FD Fire-Dependent Forest/Woodland System

photo by R.P. Dana, MN DNR

Kittson County, MN

General Description

The Prairie Parkland (PPA) and Tallgrass Aspen Parklands (TAP) provinces historically were characterized by wide expanses of open prairie and open wetlands. Forests, woodlands, and brushlands were restricted to patches of land that did not burn as frequently as surrounding prairies. In the PPA Province, woody vegetation accounted for just 4% of the landscape and was concentrated around lakes and rivers. In the TAP Province, woody vegetation covered about 36% of the landscape and was concentrated in regions with perennially high water tables and poorly drained soils. The wooded vegetation consisted of patches of true, closed-canopy forests (such as Mesic Hardwood Forest [MH] and Floodplain Forest [FF] communities) on sites well protected from prairie fires. Sites that burned often enough to prevent the formation of closed-canopy forests but not enough to favor development of prairies were characterized by patches of scrubby or brushy Fire-Dependent Forest/Woodland (FD) communities. In the past, when fires were more frequent, landscape context strongly influenced where woody vegetation developed. Areas of greater local relief, presence of lakes and wetlands, and relatively high water tables all potentially interrupted the spread of prairie fires, enabling persistence of trees and brush. Within patches of wooded vegetation, slope, aspect, and soil drainage affected the finer-scale pattern of vegetation types.

In the past, FD communities in the PPA and TAP provinces appear to have consisted predominantly of shrubs and trees resprouting after fire or stunted by fire, with scattered taller trees or groves of trees. The most common tree species in these communities were bur oak and quaking aspen. It is interesting that vast areas of Minnesota were inventoried by public land surveyors in the 1800s with rather casual mention of the upland vegetation, which was simply described as either forest or prairie. In regions of the PPA and TAP provinces where patches of woodland were intermixed with prairie, the surveyors' descriptions were more elaborate as they attempted to describe the greater complexity of vegetation patterns. In parts of the PPA and TAP provinces where oaks were the most common trees in woodlands and brushlands, the public land surveyors described the vegetation as oak barrens, oak savanna, and oak openings. In areas where aspen was more common, the land surveyors described the vegetation as groves, thickets, and parklands of aspen, often with some oak. Natural remnants of this

scrubby and brushy vegetation have developed into taller woodlands or forests following the decline in fire frequency that came with Euro-American settlement in the region. The descriptions of FD communities in this guide are based largely on current examples of these previously more fire-prone communities. In the PPA Province, the majority of these examples are on sandy, gravelly, or otherwise droughty sites where succession to closed-canopy MH communities has been slowed by harsh growing conditions. In the TAP Province, most current examples of FD communities are on wet but sandy sites that dry out during severe droughts and burn often enough to prevent succession to closed-canopy MH or Wet Forest (WF) communities.

As the name implies, FD communities are or have been strongly influenced by wildfires. The fires common in the past in the deciduous woodlands of the PPA and TAP provinces were capable of killing stands of trees and other aboveground vegetation under the right combination of climate, fuel supply, and topographic setting. However, even intense fires in these deciduous woodlands did not generate the kinds of conflagrations possible in the closed-canopy coniferous forests of the Laurentian Mixed Forest (LMF) Province, where crown fires produce enough heat to completely consume branches of live trees, coarse woody debris, litter, and even some soil organic matter, resulting in the death of most trees at a site and recolonization of the site through germination of seeds banked in the soil or dispersed from other sites. The less intense fires in the deciduous woodlands of the PPA and TAP provinces generally did not completely kill trees and shrubs on the site, but instead killed aboveground stems, promoting vegetative recovery mainly from existing rootstocks rather than from new seedlings. Any mortality of trees and shrubs that did occur in these deciduous FD communities came primarily from attrition following repeated fires rather than consumption in a single fire. In addition to promoting vegetative sprouting, these fires also enhanced sexual plant reproduction by exposing mineral soil, triggering seed dispersal, breaking seed dormancy, and increasing light and heat conditions on the ground. Fires also prevented accumulation of litter and humus, thus affecting nutrient cycling, nutrient availability, and soil-forming processes linked to humus.

At present, most of the once-extensive prairies and parklands of the PPA and TAP provinces have been converted to agricultural or urban land. Thus, the prairie wildfires that swept across the landscape and maintained the FD communities are gone. The landscape has been changed further by extensive ditching and draining of wetlands, which has altered the high local water tables and distribution of water bodies that influenced the distribution and persistence of woodlands in the fire-prone provinces. Herds of bison and elk, which likely supplemented fire in shaping the composition and structure of FD communities, are also now gone from the landscape.

Plant Adaptations

Plants that occur in FD communities have seeds or vegetative structures that can survive fire; they also tend to be good at colonizing burned sites. Many FD plants are opportunists that can take advantage of the short periods following fire when nutrients are relatively abundant and light levels are high. Such plants must also survive frequent drought and potentially long periods between fires when light levels decrease beneath increasingly dense shrub and tree canopies. The most evident characteristic of FD plants in the PPA and TAP provinces of Minnesota is their ability to sprout prolifically. The trees and shrubs, and many of the herbaceous species, are capable of storing considerable amounts of carbohydrates belowground in roots, rhizomes, or other specialized organs and then sprouting vigorously after aerial stems are destroyed by fire. These plants seem to be particularly plastic in allocating resources to underground or aboveground tissues, depending on the impact of fire on their overall vigor.

At present, FD communities in the PPA and TAP provinces have a mixture of species with life history traits and morphological features that are generally associated with either

Upland Prairie (UP) communities or MH communities. This is because the composition of FD communities includes plants adapted to the historic fire-prone conditions of the sites on which they occur as well as plants adapted to the current shadier conditions. As an example, FD communities tend to have graminoid cover dominated by sedges, as is true for MH communities, but also have grass species that are equally at home in prairies. In addition, the flora of FD communities includes ferns, which are common in MH communities and rare in UP communities, but the ferns in FD communities are limited to the most widespread species in Minnesota, such as lady fern *(Athyrium filix-femina)*, rattlesnake fern *(Botrychium virginianum)*, and bracken *(Pteridium aquilinum)*. Many additional fern species common in MH communities are absent from FD communities. Several other kinds of species present in FD communities that are shared with UP communities are summer- and fall-blooming herbs, shrubs with spines and prickles, shrubs with fleshy fruits, half-shrubs, annual plants, and plants with sticky, animal-dispersed seeds.

The dominant trees of FD communities in the PPA and TAP provinces are oaks and aspen. Bur oak and quaking aspen are by far the most common trees, but northern pin oak and balsam poplar are dominant in some stands. The oaks and aspen are well adapted to repeated burning because of their ability to store resources in their root systems and resprout after fire. The oaks develop peculiar growth forms (often referred to as “grubs”) when subjected to fire. When the tree trunk or stem is killed, a callus develops over the top of an enlarged root mass near the ground surface. These trees continue to send up sprouts from the root collar at the margin of the mass, forming a ring of stems. Such rings commonly achieve 3-foot diameters, and individual stems up to 5 feet apart may be connected to the same rootstock. These sprouts grow quickly at first, but growth eventually slows, especially when the stems are overtopped by aspens or by adjacent trees that survived the fire. Quaking aspen and balsam poplar survive repeated burning by forming suckers that sprout from an extensive network of roots. This produces a dispersed, thicket-like growth of new sprouts. These sprouts, like those of the oaks, often seem stunted, with growth of individual stems slowing after a rapid initial burst. It is significant that in the PPA and TAP provinces land surveyors in the 1800s commonly listed aspen and oak as “underbrush” rather than “timber.” Aboveground, the FD communities in the two provinces were incredibly dynamic, with the density and height of woody plants ever changing in response to fires. Belowground, however, were massive rootstocks of oaks, aspens, and many of the common shrub species. These rootstocks can attain great age, and there is every reason to believe that under natural fire regimes, oak grubs, aspen clones, and colonies of shrubs could continuously occupy a site for centuries.

Floristic Regions

FD communities in Minnesota are grouped into four floristic regions based on general differences in species composition (Fig. FD-1). Two of these floristic regions are represented in the PPA and TAP provinces: the Northwestern Floristic (FDw) Region and the Southern Floristic (FDs) Region. FDw communities are restricted to the TAP Province, while FDs communities—which are most common in the Eastern Broadleaf Forest Province—are present at scattered sites in the PPA Province.

Floristic differences between the two regions are likely to be related in part to climate. The FDw Region is under the influence of Arctic air masses in the winter much more often than the FDs Region, and is much colder. The FDw Region experiences extreme winter temperatures of -41°F to -45°F (-41°C to -43°C), which exceed the physiological tolerances of species such as northern red oak, ironwood, and black cherry, which are present in the FDs Region but not the FDw Region. The FDw Region also has, on average, about 20 to 70 days more snow cover each year than the FDs Region, which may also lead to differences in presence of species.

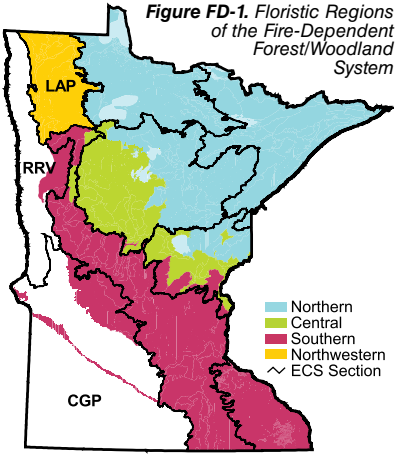

Figure FD-1. *Floristic Regions of the Fire-Dependent Forest/Woodland System*

In addition to differences in climate, the FDw and FDs regions differ strongly in physiography, parent material, and major geologic processes, all of which likely have an effect on species composition. FDw communities are present in flat landscapes with poorly developed surface drainage. In the past, before ditching and draining of wetland basins, the steady accumulation of peat in shallow depressions promoted high water tables in the adjacent uplands on which FDw communities occur. As a result, the soils in most FDw communities are moderately well drained to very poorly drained, and the water table is usually within reach of tree roots if not other plants in the community. Because FDw communities are present on seasonally wet sites and tend to occur next to perennially wet plant communities, they have plant species characteristic of mucky wetland habitats. The occurrence of FDw communities on wet sites is unusual among communities in the FD system. In other parts of Minnesota, these sites typically support WF, MH, or FF communities little affected by fire. The TAP Province, however, experiences prolonged and severe droughts during which fires will burn through almost any site with dry fuels, even sites that soils and plants would suggest are normally quite wet. The floristic composition of FDw communities suggests a successional relationship with both Wetland Prairie (WP) and WF communities. It is likely that sites currently occupied by FDw communities were previously occupied by WP communities in periods following severe fire. In the long-term absence of fire or severe drought, FDw communities may succeed to WF or possibly MH communities. Descriptions of the vegetation of northwestern Minnesota made by public land surveyors in the 1800s and researchers in the early 1900s indicate that WP, FDw, and WF communities were present in a fine-scale mosaic that shifted across the flat landscape in response to drought cycles and fire patterns.

In comparison with FDw communities, FDs communities often occur in landscapes with rolling to rugged terrain. The soils are well to excessively well drained, and the water table is beyond the reach of most plant roots. Because peatlands are less prevalent in the FDs Region, FDs communities are less likely than FDw communities to have plants characteristic of mucky wetland communities. On relatively level terrain, FDs communities were often present in the past as a buffer of brush and scattered timber separating riparian MH and FF communities from prairies. In rugged terrain, FDs communities formed larger patches of vegetation, often with inclusions of MH communities in ravines, on north-facing slopes, and around lakes. Because of proximity to MH communities, FDs communities have plant species that, although tolerant of fire, are characteristic of and more common in MH communities. With the reduction in prairie wildfires that has accompanied agricultural development of the region, FDs communities have tended to succeed toward closed-canopy MH communities, promoting occurrence of additional shade-tolerant species from adjacent MH and FF communities.

Plant Indicators of FDw vs. FDs Communities

Plant species with high fidelity for FDw communities relative to FDs communities are listed in Table FD-1. The largest group of diagnostic plants for the FDw Region relative to the FDs Region are species common on peaty or mucky habitats throughout the LMF Province, including Bebb's willow *(Salix bebbiana)*, bluejoint *(Calamagrostis canadensis)*, fringed brome *(Bromus ciliatus)*, swamp gooseberry *(Ribes hirtellum)*,

Table FD-1. *Plants useful for differentiating the Northwestern from the Southern Floristic Region of the Fire-Dependent Forest/Woodland System.*

		Common Name	Scientific Name	frequency (%) FDw	FDs
Northwestern Floristic Region	Affinity for Peaty Habitats in Northeastern Minnesota	Bebb's willow	*Salix bebbiana*	49	-
		Bluejoint	*Calamagrostis canadensis*	44	2
		Fringed brome	*Bromus ciliatus*	40	4
		Swamp gooseberry	*Ribes hirtellum*	40	-
		Flat-topped aster	*Aster umbellatus*	40	2
		Red-osier dogwood	*Cornus sericea*	37	2
		Fringed loosestrife	*Lysimachia ciliata*	31	-
		Dwarf alder	*Rhamnus alnifolia*	30	-
		White rattlesnakeroot	*Prenanthes alba*	27	2
		Red-stemmed aster	*Aster puniceus*	26	-
		Swamp thistle	*Cirsium muticum*	22	-
		Giant goldenrod	*Solidago gigantea*	20	-
		Pussy willow	*Salix discolor*	19	-
		Fowl bluegrass	*Poa palustris*	19	-
		Meadow horsetail	*Equisetum pratense*	16	-
		Meadowsweet	*Spiraea alba*	16	-
		Bog birch	*Betula pumila*	16	-
		Marsh straw sedge	*Carex tenera*	16	-
		Bunchberry	*Cornus canadensis*	10	-
		Swamp fly honeysuckle	*Lonicera oblongifolia*	10	-
	Prairie Affinity	Veiny meadow-rue	*Thalictrum venulosum*	66	-
		Bastard toadflax	*Comandra umbellata*	44	-
		Yarrow	*Achillea millefolium*	34	-
		Slender wheatgrass	*Elymus trachycaulus*	25	-
		Woods' rose	*Rosa woodsii*	21	-
		Canada anemone	*Anemone canadensis*	20	2
		Marsh vetchling	*Lathyrus palustris*	19	-
		Wood betony	*Pedicularis canadensis*	18	-
		Mexican muhly grass	*Muhlenbergia mexicana*	16	-
		Nodding wild rye	*Elymus canadensis*	16	-
		White sage	*Artemisia ludoviciana*	12	-
		Gray goldenrod	*Solidago nemoralis*	12	-
		Black-eyed Susan	*Rudbeckia hirta*	10	-
		Prairie cordgrass	*Spartina pectinata*	10	-
		Big bluestem	*Andropogon gerardii*	10	-
		Alumroot	*Heuchera richardsonii*	10	-
		Wood lily	*Lilium philadelphicum*	10	-
		Clustered muhly grass	*Muhlenbergia glomerata*	10	-
		Shrubby cinquefoil	*Potentilla fruticosa*	10	-
	Central Fire-Dependent Forest/Woodland Affinity	American vetch	*Vicia americana*	74	-
		False melic grass	*Schizachne purpurascens*	46	2
		Veiny pea	*Lathyrus venosus*	40	8
		Fireweed	*Epilobium angustifolium*	20	-
		Kalm's hawkweed	*Hieracium kalmii*	18	-
		Balsam poplar (U)	*Populus balsamifera*	14	-
		Blue giant hyssop	*Agastache foeniculum*	14	-
		Harebell	*Campanula rotundifolia*	12	-
		Poverty grass	*Danthonia spicata*	12	-
		Yellow panic grass	*Panicum xanthophysum*	10	-
	*	Interrupted wild rye	*Elymus diversiglumis*	15	-

* **Other** (U) = understory tree

flat-topped aster *(Aster umbellatus)*, red-osier dogwood *(Cornus sericea)*, fringed loosestrife *(Lysimachia ciliata)*, and dwarf alder *(Rhamnus alnifolia)*. Another group of species diagnostic for FDw communities are plants that have high frequency in Central Floristic (FDc) Region jack pine–dominated communities in the LMF Province. These communities, including Central Poor Dry Pine Woodland (FDc12) and Central Dry Pine Woodland (FDc23), occur on sites that in the past (ca. 1,000 to 2,000 years ago) were occupied by deciduous woodlands that were perhaps similar to FDw communities. In addition, like FDw communities, FDc12 and FDc23 typically occur on sandy lacustrine parent material in proximity to paludified peatlands. Species common in these FDc communities and also present in FDw communities include American vetch *(Vicia americana)*, false melic grass *(Schizachne purpurascens)*, veiny pea *(Lathyrus venosus)*, fireweed *(Epilobium angustifolium)*, Kalm's hawkweed *(Hieracium kalmii)*, and blue giant hyssop *(Agastache foeniculum)*. Other species that help to separate FDw from FDs communities include species most common in UP or WP communities, including veiny meadow-rue *(Thalictrum venulosum)*, bastard toadflax *(Comandra umbellata)*, yarrow *(Achillea millefolium)*, slender wheatgrass *(Elymus trachycaulus)*, Woods' rose *(Rosa woodsii)*, and Canada anemone *(Anemone canadensis).*

Plants with high fidelity for FDs communities relative to FDw communities are listed in Table FD-2. Most of these plants have their peak presence in MH communities, including several of the dominant tree species such as basswood, northern red oak, and ironwood. Also diagnostic are many shade-tolerant herbs such as Clayton's sweet cicely *(Osmorhiza claytonii)*, lopseed *(Phryma leptostachya)*, large-flowered bellwort *(Uvularia*

***Table FD-2**. Plants useful for differentiating the Southern from the Northwestern Floristic Region of the Fire-Dependent Forest/Woodland System.*

		Common Name	Scientific Name	frequency (%) FDw	FDs
Southern Floristic Region	Mesic Hardwood Forest Affinity	Clayton's sweet cicely	*Osmorhiza claytonii*	7	82
		Lopseed	*Phryma leptostachya*	9	64
		Early meadow-rue	*Thalictrum dioicum*	10	64
		Large-flowered bellwort	*Uvularia grandiflora*	-	57
		Common false Solomon's seal	*Smilacina racemosa*	1	53
		Pointed-leaved tick trefoil	*Desmodium glutinosum*	-	51
		Common enchanter's nightshade	*Circaea lutetiana*	1	44
		Prickly gooseberry	*Ribes cynosbati*	8	44
		Black cherry (U)	*Prunus serotina*	1	42
		Ironwood (U)	*Ostrya virginiana*	-	33
		Basswood (U)	*Tilia americana*	-	28
		Pale bellwort	*Uvularia sessilifolia*	1	26
		Bottlebrush grass	*Elymus hystrix*	-	24
		Zigzag goldenrod	*Solidago flexicaulis*	-	24
		Large-leaved aster	*Aster macrophyllus*	1	22
		Blue cohosh	*Caulophyllum thalictroides*	-	22
		Bloodroot	*Sanguinaria canadensis*	-	22
		Pagoda dogwood	*Cornus alternifolia*	-	17
		Northern red oak (U)	*Quercus rubra*	1	17
		American spikenard	*Aralia racemosa*	-	13
	Floodplain Forest Affinity	Virginia creeper	*Parthenocissus* spp.	8	66
		Prickly ash	*Zanthoxylum americanum*	1	60
		Wild grape	*Vitis riparia*	2	40
		Box elder (U)	*Acer negundo*	7	33
		Honewort	*Cryptotaenia canadensis*	1	20
		Missouri gooseberry	*Ribes missouriense*	-	13
	Other	Bush honeysuckle	*Diervilla lonicera*	3	24
		Round-leaved dogwood	*Cornus rugosa*	-	17
		Lady fern	*Athyrium filix-femina*	1	17

(U) = understory tree

grandiflora), common false Solomon's seal *(Smilacina racemosa)*, pointed-leaved tick trefoil *(Desmodium glutinosum)*, common enchanter's nightshade *(Circaea lutetiana)*, zigzag goldenrod *(Solidago flexicaulis)*, blue cohosh *(Caulophyllum thalictroides)*, and bloodroot *(Sanguinaria canadensis)*. Given the historic description of the structure of FDs communities, which ranged from woodland to brushland with scattered trees, it is difficult to imagine that shade-tolerant species were components of these communities in the past. More likely, increasing closure of the canopy in FDs communities following fire suppression has promoted invasion of these sites by shade-tolerant herbaceous species from nearby MH communities. The FDs Region is also distinguished from the FDw Region by the presence of species that have their highest presence statewide in FF communities, including Virginia creeper *(Parthenocissus* spp.*)*, prickly ash *(Zanthoxylum americanum)*, wild grape *(Vitis riparia)*, box elder, and honewort *(Cryptotaenia canadensis)*. These species are likely present in FDs communities because of the proximity of these communities to rivers and lakes.

Natural History and Fire Regimes of FDw vs. FDs Communities

The natural rotation periods of fires in FDw and FDs communities are fairly similar (Table FD-3). In the past, communities in both floristic regions were far more likely to experience moderate surface fires than catastrophic fires that killed existing trees and caused regeneration of forest stands. In general, FDw communities have rotations of 15 years for surface fires and 90 to 100 years for catastrophic fires. FDs communities have rotations of 10 to 20 years for surface fires and 100 to 110 years for catastrophic fires. The chance of any fire resulting in significant mortality of canopy trees was about one in seven for both FDw and FDs communities.

Table FD-3. *Historic tree species composition and disturbance regimes in FDs and FDw communities*

		Historic Tree Species Frequency by Class and Stand Age						Historic Disturbance Rotation Periods by Class (in years)			
		young forest age	young forest species	mature forest age	mature forest species	old forest age	old forest species	Stand-Regenerating Fire	Moderate Surface Fire	All Fires	Catastrophic Windthrow
Southern Floristic Region								ranges →	100-110	10-20	9-18	>1000
FDs36		0 - 35 yrs	**quaking aspen** *(bur oak)*	75 - 135 yrs	**bur oak** *(quaking aspen)*	> 175 yrs	**bur oak** *(American elm)* *(white pine)*		100	20	18	>1000
FDs37		0 - 75 yrs	**bur oak** *(northern red oak)*	> 75 yrs	**bur oak** white oak *(northern pin oak)*	--	--		110	10	9	>1000
Northwestern Floristic Region								ranges →	90-100	15	13-14	230-290
FDw24		0 - 90+ yrs	**quaking aspen** bur oak	--	--	--	--		100	15	14	260
FDw34		0 - 90+ yrs	**quaking aspen** *bur oak* *balsam poplar*	--	--	--	--		90	15	13	290
FDw44		0 - 90+ yrs	**quaking aspen** *balsam poplar* *tamarack*	--	--	--	--		100	15	14	230

bold = >50% normal = 25-50% *(italics)* = 10-25% *italics* = <10%

FDw and FDs communities are remnants of what the land surveyors described in the late 1800s as “thickets” or “upland brush with scattered timber.” At present, their structure is better described as woodland or even forest. Before Euro-American settlement, the number of trees per acre in FDs communities was about one-third that of MH communities in the same general region (i.e., MHs communities). Today, there is no difference in tree density between FDs communities and MHs communities. A clear consequence of fire suppression has been development of tree canopies in FDs communities, filling the gaps created in the past by frequent surface fires. The combined cover of tree species in the canopy and subcanopy of both FDs and MHs communities at present averages about 150%. The tripling of the density of aspen and bur oak and the shadier, more humid understory conditions now present in FDs communities have likely made these communities less flammable than the more open brushlands and scrubby woodlands of the past. FDw communities have not responded to decline in fire frequency in quite the same way as FDs communities. At present, tree densities in FDw communities have about the same ratio to other forest types in the region (such as WFw and MHw communities) as they did historically. Most likely the apparent lack of increase in tree density in FDw communities is a consequence of aspen dominance, in which young, thicketlike stands have high tree densities and succession to other species like oak is uncommon. Managed aspen stands in the FDw Region are clear-cut on short rotations, which results in stand structures not unlike those present under natural fire disturbance regimes.

It appears that the historic fire regimes in brushy FDw and FDs communities were more the product of landscape setting or context rather than of properties of the vegetation itself. For example, in comparison with conifer-dominated woodlands or some shrublands in the western United States, it does not appear that FDw and FDs communities were more likely to burn over time because of changes in the vegetation. The colonies of hazelnuts *(Corylus* spp.), dogwoods *(Cornus* spp.), and other native deciduous woodland shrub species that formed the dominant vegetation layer in these deciduous woodlands do not appear more likely to burn as they age. It is also unlikely that they would burn much hotter as they age because of accumulated fuel or because of intrinsic properties such as the accumulation of flammable chemicals in living tissue that occurs in some species of shrubs in the western United States. Rather, in the past, brushy deciduous woodlands developed in Minnesota in settings where the fire regime was imposed on the landscape by context more than by site properties or the developmental stage of these brushlands. FDw and FDs communities probably burned frequently because they were next to or surrounded areas of prairie. Where there were extensive areas of FDw communities in the historic landscape, they almost always had inclusions of prairie, brush-prairie, or grassy wetlands. Where there were extensive areas of FDs communities, it appears that almost always they were in areas between prairies and true forests (such as MH communities). Under dry conditions, fires that originated in prairies probably burned through FDw and FDs communities, while under wetter conditions they did not. Humans likely had influence on the past fire regime in FDw and FDs communities. Grasslands and wet hay meadows within short distances of forests and woodlands were of great value to American Indians and European settlers alike. These openings attracted game and provided food for the settlers’ horses and livestock. Therefore, in the past, people commonly set fire to maintain grassland and meadow openings within woodland areas, bringing fire to the edge of FDw and FDs communities.