**13100**

**North-Central Interior Dry-Mesic Oak Forest and Woodland**

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| **Modelers** |  | **Reviewers** |  |
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**Vegetation Type**

Forest and Woodland

**Map Zones: 51**

**Geographic Range**

This system occurs throughout southern lower Michigan primarily in Allegan, Barry, Cass, St. Joseph, Kalamazoo, Calhoun, Jackson, Washtenaw, Wayne, Monroe, Livingston, Oakland, Macomb, Lapeer and St. Clair counties. This encompasses Sections 222J and 222U (Cleland et al. 2007). Though occurring in all subsections, this system is most prevalent in 222Jg, 222Jh, the far western and eastern ends of 222Jc, 222Jb, along coastal dunes of 222Ja, and in 222Ua and 222Ue.

**Biophysical Site Description**

This system occurs most commonly in the interlobate region of southern Michigan where outwash, ice-contact and end moraine landforms are situated between former glacial lobes. Other landforms suitable for development of the dry-mesic oak forest are coarse ground moraine, sandy lake plain and dunes. Common to all these landforms is well-drained, acidic soil characterized by loamy sand and sandy loam. Dry landscape settings, such as on western and southern aspects and upper slopes and ridge tops are conducive to the development of this system. Native Americans played a critical role in the development and maintenance of oak-hickory landscapes through fire ignition. Natives burned these landscapes for a variety of reasons. Fire encouraged open habitats which, in turn, increased food-producing plants (forbs, mast) and ungulate herbivores (meat). Also, lightning-strike ignitions, though limited in frequency, would have provided an additional source of ignition.

**Vegetation Description**

Typically, the vegetation consists of forests dominated by oaks, especially white oak (*Quercus alba*), black oak (*Quercus velutina*) and red oak (*Quercus rubra*). Along with oaks are varying amounts of hickory (*Carya glabra* and *Carya ovata*), red maple (*Acer rubrum*), black cherry (*Prunus serotina*) and sassafras (*Sassafras albidum*). American chestnut (*Castanea dentata*) was once dominant or codominant in the very southeastern portion of southern MI. Currently, due to decades of fire suppression, subcanopies and shrub layers are well-developed by witch-hazel (*Hamamelis virginiana*), flowering dogwood (*Cornus florida*) and hop-hornbeam (*Ostrya virginiana*). Common low woody shrubs include brambles (*Rubus* spp.), black currant (*Ribes cynosbati*) and both native and invasive roses (*Rosa* spp.). Graminoid species such as *Carex pensylvanica, Danthonia spicate,* and *Andropogon gerardii* are also common.

**BpS Dominant and Indicator Species**

| **Symbol** | **Scientific Name** | **Common Name** |
| --- | --- | --- |
| QUAL | *Quercus alba* | White oak |
| QUVE | *Quercus velutina* | Black oak |
| CAGL8 | *Carya glabra* | Pignut hickory |
| CAOV2 | *Carya ovata* | Shagbark hickory |
| CADE12 | *Castanea dentata* | American chestnut |
| QURU | *Quercus rubra* | Northern red oak |
| ACRU | *Acer rubrum* | Red maple |
| SAAL5 | *Sassafras albidum* | Sassafras |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

**Disturbance Description**

The North-Central Interior Dry-Mesic Oak Forest and Woodland (oak-hickory forest) is predominantly Fire Regime I, characterized by low-severity surface fires. Historically, indigenous fires accounted for more than 95% of the ignitions over these landscapes. Vegetation types varied based on fire frequency and intensity. Grassland prairies burned often with fire rotations approximately less than five years and were probably associated with flat-to-slightly rolling terrain that effectively carried fire. These grasslands, deliberately maintained by Native Americans for hunting purposes, were probably scattered throughout the forest matrix. Oak-hickory grubs (tree-sprout and shrub thickets) occurred where fire frequency was a bit less, probably 5-10yrs. Also, grub conditions would arise immediately after catastrophic burns that would top-kill tree-dominated communities. Savannas and woodlands developed within a moderate burning regime, with fire return times averaging every 4-17yrs (Henderson and Long, 1984). Closed-canopy oak-hickory forests would develop where fire return intervals stretched beyond 15yrs. Shade-tolerant, fire-sensitive maples (and associated late-successional trees) would regenerate and form understories beneath oak-hickory canopies when fire was excluded over several decades (25-40yrs). With continued fire exclusion, maple and other late-successional species would gradually replace overstory oaks and hickories through gap capture (Sutherland and Hutchinson 2003). A mosaic of vegetation types comprised oak-hickory landscapes contingent on fire history (Cutter and Guyette 1994). From a gross landscape perspective, oak-hickory forests occurred in a contiguous matrix integrated with oak savannas, grassland prairies, and mesic forests dominated by red and sugar maple. Fire frequency and intensity determined the proportion of each of these landscape ecosystems across the landscape matrix. Historically, buffalo grazing would have similarly maintained open conditions in very localized patches within savannas. Currently, an overabundance of deer is limiting oak regeneration in remnant oak forests in southern Michigan. Ice-damage, periodic insect defoliation and the extinct passenger pigeon may have likely contributed to increased oak canopy openings that facilitated light penetration to the forest floor, and, ultimately, greater possibility of germination and recruitment of oaks.

**Fire Frequency**

| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| --- | --- | --- | --- | --- |
| Replacement | 160 | 6 |  |  |
| Moderate (Mixed) | 160 | 6 |  |  |
| Low (Surface) | 10 | 88 |  |  |
| All Fires | 9 | 100 |  |  |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

**Scale Description**

Pre-European oak-hickory forests covered hundreds of thousands of contiguous acres. When considered as a matrix with savannas and prairies, estimated acreage increases significantly.

**Adjacency or Identification Concerns**

Though often contiguous, oak-hickory patches are virtually always integrated in the larger landscape scale with mesic maple-dominated forests and dry oak savannas. Mesic maple forests were relegated to those areas where fire was restricted through facilitation by an edaphic factor such as heavy-textured soil or high water table or by natural fire breaks such as bodies of water and slightly protected depressions. Prolonged intervals (100-150yrs) without fire were needed for maples to manifest their dominance. Oak-hickory forests also graded into savannas (i.e., oak openings) when fire intervals shortened to the point where woody regeneration of overstory tree species was limited. Exposed areas where wind could carry flames at great distances tend to exhibit more savanna vegetation structure than a close oak-hickory forest. In areas where flat outwash extended beyond ice-contact terrain or end moraine, savannas would typically occur in the former abutting a closed forest on the latter landforms.

Currently, under the past century's practice of fire suppression, oak-hickory forests are succeeding into a red maple-dominated forest. Prolific sprouting ability, light, wind-carried fruits, and the tendency to cast dense shade has enabled red maple to outcompete white and black oak in these systems. Without fire as a natural disturbance that prevents establishment of fire-sensitive species, mesophytic species are free to invade and recruit into the overstory. Implications to forestry, wildlife, and pest and disease outbreaks become apparent. Currently, an overabundance of deer is limiting oak regeneration in remnant oak-hickory forests in southern Michigan. Furthermore, invasive shrubs such as autumn-olive, common buckthorn, multiflora rose and honeysuckle rigorously compete against oaks in the low understory. Regeneration is inhibited by such exotics, and changes in nutrient cycling may also occur because some exotics are nitrogen fixers.

**Issues or Problems**

**Native Uncharacteristic Conditions**

Though present, historically, red maple has been typified as the "native invasive" in oak hickory forests. Its abundance in these systems measured in both stem density and basal area has grown considerably due to fire suppression and the marked increase in fire return interval. Abundance of aspen, sassafras and black cherry can also be attributed to fire suppression and poor silvicultural practices.

**Comments**

Comments from R6OAHI model: This model replaces the model R8OAKdm from the Southern Appalachians model zone. This is a modification of the OKH4 FRCC model developed by Nowacki, Hutchinson, Iverson and Van-Gundy. We added a pathway from class B to class E to represent a portion of the landscape that is too moist to burn. Possible reviewers: Greg Nowacki, Marc Abrams, Burton Barnes (bvb@umich.edu), Dennis Albert and Joshua Cohen.

***Succession Classes***

**Mapping Rules**

| **Upper Layer Lifeform** | **Height (m)** | **Canopy Cover (%)** |
| --- | --- | --- |
| **0-10** | **11-20** | **21-30** | **31-40** | **41 - 50** | **51-60** | **61-70** | **71-80** | **81-90** | **91-100** |
| Herb | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 0.5-1.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | 1.0-3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Shrub | >3.0 | UN | UN | UN | UN | UN | UN | UN | UN | UN | UN |
| Tree | 0-5 | B | B | B | UN | UN | UN | UN | UN | E | E |
| Tree | 5-10 | B | B | C | C | C | C | UN | UN | E | E |
| Tree | 10-25 | B | B | C | C | C | C | D | D | E | E |
| Tree | 25-50 | UN | UN | UN | UN | UN | UN | D | D | E | E |
| Tree | >50 | UN | UN | UN | UN | UN | UN | D | D | E | E |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

**Class A 3 Early Development 1 - All Structures**

*Indicator Species*

| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| --- | --- | --- | --- |
| ANGE | Andropogon gerardii | Big bluestem | Upper |
| SCHIZ4 | Schizachyrium | Little bluestem | Upper |
| SONU2 | Sorghastrum nutans | Indiangrass | Upper |

*Description*

Class A is grassland prairie maintained by frequently recurring fire. Native Americans used these lands for hunting, and agriculture/native plant gathering. If fire is absent for a few years, tree seedlings and sprouts will establish and move the community to the mid-seral, open stage. Heavy grazing, though unlikely to have large-scale impact, would have kept certain patches from progressing to a woody shrub vegetation stage and would have maintained the early-seral stage.

*Maximum Tree Size Class*
None

**Class B 7 Mid Development 1 - Open**

*Indicator Species*

| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| --- | --- | --- | --- |
| QUAL | Quercus alba | White oak | Upper |
| QUVE | Quercus velutina | Black oak | Upper |
| SAAL5 | Sassafras albidum | Sassafras | Mid-Upper |
| CAGL8 | Carya glabra | Pignut hickory | Upper |

*Description*

This is an early tree regeneration (root and stump sprouts) phase.

*Maximum Tree Size Class*
Pole 5-9" DBH

**Class C 27 Mid Development 2 - Open**

*Indicator Species*

| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| --- | --- | --- | --- |
| QUAL | Quercus alba | White oak | Upper |
| QUVE | Quercus velutina | Black oak | Upper |
| SAAL5 | Sassafras albidum | Sassafras | Upper |
| QUMA2 | Quercus macrocarpa | Bur oak | Upper |

*Description*

This class is defined as oak-hickory savanna and woodland.

*Maximum Tree Size Class*
Large 21-33"DBH

**Class D 61 Late Development 1 - Open**

*Indicator Species*

| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| --- | --- | --- | --- |
| QUAL | Quercus alba | White oak | Upper |
| QUVE | Quercus velutina | Black oak | Upper |
| QURU | Quercus rubra | Northern red oak | Upper |
| CAGL8 | Carya glabra | Pignut hickory | Upper |

*Description*

Class D is defined as oak-hickory forest. Open understories of oak seedlings exist. If the late-succession open forest type persists for 50yrs without any type of fire, it will convert to a late-succession mixed mesophytic closed forest type. This conversion is a result of species shift from dominant oaks to dominant maple, tulip tree, and beech, which do not support fire as readily.

*Maximum Tree Size Class*
Large 21-33"DBH

**Class E 2 Late Development 2 - Closed**

*Indicator Species*

| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| --- | --- | --- | --- |
| ACRU | Acer rubrum | Red maple | Upper |
| ACSA3 | Acer saccharum | Sugar maple | Upper |
| TIAM | Tilia americana | American basswood | Upper |
| QUAL | Quercus alba | White oak | Upper |

*Description*

Maple forests develop during the absence of fire. Dense understories of shade-tolerant species develop.

*Maximum Tree Size Class*
Large 21-33"DBH

***Model Parameters***

**Deterministic Transitions**

| **From Class** | **Begins at (yr)** | **Succeeds to** | **After (years)** |
| --- | --- | --- | --- |
| Early1:ALL | 0 | Mid1:OPN | 5 |
| Mid1:OPN | 6 | Mid2:OPN | 50 |
| Mid2:OPN | 51 | Mid2:OPN | 999 |
| Late1:OPN | 51 | Late1:OPN | 999 |
| Late2:CLS | 101 | Late2:CLS | 999 |

**Probabilistic Transitions**

| **Disturbance Type** | **Disturbance occurs In** | **Moves vegetation to** | **Disturbance Probability** | **Return Interval (yrs)** | **Reset Age to New Class Start Age After Disturbance?** | **Years Since Last Disturbance** |
| --- | --- | --- | --- | --- | --- | --- |
| Native Grazing | Early1:ALL | Early1:ALL | 0.01 | 100 | No | 0 |
| Replacement Fire | Early1:ALL | Early1:ALL | 0.2 | 5 | Yes | 0 |
| Alternative Succession | Mid1:OPN | Late1:OPN | 1 | 1 | Yes | 30 |
| Replacement Fire | Mid1:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Mixed Fire | Mid1:OPN | Early1:ALL | 0.005 | 200 | Yes | 0 |
| Native Grazing | Mid1:OPN | Mid1:OPN | 0.01 | 100 | No | 0 |
| Wind or Weather or Stress | Mid1:OPN | Early1:ALL | 0.01 | 100 | Yes | 0 |
| Surface Fire | Mid1:OPN | Mid1:OPN | 0.1 | 10 | No | 0 |
| Alternative Succession | Mid2:OPN | Late1:OPN | 1 | 1 | Yes | 20 |
| Replacement Fire | Mid2:OPN | Early1:ALL | 0.002 | 500 | Yes | 0 |
| Native Grazing | Mid2:OPN | Mid2:OPN | 0.01 | 100 | No | 0 |
| Mixed Fire | Mid2:OPN | Mid2:OPN | 0.01 | 100 | No | 0 |
| Surface Fire | Mid2:OPN | Mid2:OPN | 0.1 | 10 | No | 0 |
| Alternative Succession | Late1:OPN | Late2:CLS | 1 | 1 | Yes | 50 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late1:OPN | Mid2:OPN | 0.005 | 200 | Yes | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.1 | 10 | No | 0 |
| Replacement Fire | Late2:CLS | Early1:ALL | 0.001 | 1000 | Yes | 0 |
| Mixed Fire | Late2:CLS | Late1:OPN | 0.005 | 200 | Yes | 0 |
| Wind or Weather or Stress | Late2:CLS | Late2:CLS | 0.007 | 143 | No | 0 |
| Surface Fire | Late2:CLS | Late1:OPN | 0.01 | 100 | Yes | 0 |

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