

## **Vegetation and Soils of No Man's Land Mesa Relict Area, Utah**

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### **Highlight**

**On No Man's Land Mesa, a relict area in Kane County, Utah, two distinctly different soils were found which produce significantly different kinds and amounts of vegetation. The Upland sand (Pinon-Juniper) site yielded an average of about 1100 lb/acre airdry comprising 10% grass, 5% forbs and 85% trees and shrubs. The Upland shallow breaks (Pinon-Juniper) site yielded an average of nearly 800 lb/acre comprising 5% grass, 5% forbs and 90% trees and shrubs.**

Ranchers should know what their rangelands can produce in order to evaluate how well range improvement practices will pay off. To assist them to determine

this potential production, the Soil Conservation Service uses the range site concept. Range condition is also determined by the rancher and range conservationist on non-federal range lands to assess what departure from the potential may have occurred. With this basic information, the rancher can then consider the practices which result in improved range condition.

Passey and Hugie (1962) stated that soil, plant, and climatic relationships on relict areas can be used in the intelligent interpretations of soil survey data and to identify range sites. These interpretations are essential to the planning and application of optimum programs of management and treatment for rangelands. The use of range sites and condition class in range conservation was explained by Dyksterhuis (1958).

Hugie et al. (1964) show that the nature of plant communities is the result of soil differences.

Williams and Hugie (1966) also discuss soil, climate, and vegetation characteristics that occur together under natural conditions. Several ecologists have described characteristic vegetation of relict areas and presettlement vegetation for specific geographic locations in Utah (Christensen and Johnson, 1964); Christensen and Welsh, 1963; and Welsh, 1957).

Jameson et al. (1962) report a study on Fishtail Mesa relict area in Northern Arizona which shows strikingly similar results to the current study. They found the most important species present were big sagebrush (*Artemisia tridentata*), low sagebrush (*A. bigelovi*), pinon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) making up a total of 88% of the cover. Soils were also similar.

In 1964 and 1965, we determined the plant yield and composition by weight on No Man's Land Mesa. From this data, we



FIG. 1. Upland sand (pinon-juniper) site. Prairie junegrass, tall native bluegrass, sand dropseed, Indian ricegrass, needle-andthread, big sagebrush, juniper, pinon pine, herbaceous sage, western wheatgrass, and prickly pear. Note open stand of trees with scattered clumps here and there.

concluded that there are two different range sites. They were described and range condition guides developed. These will be used to assist ranchers to plan and apply conservation practices wherever these sites occur in Utah.

#### Study Area and Procedure

No Man's Land Mesa is approximately 30 miles northeast of Kanab, Utah. It is roughly 4 miles long and 1 mile wide with a total of 1788 acres. The mesa varies from 6600 to 7222 ft in elevation and rises 600 to 1200 ft above the surrounding area.

The mesa was originally inaccessible to livestock. However, in 1927, a local rancher (Adams, 1965) constructed a goat trail and drove 800 goats to the top and 1300 to 1500 wether goats grazed the mesa for about six weeks the following spring. Although the goats did well, the area has not been grazed since by domestic livestock.

No big game were found and only 2 or 3 chipmunks, 2 porcupines and 3 or 4 mourning doves. No rabbits were seen, but old droppings and one old skeleton indicate they have been present.

Geologically, the mesa top is in the Carmel formation (Hintze, 1963). The cliff formation is Navajo sandstone.

The climate is sub-humid with cold, snowy winters and dry summers. The annual average precipitation is estimated to be from 14 to 16

inches. From 25 to 35% of the precipitation occurs during the plant growth period from April to October. The 65 to 75% that falls during the plant dormant period of October through March is the dependable supply for plant growth. The optimum growth period of plants is during May and June. The frost-free period is ordinarily about 150 days.

Soil scientists described several soil profiles in order to classify the soils and correlate them into the national standard soil survey system (USDA, 1951).

Vegetative yield and composition were determined by use of two methods. The double-sampling or weight-estimate method (Frischknecht and Plummer, 1949) was used on all species except pinon pine and Utah juniper for which the weight unit method (USDA, 1963) was used. Yield and composition information

was taken from two 10-plot transects on the deep soil and one on the shallow soil in 1964. Four 10-plot transects were taken on the deep soil and 3 on the shallow one in 1965. Each plot was 9.6 ft<sup>2</sup> in area. Green weights were estimated in grams for each species on each plot. Errors of estimating were determined by actually clipping 2 plots on each transect and correction factors were computed. Corrected green weight was reduced to dry weight of each species. The center of plot 5 of each 10-plot transect was used as the southeast corner of a 0.1-acre plot from which total annual yield of pinon pine and Utah juniper were computed by use of the weight unit method (USDA, SCS, 1963). Annual dry weight production of Utah juniper was considered to be 0.5 the weight of the fruit added to 30% of the total weight of leaves and annual

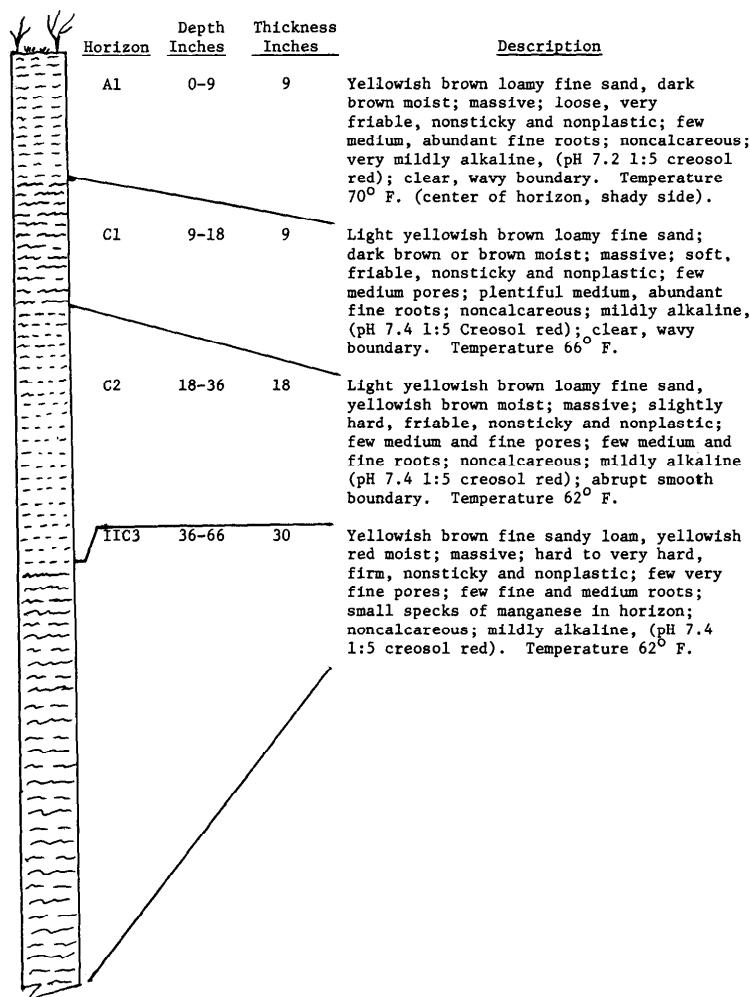


FIG. 2. Schematic profile description — Preston-like deep, loamy fine sand, typical soil in Upland sand (pinon-juniper) site.

twig growth (Mason and Hutchings, 1966). Pinon pine yields were computed by adding half the weight of cones to the weight of annual twigs and leaves which are easily recognized and can be accurately harvested. The weight of Utah juniper and pinon pine was calculated in lb/acre and added to all other species as a basis for species composition.

Posts were counted on the 0.1-acre plots. Ages of post-size juniper trees were determined by increment bore and potential in posts/acre/year was determined. Cordwood yield of both pinon pine and juniper was computed from yield tables after measuring diameter of trees at one foot height. (USDA, SCS, 1961). Cordwood potential was determined by dividing cords per acre by the average age of the mature trees.

Density of plants, litter, rock, and cryptogams were estimated directly as a percentage of the total area. Bare ground percentage was computed by subtracting the total of these four items from 100. Overstory density was computed from crown spread diameters of all trees on the plots, computed in percent of total surface area.

## Results

On the basis of distinct differences in soil resulting in significant differences in kind and amount of vegetation, two range sites were found on the mesa.

**Upland sand (Pinon-Juniper) Site.**—The topography is gently sloping with some dune-like mounds. (Fig. 1). Slopes vary from 1 to 10% and are mostly gently sloping to the north. This site covers approximately 1198 acres.

The soil is deep, well-drained, Preston-like loamy fine sand. (Fig. 2). No active current water erosion is evident. This soil absorbs about 8.5 in of water during the plant dormant period. Moderate wind erosion and deposition are taking place.

The vegetation of this site consists of about 10% grasses, 5% forbs and about 85% trees and shrubs by total annual air dry weight. The important grasses are tall native bluegrass, Indian ricegrass, ring muhly, and nee-

**Table 1. Total annual yield in lb/acre airdry in 1964 and 1965 for two range sites on No Man's Land Mesa.**

Plant Species	Upland Sand (Pinon-Juniper)			Upland Shallow Breaks (Pinon-Juniper)		
	1964	1965	Av.	1964	1965	Av.
<b>Grasses and Grass-like</b>						
Desert needlegrass ( <i>Stipa speciosa</i> )				7	3	5
Dryland sedge ( <i>Carex</i> sp.)				12	3	8
Indian ricegrass ( <i>Oryzopsis hymenoides</i> )	10	49	30		1	T
Needleandthread ( <i>Stipa comata</i> )	5	16	10	34	T	17
Prairie junegrass ( <i>Koeleria cristata</i> )		4	2			
Ring muhly ( <i>Muhlenbergia torreyi</i> )		20	10			
Tall native bluegrass ( <i>Poa fendleriana</i> and <i>P. nevadensis</i> )	49	57	53	6	10	8
Western wheatgrass ( <i>Agropyron smithii</i> )	2	4	3			
Total Grass & Grass like	66	150	108	59	17	38
<b>Forbs</b>						
Actinea ( <i>Hymenoxys bigelovi</i> )		4	2	11	5	8
Cryptantha ( <i>Cryptantha</i> sp.)	8	5	6	2	12	7
Many-flowered sunflower ( <i>Viguiera multiflora</i> )	1	2	2	21		10
Perennial mustard ( <i>Arabis pendulina</i> )	4	10	7	1	8	4
Stickseed ( <i>Lappula redowski</i> )		12	6			
Other forbs	13	40	29	11	16	12
Total forbs	28	73	52	46	41	41
<b>Shrubs and Trees</b>						
Big sagebrush ( <i>Artemisia tridentata</i> )	185	119	152			
Birchleaf mahogany ( <i>Cercocarpus betuloides</i> )				62	43	52
Bitterbrush ( <i>Purshia tridentata</i> )	49	12	30		3	2
Buckwheat ( <i>Eriogonum</i> sp.)	3	11	7		1	T
Fremont mahonia ( <i>Mahonia fremonti</i> )				65	150	108
Gambel oakbrush ( <i>Quercus gambeli</i> )	176	120	148			
Hood's phlox ( <i>Phlox hoodi</i> )	6	1	4	22	11	16
Horsebrush ( <i>Tetradymia canescens</i> )	27	4	16			
Leptodactylon ( <i>Leptodactylon pungens</i> )		9	4		5	2
Manzanita ( <i>Arctostaphylos patula</i> )	8	82	45			
Mormon tea ( <i>Ephedra viridis</i> )		17	8	135	41	88
Pinon pine ( <i>Pinus edulis</i> )	404	229	316	228	374	301
Prickly pear ( <i>Opuntia</i> spp.)	147	34	90	2	5	4
Rock goldenrod ( <i>Solidago petradoria</i> )				24		12
Serviceberry ( <i>Amelanchier mormonica</i> )					36	18
Snowberry ( <i>Symphoricarpos oreophilus</i> )	T	7	4			
Utah juniper ( <i>Juniperus osteosperma</i> )	122	58	90	158	43	100
Yellowbrush ( <i>Chrysothamnus viscidiflorus</i> )					7	4
Total shrubs and trees	1127	703	914	696	719	707
<b>TOTAL ALL VEGETATION</b>	<b>1221</b>	<b>926</b>	<b>1074</b>	<b>801</b>	<b>777</b>	<b>786</b>

Note: T in table indicates a trace or quantity less than 1.

dleandthread (Table 1). A large number of forbs occur but only cryptantha, perennial mustard and stickseed make up as much as one percent each of the total dry weight.

The important shrubs and trees are Mormon tea, bitterbrush, horsebrush, Gambel oakbrush, buckwheat, prickly pear, big sagebrush, manzanita, pinon pine and Utah juniper.

Total annual air dry yield was 1221 lb/acre in 1964 and 926 lb in 1965.

Live-plant understory density averaged 12%, litter and mulch 29%, cryptogams 7%, and bare ground 52% of the total surface. Overstory density of pinon juniper was 14%.

The potential for producing cedar posts is about 0.2 post/acre/year. The potential for juniper cordwood is .02 cord/acre/year and for pinon pine .07 cord.



**FIG. 3.** Close up of Upland shallow breaks (pinon-juniper) site showing sparse understory and considerable geologic erosion.

**Upland Shallow Breaks (Pinon-Juniper) Site.**—This site is located in the breaks on the north end and as a smaller area on the west central part of the mesa, comprising 590 acres. (Fig. 3). Slopes vary from 5 to 30% on all exposures, but north is dominant.

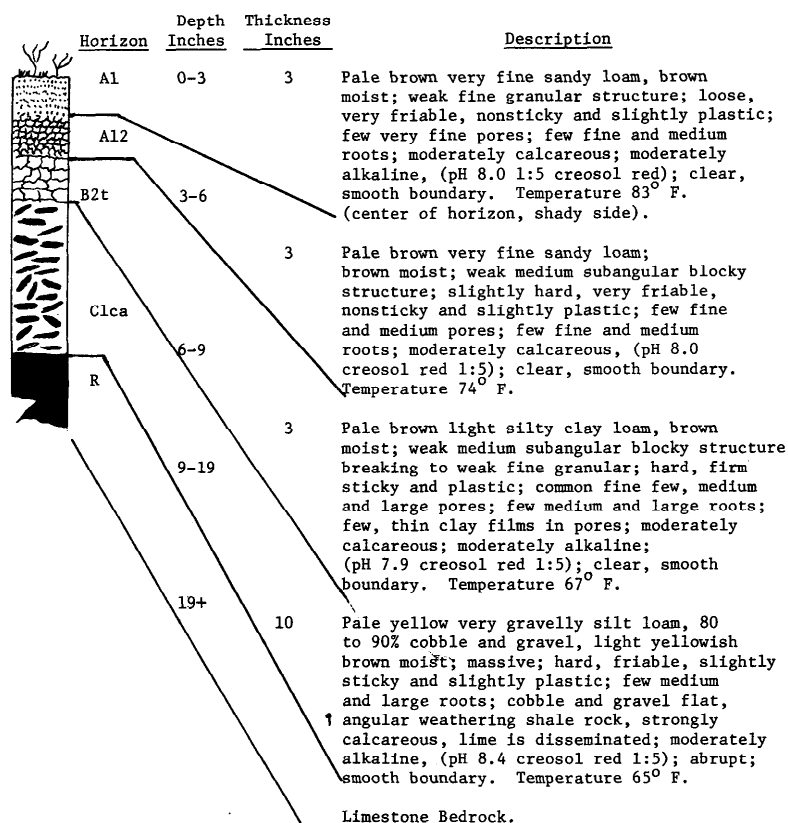


FIG. 4. Schematic profile description—Menefee-like very fine sandy loam, shallow over limestone bedrock, typical soil in Upland shallow breaks (Pinon-Juniper) site.

The soil is shallow, well-drained, Menefee-like very fine sandy loam (Fig. 4). It is a residual soil from limestone and sandstone parent rocks. The soil profile will hold only about 2 inches of moisture. Some moisture is held in the cracks of the bedrock. Runoff during the snowmelt period when the profile becomes saturated has resulted in scarcity of understory plants. Very little wind erosion or deposition occurs.

The vegetation of this site consists of 90% trees and shrubs with about 5% forbs by weight and 5% grasses and grass-like plants. Important grasses and grass-like plants are tall native bluegrass, needleandthread, and dryland sedge. Many forbs are present but only actinea, cryptantha and many-flowered sunflower comprise 1% or more of the total weight. The important

shrubs and trees are serviceberry, birchleaf mahogany, Utah juniper, pinon pine, Mormon tea, Fremont mahonia, and rock goldenrod.

Total annual air-dry yields were 801 lb/acre in 1964 and 778 lb in 1965.

Live plant understory density averaged 6%, rock fragments 30%, litter and mulch 29%, and bare soil 35% of the total surface area. Overstory density computed from the plots averaged 24%.

Three or four ponderosa pines are found on the extreme north end of the mesa in this site. They are over-mature, about 3 ft in diameter, but only about 40 ft high. No reproduction exists.

The potential for producing cedar posts, pinon cordwood and juniper cordwood is the same as the Upland sand (pinon juniper) site.

## General Comparisons of the Two Sites

There is no significant difference in wood production on the two sites. There is 10% more tree density on the shallow site. The deep sand site averages 67 pinon pine trees/acre and 20 Utah juniper while the shallow break site has 215 pinon pine trees/acre and 50 Utah juniper. What the deep sand site lacks in number of trees is made up in considerably more rapid growth so that the potentials for posts and cordwood are nearly equal on the two sites.

The deep sand site produces about 27% greater total annual yield of all vegetation than does the shallow breaks site. There is also a wide difference in the kinds of shrub species on the two sites. Big sagebrush, Gambel oakbrush and manzanita occur in substantial amounts on the deep sand site while birchleaf mahogany, Fremont mahonia, rock goldenrod and serviceberry are found on the shallow breaks site. Pinon pine and Utah juniper occur on both sites but collectively produce 37% of the total yield on the deep sand site and 50% on the shallow breaks site. Mormon tea is found on both sites but only 1% on the deep sand compared with 11% on the shallow breaks site. Prickly pear is found on both sites, but is 8% of the total on the deep sand and less than 1% on the shallow breaks site. Many other species are found exclusively on one site or the other, but only in quantities less than one percent of the total (Table 1).

## Summary

No Man's Land Mesa is a relict area in Kane County 30 miles northeast of Kanab. It has been grazed only two years (1927 and 1928) for short periods by from 800 to 1500 goats.

Climate is sub-humid with cold snowy winters and dry summers. Average annual precipitation is from 14 to 16 inches.

Two different sites are found on the mesa—the Upland sand (pinon-juniper) and the Upland shallow breaks (pinon-juniper). The Preston-like loamy fine sand soil of the first site is deep and will hold 8.5 inches of moisture in a six-foot depth. The Menefee-like very fine sandy loam of the break site is shallow and will hold 2 inches of moisture in the profile, not considering the moisture in the cracks of the bedrock. No active water erosion is evident on the deep sand site, but generally moderate wind erosion and deposition is present. Moderate to severe geologic water erosion is occurring on the breaks site, but very slight to no wind erosion or deposition is evident.

No signs of big game or predators were found.

The vegetation of the Upland sand (pinon-juniper) site yielded an average of about 1100 lb/acre air dry, consisting of 10% grasses, 5% forbs, and about 85% trees and shrubs. Live plant density of understory is 12%, litter and mulch 29%, cryptogams 7% and 52% bare ground. Overstory density is 14%. The potential for production of cedar posts is about 0.2 post/acre/year; for juniper cordwood it is .02 cord; and for pinon pine .07 cord.

The Upland shallow breaks (pinon-juniper) site yielded an average of nearly 800 lb/acre air

dry, consisting of 5% grasses and grass-like plants, 5% forbs, and about 90% trees and shrubs. Live plant density of understory is 6%, while rock fragments cover 30% of the surface and litter and mulch 29%, leaving 35% bare ground. Overstory density is 24%. The potential for production of cedar posts, pinon cordwood and juniper cordwood is about the same as the Upland sand (pinon-juniper) site.

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**U. S. D. A. Researcher Summarizes Public Funds used for Agricultural Research** — Some forty per cent of publicly funded agricultural research goes for crops and crop products and another forty per cent goes about equally into animal and animal-product research and for development of natural resources, according to research specialist Dr. Paul E. Schleusener, of U.S.D.A., speaking before a meeting of American Society of Agricultural Engineers.