# FOREST COMMUNITIES IN A NATURAL SITE AT UNION HILL, AND COMPARISONS WITH OTHER FORESTS IN ILLINOIS

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ABSTRACT.—Plant studies were made in the Union Hill Natural Area, located near Belleville, Illinois. From 27 plots found along four transects frequency, density and basal area data were collected for tree species only. Terrace, slope, and upland communities were sampled, and the relationships of these plots were compared by an ordination scheme. The basal area data were compared with two northern Illinois upland tree communities and with five southern Illinois terrace, slope, and upland communities. Comparison ordination is a valid method for the study of different communities within a floristic region.

Man is destroying many areas of natural vegetation, which makes it imperative that we hasten to describe what is left of natural communities in the world. If such work is not speedily completed, we may soon find several important links missing in the mosaic of communities. Such omissions will make it difficult to explain ecological patterns of those natural communities which remain.

Much of the previous work in descriptive plant ecology has presented communities as discrete ecological units. This is a gross over-simplification. Nearly fifty years ago Gleason (1926) proposed that, inasmuch as each plant species had environmental requirements different from those of every other species, the classification of plant communities into separate and distinct associations was inadequate. Following Gleason's concept a number of ecologists have shown vegetational gradients based on a direct analysis of the vegetation itself. Some of these studies were made by Gleason (1922), Cain (1935), Curtis and McIntosh (1951), Brown and Curtis (1952), Goodall (1954), Bray and Curtis (1957), Clausen (1957), McIntosh (1957), Lindsay *et al.* (1961), Weaver (1961), Monk (1965), Kumler (1969), and Giedeman and Kumler (1972). The concept has also been used by animal ecologists in community gradient studies of insects by Whittaker (1952), Kato *et al.* (1955), of copepods by Whittaker and Fairbanks (1958) and of birds by Bond (1957), and Beals (1960). The Union Hill investigation shows vegetational gradients based on a quantitative analysis.

One of the aims of ecological probes should be information of floristic regions. How, for example, does the Union Hill vegetational composition compare with other parts of the oak-hickory climax region? On a less ambitious scale, an attempt was made to fit investigations of forest communities in Illinois into a system to understand better this floristic sphere. The ordination techniques of Bray and Curtis (1957), Beals (1960), and Clausen (1957) were used on data taken from the literature. The Brownfield Woods (Boggess and Bailey, 1964) and Clark County (Ebinger and Parker, 1969) investigations were considered as representative of northern Illinois. The Lusk Creek (Ashby, 1968) and Shawnee National Forest (Geideman and Kumler, 1972) studies were regarded as portraying the vegetation of southern Illinois.

## Description of the Study Site

The Union Hill Natural Area was studied because it is one of the few remaining relatively undisturbed sites in this part of Illinois. It is a tract of privately owned land five kilometers from Belleville, Illinois, surrounded by homes on small tracts of land to the north, a quarry of the Hill Brick company to the west, and open farm land to the south and east. It is not only threatened by the increasing pressure from housing, but also by increasing air and water pollution. For a number of years garbage and trash have been dumped on the north side of a stream that flows through this tract (Figure 1). At present, the road leading to the quarry has been closed to wheeled traffic, which has materially reduced the solids pollution. The stream is highly polluted from strip mine acids as well as from the urban solid wastes. Yet the steep bank of this stream has protected the forest from the main destructive activities of man.

This forested area consists of 30 hectares in a 97 hectare area. (Figure 1). A narrow terrace about two meters in elevation above the level of the creek bed is found parallel to this stream. A slope rising rather abruptly from the terrace leads to a somewhat flattened ridge of upland vegetation approximately 18 meters above the terrace. Three drainage areas from the upper ridge cut through the study site. These depressions are usually dry during the summer months and handle mostly surface water, although water runs continuously throughout the winter months when there is more rainfall.

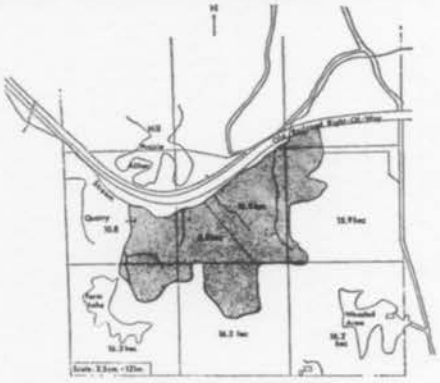

**Figure 1. Map of the Union Hill Natural Area showing roads, streams, and drainage area, as well as the location of the study site.**

## Study Methods — Field Data

Work was begun in the fall of 1965, with a preliminary survey of the area. Vegetational data were collected the following spring and also at several later times up to the spring of 1970.

Within the Natural Area four transects were established. The beginning point of three of these transects was on the terrace near the stream. Plots were sampled upward toward the top of the nearby ridge. A fourth transect was located parallel to the creek, entirely within the terrace zone. Because the terrace is quite narrow, it was necessary to add this fourth transect to obtain a representative sample of the terrace vegetation.

From center points located at six meter intervals along the transect three nested plots were set up: circular plots with a 5.64 meter radius (0.01 hectare) for tree species; square plots two by two meters square for shrubs; and plots one by one meter square for herbaceous plants. The number of plots per transect varied with the elevation of the ridge, the steepness of the slope, and the varying width of the creek terrace. Most of the data collected were concerned with tree species, but the somewhat typical shrub and herbaceous understories were noted. A total of 27 plots were sampled as typical of the Union Hill site.

TABLE 1.—Importance Values of twenty-seven plots found in the Union Hill Study Area

| Species | Plot Numbers[1] | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 3 | 2 | 6 | 5 | 1 | 10 | 9 | 4 | 7 | 8 | 23 | 20 | 18 | 21 | 22 | 13 | 19 | 24 | 14 | 11 | 26 | 17 | 25 | 16 | 27 | 15 | 12 |
| Hickory spp. | | | 31 | | | 45 | | | | | 61 | 140 | 111 | | | 133 | 118 | 66 | 87 | 131 | 62 | 67 | 49 | 71 | 85 | 97 | 65 |
| White oak §§ group § | | | | | 34 | | | 81 | 35 | | | 33 | 189 | 150 | 151 | 85 | | 59 | | | 99 | 80 | 84 | 114 | 118 | 102 | 63 |
| Red, Black §§ oak gr. § | | | | | | 29 | 110 | | 37 | 75 | 71 | 33 | | 150 | 149 | | 100 | 62 | 67 | 79 | 93 | 153 | 86 | 115 | 59 | 101 | 64 |
| Dogwood | | | 57 | 39 | | | 65 | 52 | | 63 | 19 | 19 | | | | 41 | 33 | 28 | 47 | 45 | | | | | 38 | | 40 |
| Ash spp. | | 31 | | 59 | 29 | 37 | | 67 | 37 | 67 | | 21 | | | | | | | 60 | 45 | | | 50 | | | | 28 |
| H. Chestnut | | | | | | | | | | | 22 | 27 | | | | 41 | | | | | | | | | | | 40 |
| Black Cherry | | | | | | | | | | | 105 | | | | | | | 85 | | | 46 | | 31 | | | | |
| Red Maple | 82 | 41 | 33 | 84 | 29 | | | 100 | | | | | | | | | | | 39 | | | | | | | | |
| Sugar Maple | | | | | | | | | | | 22 | 27 | | | | | | | | | | | | | | | |
| Silver Maple | | | | | | | | | | | | | | | | | 49 | | | | | | | | | | |
| Sycamore | 74 | 122 | | | 107 | | | | 62 | 95 | | | | | | | | | | | | | | | | | |
| Elm. spp. | | | 102 | 46 | 35 | 32 | | | 59 | | | | | | | | | | | | | | | | | | |
| Buckeye | 50 | 41 | | | 28 | 27 | | | 31 | | | | | | | | | | | | | | | | | | |
| Black Walnut | 94 | 32 | | 72 | | | | | 39 | | | | | | | | | | | | | | | | | | |
| Basswood | | | | | | 95 | | | | | | | | | | | | | | | | | | | | | |
| Hackberry | | 33 | | | 38 | | | | | | | | | | | | | | | | | | | | | | |
| Sour gum | | | 77 | | | | | | | | | | | | | | | | | | | | | | | | |
| Persimmon | | | | | | | 125 | | | | | | | | | | | | | | | | | | | | |
| Ky. coffee tree | | | | | | 35 | | | | | | | | | | | | | | | | | | | | | |
| Totals | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 | 300 |

1. Arranged according to X- and Y-axes ordination

TABLE 2.—Vegetation List of Tree Species found in Four Areas of Illinois Being Compared

| Species | Common name | Areas | | | | |
|---|---|---|---|---|---|---|
| | | B | C | L | UH | SF[1] |
| Hickory Group: | | | | | | |
| *Carya ovata* (Mill) K. Koch | Shagbark hickory | X | X | X | X | X |
| *C. cordiformis* (Wangenh.) K. Koch | Bitternut hickory | X | X | X | X | X |
| *C. glabra* (Mill) Sweet | Pignut hickory | | X | X | X | |
| *C. laciniosa* (Michx. f.) Loud | Kingnut hickory | | | X | | |
| *C. tomentosa Nutt.* | Mockernut hickory | | X | X | X | |
| *C. ovalis* (Wang.) Sarg. | Oval hickory | | | X | | X |
| White oak group | | | | | | |
| *Quercus alba* L. | White oak | | X | X | X | X |
| *Q. macrocarpa* Michx. | Bur oak | X | | X | | X |
| *Q. muehlenbergii Engelm.* | Chinquapin oak | X | | X | X | X |
| *Q. stellata* Wangenh. | Post oak | | | X | X | X |
| *Q. palustris* Muench. | Pin oak | | X | | | X |
| Red, Black oak group | | | | | | |
| *Q. rubra* L. | Red oak | X | X | X | X | X |
| *Q. imbricaria Michx.* | Shingle oak | X | X | X | X | |
| *Q. coccinea* Muench. | Scarlet oak | | | X | X | X |
| *Q. falcata* Michx. | Southern red oak | | | X | | X |
| *Q. marilandica* Muench. | Blackjack oak | | | X | | X |
| *Q. shumardii* Buckl. | Shumard oak | | | X | | |
| *Q. velutina* Lam. | Black oak | | X | X | X | X |
| *Cornus florida* L. | Dogwood | | X | X | X | X |
| Ash species | | | | | | |
| *Fraxinus americana* L. | White ash | X | X | X | X | X |
| *F. quadrangulata* Michx. | Blue ash | X | | | | |
| *F. profunda* (Bush) Bush | Red ash | | | | X | |
| *Castanea dentata* (Marsh.) Borkh. | Horse chestnut | | | | X | X |
| *Prunus serotina* Ehrh. | Black cherry | X | X | X | X | X |
| *Acer negundo* L. | Box elder | | | X | X | X |
| *A. rubrum* L. | Red maple | | | X | X | X |
| *A. saccharum* Marsh | Sugar maple | X | X | X | X | X |
| *A. saccharinum* L. | Silver maple | | | | X | X |
| *Platanus occidentalis* L. | Sycamore | X | X | X | X | X |
| Elm species | | | | | | |
| *Ulmus alata* Michx. | Winged elm | | | X | | X |
| *U. americana* L. | American elm | X | X | X | X | |
| *U. rubra* Muhl. | Slippery elm | X | X | X | X | X |
| *Aesculus glabra* Willd. | Buckeye | X | | X | X | |
| *Juglans nigra* L. | Black walnut | X | X | X | X | X |
| *Tilia americana* L. | Basswood | X | X | X | X | X |
| *Celtis occidentalis* L. | Hackberry | X | X | X | X | |

TABLE 2.—Continued

| Species | Common name | Areas | | | | |
|---|---|---|---|---|---|---|
| | | B | C | L | UH | SF[1] |
| *Nyssa aquatica* L. | Sour gum (Tupelo) | | | | X | |
| *Diospyros virginiana* L. | Persimmon | | X | | X | X |
| *Gymnocladus dioicus* (L.) Koch | Kentucky coffee tree | X | | | X | X |
| *Salix nigra* Marsh | Black willow | | | | | X |
| *Populus deltoides* Marsh | Cottonwood | | | | | X |
| *Alnus serrulata* (Ait.) Willd. | Common alder | | | | | X |
| *Betula nigra* L. | River birch | | | X | | |
| *Carpinus caroliniana* Walt. | American hornbeam | | X | X | | X |
| *Fagus grandiflora* (Ehrh.) | Beech | | X | X | | X |
| *Gleditsia triacanthos* L. | Honey locust | X | | X | | X |
| *Liquidambar styraciflua* L. | Sweet gum | | | X | | X |
| *Liriodendron tulipifera* L. | Tulip tree | | | X | | X |
| *Nyssa sylvatica* Marsh | Black gum | | X | X | | |
| *Sassafras albidum* (Nutt.) Nees | Sassafras | | X | X | X | X |
| *Juniperus virginiana* L. | Red cedar | | | X | | X |
| *Crataegus mollis* Scheele | Downy hawthorn | X | | | | |
| *Asimina triloba* (L.) Dunal | Pawpaw | X | | | | X |
| *Lindera benzoin* (L.) Blume | Spicebush | X | | | | |
| *Staphylea trifolia* L. | Bladdernut | X | | | | X |
| *Ostrya virginiana* (Mill.) K. Koch | Hop hornbean (ironwood) | X | X | X | | X |
| *Juglans cinerea* L. | Butternut | | X | X | | X |
| *Cercis canadensis* L. | Redbud | X | X | | X | X |
| *Morus rubra* L. | Red mulberry | | X | | | |
| Total species per location | | 25 | 28 | 42 | 32 | 43 |

[1]
B = Brownfield Woods
C = Clark County
L = Lusk Creek
UH = Union Hill
SF = Shawnee National Forest

Frequently, density, and basal area data were collected for the tree species. Woody plants over 3.2 meters in height and 10 centimeters in diameter were considered trees. The oak trees were not separated by species, but rather were considered as two groups of oaks — leaves without bristle tips and with acorns maturing at the end of one season or the white oak group; and leaves with bristle tips and with acorns maturing at the end of two seasons or the red-black oak group (Fuller, 1949). Species of elm, ash and hickory were also grouped when collecting the data (Table 2).

Elm and ash are minor constituents of this forest community, contributing only 3.3 and 6.5 percent respectively of the importance values. The hickory and oaks, on the other hand, contributed 50.2 percent of the importance values. Four species of hickory were found. Two of these species were the dominents — shagbark and bitternut. Within the white oak group there were only three species in the study site. Of these white oak was the dominent. Within the red-black oak group four species were found. Here, the red oak (*Quercus rubra* L.) and black oak (*Q. velutina,* Lam.) were domi-

nent. It is difficult to identify oak species which may contain from 15 to 20 naturally occurring hybrids. The grouping of species does not detract from the precision of the results when there were so few species found and those identified were clearly dominents. Thus, all the oak, hickory, elm and ash species were grouped.

### Study Methods — Data Analysis

The Importance Value (IV) (Curtis and McIntosh, 1951) was calculated for each of the tree species (Table 1). Once the importance of the species within the plots is established, the similarities of communities can be determined. The relationship of communities is measured by various indices of similarity or coefficients of community. These indices are used to show a distance between communities in a spatial pattern related to their ecological similarity. The most widely used similarity index in ordination procedures is attributed to several individuals. It is here called the Kulczynski index (McIntosh, 1967). Its most common expression is $\frac{2w}{a+b}$ where a is the sum of the quantitative measures of the species in one community, b is the sum for a second community, and w the sum of the lesser values for the species present in both communities.

Each plot of the transect was compared to each of the other plots. A matrix was constructed showing the coefficient of community for each of the plots compared to each of the other plots. Since the ordination of these plots attempts to arrange these stands according to their relative dissimilarity, inverse values of the coefficients of similarity were used, subtracting each value from 0.85. A value of 0.85 was chosen rather than 1.00, because in sampling one stand several times, the coefficient of similarity averages around this figure (Beals, 1960). This means that two stands with a similarity of 0.85 should probably be considered essentially identical. Two stands with nothing in common would then be 85 units apart. The sum of the inverse values with the highest number was considered the stand most different from the others and became reference stand a with a value of O. Conversely, the stand with the lowest sum of inverse values was considered to have the least in common with the first reference stand and became reference stand b. The length of the axis of an ordination is equal to the dissimilarity of the two selected reference stands.

The positions of the samples along the first of X-axis were calculated according to the method described by Beals (1960), using his formula $X=\frac{L^2+Da^2-Db^2}{2L}$ where L is the length of the axis (dissimilarity between reference plots a and b), and Da and Db are the dissimilarities of a given sample from the reference samples. This formula locates the sample by projection of the point of arc intersection onto a line between samples a and b.

The first reference sample (c) of the second or Y-axis is the sample having the highest e value or the sample which fits the X-axis least satisfactorily ($e^2=Da^2-x^2$). The second reference sample (d) of the Y-axis is chosen so that the line cd (Y-axis) is approximately perpendicular to the X-axis (line ab). Reference samples e and f for the third or Z-axis were not needed in this ordination.

### Results and Discussion — Vegetation

A total of 32 tree species were found in the study sites along the four transects (Table 2). The results of the ordination made are plotted in Figure 2. Plot 3 at O is the first re-

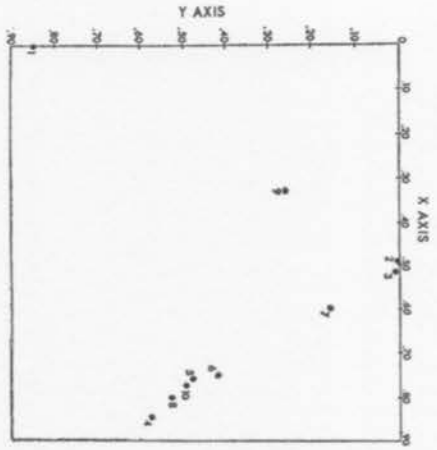


FIGURE 2. X- and Y-axis ordination of twenty-seven plots sampled at Union Hill. Reference point a on the X-axis and c on the Y-axis equal 0. Reference point b on the X-axis and d on the Y-axis equal 0.85. Plot 3 and plot 12 are the reference samples on the X-axis. Plots 2 and 12 are the reference samples on the Y-axis.

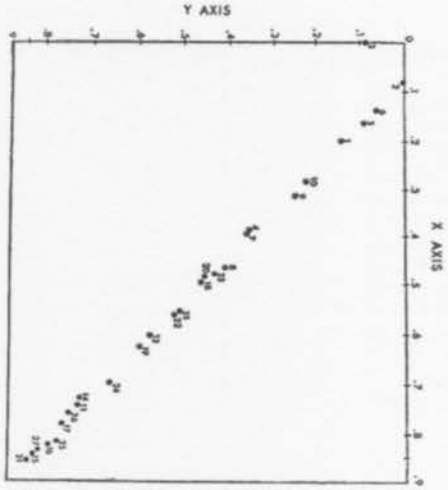


FIGURE 3. X- and Y-axis ordination of ten forest communities. Represented are terrace, slope, and upland areas found in the northern, central and southern parts of Illinois. (Numbers refer to community location as listed in Table 5).

ference stand (a) on the X axis. Plot 12 is the second reference stand (b) on the same axis and is 85 units away from Plot 3. Plot 2 at O on the Y axis (c) and Plot 12 at 0.85 (d) are the most dissimilar plots. The X and Y values as coordinates show the spatial relationships between the stands. Plots 1 through 10 were sampled within the creek terrace. Their ordination or relationship with each other is 2, 3, 6, 5, 1, 10, 9, 4, 7, and 8. The remaining 17 plots sampled were located on slopes and upland. It is apparent from these results that there was no validity in any assumption that the vegetation of all plots of the terrace was greatly different from slope and upland vegetation. In fact, the X and Y values of plot 8 within the terrace are very close to that of plot 23, which is located in the upland area. Plots 11 through 20 were located on slopes, while plots 21 through 27 were found in the upland of the Union Hill ridge.

The dominant species of trees growing at Union Hill are those found widespread throughout Illinois. Twenty-three species of trees were found on the terrace. The dominants of this site along the creek were two ash species (white and red), red maple, two species of elm (American and slippery), dogwood, red oak and white oak. Other species not found outside the terrace were buckeye, black walnut, hackberry, sour gum, persimmon, basswood, Kentucky coffee tree, redbud, sassafras and box elder. Most of the red maple growing in this location is found on the terrace.

Dominant trees found on the slopes and upland were white and red oak, shagbark and bitternut hickory, silver and sugar maple, horse chestnut, and black cherry. Trees from the terrace such as white and red ash, red maple, and dogwood are found in

these plots but in decreasing numbers. White and red oak as well as shagbark and bitternut hickory, dominants of the upland, were also found scattered throughout the terrace along the stream (Table 1).

The shrub understory of the terrace consisted of hickory species, oaks of both the bristle and non-bristle tip leaved groups, elm and ash species, cottonwood, box elder, sassafras, redbud, mulberry, sour gum, buckeye, and wild grape. These dominants of the shrub understory correlated well with the dominant trees. There appears to be no problem of forest regeneration in this area, if this forest is left undisturbed. The lowland species of shrubs such as cottonwood, elms, box elder, mulberry, sour gum, buckeye, sycamore, basswood, hackberry, persimmon, and Kentucky coffee tree were not found on the upland sites. Horse chestnut, black cherry, sugar and silver maple were found almost exclusively at higher elevations. A list of the main shrub species is found in Table 3. The Latin names are taken from Gray's Manual (Fernald, 1950) and Little (1953).

The main herbaceous plants varied with the seasons. A list of those plants observed and collected is shown in Table 3. In addition, there were a number of different mosses and lichens in a few areas where rock outcrops were present.

TABLE 3.—Vegetation List of Shrubs and Herbaceous Plants Found In the Understory of the Union Hill Plots

| Shrubs | |
|---|---|
| *Acer negundo* L. | Box elder |
| *Aesculus glabra* Willd. | Buckeye |
| *Carya cordiformis* (Wangenh.) K. Koch | Butternut hickory |
| *C. glabra* (Mill) Sweet | Pignut hickory |
| *C. ovata* (Mill) K. Koch | Shagbark hickory |
| *C. tomentosa* Nutt. | Mockernut |
| *Castanea dentata* (Marsh.) Borkh. | Horse chestnut |
| *Cercis canadensis* L. | Redbud |
| *Cornus florida* L. | Dogwood |
| *Fraxinus americana* L. | White ash |
| *F. profunda* (Bush) Bush | Red ash |
| *Morus rubra* L. | Mulberry |
| *Populus deltoides* Marsh. | Cottonwood |
| *Quercus alba* L. | White oak |
| *Q. macrocarpa* Michx. | Bur oak |
| *Q. muehlenbergii* Engelm. | Chinquapin oak |
| *Q. stellata* Wangenh. | Post oak |
| *Q. rubra* L. | Red oak |
| *Q. imbricaria* Michx. | Shingle oak |
| *Q. velutina* Lam. | Black oak |
| *Sassafras albidum* (Nutt.) Ness. | Sassafras |
| *Ulmus alata* Michx. | Winged elm |
| *U. americana* L. | American elm |
| *U. rubra* Muhl. | Slippery elm |
| *Vitis palmata* Vahl. | Wild grape |

TABLE 3.—Continued

| Herbaceous | |
|---|---|
| *Adiantum pedatum* (L.) Planch. | Maidenhair fern |
| *Arisaema dracontium* (L.) Schott | Green dragon |
| *A. triphyllum* (L.) Schott | Jack in the pulpit |
| *Asarum canadense* L. | Wild ginger |
| *Capsella bursa-pastoris* (L.) Medic | Shepherd's purse |
| *Carex amphibola* Steud. | Sedge |
| *Cerastium nutans* Raf. | Mouse ear chickweed |
| *Claytonia virginica* L. | Spring beauty |
| *Convallaria majalis* L. | Lily of the valley |
| *Desmodium glutinosum* (Muhl.) Wood | Beggar's tick |
| *Dentaria laciniata* Muhl. | Toothwort |
| *Dryopteris* sp. Adams | Wood fern |
| *Equisetum arvense* L. | Horsetail |
| *E. hyemale* L. | Scouring rush |
| *Erigeron philadelphicus* L. | Fleabane |
| *Erysimum repandum* L. | Treacle mustard |
| *Erythronium albidum* Nutt. | White dog's tooth violet |
| *Fragaria virginiana* Duchesne | Strawberry |
| *Galium* spp. | Bedstraw |
| *Geranium dissectum* L. | Dissected geranium |
| *G. maculatum* L. | Wild geranium |
| Gramineae spp. L. (Two) | Grass |
| *Lamium amplexicaule* L. | Henbit |
| *L. purpureum* L. | Dead nettle |
| *Lepidium ramosissimum* Nels. | Pepper grass |
| *Lonicera japonica* Thunb. | Japanese honeysuckle |
| *Mentha spicata* L. | Spearmint |
| *Mertensia virginica* (L.) Pers. | Bluebells |
| *Osmorhiza claytoni* (Michx.) C. B. Clarke | Sweet cicely |
| *Oxalis stricta* L. | Erect wood-sorrel |
| *Parthenocissus quinquefolia* (L.) Planch. | Virginia creeper |
| *Phlox divaricata* L. | Phlox |
| *Podophyllum pletatum* L. | Mayapple |
| *Polypodium virginianum* L. | Polypody fern |
| *Polystichum acrostichoides* (Michx.) Schott | Christmas fern |
| *Potentilla* sp. L. | Cinquefoil |
| *Ranunculus abortivus* L. | Kidney leaf |
| *R. septentrionalis* Poir. | Swamp buttercup |
| *Rhus radicans* L. | Poison ivy |
| *Ribes missouriense* Nutt. | Gooseberry |
| *Rumex acetosella* L. | Sheep sorrel |
| *Sanguinaria candensis* L. | Bloodroot |
| *Smilacina stellata* (L.) Desf. | False Solomon's seal |
| *Trillium recurvatum* Beck | Trillium |
| *Urtica urens* L. | Burning nettle |
| *Uvularia perfoliata* L. | Bellwort |
| *Veronica arvensis* L. | Corn speedwell |
| *V. peregrina* L. | Purslane speedwell |
| *Vinca minor* L. | Common myrtle |
| *Viola papilionacea* Pursh | Blue violet |
| *V. pensylvanica* Michx. | Yellow violet |
| *V. kitaibeliana* var. *rafinesquii* (Greene) Fern. | Field pausy |

TABLE 4.—A comparison of five locations of tree communities in Illinois showing the Relative Basal Area

| Species | Numbers of Locations[1] | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 9 | 2 | 3 | 7 | 6 | 5 | 10 | 8 | 4 |
| Hickory species | 3 | 15 | 12 | 19 | T[2] | 17 | 24 | 17 | 13 | 14 |
| White oak group | 3 | 5 | 3 | T | 13 | 34 | 27 | 24 | 47 | 48 |
| Red, Black oak group | 8 | 5 | 2 | 4 | 18 | 41 | 39 | 23 | 25 | 14 |
| Dogwood | 3 | T | T | T | | 1 | 2 | | T | T |
| Ash species | 6 | | 3 | 5 | 10 | 1 | 4 | | 1 | 1 |
| Horse chestnut | | | | | | 1 | 1 | | | |
| Black cherry | | | 1 | 1 | T | 4 | | | T | |
| Red maple | 5 | 23 | 1 | | | | 1 | 9 | | |
| Sugar maple | | 4 | 26 | 25 | 36 | 1 | 1 | 1 | 5 | 10 |
| Silver maple | | 6 | | | | | 1 | 4 | | |
| Sycamore | 32 | 10 | 2 | 1 | T | | | | | 1 |
| Elm species | 8 | | 5 | 4 | 6 | | | T | 1 | 3 |
| Buckeye | 1 | | 1 | T | 1 | | | | | T |
| Black walnut | 6 | | 2 | 4 | 2 | | | | 3 | 1 |
| Basswood | 13 | | 1 | | 6 | | | | | |
| Hackberry | 2 | | 2 | 2 | 5 | | | | | T |
| Sour gum | 3 | | | | | | | | | |
| Persimmon | 5 | | | | | | | | | |
| Kentucky coffee tree | 2 | | | | T | | | | | |
| Box elder | T | T | 1 | | | | | | | |
| River birch | | | 1 | | | | | | | |
| Hornbeam | | | T | 1 | | | | | | T |
| Beech | | 21 | 21 | 20 | | | | 10 | 1 | 1 |
| Honey locust | | 1 | T | | T | | | T | | |
| Sweet gum | | T | T | | | | | T | | |
| Tulip tree | | | 12 | 9 | | | | | | 3 |
| Black gum | | | 4 | 5 | | | | | | 3 |
| Sassafrass | T | | T | | | | | T | 1 | 1 |
| Red cedar | | 3 | | | | | | 2 | | T |
| Hawthorn | | | | | T | | | | | |
| Pawpaw | | | | | T | | | | | |
| Spicebark | | | | | T | | | | | |
| Bladdernut | | | | | T | | | | | |
| Hop hornbeam | | | | | T | | | | 1 | |
| Other | | 7 | | | 3 | | | 10 | 2 | |
| Totals | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

1. Location 1 Union Hill Terrace, Central Illinois
   Location 2 Lusk Creek Terrace, Southern Illinois
   Location 3 Little Lusk Creek Terrace, Southern Illinois
   Location 4 Lusk Creek Slope, Southern Illinois
   Location 5 Union Hill Slope, Central Illinois
   Location 6 Union Hill Upland, Central Illinois
   Location 7 Brownfield Woods Upland, Northern Illinois
   Location 8 Clark County Upland, Northern Illinois
   Location 9 Shawnee National Forest Terrace, Southern Illinois
   Location 10 Shawnee National Forest Upland, Southern Illinois

2. T = Trace

## Results and Discussion — Comparisons

Two other general Illinois areas were compared with Union Hill communities. The data in published reports of these studies were in basal area of the trees. The relative basal area (relative dominance) was determined for all communities. The individual species data of oak, hickory, ash and elm from the published reports were grouped in the same manner as with the Union Hill data. Two upland communities were located in northern Illinois — the Brownfield Woods (Boggess and Bailey, 1964) and an oak-hickory-maple woodlot in Clark County (Ebinger and Parker, 1969). The 27 plots of the Union Hill site were grouped into three communities — terrace, slope, and upland — for the purposes of comparison. Five communities were located in southern Illinois — the Lusk and Little Lusk Creek terraces and Lusk Creek slope (Ashby, 1968) and the Shawnee National Forest terrace and upland (Giedeman and Kumler, 1970). The relative basal areas for these ten communities are presented in Table 4. Figure 3 shows the X and Y values in the ordination of these communities. The ordination is 1, 9, 7, 2, 3, 6, 5, 10, 8, and 4. The Union Hill terrace (1) is represented as one extreme and becomes reference point (a) on the X-axis with a value of O. Lusk Creek slope (4) is the second reference point (b) on this same axis, 85 units apart from a. Lusk Creek terrace (2) is reference stand c of the Y-axis with a value of O. Lusk Creek slope is reference stand d on the Y-axis with a value of 0.85.

One conclusion to be drawn from these data is that Brownfield Woods (7) an upland community in northern Illinois appears to be similar to terrace communities in southern Illinois. In the ordination this tract has values on both the X-and Y-axes close to the Lusk Creek terrace. The Union Hill terrace (1) is very dissimilar to any other community examined although plot 8 in this area is not dissimilar from Union Hill slope and upland. This is emphasized by the fact that this site is the reference point on both the X- and Y-axes (a and d). The other terrace regions Shawnee National Forest (9), Lusk Creek (2), and Little Lusk Creek (3) are closely related as shown by their locations on the X- and Y-axes.

Union Hill upland (6) and slope (5) are again shown to be very nearly alike. These communities along with the Shawnee National Forest upland (10) and Clark County upland (8) have X and Y values which cluster around the Lusk Creek slope (4) values, showing similarity in vegetational composition.

The Brownfield Woods is of mixed-mesophytic composition with hard or sugar maple as the now dominant species. Both beech and tulip tree which are characteristic of the Western Mesophytic Forest described by Braun (1950) are missing. These forests developed on uplands which were occupied by prairie grasslands from four to six hundred years ago. White oak is also characteristically absent (Boggess and Bailey, 1964). The elms were destroyed by disease between 1960 and 1962 (Kulfinski, 1970). There were only nine dominant trees or groups of trees from among the 25 species listed. This somewhat atypical upland forest of the Western Mesophytic type showed a closer relationship to Lusk Creek and Shawnee National Forest terraces than to the Clark woodlot.

The Lusk Creek terrace showed ten dominants (Ashby, 1968), consisting of sugar maple, beech, tulip tree, bitternut hickory, black gum, pignut hickory, ash species, shagbark hickory, sycamore, and American elm. Little

Lusk Creek terrace had in addition to these species red elm, black walnut, and red oak instead of shagbark hickory, sycamore, and American elm.

The Lusk Creek slope dominants were white oak, red oak, pignut hickory, black oak, sugar maple, tulip tree, red elm, black gum, chinquapin oak, and shumard oak. This community composition was the most dissimilar of the terrace communities.

Clark county woodlot had a total of 23 tree species (Ebinger and Parker, 1969). The dry, relatively flat uplands were dominated by white oak, with black oak and shagbark hickory the most common associates. The steep, north-facing slopes were dominated by sugar maple, red oak, and to a lesser degree, bitternut hickory, beech, and ironwood. The remainder of the woods consisted of gentle to relatively-steep slopes and a lowland area in which white oak dominated, associated with black and red oaks, and shagbark hickory.

The Shawnee National Forest terrace contained an association mainly of beech, red maple, black willow, cottonwood, and sycamore. The oaks and hickories were also found here, but these were not the dominants. Red cedar was found throughout both terrace and upland, although it was found in greater abundance in the latter community. The highest concentration of hickories and oaks were found in the upland. Beech persisted into the lower elevations of the upland as well as elm species, sassafrass, tulip tree, and the maples. A pine plantation is also a part of the upland sites.

From this comparison of various forest communities in different parts of Illinois and from an inspection of the species list (Table 2) one sees that the number of tree species increases as one moves southward in Illinois. The northern communities had an average of 26 tree species, Union Hill representing central Illinois had 32, and the southern communities of Lusk Creek and Shawnee National Forest had an average of 42 species.

This comparison of these communities with its attendant ordination is a valid method for the study of different communities within a floristic region. The ordination technique enables one to examine the distributional relationships among species as well as communities. But whether the vegetation is merely described and classified rather than studied as a continuum, there is an urgent need for completion of such studies of natural areas before they are completely destroyed by man's activities.

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