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NOTES ON THE FORESTS OF SOUTHERN IOWA¹

J. A. LARSEN AND J. R. DILWORTH

In the southernmost tier of counties in Iowa, particularly in Jefferson, Van Buren, Wapello, Davis, Monroe, Appanoose, Lucas and Wayne counties there exist rather extensive natural forests of oak and other hardwood species. These counties lie within an area of considerable loessal soils. This part of the state has been designated in agricultural parlance as the southern Iowa pasture section.

The relief of the land in these parts consists of a rather distinct upland plain lying generally about 1000 feet above sea-level. Dissection of this plain by drainage has resulted in numerous fingering and tortuous headwaters creating slopes or terraces, and flat to narrow ridges and bottoms of variable widths and patterns. The plain is composed of a number of soil types⁽⁷⁾; the Clinton silt loam, the Lindley silt loam, the Edina, the Marion and Grundy silt loams, etc. The Clinton silt loam is one of the most prevalent upland loess soils; it has a light gray yellow and buff color and a loose texture. It overlies much of the loose and erosive Lindley drift soil which comprises a goodly proportion of the slope land. Some upland sections contain small quantities of the whitish Edina and powdery Marion soils. In the bottoms we find generally deep accumulations of the dark and fertile Wabash silt loam.

The occurrence and distribution of the looser and more erosive Lindley soil may in some measure account for the drainage and the position of the stream headwaters in that this soil has yielded more readily to stream action than the other formations.

Originally most of the upland and all of the slopes, terraces and valleys were forested, but on most of the flat uplands lying between the drainages, the forests have given way to farm land. The present forests, therefore constitute a more or less broken belt or belts along the narrower bottoms, the slopes, terraces and the narrowest ridges. No doubt the improved drainage occasioned by the slopes and the better natural protection afforded from drought and fire incident to slopes and valleys have helped foster and preserve the forests within these depressions.

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Larsen⁽³⁾ states that on the uplands in Lucas and Monroe counties, the forest is composed mainly of oaks, — white oak and burr oak, — on the better soils, degrading into black oak and even occasional jack oak on the poorer sites. Several large but defective virgin white oaks still remain scattered over the upland sections of Monroe county, testifying to the large and stately forests of earlier days. The remaining present-day upland oak stands consist of open and low-branching trees with an abundance of brush understory. In the understory the chinquapin oak, snowberry, hazel and sumac figure conspicuously. In such locations reforestation will present a real problem.

On the upper slopes and terraces, hickory poles and saplings occur patchwise, especially over the run down pastures. It appears that the hickory is possessed with unlimited recuperative powers and tenaciousness.

Here and there in Monroe county were found forests of red oak with black, burr or white oaks according to local variations of the soil. This red oak is more prevalent on north than on south exposures. It has survived better than the white since it is less ardently sought after for ties, posts, and mine timber. The red oak stands give the impression of rather favorable to ideal forest soil conditions with considerable litter and a loose top soil. Something which cannot be said for most of the white oak stands.

On the lower slopes the oaks integrate with basswood, white ash, walnut, butternut, elm and maple.

The forests of the bottomlands show considerable variety from the temporary species of elm, cottonwood, boxelder, willow and birch to the more stable and permanent walnut, ash, and buckeye. These trees occur here and there as nearly mature individuals and not in full stands. What now remains of this original bottomland forest are but scattered, crooked and defective individuals.

In a classification of more than 3000 acres within the purchase units in Monroe and Lucas counties, the senior author arrived at the following percents by areas: Open meadow, on upland and bottoms 11%; Clean cultured uplands slopes and bottoms 6% brushland 5%; Sprout lands — in various degrees of restocking 12%; sapling stands 8%; pole stands 38%; niature stands of trees in various degrees of density 4%; over-mature forests, usually heavily culled 1%; woodland pasture with poor forest restocking everywhere 14%; and hickory pole stands less than 1%.

Milius⁽⁴⁾ reports from the southeastern counties of Muscatine, Louisa, Des Moines and Lee, that the total forest area, as deter-

mined by the Iowa Timber and Wasteland Survey, covers 185,929 acres, of which 78.8 percent is in upland, 18.2 percent bottomland and about 3 percent terraces or slope. The bulk of these areas are in private ownership, usually in connection with a going farming enterprise. The size of the individual holdings range from several hundred acres down to tracts of five acres or less.

The relation between the number of trees per acre in these forests is not so clear as in the young or the undisturbed forests, nor is there any distinct or satisfactory relation between age and the number of trees. Mr. Milius' conclusions were based on the study of trees on 271 plots, each of 1/5 acre. Of these 139 represented the upland type, 81 the bottomland and 51 slopes and terraces. The composition of the upland showed white oak 52 percent, red oak 28 percent, elms and ashes 11 percent, and hickory, maple, basswood and cherry about 9 percent. In these stands the average volume per acre for all trees greater than 11.5 inches d.b.h. is 2,123 board feet. The average merchantable height is 22 feet and the average diameter 14.2 inches.

In the terrace type elms and hickories constitute 35 percent; red and white oak 28 percent; swamp-white oak 11 percent. The balance is made up of hard maple, walnut, butternut, soft maple, basswood, ash, honey locust, black birch and sycamore. In these locations the average diameter for trees above 11.5 inches is 17.9 inches and the average merchantable height 24 feet. The stand averaged 2,585 board feet per acre.

In the bottomland type the elms, soft maple and cottonwood run 74 percent, with pin oak, swamp-white oak, black willow, sycamore and black birch 19 percent. Hickory, honey locust, black walnut and others 7 percent. The stand in the bottom type averaged 3,467 board feet per acre.

From Patterson,⁽⁵⁾ we learn that the average time required for the unevenaged oak forest to attain an average diameter of 12 inches on the best quality site is 59 years; on site III this may require 83 years and on site V 106 years, and on the very poorest, designated as site VII, 130 years.

Milius,⁽⁴⁾ states that the stands have been continually culled over for the last hundred years, the heaviest cutting taking place about 70 years ago, that all of the upland type is grazed more or less heavily, while fires have played their destructive rôle in many of the stands; that over-grazing, cutting and lack of knowledge of silvicultural principles of maintaining and re-establishing a forest have resulted in a great irregularity and depletion; that the ma-

majority of the sawtimber stands are open, understocked and devoid of reproduction; the distribution of the age classes very poor, with a great preponderance in young and in over-mature stands and a great scarcity of pole sized and small sawtimber classes; that there are considerable areas of young sprout forests ranging from reproduction up to saplings which are well stocked, but that merchantable stands are dwindling and gradually decreasing.

Dilworth ⁽¹⁾ studied the influence of soil, aspect, gradient, grazing and fire damage on form, volume and rate of growth of the forests in Lee, Lucas and Monroe counties. This was a rather intensive study by means of 19 plots in sizes varying from 1/10 to 1/4 acre. After tallying and measuring all trees on the plot, three of the dominant trees were felled and measured as to height, form, volume and growth. Soil samples were also taken for the plots at A and B horizons. The samples were analyzed in the laboratory at Iowa State College.

The stands which Dilworth measured varied from 776.8 to 2,141 cubic feet per acre. Height growth appeared best in Lee county with from 1.0 to 1.4 feet per year for the dominant trees. In the more central Monroe and Lucas counties, height growth varied from 0.6 to 0.95 feet per year. It appears that the ridge-top locations show the slower height growth generally and the middle and lower slopes a more rapid height growth, particularly the north and east aspects and bottoms. South and west aspects in Lee county show 0.78 to 1.01 feet per year, and the north and east aspects 1.13 feet per year. In some cases, however, a steep slope would indicate a better height growth than one less steep. It became strikingly apparent from the study that heavy grazing and fires would cause a reduction in the humus, nitrogen and phosphorus content of the soil and bring about a decrease in the rate of height growth. On the burned plots the nitrogen and phosphorus content showed respectively .2497% and 0.0556% while on the unburned the figures were .3556 and .0722%. In some instances the average annual increment of the trees on the burned plot was only one half as much as on the unburned. The form quotient was also reduced from 0.719 to 0.619 by the burning and over-grazing.

In most instances the moisture equivalents of the soils run above 15 percent and the wilting coefficients above 5 percent. In some individual cases as high as 9 and 10 percent. The hydrogen-ion concentration tests reveal that these soils are definitely acid in reaction. This is particularly true of the B-horizons which range

in pH from 4.27 to 5.07. The A-horizons show a more favorable condition ranging from 5.5 to 6.7. Since the unforested prairie and agricultural soils in this region are generally less acid, even bordering on the alkaline side in the B-horizon it is reasonable to impute the acidity of the forest soils to the forest itself, or certain combinations of soil, climate and forests which bring this about.

According to Gaarder and Alvsaker ⁽²⁾ an insufficient supply of basic material in the soil, which is needed for neutralization of the acids and for a suitable medium for bacterial activity, will result in an increased carbon-nitrogen ratio. This situation is aggravated by a leaching out of the nitrogen products in areas of heavy summer precipitation. It is known that the loessal soils in southern Iowa are poor in bases and that summer rainfall often comes in heavy downpours. Viewed in this light one might say that the soil and the climate are prime factors in high acidity of the soils and the presence of these oak stands which are able to grow on an acid substratum.

Some of the more outstanding facts gathered from the Iowa Basebook ⁽⁶⁾ indicate that the wooded areas and woodland pastures in the southern Iowa counties comprise a much larger proportionate area than in the central and more fertile parts of the state. By way of example, Decatur county in the southern part shows about 322,000 acres of farm land, 66,000 acres of which are in corn and 48,000 in woodland pasture; while Story county in the central section has 343,000 acres of farm land, of which 131,000 acres are in corn and only 13,000 acres in woodland pasture. Furthermore, the yield per acre for farm lands in the southern part of the state is considerably less than in most of the other sections. This is witnessed by the cash values of the land itself which averages from 32 to 36 dollars per acre in the middle southern counties, compared with 92 to 100 dollars per acre in central Iowa.

In this southern part of the state much additional land was cleared twenty years ago when good prices were received for agricultural crops incident to the war. Under clean culture the upper Clinton and the Lindley soils with their scant cover of A-horizon soil lasted but a few years. In the wake of the clearing, mismanagement and overgrazing, excessive erosion set in. The top soil has washed into the creeks, the slopes are disfigured by deep gullies and in most instances the bottoms are cut by deep V-shaped gullies. These being cut out by the rush of water from the upland cornfields.

In the presence of this very acid soil and the overlying thin cover of A-horizon soil one may notice a slight stand of bluegrass under

the more open oak forests. This has led many to the false assumption that a good and a luxurious cover of bluegrass will result as soon as the forest is cut. Experience, however, points to the fact that a bluegrass pasture is not forthcoming, for the thin cover of A-horizon is rapidly washed away, giving rise to a profusion of weeds of cinquefoil, proverty grasses, peppergrass, ragweed, plantain, goldenrod, etc. In many instances shrubs are advancing. These are sumac, wild plum, hazel, hawthorn and snowberry.

In looking forward to the soil rehabilitation on most of the eroded and depleted areas and the fitting of these lands into the economic life of the counties and the state, the authors recommend the continued consolidation of sub-marginal farm land areas with their surrounding woodlands into suitable blocks or units for protection, reforestation, and proper management; heavy liming of farm and pasture lands, the acquisition of knowledge regarding the requirements of the trees for soil and moisture, their relative values on the market and the products which may most profitably be produced; the amount of salable material which can be obtained from thinnings and other forms of stand improvement; the designation of various land use areas for wild life restocking, recreation and water conservation; the preparation of an adequate planting plan or plans for rehabilitation of the denuded and eroded slopes; plans for the construction of suitable dams and water reservoirs along the bottoms to arrest the vicious dissection, and the construction of diversion ditches on slopes in order to prevent the wash from the cleared upland from further damaging these low areas; the construction of fire lines and fire breaks wherever needed and the energetic pursuit of research along these several lines. Since so much of this land is abused or depleted the preponderance of activities must obviously be directed towards reforestation and rehabilitation.

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