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May, 2001

Ecological Types of the Upper Gunnison Basin

Vegetation-soil-landform-geology-climate-water land classes for natural resource management

Let them read the titles!
Martin Luther's lawyer, at the Diet of Worms

As I did stand my watch upon the hill,
I look'd towards Birnam, and anon,
Methought, the wood began to move ...
William Shakespeare, Macbeth, Act 5, Scene 5

In the administration of the National Forests
the aim is to convey to the greatest possible
number the full benefit of all the resources
which the Forests contain and at the same time
to perpetuate those resources
by regulating their use.
James Jardine and Mark Anderson, 1919

Every plant is an indicator. This is an inevitable conclusion from the fact that each plant is the product of the conditions under which it grows, and is thereby a measure of these conditions. ... The question of species and community values is much simpler than appears at first. It is not a matter of employing one to the exclusion of the other, but of taking advantage of their complementary relation. There can be no doubt that the community is a more reliable indicator than any single species of it. ... The community not only affords a better norm for the major indications, but it is likewise, so to speak, more finely graduated and hence more sensitive, owing to the fact that no two of its dominants or subdominants are exactly equivalent. It is also a better indicator of the whole habitat, since it levels the variations from one point to another.
Frederic E. Clements, 1920 (pp. 28-30)

Each [geographical area] is a complex of climax and developmental habitats of varying rank and extent, each controlling a plant community which serves as the indicator of it.
Frederic E. Clements, 1920 (p. 39)

It is a simple matter to trace the line of 20 inches of rainfall, or the 60 per cent ratio of rainfall to evaporation and to assume that it marks the line between prairies and plains. Such an assumption reverses the proper procedure, in which the associations themselves must be permitted to indicate their respective climates.
When this has been done and the limits of the various communities established, it will be possible to determine the correlated factors.
Frederic E. Clements, 1920 (p. 40)

When the relation between the silvicultural characteristics and the physical factors which affect tree growth and the correlation of increment with the associated shrubby and herbaceous species are better understood, the different sites may be regarded as integral biological units which the administrator can use an a basis for the rational organization of his forest.
Clarence F. Korstian, 1920

Every plant has a story to tell about its environment, especially soil conditions...
This story or indicator significance is of great help in interpreting conditions over an area as well as in utilizing the land to its fullest extent.
Herbert C. Hanson, 1929

Ecology is not to be regarded as a specialized field comparable to physiology or morphology or even zoology, botany, or geology, but as a point of view and a plan of attack.
Frederic E. Clements, 1935

The natural plant communities are not merely the best integrators of the effects of climate and soil, but axiomatically they are also by far the best judges of these two complexes in terms of plant production.
Frederic E. Clements, 1935

Who among these overland voyagers could have dreamed that within a few short decades other settlers would engage in fierce wars among themselves for possession of this "desert" land; how could they have guessed that this land would produce five times more wealth ... through the pasturage of livestock than all the gold they would dig out of the earth with their picks and shovels?
Richard E. McArdle and David F. Costello, 1936

The general correlation between plant succession stages and range condition would frequently not hold true were forage production as reflected by floristic composition used as the sole criterion for determining condition.
R. R. Humphrey, 1947

Since simple correlations [between climate, soils, and vegetation] in small areas are of little or no value for general use, it follows that vegetation and soil maps can be constructed only by direct observation. There are no short cuts –
unless one knows <u>all</u> the independent variables.
N. C. W. Beadle, 1951

The most significant biogeographic classification of the land surface is that based on climax conditions exclusively. One important fact that supports this conclusion is that seral communities are not well organized.
Rexford Daubenmire, 1952

One can, with knowledge of the ecology of the plants which are growing there and the climate, make a good estimate of the [soil] moisture regime. The correlation between the vegetation and climate is generally pretty good.
Guy Smith, 1981

A soil classification or map is not an ecological classification if the relationship of the classes to the vegetation of the area is unknown. Similarly, a vegetation map is not an ecological classification unless the interrelationships between the vegetation types and the environmental factors is known.
Barnes, Pregitzer, Spies, and Spooner, 1982

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Barry C. Johnston[1]

Laurie Huckaby[2]

With Contributions By:

Terry J. Hughes[3]

Joseph Pecor[4]

A Cooperative Project of

Bureau of Land Management, United States Department of the Interior
Gunnison Field Office
216 North Colorado Street, Gunnison, Colorado 81230-2197

Colorado Division of Wildlife, Habitat Partnership Program
Gunnison Area Office
310 West New York Avenue, Gunnison, Colorado 81230-2706

Forest Service, United States Department of Agriculture
Grand Mesa, Uncompahgre, and Gunnison National Forests
216 North Colorado Street, Gunnison, Colorado 81230-2197

1. Ecologist, USDA Forest Service, Grand Mesa-Uncompahgre-Gunnison National Forests, Gunnison, Colorado 81230-2197
2. Writer-Editor, USDA Forest Service, Rocky Mountain Experiment Station, Fort Collins, Colorado 80526-2098
3. Soil Scientist, USDA Forest Service, Grand Mesa-Uncompahgre-Gunnison National Forests, Delta, Colorado 81526-2485
4. Physical Sciences Technician, USDA Forest Service, Grand Mesa-Uncompahgre-Gunnison National Forests, Delta, Colorado 81526-2485

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If sage grouse had antlers
Art Hayes

If sage grouse had antlers, horns or big tusks
hunters would chase them from dawn until dusk

Their decline in the basin would have not been allowed
the habitat improved, all men would avow

No roads or mill tailings would cause them a fuss
if sage grouse had antlers, horns or big tusks

The sagebrush where these birds like to nest
from cows would be given a short rest

We would plant grass and forbs with shrubs in between
and less would be heard of moose yet unseen

Plans would be finished and lands managed with trust
if sage grouse had antlers, horns or big tusks

Acknowledgements

My heartfelt thanks to those wise, visionary resource managers who were willing to allow the time and resources to finish this: Steve Marquardt, Bob Storch, Jim Dawson, Miles Hemstrom, Barry Tollefson, Jim Young, John Mumma, Glen Hetzel, Dave Anderson, Elizabeth Estill, Tom Thompson, and Lyle Laverty. Special thanks have to go to Craig Whittekiend, whose idea this was all along – he guided it through the first, critical half.

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The members of the Gunnison Habitat Partnership Committee had the foresight to support this classification. The non-agency people on the HPP committee have shown remarkable foresight, good ranchers and sportsmen that they are. Especially important to me were the agency members of this committee: Jim Young, Bill Wallis, Mark Hatcher, and Joe Capodice. You have always been there for me, and I appreciate it greatly.

I have had the pleasure of working with some excellent field crew persons, from whom I have learned a great deal. The biggest credit goes to Joseph (Joe) Pecor, one of the best field people around – he's an ecologist in the best sense of the word. His commitment, hard work, humble attitude combined with a high degree of technical ability, and ability to think critically about science, makes him a special person. Thanks, Joe!

Kim Parker deserves special credit for commitment way beyond what was needed, quality work, and a lot of sweat and extra time, during the critical 1994 year. Other field people have been Les Choy, Ed Mauch, Suzanne Parker, and Duane (Ken) Kenlon.

Special thanks to Gay Austin, Art Hayes, and Sandy Hayes, my "techno" partners in this HPP project. They have done it all – advise, counsel, procuring vehicles, selling the program to agency people and outsiders alike, coming up with funding when most needed, helping with field sampling, it goes on and on. You three are the *sine qua non* of this classification, valued friends.

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Vera Komárková kindly allowed the use of a few of her samples from the early 1980's.

The interagency-plus-the-public spirit, "we can get it done if we work together for the good of the public" attitude shows abundantly in the way all of you have supported this classification. This surely is the future, working together for a common goal. Thanks very much!

God bless you all!

March 5, 2001 *B. C. J.*

Cover: Looking west across the East River, visible in the middleground, toward Crested Butte Mountain. Aspen, mountain big sagebrush, and Thurber fescue occupying the lower east slopes of Crested Butte on slumps in Mancos Shale, spruce-fir on volcanics of the upper part of the mountain. The lower line of continuous forest is formed by an irregular edge of aspen. September 21, 1994.

Summary

1. A classification of the ecological types of the Upper Gunnison Basin has been completed. Between 1982 and 1998, we collected data about the vegetation, soil, and landform at 1,666 points throughout the Upper Gunnison Basin. The result is a classification of 97 Ecological Types (ET) grouped into 33 Ecological Series (Table S-1). The 33 Ecological Series were grouped into eleven Groups (Table S-2) for convenience in description and display.

Each Ecological Type represents a balanced combination of potential vegetation, soil, landform, geology, climate, and water. Each Ecological Type is mappable. Therefore, each Ecological Type is a significantly different environmental regime for natural resource management.

2. We designed one or more Community Types (CT) within each Ecological Type (ET), based on current vegetation (Table S-1). This resulted in 377 Community Types.

3. The bottom of the Upper Gunnison Basin is dominated by big sagebrush.* Shallow clay soils on the slopes are usually dominated by black sagebrush. Many riparian areas are now dominated by big sagebrush; in good condition, they have narrowleaf cottonwood and a variety of tall shrubs such as thinleaf alder, Bebb willow, and Geyer willow. Protected areas, such as lee (east) sides of ridges may have Utah serviceberry or Gambel oak. The Foothills-Semidesert Shrub Zone is largely non-forested, although there are islands of Douglas-fir, sometimes mixed with aspen, on some protected upper slopes.

4. The Mountain Shrub Zone lies between the semidesert shrubs and the Montane Zone. The Mountain Shrub Zone is not continuous in the UGB, as it is in other areas of the Western Slope of Colorado, but occurs as smaller patches and stripes of serviceberry, mountain-mahogany, and oak, alternating with "islands" of Douglas-fir forest on steep, north-facing slopes. These patches and striped often interfinger into the Montane Zone above or the Foothills Zone below.

Table S-1. Ecological Series in the Upper Gunnison Basin, and numbers of Ecological Types (ET) and Community Types (CT) in each.

Series*	ET	CT	NS†
1. Rocky Mountain juniper	1	3	8
2. Ponderosa Pine	2	5	19
3. Bristlecone Pine	2	6	12
4. Douglas-Fir	8	70	333
5. Blue Spruce (Uplands)	2	5	12
6. Lodgepole Pine	3	5	24
7. Subalpine Fir-Douglas-Fir	2	7	19
8a. Subalpine Fir-Engelmann Spruce (Tall)	8	27	157
8b. Subalpine Fir-Engelmann Spruce (Krummholz)	1	1	2
9. Limber Pine	1	1	2
10. Aspen	3	12	59
11. Narrowleaf Cottonwood	2	14	59
12. Blue & Engelmann Spruces-Subalpine Fir (Riparian)	4	14	43
13. Yellow Willow	1	12	71
14. Blue Willow-Serviceberry Willow-Booth Willow	2	12	53
15. Planeleaf Willow-Wolf Willow-Bog Birch	4	11	45
16. Grayleaf Willow-Barrenground Willow	1	2	7
17. Water Sedge	1	5	18
18. Indian Ricegrass-Needle-and-thread	1	6	19
19. Arizona Fescue	2	9	41
20. Thurber Fescue	3	12	39
21. Osha	1	2	6
22. Idaho Fescue	1	1	4
23. Timber Oatgrass	1	1	4
24. Purple Pinegrass	1	1	3
25. Utah Serviceberry-Saskatoon Serviceberry	6	36	134
26. Rocky Tall-Shrublands	1	1	9
27. Wyoming Big Sagebrush	1	7	36
28. Black Sagebrush	2	10	50
29. Big Sagebrush-Antelope Bitterbrush	6	34	186
30. Mountain Big Sagebrush	3	18	76
31. Low Sagebrush	3	8	37
32. Silver Sagebrush	1	3	10
33. Alpine Ecological Types	16	16	69
Totals…	97	377	1,666

*. Names for plant species are explained in Appendix A.
†. Number of samples identified to Ecological Type.

5. Between the Mountain Shrub Zone and the lower line of continuous forest lies the Montane Zone. In some other areas in Colorado, the Montane is continuous forest, but here the southerly and westerly slopes are usually dominated by big sagebrush, sometimes with antelope bitterbrush codominant. As before, shallow clay soils on the southerly or westerly slopes are usually dominated by black sagebrush. Many riparian areas are now dominated by big sagebrush; in good condition, a variety of tall shrubs such as yellow willow, serviceberry willow, thinleaf alder, Bebb willow, and Geyer willow.

*. Names for plant species are explained in Appendix A.

Protected areas may have Saskatoon serviceberry or mountain-mahogany.

The moister and cooler northerly and easterly slopes in the Montane Zone are often forested. If the slopes are moderate to steep, they often have a mix of aspen and Douglas-fir, with lodgepole pine added to the mix at higher elevations. In rainshadow climates, there may be a few stands of blue spruce in uplands of deep rainshadows, or stands of ponderosa pine on gentler slopes in partial rainshadows. Openings in the forest have the same sagebrush-bitterbrush mix as the southerly slopes, and riparian areas have the same species as well.

6. The lower line of continuous forest in the Upper Gunnison Basin is usually the lower edge of the Subalpine Zone.

In the northern part of the Basin, away from deep rainshadows, the lower line of continuous forest is often formed by a narrow or broad transitional belt of mixed aspen, Douglas-fir, and subalpine fir. There may also be stands dominated by aspen to the exclusion of conifer trees.

In the southern part of the Basin where rainshadow climates are dominant, the lower forest edge is often formed by a narrow to broad transitional belt of mixed-conifer forest, with blue spruce, Douglas-fir, and aspen, sometimes mixed with bristlecone pine on rocky slopes at the forest edge.

Across the whole Upper Gunnison Basin, the belt between the transitional belt below and the upper treeline is usually a broad expanse of conifer forest, of subalpine fir and Engelmann spruce.

Within the Subalpine Zone in the Upper Gunnison Basin, there are openings in the forest of various kinds. There are several large parks – Taylor Park and Waunita Park, for example – where cold air drainage eliminates trees. These parks are dominated by mountain big sagebrush or fescue grasslands. Within the grasslands, Thurber fescue is often prominent, sometimes with Arizona fescue or Idaho fescue also present. There are also many other, smaller parks and openings with mountain big sagebrush or fescue grasslands. Shallower clay soils may have low sagebrush.

Riparian areas in the lower part of the Subalpine Zone have blue spruce, Engelmann spruce, and thinleaf alder along the coarser, higher-gradient streams. Blue (Drummond) willow, serviceberry willow, and beaked sedge often dominate finer-textured, lower-gradient riparian areas, wet pockets in a slope, or wetlands.

Riparian areas and other wet sites in the upper part of the Subalpine Zone are usually dominated by short shrubs – planeleaf willow, Wolf's willow, and bog birch – with water sedge and other wet-site plants. Forested riparian areas are dominated by Engelmann spruce, with or without subalpine fir.

Table S-2. Statistical summary by Groups of Ecological Types.

Group	Code	Series Numbers	ET*	CT†	NS‡	NS/CT	NS/ET
A. Dry Forests	FD	1, 2, 3, 4, 5, 6	18	94	408	4.3	22.7
B. Moderately-Moist Forests	FL	7, 8a, 8b, 9	12	36	180	5.0	15.0
C. Moist Forests	FM	10	3	12	59	4.9	19.7
D. Riparian Forests	FR	11, 12	6	28	102	3.6	17.0
E. Non-Forested Riparian	RI	13, 14, 15, 16, 17	9	42	194	4.6	21.6
F. Non-Riparian Grasslands	GA	18, 19, 20, 21, 22, 23, 24	10	32	116	3.6	11.6
G. Tall Non-Riparian Shrublands	SA	25, 26	7	37	143	3.9	20.4
H. Dry Sagebrush Shrublands	SB	27, 28	3	17	86	5.1	28.7
I. Big Sagebrush Shrublands	SS	29	6	34	186	5.5	31.0
J. Subalpine Sagebrush Shrublands	SU	30, 31, 32	7	29	123	4.2	17.6
K. Alpine Ecological Types	AL	33	16	16	69	4.3	4.3
Totals and Averages			97	377	1,666	4.4	17.2

* ET = Number of Ecological Types. †. CT = Number of Community Types. ‡. NS = Number of samples.

7. The transitional belt between the mostly forested Subalpine Zone and the non-forested Alpine Zone usually is formed of gnarled, wind-formed trees. Usually these trees are Engelmann spruce, sometimes subalpine fir; or perhaps bristlecone pine in the southern part of the basin. Here, this transitional belt, called 'Krummholz,' is usually fairly narrow.

The boundary between the Subalpine and Alpine is usually taken as treeline, but in some places Subalpine plant communities can extend upward into the Alpine. In many places, short willow stands can extend the Subalpine upward past treeline, and in other places Thurber fescue grasslands can extend above treeline.

The Alpine Zone is dominated by gravity and freeze-thaw processes, rather than vegetation. The vegetation is all short, and almost all has no woody growth above the surface; none has woody growth over 8 cm (3 in) above the surface. Characteristic

Alpine plant species include curly sedge, alpine avens, dryad, alpine fescue, kobresia-like sedge, kobresia, and a wide variety of low forbs.

8. Forested upland soils in the Upper Gunnison Basin include Mollisols, Inceptisols, and Entisols at lower elevations. At higher elevations, Mollisols are less common in forests, and Alfisols more common. Forested sites are usually better drained than non-forested sites, often as a combination of having coarser soils or steeper slopes. Forested sites are more often northerly at lower elevations, and on all slopes at higher elevations.

9. Non-forested upland soils in the Upper Gunnison Basin are usually Mollisols. Alfisols may occur in some shale areas. There are a few scattered Inceptisols or Entisols. In the deep rainshadow climate in the bottom of the basin, there are some sites with Aridisols or Aridic Mollisols.

10. Riparian and wetland soils are often Endoaquolls, Cryaquolls, or Cryaquents. At higher elevations, there are some Histosols. Riparian and wetland soils are usually highly variable within even a small site.

11. The Upper Gunnison Basin has a cool to cold, dry to moist climate. In the Upper Gunnison Basin, precipitation ranges from less than 10 in/yr to more than 50 in/yr (<250 to >1,300 mm/yr). In the bottom of the Basin and at middle elevations, the climate is cold and dry, related to the climate of the Colorado Plateau in Utah and far western Colorado.

Average annual temperature in the Upper Gunnison Basin ranges from just above freezing to about 40°F in the bottom of the basin (0-5°C).

A significant feature of the climate of the UGB is *rainshadows*, especially prominent in the southern part of the Basin.

12. Mule deer numbers have declined, so that there are perhaps 20% of the numbers that there were in the late 1950s in the Upper Gunnison Basin. A predicted peak in deer numbers in the early 1990s failed to materialize. At present, mule deer numbers are about 60% of habitat capacity.

Some habitat deterioration probably occurred during the peak in deer numbers in the late 1950s, especially heavy browsing on palatable shrubs in their winter ranges.

13. Cattle numbers and the intensity of their use in the Upper Gunnison Basin has declined significantly in the 25-30 yr since their peak in the early 1970s. There has been insignificant grazing of other livestock in the Upper Gunnison Basin, although the number of horses continues to grow.

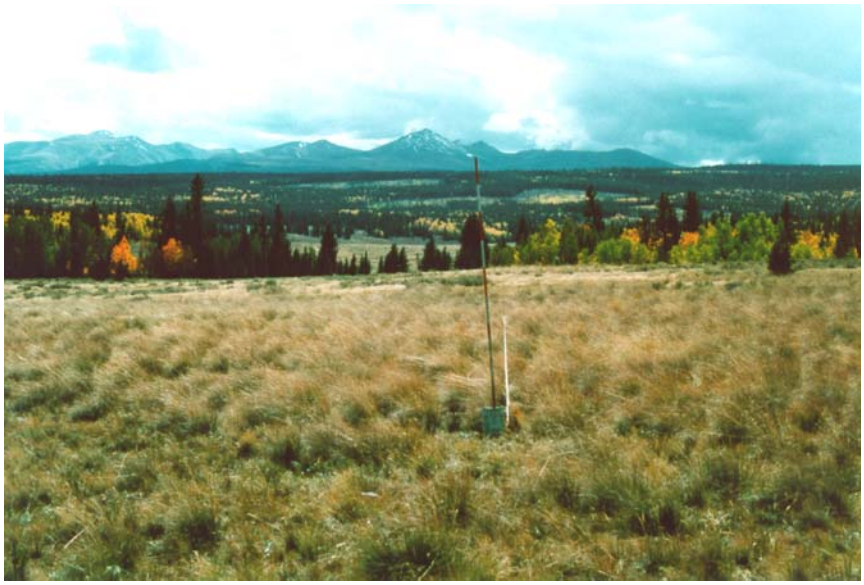
Habitat deterioration has occurred, and is still visible, as a result of livestock grazing in places in the basin. Most of the deterioration is visible in greater bare soil and gravel than expected, as well as decline in quantity and vigor of palatable graminoids. Most of the deterioration occurred within a few miles of the valleys of the Gunnison River and Tomichi Creek, and was a result primarily of the long duration (6-9 decades) of moderate to heavy grazing, rather than its intensity.

The trend in range condition has reversed as livestock numbers have declined, so that most sites are now in an upward trend, recovering slowly.

14. Elk were introduced into the Upper Gunnison Basin in the early 1950s, and since then have grown steadily. At present, elk numbers are about 125% of habitat capacity.

Habitat deterioration from elk use is visible in a number of places in the Upper Gunnison Basin, and is increasing in frequency and area. This is especially illustrated by continuing declines in palatable shrub numbers and vigor, and by deteriorating condition of aspen stands and riparian areas within elk winter range. Many of the areas where deterioration is occurring have experienced large-scale reductions in livestock numbers and length of grazing seasons over the last two decades.

From Almont Triangle, looking across the valley of the East River and the village of Jack's Cabin, between Red Mountain (left) and Cement Mountain (right) with Crested Butte Mountain in between. September 22, 1993.



From upper Cochetopa Park, in the southeastern part of the UGB, looking towards the 14,000 ft peaks of the La Garita Range. In the foreground, a Thurber fescue/Arizona fescue site. Thurber fescue 79%, Parry oatgrass 11%, silvertop sedge 11%, Arizona fescue 11%, mountain muhly 7%. Coarse Fragments Cover = 1%, Total Live Cover = 160%, Coarse Fragments in Soil = 43. Soil sampled as a Typic Cryoboroll, Loamy-Skeletal, Mixed. Cold Spring Park Quadrangle, Elevation 10,130 ft, 4% ESE-facing slope. September 16, 1992.