1938

Experiment Designed to Show the Relationship Between Soil and Changes in the Vegetational Cover.

by
D. P. Duncan and R. W. Varner

Introduction

During the summer of 1938, a long-time study was inaugrated designed to show the relationship between the soil and vegetational cover in the region of Douglas and Burt Lakes in the western part of Cheboygan County, Mich. The study is being carried out under the direction of F. C. Gates, botanist, W. F. Ramsdell, forester, and L. R. Schoenmann, soil scientist.

Object of the Experiment

It is expected that the study will cover a period of fifty years or more and will be directed not only at a determination of the changes, both qualitative and quantitative, which take place in the soil and plant cover during that time but also at the establishment of a correlation between soil succession and plant succession. The data secured will also furnish information as to the rate of growth that can be expected of the tree species on the various soil types studied.

Prior to 1870, this part of Michigan was covered with fine stands of virgin timber. The Heavier upland

soils were forested largely with the northern hardwood species, sugar maple (Acer saccharum), beech (Fagus grandifolia), yellow birch (Betula lutea), basswood (Tilia americana), and hemlock (Tsuga canadensis) with scattered white pine (Pinus strobus). The more sandy upland soils supported excellent stands of white and red pine (Pinus resinosa), while the wetter and more poorly drained lowland soils were covered with dense forests composed largely of white cedar (Thuja occidentalis), black spruce (Picea mariana), balsam fir (Abies balsamea), and larch (Larix laricina). The better drained lowland soils supported stands of the so called swamp hardwoods, elm (Ulmus americana), black ash (Fraxinus americana), red maple (Acer rubrum), and balm of gilead (Populus balsamifera). Logging and repeated fires have resulted in the destruction of almost all of this original forest and left the land in the condition in which we now find it. The swampy and boggy areas have not suffered so greatly from fire as the upland areas and consequently contain stands much like those originally present. Except for a few relatively rare exceptions, the sandy upland soils are covered with scrubby stands of variable composition but made up largely of such species as large tooth aspen (Populus grandidentata), quaking aspen (Populus tremuloides), jack pine (Pinus banksiana), white birch (Betula papyrifera), red maple (Acer rubrum), red oak (Quercus borealis maxima), and fire cherry (Prunus pennsylvanica). The heavier upland

soils have little or no pine or oak and considerable sugar maple largely in sprout or coppice form.

In initiating this experiment, the aim has been to select plots so located that they cover representative local conditions on the more important soil types. The plots include areas located on wet organic soils supporting stands of much the same composition as the virgin stand as well as on the poorest sandy soil covered with stands very different from those originally on the area. In general the plots are located in younger, growing forest stands where appreciable changes are taking place in volume and composition.

Since this region is not, in general, very satisfactory for agriculture, forest production and wildland recreation are the best uses to which most of the land can be put. This study is expected to furnish data that will be usefull in the preparation of management plans designed to secure optimum yields of forest products.

More specifically, the aims are:

1. To establish the quantitative and qualitative make up of the ground cover found in typical forest cover associations on defined soils with a given drainage.

2. To determine the relationships and changes taking place in ground cover, forest cover, and soil condition.

3. To ascertain the most reliable plant indicators, if any, correlating soil and drainage with forest cover type and its stage of development, ground cover

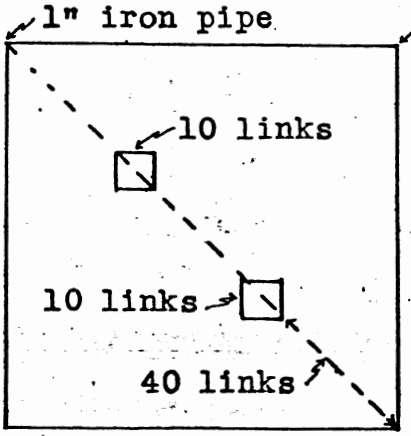
associations, and rate of growth of tree species.

4. To determine and predict the probable composition of the ground and forest cover at intervals in the future on soils which are now of a given drainage and cover.

Procedure

During the first summer, the mechanics of the field work were as follows:

Plots of one tenth acre (404.4 sq. meters) and one thousandth acre (4.04 sq. meters) were established, the corners of the tenth acre plots being laid out with compass and chain on cardinal compass directions whenever that was convenient. Iron pipes were driven marking two diagonal corners, the other two corners being marked by creosoted, inch square wooden stakes. The thousandth acre quadrats were located on the diagonals between the two pipes, their outer corners (those nearest the pipes) being forty links from the corner except on plot seven where existing conditions made departure from this distance desirable. At the corners of these quadrats, similar creosoted stakes were driven.



In mapping the trees, heavy sash cords marked at ten link intervals were stretched along opposite sides of the plot and pins placed at these marked points. Then between opposite pins, lighter cords were stretched and the mappers progressed across these strips in ten link squares. Ordinarily, two members made up the mapping crew one of them doing the recording and the other calling out the location, species, and diameter of each tree as well as locating physical obstructions on the ground surface such as logs and boulders which were sketched to scale. The location of each tree within each ten link square was indicated by its latitude and departure from a given corner previously agreed upon.

Ground cover on the thousandth acre quadrats was mapped by criss-crossing string over them at two link intervals and the plants were then located within these squares by eye and mapped by one man. On the areas where ground plants were so abundant that mapping was virtually impossible, as on the Rifle Peat (plot no. 7), the more permanant forms were mapped and the remainder were recorded in groups without mapping, from areas two links square (1 / 25,000 acre). Thus the thousandth acre plots were divided into 25 smaller units and the plants recorded for each of these subquadrats in list form.

During the summer of 1939, soil samples will be taken from just outside each plot, preserved and accurately described. Additional samples and descriptions will be made at intervals

of from ten to twenty years and the changes which are occuring determined. Similarly, plant surveys will be made at regular but shorter intervals of perhaps five years, and changes in the associations noted.

Predictions.

The manner in which cutting and fire brought about the destruction of the original forest and resulted in its replacement by the present cover has already been discussed. Now that logging and fire have become less widespread, it is to be expected that the succession will proceed differently than at the time that these factors were active. It is this succession that takes place in the absence of fire and cutting that is of particular concern in this paper. Although no carefully planned long-time studies have been carried out in connection with this problem, it should be possible to make relatively accurate predictions regarding future plant development based on short-time studies made in the past and a knowledge of the ecological characteristics of the plant species concerned. It will be interesting at the end of this study to see how closely predictions based on the above data compare with the actual results obtained.

On the sandiest soils of the region of which the Grayling Sand is an example, the present tree cover is composed almost entirely of jack pine and red oak. As time goes on, it is to be expected that these species will be replaced by red pine and red pine will be replaced in turn by white pine. The rate at which this replacement will go on depends upon the number of seed trees of these species in the vicinity. The present ground cover on these jack pine and oak

areas is composed largely of Vaccinium pennsylvanicum, Carex leucorum, Prunus cuneata, and Arctostaphylus uva-ursi. There will probably be little change in the ground cover as the succession proceeds except that it will become more sparse as the jack pine is replaced by the more tolerant species.

On the somewhat heavier upland soils of which the Rubicon and Roselawn Sands are examples, the present forest cover is composed of Populus grandidentata, Acer rubrum and a few scattered red and white pine relics. These stands are thin crowned permitting passage of sufficient light to encourage survival and fairly rapid growth of pine seedlings. Since this is true, it is to be expected that aspen and maple will soon be peplaced by pine. Probably the outstanding change that will take place in the ground cover is the disappearance of Pteris aquilina which is now so abundant.

On the more moist sandy soils of which Saugutuck Sand is an example, the present forest cover is composed largely of Populus tremuloides and Betula papyrifera. Since these areas were originally covered with white pine and seedlings of this species are now present, it is to be expected that white pine will be more important in the new stand than the red pine.

On the heavier upland soils of which the Emmet Sand is an example, the present forest cover is composed of Populus grandidentata, Acer rubrum and seedlings of such species as Acer saccharum and Fagus grandifolia. These more tolerant hardwood species shade the ground so completely that seedling Populus grandidentata and Acer rubrum will not survive. There-

fore, as the trees of these temporary species die, the tolerant hardwood species will gain complete control of the site. Pteris and Rubus, both of which make up a large part of the ground cover on these heavier upland soils, since they are relatively intolerant plants; will drop out as the tolerant tree species become more important.

On the very wet sandy soils such as the Granby Sand, the present forest cover is composed almost entirely of such species as Populus tremuloides, Populus grandidentata, Populus balsamifera, and Salix bebiana. The seedlings below these stands are predominantly swamp conifers; Thuja occidentalis, Picea mariana, and Abies balsamea. It is these species that will make up the stand when the present generation of Populus dies. The ground cover on these soils is now relatively complex and it is probable that less tolerant species will drop out as the Thuja and its associates take over the site.

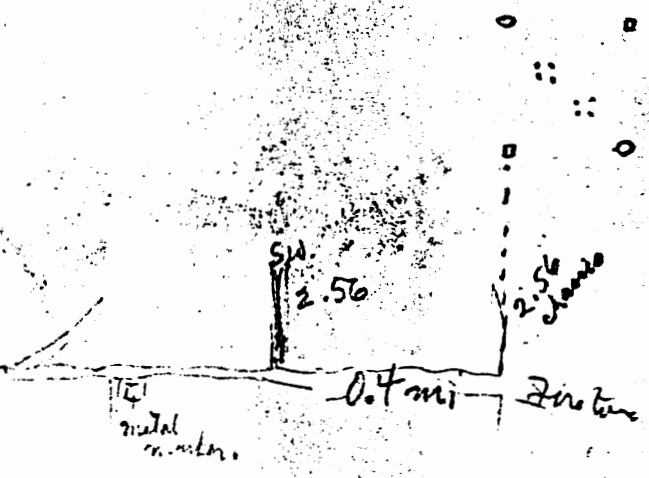
On the very wet organic soils such as the rifle peat, fire has not been a serious factor and a few years after such an area has been cut, it is probable that a cover of the same species as originally occupied the site, will reappear.

Plot No. 1.

Grayling Sand. Soil Number 56.

Plot number one is located in the S ½ of the SW ¼ of the SE ¼ of section 35, T. 35 N. R. 3 W. on level jack pine plains about two miles south of Burt Lake.

In locating the plot, follow the sand road which extends west from highway U. S. 27 about 1.6 miles south of the intersection of highway U. S. 27 and M 68. Drive westerly about one half mile to the north quarter corner of section 2, T. 34 N. R. 3 W. which is marked on an eight inch jack pine on the south side of the road. From the above quarter corner, move easterly along the road ten chains, four links to a six inch blazed jack pine on the north side of the road, thense magnetic north ~~four chains, sixty eight links~~ 2.56 chains to a creosoted stake which marks the southwest corner of the plot. The iron pipes are at the northwest and southeast corners of the plot.



Plot No. 2.

Rubicon Sand. Soil Number 46h (flat-topped hills).

Plot number two is located in the SW ¼ of the NE ¼ of section 32, T. 37 N. R. 3 W. and is practically level with a very slight southerly slope.

In locating the plot, proceed from the crossing of the old railroad grade and the emergency truck road, easterly along the center line of the railroad grade eight and seven tenths chains, thence magnetic south four and eight tenths chains to a one inch iron pipe which marks the northwest corner of the plot.

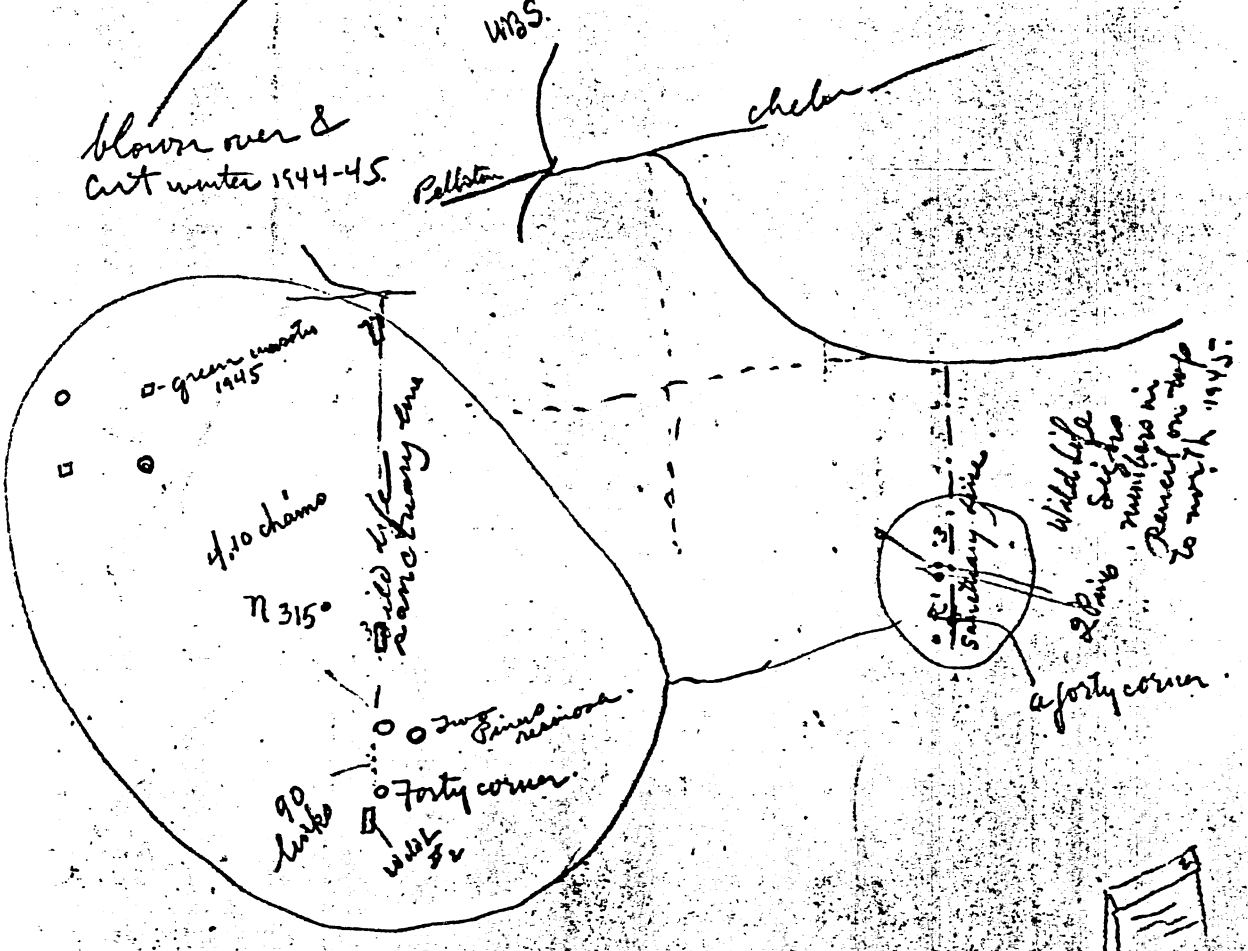
Plot No. 3.

Roselawn Sand. Soil Number 16.

Plot number three is located in the SE ¼ of the NE ¼ of the SW ¼ of section 34, T. 37 N. R. 3 W. on the summit of the ridge running northwesterly from Crump Hill.

In locating the plot, proceed from the intersection of the forty lines at the center of the SW ¼ of sction 34 east along the cut out forty line two chains, six links to the intersection with a north-south trail marked by a sixteen inch Norway pine tree, thence eastward fifteen chains, eighteen links along the forty line, to a point which is thirty-three links to the southwest of a sixteen inch Norway pine, thence magnetic north three chains, sixty six links to an iron pipe at the southeast corner of the plot.

new directions

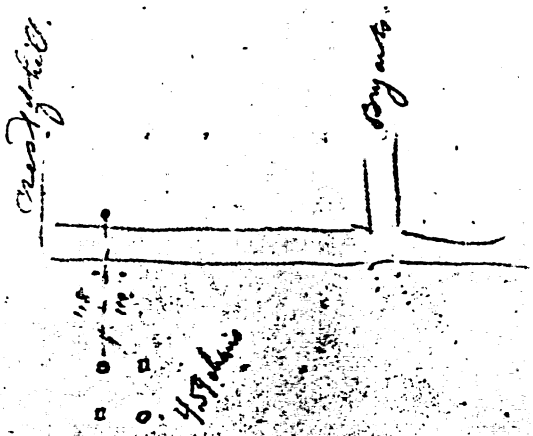


Plot No. 4.

Emmet Loamy Sand. Soil Number 26.

Plot number four is located in the NE ¼ of the NW ¼ of section 6, T. 36 N. R. 3 W. and lies on the westerly slope of the Big Hill Ridge.

In locating the plot, proceed from the powerline pole lying north of the Pelston road 24.35 chains west of the northwest corner of section 5, to the south 4.59 chains to a one inch iron pipe which is the northwest corner of the plot. The powerline pole used for reference is blazed on the north side and lies about midway between pole 118 and 119 of the telephone line which lies along the south side of the road.



Plot No. 5.

Saugatuck Sand. Soil No. 36

Plot number five is located in the SE ¼ of the NW¼ of the NE ¼ of section 22, T. 37 N., R. 3 W. north of North Fishtail Bay of Douglas Lake.

In locating the plot, proceed from the SE corner of the NW ¼ of the NE ¼ of section 22, west 1.11 chains to an old roadway thence N 9° W (351°) 2.40 chains along the old roadway, thence west 35 links to an iron pipe stake which is corner number one of the plot. From corner number one, corner number two lies south 57° (N-237°) west and corner number four lies north 33° (327°) west. The distance is one chain in both cases. The SE corner of the NW ¼ of the NE ¼ of section 22 is a fence corner which lies north 3.43 chains from the road corner where the North Fishtail public beach roadway turns south to the lake along the east boundary of the University of Michigan land in section 22.

Plot No. 6.

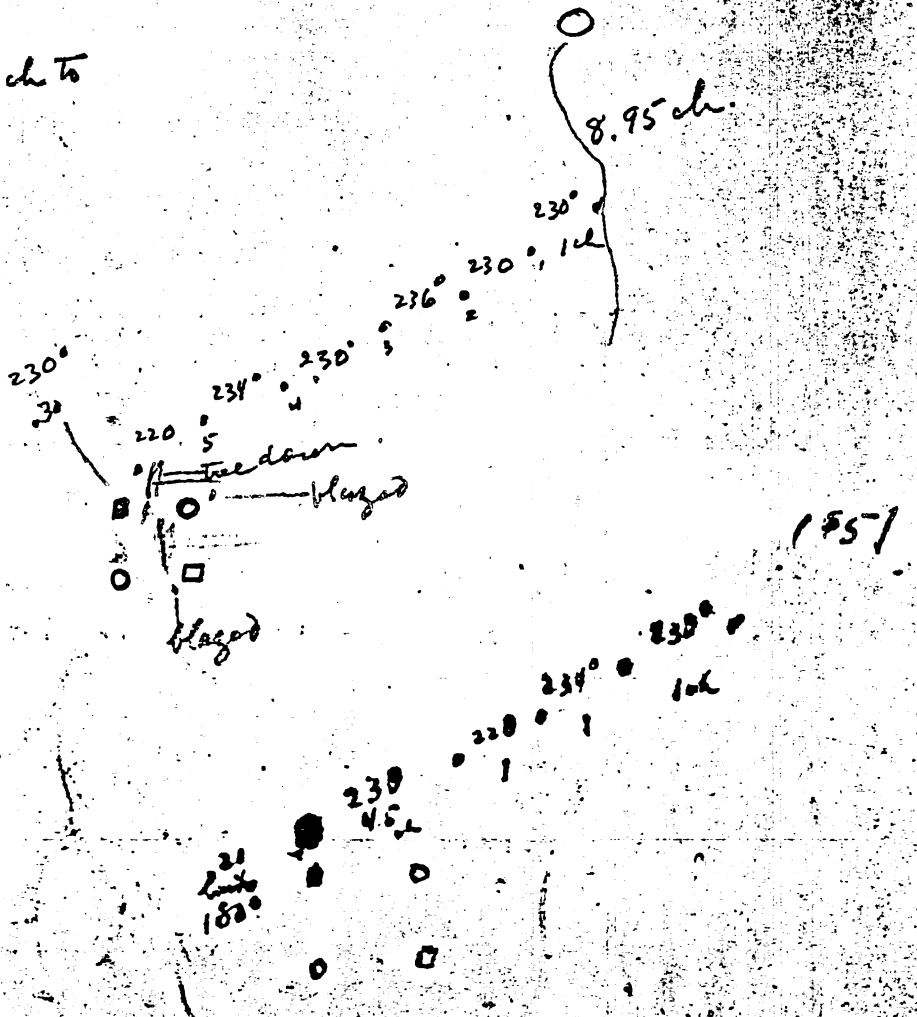
Granby Sand. Soil Number 89.

Plot number six is located in the SE ¼ of the NW ¼ of section 4, T. 37 N., R. 5 W. in a bog swamp forest west of Carp Creek.

In locating the plot, proceed from the south end of the old beaver dam road and the begining of the Carp Creek trail, a point marked by an 11 inch Norway Pine tree, blazed sap southerly along the trail 8 chains and 95 links to a point ~~where a heavy cedar stake stands along the west side,~~ thence southeasterly along a heavily blazed irregular line 7 chains and 50 links to an iron pipe at the northeast corner of the plot.

thence Southwesterly 220°-236° 7.3 ch to creosoted stake which is the northwest corner.

damage in Nov 11 [illegible] storm



Plot No. 7.

Rifle Peat. Soil Number 70.

Plot number seven is located in the NW ¼ of the SW ¼ of section 4, T. 36 N., R. 3 W. in Burt Lake swamp (Westand Reese bog)

In locating the plot, start at the southeast corner of the NW ¼ of the SW ¼ of section 4 and proceed east along the cleared line 4.78 chains to the intersection between this and an old strip road; 27 links south of this intersection is an iron pipe which marks the northeast corner of the plot. In this plot the thousandth acre quadrats are 23 links in from the iron pipes on the diagonal.