# A CONTRAST OF PLANT HABITATS, WITH REFERENCE TO HYDROGEN-ION CONCENTRATION AND PLANT DISTRIBUTION

BY

JEROME ISENBARGER

*Crane Junior College, Chicago, Illinois*

## INTRODUCTION

It has occurred to the writer in the study with regard to soil acidity of various plant habitats in Illinois, Wisconsin, and Indiana, that there is a definite relation between the hydrogen-ion concentration of the soil and the nature of the underlying sub-soil strata and that this is reflected in the character of the vegetation which the habitat supports.

Two typical plant habitats in Illinois are selected to illustrate these relations. One is in the flatwoods of the Thornton forest preserve located 22 miles south of Chicago, the other is a young bog at the west end of Cedar Lake, near the village of Lake Villa in Lake County.

## THORNTON FOREST PRESERVE

The Thornton region is a part of the Chicago plain. It is underlain by dolomitic limestone which crops out in some places and in others is covered to a considerable depth by rock waste and glacial drift. In the particular spot studied the depth of the surficial material has not been determined. The topography of the region is flat, variations occurring in the form of flat land a few feet below the general surface.

Two soil profiles were studied in the Thornton woods, one within a flat depression, and the other several hundred feet distant where the surface is slightly higher. The top soil at the point where the first profile was studied is a dark brown mixture of organic material and fine sand. Above this is a layer, several inches thick, of partly decayed vegetation, made up mainly of leaves from oak trees. Extending from a foot below the surface to an undetermined depth, the material is fine sand. The character of the adjacent region indicates that the sand is underlain by yellow clay. The soil is poorly drained and always moist, yet it is saturated with water only during extended rainy seasons, and is fairly well aerated during the greater part of the year. The conditions which favor acid formation here are the presence of decaying vegetation, consisting mainly of oak leaves, infusions of which have a marked acid reaction, and a deep, silicious sub-soil. Acid accumulation may occur in this type of habitat, due to the fact that basic compounds are not present to neutralize the acids.

At the higher location in the Thornton woods, where the second profile was studied, the material is Miami silt loam, sandy near the surface, but grading rapidly into clay. There is very little undecomposed leaf deposit, the organic matter being in an advanced state of decomposition. The drainage here is good, for this region, and although the presence of decomposing vegetable matter and silicious soil favor acidity, there may be a constant leaching of materials to the clay subsoil where the acids are neutralized by basic carbonates so that the hydrogen-ion concentration changes from acid at the top to alkaline at a depth of two and a half feet.

## CEDAR LAKE BOG

In the Cedar Lake bog the peat at the point studied is about 12 feet deep and overlies a substratum of calcium carbonate in the form of marl. The peat is always saturated with water. Sphagnum, which is highly acid, forms the principal part of the peat. Poor drainage, poor acration, and presence of decomposing Sphagnum and other plain materials, all favor the production of acid. The soil profiles, however, do not show high acidity except within a few inches of the living Sphagnum. Downward from this point throughout the saturated peat, the readings range from slightly acid to neutral or even slightly alkaline. In the part of the bog covered with tamarack trees and without Sphagnum, the surface shows only slight acidity. The neutral or near neutral condition evidently results from reaction with calcium bicarbonate which could diffuse freely upward from the marl substratum.

## METHODS

In studying the Thornton profiles, holes were dug with a spade and samples were taken from the vertical sides. A peat sampler was used in the Cedar Lake bog to get material from the different depths down to the marl. All hydrogen-ion readings were taken in the field at the time the samples were taken. In general, the colorimetric method, using the Morgan soil-testing outfit, seemed sufficiently accurate, but results were checked from time to time by means of a portable electric set-up using the quinhydrone electrode.

The severe acid conditions of the lower Thornton habitat are reflected in the character of the vegetation. The number of species is limited to the few that can tolerate the conditions of this exceptional habitat. The trees are practically limited to oaks, *Q. rubra, Q. alba,* and *Q. ellipsoidalis,* and the black gum, *Nyssa sylvatica.* Many of these oaks, in various stages of development, have died within the past few years. Others of those which remain are in poor condition. The black gum seems fully fitted to cope with the conditions as they are at present. A low-growing species of *Sphagnum* is found in patches. The ferns, *Osmunda regalis* and *Osmunda cinnamomea* are thriving.

The higher Thornton habitat supports a vegetation consisting of the species found in the lower woods and in addition, a number of ferns and other herbaceous plants, the blueberry, *Vaccinium pennsylvanicum,* and *Sassafras variifolium.* The trees are in excellent condition. There is no evidence of deleterious effects of acid on any of the vegetation.

The plants of the Cedar Lake bog include a comparatively few species. Typical bog plants, as *Sphagnum acutifolium;* cranberry, *Vaccinium macrocarpon;* sundew, *Drosera rotundifolia;* pitcher plant, *Sarracenia purpurea; Betula pumila,* and tamarack are growing here and are in excellent condition.

## CONCLUSIONS

(1) In poorly drained silicious soils, as in the lower Thornton flatwoods, acids formed in the decomposition of vegetation near the surface

gradually pass to the lower strata. If the substratum is silicious to a considerable depth, there is an accumulation of acids which limit the plants of the habitat to the species most tolerant to acid.

(2) In well-drained soils where acids are formed in the presence of decaying organic matter, these acids are removed by leaching to the lower strata. If calcium and magnesium bases are present in the sub-soil, acids are neutralized and the accumulation of a marked excess is prevented.

(3) In water-saturated peat underlain by calcium carbonate, there is formed, in the presence of acidulated water, the bicarbonate, which readily diffuses upward, reducing acidity by buffer action or neutralization.

(4) Hydrogen-ion concentration is the dominant factor in limiting the vegetation in the lower acid flatwoods of the Thornton forest preserve.

(5) Aeration is the dominant factor in the determination of the character of the vegetation of the Cedar Lake bog.

## REFERENCES

1. KURZ, HERMAN: Hydrogen-ion concentration in relation to ecological factors. Bot. Gaz., LXXVI: 1-29, 1923.
2. KURZ, HERMAN: Influence of sphagnum and other mosses on bog reactions. Ecology IX: 56-69, 1928.
3. SALISBURY, E. J.: Significance of the calcicolous habit. Jour. Ecol. IX: 220-240, 1921.
4 SALISBURY, E. J.: Stratification of hydrogen-ion concentration, with special reference to woodlands. Jour. Ecol. IX: 220-240, 1921.
5. WEAVER and CLEMENTS: Plant ecology. 208-211. 1929.