THE MIXED MESOPHYTIC FOREST COMMUNITY
OF NORTHEASTERN OHIO.*

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Botanists and foresters working in the deciduous forest area of the Eastern United States frequently encounter mixed communities of mesophytic trees that cannot be readily classified by means of the binomial or trinomial terms in general use. Neither are these mixed communities the usual transitional zones dominated by the dominant species of the two "competing" associations. They are generally characterized by an unusual increase in abundance of several of the commonly occurring secondary species intermingled with the dominants of from two to three or more associations.

Griggs[1] called attention to the diversified forests of some of the coves of the Sugar Grove region of Ohio. Miss Braun[2] recognized a mixed mesophytic forest in the Cincinnati region. Frothingham, et al[3] described under the heading of "cove hardwood type," a mixed forest community in the Southern Appalachian Mountains. They report that this forest type in the Southern Appalachians occupies moist coves or ravines with their adjacent lower slopes, sometimes extending for some distance up protected slopes of north exposure. When Transeau first attempted to classify the forest communities in central and eastern Ohio he became convinced that it was necessary to recognize a mixed mesophytic forest community. He first called my attention to it in 1917. Since then we have seen numerous areas of it in Ohio and adjacent states. In a recent reconnaissance survey of the southern states Transeau[4] concluded

that the mixed mesophytic forest of Ohio is a northward extension of the magnificent forests of the lower slopes of the Great Smokies and the dissected Allegheny plateau of eastern Tennessee.

The mixed mesophytic forest community has not been generally recognized as such, neither has it received a critical ecological analysis. Very little is known of the variants that will need to be recognized when it is studied throughout its entire geographical and altitudinal ranges. The conditions under which the mixed mesophytic forest develops in northeastern Ohio appear to be relatively simple. The data in this report are presented for what value they may have in the way of suggestions.

The accompanying chart (Chart I) showing the approximate habitat range of species occurring in the mixed mesophytic forest community of northeastern Ohio is sufficiently accurate in detail to show (1) the composition of the mixed mesophytic community, (2) that it is characterized by an increase in abundance of secondary species intermingled with the dominants of two or more associations, (3) that it appears to be a special type of transitional community occupying a position between dry sites covered by oak-chestnut and moist sites in which the complex of factors is favorable to the dominance of beech-maple, and (4) that there are sufficient differences in drought resistance of the species involved and the consequent order of their invasion of the oak-chestnut association with increasing moisture that considerable variation in the composition of the mixed mesophytic community may occur locally.

The chart is constructed on the same plan as the chart described in the previous paper on the swamp forest formation of northern Ohio, with the exception that the present chart shows the order of invasion of the oak-chestnut community by the trees found in the mixed mesophytic community. Owing to lack of space the names of the four forest communities of the swamp forest formation indicated in the chart were omitted. Reading from left to right they are the tulip-walnut, red oak-linden, bur oak-big shellbark hickory transitions of the elm-white ash-red maple community, and the elm-black ash-soft maple association described in the prvious paper. The two vertical broken lines in the chart enclosing a part of the oak-chestnut community and a part of the mixed mesophytic community were added to indicate an intermediate community

CHART I

Chart showing the approximate habitat range – horisontal lines – of trees occurring in the Mixed Mesophytic Community in northeastern Ohio. The relative abundance of each species when present is indicated by the following symbols: a = abundant, c = common, f = frequent, o = occasional, r = rare. The Mixed Mexophytic Community is limited to particular sites in which several secondary species become relatively abundant together with the dominant species of two or more associations.

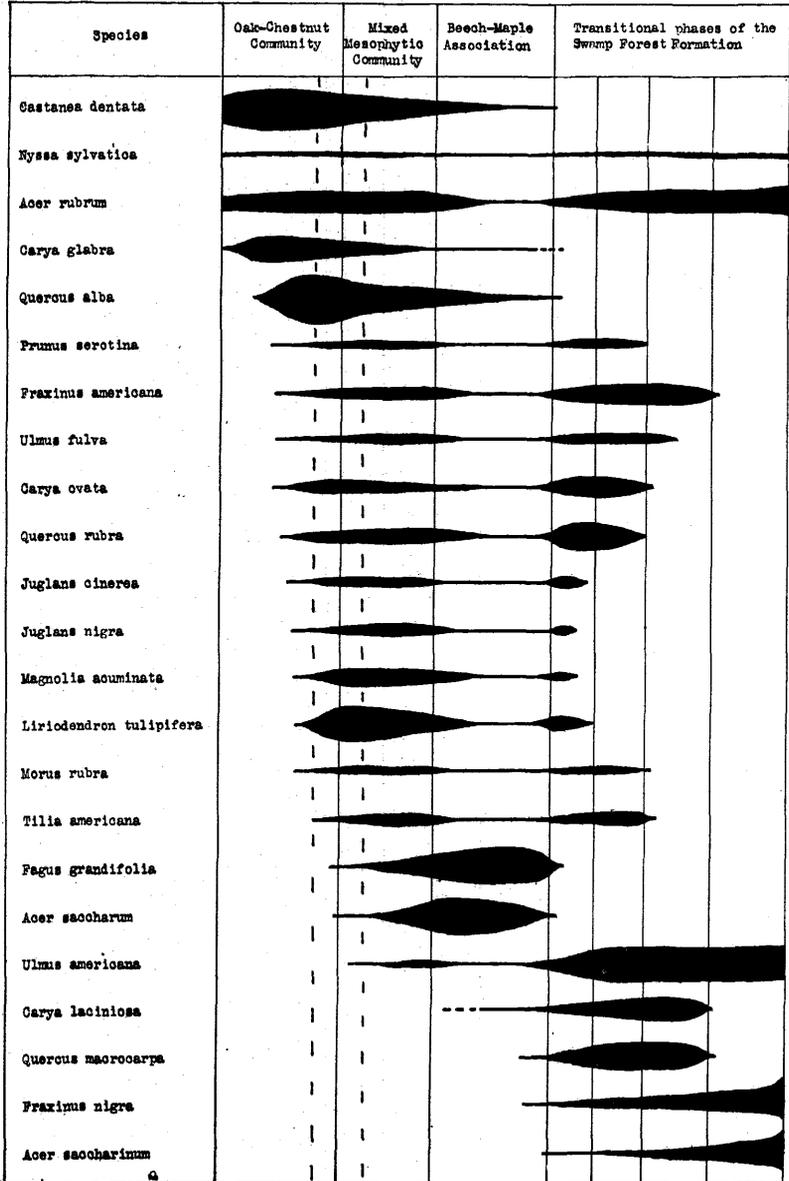| Species	Oak-Chestnut Community	Mixed Mesophytic Community	Beech-Maple Association	Transitional phases of the Swamp Forest Formation
Quercus coccinea Scarlet Oak		r-o		
Quercus velutina Black Oak		r-f		
Quercus prinus Chestnut Oak		r-f	o	
Castanea dentata Chestnut		r-a	r-c	
Nyssa sylvatica Sour Gum		r-f	r	r-c
Acer rubrum Red Maple		f-a	r-c	f-a
Sassafras variifolia Sassafras		r-f		
Cornus florida Flowering Dogwood		o-f	r-f	o-f
Amelanchier canadensis Shad Bush		r-o		
Prunus virginiana Choke Cherry		r-o		
Carya microcarpa Little Bitternut Hickory			...	
Carya glabra Pignut Hickory		r-o	r-f	...
Quercus alba White Oak		r-a	r-c	r-f
Quercus Muhlenbergii Yellow Oak		r-o	r-f	r-c
Carya alba Mockernut Hickory		r-f	r-f	...
Prunus serotina Black Cherry		r-f	r-f	r-f
Fraxinus americana White Ash		r-a	r-c	r-a
Fraxinus lanceolata Green Ash		r-f	r-f	r-f
Ulmus fulva Red Elm		r-c	r-f	r-c
Carya ovata Shag-bark Hickory		o-f	o-o	f-a
Quercus rubra Red Oak		r-a	r-c	f-a
Carya cordiformis Bitternut Hickory		r-f	r-f	r-c
Juglans cinerea White Walnut		f-o	r-o	r-o
Juglans nigra Black Walnut		r-o	r-o	r-a
Magnolia acuminata Cucumber Tree		r-a	r-f	r-f
Liriodendron tulipifera Tulip Tree		f-a	r-c	r-a
Ostrya virginiana Hop Hornbeam		r-f	r-f	r-o
Morus rubra Red Mulberry		r-f	r-o	r-f
Carpinus caroliniana Blue Beech		r-f	r-f	f-c
Tilia americana Linden		r-c	r-c	r-a
Fagus grandifolia Beech		r-a	c-a	r-f
Acer saccharum Sugar Maple		r-a	f-a	
Acer nigrum Black Maple		r-a	f-a	
Ulmus americana American Elm		r-c	r-c	o-a
Tsuga canadensis Hemlock			r-c	r-a

which is variously referred to as oak-tulip, oak-chestnut-tulip, or dryer phase of the mixed mesophytic community depending upon variations in its composition, and also upon the different objectives an observer may have in making classifications of forest communities.

The first ten species listed at the top of the chart occur in the dryest oak-chestnut forests found in northeastern Ohio. An attempt was made to list the remaining species in the chart in the approximate order of their invasion of the oak-chestnut forest with increasing moisture. Major attention was given to the order of invasion of the oaks, hickories, tulip, magnolia, beech and hard maple. The number of observations made was not as large as desired, and perhaps the order of some of the species is incorrectly listed. Furthermore the order of invasion of some of the species is modified somewhat by the nature of the substratum, being different for sand, rock outcrops, and clay. The possibility of a few minor errors, however regretable, does not annul the major facts illustrated by the chart.

The chart shows the relative distribution of the species under the combined effects of all the factors of the natural habitat, primarily the combined effects of the moisture gradient, soil aeration, and shade. Wherever man interfers with the factors of "natural competition" the habitat range of a species often becomes extended.

The species frequently found occupying first place in the mixed mesophytic community of northeastern Ohio on the basis of number of individuals present are beech, sugar, black, and red maple, tulip, magnolia, chestnut, white and red oak, and white ash. Somewhat less abundant, but decidedly more abundant than they occur as secondary species in the beech-maple association are red elm, black and white walnut, linden, black cherry, sour gum, flowering dogwood, pignut, bitternut, shag-bark, and mocker nut hickories, red mulberry, and american elm. Chestnut oak and hemlock are of very local occurrence in northern Ohio. The mixed mesophytic community is referred to above as a special transitional phase with the distinction in mind that any transitional forest in which the dominants of the two "competing" associations remain dominants of the transition and the secondary species continue to remain subordinate should be referred to merely as a transition. For instance, an oak-chestnut beech-maple transition in which only oaks, chestnut, beech, and maple are the dominant trees.

CHART II

Chart showing where the maximum abundance of individuals of a species may occur in virgin plant communities of which the species is a member. The relative endurance of poor soil aeration, shade, and drought by the different species in the chart is exemplified. The data also illustrate transitional phases, and the dominance of beech and hard maple in certain habitats.

Species	Oak-Chestnut Community	Mixed Mesophytic Community	Beech-Maple Association	Transitional phases of the Swamp Forest Formation
Castanea dentata				
Nyssa sylvatica				
Acer rubrum				
Carya glabra				
Quercus alba				
Prunus serotina				
Fraxinus americana				
Ulmus fulva				
Carya ovata				
Quercus rubra				
Juglans cinerea				
Juglans nigra				
Magnolia acuminata				
Liriodendron tulipifera				
Morus rubra				
Tilia americana				
Fagus grandifolia				
Acer saccharum				
Ulmus americana				
Carya laciniosa				
Quercus macrocarpa				
Fraxinus nigra				
Acer saccharinum				

Attention is particularly called to the invasion of the oak-chestnut association with increasing moisture by such species as white and red oaks, magnolia, tulip, white and black walnut, mockernut, shagbark, and bitternut hickories, white and green ash, and cherry before the entrance of beech and hard maple. When several of these species become abundant it is necessary to recognize either an early dryer phase of the mixed mesophytic community or a luxuriant phase of the oak-tulip or the oak-chestnut-tulip community* in which beech and hard maple are either absent or appear only as scattered small undergrowth trees.   With increasing moisture beech and hard maple through increase in size and abundance also assume the rank of dominants, though in the mixed mesophytic community they were apparently often overtopped by oaks, chestnut, tulip and magnolia.

In northeastern Ohio beech invades the oak-chestnut association earlier than hard maple.   This fact appears to account for the absence in northeastern Ohio of the oak-maple community that is frequently found as one approaches an oak-hickory and prairie climate.

Other variants of the mixed mesophytic community include (1) local variation in the relative abundance of individual species such as tulip, magnolia, oaks, chestnut and walnut, and (2) elimination of species beyond their geographical range. As one crosses northern Ohio from east to west, hemlock, chestnut, and magnolia drop out.   The mixed mesophytic community on limestone outcrops in northen Ohio differs from the one described in having a greater abundance of yellow oak and blue ash and no chestnut.   Altitudinal and geographical variants throughout the entire range of the mixed mesophytic community have been but partially analysed at present.

A second chart (Chart II) showing where the maximum abundance of individuals of several tree species may be found in northern Ohio further emphasizes (1) the possibilities of transitional variants, (2) the dominance of beech and hard maple in certain habitats and (3) the similarity of the mixed mesophytic community and the mixed swamp forest transition that sometimes develops on areas slightly too poorly drained for the dominance of beech and maple as previously described for northern Ohio.†

*This community is indicated in the charts by the two vertical broken lines.

†Sampson, H. C.   Succession in the Swamp Forest Formation in Northern Ohio.   Ohio Jour. Science, 30: 340–357, 1930.

The secondary species of the beech-maple association in northern Ohio include all of the species listed for the mixed mesophytic community. But where the habitat conditions are most favorable for beech and maple their dominance is very effective, and the secondary species occur only as scattered and occasional trees. Attention is also called to the fact that certain species especially tulip, magnolia, the walnuts and hickories, red and yellow oak, cherry, linden, red elm, and white ash, endure slightly less drainage than beech and hard maple. Consequently they sometimes become abundant in the best drained phases of the swamp forest before conditions are favorable for the dominance of beech and hard maple. It appears, therefore, that but for the dominance of beech and hard maple, the mixed mesophytic forest community in northeastern Ohio might occupy a much larger portion of the area exhibiting the soil-moisture gradient within the range favorable to such species as tulip and magnolia.

Two questions, therefore, arise. What are the conditions that favor the dominance of beech-maple and restrict the mixed mesophytic community to certain local habitats in northeastern Ohio? Is the mixed transitional swamp forest that sometimes develops on areas not quite sufficiently drained for the dominance of beech and hard maple a phase of the mixed mesophytic community already described as a special transitional phase between oak-chestnut and beech-maple?

For an opinion on the last question reference should be made to the charts presented in this paper and to the chart in the earlier paper on the "Succession in the Swamp Forest Formation in Northern Ohio." On the basis of the data presented in the charts it is obvious that the mixed mesophytic community described above and the mixed transitional swamp forest community sufficiently drained for the entrance of tulip, magnolia, the walnuts, and frequent individuals of beech and hard maple have much in common. They differ primarily in three respects. First in their vegetational history. The one succeeds the elm-ash-soft maple community as the result of the filling and drainage of swamp habitats, while the successional relations of the other are associated with the beech-maple and oak-chestnut communities. Secondly they differ in the presence and absence of certain secondary species; the one having certain secondary species holding over from the oak-chestnut association, the other having certain secondary species holding over from the

elm-ash-soft maple association.   In the third place there is a
difference in the proportion of the principal species.   For
instance american elm, red oak, ash and linden are relatively
more abundant in the mixed swamp forest transition, while
such species as white oak, chestnut oak, and chestnut are rare
or entirely absent.   Perhaps one may be regarded as a wetter
phase, the other as a somewhat dryer phase of the mixed
mesophytic community.   If they may be so regarded it follows
that the mixed mesophytic community in northeastern Ohio
has a somewhat wider soil-moisture gradient than beech-maple
and is eliminated from the middle portion of this range wherever
edaphic conditions are most favorable to the dominance of
beech-maple.

The habitats in which the mixed mesophytic community
occurs in northeastern Ohio appear to have certain conditions
in common, but these conditions may not hold throughout its
entire geographical range since the influence of Lake Erie may
be a factor and still other factors may become more prominent
elsewhere.

Northeastern Ohio includes a portion of the glaciated area
of the Allegheny plateau.   The streams are relatively young
with narrow flood plains and medium sized valleys 100 to 200
feet below the level of the surrounding country.   The climate is
sufficiently moist for the beech-maple forest through out the
entire range in altitude from about 580 feet near Lake Erie to
about 1200 feet on the divide between the Lake Erie and Ohio
River systems in Portage and Trumbull Counties.   Owing to
differences in physiography and soils numerous local areas are
not covered by a beech-maple forest but are occupied by
relict bogs, conifer bog forests, swamp forests, beech-maple-
birch-hemlock forests of gorges and deep valleys, oak-chestnut,
and mixed mesophytic communities.   The most extensive
development of the last two communities named above occur
on the gravelly hills of the interlobate moraine and the slopes of
the Cuyahoga River from near Burton in Geauga County
southward beyond Massillon in Stark County.

The mixed mesophytic community occurs at all altitudes
from that of the old lake bed near Lake Erie to the top of the
divide.   Its restriction to local habitats in northeastern Ohio
appears therefore to be due entirley to edaphic conditions,
local exposure, and the supreme dominance of beech-maple in

certain habitats.   The local habitats in which it is found may
be summarized as follows:

1.   Slopes of valleys in which the soil is a mixture of decay-
ing rock fragments, loose soil, and humus.   Narrow belts occur
at various places on slopes of several valleys where the suc-
cession with accompanying physiographic changes may be (1)
beech-maple on upland —→ mixed mesophytic on slope —→ beech-
maple on flood plain, or (2) beech-maple on upland —→ oak-
chestnut on ledge —→ mixed mesophytic on slope —→ beech-maple
on flood plain.   Similar slopes physiographically but with
heavy soils with poor internal drainage are covered by beech-
maple.

2.   Slopes of hills of the interlobate moraine where the
successional relations are oak-chestnut ←—→ mixed mesophytic
←—→ beech-maple depending upon whether the change is from
dry to moist conditions or the reverse.

3.   Four exceptions to slope habitats were found: (1) gravel-
rich swales between hills of the interlobate moraine with
sufficient drainage to exclude lake and bog formation, (2)
occasional high terraces between slopes covered with mixed
mesophytic forest, (3) low sand ridges on swamp forest areas
on the old lake beds, and (4) similar low ridges of sandy loam
on top of a wet flat upland near to the top of the divide in
Trumbull County.

All of the above habitats occupied by the mixed mesophytic
community, therefore, appear to be alike in having soils with a
good supply of water and at the same time with good internal
drainage.   Slopes with heavier soils and poorer internal drain-
ages are covered by beech-maple.   The dryest habitats are
covered by oak-chestnut.   Certain rocky slopes with numerous
irregularities in depth of soil are also favorable sites for mixed
forests.

The soil types that appear most favorable to the develop-
ment of the mixed mesophytic community in northeastern Ohio
are certain areas of Wooster loam and gravelly loam, Volusia
loam, and Dunkirk sand, but other forest associations are also
found on these soil types.   The location of the soil types
named above was obtained from published maps.   Attention
should also be called to the fact that the soil survey of this area
was made before the methods of soil survey reached their
present state of development.   Apparently modern soil surveys

will be more helpful in detecting some of the important edaphic
conditions that become controlling factors over local areas.

Secondary associations that follow the cutting of a mixed
mesophytic forest community are dependent not only on the
varied methods of cutting and the subsequent activities of man
on the area but also upon the composition and phase of develop-
ment of the community that is cleared. The community may
reproduce itself with but slight variations from the original, but
there is usually a noticeable change in composition. On the
dryer sites oaks, chestnut and hickories often become the most
abundant trees. On moist sites cherry, ash, elm, tulip, walnuts,
red oak, and maple may become the most abundant species.
On favorable sites beech and hard maple increase in abundance
in secondary forests following selective cutting of oaks, chest-
nuts, tulip, and magnolia in mixed mesophytic forests.