

Ground Hemlock Harvesting Guidelines

Developed jointly by

NRCAN, Canadian Forest Service, Fredericton, and the PEI Dept. Agriculture and Forestry
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INTRODUCTION AND BACKGROUND

Harvesting of ground hemlock (*Taxus canadensis*) branches (biomass) for use as a source of raw material in producing Taxol® and (or) similar but related anti-cancer drugs has been increasing steadily since the late 1990s. Ground hemlock represents what is likely the last yew species worldwide for which large-scale harvesting programs have yet to be established. However, in 1999, researchers at Natural Resources Canada, in conjunction with staff from the PEI Department of Agriculture and Forestry, developed the first set of ‘Recommended Harvest Guidelines’ for use in Atlantic Canada as part of a coordinated effort to ensure that the overharvesting which has occurred for most yew species worldwide, does not also occur with ground hemlock. Efforts to coordinate developing sustainable harvesting standards have now increased such that in April 2002, The Eastern Canadian Ground Hemlock Working Group was formed. Comprised of representatives from the five eastern provinces, Quebec, New Brunswick, Prince Edward Island, Nova Scotia and Newfoundland (federal and provincial governments, ENGO, and the private sector) this group will actively promote the sustainable management of the ground hemlock resource.

This version of the Atlantic Canada guidelines (the fifth draft) incorporates some significant changes from previous versions, reflecting our increased knowledge and familiarity with our native yew. Specifically, this version moves towards advocating the removal of significantly SHORTER branches than what was previously accepted. This change has been predicated based on early results from field harvesting trials (albeit limited in number), discussions with harvesters and harvest contractors, as well as general observations in Quebec and Atlantic Canada. Harvesting standards developed in Quebec by Bioxel Pharma Inc. are similarly, if not more rigorous than those proposed here, but more importantly, likewise recognize the importance of ONLY removing short lengths of branches.

In the early versions of the harvest guidelines, removing more than three years of growth was deemed to be acceptable provided that the amount removed did not exceed a certain portion of the total green biomass of individual branches. The rationale for the initial guidelines was that removing up to 4 or 5 years of growth was ‘biologically’ acceptable provided that the same plants were not re-harvested for period of time equal to, or slightly longer than the number of years of growth removed. This thinking now appears to have been somewhat faulty. Measurements of research harvest trials by staff at the PEI Dept. Agriculture and Forestry have clearly shown that plant recovery (regrowth) following removal of 5 or more years of growth has been poor. Based on the results from these trials and others elsewhere, it is now apparent that a second or follow-up harvest would likely not be advisable for a significantly longer period than first thought.

Therefore, in October 2001, the first draft of a revision to the harvest guidelines which recommended ‘shorter’ cuts (up to a maximum of 6 inches (15 cm)) was proposed. Recommending harvesting shorter pieces is also in general agreement with our colleagues / collaborators in Quebec whose experiences parallel ours e.g., superior recovery (regrowth) following harvesting shorter pieces of branches. Furthermore, we now know that the taxane content in needles and ‘small’ shoots is higher than in large woody branches/stems and that these smaller branches can be utilized almost completely whereas other than the bark, larger woody material was essentially waste from the extraction of taxanes perspective. Therefore, by harvesting smaller branches, less total biomass is required to yield a given amount of taxanes which is both better for the sustainability of the plants AND more economical from the processing side.

This ‘new’ approach which can be described as being similar to a modest hedge pruning will also make harvesting during the active growing season an acceptable option. This latter point has been one of

considerable debate in regards to the economic viability of yew harvesting. The new guidelines continue to take into account efforts to provide harvesters a continuous period of employment of significant duration, as well as help to ensure a continuous supply of biomass to industrial processors.

Concomitant with shifting to harvesting shorter branches will be an increased cost per unit fresh weight. Harvesters will be required to make more cuts to obtain a given weight of material. However, rather than the harvesters alone having to absorb the increased costs (i.e., ensuring the sustainability of the resource is the first priority), an increase in the price paid per unit of biomass is likely. In fact, the price paid per pound fresh weight has been increasing steadily throughout most of eastern Canada, although over the past four years, there has been a considerable discrepancy in the price paid to harvesters. It is now CLEAR that there is sufficient value in this resource to accommodate the increased costs associated with following a ‘sustainable harvest program’.

Following acceptable harvesting practices is but the first step in a sustainable management system. This latter point is particularly important if a viable long-term value-added industry in eastern Canada is to be developed and maintained. Organizations such as the FDA in the US are increasingly requiring that any plant-derived product (e.g., taxanes from ground hemlock) must originate from sustainably managed sources. With this goal in mind, a harvest verification system is being developed. This system will require that all *Taxus* biomass that originates from ‘wild collections’ be inspected by an independent third party to ensure that proper harvest guidelines have been followed. In doing so, the raw material can be tracked from place of origin through to the finished product. By being proactive in ensuring that current harvest practices are sustainable now, the competitiveness of this fledgling industry in eastern Canada should actually increase relative to programs which do not have a similar long-term perspective.

We recognize that there is no single ‘one right way’ to harvest *Taxus* sustainably. Therefore, the philosophy behind these guidelines is to try to make them practicable, specific enough that they can be used by harvesters yet not overly cumbersome, and most importantly, rigorous enough to protect the resource over the long term.

Although outside the Harvest Guidelines per se, it is important to note that funding is in place to establish a series of new research plots starting in 2002. These new trials will help to verify whether or not, that by following these ‘revised’ guidelines, the harvest will be sustainable over the long-term. An important objective of the new research program will also be to actually ‘increase’ the biomass available for subsequent harvests in the same way the density (and hence biomass) of hedges are increased through following proper pruning practices. Partners in these research trials include university and government researchers, NGOs, and as well as private sector partners in both Quebec and Atlantic Canada.

Minimum Standards for Harvesting Ground Hemlock

Background

Revised April 2002

If you are considering harvesting yew foliage to sell, you should take a moment to read the following background information.

These guidelines have been developed using results from pruning trials conducted in Atlantic Canada by staff from the Provincial Dept. Agriculture and Forestry on PEI and the Canadian Forest Service, and by collaborators in Quebec. These guidelines represent the ‘fifth’ version since the first draft was released in May 1999. The number of revisions reflects efforts to incorporate new knowledge and information as soon as it has become available.

MEMBERS OF THE EASTERN CANADIAN GROUND HEMLOCK WORKING GROUP SUPPORT THE USE OF THESE GUIDELINES AS THE MINIMUM STANDARDS FOR HARVESTING.

A ‘management’ system for *Taxus canadensis* in eastern Canada is currently being developed. This integrated program will incorporate protocols for protecting the resource (conservation and sustainable harvesting) with methods of not only sustaining the industry, but in-fact helping it to grow such as through establishing a domestication program. Verifying that any and all harvesting is done sustainably by an independent third-party will be an integral part of managing the resource.

An Introduction to the Biology of Ground Hemlock

Yew is generally a low growing shrub. It is a favoured food for both deer and moose. In areas that it is heavily browsed, the plants rarely reach a height greater than 50 cm. However, where browsing has not occurred, such as on PEI, i.e., because there are no deer or moose there, the yew plants can reach a height of approximately 2 metres (6 feet). Regardless of where yew is growing, or what a given area of yew looks like, understanding ‘how’ it grows will help you better understand the rationale for the harvesting guidelines.

One of the main ways yew spreads is by ‘layering’. That is, the low spreading branches, when they come into contact with the ground, can be covered over by leaves and other litter. Then, over time, they ‘root’. These rooted branches will then start to behave as new plants, but in-fact, they are ‘clones’ (genetically identical) to the original. This is important to remember, because although it may look like there are a lot of individual stems, often they are connected underground. This means that what you do to one plant, can have an effect (good or bad) on many of its neighbours (see Figure 1)

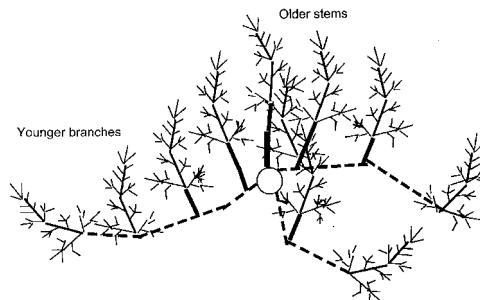


Figure 1. Yew typically spreads by layering. Note that the stems close to the centre are older, and if not browsed, can grow into ‘small trees’.

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Quick Reference Sheet

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I. When to Harvest

Although harvesting can be done throughout the year, there are several factors to consider that affect the quality of the material, the costs of harvesting, and equally importantly, how the plants will respond. Taxane yields are generally higher in dormant than in actively growing shoots. If your purchase arrangement is based on a sliding scale, e.g., higher selling price for higher taxane content, then the recommended time to harvest will likely be from late August to March/April when the plants are dormant. From December to February/March snow cover will usually prevent you from harvesting, whereas in the early spring (March/April) access to harvest sites may be limited by road conditions.

II. What trees to Harvest from

ONLY harvest branches from plants (stems) that are 1 metre (36 inches) or more in height. This minimum plant size is recommended to help ensure that plants have a minimum vigour prior to harvest. Adopting the minimum size increases the likelihood that heavily browsed or recently harvested plants would be excluded.

III. How much to Harvest

1. Harvest the terminal shoot and the two or three most vigorous lateral shoots closest to the top of the plant (see Figure 2).
2. Remove up to three years of growth. On a moderately 'vigorous' branch / plant, current-year growth will be approximately 7 to 10 cm. Therefore harvesting three years of growth will typically produce a branch with a total length of 20 to 25 cm.
3. In ground hemlock, the shoots typically stay green for up to three years. DO NOT make cuts into the brown woody stem below the third year (see Figure 3).

NOTE: Following pruning, new buds (and the shoots that are produced from these buds) form close to the cut surface. For plants that are heavily pruned, e.g., 4 to 6 years of growth or more removed, these 'new' shoots usually take longer to form AND although there may initially be a large number of new shoots, they typically are very 'weak' and thus grow very slowly. Measurements from research plots now show clearly that when more than three years of growth is removed, new or replacement growth is less than what was previously predicted.

IV. How to Harvest

1. Use hand pruners. DO NOT break or tear branches.
2. Regardless of how much you are removing (up to the maximum of 3 YEARS OF GROWTH), try to make your cut just above side branches (see Figure 2). This will allow for the lateral branches just below the cut to grow out and 'replace' the removed shoot. Furthermore, new shoots may originate from the tissue located at the nodes and the regrowth from the pruned branch will therefore be quicker and likely more vigorous.
3. LEAVE EVERY FIFTH STEM UNPRUNED.
4. DO NOT 'reharvest' a site for at least 4 years (= number of years of growth removed +1).

NOTE: In previous harvest guidelines, it was recommended to leave at least one stem in every 'clump' intact. This method is still valid. However, identifying individual clumps can be very difficult where *Taxus* is particularly dense. Therefore leaving at least 1 in 5 stems should be practicable and accomplish the same goal.

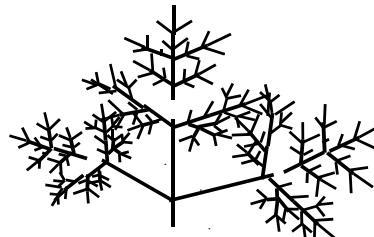


Figure 2. Examples of how much foliage to remove from a given plant stem. NOTE: the amount to be cut = a maximum of 3 years of growth will vary between 15 and 25 cm length. ALL cuts should be made immediately above the lateral branches. These lateral branches should become "invigorated" in response to the removal of the terminal portion of the branch as occurs in hedges.

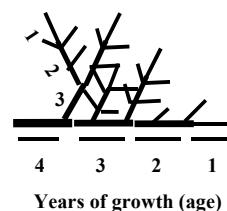


Figure 3. Close-up illustrating how to quickly identify the age of a branch. Cuts should be made close to the base of '3' (= 3-year-old wood) and not into the part of the stem marked '4'.