

Conserving Biodiversity: A Public Health Imperative

5 APRIL 2017



Contents

Foreword.....1

Introduction.....1

Biodiversity Supports Health in Ontario.....2

 Climate change—a complicating factor7

Opportunities8

Endnotes.....10

EcoHealth Ontario gratefully acknowledges the Ontario Trillium Foundation, Forests Ontario, the Canadian Community of Practice in Ecosystem Approaches to Health – Ontario Node and our Steering Committee and Workgroup members for their generous support of our work.

Foreword

EcoHealth Ontario, a working group of the Ontario Biodiversity Council, prepared this background paper to initiate a discussion about the impacts of biological diversity, climate and social change on human health and wellbeing in Ontario. An understanding of these important connections across all sectors will enable the creation of policies that help achieve the goals of both groups.

Introduction

Biological diversity can be defined as “the variety of life on Earth, from the tiniest insect to a vast northern forest. Biodiversity is also about being connected – no species, including people, can live without others to provide it with food and habitat. All living things are part of this life system” (Ontario Biodiversity Council, 2016).

There is an intrinsic connection between human health and wellbeing and biodiversity (Figure 1¹). Ontario’s Biodiversity Strategy builds on this connection: “Our vision is a future where biodiversity loss is halted and recovery is advanced. People value, protect and enhance biodiversity and the ecosystem services essential for human health and wellbeing.” (Ontario Biodiversity Council, 2011) However, many people, including health professionals, don’t fully appreciate how biodiversity supports our quality of life and our health in this province.

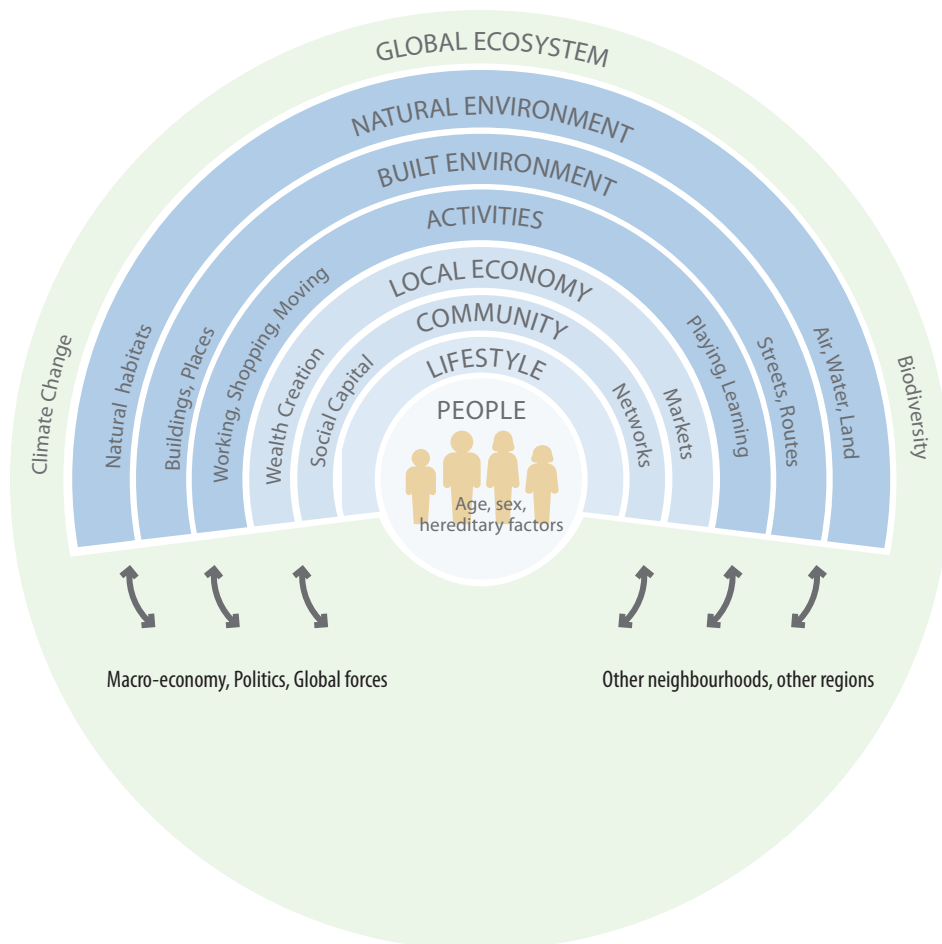


FIGURE 1

A Health Map for the local human habitat: Determinants of health and wellbeing in our neighbourhoods

(Source: Barton and Grant, 2006)

The purpose of this background paper is not to debate the linkages between human health and biodiversity. These connections are comprehensively laid out in the internationally-accepted, peer reviewed literature (Table 1) where links are specifically made to the health sector. Rather, the purpose is to move forward from the foundation of knowledge detailed in these reports to focus specifically on how this research can be leveraged to protect and promote the health and wellbeing of current and future generations of Ontarians (Table 2).

There is a growing conversation about how human health and wellbeing are dependent on the environment. The ecological determinants of health, as articulated in a 2015 Canadian Public Health Association discussion paper², are *the ecological processes and natural resources that are essential to life on the planet such as oxygen, water, and resilience food systems*. Biodiversity is intrinsically connected to these ecological determinants of health.

TABLE 1
Selected international documents summarizing the relationship between biodiversity and human health and wellbeing

Title (Year)	Author
Climate Change and Biodiversity: IPCC Technical Paper V (2002)	Intergovernmental Panel on Climate Change
Millennium Ecosystem Assessment Reports—including Biodiversity and Health reports (2000)	Millennium Ecosystem Assessment
Nature and Health: The influence of nature on social, psychological and physical wellbeing (2004)	Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, Nature and the Environment
Forests and Human Health (2006)	Food and Agriculture Organization of the United Nations
Human health. Climate Change: Impacts, Adaptation and Vulnerability (2007)	Intergovernmental Panel on Climate Change
Healthy wetlands, healthy people: A review of wetlands and human health interactions (2012)	World Health Organization, RAMSAR Convention
Connecting Global Priorities: Biodiversity and Human Health: A State of Knowledge Review (2015)	World Health Organization; Convention on Biological Diversity; United Nations Environment Programme

Biodiversity Supports Health in Ontario

The right of every person to a healthy life has been recognized since the 1940s in the World Health Organization's constitution as well as by the Universal Declaration of Human Rights. The categories direct, indirect and tertiary impacts on health are increasingly being used to summarize the complex landscape of health as it relates to social factors, climate change and biodiversity loss (Figure 2 below, see also: Butler, 2014a; WHO 2016³). They are defined as:

- Direct impacts: those that are directly, causally attributable to environmental and climate-related factors (such as cardiovascular risk associated with heat waves, or the risk of injury associated with more intense and frequent storms).
- Indirect risks: those that are downstream effects of social-ecological system changes at different spatial scales (global, regional, local, household etc.). They include changes in infectious disease vector distribution, air pollution interactions with heat waves, and the social and mental health impacts of damage to infrastructure and human settlements.

- Tertiary impacts: considered to be “the most important health risk” (Butler, 2014b⁴) they are those associated with adverse changes to climate systems and biodiversity. They include the health impacts of large-scale famine, forced migration and human conflict that are exacerbated by the alteration of ecosystems, sea-level rise and a loss of resilience in food production and water systems.
- The World Health Organization (2016) in its report *Connecting Global Priorities: Biodiversity and Human Health* describes biodiversity conservation as a health sector imperative:

Health and biodiversity strategies could be developed with the aim of ensuring that the biodiversity and health linkages are widely recognized, valued, and reflected in national public health and biodiversity strategies, and in the programs, plans, and strategies of other relevant sectors, with the involvement of local communities (p. 19).

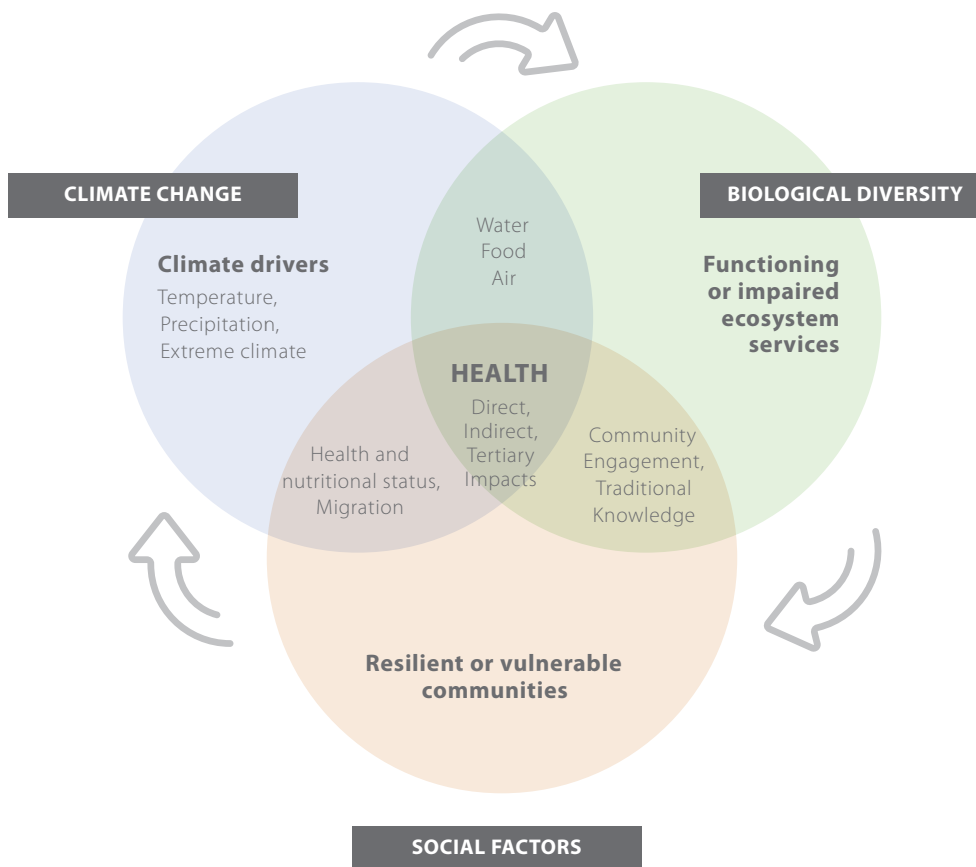


FIGURE 2
Putting health at the Centre: Climate change, biological diversity and social factors influencing the health and wellbeing of current and future generations
(WHO, 2016, p. 228)

The health sector in Ontario has been working for decades to advocate that everyone who lives in this province has equal access to the conditions that provide for a healthy life. Much of this work has focused on addressing the evidence showing how the built environment can impact the health and wellbeing of the public. There is an emerging ecological public health perspective⁵, which builds on community health work and combines it with an awareness of how ecosystems and greenspaces offer health-benefitting functions. It offers a worldview that connects public health to ecological resilience and reminds us that our health and wellbeing as humans is shared with ecosystems, the landscape and other species.

An ecological public health approach—or an ecohealth approach—to biodiversity recognizes that human health and biodiversity are intrinsically connected. This connection is fundamental to our wellbeing. In order to ensure our health and the health of future generations, it is necessary to not only react to threats to biodiversity but also to prevent its further deterioration. An understanding of these connections leads to the realization that protecting and preserving biodiversity is personal.

In its 2014 survey of biodiversity awareness, the Ontario Biodiversity Council found that the majority of respondents agreed with the statement that “biodiversity plays an important role in maintaining my health and wellbeing”. The majority were also able to select from a list of potential health incomes one that they felt had the greatest impact on their health. This suggests that framing biodiversity as a health issue will allow ecologists to better collaborate with Ontario’s health sector.

An ecohealth approach to biodiversity will help to explain to both the health sector and to the public in general that we all live downstream from environmental factors that have an impact on our health, including threats to biodiversity, and that addressing these issues is a critical component of public health prevention. We need institutions and policy to protect our biodiversity upstream so that we all can live in healthier communities downstream. In this way, it will not only help to spread the word about the positive benefits of protection and enhancing biodiversity, personalizing the issue, but also enable the creation of policies in different government sectors that support biodiversity in Ontario.

Biodiversity has always contributed to health and wellbeing in Ontario. We depend on freshwater to live and the province’s lakes, rivers and streams support subsistence and recreational fishing for some Ontarians⁶. Our soils nourish communities and food that is produced here, and is exported around the world, contributing to our economy via the food industry. Forests help clean our air and maintain the integrity of our watersheds, providing a wide range of ecological services⁷. We seek the calm and wonder of the natural landscape of parks, conservation authorities and wilderness areas. We experience the pleasure of blue spaces—places with a vista of a body of water, such as a lake or a pond, or waterway—and enjoy recreational opportunities in the green spaces of both urban and rural communities. Biodiversity also nourishes culture in the province. The landscape of the Canadian Shield as captured by the Group of Seven fosters a sense of place and identity. Culturally significant species⁸ and their ecosystems have become connected to the identities of indigenous communities over generations, such as loons and moose in Ontario. They not only provide healthy food to these communities but also foster spirituality and education⁹. The significance of socio-cultural connections to biodiversity and place is important to our emerging understanding of mental and emotional health (see Box 1).

But we often fail to recognize the intimate connections between human health and that of our environment. Our history is marked by periods of imprudent over-exploitation of the biodiversity of the province, followed by disruption and even collapse of ecosystems. A long-forgotten chapter in Ontario’s history reminds us how the ecological determinants of health—such as air, water and food—are dependent on healthy ecosystems (see Box 2). And ecosystems degrade perilously in ways that undermine our collective health, wellbeing and security if we don’t take care of them.

EcoHealth Ontario’s casebook describes how green spaces provide both environmental and public health benefits in Ontario. They include:

- providing tree cover on city streets to provide shade and cooling during increasingly hot summers and contribute to storm water management and improved air quality;
- linking mental health outcomes to exposure to nature; and
- protecting and expanding the province’s Greenbelt which protects natural areas and farmland and contributes to the integrity of the province’s social and ecological determinants of health.

EcoHealth Ontario is also preparing a policy toolkit to support the integration of ecological and health considerations into municipal policies in a range of sectors, including parks and recreation, forestry, public health and planning. This discussion paper furthers the casebook and policy toolkit by highlighting the fundamental links between EcoHealth Ontario’s work on green spaces and the larger issues raised by biodiversity loss in the province.

TABLE 2
Biodiversity protection as an investment in health promotion and preventive health care

Term	Definition	Relation to Biodiversity Protection
Health Promotion	Health promotion is the process of enabling people to increase control over, and to improve, their health. It moves beyond a focus on individual behavior towards a wide range of social and environmental interventions. xii	Biodiversity protection is an environmental intervention that enables people to increase control over their health by: reducing the local impact of disasters and environmental hazards; providing alternative food sources in times of food insecurity; providing clean air, water and soil; fostering mental and physical health and wellbeing and sustaining a livable environment for future generations.
Preventive Health Care	Measures taken for disease prevention, as opposed to disease treatment.xii	Biodiversity protection is a measure that can be taken to prevent disease, including physical and mental health disorders, in at-risk populations. The evidence base for these interventions is increasing and is well-summarized in a variety of recent international reports.

Box 1. Socio-Cultural Health and Biodiversity in Ontario

Positive health outcomes in a variety of areas can be linked to biodiversity in Ontario. Our provincial identity, art and culture are strongly tied to the natural world, and there is a strong reciprocal relationship between biodiversity, cultural diversity and health. Our cultural traditions, and the social interactions they support, enhance our wellbeing in a myriad of ways. As the WHO (2015) points out: "Species, habitats, ecosystems, and landscapes form essential elements of food production systems, culinary traditions, traditional medicine, rituals, worldviews, attachments to place and community, and social systems. The constructs of cultural ecosystem services, and ecosystems as settings, can be used to frame the relationships between biological diversity and cultural diversity, and human health and wellbeing. The cultural services provided by an ecosystem provide a useful lens through which the interlinkages between biodiversity and health can be seen" (p. 219).

Ontarians have an entire museum dedicated to the canoe. It is worth asking: Who would we be in Ontario without the white pine, the black bear, the Carolinian forest or the trillium? What would be the public reaction to the extirpation of the loon, the moose, the monarch butterfly, the tundra swan or the snowshoe hare? Many of the ceremonies and festivals in Ontario celebrate the natural world and may be tied to specific places and landscapes. These include pow wows, Oktoberfest, fall fairs, butterfly festivals, and local food festivals, such as Foods of the Boreal in Algoma, Ontario and the Guelph Wellington Local Food Fest. In addition, our folklore, stories and songs feature natural places and histories such as the Lake Superior dragon, Missshepezhieu¹⁰, and Franco-Ontario song catalogues referencing the discoverers, explorers and voyageurs¹¹.

The strong link among cultural values, biological diversity, and the wellbeing of families and communities are a powerful feature of indigenous life in Ontario (Berkes and Davidson-Hunt, 2005)¹². Indigenous knowledge about biodiversity is valuable. Concern about the misuse, misappropriation and biopiracy of aboriginal traditional knowledge has led some First Nations' communities to keep their knowledge in-house¹³. We are encouraged to take into account the recommendations of the Truth and Reconciliation Commission¹⁴, including those pertaining to treaty rights, indigenous languages, customs and ceremonies.

The links among biodiversity and socio-cultural health and the wellbeing of diverse communities in Ontario warrants further exploration as a way to highlight biodiversity and health relationships in the province. Such a review could be complemented by a focus on the direct benefits to the physical, emotional, social and mental health of populations related to contact with nature.

Box 2. Norfolk County Example

Some of the first bites of spring asparagus are picked from the fields of Norfolk County, not far from Lake Erie. This area of the province tends to be warmer than other farming areas in Ontario and the warm temperatures, combined with the lake effect and sandy loam soil, mean that the asparagus grows early. Norfolk County has been dominated by agriculture since before the Second World War and today its farmers produce a wide variety of foods, from organic vegetable crops to grass fed beef. The area is also rich in different habitats such as wetlands and is home to Carolinian Forests. The Nature Conservancy of Canada calls the Norfolk County Sand Plain a biodiversity hotspot¹⁵ because there you can find 25 percent of Canada's species at risk. It is therefore hard to reconcile Norfolk County's natural abundance today with its not-so-distant history.

Only one century ago, Norfolk County was suffering from severe desertification. The county, along with much of Ontario, had been logged to feed the export lumber industry. Keystone tree species such as the white pine and the American chestnut had been felled, leaving the county soils vulnerable to erosion and desertification. By 1908, as agricultural researcher John Bacher documented in his book *Two Billion Trees and Counting*, desertification in Norfolk County was so severe that blowing sand covered fences and even threatened to bury barns. Agriculture was threatened and the crops that farmers did grow were so paltry that they could hardly pay their expenses.

If it weren't for the reforestation efforts initiated in the early 1900s, Norfolk County and the rest of Ontario might not look as it does today. The provincial government initiated a reforestation program that would triple forest cover in the province by 1963 (Bacher 2011: 197). In so doing it helped to support biodiversity in Norfolk County and beyond. Today in the county people continue to work towards preserving and managing biodiversity. Farmers in the area are collaborating with the Ontario Bobolink Roundtable to protect this bird, which is a species at risk. The Nature Conservancy of Canada owns and protects an older-growth forest in the Carolinian Life Zone and is working to protect pollinator habitat and connect natural areas. Community groups, such as the Norfolk Field Naturalists, landowners, foundations and the conservation authority work together to protect and grow forest corridors to support biodiversity¹⁶. And the Alternative Land Services program in Norfolk County rewards farmers who protect and enhance ecosystem services.

The desertification that plagued Norfolk County and other parts of Ontario has faded from our collective memory. However, looking back reminds us that our ecosystems are fragile and that human activity can have catastrophic consequences. Damage to the natural world can trigger cascading losses of ecosystem services to the point where they can no longer support the communities that depend on them. In the case of Norfolk County, we saw how desertification began to erode society's ecological determinants of health. A turn to ecosystem thinking offered a path forward. When we make the connection between the health sector and biodiversity, the state of the environment in which we live becomes fundamental for supporting public health and wellbeing as well as sustainable livelihoods.

Opportunities

The Ontario Biodiversity Council and EcoHealth Ontario share the worldview that health and biodiversity are connected. A key action for the Ontario Biodiversity Council is to “develop a strong network of partners engaged in acquiring a deeper understanding of the linkages between biodiversity and human health and wellbeing.” One of EcoHealth Ontario's objectives is to understand “the interactions among natural systems and human health and wellbeing” (EcoHealth Ontario, 2016). Based on these shared perspectives, this report highlights four potential areas of convergence, where there is an opportunity to strengthen the call for biodiversity protection and enhancement by cultivating the health sector's voice:

- i. Biodiversity sustains the resilient ecosystems that provide the foundation for Ontario's society to survive.**
Protecting and enhancing biodiversity is critical to fostering the critical ecological determinants of health that are fostered by resilient ecosystems, particularly as we confront the challenges of global climate change.
- ii. Agricultural sustainability and resilience are crucial to human health and wellbeing and depend on diverse**

soil and food crops. Planning and environmental management approaches that fully account for the importance of biodiverse landscapes and communities and prioritize climate change mitigation and adaptation measures are needed in all sectors, including health;

iii. Biodiversity underpins human health and wellbeing both physically and socio-culturally. Investments in biodiversity, including through the protection of air, land and water resources, are both health promoting and timely. They enhance our collective resilience to climate change, and support health promotion as well as preventive health objectives;

iv. Investments in biodiversity also support the call from the Truth and Reconciliation Committee for fostering improved socio-cultural relationships, health equity and connections to place within the country. Measures to preserve and protect native species will benefit all Canadians, and are particularly important for the resilience of indigenous health systems, socio-cultural knowledges and local practices. Many medical innovations draw on indigenous knowledge and the properties of non-human species and processes—an approach to knowledge generation and translation that can have significant benefits to society.

There is an urgency to spread the word about how our health depends on biodiversity. As outlined in the State of Ontario's Biodiversity Report, environmental degradation, climate change, urbanization as well as land use and habitat change today threaten biodiversity in this province—and therefore threaten our health and the health of future generations. A key step will be increasing the awareness of the health community of how and why increased biodiversity in communities can increase the resilience of Ontario populations to both social and climate changes.

This may encourage the health sector to become more active in local planning decisions that affect the ecological determinants of health. It is part of a growing national and provincial push for a more active role for the health sector in addressing both the ecological determinants of health and the need for locally developed adaptations to climate change. Fostering these connections will enable the creation of policy and programming that supports our health and our ecosystems for generations to come. Table 3 highlights opportunities where biodiversity can be further addressed in the health sector.

EcoHealth Ontario welcomes feedback from the Ontario Biodiversity Council and other interested parties to refine this nascent agenda for action linking human health and biodiversity in Ontario.

TABLE 3
Health Sector
Opportunities
linking
Biodiversity
and Health in
Ontario

Adapted from
 WHO, 2015

Biodiversity and Health Topic	Health Sector Opportunity
<p>Water</p> <ul style="list-style-type: none"> • Water quantity • Water quality • Water supply 	<p>DIRECT</p> <ul style="list-style-type: none"> • Integrate watershed and ecosystem resilience into source water protection, watershed and health policies <p>INDIRECT</p> <ul style="list-style-type: none"> • Promote protection of ecosystems that supply water and promote equitable and sustainable water use
<p>Food and Nutrition</p> <ul style="list-style-type: none"> • Species, varieties and breeds including domesticated and wild components • Diversity of diet • Ecology of production systems • Total demand on resources • Sustainability of offtake, harvesting and trade of species used as food • Change status of species used as food 	<p>DIRECT</p> <ul style="list-style-type: none"> • Recognize and promote dietary diversity, food cultures and their contribution to good nutrition • Recognize synergies between human health and sustainable use of biodiversity (e.g. moderate consumption of meat) • Recognize and respond to shifting food harvesting and consumption practices (e.g. urban crawfish harvesting) <p>INDIRECT</p> <ul style="list-style-type: none"> • Promote sustainable production harvesting and conservation of biodiversity
<p>Diseases</p> <ul style="list-style-type: none"> • Disease source and regulation services • Ecosystem integrity and diversity 	<p>DIRECT</p> <ul style="list-style-type: none"> • Integrate ecosystem management considerations into health policy • Prepare for new and emerging outbreaks of infectious disease <p>INDIRECT</p> <ul style="list-style-type: none"> • Promote ecosystem integrity
<p>Contaminants</p> <ul style="list-style-type: none"> • Bioaccumulation and biomagnification of persistent organic pollutants and heavy metals 	<p>DIRECT</p> <ul style="list-style-type: none"> • Assess the potential risks to human health posed by new and existing substances • Communicate risks to the public and other stakeholders <p>INDIRECT</p> <ul style="list-style-type: none"> • Develop environmental standards and programs that protect biodiversity • Oversee a biomonitoring system to track contaminant levels

Biodiversity and Health Topic	Health Sector Opportunity
<p>Medicine</p> <ul style="list-style-type: none"> • Traditional medicines • Drug development (genetic resources and traditional knowledge) • Chemical/pharmaceutical accumulation in ecosystems • Sustainability of offtake/harvesting and trade of medicinal species • Changing status of species used as medicine 	<p>DIRECT</p> <ul style="list-style-type: none"> • Recognize contribution of genetic resources and traditional knowledge to medicine <p>INDIRECT</p> <ul style="list-style-type: none"> • Protect genetic resources and traditional knowledge • Ensure benefit sharing with traditional knowledge holders
<p>Physical, mental and cultural dimensions of health</p> <ul style="list-style-type: none"> • Physical and mental health • Cultural/spiritual enrichment 	<p>DIRECT</p> <ul style="list-style-type: none"> • Integrate ‘value of nature’ into health policy • Promote biodiversity and access to nature in the built and natural environments <p>INDIRECT</p> <ul style="list-style-type: none"> • Promote protection of values, species and ecosystems
<p>Adaptation to climate change</p> <ul style="list-style-type: none"> • Ecosystem resilience <p>Disaster risk reduction</p> <ul style="list-style-type: none"> • Genetic resources (‘options’ for adaptation) • Shifting reliance to biodiversity to climate change ‘shocks’ 	<p>DIRECT</p> <ul style="list-style-type: none"> • Integrate biodiversity when possible to climate change health vulnerability assessments and adaptation plans <p>INDIRECT</p> <ul style="list-style-type: none"> • Promote ecosystem resilience and conservation of genetic resources • Decrease vulnerability of people reliant on important food and medicinal species which are likely to be impacted by climate change
<p>Air</p> <ul style="list-style-type: none"> • Air quality • Removal of pollutants • Emission of chemicals, pollen 	<p>DIRECT</p> <ul style="list-style-type: none"> • Evaluate Ontario tree species role in air quality <p>INDIRECT</p> <ul style="list-style-type: none"> • Promote tree planting that encourages diversity and improve air quality

Endnotes

- ¹ Barton, H. and M. Grant. 2006. A health map for the local human habitat. *The Journal for the Royal Society for the Promotion of Health*. 126(6):252-253.
- ² Canadian Public Health Association. 2015. Global change and public health: Addressing the ecological determinants of health. Discussion Document. Ottawa: Canadian Public Health Association.
http://www.cpha.ca/uploads/policy/edh-discussion_e.pdf
- ³ Butler, C.C. 2014a. Climate change and global health: a new conceptual framework – Mini Review. *CAB Reviews*. 9:027.
World Health Organization. 2015. Connecting global priorities: biodiversity and human health: a state of knowledge review. Geneva: World Health Organization and the Secretariat of the Convention on Biological Diversity.
- ⁴ Butler, C.D. (ed.). 2014b. *Climate Change and Global Health*. Boston: CABI.
- ⁵ Not to be confused with the similarly named, traditional ecological model in public health, which is a model of health that emphasizes the linkages and relationships among multiple factors (or determinants) affecting health. It focuses on the individual, interpersonal, institutional, community and social/policy influences, but rarely (and only recently), the ecological context in an environmental sense.
- ⁶ Refer to the Ministry of the Environment and Climate Change's Eating Ontario Fish (2015-16) for consumption limits and advisories related to the contamination of Ontario fish by metals and persistent organic pollutants.
<https://www.ontario.ca/document/guide-eating-ontario-fish>
- ⁷ Ecosystem services are the tangible and intangible goods and services provided by biotic and abiotic systems.
- ⁸ Noble, M. et al., 2016. Culturally significant fisheries: keystones for management of freshwater social-ecological systems. *Ecology and Society*. <http://www.ecologyandsociety.org/vol21/iss2/art22/>
- ⁹ Assembly of First Nations. 2007.. Traditional foods: Are they safe for First Nations consumption? Environmental Stewardship Unit. http://www.afn.ca/uploads/files/env/traditional_foods_safety_paper_final.pdf;
Kuhnlein, H.V. and H.M. Chan. Environmental and Contaminants in Traditional Food Systems of Northern Indigenous Peoples. *Annual Review of Nutrition*. 2000. 20:595-626.
- ¹⁰ Unwin, P. 2003. *The Wolf's Head: Writing Lake Superior*. Toronto: Cormorant Books. Chapter 3.
- ¹¹ Beneteau, M. n.d. Traditional French Songs in Ontario. Encyclopedia of French Cultural Heritage in North America.
http://www.ameriquefrancaise.org/en/article-726/traditional_french_songs_in_ontario.html
- ¹² Berkes, F. and I.J. Davidson-Hunt. 2006. Biodiversity, traditional management systems, and cultural landscapes: examples from the boreal forest of Canada. *International Social Sciences Journal*. 187: 35-147
- ¹³ Assembly of First Nations. n.d. Aboriginal Traditional Knowledge and Intellectual Property Rights. Discussion paper. p. 5
http://www.afn.ca/uploads/files/env/atk_and_ip_considerations.pdf; Uprety, Y., H. Asselin, A. Dhakal and N. Julien. 2012. Traditional uses of medicinal plants in the boreal forest of Canada: review and perspectives. *Journal of Ethnobotany and Ethnomedicine*. 8(7): on-line pagination. DOI: 10.1186/1746-4269-8-7
- ¹⁴ Truth and Reconciliation Commission. 2012. Call to Action. Winnipeg: Truth and Reconciliation Commission of Canada.
http://www.trc.ca/websites/trcinstitution/File/2015/Findings/Calls_to_Action_English2.pdf
- ¹⁵ Nature Conservancy. 2016. Southern Norfolk Sand Plain Natural Area. <http://www.natureconservancy.ca/en/where-we-work/ontario/our-work/southern-norfolk-sand-plain-natural-area.html>
- ¹⁶ Carolinian Canada. 2016. The Big Picture Network: Norfolk Count http://caroliniancanada.ca/legacy/BigPicture_Network_Norfolk.htm
- ¹⁷ Intergovernmental Panel on Climate Change (IPCC). 2002. Climate Change and Biodiversity. Geneva: IPCC.
<https://www.ipcc.ch/pdf/technical-papers/climate-changes-biodiversity-en.pdf>

- ¹⁸ World Health Organization. Global Health Risks: Mortality and burden of disease attributable to selected major risks. 2009. Geneva: WHO. http://apps.who.int/iris/bitstream/10665/44203/1/9789241563871_eng.pdf?ua=1&ua=1;
- Haines, A. and J. Patz. 2004. Health Effects of Climate Change *JAMA*, 291, 99-103
- McMichael, A. Woodruff, R. Hales, S. 2006. Climate change and human health: present and future risks *The Lancet*, 367:859-869.
- ¹⁹ Patz, J., Campbell-Lendrum, D., Holloway, T., & Foley, A. 2005. Impact of regional climate change on human health *Nature*. 438:310-317
- ²⁰ Centres for Disease Control. *Climate Effects on Health*. (September 27, 2015) Retrieved from <http://www.cdc.gov/climateandhealth/effects/>
- ²¹ Pathogens are microorganisms that can causes disease, such as, for example, bacteria, fungi, parasites and viruses. Zoonoses are diseases that can be transmitted from animals to humans. Infectious diseases involve the transmission of pathogenic microorganisms from one person to another; many zoonoses of concern are also infectious (e.g. SARS, MERS).
- ²² SARS stands for Sudden Acute Respiratory Syndrome; MERS is the Middle East Respiratory Syndrome

