Taylor Ranch

#1007

PROJECT COMPLETION REPORT

Soil Relationships of the Taylor Ranch and Vicinity

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Undergraduate Soils Research

Summer 1980

INTRODUCTION

It is not often one has the opportunity to develop a research project as an undergraduate. Even less often is one fortunate enough to be able to carry out this research at a facility as unique as the Taylor Ranch. On and around the Taylor Ranch, unlimited possibilities for research in geology, forestry, wildlife, range, soils, microbiology, history, and many other related fields present themselves. Research facilities, such as the Taylor Ranch, play a very important role in expanding the understanding of intricate relationships of studies of seemingly separate interests. It is here the educational experience goes beyond the structured classroom and textbook memorization to interactions between people sharing practical experience and recieving "hands on" application of what they have learned. One "do" is worth ten "sees" and that is what the Taylor Ranch research facility is all about: a chance to "do."

PURPOSE

Stated Objectives

In my proposal to justify my project last spring, I stated my initial objective as describing and classifying the major soils at the Taylor Ranch and vicinity. Through this work, I was hoping to gain valuable "hands on" experience in collecting, describing, and interpreting soil samples and developing my skills in organizing and conducting soils research.

Achievements

I have gained invaluable personal experience from my work at the Taylor Ranch, both in furthering my knowledge of soil systems and in understanding the need to expand my idea of learning to include experiences outside the scope of the tunnel vision we all tend to look through after labeling ourselves with a specific field of study.

Primary in my mind when carrying out my project were ways in which to apply my knowledge and efforts to make a contribution in maintaining or improving the Taylor Ranch as a wilderness research facility. Leaving little or no evidence of disturbance to the environment while carrying out research is of utmost importance (see PROBLEMS). I also tried to coordinate my project with the immediate needs and problems concerning soils at the ranch in which my field of study might be of assistance. Some opportunities to do this arose such as: Alleviating the "sand trap" problem on the airstrip, Minimizing domestic animal waste impact without losing its fertility benefits where such wastes are concentrated, or Reducing erosion and maintaining the watershed value of streams used for irrigation so this valuable use of the abundant surface water resources on the ranch are not lost. By far, however, the most important problem I found and, from the day I arrived at the ranch, was determined to improve was the disposal of human fecal waste in a soil incapable of performing the proper cleansing and filtering action.

My first site for a soil study pit was in the area and the same position relative to landforms as the existing outhouse at the time, to confirm the suspicions and reservations I had about this soil. At this site (see map, site #1, under General Classifications), I found a very shallow soil depth to a fluctuating water table that will rise close to the soil surface in the early spring. At this point, I altered my project schedule to find a location with suitable soil depth, percolation, and distance from a water source, both surface and ground, to insure the continued high quality of the water in the area, and further downstream on the Big Creek drainage.

After studying landforms, measuring distances to surface water sources, and making a number of auger test samples, I built a new outhouse on pit site #2. (see map) This spot met the three major criteria for an adequate site: 1. Distance from surface and ground water as stated in the Management Plan for the Idaho Primitive Area[1] "Toilets must be located at least 200 feet from live water and not in the water table at wet sites." 2. Adequate soil depth and percolation to allow a trickling filter effect, 3. Within close proximity to areas of heaviest use. The new outhouse is located over 300 feet from either Big or Pioneer Creeks, the bottom of the pit is over six feet from the water table at its highest point of fluctuation, the soil is fine to coarse loamy sand textured, deep, with no water restrictive clay layers, and, finally, is close to and actually more accessable than the old site to the areas of highest use.

Purpose of This Paper

In writing this paper my goal is to steer clear of just making a compilation of data to dazzle the reader with numbers and names that need a code book to understand. My intent by this paper is to lend to the better understanding, by both lay people and those with scientific backgrounds, of soil relationships and how they affect the ecosystem (and vice-versa) of the Taylor Ranch.

PROBLEM

Achieving the purposes of my research and this paper necessitated digging soil observation and sampling pits and boring dozens of auger samples. As I stated earlier, this work must be undertaken with care to cause as little disturbance to the soil system as possible. This means not only taking care of the surface appearances, but also minimizing subsurface disturbance. Replacing a clay layer from a five foot depth to the surface when refilling a pit will obviously reduce the soil permiability at a site. Due to the extreme local relief of the area and the high erosion potential of the resulting steep slopes, there were many areas unsuitable for digging soil pits. In these areas it is necessary to make soil interpretations by association to related sites instead of direct observation and sampling. Throughout my research, I took great care to replace as I removed and not create any future erosion problems.

SCOPE.

The scope of this paper is centered upon the accomplishment of a three-fold objective: 1. A better understanding of soils and their development by the reader, 2 Demonstrating how soils information is useful on a cross disciplinary level and, 3 Providing some answers to the question "why is that kind of soil there?" Throughout my explanations and interpretations I will use straightforward descriptions and minimize the use of technical terms and names so that the application of this information can be seen without requiring a degree in Soil Science to understand.

UNDERSTANDING SOILS

Soils Defined

Soil is alive; dirt is dead. This is the first and most important concept one must come to understand to begin understanding soils. Dirt is that static, unchanging pile of material one sweeps off the floor or scrapes out from under fingernails. Soil as alive means being in an ever changing, developing state acted upon by and acting upon the environment around it. Because the soil itself outwardly shows little evidence of "life," it is to many people an inert mass upon which we build our highways and buildings and plant our crops. A single, all encompassing definition for the word soil is hard to come by and most definitions contain only those characteristics important to the person doing the defining. The geologist speaks of "soil material," the engineer deals with "shear strengths and discontinuity," the botonist looks at the "depth of rooting by plants," and the archiologist complains about "that stuff covering my digs."

The soil as a whole is "that part of the earth's crust that has properties reflecting the effects of local or zonal soil forming agents."[2] Individual soils, however, are each unique, independant natural bodies with their own morphology due to a specific combination of the five soil forming factors: Parent material, Climate, Organisms, Topography, and Time.

The Importance of Soil Forming Factors

An understanding of soils is acquired by learning how, why, and where various soils have developed. To the casual observer, it may appear that chance determines the type of soil that develops at any location. However, nothing could be further from the truth for chance plays so small a part in soil formation and the climate, organisms, parent material, topography, and time so large a part, that it is possible to predict the collective soil properties and soil types that will be present at a location from information on the factors governing formation at that location. Conversely, from the type, properties, and pattern of formation of a soil at a given location, one can look back in time and obtain an excellent idea of the combination of influences causing the morphology of that soil.

It is for this reason soils information is valuable on an interdisciplinary level. When we study a soil, we study the short term fluctuation and long term stability of processes within the ecosystem a soil has formed. We can "read" the succession of slow physical, chemical, and biological events from the profile of a soil and determine whether what we see on the surface "today" was there "yesterday" and will remain there "tomorrow."

FACTORS OF SOIL FORMATION and the TAYLOR RANCH

Parent Material

Throughout the cycle of soil formation, the original material a soil is formed from, the parent material, influences the time, rate, degree, and end product of soil development. Texture, mineral composition (fertility), reaction (pH), depth, and other soil properties relate to the composition of the original material and its resistance to decomposition by the climate and organisms.

PARENT MATERIAL/GEOLOGY: TAYLOR RANCH

Geologically, the Taylor Ranch is situated precisely between three major formations[3] that influence the development of differing soil properties in residual soils (those formed in place) of relatively close proximity. Though the dominant formation is the granitic mass of the Idaho batholith, from Big Creek south this gives way to a major formation of yellowjacket and hoodoo quartzite with a third formation of black latite and other intrusive complexes found to the south and east of the ranch. Deeper soil development and less course rocky and stony material seem to occur in those soils derived from the granitic material.

Alpine glaciation during early Pleistocene times and resultant para-glacial effects of floods, outwash, and freeze/thaw breakdown of rock formations also affect the geology and soil parent material of the area.

Heavy deposits of additional transported parent material are carried by (and removed by) the many streams in the area ranging from stony coarse sand found in former stream beds (see figure 1) to the very fine sand and silt found on level flood plains (see figure 2). The constant cutting and filling action of these streams allow only limited development of these soils which have many horizons (subsurface soil layers) from multiple alluvial depositions in the recent geologic past. (also figure 2)

There is little evidence of volcanic or other loessal (wind borne) deposits in the area, though, undoubtedly, when looking at the geologic history of this area[4], these materials contributed to the total picture of soil formation especially on the flat benches and upper meadows where erosion is minimal.

Climate

Climate itself can be divided into soil forming subfactors such as: temperature, precipitation, wind, direction, and humidity. Of primary importance to the soil forming processes are the mean annual temperatures and precipitation. A region's climate has a direct influence on soil formation by determining the extent, rate of, and type of weathering that will occur on parent material with time as well as an influencial control of the growth and development of the natural vegetative types which make up the bulk of the soil forming factor; Organisms.

CLIMATE: Taylor Ranch

Unfortunately, the climate data on the Taylor Ranch is minimal. Through information collected at stations within a one hundred mile radius of the ranch, estimates and inferences for mean annual temperature and precipitation and their monthly variations must serve for research at the facility instead of an exact reference. James Claar[5] (1973) placed

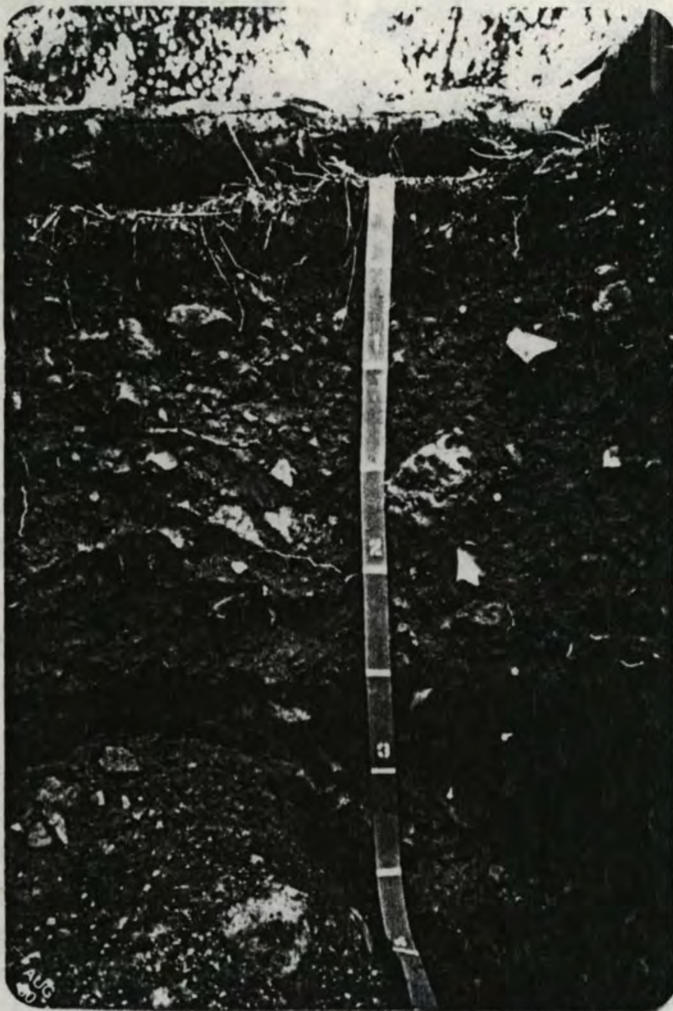


Figure 1. Dystric Fluventic Xerochrept at site #2.

Former stream bed of Big Creek buried under later floodwaters.

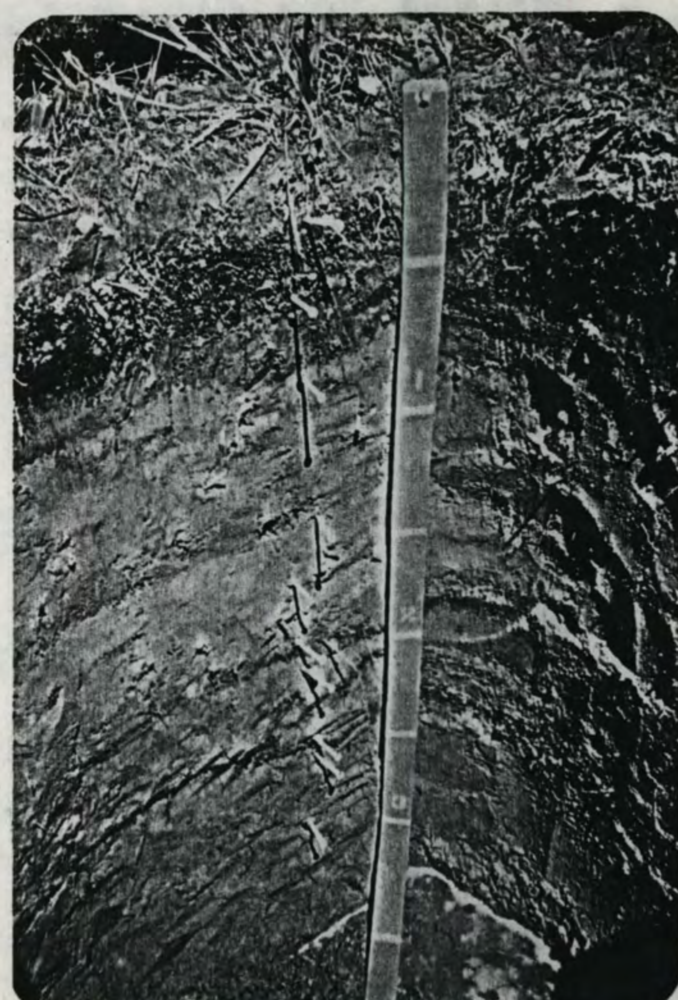


Figure 2. Fluventic Xeraquept at site #7.

Multiple alluvial layers with water table at 3.5 feet.

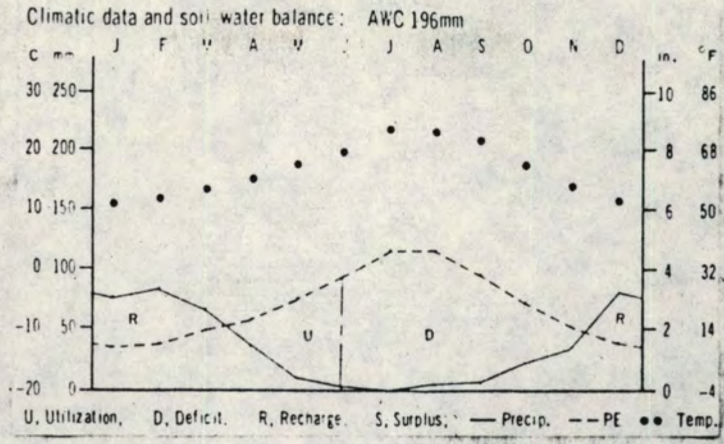
the moisture regime at fifteen inches annual precipitation, mostly falling between late fall and early spring (citing a midpoint between Salmon ranger station and Big Creek ranger station). Ross and Savage[6] (1967) cite the area on a regional basis as having between sixteen and twenty four inches of annual precipitation and a mean annual temperature of approximately 45 °F with a 50 °F annual temperature range. Dr. Dale Thornburgh[7] places the ranch in a Xeric moisture regime which is typified in Mediterranean climates where winters are cool and wet and summers hot and dry. This moisture coming in winter when evapotranspiration (organism activity) is at a minimum, is particularly effective for leaching of materials down through the soil.

After studying the soils around the ranch, I place the moisture regime somewhere between Xeric and Udic (see figure 3), which show a higher fluctuation in temperature but a more even distribution of precipitation with a peak in themonths of winter to late spring. Many areas affected by high water tables show a tendancy toward an Aquic moisture regime characterized by saturated soils. I suggest a mean annual temperature around 40-45 °F.

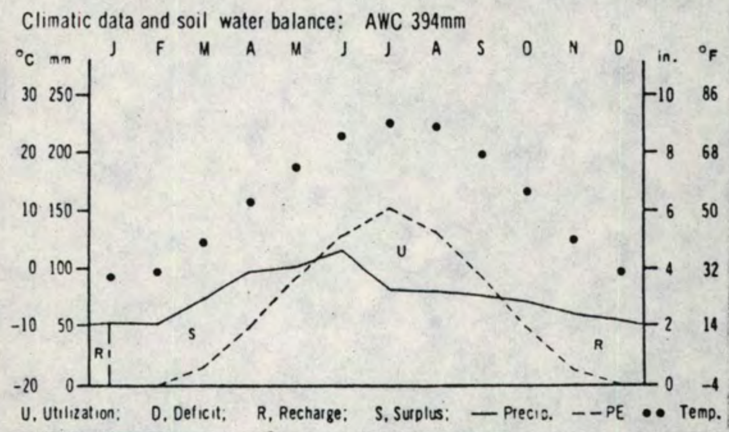
The effect of cool season precipitation is most marked on organism activity, both micro and macro, which is restricted by low available moisture in warm months and low temperatures in moist months. However, on the micro climate level, the topography of the area allows for a wide combination and variation in temperature and moisture regimes.

Topography

Topography, where highly varied, plays a key role in modifying the local climate. The Taylor Ranch area is an excellent example of



Climatic data and soil water balance for
a soil with a xeric moisture regime.



Climatic data and soil water balance for
a soil that has a udic moisture regime.

Figure Three: Soil moisture and temp. regime comparison this variation resulting in a large number of microclimates and "sub" ecosystems occurring in a fairly restricted area.

TOPOGRAPHY: Taylor Ranch

Variations in aspect of slope alone causes extreme alteration of effective precipitation and soil temperatures (soil climate). South facing slopes will be a full moisture regime lower than north slopes and the soil shows evidence of approaching an Aridic moisture regime on these south slopes in the past. Higher temperatures in the soil of south facing slopes favor a high evaporation rate on these sides leaving much of the water soluble salts and minerals intact within the soil. North slopes show a much higher precipitation effect: steeper slopes, greater erosion, and a lower average pH value (5.94 north-6.85 south*). These values indicate a higher degree of water leaching down through the soil profile or down slope rather than evaporating from the surface.

Gravity and surface water erosion due to the long, steep slopes lend to highly mixed materials in most of the soils. The rough and jagged surfaces of rocky and stony material throughout the profile of all but one pit site (see figure 4), indicate constant colluvial deposition from land sloughing, physical dislodgement of material up-slope, and in some cases short term transport within flood waters.

By modifying regional and local climate, topography causes a wide variety of organism type and activity resulting in very marked contrasts in soil development.

* saturated pH average of forty four random soil samples

Figure 4. Heavy deposit of colluvium on north-east face slope.

Figure 5. Multiple microclimates created by variable topography.

in its immediate vicinity[8].

Populus Trichocarpa Type (Cottonwood type)

Along the streams and in soils with high water tables is where this community dominates. In it we find aspen, cottonwood, dogwood, hawthorn, and willow trees in conjunction with a lush understory resulting in a large amount of organic matter being deposited on the soil surface. Their associated shallow, extensive root systems add much organic matter under the surface of the soil from the cyclic die off, decomposition, and regrowth of these roots. The presence of this community, a primary invader of areas where flood waters have recently receded, indicates a very young soil of relatively high organic matter content, an aquic moisture regime influenced by periodic flooding and a high water table, the presence of clay and reduced minerals and metals in the lower part of the soil profile, and generally a lower percentage of rocky and stony material compared to the sands and silts from alluvial deposition.

Pseudotsuga menziesii-Physocarpa malvaceus Type
(Douglas Fir-ninebark)

This habitat type dominates and occurs primarily on the north slopes but is also found on old stream terraces where the water table has receded to the point where the Populus Trichocarpa type can no longer compete. There is some encroachment by this type on some protected southerly slopes, but this is dependant upon a close proximity to a ground water supply. Soils associated with this type are typically shallow to moderate in depth (4 - 7 feet) to a lithic or paralithic contact (geologic rock material), show conspicuous signs of erosion, and have greater than fifty percent by volume stones and rocks, on the north slopes. These soils are unstable and erosive with most of the organic duff remaining in an undecomposed

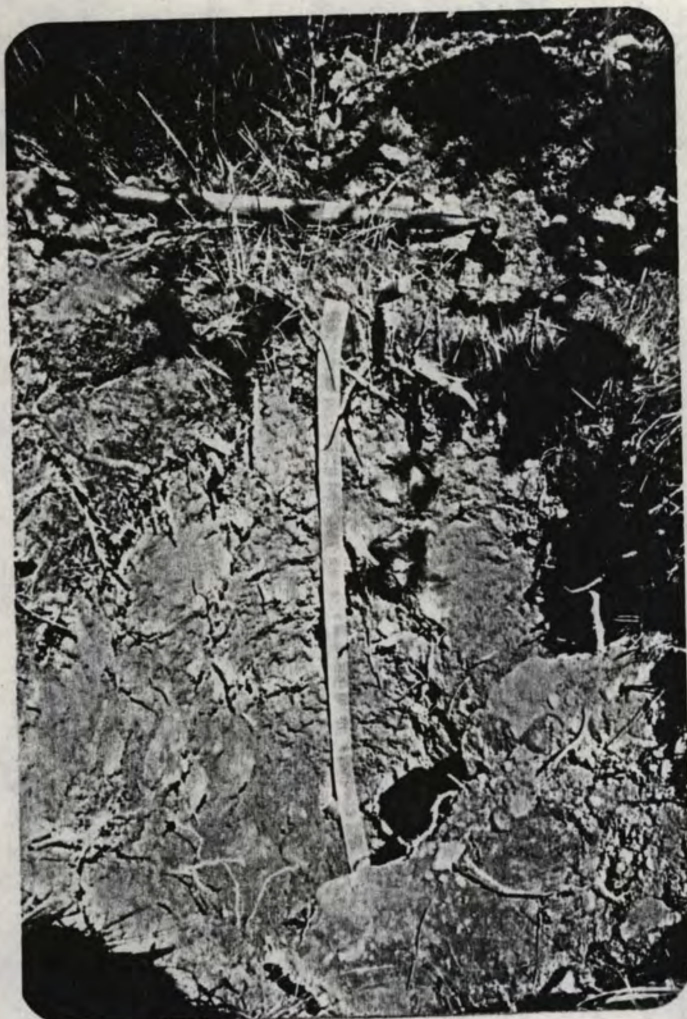


Figure 6. Shallow, fine textured soil, wet at the bottom. Populus Trichocarpa ht.

Fluventic Xerochrept Site #3.

Figure 7. Typic Xerumbrept, Site #5
Douglas fir-ninebark ht.

recognizable form due to lower effective soil temperatures from shading and retained snow cover inhibiting microorganism activity. In the areas where this type has invaded other habitat types, the soil more readily reflects the influence of the original type because of the relatively short establishment time and lesser subsurface effect of the Douglas fir type.

Agropyron spicatum-Balsamorhiza sagitteta Type
(Bluebunch wheatgrass-Balsam root)

A pattern of relatively deep, fertile, and erosively stable soils characterize the habitat type dominated by the bunchgrasses. Extensive root systems by the vegetation associated with this type result in stable, porous, dark (high in organic carbon), and well aggregated surface horizons in these relatively deep, southerly aspect soils. The occurrence of this vegetation/soil relationship is most obvious on the flat, south facing, upper meadows and the more gently sloping south slopes, though even on steeply sloping southern slopes, the soils are stable when not disturbed by animal or human activity. Soil temperatures are higher than in the bottom lands and north slopes and remain relativly high during the cold wet winter months resulting in a greater soil microorganism activity as is evidenced by the mollic epipedon ("soft" dark surface layer). A lower effective moisture regime (see Topogr.) results in a higher base saturation (more nutrient cations) and higher pH because of a shallow moisture penetration depth.

Pseudotsuga menziesii-Agropyron spicatum Type
(Douglas fir-Blubunch wheatgrass)

This habitat type is typical of old river terraces and lower slopes protected from direct southerly exposure but with dryer and warmer soil influences than those found on the north slopes. It consists of scattered, invading Douglas fir on a mainly bunchgrass surface cover. Soils in this

Figure 8. Bunchgrass ht.

Figure 9. Douglas fir-bunchgrass ht.

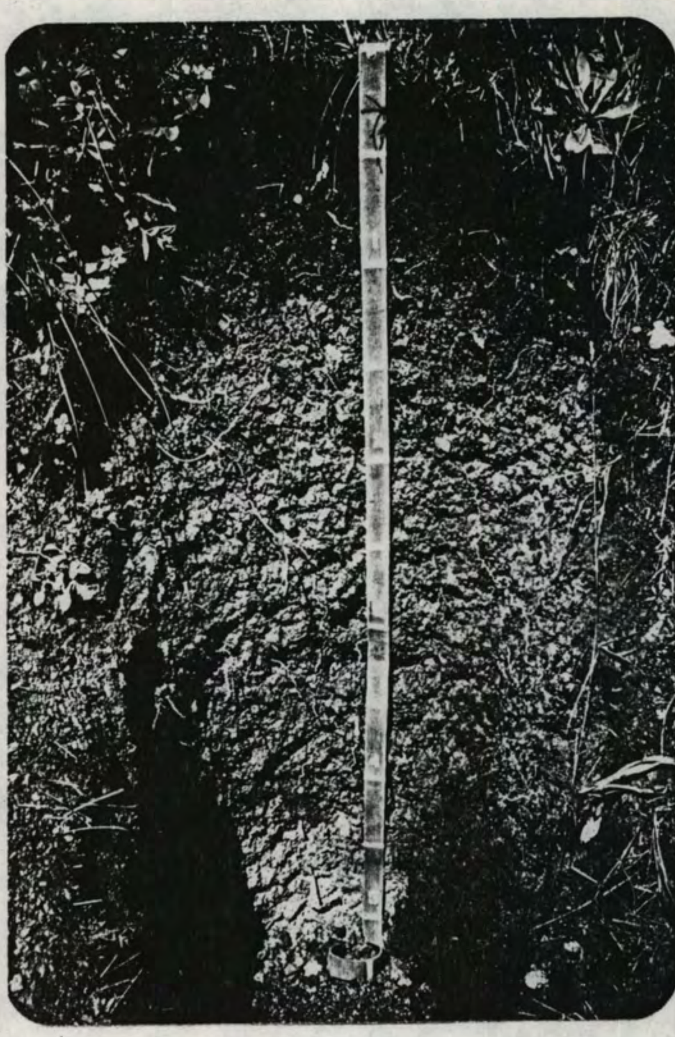


Figure 10. Typic Xerumbrept. Douglas fir-bunchgrass ht.

habitat are of moderate depth, high in organic carbon in the upper surface, erosively stable, and tend to have greater than 50% by volume stones and rocks in the upper profile (three foot depth).

Time

The controlling factor of soil formation. Soil formation, even under the best combination of conditions created by the other four factors, is an extremely slow process. One needs only to refer to the weak to moderate development of soils formed from glacial deposits of the most recent glaciation period, seven to ten thousand years ago, to get a perspective on this factor. It is this factor we must keep in mind when we disturb the land, either by removing or replacing its cover or by displacing the soil. All ecosystems have the ability for recovery and regeneration but without careful consideration by man, what may take years or months or even minutes to alter, may take thousands of years to repair.

TIME: Taylor Ranch

One characteristic common to all the soils found on and around the Taylor Ranch is their relatively young stage of development. In the steam valley the constant cutting and filling action allow soils to develop for only a relatively short period of time before being swept away in flood waters or buried under new sediments. The steep slopes of the area have caused soil erosion to keep pace with formation and in some cases will not allow any formation to occur at all. The areas that seem to be stablizing, have only "recently" done so and could easily be disrupted by a slight change in climate or land use. Though some geologic formations in the area date back to the hundreds of millions of years[9], long term soil development has not in the past and most likely will not occur in the future due to the regions dynamic succession of deposits, removals, and tranfers.

CONCLUSION

I count this past summer as being the greatest educational experience I have had in five years of college study, The Taylor Ranch is an ideal wilderness research facility for a vast variety of natural science disciplines. In addition to this it serves a function in providing students with a chance to confront the depths of their ignorance in understanding the complexities and interactions in nature that defy the printed word or pictoral reproduction.

As a break from tradition, I will refrain from repeating highlights of or summarizing this paper. My attempt, in writing this report, is to demonstrate the value of soils research to:the better understanding of soils relationships to other natural science disciplines, people in land management positions, and situations in our everyday lives.

Past researchers have made generalizations and educated guesses about "the soil" around the Taylor Ranch. (By the way there are soils at the ranch, not the soil) Evidence of charcoal at a four to seven inch depth in sites 4, 5, and 15, completely reverse past claims that there is no evidence of fire influence on the vegetative cover. Historic, long term, climatological influences "imprint" themselves in a soil and allow us to draw some conclusions as to why we see what we see on the surface today (though the collection of daily weather data would be invaluable, especially at a research station).

Soils are always affected by and will affect land use decisions. Thus, knowledge of the positive and/or negative aspects of these decisions before the manifestation of their results should be placed on the balance when weighing the pros and cons of a management decision.

Finally, we come to the everyday value of soils information such as: the placement of an outhouse, the position of a building, the irrigation of the land, or the stabilization of a highly disturbed system such as an airplane landing strip. An understanding of soils as systems with multiple influences can save time, money, and the land. Consulting a soil scientist is not <u>always</u> necessary, but common sense consultation with the soil is.

GENERAL CLASSIFICATIONS: Soil Pit Sites

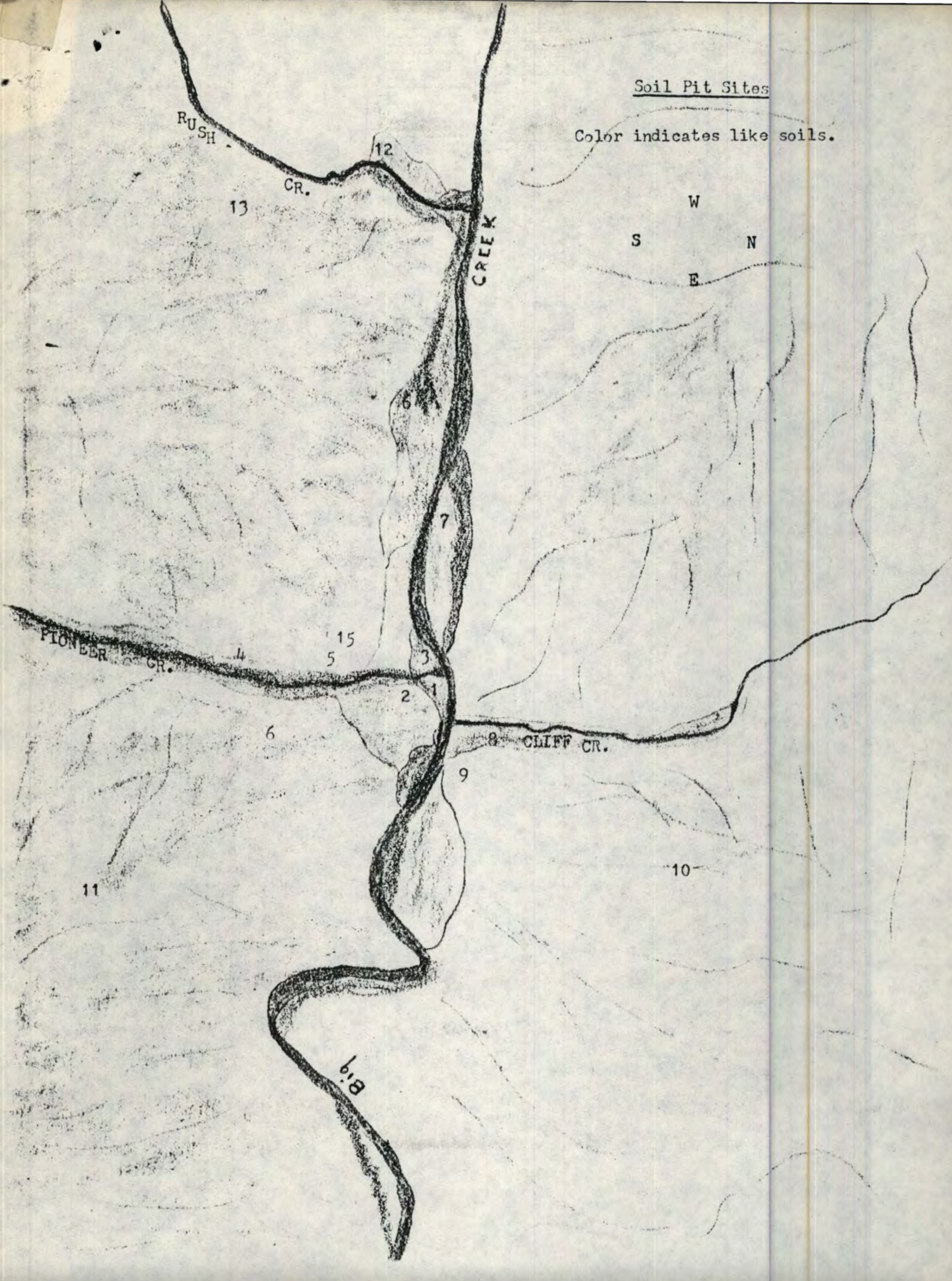
The following are general soil classifications (Order-Suborder-Great and Sub Group) of the soils at the sites located on the map. Four other pits were located off the map and like pits 11, 13 and 14, were not classified but used to to develop this study. This is not a strict classification as my past experience in soil classification is limited.

1. Fluvaquentic Humaquept
2. Dystric Fluventic Xerochrept
3. Fluventic Xerochrept
4. Pachic Xerumbrept
5. Typic Xerumbrept
6. Typic Haplaquept
7. Fluventic Xeraquept
8. Fluventic Xerumbrept
9. Entic Xerumbrept
10. Typic Haploxeroll
12. Fluventic Xerochrept
15. Lithic Xerumbrept

The formative elements of the names reflect influences of the formation factors. Example: Site 15, An Inceptisol (young) with an umbric epipedon (dark, deep surface), having a xeric moisture/temperature regime and a lithic contact (soil formation influences down to geologic rock material.

Soil Pit Sites

Color indicates like soils.



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