Policy Statement

The role of standing dead trees & coarse woody material in maintaining & improving forest health & productivity at the Otter Ponds Demonstration Forest

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> *"Maintaining standing and fallen dead and dying trees is perhaps the easiest and most effective action woodlot owners can take to promote wildlife and sustain a healthy, resilient and productive forest."*
>
> —*Jamie Simpson,* Restoring the Acadian Forest

[1] The author wishes to thank Flora Johnson for contributing research and recommendations to this document.

Introduction

The life of the forest is an endless cycle in which trees use sunlight, water, and the chemicals found in air and soil to grow foliage and wood. As trees die and fall to the forest floor, their wood is slowly broken down and used by a variety of organisms. This fuels growth in other living things, including organisms that contribute nutrients to forest soils. While fallen wood is in the process of decay, it protects soil nutrients and water quality by absorbing and filtering water, slowing runoff, stabilizing slopes, and preventing soil erosion. It serves as a moist, rich spot where seeds of other plants can take root and grow. Larger pieces of fallen wood, along with standing dead and dying trees, provide various habitats for countless organisms, large and small, which add to the overall species and structural diversity of the forest ecosystem.

Even when the wood is finally reduced to small particles, it contributes organic matter, moisture, and nutrients to forest soils as well as to soil life. This process also moves carbon from the trees themselves into forest soils, preventing carbon from entering the atmosphere, where it would contribute to global climate change. During every stage in this process, which can take centuries to complete, standing and fallen dead and dying trees are essential in the maintenance of biodiversity and overall ecosystem health. For this reason dead wood is often referred to as “the life of the forest”.

Many woodlot owners still insist on removing dead wood from their forests. They do this in the belief that leaving wood to decompose is “wasteful”, that a well-managed woodlot should be “clean”, and that if left behind this material could be a source of pests or disease. But contemporary research has shown that the opposite is true. In a forest deprived of dead wood, the web of life becomes broken and will show significant declines in health, as well as wood fibre production, over the course of just a few generations.

And when forest health is lost, many of the benefits of healthy forests—clean water, biodiversity, wildlife habitat—are lost. The ability of the forest to produce wood fibre also declines, making it increasingly difficult for rural communities and businesses to survive. This is of particularly great concern in the Maritimes, where there is mounting evidence that widespread clearcutting is leading to a loss of soil health and with it, a diminishing ability to grow trees suitable for production of high-quality sawlogs.[2] In addition to the increasing clear-cutting in our forests over the last 50 years, there are rising pressures to harvest forest biomass as biofuel to generate energy.

These practices, i.e. extensive clear-cutting that has high utilization standards of all merchantable wood on short harvest rotations, do not allow for continual maintenance and/or recruitment of deadwood or conditions needed to fulfill the ecological role of deadwood. The resulting loss of protection for soil health, along with overall biodiversity, thus wood fibre production, is likely to have devastating long-term consequences for our forest sector. Therefore is an urgent need for guidelines to ensure that both sufficient quantities of dead wood and conditions that allow slow decomposition of dead wood are maintained in forests during and after harvest.

The managers of the Otter Ponds Demonstration Forest recognize the need to maintain deadwood and appropriate forest cover as part of overall biodiversity, in order to truly maintain proper ecosystem

[2] Dale Prest, “From the Ground Up”, *Atlantic Forestry Review* March 2013.

functions and processes. This is the foundation of forest health that will enable full ecological services, social values, and production of timber and other forest products to be maintained for future generations. The following guidelines have been created on behalf of the Nova Scotia Woodlot Owners and Operators Association for use in management of the Otter Ponds Demonstration Forest, but these recommendations will also be applicable to a wide variety of Nova Scotia forests.

Definitions

Terminology used to refer to coarse woody debris and snags is not always used consistently in the forestry literature. For management of dead wood at Otter Ponds Demonstration Forest, we use the following definitions:

Dead wood: All dead woody material, whether standing or fallen. Dying trees no longer suitable for merchantable saw material due to drying are considered to be dead wood.

Coarse Woody Debris (CWD): Large pieces of fallen wood in any stage of decay, < 45˚ from horizontal and ≥ 10 cm dbh. [3]

Snag: A standing dead or dying tree, ≥ 45˚ from horizontal and ≥ 25 cm dbh. [4]

Cavity trees: A tree with a cavity, crevice, hollow bole, loose bark, deformity, or other feature that represents special value for wildlife. Cavity trees provide escape, nesting, roosting, or denning cover for many species of birds and animals. The value and utility of cavity trees increases with dbh and height. The best cavity trees are living, but snags may be cavity trees.

General considerations

A piece of CWD left to dry out in an exposed location will not perform ecosystem functions to the extent they would be performed by the same piece of CWD left under forest cover. A cavity tree left standing in the middle of a large clear-cut will not provide food and shelter for the same species that used that same tree before harvest.

Like every other part of the healthy forest ecosystem, dead wood is able to perform its full ecological functions and processes only when all elements of the ecosystem are also present and functioning well. When components of a forest ecosystem cannot perform their functions or undergo certain processes because other components are lacking or absent, the entire ecosystem becomes more and more out of balance, thus less healthy and productive. In some cases, these components can be restored. However, this restoration can take a century or more to accomplish. Thus well-informed management must strive to avoid imbalances that lead to degradation of forest health. This requires a long-term outlook—an

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[3] *The Forest Management Guidelines to Protect Native Biodiversity in the Greater Fundy Ecosystem* define CWD as having a diameter greater than 10 cm (p. 87) while the Nova Scotia Department of Natural Resources uses the term to refer to pieces as small as 7.5 cm in diameter. NSDNR also notes that the term fallen should be used to refer to dead wood "laying horizontally at 45 degrees or less."

[4] The forest management guidelines for the GFE define a snag as being a dead tree greater than 25 cm diameter at breast height, while NSDNR defines snags as dead trees larger than 7.5 cm dbh and standing at 45 degrees or more.

outlook that embraces the concept of "forest time", the natural growing time of trees within the forest, which can range from 40 years to as long as 800 years.[5]

Since the retreat of the glaciers more than 10,000 years ago, the Acadian Forest has evolved into a diverse temperate forest shaped and renewed by frequent, relatively small scale natural disturbances. These small scale natural disturbances are primarily wind related weather events as well as natural mortality. This process, referred to as gap dynamics, creates small openings in the forest canopy as trees die and fall. Partial sunlight reaching the forest floor provides conditions suitable for seedlings establishment and growth. This process allows maintenance of a partial, uneven-aged forest canopy along with continual recruitment of species suited to local growing conditions.

Partial harvest systems mimic the natural disturbance patterns that create and maintain our naturally diverse, uneven-aged Acadian Forest. Individual tree selection and group selection (patch cuts) continually maintain forest cover for partial shade, retaining moisture and regulating temperature fluctuations on the forest floor and in the soil. These systems are necessary to conserve the delicate balance of life within the Acadian Forest.

Partial harvesting must be conducted with careful attention to maintenance of appropriate canopy cover along with a range of species and structural characteristics appropriate to the ecosite, which is the smallest level of ecological classification as delineated by the *Forest Ecosystem Classification (FEC) for Nova Scotia*. A crown closure of at least 60-70% should be maintained post-harvest in order to provide appropriate conditions for dead wood. Some sites should have higher retention rates of CWD and snags together with partial canopy in order to help maintain moisture and soil fertility, and to provide site stability over the long term. (See Appendix C.) Management must also be directed not only toward individual stands but also toward larger units such as the ecoregions and ecodistricts delineated through the Ecological Land Classification system.

It is critically important to leave adequate quantities and species of dead wood behind within specific areas of forest immediately following harvest. But an ecological approach to management, in which natural processes of the ecoregion, ecodistrict or more localized ecological unit or forest stand are emulated and respected, is equally as important for protection of dead wood.

The following guidelines are intended to be applied within the context of partial harvesting combined with planning for long-term protection and conservation of all aspects of forest ecosystem health. They reflect only one aspect of the far broader practice of responsible stewardship in the Acadian Forest.

[5] "Forest Time", Donna Smyth. Nova Scotia Woodlot Owners and Operators Association archive, http://nswooa.blogspot.ca/2007/07/remembering-last-falls-field-day.html

Guidelines for protection of dead wood during harvesting in natural Acadian Forest

Surveys & Sampling

The first step toward developing appropriate retention recommendations for CWD and snags, including cavity trees, is to survey the forest vegetation groups found within operable areas of the woodlot. This information serves as an important basis to aid in developing recommendations for management and operational planning for a specific area. Levels and distribution of ecosystem structures can then be monitored by additional sampling over time to help with future planning decisions.

Please refer to Appendix B for the recommended sampling procedures. Forest managers should seriously consider establishing permanent sample plot locations in order to properly monitor rates of decay and accumulation per species and types of these features during forest development stages.

Sampling should be completed prior to harvesting via pre-treatment assessments and during regular forest inventory updates (i.e., management plan updates). Sampling can be made most efficient and cost effective by incorporating it in the initial forest inventory and Forest Ecosystem Classification (FEC) assessment as described in Appendix C.

The assessments would include a tally of live trees, standing dead and dying trees, and fallen wood. Tallies of standing live trees would differentiate between acceptable growing stock (AGS, good quality and form) and non-acceptable growing stock (UGS, poor quality and form), giving indication of existing and potential cavity trees. CWD and snags would be surveyed to capture essential information on species, size, stage of decay and distribution, including location in relation to sensitive areas such as raptor nests or riparian areas.

During the FEC and pre-treatment assessments, the classification of soil types, vegetation types and corresponding ecosites will reveal associated hazards and sensitivities of these sites. Taken together with information from the samples and survey, this will provide indication of the current status of CWD and snags and the possible need for additional recruitment.

Retaining snags during harvesting

1. During on-the-ground layout, prior to harvest, use tree marking to ensure desired snags are clearly identified by blue paint or flagging tape and protected during harvest and extraction activities. Tree marking should be conducted by a trained person who understands the importance of dead wood.
2. As much of the dead or dying trees equal to or greater than 25 cm in diameter at breast height (dbh) should be retained during partial harvesting, unless they present a hazard. Individual trees that must be felled for safety reasons should not be removed from the forest. (Trees that must be felled can count towards CWD retention targets.) Dead or dying trees greater than or equal to 46 cm in dbh should be given especially high priority for retention due to their rarity and potential suitability for use by larger mammals.
3. The most valuable snags should have retention patches around them to maintain conditions suitable for wildlife, to ensure worker safety and to ensure no trails are established within the designated patch. The retention patches for snags should be exclusion zones, areas in which no

cutting is to occur. This will allow the snag to be left standing without presenting a hazard to forest workers, and will protect the snag from being disturbed during trail establishment and use. A trained tree marker should determine which snags require retention patches.

4. Ordinarily the distance from the snag to the outer edge of the exclusion zone will be at least the height of the snag, so the snag will not pose any safety risk. Retention patches should also contain large CWD and active cavity trees if possible. However, the tree marker should determine the appropriate size for each retention patch that surrounds them because this will vary due to a range of factors.
5. Following harvest, each hectare of forest should have a minimum of 8 snags and an ultimate goal of 12 snags with dbh greater than 25 cm. In some instances cavity trees may be substituted for snags (or vice versa); such decisions should ultimately be made by the tree marker.
6. If there are no or minimal snags with dbh greater than 25 cm present, leave the largest available, of different species to the extent possible. Retaining a range of species and sizes is ideal.
7. Where there are not enough snags within a defined area, create them which can be a long term process in certain situations. This can be done by leaving or planting poplars, which tend to be preferred by a variety of bird species, and-tamaracks, and also by leaving a portion of balsam fir. These fast-growing trees will complete their life cycles fairly quickly. An even faster way to create snags is by killing living trees. This can be done by girdling, however other methods are preferable to create snags with strong exteriors and soft interiors, the type of snag preferred by cavity-nesting birds.[6]

Retaining CWD during harvesting

1. The pre-treatment assessments will indicate current levels and distribution of CWD on a per-stand basis as well as sensitivities and hazards of the site. This will allow proper development of site-specific retention targets to maintain during harvesting.
2. During on-the-ground layout, prior to harvest, clearly identify locations of large, valuable CWD by hanging blue flagging tape surrounding the locations, especially if young trees have grown around it. This will help ensure the CWD is not damaged by machinery during harvest and extraction activities. The CWD can be further protected by concentrating machine traffic onto designated trails.
3. Existing CWD should not be harvested unless it consists of large trees that have recently blown down, still have green foliage and consist of sawable material that is economically feasible to extract. These materials may be harvested only if existing levels of CWD are known to be adequate.
4. The potential net economic value of extracting CWD must always be weighed against the long-term ecological value of leaving it in the forest. If the perceived economic gain is nil to minimal after considering costs of harvest, extraction to roadside and hauling resulting wood products to market, the material should be left so that it can contribute to diversity, soil health and tree growth.
5. Large diameter CWD greater than 25cm dbh is especially critical because it persists longer than smaller size CWD, serves as a long-term source of nutrients and habitat for many species and supports more species of fungi, lichens and bryophytes. For this reason larger pieces of CWD should

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[6] See "Creating Snags from Live Trees", *Snags-The Wildlife Tree* web page,Washington Department of Fish and Wildlife, http://wdfw.wa.gov/living/snags/

have retention patches established around them to maintain conditions suitable for the range of species that use them and to protect the large CWD from being disturbed. A trained tree marker should identify the CWD of greatest ecological value to be protected and the size of the retention patch suitable for each situation

6. The retention patches for CWD should be considered special management zones, in which a few live trees may be cut, but only if they can be felled in a direction that would not disturb the CWD or greatly compromise conditions surrounding it. These retention patches may also contain snags, helping to achieve recommended targets for CWD as well as for snags. If trees are cut in these patches, precautions must be taken to ensure the snags will not pose a safety risk.
7. Where there is not sufficient CWD currently present on site, a portion of harvested trees should be left on site to bring CWD levels up to the minimum recommended quantities. The levels outlined in the following table are recommended as a starting point.

Currently the *Forest Ecosystem Classification Manual for Nova Scotia* does not provide sufficient information to draw conclusions about the amounts of CWD and snags that should be left on site post-harvest. (See Appendix C.) Until further research is conducted by NSDNR, the recommended retention targets listed below can be used and modified with updated information as it becomes available.

Abundance of CWD to be left post-harvest in stands containing low levels of CWD prior to harvest

Cover type	Abundance of CWD/ha, average piece diameter greater than or equal to 10 cm, average length greater than or equal to 2 m
Hardwood	40
Mixedwood	60
Softwood	110

Source: *Forest Management Guidelines to Protect Native Biodiversity in the Greater Fundy Ecosystem*, second edition (Parks Canada, 2005), M.G. Betts and G.J. Forbes (eds.), page ix

Providing for future recruitment of CWD and snags

To enable a continuous replenishment of CWD and snags for future as well as present needs, recruitment of these critical ecological structures must be incorporated in long-term management planning and during operational implementation. Fortunately within partial harvest systems designed to conserve and protect biodiversity, living trees of all ages and many species will remain in the forest, creating a pool from which dead wood can be recruited over time.

To ensure that the future supply will always include trees in an appropriate range of ages, sizes, and species, forest managers should also take steps to ensure that the forest contains an appropriate number and species mix of full-cycle trees. Full-cycle trees are individual trees allowed to live out their full lifespans without being cut. While alive they grow to be large and serve as a seed source, ensuring continued regeneration of their species. As they age and die they become a source of dead wood, especially the large pieces that are usually in short supply.

Long-lived full-cycle trees will, after many years, become forest giants forming the top canopy layer that is an essential part of a fully functioning mature Acadian Forest. They serve as super canopy trees and are critical to maintaining wind firmness of the forest, providing enhanced growing conditions for better-formed neighboring trees within the stand. Trees chosen for this purpose, also referred to as *legacy trees*, should be of long-lived native species and expected to live the full lifespan that is normal for their species.

A legacy tree is an investment made on behalf of future generations. This may require a short-term economic deferral if a harvestable tree, known as acceptable growing stock, is chosen as a legacy tree. Sometimes this sacrifice is unavoidable. However, legacy trees do not always need to be acceptable growing stock. They can be unacceptable growing stock as long as they are of good health and vigor, and do not have defects that may affect their lifespans. A good candidate legacy tree is one that will make an above-average contribution to ecosystem structure and function over a long period of time.

Defective trees that are expected to die within less than their normal lifespan should not be ruled out to designate as full-cycle trees since these trees will become snags and CWD sooner than other, less defective trees. Trees of poor form that are considered "ugly" are ecologically valuable as full-cycle trees. Thus, management during all stages of tree development should aim to maintain a proportion of unacceptable growing stock while striving to increase components of acceptable growing stock.

Our recommendations are as follows:

1. During on-the-ground layout, prior to harvest, clearly identify trees that will serve as future full-cycle trees. Future full cycle trees should be greater than 25 cm dbh, be of various species if possible and should be left at a density of at least 8 per hectare with an optimum goal of 12 per hectare. A qualified tree marker should select these trees, ensuring an appropriate mix of species.
2. If a native species is uncommon in the area, any representative of the species should be designated as a full-cycle tree regardless of whether it is acceptable or unacceptable growing stock and regardless of size.
3. Leave components of unacceptable growing stock as a source to easily draw from for future selection of full-cycle trees. Begin at early tree development stages during pre-commercial and pole-stage thinning operations, leaving a portion of dominant poorly formed trees.
4. If appropriate species of sufficient size are not present on a site, choose smaller specimens as full-cycle trees.
5. Attempt to class full cycle trees within retention patches that are designated to protect CWD, snags and cavity trees as discussed in the section below.
6. If species formerly found on a site are no longer present due to previous harvesting activities, plant and protect individual examples of the missing species. Missing species may be determined by referring to the information on ecosite in the *Forest Ecosystem Classification Manual for Nova Scotia Part III: Ecosites*. (See Appendix C.)

Special considerations regarding cavity trees

Cavity trees are individual trees that have special value for wildlife. They may be healthy, dying, damaged, diseased, or dead trees. Sometimes only a portion of the tree, such as a large branch or the tree bole, is damaged or diseased. Sometimes the tree is merely deformed but healthy. Typically these trees have cavities of some type in them, but these range in type from loose bark to very large cavities (dens) in the tree bole. A cavity tree may even appear to be intact on the outside but have an interior that is in decay. Woodpeckers create cavities in such trees by drilling through the bark and sapwood to reach the soft interior.

Cavity trees are critical for wildlife—so much so that the term *cavity-dependent wildlife* is used to describe the wide array of species that require cavities of one type or another to survive. However, different wildlife species require different types of cavity trees including both hardwoods and softwoods. Cavity trees are used for many different purposes, including roosting, nesting or feeding, or as den sites. In addition, the setting in which a cavity tree is found affects which wildlife species will use the cavity tree and how. As Stephen Woodley writes in the *Forest Management Guidelines to Protect Native Biodiversity in the Greater Fundy Ecosystem* [7] "Managing cavity-dependent species is not a simple matter of leaving snags and cavity trees."

Because they are sensitive to overall ecosystem health, cavity-using species are often used as way to monitor how well a forest is being managed. In the Maritimes, the pileated woodpecker and northern flying squirrel are often used as "keystone species" for this purpose. The assumption is that if these species can flourish on a property, the ecosystem is healthy and can support a wide array of other species as well.

Our recommendations are as follows:

1. Before harvest use tree marking to ensure that cavity trees are clearly marked and protected during harvest by identifying them with a blue painted 'W'. Tree marking should be conducted by a person who is knowledgeable about wildlife and wildlife habitat needs.
2. Most cavity-dependent wildlife require forests that are 20 years old or older. Leave patches of undisturbed, older forest in each stand, landscape and ecosite, favoring the patches that are most suitable as wildlife habitat.
3. Ideally patches of undisturbed forest will contain various components of existing and potential cavity trees as well as larger snags and CWD. These patches may overlap with or encompass exclusion zones and special management zones designated for larger snags and CWD. ("Clumping" these structures in concentrated areas embedded in a matrix of partially harvested forest may help achieve desired retention targets of these structures over the short and longer term.) The tree marker should strive to identify patches that contain some of each of these various structures.
4. Leave all cavity trees as well as trees that are becoming cavity trees, unless they present a hazard. If they present a hazard and are felled they should not be removed from the forest.

[7] Chapter 8, page 61

Look for fungi on the bark, evidence of wildlife use (e.g. a row of woodpecker holes), and splits in the trunk or other damage as indicators that a tree is on its way to becoming a cavity tree.

5. Following harvest, a site should have at least 8 *live,* healthy cavity trees per hectare with a diameter at breast height more than 25 cm. (Note that this is in addition to snags.) There should also be at least 8 potential cavity trees per hectare identified to retain if possible; however these potential cavity trees could count towards the retention target for total number of future snags and full cycle trees per hectare. There may be instances in which cavity trees may be substituted for snags or vice versa. Ultimately the decision is left up the tree marker.
6. Try to ensure that cavity trees and potential cavity trees represent a variety of species and sizes, keeping in mind that cavity trees more than 46 cm dbh are in especially short supply. Some species, such as little brown bats, require cavity trees 60 cm dbh or larger.
7. Make sure that cavity trees and potential cavity trees are distributed throughout the woodlot. Cavity trees located near water are especially valuable.
8. Ensure retention patches are maintained surrounding the more valuable, active cavity trees to provide favorable conditions for wildlife use, to ensure worker safety and to prevent cavity trees from being disturbed or damaged. A trained tree marker should decide the size of each retention patch because this will vary due to a range of factors.
9. Retention patches surrounding live healthy cavity trees can be considered special management zones , in which a few live trees may be cut, but only if they can be felled in a direction that would not disturb the cavity tree or greatly compromise conditions surrounding it. As mentioned above, such retention patches should contain other ecological structures such as snags, CWD and full cycle trees if possible.
10. If cavities are in short supply consider putting up nest and roost boxes. *Restoring the Acadian Forest* contains instructions on how to create these features,[8] and also instructions on how to make a den tree.[9]
11. Consider having your woodlot surveyed by a wildlife biologist or other qualified person in order to choose one or more keystone wildlife species. Recommendations for the creation or enhancement of habitat (including but not limited to cavity trees) for those species would then be incorporated in the management plan.

Finally, remember that blowdown, lightning strikes, disease, occasional insect outbreaks and old age are all normal parts of the life of a natural forest. A healthy, diverse forest will grow stronger when the manager allows forest life to follow a natural course. It is imperative that forest management practices mimic the natural disturbance regime of the ecosite, allowing for the full range of species and structural diversity that in turn will permit ecological processes and functions to continue.

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[8] pp 75-79
[9] p 36