

# CENTRAL HARDWOOD NOTES

## Ecological Principles: Climate, Physiography, Soil, And Vegetation

The central hardwood region is a land of transitions in climate, physiography, soils, plants, and animals. Winter temperature and drought are the two most important climatic variables operating on plants and animals. Occasional severe periods of low winter temperatures in the northern half of the region restrict the northern occurrence of many plant and animal species. Summer drought is the most important factor, increasing from east to west in the region and to a lesser extent from north to south. Fire interacts with drought directly and is more ecologically important in the western and southern areas of the region.

Physiography interacts with climate to influence what species occur locally on different slope faces, slope positions, and elevations. North and east aspects are the most mesic or moderately moist sites, along with lower slopes on all aspects, especially in the southern half of the region. Soil is often deeper on lower slopes due to colluvial or gravity-caused deposits and water-holding capacity is greater. The mountains are not high enough to influence precipitation except on the western slope of the Appalachian Mountains. Here, and in the Cumberland Mountains of Kentucky and Tennessee, lower summer temperatures mean less evapotranspiration and more available soil moisture than in other parts of the region.

Soil moisture, aeration, and to a lesser extent available nutrients, exert the main influence on vegetation. Soils of the glaciated area in the northern parts of the region tend to be deep and fertile but surface drainage is often limited. These soils are predominantly mesic or wet depending on microtopography and internal drainage. In southern Illinois, Indiana, and Ohio, internal drainage on level areas is impeded and aeration restricted. These soils are wet during winter and dry during summer.

Soils of the southern hilly regions vary in depth, fertility, and texture. Limestone soils in parts of southern Indiana, central and western Kentucky, and central Tennessee vary from shallow to deep. Plant nutrients are often limited where soil weathering is advanced. Limestone-derived soils tend to support more plant species and are more productive than sandstone soils. Soils are especially shallow and droughty in the Nashville Basin and the Kentucky Bluegrass region. Upland sandstone soils in Tennessee and Kentucky are often shallow and nutrients are usually limited.

Loess deposits of varying depths occur in parts of northern Missouri, Iowa, and from southern Illinois to southern Ohio. These windblown materials form silty soils that are often high in most plant nutrients and favor tree growth. Loess caps may

occur on ridge tops creating better sites than adjacent south or west slopes. Fragipans, which obstruct air and water movements, may develop on level and gently rolling topography. Rooting depth is severely limited and tree growth and composition are adversely affected when fragipans are near the surface.

On bottomland, small variations in relief from just inches to a few feet provide markedly different growing conditions for trees. Low areas of slackwater, or former sloughs, remain inundated or wet most of the year and only support a few tree species. Higher areas can range from poorly to excessively drained and species composition and tree growth can vary from poor to excellent. Productive upland-like, mesic forests occur on higher bottomland areas that have medium to coarse textured soils with adequate moisture and freedom from flooding.

Species occur in north-south and east-west gradients produced by the combinations of climate, geology, physiography, and soils. The pattern of local occurrence can be very complex depending on site conditions and past disturbance. This diversity of species and site presents a wide range of management options.

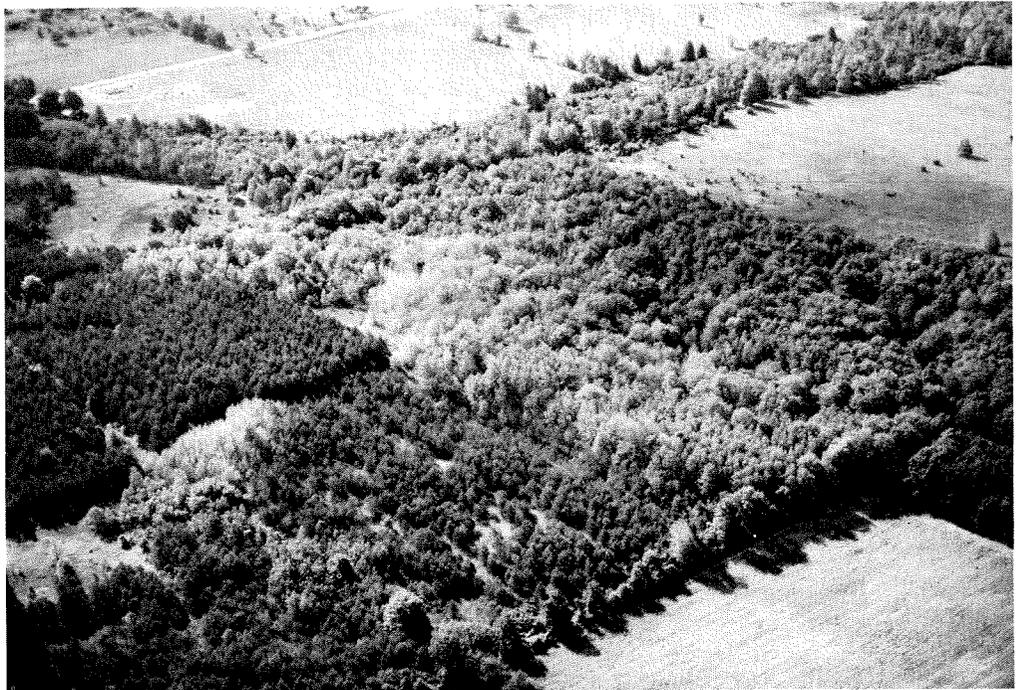
Extremely wet, dry, or infertile sites generally support fewer tree species than mesic sites and are less apt to change in species composition after disturbance. However, severe disturbance on extreme sites may result in decreased site potential, loss of species, and delays in regeneration. On the species-rich mesic sites it is more difficult to predict species composition after disturbances such as timber harvests. However, these sites generally require more understory treatment to shift species composition. Mesic sites can withstand more severe disturbance without loss of species than extreme sites.

The species composition of the overstory of most current forests has been strongly influenced by human disturbance starting in the 1800's. Early Europeans practiced a "slash and burn agriculture" similar to that used by Native Americans in the region. This consisted of clearing understories of mesic forests, girdling overstories, and burning slash piles around standing large trees. Many cleared areas were abandoned after a few years due to low fertility and declining productivity. Natural reforestation followed. The practice of slashing maple stems for sap production reduced the abundance of this species. Other practices such as coppicing for charcoal were important locally. Extensive areas in the southern hilly areas of the region were logged in the early 1900's with little concern for the composition of the new stands.

Widespread burning and grazing continued in these forests until the 1930's. Since that time, the primary disturbance has been periodic timber harvests while disturbance to the understory has been greatly reduced. This has allowed shade tolerant species to re-invade.

Past land use practices have resulted in widespread oak-dominated stands which are not stable ecologically. Currently, over much of the region stands dominated by oaks are trending more toward tolerant mesic hardwoods such as sugar maple on all but the more extreme wet and dry sites. There is evidence that the trend toward domination by sugar maple and other shade-tolerant species will result in lowered biotic diversity.

Another ecological problem confronting the resource manager in the central hardwood region is fragmentation of the forest landscape through agricultural clearing, road systems, and urban development. Fragmentation began in the early 1880's and was nearly complete in the northern half of the region by the 1890's. Forests in the southern half of the region are less fragmented today than they were at the turn of the century due to more public forest land and reforestation of abandoned croplands. However current pressures for pasture, stripmining, and urban development result in continued clearing of forest on private land throughout the region.



Forest fragmentation can result in fewer plant and animal species. (A. Steven Munson)

Fragmentation results in small, isolated woodlands with increased “edge” and potential loss of genetic diversity. Edge areas generally have lower tree and site quality with increased potential for invasion by exotic and/or pest species. Isolated forest stands have less chance to regain genetic diversity lost through poor management. While there is still much to learn about the effects of fragmentation, a general recommendation is to maintain large management units where possible and to increase the size of small forest areas where feasible.

## References

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