	35																					

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INVERTEBRATES

GENERAL LISTS OF INSECTS AND TICKS

Ernest Riley and James L. Eastin

MAYFLIES

Delbert W. Argyle and George F. Edmunds

BAT FLIES

A. Dean Stock

CONTENTS

General lists of insects	168
Mayflies	178
Bat flies	190

University of Utah
Anthropological Papers, No. 59, 1962
Upper Colorado Series, No. 8

GENERAL LISTS OF INSECTS
OF CURECANTI RESERVOIR BASINS, 1961

All specimens are from Gunnison County, Colorado, except those below Morrow Point Dam which are in Montrose County, Colorado. All specimens are collected by Ernest Riley and identified by James L. Eastin, unless otherwise indicated. Initials after the record indicates other collectors as follows: AWK = Allen W. Knight, CRL = Calvin R. Lamborn, PCM = Paul C. Mountford, and RWO = Ronald W. Olson.

COLLEMBOLA (order) Spring-tails

Entomobryidae (family)

Red Creek, July 10, gravel on streamside.

THYSANURA (order) Bristle-tails

Machilidae (family) Machilids

Machilis sp.

Dry Gulch, June 28, 14 mi. above Blue Mesa Dam, dry rocky stream and river bank, many crawling and jumping; July 16, 7500 ft., dry sagebrush hillside; July 20, dry hillside of sagebrush; and July 20, 8300 and 8600 ft., dry hillsides of Artemisia and Chrysothamnus. Red Creek, June 29, 20 ft. from stream. Lake Fork, July 18, 8000 ft. dry rocky, sagebrush hillside.

NEUROPTERA (order) Lacewings and allies

Chrysopidae (family) . Green lacewings

Genus species

Dry Gulch, July 3, 7480 ft., 4 mi. above camp, sagebrush and grass; East Elk Creek, July 10, 7460 ft. streamside on willows.

Chrysopa sp.

Dry Gulch, July 20, 8300 ft., 1 mi. west of camp, dry hillside of sagebrush; East Elk Creek, July 20, wet meadow along stream; and Cebolla Creek, July 7.

Myrmeleontidae (family) . . Ant lions

Dry Gulch, June 28, grass along river bank; June 30, inside cabin; July 14;

Myrmeleontidae (family) continued

July 2; and July 16. Soap Creek, July 2, 7220 ft., streamside rocks.

Raphidiidae (family) . Snake flies

Aquila sp.

Dry Gulch, July 16, 7500 ft., dry sagebrush, hillside; July 6, 200 yds. above campsite. Cimarron Cr. July 13, 6780 ft., streamside alder, willow and cottonwood. West Elk Creek, July 3, 7220 ft., grass 50 ft. from stream. Steuben Creek, July 5, 7600 ft.

INSECTS

HEMIPTERA (order) Bugs

Identification by H. H. Knight

Miridae (family) . . . Mirid bugs

Deraeocoris schwarzii (Uhl.)

Bridge on Blue Creek, Hwy. 50,
streamside Salix, 8500 ft.,
1♀, July 12 (ER).

Eustictus pusillus (Uhl.)

One mi. west of mouth of Dry Gulch,
dry Artemisia hillside, 8300 ft.,
1♂, July 20 (ER).

Labops hirtus Knegt.

Blue Creek, edge Hwy 50, streamside,
Alder and Salix, ♂, July 12 (ER).

Lopidea sp. I.

One mi. up West Elk Cr., sagebrush
and Chrysothamnus, 7400 ft., ♀,
July 3 (ER); 5 mi. up East Elk Cr.,
Chrysothamnus, 7460 ft., ♀♂, July
20, (ER); and West Elk Cr., stream-
side grass, 7220 ft., 2♂, July 3
(ER).

Lygus hesperus Knegt.

200 yds. above mouth of Dry Gulch,
meadow grass, 7440 ft., ♀, July 5,
(ER).

Lygus sp.

Bridge at Blue Creek, Hwy. 50, Salix
and Alder, 8500 ft., ♀, July 12,
(ER).

Megaloceroea debilis Uhl.

Dry Gulch, streamside willows, 7400
ft., ♂, July 3 (AWK).

Neolygus atritylus Knegt.

Five mi. above mouth East Elk Cr.
swamp grass, 7360 ft., ♂, July
20, (ER).

Orthotylus angulatus (Uhl.)

Beaver Cr., streamside willow,
7500 ft., ♂, July 4 (ER).

Orthotylus ute Knegt.

Beaver Cr., streamside Salix,
7500 ft., ♂, July 4 (ER).

Plagiognathus annulatus Uhl.

Steuben Cr., 8 mi. up, stream-
side willow, 7500 ft., 2♀,
July 5,

Stenodema virens (L.)

Bridge at Blue Cr., Hwy. 50,
streamside Salix, 8500 ft.,
♀, July 12 (ER).

Strongylocoris sp. I.

One mi. up West Cr., sagebrush
and Chrysothamnus, 7400 ft., ♀,
July 3 (ER); Cebolla Cr., dry
grass streamside, 7820 ft. ♂,
July 7; Red Cr., streamside Salix,
7400 ft., ♀, July 10; Red Creek,
streamside Salix, 7400 ft., July
10, (ER); and East Elk Cr., 5 mi.
up, Chrysothamnus, 7460 ft., ♂,
July 20 (ER).

Strongylocoris sp. II

West Elk Cr., streamside grass,
7220 ft., ♂, July 3 (ER).

INSECTS

COLEOPTERA (order) Beetles

Anthicidae (family)

Notoxus sp.

Dry Gulch, July 5, 8600 ft., dry hillside; Cebolla Cr., July 7, 7320 ft., dry grass; and Beaver Cr., July 4, 8600 ft., streamside.

Buprestidae (family)

Anthaxia sp.

Curecanti Cr., July 19, 7400 ft., cow parsnip.

Acmaeodera sp.

Dry Gulch, July 6, streambed; and East Elk Cr., July 10, 7460 ft., streamside willows.

Agrilus sp.

Dry Gulch, July 18, 7400 ft.; and Blue Cr., July 12, 8500 ft., streamside willows and alder.

Carabidae (family)

(3 genera)

#1. Steuben Cr., July 5, 7480 ft. on bridge; and Soap Cr., July 11, 7240 ft., side of river in soil.

#2. Cebolla Cr., July 7, 7320 ft., in water.

#3. Dry Gulch, July 6, 7460 ft., streamside grass and willows; Cebolla Cr., July 7; Red Cr., July 10, 7500 ft., under leaves along streamside; and Soap Cr., July 12, litter along stream bank.

Chlaenius sp.

Soap Cr., July 1, 7240 ft., grass along bank.

Cantharidae (family)

Podabrus sp.

Soap Cr., July 12, 7600 ft., streamside willows.

Cerambycidae (family)

Lamiinae (sub-family)

Dry Gulch, July 6, 7500 ft., streamside grass and willows; July 9, 7500 ft., on sagebrush; July 12, 7500 ft., streamside; and July 20, 8600 ft., dry hillside.

Anoplodera canadensis (Fab.)

Dry Gulch, July 18; and Meyer Gulch, July 19, adults and pupae, rotten cottonwood.

Batyle ignicollis (Say)

Dry Gulch, July 6, 7460 ft.

Leptura propinqua Bland

Soap Creek, July 16.

Prionus sp.

Soap Cr., July 12; and East Elk Cr., July 16.

Tetraopes sp.

Red Creek, June 29, 7400 ft.

Chrysomelidae (family)

Camptosomatinae

Cryptocephalus sp.

Dry Gulch, June 29, 7400 ft.; Lake Fork, July 17, dry Douglas fir; Beaver Cr., July 4; Red Creek, June 29, 7420 ft., dry ground; Blue Cr., July 12, 8500 ft.; streamside willows and alder; and Steuben Cr., July 5, streamside.

Monachulus sp.

Dry Gulch, July 9, 7480 ft., dry sagebrush; and Red Cr., July 10, 7500 ft., grass.

INSECTS

Chrysomelidae (family) continued

Galerucinae

Disonycha quinquevittata Say

Dry Gulch, July 12, 7500 ft., streamside; Lake Fork, July 8, 7220 ft., streamside alders and willows; Soap Cr., July 1, 7200 ft., dry bank; Red Cr., June 29, 7400 ft., streamside; and West Elk Cr., July 3, rocky and sandy beach.

Galeryca sp.

Dry Gulch, July 18, 7400 ft.; Red Cr., June 29, 7420 ft., dry ground; and Tomichi Cr., July 16, 8550 ft., tall swamp grass.

Monoxia sp.

Dry Gulch, July 20, 8600 ft., dry hillside; Lake Fork, July 8, 7220 ft.; and Soap Cr., July 1, 7240 ft., willows.

Trirhabda sp.

Dry Gulch, July 5, 7440 ft., meadow grass, and July 20, 8000 ft., dry sagebrush on hillside; Lake Fork, July 18, 7500 ft., streamside; East Elk Cr., July 20, Chrysothamnus; Red Cr., June 29, 7420 ft., dry ground, alder; West Elk Cr., July 3, 7200 ft., streamside, grass, dry sagebrush; and Beaver Cr., July 4, 7500 ft., streamside.

Halticinae

Blepharida sp.

Lake Fork, July 18, 7500 ft., streamside.

Dysphenges sp.

Red Cr., June 29, 7400 ft., alder near creek.

Cicindelidae (family)

Cicindela longilabris Say

Soap Cr., July 16, 7500 ft., streamside.

Cicindela oregona LeC.

Soap Cr., July 12; Cimarron Cr., July 13.

Cicindela oregona guttifera LeC.

Soap Cr., July 1, 7200 ft., streamside; and West Elk Cr., July 3, 7400 ft. on soil.

Cleridae (family)

Dry Gulch, July 16, dry sagebrush; Lake Fork, July 8, 7220 ft., streamside willows; Red Cr., July 16, 7500 ft., on grass; and West Elk Cr., July 3, 7220 ft., dry road.

Trichodes ornatus Say

Dry Gulch, July 12; and West Elk, July 3, 7400 ft., dry saged Chrysothamnus.

Xenoclerus sp.

Dry Gulch, July 20, 8300 ft., 8600 ft., 1 specimen parasitized by a mite, dry sagebrush; and Red Cr., June 29, 7400 ft., alder near creek.

Callotillus sp.

Dry Gulch, July 16, dry sagebrush.

Coccinellidae (family)

Coccinella transversogutta Fald

Soap Cr., July 12; and Blue Cr., July 12, 8500 ft., willow and alders along streamside.

Exochomus septentrionis Weise

Dry Gulch, July 20, 8300 ft., sagebrush on dry hillside.

INSECTS

Coccinellidae (family) continued

Hippodamia convergens Guer.

Dry Gulch, July 12, 7500 ft.,
streamside; East Elk Cr., July
20, 7480 ft., grass on streamside;
Cebolla Cr., July 7, 7320 ft.,
Salix grass; Red Cr., July 10,
7500 ft., grass and cottonwood;
and West Elk Cr., July 3, 7220
ft., on grass.

Hippodamia parenthesis (Say)

Dry Gulch, July 5, 7440 on grass.

Psyllobora sp.

Dry Gulch, June 29, 7400 ft.,
white top blossom; Lake Fork,
July 18, 7500 ft., streamside;
and Cimarron Cr., July 13,
6780 ft., rocks and gravel.

Cucujidae (family)

Cucujus clavipes Fab.

Meyers Gulch, 7500 ft., rotten
cottonwood.

Curculionidae (family)

Curculioninae

Dry Gulch, July 20, 8300 ft.,
dry sagebrush; Soap Cr., July
6, 7240 ft., willows; West
Elk Cr., July 3, 7400 ft., dry
sagebrush and Chrysothamnus;
Blue Cr., July 12, 8500 ft.;
Steuben Cr., July 5, 7500 ft.,
2 mi. up canyon; and Beaver
Cr., July 4, 7600 ft., stream-
side alder and Salix.

Otiiorhynchinae

West Elk Cr., July 3, 7200 ft.,
shore line; Steuben Cr., July 5,
7500 ft.; and Lake Fork, July 7,
7500 ft., streamside.

Curculionidae (family) continued

Phyllobius sp.

Curecanti Cr., July 19, 7500 ft.,
rasberry composite; and Soap
Cr., July 3.

Rhynchitinae

Rhynchites bicolor Fabr.

Dry Gulch, July 6, 7400 ft.;
West Elk Cr., July 3, 7400 ft.;
and Steuben Cr., July 5, 7600
ft.

Dermestidae (family)

Anthrenus sp.

Blue Cr., July 12, 8500 ft.,
streamside willow and alder.

Dermestes sp.

Dry Gulch, July 12, 7500 ft.;
and Lake Fork, July 18.

Creophilus sp.

Dry Gulch, July 10, 7500 ft.,
deer carcass.

Dryopidae (family)

Helichus sp.

Red Cr., June 29, 7400 ft.,
alder on creek.

Dytiscidae (family)

Hydroporus sp.

Dry Gulch, July 6, 7460 ft.,
streamside alder and willows.

Elateridae (family)

Red Cr., June 29, 7400 ft.,
streamside; Steuben Cr., July 5,
7600 ft.; and Soap Cr., July 1,
7240 ft., riverside damp soil.

Histeridae (family)

Dry Gulch, July 10, 7500 ft.,
deer carcass.

INSECTS

Lampyridae (family)

Lucidota sp.

Soap Cr., July 21, 7200 ft., willows; Cimarron Cr., July 13, 6780 ft., streamside; Red Cr., June 29, 7400 ft., streamside alder, and July 10, 7500, streamside; and Tomichi Creek, July 18, 8550 ft., swamp grass.

Malachiidae (family)

Malachius sp.

Dry Gulch, July 16, dry sagebrush; Lake Fork, July 18, 7500 ft., streamside grass; Soap Cr., July 13; Red Cr., July 10, 7500 ft., streamside Alder and Rosa woodsii; West Elk Cr., July 3, 7110 ft., dry sagebrush; Blue Cr., July 12, 8500 ft., streamside alder and willows; Steuben Cr., July 5, 7480 ft., ground; and Cebolla Cr., July 7, 7320 ft., dry grass.

Meloidae (family)

Epicauta sp.

Dry Gulch, July 16, dry sagebrush.

Nemognatha apicalis LeC.

Dry Gulch, July 5, 7440 ft., meadow grass; and Red Cr., June 29, 7400, Cirsium blossom.

Nemognatha lutea LeC.

Dry Gulch, June 29, Cirsium blossom and July 6; and Lake Fork, July 18, 7500 ft., streamside.

Zonitis sp.

West Elk Creek, July 3, 7400 ft., sagebrush and Chrysothamnus.

Mordellidae (family)

Dry Gulch, July 5, 7440 ft., meadow grass; Lake Fork, July 18, 7500 ft.,

Mordellidae (family) continued

streamside; Soap Cr., July 12, 7600 ft., streamside willow and alder; Cimarron Cr., July 13, 6780 ft., streamside gravel; Red Cr., July 10, 7500 ft., cow parsnip; Blue Cr., July 12, 8500 ft., streamside willow and alder; Steuben Cr., July 5, 7500 ft.; and Beaver Creek, July 4, 7500 ft., willows at streamside.

Mordella sp.

Dry Gulch, June 29, 7400 ft., flower blossoms; Curecanti Cr., July 19, streamside; Lake Fork, July 18, 7500 ft., streamside; Red Cr., July 10, 7500 ft., willow and Rosa woodsii; West Elk Cr., July 3, 7400 ft., sagebrush and Chrysothamnus; and Blue Cr., July 12, 8500 ft., streamside willow and alder.

Nitidulidae (family)

East Elk Creek, July 10, 7460 ft., willows.

Phalacridae (family)

Phalacrus sp.

Dry Gulch, July 5, 7480 ft., meadow grass.

Scarabaeidae (family)

Trichiotinus sp.

Red Cr., June 29, 7400 ft., streamside alder.

Silphidae (family)

Nicrophorus sp.

Dry Gulch, July 10, July 11, and July 12.

Silpha sp.

No information.

INSECTS

Staphylinidae (family)

Dry Gulch, July 10, 7500 ft.; Lake Fork, July 18, 7500 ft., streamside; Soap Creek, July 11, 7225 ft., streamside; Red Cr., July 10, 7350 ft., streamside gravel; and Cebolla Cr., July 7, 7320 ft., grass.

Tenebrionidae (family)

Eleodes sp.

Dry Gulch, July 16, under dry sagebrush; and Red Cr., June 29, 7420 ft., 20 ft., from river.

Trogidae (family)

Trox sp.

Dry Gulch, July 2, campsite.

LEPIDOPTERA (order) Butterflies and moths

Lycaenidae (family)

Plebeinae

Dry Gulch, July 3 (PCM).

Lycaeninae

Curecanti Cr., July 20.

Nymphalidae (family)

Argynnis sp.

Dry Gulch, July 19, composite blossom; Curecanti Cr., July 19, composite blossom; and Lake Fork, July 17, composite blossom.

Basilarchia sp.

Curecanti Cr., July 19, on composite flower; and Meyer Gulch, July 19, streamside vegetation.

Papilionidae (family)

Papilio sp.

Cebolla Cr., July 7, dry grassy area; Red Cr., June 29, streamside thistle; Blue Cr., July 12, streamside thistle; and Curecanti Cr., July 19, streamside thistle.

Papilionidae (family) continued

Parnassius sp.

East Elk Cr., July 6, damp meadow by river side.

Pieridae (family)

Pieris sp.

Dry Gulch, July 3, (PCM); Curecanti Cr., July 19, composite patch; and Cebolla Cr., July 10.

Sphingidae (family)

Pachysphinx sp.

Dry Gulch, July 3.

Smerinthus sp.

Dry Gulch, July 8, on composite flower.

INSECTS

DIPTERA (order) Two-winged flies

Culicidae (family) . . Mosquitoes
Identified by Lewis T. Nielsen

Aedes dorsalis (Meigen) 1830
Dry Gulch, ad., June 28; Dry
Gulch, ad., 7400 ft., July 3;
Steuben Cr., ad., 7740 ft.,
July 5; Cebolla Cr., ad., 7300
ft., July 7; Steuben Cr., 7440
ft., July 7; and Dry Gulch,
ad., July 20.

Aedes fitchii (Felt & Young) 1914
Beaver Cr., ad., July 1.

Aedes increpitus Dyar 1916
Beaver Cr., larvae, July 4.

Aedes melanimon Dyar 1924
Beaver Cr., ad., July 1; Dry
Gulch, ad., 7400 ft., July 3;
Steuben Cr., ad., 7740 ft., July
5; Steuben Cr., ad., 7460 ft.,
July 5; Dry Gulch, ad., July 6;
Cebolla Cr., ad., 7300 ft., July
7; Dry Gulch, ad., 7480 ft., July
9; Blue Cr., ad., 9000 ft., July
12; Blue Cr., ad., 8400 ft., July
12; Soap Cr., ad., 7600 ft., July
13; Dry Gulch, ad., July 14; Soap
Cr., ad., 7500 ft., July 16; and
Dry Gulch, ad., July 19.

Aedes pullatus (Coquillett) 1904
Soap Cr., ad., 7600 ft., July 13;
and Beaver Cr., larvae, July 4.

Aedes spencerii (Theobald) 1901
Dry Gulch, ad., June 28; Beaver
Cr., ad., July 1; West Elk Cr.,
ad., July 3; Beaver Cr., ad.,
July 4; Dry Gulch, ad., July 5;
Steuben Cr., ad., 7500 ft., July
5; Steuben Cr., ad., 7460 ft.,
July 5; and Cebolla Cr., ad.,
7300 ft., July 7.

Culicidae (family) continued

Aedes trivittatus (Coquillett) 1902
Soap Cr., ad., 7240 ft., July 1;
Cebolla Cr., ad., 7300 ft., July
7; and Steuben Cr., ad., 7740
ft., July 7.

Aedes vexans (Meigen) 1830
Beaver Cr., ad., July 1.

Culex tarsalis Coquillett 1896
Soap Cr., larvae, July 1; Soap
Cr., larvae, July 1; and Dry
Gulch, larvae, July 18.

Culiseta impatiens (Walker) 1848
Dry Gulch, ad., July 20; and
Dry Gulch, ad., July 21.

Culiseta incidens (Thomson) 1868
Dry Gulch, ad., July 18; Dry
Gulch, ad., July 19; Dry Gulch,
ad., July 20; and Red Cr., ad.,
July 21; Soap Cr., larvae, July
1; Beaver Cr., larvae, July 4;
Dry Gulch, larvae, July 6; Dry
Gulch, larvae, July 18; Dry
Gulch, larvae, July 21; and
East Elk Cr., larvae, July 21.

Culiseta inornata (Williston) 1893
Soap Cr., July 1; Soap Cr., July
1; Dry Gulch, July 6; and Dry
Gulch, July 21.

Asilidae (family)

Bombomina sp.
Dry Gulch, July 3 (PCM).

Scleropogon sp.
Dry Gulch, July 20, dry sagebrush
hillside.

INSECTS

Conopidae (family)

Physocephala sp.

West Elk Cr., July 3, sagebrush
and Chrysothamnus, 7400 ft.

Cuterebidae (family)

Cuterebra sp.

Dry Gulch, July 20, found dead in
supply box (RWO).

SIPHONAPTERA (order) Fleas

Identification by Dale D. Parker

Ceratopsyllidae (family)

Monopsyllus eumolpi (Baker)

Dry Gulch, July 20, found
under log.

Ceratopsyllidae (family)

Thrassis sp.

Dry Gulch, July 10, found on
squirrel carcass.

Opisocrostis hirsutus (Baker)

Steuben Cr., July 14, found on
Gunnison prairie dog; Steuben
Cr., July 11, found on prairie
dog; and Dry Gulch, July 20,
found on prairie dog.

Pulicidae (family)

Cediopsylla inaequalis (Baker)

Near camp, RM 50, July 29, found
on cottontail; RM 50, July 14,
found on jack rabbit; Dry Gulch,
July 7, found on cottontail; and
Dry Gulch, 1 mi. east Hwy 50,
July 6, found on cottontail.

Diamanus montanus (Baker)

Steuben Cr., July 14, found
on Gunnison prairie dog;
Dry Gulch, July 20, found on
marmot; and Dry Gulch, July 10,
found on squirrel carcass.

HYMENOPTERA (order) Bees, wasps, ants and allies

Apidae (family)

Bombus sp.

Dry Gulch, July 6, and 12, along
streamside; and Curecanti Creek,
July 19, vegetation along stream.

Sphecidae (family) continued

Sceliphron sp.

Dry Gulch, June 30 and July 6,
composite in dry field.

Ichneumonidae (family)

Dry Gulch, July 14.

Megarhyssa sp.

Cimarron Creek, July 12.

Vespididae (family)

Mischocyttarus sp.

Lake Fork, July 15, streamside (CRL)

Polistes sp.

Dry Gulch, July 6.

Mutillidae (family)

Dasymutilla sp.

Gunnison River, July 7, stream-
side, all ♂♂'s.

Stenodynerus sp.

Cebolla Creek, July 7.

Sphecidae (family)

Ammophila (Sphex) sp.

Curecanti Creek, July 19, vegeta-
tion along streamside.

Vespula sp.

Dry Gulch, July 6; and Curecanti
Creek, July 19, vegetation along
streamside.

ARACHNIDA (class) Spiders, mites, ticks, etc.

ACARINA (order) Mites and ticks

Ixodidae (family) . . Hard-bodied ticks

Identified by D. E. Johnson

Dermacentor andersoni Stiles

Sapinero, Hwy 50, July 14, adults found on white-tailed jack rabbits; Steuben Cr. jct., Gunn. R., July 5, adult on willows; Lake Fork jct. Gunnsion R., July 8, adult found on willows; Sapinero, side of Hwy 50, July 12, adult found on porcupine; Dry Gulch, July 7, adult found on cottontail; Curecanti Creek, July 14, adult found on willows; July 1, Beaver Creek, adult found on humans; Gunnison campsite, June 29, nymphs found on Citellus variegatus; two mi. east of campsite, June 30, nymphs found on jack rabbit.

Ixodidae (family) continued

Haemaphysalis leporis-palustris (Packard)

Dry Gulch, July 7, nymphs found on cottontail; Gulch on Hwy 50, July 5, larvae and nymphs found on cottontail.

Ixodes kingi Bishopp

Three mi. west of Willow Creek, July 10, nymphs found on prairie dog; and 1 mi. west Steuben Cr.; nymphs found on Cynomys gunnisoni.

Ixodes marmotae Cooley & Kohls

West Elk Creek, 1 mi. up canyon, July 3, nymphs and adults found on marmot.

MAYFLIES (EPHEMEROPTERA) OF THE CURECANTI RESERVOIR BASINS

GUNNISON RIVER, COLORADO

Delbert W. Argyle

George F. Edmunds

CONTENTS

Introduction	179
Geography	179
Tributaries	179
Habitats	180
Collections	180
Annotations	180
Reference	189

TABLE

1. Distribution of mayflies	182
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University of Utah
Anthropological Papers, No. 59, 1962
Upper Colorado Series, No. 8

MAYFLIES

INTRODUCTION

An ecological study of a portion of the Gunnison River drainage in southwestern Colorado was conducted during the summer of 1961 by the University of Utah Ecological Expedition, supported by the U. S. Bureau of Reclamation, University Research Fund, Division of Biological Sciences, and the National Science Foundation.

The purpose of the study was to record the fauna and flora of the area. This was necessary because of the future inundation of the area by the proposed construction of the three dams of the Curecanti Project, Crystal, Morrow Point, and Blue Mesa dams. This flooding will destroy the habitats of many of the aquatic organisms present in the area. It is also possible that certain species of limited distribution may be completely eliminated. Mayflies appear to be extremely susceptible to such changes in their environment.

GEOGRAPHY

The general drainage system under consideration is that of the South Fork of the Gunnison River. The drainage basin is bounded by high mountains, particularly on the south and southeast where the very high peaks of the "Switzerland of America", (San Juan Mountain Range), rise to a height in excess of 14,000 ft. elevation. To the north are the West Elk Mountains and several high mesas. In the northeast, east, and southeast, out of the study area, are the Elk and Sawatch mountains and the Cochetopa Hills. The area considered here is mainly that which will be inundated by the Morrow Point and Blue Mesa dams. Most of the area is in Gunnison County and is part of the Gunnison National Forest. The Gunnison River in the Morrow Point Basin is deeply intrenched in ancient schists and gneiss of Archean age. This deep gorge is the upper portion of the famous Black Canyon. At the site of the future reservoir formed by Blue Mesa Dam, the river flows through an area of ranch land and, for the most part, is still bedded in Archean biotite schist. This section of the river is one of the most renowned trout fishing areas in the western United States. Numerous fishing resorts are located along the river and most of the ranches have facilities for fishermen. The Gunnison River in the area studied ranges from an elevation of 6760 ft. near the site of the Morrow Point Dam to 7540 ft. near the upper limits of the Blue Mesa Basin.

TRIBUTARIES

Two tributaries which do not directly enter either of the reservoir basins were studied to supply more complete data on the mayfly distribution within the drainage. Cimarron Creek is a highly silted stream entering the Gunnison River immediately below the proposed site of the Morrow Point Dam. This is the only stream studied which is located in Montrose County. Tomichi

MAYFLIES

Creek enters the Gunnison River near the town of Gunnison, Colorado. Because of its higher elevation, 8550 ft., it was studied in an attempt to secure a different fauna than found in the lower area.

The Lake Fork of the Gunnison and Cebolla Creek are the major tributaries of the Gunnison River in the study area. They arise in the San Juan Mountains and follow a north-northwest course to the Gunnison River, roughly paralleling each other. These streams and two others, Soap Creek and West Elk Creek, will have 3 to 5 mi. embayments of the Blue Mesa Reservoir formed in their canyons. The other tributaries will be relatively unaffected by the inundation except near their mouths.

The streams studied and the areas they drain are as follows: Cimarron Creek, Blue Creek, Lake Fork, and Cebolla Creek drain the San Juan Mountains; Myers Gulch and Curecanti Creek drain Black Mesa; Soap Creek drains Sapinero Mesa and West Elk Mountains; West Elk Creek, Red Creek, East Elk Creek, Steuben Creek, and Beaver Creek drain from West Elk Mountains; Tomichi Creek flows from the Cochetopa Hills and south end of Sawatch Mountains.

HABITATS

The habitats in the streams studied are predominately riffle and torrential. The bottom type is generally rubble but in many places small boulders are present. At the junction of some of the tributaries with the Gunnison River, there are a few areas of very deep slow moving water. These have a sand or a mixed sand-gravel bottom. The bottom of the Gunnison River is composed of large rubble and boulders. The difficulty of sampling in the fast deep water of the river is compounded by a great deal of large jagged rock debris which was dumped in the river when the roadbed of a narrow gauge railway was blasted out of the bed rock many years ago.

COLLECTIONS

The collections were made with the use of a 3 ft. square handscreen. This was placed across the current flow and then the stream bottom was disturbed allowing the current to carry the dislodged insects onto the screen. The specimens were removed by hand picking and preserved in 70 per cent ethyl alcohol in four-dram corked vials.

The major collections were made by the University of Utah Ecological Expedition between June 28 and July 19, 1961. Those participating in the collecting were Allen Knight, Jay Richardson, Ernest Riley, and Delbert W. Argyle. Additional records were obtained during preliminary studies of the area by Dr. Arden R. Gaufin. These collections were made on April 1 and June 7-8, 1961. Records from these collections are designated by the

MAYFLIES

initials ARG. A single additional record, obtained from the literature, was included to expand the distribution of one species (Allen and Edmunds, Jr, 1959). It is indicated in the annotations by an asterisk. All records were taken in Gunnison County except those for Cimarron Creek and Gunnison River junction with Cimarron Creek which are in Montrose County. Table 1 shows the distribution of specimens collected.

ANNOTATIONS

Siphonuridae (family)

Siphonurus occidentalis Eaton

Nymphs of this species occurred in ponds and pools originally part of the stream or in heavily vegetated parts of the stream. They are not usually found where fish can prey on them. The species is not abundant because of the relative scarcity of suitable habitat in this area. The single imago collected was taken outside of the expedition headquarters building.

Records - Gunnison R. jct. Soap Cr., 1 nymph, July 1, 7220 ft.; Soap Cr. 100 yds. above Highway 50, 11 nymphs, July 1, 7250 ft.; West Elk Cr. jct. Gunnison R., 3 nymphs, July 3, 7230 ft.; Red Cr. jct. Gunnison R., 1 nymph, June 29, 7280 ft.; Dry Gulch, 100 yds. above Highway 50, July 3, 1 imago; and Tomichi Cr., Highway 114 bridge, 1 nymph, July 11, 8550 ft.

Ameletus sp.

There are at least 4 and probably 5 species represented by these collections. Until they are successfully reared, they cannot be identified. They were collected from riffle areas or quiet water by a riffle. They were often found closer to the bank than to the center of the stream. They were found at only one station in the Gunnison River. Subsequent collections in the spring of 1962 indicate that they are well distributed in the main river.

Records - Myers Gulch jct. Gunnison R., 5 nymphs, June 8, 6950 ft. (ARG); Myers Gulch, at mouth and 100 yds. above, 8 nymphs, July 19, 6950-7000 ft.; Curecanti Cr. jct. Gunnison R., 2 nymphs, June 8, 7050 ft. (ARG); Soap Cr., Highway 50 bridge, 5 nymphs, June 7, 7230 ft. (ARG); Soap Cr., 100 yds. above Highway 50 bridge, 1 nymph, July 1, 7255 ft.; Soap Cr. upper campgrounds, 10 nymphs, July 12, 7510-7875 ft.; West Elk Cr. jct. Gunnison R., 3 nymphs, July 3, 7230 ft.; West Elk Cr., 1 mi. above mouth, 2 nymphs, July 3, 7360 ft.; Gunnison R. jct. Red Cr., 2 nymphs, June 29, 7260 ft.; Red Cr., 1 mi. above mouth, 1 nymph, July 10, 7500 ft.; East Elk Cr., jct. Gunnison R., 2 nymphs, June 7, 7335 ft. (ARG); Steuben Cr., lower 1 mi. of stream, 29 nymphs, July 5, 7460-7660 ft.; Beaver Cr. jct. Gunnison R., 4 nymphs, June 7, 7540 ft. (ARG); Beaver Cr., 100 yds. above mouth, 1 nymph, July 4, 7540 ft.; Beaver Cr., Highway 50 bridge, 2 nymphs, April 1, 7550 ft. (ARG); and Beaver Cr., 150 yds. above Highway 50 bridge, 4 nymphs, June 7, 7560 ft. (ARG).

Table 1. Distribution of mayflies in the Curecanti region.

	Cimarron River	Gunnison River, 6760'	Myers Gulch	Curecanti Creek	Blue Creek	Lake Fork, Gunnison R.	Gunnison River, 7210'	Soap Creek	Gunnison River, 7215'	West Elk Creek	Gunnison River, 7230'	Red Creek	Gunnison River, 7300'	Cebolla Creek	Gunnison R, Dry Gulch	East Elk Creek	Steuben Creek	Gunnison River, 7480'	Beaver Creek	Gunnison River, 7540'	Tomichi Creek
SIPHONURIDAE																					
<u>Siphonurus occidentalis</u>																					X
<u>Ameletus</u> sp.			X	X	X			X	X	X		X	X			X	X		X		
BAETIDAE																					
<u>Baetis</u> sp.	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
<u>Pseudocloeon</u> sp.	X				X				X	X											
<u>Centroptilum</u> sp.																					X
HEPTAGENIIDAE																					
<u>Heptagenia solitaria</u>	X	X					X		X	X			X	X	X		X				
<u>Heptagenia</u> spp.	X	X					X	X			X	X	X	X	X			X	X		X
<u>Cinygmula</u> sp.		X	X		X	X		X		X							X		X		
<u>Rhithrogena robusta</u>			X																		
<u>Rhithrogena</u> sp.	X	X		X	X			X		X			X	X	X		X		X		
<u>Epeorus albertae</u>		X		X	X			X		X		X			X		X	X	X	X	
<u>Epeorus longimanus</u>	X		X	X	X			X		X		X				X	X	X	X		
EPHEMERELLIDAE																					
<u>Ephemerella doddsi</u>			X							X						X					
<u>Ephemerella grandis</u>	X		X	X	X			X		X						X	X	X	X		
<u>Ephemerella hecuba hecuba</u>							X			X				X			X			X	
<u>Ephemerella inermis</u>	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
<u>Ephemerella margarita</u>							X							X							X
<u>Ephemerella tibialis</u>			X							X		X	X								X
TRICORYTHIDIDAE																					
<u>Tricorythodes minutus</u>							X			X	X			X							X
LEPTOPHLEBIIDAE																					
<u>Paraleptophlebia pallipes</u>																X					
<u>Paraleptophlebia</u> sp.			X	X	X			X		X			X						X		

MAYFLIES

Baetidae (family)

Baetis sp.

The nymphs were not identified to species because of the difficulty in doing so without reared adults. There are probably 4 or 5 species represented. They occurred in numbers at all collection stations. Because of this complete distribution, the records have not been listed.

Pseudocloeon sp.

All of the specimens collected represent 1 species whose identity is uncertain. They are probably widespread in the Gunnison River. The few records in the side streams compared to the intensive collecting done indicate that this is not the preferred habitat. Young specimens were probably collected from the river but were not separated from Baetis sp. because of the very detailed examination required upon young nymphs.

Records - Cimarron Cr. jct. Gunnison R., 1 nymph, July 13, 6760 ft.; Lake Fork jct. Gunnison R., 3 nymphs, July 8, 7210 ft.; Lake Fork Cr., 200 yds. above mouth, 3 nymphs, July 8, 7215 ft.; Gunnison R. jct. Soap Cr., 1 nymph, July 1, 7220 ft.; and West Elk Cr., 1.5 mi. above mouth, 5 nymphs, July 3, 7420 ft.

Centroptilum sp.

The members of this genus were restricted to cold waters at high elevations. The single record is from the highest station collected during the study and appears to support the known distribution pattern.

Record - Tomichi Cr., Highway 114 bridge, 2 nymphs, July 11, 8550 ft.

Heptageniidae (family)

Heptagenia solitaria McDunnough

This species was found distributed between 6760 and 7495 ft. elevation. It appears to be restricted to the river with a few ingresses into side streams and is most abundant in very rapid water riffles. The three streams in which it attains some elevation all have a high velocity.

Records - Gunnison R. jct. Cimarron Cr., 7 nymphs, July 13, 6760 ft.; Cimarron Cr., 1.1 mi. below Cimarron, 1 nymph, July 13, 6940 ft.; Gunnison R. jct. Lake Fork, 1 imago, 15 nymphs, July 8, 7210 ft.; Gunnison R. jct. Soap Creek, 5 nymphs, July 1, 7220 ft.; West Elk Cr. jct. Gunnison R., 1 nymph, July 3, 7225 ft.; West Elk Cr., 600 yds., 1 mi. above mouth, 20 nymphs, July 3, 7260 ft.; Cebolla Cr., 200 yds. above mouth, 8 nymphs, July 7, 7320 ft.; Cebolla Cr., 2 mi. above mouth, 12 nymphs, July 7, 7295 ft.; Gunnison R. jct. Dry Gulch, 1 nymph, June 28, 7330 ft.; and Steuben Cr. jct. Gunnison R., 2 nymphs, July 5, 7480 ft.

Heptagenia spp.

The nymphs of at least 2 species are included here. Rearing of the nymphs will be necessary to establish the identity of the nymphs. The nymphs were found between 6760 and 8550 ft. elevation. They occurred in riffle areas but in some cases were found in the slow deep water at the confluence of a stream with the Gunnison River.

MAYFLIES

Heptageniidae (family) continued

Heptagenia spp. (continued)

Records - Cimarron Cr. jct. Gunnison R., 10 nymphs, July 13, 6760 ft.; Cimarron Cr., $\frac{1}{2}$ mi. below Cimarron, Colo., 2 nymphs, July 13, 6905 ft.; Gunnison R. jct. Lake Fork, 10 nymphs, July 8, 7210 ft.; Soap Cr., area near mouth, 18 nymphs, July 1, 7220-7240 ft.; Gunnison R. jct. West Elk, 17 nymphs, July 3, 7225 ft.; Gunnison R. jct. Red Cr., 16 nymphs, June 29, 7260 ft.; Red Cr., 50-100 yds. above mouth, 6 nymphs, June 29, 7300 ft.; Red Cr., 1 mi. above Highway 50, 6 nymphs, July 10, 7500 ft.; Cebolla Cr. jct. Gunnison R., 3 nymphs, July 7, 7320 ft.; Gunnison R. jct. Dry Gulch, 1 nymph, June 28, 7330 ft.; Gunnison R. jct. Steuben Cr., 4 nymphs, July 5, 7480 ft.; Gunnison R. jct. Beaver Cr., 18 nymphs, July 4, 7540 ft.; Beaver Cr., 300 yds. above mouth, 3 nymphs, July 4, 7555 ft.; and Tomichi Cr., Highway 114 bridge, 21 nymphs, July 11, 8550 ft.

Cinygmula sp.

The species represented in this group are unidentifiable. The taxonomy of the nymphs in this genus is poorly known, and the reared species are exceedingly similar. The specimens were taken mainly from fast riffle areas not far from the shore.

Records - Gunnison R. jct. Cimarron Cr., 1 nymph, July 13, 6760 ft.; Myers Gulch, 100 yds. above mouth, 15 nymphs, July 19, 7000 ft.; Blue Cr., 1 mi. above Highway 50 bridge, 1 nymph, July 11, 8360 ft.; Lake Fork, 5 mi. above mouth, 6 nymphs, July 18, 7420 ft.; Soap Cr., near mouth, 19 nymphs, July 1, 7225 ft.; Soap Cr., upper campgrounds, 5 nymphs, July 12, 7750-7875 ft.; West Elk Cr. mouth to 1.5 mi. above, 37 nymphs, July 3, 7220-7420 ft.; Steuben Cr., 1 mi. above mouth, 6 nymphs, July 5, 7660 ft.; and Beaver Cr., 200 yds. above mouth, 1 nymph, July 4, 7550 ft.

Rhithrogena robusta Dodds

The large nymphs have a sclerotized line on the under side of its gills and lack the small dorsal lobe on each gill that is found in the hageni group. Only 1 specimen was collected. The species is either uncommon in this drainage or the specimen may have been one of the few remaining at the end of an earlier emergence. The habitat was torrential.

Record - Myers Gulch, jct. Gunnison R., 1 nymph, June 8, 6950 ft. (ARG).

Rhithrogena sp.

These specimens may represent more than one species. They are identifiable only as members of the hageni group represented in Colorado by such species as R. hageni (=doddsi), R. morrisoni and R. undulata. All of these species have a small lobe projecting from the inner margin of the gill. The specimens were all found in the typical riffle habitat.

Records - Gunnison R. jct. Cimarron Cr., 6 nymphs, July 13, 6760 ft.; Cimarron Cr. at Cimarron, Colo., 1 nymph, June 8, 6930 ft. (ARG); Curecanti Cr. jct. Gunnison R., 3 nymphs, June 8, 7050 ft. (ARG); Blue Cr., Highway 50 bridge and 1 mi. above, 81 nymphs, July 11, 8360 ft.; Soap Cr. jct. Gunnison R., 1 nymph, July 1, 7220 ft.; Soap Cr., upper campgrounds,

MAYFLIES

Heptageniidae (family) continued

Rhithrogena sp. (continued)

7 nymphs, July 12, 7510-7875 ft.; West Elk Cr. mouth and 1 mi. above, 7 nymphs, July 3, 7230-7360 ft.; Cebolla Cr. mouth to 2 mi. above, 8 nymphs, July 7, 7320-7495 ft.; Gunnison R. jct. Dry Gulch, 1 nymph, June 28, 7335 ft.; Steuben Cr. jct. Gunnison R., 7 nymphs, June 7, 7480 ft. (ARG); Steuben Cr. jct. Gunnison R., 8 nymphs, July 5, 7480 ft.; Beaver Cr., Highway 50 bridge, 3 nymphs, April 1, 7555 ft. (ARG); Beaver Cr., jct. Gunnison R., 4 nymphs, June 7, 7540 ft. (ARG); and Beaver Cr., 150 yds. above Highway 50, 4 nymphs, June 7, 7560 ft. (ARG).

Epeorus albertae McDunnough

The nymphs were found clinging to the surface of rubble stones in riffle areas. They are generally distributed at lower elevations in the Colorado River system. These collections probably represent the upper limits of their altitudinal distribution in this particular part of the Upper Colorado River Basin.

Records - Gunnison R. jct. Cimarron Cr., 5 nymphs, July 13, 6760 ft.; Curecanti Cr. jct. Gunnison R., 6 nymphs, July 19, 7050 ft.; Curecanti Cr., 500 yds. above mouth, 9 nymphs, July 19, 7360 ft.; Blue Cr. Highway 50 bridge, 56 nymphs, July 11, 8300 ft.; Soap Cr. Highway 50 bridge to mouth, 74 nymphs, July 1, 7220-7245 ft.; Soap Cr., upper campgrounds, 22 nymphs, July 12, 7510-7750 ft.; West Elk Cr. jct. Gunnison R., 38 nymphs, July 3, 7230 ft.; West Elk Cr., 600 yds. above mouth, 2 nymphs, June 7, 7280 ft. (ARG); West Elk Cr., 1 mi. above mouth, 12 nymphs, July 3, 7360 ft.; Gunnison R. jct. Red Cr., 6 nymphs, June 29, 7260 ft.; Red Cr., area near mouth, 14 nymphs, June 29, about 7300 ft.; Red Cr., 1 mi. above Highway 50, 6 nymphs, July 10, 7500 ft.; Gunnison R. jct. Dry Gulch, 2 nymphs, June 28, 7335 ft.; Steuben Cr. jct. Gunnison R., 16 nymphs, July 5, 7480 ft.; Steuben Cr., 1 mi. above mouth, 12 nymphs, July 5, 7560 ft.; Beaver Cr. jct. Gunnison R., 89 nymphs, July 4, about 7540 ft.; and Beaver Cr., 100-300 yds. above mouth, 125 nymphs, July 4, 7550 ft.

Epeorus longimannus Eaton

This species is often found with E. albertae in riffle areas. It seems, however, to be more tolerant of cold water and usually achieves greater elevation in its distribution. In this particular drainage, it was found at only one station above the distribution of E. albertae. In Blue Creek it was found at 8360 ft., while E. albertae reached only 8300 ft. in the same stream.

Records - Cimarron Cr., $\frac{1}{4}$ mi. below Cimarron, Colo., 1 nymph, July 13, 6905 ft.; Myers Gulch jct. Gunnison R., 14 nymphs, June 8, 6950 ft. (ARG); Myers Gulch, 100 yds. above mouth, 29 nymphs, July 19, 7000 ft.; Curecanti Cr. jct. Gunnison R., 4 nymphs, June 8, 7050 ft. (ARG); Curecanti Cr. jct. Gunnison R., 8 nymphs, July 19, 7050 ft.; Curecanti Cr., 500 yds. above mouth, 3 nymphs, July 19, 7360 ft.; Blue Cr., Highway 50 bridge, 23 nymphs, July 11, 8300 ft.; Blue Cr., 1 mi. above Highway 50 bridge, 50 nymphs, July 11, 8360 ft.; Soap Cr., area near mouth, 22 nymphs, July 1, 7220-7260

MAYFLIES

Heptageniidae (family) continued

Epeorus longimannus (continued)

ft.; Soap Cr., upper campgrounds, 22 nymphs, July 12, 7510-7875 ft.; West Elk Cr. jct. Gunnison R., 10 nymphs, July 3, 7230 ft.; West Elk Cr., 1 mi. above mouth, 11 nymphs, July 3, 7360 ft.; West Elk Cr., 1.5 mi. above mouth, 53 nymphs, July 3, 7420 ft.; Red Cr., area near mouth, 18 nymphs, June 29, 7300 ft.; Red Cr., 1 mi. above Highway 50, 7 nymphs, July 10, 7500 ft.; Red Cr., 2 mi. above mouth, 12 nymphs, July 10, 7540 ft.; East Elk Cr. jct. Gunnison R., 8 nymphs, June 7, 7335 ft. (ARG); Steuben Cr., jct. Gunnison R., 5 nymphs, June 7, 7480 ft. (ARG); Steuben Cr. jct. Gunnison R., 13 nymphs, July 5, 7480 ft.; Steuben Cr., $\frac{1}{2}$ mi. above mouth, 40 nymphs, July 5, 7540 ft.; Steuben Cr., 1 mi. above mouth, 12 nymphs, July 5, 7660 ft.; and Beaver Cr. jct. Gunnison R., 9 nymphs, July 4, 7540 ft.

Ephemerellidae (family)

Ephemerella doddsi Needham

This species was uncommon in the collection. It is particularly well adapted to the torrential habitat occurring in several streams in this drainage, but it was only taken from three collection streams. Most of the specimens may have emerged before the intensive July collections.

Records - Myers Gulch, jct. Gunnison R., 5 nymphs, June 8, 6950 ft. (ARG); Myers Gulch, 100 yds. above mouth, 2 nymphs, July 19, 700 ft.; West Elk Cr. jct. Gunnison R., 1 nymph, July 3, 7230 ft.; West Elk Cr., 1 mi. above mouth, 1 nymph, July 3, 7360 ft.; and East Elk Cr. jct. Gunnison R., 1 nymph, June 7, 7335 ft. (ARG).

Ephemerella grandis grandis Eaton

This species is quite common in most streams in the area. The emergence of this species concludes in the first part of July with the principal emergence taking place during the last two weeks in June. The nymphs were taken in riffle areas, generally close to the bank.

Records - Cimarron Cr. at Cimarron, Colo., 11 nymphs, June 8, 6930 ft. (ARG); Myers Gulch, jct. Gunnison R., 7 nymphs, June 8, 6950 ft. (ARG); Curecanti Cr. jct. Gunnison R., 2 nymphs, June 8, 7050 ft. (ARG); Blue Cr. Highway 50 bridge, 8 nymphs, July 11, 8300 ft.; Blue Cr., 1 mi. above Highway 50 bridge, 6 nymphs, July 11, 8360 ft.; Soap Cr. Highway 50 bridge, 1 nymph, April 1, 7230 ft. (ARG); Soap Cr., Highway 50 bridge, 2 nymphs, June 7, 7230 ft. (ARG); Soap Cr. near Highway 50 bridge, 2 nymphs, July 1, 7260 ft.; Soap Cr. upper campgrounds, 8 nymphs, July 12, 7750-7875 ft.; West Elk Cr., 1.5 mi. above mouth, 1 nymph, July 3, 7420 ft.; East Elk Cr. jct. Gunnison R., 3 nymphs, June 7, 7335 ft. (ARG); Steuben Cr. jct. Gunnison R., 1 nymph, July 5, 7480 ft.; Steuben Cr. jct. Gunnison R., 5 nymphs, June 7, 7480 ft. (ARG); Steuben Cr., 1 mi. above mouth, 7 nymphs, July 5, 7660 ft.; Beaver Cr. jct. Gunnison R., 2 nymphs, June 7, 7540 ft. (ARG); Beaver Cr. Highway 50 bridge, 13 nymphs, April 1, 7555 ft. (ARG); and Beaver Cr., $\frac{1}{4}$ mi. above mouth, 4 nymphs, June 7, 7560 ft. (ARG).

MAYFLIES

Ephemerellidae (family)

Ephemerella hecuba hecuba Eaton

The records of this species appear to indicate that it is confined to the main Gunnison and the larger tributaries. It is probably more abundant than the records show because the river was not worked with the intensity that the streams were, mainly because of its inaccessibility.

Records - Lake Fork jct. Gunnison R., 2 nymphs, July 8, 7210 ft.; West Elk Cr., 100 ft. above mouth, 1 nymph, July 3, 7230 ft.; Cebolla Cr., 200 yds. above mouth, 2 nymphs, July 7, 7320 ft.; Gunnison R., Iola, Aug. 16, 1949, 7430 ft. (H. Higgins*); Steuben Cr. jct. Gunnison R., 1 nymph, July 5, 7480 ft.; and Beaver Cr. jct. Gunnison R., 2 nymphs, July 4, 7540 ft.

Ephemerella inermis Eaton

This is the most widespread species in the entire drainage. The nymphs were collected from all of the streams and all but a few of the collection stations. All specimen of this species complex are being studied by R. K. Allen and G. F. Edmunds who are attempting to revise this taxonomically difficult complex. One specimen seems to be different than the other nymphs collected.

Records - Cimarron Cr. jct. Gunnison R., 19 nymphs, July 13, 6760 ft.; Cimarron Cr., $\frac{1}{4}$ mi. below Cimarron, Colo., 3 nymphs, July 13, 6905 ft.; Cimarron Cr. at Cimarron, Colo., 2 nymphs, June 8, 6930 ft. (ARG); Myers Gulch jct. Gunnison R., 7 nymphs, June 8, 6950 ft. (ARG); Curecanti Cr. jct. Gunnison R., 3 nymphs, June 8, 7050 ft. (ARG); Blue Cr., 1 mi. above Highway 50 bridge, 1 nymph, July 11, 8360 ft.; Lake Fork jct. Gunnison R. 58 nymphs, July 8, 7210 ft.; Lake Fork, 5 mi. above mouth, 28 nymphs, July 18, 7420 ft.; Soap Cr., near mouth, 190 nymphs, July 1, 7225 ft.; Soap Cr., Highway 50 bridge, 1 nymph, June 7, 7230 ft. (ARG); Soap Cr., upper campgrounds, 12 nymphs, July 12, 7510-7875 ft.; West Elk Cr. jct. Gunnison R., 98 nymphs, July 3, 7230 ft.; West Elk Cr., 0.3 mi. above mouth, 30 nymphs, July 3, 7280 ft.; West Elk Cr., 1.5 mi. above mouth, 18 nymphs, July 3, 7420 ft.; Red Cr. jct. Gunnison R., 10 nymphs, June 29, 7280 ft.; Cebolla Cr., near mouth, 9 nymphs, July 7, 7320 ft.; Cebolla Cr. 2 mi. above mouth, 10 nymphs, July 7, 7495 ft.; Dry Gulch jct. Gunnison R., 16 nymphs, June 28, 7330 ft.; East Elk Cr. jct. Gunnison R., 1 nymph, June 7, 7335 ft. (ARG); Steuben Cr. jct. Gunnison R., 3 nymphs, June 7, 7480 ft. (ARG); Steuben Cr. jct. Gunnison R., 120 nymphs, July 5, 7480 ft.; Steuben Cr., $\frac{1}{2}$ -1 mi. above mouth, 2 nymphs, July 5, 7540-7660 ft.; Beaver Cr. jct. Gunnison R., 3 nymphs, June 7, 7540 ft. (ARG); Beaver Cr. jct. Gunnison R., 120 nymphs, July 4, 7540 ft.; Beaver Cr., 200 yds. above mouth, 1 nymph, July 4, 7550 ft.; Beaver Cr., 150 yds. above Highway 50, 9 nymphs, June 7, 7560 ft. (ARG); and Tomichi Cr., Highway 114 bridge, 58 nymphs, July 11, 8550 ft.

MAYFLIES

Ephemerellidae (family) continued

Ephemerella margarita Needham

The nymphs of this species were very young and many of them were probably not detected in hand screen collections.

Records - Lake Fork jct. Gunnison R., 2 nymphs, July 8, 7210 ft.; Cebolla Cr. jct. Gunnison R., 2 nymphs, July 7, 7320 ft.; Cebolla Cr., 2 mi. above mouth, 1 nymph, July 7, 7495 ft.; and Tomichi Cr., Highway 114 bridge, 4 nymphs, July 11, 8550 ft.

Ephemerella tibialis McDunnough

This species is recorded from three streams. The greatest concentration of them was found in a torrential habitat in association with a large amount of algae in the rocks.

Records - Myers Gulch, 199 yds. above mouth, 2 nymphs, July 19, 7000 ft.; West Elk Cr. area near mouth, 2 nymphs, July 3, 7225 ft.; West Elk Cr., 1.5 mi. above mouth, 1 nymph, July 3, 7420 ft.; Red Cr. jct. Gunnison R., 18 nymphs, June 29, about 7280 ft.; Red Cr., above Highway 50 culvert, 1 nymph, July 10, 7425 ft.; and Red Cr., 1 mi. above Highway 50, 1 nymph, July 1, 7500 ft.

Tricorythididae (family)

Tricorythodes minutus Traver

Nymphs of this species were found predominately in slow deep water or in the larger tributaries. They are found principally where a moderate current moves through vegetated areas or areas where organic detritus is deposited.

Records - Lake Fork jct. Gunnison R., 2 nymphs July 8, 7210 ft.; West Elk Cr. jct. Gunnison R., 1 nymph, July 3, 7225 ft.; West Elk Cr., 1 mi. above mouth, 2 nymphs, July 3, 7360 ft.; Cebolla Cr. jct. Gunnison R., 2 nymphs, July 7, 7320 ft.; Cebolla Cr., 2 mi. above mouth, 1 nymph, July 7, 7495 ft.; and Tomichi Cr., Highway 114 bridge, 12 nymphs, July 11, 8550 ft.

Leptophlebiidae (family)

Paraleptophlebia pallipes (Hagen)

Only one station revealed the presence of this species. The record is from an early collection and the size of the nymphs plus the known biology of this species indicates that the main emergence had passed before intensive collections were made. The specimens were from a riffle area near the bank.

Records - East Elk Cr. jct. Gunnison R., 2 nymphs, June 7, 7335 ft.

MAYFLIES

Leptophlebiidae (family)

Paraleptophlebia sp.

The nymphs recorded here are probably P. debilis Walker, but their immature condition precludes certain identity. They were in relatively small numbers, although well distributed in the area. A few specimens were taken from pool environments but the majority came from riffles. All specimens were from tributaries to the Gunnison River.

Records - Myers Gulch, jct. Gunnison R., 3 nymphs, June 8, 6950 ft. (ARG); Myers Gulch jct. Gunnison R., 1 nymph, July 19, 6950 ft.; Curecanti Cr. jct. Gunnison R., 1 nymph, June 8, 7050 ft. (ARG); Curecanti Cr., 300 yds. above mouth, 2 nymphs, July 19, 7320 ft.; Blue Cr., Highway 50 bridge, 9 nymphs, July 11, 8300 ft.; Blue Cr., 1 mi. above Highway 50 bridge, 2 nymphs, July 11, 8360 ft.; Soap Cr., Highway 50 bridge, 1 nymph, July 1, 7230 ft.; Soap Cr., commissary campground, 1 nymph, July 12, 7875 ft.; West Elk Cr., area near mouth, 6 nymphs, July 3, 7230 ft.; Cebolla Cr. jct. Gunnison R. 2 nymphs, July 7, 7320 ft.; Cebolla Cr., 2 mi. above mouth, 2 nymphs, July 7, 7495 ft.; and Beaver Cr., mouth and 300 yds. above, 2 nymphs, July 4, 7540-7555 ft.

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BAT FLIES OF THE CURECANTI AREA OF GUNNISON COUNTY, COLORADO

A. Dean Stock

This paper presents a report of the bat flies collected on the University of Utah Ecological Expedition of 1961, under the overall direction of Angus M. Woodbury and field direction of Stephen D. Durrant. Of a total of 13 bats collected, only five specimens of four species of Myotis carried bat flies and no flies were found on seven specimens of Myotis and one specimen of Eptesicus. In the field, the bats were collected by shooting and were examined for ectoparasites shortly after they were taken and again as they were being skinned. The 13 flies taken were all of the same species, Basilia forcipata Ferris (Nycteribiidae). This species is a common ectoparasite of Myotis in North America.

A list of bat specimens examined and flies taken follows:

Myotis lucifugus carissima Thomas Big myotis

One specimen: Dry Gulch, near junction with Gunnison River, 7450 ft., July 20, with 2♂♂ 1♀ flies.

Myotis evotis evotis (H. Allen) Long-eared myotis

Three specimens: One at junction of Dry Gulch, and Gunnison River, 7440 ft., July 7, with 1♀ fly; 1 near junction at Red Creek and Gunnison River, 7350 ft., July 10, negative; and 1 at junction of Red Creek and Gunnison River, 7300 ft., July 11 with 2♂♂ 2♀♀ flies.

Myotis volans interior Miller Hairy-winged myotis

Three specimens: One near junction of Dry Gulch and Gunnison River, 7450 ft., July 20, negative; 2 at junction of Dry Gulch and Gunnison River, 7440 ft., July 20, 1 negative, and 1 with 3♀♀ flies.

Myotis subulatus melanorhinus (Merriam) Small-footed myotis

Five specimens: Two near junction of Dry Gulch and Gunnison River, 7450 ft., July 7, both negative; 1 at junction of Red Creek and Gunnison River, 7340 ft., July 9, with 2♀♀ flies; and 2 at junction Dry Gulch and Gunnison River, 7440 ft., July 21, both negative.

Eptesicus fuscus pallidus Young Big brown bat

One specimen: Junction of Dry Gulch and Gunnison River, 7440 ft., July 7, negative.

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VERTEBRATES

AMPHIBIANS AND REPTILES

OF THE CURECANTI AREA OF COLORADO

A. Dean Stock

CONTENTS

Introduction	192
Annotated list	192
Literature consulted	193

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AMPHIBIANS AND REPTILES

INTRODUCTION

During the summer of 1961, from June 26 to July 22, a crew of 15 men from the University of Utah conducted an ecological survey of the three reservoir basins included under the Curecanti project on the Gunnison River in Gunnison County, Colorado. The survey was primarily a quantitative botanical survey conducted for the Bureau of Reclamation, but through assistance from the National Science Foundation and the University of Utah Research Fund, the survey was expanded to include studies of the fauna of the area. The survey was under the overall direction of Angus M. Woodbury with field work supervised by Stephen D. Durrant and Seville Flowers.

This paper deals with the amphibians and reptiles collected in the course of the expedition. The specimens are now in the Herpetology Collection, University of Utah.

Reptiles and amphibians were scarce in the area, both in numbers of species and individuals. The area has little rainfall and is very mountainous, being above the preferred altitude range of most species. Distribution maps of many reptiles leave this area near the western edge of the Continental Divide blank. Amphibians do not seem to be as much restricted as the reptiles and our representation of these may not be complete for the area.

ANNOTATED LIST

Amphibia (class) Amphibians

Rana pipiens Schreber 1782 Lopard frog

Five specimens as follows: Junction of Dry Gulch and Gunnison River, 7440 ft., June 30, UU3768; junction of Red Creek and Gunnison River, 7350 ft., July 2, UU3769; Lake Fork of the Gunnison, 7450 ft., July 15, UU3772; Black Canyon of the Gunnison, junction of Cimarron Creek and Gunnison River, 7100 ft., July 19, UU3770; July 10, UU3771. This was the only amphibian collected during the survey and was fairly common along the numerous streams and in the marsh areas along the Gunnison River. Nearly mature tadpoles were found in the numerous beaver ponds along Red Creek.

Reptilia (class) Reptiles

Sceloporus undulatus elongatus Stejneger 1890 . . . Northern plateau lizard

Five specimens as follows: Junction of Red Creek and Gunnison River, 7300 ft., July 9, UU3776; 3/4 mi. north of junction of Dry Gulch and Gunnison River, 7460 ft., July 20, UU 3773; 1½ mi. northwest of junction of Dry Gulch and Gunnison River, 8100 ft., July 4, UU3774; 1 mi. north of junction of Dry Gulch and Gunnison River, 8300 ft., July 4, UU3775; junction of Cimarron Creek and Gunnison River, 7170 ft., July 19, UU3777.

AMPHIBIANS AND REPTILES

Sceloporus undulatus elongatus (continued)

This species was nowhere common, being limited to rocky outcrops on the mesas, and the canyon walls of the Gunnison River. Our specimens show the high dorsal scale count typical of this subspecies. Dorsal scale counts on this race are nearly identical to the dorsal scale counts of the specimens of Sceloporus graciosus found in the same area, making the two difficult to separate when small.

Sceloporus graciosus graciosus B. & G. 1852. . . . Great Basin sagebrush lizard

Three specimens as follows: Black Canyon of the Gunnison, 3/4 mi. west Sapinero, 7500 ft., UU3778; Black Canyon of the Gunnison at junction of Cimarron Creek and Gunnison River, 7180 ft., July 19, UU3780; and same, 7150 ft., July 19, UU3779.

This species was less common than the preceding one, but was less restricted to rocky areas. However, it too seemed more restricted to rocky ledges than at other localities I have collected it. All of our specimens are from the Black Canyon of the Gunnison in an area containing pinyon pine.

Thamnophis elegans vagrans B. & G. 1853 Wandering garter snake

Seven specimens as follows: 1/4 mi. north junction of Red Creek and Gunnison River, 7360 ft., July 2, UU3785; 1 mi. north junction of Steuben Creek and Gunnison River, 7400 ft., July 6, UU3786; Willow Creek, 1 1/2 mi. south Elkhorn Bridge, 7540 ft., July 7, UU3787; East Elk Creek, 1 mi. north Gunnison River, 7430 ft., July 1, UU3784; junction of Dry Gulch and Gunnison River, 7440 ft., June 30, UU3782, UU 3783; and June 28, UU3781. This was the only species of snake seen or collected by the survey. Specimens were often common along small grassy streams and were sometimes encountered some distance from water on dry sagebrush slopes.

There are a few other species of snakes which may occur in the area, but daily inspection of a considerable length of well traveled highway running through the area failed to yield any evidence of their presence.

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BIRDS OF THE CURECANTI AREA IN COLORADO, 1961

A. Dean Stock

CONTENTS

Introduction	196
Avian habitats	197
Annotations	199
Literature cited	221

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BIRDS

INTRODUCTION

From June 26 to July 22, 1961, a crew of 15 men from the Division of Biological Sciences, University of Utah, conducted an ecological survey of the three reservoir basins, included under the Curecanti Project, on the Gunnison River in Gunnison County, Colorado. The survey was primarily a quantitative botanical survey conducted to satisfy the needs of the United States Bureau of Reclamation. It was under the overall direction of Angus M. Woodbury with supervision of the field work by Stephen D. Durrant and Seville Flowers. Through assistance from the University of Utah Research Fund and the National Science Foundation, the survey was expanded to include studies of the fauna of the area.

This paper presents an annotated list of the birds of the area prepared from 1) collections of specimens, 2) personal observations and 3) available literature records. In addition to the published records for the area, Dr. A. Sidney Hyde of Western State College, Gunnison, Colorado, supplied me with his mimeographed checklist of the resident and summer birds of Gunnison County, Colorado. This checklist was used in preparation of this report. My thanks are extended to the members of the crew who facilitated these studies by reporting interesting bird observations to me.

TOPOGRAPHY, LIFE ZONES AND THE AVIFAUNA

The region covered in this report is extremely mountainous, located immediately west of the Continental Divide in Gunnison County, Colorado. There are several summits near the proposed reservoir sites of elevations in excess of 12,000 feet, and the lowest elevation considered is 6,800 feet. Generally, the region is characterized by rather long winters, and deep snows on the mountains. The summers are generally cool. The long, cold, winters force the birds down from the mountains into the Gunnison River Valley, thus making an ever changing display of the avian fauna. As I was present only during the summer months, the records of wintering birds are taken entirely from the literature.

The life zones in the area range from the upper part of the Upper Sonoran through the Canadian and Hudsonian to the Artic-Alpine on the nearby peaks. The Upper Sonoran consists mainly of pygmy forest of juniper and pinyon pine, above which are scattered areas of vegetation typical of the Transition Zone, composed of some extensive stands of yellow pine. Often Upper Sonoran and Transition vegetational types are mixed and occur up to 7500 ft., Canadian Zone up to 10,000 ft., Hudsonian to 12,000 ft., and above this is Artic-Alpine timberline.

These vegetational types are often mingled to the extent that the vegetation present is characteristic of no single zone. Thus the topography of this area furnishes the proper conditions for plants that are typical of different

BIRDS

altitudes and habitats to grow in close proximity to each other. Often aspen, narrowleaf cottonwood, Douglas fir, yellow pine, blue spruce, alder and other plants representative of different zones were found growing side by side at elevations as low as 7400 ft. This mixture of zonal vegetational types is further complicated by a merging of vegetation characteristic of hillside, streamside, terrace and farmland.

This merging of vegetational types directly influences bird population in the area and often results in bringing birds of different ecological requirements into close contact with each other. It is often difficult to recognize more than two zones of bird distribution, plains and mountains.

I have listed 165 species of birds from the area, of which 63 are considered as permanent residents, 71 as summer residents and 31 as winter residents, migrants or casual as indicated.

Several species of birds known to occur immediately to the north of this area such as lesser snow goose, white pelican, double-crested cormorant, blue jay, marbled godwit, black-necked stilt, black-bellied plover and avocet are not listed but may occur along the Gunnison River during migration. The list of birds from this area will undoubtedly be enlarged by future collecting and study, especially in fall and winter.

HABITAT TYPES

Many different habitats for birds exist in this diverse area. They are often quite mixed and localized. Each has some birds restricted to it, while many birds ranged through more than one, both in nesting and feeding. The habitats are:

Open water. The large Gunnison River and its many tributaries form an extensive open water habitat for such birds as the eared grebe, American merganser and several species of ducks. In addition there are many large beaver ponds within the area which are suitable as nesting sites for ducks.

Gravel banks. The Gunnison River for much of its length has an area of exposed banks which is frequented by such birds as the spotted sandpiper and the killdeer, both of which breed in the area.

Streamside. This is one of the most extensive habitats for birds within the area and as a result contains the largest population both in number and kinds. The streamside is frequently covered with dense stands of willow and alder, containing numerous narrowleaf cottonwoods. This dense tangle of vegetation contained such birds as western wood peewee, McGillivray's warbler, yellow warbler, black-headed grosbeak, yellow-breasted chat, catbird, song sparrow and veery.

BIRDS

Swampland. This is a limited habitat in the area, but exists in several places along the Gunnison River and in places where waste water from irrigation is impounded. Red-winged blackbird, coot and sora rail breed here; also Wilson's phalarope is found breeding in the swampy, grass meadows.

Farmland. Farmland, absent from the lower two reservoir sites, makes up an extensive part of the larger upper reservoir basin and the surrounding valleys. This area is usually covered by thick stands of grass, and meadow larks and bobolinks seemed restricted to it.

Terrace. Terrace types of vegetation were rarely encountered, but in some areas of this, mingled with grasses and sagebrush to form a plains-like situation, supported large numbers of vesper sparrows, savanna sparrows, sage thrasher, horned lark, and some burrowing owls. The burrowing owls are usually found associated with prairie dogs, which are abundant in the area.

Hillside. Hillside at lower elevations were covered with sagebrush, grasses, mountain mahogany and bitterbrush with some junipers. Higher up, the slopes are covered with oak and eventually conifers such as Douglas fir and blue spruce are dominant. Many birds are found in this habitat such as pine siskin, blue grouse, Townsend's solitaire, olive-sided flycatcher, hairy woodpecker, ruby-crowned kinglet, evening grosbeak and Steller's jay.

Pigmy forest. Near the lower end of the Morrow Point Reservoir site there is a considerable area of pinyon and juniper and in this area were found the pinyon jay and lead-colored bushtit.

Cliff face. The lower two reservoir sites are bounded on both sides by the tremendous cliffs of the Black Canyon of the Gunnison and above these sites smaller cliffs occur all along the Gunnison River. Along these cliffs great numbers of violet-green swallows and cliff swallows nest. There are also numerous white-throated swifts nesting here and an occasional black swift was seen.

BIRDS

ANNOTATED LIST

AVES (class) Birds

Podicipediformes (order) Grebes

Podicipedidae (family) Grebes

Podiceps caspicus californicus Heermann Eared grebe

Common migrant especially in spring. Warren (1916) records this grebe as common in spring on Hillside Lake near Crested Butte, a locality only a few miles north of Gunnison, Colorado.

Aechmophorus occidentalis (Lawrence) Western grebe

Uncommon migrant. Baily and Brandenburg (1941) list the western grebe as a common breeder on Trites Lake, Saguache County, Colorado, only about 50 mi. away from the Gunnison River. Western grebes have been recorded regularly from the north central part of Colorado and undoubtedly spring and fall collecting would show this species present along the Gunnison River.

Podilymbus podiceps (Linnaeus) Pied-billed grebe

Migrant and possible summer resident. Warren (1916) records this grebe from Nichol's Lake in October. Probably occurs here in spring and fall as there are frequent records of this bird in the north central area of Colorado (Niedrach and Rockwell, 1939).

Ciconiiformes (order) Herons, ibises and allies

Ardeidae (family) Herons and bitterns

Ardea herodias treganzai Court. Great blue heron

Common resident. Hyde (1960) lists this heron as common in the area. Observations: Adult and nest placed in dense stand of narrowleaf cottonwood near the Iola Bridge on July 19. The nest contained one young bird nearly feathered. I found three more young herons in the surrounding trees.

Leucophoyx thula brewsteri (Thayer and Bangs) Snowy egret

Migrant especially in spring. Hyde (1960) lists this species as migrant, seen as late as June 10, 1955. It breeds in fair numbers 50 mi. south-east at Trites Lake in Saguache County, Colorado, and also farther north at Barr Lake (Baily and Brandenburg, 1939) and may breed in the Gunnison area.

Nycticorax nycticorax hoactli (Gmelin) Black-crowned night heron

Common resident. Hyde (1960) lists this heron as common. Warren (1916) lists one specimen from near Crested Butte, May, 1915. Gary Ranck and Newell Reynolds observed one bird of this species on Soap Creek, 3/4 mi. up from its junction with the Gunnison River on July 12, 1961. I observed

BIRDS

Ardeidae (family) continued

Nycticorax nycticorax hoactli (continued)

a pair of this species at the same locality on July 14 as they fed at the edge of a small beaver pond.

Botaurus lentiginosus (Rackett) American bittern

Uncommon resident. Hyde (1960) lists this species as resident but uncommon. Warren (1916) lists one specimen from Green Lake above Crested Butte, October 22, 1900, and Knox (1944) lists one sight record from near the same locality in the summer of 1936.

Anseriformes (order) Swans, geese and ducks

Anatidae (family) Swans, geese and ducks

Anas platyrhynchos platyrhynchos Linnaeus Common mallard

Common resident. Hyde (1960) lists this species as breeding in the area. Warren (1916) listed it as common in migration and thought it bred in the area. Heber H. Hall and Delbert Argyle saw two on the Gunnison River near the Iola Bridge, July 3. I observed several ♀♀ and 2 ♂♂ feeding in a flooded field 1/2 mi. southeast of the Iola Bridge on July 4, and 1 ♀ on beaver pond on North Willow Creek near its junction with the Gunnison River on July 6.

Anas acuta Linnaeus Pintail

Uncommon summer resident. Observation: 1 ♀ with other ducks in a flooded field, 3/4 mi. southeast of the Iola Bridge on July 4.

Anas carolinensis Gmelin Green-winged teal

Migrant and summer resident. Hyde (1960) lists this bird as rare in summer. Warren (1916) lists as common in migration and a probable breeder. I saw a pair on a pond just west of Gunnison, July 11.

Anas discors discors Linnaeus Blue-winged teal

Migrant and uncommon summer resident. Warren (1916) had one record for Yule Creek near Marble, Oct. 4, 1902. Hyde (1960) lists it as a probable breeder.

Anas cyanoptera septentrionalium Snyder and Lumsden . . . Cinnamon teal

Migrant and uncommon summer resident. Hyde (1960) lists it as a probable breeder. I saw a pair on Red Creek near its junction with the Gunnison on July 9.

Spatula clypeata (Linnaeus) Shoveler

Uncommon summer resident more common in migration. Warren (1916) lists one specimen from Hillside Lake, Oct. 18, 1902. Observations: 2 ♀♀ and 1 ♂ on a small pond near the Columbine Resort, Gunnison River, July 4, and 1 ♀ on a beaver pond on Red Creek 2 mi. up from its junction on July 9.

BIRDS

Anatidae (family) continued

Aythya americana (Eyton) Redhead

Uncommon migrant. Warren (1916) lists three specimens from Hillside Lake, Oct. 18, 1902.

Oxyura jamaicensis (Gmelin) Ruddy duck

Uncommon migrant and possible summer resident. Warren (1916) records one specimen from Hillside Lake, May 31, 1899. Heber Hall and Delbert Argyle observed 1 ad. ♂ in breeding plumage on the Gunnison River near the Iola Bridge, July 3. I observed what was probably the same bird at the same locality on July 5.

Mergus merganser americanus Cassin Common merganser

Migrant and uncommon winter resident. Observation: Adult ♂ on the Gunnison River near Eagle Rock, July 12, seemingly a late date for a supposed non-breeding species.

Falconiformes (order) Vultures, hawks and falcons

Accipitridae (family) Hawks and harriers

Accipiter gentilis atricapillus (Wilson) Goshawk

Resident on mountains, winters in valleys. Hyde (1960) records this large accipiter as a breeder in coniferous forests of the area. It descends into the valley of the Gunnison in winter. Observations: 1 ad. flying through conifers in Lake Fork Canyon 4 mi. up from its junction with the Gunnison River, July 15.

Accipiter striatus velox (Wilson) Sharp-skinned hawk

Resident more common in winter. Hyde (1960) lists this small hawk as breeding though uncommon in the area. Observations: 1 ad. chasing a small bird at Cebolla Creek, 2 mi. above its junction with the Gunnison River on July 6; one ad. sitting on a fence post just west of Gunnison, Colorado on July 9.

Accipiter cooperi (Bonaparte) Cooper's hawk

Resident more common in winter. Hyde (1960) lists it as sparse breeder in area. Observation: 1 ad. at Lake Fork Canyon 2 mi. up from its junction with the Gunnison River on July 12.

Buteo jamaicensis calurus (Cassin) Red-tailed hawk

Resident but more common in summer. Hyde (1960) lists it as a common breeder. Warren (1916) states that "it is especially abundant in autumn." Observations: ad. carrying food at the junction of Red Creek and the Gunnison River on July 30; immature in a cottonwood tree at the Columbine Resort near the Gunnison River, July 5; both ad. and nest with young nearly fully feathered on a cliff near a ranch building at West Elk Creek, 1 mi.

BIRDS

Accipitridae (family) continued

Buteo jamaicensis calurus (continued)

above its junction with the Gunnison River on July 11; ad. near Soap Creek at upper limit of reservoir basin; and ad. at Lake Fork Canyon 1 mi. from junction with Gunnison River on July 15.

Buteo swainsoni Bonaparte Swainson hawk

Summer resident. Hyde (1960) lists it as a breeder in the area and Warren (1916) had one record of this hawk in September near Crested Butte. Observation: 1 near the Iola bridge on July 3. This species is not as common as the Red-tailed hawk.

Buteo regalis (Gray) Ferruginous hawk

Fall migrant and winter resident at lower elevations. Warren (1916) lists it as occasional in fall, usually in October. More definite records lacking.

Aquila chrysaetos canadensis (Linnaeus) Golden eagle

Common resident. Observations: 2 flying over camp, Dry Gulch, 1/2 mi. north of Gunnison River, June 27; ad. carrying a rabbit near cliffs at Eagle Rock, Gunnison River, June 30; 3 and very large nest high on cliff in canyon of Cebolla Creek, July 6; pair and 2 young at nest on cliff, Lake Fork Canyon, 4 mi. above junction with Gunnison River, July 15; 1 flying in canyon, Black Canyon of the Gunnison near Cimarron Creek, July 19. This is the most abundant large raptor in the area and was seen daily during the survey.

Circus cyaneus hudsonius (Linnaeus) Marsh hawk

Migrant and sparse breeder. Warren (1916) lists the marsh hawk as occurring in autumn as late as Oct. 14. Heber H. Hall and Gary Ranck saw 1 flying over a field on the mesa above Sapinero, July 22.

Falconidae (family) Caracaras and falcons

Falco mexicanus (Schlegel) Prairie falcon

Resident but not common. Hyde (1960) lists it as breeding occasionally, perhaps regularly. Observations: one 1 mi. east of Dry Gulch near Gunnison River, July 1; and 1 in Black Canyon of the Gunnison near Cimarron Creek, July 19. This species is probably much more common than records indicate.

Falco peregrinus anatum Bonaparte Peregrine falcon

Rare resident. Hyde (1960) records this bird as having bred formerly just north of Gunnison. This falcon undoubtedly still breeds in this area of many remote mountains and high cliffs.

Falco sparverius sparverius Linnaeus Sparrow hawk

Common resident less common in winter. Observations: pair with nest placed in crack in large, dead yellow pine, Dry Gulch, 1 mi. north of Gunnison River, June 28; pair at junction of Dry Gulch and Gunnison River with nest in large cottonwood near Gunnison River, June 30;

BIRDS

Falconidae (family) continued

Falco sparverius sparverius (continued)

one carrying food into grove of cottonwoods, junction at Beaver Creek and Gunnison River, July 1; pair with nest on West Elk Creek, 3 mi. above junction with Gunnison River, July 11; and 2 ad. ♂♂, Soap Creek, 1 mi. above junction with Gunnison River, July 12. This colorful little falcon was the most abundant raptor in the area and was observed in numbers on every day of the survey.

Galliformes (order) Pheasants, grouse and allies

Tetraonidae (family) Grouse and ptarmigans

Dendragapus obscurus obscurus (Say) Blue grouse

Common resident. One specimen: ad. ♀, UU16438, Lake Fork of the Gunnison, 2 mi. up from junction with Gunnison River, July 17. Observations: 4 in Douglas fir, Soap Creek near upper limit of reservoir area, July 12; and ad. ♀ with several chicks, Dry Gulch, 1 mi. up from junction with Gunnison River, July 4.

Lagopus leucurus altipetens Osgood White-tailed ptarmigan

Resident at high altitudes, moves into valleys during severe winters. Warren (1916) found them quite common.

Centrocercus urophasianus urophasianus (Bonaparte) . . . Sage grouse

Abundant resident. One specimen: ad. ♀, UU16437, 1/2 mi. south Iola Bridge, July 5. Observations: several in field 1/2 mi. south Iola Bridge, July 6; and ad. ♀ with several young near junction of Red Creek and Gunnison River, July 9.

Gruiformes (order) Cranes, Rails and allies

Rallidae (family) Rails, gallinules and coots

Porzana carolina (Linnaeus) Sora

Uncommon summer resident. Hyde (1960) lists it as a breeder, but not common. Warren (1916) records it from Hillside Lake, Sept. 23, 1900. Observations: 1 in thick willows adjoining marsh on North Willow Creek near junction with Gunnison River, July 4.

Fulica americana Gmelin American coot

Migrant and sparse summer resident. Warren (1916) lists as common migrant about Crested Butte as late as June 20. Hyde (1960) lists as possible breeder. Observations: 1 on pond near Columbine Resort near Gunnison River, July 5; and 1 on Beaver pond at North Willow Creek near junction with Gunnison River, July 6.

BIRDS

Charadriiformes (order) Shorebirds, gulls and allies

Charadriidae (family) Plovers, turnstones and surf-birds

Charadrius vociferus Linnaeus Killdeer

Resident, abundant in summer. Observations: ad. on sandbar near mouth of Beaver Creek on Gunnison River, July 1; pair with 2 young on terrace 1/2 mi. northwest of Iola Bridge, July 3; ad. near mouth of Dry Gulch on gravel bank of Gunnison River, July 12; and 3 ad. along Gunnison River near mouth of Cimarron Creek.

Capella gallinago delicata (Ord.) Common snipe

Common resident. Hyde (1960) lists it as a common breeder. Observation: 1 feeding in flooded field 1/2 mi. southeast of Iola Bridge on July 5.

Catoptrophorus semipalmatus inornatus (Brewster) Western willet

Uncommon migrant. Warren (1916) lists specimens from Hillside Lake, May 22, 1899. I know of no other records for the area.

Actitis macularia (Linnaeus) Spotted sandpiper

Common summer resident. Hyde (1960) lists it as a common breeder. Warren (1916) also lists it as a common summer resident along streams. Observations: 2 on riverbank at junction of Dry Gulch and Gunnison River, June 30; several along stream banks on Gunnison River near Iola Bridge, July 3; H. Hall and G. Ranck saw ad. ♀ with young on same date at above locality; 1 along stream, Cebolla Creek, near confluence with Gunnison River, July 6; and ad. near stream, Soap Creek, near upper limit of reservoir site, July 12.

Tringa solitaria Wilson Solitary sandpiper

Migrant in fall. Hyde (1960) lists migrants present in August near Gunnison.

Phalaropodidae (family) Phalaropes

Steganopus tricolor Vieillot Wilson's phalarope

Common summer resident. Hyde (1960) lists it as a common breeder. One specimen: ad. ♂, UU16424, 1/2 mi. south Iola Bridge, July 4. The bird was taken from a flooded field and several others were seen.

Chlidonias niger surinamensis (Gmelin) Black tern

Migrant especially in fall. Hyde (1960) lists this small tern as being seen occasionally in late summer.

BIRDS

Columbiformes (order) Sand-grouse, pigeons and doves

Columbidae (family) Pigeons and doves

Columba fasciata fasciata Say Band-tailed pigeon

Probable summer resident on mountains. Warren (1916) had records from the area but in reduced numbers. Hyde (1960) believes it to breed only in the northwest portion of Gunnison County, if at all.

Zenaidura macroura marginella (Woodhouse) Mourning dove

Abundant summer resident. Observations: ad. and nest with well incubated eggs placed in large hawthorn near stream in Dry Gulch, 1/2 mi. north of Gunnison River, June 30; nest on ground with 2 well feathered young among sagebrush on hillside near junction of Red Creek and Gunnison River, June 29; nest in narrowleaf cottonwood, 10 ft. above ground with 2 freshly laid eggs, near mouth of Beaver Creek, July 1; 7 along fence line 1 mi. east of Dry Gulch, 1/2 mi. north of Gunnison River, July 2; and nest in Boxelder tree, 8 ft. above ground with 1 egg, near junction of Gunnison River and Curecanti Creek, July 18.

Cuculiformes (order) Cuckoos and plantain-eaters

Cuculidae (family) Cuckoos, roadrunners and anis

Coccyzus erythrophthalmus (Wilson) Black-billed cuckoo

Rare summer resident, on July 1, I found a pile of feathers and parts of a cuckoo presumably killed by a hawk. The blood and meat were fresh. I saved the wings and 1 tail feather for identification. The tail feather, however, was later lost. The primaries and secondaries bear none of the rufous color of the yellow-billed cuckoo and the tail feather had only a small tip of white. Comparison with specimens in the University of Utah collection confirms the above identification. The wings have been retained as a specimen, UU16439, in the University of Utah Ornithological Museum.

Strigiformes (order) Owls

Strigidae (family) Typical owls

Bubo virginianus occidentalis Stone Great horned owl

Abundant resident. Observations: Heber Hall and Delbert Argyle saw 1 being chased by small birds near the Columbine Resort, Gunnison River, July 4; 1 in Douglas fir, West Elk Creek, 2 mi. above junction with Gunnison River, July 11; and R. N. Reynolds saw 3 owls, 2 ad. and 1 immature, along the cliffs near the junction of Red Creek and Gunnison River, July 11.

Speotyto cunicularia hypugaeae (Bonaparte) Burrowing owl

Uncommon summer resident. Hyde (1960) lists it as occurring occasionally. Observation: 1 and nest burrow on the edge of a large prairie dog town 1/2 mi. west of the Iola Bridge near the Gunnison River.

BIRDS

Strigidae (family) continued

Asio otus wilsonianus (Lesson) Long-eared owl

Resident less common in winter. Warren (1916) lists 2 records, 1 from near Crested Butte, Sept. 7 and 1 found dead near Green Lake on Sept. 20. Hyde (1960) lists the species as breeder and probable resident.

Asio flammeus flammeus (Pontoppidan) Short-eared owl

Uncommon winter resident. Warren (1916) records this species from Muddy Creek in June of 1903. I have no other records.

Aegolius acadicus acadicus (Gmelin) Saw-whet owl

Uncommon resident. Hyde (1960) lists it as breeding in the area and probable resident.

Glaucidium gnoma californicum Sclater Pygmy owl

Resident, rare. Warren (1916) lists one sight record for the area west of Muddy Creek, July 22, 1901. This small owl may be much more common than records indicate, as little collecting has been done and this species is easily overlooked.

Caprimulgiformes (order) Goatsuckers, oilbirds and allies

Caprimulgidae (family) Goatsuckers

Phalaenoptilus nuttallii nuttallii (Audubon) Poor-will

Common summer resident. Observation: heard several birds calling and saw 2 flying low over sagebrush near dusk, Dry Gulch, 1/2 mi. north of Gunnison River, June 30; and saw 1 land in driveway near camp near dusk, Dry Gulch, 1/2 mi. north of Gunnison River, July 3.

Chordeiles minor henryi Cassin Western nighthawk

Abundant summer resident. One specimen: ad. ♂, UU16423, junction Dry Gulch and Gunnison River, 7420, July 9. Observations: nest with 2 eggs on bare ground in sagebrush, Soap Creek 2 mi. above junction with Gunnison River, July 12; several flying over field at dusk, Dry Gulch, 1/2 mi. north of Gunnison River, July 1; and numerous over river and along bluffs near junction of Dry Gulch and Gunnison River, July 12.

Apodiformes (order) Swifts and hummingbirds

Apodidae (family) Swifts

Cypseloides niger borealis (Kennerly) Black swift

Uncommon summer resident. Knorr (1961) records a small colony of black swifts in the Black Canyon of the Gunnison. I observed these swifts flying up and down the canyon near the waterfall at the mouth of Corral Creek, July 19.

BIRDS

Apodidae (family) continued

Aeronautes saxatalis saxatalis (Woodhouse) White-throated swift
Common summer resident. Observations: several ad. flying about cliffs along Gunnison River, near mouth of Red Creek, July 11; and numerous nesting about the cliffs in the Black Canyon of the Gunnison near the mouth of Curecanti Creek, July 19.

Trochilidae (family) Hummingbirds

Archilochus alexandri (Bourcier and Mulsant) . . Black-chinned hummingbird
Uncommon summer resident. Observations: 2 ♂♂ feeding among flowers, Soap Creek, near upper limit of reservoir, July 12, pair and 2 young in nest in juniper on hillside, among juniper, mountain mahogany, bitterbrush and Douglas fir near the junction of West Elk Creek and the Gunnison River, July 11.

Selasphorus platycercus platycercus (Swainson) . . Broad-tailed hummingbird
Abundant summer resident. One specimen: ad. ♂, UU16425, Soap Creek, 3 mi. up from junction with Gunnison River, 7500 ft., July 12. Observations: pair and nest with 3 eggs, Steuben Creek, 1/2 mi. from Gunnison River, July 6; ad. ♀ and nest with young, Dry Gulch, 1 mi. from Gunnison River, July 7; and saw several ad. and found 1 nest with eggs, Soap Creek near upper limit of reservoir, July 12.

Selasphorus rufus (Gmelin) Rufous hummingbird
Migrant in July and September, possible summer resident. Hyde (1960) lists as migrant only. Observation: ad. ♂ feeding on Cirsium flowers near junction of Gunnison River and Curecanti Creek, July 19.

Stellula calliope (Gould) Calliope hummingbird
Migrant in August. Hyde (1960) lists this species as occurring occasionally in August.

Coraciiformes (order) Kingfishers

Alcedinidae (family) Kingfishers

Mergaceryle alcyon caurina (Grinnell) Belted kingfisher
Common resident. Observations: ad. ♀ on dead limb of narrowleaf cottonwood overhanging Gunnison River near mouth of Steuben Creek, July 1; and pair near nest burrow in high stream bank near Columbine Resort and Gunnison River, July 4.

BIRDS

Piciformes (order) Woodpeckers and allies

Picidae (family) Woodpeckers and wrynecks

Colaptes auratus luteus Bangr. Yellow-shafted flicker

Two flickers with bright yellow wing and tail shafts were seen; one along highway near North Willow Creek, July 3 and 1 near Soap Creek, 2 mi. up from junction with Gunnison River, July 12. Also 1 bird which appeared intermediate between C. auratus and C. cafer near the junction of West Elk Creek and Gunnison River, July 12. These birds may all be hybrids although the 2 with bright yellow shafts appeared to be typical C. auratus.

Colaptes cafer collaris Vigors Red-shafted flicker

Abundant resident, less common in winter. Observations: 1 ad. on telephone pole, Dry Gulch 1/2 mi. above Gunnison River, July 1; several in narrowleaf cottonwood, Red Creek, 2 mi. above junction with Gunnison River, July 9; and ad. with nest hole in aspen, West Elk Creek near upper limit of reservoir, July 11.

Asyndesmus lewis (Gray) Lewis woodpecker

Common resident. Warren (1916) lists it as not uncommon in summer on Muddy Creek. Observations: 1 ad. with nest in narrowleaf cottonwood near mouth of Beaver Creek, July 1; and 1 in yellow pine near upper limit of reservoir in Cebolla Creek Canyon, July 6.

Sphyrapicus varius nuchalis Baird Yellow-bellied sapsucker

Abundant summer resident. Observations: 1 in aspens, Steuben Creek, 1 mi. up from junction with Gunnison River, July 1; and 3 in aspens, Red Creek, 2 mi. up from junction with Gunnison River, July 9.

Sphyrapicus thyroideus nataliae (Malherbe) . . . Williamson's sapsucker

Common resident in coniferous forests. Hyde (1960) lists it as breeder. I saw 2 in yellow pine, Cebolla Creek, near upper limit of reservoir, July 6.

Dendrocopos villosus monticola (Anthony) Hairy woodpecker

Common resident. Warren (1916) lists as not uncommon and present in all seasons to 11,000 ft. Observations: 3 along stream in narrowleaf cottonwood and Douglas fir, Soap Creek, near upper limits of reservoir site, July 12; and 1 near mouth of Beaver Creek, July 1.

Dendrocopos pubescens leucurus (Hartlaub) Downy woodpecker

Fairly common resident. Warren (1960) lists 1 seen at Hillside Ranch in January. Observation: 1 in conifers, Soap Creek near upper limits, July 12.

Picoides tridactylus dorsalis Baird . . . Northern three-toed woodpecker

Uncommon resident in high forests. Hyde (1960) lists as breeding in high coniferous forests of the area but uncommon.

BIRDS

Passeriformes (order) Perching birds

Tyrannidae (family) Tyrant flycatchers

Tyrannus tyrannus (Linnaeus) Eastern kingbird

Uncommon summer resident. Hyde (1960) lists as a summer resident but rare. Probably breeds in the area occasionally.

Tyrannus verticalis Say Western kingbird

Uncommon summer resident. Hyde (1960) lists it as a breeder though rare.

Sayornis saya saya (Bonaparte) Say's phoebe

Common summer resident. Observations: ad. with nest in barn near mouth of Beaver Creek, July 1; and both adults and nest with 4 young along rafter of car shed near Columbine Resort, Gunnison River, July 5.

Empidonax traillii brewsteri Oberholser Traill's flycatcher

Common summer resident. Observations: pair with nest in alder, Dry Gulch, 1/2 mi. north Gunnison River, July 1; and common in alders and willow along all canyon streams in the area.

Empidonax wrightii Baird Gray flycatcher

Common summer resident. Observations: 1 ad. in narrowleaf cottonwood near mouth of Beaver Creek, July 1; and pair with nest in dead branches of narrowleaf cottonwood near mouth of Soap Creek, July 12.

Empidonax difficilis hellmayri Brodorb. Western flycatcher

Common summer resident. Observations: pair with nest in Douglas fir, Soap Creek near upper limit of reservoir, July 12; and these small flycatchers were abundant in conifers in the area.

Contopus sordidulus veliei Coues. Western wood pewee

Abundant summer resident. One specimen: ad. ♀, UU16432, Dry Gulch, 1/2 mi. north Gunnison River, June 28. Observations: pair with nest in narrowleaf cottonwood near mouth of Red Creek, July 11; and common along streams in cottonwood and aspen.

Nuttallornis borealis (Swainson) Olive-sided flycatcher

Common summer resident. Observations: ad., Red Creek, 2 mi. up from junction with Gunnison River, July 9; pair with nest in small Douglas fir, West Elk Creek, 2 mi. from junction with Gunnison River, July 11; and several ad. in conifers, Soap Creek, near upper limit of reservoir site, July 12.

Pyrocephalus rubinus flammeus van Rossem Vermillion flycatcher

Hyde (1953) lists a female taken Nov. 18, 1952 about 5 mi. west of Gunnison.

BIRDS

Alaudidae (family) Larks

Eremophila alpestris leucolaema Coues. Horned lark

Common resident. Observations: several ad. and immatures, on terrace 1/2 mi. east of North Willow Creek 1/2 mi. north Gunnison River, July 3; and 4 on sagebrush flat near mouth of Cebolla Creek, July 10.

Hirundinidae (family) Swallows

Tachycineta thalassina lepida Mearns Violet-green swallow

Abundant summer resident. Specimens: ad. ♂, UU16426, junction of Red Creek and Gunnison River, June 29; ad. ♂, UU16427, junction of Red Creek and Gunnison River, June 29. Observations: abundant, nesting in cliffs near river, Dry Gulch and Gunnison River, July 1; and numerous, nesting in cliffs near Eagle Rock, Gunnison River, July 6. This species was an abundant breeder along all cliffs near the Gunnison River and in many side canyons.

Iridoprocne bicolor (Vieillot) Tree swallow

Uncommon summer resident. Observations: 3 flying over marsh near junction of North Willow Creek and Gunnison River; and ad. with nest hole in aspen, Red Creek, 2 mi. up from junction with Gunnison River, July 9.

Riparia riparia riparia (Linnaeus) Bank swallow

Uncommon summer resident. Observation: pair with nest hole in high earth bank in small canyon near Columbine Resort, Gunnison River, July 4.

Stelgidopteryx ruficollis serripennis Audubon Rough-winged swallow

Uncommon summer resident. Hyde (1960) lists this species as fairly common in the area.

Hirundo rustica erythogaster Boddaert Barn swallow

Common summer resident. Observations: pair with nest in culvert under highway near Moncrief Ranch, July 8; pair with nest under Iola Bridge, July 4; and 2 pair with nests under bridge at Soap Creek near junction with Gunnison River, July 11.

Petrochelidon pyrrhonota pyrrhonota (Vieillot) Cliff swallow

Abundant summer resident. Observations: large colony on river cliffs near junction of Dry Gulch and Gunnison River, July 1; and several pair nesting on cliffs near mouth of Lake Fork of Gunnison River, July 15; and not as abundant as violet-green swallows but still very common.

Corvidae (family) Jays, magpies and crows

Perisoreus canadensis capitalis Ridgway Gray jay

Common resident in coniferous forests. Observations: 1, 3 mi. north of junction of Dry Gulch and Gunnison River, July 7; and several in aspens and spruce, Soap Creek, near upper limit of reservoir site, July 12.

BIRDS

Corvidae (family) continued

Cyanocitta stelleri macrolopha Baird Steller's jay

Common resident in conifers. One specimen: ad. ♀, UUI6436, Gunnison River, 1 mi. up from Cimarron Creek, July 21. Observations: several ad. and immatures in Douglas fir, Cebolla Creek, 2 mi. from junction with Gunnison River, July 6; and several ad. and immatures, Soap Creek, near upper limits of reservoir, July 12.

Aphelocoma coerulescens woodhouseii (Baird) Scrub jay

Uncommon resident. Observations: 3 in oak, 3/4 mi. northwest of Dry Gulch, 1/2 mi. north of Gunnison River, June 28; and several ad. and immatures in pinyons, Black Canyon of the Gunnison near Cimarron Creek, July 19.

Pica pica hudsonia (Sabine) Black-billed magpie

Abundant resident. Observations: several pairs with nests in narrowleaf cottonwood, many of the young out of nest and flying, July 1; and 3 pairs with nests in juniper, 1/4 mi. northeast of mouth of West Elk Creek, July 11.

Corvus corax sinatus Wagler Common raven

Uncommon resident. Hyde (1960) lists it as not uncommon about cliffs. Warren (1916) lists it as not common. Observation: 1 near cliffs, 1/2 mi. north of junction, Red Creek and Gunnison River, July 9.

Corvus brachyrhynchos hesperis Ridgway Common crow

Uncommon resident, rare in summer. Hyde (1960) lists it as rare in summer, Warren (1916) lists a small flock seen just north of Gunnison on October 27, 1905.

Gymnorhinus cyanocephala Wied. Pinyon jay

Uncommon resident. Observations: 3 in pinyon, Black Canyon of the Gunnison, 3/4 mi. east of Cimarron Creek, July 19.

Nucifraga columbiana (Wilson) Clark's nutcracker

Uncommon resident. Hyde (1960) lists as occasionally seen near timber line in summer. I found the bird much lower than this and not uncommon. Observations: 1, 1 mi. northwest of junction, Dry Gulch and Gunnison River, June 28; 2 in spruce, Red Creek, 5 mi. up from junction with Gunnison River, July 9; and 3, Soap Creek, near upper limit of reservoir, July 12.

Paridae (family) Titmice, verdin and bushtits

Parus atricapillus garrinus Behle Black-capped chickadee

Common resident. Observations: 3 ad. in cottonwood near camp, Dry Gulch, 1/2 mi. north Gunnison River, June 28; several in spruce and fir near stream in Cebolla Creek Canyon, 2 mi. from junction, July 6; several ad. and immatures in pinyon and juniper, Black Canyon near Cimarron Creek, July 19.

BIRDS

Paridae (family) continued

Parus gambeli gambeli Ridgway Mountain chickadee

Common resident, more abundant in mountains. One specimen: ad. ♂, UU16433, Gunnison River, 1 mi. up from Cimarron Creek, July 20. Observations: several ad. and immatures in Douglas Fir, Soap Creek, near upper limits of reservoir site, July 12; 1 ad. near camp, Dry Gulch, 1/2 mi. north of Gunnison River, July 8; several ad. and immatures, Gunnison River, near Cimarron Creek, July 20; and this species prefers coniferous forests while the Black-capped chickadee was found more commonly in open aspen or other deciduous groves, however, the 2 species were often seen together.

Psalttriparus minimus plumbeus (Baird) Common bushtit

Uncommon resident. Observation: 1 in pinyon, Gunnison River, 1 mi., up from Cimarron Creek, July 19.

Sittidae (family) Nutthatches

Sitta carolinensis nelsoni Mearns White-breasted nuthatch

Common resident. Observations: several in narrowleaf cottonwoods, Gunnison River at upper limit of Blue Mesa Reservoir Site (Jointed Rod Resort), July 1; 2 in spruce, fir and narrowleaf cottonwoods, near stream in Cebolla Creek Canyon, 2 mi. up from Gunnison River, July 6; and several in conifers, Soap Creek, near upper limits of reservoir site, July 12.

Sitta canadensis Linnaeus Red-breasted nuthatch

Uncommon resident. Hyde (1960) lists as fairly common in coniferous forests.

Sitta pygmaea melanotis van Rossem Pigmy nuthatch

Uncommon resident. Hyde (1960) lists it as occurring in coniferous forests but status undetermined. Warren (1916) lists only one record, from Middle Brush Creek, Sept. 28, 1910. Observation: this small, noisy nuthatch was fairly common in the yellow pines between Iola and Cap mountains, July 15.

Certhiidae (family) Creepers

Certhia familiaris montana Ridgway Brown creeper

Common resident. Hyde (1960) lists it as common in higher forests.

Cinclidae (family) Dippers

Cinclus mexicanus unicolor Bonaparte Dipper

Common resident. Observations: ad. and nest, Red Creek, near Gunnison River, June 29; 3 along stream, Soap Creek, near upper limit of reservoir site, July 12; several along stream, Lake Fork Canyon, 4 mi. above junction with Gunnison River, July 15; and several young birds with ad., Gunnison River, near Curecanti Creek, July 18.

BIRDS

Troglodytidae (family) Wrens

Troglodytes aedon parkmanii Audubon House wren

Common summer resident. Observations: pair with nest in building, Dry Gulch, 1/2 mi. north Gunnison River, July 3; and ad. with 3 young, Red Creek near junction with Gunnison River, July 9.

Salpinctes obsoletus obsoletus (Say) Rock wren

Common summer resident. One specimen: ad. ♂, UU16428, Dry Gulch, 1 mi. north Gunnison River, 7600 ft., June 28. Observations: several along cliffs, 1 mi. northwest of junction Dry Gulch and Gunnison River, July 1; 2 ad. in rocks, 1/2 mi. northeast of junction, Red Creek and Gunnison River, July 9; and common along cliffs, Gunnison River near Curecanti Creek, July 19.

Mimidae (family) Mocking birds and thrashers

Dumetella carolinensis (Linnaeus) Catbird

Uncommon summer resident. Observations: 1 in willows near mouth of Beaver Creek, July 1; and pair in willows near mouth of North Willow Creek, July 3.

Toxostoma rufum Linnaeus Brown thrasher

Hyde (1953) lists this species as being seen in the Black Canyon of the Gunnison a few miles below Sapinero on October 12.

Oreoscoptes montanus (Townsend) Sage thrasher

Abundant summer resident. Observations: several in sagebrush, 3/4 mi. southeast of Iola Bridge, July 4; pair with nest, 1/2 mi. west of junction of Dry Gulch and Gunnison River, July 3; and pair with nest 1/2 mi. east of junction of Red Creek and Gunnison River, July 9.

Turdidae (family) Thrushes, solitaires and bluebirds

Turdus migratorius propinquus Ridgway Robin

Abundant summer resident, uncommon winter resident. Observations: pair with nest, Dry Gulch 1/2 mi. north Gunnison River, June 29; pair with nest, mouth of Beaver Creek, July 1; and ad. and 2 fledged young, mouth of Soap Creek, July 12.

Hylocichla guttata auduboni (Baird) Hermit thrush

Common summer resident. Hyde (1960) lists it as very common in conifers. Observations: 1 near Beaver Pond, Red Creek, 2 mi. north Gunnison River, July 9; and 2 in Douglas fir, Sage Creek near upper limits of reservoir site, July 12.

Hyocichla fuscescens salicicola Ridgway Veery

Common summer resident. Hyde (1960) lists it as common in dense willows. Observation: 1 in willows, near mouth of Red Creek, June 29.

BIRDS

Turdidae (family) continued

Sialia currucoides (Beckstein) Mountain bluebird

Common summer resident. Observations: pair with nest in building, Dry Gulch 1/2 mi. north Gunnison River, June 29; 2 ad. on fence, 1/2 mi. west of Iola Bridge, July 1; and pair with 3 fledged young in aspen grove, Red Creek, 3 mi. north Gunnison River, July 9.

Myadestes townsendi (Audubon) Townsend's solitaire

Common resident. Observations: 1, Dry Gulch, 1/2 mi. north Gunnison River, July 3; 3, West Elk Creek, 3 mi. above Gunnison River, July 11; and several along hillside in Douglas fir and oak, Soap Creek, 3 mi. above Gunnison River, July 12.

Sylviidae (family) Old World warblers, gnatcatchers and kinglets

Regulus satrapa amoenus van Rossem Golden-crowned kinglet

Common resident. Hyde (1960) lists as abundant in coniferous forests. Observation: 1 in Blue spruce, Cebolla Creek Canyon, 3 mi. up from Gunnison River, July 6.

Regulus calendula cineraceus Grinnell Ruby-crowned kinglet

Common resident. Hyde (1960) lists it as common in conifers. Observations: 1 in willows, Dry Gulch, 1/2 mi. north Gunnison River, July 1; and pair in Douglas fir, Lake Fork Canyon, 4 mi. above Gunnison River, July 15.

Motacillidae (family) Wagtails and pipits

Anthus spinoletta alticola Todd. Water pipit

Common summer resident in Alpine zone. Hyde (1960) lists it as nesting in grass above timber line. Warren (1916) lists it as nesting at Elk Basin in late June. Found at lower elevation in winter.

Laniidae (family) Shrikes

Lanius excubitor invictus Ginnell Northern shrike

Uncommon migrant and winter resident. Warren (1916) lists it as a visitor in late fall and early winter.

Lanius ludovicianus excubitorides Swainson Loggerhead shrike

Fairly common migrant and possible summer resident. Hyde (1960) lists it as migrant but summer status in doubt. Observation: 1 on fence post near highway, 1/2 mi. west of Iola junction, July 2.

BIRDS

Sturnidae (family) Starlings

Sturnus vulgaris vulgaris Linnaeus Starling

Common resident. Observations: pair with nest in dead narrowleaf cottonwood, near mouth Beaver Creek, July 1; 1 ad. in field near mouth of Soap Creek, July 12; and several in field near Gunnison, July 7.

Vireonidae (family) Vireos

Vireo solitarius plumbeus Coues. Solitary vireo

Common summer resident. Observations: several in conifers, Lake Fork Canyon, upper limits of reservoir site, July 15; and this is the common vireo of the ponderosa pine forest in this area.

Vireo gilvus swainsonii Baird Warbling vireo

Common summer resident. Hyde (1960) lists it as very common in the area. Observation: ad. with nest in narrowleaf cottonwood, mouth of Steuben Creek, July 1.

Parulidae (family) Wood warblers

Vermivora celata orestera Oberholser Orange-crowned warbler

Uncommon summer resident. Hyde (1960) lists it as breeding in the area but not common.

Vermivora virginiae (Baird) Virginia's warbler

Common summer resident. Hyde (1960) lists it as common in oak brush.

Parula americana (Linnaeus) Parula warbler

Migrant, rare. Hyde (1953) lists an ad. ♂ in full song taken from a clump of cottonwood trees about 4 mi. southwest of Gunnison on May 24, 1952.

Dendroica petechia morcomi Coale Yellow warbler

Common summer resident. Observations: ad. singing in narrowleaf cottonwood, Dry Gulch, $\frac{1}{2}$ mi. north Gunnison River, July 1; and several in willows near mouth of Red Creek, July 9.

Dendroica auduboni memorabilis Oberholser Audubon's warbler

Common summer resident. Hyde (1960) lists as very common in deciduous forests.

Oporornis tolmiei monticola Phillips McGillivray's warbler

Abundant summer resident. One specimen: ad. ♂, UU16429, Red Creek near junction with Gunnison River, 7500 ft., June 29. Observations: abundant in willow and alder, Dry Gulch, $\frac{1}{2}$ mi. north of Gunnison River, June 29; several in thick willows near mouth of Red Creek, July 8; and ad. and nest with 4 eggs, Soap Creek near upper limits of reservoir site, July 12.

BIRDS

Parulidae (family) continued

Geothlypis trichas occidentalis Brewster Yellow-throat

Uncommon summer resident, more common in migration. Hyde (1960) lists it as breeding but not common.

Icteria virens auricollis (Deppe) Yellow-breasted chat

Uncommon summer resident. Hyde (1960) lists it as rare in the area. Observations: ad. singing in willows, alder along stream, near mouth of Beaver Creek, July 2; pair in dense hawthorn and willows near mouth of Steuben Creek, July 3.

Wilsonia pusilla pileolata (Pallas) Wilson's warbler

Common summer resident. Hyde (1960) lists as common along higher streams.

Ploceidae (family) Weaver finches

Passer domesticus (Linnaeus) House sparrow

Common resident. Hyde (1960) lists it as abundant about towns and ranch-buildings. Observations: abundant near buildings at mouth of Beaver Creek, July 1; and common about town of Gunnison, July 7.

Icteridae (family) Meadowlarks, blackbirds and orioles

Dolichonyx oryzivorus (Linnaeus) Bobolink

Uncommon summer resident. Hyde (1953) lists three pairs thought to be nesting in clover fields north and west of Gunnison and subsequently 1 nest with 5 eggs was found on July 1. Observations: several in clover and grain field $\frac{1}{2}$ mi. southeast of Iola Bridge, July 3. This species is fairly common but very localized in the area.

Sternella neglecta neglecta Audubon Western meadowlark

Common resident. Observations: several along grassy hillside, $\frac{1}{2}$ mi. west of Iola junction, July 2; abundant in meadows, $\frac{1}{2}$ mi. southeast of Iola bridge, July 3; 3 in hay field, Dry Gulch, $\frac{1}{2}$ mi. north of Gunnison River, July 5; and several in clover field, Soap Creek, 1 mi. above junction with Gunnison River, July 12.

Xanthocephalus xanthocephalus (Bonaparte) . . . Yellow-headed blackbird

Common summer resident. Observations: several pairs, wet meadow $\frac{1}{2}$ mi. southeast of Iola Bridge, July 3; pair in swampy field near mouth of North Willow Creek, July 3; and several in field near mouth of Soap Creek, July 12.

Agelaius phoeniceus fortis Ridgway Red-winged blackbird

Common resident. Observations: 3 ad. along stream near mouth of Beaver Creek, July 1; several pairs of flooded field, $\frac{3}{4}$ mi. southeast of Iola Bridge, July 3; and several along fence and in wet meadow, near mouth of Soap Creek, July 12.

BIRDS

Icteridae (family) continued

Icterus bullockii bullockii (Swainson) Bullock's Oriole

Common summer resident. Hyde (1960) lists it as common in the area.

Observations: ad. ♂ in narrowleaf cottonwood near mouth of Steuben Creek, July 1; and pair with nest in narrowleaf cottonwood, Dry Gulch, 1/2 mi. north Gunnison River, July 6.

Euphagus cyanocephalus (Wagler) Brewer's blackbird

Common resident. Observations: several around corral and farm buildings, near mouth of Beaver Creek, July 1; abundant along flooded field, 1/2 mi. south of Iola Bridge, July 3; and several in meadow near mouth of Soap Creek, July 12.

Molothrus ater artemisiae Grinnell Brown-headed cowbird

Common summer resident. Hyde (1960) lists it as breeding and fairly common. Observation: nesting in nest of Green-tailed towhee, Soap Creek 2 mi. above junction with Gunnison River, July 12.

Thraupidae (family) Tanagers

Piranga ludoviciana (Wilson) Western tanager

Common summer resident. One specimen: ad. ♀, UU16434, Gunnison River near Cimarron Creek, July 20. Observations: 1 in Douglas fir, Soap Creek near upper limit of reservoir site, July 12; 1 near mouth of North Willow Creek, July 8; and pair with nest near mouth of Beaver Creek, July 1.

Fringillidae (family) Grosbeaks, finches, sparrows and buntings

Pheucticus melanocephalus melanocephalus Swainson Black-headed grosbeak

Common summer resident. Hyde (1960) lists it as a common breeder. Observation: ad. ♂ in hawthorn tangle, near mouth of Beaver Creek, July 1.

Guiraca caerulea interfusa Dwight and Griscom Blue grosbeak

Uncommon summer resident. Observations: 1 in streamside willows, Gunnison River near mouth of West Elk Creek, July 12; and ad. ♂ dead on road, near Sapinero, July 19.

Passerina amoena (Say) Lazuli bunting

Uncommon summer resident. Hyde (1960) lists as very local. Observation: 1 near Dry Gulch, 1/2 mi. north of Gunnison River, July 11.

Hesperiphona vespertina brooksi Grinnell Evening grosbeak

Uncommon summer resident in conifers. One specimen: ad. ♂, UU16430, Soap Creek, near upper limit of reservoir site, 7520 ft., July 12. Observation: several in Douglas fir, Soap Creek, near upper limits of reservoir site, July 12.

BIRDS

Fringillidae (family) continued

Carpodacus cassinii Baird Cassin's finch

Common resident. Hyde (1960) lists it as common in high spruce woods.
Observation: ad. ♂ in Douglas fir, Soap Creek near upper limits of reservoir site, July 12.

Carpodacus mexicanus frontalis (Say) House finch

Abundant resident. Observations: ad. ♂ at corral near mouth of Beaver Creek, July 1; and several about camp, Dry Gulch $\frac{1}{2}$ mi. north of Gunnison River, July 6, and pair on riverbank, Gunnison River near Curecanti Creek, July 19.

Pinicola enucleator montana Ridgway Pine grosbeak

Uncommon resident. Hyde (1960) lists as fairly common in spruce woods.
Observation: pair in blue spruce, Cebolla Creek Canyon, 4 mi. up from Gunnison River, July 6.

Leucosticte australis Ridgway Brown-capped rosy finch

Common resident, breeds on high mountain tops above timberline, winters at lower elevations. Hyde (1960) lists it as breeding from 12,500 ft. up. Occurs in the Gunnison Valley during winter.

Spinus pinus pinus (Wilson) Pine siskin

Common resident. Observations: several pair in Douglas firs and narrow-leaf cottonwoods, Soap Creek near upper limit of reservoir site, July 12; and 1 in clover field near mouth of Soap Creek, July 12.

Spinus tristis pallidus Mearns American goldfinch

Fairly common resident. Hyde (1960) lists it as breeding in the area and fairly common. Observation: 1 feeding on Cirsium, Dry Gulch, $\frac{1}{2}$ mi. north of Gunnison River, July 5.

Loxia curvirostra benti Griscom Red crossbill

Uncommon resident. Hyde (1960) lists it as locally common in spruce woods of the area.

Chlorura chlorura (Audubon) Green-tailed towhee

Abundant summer resident. One specimen: ad. ♀, UU16431, Dry Gulch, $\frac{1}{2}$ mi. north Gunnison River, 7440 ft., July 2. Observations: pair with nest, Dry Gulch $\frac{1}{2}$ mi. north Gunnison River, July 1; abundant along hillside in sagebrush and Amelanchier, $\frac{3}{4}$ mi. southeast of Iola Bridge, July 3; pair with nest placed in sagebrush, West Elk Creek, 1 mi. up from Gunnison River, July 11; ad. with nest in sagebrush, Soap Creek near upper limit of reservoir site, July 12; and ad. with nest containing one egg and nestling cowbird, Soap Creek, 2 mi. from Gunnison River, July 12.

BIRDS

Fringillidae (family) continued

- Calamospiza melanocorys Stejneger Lark bunting
Occasional migrant in spring and late summer. Hyde (1953) lists two specimens taken from a small flock on April 28, 1952.
- Passerculus sandwichensis nevadensis Grinnell Savannah sparrow
Abundant summer resident. Observations: abundant in streamside grasses, 3/4 mi. west of Iola junction, July 2; and several in clover meadow near mouth of Soap Creek, July 12.
- Ammodramus savannarum perpallidus (Coues) Grasshopper sparrow
Straggler, rare. Hyde (1958) lists an immature ♂ of this species taken about 1 mi. south of Gunnison on October 15, 1953.
- Passerherbulus caudacutus (Latham) LeConte's sparrow
Uncommon migrant. Hyde (1953) lists an ad. ♂ taken on May 6, 1952 about 1½ mi. south of Gunnison.
- Ammodramus caudacuta nelsoni (Allen) Sharp-tailed sparrow
Hyde (1958) lists a ♂ taken on October 24, 1952 near Gunnison.
- Poocetes gramineus confinis Baird Vesper sparrow
Abundant summer resident. Observation: several ad. and immatures on sagebrush flat ½ mi. northwest of Iola junction, July 2.
- Chondestes grammacus strigatus Swainson Lark sparrow
Migrant, fairly common, possible summer resident. Observation: ad. near road ½ mi. north Sapinero, July 12.
- Amphispiza belli nevadensis (Ridgway) Sage sparrow
Uncommon summer resident. Observations: pair with three young in sagebrush, near Columbine Resort ¼ mi. from Gunnison River, July 6; and 1 in sagebrush, Dry Gulch, ½ mi. north Gunnison River, July 8.
- Junco oreganus shufeldti Coale Oregon junco
Common winter resident. Warren (1916) lists it as quite common in spring and fall near Crested Butte.
- Junco caniceps caniceps (Woodhouse) Gray-headed junco
Common resident. Hyde (1960) lists it as very common in aspens and conifers in this area. Warren (1916) lists it as common breeder.
- Spizella arborea ochracea Brewster Tree sparrow
Common migrant. Warren (1916) lists it as quite common about Crested Butte and Marble in October. Hyde (1953) lists a small flock on November 5, 1952, 1½ mi. south of Gunnison.

BIRDS

Fringillidae (family) continued

Spizella passerina arizonae Coues Chipping sparrow

Uncommon summer resident, more common in migration. Observation: several in Cebolla Creek Canyon, 2 mi. up from Gunnison River, July 6.

Spizella breweri breweri Cassin Brewer's sparrow

Common summer resident. Hyde (1960) lists it as abundant in sagebrush. Observation: 1 in sagebrush 1 mi. southwest of Iola Bridge, July 3.

Zonotrichia querula (Nuttall) Harris' sparrow

Hyde (1953) lists an immature ♂ taken from a flock of tree sparrows on Nov. 5, 1952, 1½ mi. south of Gunnison.

Zonotrichia leucophrys leucophrys (Forster) . . . White-crowned sparrow

Common resident, Warren (1916) lists it as a common breeder near Crested Butte. Hyde (1960) lists it as very common at higher elevations.

Zonotrichia albicollis (Gmelin) White-throated sparrow

Hyde (1953) lists one seen and watched for several minutes at close range about ½ mi. southwest of Gunnison on Nov. 22.

Passerella iliaca schistacea Baird Fox sparrow

Hyde (1953) lists a specimen taken along the Gunnison River just west of Gunnison, May 11, 1951, and reports others singing in heavy thickets along Ohio Creek north of Gunnison.

Melospiza lincolni alticola (Miller and McCabe) . . . Lincoln sparrow

Summer resident, common. Hyde (1960) lists it as a common breeder in brushy swamps at higher elevations.

Melospiza melodia montana Henshaw Song sparrow

Common resident. Observations: pair with nest in rosebush near mouth of Soap Creek, July 11; and 1 in willows, junction Dry Gulch and Gunnison River, July 5.

Calcarius lapponicus alascensis Ridgway Lapland longspur

Hyde (1953) lists one seen flying and reports hearing a note near Gunnison on Dec. 15, 1952, and also records a specimen collected and others seen and heard on Nov. 29, 1952 near Delta in nearby Delta County.

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MAMMALS OF THE SUBAQUATIC HABITATS
IN THE BLUE MESA RESERVOIR BASIN, COLORADO

Ronald W. Olsen

CONTENTS

Abstract	223
Introduction	223
Methods and procedures	224
Habitats	224
Results of trapping	225
Account of species	225
Summary	230
References	231

TABLES

1. Distribution of traps	227
2. Small mammals taken from subaquatic	227

University of Utah
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ABSTRACT

Mammals of ten species were taken in three subaquatic habitat types. Two kinds of shrews, Sorex vagrans and Sorex palustris, and three kinds of meadow mice, Microtus montanus, Microtus longicaudus, and Microtus pennsylvanicus, were taken in the moist meadows among grasses, Agrostis alba and Poa pratensis, and sedges, Juncus spp. Jumping mice, Zapus princeps, and a muskrat, Ondatra zibethicus, were taken among streamside vegetation containing narrowleaf cottonwood, Populus angustifolia, willow, Salix spp., alder, Alnus tenuifolia, birch, Betula fontinalis, and wild rose, Rosa woodsii; and a beaver, Castor canadensis, was taken from its pond in a streamside area. Chipmunks, Eutamias minimus, were found around the edges of ponds, and deermice, Peromyscus maniculatus, were quite ubiquitous.

INTRODUCTION

While on a University of Utah expedition to the Gunnison Valley in western Colorado, I made a study, as a student under grant from the National Science Foundation, of the mammals of the subaquatic habitats in the Blue Mesa Reservoir Basin. The purpose of the expedition, under the supervision of Dr. Angus M. Woodbury, was to survey the flora and fauna of the proposed Curecanti Reservoirs in Colorado before the waters of the reservoirs inundate them. Of primary importance was the vegetation survey, sponsored by the Bureau of Reclamation, and all other work was geared to its progress. The survey began June 27 and ended July 22. The field work was supervised by Dr. Stephen D. Durrant.

In addition to making a study of the subaquatic mammals, my duties included participation in the collection and preservation of the vertebrate specimens taken during the survey.

The Gunnison River and many of its tributaries flow through the Blue Mesa Reservoir Basin and farmers use this water to irrigate their fields. Moist meadows are common as are streamside habitats. Beavers are present in the area and many beaver ponds are available for study. Stock watering ponds are also available.

In most cases the subaquatic habitats give way suddenly to terrace vegetation. Sagebrush is the most abundant plant in the area, and the hills are covered with it. A few places devoid of sagebrush are cliffs, areas where subsurface water is available, and places where other plants have succeeded in competition with it.

METHODS AND PROCEDURES

In the field specimens were gathered by trapping, shooting and field collection of skulls and skeletons. Much of the latter was done by our vegetation survey crews as they worked over the area.

With the exception of one meadow mouse captured in the late afternoon by hand, all of the small rodents and shrews were taken in Museum Special snap traps. The traps were set in the afternoon and picked up early the next morning. A trap set one night is considered a trap night and approximately 600 such trap nights were spent trapping subaquatic habitats. Both dry oatmeal and an oatmeal-peanut butter compound were used for bait. No preference for either bait was noticed. However, the oatmeal-peanut butter compound was used most often because the wind sometimes blew the dry oatmeal from the traps.

Traps were set in three different ways. One quadrat was made of 100 traps set approximately 10 yds. apart. It was set in a meadow but was very unproductive. A second method used was to set a line of traps at intervals of 4 or 5 yds. These lines were as few as five or as many as 50 traps long depending upon the situation. The third method was the most time consuming but most productive. It consisted of selecting sites for traps near burrows or runways and marking their locations. This method was especially valuable for meadow mice.

We shot one muskrat and W. C. Coghill, a Colorado State Fish and Game representative, brought to us a beaver that he had trapped. Members of the expedition found skulls of several other beavers.

In the laboratory the flora of different localities was established by using the overlay maps and other information prepared by the vegetation survey crews. Data about the fauna of the different localities were taken from the field notebooks. Supplementing the field and laboratory studies, I reviewed in the library the natural history of the small mammals including such things as food and habitat preference as background for my studies.

HABITATS

Streamside vegetation was generally limited to strip of land 10 to 15 yds. wide on each side of the stream. This strip was bordered on the outside by either terrace or meadow vegetation. The dividing line was usually very sharp between these plant communities. Willows of the genus Salix were the most dominant plants along the streamside. These were often mixed with narrowleaf cottonwood, Populus angustifolia, Alder, Alnus tenuifolia, birch, Betula fontinalis, and wild rose, Rosa woodsii. The grasses, sedges and herbs were represented by smooth brome, Bromus inermis, downy brome, Bromus

tectorum, redtop, Agrostis alba, wire grass, Juncus balticus, Kentucky blue grass, Poa pratensis, dandelion, Taraxacum officinale, and other less common plants.

There were no natural meadows in this study; those found were all on farmland. Exotic grasses were more numerous than native ones on these meadows. Some of the more common plants were: smooth brome, sedges of the genus Carex, bulrushes of the genus Juncus, Kentucky blue grass, redtop, alfalfa, Medicago sativa, and yellow sweet clover, Melilotus officinalis. These meadows are included in this paper as subaquatic habitat because they were flooded with irrigation water quite often and some were boggy or swampy. Meadows that were not this moist are not included in this paper.

Several ponds are also included. A stock watering pond was one of these. It was located in a small depression that had an intermittent stream running through it. One side of this pond was lined with willows; the other sides with meadow grasses. Beaver ponds were also included. The beaver dam formed ponds that backed up into groves of trees where the vegetation was primarily streamside vegetation. The third was a stagnant pond at the edge of U. S. Highway 50. No water was running into it so it must have been fed by a spring or seep. The vegetation around this small pond was mostly sagebrush although some cattails, Typha latifolia, were found in one end.

RESULTS OF TRAPPING

Of 1191 trap nights used on the expedition, approximately 600 were set in subaquatic habitats. The distribution of these traps are shown in Table 1. The mammals taken in these subaquatic habitats are shown in Table 2. Ecological data obtained are given under the species accounts.

ACCOUNT OF SPECIES

Ondatra zibethicus osoyoosensis Lord

One muskrat was taken in the Blue Mesa Reservoir Basin, the only one seen. It was taken from an irrigation ditch at the side of a big alfalfa field. In several places, willows hung over the ditch and it was in these willows that the muskrat was taken. Investigation of the area showed no signs of a burrow although several depressions thought to be resting places were found. These depressions were in the grass among the willows at the water's edge. Several cuttings of a submergent grass were also found. Other grasses and sedges were found at the water's edge. A large stand of cattails, Typha latifolia, was also in the neighborhood. According to Errington (1948) cattails provide the best food for muskrats, but they will also eat bulrushes of the genus Scirpus. Bellrose & Low (1943) found that muskrats will eat the twigs and bark of willows. These plants are all available in the Blue Mesa Reservoir Basin, but muskrats were not observed to be common.



Fig. 1. Some of the mammal skins displayed by R. W. Olson and E. B. Robinson. Photo by Heber H. Hall

TRAPS SET

Table 1. Distribution of traps set in localities and habitats.

Date	Location	No. traps set	Approx. No. set in subaquatic habitat
June			
30	Junction of Dry Gulch & Gunnison R.	100	40 moist meadow 30 streamside
July			
1	East Elk Cr., 0.5 mi. upstream	100	35 streamside
2	Gunnison R., 0.2 mi. east of Red Cr.	104	10 moist meadow 10 farm pond
3	Dry Gulch, 1.5 mi. upstream	60	20 beaver pond
4	West Elk Cr., 0.1 mi. upstream	75	25 moist meadow 50 streamside
4	North Willow Cr., 0.5 mi. upstream	83	50 moist meadow 28 streamside
6	0.5 mi. northeast Beaver Cr., Highway 50	10	10 man made pond
6	Steuben Creek, 1.4 mi. upstream	84	40 moist meadow 20 streamside
7	Willow Cr., 0.5 mi. upstream	10	10 streamside
7	Willow Cr., 1.5 mi. upstream	63	30 streamside
10	Red Cr., 1 mi. upstream	43	10 streamside 33 beaver pond
13	Soap Cr., 4 mi. upstream	143	32 streamside
18	Lake Fork, 2 mi. upstream	60	5 streamside
18	Lake Fork, 5.5 mi. upstream	24	24 streamside
19	Junction Dry Gulch & Gunnison R.	100	45 streamside
20	Gunnison R., 2 mi. northeast of Cimarron	58	20 streamside
21	Gunnison R., 2 mi. west of Pine Cr.	60	15 moist meadow
21	Junction Pine Cr. & Gunnison R.	14	8 streamside
TOTAL		1191	600

SMALL MAMMALS CAUGHT

Table 2. Small mammals taken from subaquatic.

Small mammals	Subaquatic habitat			Non-aquatic Habitat
	Stream-side	Moist meadow	Pond	
<i>Sorex palustris</i> , water shrew	3	16	0	0
<i>Sorex vagrans</i> , vagrant shrew	1	2	0	0
<i>Eutamias minimus</i> , least chipmunk	0	0	0	9
<i>Peromyscus maniculatus</i> , deer mouse	50+	6	2	122+
<i>Microtus montanus</i> , meadow mouse	1	2	2	0
<i>Microtus longicaudus</i> , meadow mouse	9	3	4	0
<i>Microtus pennsylvanicus</i> , meadow mouse	2	11	0	0
<i>Zapus princeps</i> , jumping mouse	5	1	0	4
TOTAL	71	41	8	135

Peromyscus maniculatus rufinus Merriam

The deermouse was found in all environments trapped but they seemed to be more abundant in dry than in wet habitats. Jameson (1954) found that deermice feed largely upon fruiting bodies of various plants; mostly the mast produced by trees and fruiting shrubs. Williams (1957) said " . . . starchy interiors and integuments of seeds comprised roughly 2/3 to 3/4 of the material found in the stomachs examined. Conifer mast was an important item. One tenth to 1/5 of the material identified consisted of insect and arachnid remains. Grubs and caterpillars were frequently represented. Fruits, fungus, annelids, and green vegetation comprised the other foods identified."

The sedges and the grasses of the wet meadows and streamside areas were in seed as were also the plants found on the dry terrace areas. Insects were abundant in both environments although they differed in kind. Food then was plentiful in subaquatic environments and the reason why deermice were not as abundant there as elsewhere must be due to something else. Perhaps the deermice prefer dry areas or possibly there was competition with meadow mice for nesting sites. I could find nothing in the literature that would explain this phenomenon. Lack of food, however, does not seem to be the answer and the work of Cogshall (1928) supports this hypothesis. She found that regardless of the wide variation of range inhabited by forest, prairie, and desert forms of Peromyscus, all readily ate the same sort of food with only slight differences in food preferences.

Sorex palustris navigator Baird

Sorex vagrans obscurus Merriam

Shrews belonging to two species were taken in this study, the water shrew of which four were taken and the vagrant shrew of which three were taken. Both kinds were taken in moist meadow and streamside habitats. No preference was observed for either of these vegetation types.

All shrews taken in streamside habitats were either in the water or under overhanging banks. One, probably a water shrew, was observed to dive into the water and swim across the pool and under a rock. This observation was made in the late afternoon indicating that even though we took our shrews by trapping at night, they were also active during at least part of the day.

Three of the seven shrews were found in moist meadows, and two of the three were taken in meadow mouse runways where the traps were partly submerged in water.

Several workers, Conaway (1952), Williams (1954), and Getz (1961) have stated that shrews are usually found in habitats close to water; the reason being that shrews have a tremendous water turnover, Chew (1951). Since shrews are primarily insectivores according to Hamilton (1930) and Sorenson (1960) and since insects are common in all environments, shrews could probably forage wherever there was cover and food except their need for water keeps them close to the streamside.

Eutamias minimus consobrinus Allen

We took four chipmunks in moist habitats although they are not subaquatic rodents. All four were taken at the edges of ponds which bordered rather than modified the chipmunks natural environment. In Red Creek, two specimens were taken at the edge of a beaver pond, but the pond had not changed the area to any noticeable degree. Sagebrush extended down to the water's edge on the west side, and the pond was backing water into a grove of narrowleaf cottonwood on the north. Both of these areas were typical chipmunk habitat and I feel that the chipmunks were there in spite of the pond rather than because of it.

A similar situation was found 1/2 mi. northeast of Beaver Creek where a small stagnant pond was lying adjacent to U. S. Highway 50. This pond was bordered on one side by the highway and on the other by a sagebrush flat. The chipmunks were taken on the sagebrush side and I believe they lived and fed there possibly coming to the pond for water.

Chipmunks were never seen or taken in the moist meadows. Seeds of grasses have been found in chipmunk stomachs, Howell (1929) so it seems that they could find food in the meadows, but they are found most often in drier areas on terraces and in rocks. Howell (op.cit.) also found them to eat seeds and fruits of many other plants as well as nuts and buds. Food does not seem to restrict chipmunks in the Blue Mesa Reservoir Basin, but a preference for drier habitats does.

Zapus princeps princeps Allen

In this study six jumping mice were taken. Four of them were from stream side but two were from moist meadows. In a study by Williams (1954) jumping mice were limited to the wetter parts of the stream bottom; we, however, took three of them some distance from water in a very dry habitat. The common plant found there, giant wild rye, extended to the rock pile that marked the river's edge and no streamside vegetation was near. In the light of Williams' findings, it is difficult to explain their occurrence in this habitat. Possibly jumping mice are not limited to stream bottom vegetation and are able to survive elsewhere also.

Microtus longicaudus mordax Merriam

Microtus montanus fusus Hall

Microtus pennsylvanicus modestus Baird

Meadow mice of three species were found in this study area: M. longicaudus, the longtailed meadow mouse; M. pennsylvanicus, the common meadow mouse; and M. montanus, the mountain meadow mouse. Sixteen longtailed meadow mice were taken, nine along streamside, four in meadow grass bordering ponds, and three in meadows. Thirteen common meadow mice were taken, two in meadow grasses near a stream and eleven in moist meadows. Only five mountain meadow mice were taken, one in streamside vegetation, two in meadows, and two at edge of a farm pond. It appears that longtailed meadow mice inhabit both meadow and streamside vegetation while the common and mountain meadow mice are generally restricted to meadows.

Bailey (1900) and Jameson (1954) found meadow mice to feed on vegetative parts, roots, and bark of plants. They also found meadow mice to eat seeds

Microtus spp. (continued)

and grain although grass forms the bulk of their food. We often found cuttings of grass in their runways, but in one location little, if any, grass was available to the meadow mice. This was approximately 5 mi. up Lake Fork of the Gunnison River where four longtailed meadow mice were taken in a pile of rocks at the water's edge where the predominant plant was wild rose.

Castor canadensis concisor Kuhl

Several beavers were seen in ponds throughout the course of this study, but only one was taken. Beaver dams and ponds were found in Red Creek, Dry Gulch, East Elk Creek and several others. One dam on Red Creek was about 10 ft. high and backed water up more than 125 ft. The only beaver lodge I saw was located on one of the steep banks of this pond.

Warren (1926), Packard (1940) and Hall (1960) found aspen to be preferred to any other tree for food. Warren (op.cit.) found, however, that when aspen was absent, beaver in Yellowstone Park ate birch, cottonwood, wild rose, willow, and alder. In summer he found them to eat shrubs, grasses and herbs as well. In the study area, no aspens were found; they were found, however, higher up the mountains. All the other plants were available to beaver and I saw many branches of narrowleaf cottonwood which had been stripped of bark. Many willows were also cut.

Durrant and Dean (1959 and 1960) found beaver to be plentiful in the Colorado River, in the Glen Canyon and Flaming Gorge areas. We, however, found beaver to be rare on the Gunnison River and the Lake Fork of the Gunnison River in the Curecanti Reservoirs area. Only one was seen in the Gunnison River. Some signs were found on the Lake Fork of the Gunnison River but no animals were observed. Why were beaver so scarce here? Apparently food was plentiful along both streams, but was adequate shelter available? It would be improbable that beavers could construct permanent dams and houses on these rivers because of their swift currents and spring floods. The banks were mostly rocky so they had few areas available for digging dens. Probably this lack of shelter kept the beaver in the smaller tributary streams instead of the main rivers because every other requisite save shelter appeared to be present in the main rivers.

SUMMARY

While on a University of Utah expedition to the proposed Curecanti Reservoirs in western Colorado, I made a study of the mammals of three sub-aquatic habitats. I trapped the mammals in Museum Special snap traps and took notes of the ecological situation in which they were taken, narrowleaf cottonwood, willow, alder, birch, and wild rose were common streamside plants; and wire grass, sedges, smooth and downy bromes and alfalfa were found often in meadows. Some ponds were bordered by streamside vegetation and others were bordered by meadow grasses and sedges.

Mammals taken were of ten species. Two kinds of shrews and three kinds of meadow mice were taken in moist meadows and streamsides. Jumping mice and muskrat were taken from streamside habitat, and a beaver was taken from its pond. Chipmunks were found around the edges of ponds, and deermice were quite ubiquitous.

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MAMMALS OF THE GUNNISON RIVER BASIN

by

Stephen D. Durrant

Elroy B. Robinson

CONTENTS

Introduction	234
Accounts of species	238
Checklist of supplementary mammals	258
Remarks on distribution	261
Effects of the reservoirs upon mammals	261
Literature cited	262

TABLES

1. Rodents collected	240
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MAMMALS

INTRODUCTION

This expedition was the fourth conducted during the past four consecutive summers upon the reservoir basins in the Upper Colorado River Development Project. Unlike the previous three, which involved but a single basin, this, the Curecanti Project, consists of three basins to result from the Blue Mesa, Morrow Point and Crystal dams on the Gunnison River in west central Colorado. The expedition was under the auspices of the University of Utah Curecanti Project and was in the field from June 26 through July 23, 1961.

The junior author was responsible for collecting and preparing specimens of mammals. In addition, he had charge of the collections of amphibians and reptiles. In all of his activities, he was under the direct supervision of the senior author, who was Field Director of the expedition. Occasionally, other crew members aided him in his duties, but Ronald C. Olson, an undergraduate student, sponsored by the National Science Foundation, served full time. Gary L. Ranck, leader of one of the botanical teams, aided almost daily in the preparation of specimens. As expected, the majority of the mammalian specimens were small rodents obtained by Museum Special snap traps. In addition, some other kinds were obtained by shooting and skeletal remains "pick ups" were also acquired.

The primary purpose of this expedition, as in the previous three, was the quantitative and qualitative study of the vegetation of the reservoir basins, and all other activities were subservient to this main objective. The operational procedures on this expedition were similar to those employed in 1960 on the Navajo Project, on the San Juan River, in that all operations were conducted by truck from one base camp. All three reservoir basins were small, distances were short and roads were adequate along the Gunnison River and in the canyons of the tributaries. This permitted detailed trapping of each type of habitat and enabled retrapping of mammals in areas of greater significance or when larger series of mammals were desired. Moreover, because of the easy access and good accommodations at camp, sufficient time was available to adequately prepare the specimens. Generally, the mammals were skinned and both the skin and skull were preserved. In some instances, only the skull was preserved. Similar habitats existed on both sides of the Gunnison River and trapping was carried out on both sides to ascertain any differences that might exist in the mammalian fauna and its distribution on either side.

In addition, mammals were obtained from all of the side canyons. Generally, they were trapped from only the area that was within the confines of the reservoir basins which would be inundated. In some canyons, however, trapping was conducted for short distances beyond the limits of the reservoir basins, especially when it was considered that additional significant information would be disclosed to permit better understanding of the fauna of the basin itself. Because of the restrictions of time and the nature and physiography of the basins no attempt was made to obtain detailed ecological information. Such notes as were taken refer only to types of plant cover and soil. With the

MAMMALS

exception of 7 shrews, 14 bats, 5 cotton tails, 4 white-tailed jackrabbits, 2 striped skunks, 1 badger, 3 bobcats, 5 mule deer and 1 wapiti, all remaining specimens were rodents.

We trapped rodents both by the quadrat and trap line methods. Within the reservoir sites proper, little suitable area exists for collecting by the quadrat method. Therefore, the majority of the specimens were obtained by the trap line method. The reservoir areas abound in steep hillsides, ledges, cliffs, large boulders and steep walled canyons and this method is the most efficient in this type of terrain. Only two quadrats were set, one consisting of 100 and the other of 90 traps. In each, the traps were set roughly 30 ft. apart; being placed 10 steps apart in 10 or 9 rows of 10 traps each. The trap lines varied as to number of traps from a high of 166 to as few as 4. Although trap lines were used nearly exclusively, we attempted, where possible, to place the lines in a single type of habitat. In many instances, the areas of the specific habitats were small and the lines traversed several especially the micro habitats. The bait usually consisted of moistened rolled oats. Sometimes dry oats were used and also mixtures of oats and peanut butter.

Table I summarizes the collecting activities as to date, kind, physiography, soil type, and vegetational type where rodents were caught. It also contains, by kind, the number caught and those prepared as specimens. We operated out of a single base camp, nevertheless, no attempt was made to repeatedly trap any given area. Reference to the localities of capture, however, will inform the reader that on occasion certain areas were trapped several times. This usually resulted from having captured a single specimen of a somewhat rare mammal at a locality and the repeated trapping was an attempt to secure adequate study series of these mammals. Examples of this would be meadow mice, pocket gophers and jumping mice. We planned to sample as many different habitats as possible. The area was not greatly diversified in habitats and this also caused some repetition in trapping in some localities.

No attempt was made to study home ranges or the behavioral characteristics of any of the rodents. Therefore, nothing can be interpreted as accurately portraying either the size of the populations or their dynamics. This is undoubtedly reflected in the success in collecting. The same bait is not equally palatable to all kinds and some come to the traps more readily than others. Also, if traps were placed within the area of the home range, the probability of the animal being caught would be enhanced.

As previously mentioned, the Gunnison River is to be impounded by three dams which will form three consecutive reservoirs. The upper dam, the Blue Mesa, will form a lake approximately 22 mi. in length and approximately 1 mi. wide at its widest point. Arms of the lake will form up the tributary stream, the major ones being 8 mi. up Lake Fork and 4 1/2 mi. up Cebolla Creek on the southern side and 4 mi. up Soap Creek and 2 1/2 mi. up West Elk Creek on the northern side. In addition, arms will project for short distances up all tributaries. Although the Blue Mesa Reservoir is the widest, it is composed

MAMMALS

of two wider segments separated from each other by a narrow gorge 4 mi. in length, downstream from the mouth of West Elk Fork. In this gorge, the reservoir will be less than 250 yds. wide. In these wide areas extensive ranching and farming occurs. Throughout the 22 mi. of Blue Mesa Reservoir, fishing resorts, ranches and private homes make it practically totally privately owned. This is the only one of the three reservoirs that conflicts with other human interests at present. After leaving the Blue Mesa damsite, the river plunges into the spectacular Black Canyon of the Gunnison River. This is a deep, sheer entrenchment in the hard metamorphic rocks mostly of the Paleozoic Era. Eleven mi. downstream the Morrow Point Dam will again impound the stream and 8 mi. below this point the final impoundment will be caused by the Crystal Dam which will be but 1 mi. above the eastern boundary of the Black Canyon of the Gunnison National Monument. The Morrow Point Reservoir will be long, narrow and deep, being only $\frac{1}{3}$ mi. wide at its widest point and less than $\frac{1}{4}$ mi. wide for most of its distance. There are few tributaries to this reservoir. Meyers Creek and Curecanti Creek enter exceedingly steeply from the north while Blue Creek and Round Corral Creek enter in like manner from the south. Crystal Reservoir, still further downstream, is more deeply and narrowly engorged, being less than $\frac{1}{4}$ mi. wide at its widest point. It has one large tributary, Cimarron Creek, which enters from the southern side and one fairly large tributary, Crystal Creek, which arises to the north. The Gunnison River at the upper end of Blue Mesa Reservoir is 7490 ft. in elevation and at the Crystal Dam, 41 mi. downstream, the elevation is 6530 ft. and a drop of 960 ft. in 41 mi. Hence, the river flows fairly rapidly throughout the entire length of the reservoir sites.

The foregoing description will impress upon the reader that as concerns mammals there is quite a similarity in the types of habitats throughout the length of the reservoir sites. The upper, Blue Mesa Reservoir area, where the terrain is more open provides streamside, marsh, farmland, hillside and some cliff habitats, while in the lower two sites there exists streamside, a narrow band of steep hillside followed by sheer cliffs. In addition, along tributary streams, the canyon possesses streamside, steep hillside and cliff habitats. The streams that enter from the northern side have wider basins and more vegetation than do those from the southern side. The southern tributaries from their confluences with the Gunnison River to their headwaters are deeply entrenched in narrow, precipitous canyons which at best provide slight streamside habitats, but abound in ledges, and cliffs. The opposite occurs on the northern tributaries where the confluences are frequently in wide open valleys where farming occurs at present.

As concerns mammals, there are some differences in kinds between those of the open areas of the Blue Mesa Reservoir and those of the steep narrow gorges of its tributaries and the narrow precipitous Black Canyon of the Gunnison River. Our collections disclose the presence of some kinds that appear to be restricted to the particular habitats present in the two different areas. In some instances, we did not obtain certain kinds throughout the different regions, but we are certain, judging from the terrain, that they

MAMMALS

will be found to occur in both areas. Distances are too short to prevent animals from moving back and forth, and we saw no physiographic barriers that would impede movement throughout the areas. Such differences, then, that do occur, must be a direct reflection of the differences in types of habitats, especially the microhabitats.

Mammals we obtained only from the upper basin and perhaps restricted to it are the prairie dog, Cynomys gunnisoni, least chipmunk, Eutamias minimus, and the northern pocket gopher, Thomomys talpoides. In addition, we obtained others from only the upper open areas and they may be restricted to this area. They are white-tailed jack rabbit, Lepus townsendii and Nuttall's cottontail, Sylvilagus nuttallii. These two lagomorphs are perhaps quite restricted to greasewood and sagebrush, which are in short supply in the deep gorges. We obtained only muskrats, Ondatra zibethicus and beaver, Castor canadensis from the upper area. Perhaps the gorges of the lower regions are too rocky and precipitous, and the stream too swift and turbulent, especially in high water, to provide adequate habitats for them. Others that we obtained only from the upper area, but that we are certain will be found throughout the reservoir sites, are the vagrant shrew, Sorex vagrans, all species of bats (see accounts of species), marmot, Marmota flaviventris, montane meadow mouse, Microtus montanus, and the jumping mouse, Zapus princeps. According to our records, the lower gorge of the Gunnison River and the steep gorge of Lake Canyon have but two kinds restricted to them. The lower gorge in the region of the Crystal Reservoir alone possesses the brush mouse, Peromyscus boylei. This is perhaps because this is the only area which contains pinyon pine. In the gorges of the Gunnison River and Lake Fork, we found the Colorado chipmunk, Eutamias quadrivittatus. Other kinds, such as the water shrew, Sorex palustris, rock squirrel, Citellus variegatus, golden-mantled ground squirrel, Citellus lateralis, bushy-tailed woodrats, Neotoma cinerea, long-tailed meadow mouse, Microtus longicaudus, porcupine, Erethizon dorsatum occur throughout the reservoir sites in suitable habitats. Deer mice, Peromyscus maniculatus were ubiquitous, occurring throughout the area in all habitats. Our specimens of carnivores and ungulates are from skeletal remains, and we are certain that they occur throughout all the reservoir sites.

Trapping was excellent: 2194 trap nights produced 553 animals or a success of 25.2 per cent. All lines and quadrats produced animals, but the success was much higher in the lines than in the quadrats, 27.2 per cent as opposed to 3.1 per cent. All habitats save that of meadow hay produced good catches, ranging as high as 50 per cent. The success in quadrats in uncut hay fields yielded only 3 per cent. The table will indicate the success of capture, the types of habitats and will also disclose that the fauna of this small region is rich in kinds.

The accounts of the species of mammals are primarily based upon data collected by the expedition of 1961 through the three reservoir sites of the Curecanti project on the Gunnison River. This report is based essentially upon the collection of 595 animals of which 276 were preserved as scientific

MAMMALS

specimens, either skins and skulls, or skulls only and some post cranial skeletal remains. Data from scats, burrows and observation of animals are also included. We have also included some data from observations as reported by Clifford Coghill, Conservation Officer, of the Colorado State Department of Fish and Game, who is in charge of this general region, particularly of the deer and wapiti range with headquarters on East Elk Creek. Unless otherwise noted, all specimens are in the collections of the Department of Zoology and Entomology, University of Utah, Salt Lake City, Utah. Additional information relative to the mammals from the general region may be found in Hall and Kelson (1959), Warren (1942), and Durrant (1952). For reference to the plant communities associated with the ecological niches see Woodbury, Durrant and Flowers (1962).

The main maps of reference to the exact localities of capture of the mammals are the following: United States Geological Survey Quadrangle Sheets: Iris, NW, Colo., 1954; Iola, Colo., 1954; Cebolla, Colo., 1954; Sapinero, Co o., 1954; Curecanti Needle, Colo., 1956; Cimarron, Colo., 1956; Cathedral Peak, Colo., 1957; Grizzly Ridge, Colo., 1957. In some instance river miles are given. They begin at river mile 20, located approximately one mi. below Crystal Dam, at East Portal and proceed upstream to the head of the Blue Mesa Reservoir. When used, the letters L and R following the river mile indicate left or right bank respectively facing downstream.

From the data obtained by the expedition, and from Hall and Kelson (1959), and from other pertinent references, the mammalian fauna of the three previously mentioned reservoir sites and environs belongs to six orders, 18 families, 52 genera, 83 species and 85 subspecies. This is an imposing list, but perhaps is not yet complete for the region. Without doubt, certain kinds now considered as occurring within the area will be found to not occur there. Furthermore, some kinds now thought to be absent from the region may prove to occure there. The taxonomic arrangement here employed from order to species and subspecies is arranged after Hall and Kelson (op.cit.) In some instances we have departed from their names of genera where we are not in accord with their arrangement. Vernacular names for species are after Hall et al. (1957). Records of the rodents collected are given in Table 1.

ACCOUNTS OF SPECIES

INSECTIVORA (order) Insectivores

Soricidae (family) Shrews

We obtained representatives of two species of this family from within the confines of the three reservoir sites.

Sorex vagrans obscurus Merriam 1891 Vagrant shrew

We obtained only 3 specimens of this species, and they were all from the area of the Blue Mesa Reservoir. Although sought for, but not obtained from the lower gorge, we are certain that additional collections will

MAMMALS

Sorex vagrans obscurus (continued)

disclose that they occur throughout the entire area in moist environments. Our specimens are from moist meadows adjacent to the streamsides or from the streamsides proper. They come from boggy areas characterized by grass and Carex. Along the streamsides, these areas were further provided with other woody types of vegetation, such as willow, cottonwoods, birch and rose.

Available specimens are 2 from Dry Gulch, at junction with the Gunnison River, 14 mi. above the Blue Mesa Dam site, 7380 ft. and 1 from Willow Creek 1/2 mi. above mouth on the Gunnison River, 7600 ft. Both localities are in Gunnison County, Colorado.

Sorex palustris navigator (Baird) 1858 Water shrew

Water shrews are apparently somewhat rare in the region. We obtained only four animals, but they were from localities both within the open areas of the Blue Mesa Reservoir site and from the deep gorge of the Black Canyon of the Gunnison River. These shrews as their name indicates are restricted to water. Our specimens were from the edge of the streams and one animal was observed swimming in the river. Although restricted to water and its near vicinity, they do show a somewhat wider range of microhabitats, varying from dense grass-sedge, herb habitat to those characterized by tumbled, broken rocks.

Available specimens are 2 from 1 mi. west of Gunnison River on West Elk Creek, 7400 ft., Gunnison County, Colorado; 1 from Dry Gulch, junction with Gunnison River, 14 mi. above Blue Mesa Dam, 7350 ft., Gunnison County, Colorado; 1 from the confluence of Pine Creek and Gunnison River, Black Canyon, 7260 ft., Gunnison County, Colorado.

CHIROPTERA (order) Bats

After camping for a week on Dry Gulch with an intermittent stream and finding no bats, we had occasion to be on the Gunnison River at dusk. Here, we found a heavy population of bats. They flew over the water and the dense vegetation of the banks. This large population occurred throughout the entire length of the river within the basins of the three reservoir sites. The banks of the river throughout are cliffs with many cracks and crevices affording innumerable sites for roosting. They were observed leaving these cracks and crevices in goodly numbers at dusk. We obtained 10 specimens belonging to one family, 3 genera and 6 species. Our studies lead us to conclude that the area is rich in numbers of bats, but somewhat depauperate in the number of kinds. In addition to those actually shot and prepared as scientific specimens only one kind Lasiurus cinereus was observed.

Vespertilionidae (family) Vespertilionid bats

Myotis lucifugus carissima Thomas 1904 Little brown myotis

Several bats of this species were observed, but we were successful in obtaining but a single specimen from Dry Gulch and Gunnison River, 7400 ft., Gunnison County, Colorado.

Table 1. Rodents collected in the Curecanti Reservoir Basins, 1961.

Species	Common name	Physiography	Soil
SCIURIDAE			
<u>Eutamias minimus</u>	Least chipmunk	Hillside, canyon, ledges	Clay, sand, rocks
<u>Eutamias quadrivittatus</u> . . .	Colorado chipmunk	Canyons	" "
<u>Marmota flaviventris</u> . .	Yellow-bellied marmot	Streamside ledges, cultivated fields	" "
<u>Citellus variegatus</u>	Rock squirrel	Canyons	" "
<u>Citellus lateralis</u> .	Golden-mantled gr. squirrel	Canyon, ledges, hillside	" "
<u>Cynomys gunnisoni</u>	Gunnison prairie dog	Hillside	Sandy clay, clay loam
<u>Tamiasciurus hudsonicus</u>	Red squirrel	Canyon	
GEOMYIDAE			
<u>Thomomys talpoides</u> . .	Northern pocket gopher	Cultivated fields	Clay sand loam
CASTORIDAE			
<u>Castor canadensis</u>	Beaver	Canyons, stream-side	
CRICETIDAE			
<u>Peromyscus maniculatus</u>	Deer mouse	Ubiquitous	
<u>Peromyscus boylei</u>	Brush mouse	Canyon ledges	Rocky
<u>Neotoma cinerea</u>	Bushy-tailed wood rat	" "	"
<u>Microtus pennsylvanicus</u>	Meadow vole	Moisty areas	
<u>Microtus montanus</u>	Montane vole	Streamside, canyons	
<u>Microtus longicaudus</u>	Long-tailed vole	Streamside, canyons	
<u>Ondatra zibethicus</u>	Muskrat	Streamside canyons	
ZAPODIDAE			
<u>Zapus princeps</u>	Western jumping mouse	Hillside, stream-side	
ERETHIZONTIDAE			
<u>Erethizon dorsatum</u>	Porcupine	Hillside	Clay sand

Rodents collected (continued)

June - July					TOTALS		Vegetation type				
28-2	3-7	8-12	13-17	18-21			Stream side	Sage brush	Wet meadows	Mixed conifers & brush	Farm land
8	14	10		3	35	26	x	x		x	
		1	6	5	12	12				x	
2	3	1	1	1	8	8	x				
1				3	4	4		x			
2	1	4	8	4	19	19	x	x		x	
1		4	3		8	8		x			
		1			1	1				x	
3			5	4	12	12					x
		2	1	1	4	4	x		x		
103	99	48	28	92	370	71	x	x	x	x	x
				2	2	2				x	
1	5	1		4	11	11		x		x	
4	8	1			13	13	x		x		
2	2	1			5	5	x		x		
3	8		1	20	32	23	x		x		
	1				1	1	x				
3	2	4	1	4	14	14	x		x		
	1		1		2	2		x			
133	143	79	55	143	553	236					

MAMMALS

Vespertilionidae (family) continued

Myotis evotis evotis (H. Allen) 1864 Long-eared myotis

Our collecting records indicate that this is one of the commonest kinds of bats in this general region. They were obtained in company with other kinds (see general account) as they flew at dusk and well into darkness over the Gunnison River. Because our localities of capture approach the eastern limits of the known range of this subspecies, we suspected that they may be undergoing some significant differentiation along the periphery of their range. Our specimens, however, appear to be constant in their characters and fall well within the range of variability of this subspecies.

Available specimens are 1 from Dry Gulch and Gunnison River, 7400 ft., Gunnison County, Colorado and 2 from Red Creek and Gunnison River, 7460 ft., Gunnison County, Colorado.

Myotis volans interior Miller 1914 Long-legged myotis

Our 3 specimens are from Dry Gulch and Gunnison River, 7400 ft., Gunnison County, Colorado. Compared with specimens from other localities in our collections, they exhibit all the characters typical for this subspecies.

Myotis subulatus melanorhinus (Merriam) 1890 Small-footed myotis

As understood at present, the ranges of this subspecies and its close relative Myotis s. subulatus come into contact in Colorado. A line from the northwestern corner through the southeastern corner of Colorado roughly approximates the limits of the ranges of these two subspecies in this region. Bats belonging to these 2 subspecies are difficult to distinguish from each other. The main character employed is color in which animals referred to M. s. melanorhinus are stated to be slightly darker. Our specimens are from western Colorado, not far removed from the western limits of the range of M. s. subulatus. They are dark and show none of the supposed lighter color of M. s. subulatus. We are not convinced that these characters are really meaningful, because in areas in Utah in the central part of the range of M. s. melanorhinus, we find tremendous variation in specimens. This species needs further study.

Available specimens are 1 from Dry Gulch and Gunnison River, 7400 ft., Gunnison County, Colorado and 1 from Red Creek and Gunnison River, 7460 ft., Gunnison County, Colorado.

Eptesicus fuscus pallidus Young 1908 Big brown bat

Our single specimen was taken at Dry Gulch and Gunnison River, Gunnison County, Colorado. An interesting observation is that on the night this bat was collected by shooting, representatives of the species Myotis evotis, M. volans and M. subulatus were taken from the same locality.

Lasiurus cinereus cinereus (Palisot deBeauvois) 1796 Hoary bat

Dean Stock, a member of the crew, reported seeing one in flight. It was observed at the mouth of Dry Gulch, 7400 ft., Gunnison County, Colorado.

MAMMALS

LAGOMORPHA (order) Hares, rabbits and pikas

Leporidae (family) Hares and rabbits

Within the reservoir area, this order is represented by animals belonging to two general and two species.

Sylvilagus nuttallii pinetis (J. A. Allen) 1894 . . . Nuttall's cottontail

These cottontails occurred throughout the area of the reservoir. They were observed daily on the hillsides, in the canyons and along fence rows in the cultivated areas. They were more numerous in stands of sagebrush and mixed stands of sagebrush and rabbitbrush on the hillsides. Compared with specimens of this subspecies from southeastern Utah, these specimens from the reservoir area fall well within the limits of variation of the subspecies. As a group, they are darker in dorsal coloration, and the reddish coloration, is less intense. In total length they are shorter, but the lengths of tail, hind foot and ear are greater. The skulls are comparable, but those from the study area are generally larger and more robust. It is entirely possible that this population inhabiting this high valley of the Gunnison River constitutes a local population somewhat isolated which is undergoing some slight evolution leading to distinctiveness.

Available specimens are 2 from Dry Gulch, 3/4 mi. above Gunnison River, 7470 ft.; 1 from Dry Gulch and Gunnison River, 7300 ft.; 1 from Dry Gulch, 4 mi. northeast of Sapinero, 7500 ft., 1 from Cebolla Creek. All localities in Gunnison County, Colorado.

Lepus townsendii townsendii Bachman 1839 White-tailed jack rabbit

These large hares were noted rather commonly throughout the basin of the river and the side canyons. They were somewhat more abundant on the hillsides in sagebrush and sagebrush mixed with rabbitbrush. Although generally somewhat sympatric with Nuttall's cottontails, they did not favor the areas of dense brush. Our observations indicate that they preferred areas of broken stands of brush through which were found open bare areas and areas vegetated by bluestem grass. Several were noted dead on U. S. Highway 50 where it traversed the hillside terrain.

Available specimens are 1 from Gunnison River, 3 mi. east of confluence with Dry Gulch, 7600 ft., 1 from 1/4 mi. above confluence of Red Creek and Gunnison River, 7350 ft.; 1 from Soap Creek, 2 mi. from Sapinero, 6000 ft.; 1 from Gunnison River near Sapinero, 7490 ft. All localities in Gunnison County, Colorado.

RODENTIA (order) Rodents

We obtained specimens from the area of the reservoir and environs representative of 6 families, 13 genera and 17 species.

MAMMALS

Sciuridae (family) Squirrels

This family is represented in the area of the reservoir by animals belonging to 5 genera, 7 species and 7 subspecies. Therefore, it is noted that this family constitutes a large part of the fauna of rodents containing nearly one half of the genera and one third of the species represented.

Eutamias minimus operarius Merriam, 1905 Least chipmunk

These little chipmunks were nearly ubiquitous within the confines of the reservoir. We obtained specimens from 10 localities ranging from the leges on the mountain sides downward throughout the hillsides to the streamsides in the bottomlands. They were likewise common within the canyons of the tributary streams. They were generally sympatric with the other species Eutamias quadrivittatus, but closer observations reveal that although they occurred together, least chipmunks were also found in drier more xeric situations than the Colorado chipmunks.

According to their distributional map of this species, Hall and Kelson (1959:301) include the entire study area within the range of the subspecies Eutamias minimus consobrinus (J. A. Allen). We compared our specimens with near topotypes of E. m. consobrinus and with representatives of the subspecies E. m. operarius from extreme eastern Utah. The specimens from the study area differ markedly from the aforementioned specimens of E. m. consobrinus. They are larger, much more rufescent dorsally, and the underneath side of the tail has a richer buffy color. The skulls are larger. In all these characters they closely resemble specimens of E. m. operarius to which they are here referred. If our materials are representative of specimens from elsewhere in west-central Colorado, then the entire southern half of Colorado is not populated by any members of the subspecies E. m. consobrinus, and the range of this latter subspecies in Colorado would be restricted to the northwestern part of the state.

Available specimens are 1 from Dry Gulch at junction with Gunnison River; 2 from Dry Gulch $1\frac{1}{4}$ mi. north of Gunnison River, 7900 ft.; 2 from Dry Gulch $1\frac{1}{2}$ mi. north of Gunnison River, 8000 ft.; 2 from butte northwest of Dry Gulch, 7800 ft.; 2 from Willow Creek, $2\frac{1}{2}$ mi. north of Gunnison River, 7500 ft.; 3 from Gunnison River at confluence with Red Creek, 7300 ft.; 1 from Red Creek, 1 mi. above confluence with Gunnison River, 7544 ft.; 3 from confluence of Beaver Creek and Gunnison River, 7600 ft.; 2 from Gunnison River, $\frac{1}{2}$ mi. northeast of Beaver Creek, 7600 ft.; 2 from Beaver Creek at junction with Gunnison River, 7600 ft.; 1 from Gunnison River, $\frac{1}{2}$ mi. east of junction with Cebolla Creek, 7400 ft.; 2 from Cebolla Creek, 2 mi. from mouth, 7400 ft. All localities in Gunnison County, Colorado.

Eutamias quadrivittatus quadrivittatus (Say) 1823 Colorado chipmunk

Members of this species although occurring sympatrically with those of the species Eutamias minimus were quite restricted to the main gorge of Black Canyon and to the gorges of the tributary streams. We found none in the open valleys where representatives of the latter species were common. Throughout the reservoir area, in suitable habitats, Colorado chipmunks

Sciuridae (family) continued

Eutamias quadrivittatus quadrivittatus (continued)

were common. Our field notes record their predilection for rocky situations containing currant bushes where they fed eagerly upon the fruits. Golden-mantled ground squirrels (Citellus lateralis) occupied the same areas and both kinds were taken in the same trap lines.

As concerns the taxonomy and distribution of the large chipmunks of Colorado, the study area is critically located. As understood at present, the study area is nearly all within the range of this subspecies (Hall and Kelson, 1959:318). According to their map (loc. cit.) the line forming the western boundary of the range of this subspecies crosses the Black Canyon of the Gunnison National Monument from north to south. The western limits of the study area end at the eastern limits of this monument. Moreover, according to the map (loc. cit.) part of the study area is also contained within the range of another species Eutamias umbrinus montanus White. In addition to the specimens from the study area, the senior author also studied a series of 16 specimens from the general vicinity of Cochetopa Dome, not far removed southeastward from the study area. In all our study, we have found no specimens that we can refer to the species Eutamias umbrinus. Likewise, we found no specimens referable to the other subspecies E. q. hopiensis Merriam. All students of chipmunks know, on the one hand, that it is extremely difficult to distinguish between specimens referred to the subspecies E. q. quadrivittatus and those at present assigned to any of the subspecies of E. umbrinus. On the other hand, specimens of E. quadrivittatus can be easily assigned to one or the other of the two presently recognized subspecies. Formerly, the two aforementioned species were considered as one. White (1953) established E. umbrinus as distinct from E. quadrivittatus, placing his greatest emphasis on differences of the baculum. We have not had access to this structure in our specimens. On the basis of size, color and cranial characters, we find no differences sufficient magnitude to merit placing these animals in different species. Actually, the only distinctive group of this entire complex of chipmunks is the subspecies E. q. hopiensis. This subspecies differs much more markedly from E. q. quadrivittatus, than the latter does from any subspecies E. umbrinus. It is further of interest that great ecological differences exist between animals of E. q. hopiensis and the others. E. q. hopiensis is a desert form, inhabiting extreme xeric habitats, while E. q. quadrivittatus and E. umbrinus occur only in montane and submontane environments in mesic habitats.

Closer examination of the distribution map (Hall & Kelson, 1959:318) will evoke further questions. The first thing that catches the eye is the fact that both species are totally allopatric and in this act as subspecies. This seems quite improbable inasmuch as E. q. quadrivittatus and E. umbrinus are montane animals and are known to occupy similar habitats. The entire problem of the large montane chipmunks of Colorado needs further study to clarify their taxonomic status and distributional characteristics.

Available specimens are 1 from Cebolla Creek, 2 mi. up from Gunnison River, 7420 ft.; 2 from junction Pine Creek and Gunnison River, 7300 ft.;

MAMMALS

Sciuridae (family) continued

Eutamias quadrivittatus quadrivittatus (continued)

2 from 5 mi. above mouth of Lake Fork, 7400 ft.; 3 from $5\frac{1}{2}$ mi. above mouth of Lake Fork, 7400 ft.; 2 from Black Canyon of the Gunnison River, 5 mi. west of Sapinero, 7500 ft.; 2 from Black Canyon of the Gunnison River, 8 mi. west of Sapinero, 7400 ft. All localities in Gunnison County, Colorado.

Marmota flaviventris luteola A. H. Howell 1914 Yellow-bellied marmot
Ledges and tumbled down rocks near water and succulent vegetation are ideal habitats for marmots in the mountainous west. Throughout the sites for the impending reservoirs, the Gunnison River and its many tributaries have entrenched themselves forming limitless rocky areas suitable for marmots. Along the streamsides the phreatophyte vegetation abounds in the near vicinity of the ledges, and marmots are exceedingly common throughout the area. Although usually found in greater numbers in the ledges along the streams, they were commonly observed considerable distances from the river feeding in cultivated hay fields. They appeared to be fond of the succulent shoots of alfalfa and clover.

Within the species M. flaviventris, color is extremely variable, and we put little or no significance in its use as a good taxonomic character. Comparisons of our specimens with those of the subspecies M. f. engelhardti, and M. f. nosophora, the closest subspecies to the west, show close relationships in the variations of color. Compared to specimens of M. f. obscura from northwestern New Mexico, our specimens are all markedly lighter in color. Cranially, specimens from the study area possess wide flaring, strongly decurved nasals, strongly decurved postorbital processes and deep strongly concave interorbital regions. These characters with the less inflated tympanic bullae place them within the subspecies M. f. luteola.

Available specimens are 6 from the confluence of Dry Gulch and Gunnison River, 7400 ft.; 1 from Jointed Rod Resort on Gunnison River, 7520 ft.; 1 from West Elk Creek, 1 mi. north of Gunnison River, 7400 ft.

Citellus variegatus grammurus (Say) 1823 Rock squirrel

We found rock squirrels throughout the study area, but nowhere abundant. They occurred on the hillsides in sagebrush and rabbitbrush, along the hay fields but were most numerous on south facing ledges along the Gunnison River. We obtained only 4 specimens and they are quite variable in color. They all possessed the typical variegated white mottlings on the back which is characteristic of this subspecies. None possessed the discrete white mottlings of the subspecies to the west, C. u. utah (Merriam).

Available specimens are 1 from Dry Creek, $\frac{3}{4}$ mi. north of Gunnison River, 7460 ft.; 1 from Gunnison River, 3 mi. northeast of Cimarron, 6907 ft. and 2 from Black Canyon, Gunnison River, 2 mi. northeast of Cimarron, 7150 ft. All localities from Gunnison County, Colorado.

MAMMALS

Sciuridae (family) continued

Citellus lateralis lateralis (Say) 1823 . . Golden-mantled ground squirrel

Next to chipmunks, these ground squirrels were the commonest sciurids in the study area. They were practically ubiquitous, occurring in rocky ledges, rocky hillsides, rolling hillsides, borders of cultivated fields, along roads and even on the streamsides. They were associated with many plants but appeared to be more numerous in areas containing sagebrush, roses and currants. Several were noted also in xeric situations characterized by juniper. In color, members of this subspecies are generally characterized by having reduced dark dorsal stripes with the medial one practically or totally obliterated. With reference to these median dark dorsal stripes, our examples show a marked variation from strongly expressed to completely absent. Some specimens have this character expressed in a manner representative of their closest western relative from north central Utah, C. l. castanurus (Merriam). Because of the wide ecological tolerances of these ground squirrels, and because no apparent barriers are present to effect isolating mechanisms, it is entirely possible that some interchange of genes occurs between animals of these two subspecies.

Available specimens are 4 from Dry Gulch, 3/4 mi. north of Gunnison River, 7460 ft.; 1 from Dry Gulch, 1 1/2 mi. north of Gunnison River, 8000 ft.; 1 from Gunnison River, RM 55.2, 7600 ft.; 1 from confluence of Beaver Creek and Gunnison River, 7600 ft.; 1 from confluence of Red Creek and Gunnison River, 7350 ft.; 4 from Lake Fork, 5 mi. above mouth, 7400 ft.; 2 from Lake Fork, 5 1/2 mi. above mouth, 7460 ft.; 1 from Black Canyon, Gunnison River, 5 mi. west of Sapinero, 7500 ft.; 1 from Black Canyon of Gunnison River, 8 mi. west of Sapinero, 7400 ft.; 1 from Pinyon Forest, 3 mi. northeast of Cimarron, 7100 ft.; 2 from Gunnison River, 2 mi. northeast of Cimarron, 7150 ft. All localities in Gunnison County, Colorado.

Cynomys gunnisoni gunnisoni (Baird) 1855 Gunnison's prairie dog

Our 8 specimens are all from the right side of the Gunnison River near the upper limits of the site of the Blue Mesa Reservoir. Ecologically, they were restricted to gravelly areas vegetated with sagebrush and bluestem grass. Their burrows were in bare areas that were somewhat higher than the surrounding terrain, thereby insuring adequate drainage.

Our localities of capture are not far removed from the type locality of this subspecies and according to Hall and Kelson (1959:368) are well within the range ascribed to this subspecies. For comparison, we had 8 near topotypes from Cochetopa Park, Saguache County, Colorado. This locality is roughly 20 mi. (airline) southeastward from our localities of capture, and as near as we can estimate it is within the drainage system of the Gunnison River. Despite this closeness geographically, specimens from the study area differ quite markedly in some characters from the topotypes. Comparisons of comparable July - taken specimens discloses that those from the study area are markedly darker dorsally (more a mixture of black) and especially so on the dorsal surface of the head. The feet, axillary and inguinal regions, and sides of head have a darker, richer buffy color.

MAMMALS

Sciuridae (family) continued

Cynomys gunnisoni gunnisoni (continued)

Cranially, some differences are discernable. Skulls of the topotypes possess less dilated ends of the masals and more ventrally inflated tympanic bullae. In these characters, especially those of color, our specimens are reminiscent of those of the other subspecies C. g. zuniensis Hollister from southeastern Utah. These latter animals are lighter dorsally, but have darker, richer buffy color on the feet and sides than those from the study area.

Our observations of the nature of the terrain along the Gunnison River convince us that suitable habitats for prairie dogs is scarce and the localities of occurrence are rather disjunct. This possibly accounts for the rather high degree of endemism exhibited by our specimens. With possibly no more than a trickle of gene exchange between these small populations, each can rapidly become a rather distinct deme within the complex of the subspecies.

Judging from their distribution map, Hall and Kelson (loc. cit.) consider the Colorado River proper in western Colorado to form the boundary between the ranges of the species C. gunnisoni and C. leucurus Merriam. They further consider the Gunnison River below its junction with the Uncompahgre River, and the Uncompahgre River to form the boundary between the two subspecies of C. gunnisoni. We found no animals belonging to the species C. leucurus, and found none we could refer to the subspecies C. g. zuniensis. We are intrigued with the possibilities of a study in this general region upon speciation of prairie dogs.

Available specimens are 7 from 1 mi. west of Steuben Creek on Gunnison River, 7460 ft.; 1 from $\frac{1}{2}$ mi. east of Eagle Rock along Gunnison River, 7560 ft. Both localities in Gunnison County, Colorado.

Tamiasciurus hudsonicus fremonti (Audon and Backman) 1853 . . Red squirrel

These mammals were restricted within the area to the extreme upper reaches of the reservoir sites in the side canyons. We obtained but a single specimen from Soap Creek, 4 mi. above its confluence with the Gunnison River, 7500 ft., Gunnison County, Colorado. Several others were observed at this locality where they occurred in association with the Colorado blue spruce and narrowleaf cottonwoods. Another was shot in Lake Fork but not retrieved. Here again, Colorado blue spruce was part of the habitat of this animal.

Geomyidae (family) Pocket gophers

Thomomys talpoides fossor J. A. Allen 1893 Northern pocket gopher

These rodents occur in suitable habitats throughout the entire site of the Blue Mesa Reservoir. As previously stated, this is the only reservoir site that is in a valley and considerable areas are under cultivation. They are found in considerable numbers in hay fields and in deeper soils along the river. We found mounds in the floors of the side canyons and on lower hill-sides possessing soils of sufficient depths. In the Morrow Point and Crystal sites, both contained within the sheer rocky canyons of the Black Canyon of the Gunnison River, there was little evidence of their occurrence. In the

MAMMALS

Geomyidae (family) Continued

Thomomys talpoides fossor (continued)

few areas containing deeper, stabilized soils some few mounds were observed. Our study area is well within the range ascribed to this subspecies (Hall and Kelson, 1959:438), and our specimens agree in their diagnostic characters with those from elsewhere assigned to this subspecies.

We obtained 12 specimens from the confluence of Dry Gulch and the Gunnison River, 7350 ft., Gunnison County, Colorado.

Castoridae (family) Beaver

Castor canadensis concisor Warren and Hall 1939 Beaver

Beavers occur throughout the three reservoir sites. Our observations indicate that along the Gunnison River in the Blue Mesa site, there are not many beavers. We never saw any animals but did note an occasional track along the streamside or evidence of their having cut down some trees. Perhaps the great amount of human activity throughout this area may in part account for their apparent paucity of numbers. We also suspect that this can also be accounted for because of the nature of the stream and its banks in this area. Plenty of food exists but the banks are not conducive to burrowing and the stream is too large and swift to enable these animals to construct dams. Throughout the Morrow Point and Crystal reservoir sites, the nature of the gorge and stream and the reduced area of phreatophyte vegetation practically precludes the possibility of any sizeable population of beavers in these areas. Concerning the side canyons, this is just about the reverse. Every tributary stream that we visited had a good population of beavers. In some tributaries, with little water, we were astonished to find such large populations. The reasons for their abundance in the side canyons and their lack of large numbers in the main river are immediately apparent. The tributary streams are in canyons adequately provided with sufficient phreatophytes for food and the streams lend themselves readily to impoundment by dams.

We obtained but a single specimen which was trapped and given to us by Clifford Coghill of the Colorado State Department of Fish and Game. He trapped it on East Elk Creek, 7500 ft., Gunnison County, Colorado. At present, beavers from this general region are referred to the subspecies C. c. concisor. We have no comparative material of this subspecies, but comparing this animal with the original by Warren and Hall (1939:358), it agrees generally with the diagnostic characters.

Cricetidae (family) Cricetids

We trapped for one month and were successful in obtaining representatives of only 4 genera and 7 species from the entire area of the sites of the three reservoirs. This somewhat surprised us because in our previous study on three other tributaries of this Colorado River complex, we found many more kinds.

MAMMALS

Cricetidae (family) continued

Peromyscus maniculatus rufinus (Merriam) 1890 Deer mouse

The journal of the junior author has the following statement "Utterly ubiquitous, caught 275 that I have recorded in every possible kind of habitat . . . Sagebrush, rocks and rock piles, base of rimrocks, stream-side, rose clumps, wet meadows, dry meadows, edge of beaver ponds, alfalfa fields, inside houses, under houses, pinyon woods, spruce-fir woods, scrub oak, crevices in cliffs, Elymus flats, under bridges and culverts, along roadside, mixed shrubs, mixed shrubs and grasses, carnivore dens, Neotoma dens, top of waterfall, cottonwood grove and hillside rocks and brush." Not only are they everywhere in occurrence, but they are present in great numbers. Reference to the chart will inform the reader that 370 of the 553 animals obtained by the expedition belonged to this subspecies.

The nearest subspecies geographically to this subspecies in Colorado are P. m. nebrascensis (Coues.) which occurs to the northwest, north and east, and P. m. sonoriensis (LeConte) to the southwest. Our experience with deer mice of the intermountain west is that large series of specimens from nearly anywhere, belonging to any of the presently recognized subspecies present considerable variation in color and in the subtle, diagnostic cranial characters. Our series of 71 specimens lack the dimorphism in color usually characteristic of members of this species and cranially are quite constant.

Available specimens are 2 from $\frac{1}{2}$ mi. northeast Beaver Creek on Gunnison River, 7600 ft.; 1 from confluence of Beaver Creek and Gunnison River, 7600 ft.; 2 from $\frac{1}{2}$ mi. south of confluence of South Willow Creek and Gunnison River, 7500 ft.; 2 from Steuben Creek, $1\frac{1}{4}$ mi. above mouth, 7740 ft.; 4 from 1 mi. below Steuben Creek, 7460 ft.; 2 from Willow Creek $1\frac{1}{2}$ mi. north of Gunnison River, 7500 ft.; 2 from Willow Creek, $1\frac{1}{2}$ mi. south of Gunnison River, 7540 ft.; 1 from Willow Creek, 2 mi. south of Gunnison River, 7600 ft.; 2 from $\frac{3}{4}$ mi. southwest of Iola Bridge, Gunnison River, 7600 ft.; 2 from U. S. Highway 50, $\frac{1}{2}$ mi. east of East Elk Creek, 7560 ft.; 4 from junction of Dry Creek and Gunnison River, 7400 ft.; 3 from Dry Gulch, $1\frac{1}{2}$ mi. north of Gunnison River, 8300 ft.; 7 from Dry Gulch, $\frac{3}{4}$ mi. north of Gunnison River, 7460 ft.; 2 from Red Creek, $\frac{1}{2}$ mi. from mouth, 7428 ft.; 5 from Gunnison River, east of junction of Red Creek, 7350 ft.; 2 from West Elk Creek, 1 mi. north of Gunnison River, 7400 ft.; 4 from Cebolla Creek, 2 mi. above mouth, 7400 ft.; 5 from Cebolla Creek, $\frac{1}{2}$ mi. above junction with Gunnison River, 7400 ft.; 7 from Soap Creek, 4 mi. north of Gunnison River, 7520 ft.; 2 from Lake Fork, 2 mi. from mouth, 7295 ft.; 3 from Lake Fork, 5 mi. from mouth, 7400 ft.; 1 from 3 mi. below junction of Pine Creek and Gunnison River, 7550 ft.; 1 from $\frac{1}{2}$ mi. west of Meyers Gulch and Gunnison River, 6976 ft.; 1 from Gunnison River, 3 mi. northeast of Cimarron, 7100 ft.; 3 from Gunnison River, 2 mi. northeast of Cimarron, 6700 ft., All localities in Gunnison County, Colorado.

MAMMALS

Cricetidae (family) continued

Peromyscus boylei rowleyi (J. A. Allen) 1893 Brush mouse

We obtained only 2 specimens (1 adult, 1 immature) from 3 mi. northeast of Cimarron, Gunnison River, 7100 ft., Gunnison County, Colorado. This locality is within the site of the Crystal Reservoir.

Initially, we thought these 2 animals belonged to the species P. difficilis (J. A. Allen), and to the subspecies P. d. nasutus (J. A. Allen). Superficially, animals of these two species are difficult to distinguish from each other. Comparisons of the skulls of our two specimens with those of topotypes of P. b. rowleyi and near topotypes of P. d. nasutus from Fort Collins, Colorado, prove these 2 animals to be referable to the former kind. They differ from P. d. nasutus in smaller skulls, shorter rostrum and incisive foramina and in smaller less inflated auditory bullae. The skins also resemble P. b. rowleyi in being more rufescent and with less gray than members of P. d. nasutus.

The terrain from which our 2 specimens were obtained is distinctive from that of the majority of the study area. This is the only area having scrub oak and sagebrush in addition to pinyon pine. Our experiences with members of the species P. boylei, from elsewhere within their range indicate that they show a predilection for this habitat. Not only did we find a distinctive mammalian fauna in this singular habitat but the bird fauna also changed abruptly and markedly from that of the other reservoir sites (see account of the birds).

Neotoma cinerea orolestes Merriam 1894 Bushy-tailed wood rat

This is the only kind of wood rat we found within the study area. Because the Gunnison River and its tributaries have deeply entrenched themselves in this region, these animals abound in ledges and tumbled down boulders. These are ideal sites for wood rats to build their dens. Every ledge throughout the area had sign of wood rats everywhere within its crevices and cracks. At one place they were obtained from ledges only 200 ft. removed from a large resort on the river.

Available specimens are 1 from confluence of Beaver Creek and Gunnison River, 7600 ft.; 1 from 3/4 mi. northwest of Dry Gulch camp, 7800 ft.; 4 from Butte, 1 1/2 mi. northwest of Dry Gulch, 8300 ft.; 1 from 2 mi. above junction of Cebolla Creek and Gunnison River, 7550 ft.; 4 from 5 1/2 mi. up Lake Fork above mouth, 7400 ft. All localities are in Gunnison County, Colorado.

Microtus pennsylvanicus modestus (Baird) 1858 Meadow vole

Three kinds of voles occurred sympatrically within the study area. As concerns members of this species, they were the more numerous of the short-tailed types and were only found in the Blue Mesa Reservoir site. This is understandable because meadow voles, as their name indicates, are quite restricted to boggy meadows or to meadow like areas along stream-sides. These types of ecological niches are restricted to the valley and side tributaries that make up the site for this reservoir. Our specimens were all taken in boggy meadows where Carex was the dominant vegetation.

MAMMALS

Cricetidae (family) continued

Microtus pennsylvanicus modestus (continued)

The rough, craggy nature of the Morrow Point and Crystal reservoir sites practically precludes the development of boggy areas that would be attractive to these voles.

The type locality of this subspecies is at Cochetopa Pass which forms part of the headwaters of the Gunnison River, hence, geographically these specimens are near topotypes. We had a series of animals from the general area of the type locality and our specimens closely resemble them.

Available specimens are 1 from RM 55.2, Gunnison River, 7600 ft.; 1 from 1 mi. below Steuben Creek, Gunnison River, 7430 ft.; 1 from junction of Dry Gulch and Gunnison River, 7350 ft.; 2 from Willow Creek, 1 mi. north of Gunnison River, 7429 ft.; 4 from Willow Creek, $\frac{1}{4}$ mi. above mouth, 7600 ft.; 3 from meadow, $\frac{1}{2}$ mi. north of Willow Creek on Gunnison River, 7600 ft.; 1 from East Elk Creek, $1\frac{1}{2}$ mi. north of Gunnison River, 7429 ft. All localities are in Gunnison County, Colorado.

Microtus montanus fusus Hall 1938 Montane vole

We obtained 5 specimens from essentially the same types of habitats from which we obtained meadow voles. Montane voles seem to have a slightly wider range of ecological tolerances because some of our specimens are from rather dry areas while others occur sympatrically with M. p. modestus and M. l. mordax.

An item of interest is that both the type locality of this subspecies and that of M. p. modestus are in near proximity to each other. Both localities are not far removed from our study area, so our specimens are all near topotypes. They agree with series we have from the vicinity of the type locality. Our specimens have the reddish wash which was one of the diagnostic characters in the original description of this subspecies (Hall, 1938).

Available specimens are 1 from 1.4 mi. up Steuben Creek from Gunnison River, 7440 ft.; 1 from $1\frac{1}{2}$ mi. east of East Elk Creek, Gunnison River, 7560 ft.; 1 from Cebolla Creek, 2 mi. up from junction with Gunnison River, 7400 ft.; 2 from 2 mi. east of Red Creek on Gunnison River, 7355 ft. All localities are in Gunnison County, Colorado.

Microtus longicaudus mordax (Merriam) 1891 Long-tailed vole

Judging from our collection records, these are the commonest voles within the confines of the reservoir sites. Although found to occur sympatrically with voles of the species M. montanus and M. pennsylvanicus, they had wider ecological tolerances than either of the latter two kinds. We obtained them from localities immediately adjacent to the Gunnison River and its tributaries. Such areas were extremely wet, vegetated with Carex and willows, and in many instances the runways contained standing water. At the other extreme, in Lake Fork Canyons, they were extremely common in dry, sandy, grassy meadows interspersed with clumps of rose, willow, sagebrush and rabbitbrush. Runways abounded in this area and droppings were present in large numbers over the entire area. It appeared to us that although

Cricetidae (family) continued

Microtus longicaudus mordax (continued)

these voles occurred in several habitats, the dry, lush meadows not far removed from water, were the areas of predilection.

Comparison of our specimens with those of this subspecies from Utah, discloses no significant differences. Hall and Kelson (1959:738) indicate that all of Colorado save the extreme western part is within the range of this subspecies. The distribution map (loc.cit.) places this western area within the range of another subspecies M. l. alticola (Merriam). In his detailed study of montane mammals of southeastern Utah, Lee (1960:95) referred all specimens from southeastern Utah, east of the Colorado River to the subspecies M. l. mordax, thus practically restricting the range of M. l. alticola to the type locality in Arizona. We are of the opinion that Colorado long-tailed voles are all of the subspecies M. l. mordax. We base our conclusion upon the fact that the site of the impending reservoir is not far removed eastward from the area assigned by Hall & Kelson (loc.cit.) to the range of M. l. alticola. The Gunnison River transects both areas, and these voles being streamside inhabitants have ready access to both areas. None of our specimens showed any characters of M. l. alticola.

Available specimens are 3 from 1.4 mi. up Steuben Creek from Gunnison River, 7440 ft.; 1 from junction of Dry Gulch and Gunnison River, 7400 ft.; 1 from Dry Gulch, 2 mi. above Gunnison River, 7600 ft.; 1 from willow Creek, $\frac{1}{4}$ mi. north of Gunnison River, 7600 ft.; 1 from near junction of Red Creek and Gunnison River, 7350; 1 from $\frac{1}{2}$ mi. north of the mouth of Willow Creek, 7600; 1 from West Elk Creek, $\frac{1}{4}$ mi. north of Gunnison River, 7400 ft.; 1 from Soap Creek, $\frac{1}{4}$ mi. north of Gunnison River, 7520 ft.; 1 from $\frac{1}{2}$ mi. west of junction of Meyers Gulch and Gunnison River, 6976 ft.; 4 from $5\frac{1}{2}$ mi. up Lake Fork of the Gunnison River, 7400 ft.; 2 from 2 mi. up Lake Fork of the Gunnison River, 7295 ft.; 6 from 1 mi. up Lake Fork of the Gunnison River, 7290 ft. All localities in Gunnison County, Colorado.

Ondatra zibethicus osoyoosensis (Lord) 1863 Muskrat

According to our studies, muskrats are uncommon within the reservoir sites. We saw no evidence of their occurrence in the Morrow Point and Crystal Reservoir sites. We hardly expected to find them there because of the nature of the stream, its rocky, rough bed, and the rocky, rugged nature of the gorge. Our experience leads us to believe that this combination of environmental conditions practically precludes their occurrence there. The Blue Mesa Reservoir site, however, appears somewhat ideal with its meadows, streamside vegetation and bogs. Nevertheless, we saw little evidence of their presence. We did obtain 1 specimen, 18027, from an irrigation ditch along a hayfield, $\frac{1}{2}$ mi. south of the Iola Bridge on the Gunnison River, Gunnison County, Colorado.

MAMMALS

Zapodidae (family) Jumping mice

Zapus princeps princeps J. A. Allen 1893 Western jumping mouse

Jumping mice were fairly common within the Blue Mesa Reservoir site, where we obtained 14 specimens. We obtained none from the Morrow Point or Crystal sites. Within the site of the Blue Mesa Reservoir, they occurred sympatrically with microtines of the species M. pennsylvanicus and M. longicaudus. They were never found in localities far removed from some source of water. Ecologically, however, they occurred along streamside in boggy situations and through the intermediate mesic conditions to quite xeric situations consisting largely of sagebrush, rabbitbrush and wild rye. In this characteristic, they were practically sympatric ecologically with the long-tailed voles.

Krutzsch (1954:395) referred all specimens from Colorado to this subspecies. The type locality is in southwestern Colorado, not greatly distant from our study area. According to his account of specimens studied, Krutzsch (loc.cit) had not specimens from the valley of the Gunnison River. He did have them from Saguache County, Colorado, immediately to the south. Comparisons of our specimens with this accounts, place them within this subspecies. Some things are notable, however. Cranially, our specimens are uniformly smaller, and suggests that possibly some endemism is occurring in these animals from the study area. Because of their predilection for more mesic conditions, they occur in drainages in mountainous areas, which might restrict their movements and permit little gene exchange between populations of the several drainages. This seems to be somewhat indicated by our specimens.

Available specimens are 1 from Steuben Creek, 1.4 mi. from mouth, 7440 ft.; 6 from junction of Dry Gulch and Gunnison River, 7400 ft.; 1 from Red Creek, $\frac{1}{4}$ mi. above junction with Gunnison River, 7340 ft.; 3 from 1 mi. up Red Creek, from Gunnison River, 7544 ft.; 1 from West Elk Creek, at mouth on Gunnison River, 7400 ft.; 1 from 4 mi. up Soap Creek from Sapinero, 7520 ft.; 1 from Lake Fork, 2 mi. above mouth. All localities in Gunnison County, Colorado.

Erethizontidae (family) New World porcupines

Erethizon dorsatum epixanthum Brandt 1835 Porcupine

Porcupines are uncommon within the study area. We found only 1 animal which was preserved as a skin and skull, No. 18029, and 1 skull, No. 18053. The first was from Gunnison River, $\frac{3}{4}$ mi. southwest of Sapinero, 7340 ft.; and the second from 2 mi. above the mouth of Cebolla Creek, 7400 ft.; Gunnison County, Colorado.

Our designation as to subspecies is based solely upon distributional basis as set forth by Hall & Kelson (1959:782).

MAMMALS

CARNIVORA (order) Carnivores

We obtained skulls and skeletons representing 2 families, 3 genera and 3 species. Others are here reported as being in the area by Clifford Coghill of the Colorado State Department of Fish and Game stationed at the Big Game Refuge, East Elk Creek.

Canidae (family) Wolves, coyotes, dogs and foxes

Canis latrans lestes Merriam 1897 Coyote

Coyotes are scarce in the study area, but are generally distributed. Mr. Coghill informed us that the trappers take several a year. Although we saw none perhaps the mid-summer season (July 1 when we were there) accounted for their absence. Sheep are no longer herded within the area and the cattle were on the mountains on the summer ranges. Likewise, deer and elk herds, which are large in winter had now retreated to the high country for the summer.

Mustelidae (family) Mustelids

Mustela frenata nevadensis Hall 1936 Long-tailed weasel

We obtained no specimens, but they were seen by members of the crew on several occasions. Undoubtedly, they occur throughout the area of all three reservoir sites.

Mustela vison energumenos (Bangs) 1896 Mink

We saw no animals and observed no tracks along the streams. Mr. Coghill reported that they occur sparingly along the Gunnison River and its tributaries within the sites of the reservoirs. This entire river system in this region is noted for its excellent fishing so sufficient food is available for these small carnivores.

Concerning the taxonomy of mink, there can be questions relative to the animals throughout the Intermountain Area. The raising of mink is common and the possibility always exists for some to escape from the farms and interbreed with members of the native fauna.

Taxidea taxus berlandieri Baird 1858 Badger

Badgers exist throughout the areas of the reservoir sites in all localities possessing soil of sufficient depth for burrowing. We obtained a single specimen (skull only) No. 18059, from the confluence of Red Creek and the Gunnison River, 7400 ft., Gunnison County, Colorado. We did not observe animals but their burrows were observed in many localities.

According to Hall and Kelson (1959:927) the reservoir sites are in the general region where the ranges of this subspecies and Taxidea taxus taxus (Schreber) contact each other. Their northernmost marginal record for T. t. berlandieri is Crested Butte, Colorado, a locality approximately 30 mi. north of the study area. We compared our single skull with those belonging to each of these subspecies and it agrees rather closely with

MAMMALS

Mustelidae (family) continued

Taxidea taxus berlandieri (continued)

specimens of T. t. berlandieri. Some intergradational features, however, are observed in the size and inflation of the auditory bullae in which it is intermediate between the two subspecies. It is also somewhat intermediate in the extension of the hard palate posterior to the upper molar.

Spilogale putorius gracilis Merriam 1890 Western spotted skunk

We neither obtained specimens nor saw any animals. Ideal habitat for these small mustelids abounds in the Black Canyon of the Gunnison River, the site of the two lower reservoirs. Mr. Coghill informs us that they are occasionally seen in this area.

Hall and Kelson (1959:930) include the study area within the range of the subspecies Spilogale gracilis saxatilis. Van Gelder (1959:279) in his revision of these skunks placed this latter name in synonymy under the subspecies S. p. gracilis.

Mephitis mephitis hudsonica Richardson 1829 Striped skunk

We obtained 2 skulls, 1 from 1 mi. above the junction of Red Creek and the Gunnison River, 7350 ft., and 1 from Cebolla Creek, 1½ mi. from Gunnison River, 7480 ft., Gunnison County, Colorado.

From reports of the local people and based upon this single skull, these animals are considered to be generally restricted to the open parts of the site of the Blue Mesa Reservoir, where farmland and meadows are prevalent. From our experience with these small carnivores, we consider the rocky, precipitous sites of the Morrow Point and Crystal reservoirs to be unsuitable habitat for them.

Judging from their distribution map, Hall and Kelson (1959:935) must have had quite a problem in this region. If a line 100 mi. long is drawn from east to west through the study area, it will run through the ranges of 3 subspecies, M. m. hudsonica, M. m. estor Merriam and M. m. varians Gray. For the subspecies M. m. hudsonica and M. m. varians, they have two identical localities from which specimens have been assigned to each of these subspecies. The striped skunks of Colorado need further study as concerns their subspecific arrangement. We compared our single specimens, a mature female and a mature male (as judged by the size, fusion of sutures and wear of teeth) with comparable material of M. m. estor and M. m. hudsonica. They compare favorably with the latter in details of the auditory bullae and interygoid space. We did not have access to specimens of M. m. varians which occurs eastward of the Rocky Mountain (Continental) Divide.

Felidae (family) Cats

Felis concolor hippolestes Merriam 1897 Mountain lion

These large cats are occasional visitors to the area. It is somewhat surprising that they are not rather common, because the area harbors large herds of mule deer and wapiti. In addition, there exists an abundance of rimrock and ledges for dens and retreats.

MAMMALS

Felidae (family) continued

Lynx rufus pallescens Merriam 1899 Bobcat

To the experienced observer, the side canyons of the Blue Mesa Reservoir and the Black Canyon of the Gunnison River with their numerous sheer cliffs, ledges, and tumbled down boulders appear to be ideal habitats for bobcats. Moreover, the entire region is rich in prey species thereby providing abundant food for them.

We obtained 2 complete skeletons from the junction of U. S. Highway 50 and North Willow Creek, 7550 ft., and 1 skull from Red Creek, near junction with Gunnison River, 7800 ft.; both localities are in Gunnison County, Colorado.

As presently understood, bobcats from Colorado belong to 2 subspecies L. r. pallescens and L. r. baileyi Merriam. As is the case in many other mammals, the study area is close to the area in which the ranges of these 2 subspecies contact each other.

We compared our 3 specimens with representative materials of these 2 subspecies from Utah, Nevada and Arizona. They are nearly intermediate in size between the 2 subspecies. In the outline of the zygomatic arches they resemble specimens of L. r. baileyi. In features of the auditory bullae, 2 resemble L. r. pallescens while the other resembles L. r. baileyi. Hall and Kelson (1959:970) include the study area within the range of L. r. pallescens. From our material, we consider the study area to be populated by intergrades.

ARTIODACTYLA (order) Artiodactyls

The study area contains 2 kinds, mule deer and wapiti.

Cervidae (family) Cervids

Cervus canadensis nelsoni V. Bailey 1935 Wapiti

By the nature of their physiography, the sites of the Morrow Point and Crystal reservoirs do not contain many wapiti at any time of the year. The open areas of the site of the Blue Mesa Reservoir, however, is heavily populated in winter. This is one of the largest winter ranges in this section of Colorado. It is of such importance that the Colorado State Department of Fish and Game has established a Big Game Refuge here with headquarters on East Elk Creek. In so doing they purchased several hay ranches along the north side of the Gunnison River and considerable acreage of grazing land on the adjacent hillsides. Because our studies were conducted in mid-summer, the animals had departed for the summer range on the high mountains. Tracks and an occasional animal were observed upstream on the tributaries of the Gunnison River in this area.

Our single specimen is a skull "pickup" from head of Red Creek, 9000 ft., Gunnison County, Colorado.

MAMMALS

Cervidae (family) continued

Odocoileus hemionus hemionus (Rafinesque) 1817 Mule deer

The study area is well populated by these animals. The same conditions with respect to physiography that apply to wapiti in this area also apply to mule deer. Unlike the wapiti, the area harbors a good-sized herd in summer as well as winter. We found 2 freshly killed carcasses on U. S. Highway 50 where it traverses the study area. Skeletal remains were rather common and the crews brought in 5 skulls "pick up". They are 2 from base of rimrock, top of mesa, northwest of Dry Gulch, 8300 ft., 2 from Dry Gulch, $1\frac{1}{2}$ mi. north of Gunnison River, 8300 ft. and 1 from dry sagebrush flat, $\frac{1}{4}$ mi. up Dry Gulch from camp (1 mi. north of Gunnison River), 7550 ft. All localities from Gunnison County, Colorado.

CHECKLIST OF SUPPLEMENTARY MAMMALS

As previously stated, this report is largely restricted to information obtained by members of the expedition from the area of the impending reservoirs and from areas immediately adjoining it. This entire area to be inundated is the smallest of all the major projects in the Upper Colorado River Development Project and is but a small segment of the general region where it is located. The impending reservoirs will be constructed in a drainage system that is surrounded on the north, south and east by high, mountainous terrain, while to the west it falls away to the lower desert-like region of the Colorado River proper. Considering the entire region of the reservoir sites and environs, the habitats for mammals are extensive and highly varied. Likewise, the mammalian fauna is quite diverse. With this in mind, we have deemed it advisable to attach a checklist of mammals of the entire region, additional to those reported in the body of this paper. We are quite certain that we have adequately covered the mammals of the reservoir sites. Therefore, the majority of the animals here listed occur beyond these sites. The checklist is based upon Hall and Kelson (1959).

INSECTIVORA (order) Insectivores

Soricidae (family) Shrews

Sorex cinereus cinereus Kerr Masked shrew

Sorex nanus Merriam Dwarf shrew

Sorex merriami leucogenys Osgood Merriam's shrew

CHIROPTERA (order) Bats

Vespertilionidae (family) Vespertilionid bats

Myotis velifer incautus (J. A. Allen) Cave bats

Myotis thysanodes thysanodes Miller Fringed myotis

Myotis californicus stephensi Dalquest California myotis

Myotis californicus californicus (Audubon and Bachman) . California myotis

Lasiorycteris noctivagans (Le Conte) Silver-haired bat

MAMMALS

Vespertilionidae (family) continued

Pipistrellus hesperus santarosae Hatfield . . . Western pipistrelle
Euderma maculatum (J. A. Allen) Spotted bat
Plecotus townsendii pallescens Miller Townsend's big-eared bat
Antrozous pallidus pallidus (Le Conte) Pallid bat

Molossidae (family) Free-tailed bats

Tadarida brasiliensis mexicana (Saussure) . . Brazilian free-tailed bat
Tadarida molossa (Pallas) Big free-tailed bat

LAGOMORPHA (order) Hares, rabbits and pikas

Ochotonidae (family) Pikas

Ochotona princeps figginsi J. A. Allen Pika

Leporidae (family) Hares and rabbits

Sylvilagus audubonii baileyi (Merriam) Desert cottontail
Sylvilagus audubonii warreni Nelson Desert cottontail
Lepus americanus bairdii Hayden Snowshoe rabbit
Lepus californicus texianus Waterhouse Black-tailed jack rabbit

RODENTIA (order) Rodents

Sciuridae (family) Squirrels

Eutamias minimus consobrinus (J. A. Allen) Least chipmunk
Citellus leucurus pennipes A. H. Howell . . White-tailed antelope squirrel
Citellus richardsonii elegans Kennicott . . . Richardson's ground squirrel
Citellus tridecemlineatus parvus J. A. Allen. Thirteen-lined ground squirrel
Cynomys leucurus Merriam White-tailed prairie dog
Sciurus aberti ferreus True Abert's squirrel

Cricetidae (family) Mice and rats

Reithrodontomys megalotis aztecus J. A. Allen . . Western harvest mouse
Peromyscus crinitus auripectus J. A. Allen Canyon mouse
Peromyscus truei truei (Shufeldt) Pinyon mouse
Peromyscus difficilis nasutus J. A. Allen Zacatecan deer mouse
Onychomys leucogaster pallescens Merriam Northern grasshopper mouse
Clethrionomys gapperi galei (Merriam) Gapper's red-backed mouse
Phenacomys intermedius intermedius Merriam Heather vole
Lagurus curtatus levidensis (Goldman) Sagebrush vole

MAMMALS

CARNIVORA (order) Carnivores

Canidae (family) Dogs, wolves, coyotes, foxes

Canis lupus youngi Goldman Gray wolf

Vulpes fulva macroura Baird Red fox

Urocyon cinereoargenteus scottii Mearns Gray fox

Ursidae (family)

Ursus americanus amblyceps Baird Black bear

Ursus horribilis bairdi Merriam Grizzly bear

Procyonidae (family) Raccoons, ringtails

Bassariscus astutus flavus Rhoads Ringtail

Procyon lotor pallidus Merriam Raccoon

Mustelidae (family) Mustelids

Martes americana origenes (Rhoads) Marten

Mustela erminea muricus (Bangs) Ermine

Mustela nigripes (Audubon and Bachman) Black-footed ferret

Gulo luscus luscus (Linnaeus) Wolverine

Taxidea taxus taxus (Schreber) Badger

Mephitis mephitis estor Merriam Striped skunk

Mephitis mephitis varians Gray Striped skunk

Lutra canadensis sonora Rhoads River otter

Lutra canadensis nexa Goldman River otter

Felidae (family) Cats

Lynx canadensis canadensis Kerr Lynx

ARTIODACTYLA (order) Even-toed ungulates

Antilocapridae (family) Pronghorn

Antilocapra americana americana (Ord) Pronghorn

Bovidae (family) Bovids

Bison bison bison (Linnaeus) Bison

Ovis canadensis canadensis Shaw Mountain sheep

MAMMALS

REMARKS ON DISTRIBUTION

This is the fourth in a series of reports upon the mammals of the reservoir sites in the Upper Colorado River Development Project. In each, we have been extremely interested in ascertaining if the river system, in which the reservoir was to be located, has operated in establishing distributional limits upon the mammals of the region. In Glen Canyon, Durrant and Dean (1959), found that the Colorado River and its gorge exerted tremendous isolating effects upon mammals. In Flaming Gorge, Durrant and Dean (1960) showed that the Green River restricted the distribution of only two kinds. In the Navajo, Durrant and Dean (1962), demonstrated that the San Juan River did not function in restricting the movements of mammals.

If one closely studies the distribution maps of the mammals of west central Colorado in Hall and Kelson (1959), he will note several in which the Gunnison River appears as a barrier between the ranges of the adjoining subspecies. Our study did not show this to be the case, as we found no barrier effects being exerted by the river in the section where the three reservoirs are to be constructed. We did notice some differences in the mammalian fauna between the area of the Blue Mesa site and those of Morrow Point and Crystal. We did not notice, however, any differences between animals from both sides within the respective areas. Several kinds of the mammals we obtained appear to be intergrades (see species accounts), between adjoining subspecies which indicates that the area is one where gene exchange is occurring between subspecies rather than being prevented.

EFFECTS OF THE RESERVOIRS UPON MAMMALS

With the construction of the three dams, the reservoirs will fill and all land vertebrates will be forced out of the basins. The entire area will be changed from an upper valley and lower gorge containing a fast running stream with typical phreatophyte vegetation to placid lakes abutting on sheer ledges and rolling, dry hillsides. Also gone will be the mesic meadows and ponds with their characteristic mammals. At present in the Blue Mesa Reservoir Site, we find three sharply distinctive ecological types. Along the streams and the ponds the hydrophytic type exists followed by the mesophytic meadows and farmland which is replaced upward by the xerophytic rolling hills and ledges. Here the water will remove the mesophyte bond and the lakeshore will be directly adjacent to the xeric hillsides. In the Black Canyon of the Gunnison River (sites of the Morrow Point and Crystal reservoirs), the change will not be so drastic. The river banks in this region are provided with good riparian phreatophytic vegetation, which abuts on the xeric ledges. When filled this gorge will lose all of its phreatophytes. In both cases, the areas of phreatophytes will disappear and the water will stand against the xeric hillsides and ledges. This band of phreatophytic vegetation is the main source of food for some mammals and is an important part of the food chain in all.

MAMMALS

The effects upon the mammals will be direct and drastic. Those whose habitats consist of ledges and dry hillsides can escape upward to suitable habitats above high water. Here, they will be able to establish themselves, unless the habitat is already saturated by members of their kind. For those dependent upon the phreatophytic vegetation the results of displacement will be more severe. Muskrats, beavers and voles will undoubtedly move up the tributaries where suitable habitats exist above high water and phreatophytes are present. These areas can probably absorb the beavers and muskrats which are not numerous at present along the river. Voles on the other hand, may find all available areas already populated.

The big game herds present another problem, especially in the Blue Mesa Site. This is one of the main wintering grounds for mule deer and wapiti. The entire bottomland with its good forage will be lost, hence the size of the herds could become lessened. Another unanswered problem is that of migration of these two cervids. At present, both traverse the reservoir sites in going from the summer to the winter range and vice versa. These reservoir sites are at high elevations, and subject to severe winters. These lakes will freeze over. Deer and wapiti swim well and can swim these lakes in several localities. With the formation of ice, their movements could become fatal. They might start out on ice, break through or fall, or they may find shore ice and be unable to haul out. A herd could be drastically reduced in a short time in these situations. Fortunately, this reservoir is not large and the herds can easily circumvent it upstream if they can alter their habits. In the other two reservoirs, however, migrations would meet a nearly total impasse. Unless the animals descended a tributary stream to the lake they could find no access. Also, they would be forced to haul out at the mouth of a tributary stream on the other side, because the sheer ledges would prevent hauling out at any other place. Tributary streams are few and extremely rugged in this section, so to all intent, the Black Canyon of the Gunnison River would form a definite barrier to movements between summer and winter range.

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MAMMALS

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INDEX

- Abert's squirrel, 259
 Acanthocephala, 162, 165
 Acarina, 8, 9
 Accipiter cooperii, 201
 gentilis atricapillus, 201
 striatus velox, 201
 Accipitridae, 201
 Acer glabrum, 72
 negundo interius, 73
 Aceraceae, 72
 Achillea lanulosa, 27, 40, 84, 106, 107,
 108, 109, 116
 Acmaeodera sp., 170
 Actaea arguta, 62
 Actitis macularia, 204
 Aechmophorus occidentalis, 199
 Aedes dorsalis, 175
 fitchii, 175
 increpitus, 175
 melanimon, 175
 pullatus, 175
 spencerii, 175
 trivittatus, 175
 vexans, 175
 Aegolius acadicus acadicus, 206
 Aeronautes saxatalis saxatalis, 207
 Agelaius phoeniceus fortis, 216
 Agoseris glauca, 27, 37, 40, 84
 glauca dasycephala, 84
 glauca parviflora, 28, 40, 84
 parviflora, 37
 Agrilus sp. 170
 Agropyron desertorum, 34, 38, 92, 106, 116
 saundersii, 92
 smithii, 26, 33, 38, 92, 113, 116, 133
 spicatum, 38
 subsecundum, 92
 trachycaulum, 26, 38, 92
 Agrostis alba, 26, 93, 101, 133, 223, 225
 exarata, 93
 palustris, 18, 21, 93
 scabra, 93
 Alaudidae, 210
 Alcedinidae, 207
 Alder, 7, 8, 20, 25, 29, 41, 110, 124, 158,
 197, 223, 224, 230
 Alfalfa, 7, 32, 33, 70, 225, 230
 Algae, 44, 48, 49, 156, 158
 Alkali grass, 23, 30, 31, 100
 Allium macropetalum, 27, 38, 56
 Alnus tenuifolia, 25, 58, 107, 116, 124,
 133, 153, 158, 223, 224
 Alopecurus aequalis, 18, 19, 21, 93
 Alsike clover, 18, 26, 32, 33, 71, 133
 Alumroot, 35, 39, 42, 66
 Amarathaceae, 61
 Amaranthus blitoides, 34, 61
 graecizans, 61
 Amblystegium orthocladon, 51
 riparium, 43, 51
 serpens, 43, 51
 trichopodium kochii, 43, 51
 Amelanchier alnifolia, 25, 37, 67, 116,
 133, 218
 Ameletus sp., 181, 182
 American bittern, 200
 American bulrush, 55
 American coot, 203
 American goldfinch, 218
 American manna grass, 18, 22, 97, 117, 124
 American merganser, 197
 American parsley fern, 42
 American sloughgrass, 94
 American speedwell, 18, 23, 82
 American vetch, 28, 41, 71, 117
 Ammodramus savannarum perpallidus, 219
 Ammophila sp., 176
 Ammospiza caudacuta nelsoni, 219
 Amorpha ovalis, 45, 49
 Amphibians, 191, 192
 Amphispiza belli nevadensis, 219
 Amsinckia rugosa, 39, 78
 Anabaena inaequalis, 46, 49
 oscillarioides, 46, 49
 sp., 156
 tortulosa, 49
 variabilis, 46, 49
 Anas acuta, 200
 carolinensis, 200
 cyanoptera septentrionalium, 200
 discors discors, 200
 platyrhynchos platyrhynchos, 200
 Anatidae, 200
 Androsace septentrionalis, 28, 37, 39, 41, 76
 Anis, 205
 Annual atriplex, 23, 30, 31, 60
 Annual inkweed, 23, 30, 61
 Anoplodera canadensis, 170
 Ant lions, 168
 Antennaria anaphaloides, 40, 85
 microphylla, 28, 37, 40, 85
 parvifolia, 28, 37, 40, 85, 116
 Anthaxia sp. 170
 Anthicidae, 170

INDEX (continued)

- Anthrenus sp., 172
- Anthus spinoletta alticola, 214
- Antilocapra americana americana, 260
- Antilocapridae, 260
- Antrozoas pallidus pallidus, 259
- Ants, 176
- Aphelocoma coerulescens woodhouseii, 211
- Apidae, 176
- Aplopappus, 40, 41, 42, 85
 - acaulis, 37, 40, 85
 - amerioides, 37, 40, 85
- Apocynaceae, 77
- Apocynum cannabinum, 23, 77, 116
 - medium floribundum, 77
- Apodidae, 206
- Aquila chrysaetos canadensis, 202
- Aquilla sp., 168
- Arabis demissa, 37, 39, 64
- Arachnids, 9, 177
- Archilochus alexandri, 207
- Arctium minus, 34
- Arctostaphylos uva-ursi, 76, 116
- Ardea herodias tregazai, 199
- Ardeidae, 199
- Arenaria congesta, 62
 - fendleri, 38, 62
- Argemone intermedia, 38, 64
- Argynnis sp. 174
- Aristida fendleriana, 38, 94
- Arnica fulgens, 18, 22, 85
- Aromatic sagebrush, 30, 31, 37, 85
- Arrowgrass, 17, 23, 54
- Artemisia dracunculoides, 30, 31, 37, 107
 - dracunculus glauca, 85, 106, 116
 - frigida, 37, 85, 116, 133
 - ludoviciana, 27, 37, 40, 85
 - michauxiana, 40, 85
 - nova, 37, 86
 - tridentata, 7, 35, 37, 86, 106, 107, 108, 109, 116, 133, 158
- Artiodactyla, 257
- Asclepiadaceae, 77
- Asclepias speciosa, 23, 28, 31, 33, 77
 - subverticillata, 77
- Asilidae, 175
- Asio flammens flammens, 206
 - otus wilsonianus, 206
- Aspen, 15, 43, 123, 134, 197, 230
- Aspiculuris sp., 163, 164
- Aster, 28, 86
- Aster adscendens, 28, 86
- Asterella ludwigii, 43, 50
- Astragalus agrestis, 25, 26, 69, 107
 - diversifolius, 28, 69
 - iodopetalus, 70
 - spp. 39, 70
- Asyndesmus lewis, 208
- Atriplex canescens, 31, 37, 60
 - hastata, 23, 30, 31, 60
 - rosea, 31
- Audubon's warbler, 215
- Avens, 19, 67
- Avifauna, 196
- Avocet, 197
- Aythya americana, 201
- Bacillarieae, 49, 156
- Badger, 255, 260
- Baetidae, 182, 183
- Baetis sp., 182, 183
- Baltic rush, 20, 21, 22, 32, 33
- Baltic wiregrass, 55, 117, 124
- Band-tailed pigeon, 205
- Baneberry, 62
- Bank swallow, 210
- Barberry, 63
- Barn swallow, 210
- Barnyard grass, 33, 34
- Bartramiaceae, 51
- Basilarchia sp., 174
- Basilia forcipata, 8, 190
- Bassariscus astutus flavus, 260
- Bat flies, 167, 190
- Batrachium trichophyllum, 62
- Bats, 10, 162, 237, 239, 258
- Batyle ignicollis, 170
- Beaked sedge, 21, 33, 54
- Bearberry, 43, 76, 116
- Bearberry honeysuckle, 83
- Bearded wheatgrass, 92
- Beardgrass, 21, 23
- Beardtongue, 27, 39, 82, 117
- Bears, 260
- Beavers, 11, 158, 163, 223, 230, 231, 237, 240, 249, 262
- Bebb willow, 25, 28, 57
- Beckmannia syzigachne, 18, 21, 94
- Bedstraw, 23
- Beech, 58
- Bees, 9, 176
- Beetles, 8, 9, 158, 170
- Bellflowers, 27, 84, 116
- Belted kingfish, 207
- Berberidaceae, 63

INDEX (continued)

- Berberis repens, 26, 37, 63, 116
- Betula fontinalis, 25, 58, 116, 223, 224
 - occidentalis, 58, 124, 133
- Betulaceae, 58
- Big brown bat, 162, 190, 242
- Big free-tailed bat, 259
- Big myotis, 190
- Big plantain, 18, 21, 83
- Big rabbitbrush, 31, 37, 87, 158
- Big sagebrush, 15, 30, 35, 37, 41, 42, 43, 86, 110, 116, 127, 133, 158
- Birch, 8, 25, 41, 58, 223, 224
- Birds, 9, 195, 199
- Bison bison bison, 260
- Bitterbrush, 35, 37, 68, 116, 133, 198
- Bittercress, 19, 42, 64
- Bitterns, 199
- Black bear, 260
- Black currant, 41, 69
- Black mustard, 33
- Black nightshade, 33
- Black sagebrush, 37, 85
- Black swift, 198, 206
- Black tern, 204
- Black-bellied plover, 197
- Black-billed cuckoo, 205
- Black-billed magpie, 211
- Blackbirds, 216
- Black-capped chickadee, 211
- Black-chinned hummingbird, 207
- Black-crowned night heron, 199
- Black-eyed Susan, 18, 22, 85, 89, 117
- Black-footed ferret, 206
- Black-headed grosbeak, 197, 217
- Black-necked stilt, 197
- Black-tailed jack rabbit, 259
- Bladderpod, 35, 39, 41, 65
- Bladderwort, 22, 82
- Blazing star, 39, 74
- Blepharida sp., 171
- Blite, 25, 27, 60
- Blitum capitatum, 25, 27, 60
- Bloomer ricegrass, 98
- Blue brome, 94
- Blue flax, 28, 37, 39, 72, 117
- Blue grosbeak, 217
- Blue grouse, 198, 203
- Blue iris, 56, 117
- Blue jay, 197
- Blue lettuce, 28
- Blue pentstemon, 39
- Blue spruce, 8, 24, 30, 41, 42, 53, 116, 133, 197, 198
- Blue verbenia, 79
- Bluebell, 25, 27, 79
- Bluebird, 213
- Blue-eyed grass, 22, 56
- Blue-eyed Mary, 28, 39, 41, 81
- Blue-green algae, 49, 156
- Bluejoint, 95
- Bluestem wheatgrass, 116, 127
- Blue-winged teal, 200
- Bobcat, 257
- Bobolink, 198, 216
- Bombomina sp., 175
- Bombus sp., 176
- Borages, 78
- Boraginaceae, 78
- Botaurus lentiginosus, 200
- Botrydium granulatum, 45, 49
- Bouteloua gracilis, 38, 94
- Bovidae, Bovids, 260
- Boxelder, 41, 73
- Brachythecium albicans, 43, 51
 - collinum, 43, 51
 - collinum idahense, 51
 - rivulare, 43, 51
 - salebrosum, 43, 51
 - utahensis, 43, 51
- Brassica nigra, 33
- Brasilian free-tailed bat, 259
- Brewer's blackbird, 217
- Brewer's sparrow, 220
- Brickellia grandiflora, 41, 42
- Bristle-tails, 9, 168
- Brittle fern, 35, 38, 42
- Broad-tailed hummingbird, 207
- Bromus anomalus, 94
 - ciliatus, 18, 27, 94
 - commutatus, 27, 94, 101
 - inermis, 26, 33, 95, 99, 101, 106-108, 153
 - polyanthus, 95
 - racemosa, 33, 34
 - tectorum, 26, 31-38, 95, 106, 107, 116, 133, 153, 224
- Brookgrass, 18, 21, 95
- Brown creeper, 212
- Brown thrasher, 213
- Brown-capped rosy finch, 218
- Brown-headed cowbird, 217
- Brush mouse, 237, 240, 251
- Bryaceae, 51
- Bryum angustirete, 43, 51
 - caespitium, 51
 - cirratum, 43, 51

INDEX (continued)

- Bryum cuspidatum, 19,43,51
 - pallescent, 43,51
 - pseudotriquetrum, 43,51
 - turbinatum, 43,51
- Bubo virginianus occidentalis, 205
- Buckwheats, 59
- Buffalo berry, 30,74
- Bugs, 9,158,169
- Bull berry, 26, 74
- Bull thistle, 87
- Bullock's orioles, 217
- Bulrushes, 22,54,225
- Bunch wheatgrass, 37,38
- Buntings, 217
- Buprestidae, 170
- Burdock, 32, 34
- Burrowing owl, 198,205
- Bushtits, 211
- Bushy-tailed wood rat, 164,237,240
- Buteo regalis, 202
 - swainsoni, 202
- Butter and eggs, 28,81,117
- Butterflies, 9,174

- Cactaceae, 74
- Cacti, 42
- Cactuses, 74
- Caddisflies, 10,158
- Caespitosa phlox, 39,78,117,127,133
- Calamagrostis canadensis, 95
 - inexpansa, 95
 - neglecta, 95, 101
- Calamospiza melanocorys, 219
- Calcarius lapponicus alascensis, 220
- California brome, 41
- California myotis, 258
- Calitriche, 17
- Calliope hummingbird, 207
- Callotillus sp. 171
- Calochortus gunnisonii, 38,56,116
 - nuttallii, 38,56
- Calothrix parietina, 46,49
- Caltrop, 72
- Camelina microcarpa, 33,34,64
- Campanula parryi, 28,84
 - rotundifolia, 27,84,107,116
- Campanulaceae, 84
- Campanulated eriogonum, 38,59
- Camptosomatinae, 170
- Campylum radicale, 43,51
- Canadian bluegrass, 24,27,37,38,99
- Canadian fleabane, 19,34
- Canadian goldenrod, 22,34,41
- Canadian ryegrass, 22,27,33
- Canadian wild rye, 96
- Canidae, 255, 260
- Canis latrans lestes, 255
 - lupus youngi, 260
- Cannabinaceae, 58
- Cantharidae, 170
- Canyon mouse, 259
- Capella gallinago delicata, 204
- Capers, 64
- Capillaria hepatica, 164
- Capparidaceae, 64
- Caprifoliaceae, 83
- Caprimulgiade, 206
- Carabidae, 170
- Caracaras, 202
- Cardamine cordifolia, 19,64
- Carex foenea, 19,20,54
 - microptera, 19,21,54
 - nebraskensis, 19,20,33,54,117,133
 - praegracilis, 19,20,54
 - rostrata, 21,33,54
 - sartwellii, 54
 - sp., 20,153,225
- Carnivores, 10,11,255,260
- Carpodacus cassinii, 218
 - mexican frontalis, 218
- Carrot, 76
- Caryophyllaceae, 62
- Cassin's finch, 218
- Castilleja hispida, 37,39,80
 - linariaefolia, 27,37,39,80
 - lineata, 81
 - sulphurea, 28,81
- Castor canadensis, 223,230,237,240
 - canadensis concisor, 163,249
- Castorstrongylus castoris, 163
- Castoridae, 163,249
- Cat eye, 39,78
- Catabrosa aquatica, 18,21,95
- Catbird, 197,213
- Catchfly, 27,62
- Catoptrophorus semipalmatus
 - inornatus, 204
- Cats, 256, 260
- Cattails, 53, 225
- Cave bats, 258
- Cediopsylla inaequalis, 176
- Centaurea picris, 28,31,86
- Centrocercus urophasianus
 - urophasianus, 203
- Centropitulum sp., 182, 183

INDEX (continued)

- Cerambycidae, 170
- Ceratodon purpureus, 50
- Ceratoneis arcus, 45,49
- Cercocarpus montanus, 37,67,116,133
- Cerous canadensis nelsoni, 257
- Cervidae, cervids, 257
- Certhia familiaris montana, 212
- Certhiidae, 212
- Cestodes, 162, 163
- Chaenactis, 41
- Chaenactis douglasii, 40,86
- Chaetophora elegans, 50
 - incrassata, 46,50
 - piciformis, 46,50
 - sp., 156
- Charadriidae, 204
- Charadrius vociferus, 204
- Cheat grass, 32,33,34,37,38,42,95,116,133
- Cheilanthes feei, 52
- Chenopodiaceae, 60
- Chenopodium album, 27,31,33,38,60,108,109
 - glaucum, 27,33,61
 - leptophyllum, 27,31,38,61
- Chipmunks, 223,231
- Chipping sparrow, 220
- Chiroptera, 258
- Chlaenius sp., 170
- Chlidonias niger surinamensis, 204
- Chlorophyceae, 156
- Chlorura chlorura, 218
- Chokecherry, 8,24-42,68,116,133
- Chondestes grammacus strigatus, 219
- Chordeiles minor henryi, 206
- Chorispora, 23,32,33,64
 - tenella, 23,33,64
- Chrysanthemum leucanthemum pinnatifidum, 86
- Chrysomelidae, 170
- Chrysopa sp., 168
- Chrysophyceae, 156
- Chrysopidae, 168
- Chrysopsis villosa, 28,37,40,86
- Chrysothamnus, 107,108,109,116
 - depressus, 38,87,124,133
 - nauseosus, 30,31,37,87,158
 - parryi, 31, 87
 - vaseyi, 87
 - viscidiflorus, 30,31,37,87,127,153
 - v. stenophyllus, 38,87
 - v. tortifolius, 30,31,87,133
- Cicindela longilabris, 171
 - oregona, 171
 - o. guttifera, 171
- Cicindelidae, 171
- Cicuta douglasii, 23,33,76,117
- Cinclidae, 212
- Cinclus mexicanus unicolor, 212
- Cinnamon teal, 200
- Cinquefoil, 19,27,28,68
- Cinygmula, 182,184
- Circus cyaneus hudsonius, 202
- Cirsium, 107,117
 - undulatum, 31,40,87
- Citellus lateralis, 237,240,245
 - lateralis lateralis, 163,247
 - leucurus pennipes, 259
 - richardsonii elegans, 259
 - sp., 163
 - tridecemlineatus parvus, 259
 - u. utah, 246
 - variegatus, 177, 237, 240
 - variegatus grammurus, 163,246
- Cittotaenia variabilis, 162,163
- Cladophora, 46
 - kuetzingiana, 44,50
- Clammyweed, 35,38,64
- Clark's nutcracker, 211
- Clematis hirsutissima, 38,62
 - ligusticifolia, 26,63,116
 - pseudoalpina, 63
- Cleome serrulata, 26,31,38,64
- Cleridae, 171
- Clethrionomys gapperi galei, 259
- Clevea hyalina, 43,50
- Cliff swallows, 198,210
- Cloakfern, 52
- Closed dropseed, 42
- Closterium acerosum, 46,50,156
 - cucumis, 46,50
- Clover, 7
- Coccinella transversogutta, 171
- Coccinellidae, 171
- Cocconeis pediculus, 45,49
- Coccyzus erythrophthalmus, 205
- Cocklebur, 23,32,34,91
- Colaptes auratus, 208
 - auratus luteus, 208
 - cafer, 208
 - cafer collaris, 208
- Coleoptera, 8,9
- Coleosanthus grandiflorus, 37
- Collembola, 8,9
- Collinsia parviflora, 28,39,80
- Collomia, 25,27,39,77
 - linearis, 27,39,77
- Colorado bedstraw, 35,40,42,83

INDEX (continued)

- Colorado chipmunk, 163, 237, 240, 244
- Colorado pentstemon, 39, 81
- Columba fasciata fasciata, 205
- Columbia needlegrass, 101
- Columbian virginbower, 41
- Columbidae, 205
- Comandra pallida, 27, 38, 59
- Common bushtit, 212
- Common crow, 211
- Common dandelion, 19, 28, 91, 117
- Common mallard, 200
- Common mallow, 32, 33
- Common merganser, 201
- Common raven, 211
- Common snipe, 204
- Common sunflower, 40, 89
- Compositae, 84
- Cone-bearing flowers, 53
- Coneflower, 22, 90
- Conifers, 110, 123, 198, 227
- Conopidae, 176
- Contopus sordidulus veliei, 209
- Convolvulaceae, 77
- Convolvulus arvensis, 33, 77
- Coopers hawk, 201
- Coots, 198, 203
- Cornaceae, 76
- Cornus stolonifera, 25, 76, 116, 124, 133
- Corvidae, 210
- Corvus brachyrhynchos hesperis, 211
- corax sinuatus, 211
- Corydalis, 64
- aurea, 27, 64
- caseana, 64
- Cosmarium crenulatum, 46, 50
- ovale, 46, 50
- tetrophthalmum, 46, 50
- Cottontail, 176, 177
- Cottonwood, 24, 127, 230
- Cow parsnip, 23, 41, 76, 117
- Coyote, 255, 260
- Cranes, 203
- Crassulaceae, 66
- Crataegus rivularis, 26, 29, 67
- saligna, 25, 29, 67, 106, 116, 133, 153
- Cratoneuron filicinum, 43, 51
- Creepers, 212
- Creeping bent, 93
- Creophilus sp., 172
- Crepis occidentalis, 40, 88
- o. costata, 40, 88
- Cricetidae, Cricetids, 164, 249
- Crows, 210
- Cruciferae, 64
- Cryptantha, 39, 117
- crassiseppola, 39, 78
- fendleri, 117
- flaviculata, 39, 78
- gracilis, 39, 78
- jamesii, 39, 79
- Cryptocephalus sp., 170
- Cryptogramma acrostichoides, 52
- Cuckoos, 205
- Cucujidae, 172
- Cucujus clavipes, 172
- Cuculidae, 205
- Cudweed, 19, 88
- Culex tarsalis, 175
- Culicidae, 175
- Culiseta impatiens, 175
- incidens, 175
- inorata, 175
- Curculionidae, Curculioninae, 172
- Curly dock, 19, 21, 33, 60
- Currants, 7
- Cursed crowfoot, 23
- Cuterebra sp., Cuterebridae, 176
- Cyanocitta stelleri macrolopha, 211
- Cylindrospermum comatum, 46, 49
- Cymbella, 45, 49
- Cynomys gunnisoni, 176, 237, 240, 248
- g. gunnisoni, 163, 247
- leucurus, 248, 259
- Cyperaceae, 54
- Cypseloides niger borealis, 206
- Cystopteris fragilis, 38
- Dactylis glomerata, 27, 33, 96, 99, 101
- Dandelion, 21, 23, 32, 33, 225
- Dasymutilla sp., 176
- Deer, 11, 262
- Deer mouse, 164, 223, 227, 231, 237, 240, 250
- Deervetch, 28, 39, 70
- Dendragapus obscurus obscurus, 203
- Dendrocopos pubescens leucurus, 208
- villos monticola, 208
- Dendroica auduboni memorabilis, 215
- petechia morcomi, 215
- Depressed rabbitbrush, 87, 127
- Dermacentor andersoni, 177
- Dermatoxys veligera, 162, 163
- Dermestes sp., 172
- Descurainia pinnata, 26, 31-39, 64
- sophia, 26, 33, 34, 64, 107
- Desert cottontail, 259

INDEX (continued)

- Desert pink, 91
- Desert saltgrass, 96
- Desert wheatgrass, 34, 38, 92, 116
- Desmids, 46
- Diamanus montanus, 176
- Diatoma hiemale, 45, 49
- Diatoms, 49, 156
- Dicots, 57
- Didymodon mexicanus subulatus, 43, 50
 - trifarius, 43, 50
- Dipper, 212
- Diptera, 8, 9, 158, 175
- Disonycha quinquevittata, 171
- Distichium capillaceum, 43, 50
- Distichlis stricta, 23, 30, 31, 96
- Ditrichaceae, 50
- Dodecatheon pulchellum, 76
 - radicatum, 22, 76
- Dogbane, 41, 77, 116
- Dogs, 255, 260
- Dogwood, 7, 20, 41, 76, 110
- Dolichonyx oryzivorus, 216
- Doormat weed, 27, 31, 34, 59
- Double-crested comorant, 197
- Doubleleaf pinyon pine, 53
- Douglas fir, 8, 24, 30, 41, 42, 43, 53, 116, 127, 133, 134, 197, 198
- Doves, 205
- Downy brome, 224, 230
- Downy chess, 26, 31, 95
- Downy woodpecker, 208
- Dragonflies, 10
- Drepanocladus aduncus, 43, 51
- Drepanaldia acuta, 46, 50
- Dropseed muhly, 23, 30, 31
- Dryopidae, 172
- Ducks, 197, 200
- Dumetella carolinensis, 213
- Dwarf rabbitbrush, 133
- Dwarf shrew, 258
- Dysphenges sp., 171
- Dytiscidae, 172

- Eared grebe, 197, 199
- Eastern kingbird, 209
- Echinochloa crus-galli, 33
- Edible valerian, 28, 84
- Elaeagnaceae, 74
- Elaeagnus angustifolia, 74
 - commutata, 26, 74
- Elateridae, 172
- Elderberry, 41

- Eleocharis macrostachya, 55
 - palustris, 17, 20, 55, 117, 124
 - sp., 55
- Eleodes sp., 174
- Elk, 11
- Elymus canadensis, 27, 33, 96
 - condensatus, 26, 31, 33, 96, 106-109, 117, 124, 133
- Empidonax difficilis hellmayri, 209
 - traillii brewsteri, 209
 - wrightii, 209
- Encalypta rhabdocarpa, 50
 - vulgaris mutica, 43, 50
- Endoparasites, 161
- Entomobryidae, 168
- Epeorus albertae, 182, 185
 - longimannus, 182, 185
- Ephemerella doddsi, 182, 186
 - grandis grandis, 182, 186
 - hecuba hecuba, 182, 187
 - inermis, 182, 187
 - margarita, 182, 188
 - tibialis, 182, 188
- Ephemerellidae, 182, 186
- Epicauta sp., 173
- Epilobium adenocaulon, 18, 19, 20, 23, 74, 108
 - angustifolia, 22, 75
 - latifolium, 81
- Epithemia argus, 45, 49
- Eptesicus, 8, 190
 - fuscus pallidus, 162, 190, 242
- Equisetaceae, 52
- Equisetum arvense, 17-20, 52, 117, 124, 133
 - kansanum, 17, 20, 52, 108, 117, 124
 - prealtum, 52
- Eremophila alpestris leucolaema, 210
- Erethizon dorsatus, 237, 240
 - d. epixanthum, 254
- Erethizontidae, 240, 254
- Ericaceae, 76
- Erigeron canadensis, 19, 34
 - concinus, 37, 40, 88, 117
 - divergens, 40, 88
 - d. cinereus, 37, 88
 - flagellaris, 31, 37, 40, 88
 - philadelphicus, 88
 - speciosus, 109, 117
 - s. macranthus, 28, 88
 - s. speciosus, 28, 88
- Eriogonum campanulatum, 35, 37, 38, 59
 - cernuum, 38, 42, 59

INDEX (continued)

- Eriogonum, 38, 117
 - ovalifolium, 38, 59
 - racemosum, 27, 37, 38, 59
 - tristichum, 38, 59
 - umbellatum, 37, 38, 59, 117
- Ermine, 260
- Erysimum capitatum, 27, 39, 65
- Euderma maculatum, 259
- Euphagus cyanocephalus, 217
- Euphorbia fendleri, 39, 72
 - glyptosperma, 28, 34, 72
 - robusta, 28, 39, 72
- Euphorbiaceae, 72
- Eurhynchium strigosum, 51
- Eurotia lanata, 37, 61
- Eutamias minimus, 223, 227, 237
 - m. consobrinus, 229, 244, 259
 - m. operarius, 163, 244
 - quadrivittatus, 237, 240, 244
 - q. hopiensis, 245
 - q. quadrivittatus, 163, 244
 - umbrinus montanus, 245
- Evening grosbeak, 198, 217
- Evening primrose, 19, 39, 74, 75, 117
- Even-toed ungulates, 260
- Everlasting, 19, 28, 40, 85
- Exochomus septentrionis, 171

- Fagaceae, 58
- Falco mexicanus, 202
 - peregrinus anatum, 202
 - sparverius sparverius, 202
- Falconidae, Falcons, 201, 202
- False buffalo grass, 34, 98
- False dandelion, 25, 27, 28, 40, 84
- False mallow, 23, 26, 73, 117
- False Solomon seal, 23, 25, 26, 27, 42, 56, 110, 117, 124, 133
- False toadflax, 27, 37, 38, 59
- False yarrow, 40, 86
- Felidae, 256, 260
- Felis concolor hippolestes, 256
- Fendler cloakfern, 35, 38, 41
- Fendler clover, 25, 26, 71
- Fendler sandwort, 35, 62
- Fendler spurge, 35, 39, 72
- Fendler three-awn, 94
- Ferns, 52
- Ferruginous hawk, 201
- Fescuta elatior, 96, 101
 - ovina, 27, 38, 96
 - rubra, 27, 38, 97
- Fiddleneck, 39, 78

- Figworts, 80
- Finches, 217
- Fireball, 30, 31, 33, 61
- Fireweed, 41, 75
- Flax, 72
- Fleabane, 28, 31, 37, 40, 88, 117
- Fleas, 9, 176
- Fontinalaceae, 51
- Fontinalis duriaei, 43, 51
- Four o'clock, 35, 38, 61
- Four-winged saltbush, 31, 37, 60
- Fowl bluegrass, 18, 100
- Fowl manna grass, 19, 22, 33, 41, 97
- Fox sparrow, 220
- Foxes, 255, 260
- Foxtail barley, 21, 31, 32, 33, 97, 117
- Fragilaria bracteata, 28, 67
 - sp., 45, 50
- Free-tailed bat, 259
- Fremont geranium, 28, 71
- Fringed brome, 18, 27, 41, 94
- Fringed myotis, 258
- Fringillidae, 217
- Fumitory, 64
- Funaria hygrometrica, 19, 43, 51
- Funariaceae, 51

- Galerucinae, 171
- Galeryca sp., 171
- Galium boreale, 28, 82
 - coloradoense, 40, 83
- Galleta grass, 31, 38, 42, 97, 133
- Gallinules, 203
- Gambel oak, 8, 15, 24, 25, 30, 35, 37, 42, 43, 58, 116, 127, 133, 134
- Gapper's red-backed mouse, 259
- Gaura, 28, 75
 - coccinea glabra, 28, 75
- Gayophytum, 26, 28, 39, 75
 - ramosissimum, 26, 28, 39, 42, 75
- Geese, 200
- Gentian, Gentianaceae, 76
- Geomyidae, 164, 248
- Geothlypis trichas occidentalis, 216
- Geraniaceae, 71
- Geranium, 71
 - fremontii, 28, 71, 117
 - parryi, 28, 71
- Geum macrophyllum, 19, 67
- Geyer willow, 25, 29, 57
- Giant ryegrass, 22, 24, 26, 31, 33, 96, 117, 133
- Giant wildrye, 110

INDEX (continued)

- Gilia, 39,78
 - aggregata, 27,39,77,117
 - aggregata attenuata, 39,77
 - sinuata, 39,78
- Glaucia aromatic sagebrush, 116
- Globe mallow, 37,39,73
- Gloeocystis gigas, 50
- Glyceria grandis, 18,97,117,124
 - striata, 19,33,97
- Glycyrrhiza lepidota, 18,26,33,70
- Gnaphalium palustre, 19,88
- Gnatcatchers, 214
- Goatsbeard, 28,91
- Goatsuckers, 206
- Gold of pleasure, 32,33,34,64
- Golden aster, 28,40,41,42,86
- Golden corydal, 27,42,64
- Golden currant, 25,29,68,110,116,133
- Golden dock, 19,21,60
- Golden Eagle, 201
- Golden ray, 40,41,42,91
- Golden weed, 40,85
- Golden-crowned kinglet, 214
- Golden-mantled ground squirrel, 163,237, 240,245,247
- Goldenrod, 21,90,91,117
- Gomphonema, 45,50
- Gophers, 164
- Goshawk, 201
- Gooseberries, 69
- Goosefoot, 60
- Gramineae, 54,92
- Grass flora, 92
- Grasses, 7,22-54,152,198,223-225
- Grasshopper sparrow, 219
- Gray flycatcher, 209
- Gray fox, 260
- Gray jay, 210
- Gray-headed junco, 219
- Greasewood, 237
- Great Basin sagebrush lizard, 193
- Great blue heron, 199
- Great horned owl, 205
- Grebes, 199
- Green algae, 156
- Green gentian, 28,41,76
- Green lacewings, 168
- Green-tailed towhee, 218
- Green-winged teal, 200
- Grimmia alpestris, 44,51
 - anodon, 44,51
 - calyptrata, 44
 - ovalis, 44,51
- Grimmia plagiopodia, 44
- Grimmiaceae, 51
- Grizzly bear, 260
- Gromwell, 39,79
- Grosbeaks, 217
- Grouse, 203
- Ground cherry, 28,32,33,80
- Groundsel, 28,40,90
- Guiraca caerulea interfusa, 217
- Gulls, 204
- Gulo luscus luscus, 260
- Gunnison's prairie dog, 163,240,247
- Gutierrezia microcephala, 34
 - sarothrae microcephala, 89
- Gymnorhinus cyanocephala, 211
- Haemaphysalis leporis palustris, 177
- Hawksbeard, 40
- Hairy chess, 24,94
- Hairy waterleaf, 28,37,39,78
- Hairy woodpecker, 198,208
- Hairy-winged myotis, 190
- Haloragidaceae, 75
- Halticinae, 171
- Hardbody ticks, 177
- Hares, 162,243,259
- Harriers, 201
- Harris's sparrow, 220
- Hawk, 201
- Hawksbeard, 88
- Hawthorn, 7,8,25,29,41,67,110,116,133
- Hay, 7,32
- Heath, 76
- Heather vole, 259
- Hedge nettle, 18,23,80,117
- Helianthus annuus, 31,34,40,89
 - petiolaris, 40,89
- Helichus sp., 172
- Hemiptere, 8,9,169
- Hemp, 58
- Heptagenia solitaria, 182,183
 - sp., 182,183
- Heptageniidae, 182,183
- Heracleum lanatum, 23,76,116
- Herbaceous sagebrush, 27,40,41,42,85
- Herbs, 18,20,25,29,37,41,124,152,224
- Hermit thrush, 213
- Hérons, 199
- Hesperiphona vespertina brooksi, 217
- Heteroxynema cucullatum, 163
- Heuchera parviflora, 39,66
 - spp., 66
- Hilaria jamesii, 31,38,97,133

INDEX (continued)

- Hippodamia convergens, 172
 - parenthesis, 172
- Hippuris vulgaris, 22,75
- Hirundinidae, 210
- Hirundo rustica erythrogaster, 210
- Histeridae, 172
- Hoary bat, 242
- Holodiscus, 35,41
 - dumosus, 37,67,81,116,133
- Honeysuckle, 83
- Hop, 24,117
- Hordeum brachyantherum, 97
 - jubatum, 21,23,31,33,97,116
 - nodosum, 19
- Horned lark, 198, 210
- Horsebrush, 35
- Horsetails, 17,41,42,52
- House finch, 218
- House sparrow, 216
- House wrens, 213
- Hummingbirds, 206,207
- Humulus lupulus, 117
 - l. neomexicanus, 27,58
- Hybrid Gambel oak, 58
- Hydrophyllaceae, 78
- Hydroporus sp., 172
- Hygrohypnum, 158
 - cochlearifolium, 43,51
 - ochraceum, 43,51
 - palustre, 43,156
- Hylocichla fuscescens salicicola, 213
 - guttata auduboni, 213
- Hymenoptera, 9,176
- Hymenoxys acaulis, 89
- Hypericaceae, 74
- Hypericum formosum, 18,23,73
- Hypnaceae, 51
- Hypnum patientiae elatum, 43,51
 - revolutum, 43,51
- Ibises, 199
- Ichneumonidae, 176
- Icteria virens auricollis, 216
- Icteridae, 216
- Icterus bullockii bullockii, 217
- Indian hemp, 23,29,77
- Indian paintbrush, 25,27,39,80
- Indian ricegrass, 37,38,42,98,117, 127,133
- Insectivores, 238,258
- Insects, 9,10,158,167,168
- Invertebrate fauna, 8
- Invertebrates, 161,167
- Iridaceae, 56
- Iridoprocne bicolor, 210
- Iris, 56
- Iris missouriensis, 22,56,117
- Iva axillaris, 28,31,34,89,117
- Ixodes marmotae, 177
- Ixodidae, 177
- Jackrabbits, 176,177
- Jays, 210
- Jumping mice, 223-237, 254
- Juncaceae, 55
- Juncaginaceae, 54
- Junco caniceps caniceps, 219
 - oreganus shufeldti, 219
- Juncus, 223
 - balticus, 17,20,33,124,153,225
 - b. montanus, 55, 117, 133
 - longistylis, 21,33,55
 - saximontanus, 19,21,55
- June grass, 38,97
- Junipers, 127,196,198
- Juniperus communis, 53
 - scopulorum, 53,107,108,116,124, 127,133
- Kansas horsetail, 20,52,117,124
- Kentucky bluegrass, 21-41, 100, 110,117,124,133,225
- Killdeer, 197,204
- King lupine, 39,70
- Kingfishes, 207
- Kinglets, 214
- Kochia scoparia, 27,30-33,61
- Koeleria cristata, 38,97
- Labiatae, 79
- Labops hirtus, 169
- Lacewings, 9,168
- Lactuca pulchella, 28,89
 - scariola, 28,34,89
- Lagopus leucurus altipetens, 203
- Lagurus curtatus levidensis, 259
- Lambsquarters, 27,31-38, 60
- Lamiinae, 170
- Lampyridae, 173
- Laniidae, 214
- Lanius excubitor invictus, 214
 - ludovicianus excubitorides, 214
- Lapland longspur, 220
- Lappula florabunda, 27,79,117
 - occidentalis, 34,39
 - redowskii, 28,79

INDEX (continued)

- Lark bunting, 219
- Lark sparrow, 219
- Larks, 210
- Lasionycteris noctivagans, 258
- Lasiurus cinereus cinereus, 239, 242
- Lathyrus brachycalyx, 26, 70
 - eucosmus, 70
- Laxuli bunting, 217
- Lead colored bushtit, 198
- Least chipmunk, 227, 237, 240, 244, 259
- LeConte's sparrow, 219
- Leguminosae, 69
- Lentibulariaceae, 82
- Leopard frog, 9, 192
- Lepidium densiflorum, 27, 31, 65
 - draba, 33, 65, 116
 - montanum, 39, 65
 - sp., 34
 - virginicum, 26, 33, 34, 65
- Lepidoptera, 8, 9
- Leporidae, 162, 243, 259
- Leptobryum pyriforme, 43, 51
- Leptodactylon pungens, 39, 78, 35
- Leptophlebiidae, 182, 188
- Leptura propinqua, 170
- Lepus americanus bairdii, 259
 - californicus taxianus, 259
 - townsendii townsendii, 162, 237, 240
- Leskea tectorum, 44, 51
- Leskeaceae, 51
- Lesser snow goose, 197
- Letterman needle grass, 27, 101, 133
- Letterman stipa, 37, 38
- Leucophoyx thula brewsteri, 199
- Leucosticte australis, 218
- Lewis woodpecker, 208
- Lichens, 8
- Liliaceae, 56
- Lily, 56
- Limoselle aquatica, 22, 81
- Linaceae, 72
- Linaria vulgaris, 28, 81, 117
- Lincoln sparrow, 220
- Linum lewisii, 28, 39, 72, 117
- Lipfern, 52
- Lithospermum multiflorum, 39, 79
- Little brown myotis, 239
- Little club moss, 42
- Little rabbitbrush, 38
- Little spurge, 28, 34, 72
- Littleseed ricegrass, 99
- Liverwort, 19, 43, 50
- Loasa, Loasaceae, 73
- Loco, 25, 26, 28, 39, 69
- Loggerhead shrike, 214
- Long-eared myotis, 190, 242
- Long-eared owl, 206
- Long-legged myotis, 162, 242
- Long-tailed meadow mouse, 237
- Long-tailed vole, 240, 252, 254
- Long-tailed weasel, 255
- Lonicera fragrantissima, 83
 - involucrata, 83
- Lopidea sp., 169
- Lotus wrightii, 28, 39, 70
- Lousewort, 22, 81
- Loxia curvirostra benti, 218
- Lucidota sp., 173
- Lupine, 25, 26, 39, 43, 70, 117
- Lupinus caespitosus, 70
 - greenei, 26, 39, 70, 107, 108, 117
 - kingii, 39, 70
- Lutra canadensis nexa, 260
 - c. sonora, 260
- Luzula parviflora, 21, 55
- Lycaenidae, 174
- Lycaeninae, 174
- Lygus hesperus, 169
- Lynx, 260
 - canadensis canadensis, 260
 - rufus baileyi, 257
 - rufus pallescens, 257
- McGillivray's warbler, 197, 215
- Machilidae, Machilids, 168
- Macoun's buttercup, 17, 18, 19, 21, 63
- Madder, 82
- Magpies, 210
- Malcolmia africana, 34
- Malachiidae, Malachius, 173
- Mallow, 73
- Malva rotundifolia, 33
- Malvaceae, 73
- Mammals, 9, 222, 233
- Maple, 72
- Maple-leaved goosefoot, 32
- Marchantia polymorpha, 19, 43, 50
- Marchantiaceae, 50
- Mares tail, 22, 75
- Mariposa lily, 38, 56
- Marmot, 177, 237
- Marmota, 176
 - flaviventris, 237, 240
 - f. engelhardti, 246
 - f. luteola, 163, 246

INDEX (continued)

- Marmota flaviventris nosophara*, 246
 f. obscura, 246
 Marsh bluegrass, 21
 Marsh foxtail, 18, 19
 Marsh hawk, 201
 Marsh muhly, 41, 98
 Marsh redtop, 18, 21, 22
 Marten, 260
Martes americana origenes, 260
 Masked shrew, 258
 Mat muhly, 98
 Matchweed, 34
 Mayflies, 10, 158, 167, 178, 179
 Meadow barley, 19, 97
 Meadow fescue, 96
 Meadow horsetail, 18, 19, 20, 52, 117, 124, 133
 Meadow lark, 198, 216
 Meadow mice, 223, 227, 229, 231
 Meadow rue, 26, 41, 63
 Meadow rush, 55
 Meadow vole, 240, 251
 Meadow wiregrass, 21, 33
Medicago sativa, 33, 70, 225
Megaloceraea debilis, 169
Megaryssa sp., 176
Melica bulbosa, 27, 38, 97
 porteria, 98
Melilotus alba, 23, 26, 33, 71
 officinalis, 26, 33, 71, 106, 107, 117, 225
 Meloidae, 173
Melosira sp., 45, 46, 50
Melospiza lincolni alticola, 220
 melodia montana, 220
Mentha canadensis, 107, 117, 119
 penardi, 18, 23, 79
Mentzelia albicaulis, 73
 dispersa, 39, 74
 d. compacta, 74
 pumila, 42, 74
 rusby, 74
Mephitis mephitis estor, 256, 260
 m. hudsonica, 256
 m. varians, 256, 260
Mergaceryle alcyon caurina, 207
Mergus merganser americana, 201
 Merriam's shrew, 258
Mertensia ciliata, 25, 26, 43, 79
 Mexican dock, 21, 27, 60
 Mice, 164
Microtus longicaudus, 223, 227, 229, 237, 240
 l. alticola, 253
 l. mordax, 229, 252
 montanus, 223, 227, 229, 237, 240, 252
Microtus montanus fusus, 164, 229, 252
 pennsylvanicus, 240, 252
 p. modestus, 227, 229, 251
 Milkweed, 23, 28, 31, 33, 42, 77
 Mimidae, 213
Mimulus guttatus, 19, 22, 81

 Mink, 255
 Mint, 18, 23, 79, 117
Mirabilis linearis, 38, 61
 Mirid bugs, 169
 Miridae, 169
Mischocyttarus sp., 176
 Mites, 177
Mnium serratum, 43, 51
 Mock orange, 66
 Mocking birds, 213
 Molossidae, 259
Molothrus ater artemisiae, 217
Monachus sp., 170
Monardella, 42, 79
 odoratissima, 79
Moniliformis clarkii, 164
 Monkey flower, 22
Monolepis nuttalliana, 25, 26, 34, 38, 61
Monopsyllus eumolpi, 176
Monostroma quaternarium, 45, 50
 sp., 156
Monoxia sp., 171
 Montane meadow mouse, 237
 Montane vole, 164, 240, 252
Mordella sp., 173
 Mordellidae, 173
 Morning glory, 77
 Mosses, 8, 19, 43, 48, 50, 156, 158
 Motacillidae, 214
 Moths, 9, 174
 Mougeotia, 46, 50
 Mountain bluebird, 214
 Mountain chickadee, 212
 Mountain dandelion, 84
 Mountain hollyhock, 25, 41
 Mountain juniper, 53
 Mountain lion, 256
 Mountain mahogany, 37, 64, 116, 133, 134
 Mountain peppergrass, 37, 39, 65
 Mountain red currant, 41
 Mountain red juniper, 8, 24, 35, 41, 42, 53, 116, 124, 127, 133
 Mountain red maple, 41, 72
 Mountain sheep, 260
 Mountain spurge, 39
 Mourning dove, 205

INDEX (continued)

- Mudwort, 22,81
- Muhlenbergia asperifolia, 23,30,31,98
 - filiformis, 27,98
 - racemosa, 98
 - richardsonia, 98
- Mule deer, 257,258
- Mule ear, 40,91
- Munroa squarrosa, 34,98
- Muskrat, 164,223,225,231,237,240,253
- Mustards, 64,262
- Mustela erminea muricus, 260
 - frenata nevadensis, 255
 - nigripes, 260
 - vison energumenos, 255
- Mustelidae, Mustelids, 255,260
- Mutillidae, 176
- Myadestes townsendi, 214
- Myotis, 8, 190
 - californicus californicus, 258
 - c. stephensi, 258
 - evotis evotis, 190,242
 - lucifugas carissima, 190,239
 - subulatus melanorhinus, 162,190,242
 - s. subulatus, 242
 - thysanodes thysanodes, 258
 - velifer incantus, 258
 - volans interior, 162,190,242
- Myriophyllum exalbescent, 22,75
- Myrmeleontidae, 168
- Myxophyceae, 156

- Najadaceae, 53
- Narrowleaf cattail, 22,53
- Narrowleaf chenopodium, 38
- Narrowleaf cottonwood, 15,23,40,57,110,
 - 116,124,133,152,158,197,223,224
- Narrowleaf goosefoot, 27,31,61
- Narrowleaf yucc, 35,37,56,113
- Navicula, 45,50,156
- Nebraska sedge, 18,22,33,54
- Neckera pennata oligocarpa, 51
- Neckeraceae, 51
- Needle and thread grass, 27,37,38,42,
 - 101,117,133
- Nematodes, 162,163
- Nemognatha apicalis, 173
 - lutea, 173
- Neolygus atritylus, 169
- Neotoma cinerea, 240
 - cinerea orolestes, 164,251
- Nettles, 58,117
- Neuroptera, 8,9
- Nevada bluegrass, 27,99

- New Mexican hop, 27,58
- New World porcupines, 254
- New World rats, 164
- Nicrophorus sp., 173
- Nightshade, 28,32,80
- Ninebark, 67
- Nitidulidae, 173
- Nodding brome, 27,94
- Nodularia amorica, 49
 - spaeocarpa, 46,49
 - spumigena, 46,49
- Non-vascular plants, 49
- Northern bedstraw, 25,28,82
- Northern grasshopper mouse, 259
- Northern plateau lizard, 192
- Northern pocket gopher, 164,237,240,248
- Northern reedgrass, 95
- Northern shrike, 214
- Northern three-toed woodpecker, 208
- Notholaena fendleri, 38,52
- Nostoc sp., 45,49,156
- Notoxus sp., 170
- Nucifraga columbiana, 211
- Nuthatches, 212
- Nuttall cottontail, 162,237,243
- Nuttallornis borealis, 209
- Nyctaginaceae, 61
- Nycticorax nycticorax hoactli, 199

- Oaks, 43,121,127
- Ocean spray, 37,67,116,133
- Ochotona princeps figginsi, 259
- Ochotonidae, 259
- Odocoileus hemionus hemionus, 258
- Oedogonium sp., 46,50,156
- Oenothera caespitosa marginata, 39,75
 - hookeri, 19,22,75,117
 - marginata, 75
 - pallida, 39,75
 - strigosa, 75,117
- Oibirds, 206
- Old World warblers, 214
- Oleaster, 74
- Olive-sided flycatcher, 198,209
- Ondata zibethicus, 223,237,240
 - z. osoyoosensis, 164,225,253
- Onion grass, 27,38,97
- Onychomys leucogaster pallescens, 259
- Opisocroatis hirsutus, 176
- Oporornis tolmiei monticola, 215
- Opuntia hystrix, 37,74,117,133
- Orange-crowned warbler, 215
- Orchard grass, 27,32,33,34,41,96

INDEX (continued)

- Oregon grape, 24, 26, 37, 41, 42, 63, 116
- Oregon junco, 219
- Oreoscoptes montanus, 213
- Orioles, 216
- Orthotrichaceae, 51
- Orthotrichum alpestre, 44, 51
 - halli, 44, 51
 - jamesianum, 44, 51
- Orthotrichum texanum, 44, 51
- Orthotylus angulatus, 169
 - ute, 169
- Oryzopsis bloomeri, 98, 101
 - hymenoides, 38, 98, 117, 127, 133
 - micrantha, 99
- Oscillatoria angustissima, 46, 49
 - animalis, 46, 49
 - limosa, 46, 49
- Otiiorhynchinae, 172
- Ovis canadensis canadensis, 260
- Oxytropis albiflora, 26, 39, 71
- Oxyura jamaicensis, 201
- Owls, 205

- Pachysphinx sp., 174
- Paintbrush, 37, 39, 81
- Pale aster, 41
- Pale evening primrose, 35, 39
- Pallid bat, 259
- Panicum capillare, 19, 33, 99
- Panicum virgatum, 99, 101
- Papaveraceae, 64
- Papilio sp., Papilionidae, 174
- Paraleptophlebia pallipes, 182, 188
 - sp., 182, 189
- Paridae, 211
- Parnassius sp., 174
- Parry bellflower, 28, 84
- Parry geranium, 28, 71
- Parry rabbitbrush, 31
- Parsley fern, 52
- Parula americana, 215
- Parula warbler, 215
- Parulidae, 215
- Parus atricapillus garrinus, 211
 - gambeli gambeli, 212
- Passer domesticus, 216
- Passerculus sandwichensis nevadensis, 219
- Passerella iliaca schistacea, 220
- Passerherbulus caudacutus, 219
- Passerina amoena, 217
- Pea, 69
- Peachleaf willow, 57
- Peavine, 70

- Pearly everlasting, 84
- Pedicularis crenulata, 22, 81
- Penny cress, 25, 26, 28, 33, 34, 66
- Pentstemon, 43
 - barbatus, 37, 39, 81
 - coloradensis, 37, 39, 81
 - comarrhenus, 25, 27, 37, 39, 82, 117
 - crandallii, 39, 81
 - watsonii, 40, 81
- Peppergrass, 25, 26, 27, 31-34, 65
- Perching birds, 209
- Peregrine falcon, 202
- Perisoreus canadensis capitalis, 210
- Peromyscus boylii, 237, 240
 - boylii rowleyi, 251
 - crinitus auripectus, 259
 - difficilis, 251
 - difficilis nasutus, 251, 259
 - maniculatus, 176, 223, 227, 237, 240
 - m. nebrascensis, 250
 - m. rufinus, 164, 227, 250
 - m. sonoriensis, 250
 - truei truei, 259
- Petrochelidon pyrrhonota pyrrhonota, 210
- Phacelia heterophylla, 28, 39, 78
- Phalacridae, Phalacrus sp., 173
- Phalaropes, Phalaropodidae, 204
- Pheasants, 203
- Phenacomys i. intermedius, 259
- Pheucticus m. melanocephalus, 217
- Philadelphus m. microphyllus, 66
 - m. occidentalis, 66
- Philonotis fontana, 43, 51
- Phleum pratense, 18, 19, 27, 33, 99, 101
- Phlox, 77
 - caespitosa, 37, 39, 78, 117, 127, 133
 - longifolia, 27, 39, 78
- Phormidium autumnale, 46, 49
 - retzii, 46, 49
- Phragmites communis, 22
- Phyllobius sp., 172
- Physalis longifolia, 28, 33
- Physaria floribunda, 39, 65
- Physocarpus alternans, 67
 - malvaceus, 67
- Physocephala sp., 176
- Pica pica hudsonia, 211
- Picoides tridactylus dorsalis, 208
- Picea pungens, 53, 116, 133
- Picidae, 208
- Pied-billed grebe, 199
- Pieridae, 174
- Pieris sp., 174

INDEX (continued)

- Pigeons, 205
- Pigmy nuthatch, 212
- Pigweed, 27, 32, 33, 34, 61
- Pikas, 162, 243, 259
- Pinaceae, 53
- Pine grosbeak, 218
- Pine siskin, 198, 218
- Pines, 53
- Pinicola enucleator montana, 218
- Pink fireweed, 22
- Pinks, 62
- Pintail, 200
- Pinus edulis, 53
 - ponderosa, 53, 116
- Pinyon jay, 198, 211
- Pinyon mouse, 259
- Pinyon pine, 42, 196, 237
- Pipistrellus hesperus santarosae, 259
- Pipits, 214
- Piranga ludoviciana, 217
- Plagiognathus annulatus, 169
- Plains mustard, 25, 26, 65
- Plantaginaceae, 83
- Plantago eriopoda, 21, 83
 - major, 18, 21, 33, 83
- Plantain, 21, 32, 33, 83
- Plantain-eaters, 205
- Plants, 47
- Plecotus townsendi pallescens, 259
- Ploceidae, 216
- Plovers, 204
- Poa, 158
- Poa compressa, 27, 38, 99
 - nevadensis, 27, 99
 - palustris, 18, 21, 00
 - pratensis, 21, 26, 33, 100-109, 117, 124, 133, 153, 223, 225
- Pocket gopher, 248
- Podabrus sp., 170
- Podgrass, 21, 54
- Podicipedidae, 199
- Podiceps caspicus californicus, 199
- Podilymbus podiceps, 199
- Pohlia cruda, 43, 51
 - gracilis, 51
 - wahlenbergii, 43, 51
- Poison ivy, 41, 72, 116
- Polanisia trachysperma, 38
- Polemoniaceae, 77
- Polistes sp., 176
- Polygonaceae, 59
- Polygonum amphibium, 21, 22, 59
 - aviculare, 27, 31, 34, 59
- Polygonum monspeliensis, 21, 23
- Polypodiaceae, 52
- Ponderosa pine, 42, 53, 116
- Pondweed, 22, 53
- Poecetes gramineus confinis, 219
- Poor-will, 206
- Poppy, 64
- Populus angustifolia, 23, 57, 106, 108, 116, 124, 133, 153, 158, 223, 224
 - tremuloides, 57, 116, 133
- Porcupines, 177, 237, 240, 254
- Porter melica, 98
- Porzana carolina, 203
- Potamogeton pectinatus, 22, 53
- Potato, 80
- Potentilla anserina, 17, 18, 19, 20, 68
 - diversifolia, 26, 68
 - fruticosa, 26, 68, 111, 116, 133
 - glandulosa, 28, 68
 - monspeliensis, 68
 - pectinisecta, 28, 68
 - plattensis, 68
- Pottia heimii, 43, 50
- Pottiaceae, 50
- Poverty weed, 25, 26, 28, 31, 34, 89, 117
- Prairie dogs, 176, 177, 198, 237
- Prairie falcon, 202
- Prairie mallow, 73
- Prickly lettuce, 28, 32, 34
- Prickly pear cacti, 35, 117
- Prickly poppy, 38, 64
- Primrose, 76
- Primulaceae, 76
- Prionus sp., 170
- Procyon loter pallidus, 260
- Procyonidae, 260
- Pronghorn, 260
- Prostrate pigweed, 34, 61
- Prunella vulgaris, 19, 21, 80
- Prunus virginiana, 25, 37, 68, 116, 133
- Psaltiparus minimus plumbeus, 212
- Pseudocloeon sp., 182, 183
- Pseudotsuga menziesii, 53, 116, 133
- Psyllobora sp., 172
- Ptarmigans, 203
- Ptiloria, 40
 - pauciflora, 89
 - tenuifolia, 90
- Puccinellia distans, 23, 30, 31, 100
- Pull-up muhly, 27, 41, 98
- Puncture vine, 34, 72
- Purple yarrow, 27, 40, 84
- Purshia tridentata, 37, 68, 116, 133

INDEX (continued)

- Pussytoes, 28,40,85,116
- Pygmy forest, 196
- Pygmy owl, 206
- Pyrocephalus rubinus flammeus, 209
- Quaking aspen, 57,116,133
- Quercus gambelii, 25,37,58,104,108,
116,127,133
- gambelii, turbinella, 58
- Rabbitbrush, 30,34,35,87,116,152,254
- Rabbits, 10,162,243,259
- Raccoon, 260
- Radicula lyrata, 18,21,65
- Raillietina retractilis,163,164
- Rails, 203
- Rallidae, 203
- Rana pipiens, 192
- Ransomus rodentorum, 164
- Ranunculaceae, 62
- Ranunculus aquatilis, 63
- circinatus, 63
- cymbalaria, 17,18,19,21,63
- macounii, 17,18,19,21,63
- sceleratus, 23
- Raphidiidae, 168
- Red baneberry, 41
- Red birch, 110
- Red clover, 22,23,28,32,33,71
- Red crossbill, 218
- Red currant, 68
- Red elderberry, 24, 83
- Red fescue, 27,38,97
- Red pentstemon, 39,41,81
- Red raspberry, 69, 116
- Red river birch, 25,58,116
- Red squirrel, 240,248
- Red top, 22,24,26,32,93,133,225
- Red wax currant, 37
- Red-breasted nuthatch, 212
- Redhead, 201
- Red-osier dogwood, 25,29,76,116,124,133
- Redroot, 32,33,34,41
- Redroot pigweed, 61
- Red-shafted flickers, 208
- Red-tailed hawk, 200
- Red-winged blackbird, 198,216
- Reed, 22
- Regulus calendula cineraceus, 214
- satrapa amoenus, 214
- Reithrodontomys megalotis aztecus, 259
- Reptiles, 9, 191,192
- Rheum raphonticum, 60
- Rhithrogena robusta, 182,184
- sp., 182,184
- Rhizoclonium hieroglyphicum, 46,50
- Rhopalodia gibba, 45,50
- Rhubarb, 60
- Rhus radicans, 72,116
- trilobata, 26,72,104,106,116,133,153
- Rhynchites bicolor, 172
- Rhynchitinae, 172
- Ribes aureum, 25,68,116,133
- cereum, 37,68,
- inermis, 25,69,116
- leptanthum, 69
- montigenum, 69
- Ricci frostii, 43,50
- Ricciaceae, 50
- Richardson's ground squirrel, 259
- Rictularia coloradensis, 163,164
- Ringtail, 260
- Riparia riparia riparia, 210
- River birch, 7, 29
- River hawthorn, 26,29,67
- River otter, 260
- Rivularia borealis, 46,49
- sp. 49
- Roadrunner, 205
- Robins, 213
- Robust spurge, 28,72
- Rockcress, 35,37,39,41,64
- Rockjasmine, 28,39,76
- Rockjasmine lover, 42,66
- Rock mosses, 44,51
- Rock squirrel, 163,237,240,246
- Rock wrens, 213
- Rocky Mt. beeflower, 26,31,38,64
- Rocky Mt. beeweed, 25
- Rocky Mt. rush, 19,55
- Rocky Mt. wiregrass, 21
- Rodents, 10,11,163,240,243,259
- Rosa woodsii, 25,34,69,104,106,111,
116,124,133,153,158,223,224
- Rosaceae, 67
- Rose atriplex, 31,34
- Rose, 67
- Rough-winged swallow, 210
- Rubiaceae, 82
- Rubus strigosus, 69,116
- Ruby-crowned kinglet, 198,214
- Rudbeckia hirta, 22,89,117
- laciniata, 22,90
- Ruddy duck, 201
- Rufous hummingbird, 207
- Rumex crispus, 19,21,33,60

INDEX (continued)

- Rumex mexicanus, 21, 27, 60
 - persicarioides, 19, 21, 60
- Rushes, 7, 17, 20, 21, 22, 29, 55
- Russian knapweed, 28, 31, 86
- Russian thistle, 28, 31, 32, 34, 38, 61, 117, 133
- Rye grass, 124

- Sage grouse, 203
- Sage sparrow, 219
- Sage thrasher, 198, 213
- Sagebrush, 7, 127, 134, 198, 218, 223, 225, 237, 254
- Saint Johnswort, 18, 23, 73
- Salicaceae, 57
- Salix, 104, 107, 116, 223, 224
 - amygdaloides, 57
 - bebbiana, 25, 29, 57
 - caudata, 25, 29, 57, 124, 133, 153
 - exigua, 25, 29, 34, 57, 124, 133, 158
 - geyeriana, 25, 29, 57
 - lutea, 29, 57
 - lutea watsonii, 26
 - watsonii, 58
- Salpinctes obsoletus obsoletus, 213
- Salsola kali, 27, 31, 38, 117, 133
 - kali tenuifolia, 34, 62
- Salt cedar, 73
- Salt grass, 23, 30, 31
- Sambucus pubens, 83
- Sand dropseed, 38, 101
- Sand grouse, 205
- Sandalwoods, 59
- Sandbar willow, 25, 29, 57, 124, 133, 158
- Sandpipers, 197
- Sandwort, 38, 41, 62
- Santalaceae, 59
- Saunders wheatgrass, 92
- Savannah sparrow, 198, 219
- Saw-whet owl, 206
- Saxifraga arguta, 66
 - bronchialis, 42, 66
- Saxifragaceae, 66
- Saxifrage, 66
- Sayornis saya saya, 209
- Say's phoebe, 209
- Scarabaeidae, 173
- Scarlet gilia, 25, 27, 37, 39, 43, 77, 117
- Scarlet globe mallow, 39, 73
- Sceliphron sp., 176
- Sceloporus, 9
 - graciosus, 192
 - g. graciosus, 193
 - undulatus elongatus, 192
- Schard, 38, 61
- Schoenocrambe linifolia, 25, 26, 65
- Scirpus, 225
 - americanus, 22, 55
 - microcarpus, 22, 55
 - rubrotinctus, 22, 55
- Sciuridae, 163, 243, 259
- Sciurus aberti, 259
- Scleropogon sp., 175
- Scratchgrass, 98
- Scrophularia, 28
 - lanceolata, 82
 - occidentalis, 28, 82, 104, 117
- Scrophulariaceae, 80
- Scrub jay, 211
- Scutellaria galericulata, 18, 80, 117
- Seaside arrowgrass, 21, 54
- Sedge, 7, 20-32, 54, 117, 133, 223-230
- Sedum stenopetalum, 39, 66
- Seed plants, 53
- Sego lily, 38, 56, 117
- Selasphorus platycercus platycercus, 207
- Selasphorus rufus, 207
- Selfheal, 19, 21, 80
- Senecio, 25, 27, 28, 40, 41, 90, 107, 117
 - ambrosioides, 28, 37, 40, 90
 - atratus, 90
 - crassulus, 28, 37, 40, 90
 - cymbalarioides, 27, 37, 40, 90
 - integerrimus, 27, 90
 - mutabilis, 28, 40, 90
 - pauciflorus, 40
 - platylobus, 28, 40, 90
- Service berry, 7, 24, 25, 35, 37, 42, 43, 67, 116
- Sharp-skinned hawk, 201
- Sharp-tailed sparrow, 219
- Shasta daisy, 86
- Sheep fescue, 27, 38, 96
- Shepherdia argentea, 30, 74
- Shooting star, 22, 76
- Shorebirds, 204
- Short-awn foxtail, 93
- Short-eared owl, 206
- Shoveler, 200
- Shrikes, 214
- Shrubby cinquefoil, 24-29, 43, 68, 116, 133
- Shrubs, 7, 23
- Shrews, 10, 223, 231, 238, 258
- Sialia currucoides, 214
- Siberian juniper, 43
- Sidalcea candida, 23, 73,
 - neomexicana, 23, 26, 73, 111, 117

INDEX (continued)

- Side-oats gramma, 42
- Silene noctiflora*, 27, 62
- Silpha* sp., *Silphidae*, 173
- Silver plant, 38, 59
- Silver sagebrush, 35, 37, 41, 42, 85, 116, 133, 152
- Silverberry, 74
- Silver-haired bat, 258
- Silverweed, 17, 18, 19, 20, 68
- Siphonuridae*, 181, 182
- Siphonurus occidentalis*, 181, 182
- Siphonaptera*, 8, 9, 176
- Sisymbrium altissimum*, 33, 65, 107, 117
- Sisyrinchium demissum*, 56
 - montanum*, 22, 56
- Sitanion hystrix*, 31-38, 100, 117, 127, 133
- Sitta canadensis*, 212
 - carolinensis nelsoni*, 212
 - pygmaea melanotis*, 212
- Sittidae*, 212
- Sium suave*, 23, 33, 76
- Skullcap, 18, 80, 117
- Slender eriogonum, 38, 59
- Slender gramma grass, 38, 42
- Slender lipfern, 41
- Slender wheatgrass, 24, 26, 37, 38, 41, 42, 92
- Sloughgrass, 18, 21
- Small-footed myotis, 162, 190, 242
- Smerinthus* sp., 174
- Smilacina racemosa*, 27, 56
 - stellata*, 23, 26, 56, 111, 117, 124, 133
- Smooth brome, 24, 26, 32, 33, 95, 110, 116, 127, 133, 224, 230
- Snake flies, 168
- Snakes, 9, 11
- Snowberry, 24, 26, 29, 35, 37, 41, 42, 43, 83, 116, 133
- Snowshoe rabbit, 259
- Snowy egret, 199
- Soft chess, 32, 33, 34
- Solanaceae*, 80
- Solanum nigrum*, 33
 - triflorum*, 28, 80
- Solidago canadensis*, 22, 34, 90, 117
 - sparsiflora*, 21, 91
- Solitaires*, 213
- Solitary sandpiper, 204
- Solitary vireo, 215
- Song sparrow, 197, 220
- Sora, 203
- Sora rail, 198
- Sorex cinereus cinereus*, 258
 - merriami leucogenys*, 258
- Sorex nanus*, 258
 - palustris*, 223, 227, 237
 - palustris navigator*, 239
 - vagrans*, 223, 227
 - vagrans obscurus*, 228, 237, 238
- Soricidae*, 238
- Sparrow hawks, 202
- Sparrows, 217
- Spatula clypeata*, 200
- Speedwell, 17, 18, 21, 23, 82
- Speotyto cunicularia hypugaea*, 205
- Sphaeralcea coccinea*, 39, 73
 - coccinea elata*, 39, 73
- Sphecidae*, 176
- Sphingidae*, 174
- Sphyrapicus varius nuchalis*, 208
 - thyroideus nataliae*, 208
- Spike bent, 93
- Spike rush, 20, 21, 55, 117
- Spiders, 177
- Spilogale gracilis sazatalis*, 256
 - putorius gracilis*, 256
- Spineless horsebush, 38, 91
- Spinus pinus pinus*, 218
 - tristis pallidus*, 218
- Spiny phlox, 39, 42, 78
- Spirogyra*, 46
 - inflata*, 50
 - longata*, 50
 - porticalis*, 50
 - varians*, 50
 - weberi*, 50
- Spizella arborea ochracea*, 219
 - breweri breweri*, 220
 - passerina arizonae*, 220
- Sporobolus airoides*, 23, 31, 100
 - cryptandrus*, 38, 101
- Spotted bat, 259
- Spotted sandpiper, 204
- Spring-tails, 9, 168
- Sp̄ruce-fir, 15, 42, 43
- Spurge, 72
- Squawbush, 24, 26, 30, 41, 42, 72, 116, 133
- Squirrels, 163, 243, 259
- Squirreltail, 31, 100, 127
- Squirreltail barley, 23, 117, 133
- Squirreltail grass, 34, 37, 38
- Stachys palustris*, 18, 23, 80, 117
- Staphylinidae*, 174
- Starlings, 215
- Starwort, 28, 41, 62
- Steganopus tricolor*, 204
- Stelgidopteryx ruficollis serripennis*, 210

INDEX (continued)

- Stellar's jay, 198, 211
- Stellaria jamesiana*, 62
- Stellula calliope*, 207
- Stenodema virens*, 169
- Stenodynerus* sp., 176
- Stephanomeria tenuifolia*, 91
- Sternella neglecta neglecta*, 216
- Stick leaf, 74
- Stickseed, 27, 79, 117
- Stinging nettle, 19, 23, 25, 26, 33, 41, 58
- Stipa columbiana*, 101
 - comata*, 38, 101, 104, 117, 133
 - lettermani*, 27, 38, 101, 133
 - pinetorum*, 27, 37, 38, 101
- Stonecrop, 35, 39, 41, 66
- Stoneflies, 10, 158
- Strongylocoris* sp., 169
- Streptanthus cordatus*, 39, 66
- Strigioclonium*, 46
 - attenuatum*, 50
 - stagnatile*, 45, 50
- Striped skunk, 256, 260
- Sturnidae, 215
- Sturnus vulgaris vulgaris*, 215
- Suaeda depressa*, 23, 30, 61
- Sulfur eriogonum, 38, 59
- Sulfur paintbrush, 28, 81
- Sumacs, 72
- Summer cypress, 28
- Sunflower, 31, 32, 33
- Surf-birds, 204
- Swainson hawk, 201
- Swallows, 210
- Swerta radiata*, 76
 - radicatum*, 28
- Switchgrass, 99
- Swifts, 206
- Sylviidae, 214
- Sylvilagus audubonii baileyi*, 259
 - audubonii warreni*, 259
 - nuttallii*, 237
 - nuttallii pinetis*, 162, 243
- Symphatineria eutanaii*, 163
- Symphoricarpos albus*, 83, 116
 - longiflorus*, 26, 37, 83
 - oreophilus*, 26, 37, 83, 133
- Synedra ulna*, 45, 50, 156
- Symphacia obvelata*, 164
 - peromysci*, 164
- Tabellaria flocculosa*, 45
- Tachycineta thalassina lepida*, 210
- Tadarida braziliensis mexicanus*, 259
 - mollosa*, 259
- Tall evening primrose, 22
- Tall horsetail, 52
- Tall loco, 25, 26, 71
- Tall rabbitbrush, 30, 37, 87
- Tall stickseed, 25
- Tamaricaceae, 73
- Tamarix*, 26, 73
- Tamarix pentandra*, 26, 73
- Tamasciurus hudsonicus fremonti*, 248
- Tanacetum vulgare*, 28, 91
- Tanagers, 217
- Tansy, 28, 91
- Tansy mustard, 25, 26, 31-34, 39, 64
- Taraxacum officinale*, 19, 21, 23, 28, 33, 91, 107, 117, 153, 225
- Taxidea taxus berlandieri*, 255
 - taxus taxus*, 255
- Tenebrionidae, 174
- Tetradymia canescens*, 38, 91
- Tetraopes* sp., 170
- Tetraspora gelatinosa*, 46, 50
- Thalictrum fendleri*, 26, 63
- Thamnophis*, 9
 - elegans vagrans*, 193
- Thermopsis montana*, 18, 23, 71, 117
- Thinleaf alder, 58, 116, 124, 133
- Thirteen-lined ground squirrel, 259
- Thistle, 31, 84, 117
- Thlaspi alpestre*, 28, 39, 66
 - arvense*, 26, 33, 66
- Thomomys talpoides*, 237, 240
 - talpoides fossor*, 164, 248
- Thrashers, 213
- Thraupidae, 217
- Three-awn grass, 38
- Thrushes, 213
- Thysanura, 8, 9
- Thuidium abietinum*, 51
- Ticklegrass, 41, 93
- Ticks, 9, 167, 177
- Tiloria, 89
- Timmia barvarica*, 43, 51
- Timmiaceae, 51
- Timothy, 18, 19, 27, 32, 33, 99
- Titmice, 211
- Torrey bulrush, 55
- Tortella fragilis*, 43

INDEX (continued)

- Tortula mucronifolia, 50
 - papillosissima, 50
 - ruralis, 43,50
- Townsend, 91
- Townsend big-eared bat, 259
- Townsendia, 40
- Townsendia exscapa, 40,91
- Townsend's solitaire, 198,214
- Toxostoma rufum, 213
- Tragopogon dubius, 28,91
- Trailing buttercup, 17,18,19,21,63
- Trailing verben, 34
- Traill's flycatcher, 209
- Tree communities, 23
- Tree sparrow, 220
- Tree swallow, 210
- Trees, 43
- Tribonema, 46
 - bombycina, 49
 - minor, 49,156
- Tribulus terrestris, 34,72
- Trichiotinus sp., 173
- Trichodes ornatus, 171
- Trichurus sp., 162
 - stansburyi, 164
- Tricorythididae, 182,188
- Tricorythodes minutus, 182,188
- Trifolium fendleri, 26,71
 - hybridum, 18,26,33,71,133
 - pratense, 22,23,28,33,71,99
 - repens, 18,19,33,71,117,153
- Triglochin maritima, 17,21,23,54
 - palustris, 17,21,54
- Tringa solitaria, 204
- Trirhabda sp., 171
- Trochilidae, 207
- Trogidae, 174
- Troglodytes aedon parkmanii, 213
- Troglodytidae, 213
- Trout, 158
- Trox sp., 174
- Tumbleweed redroot, 61
- Tumbling mustard, 32,33,65,117,127
- Turdidae, 213
- Turdus migratorius propinquus, 213
- Turnstones, 204
- Twinberry, 29,41
- Twistedleaf rabbitbrush, 31,87
- Twistflower, 39,66
- Two-winged flies, 9,175
- Typha angustifolia, 22,53
 - latifolia, 225
- Typhaceae, 53
- Typical owl, 205
- Tyrannidae, 205
- Tyrannus tyrannus, 209
 - verticalis, 209
- Tyrant flycatcher, 209
- Ulothrix, 45
 - tenuissima, 45,50
 - zonata, 46,50
- Umbelliferae, 76
- Ungulate, 10
- Urocyon cinereoargenteus scottii, 260
- Ursidae, 260
- Ursus americanus amblyceps, 260
 - horribilis bairdi, 260
- Urtica breweri, 104,107
 - gracilentia, 19,23,26,33,58,117
- Urticaceae, 58
- Utah sunflower, 40,89
- Utrichularia vulgaris, 22,82
- Vagrant shrew, 227,237,238
- Valerian, 84
- Valeriana edulis, 23,28,84
- Valerianaceae, 84
- Varnishleaf rabbitbrush, 30,31,37,
 - 87,124,133
- Vascular plants, 52
- Vaucheria, 46, 156
 - borealis, 45
 - geminata, 49
 - longipes, 49
 - pachyderma, 49
 - sessilis, 49
- Veery, 197,213
- Vegetation, 12
- Verbena bracteata, 34,79
- Verbenaceae, 79
- Verdins, 211
- Vermilion flycatcher, 209
- Vermivora celata orestera, 215
- Vermivora virginiae, 215
- Veronica americana, 18,21,23,82
 - anagallis-aquatica, 21,23,82
 - wormskjoldii, 17,18,21,82
- Vertebrate, 9, 191
- Vertebrate fauna, 9
- Vervain, 79
- Vesper sparrow, 198,219
- Vespertilionid bats, 162,239,258
- Vespertilionidae, 162,239,258
- Vespidae, 176
- Vespula sp., 176

INDEX (continued)

- Vicia americana, 28,117
- Viguiera multiflora, 40,91
- Violet-green swallow, 198,210
- Vireo gilvus swainsonii, 215
- solitarius plumbeus, 215
- Vireonidae, 215
- Vireos, 215
- Virginbower, 24,38,62,63
- Virginia's warbler, 215
- Voles, 262
- Vulpes fulva macroura, 260

- Wagtails, 214
- Wall flower, 25,27,37,39,65
- Wandering garter snake, 9,193
- Wapiti, 257,262
- Warbling vireo, 215
- Wasps, 176
- Water birds, 11
- Water buttercup, 22,62,63
- Water foxtail, 21
- Water hemlock, 23,33,76,117
- Water milfoil, 22,75
- Water parsnip, 23,33,76
- Water pipit, 214
- Water shrew, 227,237,239
- Water smartweed, 21,22,59
- Water starwort, 17
- Waterleaf, 78
- Watson pentstemon, 40,82
- Wax currant, 35,41,42
- Weeds, 7
- Western bluestem, 24,32,33,38,92,133
- Western flycatcher, 209
- Western grebe, 199
- Western harvest mouse, 259
- Western jumping mouse, 164,240,254
- Western kingbird, 209
- Western meadowlark, 216
- Western mock orange, 41,66
- Western nighthawk, 206
- Western ninebark, 41
- Western pipistrelle, 259
- Western riverbirch, 58,124,133
- Western spotted skunk, 256
- Western stickseed, 28,32,34,39,79
- Western tanager, 217
- Western thistle, 37,40,42
- Western valerian, 23
- Western virgin bower, 26,63,116
- Western wheatgrass, 26,92
- Western willet, 204
- Western wood pewee, 197,209

- Whiplash willow, 25,28,57,124,133
- White clover, 18,19,33,71,117
- White geranium, 117
- White pelican, 197
- White prairie mallow, 23
- White saxifrage, 42
- White sweetclover, 23,25,26,32,33,71
- White top, 33, 117
- White-breasted nuthatch, 212
- White-crowned sparrow, 220
- White-flowered Mt. hollyhock, 25
- White-tail antelope squirrel, 259
- White-tailed jackrabbit, 162,177,237,243
- White-tailed prairie dog, 259
- White-tailed ptarmigan, 203
- White-throated sparrow, 220
- White-throated swifts, 198,207
- White-top mustard, 34,65
- Wild black currant, 25,29
- Wild buckwheat, 27,38,59
- Wild currants, 24,30
- Wild fleabane, 28,88,117
- Wild geranium, 43
- Wild lettuce, 89
- Wild licorice, 18,26,29,32,70
- Wild morning-glory, 33,77
- Wild onion, 27,37,38,56
- Wild raspberry, 41
- Wild rose, 7,24,25,29,34,41,69,110,116,124,133,158,223,224,230
- Wild strawberry, 28,41,67
- Wild sweetpea, 25,26,70
- Wild sweet William, 25,27,39,78
- Williamson's sapsucker, 208
- Willowherb, 18,19,20,23,42,74
- Willows, 7,20,25,40,41,57,116,124,152,177,223,224,225,230
- Willowweed, 81
- Wilsonia pusilla pileolata, 216
- Wilson's warbler, 216
- Winter honeysuckle, 83
- Winterfat, 37,61
- Wine gooseberry, 69,116
- Wiregrass, 20,133,224,230
- Wirelettuce, 40,89
- Witchgrass, 19,33,34,99
- Wolverine, 260
- Wolves, 260
- Wood rush, 21,55
- Wood warblers, 215
- Woodpeckers, 208
- Wrens, 213
- Wrynecks, 208
- Wyethia amplexicaulis, 40,91

INDEX (continued)

- Xanthocephalus xanthocephalus, 216
- Xanthium saccharatum, 23,33,91
- Xenoclerus sp., 171

- Yarrow, 25,37,110,116
- Yellow evening primrose, 41
- Yellow green algae, 49,156
- Yellow monkey flower, 19,42,81
- Yellow Mt. thermopsis, 18,23,71
- Yellow pine, 15,43,196,197
- Yellow prickly pear, 37,74,133
- Yellow sweetclover, 25,26,33,71,110,
117,225
- Yellow warbler, 197,215
- Yellow watercress, 18,21,65
- Yellow willow, 26,29,57
- Yellow-bellied marmot, 163,240,246
- Yellow-bellied sapsucker, 208
- Yellow-breasted chat, 197,216

- Yellow-headed Brewer's blackbird,216
- Yellow-shafted flicker, 208
- Yellow-throat, 216
- Yucca, 42
- Yucca angustissima, 37,56,117,133

- Zacatecan deer mouse, 259
- Zapodidae, 164,254
- Zapus princeps, 223,229,237,240
princeps princeps, 164,254
- Zenaidura macroura marginella, 205
- Zygnema, 46
- Zygnema insigne, 50
- Zygophyllaceae, 72
- Zonitis sp., 173
- Zonotrichia albicollis, 220
guerula, 220
leucophrys leucophrys, 220

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