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Re: Naturally Resilient. MNRF's Natural Resource Climate Adaptation Strategy (EBR Registry Number 012-9499)

Dear Ms. Carter:

Thank you for the opportunity to comment on the draft Climate Adaptation Strategy for the Ministry of Natural Resources and Forestry (MNRF). 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 Ontario's Far North.

MNRF is the primary ministry responsible for managing the provincial land base – 87 percent of the province¹ - and conserving Ontario's fish, wildlife, and ecosystem services in both managed and unmanaged systems. MNRF also has significant responsibility in decision making about land use and its interactions with climate change and planning for the future of species, ecosystems, and landscapes in managed and unmanaged systems alike. As such, MNRF plays an essential role in addressing both the impacts (e.g., mitigation) and adaptation of ecological and human communities to climate change.

The current strategy acknowledges these responsibilities, does a reasonable job of listing and prioritizing the elements of MNRF's mandate that affect and is affected by climate change, and identifies critical research efforts. But, the strategy falls short in the following key ways:

1. The actual substance of the work needed to address climate change adaptation (and mitigation) is in Goal 2. Yet, this Goal contains a generic set of actions, with no articulated targets or focus. This Goal is disconnected from research actions in Goal 3 and relies on other strategies (e.g., Wetlands Conservation Strategy, Biodiversity Strategy) to deliver on climate change adaptation outcomes.
2. There is too little attention in this strategy to the actual content of other MNRF strategies being invoked as actions to address climate change adaptation, specifically the draft wetland conservation strategy² and draft Far North Land Use Strategy (FNLUS)³, which is only mentioned within the context of climate change mitigation on pg. 6. We have commented on the Environmental Registry about the limitations of these strategies to deliver on tangible climate change outcomes.

¹ <https://www.ontario.ca/page/september-2016-mandate-letter-natural-resources-and-forestry#section-4>

² <http://nr-escape.esolutionsgroup.ca/filestream.ashx?DocumentId=4173>

³ <http://apps.mnr.gov.on.ca/public/files/er/draft-far-north-strategy-2015-09-29.pdf>

3. There is no attention to key stressors of land use and climate change and how they interact and can exacerbate one another (e.g., cumulative effects). These effects must be considered more explicitly as a means to address climate change adaptation.
4. There is a surprising lack of attention to well-known and established measures to address adaptation of species, ecosystems, and landscapes to climate change, including those focused on intactness, connectivity, and protected area networks.
5. Ecosystem services and “unmanaged” systems such as those within Ontario’s Far North remain invisible despite their importance in the addressing both climate change mitigation and adaptation and their significance in conferring resilience in human societies to climate change.

Our comments include general background and comments on the strategy. We then use the remainder of our comments to focus on Goal 1 (Mainstream adaptation), Goal 2 (Build resilience and biodiversity) and Goal 3 (Increase Science, Research, and Monitoring) because these goals are most aligned with our area of expertise.

General Background

Globally, there is clear evidence that climate change impacts have already been observed across more than 82% of all the ecological processes that underpin ecological function (Scheffers et al. 2016). These range from impacts on genes, species, and ecosystems which result in direct and cumulative impacts on people, their communities and economies. Research by MNRF scientists has shown that climate change is already affecting natural systems in Ontario (e.g., Varrin et al. 2007, Dove-Thompson et al. 2011, Nituch and Bowman 2013, McLaughlin and Webster 2013). Climate models for Ontario predict warmer temperatures, particularly in the north, more frequent and extreme weather events, and variable precipitation depending on the region (Colombo et al. 2007, McDermid et al. 2015).

Species

Managing species is a primary mandate for MNRF, including fish and wildlife management, research, assessment, and monitoring. Some species such as moose and coldwater fish (e.g., lake trout, sea-run brook trout) are already responding to climate change as well as other impacts. While a number of species, for whom climate change is a key threat, are at risk and managed under MNRF-led recovery strategies (e.g., caribou, wolverine, lake sturgeon). Again, MNRF’s recovery strategies emphasize that climate change is one of a number of threats tied to land use and development. Finally, MNRF is also responsible for conserving biodiversity in Ontario under a changing climate and these commitments contribute to national and international targets (e.g., Canada’s Biodiversity Strategy⁴, 20 Aichi Biodiversity targets⁵). Looking forward, cold-water species and snow-dependent species are expected to decline in range and abundance in Ontario while species that are more tolerant of warmer waters and disturbed landscapes are already shifting their ranges (e.g., Alofs et al. 2014). Despite good research on the potential impacts of climate change on species, MNRF has yet to take more proactive measures in addressing climate change in environmental planning and decision making.

Managed ecosystems

MNRF is responsible for managing ecosystems adapting to climate change whether they are formally under regulated management systems or not. The current climate change adaptation strategy should

⁴ <http://biodivcanada.ca/default.asp?lang=En&n=560ED58E-1&offset=1&toc=show>

⁵ <https://www.cbd.int/sp/targets/>

outline how MNRF plans to enable both managed and unmanaged systems to adapt in the face of climate change. For example, MNRF is responsible for management across 270,000 km² of boreal forest. While MNRF continues to argue forest management is sustainable, research has called this premise into question because of factors such as landscape-level loss of older forests, homogenization of within-stand structure, declines in certain key habitat resources such as deadwood, large trees and area-sensitive species, and management actions that “force” forests outside their range of natural variability (e.g., Imbeau et al. 2001, Cyr et al. 2009). As such forest management is a “passive experiment on an enormous scale” while logging remains a key threat to many boreal species (Venier et al. 2014). Looking ahead, fire seasons, essential to growth and regeneration in the boreal forests, are expected to be longer, more severe, and increase in the northwest. In general, forest management and harvest focused on a number of different species, are more resilient than systems which target single species. Despite over 20 years of research, monitoring, and partnerships, it remains unclear to us how MNRF is currently addressing climate change and proactively considering it in forest management planning. We have already provided comments about limitations and concerns with MNRF’s plan to address mitigation of climate change through forest management (i.e., forest carbon policy, EBR No. 012-8685).

Unmanaged ecosystems

Unmanaged ecosystems such as permafrost, peatlands, and intact wetlands in Ontario’s Far North deliver critical ecosystem services such as climate regulation (e.g., McLaughlin and Webster 2013) and are both large enough and intact enough to be considerable elements of climate change mitigation and adaptation efforts led by Ontario, particularly MNRF. Yet, MNRF is unable to address the protection of these vast systems even though it is responsible for managing protected areas and, under the *Far North Act, 2010*, create new protected areas with interested First Nation communities. At present, the only way in which unmanaged ecosystems can be conserved in the face of climate change is by limiting land use and valuing (*sensu* protecting) these ecosystems. Looking ahead, it remains unknown how well Ontario’s current protected area network will support species, community and ecosystem adaptation to climate change. It remains to be seen whether MNRF’s advice on peatlands and climate change in the Far North Land Use Strategy will be relevant in meeting Ontario’s goals for climate change mitigation and adaptation.

General comments

- MNRF has developed some excellent research (e.g., Wotton et al. 2005, Varrin et al. 2007, Dove-Thompson et al. 2011, Nituch and Bowman 2013, McLaughlin and Webster 2013) and tools (e.g., Gleeson et al. 2010) for considering climate change adaptation in Ontario; however, it is still unclear to the public how MNRF (and other ministries) use these results and insights to address climate change in their decision making about land use, forest management, and project development explicitly.
- We would like to see some analysis of whether the actions MNRF have engaged in to date are actually working and/or influencing planning and policy. For example, MNRF had a previous adaptation plan yet we’ve seen no critical or public assessment of it. As an important component of learning and adaptive management, we suggest a critical synthesis and review of what is and isn’t working in terms of current actions led by MNRF on climate change, including adaptation and mitigation, is needed.
- The lack of quantifiable targets for each goal is problematic for anyone outside of MNRF who seeks to assess what MNRF is actually going to do and deliver on in the short-term and long-

term. While Table 1 on pg. 21 is a start, the current adaptation strategy makes it difficult to assess what MNRF is actually going to deliver on. For example, there are 11 priority risk areas and a visual of how these risks are linked to climate change in Ontario (Figure 3), but no bridge to how the strategy goals presented on page 10 actually map back to risks.

- Indigenous peoples and the impacts that they are also experiencing due to climate change receives attention in the strategy which is encouraging. However, this needs more thought. The causes of human-induced climate change are at the core of western societies and industrial economies and our ever increasing consumption of energy and resources in order to maintain our way of life. Indigenous peoples have often been the first to feel the impact of climate change. For example, Indigenous people living in the Arctic and Subarctic regions are extremely vulnerable to climate change and already experiencing physical, ecological, and economic impacts disrupting traditional lifestyles, food systems, and impacting infrastructure and transportation routes. In addition, climate change impacts on Indigenous peoples may also occur because of actions undertaken by governments to address climate change (e.g., mitigation, adaptation). The impacts of climate change on First Nations in Ontario's Far North has already been documented (MTO and MNDF 2016, MOECC 2016). In reality, the same fish, wildlife, and ecosystem services (including cultural services) that MNRF is mandated to conserve and describing in the current document are also Treaty and aboriginal rights in Ontario and protected under the Canadian Constitution. Although climate change has largely been considered a problem of science, economics, or international political processes, the complexity of climate change, and the interconnectedness of various human rights to the expected impacts of climate change on vulnerable and marginalized populations, suggests the list of possible human rights violations is significant. At the same time, the United Nations Declaration on the Right of Indigenous Peoples (UNDRIP)⁶ already creates a framework for the protection of indigenous rights with respect to the environment. Implying there will be *de facto* benefits for First Nations in Ontario engaging in government-led climate change mitigation and/or adaptation actions seems naïve. A more precautionary approach would include a critical assessment of whether MNRF actions on climate change pass an equity test and can contribute to federal and provincial commitments to UNDRIP, recommendations of the Truth and Reconciliation Commission⁷, and protection of Treaty and aboriginal rights.

Goal 1. Mainstream adaptation

Recommendation 1. Address limitations of current MNRF strategies and technical guidance to address climate change.

Despite Actions 1.2 and 1.4, there is no detail in this strategy about the actual content of current MNRF strategies being invoked as actions to address climate change adaptation, specifically the draft Wetland Conservation Strategy⁸, and draft Far North Land Use Strategy (FNLUS)⁹. For example, the latest draft Wetlands Strategy was unacceptably weak in terms of restoring ecosystem functions where wetlands have been damaged and destroyed, provided no consideration for protection of intact wetlands and peatlands, and offered little or no direction on how climate change will be incorporated into wetland

⁶ http://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf

⁷ http://www.trc.ca/websites/trcinstitution/File/2015/Findings/Calls_to_Action_English2.pdf

⁸ <http://nr-escrbe.esolutionsgroup.ca/filestream.ashx?DocumentId=4173>

⁹ <http://apps.mnr.gov.on.ca/public/files/er/draft-far-north-strategy-2015-09-29.pdf>

conservation and land-use planning that affects wetlands. Similarly, while promoted as technical guidance, the *advice* provided in the draft FNLUS offers no clear means to address climate change in the Far North nor can it ensure conservation of peatlands and wetlands and their carbon stocks in particular. Most of the language is tentative and does not suggest *how* community-based land-use planning teams should address climate change (e.g., maintaining carbon stocks and flows, consider implications of zoning for development, protection and general use given climate change). The latest draft of the FNLUS was not linked to Ontario's provincial goals for addressing climate change. Importantly, the FNLUS is the only instrument where there is any explicit consideration of climate change in planning in the Far North and remains a key action in Ontario's Climate Change and Adaptation Strategy (MOECC 2016).

As such, these two MNRF strategies, which are critical from a climate change perspective, do not provide technical guidance for considering climate change adaptation and do not address land use impacts interacting with climate change. We have provided public comments on the draft FNLUS (EBR No. 012-0598) and the draft Wetland Conservation Strategy (EBR No. 012-7675) and remain concerned about the effectiveness of these strategies to address climate change adaptation and mitigation goals in Ontario.

Recommendation 2. Identify how MNRF will address ecosystem services and climate change adaptation.

We could not find any explicit commitment to protecting and valuing ecosystem services in this strategy. We suggest this is an important oversight in trying to address resilience in the face of climate change, particularly in social-ecological systems. In addition, Ontario's Biodiversity Strategy Target 14 states that addressing resilience includes developing programs and policies to maintain and enhance ecosystem services. We think MNRF's climate change adaptation strategy is an important opportunity to consider this target more explicitly and should be considered more directly in the adaptation strategy.

Goal 2. Build resilience and biodiversity

Recommendation 3. Provide a definition of resilience and consider current wording such as "helping" and "building" biodiversity.

Resilience means different things to different people and is used across many disciplines (e.g., social, economic, and ecological). MNRF should define resilience and make clear whether they are focused on managing change in ecological systems and/or maintaining existing conditions (e.g., resistance). MNRF should also clarify whether they are referring to social-ecological resilience which we would recommend as a working understanding of resilience given the relationship between humans and their environment¹⁰.

It is not clear what is meant when MNRF states they will "help" various levels of ecological systems to "withstand" changes in climate. As written, this suggests a focus on resistance to climate change, as opposed to resilience. It also isn't clear to us how MNRF will "build biodiversity". In general, we find the terminology and wording confusing from an ecological perspective.

¹⁰ <http://www.resalliance.org/resilience>

Actions 2.1 through 2.3 sound very good on paper, but are too generic as written to enable critical review or feedback. How will MNRF do these things at each scale and how will it know if it has succeeded?

In order to address Goal 2 and build resilience in the face of climate change, there are a number of well-known and established strategies to conserve biodiversity including: reducing non-climate stressors, increasing connectivity and areas under protection, and addressing cumulative effects to improve adaptation planning and support decision making. The absence of any mention of these in this draft is a significant oversight. These strategies support conservation goals that align with MNRF's mandate and responsibilities in managed and natural systems and efforts to address climate change increases their importance. As such, these strategies and the actions required could certainly be applied under Action 2.1 through 2.3 to support more resilient outcomes at various levels of ecological organization.

We use this next section of our comments to introduce and describe these well-known strategies for conserving biodiversity in the face of climate change and think they need to be included more explicitly under Goal 2.

Recommendation 4. Reduce or remove non-climate stressors.

Reducing existing direct threats associated with human activities including forestry, mining, hydroelectric development and infrastructure is an important climate change adaptation strategy in terrestrial (e.g., Lawler 2009, Hodgson et al. 2009) and freshwater (e.g., Heino et al. 2009, Lapointe et al. 2014) systems. It is well established that these land uses and their resulting effects, including habitat degradation and fragmentation, introduction of invasive species, and pollution, all of which can lead to overexploitation impact species, ecosystems and landscapes. Reducing these impacts can help species, ecosystems, and landscapes cope with additional stresses caused by changing climate and is an essential first step in making populations more robust to climate change (Hodgson et al. 2009). In addition, as the climate changes, human land use may impede species from moving to areas with suitable climates. Connectivity between protected areas, core regions, or other designated areas should also consider temperature gradients that could also allow organisms to move in order to allow species to continue to occupy the same temperature space as the climate warms (e.g., Nunez et al. 2013).

Proposed Actions

- Consider which stressors will directly interact with climate and land use scenarios and models to help prioritize conservation action accordingly (e.g., contaminant load increase in benthics and fish as climate change causes streamflows to decline, declining precipitation in the future that require reduced water withdrawals today).
- Address the increased habitat availability for invasive warm-water species more proactively. We already know that warm-water species will move north if habitat is available. While fish may not be able to access northern watersheds naturally due to hydrological connectivity, they can through intentional or accidental translocation by people. One important management action would be to reduce (or eliminate) live bait for personal and commercial use in Ontario and prohibit live bait in all watersheds flowing to the Arctic Ocean in the Far North¹¹.
- Invest in monitoring variables relevant to climate change to provide data for modeling that can consider thresholds (e.g., cumulative disturbance for caribou, intactness metrics) as well as the

¹¹ MNRF have just released draft bait use guidelines for public comment (EBR No. 012-9791)

suite of indicators missing in existing MNRF monitoring programs [Appendix 1, Furrer et al. 2014]).

- Create a **net gain** policy for wetlands in the Great Lakes and restore wetlands in the southern region of the province and protect intact wetlands from additional industrial land use in the Far North.

Recommendation 5. Proactively conserve and protect habitat and expand existing conservation areas.

Sustaining a diversity of healthy fish, wildlife and plant populations and ecosystem functions in a changing climate over time requires conserving a sufficient variety and amount of habitat and species as well as their functions and processes. There is strong evidence for both general ecosystems and boreal systems in particular, that those with greater diversity (in its largest sense) will generally be more resilient to changes associated with climate change and will perform better in maintaining its function and processes than a less diverse one. While species numbers may be low at both local and regional scales in boreal regions (e.g., Reist et al., 2006, Far North Science Advisory Panel 2010) compared to temperate and tropical systems, this taxonomically and functionally diverse biota provides ‘insurance’ within a system by allowing some components to compensate for the loss or failure of others. Redundancy is also more valuable when the components providing the redundancy react differently to change and disturbance (response diversity). The diversity and redundancy in the ecosystem can enable it to more easily adapt to climate change.

Increasing numbers of species (e.g., biodiversity) are associated with greater area. Effective biodiversity conservation requires sufficient habitat where a species currently occurs and additional locations that will support populations whilst the distribution is changing in response to climate change and other stressors. Protected areas are one of the best ways do this because they can act as refuges and sources for recovery, reducing non-climate stressors and the spread of human-caused disturbance. Increasing connectivity among these areas may be another way of maintaining biodiversity (assuming invasive species are not facilitated in doing so) since connectivity can influence the resilience of species, ecosystems, and landscapes by facilitating recovery or reducing the spread of disturbance. Reduced connectivity caused by anthropogenic fragmentation, like roads, clearcuts, or dams, has a negative effect on population viability, particularly among large mammal populations and in freshwater species that must disperse along water courses or between waterbodies. The quality of these systems is likely to change along gradients with climate requiring more options for both terrestrial and freshwater movements and more explicit attention to impacts on the surrounding matrix and watershed, respectively. Finally, planning for protection must consider future climate scenarios (Scott and Lemieux 2005).

MNRF is responsible for managing Ontario’s protected areas as a *system* where the management and planning principle under Ontario's *Provincial Park and Conservation Reserve Act, 1996* is ecological integrity. To consider climate change adaptation, MNRF must consider how the current protected area system and the principle of ecological integrity is likely to change. In the Far North, MNRF currently has an unprecedented opportunity to consider a range of biodiversity values, including intactness and redundancy, to create a protected area network that can consider current and future climate change impacts and a mandated conservation target of *at least* 50% in doing so. Yet, the current approach to protected area planning is not systematic and does not address basic conservation principles such as representation of biodiversity at various scales, vulnerability assessments to direct and cumulative impacts of land use and climate change, persistence (*sensu* refugia), and site irreplaceability (Margules and Pressey 2000, Margules and Sarkar 2007).

Finally, a growing body of research supports the maintenance of large intact systems for the purpose of enabling adaptation to climate change of species and the ecosystems in which they function (Watson et al. 2013, Eigenbrod et al. 2014, Martin and Watson 2016). Protecting these intact regions may be more effective in providing climate adaptation options for species, ecosystems, and landscapes than trying to restore or recreate them after they have been damaged or fragmented by piecemeal development (Hodgson et al. 2009).

Proposed Actions

- Evaluate Ontario's current protected area network under current and future climates for addressing protected area targets for biodiversity and ecological function and process (e.g., 17% overall, 50% under the *Far North Act, 2010*).
- Consider whether more protection may be needed in the face of various cumulative effects scenarios and MNRF's mandate.
- Explicitly address the importance of planning for and protecting freshwater species and their habitats (e.g., Suski and Cooke 2007, Hermoso et al. 2016).
- Include protected area planning approaches that take into account the climatic diversity and space as "strategic additions" to protected area networks (e.g., Davison et al. 2012).
- Consider mapping connectivity and identify vulnerable (e.g., isolated) and more resilient (e.g., well-connected) elements in the network in light of climate change (e.g., Nunez et al. 2013; climate envelope models, Phillips et al. 2008, Carroll et al. 2010).
- Prioritize restoration of connectivity in fragmented landscapes (e.g., other regions Ontario) and intactness values (e.g., Far North) to address climate change adaptation.
- Undertake systematic conservation planning for existing and potential conservation areas in the Far North that explicitly considers current and future climates, ecological and social (e.g., subsistence) values and delivers on MNRF's mandate under the *Far North Act, 2010*.

Recommendation 6. Address cumulative effects in government-led planning and decision making on permits and approvals.

Climate change is a manifestation of the cumulative effects of piecemeal land use planning, particularly industrial development, and siloed decision making. In addition, the effects of climate change are felt at multiple scales from local to global and future generations. In general, climate change cannot be linked back to any one individual development project, land use, or sector. The only time climate change and cumulative effects are really considered in decision making in Ontario is when an environment proposal triggers a regulated legislative environmental assessment (EA) process at the federal level. While current EA legislation for environmental assessment does not require proponents to consider climate change, project-based EA processes in Ontario (and Canada) have barely begun to resolve how climate change should affect whether an EA is required, what information about the climate change implications should be gathered in EA processes, and how climate change implications (both mitigation and adaptation) should factor into project decisions. For example, MOECC recently developed *nonprescriptive* guidance on how a proponent may consider climate change both within its project and how the project may contribute to climate change (EBR No. 012-5806). But, it remains unclear how MOECC addresses the impacts of climate change (and cumulative effects) in making its decisions about project approvals.

Similarly, we are not sure how MNRF considers climate change in its decision making about land use planning, permits, or other regulatory processes it administers that impact the species, ecosystems, and landscapes that MNRF is mandated to conserve. In the Far North, for example, the draft FNLUS does not

address climate change in any prescriptive way and does not consider how protection and development zoning will be affected by climate change nor how climate change will affect development and protected area zoning now or in the future.

While we are encouraged by the side panel note that MNRF is developing a framework for addressing multiple stressors in aquatic systems, we think that this kind of a framework is necessary to address terrestrial and freshwater biodiversity at a variety of scales given climate change and ongoing development regardless of federal and/or provincial environmental assessment legislation. There are examples from other jurisdictions developing regional-scale frameworks to address cumulative impacts in terrestrial (e.g., Noble 2015) and freshwater systems (e.g., Dubé et al. 2013). While others are applying planning tools to address freshwater conservation more explicitly in the face of land use and climate change (e.g., Suski and Cooke 2007, Hermoso et al. 2016). Elsewhere, we have made the case for regional planning and strategic environmental assessment (SEA) in order to address cumulative effects and climate change, particularly in Ontario's Far North (Chetkiewicz and Lintner 2014). There are a number of recommendations for reforming legislation (e.g., Ontario's *Environmental Assessment Act*) in order to address cumulative effects assessment of climate change and land use¹².

Proposed Actions

- Develop a regional cumulative effects framework that includes statements about the desired future condition (e.g., targets) of the species, ecosystems, and landscapes and considers scenarios of current development and climate change along with scenarios of alternative futures.
- Predicting the effects of climate change on biodiversity requires consideration of multiple spatial and temporal scales, ideally based on ecological requirements for species and ecological functions and processes that should also be addressed within the framework.
- Ensure this information is considered in decision making about land use planning for protection and development.

Goal 3. Increase science, research, and knowledge

In general, actions 3.1 to 3.7 are all reasonable, but we recommend adding targets to help assess effectiveness. The examples in the boxes are helpful and implicitly suggest MNRF priorities (e.g., permafrost mapping, tools and datasets; assessing multiple stressors on freshwater fish), but as presented do not map clearly onto various actions. It would be useful to provide an appendix of existing and planned activities for each broad action and MNRF should identify priorities across both space and time.

¹² <https://canada.wcs.org/Portals/96/Documents/EABriefing.pdf?ver=2016-12-01-124453-427>

Recommendation 7. Monitor species and ecosystems vulnerable to transition under climate change as well as MNRF program effectiveness in addressing climate change.

Monitoring environmental change, including climate, and associated ecosystem responses is vital to allow for adjustments in management strategies and is particularly relevant in times of rapid climate change (Fischlin et al. 2007). Monitoring and evaluation approaches can be grouped into four broad purposes: basic research; accounting and certification; status assessment; and effectiveness measurement (Stem et al. 2005). While MNRF has conducted an assessment of its current monitoring programs to address climate change (Furrer et al. 2014), they identified a lack of information relevant to climate change indicators, particularly for rivers, wetlands, and most terrestrial wildlife (Appendix 1). It remains unclear how MNRF will implement these moving forward. In addition, it is also important that MNRF consider how it monitors the effectiveness of its actions in delivering outcomes associated with these goals.

Proposed Actions

- MNRF identify how it will monitor program effectiveness.
- Prioritize monitoring for species and ecosystems vulnerable to transition under climate change (e.g., caribou, cold-water fish species) and address known gaps in existing programs (Furrer et al. 2014).

Recommendation 8. Ensure species management and land use planning explicitly consider climate change.

While MNRF has conducted applied and field research on climate change, it should incorporate climate change in species planning (e.g., caribou, lake sturgeon, polar bears, wolverine) and land management plans and programs (e.g., community-based land use plans).

Proposed Actions

- Ensure plans and programs explicitly consider species' abilities to adapt to climate change, such as caribou, by reviewing and incorporating climate change scenarios into existing and new management plans.
- Identify species and ecosystems more vulnerable to transition under climate change could help prioritize actions around refugia and conservation actions (e.g., protecting cold, deepwater lakes for cold-water fishes). These areas need to be considered more proactively in protected area planning (e.g., the Far North under community-based land use plans) and in evaluating existing protected areas.
- Apply climate change projections in planning and decision making (e.g., ensuring community-based land-use planners have current and future climate change scenarios for the Far North when considering development and protection zoning).
- Undertake vulnerability and risk assessments at different scales such as ecoregions and watersheds (e.g., Douglas et al. 2014). We support McLaughlin and Webster (2014) in their recommendation to develop a climate change vulnerability and adaptation assessment framework for the Hudson Bay Lowlands.
- Employ scenario planning of current and future land use and climate change at relevant scales. WCS Canada has invested in the use of a cumulative effects simulation tool (ALCES) to explore

the potential impacts of land use and climate change on fish and wildlife in the Far North (e.g., Carlson and Chetkiewicz 2013).

- Prioritize species and management needs (e.g., keystone species, rare systems and species, highly valued systems and species) under a changing climate within management plans (e.g., Fisheries Management Zone Plans, Species Tool Kits) and recovery strategies (e.g., wolverine, lake sturgeon, polar bears).
- Revise fish and wildlife management objectives around maximum sustained yield (MSY) to a more precautionary one by considering MSY as a “limit reference point” for exploitation in order to safeguard productivity (e.g., Lester et al. 2003). Action plans need to detail responses when this point is exceeded. At present, MNRF’s approach to “sustainable fishing and hunting” is focused on monitoring the increased demand for fishing and/or hunting and devising counter-measures to lessen its impact rather than managing for resilience in the face of climate change and other impacts (Lester et al. 2003).

In conclusion, climate change remains one of the most challenging and pressing threats facing ecological and human communities as well as the economies that have contributed to climate change and will be impacted by climate change. MNRF holds significant responsibilities for addressing how species, managed and unmanaged ecosystems, and regional landscapes will be affected by climate change as well as opportunities to address how we can maintain biodiversity in the face of climate change. We hope our comments provide additional direction to advance MNRF’s efforts to address climate change adaptation. 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,



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Appendix 1. The relationship between aquatic long-term monitoring programs sponsored by the MNR and climate change monitoring needs (response indicators) for aquatic ecosystem components (modified from Furrer et al. 2014).

Lakes and streams	Wetlands	Fish*
Disease, parasite, and pest distribution x	Coastal wetlands x	Disease, parasite, and pest distribution x
Ecosystem productivity ✓✓	Distribution of ecosystems x	Habitat quality x
Ice Cover x	Ecosystem productivity x	Phenological events x
Phenological events x	Permafrost x	Species abundance ✓✓
Species abundance* ✓✓	Species distribution and composition x	Species distribution ✓✓
Species distribution* ✓✓	Water quantity x	Species composition x
Species composition* ✓	Wildfires x	
Water quality* ✓		
Water quantity ✓✓		

*lakes only