

UNITED STATES GOVERNMENT

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE*Memorandum*

TO : Harold W. Bradford, District Conservationist, DATE: Feb. 25, 1969
SCS, Cortez Work Unit, Cortez, Colo.

FROM : Vern K. Hugie & Erasmus W. Williams, Soil-Range
Interpretation Project, SCS, Salt Lake City, Utah

SUBJECT: SOIL-RANGE INTERPRETATION PROJECT REPORT

Attached report is a record of our pinon-juniper studies completed in the Mesa Verde National Park, 1968. As new studies are completed their data will be added to this report.

Vern K. Hugie

SOIL CONSERVATION SERVICE

SOIL-RANGE INTERPRETATION PROJECT

DOCUMENTARY STUDIES

MESA VERDE NATIONAL PARK

MONTEZUMA COUNTY, COLORADO

1964, 1967, 1968

MESA VERDE NATIONAL PARK AREA

Mesa Verde National Park is located in the southwestern part of Colorado, Montezuma County. It is on a high plateau that has been deeply dissected by streams flowing south and southwest into the San Juan River. Remnants of the plateau "mesas" are bordered by steep cliffs and deep canyons. Elevations range from 6,000 feet at the New Mexico State line to 8,600 feet at the north rim.

Mesa Verde National Park has a semiarid climate. Average annual precipitation, Park Headquarters, Chapin Mesa, is 18.28 inches. On average years precipitation is fairly evenly distributed throughout the year but wide fluctuations in both amount and distribution are the general rule. Mean annual temperature is 50.5° F. Maximums of 96° and minimums of -20° F. have been recorded. Annual soil temperature is more than 47° F. Average growing season is about 160 days. Recorded and calculated weather data for the Mesa Verde National Park Weather Station, Table 1, indicates that on average years evapotranspiration needs of vegetation would be satisfied up to near the middle of the third week in July.

Vegetation appears stable with the exception of areas that have been burned. Pinon (*Pinus edulis*) and juniper (*Juniperus osteosperma*) are the vegetation dominants, but yellow pine (*Pinus ponderosa*), Douglas fir (*Pseudotsuga menziesii*), and Rocky Mountain juniper (*Juniperus scopulorum*) occur along the north rim, in the heads of, and along canyons. The more common shrubs associated with the pinon-juniper are black sagebrush (*Artemisia nova*), big sagebrush (*Artemisia tridentata*), gamble oak (*Quercus gambelii*), Utah serviceberry (*Amelanchier utahensis*), mountain mahogany (*Cercocarpus montanus*), antelope bitterbrush (*Purshia tridentata*), Fendlerbush (*Fendlera rupicola*) and squaw apple (*Peraphyllum ramosissimum*). These shrub species are numerous, large and vigorous in those areas which have been burned.utton grass (*Poa fendleriana*) is the dominant grass and grows in an open stand. A small, almost shrubby, penstemon (*Penstemon linarioides* ssp. *coloradoensis*) and rock goldenrod (*Solidago patradoria*) occurred commonly in the understory.

The Mesa Verde area was open to grazing by domestic livestock from about 1870 until its designation as a national park, June 29, 1906. The park was increased in size by additions in 1913, 1931, and 1932. It now includes approximately 90 square miles. Grazing is limited to wildlife and occasional trespass livestock. Currently deer are overstocked and are a major problem to park personnel.

Geologic formations of this area are dominated by sedimentary rocks of the late Cretaceous age, 3,600 feet thick. Rock consists of sandstone, siltstone, shale and coal. Cliff House sandstone caps the mesa tops. Remnants of aeolian material are present in the broader parts of the mesas.

Five soil-vegetation relationship studies are planned for the Mesa Verde area. Three each on Wetherill, Chapin and Moccasin Mesas. Six studies are now complete and three are planned for completion in 1969.

Table 1. Recorded and Calculated Weather Data - Mesa Verde National Park (October - September Water Year)

Recorded and Calculated Weather Data - Mesa Verde National Park (October - September Water Year)

Month	Temperature (°F)		Precipitation (in)		Potential Evaporation (in)		Actual Evaporation (in)		Water Budget (in)												
	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	Average	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	Average	1963-64	1964-65	1965-66	1966-67	1967-68	1968-69	Average
Oct.	52.7	58.4	56.7	55.1																	
Nov.	39.5	41.9	36.7	43.8																	
Dec.	32.1	34.9	28.0	25.2																	
Jan.	27.8	27.9	31.0	28.2																	
Feb.	35.0	38.1	31.6	37.1																	
Mar.	38.6	33.7	34.6	40.7																	
Apr.	48.1	43.9	45.6	43.3																	
May	57.0	57.4	62.6	55.2																	
June	67.4	65.9	61.7	68.9																	
July	72.9	74.1	70.2	72.0																	
Aug.	70.8	69.2	69.1	66.0																	
Annual	50.5	49.6	48.1	49.9																	

Reference - Ashley, Rodney S. and Ulrich, Rudolph. The Use of Calculated Actual and Potential Evapotranspiration for Estimating Potential Plant Growth - Hesperia, May 1962, Vol. 32, No. 10 University of California, Berkeley, California

COLORADO 1-64

LOCATION: Wetherill Mesa, Mesa Verde National Park, Montezuma County, Colorado. Specific location is .2 mile south of road to "Step House" and 200 yards southwest, up the slope, from the graded road. Study site is approximately .5 mile slightly west of north from the "Long House" cliff ruin.

LAND FORM: Mesa, gently rolling upland. The study occupies an 8% north-east facing slope.

CLASSIFICATION: Wetherill loam, a member of the fine, silty, mixed, mesic, family of TYPIC PALEUSTALFS (Chestnut).

PARENT MATERIAL: Aeolian with some residuum materials (calcareous loess and some fine grained sandstone).

ELEVATION: 7181 feet.

PEDON: Wetherill loam, Colo. 1-64; pedon described from open area between trees, with an understory of mutton grass (*Poa fendleriana*); colors are for dry soil unless otherwise stated.

- | | | |
|------|--------|---|
| A1 | 0-2" | Reddish brown (5YR 4/4) loam, dark reddish brown (5YR 3/4) moist; weak fine platy, breaking easily into very fine granular; soft; very friable; slightly sticky, slightly plastic; common medium and fine vesicular and tubular pores; plentiful roots; pH 6.6 (B.T.B.); abrupt smooth boundary. Few scattered fragments of sandstone on the surface. |
| B21 | 2-10" | Reddish brown (5YR 4/4) light clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic, breaking to moderate subangular, angular and cylindrical blocky; very hard; friable; slightly sticky, plastic; many medium and fine tubular pores; abundant roots; no clay films present; pH 6.4 (B.T.B.); gradual smooth boundary. |
| B2t2 | 10-22" | Reddish brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; moderate medium angular, subangular and cylindrical blocky; very hard; friable; sticky, plastic; abundant roots; many medium and fine and few coarse tubular pores; thin patchy clay films on ped surfaces; pH 6.2 (B.T.B.); clear wavy boundary. |

- IIB2t3b 22-31" Reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium prismatic; extremely hard; friable; sticky, plastic; plentiful roots, mostly between peds; common fine tubular pores; pH 7.2 (P.R.); outer faces of prisms mildly effervescent; secondary carbonates as thin veins; flakes of manganese; thin continuous clay films on ped surfaces; some organic staining on vertical cleavage plains; gradual boundary.
- IIB2ca4b 31-38" Reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium and coarse prismatic; extremely hard; friable; sticky, plastic; few roots between peds; few fine tubular pores; pH 8.2 (T.B.); outer faces of prisms strongly calcareous; secondary carbonates as coatings and thin veins; moderate continuous clay films which appear to be coated in places with secondary carbonates; common flakes of manganese; few weathered fragments of fine grained sandstone; diffuse smooth boundary.
- IIB2ca5b 38-45" This horizon is very similar to the IIB2ca4 horizon except the number of weathered sandstone fragments increases. Sandstone was pale brown color (10YR 7/4) and was not effervescent; clear wavy boundary.
- IIB3cab 45-50" Reddish brown (5YR 5/4) clay loam, reddish brown (5YR 4/4) moist; moderate medium angular and subangular blocky; hard; friable; sticky, plastic; few roots; few fine tubular pores; clay films and flows in pores; pH 8.4 (T.B.); strong effervescence; secondary flakes manganese; many weathered sandstone fragments; abrupt irregular boundary.
- IIIRb 50" + Fractured pale brown fine grained sandstone.

One dead and two small cicada nymphs were observed during the excavation of the soil pit. The two live nymphs were found at a depth of 10-12 inches. Structure of this pedon has been influenced by cicada nymph burrowing between the depths of 6-22 inches. Below a depth of 22 inches cicada nymph activity was minimal.

This pedon is considered to be polygenetic. The top 22 inches appears to be a product of our present climate, where as the rest of the pedon is much older. Coating of the soil peds "prisms" with secondary carbonates supports this theory. Carbon 14 dating of secondary carbonates at a depth of 93 inches in the Wetherill loam, sampled on Chapin Mesa, indicated it was $21,000 \pm 500$ years old.

As described, this pedon is different from the typical Wetherill loam. It contains many weathered fragments of weathered sandstone below a depth of 38 inches and is underlain by sandstone at a depth of 50 inches. Sandstone residuum apparently has contributed a larger proportion of the parent material in this pedon than typical Wetherill loam.

VEGETATION: Appears to be relatively stable, with reproduction and necrosis about in balance. It is dominated by an apparently mature Pinon-Juniper association. There is no evidence of recent fire. Many old almost totally disintegrated limbs and stems of pinon and juniper are scattered over the ground. Mature pinon and juniper trees appear to be growing on mounds, from the accumulation of duff under the canopy. Old over-mature trees are usually ringed by pinon and juniper seedlings.

The ground cover consists principally of mutton grass (*Poa fendleriana*). No other grass was observed in the area or occurred in the 23, 9.6 sq. ft. plots examined. Needle and thread (*Stipa comata*), blue grama (*Bouteloua gracilis*) and Indian ricegrass (*Oryzopsis hymenoides*) occur nearby but outside the study area.

Mutton grass grows as well defined bunches with unoccupied soil between bunches.

Pinon and Juniper trees are relatively evenly spaced at intervals of 8-12 feet with occasional small openings up to 30 or 40 feet. Mutton grass is concentrated around the outer periphery of the tree canopies. The center of the larger openings, ranging up to 10 feet diameter, are almost bare of vegetation.

There is some evidence of slight soil erosion, small incipient rills and slight surface flow.

There is no evidence of recent grazing by domestic livestock.

PLANT LIST COLORADO 1-64

GRASSES

Poa fendleriana

FORBS

Solidago petradoria

Astragalus scopulorum

Eriogonum spp (2)

Lupinus sp.

Phlox hoodii

Crepis acuminata

Calochortus sp.

WOODY PLANTS

Juniperus osteosperma

Pinus edulis

Artemisia nova

Penstemon linarioides ssp. *coloradoensis*

Yucca baccata

Opuntia polyacantha

ANNUALS

Arabis sp.

STUDY LOCATION COLORADO 1-64

TOTAL ANNUAL YIELD 1965

Grass, forbs, and shrubs on basis of 20 random 9.6 sq. ft. plots, within a 1/10 acre plot (66' x 66'), from which estimates of Pinon and Juniper yields were made. All yields converted to air dry lbs. per acre.

<u>Species</u>	<u>Lbs. Air Dry Acre</u>	<u>% Total Comp.</u>
Grass		
Poa fendleriana	168	9
Koeleria cristata	6	T
Forbs		
Antennaria sp.	1	T
Astragalus	1	T
Lupinus	9	1
Phlox hoodii	9	1
Eriogonum sp.	6	T
Shrubs		
Penstemon linaria	30	2
Soldaga petradoria	33	2
Pinus edulis	623	34
Juniperus osteosperma	943	51
Annuals		
All	T	T
TOTAL	1829	100

PHOTOGRAPHS COLORADO 1-64



General View of Vegetation



Close up Understory Vegetation

PHOTOGRAPHS COLORADO 1-64



Soil Profile

TREE DATA (1965) COLORADO 1-64

YIELD BY TREE "JUNIPER"

Tree No.	Height (ft.)	Crown Diameter (ft.)	Foliage Density (Dense-D Med. -M Sparse-S)	Wt. Dry Matter (lbs)				
1	13.5	3.6	S	2.0				
2	10.0	2.3	S	1.4				
3	16.0	7.5	S	3.2				
4	5.0	1.2	S	.4				
5	17.0	3.0	S	1.6				
6	11.0	3.0	S	1.2				
7	3.5	1.0	S	.4				
8	1.5	1.0	S	.1				
9	2.5	1.5	S	.1				
10	1.0	1.0	D	.2				
11	1.0	0.5	M	.1				
12	1.0	0.5	-D	.1				
13	2.0	1.0	S	.2				
14	11.0	4.0	S	1.6				
15	2.5	1.0	M	.1				
16	6.5	4.0	S	.5				
17	1.0	0.5	M	.1				
18	1.0	0.5	M	.1				
19	1.5	1.0	M	.1				
20	10.5	3.0	S	1.0				
21	9.0	2.0	S	.9				
22	6.5	1.5	S	.2				
23	1.0	0.5	D	.1				
24	4.0	3.0	S	.5				
25	10.0	3.5	S	.7				
26	1.5	1.0	S	.1				
27	5.0	1.5	S	.2				
28	10.5	4.5	M	.1				

TREE DATA (1965) COLORADO 1-64

YIELD BY TREE "JUNIPER" (Cont)

Tree No.	Height (ft.)	Crown Diameter (ft)	Foliage Density (Dense-D, Med. -M, Sparse-S)	Wt. Dry Matter (lbs.)				
29	10.0	2.5	S	1.2				
30	10.0	3.5	S	2.0				
31	21.0	14.5	S	8.8				
32	1.0	1.0	D	.1				
33	3.0	1.5	S	.2				
34	10.0	3.0	S	1.8				
35	1.0	1.0	D	.1				
36	0.5	0.5	M	.1				
37	4.0	2.0	S	.3				
38	5.0	1.2	M	.2				
39	15.0	4.0	S	3.0				
40	22.5	5.0	S	3.7				
41	21.0	5.5	S	4.2				
42	2.0	1.0	M	.1				
43	13.0	4.5	S	3.2*				
44	16.0	4.5	S	3.2*				
45	2.0	0.5	S	.1				
46	1.0	1.0	D	.1				
47	0.5	0.5	D	.1				
48	2.5	1.0	S	.1				
49	24.0	7.5	M	6.5				
50	2.0	1.0	M	.2				
51	19.0	9.5	S	6.3				
52	17.0	5.5	S	2.0				
53	6.5	2.5	M	.2				
54	12.0	3.0	S	1.0				
55	1.0	1.0	D	.1				
56	9.0	4.5	M	1.3	50.2			

Av. of all crown spread (4, 4½ & 5) with sparse foliage.

TREE DATA (1965) COLORADO 1-64

YIELD BY TREE "JUNIPER" (Cont.)

Tree No.	Height (ft.)	Crown Diameter (ft.)	Foliage Density (Dense-D Med. -M Sparse-S)	Wt. Dry Matter (lbs.)				
57	10.0	4.0	S	1.0				
58	5.5	1.0	S	.3				
59	3.0	1.0	S	.1				
60	2.0	1.5	M	.1				
61	6.0	1.5	M	.7				
62	7.0	1.5	S	.4				
63	2.5	1.5	M	.3				
64	8.0	1.5	S	.5				
65	8.0	1.5	S	.4				
66	0.5	1.0	M	.1				
67	0.5	0.5	M	T				
68	2.0	0.5	S	.1				
69	2.0	1.0	S	.1				
70	4.0	2.0	S	.2				
71	2.5	1.0	D	.2				
72	1.0	1.0	D	.1				
73	0.5	0.5	M	T				
74	7.5	1.5	S	.4				
75	5.0	2.0	M	.2				
76	5.0	3.5	S	.4				
77	2.0	1.0	S	.1				
78	1.0	1.0	M	.1				
79	1.5	1.0	M	.1				
80	2.5	1.5	S	.1				
81	2.5	1.0	S	.1				
82	6.5	1.5	S	.2				
83	6.0	3.0	M	.7				
84	4.0	1.5	S	.2				

TREE DATA (1965) COLORADO 1-64

YIELD BY TREE "JUNIPER" (Cont.)

Tree No.	Height (ft.)	Crown Diameter (ft.)	Foliage Density (Dense-D Medial-M Sparse-S)	Wt. Dry Matter (lbs)				
85	1.0	1.0	S	.1				
86	1.5	0.5	M	.1				
87	6.5	2.0	S	.8				
88	3.5	0.5	M	.2				
89	14.5	2.5	S	2.5				
90	11.0	2.0	M	1.3				
91	8.5	1.0	S	.7				
92	5.0	1.0	S	.2				
93	1.5	1.0	M	.1				
94	2.0	1.0	M	.1				
95	11.5	9.0	S	2.5				
96	1.5	1.0	M	.2				
97	24.0	5.0	S	4.0				
98	9.5	2.0	S	.7				
99	6.0	2.0	S	.5				
100	4.5	2.5	S	.2				
101	10.0	2.5	S	1.3				
102	18.0	7.5	M	3.8				
103	0.5	1.0	M	.1				
104	0.5	0.5	D	.2				
105	0.5	0.5	M	T				
				19.6				
				94.3 lbs on .1 acre				
				943 lbs dry matter per acre				

TREE DATA (1965) COLORADO 1-64

YIELD BY TREE "PINON"

Tree No.	Height (ft.)	Crown Diameter (ft.)	Foliage Density (Dense-D Med. -M Sparse-S)	Wt. Dry Matter (lbs)				
1	6.5	2.0	S	.2				
2	25.0	9.0	M	3.8				
3	1.0	1.0	-	T				
4	1.0	1.0	-	T				
5	14.5	7.5	S	1.8				
6	10.6	4.6	M	1.2				
7	20.0	17.0	M	6.1				
8	28.0	16.0	S	4.3				
9	16.0	4.0	S	1.4				
10	1.0	0.8	-	T				
11	1.0	0.7	-	T				
12	23.0	9.0	S	3.3				
13	20.0	7.0	S	2.3				
14	7.0	3.5	M	.5				
15	17.5	12.0	S	3.4				
16	2.0	2.0	M	.2				
17	2.0	1.5	S	T				
18	2.0	1.0	S	T				
19	1.0	1.0	M	T				
20	6.0	4.5	S	.4				
21	25.0	23.0	M	10.4				
22	1.5	1.5	S	T				
23	1.5	1.0	M	T				
24	0.5	0.5	S	T				
25	0.5	0.5	S	T				
26	0.5	0.5	M	T				
27	2.5	2.0	S	.2				
28	20.5	8.0	S	2.7				

TREE DATA (1965) COLORADO 1-64

YIELD BY TREE "PINON" (Cont.)

[illegible]

TREE DATA

Age Distribution - Table 1

Table 1 (Based on 1/10 acre plot, 66' x 66')

Species	<u>1/</u> Mature	<u>2/</u> Young	<u>3/</u> Seedlings	<u>4/</u> Dead	Total
Juniper	7	68	15	7	97
Pinon	17	15	88	3	113
	<u>24</u>	<u>83</u>	<u>103</u>	<u>10</u>	<u>210</u>

1/ Mature - over 6" in diameter at ground level.

2/ Young - over 2 ft. in height, less than 6" in diameter at ground level.

3/ Seedlings - 0-2 ft. in height.

4/ Dead - Trees still standing.

Growth MATURE TREES (Table 2)

Species	Tree No.	Dia. Gr. Level (in.)	D.B.H. (in.)	Height (ft.)	Crown diameter (ft.)	Folage Density	Ring Count	Prod. dry mat. (lbs.)
Pinon	1	10.4	9.4	28	16.0	S	129	4.3
	2	16.1	13.1	25	23.0	M	196	10.4
	3	10.7	9.3	20	17.0	M	153	6.1
	4	12.8	11.3	26	12.0	S	153	2.9
	5	7.2	4.0	16	7.5	M	117	1.4
Juniper	1 <u>1/</u>	5.2	3.9	17	3.0	S	-	1.6
	2	12.0	10.4	24	5.0	S	143	4.0
	3 <u>1/</u>	12.9	-	24	7.5	M	-	6.5
	4 <u>1/</u>	17.7	-	14.5	14.5	S	-	8.8

1/ Multiple stemmed at 4 feet.

Annual air dry yield per acre:

Pinon - 623 lbs.
Juniper - 943 lbs.

PLOT SUMMARY

Colorado Plot 1-64 (from .1 acre - total count)
All trees 4.5+ feet in height on a per acre basis.

	<u>Total</u>	<u>Pinyon</u>	<u>Juniper</u>
No. Trees/Acre	850	260	590
Percentage	100%	31%	69%

Average spacing	6.9 feet
Average diameter at one foot (stump height, SH)	4.3 inches
BA = 87 square feet	
Average diameter at BH	2.9 inches
BA = 39 square feet	
D+ spacing at one foot (SH)	2.6
D+ spacing at BH	4.0
Average crown diameter	5.8 feet
Crown canopy cover measured in square feet	22,457 sq.ft./acre
Crown canopy	52 percent
D+ to crown canopy relationship	D+4 = 52% cc
NOTE: cc to D+ relationship = same as ponderosa pine	
Site Index	107 I-
Lbs/acre pinyon, juniper	1,287 pounds
	83 percent
	264 pounds
	17 percent
	15 cds/acre
Lbs/acre grass, forbs, shrubs	
Yield W-886 @ 5" DSH	
SOIL: Silty clay loam, 50 inches to sandstone.	

COLORADO 2-64

LOCATION: Wetherill Mesa, Mesa Verde National Park, Montezuma County, Colorado. Specific location of this study site is difficult but is approximately 235 yards northwest from the intersection of the temporary road and old Wetherill trail west of the Double House cliff ruin.

LAND FORM: Mesa, gently rolling upland. The study site occurs on a 4% south southwest facing slope.

CLASSIFICATION: Unnamed loam, a member of the fine, silty, mixed, mesic, family of TYPIC HAPLUSTALFS (Chestnut).

PARENT MATERIAL: Residuum and aeolian materials; sandstone, shale, limestone and some loess.

ELEVATION: 7,000 feet.

PEDON: Unnamed loam, Colo. 2-64; pedon described is from open area between trees, with an understory of mutton grass (*Poa fendleriana*), colors are for dry soil unless otherwise stated.

- | | | |
|------|--------|--|
| A1 | 0-3" | Brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; weak thin platy; soft; very friable; nonsticky, slightly plastic; abundant roots, many fine and very fine interstitial pores; pH 5.8 (B.C.P.); clear wavy boundary. |
| B1 | 3-6" | Reddish brown (5YR 5/4) light clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic, breaking into moderate medium and fine subangular blocky; hard; friable; slightly sticky, plastic; abundant roots; many fine tubular pores; pH 6.0 (B.C.P.); clear smooth boundary. |
| B2t | 6-12" | Reddish brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic, breaking into moderate medium angular, subangular and cylindrical blocky; very hard; friable; sticky, plastic; thin patchy clay films on many ped surfaces; plentiful roots; many medium and fine tubular pores; pH 6.4 (B.T.B.); clear irregular boundary. |
| B22t | 12-18" | Reddish brown (5YR 5/4) clay loam, dark reddish brown (5YR 3/4) moist; weak medium prismatic, breaking into moderate medium angular, subangular, and cylindrical blocky; very hard; friable; sticky, plastic; plentiful roots; many medium and fine and few coarse tubular pores; thin continuous clay films on ped faces; pH 6.6 (B.T.B.); abrupt irregular boundary. |

- B3ca 18-27" Brown (7.5YR 5/4) clay loam, dark brown (7.5YR 3/2) moist; moderate medium angular, subangular and cylindrical blocky; very hard; friable; slightly sticky, plastic; plentiful roots; many medium and fine and few coarse tubular pores; thin patchy clay films; moderate to strong effervescence; pH 8.2 (B.T.B.); contains many fragments and concretion of carbonate; clear irregular boundary.
- Clca 27-36" Brown (7.5YR 5/4) light clay loam, brown (7.5YR 4/4) moist; weak medium subangular and cylindrical blocky; hard; friable; slightly sticky, plastic; plentiful roots; many medium and fine tubular pores; strong effervescence; pH 8.2 (B.T.B.); many fragments of carbonate; abrupt irregular boundary.
- C2ca 36-48" Pinkish white (7.5YR 8/2) loam, pink (7.5YR 7/2) moist; massive but in places appears weakly cemented with carbonate, contains occasional thin lenses of strongly cemented material; few roots; few fine tubular pores; violent effervescence; many carbonate nodules; gradual, smooth boundary.
- Csca 48-60" + Similar to the above horizon (C2ca) but contains fragments of partially decomposed sandstone.

Cicada nymphs have been very active in this pedon and have influenced the soil structure between the 6 and 36 inch depths. Numerous cicada nymphs were observed while excavating the soil pit. Three wireworms were observed in the top 6 inches of soil.

This pedon is similar to the pedon described at study Colo. 1-64, except it lacks the deeply developed argillic horizon (lacks the buried paleosol).

Moisture relationships of this pedon are similar to that in Wetherill loam, Colo. 1-64.

VEGETATION: The plant community is dominated by a Juniper-Pinon association (*Juniperus osteosperma*, *Pinus edulis*). The juniper-pinon stand is uneven aged with standing dead, old partly dead, mature, young and seedling plants all present. Death and reproduction of these species appears to be about in balance, with only enough young trees present to replace those that are dead and dying.

Associated with the dominant trees are a number of shrubby species, and an open stand of grass, and forbs. The most common shrubs are a small shrubby *Penstemon* (*P. linarioides* ssp. *coloradoensis*) black sagebrush (*Artemisia nova*), antelope bitterbrush (*Purshia tridentata*), mountain mahogany (*Cercocarpus montanus*) a low growing rabbitbrush, (*Chrysothamnus depressus*) and occasional scattered plants of datil (*Yucca baccata*), prickly pear (*Opuntia polyacantha*), and pincushion cactus (*Mamillaria vivipara*). The individual plants of black sagebrush, antelope bitterbrush, mountain mahogany, and rabbitbrush are small, with many dead twigs and branches. They appear to have been closely browsed by deer and are producing little annual growth.

The herbaceous understory is dominated by an open stand of mutton grass, (*Poa fendleriana*). A few plants of squirreltail (*Sitanion hystrix*) are present. Although not present in the sample area, blue grama grass (*Bouteloua gracilis*), and Indian ricegrass, (*Oryzopsis hymenoides*) were observed nearby.

Forbs are widely scattered and few in number as well as in species. The most common are loco (*Astragalus scopulorum*), rock goldenrod (*Solidago petraeoides*), *Phlox hoodii*, and a lousewort (*Pedicularis centranthera*). The lousewort grows only in the litter and duff directly under the crowns of the trees, it is quite prominent in the spring and early summer, but dries up early and is quite inconspicuous later in the year.

STUDY LOCATION COLORADO 2-64

TOTAL ANNUAL YIELD 1964

Grass, forbs, and shrubs on basis of 20 random 9.6 square ft. plots, within a 1/10 acre plot (66' x 66'), from which estimates of Pinon and Juniper yields were made. All yields converted to air dry lbs. per acre.

Species	Lbs. Air Dry Acre	% Total Comp.
Grass		
Poa fendleriana	389	30
Forbs		
Astragalus scoparius	1)	3
Eriogonum sp.	5)	
Phlox hoodii	23)	
Solidago petradoria	15)	
Pedicularis centranthera	7)	
Shrubs		
Purshia tridentata	43)	6
Penstemon linarioides ssp. coloradoensis	26)	
Chrysothamnus depressus	6)	
Trees		
Juniperus osteosperma	422	33
Pinus edulis	362	28
TOTAL	1292	100

PLANT LIST COLORADO 2-64

GRASSES

Poa fendleriana

Sitanion hystrix

FORBS

Astragalus scopulorum

Eriogonum sp.

Erigeron sp.

Lupinus sp.

Phlox hoodii

Pedicularis centranthera

WOODY PLANTS

Juniperus osteosperma

Pinus edulis

Artemisia nova

Chrysothamnus depressus

Penstemon linarioides asp. *coloradoensis*

Yucca baccata

Cercocarpus montanus

Mamillaria vivipara

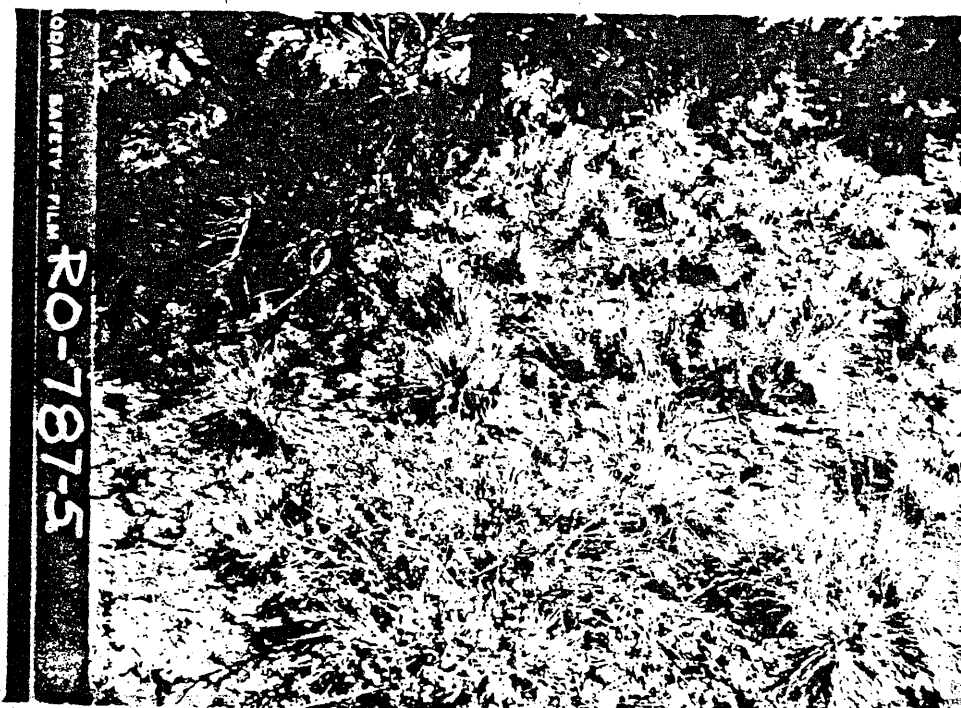
Opuntia polyacantha

ANNUALS

-None-



General View Vegetation



Close up Understory Vegetation

PHOTOGRAPHS COLORADO 2-64



Soil Profile

JUNIPER TREE ESTIMATES COLORADO 2-64

Tree No.	Height (ft.)	Diameter @ Ground (in.)	Crown Diameter (ft.)	Dry Weight (lbs)	Posts			
1	0.5	0.1	.4	T				
2	17.0	13.8	12.0	7.1	1			
3	4.0	1.8	1.5	.2				
4	12.0	9.0	5.0	7.1	1			
5	1.5	0.3	1.0	.1				
6	0.7	0.1	0.2	T				
7	.6	0.2	0.2	T				
8	.7	0.2	0.5	T				
9	.8	0.3	1.0	T				
10	.7	0.2	0.5	T				
11	1.2	0.5	1.0	T				
12	5.0	1.6	2.5	.1				
13	14.0	13.5	8.0	5.9				
14	20.0	8.0	6.0	7.1				
15	25.0	14.2	15.0	23.6	4			
16	1.0	0.2	0.7	T				
17	1.6	0.2	1.0	T				
18	18.0	25.0	20.0	5.3	4			
19	14.0	7.8	5.0	4.1	1			
20	1.1	0.2	0.5	T				
21	0.8	0.3	0.5	T				
22	0.6	0.2	0.4	T				
23	1.7	0.5	1.2	T				
24	0.8	0.3	0.5	T				
25	0.9	0.3	0.3	T				
26	2.0	1.0	1.0	T				
27	0.6	0.2	0.3	T				
28	18.0	24.2	14.0	11.8				

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

[illegible]

PINON TREE ESTIMATES COLORADO 2-64

Tree No.	Height (ft.)	Diameter @ Ground (in.)	Crown Diameter (ft.)	Dry Weight (lbs)	Ring Count			
1	15.0	6.5	9.0	10.0				
2	1.9	1.1	1.5	.1				
3	3.4	1.5	5.0	.7				
4	3.2	0.7	3.0	.2				
5	1.5	0.2	0.3	T				
6	1.0	0.2	.5	T				
7	4.2	1.0	2.0	.1				
8	0.8	0.2	0.7	.1				
9	1.4	0.3	1.5	T				
10	23.0	12.4	18.0	18.0	272			
11	1.0	0.2	0.5	T				
12	1.2	0.5	2.0	.1				
13	1.0	0.5	0.8	T				
14	1.0	0.7	0.5	T				
15	0.7	0.3	0.7	T				
16	2.0	0.5	1.5	T				
17	0.8	0.5	1.0	T				
18	1.5	0.3	1.5	T				
19	1.5	0.5	1.5	.1				
20	1.2	0.3	1.0	T				
21	1.0	0.2	0.7	T				
22	1.0	0.2	0.7	T				
23	16.0	8.0	9.0	10.5				
24	26.0	7.9	8.0	7.5	295			
25	2.0	0.3	2.0	0.1				
26	2.5	0.7	2.8	0.3				
27	1.0	0.4	1.2	0.1				
28	1.2	0.2	1.0	0.1				

PINON TREE ESTIMATES COLORADO 2-64 (Cont.)

Tree No.	Height (ft.)	Diameter @ Ground (in.)	Crown Diameter (ft.)	Dry Weight (lbs)	Ring Count			
29	1.0	0.4	0.6	.1				
30	1.2	0.3	1.0	T				
31	1.8	0.8	0.3	T				
32	1.0	0.4	0.6	T				
33	0.8	0.2	0.7	T				
34	0.7	0.2	0.4	T				
35	1.0	0.2	1.0	T				
36	0.8	0.2	0.6	T				
37	0.8	0.2	0.5	T				
38	2.0	1.0	1.8	.1				
39	2.5	1.2	2.0	.5				
40	5.5	1.5	3.0	.7				
41	2.5	1.0	3.0	.5				
42	1.5	0.3	1.0	T				
43	2.5	1.0	2.0	.2				
44	16.0	6.3	8.0	9.0				
45	9.0	3.0	3.0	1.2				
46	23.0	13.4	14.0	17.5	343			
47	23.0	11.9	15.0	20.0				
48	5.0	4.2	6.0	.7				
49	25.0	10.5	15.0	6.0				
50	21.0	10.3	9.0	9.0	271			
51	12.0	5.5	4.0	1.0				
52	16.0	8.9	10.0	2.0				
53	23.0	10.5	12.0	4.0	285			
Grand Total		1208 =	4 1/2' x 10' of Pinon	72.5				
all species		347.8						
				362 lbs				

PLOT SUMMARY

Colorado Plot 2-64 (from .1 acre - total count)
All trees 4.5+ feet in height on a per acre basis.

	<u>Total</u>	<u>Pinyon</u>	<u>Juniper</u>
No. Trees/Acre	930	150	180
Percentage	100%	45%	55%

Average spacing	11.5 feet
Average diameter at one foot (stump height, SH) BA = 169 square feet	9.7 inches
Average diameter at BH BA = 104 square feet	7.6 inches
D+ spacing at one foot (SH)	1.8
D+ spacing at BH	3.9
Average height	17.9 feet
Average crown diameter	9.1 feet
Crown canopy cover measured in square feet	21,463 sq.ft./acre
Crown canopy	50 percent
Crown canopy to D+ relationship	D+3.9 = 50%
NOTE: cc to D+ relationship = same as ponderosa pine, approximately	
Site Index	113 I-
Lbs/acre pinyon, juniper	983 pounds
	66 percent
Lbs/acre grass, forbs, shrubs	509 pounds
	34 percent
Yield W-886 @ 5" DSH	15.5 cds/acre
SOIL: Silty clay loam, 60 inches to sandstone	

COLORADO 1-67

LOCATION: Wetherill Mesa, Mesa Verde National Park, Montezuma County, Colorado. Specific location is 1,980 feet east and 660 feet south of Rock Springs or 925 feet east of the 108° 32' 30" W. and 2,640 feet north of 37° 12' 30" N. coordinates.

LAND FORM: Mesa, gently rolling upland, narrow ridges and edges of mesas near deep canyons. This study occupies a 2 percent convex slope (ridge top).

CLASSIFICATION: Unnamed fine sandy loam (tentative) a member of the loamy, mixed, mesic family of Lithic Camborthids.

PARENT MATERIAL: Sedimentary rock residuum-sandstone.

ELEVATION: 7,380 feet.

PEDON: Montvale fine sandy loam, Colo. 1-67; pedon described from pit in an open area between trees, with an understory of mutton grass; colors are for dry soil unless otherwise stated.

A1 **0-3"** Brown (7.5YR 5/4) fine sandy loam (12 percent clay), dark brown (7.5YR 4/2) moist; weak thin platy; soft; very friable; nonsticky, nonplastic; few fine and very fine roots; many fine and very fine interstitial and few fine tubular pores; mildly alkaline, pH 7.8 (CR); clear wavy boundary; 1.5 to 3 inches thick.

B2 **3-15"** Reddish brown (5YR 5/4) fine sandy loam (20 percent clay) dark reddish brown (5YR 3/4) moist; weak coarse prismatic breaking to weak medium subangular blocky; very hard, friable, slightly sticky, slightly plastic; many medium, fine and very fine and few coarse tubular pores; plentiful fine and very fine and few coarse roots, mildly alkaline, pH 7.6 (CR); abrupt wavy boundary; 9 to 12 inches thick.

R Bedrock fractured sandstone in layers 3 to 5 inches thick.

Layers of sandstone residuum is fractured and contains many coarse, medium and fine roots between the layers. Roots frequently form a mat 1/4 to 3/4 inches in thickness. Coarse roots are flattened and deformed. Roots of trees grew horizontally along the top of the bedrock entering the cracks in the sandstone and grew laterally between the sandstone layers.

One live cicada nymph, three white grubs, larva of the June beetle, and one wireworm, larva of the robberfly, were recovered from the soil pit. The cicada nymph was near the bedrock, 15 inches deep and the larva were found at a depth of 6 inches.

VEGETATION: The plant community of this location is dominated by a mature stand of pinon and juniper. There are approximately 150 pinon and 120 juniper trees per acre. Trees range from 5 feet to 29 feet in height. Trees are mature to over-mature. Old trees have a mound of duff surrounding their trunk.

The understory consists of many stunted and suppressed shrubs, a scant stand of mutton grass and numerous pinon and juniper seedlings.

The most common shrub is antelope bitterbrush (*Purshia tridentata*). Other shrubs present are gambel oak (*Quercus gambelii*), black sagebrush (*Artemisia nova*), fendlerbush (*Fendleria rupicola*), mountain mahogany (*Cercocarpus montanus*), snowberry (*Symphoricarpos oreophilus*), serviceberry (*Amelanchier utahensis*) prickly pear (*Opuntia polyacantha*) and datil (*Yucca baccata*). Shrubs are small and dwarfed and many have been grazed severely by deer.

Total annual yield by plant species and percent composition by weight are in table 6. The growing season in 1967 was near to slightly below normal.

Comparison of pinon and juniper data collected from 1/10 acre (66' x 66') plot and the zigzag method are shown in table 7. This sample of trees (12) measured by the zigzag method at this study appears to be too small.

PLANT LIST COLORADO 1-67

Grasses

Poa fendleriana

Forbs

Antennaria spp.

Aster bigelovii

Chaenactis douglasii

Chrysopsis spp.

Delphinium spp.

Mustard spp.

Solidago petradoria

Viguiera spp.

Shrubs

Amelanchier utahensis

Artemisia nova

Eriogonum spp. (shrub)

Opuntia polyacantha

Penstemon linarioides ssp. *coloradoensis*

Purshia tridentata

Quercus gambelii

Symphoricarpos oreophilus

Cercocarpus montanus

Fendleria rupicola

Yucca baccata

Trees

Juniperus osteosperma

Pinus edulis

Table 6

TOTAL ANNUAL YIELD
BY PLANT SPECIES AND PERCENT COMPOSITION BY WEIGHT, COLO. 1-67, 1967

Plant Species	Lbs. Per Acre	1967	Percent Comp.
Grass			
Poa fendleriana	300		22
Forbs			
Antennaria	1		
Delphinium sp.	1		
Chaenactis douglasii	1		
Mustard sp.	6		1
Aster bigelovii	1		
Chrysopsis sp.	7		
Viguiera sp.	12		1
Solidago petradoria	20		2
Shrubs			
Eriogonum sp.	1		T
Amelanchier utahensis	6		
Penstemon linarioides ssp. coloradoensis	7		1
Quercus gambelii	5		
Purshia tridentata	57		4
Trees			
Pinus edulis	150		11
Juniperus osteosperma	779		58
Annuals	1		T
TOTAL	1355		100

Data based on 20 random 9.6 sq. ft. plots within a 1/10 acre (66' x 66') plot from which estimates of pinon and juniper yields were made. All yields in air dry pounds per acre.

Table 7

PINON AND JUNIPER TREE MEASUREMENTS
BY STANDARD AND ZIGZAG METHODS, COLORADO 1-67

MEASUREMENT	STANDARD METHOD ^{1/}		ZIGZAG METHOD ^{2/}	
	Pinon	Juniper	Pinon	Juniper
TOTAL number of trees	610	250		
Seedlings ^{3/}	460	130		
Mature ^{4/}	150	120	298	100
Cubic foot volume	87	2350	74	3030
Posts ^{5/}		290		400
4' Sticks (firewood) ^{6/}	120		298	
AVERAGE height of trees (ft.)	7.3	18.4	8.0	23.0
Crown spread (ft.)	4.8	11.8	5.5	17.0
Diameter breast height (in.)	1.5		1.7	
Diameter at 1 foot (in.)		11.5		13.8

^{1/} Based on measurement of all trees in 1/10 acre plot (66' x 66').

^{2/} As outlined by W. J. Sauerwein, Woodland Conservationist, SCS, WRTSC, Portland, Oregon.

^{3/} All trees up to 4½ feet tall.

^{4/} All trees 4½ feet or more tall.

^{5/} Posts 7' long, minimum diameter 4" at small end.

^{6/} Sticks must be 4' x 2" in diameter or larger at small end.

PHOTOGRAPHS - COLORADO 1-67



General view of vegetation



Close up of vegetation

PHOTOGRAPHS - COLORADO 1-67



Soil Profile



Close up of mat of roots

COLORADO 2-67

LOCATION: Chapin Mesa, Mesa Verde National Park, Montezuma County, Colorado. Specific location is about 50 yards northeast from the northeast corner of the garbage pit on Chapin Mesa, Sec. 28, T34N, R15W.

LAND FORM: Mesa, gently rolling upland. This study has a 1 percent southeast-facing slope.

CLASSIFICATION: Witt loam (tentative) a member of the fine-silty, mixed, mesic, family of Ustollic Hapargids.

PARENT MATERIAL: Aeolian materials, loess high in fine sands and silts.

ELEVATION: 6,850 feet.

PEDON: Witt loam, Colo. 2-67; pedon is described from a pit in an open area between the trees, with a thin cover of mutton grass; colors are for dry soil unless otherwise stated.

- | | | |
|------|--------|--|
| A1 | 0-2" | Brown (7.5YR 5/2) fine sandy loam, brown (7.5YR 4/2) moist weak thin platy; soft, friable, slightly sticky, slightly plastic; few fine roots; many fine interstitial and vesicular pores; neutral, pH 7.0 (BTB); clear wavy boundary; 1½ to 3 inches thick. |
| B21 | 2-16" | Reddish brown (5YR 4/4) light silty clay loam (28 percent clay) dark reddish brown (5YR 3/4) moist; weak coarse prismatic, breaking to moderate fine angular, subangular and cylindrical blocky; very hard, friable, slightly sticky, slightly plastic; plentiful medium and fine roots; many fine and few coarse tubular pores; thin patchy clay films on vertical cleavages; clean sand and/or silt grains on ped faces; slightly acid, pH 6.4 (BTB); gradual wavy boundary; 9 to 12 inches thick. |
| B22 | 16-28" | Reddish brown (5YR 5/4) silty clay loam (33 percent clay) reddish brown (5YR 4/4) moist; weak medium prismatic breaking to moderate medium angular, subangular and cylindrical blocky; extremely hard, firm, sticky, plastic; plentiful fine, medium and coarse roots; common fine and very fine and few coarse tubular pores; thin continuous clay films; neutral, pH 6.6 (BTB); clear irregular boundary; 9 to 18 inches thick. |
| B3ca | 28-38" | Reddish brown (5YR 5/4) silty clay loam (32 percent clay) reddish brown (5YR 4/4) moist; moderate medium subangular, angular and cylindrical blocky; extremely hard, friable, |

sticky, plastic; few medium and fine roots; many fine and very fine and few medium and coarse tubular pores; strong effervescence, secondary carbonates as coatings on cicada krotovina and as thin veins; moderately alkaline, pH 8.4 (TB); gradual wavy boundary; 10 to 12 inches thick.

IIA1cab 38-54" Reddish brown (5YR 5/4) silty clay loam (28 percent clay) dark reddish brown (5YR 3/4) moist; weak angular, subangular and cylindrical blocky; extremely hard, friable, slightly sticky, slightly plastic; few medium and fine roots; common fine and very fine and few medium tubular pores; moderate effervescence; secondary carbonates as thin veins and coatings on cicada krotovina; moderately alkaline, pH 8.2 (TB); gradual wavy boundary; 12 to 16 inches thick.

IIB2cab 54-72" + Reddish brown (5YR 5/4) silty clay loam (36 percent clay) dark reddish brown (5YR 3/4) moist; PED reddish brown (5YR 5/3) and reddish brown (5YR 4/3) moist; moderate medium and coarse prismatic; moderate clay films on vertical cleavages; mildly alkaline, pH 7.8 (TB); secondary carbonates thickly coating vertical cleavages; inner part of prisms noncalcareous while outer faces are violently effervescent; few medium and fine roots between soil peds; common fine and very fine tubular pores.

This pedon was described from a pit adjacent to (50 Yards) the garbage pit where Witt loam was described. It is deeper to the buried soil in this pedon than the one described at the soil pit. The buried IIB2cab horizon continued below a depth of 72 inches.

The soil horizon 38-54" was slightly darker in color and considered a buried A1 horizon of the buried soil.

Roots of pinon and juniper appeared to be concentrated above the carbonate horizon but also continued below the bottom of the pit 72 inches.

Many live and dead cicada nymphs were observed while excavating the soil pit. Soil structure from a depth of 2 inches to a depth of 54 inches was greatly influenced by cicada nymph burrowing. Cicada nymphs appeared to be larger than usual.

Five wireworms, larva of robberfly, and four white grubs, larva of the Junebeetle were found in the top 12-16 inches of this soil.

This pedon has an ochric epipedon, argillic horizon and a calcic horizon.

VEGETATION: The plant community is dominated by a mature open stand of pinon and juniper trees. Older trees have a mound of duff under their canopy. There are approximately 540 trees per acre at this study, 230 pinon and 310 juniper.

The understory is dominated by mutton grass (*Poa fendleriana*) with small amounts of buckwheat (*Eriogonum*), penstemon (*Penstemon linarioides* ssp. *coloradoensis*), prickly-pear (*Opuntia polyacantha*), datil (*Yucca baccata*) and antelope bitterbrush (*Purshia tridentata*). Shrubs are stunted and suppressed.

Total annual yield at this study is in table 8. Growing season in 1967 was near to, or slightly below normal.

Tree data collected by the standard 1/10 acre plot and zigzag methods are compared in table 9. For some measurements the zigzag method compares reasonably well with the standard method. However, it appears that a larger number of trees should be measured in the zigzag method if such measurements as number of 4 foot by 2 inch sticks (firewood), posts, cubic foot volume and number of trees per acre are to be reliable.

Plant List - Colorado 2-67

Grass:

Poa fendleriana

Forbs

Eriogonum sp.

Shrubs

Opuntia polyacantha

Penstemon linarioides ssp. *coloradoensis*

Trees

Pinus edulis

Juniperus osteosperma

Annuals

Polygonium sp.

Table 8

TOTAL ANNUAL YIELD
BY PLANT SPECIES AND PERCENT COMPOSITION BY WEIGHT, COLORADO 2-67 - 1967

Plant Species	1967	
	Lbs. Per Acre	Percent Comp.
Grass		
Poa fendleriana	133	11
Forbs		
Eriogonum sp.	1	T
Opuntia polyacantha	2	T
Shrubs		
Penstemon linarioides ssp. coloradoensis	13	1
Eriogonum sp. (shrub)	1	T
Trees		
Pinus edulis	594	47
Juniperus osteosperma	520	41
Annuals		
Polygonum sp.	1	T
Total	1265	100

Data based on 20 random 9.6 sq. ft. plots within a 1/10 (66' x 66') acre plot from which estimates of pinon and juniper yields were made. All yields in air dry pound per acre.

Table 9

Sept. 1967

PINON AND JUNIPER TREE MEASUREMENTS
BY STANDARD AND ZIGZAG METHODS - COLORADO 2-67

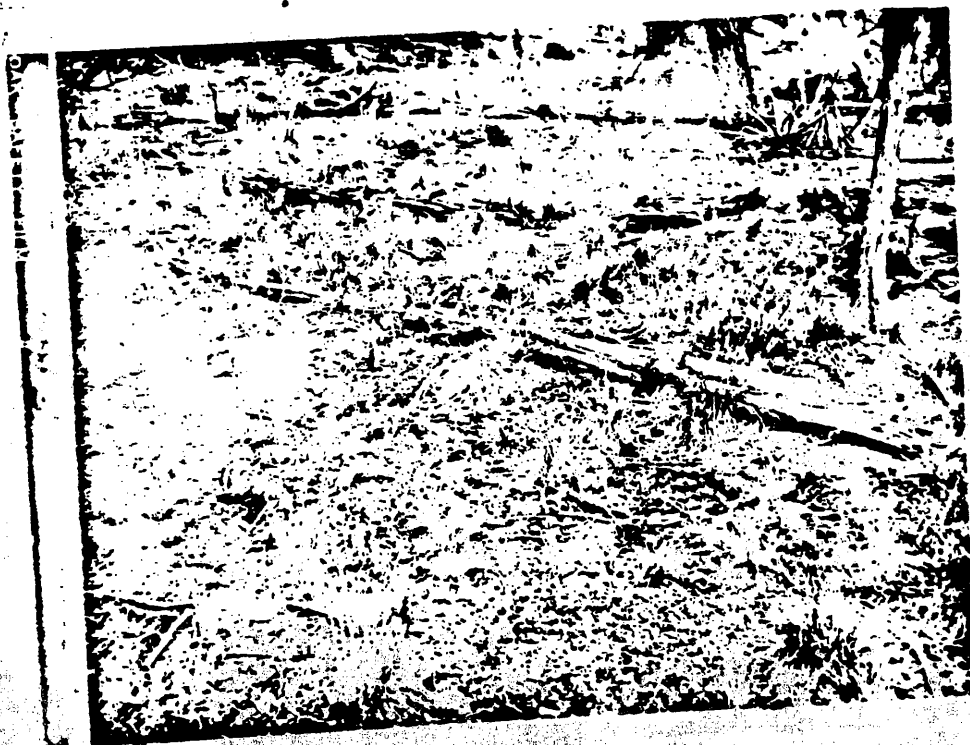
MEASUREMENT (Acre)	STANDARD METHOD ^{1/}		ZIGZAG METHOD ^{2/}	
	Pinon	Juniper	Pinon	Juniper
TOTAL Number of trees	1260	570		
Seedlings <u>3/</u>	1030	260		
Mature <u>4/</u>	230	310	139	193
Cubic foot volume	836	2321	1399	1116
Posts <u>5/</u>		380		186
4 foot sticks (firewood) <u>6/</u>	940		486	
AVERAGE height of trees (ft.)	15.9	15.5	16.0	15.5
Crown spread (ft.)	8.6	6.3	9.7	6.6
Diameter breast height (in.)	4.9		5.4	
Diameter at 1 foot (in.)		7.6		8.3

- 1/ Based on measurement of all trees in 1/10 acre plot (66' x 66').
2/ As outlined by W. J. Sauerwein, Woodland Conservationist, SCS, WRTSC, Portland, Oregon.
3/ All trees up to 4½ feet tall.
4/ All trees 4½ feet or more tall.
5/ Posts 7 feet long minimum diameter of 4 inches at small end.
6/ Sticks must be 4 feet long and 2 inches in diameter or larger.

PHOTOGRAPHS - COLORADO 2-67

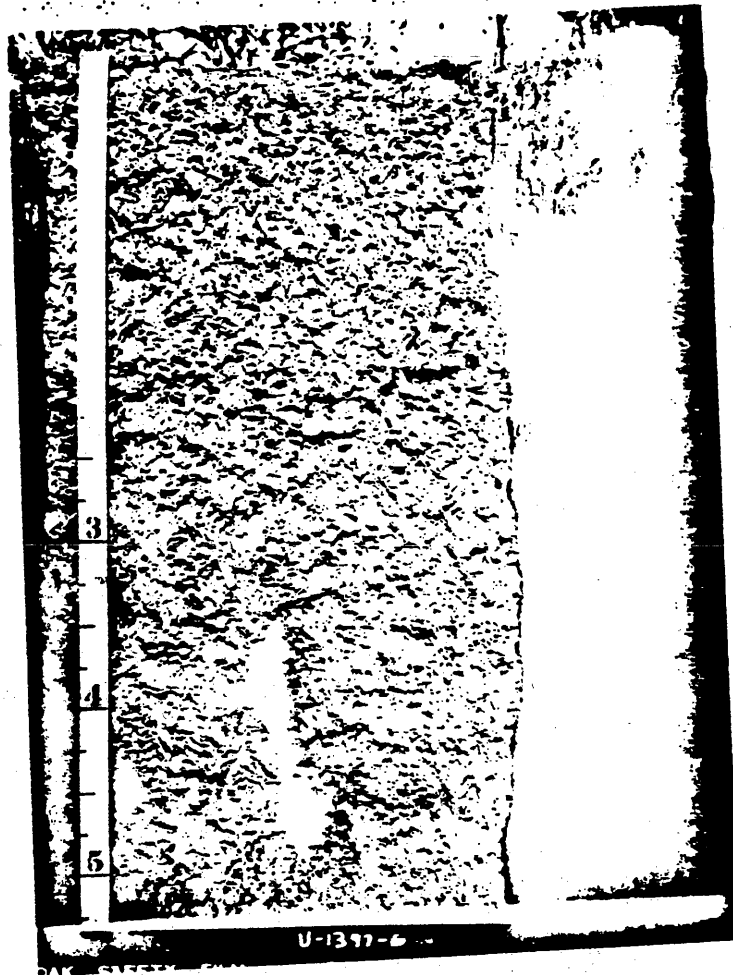


General view of vegetation



Close up of vegetation

PHOTOGRAPHS - COLORADO 2-67



Soil Profile

COLORADO 5-68

LOCATION: Chapin Mesa, Mesa Verde National Park, Montezuma County, Colorado. Specific location is 250 feet west on service road 120 feet north of the Mesa Top Ruin and Cliff House Junction, Sec. 21, T34N, R15W.

LAND FORM: Mesa, gently rolling upland. This study is on a 5 percent southwest slope.

CLASSIFICATION: Unnamed very fine sandy loam (tentative), a member of the loamy, mixed, mesic family of Lithic Camborthids.

PARENT MATERIAL: Sedimentary residuum, sandstone, limestone, shale, siltstone, and possibly some loess.

ELEVATION: 7,000 feet.

PEDON: Montvale very fine sandy loam, Colo. 5-68; pedon is described from a soil pit located in an open area between pinon and juniper trees, with an understory of mutton grass; colors are for dry soil unless otherwise stated.

- | | | |
|------|------|---|
| A1 | 0-2" | Reddish brown (5YR 4/4) very fine sandy loam (19 percent clay), dark reddish brown (5YR 3/4) moist; soft, friable, slightly sticky, slightly plastic; many fine interstitial pores; plentiful fine and very fine roots; mildly alkaline, pH 7.6 (PR); scattered sandstone pebbles; clear smooth boundary; 1 to 3 inches thick. |
| B2 | 2-5" | Reddish brown (5YR 4/4) moist silt loam (25 percent clay), dark reddish brown (5YR 3/4) moist; weak medium prismatic breaking into weak medium subangular blocky; slightly hard, friable; sticky, plastic; abundant medium and fine and a few coarse roots; many medium and fine tubular pores; mildly alkaline, pH 7.8 (PR); slight effervescence; clear wavy boundary; 3 to 5 inches thick. |
| B3ca | 5-8" | Brown (7.5YR 5/4) silt loam (25 percent clay), dark brown (7.5YR 4/4) moist; weak medium prismatic breaking to weak medium subangular blocky; hard, friable, sticky, plastic; many medium, fine and very fine and few coarse roots; strong effervescence; carbonates as concretions and fine veins; strongly alkaline, pH 8.6 (TB); many fine and very fine and common medium tubular pores; many soft sandstone pebbles; gradual wavy boundary; 3 to 5 inches thick. |

Clca

8-14"

Very pale brown (10YR 8/4) gritty loam (15 percent clay), light yellowish brown (10YR 6/4) moist; moderate medium platy; extremely hard, firm, slightly sticky, slightly plastic; abundant very fine, fine and medium and few coarse roots; many fine and very fine tubular pores; soft sandstone and/or siltstone pebbles occupy about 20 percent of the volume; violent effervescence, secondary carbonates disseminated and as concretions; strongly alkaline, pH 9.0 (TB); gradual wavy boundary; 7 to 14 inches thick.

R1

14-30"

Light gray (10YR 7/2) partially weathered fine grained sandstone, very pale brown (10YR 7/3) moist; containing thin horizontal veins of brown (10YR 5/4) stains; sandstone occurs in layers 2 to 4 inches thick with soft limestone material between layers; coarse medium and fine roots of pinon and juniper occur between the layers of sandstone; 10 to 14 inches thick.

R2

30"

Sandstone.

This soil is similar to Montvale soils except it has an ochric epipedon, has a calcic horizon and is deeper to bedrock.

Roots of pinon and juniper grew laterally on top and between the sandstone layers entering the vertical fractures. Roadside cuts show roots of these trees penetrating 10-20 feet in this fractured and layered sandstone bedrock.

VEGETATION: The vegetation at this location is dominated by a pinon-juniper association (*Pinus edulis*, *Juniperus osteosperma*) which averages approximately 620 pinon and 120 juniper trees per acre. The tree stand is mostly mature and reproduction and mortality of tree species are in approximate balance.

Associated woody species are antelope bitterbrush (*Purshia tridentata*), black sagebrush (*Artemisia nova*), a few stunted Utah serviceberries (*Amelanchier utahensis*). Toadflax penstemon (*Penstemon linarioides* ssp. *coloradoensis*), a suffrutescent species is common throughout the study area. A few datils (*Yucca baccata*) are present.

The herbaceous understory consists of a sparse stand of grass and forbs. The most common grass is mutton grass (*Poa fendleriana*). Other grasses present are bottlebrush squirreltail (*Sitanion hystrix*), and Indian ricegrass (*Oryzopsis hymenoides*). The most abundant forbs are rock goldenrod (*Solidago petradoria*), locoweed (*Astragalus scopulorum*) and toadflax (*Comandra umbellata*).

Annuals are occasional plants of false yarrow (*Chaenactis douglasii*) and birdbeak (*Cordylanthus wrightii*).

Shrubby species, particularly antelope bitterbrush, bear evidence of heavy browsing by deer, and are in a low state of vigor.

Total annual yield by species in 1968 is in table 10. Growing conditions, as calculated, table 1, are below average in 1968. Daily precipitation records for July show that precipitation fell late in the month so the growing season was even poorer than the calculations indicate. The 1968 growing season was about 2½ weeks shorter than average.

The juniper stand contains 1943 cubic feet, approximately 16 cords, and the pinon 796 cubic feet, approximately 6 cords, of wood per acre, table 11. If cut for posts the juniper contains approximately 170 7-foot posts with a minimum diameter of 4 inches.

The zigzag method gave comparable results on some measurements but were unrealistic in others. It appears that more trees should be sampled before the zigzag method will give as reliable results as the measurement of all trees on 1/10 acre plot.

Plant List - Colorado 5-68

Grasses

Oryzopsis hymenoides

Poa fendleriana

Sitanion hystrix

Forbs

Astragalus scopulorum

Comandra umbellata

Eriogonum spp.

Solidago petradoria

Woody Species

Amelanchier utahensis

Artemisia nova

Juniperus osteosperma

Penstemon linarioides ssp. *coloradoensis*

Pinus edulis

Purshia tridentata

Yucca baccata

Annuals

Cordylanthus wrightii

Chaenactis douglasii

Mustard (unidentified)

Table 10

TOTAL ANNUAL YIELD
BY PLANT SPECIES AND PRECENT COMPOSITION BY WEIGHT, COLORADO 5-68, 1968

Plant Species	1968	
	Lbs. per Acre	Percent Comp.
Grasses		
Poa fendleriana	112	8
Oryzopsis hymenoides	2	T
Forbs		
Astragalus scopulorum	14	1
Comandra umbellata	1	T
Eriogonum spp.	1	T
Solidago petradoria	6	T
Annuals		
Chaenactis douglasii	1	T
Mustard	3	T
Woody Plants		
Penstemon linarioides ssp. coloradoensis	10	1
Purshia tridentata	48	3
Juniperus osteosperma	924	64
Pinus edulis	321	22
TOTAL	1443	100

Data based on 20 random 9.6 sq. ft. plots within a 1/10 acre (66' x 66') plot from which estimates of pinon and juniper yields were made. All yields in air dry pounds per acre.

Table 11
PINON AND JUNIPER TREE MEASUREMENTS
BY STANDARD AND ZIGZAG METHODS, COLORADO 5-68

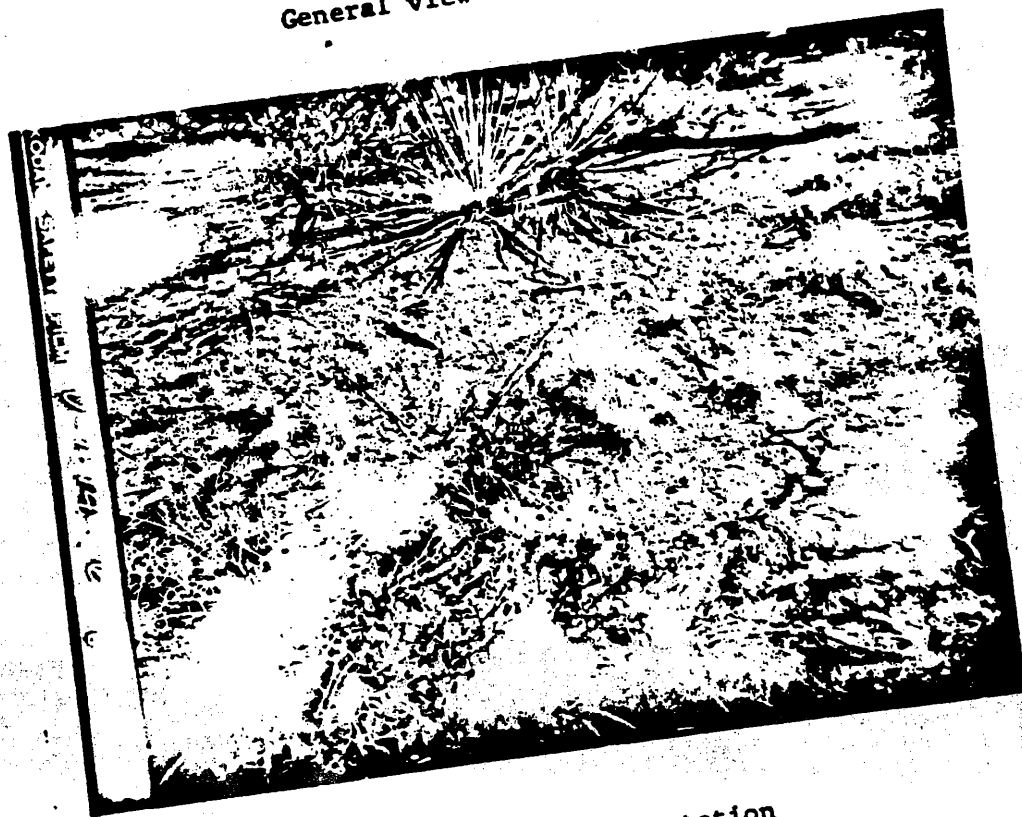
MEASUREMENT	STANDARD METHOD ^{1/}		ZIGZAG METHOD ^{2/}	
	Pinon	Juniper	Pinon	Juniper
TOTAL number of trees	890	240		
Seedlings ^{3/}	390	120	1307	435
Mature ^{4/}	500	120	1137	1144
Cubic foot volume	796	1943		174
Posts ^{5/}		170	2182	
4' Sticks (firewood) ^{6/}	940			
AVERAGE height of trees (ft.)	11.6	11.6	12	10
Crown spread (ft.)	6.8	7.6	6	5
Diameter breast height (in.)	3.5		3.4	
Diameter at 1 foot (in.)		7.4		4.1

- ^{1/} Based on measurement of all trees in 1/10 acre plot (66' x 66').
- ^{2/} As outlined by W. J. Sauerwein, Woodland Conservationist, SCS, WRTSC, Portland, Oregon.
- ^{3/} All trees up to 4½ feet tall.
- ^{4/} All trees 4½ feet or more tall.
- ^{5/} Posts 7' long, minimum diameter 4" at small end.
- ^{6/} Sticks must be 4' long, 2" in diameter or larger at small end.

PHOTOGRAPHS - COLORADO 5-68



General view of vegetation



Close up of vegetation

PHOTOGRAPHS COLORADO 5-68



Soil Profile

COLORADO 6-68

LOCATION: Chapin Mesa, Mesa Verde National Park, Montezuma County, Colorado. Specific location is west side of Chapin road near Station No. 2.

LAND FORM: Mesa, gently rolling upland. This study is on a 4 percent south-facing slope.

CLASSIFICATION: Witt loam, a member of the fine silty, mixed, mesic family of Ustollic Haplargids.

PARENT MATERIALS: Aeolian materials, high in silts and very fine sands.

ELEVATION: 7200 feet.

PEDON: Witt loam, Colo. 6-68. Pedon is described from a soil pit located in an open area between pinon and juniper, with an understory of mutton grass and scattered shrubs. Colors are for dry soil unless otherwise stated.

- A1** 0-3" Brown (7.5YR 5/4) very fine sandy loam, dark reddish brown (5YR 3/4) moist; weak thin platy; soft, friable, slightly sticky, slightly plastic; abundant fine and very fine roots; many very fine and fine tubular pores; neutral (pH 6.6 BTB); clear wavy boundary; 1 to 3 inches thick.
- B21** 3-16" Reddish brown (5YR 5/4) silt loam, dark reddish brown (5YR 3/4) moist (25 percent clay); weak coarse prismatic breaking to weak medium subangular, angular and cylindrical blocky; extremely hard, firm, sticky, plastic; plentiful medium and coarse roots; many very fine, fine and medium and common coarse tubular pores; thin clean silt and/or very fine sand coatings on vertical cleavages; neutral (pH 6.6 BTB); diffuse smooth boundary; 12 to 16 inches thick.
- B22** 16-29" Reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist (25 percent clay); weak coarse prismatic breaking to weak medium angular, subangular and cylindrical blocky; extremely hard; firm, sticky, plastic; many medium, fine and very and few coarse tubular pores; plentiful medium, fine and very fine and few coarse roots; neutral (pH 6.8 BTB); vertical cleavage planes have thin coating of clean silt and/or very fine sand; gradual smooth boundary; 12 to 16 inches thick.

B23 29-42" Reddish brown (5YR 4/4) silt loam, dark reddish brown (5YR 3/4) moist (25 percent clay); weak medium prismatic breaking to medium angular, subangular, and cylindrical blocky; extremely hard; firm, slightly sticky, plastic; many medium, fine and very fine and few coarse tubular pores; plentiful medium and fine roots; slightly effervescent in places, secondary carbonates as thin veins; neutral (pH 6.6 BTB); abrupt wavy boundary; 12 to 16 inches thick.

IIB24b 42-60" Reddish brown (5YR 5/4) silty clay loam, reddish brown (5YR 4/4) moist (35 percent clay); strong medium and coarse prismatic; extremely hard, firm, very sticky, very plastic; few medium and fine roots between peds; few fine and very fine tubular pores; strongly calcareous (outer portion of prisms, inner part noneffervescent); secondary carbonates as coatings and veins on vertical prism faces; thin to moderate clay films; concretions and flakes of manganese; neutral (pH 7.2 BTB).

This pedon is similar to the soil described in the garbage pit on Chapin Mesa. However, this pedon is slightly deeper to the buried paleosol.

Live cicada nymph were found during the excavation of this soil pit. Secondary structure between the depth of 6 to 42 inches was largely a product of cicada nymph burrowing.

This pedon has an ochric epipedon, argillic horizon and a calcic horizon.

Colorado 6-68

VEGETATION: This study is dominated by a mature stand of juniper-pinon (*Juniperus osteosperma* - *Pinus edulis*). The juniper trees are unusually large. Other woody species are antelope bitterbrush (*Purshia tridentata*), black sagebrush (*Artemisia nova*), Gambel oak (*Quercus gambelii*) and a suffrutescent penstemon (*P. linarioides* ssp. *coloradoensis*). There are a number of large recently fallen dead trees in the area.

The understory consists of a mixture of grasses and forbs. Mutton grass (*Poa fendleriana*) is the most abundant grass. Other grasses that are present in minor amounts are bottlebrush squirreltail (*Sitanion hystrix*), Western wheatgrass (*Agropyron smithii*), prairie junegrass (*Koeleria cristata*), and needleandthread grass (*Stipa comata*).

Rock goldenrod (*Solidago petradoria*) is the most abundant forb. Others present are toadflax (*Comandra umbellata*), lupine (*Lupinus caudatus*), buckwheat (*Eriogonum* spp.), knotweed (*Polygonum sawatchensis*) and fleabane (*Erigeron* spp.).

The shrubby plants, particularly antelope bitterbrush, are heavily browsed by deer and in low vigor.

The tree stand consists of approximately 130 pinon and 100 juniper trees per acre. The juniper stand contains 5929 cubic feet, approximately 42 cords, and the pinon 731 cubic feet, approximately 6 cords of firewood per acre. The juniper stand contains approximately 410 7 foot posts with a minimum diameter of 4 inches.

PLANT LIST - COLORADO 6-68

Grasses

Agropyron smithii

Koeleria cristata

Poa fendleriana

Sitanion hystrix

Stipa comata

Forbs

Calochortus nuttallii

Comandra umbellata

Eriogonum spp.

Erigeron spp.

Lupinus caudatus

Mustard (unidentified)

Polygonum sawatchensis

Solidago petradoria

Annuals

Cordylanthus wrightii

Woody Plants

Artemisia nova

Juniperus osteosperma

Penstemon linarioides ssp. coloradoensis

Pinus edulis

Purshia tridentata

Quercus gambellii

Table 12

TOTAL ANNUAL YIELD
BY PLANT SPECIES AND PERCENT COMPOSITION BY WEIGHT, COLO. 6-68, 1968

Plant Species	1968	
	Lbs. Per Acre	Percent Comp.
Grasses		
Poa fendleriana	356	21
Sitanion hystrix	17	1
Forbs		
Calochortus nuttallii	1	T
Comandra umbellata	15	1
Erigeron spp.	2	T
Eriogonum spp.	2	T
Lupinus caudatus	31	2
Mustard (unidentified)	5	T
Polygonum sawatchensis	1	T
Solidago petradoria	68	4
Annuals		
Cordylanthus wrightii	1	T
Woody Plants		
Quercus gambellii	1	T
Penstemon linarioides ssp. coloradoensis	31	2
Juniperus osteosperma	1022	59
Pinus edulis	165	10
TOTAL	1718	100

Data based on 20 random 9.6 sq. ft. plots within a 1/10 acre (66' x 66') plot from which estimates of pinon and juniper yields were made. All yields in air dry pounds per acre.

PHOTOGRAPHS - COLORADO 6-68

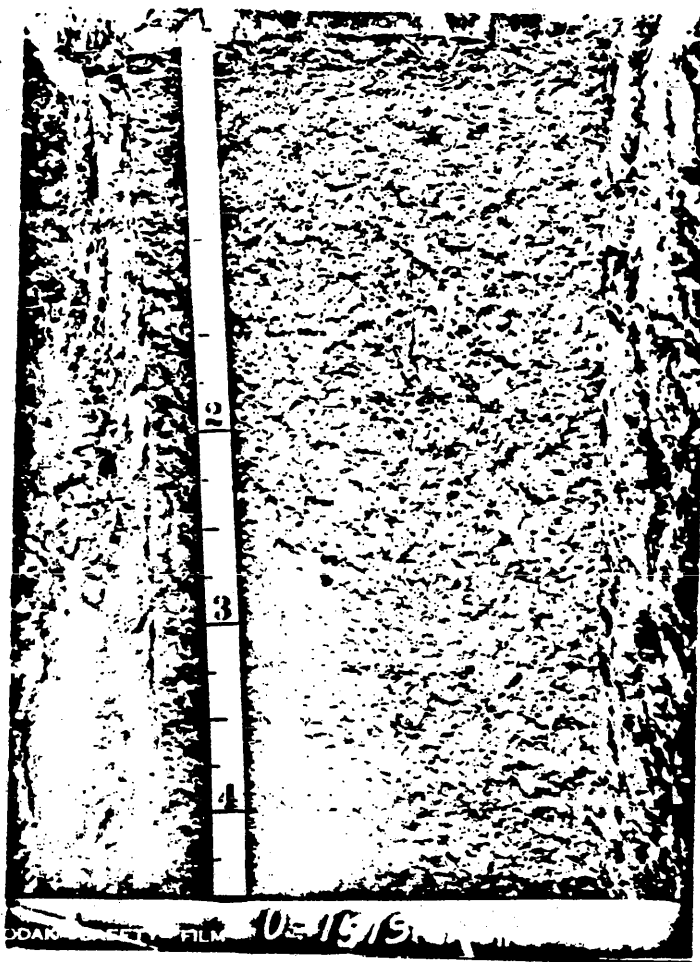


General view of vegetation



Close up of vegetation

PHOTOGRAPHS - COLORADO 6-68



Soil profile