Old Tolerant Hardwood Forests in New Brunswick

Going Down Fast

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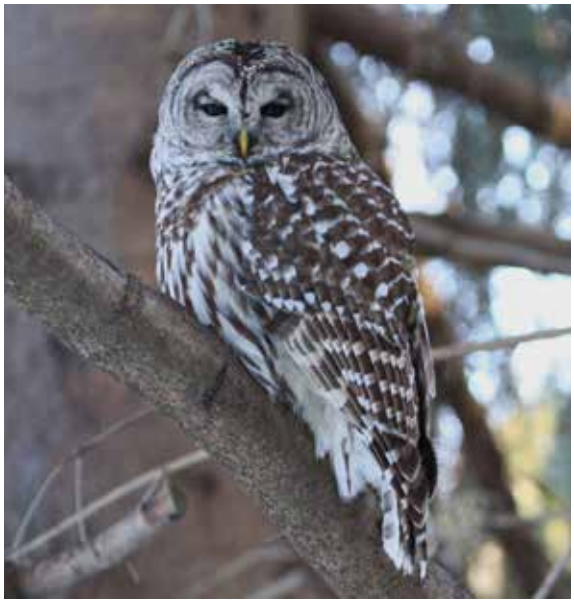
Dr. Stephen Clayden is a well-known New Brunswick botanist with a special interest in lichens.

The new forestry Strategy in New Brunswick centres on yields of spruce and fir. It sets the "sustainable harvest of softwood" at 3.9 million cubic metres per year, an increase of about 20 per cent over the average spruce/fir harvest allowed during the past few decades. On hardwoods, the Strategy has less to say—only that "the [annual] objective will remain at the current level of 1.8 million cubic metres." (A cubic metre is slightly less than a third of a standard cord of wood.) A rationale for maintenance of the hardwood yield at this level can be found in the 2008 report of the provincial Task Force on Forest Diversity and Wood Supply. The report noted that New Brunswick has "a long-standing tolerant hardwood policy that prevents clear-cutting and promotes tolerant hardwood in stands where it dominates." It concluded "the supply of tolerant hardwood is sustainable under the status quo" and under several other forest management scenarios.

Is all well, then, in our hardwood forests? The question needs context. Tolerant hardwoods are shade-tolerant, long-lived species like Sugar Maple and Beech that can become established and grow slowly in the understory of an existing forest, or in small gaps. Old hardwood forests thus come to include trees of many ages. They also accumulate large volumes of standing and fallen, dead and decaying wood. Conifers that are similarly shade-tolerant and long-lived—particularly Red Spruce and Hemlock—often form mixed associations with tolerant hardwoods, the proportions of species varying with soil fertility, regional and local-scale climate, and other factors. Yellow Birch is another frequent component of old hardwood and mixed forests in New Brunswick. It is less shade-tolerant than Sugar Maple, but rivals it in longevity.

Hardwoods like Poplars and White Birches are relatively intolerant of shade and have shorter lifespans. They dominate early stages of forest succession initiated by larger-scale disturbances such as intensive harvesting or fire. Alone, or with fir and spruce, they typically form even-aged stands, but are replaced by shade-tolerant species in old, uneven-aged forests. Intolerant hardwoods have increased greatly in abundance in the province over the past few hundred years. In contrast, forests dominated by Sugar Maple have declined in extent and average age through clearance for settlement and agriculture, and ongoing harvesting. At present, they make up about nine percent of the Crown forest.

Although all hardwoods are treated together in general reporting on yields, forest management in the province takes detailed account of the ecological differences between tolerant and intolerant stands and species. The overall objective for tolerant hardwood forests is to maximize the sustainable yield of good quality sawlogs while meeting standards (thresholds) for biodiversity conservation and other non-timber values. Achieving this balance is a complex, many-layered challenge. The threshold for conservation of old tolerant hardwood and other old forest communities in the province is currently set at 12% of their approximate natural occurrence (area). This percent-



Barred Owl
Photo by H. Scarth

age is based largely on modelling of the habitat requirements of old-forest-dependent indicator species of birds and mammals—Barred Owls and Black-throated Blue Warblers, for example, in the case of old tolerant hardwoods. "Old forest" definitions are based, in turn, on stand composition and structural features specific to each forest community type; the criteria include, for example, the number of trees per hectare in various size-classes, the volume of coarse woody debris on the forest floor, and the frequency of dead standing trees (snags) of different sizes.

Harvesting "prescriptions" for tolerant hardwoods are likewise based on site-specific measurements of stand composition and structure. Licensees carry out pre-harvest assessments (cruises), and the New Brunswick Department of Natural Resources approves the prescriptions (treatments). In stands considered to have good potential for sawlog production, harvesting techniques are required that promote the development or maintenance of uneven-aged structure. The recommended treatments are variations on "selection-cutting": "Individual tree selection" removes scattered trees in all size-classes in any one cut, up to a maximum of 30% of the total basal area of the stand. "Group selection" involves small patch-cuts totaling less than 10% of the overall stand-area at any one time.

Black-throated Blue Warbler
Photo by H. Scarth

Against this backdrop of definitions, prescriptions, annual allowable cuts, and conservation thresholds, the harvesting of old tolerant hardwood forests in New Brunswick has increased sharply over the past few decades. On the ground, in low-level aerial photographs, and in satellite images, the evidence is stark. Throughout the province's major hardwood regions, extensive, formerly intact forests of Sugar Maple, Yellow Birch and Beech on slopes and uplands have been gridded with new forest-roads and subjected to unprecedented levels of strip- and selection-cutting.

Developments in technology and markets have driven these changes. In earlier decades, the major products of the province's tolerant hardwood forests were sawlogs, veneer, maple syrup, and firewood. Now, a major portion of their yields is in the form of wood-chips. These are processed into dissolving pulp (from which rayon and related textiles are made), toilet paper and other tissues, wood (fuel) pellets, and other non-lumber products. Many old trees that were formerly left in the woods owing to their crooked trunks or other "defects" are now routinely chipped during harvesting operations. Bioenergy generation from the combustion of harvesting residues ("biomass") is also creating new demands for tolerant hardwoods.

Data is not readily available on the nature and extent of the structural changes that are overtaking these forests—for example, the percentage tree cover and wood-volume that are being removed from stands under various harvest treatments and in various regions, the time-intervals between treatments, or the current and projected numbers and sizes of old trees and snags. It is difficult, therefore, to reconcile statements about policies or "best management practices" that apply to tolerant hardwood stands with the visual evidence of large-scale intensive harvest-

Figure 1. Hardwood–hemlock forest in Odell Park, Fredericton, 2014.
Photo by S.R. Clayden/ New Brunswick Museum

ing. Selection cutting and small-patch (group selection) cutting are meant to be the norms for stands with uneven-aged structure. However, variations on strip cutting and patch cutting that remove large fractions (30–40%) of stands at a time appear to be common. The scale of these disturbances, from individual stands to whole landscapes, far exceeds the natural, historical, small-gap dynamics of our tolerant hardwood forests. The high yields of hardwood might be sustainable from a production standpoint. Their sustainability in relation to biodiversity conservation is far from certain.

To illustrate some potential consequences of the intensified harvesting of old tolerant hardwood forests, it may be helpful to consider examples from some species-rich groups of organisms:

Bryophytes. Old forests provide a rich array of microhabitats for mosses and liverworts. Figure 1 shows an ironwood tree in a mixed hardwood–hemlock stand in Fredericton's Odell Park. The tree-base is covered by one of the tongue-mosses (*Anomodon attenuatus*) (Figure 2), among other species. A neighbouring boulder has a distinct community: a haircap-moss (*Polytrichastrum pallidisetum*) on a thin layer of organic debris over the flat to gently inclined surfaces, and Silver-broom Moss (*Paraleucobryum longifolium*) on the steeper faces. The trunks of nearby sugar maples have overlapping tiers of a pinnately-branched liverwort (*Porella platyphylla*) (Figure 3).

Figure 2. Anomodon attenuatus *(moss), Odell Park, 2014.*
Photo by S.R. Clayden/ New Brunswick Museum

These are not rare species in New Brunswick. However, they are best developed in long-undisturbed habitats. Rocks, trees, snags, logs, and stumps in such forests are somewhat like islands, gradually acquiring floras and faunas that undergo successions of species. *Anomodon attenuatus* forms a dense cover only on the bases of older hardwoods (or on shaded calcareous rock outcrops). These moss-carpets shelter assemblages of smaller, little-studied organisms. Five other *Anomodon* species occur in

Figure 3. Porella platyphylla *(liverwort), Odell Park, 2014.*
Photo by S.R. Clayden/ New Brunswick Museum

similar habitats in the province; *A. minor* and *A. triste* are rare, and unlikely to persist here without extensive older hardwood stands to accommodate them.

Lichens. The lichens *Pertusaria globularis* and *Lobaria quercizans* (Figure 4) are not rare in the province, but both are of interest in relation to old hardwood stands. *Pertusaria globularis* is a "crustose" species that overgrows bryophytes on the trunks of old hardwoods (or sometimes cedar). It is scarce or lacking in younger forests. *Lobaria quercizans* is one of the lungwort lichens. It has broad greyish lobes and prominent disk-shaped fruiting bodies.

A study of *L. quercizans* and another lungwort species, *L. pulmonaria*, in tolerant hardwood and mixed forests in northwestern New Brunswick found that the lichen individuals growing in uncut stands were significantly more fertile (produced more fruiting bodies) than those in stands that had undergone selection cutting up to 35 years previously (M. Edman, A.-M. Eriksson, and M.-A. Villard, 2008, *Journal of Applied Ecology* 45: 26–33). These differences might be attributable to the contrast in microclimate between the interior of the intact versus the harvested stands. Many other studies have shown that forest lichen diversity, and the occurrence of rare species, are strongly correlated with the continuity of old trees and snags in space and time.

Figure 4. Pertusaria globularis *and* Lobaria quercizans *(lichens) on a Sugar Maple, 2014.*
Photo by S.R. Clayden/ New Brunswick Museum

Fungi. From wood-decay species that form large fruiting structures on trees to mushrooms and microfungi (Figures 5 to 7 - see next page), fungal diversity in New Brunswick's forests much exceeds that of their green plants. However, the fungi are much less well known, as the number of specialists (mycologists) dedicated to their study is very small in relation to the scope of the task. The fungi of spruce–fir forests have received more attention to date than those of tolerant hardwoods.

About 600 mushroom-forming species have been identified from all forested and other habitats in the province, less than half the number known in Nova Scotia. However, these differences again reflect contrasting survey-efforts, not real differences in the expected diversity of species. The numbers do offer a caution, however. Intensive modification of the province's remaining old forests will likely result in losses of yet-to-be discovered fungal species before their identities and ecological relationships are elucidated. Recent surveys of parks and Protected Natural Areas in New Brunswick have detected numerous fungi that were not previously known to occur here. Among those in tolerant hardwood and mixed

forests are the mushroom *Kuehneromyces mutabilis* (Figure 6) and the tiny, asexually reproducing basidiomycete, *Leucogloea compressa* (Figure 7 - see page 62).

Beetles. Like fungi, beetles and other insects are key agents in the breakdown and recycling of the large quantities of dead wood that accumulate in old forests. Many species are "saproxylic," living and feeding directly in or on wood. Other beetles live in the fruiting bodies produced by wood-decay fungi, in some cases preying on smaller invertebrates within these niches. The beetles that consume wood do so via symbiotic bacteria and yeasts that live in their guts and produce enzymes able to break down cellulose and lignin. A relatively small number of species (beetles and others) in these habitats have been investigated in depth, owing to economic concerns over the damage they can cause to living trees. Apart from these species, the biodiversity and complex food webs of dead wood communities in New Brunswick's old forests remain relatively little studied. In the face of ongoing reductions in the frequency of large snags and logs in intensively managed forests, these knowledge gaps increase the likelihood of losses of species and ecosystem functions.

Exceptional progress in understanding beetle diversity in New Brunswick is being made by entomologist Dr. Reginald Webster (Figure 8 - see page 62). His surveys of old forest communities have yielded hundreds of new provincial records, and numerous species new to science. Among those he has found only in old tolerant hardwood and mixed forests are several rare rove beetles (*staphylinids*) in the genus *Lordithon*. Two of these, *L. niger* and *L. quaesitor*, inhabit fleshy polypore fungi on large hardwood snags and logs. They are known here only in a few places in southern and western New Brunswick, including Bell Forest along the Meduxnekeag River. Another remarkable group of ecologically specialized beetles occurs high above the ground in such stands—more precisely, in the nests of Barred Owls in the cavities of large hardwood trees.

Such examples hint at the untold diversity and interactions of organisms in our old tolerant hardwood forests. The challenge before us is to make wise decisions on the long-term stewardship of this rich natural capital.

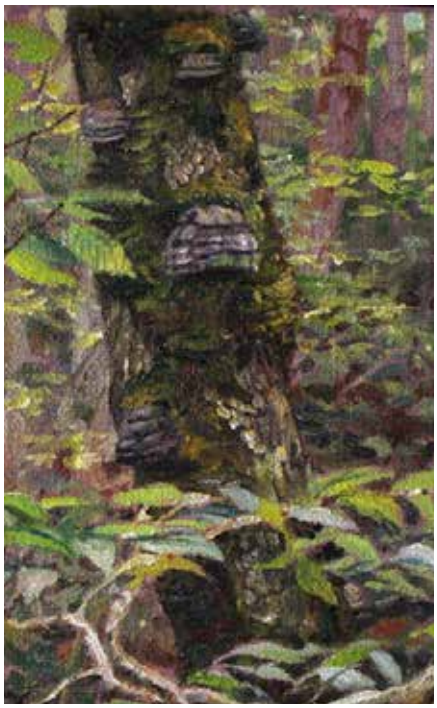


Figure 5. Tinder polypore (Fomes fomentarius) *on Yellow Birch, Caledonia Gorge Protected Natural Area. Aleta Karstad, 2011, oil on canvas, 5 × 7 inches (reproduced with permission).*

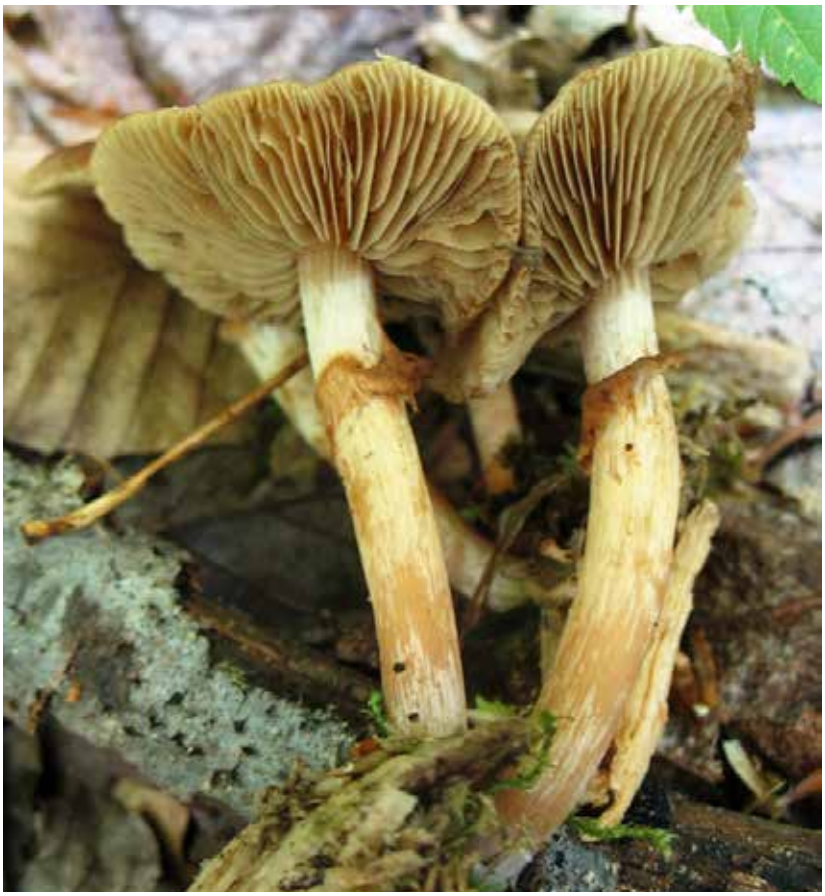


Figure 6. Kuehneromyces mutabilis, *in forest dominated by Sugar Maple and Beech, Jacquet River Gorge Protected Natural Area, 2010; collected by Stephen Clayden, identified by David Malloch. Photo by S.R. Clayden/ New Brunswick Museum*

Figure 7. Leucogloea compressa *(fungus) with* Nowellia curvifolia *(liverwort), on well-rotted birch log, Fundy National Park, 2013; collected by Jason Karakehian; identified by Joey Tanney.*
Photo by Roger Smith

Figure 8. Entomologist Dr. Reginald Webster, collecting beetles from dead wood in an old mixed forest, Currie Mountain, 2013.
Photo by S.R. Clayden/ New Brunswick Museum

Ebony Jewelwing
Photo by A. Clavette