First Nations Population Health & Wellness Agenda

Options for Finding a Path Forward to

Incorporate Ecological Health Indicators

October 31, 2017

FOR DISCUSSION

Prepared by Craig Stephen DVM PhD and Julie Wittrock BSc MSc
Canadian Wildlife Health Cooperative

University of Saskatchewan

Contents

Executive Summary

The interconnection of land, language, and culture are the foundations of wellness strategies for Aboriginal peoples of Canada. The contributions of traditional activities on the land are difficult to extract from other determinants of health, but reduced access to environmental resources can be viewed as drivers of reduced determinants of health and lack of access to land a critical source of stress for First Nations. However, there is currently no evidence-based way to select the appropriate scale, frequency, or ecological variables to construct an ecological indicator component of a British Columbia First Nation's Population Health and Wellness monitoring system.

Many of the challenges encountered are not unique to First Nations health, but rather reflect the complexity, debate, and inconsistency in how ecological indicators are selected, assessed, and measured. Compounding these challenges are the lack of consistent methodology, application of indicators across all regions relevant to the First Nations Health Authority (FNHA), and varying time and spatial scales of measurement. No single framework for either ecological or First Nations' health could be found. Work on linking ecological change to human health outcomes are rare and insufficient to prescribe an ecological monitoring approach that is valid, understandable, and repeatable for the FNHA.

Understanding and measuring changes in how communities or individuals' connections to their land and territories change is, in our view, the most relevant and generalizable indicator that could help the FNHA identify situations that require promoting, protecting, or recovering in terms of securing determinants of health related to ecosystems in BC. Unfortunately, no validated, regular, or repeated tool for measuring connections was found apart from period surveys on some attributes of extractive uses of ecosystems, such as hunting and fishing, commercial use of those resources, or in rare instances, how people feel about their environment as a source of community strength or challenges.

Three main conclusions and four options for going forward were derived from our review of literature and existing resources.

Conclusion 1: An evidence-based selection of a pre-existing indicator to link First Nations' health and ecological change is not possible apart from monitoring standard markers of public health risks.

Option1: Rely on typical environmental health information, emphasizing factors such as water and traditional food safety and security.

Option 2: Work with communities and/or regions to identify a sub-set of pre-existing ecological indicators that best reflect the contributions to the determinants of health in that region/community, cross-reference those choices with existing data sources, customize the indicators that will be used to reflect local benefits from the land and, through a local participatory process, select community-based thresholds for acceptable levels.

Conclusion 2: Monitoring people's connections to their territories is a qualitative, yet rich option for summarizing the link between well-being of people and their ecosystems, but lacks a regular and validated means for monitoring.

Option 3: FNHA develops methods or partnerships for routine surveys of how individuals perceive changes in the quality, contribution, and sustainability of their connections to their land and territory.

Conclusion 3: Challenges in prescribing ecological indicators for the FNHA reflect the general state of knowledge in ecological monitoring and assessment and the failure of past regulation and research to explicitly link ecological change to population health outcomes.

Option 4: FNHA develops clarity on its goals for monitoring ecological indicators. Key issues to resolve before tailoring the section of ecological indicators to FNHA objectives includes determining if the FNHA wants to: (i) develop locally relevant or provincially generalizable indices; (ii) create early warning of harm indicators or signals of changing capacity for health; (iii) use community derived, centrally created public data or create its own ecological monitoring system; and (iv) have regular surveillance or periodic surveys.

Details of each option are provided along with guiding principles and candidate goals for future ecological indicator development.

Introduction

The First Nations Health Authority (FNHA) is building a new suite of indicators that incorporates British Columbia (BC) First Nations' perspectives on health. These indicators complement those focused on ill-health to provide baseline information and help find priority areas for action to protect and promote health.

The objective of this report is to identify options for using ecological health information to inform the FNHA Chief Medical Health Officer and communities on non-built environmental changes affecting community health and wellness.

We acknowledge that meaningful measures that link individuals' and communities' well-being are best developed in close consultation with those individuals and communities who will use the measurements. A community-based participatory approach was not within the scope of this project. The target audience for this report is the FNHA and their staff who may develop and interpret ecological information as part of the FNHA population health and wellness agenda. This report should be viewed as a basis for future conversation and collaborations with people who will use the outcomes of an ecological health monitoring system.

The report is in four parts:

Part 1: Introduction

Part 2: Exploring conceptual options for using ecological information within the FNHA context

Part 3: Refining the focus by assessing the feasibility of using existing information

Part 4: Options for ecological health indicators

Core concepts and initial challenges

Concepts like wellness, resilience, and health vary in their definition and use across spheres of expertise and experience. The following outlines our perspectives on wellness, health, ecology, and community.

Health and wellness: Health, wellness, and resilience, at their core, each deal with situations, decisions, and actions that allow us to cope with and even thrive in a changing world. Health is our capacity to cope with life's challenges, whereas wellness is the state of living that leads to health. As per the Ottawa Charter for Health Promotion, health can only be created and sustained when we encourage reciprocal maintenance - to take care of each other, our communities and our natural environment.

Resilience: Resilience is a dynamic process of adjusting, adapting, and changing in response to challenges. Most of the literature on individual human resilience focuses on psychological characteristics such as flexibility, problem-solving, social skills, and intelligence (Kirmayer et al, 2011). Human community resilience often focuses on capacity to manage and recover from disaster, violence, or larger-scale disturbances (Norris et al, 2008). Ecological resilience can be defined as the magnitude of disturbance that can be absorbed before the system redefines its structure by changing the variables and processes (Gunderson, 2000). There is scant literature connecting these 3 forms of resilience.

Environment and ecosystem: Ecosystems are often conceived as "unowned nature", but your environment is everything that is not you. Your ecosystem is your relationships with your environment. The human ecosystem is the dynamic complex of us, plant, animal, and microorganism communities interacting with the abiotic environment to make a function unity. Human ecosystems can range from pristine areas sparsely populated by people to intensively modified and managed areas such as urban landscapes.

Community: A socio-ecological community is a group of actually or potentially interacting species, living in the same place that is bound by the network of influences that they have on one another. Those relationships can extend beyond a specific geographic area; therefore, a community is more than the place we live.

Challenges

Identifying the right set of variables that allow us to directly measure the proportion of our health attributable to nature and to predict how those attributions will evolve over time is beyond our grasp because of: (i) difficulties detecting changes in ecological drivers of vulnerability and resilience; (ii) insufficient evidence and agreement to identify thresholds for action; (iii) the lack of methods to work and integrate multiple geopolitical scales; (iv) ecological processes may be in operation for decades before changes can be seen, resulting in recovery taking equally, if not longer, periods; and (v) institutional inertia in co-managing data, environments, and relationships with the land (Spears et al, 2015).

Some specific challenges to consider in the development of ecological indicators for health and wellness monitoring by the FNHA include:

What not to include: As health is the product of our relationships with the world around us over our lifespan and our ecosystem is our relationships with the world around us, health is an ecological outcome. As such, there is no single element of an ecosystem that is not a contributor to our health status. However, the importance of specific links between individual health and well-being and the non-built environment vary within and between communities, depending on how nature is valued, used and accessed. Because human interactions vary geographically, by community, and with individuals, the potential suite of variables to track quickly becomes overwhelming.

There is no consensus on what to include: We found no single First Nations Health Framework that has been validated across Nations, communities, and generations. Age, gender, social-economic status, and other variables will affect what one considers necessary to maintain one's health. The lack of consensus on indicators and thresholds to track ecological health, apart from standards for specific environmental hazards, prevents ecological health being a standardized measurement exercise. Because there is no universal definition of well-being and because environmental determinants of health can be modified by social determinants, causal attributions of specific environmental features with health and well-being outcomes can be difficult to identify. The relationship between environmental hazards (i.e. water pollution) or environmental deficits (i.e. fishery declines) seem more straightforward to track and have more traditionally been components of ecosystem indicators for human well-being (Kjellstrom et al, 2007). However, there is growing recognition that community resilience is better served by viewing the environment as a source of positive determinants of health and enabling factor for well-being than as a constraining variable (Stephen and Duncan, 2017).

Dealing with variability and unpredictability in human and ecological systems: The health and well-being benefits from nature do not fall on all people equally because the circumstances of our lives create inequalities in our access to the sources of health found in nature. The relative contribution of an environmental component of human well-being can vary over a life-course and across geographic locations (Summers et al, 2012). The selection of the natural assets, processes, and benefits to protect and monitor are affected by the livelihood and cultural basis for each community and individual. Ecological variability and unpredictability have historically been mediated by local strategies but global trends, such as climate change, are adding new levels of complexity that are making prediction and adaptation less reliable. Our ability to understand and predict the outcome of anthropogenic or non-anthropogenic ecological changes is hampered if we consider change and stressors disconnected from dynamic interactions with major local social environmental drivers (Bozellie et al, 2009).

There are no accepted thresholds: Identifying thresholds for unacceptable change or securing consensus on what constitutes unacceptable harm are context dependent undertakings informed by local priorities, perspectives, and capacities. While there are accepted thresholds for a wide variety of environmental harms (ex. water quality standards, air pollution guidelines, food safety standards), there remains considerable debate and uncertainty on thresholds that indicate important changes to ecological health and even less on thresholds of ecological change that result in adverse human health, wellness and security outcomes. “Analysis of thresholds is complicated by nonlinear dynamics and by multiple factor controls that operate at diverse spatial and temporal scales” (Groffman et al, 2006). There are few general principles for applying ecological thresholds (Groffman et al, 2006). This necessitates intensive and expensive site-specific investigations to determine meaningful thresholds, precluding the selection of generic thresholds that can be applied across various landscapes and times.

Large uncertainties remain: Despite growing evidence of declines in the quality and sustainability of many global environments, research has inadequately determined the implications of these declines on human well-being (Raudsepp-Hearne et al, 2010). The relationship between health, social capital, and the biophysical environment has only recently been a subject of research (Maller et al, 2008). There is growing evidence of the non-linear changes in ecosystems that can result in unpredictable, irreversible, abrupt, and accelerating change (MEA, 2005). Unpacking cause and effect in the relationship between nature and health is a complex task. Because the links between human health and nature can be both direct and indirect, displaced in space and time, and influenced by a range of moderating forces, many of the standard public health methods for establishing cause-effect relationships cannot be applied. While the many hazards present in the environment have effects on health, the burden of disease attributable to these hazards cannot be quantified with any degree of confidence (von Schirnding, 2002).

Conceptualizing options for using ecological information within the FNHA context

The Land as a focus

> *For First Nations, the environment is vital in determining health and well-being. Our environment includes the land, air, water, food, housing and other resources that need to be cared for and considered to sustain healthy children, families and communities.*
> *First Nations Health Authority http://www.fnha.ca/what-we-do/environmental-health*

Place is important for health. Place constitutes and contains our relationships with social and physical resources (Cummins et al, 2007). Canadian First Nations have special cultural and legal relationships with nature based on a long history of extraction of natural resources to provide for four key elements of well-being namely: (i) basic human needs; (ii) economic needs; (iii) environmental needs; and (iv) subjective happiness from biophilia (Summers et al, 2012). The First Nations Health Council proposed that connection with the land (via medicine gathering, traditional foods [gathering berries, fishing, hunting], baths, and camping) as a main indicator for First Nations traditional wellness (FNHC, no date). The National Aboriginal Health Organization echoes the importance of nature for food and cultural resources but also emphasizes the importance of connections to nature for spiritual well-being (NAHO, no date). Hill (2009) similarly concluded that "the interconnection of land, language and culture are the foundations of wellness strategies" for Aboriginal peoples of Canada. The fundamental link between sustainable use and connection with the land and health is re-enforced in the document "Implementing the Vision: BC First Nations Health Governance" which states: "*The Ancestors taught that understanding the land, leadership, sustainable use of resources and the ability to provide for family and community were essential to survival. These values and skills, when put together, addressed what academics now call the social determinants of health*" (FNHC, 2011).

Severed ties to the land has been implicated as negative influences on physical, mental, emotional, and spiritual elements of First Nations health (Richmond and Ross, 2009). "*It is by utilizing what the land provides that individuals are able to maintain the balance necessary for health*" (Wilson, 2003). This perspective was re-enforced by a survey of members of the 'NAmgis First Nations that found, "*the ability to use the environment for traditional activities, {was} central to their native way of life*" (Richmond et al, 2005). Maintenance and renewal of relationships to the land is a cornerstone of many First Nations traditional perspectives of well-being. Communities such as the Shwah First Nation have developed their land use plans in part to encourage healthy and active lifestyles. *"Indigenous land bases and the environment as a whole remain vitally important to the practice of traditional healing*" (Robbins and Dewar, 2011).

Relationships to the land are not merely a philosophical stance but involve concrete land uses. Many of the land use plans archived on the First Nations in BC Knowledge Network (fnbc.info) emphasize the security and sustainability of natural resources for spiritual, food, physical activity, and economic uses.

The United Nations Declaration on the Rights of Indigenous Peoples indicates that Indigenous People have the right to access their traditional medicines and maintain their health practices and this includes access to their lands (UN, 2007). But, manifestation of ties between land and health will vary between communities, locations, and individuals.

While studies of the contributions of traditional activities on the land[1] are difficult to extract from other determinants of health (see for example, Wilson and Rosenberg, 2017), reduced access to environmental resources and shifting culture have been viewed as drivers of reduced determinants of health and lack of access to land a critical source of stress for First Nations (Richmond and Ross, 2009). If natural resources and special places become further diminished or inaccessible, it may not be possible to meet the spirit of the Tripartite First Nations Health Plan to ensure First Nations are equally involved in the planning and management of their resources and services for health. Given the links between the land and health, lack of access to or knowledge of ecological drivers of health will reduce health equity and impact social justice in First Nations' public health.

Where and when to monitor? Issues of space and time when planning monitoring programs

> *Land is important in two respects. First, traditional lands are the 'place' of the nation and are inseparable from the people, their culture, and their identity as a nation. Second, land and resources, as well as traditional knowledge, are the foundations upon which Indigenous people intend to rebuild the economies of their nations and so improve the socio-economic circumstance of their people – individuals, families, communities and nations.* *Anderson, Schneider and Kayseas- Paper for the National Centre for First Nations Governance 2008*

Monitoring sites, for health or ecological purposes, are established for different reasons based on the monitoring objectives. Improperly located sites or scales of monitoring will provide unsuitable results and lead to incorrect decisions. If connection to the land is to be used as a central concept to link nature and First Nations health, it is worth asking "which land?". Some questions to consider when answering this question include:

1. Is "land" defined as the place a person lives or a person's traditional territories, whether they reside there or not?
2. Should monitoring reflect the current lived experience or reflect the potential values from the land, whether accessed by a person or not?
3. Is the specific physical place the key defining feature of "the land" or are the interactions with nature, regardless of place, the more critical factor when examining effects on health?

[1] By "the land" we follow Aldo Leopold's land ethic wherein the land is all the other parts of the Earth, soils, waters, plants, and animals, that are not man-made. Therefore, the land is not referring only to terrestrial ecosystems but includes aquatic and marine ecosystems as well.

These questions are left unanswered because we found no guidance in the literature. Any answers to these questions are legitimate and reflect a philosophy of connection to the land rather than an empirically measured feature. Answers will need to be negotiated with the intended users of the ecological information to be measured.

Traditional public health indices of environmental determinants of health look at points in time; either detecting adverse human health outcomes or detecting when an environmental threat exceeds an acceptable level. The approach is unidimensional, looking at indices in isolation at a single point (or very short periods) of time. This is not consistent with a cumulative effects perspective of health that is concerned not just with present risks but future capacities. Given that Indigenous traditional healing typically sees the inter-relationships of spiritual, physical, and mental health, health needs to be considered as a cumulative or holistic effect (Robbins and Dewar, 2011). Two backbones of 2013 Xeni Gwet'in land use guidelines are to (i) *"respect the capacity of land to give, so that it can continue to give and (ii) honour the intent of the ecosystem-based management approach, such that the ecological integrity of the area can be maintained in perpetuity."* Ecological indicators should, therefore, help to see the whole rather than the parts as well as to see change both in time to avoid risks to current generations but also to ensure access to resources for health for future generations.

Sustainability and health promotion are closely allied concepts (Hancock, 1993). The Rio Declaration, states "human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature." An updated definition sees sustainable development as actions that "meets the needs of the present while safeguarding Earth's life-support system, on which the welfare of current and future generations depends." This is consistent with the United Nations 2030 sustainable development goals which aim to sustainably managing natural resources and take urgent action on climate change, so that it can support the needs of the present and future generations. Aboriginal people have a tradition of taking a long-term view to sharing and protecting the land to preserve its benefits for future generations (INAC, no date).

The primary challenge in selecting ecological indicators of sustainability is that many indicators succeed at measuring unsustainable trends, but fall short of defining or ensuring sustainability (Dahl, 2012). Candidate variables to track may be identified by looking at pillars of resource security – such as food, water, and environmental security - which are based on principles of sustainability. Key attributes of resource security - availability, access, utilization, and stability – can inform selection of ecological attributes that may be forward looking and explore aspects of the resources themselves or information on how people access and use the resource (see table 1 for example). Wood and DeClerck (2015) note "characteristics that make the environment an enabling factor for improving human prosperity are often the same as those needed to meet conservation objectives: high diversity, viable populations of service-providing species, and managed variability" (Richmond and Ross, 2009). This suggests opportunities to incorporate information on sustainable ecosystems into human well-being assessments. However, "insufficient data and a limited understanding of the complex cross-linking relationship between human and environmental health continue to challenge the section of the best ecosystem data to use for human well-being assessment" (Mahboubi et al, 2015).

Table 1 – Linking concepts of food and water security to possible insights into ecological indicators of wellness

Dimension of sustainability	Description and example
Available	Does the health promoting resource still exist in a state that renders it useable? Ex. Does fish abundance still allow fishing?
Accessible	Do people have the legal and physical means to access the health promoting resource? Ex. Are there conflicts with other land users that preclude access the resource?
Useable	Do people have the skills, knowledge to safely, sustainable, and properly use the resource? Ex. Do people know how to safely field dress hunted animals?
Stable	Are there factors that will reduce the availability, access, or utilization of the resource over time? Ex. Habitat loss due to urban development.

Tracking ecological deficits versus assets

The deficits approach

Pros of the approach: The prevailing approach to health and the environment is to track hazardous situations and substances. As such, there are agencies and standards that measure progress towards removing or reducing hazards, allowing for a consistent approach across communities, that has accepted and well-established links to public health outcomes.
Cons of the approach: The reliance on detecting harms or hazards re-enforces a perception that the environment is a source of harm, discouraging people from accessing benefits from the land. It promotes a "detect and react" approach to environmental harms rather than a "promote and protect" approach to its benefits. The selection of specific indicators to monitor will depend on the hazards prioritized by specific communities or agencies.

Both the health belief model and protective motivation model suggest that information on such environmental hazard data should inform people's perceptions of a threat and their ability to succeed in applying a planned behaviour. By understanding the need to act, the availability of the resources needed to act and barriers and opportunities to act, people are better equipped to make choices that can increase the quality of life in a given environment or range of environments (Brown et al, 2011).

The "determinants of health conversation" in recent years has focussed largely on improving social determinants of health and avoiding environmental hazards (pathogens, pollutants, unhealthy built environments). Clean air, clean water, low risks from contaminants, and acceptable distance from critical ecological thresholds are typical ecosystem services that drive well-being (Summers et al, 2012). The Health Council of Canada's 2005 report, "The Health Status of Canada's First Nations, Metis and Inuit Peoples," (HCC, 2005) cites a variety of negative environmental factors when highlighting the role of the physical environment as a determinant of health. This reflects the inequities in exposure to negative environmental conditions facing many First Nations communities.

Concerns over zoonotic pandemics has recently been driving public health investment and concern about nature as a source of harm. New, re-emerging, invasive, or introduced pathogens and vectors are

often first found in wildlife which subsequently maintains them in environments, causing human exposures (Daszak et al. 2000). Highly pathogenic influenza (Parmley et al. 2009), hantavirus (Drebot et al. 2000), Lyme disease (Ogden et al. 2008), West Nile virus (Eidson et al. 2001), and a suite of re-emerging foodborne diseases (Charron 2002) are but a few recent examples where Canadian wildlife provided information to direct surveillance, public, and physician alerts, and disease management strategies. Changes in temperature, precipitation, and weather patterns associated with climate will alter the pathways, persistence, and concentrations of pollutants entering the environment via air and ocean currents (Burek et al. 2008). Climate change alterations in food webs, lipid dynamics, ice and snow melt, and organic carbon cycling are expected to affect fish and wildlife exposure to contaminants (Noyes et al. 2009), with subsequent impacts on food safety. Water security is being threatened globally by direct stressors include widespread land cover change, urbanisation, industrialisation, and engineering schemes like reservoirs and irrigation (Vörösmarty et al, 2010)

The FNHA Environmental Public Health Services focuses on many of the aforementioned environmental public health risks, including food and water safety, environmental contaminants, and waste management. In this report, we will consider no further typical public health indicators of environmental risk, assuming the FNHA Environmental Public Health Services will develop and track appropriate indicators.

Other potential environmental risks related to changes in ecosystems and non-human species are not typically tracked by public health despite their links to community and individual wellness and health. The Canadian Public Health Association has emphasized the need to identify health indicators for conditions plausibly related to ecological change as part of as early-warning or sentinel conditions to be monitored (CPHA 2015). There is a long history of wildlife serving as bio-sentinels for the effects and distribution of environmental pollutants and pathogens (Kuiken et al. 2005; Reif 2011), but emerging and changing diseases of wildlife can also affect community health without causing infectious diseases in people. For example, the recent northward range expansion of the winter tick, *Dermacentor albipictus*, in moose and caribou is attributed to landscape change (fires) together with climate warming (Kutz et al. 2009). This tick can result in large-scale die-offs of moose, limiting access to a critical food species. The effects of the cod fisheries collapse in Newfoundland is an excellent example of the community health effects of changes in access to natural resources (Gien, 2000). The decline of commercial fishing, habitat loss, and loss of access to natural resources have all been identified as negative determinants of food security of First Nations people in BC (FNHC. 2011). The relationship between climate change and Aboriginal health in Canada highlights the relationship between health and changing resources (Berry et al, 2014). Shifting fish and wildlife distribution and abundance, landscape changes affecting access to resources, increasing numbers and severity of wild fires and toxic algal blooms, shifts in contaminant bioaccumulation, population displacement and social disruption due to land loss from sea-level rise, flooding, and erosion are some examples of probable environmental changes due to climate change that will affect health. It is rare for these changes to be in the purview of public health monitoring.

Ministries of Environment or Natural Resource Ministries are generally charged with collecting data to establish trends and for early warning of changes in non-built environmental determinants of health. However, these are not typically incorporated into public health assessment and planning, in part because the links between human health outcomes and declines in the status of the environment are not well established.

The assets approach

Pros of the approach: Measuring what we have rather that what is missing can increase assurances and confidence in accessing health promoting resources from the land. A wider range of determinants of health can be accounted for by examining the benefits nature provides, producing a more holistic assessment of the links between the land and health, capturing many of the attributes of land valued by many First Nations' people.
Cons of the approach: Most measures of ecological determinants of health focus on deficits in the determinants. Thresholds for what constitutes adequate amount, quality, access, or availability are not available. These measures have both qualitative and quantitative aspects and are context specific, making consistent measurement across communities and ecosystems unlikely.

The positive contributions of landscapes are important determinants of social and physical well-being in First Nations (Wilson, 2003). The concept of ecosystem service security underpins both the links between the land and First Nations health and the expectations of the UN Declaration on the Rights of Indigenous Peoples. Critics of typical indices that look at environmental harms or deficits as part of human well-being monitoring suggest that a more relevant approach is to concentrate on strengthening ecosystem-services related to well-being targets. There is increasingly a move away from deficit models to a focus on capacities and assets – emphasizing positive attributes as much as risks and vulnerabilities. Resilience and well-being are not well represented by quantifiable indicators but rather they have subjective, relational, and context specific aspects in addition to more objective measurements (Brown and Westaway, 2011).

In general, nature supports human health by: (1) providing food, fuel, timber and fiber, and income opportunities; (2) regulating climate, water, floods, wastes, and diseases; (3) proving recreational, spiritual, and cultural places and opportunities; and (4) supporting nutrient cycling, energy flows; and soil formation (MEA, 2005). The essential contributions of biodiversity to human well-being is underscored by the inclusion of life below the waters and life on land as 2 of the 17 targets of the United Nations 2030 sustainable development goals. These goals focus on reducing pollution, preventing habitat loss and degradation, and ensuring conservation and sustainable use of biodiversity; all to protect human development.

The various dimensions that link Aboriginal peoples' health to their physical environments has been the subject of little research (Richmond and Ross, 2009). The following highlights some ways the environment positively contributes to Aboriginal well-being.

Food

What we eat is a direct reflection of the quality of the world around us. Aboriginal communities have the human right to adequate food, including the right to feed themselves and to participate in decisions about their food system. For those Canadians reliant on wildlife for food, decreased food security may be the result of decreased access to historical hunting and fishing grounds due to changing environmental conditions (Ford 2008) or changes in fish and wildlife abundance and distribution (Furgal and Seguin 2006; Humphries et al. 2004). Wild meats and seafood remain a very significant source of

protein for most of the world's poor, for many aboriginal communities globally and for rural dwellers (Bennett, 2002; Kent, 1997). Replacing this protein source comes at significant economic and nutritional costs. A 1990 study estimated that the food replacement value for wildlife hunting for 6500 Omushkego Cree living in the Hudson and James Bay Lowland was $7.8 million for one year (Berkes et al, 1994). The battle against diabetes and heart disease in indigenous communities relies, in part, on access to safe, traditional, wildlife-based foods (Patchell and Edwards 2014). Recommendations for seafood consumption to combat heart disease depend on safe and abundant fish to eat (Mozaffarian and Rimm 2006). Changes in fish and wildlife migration routes, population size, body condition, and infection and contamination status are affecting food security.

Income and employment

Nature is an important source of employment and income. The overall benefit:cost ratio of an effective global conservation program for the remaining wild nature has been estimated at least 100:1 (Balmford et al,2002). Hunting, trapping, and fishing not only contribute to aboriginal culture, food security, and the quality of life, but also generate $14-15 billion annually (POC 2015). The current harvesting economy in Nunavik alone is worth approximately $40 million annually. The value of the seafood sector (excluding aquaculture) was near $15 billion in 2012 while the recreational fishery in 2010 was responsible for $8.3 billion in spending. The Nunavut turbot fishery, for example, provides an important and growing contribution to the territory's economy generating $70 million in 2011 (GON, no date).

Indirect economic benefits of biodiversity far outstrip direct benefits. For example, through their pest control activities, bats save the Canadian agriculture and forestry economies billions of dollars per year as well as help reduce pesticide resistance and unanticipated toxic effects or occupational safety risks due to pesticide use (Boyles et al, 2011). Bird's pest control value to the forestry industry has been estimated at $5,000 per year per square mile of forest, potentially translating into billions of dollars in environmental services (Anon, no date). Such ecological services create efficiencies in industry, thus supporting job growth and sustainability.

Over half of all Canadians take part in non-consumptive wildlife oriented activities, like bird or whale watching. Direct tourist expenditures on eco-tourism in the province of British Columbia alone is approximately $1.5 billion dollars per year (WTABC, no date). A brief review of some land use plans found on the First Nations in BC Knowledge Network (https://fnbc.info) found significant interest in securing these economic contributions for many communities.

The Canadian Index of Well-being views the environment as part of a health "bank account" wherein the current amount of resources is measured against the amount needed or removed. This utilitarian approach focuses on the critical services that support our health such as clean air and water, energy and raw materials, wilderness and biodiversity, and economically important resources. This index explores natural assets available to Canadians, the flow of these resources over time, and some of the impacts of human activity on the environment. It does not include an analysis of the sustainability of Canada's environment.

Safe physical environments

Community capacity to face and manage adverse conditions, emergencies or disasters is provided by a combination of nature and people (Keim 2008). Intact, functional ecosystems such as forests and

wetlands act as natural buffers to hazardous events such as flood abatement, slope collapse, coastal storms, and avalanche (Sudmeier-Rieux and Ash, 2009). Intact coastal ecosystems are essential green infrastructure to protect communities against the threats of extreme weather and sea-level rise. Wetlands plants help breakdown human and animal derived wastewater, removing disease-causing microorganisms and pollutants (Shutes,2001). The effects of variations in the types, distribution and abundance of animal biodiversity on zoonotic disease risk has been documented and debated. Oceans, forests, and other natural ecosystems sequester carbon, decreasing the incidence and impact of climate change and climate change related disasters.

Healthy lifestyles and mental health

Vibrant natural places provide people positive lifestyles choices related to outdoor activity, community activity, occupational options, and cultural belonging. Activity in the presence of nature leads to positive short and long-term health outcomes (Barton and Pretty, 2010). There is growing evidence of the importance of nature in people's sense of community and mental health (Berto 2014) and that contact with nature may provide an effective population-wide mental health strategy (Maller et al, 2006). Cultural continuity and exposure to culturally meaningful activities involving nature have been suggested as protective factor against youth suicide in aboriginal communities in Canada (Chandler and Lalonde, 2008; Fraser et al, 2015). The BC First Nations and Aboriginal People's Mental Wellness and Substance Use - Ten Year Plan (FNHA, 2013) notes that mental health depends on concepts of wholeness, balance, the importance of relationships with family, community, ancestors, and the natural environment.

Tracking the states of versus the relationship to the land

Measuring the state of the land

Pros of the approach: Natural resource agencies invest significant resources towards measuring the state of specific functions or resources from the land. As such, data are available and there is ongoing research into defining and validating reliable and repeatable indicators
Cons of the approach: There is no universally accepted threshold or indicator(s) that best described the state of the land. Most measures focus on valued economic resources. Because ecosystems are complex dynamic systems that can undergo long-term cycles, short term assessments of the state of land may not reflect ecological reality and are subject to ongoing debate. Little work has been done to link the state of the land via current measures with population or community health.

There are no universally accepted indicators of ecological health nor is there a single definition of the concept. The concept of ecological health is usually tacitly understood to be undefinable in a rigorous sense and is useful only as conveying a vague sense of well-being (Ryder, 1990).

> *"The notion that the ecological health of the environment can be assessed is a ridiculous notion in a scientific context because there can be no objective definition of 'health' or method for defining degrees of health. Ecological health is a value judgement" (Lancaster, 2000).*

"Virtually all attempts to use ecological indicators have been heavily criticized, and many criticisms are well deserved" (Niemi and McDonald, 2004). Many of the criticisms focus on: (i) the challenge of extrapolating indices across scales, gradients, and species; (ii) the oversimplification and generalization of biological processes resulting from indices; (iii) problems in calibrating and validating indices; and (iv) linking measures such as abundance and distribution to outcomes such as productivity (Niemi and McDonald, 2004). Ecosystems are context-specific entities because they cannot be delimited without a specific social, science, or policy context. Health, analogously, is not a biological state but rather a set of capacities and expectations defined within one's social circumstances. Therefore, the idea of ecological or ecosystem health is normative because someone must decide what ecosystem condition or function is good (Lackey, 2001).

As with the healthy cities movement and the built environment (O'Neill and Simard, 2006), there is no list of indicators that can universally be applied to the non-built environment. There are a vast number of possible and legitimate ways to select indicators. Principle challenges to identifying suitable ecological indicators include: (i) practical constraints usually restrict monitoring to a small number of indicators that fail to consider the full complexity of the ecological system; (ii) the choice of indicators is confounded in management by vague long-term goals and objectives; (iii) there is a lack of scientific rigor because of the failure to use a defined, consistent protocol for identifying ecological indicators (Dale and Beyeler, 2001); and (iv) the complexity of dynamic ecological systems complicates prediction, thus reducing the value of indicators as a forward looking tool. In general, value-based concepts such as ecosystem health or ecological integrity are useful in general conversation but they are impossible to quantify (Lackey, 2001)

Despite the preceding cautions, there is a strong recent interest in science and management for reporting on the ecological condition of the environment for planning, management, and public reporting. Composition, structure, function, uses, and impacts are foundational concepts in selecting ecological indicators. Composition, in the latter case, is concerned the with presence, abundance, and distribution of key attributes; structure is concerned with elements that affect the range, distribution, and variability; and functions deal with elements of change and adaptability. The Brundtland Commission's (anon2, no date) encouragement to countries to produce "an annual report and audit on changes in environmental quality and in the stock of the nation's environmental resource assets" inspired some investment in monitoring natural capital[2]. Statistics Canada, for example, has measured the state of Canada's natural capital, the demands placed upon it by people and the efforts to manage these demands since the 1970's. BC's "State of British Columbia's Forests" reports, are an example of efforts to assemble indicators from multiple domains (human population, economics, ecosystems and biodiversity) to provide a snapshot of social and environmental performance.

There have been substantial, recent scientific advances in the development of indices that measure the condition of biological ecosystem although it is acknowledged that these advances are only initial steps (Borja et al, 2009). To be useful, ecological indicators need to: (1) include many species representing various taxa and life histories; (2) be based on a sound quantitative database from the focal region; and (3) can distinguish actual signals from variations that may be unrelated to the deterioration of ecological

[2] Natural capital is used to describe the capacity of natural processes and components to provide goods and services that satisfy human needs, in this case health needs

integrity. It is reasonable to conclude that it will be the rare community that has the necessary information to fulfill these three criteria (Carignan and Villard, 2002).

Measuring connections to the land

Pros of the approach: Opinion and evidence support the concept that the connection to land is a critical and unique determinant of Aboriginal health in Canada and elsewhere.
Cons of the approach: Despite overwhelming agreement that connection to the land is a critical determinant of health, we found no validated measures. Most work relies on surveys rather than surveillance and monitoring to describe this relationship.

Traditional knowledge and spirituality hinge on the maintenance and renewal of relationships to the land (Robbins and Dewar, 2011). Aboriginal views of health and the population health framework both recognize that well-being is the result of a complex interplay between environmental, social, and individual characteristics. A principle differentiating factor between the applications of these perspectives revolves around balance and focus. The population health framework tends to focus more on individuals rather than social and environmental capital (Reading et al, 2007) – concepts that emphasize relationships between shared resources and capacities. Aboriginal frameworks generally do not prioritize people over the environment and place environmental determinants on par with social determinants as positive contributions to health and wellness (Scott, 2005).

Culture provides important links between health and place through physical, symbolic, and spiritual relationships to the land (Wilson, 2003). The capacity of individuals to act independently and to make their own free choices regarding expressing of their cultural practices and spiritual beliefs will, therefore, depend on access to and confidence in the resources, both tangible and intangible, the land provides. Richmond and Ross' 2009 interviews with 26 community health representatives from First Nations and Inuit communities in Canada concluded that, while the 5 of the 6 determinants of health in rural and remote communities identified by these representatives aligned well with determinants recognized by Canadian health policy (e.g., personal health practices and coping skills, education, income and social status, employment, social environments, and social support networks) the determinant, environmental/cultural connections, was distinct.

We were unable to find any validated ways to monitor connection to the land. Most work in this area relied on multi-question surveys to characterize the connections individuals felt to their land or environment at a specific time and place. Many resources described and discussed the importance of cultural, spiritual, recreational, and nutritional connection to the land for aboriginal health, but few provided means to measure these connections, apart from accounting the availability of specific resources like country foods or measuring deficits and hazards within a specific region or community. While many authors made statements such as; "*Investment in programs that help Indigenous people undertake work maintaining the environmental health of their country has benefits for the environment as well as the physical, mental and cultural health of the Indigenous people involved*" (Garnett et al, 2009), few pointed to specific guidance on critical and measurable aspects of these relationships that could be the foundation of an environmental asset indicator for health.

Refining the focus by assessing the feasibility of using existing information

First Nations' health is determined in part by equitable and sustainable access to traditional resources from the land now and for future generations. Concepts of status, sustainability, equity, and security of land-based resources should, therefore, inform criteria for selecting ecological health intelligence. Control over decisions and autonomy to choose health practices will require access to natural resources that support traditional practices and beliefs that support health. Therefore, measurement of the state of an environmental determinant as well as people's connection to the determinant can give insight into the status of ecological determinants of health and the sustainability of their health contributions.

Table 2 summarizes core concepts found by the preceding review of literature on the relations of First Nations health and the land into a matrix to organize publicly available data on ecological indicators in BC. It categorizes how publicly available information was distributed in relation to elements of a safe and secure connection to the land. With the mandate of the FNHA to work at a province-wide level, we investigated the availability of already existing information for the use of ecological indicators of health for First Nations across BC. Our search strategy is in Appendix 1.

Table 2: A conceptual framework to organize and assess publicly available ecological indicator information sources from British Columbia into theses relating to health and the land.

Time Frame	Element of security of the attribute	Characteristic	**Status of the attribute of the land (98.9% of total observations)** Distribution of observations within category	**Connection to the attribute of the land (1.1% of total observations)** Distribution of observations within category
Present	**Accessible** (81.8% of total observations)	Abundant	25.7%	25%
		Safe	14.9%	0%
		Available	41.7%	25%
Future	**Sustainable** (18.2% of total observations)	At Risk	16.0%	25%
		Acceptable	1.7%	25%
		Equitable	0%	0%
			100%	**100%**

Most of the data available for assessing status of the land fell into the present time frame (82.2%), with only 17.8% of the data being applicable to the assessment of future components (Table 2). Most of the information found dealt with the present status of an ecological attribute (98.9%) versus connections to that attributes (1.1%). Table 3 summarizes our criteria for categorizing the publicly available data sources.

Measuring connection to the land

We reviewed six modern treaty agreements to explore if the defined rights of those First Nations explicitly provided a legal definition or precedence of the environmental values and land connections for

these Nations. These documents focussed primarily on access to resources and governance. The Tsawwassen First Nation Final Agreement, explicitly mentions the cultural connection to land, unlike the other five.

The First Nations Regional Health Survey (RHS), conducted by the First Nations Information Governance Centre, contains data that might be proxies for connection with the land. This survey has been administered three times, a pilot study in 1997, the first full survey in 2002/2003, and the most recent was completed in 2008/2010. The RHS collected information on participation of individuals in traditional harvesting or recreational activities and consumption of traditional foods as part of the "Physical Activity and Nutrition" component of the survey. The data was typically represented by percentages, sometimes being broken down by age group or frequency of activity/consumption. These data represent self-reported participation in these activities over the course of a year (relevant to abundance and availability in Table 2). Results may reflect opportunities for individuals and/or communities to experience traditional extractive land use practices.

The RHS that also asked about perceived community strengths and risks, of which "natural environment and resources" was a component. In the "Community Wellness" section of the RHS, participants were asked to identify challenges and strengths of their communities, selected from a predetermined list of ten items (natural environment and resources was one of the ten items). Participants were also asked to indicate whether their community was making progress or not on these ten areas. The data collected regarding the "natural environment and resources" element might serve as a summative, qualitative assessment of the both the present status of positive and negative environmental determinants of health in the non-built environment.

Neither participation in traditional activities nor perceived community strength/challenges in natural environment and resources have been validated to determine if they relate to health outcomes. The survey has only been conducted every 5-10 years thus far. The FNHA will need to determine whether this regularity is frequent enough for their needs and if the RHS will be routinely repeated in the future. However, the RHS may serve as an important springboard for FHNA monitoring of people's connection to the land.

Status of the land

First Nations in BC Knowledge Network: The First Nations in BC Knowledge Network (https://fnbc.info/directories) was searched to identify if BC First Nations groups regularly publish public reports on different aspects of environment. Six Aboriginal and First Nations groups (BC First Nations Energy and Mining Council, First Nations Fisheries Council, First Nations Agricultural Association, National Collaborating Centre for Aboriginal Health, First Nations Forestry Council, and Columbia River Inter-Tribal Fish Commission) were identified as having explicit ties to ecosystems and we searched their websites for available data. No published reports containing data on the status of land (including animals) were located from these groups.

Summative ecosystem assessments by federal and provincial governments: There are a few reports, such as The State of British Columbia's Forests (2010), Alive and Inseparable: British Columbia's Coastal Environment (2006), and Environmental Trends in British Columbia (2007) that contain information and analysis of the different components of ecosystems, such as species conservation, climate change, air and water quality, and resources harvests. While these reports and others consider multiple indicators, neither attempt to integrate this information into a single comment on the status of the environment.

Other reports, for example Indicators of Climate Change for British Columbia (2016), also contain relevant information for taking a systems approach to evaluating ecosystems, but none provide criteria or guidance on how to pull this information together.

Status of ecosystem components: There are numerous reports and data sets available through federal and provincial governments that address one or two aspects of the environment at a time (see Appendix 2). The data sources, either provincial or federal government reports or datasets, could be categorized into one or more of the status of the land characteristics as described in Table 3. Data sources that did not meet at least one of these criteria were not included in the summary.

Table 3: Criteria for categorizing reports and data available on the status of the land characteristics within the proposed ecological health framework. Data sources could qualify for one or more category.

Status of the Land Characteristic	Reports and Data Qualify for This Criteria If They Measure…
Abundance	The amount of an environmental asset (ex. wildlife population, forest cover)
Safety	Immediate risks or hazards (ex. airborne toxins or particles)
Availability	The presence and geographical distribution of an environmental asset
At Risk	The future potential for sustainability (ex. predicting the future danger to a species of extinction)
Acceptable	Perceptions of land use (ex. conflicts over land use in the case of hydro-dam projects)
Equitable	Equal opportunities for people to access the land (no examples of measures found)

Most of the available data that we found relate to the availability of environmental/ecological assets. Much of that information is due to the critical habitat data that has been identified for the various species of flora and fauna under the Species at Risk Act. Abundance, including fish stock assessments, species counts or censuses, and reports on species recovery strategies, were also common. Safety included mostly reports and datasets on air and water pollution. Reports that categorized into safety cover the traditional environmental health component of public health measures and could fall under the domain of the Ecological Health Officers within FNHA. These safety reports, including those published by the Provincial Health Officer, focus exclusively on potential harms and hazards.

There was a paucity of information available for addressing sustainability or equity of an environmental/ecological asset. A few reports and datasets that contained material on the future risks or sustainability of various ecological components (ex. species at risk, forest harvest projections). Six reports contained some type of information on the acceptability of land status. These reports contained some element of public opinion or cultural norms on projects or land use. No data sources were identified that address the attribute of equity.

Challenges to using publicly available data?

Although there is quite a bit of publically available data regarding status of the land, various methodological and logistical issues would make it challenging, if not impossible, to integrate this information into a meaningful assessment. The data that exist have been collected on different regional

scales and time frames. The data sets and reports that exist typically report on a single phenomenon, such as individual species-at-risk reports, making consolidation a methodological and intellectual challenge. Data gaps currently exist for measures of connection to the land and future aspects of status of the land, particularly equity elements of sustainable ecological health. There is no existing evidence-based method for integrating the information and no guidelines to determine when thresholds of "good" or "bad" states have been achieved. While information exists that is applicable to different components of the ecological health framework (Table 2) and there are reports that contain relevant information, a single "ecological health indicator" or even a suite of indicators does not currently exist. The FNHA will need to develop a strategy for selecting already existing information or develop new partnerships or methods to generate new information tailored to their objectives. As a final challenge, from documents provided and interviews undertaken, the desired objective for ecological indicators for use by the FNHA remain vague to us and inadequate for matching indices with objectives now. This may reflect our understanding of FNHA goals and objectives in their realm of research and monitoring.

Options for ecological health indicators for the FNHA

Conclusion 1: An evidence-based selection of a pre-existing indicator to link First Nations health and ecological change is not possible apart from monitoring standard markers of public health risks.

There is no single ecological indicator, or set of indicators that the FNHA can use from publicly available information in BC to forecast public health effects nor is there any indicator or set of indicators that are routinely collected from all regions in BC in a consistent and ongoing manner that would allow for statements on the state of ecological resources across all BC First Nations. Routinely collected data on environmental harms may be found through traditional public health measures (ex. air quality, food safety, water quality). While there are many options to report on the status of particular environmental attributes, there is no single attribute that would be universally relevant to all regions, all communities or all individuals. Nominating the "right" indicator(s) to use will be subjective as will selection of acceptable thresholds.

Option 1: Rely on typical environmental health information, emphasizing factors such as water and traditional food safety and security. The advantage is that there are known thresholds for acceptable levels, infrastructure to collect such data, and similar thresholds and capacities throughout the province. This approach would not address attributes of the land unique to First Nations, would not capture non-consumptive aspects of the connection to the land, would focus on harms rather than capacities, and would not account for sustainability of the attribute.

Option 2: Work with communities and/or regions to identify a sub-set of pre-existing ecological indicators that best reflect the contributions to the determinants of health in that region/community, cross-reference those choices with existing data sources, customizing the indicators that will be used to reflect local benefits from the land and, through a local participatory process, select community-based thresholds for acceptable levels. The advantage of this approach is it allows the FNHA to tailor indicators to regionally unique ecological and community conditions and sets thresholds based on community expectations, making the outcomes more socially and ecologically relevant. This approach would not allow for consistent assessments across all regions, would face

challenges matching community desires with available information, and would take considerable effort to establish and monitor acceptable thresholds.

Conclusion 2: First Nations are distinct from other British Columbians because of their cultural and legal ties to specific places; their territories. Monitoring people's connections to their territories is a qualitative, yet rich option for summarizing the link between well-being of people and their ecosystems, but lacks a regular and validated means for monitoring.

Understanding how an individual's beliefs and perceptions on the quality and sustainability of their connections to the land, to their traditional land, would be a unique means to integrate personal and local knowledge of the status of changes in ecological attributes as well as a very personal way to characterize the effects on those attributes on social determinants of health. No existing regular and validated means to monitor this connection across places and over time were found apart from the First Nations Regional Health Survey which focused more on extractive uses of the land as opposed to more personal and spiritual connections.

Option 3: FNHA develops methods or partnerships for routine surveys of how individuals perceive changes in the quality, contribution, and sustainability of their connections to their land and territory. Participatory tools or community lead surveys on connections should focus on how individuals perceive changes in the quality, contribution, and sustainability of the connections. This would be the most direct way to monitor how individuals and communities are experiencing and perceiving changes in connections to their territories that affect multiple determinants of health. It would focus on beliefs and experiences and therefore could be generalized across communities and could emphasize the positive values of the land rather than only emphasizing risks. We did not find a pre-existing model for ongoing monitoring of connections to the land, therefore, new methodologies would need to be developed to allow for timely and repeatable information to allow the FNHA to observe changes over time as well as to see how connections vary across the province, and what might be driving those changes. There is no evidence-based way to relate measured changes to health outcomes without further research.

Conclusion 3: Challenges in prescribing ecological indicators for the FNHA reflect the general state of knowledge in ecological monitoring and assessment and the failure of past regulation and research to explicitly link ecological change to population health outcomes, apart from exposure to hazardous substances and situations.

There is a large and growing body of work trying to identify the right ecological indicators for the right situation. As ecosystems vary over place and time, this is a challenging hurdle to overcome. Add to this challenge the need for the indicators to be regularly and easily measured and to be predictable, it is not surprising that we failed to find the right indicator(s) for the FNHA. The selection of the right indicator is predicated on a clear management goal as no single indicator can meet all goals. In public health, variations in the goals between and within communities further compounds this challenge. Consensus on the "right" things to watch, how to integrate them into a single coherent perspective, and whose values have precedence in selecting variables and threshold to monitor is elusive in most circumstances. To achieve this would require significant participatory work and local ecological research to develop for the FNHA.

Option 4: The FNHA develops clarity on its goals for monitoring ecological indicators. Key issues to resolve before tailoring the section of ecological indicators to FNHA objectives include determining if the FNHA wants to: (i) develop locally relevant or provincially generalizable indices; (ii) create early warning of harm indicators or signals of changing capacity for health; (iii) use community derived, centrally created public data or create its own ecological monitoring system; and/or (iv) have regular surveillance or periodic surveys.

Guiding principles for indicator selection

1. Community health focuses on the intersection of the community's needs, the community's understanding of and priorities for health, and the best methods for documenting necessary evidence.
    a. Therefore, ecological health indicators should address BC First Nations' community needs and support their understanding of priorities for health as it relates to the non-built environment.
2. Ecological indicators should support the FHNA objectives, roles and responsibilities.
    a. Therefore, selected information should be meaningful in terms of FHNA goals and objectives.
3. Connections to community and the environment are important for First Nations wellness and health but the transactions and relations with the environment are many and involve a diversity of important places, wildlife, and plants. They vary by place, community, and over time.
    a. Therefore, ecological indicators will need to be generalizable across place and reflective of the diversity of environmental interactions but cannot feasibly track all relations and transactions.
4. The social and ecological forces driving environmental change are happening at an unprecedented scale and rate, and will continue to act in full force for the foreseeable future.
    a. Therefore, individuals and communities need to make decisions and act in a manner that optimize their adaptive capacity.
5. As per the Information Processing Model of behaviour change, the amount of information an individual can process at once is limited and information is more useable if condensed into manageable 'chunks'.
    a. Therefore, condensed ecological health information will be more conducive to supporting healthy choices than large lists of ecological indicator data.

Proposed goals of ecological health indicators for the FNHA

An environmental health indicator expresses the link between environment and health, targeted at "an issue of specific policy or management concern and presented in a form which facilitates interpretation for effective decision-making" (von Schirnding, 2002).

We propose that the purpose of ecological health intelligence is help community members and the FNHA to take meaningful, deliberate action to remedy the impact of a problem and interpret signals indicating the quality and sustainability of the health benefits of human-nature links (After Pfefferbaum et al, 2005). This could translate into two goals:

Goal 1: To support healthy choices on the use and relationships with important landscapes by identifying changes in the supply, accessibility, safety, confidence, or sustainability of ecological services that are determinants of current and future First Nations health.

Goal 2: To deduce in a timely and most reliable manner an appropriate picture of the states of First Nations' healthscapes to prioritize issues requiring advocacy, action or investigation.

References

Anderson, R.B., Schneider, B., Kayseas, B. 2008. Indigenous Peoples' Land and Resource Rights. Research Paper for the National Centre for First Nations Governance. http://fngovernance.org/ncfng_research/robert_anderson.pdf

Anon. (no date). The State of the Birds. http://www.stateofthebirds.org/2009/home-page-documents/the-value-of-birds

Anon 2 (no date). Report of the World Commission on Environment and Development: Our Common Future. http://www.exteriores.gob.es/Portal/es/PoliticaExteriorCooperacion/Desarrollosostenible/Documents/Informe%20Brundtland%20(En%20ingl%C3%A9s).pdf

Balmford A, Bruner A, Cooper P, Costanza R, Farber S, Green RE, Jenkins M, Jefferiss P, Jessamy V, Madden J, Munro K. 2002. Economic reasons for conserving wild nature. Science. 297(5583):950-3.

Barton J, Pretty J. 2010. What is the best dose of nature and green exercise for improving mental health? A multi-study analysis. Environmental science & technology. 25;44(10):3947-55.

B.C. Ministry of Environment. 2006. Alive and inseparable: British Columbia's Coastal Environment. https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/bcce06/bcce_report.pdf

B.C. Ministry of Environment. 2007. Environmental Trends in British Columbia. https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/et2007/environmentaltrendsbc_2007_fullreport.pdf

B.C. Ministry of Forests, Mines and Lands. 2010. The State of British Columbia's Forests, 3rd ed. Forest Practices and Investment Branch, Victoria, BC. www.for.gov.bc.ca/hfp/sof/index.htm#2010_report

B.C. Ministry of Water, Land and Air Protection. 2016. Indicators of climate change for British Columbia: 2016 update. https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/climate-change/climatechangeindicators-13sept2016_final.pdf

Bennett EL. 2002. Is there a link between wild meat and food security?. Conservation Biology. 1;16(3):590-2.

Berkes et al. 1994. Wildlife harvesting and sustainable regional native economy in Hudson and James Bay lowland, Ontario. Arctic 47(4)

Berry, P., Clarke, K., Fleury, M.D. and Parker, S. 2014. Human Health; in Canada in a Changing Climate: Sector Perspectives on Impacts and Adaptation, (ed.) F.J. Warren and D.S. Lemmen; Government of Canada, Ottawa, ON, p. 191-232

Berto R. 2014. The role of nature in coping with psycho-physiological stress: A literature review on restorativeness. Behavioral sciences 4:394-409

Borja A, Ranasinghe A, Weisberg SB. 2009. Assessing ecological integrity in marine waters, using multiple indices and ecosystem components: challenges for the future. Marine Pollution Bulletin. 31;59(1):1-4.

Boyles, Justin G., et al. 2011. Economic importance of bats in agriculture. Science 332.6025: 41-42.

Bozelli, R.L, Caliman, A., Guariento, R.D., Carneiro. L.S., et al. 2009. . Interactive effects of environmental variability and human impacts on the long-term dynamics of an Amazonian floodplain lake and a South Atlantic coastal lagoon. Limnologica-Ecology and Management of Inland Waters. 39(4):306-13.

Brown, K., & Westaway, E. 2011. Agency, capacity, and resilience to environmental change: lessons from human development, well-being, and disasters. Annual review of environment and resources, 36.

Burek, K.A., Gulland, F.M.D., O'Hara, T.M. 2008. Effect of climate change on arctic marine mammal health. Ecological Applications 18: S126-S134

Carignan V., Villard, M,A. 2002Selecting indicator species to monitor ecological integrity: a review. Environmental monitoring and assessment. 1;78(1):45-61.

Chandler, M.,J, Lalonde, C.E. 2008. Cultural continuity as a moderator of suicide risk among Canada's First Nations. Healing traditions: The mental health of Aboriginal peoples in Canada.221-48.

Charron, D.F. 2002. Potential impacts of global warming and climate change on the epidemiology of zoonotic diseases in Canada. Canadian journal of public health = Revue canadienne de sante publique 93:334-335.

CPHA. 2015. Global change and public health: Addressing the ecological determinants of health. Canadian Public Health Association http://www.cpha.ca/uploads/policy/edh-discussion_e.pdf.

Cummins, S., Curtis, S., Diez-Roux, A.V., Macintyre, S. 2007 Understanding and representing 'place' in health research: a relational approach. Social science & medicine. 30;65(9):1825-38.

Dahl, A.L. 2012.Achievements and gaps in indicators for sustainability. Ecological Indicators. 30;17:14-9.

Dale, V.H,, Beyeler, S.C. 2001Challenges in the development and use of ecological indicators. Ecological indicators.1(1):3-10.

Daszak, P., Cunningham, A,A., Hyatt, A.D. 2000. Emerging infectious diseases of wildlife-- threats to biodiversity and human health. Science 287:443-449

Drebot, M.A., Artsob, H., Werker, D. 2000 Hantavirus pulmonary syndrome in Canada, 1989-1999. Canada communicable disease report = Releve des maladies transmissibles au Canada 26:65-69

Eidson, M., Kramer, L., Stone, W., Hagiwara, Y., Schmit, K. 2001. New York State West Nile Virus Avian Surveillance: Dead bird surveillance as an early warning system for west nile virus. Emerging Infectious Diseases 7:631-635

FNHA (no date). Traditional models of wellness: Environmental scan summary. First Nations Health Council. http://www.fnhc.ca/pdf/Traditional_Medicines_Scan_Executive_Summmary.pdf

FNHA. 2013. A Path Forward: BC First Nations and Aboriginal People's Mental Wellness and Substance Use - Ten Year Plan. http://www.fnha.ca/documents/fnha_mwsu.pdf

FNHC. 2011. Implementing the Vision: BC First Nations Health Governance. Fist Nations Health Council. file:///C:/Users/CWHC%20Stephen/Downloads/FNHC_Health_Governance_Book-web2.pdf

Ford. J.D. 2008. Vulnerability of Inuit food systems to food insecurity as a consequence of climate change: A case study from Igloolik, Nunavut. Regional Environmental Change 9:83-100

Fraser, S.L., Geoffroy, D., Chachamovich, E., Kirmayer, L.J. 2015. Changing rates of suicide ideation and attempts among Inuit youth: A Gender-based analysis of risk and protective factors. Suicide and life-threatening behavior. 45(2):141-56.

Furgal, C., Seguin, J. 2006. Climate change, health, and vulnerability in Canadian northern aboriginal communities. Environmental Health Perspectives 114:1964-1970

Gien, L.T. 2000. Land and sea connection: The east coast fishery closure, unemployment and health. Can J Public Health. 91(2):121-24.

Gilkeson, L., Bonner, L., Brown, R., Canessa, R., Alder, J., etc al. 2006. Alive and Inseparable

British Columbia's Coastal Environment. Government of British Columbia. https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/bcce06/bcce_report.pdf

GON. (no date). Government of Nunavut. http://www.gov.nu.ca/eia/documents/nunavut-economy

Groffman, P.M., Baron, J.S., Blett, T, Gold, A.J, et al. 2006. Ecological thresholds: the key to successful environmental management or an important concept with no practical application? Ecosystems. 9(1):1-3.

Gunderson, L.H., 2000. Ecological resilience—in theory and application. Annual review of ecology and systematics, 31(1), pp.425-439.

Hancock, T. 1993. Health, human development and the community ecosystem: three ecological models. Health promotion international. 8(1):41-7.

HCC. 2005. The Health Status of Canada's First Nations, Metis and Inuit Peoples. Health Council of Canada. http://www.healthcouncilcanada.ca/tree/2.03-BkgrdHealthyCdnsENG.pdf

Hill, D.M. 2009. Traditional Medicine and Restoration of Wellness Strategies. J of Aboriginal Health. 5(1). http://www.naho.ca/journal/2009/11/11/traditional-medicine-and-restoration-of-wellness-strategies/

Humphries, M.M., Umbanhowar, J., McCann, K.S. 2004. Bioenergetic prediction of climate change impacts on northern mammals. Integrative and Comparative Biology 44:152-162

INAC. (no date). CCP HANDBOOK Comprehensive Community Planning for First Nations in British Columbia. Indian and Norther Affairs Canada. https://www.aadnc-aandc.gc.ca/DAM/DAM-INTER-BC/STAGING/texte-text/ccphb_1100100021973_eng.pdf

Keim, M.E, 2008. Building human resilience. American Journal of Preventive Medicine 35:508-516

Kent, G. 1997. Fisheries, food security, and the poor. Food policy. 22(5):393-404.

Kirmayer, L.J., Dandeneau, S., Marshall, E., et al. 2011. "Rethinking resilience from indigenous perspectives." The Canadian Journal of Psychiatry. 56(2): 84-91.

Kjellstrom, T., Friel, S., Dixon, J., Corvalan, C., et al. 2007. Urban environmental health hazards and health equity. Journal of urban health, 84(1), 86-97.

Kuiken, T., Leighton, F.A,, Fouchier, R.A., LeDuc, J.W, et al (2005) Public health. Pathogen surveillance in animals. Science 309:1680-1681

Kutz, S.J., Jenkins, E.J,, Veitch, A.M,, B, et al .2009. The arctic as a model for anticipating, preventing, and mitigating climate change impacts on host-parasite interactions. Vet Parasitol 163:217-228

Lackey, R.T. 2001. Values, policy, and ecosystem health: options for resolving the many ecological policy issues we face depend on the concept of ecosystem health, but ecosystem health is based on controversial, value-based assumptions that masquerade as science. BioScience. 51(6):437-43.

Lancaste,r J. 2000 The ridiculous notion of assessing ecological health and identifying the useful concepts underneath. J Human and Ecological Risk Assessment: An International Journal. 6(2): 213-222

Mahboubi P, Parkes M, Stephen C, Chan HM. 2015. Using expert informed GIS to locate important marine social-ecological hotspots. Journal of environmental management. 160:342-52.

Maller, C., St Leger, L., Henderson-Wilson, C., Pryor, A., Prosser, L., Moore. M. 2008. Healthy parks, healthy people: The health benefits of contact with nature in a park context. 2nd ed. https://www.deakin.edu.au/__data/assets/pdf_file/0016/310750/HPHP-2nd-Edition.pdf

Maller, C., Townsend, M., Pryor, A., Brown, P., St Leger, L. 2006. Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations. Health promotion international. 21(1):45-54.

MEA 2005. Millennium Ecosystem Assessment, 2005. Ecosystems and Human Well-being: Synthesis. Island Press, Washington, DC.

Mozaffarian, D., Rimm, E,B, 2006. Fish intake, contaminants, and human health: Evaluating the risks and the benefits. JAMA 296:1885-1899

NAHO. no date. Holistic Health and Traditional Knowledge. National Aboriginal Health Organization. http://www.naho.ca/blog/2011/07/25/holistic-health-and-traditional-knowledge/

Niemi, G.J., McDonald, M.E. 2004.Application of ecological indicators. Annu. Rev. Ecol. Evol. Syst. 15;35:89-111.

Norris, F.H., Stevens, S.P., Pfefferbaum, B., Wyche, K.F. and Pfefferbaum, R.L., 2008. Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. American journal of community psychology, 41(1-2), pp.127-150.

Ogden, N.H., Lindsay, L.R., Hanincová, K., Barker, I.K., et al. 2008. Role of migratory birds in introduction and range expansion of ixodes scapularis ticks and of borrelia burgdorferi and anaplasma phagocytophilum in Canada. Applied and Environmental Microbiology 74:1780-1790

O'Neill, M., Simard. P. 2006. Choosing indicators to evaluate Healthy Cities projects: a political task?. Health Promotion International. 21(2):145-52.

Parmley, J., Lair, S., Leighton, F.A. 2009. Canada's inter-agency wild bird influenza survey. Integrative zoology 4:409-417

Patchell, B., Edwards, K. 2014. The role of traditional foods in diabetes prevention and management among native Americans. Current Nutrition Reports 3:340-344

Pfefferbaum, B., Reissman, D., Pfefferbaum, R., Klomp, R., & Gurwitch, R. 2005. Building resilience to mass trauma events. In L. Doll, S. Bonzo, J. Mercy, & D. Sleet (Eds.), Handbook on injury and violence prevention interventions. New York: Kluwer Academic Publishers.

POC. 2015. Licenced hunting and trapping in Canada. Parliament of Canada http://www.parl.gc.ca/HousePublications/Publication.aspx?DocId=8045718&Mode=1&Parl=41&Ses=2&Language=E. Accessed Oct 2016

Raudsepp-Hearne, C., Peterson, G.D., Tengö, M., Bennett, E.M., Holland, T., Benessaiah, K., MacDonald, G.K. and Pfeifer, L., 2010. Untangling the environmentalist's paradox: Why is human well-being increasing as ecosystem services degrade? BioScience, 60(8), pp.576-589.

Reading, J.L., Kmetic, A., Gideon, V. 2007First Nations wholistic policy and planning model. Assembly of First Nations: Discussion paper for the World Health Organization commission on social determinants of health. Ottawa, ON: Assembly of First Nations. Apr;8.

Reif, J.S, 2011. Animal sentinels for environmental and public health. Public health reports 126 Suppl 1:50-57

Richmond, C., Elliott, S.J., Matthews, R., Elliott, B., 2005. The political ecology of health: perceptions of environment, economy, health and well-being among 'Namgis First Nation. Health & place, 11(4), pp.349-365.

Richmond, C.A., Ross, N.A., 2009. The determinants of First Nation and Inuit health: a critical population health approach. Health & place, 15(2), pp.403-411.

Robbins, J.A., Dewar, J. 2011. Traditional Indigenous Approaches to Healing and the modern welfare of Traditional Knowledge, Spirituality and Lands: A critical reflection on practices and policies taken from the Canadian Indigenous Example. International Indigenous Policy Journal. 1;2(4).

Ryder, R.A. 1990. Ecosystem health, a human perception: definition, detection, and the dichotomous key. Journal of Great Lakes Research. 16(4):619-24.

Scott, K. 2005. Editorial: Population Health: Risk and Resistance. J Aboriginal Health. 2(1): 2-5. http://www.naho.ca/documents/journal/jah02_01/JournalVol2No1ENG2editorial.pdf

Shutes, R.B. 2001.Artificial wetlands and water quality improvement. Environment international. 26(5):441-7.

Spears, B.M., Ives, S.C., Angeler, D.G., Allen, C.R., Birk, S., et al. 2015. Effective management of ecological resilience–are we there yet?. Journal of applied ecology. 52(5):1311-5.

Stephen, C., Duncan, C. 2017. Can wildlife surveillance contribute to public health preparedness for climate change? A Canadian Perspective. Climatic Change 141(2), 259-271

Sudmeier-Rieux, K., Ash, N. 2009. Environmental guidance note for disaster risk reduction: healthy ecosystems for human security. International Union for the Conservation of Nature

Summers, J.K., Smith, L.M., Case, J.L., Linthurst, R.A., 2012. A review of the elements of human well-being with an emphasis on the contribution of ecosystem services. Ambio, 41(4), pp.327-340.

UN. 2007. United Nations Declaration on the Rights of Indigenous Peoples. http://www.un.org/esa/socdev/unpfii/documents/DRIPS_en.pdf

von Schirnding, Y. 2002. Health I sustainable development planning: The role of indictors. World Health Organization. http://apps.who.int/iris/bitstream/10665/67391/1/WHO_HDE_HID_02.11.pdf

Vörösmarty, C.J, McIntyre, P.B., Gessner, M.O, et al. 2010. Global threats to human water security and river biodiversity. Nature. 467(7315):555.

Wilson, K. 2003. Therapeutic landscapes and First Nations peoples: an exploration of culture, health and place. Health and Place. 9(2):83-93.

Wilson, K., Rosenberg, M.W. 2002Exploring the determinants of health for First Nations peoples in Canada: can existing frameworks accommodate traditional activities? Social Science and Medicine. 55(11):2017-31.

Wood, S.L. and DeClerck, F, 2015. Ecosystems and human well-being in the Sustainable Development Goals. Frontiers in Ecology and the Environment, 13(3): 123-123.

WTABC. (no date) Wilderness Tourism Association British Columbia Value of wilderness tourism. http://www.wilderness-tourism.bc.ca/value.html, Accessed Oct 2016

Appendix 1 – Search strategy to find publicly available information on ecological determinants as they may relate to First Nations Health in British Columbia

First Nations organizations websites

- Found through the First Nations in BC Knowledge Network - https://fnbc.info/directories
    - BC First Nations Energy and Mining Council
    - First Nations Fisheries Council
    - First Nations Agricultural Association
    - National Collaborating Centre for Aboriginal Health
    - First Nations Forestry Council
    - Columbia River Inter-Tribal Fish Commission

Modern Treaties reviewed

- Found through BC Treaty Commission - http://www.bctreaty.ca/treaties-and-agreements-in-principle
    - Tla'amin Final Agreement
    - Maa-nulth First Nations Final Agreement
    - Tsawwassen First Nation Final Agreement
    - Yale First Nation Final Agreement
    - Lheidli T'enneh Final Agreement
    - Nisga'a Final Agreement

BC government website/search criteria

- https://catalogue.data.gov.bc.ca/dataset?
    - Sector search: natural resources
- Provincial Health Officer's annual and special reports
- Environmental reports: https://www2.gov.bc.ca/gov/content/environment/research-monitoring-reporting/reporting/environmental-reporting-bc/previous-reports-indicators

Canadian government website/search criteria

- http://publications.gc.ca/site/eng/search/search.html
    - Search terms: environment and fisheries and British Columbia
    - Reports published 2015 or more recent
- http://open.canada.ca/data/en/dataset
    - Subject: nature and environment

Appendix 2 – Publically available reports and datasets identified as relevant for potentially assessing ecological determinants for First Nations Health in British Columbia

	Document or Data Title	Type of Information	Theme Category	Source
1	BC Ambient Air Quality Standards Reporting - Fine particulate matter	Dataset	Air	https://catalogue.data.gov.bc.ca/dataset/699be99e-a9ba-403e-b0fe-3d13f84f45ab
2	BC ambient Air Quality Standards Reporting – ozone	Dataset	Air	https://catalogue.data.gov.bc.ca/dataset/bc-ambient-air-quality-standards-reporting-results-ozone
3	Validated Hourly Air Quality and Meteorological Data	Dataset	Air	https://catalogue.data.gov.bc.ca/dataset/77eeadf4-0c19-48bf-a47a-fa9eef01f409
4	British Columbia greenhouse gas emissions	Dataset	Air	https://catalogue.data.gov.bc.ca/dataset/24c899ee-ef73-44a2-8569-a0d6b094e60c
5	Shellfish and finfish transfers to and from British Columbia aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/27dfcbf6-d320-4afc-9d0c-3d5df107dbe6
6	Carcass classification of culture salmon at British Columbian aquaculture sites by facility	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/0a8c5505-ecb3-4d8b-8120-462bd7def6bb
7	Incidental catch at BC marine finfish aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/0bf04c4e-d2b0-4188-9053-08dc4a7a2b03
8	Industry sea lice counts at BC marine finfish aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/3cafbe89-c98b-4b44-88f1-594e8d28838d
9	Marine mammal interactions at British Columbia marine finfish aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/a7b3fdfb-5917-4ca6-b29c-093e3f65d6ba
10	Geospatial boundaries of shellfish growing area classification in Canada	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/b6aee1d7-638c-4bf3-9d09-8db4243b81da
11	Escapes of cultured marine finfish from BC aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/691dd994-4911-433d-b3b6-00349ba9f24e
12	Escapes of cultured marine finfish from BC aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/6c891715-317c-4d4d-9fe8-ea425e01d9d2

	Document or Data Title	Type of Information	Theme Category	Source
13	Results of DFO fish health audits of British Columbian marine finfish aquaculture sites, by facility	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/5cfd93bd-b3ee-4b0b-8816-33d388f6811d
14	DFO's fish health monitoring activities at BC aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/4dc95665-3d44-428c-bb26-12f981c57060
15	Results of industry benthic monitoring of British Columbia marine finfish aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/4dc95665-3d44-428c-bb26-12f981c57060
16	Results of industry benthic monitoring of British Columbia marine finfish aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/c1a54a0c-4eb0-4b50-be1f-01aee632527e
17	Use of lights at BC marine finfish aquaculture sites	Dataset	Aquaculture	http://open.canada.ca/data/en/dataset/6d18936d-3463-422c-97ab-69906e5b682e
18	Change in timing and volume of river flow in BC	Dataset	Climate	https://catalogue.data.gov.bc.ca/dataset/change-in-timing-and-volume-of-river-flow-in-bc-1912-2012-
19	Change in sea surface temperature in BC	Dataset	Climate	https://catalogue.data.gov.bc.ca/dataset/change-in-sea-surface-temperature-in-bc-1935-2014-
20	Change in sea level in BC	Dataset	Climate	https://catalogue.data.gov.bc.ca/dataset/change-in-sea-level-in-bc-1910-2014-
21	Change in snow depth and snow water content in BC	Dataset	Climate	https://catalogue.data.gov.bc.ca/dataset/change-in-snow-depth-and-snow-water-content-in-bc-1950-2014-
22	Long-term change in growing degree days and heating and cooling degree days in BC	Dataset	Climate	https://catalogue.data.gov.bc.ca/dataset/long-term-change-in-growing-degree-days-and-heating-and-cooling-degree-days-in-bc
23	Change in size of glaciers in BC	Dataset	Climate	https://catalogue.data.gov.bc.ca/dataset/change-in-size-of-glaciers-in-bc-1985-2005-
24	Manual snow survey observations data archive	Dataset	Climate	https://catalogue.data.gov.bc.ca/dataset/manual-snow-survey-observations-data-archive
25	Long-term change in air temperature and precipitation in BC	Dataset	Climate	https://catalogue.data.gov.bc.ca/dataset/long-term-change-in-air-temperature-and-precipitation-in-bc

	Document or Data Title	Type of Information	Theme Category	Source
26	Indicators of Climate Change for British Columbia (2015-16 Update)	Report	Climate	https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/climate-change/climatechangeindicators-13sept2016_final.pdf
27	First Nations RHS - National Report 2008/10	Report	Connection	http://fnigc.ca/sites/default/files/docs/first_nations_regional_health_survey_rhs_2008-10_-_national_report.pdf
28	Fish health database	Dataset	Disease	http://open.canada.ca/data/en/dataset/2ece9991-62aa-4b7a-bd7d-4f8f1052cd21
29	Summary data on limnology and food-web structure of Great Central, Sproat, and Henderson Lakes, B.C. (2008-2013)	Report	Ecosystem	http://publications.gc.ca/site/eng/9.812174/publication.html
30	Environmental Trends in British Columbia: 2007	Report	Ecosystem	https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/bcce06/bcce_report.pdf
31	BC species and ecosystems conservation status information	Dataset	Ecosystem	https://catalogue.data.gov.bc.ca/dataset/bc-species-and-ecosystems-conservation-status-information
32	Alive and Inseparable: B.C.'s Coastal Environment 2006	Report	Ecosystem	https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/bcce06/bcce_report.pdf
33	The State of British Columbia's Forests, 3rd Edition	Report	Ecosystem	https://www2.gov.bc.ca/assets/gov/environment/research-monitoring-and-reporting/reporting/envreportbc/archived-reports/sof_2010.pdf
34	Variable density yield projection 7 input polygon	Dataset	Habitat	https://catalogue.data.gov.bc.ca/dataset/variable-density-yield-projection-7-input-polygon
35	Variable density yield projection 7 input layer	Dataset	Habitat	https://catalogue.data.gov.bc.ca/dataset/variable-density-yield-projection-7-input-layer
36	Trends in forest disturbances and reforestation	Dataset	Habitat	https://catalogue.data.gov.bc.ca/dataset/trends-in-forest-disturbances-and-reforestation
37	Terrestrial ecosystem information (TEI) data distribution packages	Dataset	Habitat	https://catalogue.data.gov.bc.ca/dataset/terrestrial-ecosystem-information-tei-data-distribution-packages
38	Trends in BC biogeoclimatic zones in parks and protected areas	Dataset	Habitat	https://catalogue.data.gov.bc.ca/dataset/trends-in-bc-biogeoclimatic-zones-in-parks-and-protected-areas
39	Summary of the West Coast Vancouver Island synoptic bottom trawl survey, June 7-29, 2010	Report	Habitat	http://publications.gc.ca/site/eng/9.810182/publication.html

	Document or Data Title	Type of Information	Theme Category	Source
40	Seasonality and physical control of water properties and sinking and suspended particles in Douglas Channel, British Columbia	Report	Habitat	http://publications.gc.ca/site/eng/9.801189/publication.html
41	Summaries of protected lands and waters in BC	Dataset	Habitat	https://catalogue.data.gov.bc.ca/dataset/summaries-of-protected-lands-and-waters-in-b-c-
42	BC municipal solid waste disposal rates	Dataset	Pollution	https://catalogue.data.gov.bc.ca/dataset/bc-municipal-solid-waste-disposal-rates
43	Waste discharge authorizations - all discharges	Dataset	Pollution	https://catalogue.data.gov.bc.ca/dataset/bc-municipal-solid-waste-disposal-rates
44	Waste discharge authorizations - all authorizations	Dataset	Pollution	https://catalogue.data.gov.bc.ca/dataset/waste-discharge-authorizations-all-authorizations
45	Consolidated community energy and emissions inventory reports	Dataset	Pollution	https://catalogue.data.gov.bc.ca/dataset/consolidated-community-energy-and-emissions-inventory-reports
46	National and provincial/territorial greenhouse gas emissions tables	Dataset	Pollution	http://open.canada.ca/data/en/dataset/779c7bcf-4982-47eb-af1b-a33618a05e5b
47	Air Pollutant Emission Inventory (APEI) Historical Trends	Dataset	Pollution	http://open.canada.ca/data/en/dataset/fa1c88a8-bf78-4fcb-9c1e-2a5534b92131
48	Pacific 2001 Air Quality Study	Dataset	Pollution	http://open.canada.ca/data/en/dataset/102d8a5a-dbbe-498c-8b1a-511394849873
49	Fraser River Basin Long-term Water Quality Monitoring 1979-Present	Dataset	Pollution	http://open.canada.ca/data/en/dataset/9ec91c92-22f8-4520-8b2c-0f1cce663e18
50	A survey of literature on oil spill effects on marine organisms on the west coast of British Columbia, Canada with a focus on bitumen related products	Report	Pollution	http://publications.gc.ca/site/eng/9.837489/publication.html
51	Oil spill trajectory on the northern British Columbia coast	Report	Pollution	http://publications.gc.ca/site/eng/9.581502/publication.html
52	Drinking water health topics	Report	Public Health	https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/current-health-topics/drinking-water-health-topics

	Document or Data Title	Type of Information	Theme Category	Source
53	Provincial Health Officer's Annual Report 2003 - Air Quality in British Columbia, a Public Health Perspective	Report	Public Health	https://www2.gov.bc.ca/gov/content/health/about-bc-s-health-care-system/office-of-the-provincial-health-officer/current-health-topics/drinking-water-health-topics
54	Pathways to health and healing - 2nd report on the health and well-being of aboriginal people in British Columbia - Provincial Health Officer's Annual Report 2007	Report	Public Health	https://www2.gov.bc.ca/assets/gov/government/ministries-organizations/ministries/health/aboriginal-health-directorate/abohlth11-var7.pdf
55	Provincial oil and gas tenure registry extract (non-confidential records)	Dataset	Resources	https://catalogue.data.gov.bc.ca/dataset/provincial-oil-and-gas-tenure-registry-extract-non-confidential-records-
56	BC annual industrial minerals production from 1904 onwards	Dataset	Resources	https://catalogue.data.gov.bc.ca/dataset/bc-annual-industrial-minerals-production-from-1904-onwards
57	BC annual coal production from 1866 onwards	Dataset	Resources	https://catalogue.data.gov.bc.ca/dataset/bc-annual-coal-production-from-1866-onwards
58	BC annual metal shipments from 1858 onwards	Dataset	Resources	https://catalogue.data.gov.bc.ca/dataset/bc-annual-metal-shipments-from-1858-onwards
59	BC annual construction aggregate production from 1930 onwards	Dataset	Resources	https://catalogue.data.gov.bc.ca/dataset/bc-annual-construction-aggregate-production-from-1930-onwards
60	Murray River coal project	Report	Resources	http://publications.gc.ca/site/eng/9.825329/publication.html
61	Report of the Joint Review Panel - Site C Clean Energy Project, BC Hydro and Power Authority, British Columbia	Report	Resources	http://publications.gc.ca/site/eng/9.652806/publication.html
62	Conservation status index values for BC vertebrates, 1992-2012	Dataset	Species at Risk	https://catalogue.data.gov.bc.ca/dataset/conservation-status-index-values-for-bc-vertebrates-1992-2012
63	History of grizzly bear mortalities	Dataset	Species at Risk	https://catalogue.data.gov.bc.ca/dataset/history-of-grizzly-bear-mortalities
64	2012 grizzly bear population estimates	Dataset	Species at Risk	https://catalogue.data.gov.bc.ca/dataset/2012-grizzly-bear-population-estimates
65	Morrison Creek lamprey survey data	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/c87886cd-d37e-459c-945f-ca35f8055e85

	Document or Data Title	Type of Information	Theme Category	Source
66	Critical habitat for species at risk, British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/6a6f314b-5272-4e7a-ac4e-8d372990f22f
67	Marbeled Murrelet (Brachyramphus marmoratus) - Critic habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/ecd01458-c303-4207-9ac1-15da32d9768b
68	Contorted-pod Evening-primrose (Camissonia contorta) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/2a159a95-7211-4070-8e12-f32da5ad9b25
69	Pacific great blue heron (Ardea Herodia fannini) Conservation regions, British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/e23ce141-996e-4c98-b4a1-3141ce6095dd
70	Williamson's Sapsucker (Sphyrapicus thyroideus) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/c70d210d-2d9f-409f-802d-63fe91eaf898
71	Yellow-breasted chat, southern mountain pop. (Icteria virens auricollis) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/31b50b53-2a33-4227-bea9-0542d5404d36
72	Roberts Bank shorebird surveys, British Columbia - sapprox. Survey area	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/4cdeec34-30e7-4070-8362-ae5bac21376b
73	Nugget moss (Microbryum vlassovii) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/c9e5f1a9-df9f-4dbb-8a6a-212e8893ad43
74	Oregon spotted frog (Rana pretiosa) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/775df6b3-512f-4d31-b93d-86590ec65f24

	Document or Data Title	Type of Information	Theme Category	Source
75	Tall bugbane (Actaea elata) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/7cb60428-399f-41ec-80d6-e727f1b404eb
76	Macoun's meadowfoam (Limnanthes macounii) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/e7bd6e36-13d4-4aa9-9ac3-6685e35e7352
77	Pacific great blue heron (Ardea Herodia fannini) potential area of occupancy, British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/456ce087-4711-442c-8445-30520f96e98e
78	Short-rayed Alkali aster (Symphyotrichum frondosum) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/68b1136b-efdb-4a11-b4e4-441950feb83c
79	Pelagic seabird atlas, west coast of Canada, average grid cell density, 2009	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/be0a3350-f755-418e-b04b-7ff9fd2ebeac
80	Woodland caribou, boreal pop. (Rangifer tarandus caribou) - critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/4e1fbc61-3993-40a8-9ede-97ae78ff6acd
81	Branched phacelia (Phacelia ramosissima) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/f74fa2b1-6161-476a-ba28-95acb7fcc9fc
82	Behr's hairstreak (Satyrium behrii) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/2a609261-6479-41ee-b305-5267063ce7f6
83	Stoloniferous pussytoes (Antennaria flagellaris) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/51c96d43-8bc8-4519-b857-e475691f2620

	Document or Data Title	Type of Information	Theme Category	Source
84	Southern maidenhair fern (Adiantum capillus-veneris) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/bf6a70b5-3d27-4471-8991-6d464800f01a
85	Fragrant popcorn flower (Plagiobothryn figuratus) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/091f4db8-b325-427d-beac-f6c407d9604d
86	Grand coulee owl-clover (Orthocarpus barbatus) - Critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/8e7d7ede-6702-4f80-b666-6c689db89f0b
87	Streambank Lupine (Lupinus rivularis) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/339fe762-64e6-4a9a-afab-3c16292f74a4
88	Townsend's Mole (Scapanus townsendii) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/33669fdf-9f95-4b0f-a262-4fba166fd3e5
89	Rocky Mountain Tailed Frog (Ascaphus montanus) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/9431a70b-e30b-4718-a27f-604be4e64324
90	Seaside Bone Lichen (Hypogymnia heterophylla) - Critical Habitat for Species at Risk, British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/f56459c9-b7c5-4e61-9ac7-1ab5334651e6
91	Slender Collomia (Collomia tenella) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/7622332a-ab4d-43e6-a33e-dc3ddf51ba85
92	Muhlenberg's Centaury (Centariuim meuhlenbergii) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/7eb16e12-aef6-4928-9e2f-34e547687878

	Document or Data Title	Type of Information	Theme Category	Source
93	Scarlet Ammannia (Ammannia robusta) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/275f70dc-87e3-4ea9-9f4b-cd64eda96ce6
94	Northern Saw-whet Owl brooksi subspeciesi (Aegolius acadicus brooksi) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/1171fc2a-7d2b-4686-a965-031f63bc8f46
95	Rigid Apple Moss (Bartramia stricta) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/e5a71860-827c-453f-990e-0e0ba0ee67bb
96	California Buttercup (Ranunculus californicus) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/29e117d3-e7ce-41d3-ad1d-d80dd01edd82
97	Brook Spike-primrose (Epilobium torreyi) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/87c2df0f-0b0a-4aa4-ac68-6668f1e5f94e
98	Coast Microseris (Microseris bigelovii) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/636778fa-145a-4c92-99fb-d8f92e152e7d
99	Spalding's Campion (Silene spaldingii) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/1700c85b-a808-4ec8-b539-6a0a3998a630
100	Lemmon's Holly Fern (Polystichum lemmonii) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/7b8d1345-a8c8-42b3-abcd-8a016ed5805a
101	Haller's Apple Moss (Bartramia halleriana) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/fcecda20-bd0c-4489-a066-82b41a9278a8
102	Halfmoon Hairstreak (Satyrium semiluna) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/d1b9d2ba-2d96-45d4-bf7a-a81611fb1376

	Document or Data Title	Type of Information	Theme Category	Source
103	Gray's Desert-parsley (Lomatium grayi) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/c4ea3138-324b-4379-9622-99f91ea9d7a4
104	Dwarf Woolly-heads, Southern Mountain pop. (Psilocarphus brevissimus) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/8a74fdb2-ac39-499f-9db2-4c74411d6387
105	Dense Spike-primrose (Epilobium densiflorum) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/e6872960-4182-4c0e-b00c-d740e6b07d80
106	Dense-flowered Lupine (Lupinus densiflorus) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/f73c868d-f416-4e92-83f2-572f98bf58d7
107	Foothill Sedge (Carex tumulicola) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/03407bcd-4ca3-4c5a-899b-115beecc88a6
108	Pacific Water Shrew (Sorex bendirii) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/303799e1-6b76-4f4c-aae0-2876fb2412d6
109	Sage Thrasher (Oreoscoptes montanus) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/8307b9d7-6a2a-4a03-a7ae-e406434c8f27
110	Pink Sand-verbena (Abronia umbellata) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/bf8fd85b-b72e-45a2-9ff8-8f07ab8ccfae
111	Lindley's False Silverpuffs (Uropappus lindleyi) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/ba05aeaf-add5-4e9e-99c1-3c01a167e34e
112	Oregon Forestsnail (Allogona townsendiana) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/a9d8eb85-09f1-44d3-94ba-b1c1990a3d59

	Document or Data Title	Type of Information	Theme Category	Source
113	Sand-verbena Moth (Copablepharon fuscum) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/d6975231-e63a-4576-8070-9a05a6b82911
114	Lewis' Woodpecker (Melanerpes lewis) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/e20092a1-9b55-4fac-9fe7-267929df6df7
115	Porsild's Bryum (Haplodontium macrocarpum) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/ff8ab2df-951e-4a29-99eb-a3bab90d7b4e
116	Vesper Sparrow affinis subspecies (Pooecetes gramineus affinis) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/9b6d6e23-af05-4aa6-9958-62826b9d9db0
117	Rusty Cord-moss (Entosthodon rubiginosus) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/2a4c6131-d510-4725-a444-0f59fce5746c
118	White Meconella (Meconella oregana) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/7b5e0039-2742-4c5d-b16b-a2c3d8fe3d55
119	Poor Pocket Moss (Fissidens pauperculus) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/1d76c780-a21f-440c-b23a-85169db0fa93
120	Toothcup (Rotala ramosior) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/0badf511-3019-49dc-8394-205dd993a401
121	Rayless Goldfields (Lasthenia glaberrima) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/59559280-cd64-4835-a98f-96118333c0ae
122	Rayless Goldfields (Lasthenia glaberrima) - Critical Habitat for Species at Risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/2743ca7f-ac50-49e3-b858-2607343d788a

	Document or Data Title	Type of Information	Theme Category	Source
123	Roberts Bank Shorebird Surveys, British Columbia - Predicted and Actual Counts, 1991-2015	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/93422381-f138-4e4f-9ea7-bd0ea064163e
124	Report on the progress of recovery strategy implementation for the transient Killer Whale (Orcinus orca) in Canada for the period 2007-2012	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/24061333-d35e-46bb-b493-070444ed382b
125	Report on the progress of recovery strategy implementation for the Leatherback Sea Turtle (Dermochelys coriacea) in Canadian Pacific waters for the period 2007-2012	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/4160941a-5498-4bb2-9a26-a6a59bef5cc3
126	Pacific Ocean perch (Sebastes alutus) stock assessments for Queen Charlotte Sound, British Columbia in 2017	Report	Species at Risk	http://publications.gc.ca/site/eng/9.843767/publication.html
127	Survey results of green sea urchin (Strongylocentrotus droebachiensis) populations in Haro Strait, British Columbia, March 2008, March and August 2009, and March 2010	Report	Species at Risk	http://publications.gc.ca/site/eng/9.834467/publication.html
128	Redbanded rockfish (Sebastes babcocki) stock assessment for the Pacific coast of Canada in 2014	Report	Species at Risk	http://publications.gc.ca/site/eng/9.842649/publication.html
129	Remotely operated vehicle surveys of rockfish conservation areas in British Columbia, February 2009–July 2011	Report	Species at Risk	http://publications.gc.ca/site/eng/9.829037/publication.html

	Document or Data Title	Type of Information	Theme Category	Source
130	Assessing the risk of lethal ship strikes to humpback (Megaptera novaeangliae) and fin (Balaenoptera physalus) whales off the west coast of Vancouver Island, Canada	Report	Species at Risk	http://publications.gc.ca/site/eng/9.842587/publication.html
131	Information in support of the identification of critical habitat for the Cowichan (Vancouver) lamprey (Entosphenus macrostomus)	Report	Species at Risk	http://publications.gc.ca/site/eng/9.830368/publication.html
132	Recovery strategy for the Salish Sucker (Catostomus sp. cf. catostomus) in Canada	Report	Species at Risk	http://publications.gc.ca/site/eng/9.809765/publication.html
133	Report on the progress of recovery strategy implementation for Cowichan Lake lamprey (Entosphenus macrostomus) in Canada for the period 2007-2015	Report	Species at Risk	http://publications.gc.ca/site/eng/9.824110/publication.html
134	Report on the progress of recovery strategy implementation for Nooksack dace (Rhinichthys cataractae) in Canada for the period 2008-2015	Report	Species at Risk	http://publications.gc.ca/site/eng/9.824097/publication.html
135	Report on the progress of recovery strategy implementation for the Cultus pygmy sculpin (Cottus aleuticus, Cultus population) in Canada for the period 2007-2015	Report	Species at Risk	http://publications.gc.ca/site/eng/9.824327/publication.html
136	Report on the progress of recovery strategy implementation for the hotwater physa (Physella wrighti) in Canada for the period 2007-2015	Report	Species at Risk	http://publications.gc.ca/site/eng/9.824330/publication.html

	Document or Data Title	Type of Information	Theme Category	Source
137	Report on the progress of recovery strategy implementation for the hotwater physa (Physella wrighti) in Canada for the period 2007-2015	Report	Species at Risk	http://publications.gc.ca/site/eng/9.824336/publication.html
138	Review of dive survey methods for northern abalone in British Columbia	Report	Species at Risk	http://publications.gc.ca/site/eng/9.825300/publication.html
139	Identification of critical habitat for coastrange sculpin (Cultus population) (Cottus aleuticus)	Report	Species at Risk	http://publications.gc.ca/site/eng/9.803086/publication.html
140	Information to support the identification of critical habitat for the Morrison Creek lamprey (Lampetra richardsoni var. marifuga)	Report	Species at Risk	http://publications.gc.ca/site/eng/9.803083/publication.html
141	Wild species 2015	Report	Species at Risk	http://publications.gc.ca/site/eng/9.840239/publication.html
142	Woodland caribou, southern mountain pop. (Rangifer tarandus caribou) - critical habitat for species at risk - British Columbia	Dataset	Species at Risk	http://open.canada.ca/data/en/dataset/62fd346b-fd95-4b66-baf3-36b893acb23e
143	Review of potential impacts associated with recent and proposed Okanagan Sockeye Salmon fry introductions to Skaha and Okanagan Lakes	Report	Stock	http://publications.gc.ca/site/eng/9.840247/publication.html
144	Data summary of trap camera video obtained during sablefish bottom longline trap fishing at SGaan Kinghlas - Bowie Seamount, 2014-2015	Report	Stock	http://publications.gc.ca/site/eng/9.835495/publication.html

	Document or Data Title	Type of Information	Theme Category	Source
145	Status of B.C. Pacific herring (Clupea pallasii) in 2013 and forecasts for 2014	Report	Stock	http://publications.gc.ca/site/eng/9.836720/publication.html
146	Stock assessment of the coastwide population of shortspine thornyhead (Sebastolobus alascanus) in 2015 off the British Columbia coast	Report	Stock	http://publications.gc.ca/site/eng/9.834997/publication.html
147	Effects of sand acclimation on burrowing rate and siphon nipping on growth of juveniles of the Pacific geoduck clam (Panopea generosa)	Report	Stock	http://publications.gc.ca/site/eng/9.841999/publication.html
148	Enumeration of juvenile and adult coho salmon at Black Creek, Vancouver Island, 2013	Report	Stock	http://publications.gc.ca/site/eng/9.833452/publication.html
149	Trap camera videos from SGaan Kinghlas - Bowie Seamount	Report	Stock	http://publications.gc.ca/site/eng/9.842950/publication.html
150	Arrowtooth flounder (Atheresthes stomias) stock assessment for the west coast of British Columbia	Report	Stock	http://publications.gc.ca/site/eng/9.843711/publication.html
151	Use of inverted echosounders to monitor the migration timing and abundance of juvenile salmon in the Discovery Islands, British Columbia	Report	Stock	http://publications.gc.ca/site/eng/9.843121/publication.html
152	Water temperature, river discharge, and adult sockeye salmon migration observations in the Chilko-Chilcotin watershed, 1975-2012	Report	Stock	http://publications.gc.ca/site/eng/9.829390/publication.html

	Document or Data Title	Type of Information	Theme Category	Source
153	Dynamic energy budget (DEB) models of bivalve molluscs inhabiting British Columbia coastal waters	Report	Stock	http://publications.gc.ca/site/eng/9.819891/publication.html
154	Integrated biological status of southern British Columbia Chinook salmon (Oncorhynchus tshawytscha) under the Wild Salmon Policy	Report	Stock	http://publications.gc.ca/site/eng/9.824333/publication.html
155	Integrated biological status of southern British Columbia Chinook salmon (Oncorhynchus tshawytscha) under the Wild Salmon Policy	Report	Stock	http://publications.gc.ca/site/eng/9.813485/publication.html
156	Results from the September 2015 CCGS Neocaligus shrimp trawl survey in Chatham Sound British Columbia with emphasis on Eulachon (Thaleichthys pacificus)	Report	Stock	http://publications.gc.ca/site/eng/9.813484/publication.html
157	Stock assessment and harvest advice for rock sole (Lepidopsetta spp.) in British Columbia	Report	Stock	http://publications.gc.ca/site/eng/9.813992/publication.html
158	Stock assessment for lingcod (Ophiodon elongatus) in the Strait of Georgia, British Columbia in 2014	Report	Stock	http://publications.gc.ca/site/eng/9.817840/publication.html
159	Stock assessment of the coastwide population of shortspine thornyhead (Sebastolobus alascanus) for British Columbia, Canada in 2015	Report	Stock	http://publications.gc.ca/site/eng/9.816324/publication.html

	Document or Data Title	Type of Information	Theme Category	Source
160	Stock status update and harvest options for the green sea urchin (Strongylocentrotus droebachiensis) fishery in British Columbia, 2016-2019	Report	Stock	http://publications.gc.ca/site/eng/9.819897/publication.html
161	Assessment of Pacific cod (Gadus macrocephalus) for Hecate Strait (5CD) and Queen Charlotte Sound (5AB) in 2013	Report	Stock	http://publications.gc.ca/site/eng/9.809197/publication.html
162	Big skate (Raja binoculata) and longnose skate (R. rhina) stock assessments for British Columbia	Report	Stock	http://publications.gc.ca/site/eng/9.809284/publication.html
163	Candidate limit reference points as a basis for choosing among alternative harvest control rules for Pacific herring (Clupea pallasii) in British Columbia	Report	Stock	http://publications.gc.ca/site/eng/9.809284/publication.html
164	Central coast juvenile herring survey, August 2011	Report	Stock	http://publications.gc.ca/site/eng/9.801163/publication.html
165	Distribution and biological characteristics of European Green Crab, Carcinus maenas, in British Columbia, 2006-2013	Report	Stock	http://publications.gc.ca/site/eng/9.557263/publication.html
166	Estimates of a biologically-based spawning goal and biological benchmarks for the Canadian-origin Taku River coho stock aggregate	Report	Stock	http://publications.gc.ca/site/eng/9.809177/publication.html
167	Harvest advice for Pacific Sardine (Sardinops sagax) in British Columbia waters for the 2015 season	Report	Stock	http://publications.gc.ca/site/eng/9.581623/publication.html

	Document or Data Title	Type of Information	Theme Category	Source
168	An index of relative biomass, abundance and condition of Juvenile Pacific Herring (Clupea pallasi) in the Strait of Georgia, British Columbia	Report	Stock	http://publications.gc.ca/site/eng/9.803355/publication.html
169	Productivity (recruits-per-spawner) data for sockeye, pink, and chum salmon from British Columbia	Report	Stock	http://publications.gc.ca/site/eng/9.800640/publication.html
170	A review of Canadian data sources and catch records for squid (spp.) in the northeast Pacific Ocean	Report	Stock	http://publications.gc.ca/site/eng/9.557302/publication.html
171	A review of data sources and catch records for Pacific Saury (Cololabis saira) in Canada	Report	Stock	http://publications.gc.ca/site/eng/9.557297/publication.html
172	Stock assessment and management advice for British Columbia Pacific Herring - 2014 status and 2015 forecast	Report	Stock	http://publications.gc.ca/site/eng/9.581491/publication.html
173	Stock assessment for lingcod (Ophiodon elongatus) for the Strait of Georgia, British Columbia in 2014	Report	Stock	http://publications.gc.ca/site/eng/9.803121/publication.html
174	Stock status update and quota options for the Green Sea Urchin (Strongylocentrotus droebachiensis) fishery in British Columbia, 2013-2016	Report	Stock	http://publications.gc.ca/site/eng/9.581549/publication.html
175	Summary of reported Atlantic salmon (Salmo salar) catches and sightings in British Columbia and results of field work conducted in 2011 and 2012	Report	Stock	http://publications.gc.ca/site/eng/9.557319/publication.html

	Document or Data Title	Type of Information	Theme Category	Source
176	Surveys for Basking Sharks (Cetorhinus maximus) and other pelagic sharks on the Pacific Coast of Canada, 2007-2011	Report	Stock	http://publications.gc.ca/site/eng/9.557201/publication.html
177	A synthesis of adult Sockeye salmon migration and environmental observations for the Somass watershed, 1974-2012	Report	Stock	http://publications.gc.ca/site/eng/9.620568/publication.html
178	Temperature and discharge conditions associated with migration of adult Sockeye salmon entering the Docee River and Long Lake watershed, B.C. from 1968-2012	Report	Stock	http://publications.gc.ca/site/eng/9.620567/publication.html
179	Trends in the abundance and distribution of sea otters (Enhydra lutris) in British Columbia updated with 2013 survey results	Report	Stock	http://publications.gc.ca/site/eng/9.803222/publication.html
180	Using the Gini coefficient to determine consolidation in the British Columbia shellfish aquaculture industry	Report	Stock	http://publications.gc.ca/site/eng/9.557308/publication.html
181	Water temperature, river discharge, and adult chinook salmon migration observations in the Cowichan watershed, 1988-2014	Report	Stock	http://publications.gc.ca/site/eng/9.802906/publication.html
182	Water temperature, river discharge, and adult sockeye salmon migration observations in the Babine watershed, 1946-2014	Report	Stock	http://publications.gc.ca/site/eng/9.557246/publication.html

	Document or Data Title	Type of Information	Theme Category	Source
183	Water temperature, river discharge, and adult Sockeye salmon migration observations in the Meziadin watershed, 1966-2012	Report	Stock	http://publications.gc.ca/site/eng/9.620572/publication.html
184	Yellowtail Rockfish (Sebastes flavidus) stock assessment for the coast of British Columbia, Canada	Report	Stock	http://publications.gc.ca/site/eng/9.581588/publication.html
185	Fraser River Action Plan resident fish contaminant and health assessment	Report	Stock	http://publications.gc.ca/site/eng/9.807466/publication.html
186	Management plan for the westslope cutthroat trout (Oncorhynchus clarkii lewisi), British Columbia population, in Canada	Report	Stock	http://publications.gc.ca/site/eng/9.827900/publication.html
187	Provincial groundwater observation well network - groundwater levels data	Dataset	Water	https://catalogue.data.gov.bc.ca/dataset/provincial-groundwater-observation-well-network-groundwater-levels-data