pH VALUES ON SITE I AREAS

OF THE McDONALD FOREST

by

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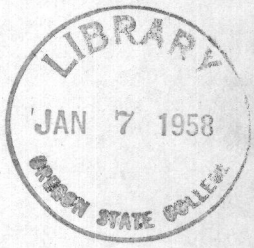

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LIST OF TABLES

pH VALUES ON SITE I AREAS OF THE McDONALD FOREST

A. Introduction

The object of this thesis is the determination of the pH values of site I areas containing Douglas Fir on the McDonald Forest.

This work was done with the idea of starting a series of projects ultimately designed to determine the relation of soil acidity to site quality on the McDonald Forest. Future work will tend to bring out better methods of procedure and more definite objectives.

The present value of this study is little. It will provide a basis for future work which may reveal facts of importance to the silviculturist or timberland owner.

Only one previous study has been made on this subject. Stanton E. Lyon, (6), a student of the School of Forestry of Oregon State College in 1938, wrote his results under the title, "Testing Samples of Soils of the McDonald Forest." He made no attempt to determine site classes, nor did he confine his work to soil covered with any particular species. His object was to get samples from different type areas over the whole McDonald Forest. No definite conclusions were reached other than the pH of the samples tested.

B. Report

Choice of Areas

Out of the seven site I areas shown on the site map of the McDonald Forest, only two were considered sufficiently high quality to be tested. The largest area shown had been logged off, and so did not come under the scope of this work. The remaining four were omitted because of the chance of error in originally mapping site quality due to their small size and insufficient number of samples used for data, and because of the difficulty in locating them accurately in the field. The two areas selected happened to be on or near roads, thus making their location relatively easy.

History of the McDonald Forest

The McDonald Forest is not a typical second growth forest; a typical second growth forest implies the presence of an original virgin stand which has been removed, allowing a new stand to grow in its place. Rather it is a new forest. This area was originally grassland with scattered Oregon White Oaks. The natural tendency of the Douglas Fir in the nearby higher hills to creep into the lower foothills had been kept in check by repeated burnings up to the late 1850's. When these fires no longer occurred, the present stand started from scattered seed trees left uninjured by the fires. As a result the forest is approximately 70 or 80 years old.

From a fire history study, made from stumps in sections 4 and 36, fires have occurred at least once every 50 years for the last 300 years. The latest fire of sufficient intensity to be observed occurred about 90 years ago, in 1848. This last fire had no appreciable affect on the present stand.

Influence of the Acidity on the Physical and Mechanical Properties of the Soil.

According to G. Luncz, (2), the physical properties of the soil generally change with an increase of acidity in such a manner that the changes may, over a relatively long period, become directly or indirectly injurious to the forest. Increased acidity is generally followed by a decreasing capacity for air. This results in seriously hindering moisture circulation and hence retards organic decomposition, resulting in forming colloidal clay and decreasing lime content. Soil structure is less markedly affected by acidity; the increase of porosity is more or less inversely proportional to the increase of pH. Decomposition of litter by bacteria is also affected by soil acidity. The various groups of different bacteria require, apparently, a certain optimum acidity which may vary according to circumstances.

Luncz (2) also shows that conifers always produce a more acid soil than deciduous species. In some cases in Sweden, pure spruce stands have so increased the acidity of

the soil that natural regeneration is impossible. Perhaps the only practical method of reducing excessively acid soil on a large scale is to plant an understory of beech, which, in a few decades, will reduce a strongly acid humus of spruce or Scot's Pine to a mild humus.

Nemec and Kvapil (1) have come to the following conclusions:

(a) coniferous forests show a greater acidity than a deciduous forest of the same region;

(b) acidity of soils under conifers varies directly as the density of the stand;

(c) the degree of acidity may vary continuously during the year, that is, the pH will be higher in the autumn than in the spring.

Location of the Areas

Area I lies in the SW 1/4, SE 1/4, Section 4, T 11 S, R 5 W, Willamette Meridian. With reference to local landmarks, it is approximately 500 feet due west of a point on the road from Lewisburg Junction to Sulphur Springs on the Soap Creek Road, about one quarter of a mile north of the crossroads at the summit. This summit is commonly known as the Saddle.

Area II lies in the SW 1/4, NW 1/4, Section 36, T 10 S, R 5 W, Willamette Meridian. With reference to local land-

marks it is on both sides of Schreiner Road, approximately one quarter of a mile east of the junction of the road branching off the Schreiner Road and making a loop past Cronemiller Lake and again connecting with Schreiner Road, and the road to the Powderhouse. The weather station (not permanent) is in the middle of the area.

Field Procedure

Since the site index of the areas was doubtful, a site classification was made of both areas. Four dominant trees were selected within each area, and increment borings were made at 4 foot heights above the ground in each, and their height determined by a topog abney, the distance from the tree to the point of observation being paced. An age count was made for each tree from the core. As this age was for that part of the tree above the boring, a correction factor, corresponding to the number of years it took the tree to grow from the ground level to a height of 4 feet, was added (see Table I). The measurements for each were then averaged and the results compared with Table II.

Soil samples were taken at 6, 12, and 18 inches below the ground line from four points within each area. Each sample was placed in a small glass bottle, corked and labeled as to area, point within the area, and depth.

Laboratory Procedure

The pH values of the samples were determined by the "spot plate" field method, using a Morgan Field Testkit. This kit was composed of a spot plate, glass stirring rod, distilled water, three indicators, and a color chart. The indicators were brom cresol green, brom cresol purple, and brom thymal blue, with pH ranges of 3.8 to 5.4, 5.4 to 6.0, and 6.0 to 7.7 respectively. About 5 cc. of soil from a sample was placed in each of three holes in the spot plate, enough distilled water was added to cover the soil without running over, and then two drops of each of the indicators was added, one indicator to each hole. This mixture was stirred slightly and allowed to set so the soil particles would settle out, then the plate was tipped up and the liquid drained off each sample into the corresponding lower row of holes. The indicator reacts with the hydrogen ions in the solution according to their concentration, which is shown by different shades of color. These colors are compared with the color chart giving the pH values for each indicator and shade for .1 of a unit.

To prevent contamination of the soil samples, either in the field or laboratory, pH tests were made on the sample bottles and the distilled water. Both had a pH value of approximately 7.0, which is neutral.

Soil Characteristics

The soil on both areas is an Aiken silty clay loam, and is a typical hill soil of the western Willamette Valley.[1] This soil is friable, even when wet. It is a residual soil of basaltic origin, typically 10 to 12 inches of red to brownish-red surface soil. The subsoil is red, about the same texture as the surface soil, and frequently contains iron concretions.

Description of the Areas

Area I. Covered with a heavy stand of Douglas Fir about 70 years old. The understory is of vine maple, especially where the canopy has been broken by an old logging road running thru the middle of the area. The average slope is about 5%, with a west exposure. The soil is of medium depth, perhaps averaging about 10 or 12 inches. The subsoil contains numerous concretions and is deeper and more clayey than in Area II. Area is 1/4 acre.

Area II. Covered with a fairly heavy stand of Douglas Fir about about 70 years old, slightly less dense than Area I. The understory is mainly bracken fern. The area is divided into two parts by the road. The soil is better than that of Area I, especially in the depth of the surface soil, which is 15 or 16 inches deep. The subsoil contains less clay, and very few concretions. The average slope varies from 0% to 5%, with a northwest exposure. Area is 1/4 acre.

Discussion

As seen from the table of pH values (Table IV), the average pH values are 5.7 and 6.2. These values correspond to Nemec's and Kvapil's conclusion (b). There is apparently no correlation between the pH values and site quality as shown here. More sample areas of each site class will be needed to show any correlation if it exists. Various factors could change the acidity, as mentioned before.

C. Summary

Conclusions

No definite conclusions can be made, except for the pH values of the two areas. There is a correlation, with only one exception out of eight samples, of pH and soil depth; the 6 inch layer was uniformly more acid than either the 12 or 18 inch layers. Another correlation was found to be between stand density and acidity; the denser the stand, the more acid the soil. The above correlations may be only coincidence; more samples should be taken before any definite results can be obtained.

Since the method used is only a field test, at best it is only approximate. More accurate methods require uniform sampling, made by thoroughly mixing many samples from each layer within an area, rather than using a few samples haphazardly chosen. A relatively few samples was used here

because the spot plate method is not accurate enough to show any variations in the two extremes of sampling.

Review of Work

The site indices of two of the best areas for producing Douglas Fir on the McDonald Forest were determined and found to be 187 and 190. Both areas were classified as Site I. The pH value of the Aiken silty clay loam soil was determined at 6, 12, and 18 inch depths. In Area I, near the Saddle, these values varied from 5.4 to 6.0, with an average of 5.7. In Area II, near the weather station, the values varied from 5.9 to 6.5, with an average of 6.2.

Both areas were nearly identical in exposure, slope, amount of humus, litter, and soil type.

A correlation was found between stand density and acidity. The denser the stand, the more acid the soil. Another correlation was found between the acidity at different depths. The 6 inch layer was more uniformly acid than either the 12 or 18 inch layer.

Recommendations

Further work on this subject should be undertaken. This can be done in conjuction with the term projects in Silviculture. Any further work should make use of more accurate methods of pH determination to give more reliable information.

Bibliography

(1) "Biochemical Studies on the Acidity of Forest Soils" by Nemec and Kvapil. International Review of the Science and Practice of Agriculture, n.s. 3:738. July 1925.

(2) "Importance of Soil Acidity on Forest Soils" by G. Luncz. International Review of Agriculture, 21 pt. 1:431-8. November 1930.

(3) "The Soil Survey of Benton County, Oregon" by Carpenter and Torgerson, Oregon Agricultural Experimental Station, Corvallis, Oregon.

(4) "Soils - With Particular Reference to those of the Forest" by A. Issacs, Pacific Northwest Experiment Station.

(5) "Soil Reaction in Relation to Forestry" by S. A. Wilde. Journal of Forestry, April 1934.

(6) "Testing Samples of Soils of the McDonald Forest" by Stanton E. Lyon, School of Forestry, Oregon State College.

(7) "The Yield of Douglas Fir in the Pacific Northwest" by W. H. Meyer and R. E. McArdle. USDA Tech. Bull. 201.

(8) Site Map of the McDonald Forest, School of Forestry, Oregon State College.

Appendix

Table I

"Height growth of dominant Douglas Fir seedlings"

(USDA Technical Bulletin 201, Table 19)

Height above ground (ft.)	Growing period required (yrs.)				
	I	II	III	IV	V
1	3	3	3	4	5
2	4	5	6	6	7
3	5	6	7	8	9
4	6	7	8	9	10
5	7	8	9	10	11

Table II

"Average total height of dominant and codominant Douglas Fir trees by site classes"

(USDA Technical Bulletin 201, part of Table I)

Age (yrs.)	V		IV			III		
	80	90	100	110	120	130	140	150
80	73'	82'	91'	100'	109'	118'	127'	136'

(Continued)

Age (yrs.)	II			I		
	160	170	180	190	200	210
80	145'	154'	163'	172'	181'	190'

Table III

Field data for site determination

Area	Tree #	Age above boring (yrs.)	Total height (ft.)
I	1	80	164
	2	75	166
	3	75	180
	4	65	166
	Ave.	73.5	169
II	1	78	178
	2	74	166
	3	77	183
	4	71	164
	Ave.	75	173

Computation of site class

Area I

Average age above boring - 73.5 years
Seedling age - 6 "
Total average age - 79.5 years

A tree 80 years old and 169 feet high has a site index of 190.

Area II

Average age above boring - 75 years
Seedling age - 6 "
Total average age - 81 years

A tree 81 years old and 173 feet high has a site index of 190.

Table IV

pH values

(numbers refer to point at which samples were taken; letters refer to depth, "a" at 6 inches, "b" at 12 inches, and "c" at 18 inches)

Area I		
sample		pH
1 a	-	6.0
1 b	-	5.6
1 c	-	5.6
2 a	-	5.7
2 b	-	5.6
2 c	-	5.6
3 a	-	5.8
3 b	-	5.8
3 c	-	5.6
4 a	-	5.6
4 b	-	5.4
4 c	-	5.4
Average	-	5.7

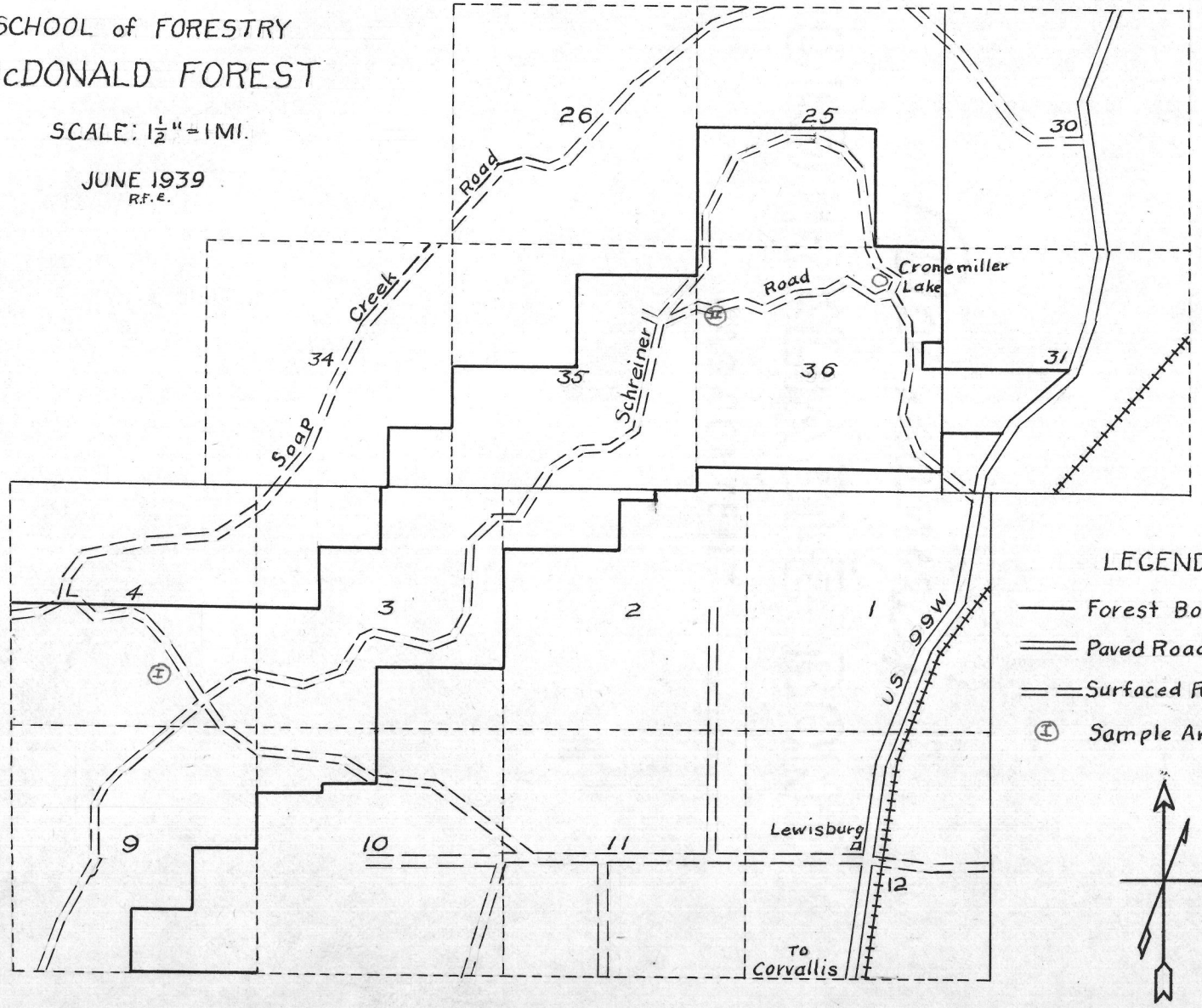
Area II		
sample		pH
1 a	-	6.5
1 b	-	6.3
1 c	-	6.4
2 a	-	6.3
2 b	-	6.3
2 c	-	6.1
3 a	-	6.2
3 b	-	5.9
3 c	-	6.0
4 a	-	6.3
4 b	-	6.2
4 c	-	6.2
Average	-	6.2

SCHOOL of FORESTRY

McDONALD FOREST

SCALE: 1½" = 1 MI.

JUNE 1939
R.F.E.



LEGEND

- Forest Boundaries
- Paved Road
- Surfaced Roads
- Sample Areas

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