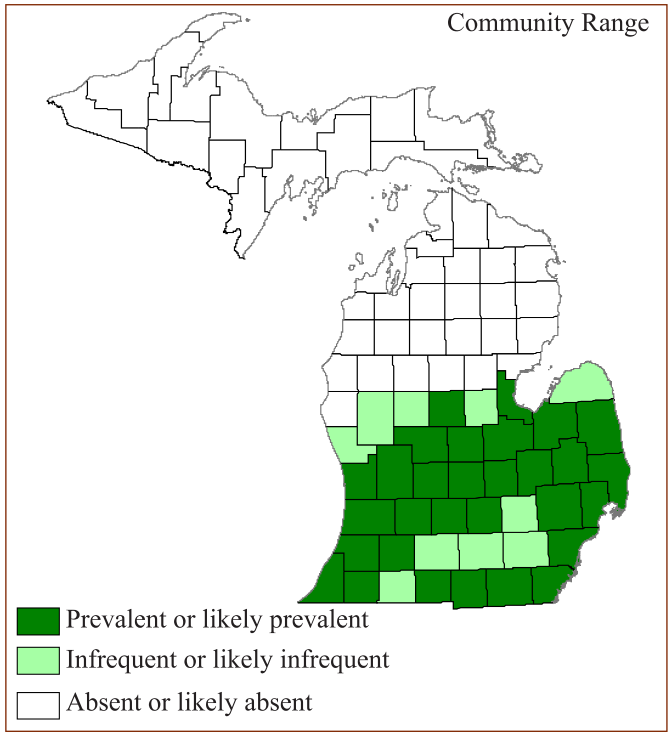
Photo by Susan R. Crispin

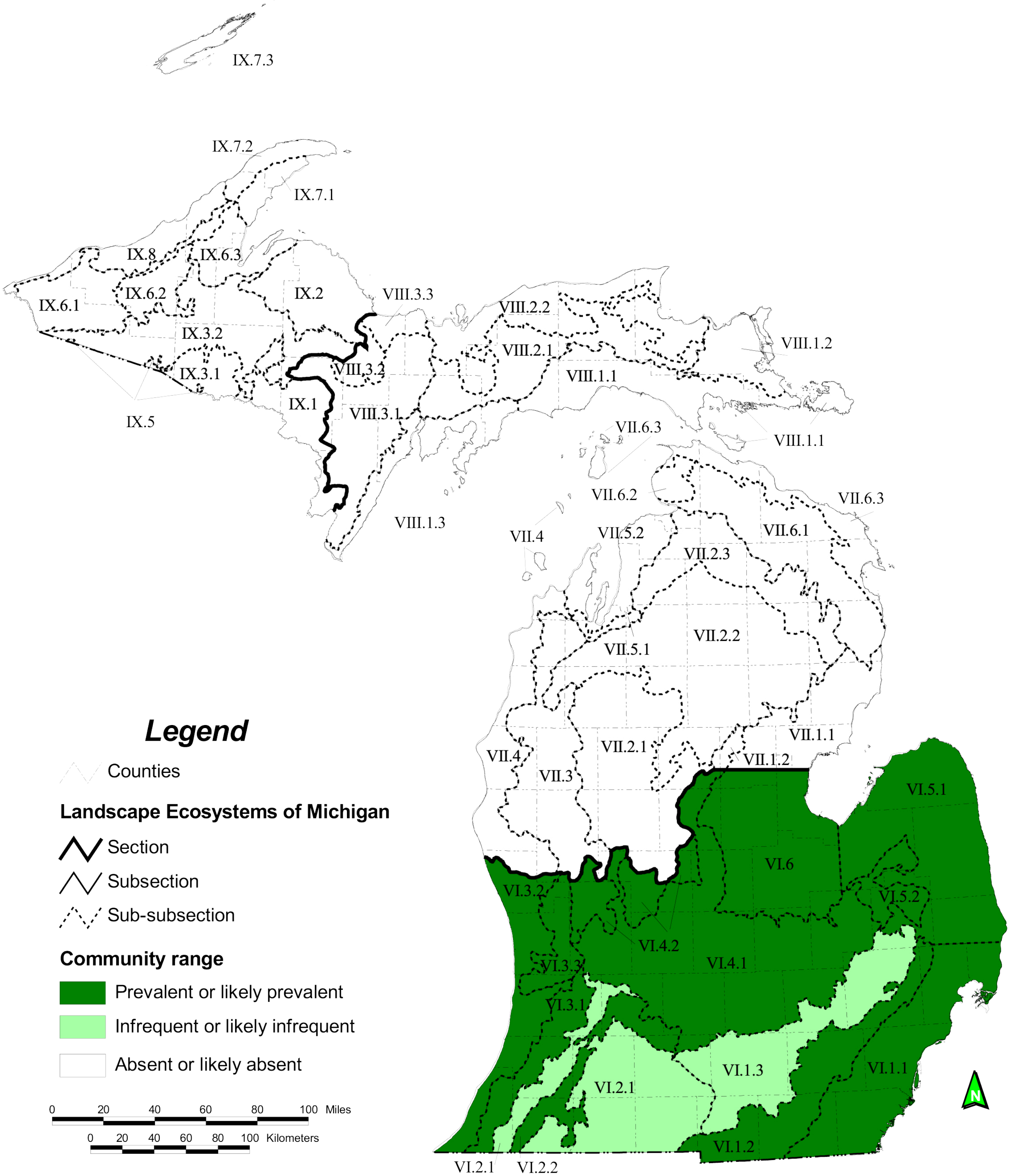


Overview: Mesic southern forests are beech- and sugar maple-dominated communities found on flat to rolling topography with predominantly silt loam, loam, or sandy loam soils and occurring principally on medium- or fine-textured moraines and silty/clayey lake plains. Within 10 to 20 miles of the Great Lakes shoreline, mesic southern forest can occur on sandy lake plains and sand dunes due to improved evapotranspiration conditions (climatic modification). The natural disturbance regime of these mesophytic hardwood forests is characterized by gap phase dynamics: frequent, small windthrow gaps allow for the regeneration of the shade-tolerant canopy dominants.

Global and State Rank: G2G3/S3

Range: The mesic southern forest has existed as a dominant assemblage in the Great Lakes for approximately 4,000 to 8,000 years, following the peak of the last interglacial warming trend (Lindsey and Escobar 1976, Davis 1976). Found in the southern Great Lakes area of the United States and Canada, this community ranges through glaciated portions of southeastern Wisconsin, Illinois, northern Indiana and Ohio, southern Michigan and Ontario, and western New York (Braun 1950, Faber-Langendoen 2001, NatureServe 2003). The northern extent of this community is the climatic tension zone, and the southern boundary follows the southern limit of the Wisconsin ice sheet (Braun 1950). Within Michigan, this forest type is found throughout the southern half of the Lower Peninsula, below the climatic tension zone. Presently the distribution of mesic southern forest has been reduced to scattered fragments throughout its original range (Parker et al. 1985).

Rank Justification: Mature/old-growth mesic southern forest was historically a widespread forest type in southern Lower Michigan. Interpretation of the notes of the original land surveyors indicates that circa 1800 this community type occupied close to 6 million acres with a mean patch size over 9,000 acres and patch sizes ranging from less than one acre to over 400,000 acres. As the result of clearing for settlement, agriculture, logging, and development, this forest type has been reduced to scattered, small fragments (often 40 acres or less), which are isolated in a matrix of anthropogenic disturbance (Cain 1935, Dodge and Harman 1985a, Beach and Stevens 1990). Most of the remaining stands are farm woodlots that have been subject to continual anthropogenic pressures. The structure and composition of the remnants have been altered by selective logging, grazing, removal of snags and logs for firewood, deer herbivory, exotic species invasion, and human-introduced diseases (e.g., Dutch elm disease and chestnut blight) (Cain 1935, Curtis 1959, Frye 1976, Brewer 1980, Parker et al. 1985, Donnelly and Murphy 1987, Robertson and Robertson 1995). Many fragments are dominated solely by sugar maple, which was often



Ecoregional map of Michigan (Albert 1995) depicting distribution of mesic southern forest (Albert et al. 2008)

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left to provide maple syrup (Beaman 1970, Dodge and Harman 1985a) and is favored in gaps created by selective logging. In addition, beech was often culled because of its poor timber value (Ward 1956, Beach and Stevens 1990, Barnes 1991). Conversely, many stands that were high-graded of valuable timber (i.e., sugar maple and red oak) are now beech-dominated.

Old-growth forest has dwindled from close to 70% to under 10% of the Great Lakes landscape (Frelich 1995). Circa 1800, Michigan contained approximately 37 million acres (15 million hectares) of forest; today that acreage has been cut in half. Prior to European settlement, mesic southern forests constituted 16% of the forested landscape in Michigan (Comer et al. 1995). Parker (1989) estimates that only 1,170 acres (474 ha) of old-growth deciduous forest remains in Michigan, constituting less than 0.007% of the present forested vegetation of Michigan. Across its range, 155 occurrences of high-quality mesic southern forest have been documented, totaling 8,895 acres (3,600 ha) (NatureServe 2003). Currently there are 44 documented occurrences of the mesic southern forest community in Michigan (3,809 acres or 1,540 hectares). Sixteen of those occurrences, constituting 2,612 acres (1,060 ha), are high-quality representations of this type.

Physiographic Context: Mesic southern forests occur principally on medium- or fine-textured ground moraine, medium- or fine-textured end moraine, and silty/clayey glacial lake plains (Kenoyer 1934, Braun 1950, Curtis 1959, Dodge and Harman 1985a, Barnes 1991, Albert 1995). Sand dunes and sandy lake plains can support these systems where proximity to the Great Lakes modifies local climate (within 10-20 miles of the shore, evapotranspiration conditions are suitable for mesic forest) (Kost et al. 2007). Mesic southern forest can also occur on ice-contact topography and on coarse-textured end moraines. Floodplain terraces in a diversity of landforms support mesic southern forest. Prevalent topographic positions of this community are gentle to moderate slopes and level areas with moderate to good drainage (Braun 1950, Rogers 1981b, Barnes 1991). In a study of woodlots on ground moraine in south-central Lower Michigan, Dodge and Harman (1985) found typical relief to range between 6 and 12 m and slope to range between 2% and 6%. Where mesic southern forest occurs on steeper slopes, it is often associated with northern to eastern exposures which receive low amounts of direct sunlight and are characterized by a cool, moist microclimate (Kron 1989).

Mesic southern forest can occur on a variety of soil types, but loam is the predominant texture. The diversity of soils which can support this system include sand, sandy loam, loamy sand, loam, silt loam, silty clay loam, clay loam, and clay (Cain 1935, Dodge and Harman 1985b, Kron 1989, Frye 1976, Donnelly and Murphy 1987). Soils are typically well-drained with high water-holding capacity and high nutrient and soil organism content (Quick 1924, Curtis 1959, Lindsey and Escobar 1976, Beach and Stevens 1980, Rogers 1981b). The soil often contains small decomposing branches and rotting herbaceous material and is insulated by a thick layer of leaf litter in autumn (Martin 1992). High soil fertility is maintained by nutrient inputs from the decomposition of deciduous leaves which contain high levels of magnesium, calcium, and potassium and enrich the top layer of soil (Curtis 1959). Where beech is dominant in the canopy, beech litter can have a podzolizing effect on the soil, increasing the acidity (Rogers 1981a). Soil pH ranges widely in mesic southern forest from slightly acidic to moderately alkaline (Lindsey and Escobar 1976).

Three physiographic subtypes of mesic southern forest occur in Michigan: one on the level, eastern and western lake plains, one on the western sand dunes, and one on the till plains and end moraines between these areas. Lake plain mesic forests often occur adjacent to or grade into hardwood swamps (southern hardwood swamp). Seasonal pools, though present in all subtypes, are a frequent feature of these lake plain forests, where drainage is often poor. Mesic southern forest on western sand dunes are often adjacent to oak-hickory forest (on south- and west-facing upper slopes and ridgetops). Mesic southern forest on moraines and on some dunes have southern hardwood swamp on adjacent lower slopes (Brewer et al. 1984, Kost et al. 2007).

The Michigan range of the mesic southern forest falls within the area classified by Braun (1950) as the Beech-Sugar Maple Region and within Albert et al.'s (1986) Region I, Southern Lower Michigan. This region has a warm, temperate, rainy to cool, snow-forest climate with hot summers and no dry season. The number of freeze-free days is between 120 and 220 and the average number of days per year with snow cover of 2.5 cm or more is between 10 and 60. The mean annual total precipitation for Region I is 820 mm. The daily maximum temperature in July ranges from 29° to 32° C (85° to 90° F), and the daily minimum temperature in January ranges from -9° to -4° C (15° to 25° F) (Albert et al. 1986, Barnes 1991). During leaf on, mesic southern forest can be significantly cooler and more humid than adjacent cover types: humidity can be 10-32% higher in forests compared to the surrounding landscape (Curtis 1959).

Natural Processes: The natural disturbance regime in mesic southern forest is characterized by frequent small-scale wind disturbance or gap phase dynamics. The Great Lakes region is one of the most active weather zones in the northern hemisphere with polar jet streams positioned overhead much of the year. More cyclones pass over this area than any other area in the continental U.S. (Frelich and Lorimer 1991). Severe low-pressure storm systems frequently generate windthrow gaps, openings in the canopy created by the death of a large branch or one or more trees (Canham and Loucks 1984, Runkle 1984). In addition to thunderstorms, glaze or ice storms are a significant source of disturbance in hardwood forests of North America (Abell 1934, Lemon 1961, Melancon and Lechowicz 1987). Glaze results in pruning of small branches, severe breakage of large branches, complete stem breakage, and the creation of canopy gaps (Lemon 1961, Melancon and Lechowicz 1987). Canopy trees affected but not killed by glaze are often subsequently infected by fungus and/or infested by insects and die standing or are eventually windthrown (Abell 1934). Estimated return interval for severe glaze storms ranges between 20 and 100 years (Melancon and Lechowicz 1987). Sugar maple and beech have been reported to be moderately affected by glaze storms (Lemon 1961) with beech showing greater susceptibility (Melancon and Lechowicz 1987). Melancon and Lechowicz (1987) speculate that beech's tendency to root sprout following stem breakage may compensate for its greater vulnerability to ice damage.

Whether from windthrow or ice breakage, approximately 1% of the total area of mesic forest is within recent gap (less than one year old) and the average canopy residence time ranges between 50 and 200 years (Runkle 1982, Runkle 1991). Frequent windthrow events generate a forest mosaic of different aged patches of gaps of a wide range of sizes; the majority of gaps are between 100 and 400 m^2 (Runkle 1981, Runkle 1984).

Photo by Gary Reese

Frequent, small windthrow gaps allow for the regeneration of shade-tolerant canopy dominants

These small-scale disturbance events are the primary source of forest turnover. Gaps close by 1) adjacent canopy trees filling the space through lateral growth of their limbs or 2) saplings within the gap filling the gap from below (Runkle 1982). The creation of canopy gaps results in temporary increases in the availability of light, water, and nutrients and decreases in root competition, which allow canopy recruitment of saplings (Moore and Vankat 1986, Franklin et al. 1987). Tree species respond differently to variation in gap size, origin, orientation, and age (Runkle 1982, Poulson and Platt 1989, Barnes et al. 1998). For example, sugar maple and beech thrive in the common small canopy gaps (20-100m^2), while white ash and tulip tree require larger canopy gaps (>400m^2), which occur less frequently (Runkle 1984, Barnes et al. 1998). As gap size increases, woody species diversity and the size and number of stems increase (Runkle 1982). Gaps formed by wind-uprooted trees are typically larger with more exposed bare soil than gaps formed by stem breakage. Stem-breakage gaps may favor root sprouted saplings (i.e., beech and basswood) and existing advanced regeneration, while uprooted tree gaps can allow recruitment of mid-tolerant opportunists as well as the shade-tolerant dominants (Barnes et al. 1998). Runkle (1984) observed that as gap age increased, so too did the importance of beech saplings. As noted by Poulson and Platt (1989), in addition to size and age, the orientation of a gap influences light regimes and patterns of canopy replacement. For example, the long northern edge of east-west oriented gaps receives high-intensity sunlight through the course of the day, while the eastern and western edges of north-south oriented gaps receive low-intensity morning and afternoon sunlight (Poulson and Platt 1989). In a study of windthrow in an old-growth, beech/sugar maple forest in Michigan, Brewer and Merritt (1978) observed that the direction of windfall was primarily east and south, reflecting the prevailing wind directions. Spatial and temporal heterogeneity of treefall gaps allows for the maintenance of shade-tolerant canopy dominance and the persistence of mid-tolerant opportunists at low densities (Runkle 1981, Runkle 1982, Runkle 1984, Poulson and Platt 1989).

Recruitment of saplings within treefall gaps is typically by shade-tolerant species (primarily sugar maple and beech) that can wait suppressed beneath the closed canopy. In a Michigan, old-growth, beech/sugar forest, Woods (1979) found that almost all small gaps were replaced by beech and sugar maple. These species can remain in a suppressed understory state for prolonged periods prior to release and canopy ascension and utilize a series of canopy gaps to reach the overstory (Canham 1985, Canham 1990, Poulson and Platt 1996). Both species display architectural plasticity, exhibiting growth in small canopy gaps (15-75m^2) an order of magnitude greater than rates of suppressed sapling growth (Canham 1988). Canham (1990) reported that sugar maple is often 110-126 years old at final release and can pass through one to five episodes of suppression which last between 22 and 28 years. Canham (1990) found that beech saplings reached final release at a younger age and after fewer episodes of suppression compared to sugar maple. Average number of periods of suppression for beech was between 1.9 and 2.4; average total length of suppression was between 45 and 52 years; and recruitment age ranged between 66 and 80 years (Canham 1990). In contrast to Canham's findings, Poulson and Platt (1996) observed the opposite trend in a study of replacement patterns of beech and sugar maple in Michigan. They found that sugar maple was suppressed on average for only 20 years, and beech reached canopy height after an average of 121 years. Both authors speculate that the relative abundance of beech will increase with low rates of treefall, while sugar maple will increase following periods with higher rates of gap formation (Canham 1988, Poulson and Platt 1996). When rates of canopy disturbance are low, beech may take less time to be released because of its greater capacity for suppressed growth compared to maple. Beech saplings have long lateral branches that grow horizontally to exploit the scattered and perpetually shifting light flecks under closed canopy conditions. As treefall disturbance increases, sugar maple may be favored because of its strong apical dominance and greater capacity for vertical growth in small gaps (Poulson and Platt 1996). In addition to different rates of treefall, variability of sapling recruitment is also influenced by landform and soil characteristics of specific sites (Barnes et al. 1998). Acidic sandy or clay lake plain sites with poor drainage are often characterized by dominance of beech recruitment, while nutrient-rich, well-drained, clayey morainal sites are frequently dominated in the overstory and understory by sugar maple (Barnes et al. 1998).

Large-scale, catastrophic disturbances are uncommon in mesic southern forests. After release, both sugar maple and beech can remain in the canopy for hundreds of years (overstory sugar maple and beech can reach 400 years old, and 200-year-old trees are common) (Curtis 1959, Goodman et al 1990, Tubbs and Houston 1990). Catastrophic stand-leveling blowdowns were infrequent disturbance factors in the northern portion of Michigan and Wisconsin, with estimated return intervals greater than 1,200 years (Canham and Loucks 1984, Whitney 1986, Frelich and Lorimer 1991). It is probable that these large-scale wind events were even more uncommon in the southern lower peninsula of Michigan as was the case for the southern portion of Wisconsin (Canham and Loucks 1984). Interpretation of the notes of the original land surveyors indicates that circa 1800 mean patch size of blowdowns was approximately 600 acres (240 ha) and that less than 1% of beech-sugar maple forest was affected by large-scale, stand-leveling blowdowns (Comer et al. 1995). In addition, it is unlikely that fire was an important disturbance factor in these systems. Less than 0.2% of the beech-sugar maple forest circa 1800 was estimated to be affected by fire (Comer et al. 1995). Both sugar maple and beech are thin-barked and shallowly rooted and therefore highly sensitive to fire (Ward 1956, Curtis 1959, Johnson 1994). However, the closed-canopy conditions of beech/sugar maple forest and the high humidity and moisture levels of the soil and leaf litter make mesic forests highly resistant to the passage of fire (Curtis 1959, Grimm 1984, Barnes 1991). Because of the low probability of large-scale, stand-replacing disturbance in this community type, numerous generations of trees can pass between catastrophes. As a result, mesic southern forests tend to be multi-generational, with old-growth conditions lasting several centuries in the absence of anthropogenic disturbance (Frelich 1995, Barnes et al. 1998). Old-growth conditions include high quantity of dead wood (snags, stumps, and fallen logs) in a diversity of ages, sizes, and stages of decomposition, high basal area, large diameter canopy dominants, multilayered canopies, numerous canopy gaps of diverse age and size, and pit and mound topography from continual, frequent gap formation (Brewer and Merritt 1978, Parker 1989, Whitney 1989, Runkle 1991, Martin 1992, Lorimer and Frelich 1994). Old-growth mesic hardwoods are characterized by numerous overstory trees older than 200 years, approximately 250 trees/ha, basal area greater than 25 m^2/ha, 16-36mg/ha of fallen dead wood covering approximately 2% of the forest floor, greater than 15 snags/ha, diameters ranging between 80 and 210 cm, and high plant species richness (Thompson 1980, Parker 1989, Martin 1992, Forrester and Runkle 1999, Runkle 2000). Due to the compositional stability of this forest type, mesic southern forest exhibits a high degree of vegetative similarity across its range (Braun 1950, Curtis 1959).

Vegetation Description: The species composition and structure of mesic southern forest is influenced by the interaction of landform, soil properties, disturbance history, and climate (Frye 1976, Barnes 1991, Arii and Lechowicz 2002). The principal dominants of this community are *Fagus grandifolia* (beech) and *Acer saccharum* (sugar maple), which together often make up over 80% of the canopy composition (Lindsey and Escobar 1976, Donnely and Murphy 1987). Beech is often more prevalent on somewhat poorly drained lake plains with slightly acidic soils and poor soil aeration. Sugar maple often dominates well-drained to moderately well-drained moraines where nutrient levels are high and soils are heavy-textured (Lindsey and Escobar 1976, Barnes 1991, Barnes et al. 1998). As mentioned earlier, frequent and larger treefall gaps favor sugar maple regeneration while less common and smaller canopy disturbance can maintain beech dominance. Canopy associates of these long-lived, shade tolerants include the following species that exploit larger canopy gaps (typically multiple treefall events): *Carya cordiformis* (bitternut hickory), *Fraxinus americana* (white ash), *Liriodendron tulipifera* (tulip tree), *Quercus alba* (white oak), *Q. rubra* (red oak), and *Tilia americana* (basswood). Sites that have been subject to recent and/or frequent anthropogenic disturbance often contain a significant component of *Acer rubrum* (red maple), *Populus* spp. (aspen), and/or *Prunus serotina* (black cherry) (Dodge and Harman 1985a). Historically, in the southeast portion of the state, *Castanea dentata* (American chestnut) was probably an infrequent canopy associate in these systems but has since been eliminated by the chestnut blight (Brewer 1982, Brewer 1995). Prior to the Dutch elm disease epidemic in the 1960s, *Ulmus americana* (American elm) and to a lesser extent *Ulmus rubra* (slippery elm) were canopy associates in mesic southern forest. However, the disease has relegated elms to understory and subcanopy status: in many stands no elms greater than 15 cm (6 in) in diameter remain (Beaman 1970, Frye 1976). In addition to elm, a large percentage of the subcanopy and understory layer is composed of *Ostrya virginiana* (hop-hornbeam) (Ward 1958).

Photo by Susan R. Crispin

Closed canopy conditions allow little light infiltration and maintain high humidity and soil moisture in beech/sugar maple forest.

On average tree species diversity for mesic southern forest is 9.5 species with a range of 3-14 species (Lindsey and Escobar 1976, Barnes 1991). Canopy tree diameters at breast height range widely between 35 and 120 cm (14-47 in) with most trees concentrated between 45 and 75 cm (18-30 in). Canopy heights typically range between 18 and 40 m (60-131 ft) with beech trees often having their first limbs at 14 m (45 ft) (Goodman et al. 1990, Tubbs and Houston 1990, Poulson and Platt 1996). Canopy closure in these systems is close to 100%, especially where beech and sugar maple are dominant. As noted by Brewer (1980), dense shade intensifies as canopy dominance of sugar maple and beech increases. As a result of the tight canopy closure and resulting heavy shade, mesic southern forest is characterized by uniform mesic conditions, a scattered, shade-tolerant understory layer, and herbaceous cover dominated by spring ephemerals. Sugar maple advanced regeneration is the overwhelming dominant within the understory layer and often the ground layer (Cain 1935, Dodge and Harman 1985a, Beaman 1970, Frye 1976). High shade tolerance in conjunction with high reproduction rates allows sugar maple to saturate the understory. Sugar maple, which is wind-dispersed, has been recorded producing 4-5 million seeds per acre and 20,000 seedlings per acre (Curtis 1959). As mentioned, beech, elm, and hop-hornbeam are also common saplings. In addition, a handful of shrub species are common, scattered components of the understory: *Asimina triloba* (pawpaw), *Carpinus caroliniana* (musclewood), *Cornus alternifolia* (alternate-leaved dogwood), *Cornus florida* (flowering dogwood), *Dirca palustris* (leatherwood), *Hamamelis virginiana* (witch hazel), *Lindera benzoin* (spicebush), *Lonicera canadensis* (fly honeysuckle), *Ribes cynosbati* (gooseberry), *Sambucus racemosa* (red elderberry), and *Viburnum acerifolium* (maple-leaf viburnum). Common vines include *Parthenocissus quinquefolia* (Virginia creeper), *Smilax* spp. (greenbriar), and *Toxicodendron radicans* (poison ivy).

One of the unique aspects of the mesic southern forest is the spring floral display by a significant portion of the herbaceous community. Spring flowering is one of the prevailing adaptations of herbaceous plants in response to heavy summer shading. In summer months, little direct sunlight penetrates the canopy and that which does is greatly reduced in intensity since it passes through several layers of leaves before reaching the ground layer (Curtis 1959). The spring ephemerals complete major portions of their life cycle (leaf expansion, flowering and/or fruiting) before the overstory trees leaf out. Many of these species are long-lived, perennial herbs of low stature with conspicuous flowers that are insect-pollinated, seeds with eliasomes that attract insect dispersers (frequently ants), and large, subterranean storage organs that allow rapid shoot expansion in the spring when labile nutrient levels are high. The leaf litter of mesic southern forest provides insulation for these spring ephemerals: temperatures in the leaf litter are higher and more stable than the fluctuating ambient temperature (Curtis 1959, Lindsey and Escobar 1976, Rogers 1981a).

Photo by Earl Wolf

A flush of spring ephemerals carpeting the ground layer.

Characteristic "true" spring ephemerals that flush, flower, and fruit in the spring include: *Claytonia virginica* (spring beauty), *Dentaria laciniata* (toothwort), *Dicentra canadensis* (squirrel-corn), *D. cucullaria* (Dutchman's-breeches), *Erythronium albidum* (trout-lily), *E. americanum* (trout-lily), and *Isopyrum biternatum* (false rue-anemone). Common shade-tolerant herbs that bloom in the spring but retain their leaves for part or all of the summer and commonly fruit in the summer include: *Actaea pachypoda* (baneberry), *Arisaema triphyllum* (jack-in-the-pulpit), *Asarum canadense* (wild ginger), *Caulophyllum thalictroides* (blue cohosh), *Geranium maculatum* (wild geranium), *Hepatica acutiloba* (sharp-lobed hepatica), *Hydrophyllum virginianum* (waterleaf), *Maianthemum canadense* (false lily of the valley), *Osmorhiza claytonii* (sweet cicely), *Phlox divaricata* (wild blue phlox), *Podophyllum peltatum* (mayapple), *Polygonatum pubescens* (Solomon's seal), *Sanguinaria canadensis* (bloodroot), *Smilacina racemosa* (false Solomon's-seal), *Trillium grandiflorum* (large-leaved trillium), *Uvularia grandiflora* (bellwort), and *Viola* spp. (violets). Additional species that are important components of the ground flora include *Adiantum pedatum* (maidenhair fern), *Allium tricoccum* (ramps), *Aster macrophyllus* (big-leaved aster), *Botrychium virginianum* (rattlesnake fern), *Carex albursina* (sedge), *Carex plantaginea* (sedge), *Circaea lutetiana* (enchanter's nightshade), *Epifagus virginiana* (beech-drops), *Geum canadense* (white avens), and *Euonymus obovata* (running strawberry-bush). (Above species lists compiled from MNFI database and from Quick 1924, Cain 1935, Braun 1950, Curtis 1959, Benninghoff and Gebben 1960, Lindsey and Escobar 1976, Brewer 1980, Rogers 1981a, Donnelly and Murphy 1987, NatureServe 2003.)

Numerous opportunistic, shade-intolerant species can occur within mesic southern forest because of the frequent generation of small-scale canopy gaps. Herbaceous species that thrive in new canopy gaps include *Impatiens capensis* (jewel weed) and *Pilea pumila* (clearweed), while *Osmorhiza claytonii* often dominates in gaps that are several years old (Moore and Vankart 1986). In addition to the canopy openings, gap phase dynamics generates a mosaic of microhabitats, a diverse microtopography with numerous fallen logs and windthrow mounds and pits. Fallen logs, pits and mounds provide suitable colonization sites for herbs because of the increased nutrient availability and lack of competition (Thompson 1980). Plants with animal-dispersed seeds often establish on treefall logs. Nests of many ant species are found in fallen logs and windthrow mounds and as noted above, many of the spring ephemerals (e.g., trilliums and violets) have ant-dispersed seeds (Rogers 1981a). Analogous to overstory diversity and composition, the species diversity and composition of the ground flora is maintained by frequent treefall gaps (Brewer 1980).

Also contributing to the species and structural diversity of these systems are the seasonally inundated ephemeral pools. Ephemeral pools within mesic southern forest are composed of species distinct from the surrounding mesic forest. The pools are often ringed by canopy *Acer saccharinum* (silver maple) and *Fraxinus nigra* (black ash). The shrub component can be heavy, with prevailing dominance by *Cephalanthus occidentalis* (buttonbush): *Ilex verticillata* (winterberry) is also common. Characteristic herbs include *Boehmeria cylindrica* (false nettle), *Impatiens capensis*, *Laportea canadensis* (wood nettle), and *Pilea pumila* (Frye 1976, Beach and Stevens 1980, Kron and Walters 1986).

As noted by Curtis (1959), the adaptations of shade tolerance and spring-ephemeralism are difficult evolutionary traits as manifest by the high degree of compositional similarity of the herbaceous community of mature mesic southern forest across its range. Although disturbance is frequent within these systems, invasive species often are incapable of becoming established in the interior of large, mature/old-growth stands and are often limited to the edges (McCarthy et al. 2001). However, mesic southern forest that has been highly disturbed anthropogenically can be ridden with exotic species such as *Alliaria petiolata* (garlic mustard) and *Lonicera* spp. (honeysuckles). The floral composition of these systems is further threatened by chronically high densities of deer, which can decimate native plant diversity. Deer herbivory causes the suppression and elimination of numerous palatable herbs of the mesic southern forest (Waller and Alverson 1997). Though adapted to dense shade conditions, many of these herbs do not have traits to limit herbivory, suggesting that they evolved under conditions of low herbivore pressure.

Conservation and biodiversity management: When the primary conservation objective is to maintain biodiversity in mesic southern forests, the best management is to leave large tracts unharvested and allow natural processes (gap phase dynamics: growth, senescence, and windthrow) to operate unhindered. It is crucial to allow dead and dying wood to remain within these systems to become snags, stumps, and fallen logs. Large contiguous tracts of old-growth and mature mesic southern forest provide important habitat for cavity nesters, species of detritus-based food webs, canopy-dwelling species, understory saprophytic plants, and interior forest obligates, including numerous neotropical migrants (Juday 1988). Forest warblers, flycatchers, thrushes, vireos, woodpeckers, and woodland raptors are area-sensitive groups dependent on these forests; their populations are larger and fare better within larger habitat patches (Vora 1994). Nest predation and nest parasitism (mainly by cowbirds) increase with forest fragmentation and account for population declines of forest birds, especially neotropical migrants (Robinson et al. 1995, Heske et al. 2001). As mentioned above, deer herbivory and exotic species invasion can alter species composition and structure within fragmented patches of mesic southern forest. Herbs of this community are highly susceptible to herbivory by deer because they never outgrow the zone of accessibility or “molar zone” (Alverson et al. 1988, Waller and Alverson 1997). Herbaceous plants constitute 87% of deer’s summer diet and often suffer from reduced flowering rates, survivorship, and plant size and can even be locally extirpated by this keystone herbivore (Waller and Alverson 1997, Augustine and Frelich 1998). Indirect impacts of deer herbivory can include the reduction of pollinators and seed dispersers of sensitive herbs (Waller and Alverson 1997, Ruhren and Handel 2003). Conservation and restoration of fragmented mesic forest communities require active long-term management of deer at low densities, which may be realized through increased hunting pressure

(Alverson et al. 1988, Augustine and Frelich 1998). Where resources are available, deer exclosure fences may be erected around concentrations of sensitive herbs and susceptible saplings. Intensive management may also be required to control non-native species invasion in fragments of mesic southern forest. Limiting anthropogenic disturbance in large tracts of old-growth and mature mesic southern forest is the best means of reducing the possibility of invasive species establishment and domination.

Much of Michigan's mesic southern forest is immature (less than 100 years old) and has not yet attained the structural and compositional features of old-growth mesic forest. Mimicking gap-dominated disturbances and promoting dead tree dynamics can hasten old-growth, uneven-aged conditions in immature and mature stands (Runkle 1991, Lorimer and Frelich 1994). In addition to retaining all naturally occurring snags and fallen logs, dead tree dynamics can be enhanced by girdling overstory trees of variable species and diameter. Manipulative treatments can create openings of natural size and at disturbance rates approximating old-growth conditions. Runkle (1991) suggests creating 50-100 m^2 patches and maintaining 1% of a given area in new gap per year. Felling early and mid-successional species to create these gaps can promote shade-tolerant species dominance.

Research needs: The mesic southern forest exhibits numerous regional, physiographic, and edaphic variants. In particular, little research has been conducted in mesic southern forest of the eastern lake plain. The diversity of variations throughout its range demands the continual refinement of regional classifications that focus on the relationships between vegetation, physiography, and soils (Barnes et al. 1982). An important research question to be addressed is how the disturbance regime, structure, and species composition of this community will change as the Great Lakes region becomes increasingly fragmented. Maintaining the species composition of mesic southern forest fragments requires addressing how the effects of fragmentation – such as high levels of deer herbivory, non-native species invasion, and nesting failure –can be reduced. Historically, tree diseases (Dutch elm disease and chestnut blight) have had a profound impact on Michigan forests. Beech bark disease has yet to be reported in the southern lower peninsula, but this disease may eventually impact mesic southern forest and has the capacity to drastically alter gap dynamics, species composition, and vegetative structure (Forrester et al. 2003). A crucial research need is to determine if it is possible to prevent this disease from drastically altering beech forests. Using hindsight gained from assessing past epidemics, researchers can formulate strategies for prevention and hypothesize about impacts future epidemics may have on forest structure and composition.

Michigan indicator species: *Acer saccharum* (sugar maple), *Actaea alba* (baneberry), *Adiantum pedatum* (maidenhair fern), *Arisaema triphyllum* (jack-in-the-pulpit), *Asarum canadense* (wild ginger), *Asimina triloba* (pawpaw), *Carex albursina* (sedge), *Carex plantaginea* (sedge), *Asimina triloba* (pawpaw), *Carpinus caroliniana* (musclewood), *Cornus alternifolia* (alternate-leaved dogwood), *Claytonia virginica* (spring beauty), *Caulophyllum thalictroides* (blue cohosh), *Dentaria laciniata* (toothwort), *Dicentra canadensis* (squirrel-corn), *D. cucullaria* (Dutchman's-breeches), *Dirca palustris* (leatherwood), *Erigenia bulbosa* (harbinger-of-spring), *Erythronium albidum* (trout-lily), *E. americanum* (trout-lily), *Euonymus obovata* (running strawberry-bush), *Fagus grandifolia* (American beech), *Hepatica acutiloba* (sharp-lobed hepatica), *Hydrophyllum virginianum* (waterleaf), *Isopyrum biternatum* (false rue-anemone), *Liriodendron tulipifera* (tulip tree), *Osmorhiza claytonii* (sweet cicely), *Podophyllum peltatum* (mayapple), *Sambucus racemosa* (red elderberry), *Sanguinaria canadensis* (bloodroot), *Tilia americana* (basswood), *Trillium grandiflorum* (large-leaved trillium), *Viola pubescens* (yellow violet), and *Viola sororia* (common blue violet).

Other noteworthy species: Numerous rare plants are associated with mesic southern forest including: *Adlumia fungosa* (climbing fumitory, state special concern), *Aristolochia serpentaria* (Virginia snakeroot, state threatened), *Bromus nottowayanus* (satin brome, state special concern), *Carex oligocarpa* (eastern few-fruited sedge, state threatened), *Carex platyphylla* (broad-leaved sedge, state endangered), *Castanea dentata* (chestnut, state endangered), *Dentaria maxima* (large toothwort, state threatened), *Euphorbia commutata* (tinted spurge, state threatened), *Galearis spectabilis* (showy orchis, state threatened), *Hybanthus concolor* (green violet, state special concern), *Hydrastis canadensis* (goldenseal, state threatened), *Jeffersonia diphylla* (twinleaf, state special concern), *Liparis* *lilifolia* (purple twayblade, state special concern), *Ophioglossum vulgatum* (southeastern adder's-tongue, state endangered), *Panax quinquefolius* (ginseng, state threatened), *Phlox ovata* (wideflower phlox, state endangered), *Polymnia uvedalia* (yellow-flowered leafcup, state threatened), *Ruellia strepens* (smooth ruellia, state endangered), *Scutellaria elliptica* (hairy skullcap, state special concern), *Smilax herbacea* (smooth carrion-flower, state special concern), *Tipularia discolor* (cranefly orchid, state endangered), *Trillium recurvatum* (prairie trillium, state threatened), *Trillium sessile* (toadshade, state threatened), *Triphora trianthophora* (three-birds orchid, state threatened), and *Vitis vulpina* (frost grape, state threatened).

Several raptor species frequently nest in mesic southern forest: *Accipiter gentilis* (Northern goshawk, state special concern), *Accipiter cooperii* (Cooper's hawk), and *Buteo lineatus* (red-shouldered hawk, state threatened). This community provides summer nesting habitat for many neotropical migrants, especially interior forest obligates such as *Dendroica virens* (black-throated green warbler), *Piranga olivacea* (scarlet tanager), and *Seiurus aurocappilus* (ovenbird). Rare songbirds of mesic southern forest include *Dendroica cerulea* (cerulean warbler, state threatened), *Protonotaria citrea* (prothonotary warbler, state special concern), *Seiurus motacilla* (Louisiana waterthrush, state threatened), and *Wilsonia citrina* (hooded warbler, state special concern). Mesic southern forests with sandy soils and a thick leaf litter layer can support *Microtus pinetorum* (woodland vole, state special concern). *Dryobius sexnotatus* (six-banded longhorn beetle, state threatened) occur in over-mature mesic southern forest and prefer to breed in dead sugar maple, beech, basswood and elm.

Temporary pools within mesic southern forest provide crucial habitat for reptiles and amphibians. Amphibian species most dependent on ephemeral pools in Michigan are *Ambystoma maculatum* (spotted salamander), *Ambystoma laterale* (blue-spotted salamander), *Psuedacris triseriata* (chorus frog), *Rana sylvatica* (wood frog), *Hyla versicolor* (gray tree frog), and *Bufo americanus* (American toad). Rare herptiles associated with these pools include *Ambystoma texanum* (smallmouth salamander, state endangered), *Ambystoma opacum* (marbled salamander, state endangered), *Emydoidea blandingii* (Blanding's turtle, state special concern), and *Nerodia erythrogaster neglecta* (copperbelly water snake, state endangered). Reptiles associated with mesic southern forest include *Pantherophis spiloides* (gray ratsnake, state special concern) and *Terrapene carolina carolina* (eastern box turtle, state special concern).

Similar communities: Mesic northern forest, dry-mesic southern forest, southern hardwood swamp, floodplain forest, wet-mesic flatwoods.

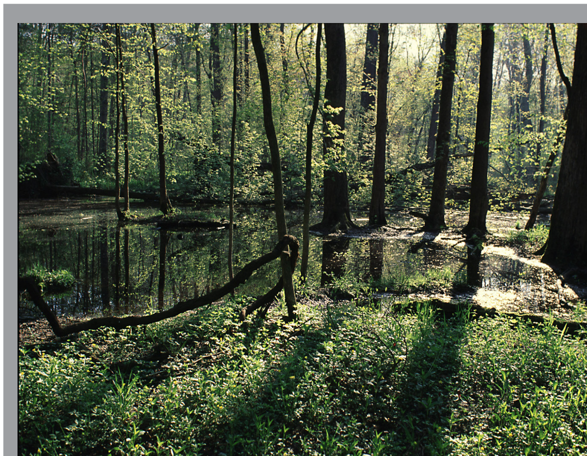

Photo by Dave Kenyon

Seasonal pools are frequent features of mesic southern forests.

Other Classifications:

Michigan Natural Features Inventory *Circa* 1800 Vegetation (Comer et al. 1995):
Beech-Sugar Maple Forest

Other Classifications:

Michigan Department of Natural Resources (MDNR): M-Northern Hardwoods

Michigan Resource Information Systems (MIRIS):
41111-411119 (Sugar Maple), 41143-41149 (Beech)

The Nature Conservancy National Classification:

CODE; ALLIANCE; ASSOCIATION; COMMON NAME

I.B.2.N.a.15; *Fagus grandifolia – Acer saccharum* (*Liriodendron tulipifera*) Forest Alliance; *Fagus grandifolia – Acer saccharum* Glaciated Midwest Forest; American Beech – Sugar Maple Glaciated Midwest Forest.

I.B.2.N.a.18; *Fagus grandifolia – Quercus* spp. – *Acer* spp. Forest Alliance; *Fagus grandifolia – Acer saccharum – Quercus bicolor – Acer rubrum* Flatwoods Forest; Beech – Hardwoods Till Plain Flatwoods.

Related Abstracts: cerulean warbler, Cooper's hawk, dry-mesic southern forest, eastern box turtle, floodplain forest, ginseng, goldenseal, mesic northern forest, northern goshawk, red-shouldered hawk, showy orchis, woodland vole.

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Abstract Citation:

Cohen, J.G. 2004. Natural community abstract for mesic southern forest. Michigan Natural Features Inventory, Lansing, MI. 13 pp.

Updated June 2010.

Funding for abstract provided by National Oceanic and Atmospheric Organization.

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