Ms. Kirsten Corrigal, Manager
Ministry of Natural Resources and Forestry
Policy Division, Crown Forests and Lands Policy Branch
Forest Legislation and Planning Section
70 Foster Drive, Suite 400
Sault Ste Marie, Ontario P6A 6V5
forestcarbon@ontario.ca

January 23, 2017

Re: Ontario's Crown Forests: Opportunities to Enhance Carbon Storage? A Discussion Paper (EBR Registry Number 012-8685)

Dear Ms Corrigal:

Thank you for the opportunity to comment on the discussion paper on Ontario's emerging "forest carbon policy". We are submitting this letter in our respective capacities as Wildlife Conservation Society (WCS) Canada scientists. A national organization, our research and conservation priorities in Ontario are largely focused on the Far North.

Although we understand that this document has been developed for public consumption, the strong scientific basis that is claimed for the policy direction described therein ("based on the most up-to-date science", p. 2), the public information session in Thunder Bay on December 7, 2016, and in the webinar we attended on January 12, 2017 is not evident. Unreferenced statements are portrayed as fact, when they actually rest on a significant set of unstated and faulty assumptions. We would have assumed that a discussion paper released prior to a policy would provide important details on the science, uncertainties, and assumptions underpinning the actions being considered. Instead, most pages are taken up with elementary background information and text that reads more like a public relations piece for Ontario's forest management and climate change research. Not even a list of relevant literature citations for scientific findings generated by OFRI staff is provided.

We also have significant concerns about the limited scope of this policy, which is restricted to forests that are managed for timber production, comprising about half of the forest cover in Ontario. Ignoring both the positive and negative contributions of unmanaged forest, including carbon-rich ecosystems such as wetlands and peatlands, particularly in the Far North, is problematic. The current scope is not adequate context for providing a scientific understanding of the carbon balance in managed forests and severely limits Ontario's ability to develop a comprehensive GHG mitigation strategy. This speaks to the incomplete nature of the current mix of policy instruments in Ontario's Climate Action Plan.

WCS Canada
344 Bloor Street West, Suite 204
Toronto, Ontario, M5S 3A7, Canada
www.wcscanada.org

Justina C. Ray
jray@wcs.org
Phone: (CAN) 416 850 9038 x.22
skype: justina.ray

In this letter, we provide details on our concerns about this discussion paper and the policy direction it describes, followed by five specific recommendations. Our remarks address both issues specific to this discussion paper (such as erroneous or incomplete statements that we would like to see corrected before any policy is developed) and the development and implementation of the broader climate change mitigation framework that Ontario is considering. Our comments focus exclusively on carbon management and not the offsets component of this discussion paper, although the two are obviously related. We are unable to comment on the latter at this stage as what is presented in this discussion paper is just too vague and lacking in details.

Weakness of assumptions and scientific evidence underpinning proposed carbon forest policy direction

Having reviewed a number of publications that have been produced from OFRI and NRCan climate research that are presumably the backbone of this emerging forest carbon policy, we have significant concerns about the certainty claimed in this discussion paper that mitigation of climate change will be accomplished by increasing carbon in boreal forests through forest management. Currently, managed forest in much of Ontario are carbon sources, despite Ontario's best management practices (Ter-Mikaelian et al. 2013). This is because many factors combine to both positively and negatively affect forest growth, and predictions around carbon in managed forests remain uncertain under climate change.

The assumption that increased carbon can be stored in forests through management processes is likely to be faulty for many reasons that range from fundamentals of ecology, to changes that forest ecosystems in Ontario are expected to experience under a warming climate, to key limitations in modeling approaches to key factors that demand more consideration. These include:

- Increased insect infestation and diseases with a warming climate that may offset increased growth, either from intensive silviculture or CO_2 fertilisation effects;
- Reduced moisture that will come from a warmer and drier climate for much of Ontario, will counteract any increased growth based on warmer temperatures alone, and may also favour higher rates and extent of insect infestation and fire;
- Reduced moisture and increased temperatures will result in increased losses of forests to fires;
- Increased methane released from northern peat soils and permafrost (particularly if peatlands are converted to other land uses, e.g., mines, hydro-development, roads) will offset increased sequestration to the south and must be considered in tandem;
- The implicit assumption that N levels in soils can support increased growth may be faulty;

WCS Canada
344 Bloor Street West, Suite 204
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www.wcscanada.org

Justina Ray
jray@wcs.org
Phone: (CAN) 416 850 9038 x.22
skype: justina.ray

- Most boreal carbon is in the soils and increasing sequestration will do little to the below-ground carbon pool unless: a) the forest burns and biochar is stored, or b) the trees are not cut, allowed to die and a portion enters the soil as long-lived carbon;
- Calculations of wood carbon storage in Ontario are not based on complete life cycle analyses, ignoring critical sources of emissions from wood products as as methane in landfills for example; and
- Carbon modeling that has been conducted in Ontario relies on wood supply modeling approaches that underestimate the amount of carbon in mid- to late-successional forests, as well as their ages where fire cycles are naturally long, thereby underestimating the value of older forests from a carbon perspective.

The main argument in this discussion paper is that the growth rate of Ontario boreal forests can be enhanced by 3 main management approaches: increased stand improvement techniques, reforestation and afforestation. CO_2 concentration is clearly important to carbon storage, but positive effects are mediated by moisture, nitrogen, diseases, fires, and chronic insect infestations. Except for fire, none of these factors is accounted for adequately in the models that have been used to derive estimated increased carbon storage in Ontario (Ter-Mikaelian et al. 2013, 2014).

For example, 'disturbance' was estimated in the Ontario modelling but was calculated as 'stand replacing'; that rate does not include the chronic endemic rate of sub-lethal effects and mortality caused by diseases and herbivory (i.e., does not account for such annual depletions). Considerable insect damage incurred to live trees manifests itself as reduced volume. For example, jack pine budworm (*Choristoneura pinus pinus*), a defoliating insect that feeds on jack pine throughout Ontario, does not ordinarily kill its host except during severe infestations (Nealis 1995), although there has been widespread mortality during some years in the northern and western parts of the province (Rose and Lindquist 1984). The mortality rate in Ontario jack pine was estimated by Gross (1992) at 1%/yr from the onset of defoliation, for a total loss in volume of >7 million m^3, during 1982 to 1987. In Ontario during 2004 to 2008, MNRF estimated that insect infestation caused tree mortality in approximately 3.4 million hectares compared to fire, which affected 125,000 hectares (MNRF 2015). Diseases are another chronic disturbance that affect almost as many trees as do insects in many years, but most damage is chronic and incurred as reduced growth as opposed to large-scale mortality (OMNR 2008). Forest volume loss to these two chronic disturbances, insect herbivory and diseases, may increase as a result of global warming (e.g., Weed et al. 2013, Price et al. 2013).

Moisture deficit is another key factor that is ignored in current modelling of the estimated potential for increased carbon storage in Ontario forests. Several studies have suggested that reduced moisture will be an issue for much of Canada's and Ontario's boreal forests, resulting in lower growth than predicted by the CO_2 fertilisation hypothesis (Lavoie et al. 2005, Krishnan et al. 2006, Peng et al. 2011, Price et al. 2013, Giardin et al. 2006, 2016). Some authors have already found no fertilisation effect in boreal forests (Giardin et al. 2011, Way and Sage 2008), suggesting that other factors likely override the effect of increased CO_2. Further, moisture is not the only factor making computation of increased carbon storage in boreal forests complicated under climate change. For example, Gamache and Payette (2004) found that increased snow load (i.e., wet snow) reduced shoot growth in black spruce, Norby et al. (2013) found that nitrogen availability also inhibited the CO_2 fertilisation effect, and Colombo (1998) reported frost damage as a result of early bud burst in white spruce. Nitrogen may be limiting and become worse under climate change (Allison et al. 2008, Reich and Hobbie 2013), especially with drier conditions (Rennenberg et al. 2009). There is also a strong potential for increased fires with reduced moisture, resulting in increased carbon emissions which is already manifested throughout the boreal (Gillett et al. 2004, Flannigan et al. 2009). Already, greenhouse gases released by wildfires are about 5% of the amount released by industrial sources in Ontario. This calculation is based on the release of 198 Mt/yr of industrial carbon dioxide equivalent (CO2e) and the average annual release of 9.9 Mt/yr of CO2e from fires in Ontario (Far North Science Advisory Panel 2010). In addition, fires burn deeper into the duff layer in drier conditions, resulting in greater emissions than would otherwise occur, as well as loss of litter carbon (Terrier et al. 2014). All these studies indicate that there is high uncertainty for any potential CO_2 fertilisation effect in boreal forests.

Even if warming and fertilisation coupled with silvicultural interventions somehow does result in increased carbon stored in managed forests, the results will have to be viewed within the larger context of climate change effects on all of Ontario's ecosystems. A major impact of global warming will be thawing of permafrost and the release of carbon, largely as methane, which has about a 25 times larger greenhouse gas effect than CO_2 over a 100-year period (Schuur et al. 2008, 2015, Flannigan et al. 2009, Packalan et al. 2014). For example, the Hudson Bay Lowland is estimated to store at least 30 Pg of carbon in both biomass and soils (Packalan et al. 2014), which is five times more than the carbon stored in Ontario's managed forests. Loss of even a small portion of this carbon would "outstrip" any gains in biomass production in managed forests (DeLuca and Boisvenue 2012).

Estimates of carbon stocks in managed forests of Ontario (Ter-Mikaelian et al. 2013, 2014) have been derived from the same modeling approach as is used for forest management planning in the province (the Strategic Forest Management Model [SFMM]), and use the same forest resource inventory data as inputs. As such, there are some important biases when trying to then apply these models to address the carbon cycle in addition to determining whether Ontario's forest management is sustainable over time.

Ontario's wood supply models are constructed and calibrated using even-aged inputs, thereby ignoring the fact that extensive stands of uneven-aged forests are known to occur in Ontario, particularly in the clay belt where fire cycles are lengthy (> 170 years) compared to the northwest (~ 100 yrs) (Bergeron et al. 2001). In addition, a lack of available empirical information on yield curves and successional rules, compounded by limitations of the FRI data mean that that late successional stages are not incorporated into wood supply modeling (Etheridge and Kayahara 2013). This key gap even calls into question the success of Ontario's forest management planning approach that seeks to emulate natural disturbance, the very basis of the CFSA (Etheridge and Kayahara 2013). A good illustration of the bias that has resulted from this critical data gap is with Ter-Mikaelian et al. (2013), who estimate among stands > 100 years of age, only 1% are > 180 years old, while Bergeron et al. (2001) estimated this same number at 52% for four units on the Ontario/Québec border. Presumably based on Ter-Mikaelian et al. (2013), this discussion paper and proposed policy direction appears to assume that older-aged trees and uneven-aged stands are a minor component of the forest and hence have little value from a carbon perspective. We know the former to be untrue, and so the latter is far from certain.

This assumption of a relative lack of carbon value in older-aged forests relates directly to another assumption that "sustainable forest management" carried out into the future will "enhance" carbon storage. This is in spite of the lack of any study on the net effects of forest management (including the removal of the original primary forest) in Canadian boreal forests. In Europe, where forest management has taken place over several more rotations than in Ontario, Naudts et al. (2016) demonstrated a net reduction in carbon stocks under forest management from 1750 to 2010, despite considerable levels of afforestation over this time period. Forest carbon losses due to forest management played a key role in this net release of carbon into the atmosphere, and carbon stocks (living biomass, coarse woody debris, litter, and soil) were lower in managed forests than in unmanaged forests.

On the matter of addressing GHG emissions by the forest sector itself, the information provided in the Discussion Paper is incomplete. For example, the discussion paper appears misleading with respect to a significant statement that appears in a prominent box on p. 4 about the forest industry's contribution to carbon emissions. The link provided with the statement "Since 1990, the pulp and paper industry in Ontario has reduced total emissions by 66% and the entire forest industry has reduced emissions by 48%" takes us to a Statistics Canada table (Table 153-0033) that displays carbon emissions intensity per industry in Canada, but not total emissions. Whereas absolute emissions are the total amount of GHG produced, emissions intensity is carbon output relative to some economic unit (in this case per thousand current dollars of production). The appropriate table to cite would have been Table 153-0034 (Greenhouse gas emissions [carbon dioxide equivalents], by sector), but the statistics offered in that table range from 1990-2008, during which time there was no net change in emissions by the Canadian forestry sector, and do not include any statistics for the Ontario sector.

That carbon stored in wood products is stated to have tipped the balance of managed forests towards a carbon sink situation ("when carbon stored in harvested wood products is factored into carbon accounting, sustainably managed forests are always a carbon sink"; p. 8). This confident statement, however, has little basis when one considers the incomplete analysis that has led to these conclusions. Ter-Mikaelian et al. (2013: 3478) themselves acknowledge that their analysis of projected carbon stocks contained in wood products did not include a complete life cycle analysis and thus ignored "emissions related to product life cycles, methane produced in landfills, and avoided emissions due to wood product displacement of more energy intensive materials". Results from a recent life cycle analysis of the forestry industry in the U.S. found that the industry was adding much more carbon to the atmosphere than it was removing (Heath et al. 2010). Carbon sequestration in both wood products and the forest itself comprised only 34-42% of total carbon emissions from the industry; for example, methane from landfills (not considered by Ter-Mikaelian et al. 2013) comprised 27% of emissions.

In our discussion above, we have provided numerous examples of uncertainties around whether and how carbon storage will be enhanced through current approaches to forest management. It would appear that because OFRI research so far is supportive of the current direction of forest management (notwithstanding a few modest improvements that might arise from this exercise), it is easy for MNRF to overlook the uncertainties and portray confidence in the assumptions that underpin them. Years of engagement by one of us (JCR) working with the province on caribou recovery as a member of the Provincial Caribou Technical Committee has demonstrated a somewhat opposite situation. In this case, the best available science would suggest a fairly significant shift for forest management, and MNRF has displayed considerable reluctance to move in this direction.

Misleading comparison between managed and unmanaged forest

The depiction of the carbon cycle in an unmanaged forest (p. 8, Figure 5) is oversimplified and inherently biased. It provides a picture of a forest "all falling down at once" and effectively losing its value from a carbon perspective at about the point when all the trees reach 80-100 years. The process of carbon cycling is not linear of course and takes place over a considerably longer time than the figure suggests, with other natural disturbances resetting the cycle in some places, but not in wholesale fashion. Where there is no disturbance event, trees die individually, not *en masse*; if a fire resets the cycle (instead of forest harvest), some wood will be left in the ground and convert to carbon. Older forests continue to accumulate carbon when they age for a much longer period of time than is suggested in this document (Luyssaert et al. 2008). The role of unmanaged forests in this document is limited to setting up an argument for a contrasting model of a perpetually younger forest actively sequestering carbon at faster rates than older forests (> 80 years) ever could (Figure 6).

In Figure 6 MNRF clearly wants to convey that there is an advantage of managed over unmanaged forests from a carbon perspective. It assumes that the carbon value of managed forests in Ontario increases through time, in contrast to the unmanaged forest, which ceases to have carbon value when it reaches 80-100 years of age. Although we recognize that this depiction is intended to be largely heuristic, the paper does not acknowledge the lack of available data to support or refute it.

Lack of cost-benefit analysis of proposed approach

Conservation and sustainable use of Ontario's forest lands under the *Crown Forest Sustainability Act* demands attention to often-competing ecological and socio-economic values.

WCS Canada
344 Bloor Street West, Suite 204
Toronto, Ontario, M5S 3A7, Canada
www.wcscanada.org
Justina Ray
jray@wcs.org
Phone: (CAN) 416 850 9038 x.22
skype: justina.ray

Although the discussion paper states the intention to "balance" such obligations at the outset (including in one of the policy goal statements), it contains no discussion of potential trade-offs of competing values to actions being considered that would fit under the proposed approach of "enhancing carbon storage". For example, it is difficult to see how biodiversity, particularly species at risk, will be maintained in forest systems "using forest management practices to influence carbon storage", given already-documented negative impacts to many species. The focus of the discussion paper offers no real way to consider how changes in forest management to support carbon goals will address the direct, indirect and cumulative costs of Ontario's approach on other values including soil, freshwater, large-scale processes such as fire, and fish and wildlife, which will also be impacted by climate change (e.g., Wotton et al. 2005, Varrin et al. 2007, Dove-Thompson et al. 2011, Nituch and Bowman 2013).

As is evident by the ongoing *Endangered Species Act* (ESA) – *Crown Forest Sustainability Act* Integration Project, almost 10 years after the ESA came into force, forest management planning in Ontario still does not fulfill the requirements of the ESA (and indeed has enjoyed an exemption for almost a decade). Fundamentally speaking, this discussion paper is making a case that carbon sequestration will be enhanced through a similar approach to forest management that would maximize timber production, without any testing of this notion. A recently-published study from central Finland did analyze trade-offs between competing objectives of harvest revenue, carbon, and wildlife through modeled comparisons of multiple scenarios over a 50-year period, and found that it was not possible to reconcile all three (Trivino et al. 2016).

While the impacts of management practices on carbon have been considered (e.g., Colombo and Parker 2005), some of these should be looked at more explicitly in the development of forest policy and updated. For example, Colombo and Parker (2005) found that areas deforested to build roads or landings have less carbon than forest regenerated by planting after harvest. They found that the total carbon loss in roads and landings was predicted to be approximately 960,000 t of carbon in 2012 compared to replanted forest. Therefore, reducing the area of new roads and landings in the managed forest could reduce carbon loss. In addition, the implications of building new roads for forestry (as well as other land uses e.g., mines, hydroelectric power) in the Far North must also consider the reduction in carbon storage.

Lack of innovative policy actions

Given the urgency to tackle climate change, one would assume that this discussion paper would provide some hint of innovative actions to enhance carbon stores. But there is no evidence that anything beyond current "business as usual" is being actively considered, in spite of the stated intention to do so (p. 14). The statement (p. 13) that "...any mitigation strategy would consist of forest operations already undertaken..." seems to preclude innovative adaptive thinking. Further, the statement that adjustment to policy would "take many years to implement" belies the urgency of the climate change problem that this paper is supposedly addressing. The final paragraph on p. 13 refers to "raising standards" and "reduce opportunities", which are rather

WCS Canada
344 Bloor Street West, Suite 204
Toronto, Ontario, M5S 3A7, Canada
www.wcscanada.org

Justina Ray
jray@wcs.org
Phone: (CAN) 416 850 9038 x.22
skype: justina.ray

conflicting, and the entire paragraph seems to eliminate any hope for change to policy to mitigate climate change.

There is minimal consideration in the discussion paper of alternative or companion strategies to carbon management forestry, including the substitution of engineered wood products especially for cement (one of the major contributors to GHG emissions), but also for steel and aluminum (see wood high-rise construction techniques). The discussion paper also does not consider tactics like investment in either high-value wood products from low value (small diameter) wood or in the development of alternative uses for wood products (e.g., nano-carbon products). Finally, significant carbon benefits derived from protection of "natural forests" (i.e., unlogged) merit consideration as a companion strategy with forest product substitution and forest management (Carlson et al. 2010), but are not even mentioned in this paper.

Narrow scope of forest carbon policy on managed forests and the explicit avoidance of carbon in Ontario's Far North

The introduction of the discussion paper does not explain why a provincial "forest carbon policy" applies only to managed forests. We fully recognize that in order to account for human-induced (as opposed to natural) carbon emissions, the UNFCC carbon reporting requirements are limited to "managed forests". Accordingly, Canada (and Ontario) has chosen an area-based approach to define managed forests, which we assume is the explanation for the limited perspective offered in this discussion paper. Yet, boreal forests – managed and unmanaged alike -- serve as a large carbon reservoir that is at least as important as tropical forests, and likely underestimated in value (Pan et al. 2011, Bradshaw et al. 2009). With this in mind, Pan et al. (2011:988) caution that developing strategies to limit greenhouse gases "will require an understanding of the current and potential future role of forest carbon emissions and sequestration in both managed and unmanaged forests".

With most unmanaged forest in Ontario in the Far North, there are well-known carbon stores within its globally-significant peatlands, which store carbon disproportionate to other natural ecosystems of Ontario (Far North Science Advisory Panel 2010; Packalen et al. 2016). With northern peatlands representing "one of the largest carbon pools in the biosphere" (Yu 2012:4071), they must be deliberately included in efforts to understand global carbon cycles (Yu 2012). A key barrier to integrating unmanaged forests ecosystems in climate change policy is the current lack of information on their carbon stocks and flux; the reliance of carbon modeling on timber inventory data, unavailable outside managed forests, is a key explanation for this limitation (Kurz et al. 2013). Although other data sources are emerging, and some estimates have been produced, they don't tend to agree on the magnitude or the direction of the net C fluxes, and so unmanaged forests are either not reported (Kurz et al. 2013) or not considered relevant (Lempière et al. 2013) in Canada.

In Ontario, OFRI has invested in research on subjects such as carbon storage potential and effects of climate change of the Far North peatlands (e.g., McLaughlin and Webster 2014;

Packalen et al., 2014; 2016). It is not clear the extent to which the findings from MNRF's work in these systems is integrated with those related to managed forests, and the extent to which it is currently informing Ontario's evolving climate change policy. We fear, however, that these avenues of research and their relationship to policy development are proceeding in silos and the focus on managed forests ensures this. An isolated paragraph in the discussion paper on p. 8 acknowledges the potentially tremendous carbon stores in the peatland systems of the Far North, but the lack of any further mention, combined with the dismissive treatment of unmanaged forests in the document, suggests that while MNRF is aware of the mitigation potential of Far North forests and peatlands, it does not know how to deal with this. MNRF's guidance on managing and conserving these systems is limited to advice to community-based land use planning teams through the emerging Far North Land Use Strategy. We have provided significant comments elsewhere (EBR No. 012-0598 and EBR No. 012-7675, respectively) regarding the current limitations in both to address carbon conservation in the Far North and wetlands in particular. This is particularly troublesome from a carbon perspective because Objective 3 of Ontario's *Far North Act, 2010*, explicitly includes an emphasis on the storage and sequestration of carbon in the Far North[1].

We submit that an inadequate understanding of carbon stocks and carbon stock changes in *all* of Ontario's forested lands will result in an incomplete understanding of the provincial carbon budget and fundamentally uninformed climate change policies. This limited perspective is problematic for at least two main reasons.

1) Failure to include this carbon pool inventory in accounting actually provides a disincentive to finding ways to protect this carbon, and to implementing conservation practices aimed at preventing climate change emissions from these forests (Moen et al. 2014). At least some proportion of the forests of the Far North will enter management at some point. Consequently, having no notion of the carbon pool potential at this stage prior to this development is problematic, as we will be without full understanding of potential trade-offs that may arise from the depletion of ecosystem carbon stocks and resultant rise in CO_2 emissions. All evidence points to Ontario's intention to welcome mineral and hydro-electric development, and fund roads, support fibre-optic cables, and approve transmission lines into the region. Forest management is included as a component in several already-approved Far North community land-use plans as well as others in progress (e.g., Whitefeather Forest, Cat Lake – Slate Falls, Taashikaywin, Moose Cree First Nation)[2], and mineral exploration as well as deliberations about road building scenarios have been actively underway for years.

[1] Objective 3 of the Far North Act (2010) states:"The maintenance of biological diversity, ecological processes and ecological functions, including the storage and sequestration of carbon in the Far North." (s. 5.3).

[2] The Far North Science Advisory Panel Report noted 6-7% (~ 27,000 km^2) of Ontario's Far North had the potential for commercial forestry (Far North Science Advisory Panel 2010: 12)

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344 Bloor Street West, Suite 204
Toronto, Ontario, M5S 3A7, Canada
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Justina Ray
jray@wcs.org
Phone: (CAN) 416 850 9038 x.22
skype: justina.ray

2) Failure to manage emissions through land use change (e.g., project approvals) together with climate change (Far North Science Panel 2010; Bragazza et al. 2013) will result in methane emissions that could easily dwarf any gains made through forest management that are assumed in this discussion paper. GHG fluxes such as these in the Far Northcan significantly add to atmospheric impacts, and need to be understood fully to appreciate the total GHG load on the global atmosphere (Cowie et al. 2007).

Package of climate change mitigation actions is insufficient

The discussion paper lists a number of companion "actions" to the "forest carbon policy" that MNRF is leading or co-leading as part of Ontario's Climate Change Action Plan (p. 6). Although absent in this discussion paper, the Far North Land Use Strategy was mentioned in the public session in Thunder Bay in December and the January 12 webinar as a "climate change mitigation effort". This (mentioned above) and Ontario's emerging Wetland Conservation Strategy will be the sole vehicles by which ecosystems such as forests and peatlands in Ontario's Far North will be included in Ontario's climate change mitigation actions and policies. We are on record (EBR No. 012-0598 and EBR No. 012-7675)pointing out the major shortcomings of both "strategies" from a climate change perspective; neither will be useful, in spite of their importance.

The Land Use Carbon Inventory (Action 2.1, Climate Change Action Plan), on the other hand, may provide a pathway for our recommendation to develop a comprehensive (and integrated) understanding of carbon values across all land uses, including wetlands and grasslands[3], in Ontario. We would also recommend including protected areas and conservation reserves as a legitimate land use under MNRF's jurisdiction. The latter is particularly important given commitments to protecting at least 50% under Ontario's *Far North Act, 2010* and 17% by 2020 under Ontario's Biodiversity Strategy (Ontario Biodiversity Council, 2011) to enhance resilience of biodiversity in the face of threats. A complete inventory of this nature would provide a critical foundation for the development of any policy, yet almost no information is forthcoming about what this initiative is, the methodology that will be deployed, and how Ontario intends to use the information. We urge Ontario to release details about the approach that is being considered so that it can undergo public review, including by independent scientists. Any development of a forest carbon policy should wait until this is completed.

Recommendations

1) Develop a discussion paper that integrates known carbon science across all forested lands in Ontario (unmanaged and managed) that is transparent about assumptions and uncertainties associated with conclusions being drawn from various modeling approaches. This paper can serve as the foundation for developing a comprehensive forest carbon policy for Ontario (recommendation # 3) and enable experts and other

[3] We note that wetlands and grasslands are not land uses but ecosystems.

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344 Bloor Street West, Suite 204
Toronto, Ontario, M5S 3A7, Canada
www.wcscanada.org

Justina Ray
jray@wcs.org
Phone: (CAN) 416 850 9038 x.22
skype: justina.ray

interested parties to offer more thoughtful feedback and address MNRF's discussion questions.

2) Prioritize the completion of the carbon land use inventory including unmanaged forests and existing protected areas, and undertake the critical first step of independent (and transparent) scientific review of the methodology and approach for developing this inventory.

3) Develop a comprehensive carbon policy that considers all sources of carbon in the province as a critical action in Ontario's Change Action Plan and support efforts for mitigation and adaptation.

4) Strengthen the climate change components of the yet-to-be-released Far North Land Use and Wetland Conservation Strategies. For example, the Far North Land Use Strategy should explicitly include Ontario's commitments and responsibilities for climate change adaptation and mitigation under both MOECC and MNRF actions. The Strategy should also include federal commitments where relevant to Ontario.

5) Develop tools that can guide land use planning in the Far North at multiple scales and measure progress on the addressing climate change, including carbon processes and functions, as mandated by Objective 3 of the *Far North Act, 2010*.

As always, we would be pleased to engage in any discussions regarding these comments, and thank you for this opportunity to provide feedback.

Yours sincerely,

Justina C. Ray, Ph.D.
President & Senior Scientist

Cheryl Chetkiewicz, Ph.D.
Associate Conservation Scientist/Landscape Lead
Email: cchetkiewicz@wcs.org; Phone: 807-285-9125

cc: Environmental Commissioner of Ontario

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WCS Canada
344 Bloor Street West, Suite 204
Toronto, Ontario, M5S 3A7, Canada
www.wcscanada.org

Justina Ray
jray@wcs.org
Phone: (CAN) 416 850 9038 x.22
skype: justina.ray

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WCS CANADA
344 BLOOR STREET WEST, SUITE 204
TORONTO, ONTARIO, M5S 3A7, CANADA
WWW.WCSCANADA.ORG

JUSTINA RAY
JRAY@WCS.ORG
PHONE: (CAN) 416 850 9038 X.22
SKYPE: JUSTINA.RAY