CH. 10. Special Status Species

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1. Introduction

Species that are rare or threatened require special attention. Coarse-scale strategies, such as maintaining broad forest cover types, may not work if a species requires a specific habitat type. The habitat type may not be in the forest management database, and could be altered simply due to ignorance of information about species or habitat distribution.

Managing rare and threatened species can be difficult because: 1) it is hard to monitor rarity; 2) we often do not know the cause of the rarity or decline; and 3) responsibility is unclear if several stressors (i.e., forest change, poaching, toxins) are interacting to create the problem. Another difficulty is the scale at which populations should be maintained. There are national lists of endangerment (Committee on the Status of Endangered Wildlife in Canada COSEWIC), provincial (NB Endangered Species Act), and regional (i.e., known recent extirpations).

Many jurisdictions have responded to these difficulties by surveying certain species, then monitoring status. We recommend that, in most cases, more information is required before substantial resources are devoted to monitoring. The purpose of monitoring is to enable managers to know if changes are occurring in processes, populations, or ecosystems. Implicit in this knowledge are two critical aspects: (1) That any change detected can be labelled as significant change. All populations and processes fluctuate in time and space. Labelling requires that managers know the minimum or maximum threshold levels of change. Most monitoring initiatives are designed to detect change, but most have not established thresholds of acceptable change. (2) Determining which factor caused the change, assuming significant change has occurred, and that managers plan to reverse the trend, it is critical to know which stressors need to be manipulated. Changes in populations can be driven by many factors (i.e., predation, changes in carrying capacity, inter- and intraspecific competition, toxins, disease, genetic drift, etc.).

The problems mentioned above should guide any research being considered as part of a monitoring program. Managers are unlikely ever to have all the information they want, but still must manage. Therefore, research should be directed at building confidence that: (1) any change can be compared to a threshold and labelled as significant; and 2) any change in a listed species can be attributed to a certain factor.

Both at the national level and in the province of New Brunswick, special status species are recognized, meeting defined criteria as endangered, threatened, vulnerable (or special concern) according to COSEWIC, Atlantic Canada Conservation Data Centre (CDC) and New Brunswick Department of Natural Resources (NBDNR), Fish and Wildlife Branch). These include species that are already rare and at risk of extirpation. Other species, e.g., trees and shrubs, (such as white elm and American beech), are of concern in New Brunswick although they do not yet appear on the provincial or federal lists. Species that have significantly declined since European colonization, or are presently under serious threat may not have fallen to population levels that would earn them an "S ranking" under CDC guidelines. An example of such a species is the butternut, which is succumbing to a new, highly virulent disease in much of the species range. (However, butternut is listed as endangered by COSEWIC.) The S ranks are sub-national conservational status ranks assigned by CDC botanists or zoologists on the basis of known occurrences of the species. Recognizing such species and implementing conservation measures now may prevent further loss.

This fine-filter guideline discusses tree species that require special management strategies or conservation measures and recommendations for their management. The species were identified through a process initiated in 1997 by a multi-stakeholder group that came to be known as the New Brunswick Gene Conservation Working Group (NBGCWG) consisting of scientists and practitioners from both levels of government, industry, and private woodlot owners. The guideline also lists species that have been ranked by COSEWIC, the province of New Brunswick or the CDC, that are known to be rare or locally extirpated in southern New Brunswick.

2. Key Biological Concepts

When population sizes are small and declining, or population survival is threatened by an insect, disease or other challenge, for which the species is not adapted, conservation management is necessary to maintain population or species viability. A number of environmental challenges are already having, or are predicted to have, serious effects on native forest species. Thus, maintaining sufficient numbers of populations and individuals to sustain a pool of genetic diversity is essential.

When a population size reaches a critically low number, it is susceptible to abrupt environmental changes, particularly if they occur in combination with chance demographic events affecting birthrate, survival, or mortality. For example, when a new pathogen is introduced, species encountering it for the first time may have some degree of natural resistance present at a very low frequency in large populations. In general, large populations contain more genetic diversity than small ones, so have a higher probability of surviving new environmental challenges.[1]

Human activities may influence evolutionary processes such as natural selection or interspecies hybridization. When land-use practices exert pressures on naturally occurring populations, the direction or intensity of selection may be altered, effectively domesticating species that must also continue to survive in natural ecosystems. High-grading is the most obvious and widely known example, whereby the genetic quality of populations or species of shade-intolerant trees is altered by harvesting only the best trees before they have reproduced. When a disturbance regime is dramatically altered over a number of generations to create conditions that are different from the conditions prevailing during its recent evolution, the species is susceptible to changed selection forces.

Human activities may create barriers to natural migration between populations or remove barriers, artificially increasing movement between populations. Altering patterns of migration between populations can result in loss of viability of small populations because of inbreeding, or loss of local adaptation when movement between populations is artificially enhanced.

3. Special Status Tree Species and Gene Conservation Needs

Conservation measures may be directed at the level of ecosystem, species, or genes. The NBGCWG identified species requiring attention at the level of forestry practices, as well as those requiring specific gene conservation strategies.[2]

Gene conservation seeks to preserve evolutionary potential of species or populations. It does not mean preserving all genes; instead it often means maintaining sufficient population sizes to allow evolutionary processes to continue. Gene conservation measures may be required when a species is not in danger of extirpation. Some considerations in identifying such species include:

1. Is the species naturally rare in the area?
2. Is there no or an uncertain viable seed source?
3. Is there a serious threat from disease or insect pest, or from changes in environmental quality?
4. Is the range or frequency of the species substantially decreasing?
5. Is the preferred habitat of the species in high demand for other uses?
6. Do certain harvesting practices prevent the regeneration of the species?
7. Is there high demand for the species for a special purpose?
8. Is there a threat of loss of the species due to hybridization and introgression?

All tree and shrub species native to New Brunswick were assessed by the Working Group and were rated according to the following system:

0 – species does not need attention;
1 – information is inadequate to judge;
2 – species requires attention at the level of forestry practices;
3 – species requires a gene conservation strategy.

Four tree species: butternut, white elm, American beech, and bur oak were identified as requiring specific gene-conservation strategies.[2] The first and last species have declined both in numbers and area of distribution since the arrival of European settlers. Butternut conservation has particular urgency because of a recently introduced disease that is sweeping the natural range of the species,

and killing most butternut trees in its path. It has recently been designated endangered by COSEWIC. Elm and beech are still relatively common, but almost all trees in southern New Brunswick are diseased, infected by fungal organisms that were inadvertently introduced from Europe decades ago. In both cases, trees that are nearly or entirely free of the respective diseases may be found with low frequency.

Butternut

Butternut decline was first reported in 1923 in the US.[3] Initially, *Melanconis juglandis* was presumed to be the cause of the decline, however, in 1967, *Sirococcus clavigignenti-juglandacearum* was found to be the causal agent for Butternut canker.[4] The true role of *Sirococcus clavigignenti-juglandacearum* in butternut decline was only clarified after extensive research, which resulted in the publication of *Sirococcus clavigignenti-juglandacearum* as a new taxon in 1979.[5] *M. juglandis* appears to be a secondary agent that moves in on dead or dying tissue after the tree has been weakened and/or branches have died off. Recent evidence of complete genetic monomorphism of the pathogen *S. clavigignenti-juglandacearum* suggests that it was recently introduced[6] or could be a recent derivative from a phylogenically close relative.

Since the first report of butternut canker in 1967, infected Butternut has been found throughout most of its range.[7] In Canada, the first report of canker was in Quebec in 1990,[8] then in Ontario, 1991,[9] and in New Brunswick in 1997.[10] The species is now listed endangered by COSEWIC.

Butternut canker infects all sizes and age classes of trees on all sites and infection can occur through buds, leaf scars, and various wounds.[8] The fungus is believed to be spread by rain-splashed spores and birds and insects, and usually starts on small branches and twigs in the crown. Butternut seeds can also carry the canker infection.[11] The canker is highly aggressive and has spread rapidly since its first report in 1967.[12] It has recently been found on two other hosts, black walnut and heartnut, but infection on these species has been limited.[13,14] To date, control for the disease does not exist. Overall, butternut mortality as a result of this disease exceeds 77% in American forests,[15] but in Canada, mortality has been estimated in Ontario to be 80%.[16]

Seedlings are commonly found where trees are producing seed, however, seedling establishment and regeneration are severely limited by shade (shade intolerant) and/or canker infection. If butternut is free of infection, it is a fast-growing and relatively short-lived tree on favorable sites.[17] A recent study examining butternut genetic diversity from seven populations in Quebec, and one in New Brunswick[18] show that genetic diversity estimates are low, with values much below those anticipated in other species of the same genus or in boreal tree species. It is likely that butternut exhibits reduced levels of genetic diversity where the disease is well established, due to the high incidence of cankered trees and the resulting high mortality rate. Butternut hybridizes with other Juglans ssp., including heartnut, producing buartnut; with Japanese walnut (*J. ailantifolia*), producing *J.x bixbyi*; and with English walnut, producing *J. x quadrangulata*.[18]

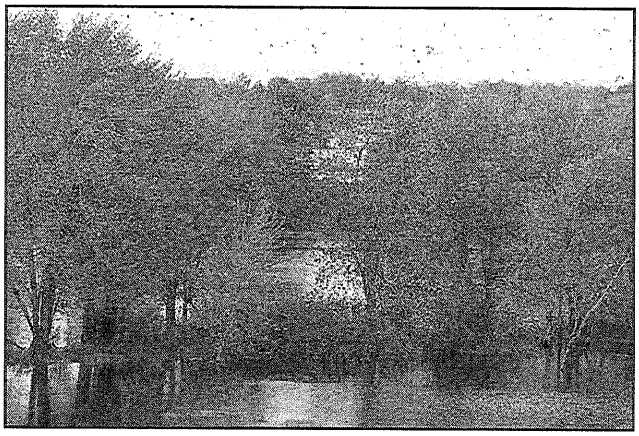
Butternut populations are declining in New Brunswick, although it is unclear how much of the decline in the southern half of the province is due to the new butternut canker. The disease-causing fungus is common north of Woodstock, and infection of stands throughout the New Brunswick range of the species is likely to occur over the next decade. The disease has spread very rapidly through the range of the species. Because of the isolation of New Brunswick populations, the canker was slow to appear in the province but now can be expected to spread rapidly. The disease can be carried in the seed, making it particularly difficult to control.

Genetic resistance to butternut canker may exist at low frequencies in natural butternut populations.[19] It will not become apparent which individuals are resistant until after the disease infects most susceptible trees, but resistant trees are essential for the long-term survival of the species. Genetic diversity is an issue because populations are already small, implying that numbers of potentially resistant trees in New Brunswick are very small.

White Elm

White elm has also been severely affected by an introduced disease, Dutch elm disease, carried by a native beetle. Like butternut, elm is likely to be an important feature of the future New Brunswick landscape if resistance or tolerance to the disease exists within native populations. It is important that any mature trees showing no sign of disease, be maintained on the landscape. White elm is scattered, nowhere forming pure or near pure stands, and the proportion of disease-resistant or tolerant trees is very low.

Dutch elm disease (DED) has devastated white elm throughout its range. The disease is caused by the fungus, *Ceratocystis ulmi*, which is introduced into a tree by the native elm bark beetle.[20] Beetles breed in and under the bark of dying or newly dead trees. When a tree is infected, small spores stick to and are carried by the beetles to nearby healthy trees. Beetles feeding on twigs of healthy trees allow the spores to enter the tree where they spread through the water-conducting vessels,[21] which soon cease to function, resulting in the death of the tree. The disease was first reported in New Brunswick in 1957 at Woodstock where it was thought to have entered from Maine. By 1961, DED was found up the Saint John River Valley as far as Grand Falls and south of Fredericton.[21] DED had spread throughout the province by the mid 1970's. The occurrence of large, healthy, older elms in the wild indicates the possibility that a mechanism exists in these trees to either prevent or tolerate infections. There is evidence of a genetic basis for relatively weak resistance to DED.



Both bur oak and white elm are found along with silver maple on flood plains near Grand Lake, N.B.

American beech

American beech is a component of tolerant hardwood forests in eastern North America, with a natural distribution extending from the east coast of Canada's Maritime provinces to about 100 km west of Lake Michigan, and as far south as mid-Texas (30° Long.). The species is broadly distributed, spanning approximately 35° in longitude and 18° in latitude.[23] Beech was once among the most common Acadian forest species, dominating upland hardwood where soil is neutral or acid. Presently, the species is often an understorey component generally considered to have no value except as fuel. Where it dominates stands, stands are scrubby with diminished ecological and economic value. An increased emphasis on hardwood resulted in a provincial government policy preventing clearcutting in tolerant hardwood stands having sawlog potential. When beech is a substantial component of a stand, however, potential for sawlog production is greatly diminished, so stands are typically logged and silviculturally treated to encourage regeneration of other species.

Around 1890, a disease-insect complex was introduced through Halifax with devastating consequences for American beech.[24] The faunal component is *Cryptococcus fagisuga*, a scale insect that attacks and makes the tree susceptible to a beech bark fungus, Nectria coccinea var. faginata.[25] The disease has spread throughout the Maritime provinces, the New England states, northern Pennsylvania, and New York. It has been detected as far south as West Virginia and west to Ontario and Ohio.[26] The "killing front" of the disease results in high mortality among mature trees. The "aftermath forests," resulting from seedlings and root suckers, consist of trees stunted in growth and deformed by cankers. Seed production is reduced in diseased trees, but root suckers are often abundant.[27]

The genetic diversity of American beech is lower than average for long-lived woody species and population genetic structure is different between disease-susceptible and resistant trees.[28] Stands are sub-structured into clonal clumps and individual trees of seed origin. Some of the clonal clumps were disease free and others were heavily diseased in the same stands.[29] Houston and Houston and Houston (1994)[29] reported that resistant trees appear to have lower genetic diversity than susceptible ones. The susceptible trees, examined using isozyme analysis in a study involving a total of 1441 trees, had higher observed heterozygosity at each of the four locations sampled.

Houston (1983)[30] challenged a number disease-free beech trees in Maine and New Hampshire with the scale insect, *Cryptococcus fagisuga*, and was unable to establish colonies. Control diseased trees were easily colonized, however. He concluded that the disease free trees are resistant to the scale. There has not been any reported evidence of resistance to the fungus. The fact that clonal clumps that he examined are entirely diseased or disease-free implies that the resistance has a genetic basis. In New Brunswick, first-year grafts from diseased and disease-free trees, have shown the same results when challenged with the scale insect. Recent work indicates that the frequency of resistant trees in beech stands throughout New Brunswick is approximately 4%.

Bur Oak

Bur oak once occurred in the flood plains all along the lower St. John River valley but now, except for occasional planted trees, it is limited to Grand Lake and associated lake shorelines, and one small site in Belleisle Bay (in the FMF).[31] Genetic analyses indicate that the diversity of these small populations has not been impaired by isolation or diminished numbers, so use of local seed sources is appropriate for restoration or horticultural planting.[31] Several restoration plantings demonstrate high survival either in open conditions or under light shade for the first five years. Survival to date is high (at least 80%) for bur oak planted on old-field, floodplain, and reclaimed garbage dump sites.

Other Vulnerable Tree Species

Seven additional tree species were recognized as being vulnerable to inappropriate forest practices: sugar maple, white ash, black ash, ironwood, red pine, eastern white cedar and red spruce.[32] Sugar maple and ironwood are shade tolerant and require some shade for optimal development in many areas. Sugar maple grows on a wide variety of sites, but performs best on deep, well-drained loams, much of which was cleared at one time for agriculture in southern New Brunswick. Sugar maple is often associated with yellow birch, which requires soil disturbance and open canopy to regenerate. Sugar maple seedlings dry out and often do not perform well without shade.[33]

White ash is moderate in shade tolerance and achieves best growth on rich, well-drained soils.[34] Many areas with soils most conducive to white ash growth have been cleared for agriculture. Although many agricultural fields have subsequently been abandoned, white ash usually does not colonize abandoned farm fields. White ash seedlings grow best under moderate shade, so a shelterwood system is ideal for reproduction. Black ash, like white ash, may be less common today than historically, but for different reasons. The species is found in wet areas, along streams and in swamps.[35] The wood is prized for basket making by Aboriginal people and good quality large trees have been selectively harvested from many areas over the years.

Red pine is thought to have declined in frequency compared with historical levels.[32] Extensive red pine stands have been cleared and converted to other uses. Fire control, combined with the fact that the species is not generally planted in New Brunswick, may be contributing to ongoing losses. Red pine was likely never frequent in the Fundy Model Forest (FMF) or Greater Fundy Ecosystem (GFE). When eastern white cedar is clearcut, it does not usually regenerate. The species has been in demand since colonists first arrived in the area because of the durability of the wood. Many cedar bogs were drained for agriculture during the 1800s because cedar tends to grow on fertile soils.[36] When agricultural fields were subsequently abandoned, cedar did not recolonize. Red spruce has declined seriously across the species range, probably only inhabiting one-fifth of its one-time range in Ontario and the eastern United States. In New Brunswick, the species does not regenerate well after clearcutting and there are indications that regenerating forest may have a high proportion of red-black spruce hybrids, leading to erosion of the red spruce gene pool.

Six tree species may require attention but currently available information is insufficient to describe their status.[32] The species are: black cherry, basswood, black willow, red ash and mountain paper birch. None of these species are identified in the provincial forest inventory, so knowledge of their frequency in the southern New Brunswick forest is sketchy and descriptions tend to be anecdotal.

Black cherry timber is highly valuable and large trees are uncommon. Small trees may often be misidentified or overlooked. It has low shade tolerance and regenerates well after partial or clearcutting. Conventional wisdom says that the species is substantially less frequent today than historically, but data are lacking to substantiate the claim. Basswood is found primarily along the Saint John River, usually where the soil is deep and rich, in areas that historically were in demand for agriculture. It is highly shade tolerant and does not colonize abandoned fields. Like sugar maple and white ash, much basswood habitat has been converted to other uses, indicating that the species may require special measures to maintain sufficient population sizes for long-term viability.

Black willow probably does not occur in the GFE or the FMF. It is known primarily in a few locations along the Saint John River, but may be more broadly distributed.[37] Likewise, little is known about the frequency of red ash relative to historical levels. Mountain paper birch is also commonly overlooked or misidentified as white birch.

Other Flora and Fauna

Other sets of criteria were used by provincial, regional, and federal bodies determining the status of species of

flora and fauna. A provincial process is underway to evaluate risk levels for native species in New Brunswick. The CDC maintains a list of species occurrences within Atlantic Canada, with an assessment of each species based on numbers of known occurrences. The COSEWIC list includes less species than either of the others, including species that are at risk on a national level (Appendix C).

A study of the FMF area identified 14 plant species that have apparently been extirpated. The one-time existence of each of the species was confirmed by herbarium specimens, and all collection locations identified by the herbaria were searched.[38] The same study confirmed the current occurrence in the FMF of at least 47 plant species that are ranked either under the provincial draft species list or by the CDC.

Species at risk listed by COSEWIC fall under the following categories: Special Concern (formerly Vulnerable) - characteristics make it particularly sensitive to human activities or natural events; Threatened: likely to become endangered if limiting factors are not reversed; Endangered: facing imminent extirpation or extinction; Extirpated: no longer existing in the wild in Canada, but occurring elsewhere; and Extinct: no longer exists.

The following listed species are only those considered to be strongly associated with forested environments. Atlantic salmon may be found in southern New Brunswick. Anatum Peregrine Falcon, gaspe shrew, Red-shouldered Hawk, Short-eared Owl, Bicknell's Thrush, Wood Turtle, and monarch butterfly.

Of the above species, research and management is underway for Atlantic salmon and Peregrine Falcon. Further research on identifying limiting factors and response to forestry practices is required for the other species.

Table 1 includes a number of plant species that may have been extirpated from the FMF, although not from the whole province as well as other species, known to occur in the FMF, that are listed by the province of New Brunswick or by the CDC. Each of the species identified as "extirpated" was recorded between 1880 and 1960, but has not been recorded since. Locations of most recent records were visited and searched. Among the species listed below, *Cryptotaenia canadensis* is listed as extirpated by the province of New Brunswick and by the CDC, and Goodyera pubescens is listed by the CDC as extirpated from the province.

Table 1. *Special-status plant species found in the FMF with provincial and CDC rankings (excluding tree species)*

Species	Frequency in FMF	Provincial Rank (Draft)	CDC Rank*
Maidenhair fern (*Adiantum pedatum*)	Extirpated	Sensitive	S3
Coastal salt grass (*Distichlis spicata*)	Extirpated	Sensitive	
Carex spp. (*Carex granularis var. haleana*)	Extirpated	Sensitive	
Carex spp. (*Carex saxatilis*)	Extirpated	May be at risk	
Carex spp. (*Carex tenuiflora*)	Extirpated	May be at risk	
Swamp-pink (*Arethusa bulbosa*)	Extirpated	Sensitive	S3
Calypso orchid (*Calypso bulbosa*)	Extirpated	May be at risk	S2
Downy rattlesnake plantain (*Goodyera pubescens*)	Extirpated	Undertermined	SX
Broad-leaved ladies'-tresses (*Spiranthes lucida*)	Extirpated	Sensitive	
American wood anemone (*Anemone Americana*)	Extirpated	Sensitive	S2
Hiked agrimony (*Agrimonia gryposepala*)	Extirpated	Sensitive	
Honewort (*Cryptotaenia Canadensis*)	Extirpated	Extirpated	SX
Large-fruited sanicle (*Sanicula trifoliate*)	Extirpated	May be at risk	S1
Maidenhair spleenwort (*Asplendium trichomanes*)	Extirpated	May be at risk	S1,S2
Fir club-moss (*Huperzia selago*)	Uncommon	May be at risk	
Rock spike-moss (*Selaginella rupestris*)	Very rare	May be at risk	S1
Northern spike-moss (*Selaginella selaginoides*)	Very rare	Sensitive	
Northern adder's-tongue (*Ophioglossum pusillum*)	Rare	Sensitive	
Laurentian bladder fern (*Cystopteris laurentiana*)	Very rare	May be risk	
Fragrant wood fern (*Dryopteris fragrans*)	Rare	Secure	S3
Braun's holly fern (*Polystichum braunii*)	Rare	Sensitive	S3
Northern woodsia (*Woodsia alpine*)	Very rare	Sensitive	S2
Smooth woodsia (*Woodsia glabella*)	Rare	Sensitive	S2,S3
Curly-grass fern (*Schizaea pusilla*)	Very rare	May be at risk	S1

Species	Frequency in FMF	Provincial Rank (Draft)	CDC Rank*
Oakes' pondweed (*Potamogeton oakesianus*)	Rare	Sensitive	
Red-head pondweed (*Potamogeton richardsonii*)	Rare	Sensitive	
Arrow-grass (*Triglochin gaspense*)	Rare	Sensitive	
Pickering's blue-node (*Calamagrostis pickeringii*)	Very rare	Sensitive	
Slender mountain-rice (*Oryzopsis pungens*)	Rare	May be at risk	
White bluegrass (*Poa glauca subsp. Glauca*)	Rare	Secure	S2,TQ
River bulrush (*Bolboschoenus fluviatilis*)	Rare	Sensitive	
Carex sp. (*Carex backii*)	Very rare	May be at risk	S1
Carex sp. (*Carex grisea*)	Very rare	May be at risk	
Carex sp. (*Carex hirtifolia*)	Rare	May be at risk	S1
Carex sp. (*Carex sprengelii*)	Rare	Sensitive	
Matted spike-rush (*Eleocharis intermedia*)	Very rare	May be at risk	S3
Rufous bulrush (*Scirpus pendulus*)	Very rare	May be at risk	S1
Wild garlic (*Allium canadense*)	Rare	May be at risk	
Wild leek (*Allium tricoccum*)	Rare	Sensitive	S2,S3
Showy lady's slipper (*Cypripedium reginae*)	Rare	Sensitive	SX
Goldie's round-leaved orchid (*Platanthera macrophylla*)	Rare	May be at risk	
Maple-leaved goosefoot (*Chenopodium simplex*)	Rare	May be at risk	S1
Small yellow water butternut (*Ranunculus gmelinii var. hookeri*)	Rare	Not listed	S1,T1
Rock whitlow-grass (*Draba arabisans*)	Rare	May be at risk	S1
Livelong saxifrage (*Saxifraga paniculata*)	Rare	May be at risk	S1
Black raspberry (*Rubus occidentalis*)	Rare	Secure	S1
Canada burnet (*Sanguisorba canadensis*)	Rare	Secure	S1
Fringed polygala (*Polygala paucifolia*)	Rare	Sensitive	S2
Purple milkwort (*Polygala sanguinea*)	Rare	Sensitive	
Two-leaf water-milfoil (*Myriophyllum heterophyllum*)	Very rare	May be at risk	S1
Whorled loosestrife (*Lysimachia quadrifolia*)	Rare	May be at risk	S1,S2
Mealy primrose (*Primula laurentiana*)	Very rare	May be at risk	S1
Twining screwstem (*Bartonia paniculata subsp. iodandra*)	Very rare	Sensitive	S2
Virginia mountain-mint (*Pycnanthemum virginianum*)	Very rare	May be at risk	S1
Rand's eyebright (*Euphrasia randii*)	Very rare	May be at risk	S1,S2
Twin-stemmed bladderwort (*Utricularia geminiscapa*)	Rare	Secure	S1
Plantain-leaved pussy-toes (*Antennaria parlinii*)	Very rare	May be at risk	
Northern bog aster (*Aster borealis*)	Very rare	Sensitive	S1
Small beggar-ticks (*Bidens discoidea*)	Very rare	May be at risk	
Allegheny hawkweed (*Hieracium paniculatum*)	Very rare	May be at risk	
Robinson's hawkweed (*Hieracium robinsonii*)	Very rare	Sensitive	

*S1: Extremely rare throughout its range in the province (typically 5 or fewer occurrences or very few remaining individuals). May be especially vulnerable to extirpation.

S2: Rare throughout its range in the province (6 to 20 occurrences or few remaining individuals). May be vulnerable to extirpation due to rarity or other factors.

S3: Uncommon throughout its range in the province, or found only in a restricted range, even if abundant in at some locations (21 to 100 occurrences).

S4: Usually widespread, fairly common throughout its range in the province, and apparently secure with many occurrences, but the element is of long-term concern (e.g. watch list). (100 + occurrences)

S5: Demonstrably widespread, abundant, and secure throughout its range in the province, and essentially not eradicable under present conditions

S#S#: Numeric range rank: A range between two consecutive numeric ranks. Denotes range of uncertainty about the exact rarity of the Element (e.g., S1S2)

SX: Extinct/Extirpated: Element is believed to be extirpated within the province.

T: A T code specifies that an S-Rank has been given to a trinomial taxon, i.e. a sub-species or variety of the binomial species.

Q: A Q code indicates that some question exists concerning the validity of the taxonomy.

4. Recommendations for Best Practices:

Target - Butternut: to conserve all healthy butternut trees for the foreseeable future.

- It is very important that landowners do not harvest healthy butternut as a preemptive measure to avoid losses from the disease.
- There is an urgent need to initiate an ex situ conservation strategy for butternut in order to preserve materials that can be used in the reestablishment of natural populations, if they become decimated similar to U.S. and Ontario populations. However, additional knowledge is required to develop effective ex situ conservation strategies at this time. The species is recalcitrant, meaning that the seed does not store well under usual conditions, and continued research is required to develop seed storage protocols.
- The progress of the disease and ongoing status of butternut populations must be monitored over time with landowner involvement.
- Horticultural nurseries use local stock as the disease exists inside the seed and can be spread by planting material from heavily diseased areas.

Target – White elm: to conserve and increase the number of healthy of white elm.

- Landowners who have live, healthy, uninfected trees larger than 65 cm DBH should maintain these trees and notify researchers at the Atlantic Forestry Centre, so the trees will be considered as candidates for selection. Trees of this size would have existed on the landscape when the disease swept through 20+ years ago and may be resistant/tolerant. Trees should be clear of epicormic branches on the main stem as this is an indication of the presence of the disease.
- Long-term: As many apparently resistant trees as possible should be selected. Cuttings can be collected in the winter and grafted onto white elm rootstock by federal, provincial, or private agencies. The grafts should be deployed into a gene bank/seed orchard for the production of seed. Each selected tree must be tested for actual resistance or tolerance as well.

Target – American beech: to expedite the process of natural selection by maintaining and enhancing the frequency of disease-resistant trees in forest ecosystems.

- Ensure that disease-free trees are not harvested.
- Surrounding diseased trees should be removed to increase the frequency of disease-free trees that contribute to the next generation.
- Under-plant with disease-free seedlings when they are available.
- Long-term: a vegetatively propagated orchard should be established to produce resistant seedlings using selected and tested material.

Target – Bur oak: to ensure the persistence of bur oak in New Brunswick, and the maintenance of existing levels of genetic diversity.

- All bur oak stands should be retained, seed should be collected from all stands and planted as shade trees, hedge rows, or as restoration plantings.
- Land managers having bur oak on their property should avoid cutting bur oak trees and encourage regeneration by avoiding cattle grazing or other site disturbance. If less than 20 trees exist in the stand and no other seed or pollen source is nearby, bring seed from the nearest bur oak stand and under-plant to increase the diversity and viability of the population.
- Horticultural nurseries should use local seed and sell seedlings from local stock.

Target – late-successional and other declining tree species: to maintain large viable populations of all late-successional and other declining species in the GFE.

- Late-successional species generally do not regenerate well after clearcutting, so partial harvests should be carried out to provide shade, at least until regeneration is well established.
- Ensure that human-caused disturbance matches the natural disturbance history that shaped the recent evolution of species.

Target – tree and shrub species insufficient knowledge: understand status of species for which knowledge is incomplete.

- A guide was published by the Canadian Forest Service in 2002 to assist in identification of each of the species for which information is incomplete, as well as those requiring conservation strategies. The guide may be obtained, free of charge, from the Canadian Forest Service-Atlantic Forestry Centre in Fredericton. Forms, designed to be completed and mailed back to the CFS, are included in each guide.
- All woods workers are requested to inform the GCWG when any of the species are encountered in the course of their work to assist in gathering the information needed to decide whether and what

type of conservation strategies are required.

Target – other flora and fauna: to maintain viable populations of all species identified as having special status through various provincial, regional, and federal processes (listed species).

- Habitat, appropriate for listed species must be assessed by naturalists and clearly identified in management plans.
- Management practices must be designed to maintain existing populations and habitat of listed species.

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