

# Comments on the Natural Resources Strategy

## Phase II Recommendations related to Forestry

and

### A Critique of Dr. Robert G. Wagner's

### Review of those Recommendations

*Text of a letter to Minister John MacDonnell, Nova Scotia  
Department of Natural Resources and Premier Darrel Dexter,  
Office of the Premier, Province of Nova Scotia, July 27th, 2010  
from David G. Patriquin, Professor of Biology, Dalhousie  
University (Retired)*

July 27, 2010

I am writing to (i) express support for the major recommendations coming out of the Natural Resources Strategy Phase 2 Report related to forestry as expressed in the Steering Panel Report and in the Bancroft-Crossland Report for the Forestry Panel, (ii) highlight three issues (biodiversity conservation, carbon sequestration, and maintenance of soil nutrients and pH) that the recommendations help to address, and (iii) provide some critique of Dr. Robert G. Wagner's review of these reports for the Forest Products Association of Nova Scotia.<sup>1</sup> I understand Dr. Wagner's review has been forwarded to government.

My comments reflect my background as a scientist with research experience in the area of nutrient budgeting and related biological processes in marine and terrestrial ecosystems. I retired from Dalhousie University as a Professor of Biology in 2008. They also reflect my interests and involvement in natural history and watershed issues. Currently I am President of the Halifax Field Naturalists, co-chair of the Woodens River Watershed Environmental Organization and I serve on the boards of the Nova Scotia Wild Flora Society and the Young Field

---

1. Dr. Robert G. Wagner. July 7, 2010. ***Review of Reports and Recommendations Relating to Forests/Forestry as Part of Phase II of Nova Scotia's Natural Resources Strategy Development Process for The Forest Products Association of Nova Scotia.*** 23 pp. Dr. Wagner is Director of the University of Maine's School of Forest Resources. While he recognizes that change is required in forestry practices in Nova Scotia, he contends that "the recommendations on clearcutting, herbicides, and whole-tree harvesting by Bancroft & Crossland were not consistent with the best available forest research or with the principles of sound forest management," and therefore believes "the underlying rationale by the Steering Panel for the regulatory restrictions of these three practices to be based on a weak scientific and/or technical justification."

Naturalists of Nova Scotia. This letter has been endorsed by the boards of the Halifax Field Naturalists and the Woodens River Watershed Environmental Organization.

I completely support the recommendations related to forestry on page 23 of the Steering Committee Report and the more detailed recommendations in the Bancroft and Crossland report. I recognize that in many ways these represent a paradigm change in our approach to forest management in Nova Scotia, but I believe they are guiding us on the right course and that future generations will be grateful if we act on those recommendations. They also are likely to have the support of a majority of Nova Scotians, as evidenced by input and discussion during Phase I of the Natural Resources Strategy development. At the same time, I recognize that the recommendations need to be implemented strategically and with some sensitivity to lessen apprehensions of many independent woodlot owners about new regulatory processes and to allow for adaptation, particularly in the industrial forestry sector

As well publicized in the local press, the recommendations are under fire from the industrial forestry sector, which could be anticipated. Although the forestry issue is much larger and operates over a longer time frame, I think a good analogy is the process that was involved in the incinerator debate in HRM in the early 1990's and the subsequent transition and success of the recycling program. It was a bitter debate and the call to move to recycling was strongly resisted by many bureaucrats and business people, scientific expertise was brought in to vouch for the safety of incineration etc., but people at large were asking for the change. In the end, HRM adopted the recycling option, businesses benefitted and today we generally hear only good things about it. We also became a model for the rest of Canada. Likewise, Nova Scotians took a lead when a pesticide bylaw restricting cosmetic use of pesticides and encouraging alternative approaches was introduced in HRM with enabling legislation passed at the provincial level. It was strongly resisted by lawncare companies and scientific expertise was brought in to vouch for the safety and rationality of cosmetic pesticides. But the bylaw went through and again big players like the lawncare franchises have adapted and developed new products and services and other municipalities have followed. I think that the changes recommended for forestry are very much in the same vein.

There are many issues, economic, ecological and social, that the recommendations of Bancroft and Crossland are intended to address. I want to highlight three: conservation of biodiversity, carbon sequestration and maintenance of soil nutrients and pH.

### **Conservation of Biodiversity**

It tends to be assumed that once we achieve 12% protected area in Nova Scotia, that is enough. It isn't. We are really only just at the beginning of large scale losses of species associated with fragmentation of habitat. The alarm bells about species loss were raised in the 1980s because of losses that had occurred until

then and, more so, because a better theoretical understanding of species diversity predicted huge losses to come with continuing destruction and fragmentation of habitats. E.O. Wilson's rule of thumb predicts that a tenfold reduction in habitat results in approximately 50% reduction in the number of species an area can support over the long term. So if we rely on the Protected Areas alone for species conservation in Nova Scotia, we could expect massive species losses over the long term. Many or most species could hang on in remnant habitats for decades or centuries, but would eventually be lost as they become locally extinct and cannot be replaced by immigration from other, still extant populations in other suitable habitats. Forests, covering 80% of Nova Scotia, are the most critical habitat at large, especially given the intensive harvesting and loss of old growth forest to the point that we now have less than 0.5% old growth, versus approximately 8.7% in 1958 and perhaps 40-50% in pre-Columbian times.

A recent study by Beazley and associates in the School for Resources and Environmental Studies at Dalhousie used a GIS and modeling based approach to estimate conservation needs in Nova Scotia.<sup>2</sup> They concluded that " ~60% of Nova Scotia, including 32% in core areas, should be managed for conservation objectives to maintain genes, species, and ecosystems over time". Similar estimates have been forthcoming from other studies. In practice this means that much larger areas than 12% of the province need to be managed for biodiversity conservation, regardless of whether they are in private or public hands. Following through on the recommendations of the Steering Committee and the more detailed recommendations of Bancroft and Crossland would be a significant step in this direction.

Dr. Wagner does not comment on the losses through clearcutting of old growth and riparian forests in Nova Scotia which are critical for conservation of suites of species as well as other ecosystem services, but criticizes Bancroft and Crossland for not considering the possible negative impacts of reducing clearcuts and use of herbicides on species conservation, as evidenced by the Maine experience:

Before embarking on such a sweeping recommendation [restricting herbicide use] it is imperative that NS review the experiences of other Canadian provinces and the state of Maine about the importance of herbicide use in maintaining softwood species. Research by Dr. Dan Harrison and his research group at the University of Maine have documented that the highest snowshoe hare and Canada lynx populations in northern Maine are found on herbicide-treated clearcuts from the spruce budworm era. Similar positive results were shown for moose usage of northern Maine clearcuts treated with herbicides. The implications for suspending the use of herbicides should have been evaluated as part of this recommendation since Nova Scotia's *State of the Forest* report indicated that lynx and moose are identified as endangered species under the NS Endangered Species Act.

His perspective on this issue warrants some comment. Maine currently has much more stringent regulations on clearcutting than Nova Scotia which followed

---

2. Beazley, K. et al. 2005. **Biodiversity considerations in conservation system planning: a map-based approach for Nova Scotia, Canada.** *Ecological Applications* 15(6): 2192-2203.

passage of the Maine Forest Practices Act (FPA) in 1989. Approval by the Maine Forest Service is required for any clearcut larger than 75 acres and all clearcuts larger than 20 acres require a management plan prepared by a professional forester. To maintain the flow of wood, there have been more partial cuts over larger areas which has had the effect of “shooting the landscape full of 20-acre holes” as one observer put it<sup>3</sup>; there are apparently no formal silviculture requirements for partial cuts (selection cutting) which exhibit variable regeneration. At the same time, reduced clearcutting is beginning to impact negatively on the endangered Canada lynx in Maine, which benefits from early successional forest (see figure on p. 20 of Wagner Report). I think it’s relevant to note that the Canada Lynx is primarily a boreal species. Populations in Maine, New Brunswick and Nova Scotia (where it occurs only in Cape Breton) are at the southern periphery of its range. The extensive softwood stands in these areas that offer good habitat for the lynx and its major prey, the snowshoe hare, are more a result of industrial forestry practices than of natural forces and in that sense they are artificially maintained. With climatic warming the softwoods will become increasingly ill-adapted. So I suggest that Dr. Wagner’s choice of the lynx to make a case for maintaining extensive stands of softwoods has some difficulties.

Dr. Wagner’s reference to moose (another boreal species) in Nova Scotia to make a case for clearcutting and herbicide use is also flawed. He does not distinguish between the approximately 8000 moose in Cape Breton, which are of recent, western origin and are not endangered and the Mainland moose which are indigenous and endangered. Hunting was banned in 1981, but that did not stop declines even while clearcuts were increasing. There are now only 1000-1200 Mainland Moose in Nova Scotia, compared to perhaps 15,000 in pre-colonial times. Moose require a diversity of habitat types, benefit from minimal human disturbance and from low abundance of deer which carry a parasite that is lethal to moose. Wildlife biologists have not cited maintenance of extensive clearcuts as critical to survival of our Mainland Moose.<sup>4</sup>

There are clearly lessons to be learned from the Maine experience which has similar landscapes and species and patterns of ownership to Nova Scotia, but the message is not as simple as Dr. Wagner seems to suggest. Lack of appropriate silviculture following partial cuts in Maine is something we don’t want to repeat here. Also we can learn from the studies of wildlife biologists on effects of

---

3. Dan Harrison, cited at

<http://www.nature.org/wherewework/northamerica/states/maine/news/news3076.html>

(Title: **Can lynx, marten and forestry co-exist in the St. John River Forest?**) Softwood

4 See, for example, Beazley, K., et al. 2007. **Complexity and information gaps in recovery planning for moose (*Alces alces americana*) in Nova Scotia, Canada.** *Alces* 42: 89-109.

selection harvesting in Maine on various species and their prescriptions for managing selection cuts for the greatest conservation benefits.<sup>5</sup>

### **Carbon sequestration**

Probably a majority of Nova Scotians accept that we need to be thinking about how all of our activities affect GHG emissions. Again, how we manage forests is very significant because 80% of our landscape is forested. Deforestation and release of soil and vegetation carbon has been a major contributor to rising CO<sub>2</sub> levels since the 1800s. Today, maintaining and, as much as possible, increasing sequestration of carbon in forests is seen as crucial to global efforts to rein in CO<sub>2</sub> emissions. There is probably no more important contribution that Nova Scotians can make towards global efforts to reduce GHG emissions than to increase carbon sequestration in our forests. The recommendations of the Steering Committee and the more detailed recommendations of Bancroft and Crossland would put us on the route to increasing carbon sequestration.

At the very least we must ensure that we do not increase net CO<sub>2</sub> emissions (reduce carbon sequestration) associated with forestry. For this reason, I raised the issue of the effects of forest biomass harvesting on carbon emissions at the Renewable Energy Consultations held at Dalhousie University in the fall of 2009 (Bancroft and Crossland referred to my written submission in the research addendum), in a letter to the government in January 2010, and in a recent letter of comment to the UARB hearings<sup>6</sup>. Before I raised the issue in the fall, it had not otherwise been raised in connection with the forest biomass issue in Nova Scotia. Over the same period (fall 2009-mid-summer 2010), a multi-authored paper was published in the Policy Forum of Science in 2009<sup>7</sup> pointing out that there is a critical accounting error in the Kyoto Protocol that allows biomass energy to be treated as carbon neutral, regardless of the source. The error is very large for forest biomass. That paper and a *Biomass Sustainability and Carbon Policy Study* commissioned by the Massachusetts Department of Energy Resources<sup>8</sup> have moved the state of Massachusetts to recently begin a

---

5. See, for example: Fuller, A.K. and Harrison, D.J. 2005. **Influence of partial timber harvesting on American martens in north-central Maine** *The Journal of Wildlife Management*, 69: 710-722. Campbell, S.P. et al. 2005 **Long-term effects of group-selection timber harvesting on abundance of forest birds**. *Conservation Biology* 21: 1218–1229

6. **The Port Hawkesbury Biomass Project (2010): Concerns related to carbon emissions and impacts of harvesting on soil nutrients & acidification**. Comments submitted to the Nova Scotia Utility and Review Board by David G. Patriquin July 14, 2010., 15 pp. Available in a document with all letters of comment at [http://www.nsuarb.ca/NSUARB\\_Exhibits\\_JOOMLA/browserecord.php?-action=browse&-recid=1445](http://www.nsuarb.ca/NSUARB_Exhibits_JOOMLA/browserecord.php?-action=browse&-recid=1445) or separately at <http://versicolor.ca/biomass/docs/PatriquinUARB24July2010.pdf>

7. Searchinger, T.D. et al., 2009. **Fixing a Critical Climate Accounting Error** *Science* 23 October 2009: Vol. 326. no. 5952, pp. 527 – 528

8. **Biomass Sustainability and Carbon Policy Study** Prepared for: Commonwealth of Massachusetts by: Manomet Center for Conservation Sciences, June 2010 [http://www.mass.gov/Eoeea/docs/doer/renewables/biomass/Manomet\\_Biomass\\_Report\\_Full\\_LoRez.pdf](http://www.mass.gov/Eoeea/docs/doer/renewables/biomass/Manomet_Biomass_Report_Full_LoRez.pdf)

process to re-evaluate its incentives for biomass.<sup>9</sup> Prior to that Massachusetts had been pursuing biomass energy for electricity with the same intensity as Nova Scotia.

I point this out to illustrate that opinions that might be commonly held by professionals – even scientists - are not always valid, indeed it is the nature of science to always challenge current concepts. The industrial forestry sector, which employs or consults many professional scientists, has steadily maintained that forest biomass harvesting is carbon neutral without critical reference to the scientific literature. Even now that there is much more widely publicized scientific documentation on the issue, they are resisting the conclusions.<sup>10</sup> While the impacts of forestry practices on carbon sequestration have been widely discussed in Maine, Dr. Wagner does not cite it as a matter to be considered in the Nova Scotian context.

Here is a science based perspective that supports the approach recommended by Bancroft and Crossland, based on considerations related to carbon sequestration (the underlining is mine):

Evans, A.M. & Perschel, R. 2009. **A review of forestry mitigation and adaptation strategies in the Northeast U.S.** *Climate Change* 96: 167-183.  
ABSTRACT The forests of the Northeast U.S. will be significantly affected by climate change, but they also play a role in mitigating climate change by sequestering CO<sub>2</sub>. Forest management decisions can increase forests' resilience and ability to adapt to altered precipitation and temperature patterns. At the same time, management strategies that increase carbon storage will help reduce climate disruptions. Because of climate change, foresters on managed lands should take Silvicultural prescriptions should emphasize low impact logging techniques, the perpetuation of structural complexity, legacy trees, extended rotations, and uneven aged management systems where appropriate. In order to maintain resilience as well as to store carbon, forests should be protected from land use conversion.

Other authors' emphasis on the need to move away from extensive softwood stands in order to adapt to climatic change also seems at variance with Dr. Wagner's focus on maintaining extensive softwood stands through clearcutting and use of herbicide (the underlining is mine):

Clearcut harvesting decreases structural complexity, eliminates old and genetically superior legacy trees, extirpates mature-forest floor vegetation, and creates hot

9. **Letter July 7, 2010 from Commonwealth of Mass. Executive Office of Energy and Environmental Affairs to Commissioner, Dept. of Energy.**

[http://www.mass.gov/Eoeea/docs/eea/biomass/070710\\_biomass\\_sustainability\\_carbon\\_regs\\_letter.pdf](http://www.mass.gov/Eoeea/docs/eea/biomass/070710_biomass_sustainability_carbon_regs_letter.pdf)

10. **"Some Mistakenly Dispute the Carbon Neutrality of Energy from Forest Biomass"** reads a heading on the website for the National Alliance of Forest Owners (U.S.)

<http://nafoalliance.org/carbon-neutrality-of-energy-from-forest-biomass/>

and dry postharvest microclimates. The short-lived, exposure-tolerant, boreal tree species that regenerate in large forest openings are believed to be less able, than the late-successional Acadian species they replace, to adapt to the climate warming expected during the next forest rotation. A strip silviculture design is presented that includes limited canopy opening, “no-traffic” areas, maintenance of “full-cycle” survivors, and programmed return harvest intervals that approximate natural gap disturbance as a means of arresting the further increase of boreal species and restoring Acadian species on the landscape. Within the confines of this silvicultural discipline, two management options are described to accommodate extremes of future energy availability. Source: Abstract from Salenius, P, 2007. **Silvicultural discipline to maintain Acadian forest resilience.** *Northern Journal of Applied Forestry*, 24(2) : 91-97.

The Bancroft and Crossland Report repeatedly emphasizes the need to plan for climatic change and offers a number of detailed recommendations in that regard.

### **A threat to the productive base of forestry: declines in critical nutrients and soil acidification**

One issue that still has not been given sufficient attention in the debates about forestry in Nova Scotia is the impacts of forestry practices on the productive base of forestry: the soil. Nova Scotian forests are the most or amongst the most intensively harvested in Canada, half or more of our soils by area are very calcium poor and highly susceptible to soil acidification, and the area is stressed by acid rain. There are worrying signs that for large areas of Nova Scotia, significant declines in productivity or other effects of low calcium may be only 1 or 2 rotations away, if not already beginning to happen. Further, climatic warming can be expected to exacerbate these stresses, e.g., because the deciduous species expected to be favoured have higher calcium requirements than softwood. I referenced some of the literature in my submission to the UARB hearings.<sup>6</sup> The Bancroft-Crossland Report does not deal in detail with this particular issue, but they do emphasize the need to manage the soil resource and their recommendations embrace the kind of overall, precautionary approach that would minimize the threats of calcium depletion and soil acidification.

Dr. Wagner does comment on the nutrient issue, but to make the point that in his estimation it is not a concern and in turn that the recommendation to stop whole-tree harvesting is irrational. I do have to question his concept of sustainability when he cites a conclusion from one study in Maine that “that whole-tree harvesting at Weymouth Point could be a sustainable practice for at least one rotation.” Surely, we have to think about sustainability over much longer periods! Further he is either not knowledgeable about the particular conditions in Nova Scotia, or chooses to ignore them. A well cited study on impacts of harvesting on

nutrient balances is that of Freedman et al. for central Nova Scotia<sup>11</sup> in which they expressed concern about high levels of calcium removal compared to soil stocks. Subsequent studies have indicated more reasons to be concerned about calcium losses, as outlined in my submission to the UARB biomass hearings.<sup>6</sup>

These include studies in Maine:

Huntington, T.G. 2005. **Assessment of calcium status in Maine forests: review and future projection.** *Canadian Journal of Forest Research* 35:1109–1121. From the Abstract:

“Forest soils in Maine are currently at lesser risk of Ca depletion compared with many forest soils in the central and southeastern United States, because levels of acidic deposition and rates of Ca accumulation in trees are lower in Maine. The rate of Ca accumulation in trees is reduced in Maine as a result of lower growth rates and a higher proportion of conifer trees that require less Ca than hardwoods. However, field-scale biogeochemical studies in Maine and New Hampshire, and regional estimates of harvest removals and soil inventories coupled with low weathering estimates, indicate that Ca depletion is a realistic concern in Maine. The synthesis of site specific and regional data for Maine in conjunction with the depletion measured directly in surrounding areas indicates that the Ca status of many forest soils in Maine is likely declining. Ca status could decrease further in the future if forest growth rates increase in response to climate trends and recovery from insect-induced mortality and excessive harvesting in recent years. Proposed climate change induced reductions in spruce and fir and increases in hardwoods would also increase the risk of Ca depletion.”

Most of these considerations apply to Nova Scotia as well.

The threat of widespread decline in soil calcium has been highlighted in a recent article in *Science*, which notes (citations deleted):

Lake-water calcium concentrations are currently falling in softwater lakes in many boreal regions. Declining calcium is part of an expected concentration trajectory that is linked to a reduction in the exchangeable calcium concentration of catchment soils. Although such reduction is part of the natural, long term process of soil acidification, it is accelerated by other factors that vary regionally in importance [for example, acidic deposition, reduction in atmospheric calcium inputs, calcium loss from forest biomass harvesting, and regrowth after multiple timber harvesting cycles.] Source: Jeziorski, A. et al. 2008.

**The widespread threat of calcium decline in fresh waters.** *Science* 322, 1374.

### **Further comments on The Wagner Review**

One would suspect that Dr. Wagner was selected for this review because it was expected he would be supportive of the position of The Forest Products Association of Nova Scotia. A little web research revealed that he is an ExOfficio member of the Board of the Maine Forest Products Council which, amongst other activities, employs lobbyists to push for their industrial interests. I don't think he is trying to hide those connections or that he would or should apologize for

---

11. Freedman B., Duinker, P.N., and Morash, R. 1986. **Biomass and nutrients in Nova Scotia forests, and implications of intensive harvesting for future site productivity.** *Forest Ecology and Management* 15, 103-127.



them, but they are relevant to his review of the Bancroft and Crossland Report. The science of forest ecosystems is not an exact science with simple, correct answers as Dr. Wagner himself comments. But as well as being complex on its own, inevitably, issues related to the risks people are willing to accept - in the context of forestry practices, that often translates to what extent they favour more precautionary approaches - and tradeoffs of clearcut-oriented forestry with alternative harvesting schemes and non-forest product values intersect with “the science” of it all. Another scientist with equivalent qualifications might have offered a quite different review. The Bancroft and Crossland recommendations, I suggest, do reflect the science, perhaps biased towards the conservation end, and the values of a majority of Nova Scotians.

I was somewhat taken aback that Dr. Wagner resorted to ridicule in parts of his submission, notably in suggesting that the Bancroft and Crossland Report might have been prepared by first year forestry students.

I have seen reports of similar tone and content from our best first or second year forestry students who have a great deal of love and passion for the forest, have been educated largely by the popular media on forest and environmental issues, and who need to be educated about the technical aspects of forest science and management. This is simply unprofessional in my opinion.

Dr. Wagner contends that the conclusions of Bancroft and Crossland related to the three major recommendations embraced by the Steering Committee are unfounded scientifically. I will comment briefly on his comments.

On clearcutting, Dr. Wagner comments:

Unfortunately, the authors of the Bancroft & Crossland report did not adequately convey the depth or breadth of understanding about the effects of clearcutting from the scientific literature, or specifically where and under what conditions the use of clearcutting in Nova Scotia has been or is likely to be ecologically or economically unsustainable. Further, the recommendation for an across-the-board conversion to uneven-aged practices for the province erroneously assumes most all of their ecological and economic concerns will be adequately addressed. No indication is provided that the authors understand the current structure and composition of Nova Scotia’s forest, or more importantly, whether the uneven-aged practices they recommend can be technically implemented. Such practices are only feasible when appropriate stand conditions exist.

I think this is a misrepresentation of what Bancroft and Crossland actually recommended, e.g., one of their five key recommendations (p.3) is to “Amend forest regulations to stop whole-tree harvesting, phase out clearcutting, and promote uneven-aged management”.

So, except in relation to whole-tree harvesting (further discussed below), their recommendation is to “phase out” and “promote” alternatives, not require in immediate terms, and they give examples of how a transition might be made, Bancroft and Crossland use the term “promote” repeatedly in their

recommendations. I think what is bothering Dr. Wagner (and likely The Forest Products Association of Nova Scotia) is, perhaps, the Steering committee's simplification of the recommendations with less "granularity", e.g. I suspect he was bothered particularly by the Steering Committee recommendation to "Allow clear-cutting by permit only". There could be a lot of latitude in how a permitting process is introduced and applied and how the requirements might change over a phase-in period in order to accommodate and encourage transition. The Bancroft and Crossland recommendations call for experts to be brought in to advise on the transitions.

On the use of herbicides, Dr. Wagner comments:

The recommendation that "*herbicide use should be banned on Crown lands, and discouraged on private lands...*" was not supported by any citation of scientific literature, or any claims about how forest ecosystems or human health were specifically at risk from the use of herbicides. To the contrary, the weight of scientific evidence from a substantial amount of research over the past 50 years by universities and other independent researchers have concluded that when used according to the labeled requirements, current herbicides used in the forest pose extraordinarily low risk to humans, wildlife, or forest ecosystems over the short and long term.

The issue of whether herbicides have direct (or indirect) ill-effects of forest herbicides is not closed. For example, there continues to be evidence forthcoming indicating some link between amphibian declines and some of the herbicides used in forestry. The findings of Chen et al. that toxicity effects are enhanced at low pH levels is very relevant to Nova Scotia:

Chen, C.Y. et al., 2008. **Multiple stressor effects of herbicide, pH, and food on wetland zooplankton and a larval amphibian.** *Ecotoxicology and Environmental Safety* 71 (2008) 209–218

*From the article:* These results have a number of implications for populations of non-target aquatic species in the field...Concentrations much lower (5–10\_) than the predicted environmental concentration for Releases or Garlon 4 applications in forestry are significantly toxic to an ubiquitous wetland zooplankton species and a common amphibian species. These results also demonstrate that the effects of Releases and other herbicides depend on the pH of the system and differences of two pH units (pH 5.5–7.5) can be critical to their toxicity (Chen et al., 2004; Edginton et al., 2004). Due to its enhanced toxicity in pH 5.5, Releases creates more of an environmental risk when applied to more acidic wetland habitats. Moreover, reductions in food resources due to seasonal fluctuations or direct chemical effects could greatly affect growth rates of herbivore populations through delays in development of juveniles or reductions in reproduction. Our results suggest that zooplankton and tadpole populations could be at risk in low pH, low productivity wetlands sprayed directly or indirectly with Releases. These habitats are common features of the northeast regions of North America where applications of triclopyr ester herbicides are made to achieve vegetation management objectives in forestry or industrial rights-of-way.

Regardless, the Bancroft and Crossland recommendations reflect a precautionary approach that is shared by probably a majority of Nova Scotians.

On whole-tree harvesting, Dr. Wagner comments:

The recommendation to “*stop whole-tree harvesting*” in the Bancroft & Crossland report failed to consider the wealth of research that has been done on this complex topic. Further, two recently completed biomass harvesting guidelines for Maine and the northeastern US states included an analysis of this topic, and neither set of guidelines makes any recommendation close to complete termination of whole-tree harvesting.

Here, I think Dr. Wagner would be strongly challenged by scientists and others involved in the policy paper in Science referred to above and by others on the basis of reduced carbon sequestration and increased carbon emissions associated with whole tree harvesting for biomass. As well, whole-tree harvesting increases nutrient removal 2 fold or more and it is well documented that it leads to greater degradation in soil quality. The comments of Peter Salonijs are pertinent:

Salonijs, P. 2007. **Will forestry follow agriculture toward unsustainable soil depletion?** *The Forestry Chronicle* 83: 375-377.

Abstract: Human settlement has increased food production by progressively converting complex, self-managing natural ecosystems with tight nutrient cycles into simplified, intensively-managed agricultural ecosystems that are subject to nutrient leaching. Conventional stem wood forest harvesting is now poised to be replaced by intensive harvesting of biomass to substitute for increasingly scarce non renewable fossil fuels. Removal of nutrient-rich forest biomass (harvesting slash) can not be sustained in the long term.

In contrast to his impressions of the Bancroft and Crossland report, Dr. Wagner is very complimentary about the Porter Report, e.g.:

I tried my best to be as critical about the scientific and technical aspects of this report as I was with the Bancroft & Crossland report. However, I found the recommendations to be largely constructive, measured, reasonable, and fairly well defended based on past and current research in the region (although the author clearly did not do a thorough literature review on every topic).

Reading that report, I find it well written and internally logical and convincing – if one does not follow up on the various evidence cited and consider alternative arguments. A number of references are cited at the end that are not included in the text. (It’s not difficult for a professor to find fault with almost any scientific or quasi-scientific document that has not been previously peer reviewed.) One of those, that to Freedman et al., cited above,<sup>11</sup> provides an example of how scientific literature can sometimes be cited to support both sides of an argument and how one really needs to “drill down” to ensure that the reference is as clear on an issue as implied by citing it. I suspect that Mr. Porter cited the Freedman paper, as others have on occasion, because he believed it supports the contention that whole-tree harvesting in Nova Scotia is sustainable. In the paper, Freedman, Duinker and Morash concluded:

It seems unlikely that one or several whole-tree harvests of these natural stands, if done on rotations of >ca. 50 years, would result in important depletions of site nutrient capital. However, calcium removals as a percentage of total site capital were large. This may be a cause for concern, and warrants further investigation

Since that paper was published, and especially in the last several years, widespread concern about calcium depletion in northeastern forested watersheds has emerged as discussed above. Freedman et al. were right that it could be a cause for concern, but that caution and subsequent research on the issue is not cited when pro-biomass advocates cite the paper.

One comment of Dr. Wagner which I very much support is his urging a quantitative approach:

Modern forest management planning tools provide the ability to conduct sophisticated analyses about the quantitative state of the forest and project how proposed forest policy options can influence a wide variety of forest resource values over the long term. This scenario planning should be done in a spatially explicit manner so that the potential influence can be seen over time. Definitive recommendations like those presented in the Steering Panel report can only responsibly be made in my view after an informed and quantitative analysis of the risks, benefits, and tradeoffs that are likely to accrue for each forest policy recommendation. Forest landowners and the people of Nova Scotia deserve to see what they are likely to get in some form. Only then can politicians and policy makers make the claim that they have made responsible decisions about critical forest resource issues.

Quantitative approaches are possible in each of the areas of concern I have addressed above, and some have been conducted in the Nova Scotian context, notably by Freedman et al. on nutrient removals, and by Beazley et al. on the land requirements for conservation, as cited above. A recently completed PhD thesis at Dalhousie University provides software for spatiotemporal simulations of nutrient removal by forestry and the impacts on soil nutrients and acidification.<sup>12</sup> I have little doubt that crunching the numbers for carbon emissions would show that implementing the recommendations of Bancroft and Crossland, would increase carbon sequestration substantially – but let's do them!

## Conclusion

I hope these remarks are sufficient to indicate that Dr. Wagner's comments reflect a certain bias, and other scientists with equivalent qualifications might have offered a very different perspective. The recommendations of Bancroft and Crossland represent a precautionary approach to managing our resources that is in tune with the perspectives of a majority of Nova Scotians and highly appropriate in an era of increasing environmental stresses on our forests.

If the government wishes to canvas other scientists for perspective on the Bancroft and Crossland recommendations and related issues, one group I suggest be consulted are foresters and ecologists associated with Harvard Forest in Massachusetts (<http://harvardforest.fas.harvard.edu/>)

Since 1907 the Harvard Forest has served as a center for research and education in forest biology and conservation. The Long Term Ecological Research

---

<sup>12</sup>, Joseph, A.A. 2009. **The development of spatiotemporal simulation methods for the strategic assessment of ecologically sustainable bioenergy supplies** PhD thesis, Dalhousie University, Halifax, Nova Scotia

(LTER) program, established in 1988 and funded by the National Science Foundation, provides a framework for much of this activity. An understanding of forest responses to natural and human disturbance and environmental change over broad spatial and temporal scales pulls together research topics including biodiversity studies, the effects of invasive organisms, large experiments & permanent plot studies, historical & retrospective studies, soil nutrient dynamics, and plant population & community ecological interactions. Major research in forest-atmosphere exchange, hydrology and regional studies places the work in regional and global context, aided by modeling tools. Conservation and management research and linkages to policy have been part of the Forest since its beginning, and the approaches used in New England can often apply to international studies.

I suggest they would offer a more balanced review than that offered by Dr. Wagner. Interestingly, they are currently conducting a study of landowner decisions in states where private forestry is regulated and where it is not. As advised by Dr. Wagner, we would be wise to learn from the experiences of others in regard to clearcutting regulations, not necessarily to evaluate the proposed policies, but to fine tune their application.

Finally, I encourage the government to consult multiple sources of expert scientific advice and to consider the nature and limits of the scientific process, particularly as it relates to complex systems and where it intersects with human values. I believe that Bob Bancroft is widely viewed as a very balanced, considered professional and he has a history of constructive interaction with many Nova Scotians. Donna Crossland is certainly well regarded as a conservation ecologist and Parks Canada administrator. I hope that as well as receiving comments on their report and on the Wagner review of their report, the government will ask Bob Bancroft and Donna Crossland to respond to the critiques such as the Wagner document.

---