# BLACK SPRUCE TIMBER SALE DESIGN AND CONTROL GUIDELINES FOR MINIMIZING THE THREAT OF EASTERN DWARF MISTLETOE

*Adapted from "Black Spruce Cover Type Guidelines, Forest Development Manual, 1994, ed. 10/2008"*

DEPARTMENT OF NATURAL RESOURCES

Updated: 10/2019

# Contents



## Review Team

Andrew Arends
Kevin Bergstrand
Val Cervenka
Paul Dubuque
Mike Parisio
Mike Reinikainen
Dave Schuller
Brian Schwingle
Doug Tillma
Harvey Tjader

## Goal and Rationale

The goal of this guidance document is to ensure foresters designing timber sales or developing prescriptions in black spruce-dominated lowland conifer stands are consistently factoring in the long-term forest health threat of eastern dwarf mistletoe (EDM). Application of this guidance to timber sale and silviculture prescription development will ensure consistency in addressing unacceptable damage to regeneration following harvest and reducing future volume and quality loss.

Detecting and diagnosing EDM infections is an important component in managing to minimize the risk EDM poses to forest productivity. While not covered in-depth in this document, more on EDM symptoms and signs can be found in the Eastern Spruce Dwarf Mistletoe Forest Insect and Disease Leaflet (Baker et al. 2006).

The following guidance pertains primarily to Division of Forestry-administered lands where desired future conditions include productive black spruce-dominated stands at rotation.

## Associated Native Plant Communities

This guidance document applies to lowland conifer stands where black spruce dominates, including the following Native Plant Communities (NPCs):

- FPn62: Northern Rich Spruce Swamp (Basin)
- FPw63: Northwestern Rich Conifer Swamp
- FPn71: Northern Rich Spruce Swamp (Water Track)
- APn80: Northern Spruce Bog
- APn81: Northern Poor Conifer Swamp

## Species Profile, Eastern Dwarf Mistletoe (*Arceuthobium pusillum*)

EDM is an obligate parasitic plant; it is only able to survive and grow on living trees. It is quite common in Minnesota and is likely underestimated in Forest Inventory and Analysis (FIA) data and MN DNR forest inventory. Hanks et al. (2011) found evidence of EDM in 56 percent of 196 stands surveyed in Minnesota. To control EDM, infected trees must be killed, but it is not necessary to remove the trees from the site.

The Division of Forestry has long held a policy where all black spruce over five feet tall are felled on a site, called the 5-foot cutting rule. The 5-foot cutting rule does not eliminate EDM from a site or eliminate its future impacts. The 5-foot cutting rule seems a reasonable approach to (1) lessen, to some degree, the future impact of EDM, (2) reasonably minimize site preparation costs, and (3) maintain some original stand structure for wildlife habitat. In some cases, the 5-foot cutting rule may not effectively achieve acceptable spruce yield goals for a given stand due to EDM.

EDM spreads most commonly by seed discharged up to 55 feet from the parent plant. Spread rates from tree to tree (bole to bole) average 2.4 feet per year. Infection can result in rapid mortality across size-classes and loss of stand volume. Studies exploring EDM infected stands in northern Minnesota have predicted anywhere from 14-30 percent volume loss and infection on up to 20 percent of the stand area at rotation (Baker et al., 2004; Baker et al., 2012). For the stand that was predicted to have a 30 percent volume loss at end of rotation, following harvest it had less than 16 infected trees per acre. Considering all sampled trees from the study, only two infected trees were over five feet tall. Therefore, these

predictions for volume loss may underestimate EDM's long-term impact in certain situations, even when the 5-foot cutting rule is employed.

Witches'-brooms are obvious signs of EDM's presence and can sometimes be visually detected from distances of 100 yards or more. Latent infections, however, cannot be detected, and for this reason it is recommended to extend treatments 1-2 chains beyond obvious infection. A combination of aerial photo interpretation, site inspection, and information from sources such as the Forest Inventory Module (FIM) should be used to determine if EDM is present. FIM data alone cannot confirm the absence of EDM on a site. A recent study indicated that Cooperative Stand Assessment (CSA) plots on state-administered black spruce stands correctly detected EDM in only one out of four stands where the study confirmed EDM was present (Baker et al., 2012). Thorough aerial image and stand examinations are needed, even if inventory data does not suggest EDM is present.

Incidence or probability of EDM infection, likely varies from NPC to NPC. This concept is based on differences in natural disturbance history and related site factors like moisture and nutrients that vary with NPC. As an example, we think historically catastrophic fire may have played a role in keeping EDM at lower abundance (e.g., FPn62 in Table 1). Also, in NPCs where species other than black spruce can dominate, the impact of EDM may be less because non-host species provide some volume if black spruce is killed by from EDM. Table 1 takes incidence and impact into consideration and assigns a hazard rating by NPC class. The hazard rating is another tool the forester should use to evaluate sites, especially since latent EDM infections are not detectable. Management efforts like the 5-foot cutting rule are more likely needed on high hazard sites (i.e., FPn71, APn81, and APn80) because rotations are longer, stand density may be lower, and black spruce makes up the vast majority of basal area, but low hazard sites can certainly have infections that require treatment.

**Table 1. Hazard rating for eastern dwarf mistletoe (EDM) in lowland Native Plant Communities (NPC) where black spruce can dominate. Hazard refers to the probability EDM is present in a NPC and is supported by our knowledge of disturbance history and varying site factors.**

| | | | | | Historic Natural Disturbance Rotation (Years) | | |
|---|---|---|---|---|---|---|---|
| **Hazard** | **NPC Class Code** | **NPC Class Name** | **Sections** | **Average Site Index (range)** | **Fire, stand-replacing** | **Fire and wind, maintenance** | **Wind, stand-replacing** |
| Low | FPw63 | Northwestern Rich Conifer Swamp | LAP | 43 (35-50) | 356 | 39 | 2490 |
| Low | FPn62 | Northern Rich Spruce Swamp (Basin) | NSU | 38 (16-50) | 221 | 207 | 2837 |
| High | FPn71 | Northern Rich Spruce Swamp (Water Track) | MOP | 36 (22-51) | 429 | 84 | 704 |
| High | APn81 | Northern Poor Conifer Swamp | LAP, MDL, MOP, MIM, NSU, SSU, WSU | 31 (16-42) | 570 | 90 | 520 |
| High | APn80 | Northern Spruce Bog | LAP, MOP, MDL, NSU, SSU, WSU | 30 (16-57) | 2400 | 120 | 690 |

## Timber Sale Design and Specification Recommendations

The first step in managing EDM is to determine where it is in the stand. This can be done by looking at aerial photography and then walking the stand to find infestations that are not visible on the aerial photo. If necessary, a hand held GPS can be used to map the infested areas, or the uninfested areas, whichever is easiest.

Much of the risk EDM poses to forest productivity can be minimized by implementing the 5-foot cutting rule:

### 5-Foot Cutting Rule

- Employ the 5-foot cutting rule or cultural clearcut to kill all black spruce stems over five feet tall. Refer to the "Cutting and Felling" harvest specification language in the Timber Sale Module (TSM) for 5-foot cutting rule specifications. Require the logger to do this on timber sales where EDM is present or where all three of the following have not been completed:
    1) thorough examination of the site for signs of EDM like mortality pockets and brooms
    2) interpretation of recent aerial photos for signs of EDM (expanding mortality pockets)

3) consultation of FIM data confirming black spruce is not the main species or no regeneration damage codes for EDM (e.g., "23 – Dwarf mistletoe") or remarks concerning EDM

- Unless the stand is confirmed free of EDM, all timber sales must require the 5-foot cutting rule. The 5-foot cutting rule may also be waived under the following exceptions:
    1) the stand is heavily infected by EDM and has too many un-merchantable trees to practically impose the 5-foot cutting rule and post-harvest treatment is planned
    2) the stand is on non-forestry administered land with goals that allow for EDM to persist in future stand (see *Land Administration Recommendations* below)

Timber sale design that incorporates the following tactics can further minimize the risks EDM poses:

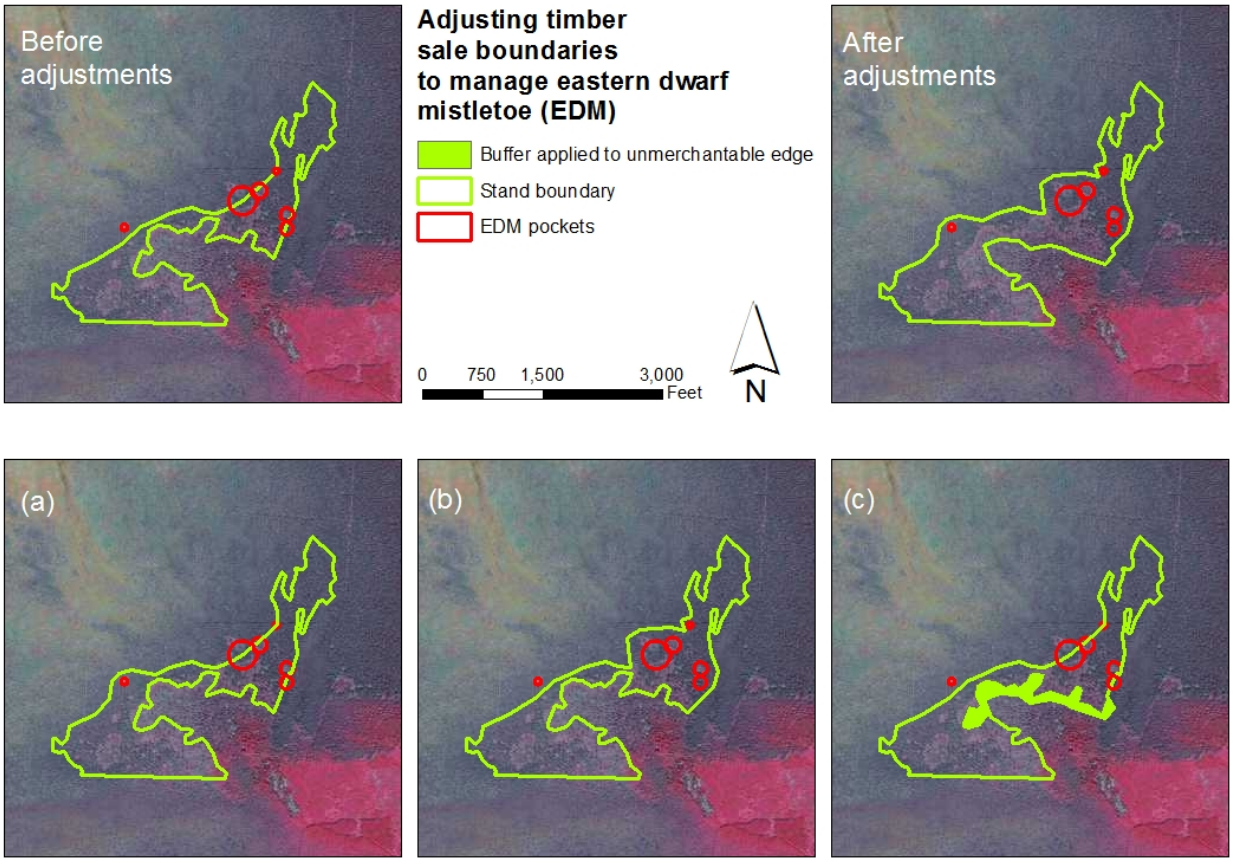
### Landings

- Locate landings in EDM pockets if possible. The extra traffic and activity is likely to kill more of the small black spruce and will therefore provide better control.

### Adjacent Stands and Timber Sale Boundaries

- Be aware of EDM infections in adjacent stands or along timber sale boundaries. Design timber sale boundaries to include adjacent EDM pockets and minimize risk of EDM to the regenerating stand. There are three scenarios where this might occur (letters correspond to Figure 1):
    a) adjusting timber sale boundaries to harvest EDM pockets within two chains of the sale boundary
    b) establishing a two-chain buffer around each pocket along the timber sale boundary
    c) if the stand has an unmerchantable edge due to EDM (many mortality pockets have grown together), expanding the timber sale boundary at least two chains into the unmerchantable area

*Figure 1. Various scenarios for adjusting timber sale boundaries to manage EDM pockets along stand edge and in adjacent stands. Scenarios include a) adjusting timber sale boundaries to harvest EDM pockets within two chains of the sale boundary, b) establishing a two-chain buffer around each pocket along the sale boundary, and c) if the stand has an unmerchantable edge due to EDM (many mortality pockets have coalesced), expanding the sale boundary at least two chains into the unmerchantable area. The stand before adjustments (top left) and after adjustments employed to manage EDM (top right) are also displayed.*




## Reserves

- Leaving reserve tree species other than black spruce is advisable. Tamarack can be infected, but according to Sinclair & Lyon (2005), it often fails to produce fewer dwarf mistletoe seeds. However, do not leave any species with witches'-brooms.
- Leaving scattered black spruce reserve trees is not recommended because of susceptibility to windthrow. Additionally, scattered infected spruce can promote widespread distribution of EDM within stands as scattered trees serve as potential epicenters with freedom to shoot seeds unobstructed in all directions.
- If black spruce is a desired leave tree and EDM is present in the stand, clump uninfected reserves in groups, locate clumps near the sale boundary and two chains or more from detected EDM.
- If black spruce is a desired leave tree but no clusters of uninfected spruce exist, do not reserve any black spruce. There is an allowed exception for forest health and disease concerns in the

Minnesota Forest Resources Council Forest Management Guidelines (p. 57), but it must be properly documented in the prescription.

- Conduct surveys of reserved black spruce clumps no sooner than five years post-harvest to ensure they are disease free. If they are diseased, they should be cut down.

## Silvicultural Recommendations

- We recommend surveying infected sites that have been harvested or treated to control EDM within one year (see Regeneration Monitoring Procedures and Standards). After the survey decide if follow-up treatment, such as hand-felling, shearing, roller-chopping or mulching, is necessary or feasible (see Post-Harvest EDM Treatment Options below).
    - Prioritize surveying previously-identified EDM mortality centers (e.g., from aerial imagery or pre-harvest ground work).
    - Consider surveying for infected spruce with transects to delineate infected areas to treat.
- Regenerate black spruce stands at high densities (greater than 600 trees per acre; see Regeneration Monitoring Procedures and Standards)
- Use of onsite seed may be appropriate to promote natural regeneration of black spruce. To do so, lop and scatter slash. Cut all trees greater than five feet in height (see the Great Lakes Silviculture Library prescription for natural regeneration in lowland black spruce).
- Silviculture systems recommended on forestry-administered lands and other regionally accepted silviculture systems include those listed in Tables 2 and 3. Regionally, trials using other even-aged (e.g., shelterwood) and uneven-aged (e.g., group selection, irregular shelterwood) systems have been successful to meet non-timber objectives but do not address the forest health threat of EDM and windthrow. Further, they do not address marketability of the overstory left for seed and shelter.

## Post-Harvest EDM Treatment Options

Eradication of EDM is not a feasible goal, but reducing its presence will protect investments made in artificial regeneration (e.g., aerially seeded black spruce) and will reduce volume loss at rotation. It may be necessary to follow a harvest with another silvicultural treatment to further reduce EDM on spruce less than five feet tall.

### Hand Crews

- Utilize hand crews to fell infected spruce when the acreage or the number of trees involved is small. The use of chainsaws, brush saws or sandviks can cut and fell trees that are not completely killed during felling and skidding operations.

### Shearing

- A dozer with a KG blade can be an effective way to shear non-merchantable infected timber, especially on large projects or immature stands.
- In large, heavily-infected stands, shearing will probably be necessary to ensure that trees over five feet tall are killed and not just pushed over.

### Mulching

- Mulching with an ASV and a forestry mowing implement has proven effective in the Pine Island State Forest (see the Great Lakes Silviculture Library prescription for post-harvest treatment of standing black spruce). This method is most effective on more easily accessed sites.

### Roller Chopping

- With adequate frozen ground conditions and low snow depth, roller chopping may be a less-expensive alternative to shearing, mulching, or brush-saw work. Abundant slash lopped and scattered across the site may limit the effectiveness of the treatment. Field trials have not been attempted to date.

### Broadcast Burning

- Broadcast burning of harvested sites can be used to minimize EDM but is usually not cost-effective or practical. Take care to get good coverage especially on and around known infection areas. Slash-free alleys with a minimum width of 16 feet are required. Burning under very dry conditions comes with the risk of flattening the peat surface and diminishing drainage, resulting in conversion to very wet open acid peatland communities (see MN DNR APn81 Interpretation p. 3). Another significant risk is of deep peat catching fire, resulting in large holes and the increase in costs to put those fires out. This is especially true if depth to mineral soil is greater than 12 inches.

## Land Administration Recommendations

The 5-foot cutting rule is a reasonable tactic to reduce EDM's impact on Division of Forestry-administered lands and all School Trust lands. Follow-up surveys and treatments of residual infected areas are also important management tools. Exceptions certainly exist on the landscape. Where a desired future condition is a productive black spruce-dominated site and where investments are made in regeneration (natural or artificial), foresters need to be able to defend prescriptions that do not address the forest health threat of EDM. Exceptions to the rule may include designing a timber sale:

- on an isolated land unit administered by a partnering division (e.g., Wildlife Management Areas, Scientific and Natural Areas) with desired future conditions of that unit and adjacent lands that do not include productive and healthy black spruce-dominated stands.
- where a thorough walk-through assessment of the site as well as adjacent stands in addition to examination of aerial imagery and FIM data confirm the absence of EDM.

**Table 2. Recommended silvicultural systems and prescription codes for managing lowland black spruce on Division of Forestry administered lands.**

| Silvicultural System | Prescription Code | Description |
|---|---|---|
| Clear cut | 1110 | Essentially all trees in the stand are removed or felled in a single cutting. |
| Clear cut-natural seeding | 1116 | Essentially all trees in the stand are removed or felled to prepare the site for natural seeding. Additional site preparation may or may not follow harvest. |
| Clear cut-artificial regen | 1118 | Essentially all trees in the stand are removed or felled to prepare the site for seeding. Additional site preparation may or may not follow harvest. |
| Sanitation-clear cut | 1150 | Essentially all trees are removed or felled from a stand to stop or reduce actual or anticipated spread of insects and disease. |

***Table 3.*** **Additional regionally appropriate silvicultural systems and prescription codes for managing lowland black spruce.** ***NOTE: We strongly advise that appraisers consult with regional forest health specialist when planning and prescribing black spruce retention*****.**

| Silvicultural System | Prescription Code | Description |
|---|---|---|
| Clear cut with reserves | 1111 | Trees left in clumps, strips, or islands occupy at least five percent of the clear-cut harvest unit, or more than five trees per acre are left scattered throughout the site.* |
| Clear cut-with rsrv-natural seeding | 1117 | Trees left in clumps, strips, or islands occupy at least five percent of the clear-cut harvest unit |
| Clear cut-with rsrv-artificial regen | 1119 | Treatment is the same as Clear cut-artificial regen except that trees left in clumps, strips, or islands occupy at least five percent of the clear-cut harvest unit |
| Seed tree | 1120 | The area is clear cut except that certain trees, called seed trees, are left standing singly* or in groups to furnish seed to restock the cleared area. Seed trees are removed after regeneration. |
| Seed tree-with reserves | 1121 | Clear cut except that certain trees, called seed trees, are left in clumps, strips, or islands occupy at least five percent of the clear-cut harvest unit |
| Sanitation–with rsrv–clear cut | 1151 | Treatment is the same as Sanitation-clear cut, but leave trees in clumps, strips, or islands occupy at least five percent of the clear-cut harvest unit |

* Leaving scattered black spruce reserve trees is not recommended due to susceptibility to windthrow and creating a potential high disease hazard to the stand.

## Literature


Baker, F.A. & Knowles, K.R. (2004). Case Study: 36 Years of Dwarf Mistletoe in a Regenerating Black Spruce Stand in Northern Minnesota. Northern Journal of Applied Forestry 21 (3): 150-153.

Baker, F.A. & French, D.W. (1994). Radial enlargement of mortality centers caused by Arceuthobium pusillum *Peck* in black spruce stands. Forest Science 37 (1): 364-367

Baker, F.A., Hansen, M., Shaw, J.D., Mielke, M., and Shelstad, D. (2012). The incidence of dwarf mistletoe in Minnesota black spruce stands detected by operational inventories. Northern Journal of Applied Forestry 29 (3): 109-112.

Baker, F.A., O'Brien, J.G., Mathiasen, Robert, and Ostry, M.E. (2006). Eastern Spruce Dwarf Mistletoe. USDA Forest Insect and Disease Leaflet NA-PR-04-06. USDA Forest Service, Northeastern Area. State and Private Forestry, Newtown Square, Pennsylvania.

Hanks, E.M., Hooten, M.B., and Baker, F.A. (2011). Reconciling multiple data sources to improve large-scale prediction of forest disease incidence. Ecological Applications 21(4):1173-1188.

MN DNR. (1994). Black Spruce Cover Type Guidelines (rev. 2008). Forest Development Manual. Guidelines may also be located on the DNR website at Black Spruce Cover Type Guidelines

MN DNR. (2003). Field Guide to the Native Plant Communities of Minnesota: the Laurentian Mixed Forest Province. Ecological Land Classification Program, Minnesota Count Biological Survey, and Natural Heritage and Nongame Research Program. MNDNR: St. Paul, MN.

MN DNR. APn81 Silviculture Interpretation. MNDNR St. Paul, MN. Silviculture Interpretations can be located on the DNR website at APn81 Silviculture Interpretation

Sinclair, W.A. & Lyon, H.H. (2005). Diseases of Trees and Shrubs, second edition. Cornell University Press.