Chapter 36

Black Spruce Cover Type

Last Full Revision: 8/9/1995
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
More than 50 percent swamp conifers with black spruce (*Picea mariana*) predominant.

Associated Species
Common associates include tamarack (*Larix laricina*), northern white cedar (*Thuja occidentalis*) and balsam fir (*Abies balsamea*).

Occasional associates include: white spruce (*Picea glauca*), hemlock (*Tsuga canadensis*), white pine (*Pinus strobus*), jack pine (*P. banksiana*), balsam poplar (*Populus balsamifera*), quaking aspen (*P. tremuloides*), black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), paper birch (*Betula papyrifera*) and yellow birch (*B. allegheniensis*).

1.2 Silvical Characteristics*

Table 36.1. Summary of selected silvical characteristics.

Species	Black spruce
Pollination	First week of June in southern part of its range across North America.
Cones Mature	Early September. Cones are only 1/2 to 1-1/2 inches long and tend to be concentrated in upper part of the crown.
Seed Dispersal	Seed fall begins in October, but because cones are persistent and semi-serotinous, seed fall occurs throughout the year with most seed being shed within 4 years. Heavy seed falls occur when cones are opened by heat, thereby allowing dense even-aged stands to become established when stands are burned over.
Good Seed Years	Crops seldom fail and successive failures are uncommon. Heavy crops occur about every four years. Seed production averages 200,000 seeds per acre per year and can be as high as 500,000. Because black spruce has yearly seed crops and semi-serotinous cones, a seed supply is almost constantly present in stands 40 years of age and older.
Germination	Germination rates depend on type of seed bed and available moisture. Germinative capacity was 88 percent in germination tests (Safford, 1974); under field conditions germination varied from 46 percent on mineral soil, to 29 percent on burned duff, to 7 percent on undisturbed duff (Fowells, 1965). Seedling establishment requires a moist, but unsaturated seed bed, free of competing vegetation. Black spruce establishment is generally successful if the surface layer is either removed by machine or fire, compacted, or composed of living sphagnum moss.
Seed Viability	Viable seed has been found in 15-year old cones. After fire exposure, most of the seed in dense clusters of cones remains uninjured. Seeds can be exposed briefly to temperatures of 185°F, and can be stored for periods of 5 to 17 years, without loss of viability.
Seedling Development	Seedlings seldom grow more than an inch the first year. Seedlings are slow growing and are usually only 3 to 5 inches tall at 3 years of age.

	Tamarack, aspen, and jack pine seedlings grow faster than black spruce, but black spruce grows faster than white spruce. Seedlings will develop under as little as 10 percent full sunlight, but best development requires open conditions. Roots penetrate to a depth of only two inches the first season on soils, and less so on moss. Root development is characteristically shallow.
Growth	On the best sites black spruce may grow to diameters of 18 inches and heights of 90 feet and may reach 250 years of age.
Shade Tolerance	Black spruce is tolerant, but not as tolerant as two of its most common competitors, balsam fir and northern white cedar. Black spruce is a pioneer species on filled-lake bogs, although it sometimes may develop uneven-aged self-perpetuating stands.
Major Pests	**Butt rot** (several species): avoid holding stands beyond recommended rotation length. **Dwarf mistletoe** (*Arceuthobium pusillum* Peck): broadcast burn slash resulting from harvest of stands infected by mistletoe to prevent new stands from becoming infected. **Flooding:** do not install road drainage structures in a manner that will impede drainage. Remove all beaver dams that impede drainage. **Windthrow:** wind breakage is more common in stands with butt rot which becomes common at 100 years of age on organic soils and at 70 years of age on mineral soils.

* Mainly from Fowells (1965) except where indicated.

2 MANAGEMENT GOALS, LANDOWNER OBJECTIVES

The management objective should be identified within an ecosystem framework, giving consideration to a variety of objectives within the local and regional landscape. Possible alternatives include managing to produce the maximum quantity and quality of pulpwood or to maintain black spruce where it now exists. Through natural succession the type may be maintained or converted, depending upon a variety of factors. Management concerns of special importance for lowland forest types include endangered resources, biodiversity, wildlife, aesthetics, and BMPs (Best Management Practices) for water quality.

3 LANDSCAPE, SITE, AND STAND MANAGEMENT CONSIDERATIONS

3.2 Site and Stand Considerations

3.2.1 Soils

Black spruce is found almost entirely on peat bogs, muck-filled seepages, and stream courses in Wisconsin. Occasionally black spruce will be found on mineral soil adjacent to a swamp that

contains black spruce. A few plantations of black spruce have also been established on upland sites.

3.2.2 Site Quality

3.2.2.1 Range of Habitat Types

Hydric (wet) site habitat types have not been developed for Wisconsin. Habitat types for swamp conifers were determined for upper Michigan (Coffman et al., 1980) and include TTM (Tsuga-Thuja-Mitella), TTS (Tsuga-Thuja-Sphagnum), PO (Picea-Osmunda), and PCS (Picea-Chamadaphne-Sphagnum). However, these types are based on very limited sampling and have not been studied adequately to offer useful management information.

4 STAND MANAGEMENT DECISION SUPPORT

4.2 Key/ Checklist for Evaluating Cover Type Stand Management Options

Key to recommendations:

1. Pole timber plantation on mineral soil	Allow stocking level to reach 160 square feet of basal area then reduce to 90 square feet. A combination of row thinning and selective marking from below will be needed. Never remove more than 50 percent of the stocking level at one time. Subsequent thinnings should be made from below, whenever the stand becomes operable, with a residual basal area of 90 square feet. To regenerate, mark a shelterwood cut and leave stand with 60 square feet of residual without removing more than 50 percent of stocking in one cutting. Harvest residual stand when regeneration reaches one foot in height.
1. Not a plantation site	**2**
2. At least 6 percent millacre stocking of vigorous advance seedling reproduction	Clearcut stand at site index rotation age (Figure 36.1). Rely on existing regeneration to regeneration stock future stand.
2. Stands lacking adequate advance regeneration	**3**
3. Sphagnum seed bed is well-distributed and low volume of slash is expected or whole tree skidding to be applied	Two options are possible: a) At site index rotation age, divide the stand into strips 2 - 4 chains wide at a right angle to the prevailing wind direction. Clearcut every third strip starting with the most leeward strip. When at least 60 percent of millacre plots become stocked with 3-year old seedlings within the clearcut strip, clearcut a second series of strips.

	Clearcut the third series of strips when 60 percent millacre stocking of regeneration is attained in the second strip series. The third strip series will have to be regenerated by leaving seed trees spaced at 100 feet. or by direct seeding. **OR** b) Clearcut entire stand at site index rotation age and direct seed to establish regeneration. If 60 percent of millacre plots fail to become regenerated, a subsequent seeding will be necessary in understocked areas.
3. Stands lacking adequate sphagnum distribution, and with heavy brush, slash, or mistletoe infection	Rotate the stand by clearcutting on an entire area or strips as previously described above. Then burn slash to prepare a suitable seed bed. Direct seeding will be needed where seed source is not within four chains on windward side of area to be regenerated.

5 SILVICULTURAL SYSTEMS

Even-age management will be applied where objectives include harvesting and spruce regeneration. In sensitive areas with deep organic soils and reduced risk of windthrow, uneven-aged management through selective harvesting may provide an alternative (competition from fir and cedar should be monitored).

When the site index is less than 25 (Figure 36.1), the site should be managed for Christmas trees. Remove trees with the best form every 10 years once sufficient height has been attained. When the site index is 25 or more, manage for pulpwood.

5.1 Seedling / Sapling Stands

Allow stand to develop naturally.

5.2 Intermediate Treatments

5.2.2 Thinning

Intermediate thinnings are not recommended due to low economic returns and the risk of mortality from windthrow.

5.3 Natural Regeneration Methods

5.3.1 Even-Age Regeneration Methods

Black spruce should not be held beyond 70 years on mineral soils because of increased incidence of butt rot.

When all other stand conditions are equal, a dense black spruce stand should be harvested before a less dense stand because it will reach culmination of mean annual growth sooner. To

control undesirable species and favor black spruce regeneration, all non-merchantable stems should be cut at the time of harvest or destroyed shortly thereafter.

Black spruce releases seed for up to four years after good seed years which occur frequently enough to provide almost continuous seed supply. Maximum seed dispersal is about four chains downwind along the prevailing wind direction from parent trees of normal height.

Sphagnum moss provides a good seed bed for black spruce, whereas feather mosses dry out quickly after clearcutting, resulting in a poor seed bed. On black spruce sites, feather mosses should be either removed through fire or scarification or compacted to form a good seed bed.

Slash should be broadcast burned if dwarf mistletoe is prevalent in a black spruce stand. The main requirements for setting up and conducting a successful broadcast burn on black spruce sites are as follows:

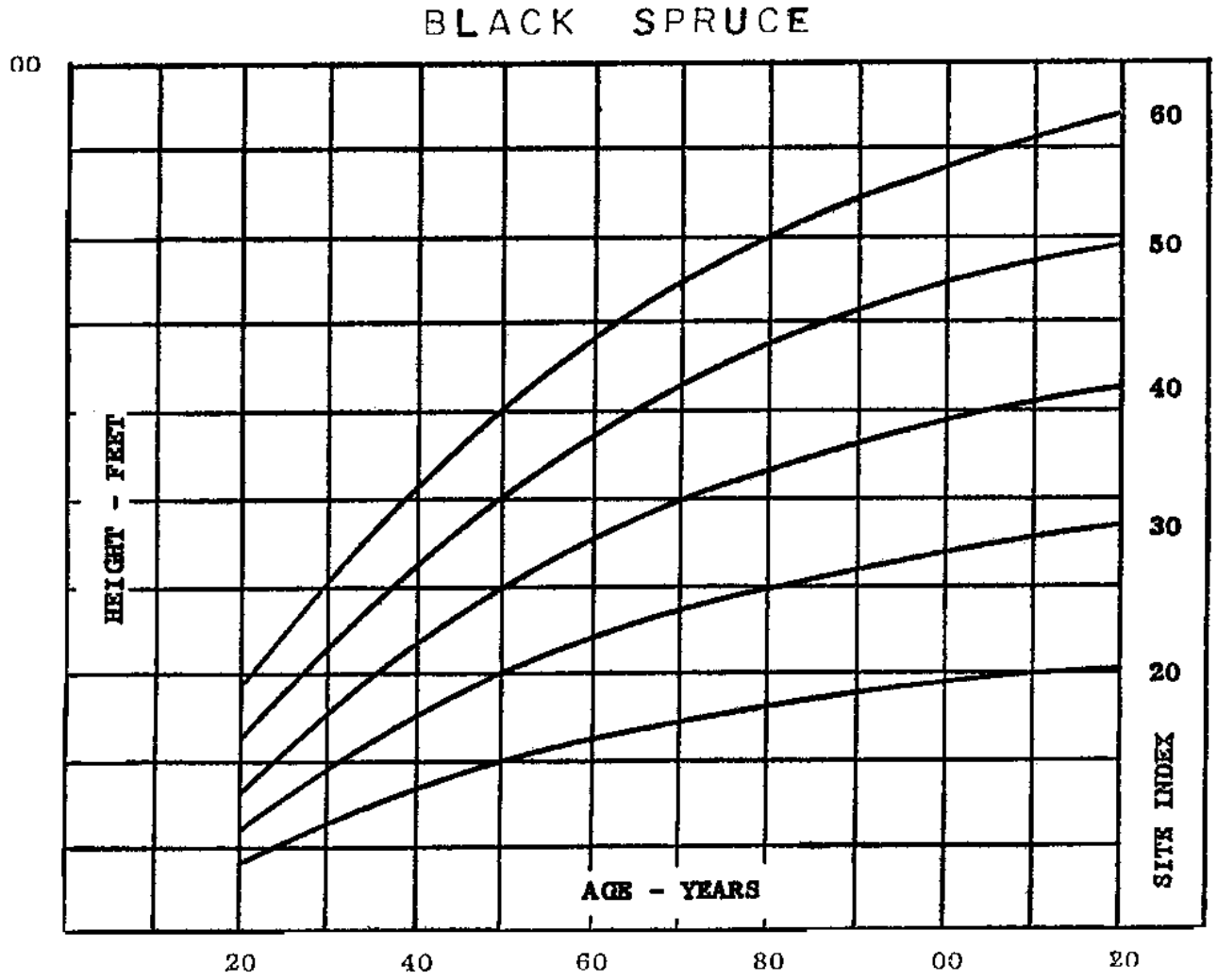
1. Locate edges of burn area on undrained organic soil. Special control measures, such as long ditches, should be taken near drained organic soils and near upland sites.
2. Make edges of burn area smooth and reasonably straight.
3. Cut all merchantable trees near the edge of the burn area.
4. Plan cutting and skidding in a manner that will distribute the slash evenly within the burn area.
5. Leave a slash-free alley about 1/2-chain wide between the burn area and the surrounding area.
6. Burn slash within a year after harvesting.
7. Burn when conditions are suitable for consuming most of the slash that is less than one inch in diameter without starting deep ground fires.
8. Burn when the wind direction is away from adjacent timber to avoid serious crown scorch or mortality. Otherwise, use center firing when the wind speed is 0 to 5 miles per hour.
9. Burn should be conducted at least three days after 0.1 inch of rainfall when the relative humidity is 30 to 60 percent and the maximum wind is 5 to 15 miles per hour.
10. Burning a non-sphagnum seed bed requires a hotter fire which is produced at least seven days after rain, when the relative humidity is less than 45 percent, and the minimum air temperature is 80°F.

Heavy brush competition can significantly reduce spruce productivity and regeneration success.

5.4 Artificial Regeneration Methods

Direct seeding of black spruce requires a seeding rate of four ounces (about 100,000 seeds) per acre for 60 percent millacre stocking. At present, seed is hard to obtain and expensive. Overstocking is a frequent problem with direct seeding. Seeding rate should be well-calibrated or seed trees should be removed as soon as 60 percent millacre stocking is achieved.

8 APPENDICES



NOTE: Total age = Breast height age + 15 years

Rotation Age					
Organic Soil Sites					
Site Index	60	50	40	30	20
Rotation Age	60	80	100	110	120
Mineral Soil Sites	70 years				

Note: Rotation ages represent minimums and can be extended to a significant degree depending on site capability and management objectives.

Figure 36.1. Site index curves for black spruce in the Lake States (Technical Note No. 473).

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