Chapter 44

Paper Birch Cover Type

6/2/2022
Last Full Revision: 1/9/2015
Note- this chapter has not been fully revised since the restructuring of the Wisconsin Silviculture Guide, therefore some subject areas may be missing in the current version of this chapter.

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1 TYPE DESCRIPTION

1.1 Stand Composition and Associated Species

Stand Composition
White birch (*Betula papyrifera*) comprises 50% or more of the basal area in sawtimber and poletimber stands, or 50% or more of the stems in sapling and seedling stands.

Associated Species
In stands dominated by white birch, the most common associates are aspen (*Populus* spp.) and red maple (*Acer rubrum*). Other common associates include: red oak (*Quercus rubra*), white oak (*Quercus alba*), balsam fir (*Abies balsamea*), white pine (*Pinus strobus*), red pine (*Pinus resinosa*), white cedar (*Thuja occidentalis*), and sugar maple (*Acer saccharum*). Many other species occur as occasional associates.

1.2 Silvical Characteristics[1]

White birch is a widespread boreal and northern species adapted to cold climates. Occurrence in Wisconsin is at the southern limits of its range. Across its broad range, white birch exhibits a diverse and very plastic gene pool; hybridization among birch varieties and species is common. One variant, *Betula cordifolia*, is occasionally found in the northern part of the state identified by its heart shaped leaves, white to pinkish bark and ascending catkins.

In Wisconsin, white birch is an early successional species adapted to colonize sites following severe disturbance; near complete canopy removal (e.g. fire, wind, logging) and fire (for seedbed preparation and competition control) provide a conducive environment for the development of stands of white birch.

White birch is monoecious. Flowers are borne in catkins clustered at the ends of twigs and lateral shoots. Catkins bearing staminate flowers are pre-formed in late summer; by winter they average about one inch long and are clearly visible. The male flowers mature the following spring and the catkins grow to 1.5 to 4 inches long. Catkins bearing pistillate flowers appear in the spring and grow to 1 to 2 inches long. Flowering occurs April through May. Catkins disintegrate when mature. Fruits are tiny, light winged nutlets 0.06 inches long and 0.03 inches wide.

Seeds generally ripen August to September, and most are dispersed September to November (some dispersal can occur throughout the year). Stands of white birch produce seed most years, with good seed crops every two years, and bumper crops about every 10 years; seed production can range from 1 million to over 35 million seeds per acre. During extremely heavy bumper seed crops, tree crown deterioration and stunted growth can occur. The abundance of male catkins in the fall can indicate potential seed production the following year. Seed viability typically ranges from 53% to 86%, and is best when seeding is most prolific (best seed years). The seeds remain viable for up to 2 years. Optimum seed bearing age is 40 to 70 years, although trees often begin production around age 15.

[1] Safford et al. 1990

Seeds are dispersed by wind. Most seed falls within the stand where it was produced, and within 100 to 200 feet of the parent tree. Although seed can be blown across the snow for long distances, the quantity of dispersed seed declines rapidly with distance from stand edge. Seed catch in clearcut openings can be reduced by 90% at 165 feet from the edge of a stand of white birch. It has been estimated that a stand needs to produce about 2 million seed per acre to regenerate an adjacent opening 165 feet wide.

Germination begins once environmental conditions (moisture, temperature, and light) are suitable. Ideal germination temperature is 68^0F to 86^0F. The ideal seedbed to facilitate germination is moist mineral soil. Germination is moderate on humus and poor on undisturbed litter. Seed germinates well on coarse woody debris that has been incorporated into the soil. Shade facilitates germination by moderating moisture and temperature. Following stand disturbance, most established seedlings develop from seed that was disseminated the previous fall and germinates the first spring. Some seed can remain dormant for a year or more. Fire can create ideal site conditions for germination, survival, early growth, and establishment.

Newly germinated seedlings are very fragile (small seed and shallow roots), and are sensitive to variations in moisture, temperature, light, and seedbed condition. Root development is enhanced with coarse woody debris such as stumps and down logs. Seedlings experience high levels of mortality in the first 2 years after germination since they are sensitive to desiccation and inadequate light. Although germination is reduced on humus, early height growth is significantly improved (moisture and nutrients). Early height growth may be best under about 50% full sunlight; severe shade limits height growth by limiting light, and full sunlight can limit height growth owing to high temperatures and reduced soil moisture availability. Seedlings often grow only 2 to 5 inches tall the first year. Competition from other vegetation (e.g. *Rubus* spp.) can limit early survival.

White birch trees can produce stump sprouts. Sprouts can be abundant and vigorous in young stands (<50years), especially with stump heights of 6 to 12 inches; sprouting can be significantly less in older stands (>100 years). Although stump sprouts can be abundant following cutting, mortality during the first several years can be high; deer browsing can be a significant limiting factor especially on stump sprouts. Intensive site preparation, including prescribed fire, can reduce sprouting abundance. Sprout origin trees tend to develop into poorer quality trees (timber) and have shorter life spans than seed origin trees. Although seed origin regeneration provides the primary regeneration in most stands, stump sprouts can supplement regeneration.

White birch is relatively shade intolerant. In Wisconsin, it is an early successional species. Dominance is expressed early during stand development. Stem diameter of seedlings and saplings can be an indicator of growth potential, with larger diameters indicating greater potentials. During stem exclusion, density dependent self-thinning can be heavy, with high mortality rates, particularly among smaller crowned and suppressed trees. In associations with aspen, birch often falls behind and loses vigor, and stand level representation becomes diminished (release from aspen competition may be needed to maintain significant representation).

White birch tends to develop a relatively shallow root system. Most roots occur in the upper 2 feet of soil, and there is no taproot. Rooting depth varies with genetics and soil conditions.

White birch is considered a medium sized, relatively fast growing tree species. It exhibits a relatively long period of seasonal height growth, beginning while minimum temperatures are still below freezing, and ending in response to day length. Maximum height growth rates occur in June. In contrast to height growth, birch exhibits a relatively short period of diameter growth, requiring warmth and moisture.

Young trees grow most rapidly, and rates decline with age. A DBH of 8 inches at 30 years age is common. At rotation, trees typically average 10-12 inches DBH and 70 feet in height. Yields at rotation (60-80 years) on good sites (SI>60) typically average 2500-4000 ft^3/acre; on poorer sites (SI 40-60) with similar rotations, yields typically average 1000-3000 ft^3/acre. On excellent sites, older trees can surpass 30 inches DBH and 100 feet in height.

White birch is a relatively short-lived tree species. Trees are often considered "mature" at 60-80 years, when height growth is generally complete. Depending on environmental conditions, stand deterioration generally occurs sometime between 70 and 120 years. Individuals rarely live more than 140 years, but trees over 200 years old have been documented.

Table 44.1. Summary of selected silvical characteristics of white birch.

White (Paper) Birch (*Betula papyrifera*)	
Flowers	Monoecious. April to May. Borne in catkins.
Fruit (seed)	Winged nutlets 0.06 inches long and 0.03 inches wide. Seeds generally ripen August to September.
No. of seeds/lb	1.4 million seed per pound
Seed Dispersal	Mostly September to November. Dispersed by wind. Most seed falls within the stand where it was produced, and within 100 to 200 feet of the parent tree.
Good Seed Years and Seed Production	Stands of white birch produce seed most years, with good seed crops every two years, and bumper crops about every 10 years. Seed production can range from 1 million to over 35 million seeds per acre.
Seed Viability	At stand level, seed viability typically ranges from 53% to 86%, and is best when seeding is most prolific (best seed years).
Seed Bearing Age	Optimum seed bearing age is 40 to 70 years, although trees often begin production around age 15

Germination	Epigeal. Germination begins once environmental conditions (moisture, temperature, and light) are suitable.
Seedbed Requirements	The ideal seedbed to facilitate germination is mineral soil. Germination is moderate on humus and poor on undisturbed litter. Seed germinates well on coarse woody debris. The best seedbed for germination and growth is mixed mineral and organic soil (the presence and incorporation of coarse organic debris, >1 inch diameter, is beneficial).
Seedling Development	Recently germinated seedlings are very fragile, and are sensitive to variations in moisture, temperature, light, and seedbed condition. Droughty surface soil conditions anytime during the first growing season can result in high seedling mortality. Although germination is reduced on humus, early height growth is significantly improved. Early height growth may be best under about 50% full sunlight; near full sunlight maximizes growth once established.
Vegetative Reproduction	Stumps sprout. Sprouts can be abundant and vigorous when young, vigorous trees are cut with stump heights up to12 inches. Sprout mortality can be high. Sprout origin trees tend to develop into relatively poor quality, short-lived trees.
Shade Tolerance	Intolerant
Maximum Tree Longevity	Stand deterioration generally occurs sometime between 70 and 120 years. Individuals rarely live more than 140 years, but trees over 200 years old have been documented.

2 MANAGEMENT GOALS, LANDOWNER OBJECTIVES

Stand management objectives should be identified in accordance with landowner property goals, and within a sustainable forest management framework on a local and regional landscape. The silvicultural systems described herein are designed to maximize tree vigor and growth to optimize productivity (quantity and quality) for a variety of timber products (e.g. pulpwood, boltwood, sawlogs) as well as to successfully regenerate the stand.

3 LANDSCAPE, SITE, AND STAND MANAGEMENT CONSIDERATIONS

3.1 Landscape Considerations

3.1.1 Historical Context

When the General Land Office Public Land Surveys (PLS) were conducted in Wisconsin (1832-1866), white birch was a strong associate in red and white pine dominated stands.

White birch dominated stands were found in small to large patches throughout the Northern Highlands Pitted Outwash (subsection 212 Xb), and less frequent in adjacent subsections and on mesic sites along Lake Superior and Lake Michigan. However, it was widespread as a component of several forest types (Schulte et al, 2002; Curtis, 1959).

White birch grows in climates ranging from boreal to humid and tolerates wide variations in precipitation patterns. It grows at the northern limit of tree growth in arctic Canada and Alaska, in boreal spruce woodlands and forests, in montane and subalpine forests of the West, in wooded draws of the northern Great Plains, and in coniferous, deciduous, and mixed forests in Wisconsin and the other Lake States. It is shade-intolerant, and abundant on burned-over and cut-over lands, but generally restricted to openings in older forests. White birch is most abundant on rolling upland terrain and alluvial sites but grows on a wide variety of soils and topography, including rugged slopes, open slopes, rock slides, muskegs, and borders of bogs and swamps (Uchytil, 1991).

White birch is adapted to disturbance and opportunistic with respect to fire but it is not fire-dependent. In mixed stands, it burns at intervals of several decades and in pure stands, it burns only during unusually dry conditions at longer intervals. The bark of white birch is both thin and highly flammable, which renders trees highly susceptible to top-killing. However, in trees less than 50 years old it sprouts vigorously from the root collar. White birch is an abundant producer of lightweight, wind-dispersed seeds which readily germinate on mineral seedbeds created by fire and prescribed fire can be used to prepare seedbeds for regeneration (Uchytil, 1991).

White birch was a historically important species to the Native American cultures throughout its range, including the Ojibwe Tribes of Wisconsin. White birch bark was made into baskets, storage containers, mats, baby carriers, moose and bird calls, torches, household utensils, and canoes. The strong and flexible wood was made into spears, bows, arrows, snowshoes, sleds, and other items (Holloway & Alexander, 1990; Kindscher & Hurlburt, 1998).

3.1.2 Current Context

Today white birch grows in a wide variety of habitats throughout Wisconsin and a few stems can be found just about anywhere trees are successfully growing, from boggy sites with Tamarack to dry uplands with Jack Pine. Nearly 75% of white birch acreage is located in northern Wisconsin with lesser amounts in the southwest and central parts of the state (WDNR, 2012). Nearly 50% of the white birch is found within the Forest Transition, North Central Forest, and Northern Highland Ecological Landscapes (
Table 44.2). Most white birch is part of the aspen / birch forest type and, to a lesser extent, the maple / basswood type. In southern and central Wisconsin, it’s also a part of the oak / hickory forest type.

The volume of white birch has decreased significantly since 1983. This is a result of both natural succession and increased mortality. The numbers of seedlings and saplings have also decreased suggesting that white birch will play a less prominent role in the future (Figure 44.7). In the last 23 years, growth rates have decreased and are currently negative (mortality exceeds growth). White birch has the highest ratio of mortality to growth and the lowest ratio of growth to volume of all species in the state. Whereas white birch makes up about 2.5% of all volume of trees in Wisconsin, it accounts for 10% of total mortality (Figure 44.2) (WDNR 2012).

Table 44.2. Acres of timberland by ecological landscape – white birch forest type (FIA 2012).

Ecological Landscape	Area of timberland-acres
Central Lake Michigan Coastal	5,990
Central Sand Hills	13,375
Central Sand Plains	5,086
Forest Transition	46,348
North Central Forest	82,148
Northeast Sands	8,749
Northern Highland	45,874
Northern Lake Michigan Coastal	10,657
NW Lowlands	18,663
NW Sands	20,157
Southeast Glacial Plains	3,770
Superior Clay Plains	27,854
Western Coulees and Ridges	63,793
Western Prairie	4,160
Total	**356,624**

Maintaining a desirable age-class distribution is a landscape-level consideration. A relatively stable age class structure, including all developmental stages, maximizes benefits to wildlife by providing a range of structural conditions. It also contributes to diversified economic interests by supplying different types of materials, including pulp, poles, sawlogs, and veneer. The amount of white birch on the landscape has declined significantly since 1983. However, the age class structure has remained fairly steady with a majority of acreage in the middle age classes and fewer acres in the youngest and oldest age classes. Today there are more acres of white birch in the older age classes than there were in 1983, even though the amount of white birch overall has declined (Figure 44.1). The current trend is a decline in the younger white birch stands. White birch in the 0-19 age class has declined by 50% since 1983 (Figure 44.1). In addition, the number of growing stock trees in the youngest age class is very low, indicating the possibility of further decline of the birch resource in Wisconsin (Figure 44.2).

Figure 44.1. Forest age-class distribution for white birch cover type in Wisconsin (FIA 2012)

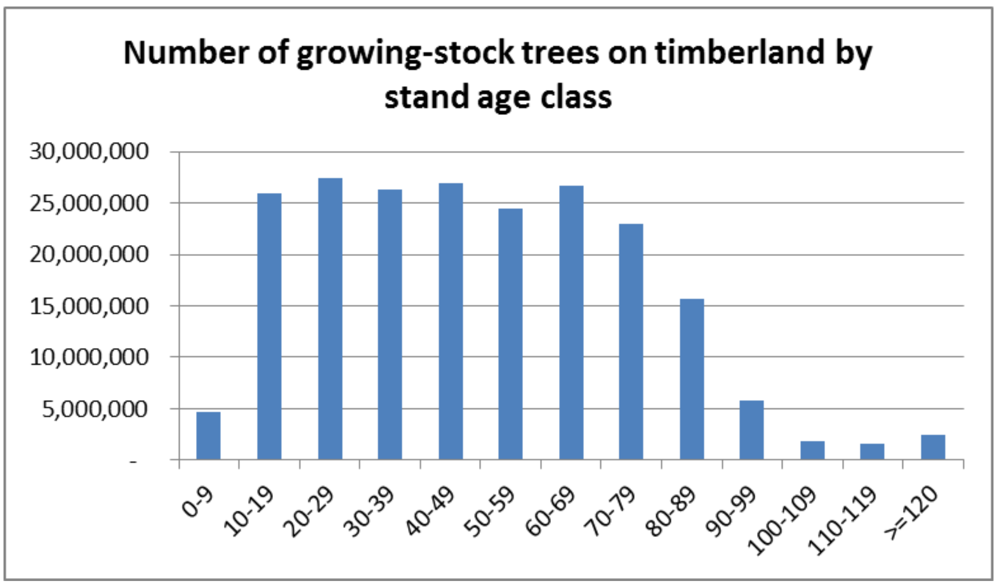


Figure 44.2. Growing stock trees on timberland by age class (FIA 2012).

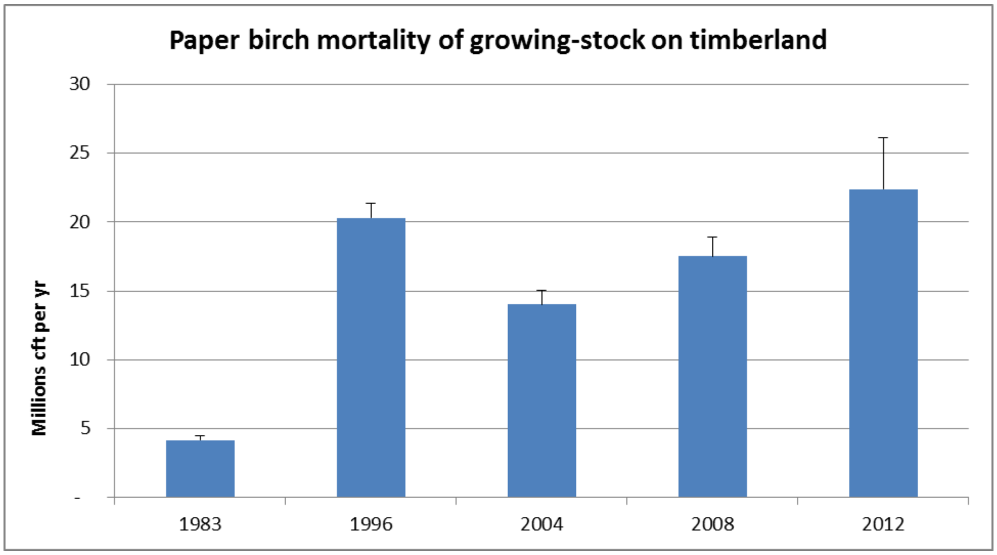


Figure 44.3. White birch growing stock mortality on timberland (FIA 2012).

3.1.3 Climate Change

White birch is a northern species adapted to cold climates, with its northern range extending to the limit of tree growth. It is seldom found growing naturally where average July temperatures exceed 70° F. Current modeling of tree response to climate change under high and low emissions scenarios predict that white birch abundance will decline in Wisconsin's forests and the optimum latitude/suitable habitat will move north perhaps out of the United States (Iverson & Prasad, 2002; Landscape Change Research Group, 2014). Currently, white birch occupies about 20% of the land area in the eastern US, that extent is predicted to decline to between 0% and 8% of land area by 2100. Under some conditions white birch is predicted to be extirpated as a major component of forests in Wisconsin (Iverson & Prasad, 2002; Scheller & Mladenoff, 2005; Iverson et al, 2008).

3.1.4 Forest Simplification

Forest simplification refers to a loss of species diversity and structural diversity, and an increased dominance of fewer species. The increase in sugar maple dominance that is occurring in northern hardwood forests is an example of simplification, as is the lack of features like large woody debris and tip-up mounds. At the landscape level, simplification and homogenization occur when forested patches become similar in size, shape, and composition. Land uses have led to homogenization and reduction of patch sizes, and creation of patch shapes that are less complex (Mladenoff *et al*. 1993). The cumulative effects of stand-level simplification make composition similar among patches. This is unlike the mosaic of forest patches found in remnant old growth forests, where white birch would have occupied large and small gaps created by disturbance (Crow *et al*. 2002). As an opportunistic early successional, intolerant species, white birch is dependent on the structural diversity of forest stands created by disturbance to maintain itself as a component of the forested landscape.

3.1.5 Landscape Pattern, Fragmentation and Edge Effects

Fragmentation describes certain kinds of landscape structure. Inherent fragmentation describes landscapes that are naturally heterogeneous due to the physical environment, such as landscapes with numerous small lakes and wetlands dispersed throughout a pitted outwash plain. Permanent fragmentation refers to long-term conversion of forest to urban, residential, or agricultural uses. Habitat fragmentation is defined as a disruption of habitat continuity, caused by forest harvesting or natural disturbance, which creates a mosaic of successional stages within a forested tract. This kind of fragmentation is shorter-term, affecting species while the forest regrows, and is a consideration in white birch management in northern Wisconsin, since white birch is an opportunistic species and relies on this mosaic of successional stages in a natural system. White birch regeneration is generally accomplished through the use of even-aged management, and dispersion of clearcuts throughout the forest creates differences in forest structure that are a type of habitat fragmentation.

In Wisconsin and elsewhere, the loss of forest habitat has a larger impact on species than shorter-term habitat fragmentation. However, area of habitat loss is often correlated with measures of fragmentation (e.g. patch size, distance between patches, cumulative length of patch edges, etc), making it difficult to quantify their separate effects. Habitat loss may result from second homes, or urban and industrial expansion. A drastic change in land cover, such as that which occurs after a clearcut harvest, represents a short-term loss of habitat for some species and a gain for others, including white birch. Dispersal can be affected if species or their propagules cannot cross or get around the open land and cannot find suitable habitat within it. The light winged white birch seeds are dispersed by wind and can travel great distances. Though seed fall drops off rapidly with distance from stand edge or clearcut opening. Seed dispersal and shade-intolerance make white birch somewhat tolerant of disturbance and fragmentation in the short term, though if habitat is lost due to permanent land use changes or fragmentation disrupts the disturbance mosaic, white birch will decline.

3.1.6 Incorporating Complexity into White Birch Management

Forest management generally simplifies forest structure and composition with some negative impacts in terms of biodiversity and resilience. Thus, maintaining structural and ecological complexity is increasingly an objective of sustainable forest management. The integration of complexity into forest management would involve designing harvest operations that maintain or enhance the capacity of forests to adapt to changing conditions, like climate change. Operationally, managing for complexity involves protecting or restoring complex patterns in forest structure. White birch is adapted to taking advantage of small and large canopy gaps created by disturbance. Management regimes which maintain complexity by mimicking natural disturbance and creating gap habitat within the forested landscape will be beneficial to maintaining white birch as a component of the forest resource.

3.1.7 Summary of Landscape Considerations

- White birch is a medium-sized, fast-growing tree that develops best on well-drained, sandy loams on cool moist sites. The species is commonly found in the mixed hardwood-conifer forests but may form nearly pure stands where they colonize areas

disturbed by fires, logging, or other disturbance. White birch has declined and is declining in acreage.
- White birch is classed as a shade-intolerant tree. In the natural succession of species, white birch usually lasts only one generation and then is replaced by more tolerant species. Whenever possible manage maintain white birch stands instead of converting them to other cover types.
- White birch tends to be more abundant on the dry sites than on the wet or poorly drained soils. Where white birch and aspen *(Populus tremuloides)* occur in mixed stands, birch predominates on the cooler, moister sites, and aspen on the warmer, drier sites. Maintaining ecological complexity on the landscape will help maintain the white birch component.
- White birch is an early successional opportunistic species adapted to disturbance. It is opportunistic with regard to fire but is not fire-dependent. Fire can also seriously harm established stands. Because the bark of white birch is thin and highly flammable, even large trees may be killed by moderate fires.
- White birch is adapted to cold climates and models indicate that suitable habitat may decline in Wisconsin under climate change.
- White birch is an important source of food for birds. The redpoll, pine siskin, and chickadee feed on seeds; the ruffed grouse eats male catkins and buds.

3.2 Site and Stand Considerations

3.2.1 Soils

White birch grows on a wide range of soils, across most textural and drainage classes. In general, best development and growth occurs on loamy soils that are well to moderately well-drained. Comparatively poor development and growth are exhibited on dry (excessively drained) and wet (poorly drained) sites.

3.2.2 Site Quality

Site productivity is an important consideration when selecting a silvicultural prescription for regenerating white birch.

<u>Very Dry to Dry-Mesic Habitat Type Groups</u>
Birch regeneration on these sites is prone to desiccation, and as a result the only prescriptions likely to succeed are those that provide adequate shading, which aids in holding soil moisture and reducing soil temperature. Narrow strip clearcuts (less than 100 feet wide), and shelterwood harvests with 30-60% crown cover are the only two methods with potential to successfully regenerate birch on these sites. Deer browse may hinder regeneration in narrow strip clearcut areas because of small treatment areas. Depending on strip orientation, sunlight may be a limiting factor as well.

<u>Mesic to Wet-Mesic Habitat Type Groups</u>
Strip clearcuts up to 200 feet wide, shelterwood harvests with 30-60% crown cover and seed tree harvests with up to 20% crown cover have potential application. Birch will successfully regenerate, but competition from other species (especially aspen) can cause mortality. Unless

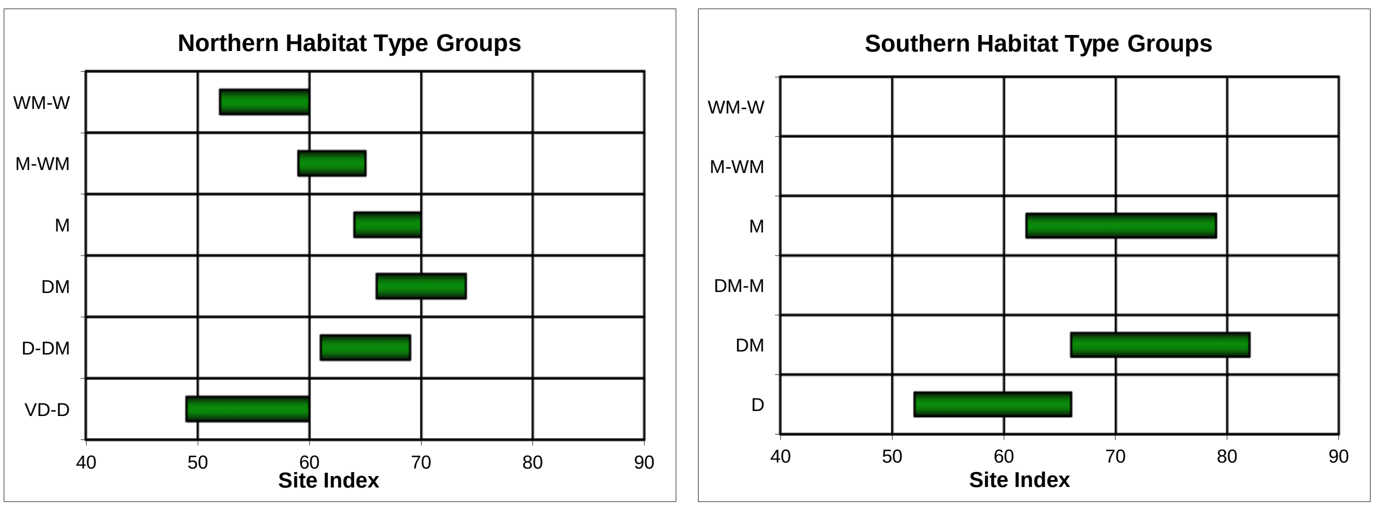
birch are released from competition, wider strip clearcuts and seed tree harvests will likely result in a mixed stand.

3.2.2.1 Range of Habitat Types

See Chapter 12 – Forest Habitat Type Classification System for information summarizing the system and the habitat type groups.

Within Wisconsin, the white birch cover type occupies about 3% of statewide forest land acres, and contains about 3% of net growing stock volume (FIA 2012). Approximately 77% of white birch cover type acres occur on northern habitat types, and 23% on southern habitat types. White birch as a species represents about 5% of statewide net growing stock volume on forest land (FIA 2012). Approximately 81% of white birch volume occurs on northern habitat type groups, and 19% on southern groups. Statewide, only about 33% of white birch species volume occurs within the white birch cover type. The northern hardwood type contains about 31% of white birch volume. Other cover types with significant white birch volume are aspen and oak.

<u>Northern Wisconsin Habitat Types</u>
In northern Wisconsin, the occurrence and relative growth potential of the white birch cover type varies by habitat type groups and habitat types (**Error! Reference source not found.**



and Figure 44.4).

Figure 44.4. Site index for white birch by habitat type group (from FIA 2012). Bars indicate the 95% confidence limits for the mean. FIA data was insufficient to develop site index values for all habitat type groups.

Table 44.3. White birch cover type – estimated relative growth potential by northern habitat type group and habitat type.

Northern Habitat Type Groups	Estimated Relative Growth Potential for White Birch Cover Type[1]			
	Poor	Fair	Good	Excellent
Very Dry to Dry	PQE[2] PQG[2] PQGCe[2]	PArV PArV-U PArVAo[2] QAp[2]		
Dry to Dry-mesic			PArVHa PArVAm PArVAa PArVAa-Vb PArVAa-Po PArVPo[2]	
Dry-mesic				TFAa AVCl AVVb AVb-V AVDe ACl AVb AAt ATFPo
Mesic				AFVb[2] ATM ATFSt ATFD[2] ATD[2] ATDH[2] AAs AHVb[2] AFAd[2] AFAl[2] ACaCi AOCa[2] AH[2]
Mesic to Wet-mesic			PArVRh ArVRp ArAbVCo ArAbVC ArAbSn ArAbCo[2] TMC AAtRp ASnMi AAtOn[2] ASaI[2] ACaI[2] AHI[2]	
Wet-mesic to Wet	Lowland habitat types not defined region wide.			

1 – Estimation of relative growth potential for white birch cover type based on:
white birch cover type average volume/acre, white birch site index, and potential tree vigor and form.
2 – Currently, the white birch cover type rarely occurs. The species may occur as a rare to common associate.

The white birch cover type is a common cover type on all northern habitat type groups, representing 2-6% of group acres, and 1-9% of group volume.

- Approximately 37% of white birch northern cover type acres occur on mesic to wet-mesic sites; 20% on dry-mesic; 12-13% on dry to dry-mesic, mesic, and wet-mesic to wet; and 7% on very dry to dry sites.
- Approximately 35% of white birch northern cover type net growing stock volume occurs on mesic to wet-mesic sites; 23% on dry-mesic; 18% on dry to dry-mesic; 8-11% on mesic and wet-mesic to wet; and 5% on very dry to dry.

Southern Wisconsin Habitat Types

In southern Wisconsin, the occurrence and relative growth potential of the white birch cover type varies by habitat type groups and habitat types (**Error! Reference source not found.** and Figure 44.4).

The white birch cover type is a somewhat common cover type on most southern habitat type groups, representing 1-3% of group acres, and 1-3% of group volume; the exceptions are mesic (phase) and mesic to wet-mesic where white birch is uncommon.

- Approximately 35% of white birch southern cover type acres occur on dry-mesic sites.
- Approximately 46% of white birch southern cover type net growing stock volume occurs on dry-mesic sites.

Table 44.4. White birch cover type – estimated relative growth potential by southern habitat type group and habitat type.

Southern Habitat Type Groups	Estimated Relative Growth Potential for White Birch Cover Type[1]		
	Poor to Fair	Good	Excellent
Dry	PEu[2] PVGy[2] PVCr[2] PVG	PVHa	
Dry-mesic			ArDe-V ArDe[2] AArVb[2] AArL[2] ArCi ArCi-Ph AQVb-Gr[2]

Southern Habitat Type Groups	Estimated Relative Growth Potential for White Birch Cover Type[1]		
	Poor to Fair	Good	Excellent
Dry-mesic to Mesic (includes Phases)			ATiFrCi[2] AFrDe[2] AFrDe(Vb)[2] ATiFrVb(Cr)[2] ATiDe(Pr) ATiCr(O) ATiCr(As) ATiDe-Ha[2] ATiDe-As[2] ATiDe ATiFrVb[2] AFrDeO[2]
Mesic (includes Phases)			ATiSa[2] ATiSa-De ATiFrCa(o)[2] ATiAs(De)[2] ATTr[2] AFTD[2] AFH[2] AFAs[2] AFAs-O[2] ATiFrCa[2] ATiH[2] ATiCa ATiCa-La ATiCa-Al[2]
Mesic to Wet-mesic		PVRh	
Wet-mesic to Wet	Lowland habitat types not defined		

1 – Estimation of relative growth potential for the white birch cover type based on:
white birch cover type average volume/acre, white birch site index, and potential tree vigor and form.
2 – Currently, the white birch cover type rarely occurs. The species may occur as a rare to common associate.

White birch height growth on good sites is moderate compared to other species such as aspen, cottonwood or balsam poplar. First year birch seedling can reach 18 inches on good sites but average about 5- 6 inches. Rapid early height growth is common; however, growth dramatically slows after 50 years. Through much of its range mature stands average 12 inches dbh and over 70 feet in height. **Error! Reference source not found.** and **Error! Reference source not found.** suggest growth potential and Figure 44.4 indicates site index on various habitat types with Wisconsin. The northern and southern dry-dry mesic and mesic habitat type groups tend to have better growth potential for this species.

Figure 44.5. Native range of white birch (USGS map).

The range of white birch closely follows the northern limit of tree growth from Newfoundland and Labrador west across the continent into northwest Alaska; southeast from Kodiak Island in Alaska to British Columbia and Washington; east in the mountains of northeast Oregon, northern Idaho, and western Montana with scattered outliers in the northern Great Plains of Canada, Montana, North Dakota, the Black Hills of South Dakota, Wyoming, Nebraska, and the Front Range of Colorado; east in Minnesota and Iowa, through the Great Lakes region into New England. White birch also extends down the Appalachian Mountains from central New York to western North Carolina.

White birch is distributed across Wisconsin in many counties with the most cubic feet volume represented in Buffalo, Burnett, Douglas and Vilas counties (Figure 44.6). The counties with more cubic feet volume represented above have better growth potential reflected in the soils and habitat type.

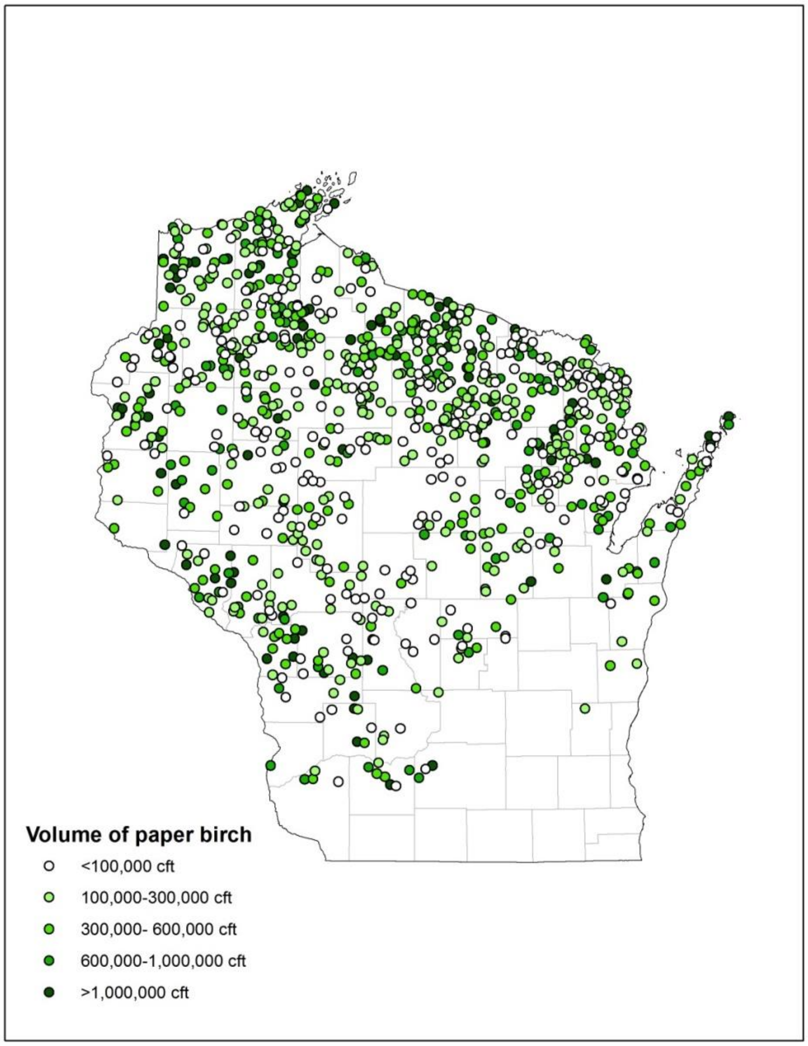


Figure 44.6. Volume of white birch from Wisconsin FIA plots (2012 data).

3.2.5 Wildlife

White birch stands make up a relatively small proportion of the northern forest and no wildlife species are exclusively associated with this cover type. However, white birch is a common associate in many timber types and it is a valuable wildlife tree regardless of its proportion in the stand. White birch is used for both food and shelter by a wide variety of wildlife. Most accounts of wildlife use are in the northern range of white birch. However, white birch provides important resources to a wide variety of wildlife species throughout its Wisconsin range. Maintaining white birch stands or as a component of other types will benefit wildlife throughout Wisconsin.

White birch foliage, twigs, and bark is palatable to browsing and gnawing mammals. Snowshoe hares, deer, and porcupines all feed heavily on white birch bark and twigs in winter months and browsing on leaves in summer and fall is important to deer.

White birch is a consistent seed producer with relatively regular large seed crops. Seed fall occurs in late summer and early fall but some seed falls during winter months. This is periodically an important food source for winter-resident songbirds such as black-capped chickadees and northern juncos. Small mammals also feed on the seeds of white birch.

The buds and catkins of white birch are important winter foods for all three of Wisconsin's grouse species. White birch flowers early in the spring and attracts insects which are utilized by migrating songbirds.

White birch is a short-lived tree with soft wood. It rots rapidly after death. In some instances, the bark is more resistant to rot than the wood and the resulting snag may be a cylinder of bark around rotted wood. Bark characteristics sometimes produce areas where small mammals or birds can shelter under flaking bark. White birch bark is also used as nest material by some birds. These characteristics of white birch make it important for nesting and shelter by small cavity-dependent species and a number of bird species which are not cavity nesters.

Maintaining white birch in a variety of age classes will provide the full spectrum of wildlife benefits. No special management beyond maintaining vigorous white birch is called for by wildlife. In seed tree treatments, the residual left for regeneration purposes should be allowed to die and provide snags for wildlife. White birch can be maintained as reserve trees during regeneration harvests. Large-crowned or open-grown trees are the best candidates for retention. Retained trees can be individuals or within retention clumps. White birch tends to have high mortality when retained after stand harvest but dead and dying trees benefit wildlife species as snags and foraging sites.

3.2.6 Endangered, Threatened and Special Concern (ETS) Species

There are no Wisconsin Endangered, Threatened, or Special Concern species (ETS) known to rely, exclusively, on white birch. However, white birch can be found in a variety of forest types, and rare species can be found in examples of any of these types. Although white birch is not often the dominant species in a stand, it can contribute to stand diversity and provide cavity trees, snags, and other habitats.

Boreal forest is the natural community type perhaps most strongly associated with white birch, at least for forests where white birch is co-dominant or even dominant. These forests, found in the northernmost parts of the state and Door County, represent the southern extent of a forest type that is much more common further north in Canada. Some of these forests in Wisconsin were once dominated by white pine or other conifers, but they are largely composed of aspen now. A variety of rare species can be associated with boreal forest, including several bird species. For example, northern goshawk can nest in older white birch trees. Many boreal forest species utilize conifers, so maintaining or increasing the now greatly diminished conifers from these stands can benefit a variety of rare or uncommon species such as Canada warbler and northern flying squirrel; the latter also benefits from cavities, especially larger examples. Allowing some of these stands to succeed to conifers and grow older, especially near ravines, may benefit some rare plants such as spreading woodfern (*Dryopteris expansa*) and ram's-head lady's-slipper (Cypripedium arietinum) on some sites. Other rare plants include Chilean sweet cicely (*Osmorhiza berteroi*), white Mandarin (*Streptopus amplexifolius*) and broad-leaved twayblade (*Listera convallarioides*).

White birch is a less-abundant associate in other natural community types such as Northern Mesic Forest (northern hardwood or hemlock cover types) and Northern Dry-mesic Forests (white pine, red pine, and pine-oak forests). Here, white birch can add to the overall diversity of the site and provide ecological values. For example, large birch trees can provide excellent cavities and later become coarse woody debris, a feature that can be in short supply in stands managed for timber production. Users of this handbook are encouraged to learn more about these community types and their associated rare species at the Wisconsin DNR web site (*dnr.wi.gov* keyword “er”).

Whether a white birch stand is likely to support rare species will depend on certain stand characteristics, including its location in the state, the composition of the surrounding landscape, stand age, stand species composition, stand structural complexity, and whether certain microhabitats are present. For example, climbing fumitory (*Adlumia fungosa*) is commonly found near white birch on rocky or sandy slopes in northern forests. There are a number of other rare species associated with white birch mainly because they are found on rocky ledges in northern forests - e.g., large-leaved sandwort (*Moehringia macrophylla*) and narrow false oats (*Trisetum spicatum*). Often microhabitats that support rare species in forests can be accommodated without precluding active timber management in the majority of the stand; examples include moist or dry cliffs, ponds and small wetlands, seeps or other aquatic features, and pockets with prairie or barrens vegetation that can support rare plants and, sometimes, associated rare invertebrates like butterflies or moths.

Handbook users are encouraged to submit sightings for species on the NHI Working List (*dnr.wi.gov* keyword “NHI”). Electronic forms are available for this purpose.

3.2.7 Economic Issues

Most white birch is utilized by primary wood-producing industries as a pulpwood or biomass product, as trees are typically smaller in diameter at the time of harvest. Some higher quality sites may be capable of growing trees that are utilized for boltwood or sawtimber. Production of white birch veneer logs is limited to higher-quality sites with a site index of 60 or greater (Marquis et al 1969).

Secondary wood-producing industries favor white birch for turning because of the smooth texture of the wood, straight grain, and the ease with which it can be machined. Most hardwood users in the industry consider birch a part of their acceptable species mix. Some industries, on the other hand, are very dependent on the birch resource with birch being a greater percentage of the pulp mix. White birch is critical to the pulping process, primarily for the sugar and lignin properties therefore being important in the composition of pulp product.

Concerns on the availability of white birch have been raised by the forest products industry. The total volume of growing stock for white birch has gradually decreased over the inventory years from approximately 850 million cubic feet to 550 million cubic feet (Figure 44.7). The changes in the growing stock reflect the issues of maintaining white birch. These issues include forest health concerns, competition from undesirables, replacement by other desirable species; lack of disturbance to maintain the species and market demand for other species.

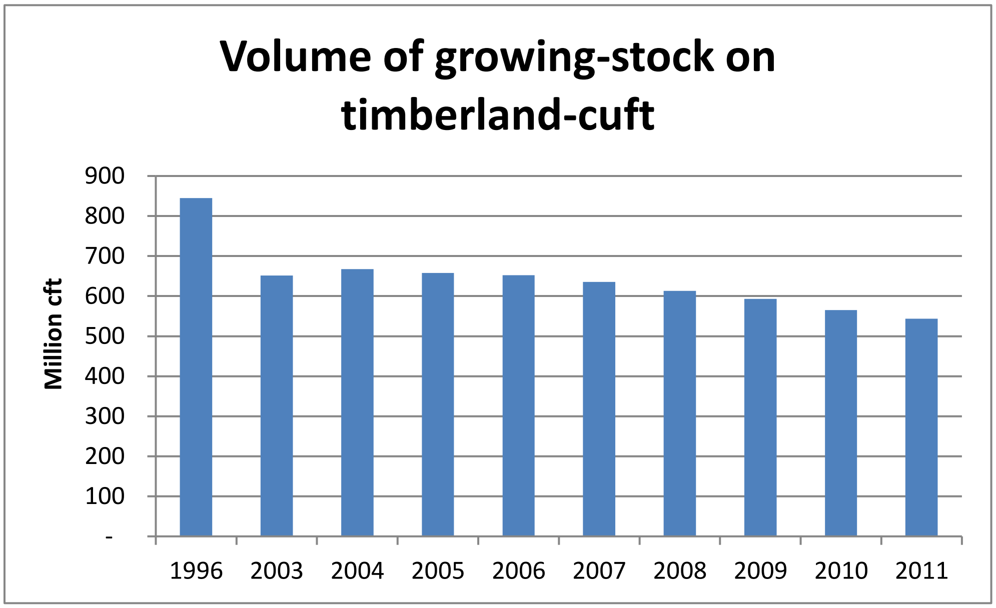


Figure 44.7. Volume of white birch growing stock in each inventory year.

3.2.7.1 Non-Timber Uses and Objectives

Although the predominant use of birch is by forest industry, non-timber uses of white birch may be the primary management goal on some parcels of land and have potential to be compatible with timber management.

Wiigwaas, or “white birch bark”, is known as a “cultural keystone species” to the Great Lake Ojibwe. Primarily the bark is the main use of the tree, however, many other parts of the tree are harvested such as branches, leaves, roots and sap. Bark is gathered in the spring and early summer and is used for crafts, shelters, medicines, ceremonial purposes and for food sources. The Great Lake Indian Fish and Wildlife Commission (GLIFWC) that represents 11 Ojibwe tribes of the Upper Great Lakes region has expressed concerns about the continued availability of the birch resource in the ceded territories. Concerns rise from the findings of a collaborative effort between GLIFWC and the USDA Forest Service FIA program (2004-2006) that has shown a decline in the white birch supply across the ceded territories. These findings may be due to insect and disease, drought, deer herbivory, cover type conversion and impacts from climate change. A report written in 1997 by GLIFWC personnel outlines management recommendations and highlights the need to perpetuate birch on appropriate habitat types (Lynch 1997).

Birch sap

Birch sap has been harvested for centuries in northern latitudes of Europe and North America. The sap is harvested in April and early May in a similar fashion as maple sap. Typically, sap is consumed straight from the tree, but also can be boiled down into syrup. Birch sap contains a much higher sap to syrup ratio than maple – about 100 gallons of sap are needed to make one gallon of birch syrup compared to 30 to 40 gallons of sap to make one gallon of maple syrup. The primary birch syrup production area of the United States is Alaska; however, very little birch syrup is produced commercially in the United States.

Birch bark

Both the outer bark and inner bark of birch trees have traditionally been used by Native people for crafts, medicines and for ceremonial purposes. The inner bark is typically boiled – either alone or with other plants – for medicinal purposes and has been used for dying cloth. Outer bark is utilized in sheets, strips, or pieces for a plethora of uses – including basketry, shoes, knife handles and sheaths, boxes, canoes, mats, and more recently as a medium for art projects.

The effect of outer bark removal on wood quality is not well documented. On trees where outer bark was removed with little damage to the inner bark, lumber quality does not appear to be affected, but veneer quality could be diminished due to light staining.

Branches, Twigs, Roots, & Leaves

Depending on the size, branches and twigs can be utilized from anything to furniture and decorative trim to whisk-brooms and crude ropes. Roots are typically used in basketry, but this use has historically been limited to northern Scandinavia. Root bark was used as medicine in Ojibwe culture. Little has been documented on the use of birch roots in North America. Leaves were traditionally used to make medicinal infusions, but leaf extracts are now commonly used in dyes and cosmetics.

4 STAND MANAGEMENT DECISION SUPPORT

4.1 Stand Inventory

Prior to development and implementation of silvicultural prescriptions, landowner property management goals must be clearly defined and stand conditions accurately assessed. Identifying objectives will determine the importance of white birch retention to the landowner as well as an individual site’s ability to regenerate white birch.

White birch stand assessment should include quantifying variables such as:

- Present species composition

  - Canopy, shrub, and ground layers
  - Sources of regeneration
  - Potential competition
- Stand structure
  - Size class distribution and density
  - Age class distribution
- Stand and tree quality
- Site quality - The habitat type is the preferred indicator of site potential. Other indicators of site potential include site index, soil characteristics, and topographical characteristics. Site has a strong influence on volume growth, potential yield, and regenerative capacity.
- Seed availability, soil scarification, moisture
- Stand and site variability
- Wildlife habitat

5 SILVICULTURAL SYSTEMS

A silvicultural system is a planned program of vegetation treatment during the entire life of a stand. The silvicultural system for white birch includes three basic components: harvesting, scarification, and regeneration. With the goal of regenerating white birch, even-aged management is the preferred method while addressing site-specific and species-specific conditions. The even-aged regeneration method generally accepted and supported by literature is:

- Shelterwood with scarification

Conditional (alternative) management recommendations include methods such as:

- Clearcut with standards
- Progressive strip clearcut
- Overstory removal and seed tree (based on a set of conditions that will ensure successful regeneration of this cover type). This section is discussed later in this chapter.

5.1 Seedling / Sapling Stands

Once established, white birch seedlings and saplings exhibit optimal vigor (growth and health) when exposed to (near) full sunlight. Crop trees that are maintained in free-to-grow conditions have the greatest potential to survive and to maximize growth and productivity. When stand is between 25-35 years, white birch stocking should be maintained at approximately 100 to 150 crop trees per acre (Safford 1983). This will provide enough crop trees to form a fully stocked stand when the trees reach merchantable size.

Following establishment, white birch seedlings and saplings can be outcompeted by other tree species resulting in birch mortality and reduced stocking and representation well into the poletimber stage. When aspen reproduces as an associate it often assumes dominance. On mesic sites, other hardwoods (e.g. red maple and white ash) can limit and outcompete white birch representation but are not nearly as significant competitors as aspen.

In instances of aspen or other species competition, release operations will generally be required to control competition and maintain tree vigor. Release operations are best implemented before desirable stems are physically suppressed and while there are still many individuals to choose from. Seedlings and saplings generally respond to release with significant increases in vigor, height and diameter growth. Release operations should be implemented early in the life of the stand, typically at 8-10 years of age. Release at an earlier or later stage will not have the same beneficial effect.

The recommended process is to select 50-200 crop trees per acre. A 10-foot release on all sides is sufficient but will likely require a second release 10-15 years later due to competing vegetation (Ave'Lallemant, 2013). For a single release to be adequate throughout the birch's lifespan, 20 feet on all sides is recommended.

5.2 Intermediate Treatments

5.2.2 Thinning

Commercial thinning may begin as soon as the stand attains merchantable size. Individual white birch designated for release should be vigorous, high quality dominant and co-dominant crown class. Although thinning birch is not readily applied, in the aspen cover type, it has been demonstrated to reduce the length of pulpwood rotations, increase volume increment, and increase sawtimber output. Thinning is an option on better quality sites with higher site index; sawtimber as one objective; vigorous trees with full crowns and/or aesthetic situations.

Intermediate treatments in birch pose some concerns, however. Thinning can cause mortality to some crop trees. The mortality is primarily because birch is shallow rooted and heavy equipment used during harvest will damage roots. Opening the stand may cause surface drying and stress crop trees. Nonetheless, considerations and timing of harvest can make thinning a viable option.

5.3 Natural Regeneration Methods

Table 44.5. Generally accepted and conditionally recommended practices.

Shelterwood	Clearcut with standards	Seed tree	Overstory removal	Strip clearcut
GAP	CR	CR	CR	CR

Note: GAP - Generally accepted practice; CR – Conditionally recommended practice

Note: The following recommendations assume the management objective is to maximize tree vigor and stand growth to optimize productivity (quantity and quality) of a variety of timber products. These methods may not be successful on all sites and may require artificial regeneration (direct seeding or other) if natural regeneration fails.

Important considerations when managing white birch include the following:

- Site quality
- Soils
- Uniform spacing of leave trees
- Timing – with seed dispersal and a good seed crop
- Scarification – mixing soil and organic material

- Maximize area scarified
- Harvest in snow free conditions and/or whole tree skidding timed with the harvest

The preferred regeneration method is **Shelterwood with Scarification**.

Other silviculture alternatives include **Clearcut with Standards**, **Seed Tree with Scarification** and **Progressive strip cut**; however, these methods can be less successful especially with the following limitations:

- Very dry, nutrient poor sites
- High temperatures hinder seed germination
- Desiccation
- Intense competition from undesirable vegetation
- Mortality of scattered, residual birch
- Deer browse especially on coppice regeneration
- Age of stand

5.3.1 Even-Age Regeneration Methods

5.3.1.1 Shelterwood with Scarification

The shelterwood method is an even-aged regeneration method designed to manipulate the overstory and understory to create conditions favorable for the establishment and survival of desirable tree species. The residual overstory serves to modify understory conditions, create a favorable environment for reproduction, and provide a seed source. The method is characterized by a preparatory cut of aspen (optional), seeding cut(s), and overstory removal over a period of time. At each cut, the most vigorous, dominant/co-dominant trees are normally retained and less vigorous trees removed.

Key aspects of applying shelterwood system in birch are optimizing seed availability uniformly throughout the stand, scarification to expose mineral soil, retaining partial shade to prevent desiccation, and controlling competing vegetation. Modifying light and understory conditions can enhance seed germination and seedling establishment. Exposing mineral soil through scarification techniques is essential to enhance germination success.

The shelterwood regeneration method is the recommended method to regenerate stands of white birch. In most cases there will be two cutting treatments: a seeding cut with scarification and the final overstory removal. Typically, this two-step shelterwood is implemented with a 2-4 year cutting interval, however, the interval can be extended longer if necessary to ensure the establishment of desirable regeneration. Follow-up release of regeneration may be necessary to maintain a fully stocked stand of white birch as described previously for seedling/sapling stands.

<u>Seeding Cut with Scarification</u>
Recommended process:

- Remove trees to create uniform, residual high crown cover of 30-60% of predominately well distributed, dominant/co-dominant birch. This shelterwood density will allow

sufficient sunlight for germination and early growth while providing partial shade to maintain soil moisture and limit the growth of some competing species. On dry to dry-mesic sites, it may be important to maintain the upper recommended range of crown cover to provide some shade and prevent desiccation.
- Retain vigorous, high quality (best phenotypes) dominant and co-dominant white birch trees to serve as seed sources. The residuals should be retained uniformly throughout the stand to provide optimum seeding potential.
- Remove poor quality trees and less desirable species. If aspen is present as an associate do not cut aspen in order to minimize sprouting. Red maple stump sprouting may need to be assessed to determine the degree of competition. However, red maple stump sprouts appear to be less significant than aspen sprouts.
- Scarify – use the best available technique to expose mineral soil. See Scarification section below.

Overstory Removal Cut

The overstory removal cut is the final removal of overstory trees to release abundant, well-distributed, established regeneration and enable vigorous growth of the new stand. Following germination, allow white birch seedlings 2-3 growing seasons under the shelterwood overstory and then be liberated by the overstory removal cut. Typically, the overstory removal cut occurs approximately two years following the seeding cut but can be later depending on specific treatments applied. Seedling size and number are important to monitor. In some cases, overstory mortality can be significant, particularly if trees are retained for more than two years following the initial seeding cut. The residual trees are prone to desiccation, crown dieback and windthrow.

The adequacy of white birch regeneration (number, size, distribution) and potential competition should be evaluated after two growing seasons. Acceptable regeneration can generally be defined as a minimum of 2000 well distributed seedlings per acre that are vigorous and free-to-grow, ideally at least 1 foot tall (Perala 1989). Release of seedlings may be required to achieve a free-to-grow condition (soon after establishment); stump sprouts may benefit from thinning the clump to 1-2 stems.

During the overstory removal cut, care should be taken to preserve as much of the desired advance regeneration as possible. Protecting established regeneration can be attained through various methods such as winter logging through deep snow, harvest design, or type of equipment used during harvest. Retain only desirable regeneration and reserve trees. Excessive deer browsing is a significant deterrent to the establishment of young white birch, especially for stump sprouts.

Scarification

A scarified seedbed is critical to the successful regeneration of white birch. Attempting white birch regeneration without adequate soil scarification has led to many failed attempts. Germination and survival of white birch seedlings depend greatly on the condition of the seedbed. Mineral soil provides the best moisture and temperature conditions for germination and initial survival. However, nutrient elements are most available from the organic material (woody debris) in the forest floor. For establishment and early growth of the seedlings, it is important for the organic material to be preserved in the seedbed. Treatments such as scarification, discing, or burning help provide the best seedbeds for establishing white birch.

Scarification of the soil by breaking up surface organic horizon and mixing with surface mineral soil provides ideal seedbed conditions for germination and establishment of white birch seedlings. Logging with modern logging equipment during seasons with no snow and unfrozen soil may provide adequate scarification. For example, under these conditions, whole-tree skidding of trees with branches attached has the potential to adequately scarify the site with minimal residual slash. For this option to be successful, the skidding must cover as much surface area as possible while not damaging residual overstory birch trees. Also, following Best Management Practices for water quality and woody biomass guidelines are important considerations during this process.

Consider the timing of harvests relative to the production of good seed crops, seed dispersal and germination, and site preparation operations. Stands of white birch produce seed most years, with good seed crops every two years. The abundance of male catkins in the fall can indicate potential seed production the following year. Most seed are dispersed September to November. Germination begins once environmental conditions (light, temperature, and moisture) are suitable, generally the following spring. Following stand scarification most established seedlings develop from seed that was disseminated during fall and germinated the first spring thereafter (i.e. stored seed usually is not a major contributor, and seed disseminated following the initial recruitment and growing season usually results in little additional establishment).

When mechanically scarifying the site, maximizing the adequate amount of area scarified is critical or the result will be an understocked stand. Scarifying at least 50 % or more of the stand area is the recommendation from various birch trials in Wisconsin. Costs are variable depending on the site and operator's skill.

There are many different types of site preparation techniques including manual, mechanical, chemical, and burning. It is important to understand the site characteristics and match the site preparations accordingly. Manual is rarely used as it is appropriate for only the smallest plantings or most difficult sites. Burning has some logistical challenges but can be an option. Mechanical is the most reliable method to adequately prepare a site for natural regeneration of white birch. The method and extent of site preparation implemented can leave long lasting effects, impacting future management decisions.

Mechanical site preparation includes blading, raking, plowing, ripping, mixing, chopping, scalping, mounding, discing, dragging, trenching and rotovating. If done properly, using the appropriate equipment and timing, mechanical site preparation will provide the best prepared site for natural regeneration of white birch. The best time to conduct site prep work is usually July-November (prior to freeze up). It is even more beneficial if you can time the site prep with a good seed crop. Although a lot of birch seed will fall in the winter when there is snow cover, thousands will fall from August-November. A well-prepared site prior to seed fall is vital to successful natural regeneration of white birch.

Blading with the use of an angled blade on a dozer, with an attached salmon blade or brush rake, or dragging an anchor chain to scarify the soil prior to or following a harvest have been the most successful scarification methods used in Wisconsin. Whole tree skidding has been successful; however, close supervision of the skidding pattern may be needed to ensure successful scarification. In some trials, herbicide has been used to treat undesirable vegetation (aspen) after scarification but is not commonly done throughout the state.

5.3.1.2 Clearcut with Standards

The clearcut method is used to regenerate a stand by the removal of all woody vegetation during harvest and leaving some patches of birch or other species as standards. Regeneration can occur from natural seeding from adjacent stands or from trees harvested. Clearcutting is not a generally accepted practice for the regeneration of white birch because of certain variables such as desiccation, deer browse, site quality, and age of birch. If this regeneration method fails, supplemental planting or direct seeding would be recommended. Stump sprouting cannot be relied on to achieve a fully stocked stand due to deer and small mammal herbivory. In Wisconsin, the successful clearcut trials in birch have relied on late summer/early fall, presale scarification (salmon blade). These birch trials had site conditions suitable for this method including sandy loam soils with larger reserve areas of white/red pine and oak for seeding as well. Relying on seeding, timing of harvest and scarification in this method are important considerations.

5.3.1.3 Seed Tree with Scarification

Seed tree method is an even-aged regeneration method designed to encourage seed origin regeneration by leaving enough trees singly or in groups to naturally seed the area with adequate stocking of desired species. This method is also considered conditional management alternative because of certain variables such as soils and desiccation, deer browse, site quality, and age of birch. In this method only a few trees (typically 3 to 10 per acre) of the original stand are left, and this residual stocking is not sufficient to protect, modify, or shelter the site in any significant way. Seed trees may be removed after establishment or retained indefinitely. In Wisconsin, this method has been successful in areas where the soils hold more moisture (sandy loam to silt loam) and in better nutrient habitat types (ACl and AVCl; AVDe; AAT and other habitat types mentioned in **Error! Reference source not found.**).

The seed tree regeneration method is often recommended to regenerate white birch in other regions (e.g. New England and Alaska). In the Lake States, the method has often failed because of two major reasons postulated: 1) frequent summer droughts (maintenance of soil moisture throughout the first growing season is critical to birch seedling survival), and 2) competition from aspen (Perala 1989). This method can be successful at times, but limitations include:

- Germination and establishment could be limited by high temperatures and lack of moisture
- Intense competition from other vegetation
- Scattered white birch trees often exhibit relatively rapid mortality (2-3 years) following stand harvest, thus limiting future options if initial regeneration attempt fails.

In white birch, the seed tree regeneration method most accurately applies to summer harvests (June to September). Seed trees retained will provide seed that will disperse in the fall (September to November); a good seed crop is required. Seeds germinate the following spring, and most regeneration should become established during the first growing season.

Recommended Process
At rotation, when a white birch stand is harvested, retain 3 to 10 dominant/co-dominant trees (with well-developed crowns) per acre. Scarification, timing with a good seed crop, is recommended. White birch reserve trees often decline and die within a few years providing snags. If possible, also retain other longer-lived tree species to develop into large living trees. If selecting this method, consider the limitations and species that have better success.

5.3.1.4 Progressive Strip Clearcut with Scarification

Clearcut is an even-aged regeneration method used to regenerate a stand by the removal of most or all woody vegetation Progressive strip clearcut is a variation of the clearcut method. In this method, the stand is removed using a series of strips harvested over 2-3 entries, usually covering an equal area on each occasion. The entire stand level strip removal process is completed within a period of time not exceeding 20% of the intended rotation (creating an even-aged stand). Typically, the uncut area serves as the primary seed source. Additional regeneration can come from seed previously dispersed and from trees during harvest operations, natural seeding from nearby stands, and sprouting. Regeneration is established during or following stand removal.

This method can be successful at times, but as with the seed tree method, limitations include:

- Germination and establishment could be limited by high temperatures and lack of moisture
- Intense competition from other vegetation especially in narrow strips.
- Deer browse has been observed as a significant factor in this silviculture method since the strip creates a pathway for deer to follow.

Recommended Process

- Cut narrow strips approximately 50-100 feet wide and retain 50-foot wide uncut strips. Ideally strips should be cut perpendicular to prevailing winds to aid in seed dispersal and desiccation. Retain only exceptional reserve trees if present.
- Scarify cut strips as described in “Scarification” section of this chapter. Scarification may be adequate from harvest operations alone.
- Allow 2-3 growing seasons to accurately assess regeneration success.
- Once adequate regeneration is present in the cut/scarified strips, a second harvest should be implemented in the remaining strips as described above. Leave individual birch seed trees or clumps of 6-7 seed trees every 100 feet to provide the seed source for these final cut strips.

5.4 Artificial Regeneration Methods

5.4.1 Direct Seeding and Planting

If white birch seed-producing trees are completely lacking or if harvest is done during a poor seed year and supplemental seeding is needed, it may be necessary to employ direct seeding (or planting) to obtain white birch regeneration. If direct seeding is a consideration, it is imperative that the seed be sown on a suitable seedbed by using scarification technique described previously. Scarification can be done prior to seeding. In some cases, seeding has been done during the late fall or in the winter to take advantage of the moisture from the snow to ensure germination in the spring.

5.5 Rotation Lengths

In even-aged silvicultural systems, the rotation is defined as the period between regeneration establishment and final cutting. The length of rotation may be based on many criteria, including culmination of mean annual increment (MAI), mean size, age, attainment of particular minimum physical or value growth rate, and biological condition. Ideally, the rotation length range would be defined by the maximization of MAI at the lower end and the average stand life expectancy at the upper end. However, growth and mortality rates vary among stands and can be affected by many variables, including site factors, silvics, stocking, silvicultural methods, insect and disease and units of measure.

Rotation age is defined as the age when environmental, economic, or cultural factors (such as site limitations, natural mortality, insect and disease issues, MAI, and management objectives) determine when regeneration efforts should be considered. The rotation ages provided are guidelines based on literature, empirical data, and professional experience. In application, foresters will need to regularly review stands in the field and exercise professional judgment concerning tree vigor and mortality and stand growth and productivity.

The option to rotate stands at the lower end of rotation age can be based on many conditions such as the stand occurring on drier, nutrient poor sites; disease and defoliation, and low vigor. Documenting the site and stand conditions are important when determining rotation age of the applicable stand.

Since forests provide a variety of benefits, different rotation ages can result in increased production of some benefits and reduced production of others. Landowner goals and objectives will provide the framework for rotation age determination. See the discussion under management considerations in the following sections to evaluate some benefits and costs (ecological, economic, social, and cultural) associated with different forest management strategies.

- **50 to 80 years** recommended rotation for timber management
    - Down to 50 years for poorer nutrient xeric sites and sites outside the natural range.
    - Up to 80 years for exceptional, nutrient rich mesic sites where higher value products such as saw logs and veneer can be grown through longer rotations given careful consideration of tree vigor and site capability.

- Extended rotation is not recommended for this short-lived, early successional species. However, some **vigorous** stands and vigorous individual trees on good sites could potentially be managed to 100 years or more.

8 APPENDICES

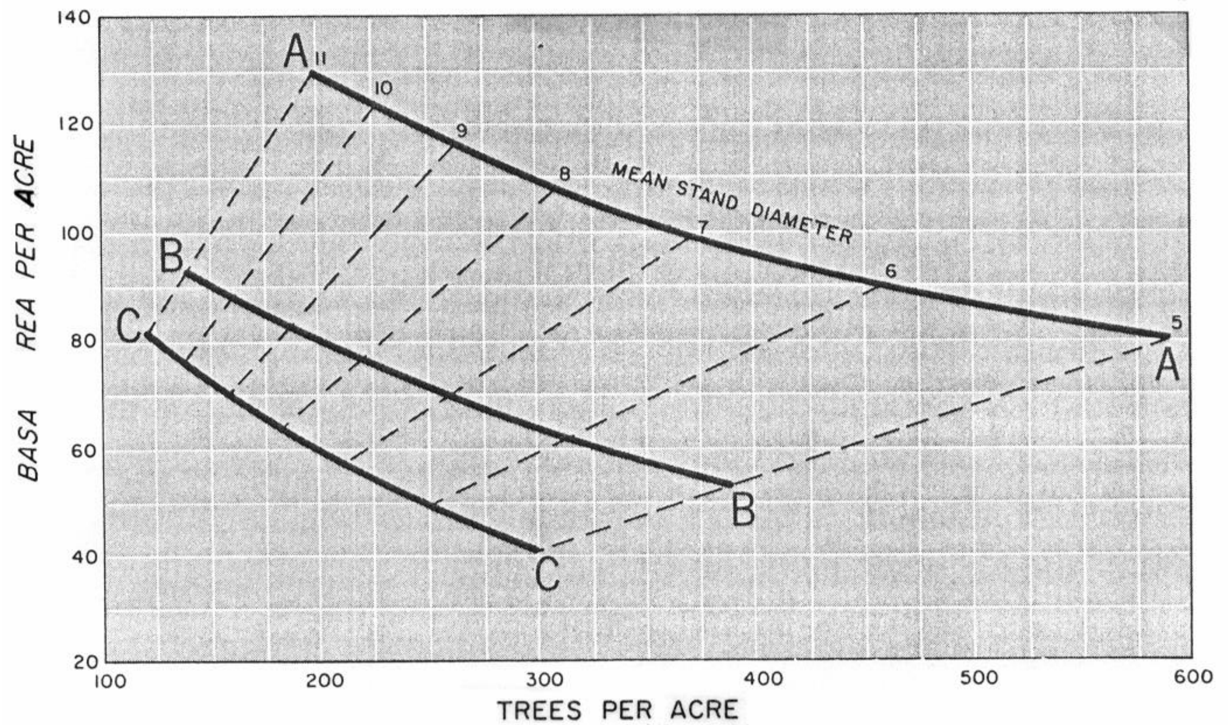


Figure 44.8. Stocking chart for white birch stands (Marquis et al. 1969).

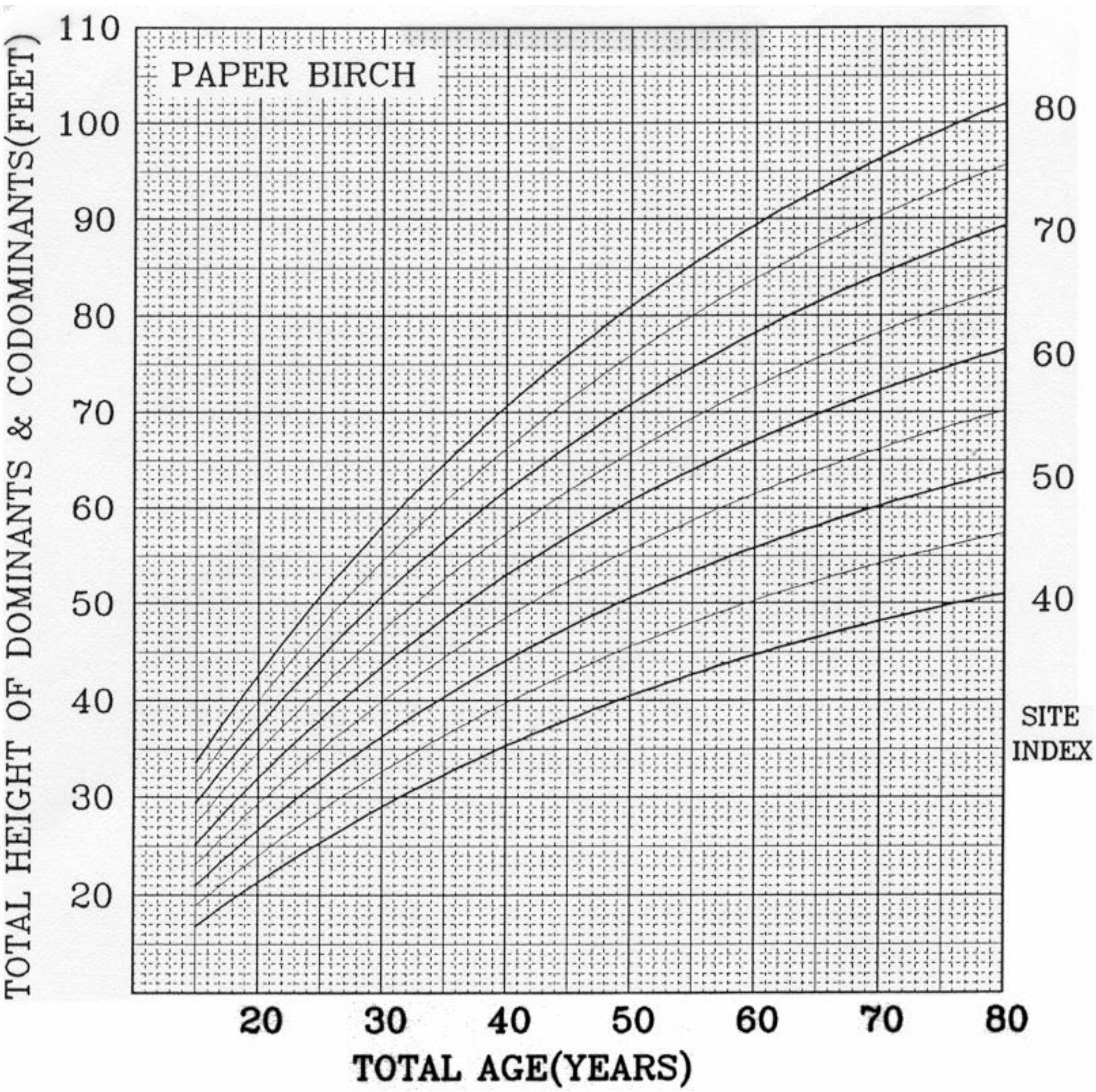
Stocking chart for white birch, displaying the relationship between basal area, number of trees, and mean stand diameter. The area between the A-line and B-line indicates the range of stocking where trees can fully occupy and utilize the site (fully stocked stand).

The stocking chart provides a statistical approach to guide stand density management (see Chapter 23).

- To utilize the stocking guide, statistically accurate estimates of at least two stand variables must be obtained, including basal area per acre, number of trees per acre, and/or mean stand diameter. For the birch stocking guide, these variables are measured only for main canopy trees (dominant, codominant, and intermediate crown class trees)
- The area between the A-line and B-line indicates the range of stocking where optimum stand growth and volume yield can be maintained.
    - The A-line represents maximum stocking. Maintaining stocking levels near (but below) the A-line will produce comparatively more trees, but of smaller diameter.
    - The B-line represents minimum stocking. Maintaining stocking levels near (but above) the B-line will produce larger diameter trees faster, but comparatively fewer trees.
    - The C-line shows the limit of stocking necessary to reach the B-line level in 10 years on average sites.
- When designing and implementing a thinning regime for a stand, do not reduce stand density to below the B-line or allow it to surpass the A-line.

- Thinning can occur at any time as long as stand density is maintained between the A-line and B-line. The A-line is not a thinning “trigger.” When to thin depends on management objectives, stand conditions, and feasibility.

Typically, thinning is implemented when average stand stocking is halfway or more between the B-line and A-line. Stocking is reduced to near but above the B-line. A general rule of thumb is do not remove >35% of the basal area in any one thinning operation. Crop tree concepts are applied to retain and focus growth on desirable trees, and order of removal concepts are applied to select which trees will be cut to achieve stand management objectives.



Paper birch (Cooley 1958, 1962)
Northern Wisconsin (104 plots); Upper Michigan (4 plots)
108 plots, number of dominant and codominant trees not given
Total height and age, anamorphic, equation not given
Add 4 years to d.b.h. age to obtain total age (BH = 0.0)

	b_1	b_2	b_3	b_4	b_5	R^2	SE	Maximum difference
H	1.5980	1.0000	-0.0198	0.9824	0.0000	0.99	0.32	0.6
SI	0.6258	1.0000	-0.0198	-0.9824	0.0000	0.99	0.32	0.6

Figure 44.9. Site index curves for white birch in northern Wisconsin and upper Michigan (Carmean et al. 1989).

8.1 Forest Health Guidelines - Forest Health Protection (FHP)

Insect/ Disease/ Disturbance	Loss or Damage	Prevention, Minimizing Losses, Management Alternatives	References
Foliage Insects			
Birch Leafminer *Fenusa pusilla*	Periodic outbreaks cause leaf destruction in early summer. All age and size classes are susceptible. Injury can cause growth loss. Combined with drought or other stress factors, birch may sustain branch dieback and become more susceptible to attacks by the bronze birch borer.	No direct controls are practical in a forest stand. Monitor heavily defoliated stands for birch dieback.	Conklin, James G. 1969. Insect enemies of birch. In: The birch symposium: proceedings; 1969 August 19-21; Durham, NH. Res. Pap. NE-146.Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 151-154. http://www.extension.umn.edu/distribution/horticulture/DG6134.html
Birch Skeletonizer *Bucculatrix canadensisella*	Periodic outbreaks cause leaf destruction in late summer. Late-summer leaf injury typically has minimal impact on tree health yet injury can cause growth loss. All age and size classes are susceptible. Combined with drought or other stress factors, birch may sustain branch dieback and become more susceptible to attacks by the bronze birch borer.	No direct controls are practical in a forest stand. Monitor heavily defoliated stands for birch dieback.	http://www.forestpests.org/vermont/birchskeletonizer.html
Forest Tent Caterpillar *Malacosoma disstria*	Periodic outbreaks cause defoliation in spring on aspen that may also defoliate nearby birch, basswood and oak.	A natural enemy, *Sarcophaga aldrichi*, is a native parasite of the pupal stage that can significantly	http://www.na.fs.fed.us/spfo/pubs/infosheets/tentcat/index.htm

Insect/ Disease/ Disturbance	Loss or Damage	Prevention, Minimizing Losses, Management Alternatives	References
	Outbreaks typically last 2-5 years. Combined with drought or other stress factors, birch may sustain branch dieback and become more susceptible to attacks by the bronze birch borer.	contribute to mortality of FTC. Monitor heavily defoliated stands for birch dieback. Although aerial application of pesticides is not typically practical, this is an option. Information is available from your DNR regional forest health specialist.	http://www.na.fs.fed.us/spfo/pubs/fidls/ftc/tentcat.htm
Gypsy Moth ***Lymantria dispar***	Widespread heavy defoliation occurs at intervals of 5-15 years, outbreaks lasting 2-5 years. Attacks a wide variety of tree species including white birch.	Various parasitoids/predators and fungus, virus that kill larvae. Aerials spraying of Bt is control measure.	Gypsy moth Silvicultural Guidelines for Wisconsin. C. Brooks and D. Hall. 1997. DNR PUB-FR-123.
		Main Stem and Root Pests	
Bronze Birch Borer *Agrilus anxius*	Larvae damage trees by feeding on the phloem and cambium, disrupting the flow of water and nutrients. Trees stressed by drought or defoliation are more likely to become infested and sustain dieback or die.	Management practices that cause stand disturbance during drought or heavy defoliation events, can make trees more susceptible to infestation by bronze birch borer. Monitor stands for birch dieback.	Conklin, James G. 1969. Insect enemies of birch. In: The birch symposium: proceedings; 1969 August 19-21; Durham, NH. Res. Pap. NE-146.Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 151-154. http://www.na.fs.fed.us/spfo/pubs/fidls/bbb/bbb.htm
Ambrosia Beetles	Adults tunnel into the sapwood, distributing a fungus that may result in stain and degrade of	No direct controls are practical in a forest stand.	Conklin, James G. 1969. Insect enemies of birch. In: The birch symposium: proceedings; 1969 August 19-21; Durham, NH. Res. Pap.

Insect/ Disease/ Disturbance	Loss or Damage	Prevention, Minimizing Losses, Management Alternatives	References
	wood products. Tunneling is typically only in stressed trees.		NE-146.Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station: 151-154.
Yellow-Bellied Sapsuckers ***Sphyrapicus varius***	Yellow-bellied sapsuckers cause very small wounds on the main stem as they feed on sap. Wounds typically close quickly and the trees compartmentalize stain and decay to a very small area. May cause degrade in wood products.	Consider leaving attacked trees in place, as sapsuckers tend to return to the same trees for feeding.	How to identify and control sapsucker injury on trees. M. Ostry, et al. 1976. USDA Forest Service.
Canker Rots ***Inonotus obliquus***	Decay of wood. Canker rots are not compartmentalized, thus decay can be extensive.	Infection occurs most often through dead branch stubs, thus there is no practical way to minimize infection. During intermediate harvests, remove infected trees.	http://forestry-dev.org/diseases/ctd/Group/Canker/canker6_e.html
Armillaria Root Disease ***Armillaria* spp.**	Typically infects roots of trees stressed by drought, defoliation or bronze birch borer. Infection may cause decay of roots and/or the root collar. Infection further stresses trees, initiating decline and potentially mortality.	Management practices that cause stand disturbance during drought or heavy defoliation events, can make trees more susceptible to infection by Armillaria.	Shaw, Charles G. and Kile, Glen A. 1991. Armillaria Root Disease. USDA Forest Service Agriculture Handbook No. 691. http://www.na.fs.fed.us/spfo/pubs/fidls/armillaria/armillaria.htm
Dieback	Dieback or upper crown twig and branch mortality may occur in response to stress from one or a combination of several factors including drought,	If more than 25% of the crown is dead or dying, the tree will probably die within the next 5 years.	

Insect/ Disease/ Disturbance	Loss or Damage	Prevention, Minimizing Losses, Management Alternatives	References
	defoliation, infestation by the bronze birch borer or infection by Armillaria spp.		
Cankers ***Nectria galligena***	Causes a target-shaped canker, typically on the main stem. Wood behind canker is discolored but typically not decayed. Stem becomes more susceptible to breakage at canker face as canker deforms the stem beyond its normal size.	Infection occurs most often through dead branch stubs, thus there is no practical way to minimize infection.	

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