The Forest and its Trees: A Critical Inquiry into the Use of Nature-based Solutions in Canada's *A Healthy Environment and A Healthy Economy* Plan

By

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Abstract

Nature-based solutions (NbS) and natural climate solutions (NCS) have emerged as promising options to address the challenges of the global climate and biodiversity crises. However, confusion persists about the meaning and practical implications of these relatively new approaches in the public, private, and political spheres.

This research paper explores how the Government of Canada conceptualizes NbS and NCS, first through a scoping review of literature regarding the conceptual definitions and limits of NbS and NCS, and then through a directed content analysis of their 2020 climate plan, titled *A Healthy Environment and a Healthy Economy* (HEHE). This research determines that the NbS and NCS concepts are frequently confused or treated as interchangeable by the Government of Canada to the detriment of the HEHE plan's strategies. The implications of these findings are discussed. The paper concludes with recommendations for improved design and deployment of NbS and NCS in Canada.

Keywords

Natural climate solutions, sustainability, climate change mitigation, Anthropocene, tree planting

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Table of Contents

List of Tables

List of Abbreviations and Acronyms

FPIC	Free Prior and Informed Consent
GHG	Greenhouse gas
GI	Green Infrastructure
HEHE	*A Healthy Environment and a Healthy Economy*
IPBES	Intergovernmental Science-Policy platform on Biodiversity and Ecosystem Services
IPCA	Indigenous Protected and Conserved Area
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for the Conservation of Nature
NbS	Nature-based Solutions
NCS	Natural Climate Solutions
PRISMA-ScR	Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews
UNDRIP	United Nations Declaration on the Rights of Indigenous Peoples

Introduction

Anthropogenic climate change and global biodiversity loss currently pose two of the greatest threats to human civilization. The current rate of increase in the Earth's atmospheric temperatures due to the presence of greenhouse gases (GHGs) from the widespread burning of fossil fuels threatens to destabilize the climatic conditions and the environment upon which human civilization has relied for the last 11,000 years (Steffen et al., 2018; IPCC, 2018). This crisis is compounded by the simultaneous loss of biodiversity as a result of both climate change and the relentless pursuit of global economic growth and resource exploitation, which threatens to further exacerbate the number and scale of threats to the Earth's ecosystems (IPBES 2019; Pörtner et al., 2021). It has also become increasingly clear that these crises cannot be addressed in isolation (Pörtner et al., 2021).

A variety of large-scale and ambitious actions are now urgently required to both mitigate the effects of climate change and to adapt to the impacts that are now unavoidable (IPCC, 2018). The mitigation of climate change is defined by the Intergovernmental Panel on Climate Change (IPCC) as "a human intervention to reduce emissions or enhance the sinks of greenhouse gases" (IPCC, 2018b). Adaptation to climate change is defined by the International Union for the Conservation of Nature (IUCN) as "initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects" (IUCN, 2020b).

In consideration of the substantial threats posed by anthropogenic climate change, creative and holistic adaptation/mitigation initiatives which simultaneously address biodiversity loss and provide tangible benefits to human beings must be aggressively pursued. In recent years, two options have begun to attain significant notice from academics, policymakers, and non-governmental organizations: nature-based solutions (NbS) and natural climate solutions (NCS). These two categories of interventions have emerged in the context of the need for viable and cost-effective options for helping to address societal challenges such as climate change while potentially offering considerable human and biodiversity co-benefits (Cohen-Shacham et al., 2016; European Commission, 2015; IUCN, 2020; Griscom et. al., 2017).

Both concepts have received considerable endorsement from organizations such as the World Wildlife Fund (2020), the Global Commission on Adaptation (2019), The Nature Conservancy (2021), and Nature United (2021) along with a number of prominent activists, scholars, and authors (e.g., Girardin et al., 2021; Thunberg et al., 2019; Turner, 2018). Given this public support, along with the considerable potential of NbS and NCS to address the challenges caused by anthropogenic climate change, it is unsurprising that there is both political and corporate interest being expressed in their uptake and deployment (Seddon, Daniels, et al., 2020).

Although these two approaches are similar in name and share certain conceptual and practical traits, they are not entirely equivalent for addressing societal challenges. NbS and NCS hold immense promise for addressing the crises of climate change and biodiversity loss, yet outside of specialist circles the concepts are relatively new and are vulnerable to misinterpretation or manipulation (Nesshöver et al., 2017; Seddon, Smith et al., 2021; Girardin et al., 2021). One particular risk arising from the differences between these approaches is that an overemphasis on the use of NCS as opposed to NbS initiatives may prove inadequate for achieving broader sustainability goals (Cohen-Shacham et al., 2019; Seddon, Smith et al., 2021).

To mitigate against the misapplication of these concepts, it is imperative that any proposed NbS or NCS interventions are designed and realized appropriately in accordance with established effective standards (Nesshöver et al., 2017). It is also similarly important for planners and practitioners to possess a clear understanding of the differences between NbS and NCS when it comes their planning, implementation, and respective limits and shortcomings (IUCN, 2020b; Seddon, Smith, et al., 2021).

In 2020, Environment and Climate Change Canada released its first comprehensive climate plan, titled *A Healthy Environment and a Healthy Economy* (hereafter referred to as the HEHE plan). The HEHE plan was developed in the context of the Covid-19 pandemic and lays out a framework for a "green economic recovery". It features promises for the implementation of a spectrum of initiatives including investment in low-carbon transportation, green infrastructure, improving the energy efficiency of buildings, and the planning and deployment of various initiatives which it refers to as NbS and/or NCS. Such initiatives include the following:

- The planting of two billion trees nationally.
- The restoration and enhancement of peatlands, wetlands, grasslands, and agricultural lands.
- The establishment of a fund for "Natural Climate Solutions for Agriculture" to support the agricultural industry's climate goals.
- Conserving 25% of Canada's lands and oceans by 2025 and 30% of each by 2030 in partnership with Indigenous Peoples through programs such as Indigenous Protected and Conserved Areas (IPCAs).

Purpose and Research Questions

This research paper has two primary objectives: The first is to glean an understanding of the extent to which the proposals described as NbS or NCS within the *A Healthy Environment and a Healthy Economy* plan align with existing definitions and conceptualizations of NbS and NCS. This objective is inspired in part by research done by Hanson et al. (2020) and Seddon, Chausson, et al. (2020), who advocate for scientific engagement with policy documents that concern NbS.

The second objective is to use the insight from this analysis to explore and elucidate the differences between NbS and NCS from a more general theoretical and practical viewpoint. To these ends, this paper poses the following research questions: (1) What are the fundamental differences between nature-based solutions and natural climate solutions? (2) Are the proposed NbS and NCS initiatives within the HEHE Plan more characteristic of NbS or of NCS? And (3): What are the implications of these findings for the successful design and implementation of NbS and NCS?

Literature Scoping Review

Literature Search Strategy

To obtain a thorough understanding of the conceptual differences between NbS and NCS, this literature review employed a scoping review strategy to gather a relevant body of literature pertaining to their definitions, limits, and relevant critiques. Scoping reviews are designed for general inquiry into a topic but do not demand the rigor of a systematic review (Munn et al., 2018). This technique is well-suited to the fields of NbS and NCS given their relatively recent emergence into the popular sustainability discourse, as well as the prominence of grey literature in the field, such as policy documents (Munn et al., 2018; Peterson et al., 2017). Scoping reviews have been used to explore subjects in this domain previously: one such review conducted in 2021 examined a body of NbS literature concerning best practices of planning and implementation to develop a concrete framework for developing future NbS projects (Albert et al., 2021).

This review employed the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) checklist (Tricco et al., 2018). The PRISMA-ScR checklist provides a standardized set of items that should be included in a scoping review to ensure methodological transparency and quality (Tricco et al., 2018). Although this scoping review informs only a portion of this research paper, all reasonable efforts were made to align the process with the PRISMA-ScR checklist as much as possible. A filled version of the checklist can be found in Appendix B.

The question chosen to guide the scoping review was: *How are the concepts of NbS and NCS defined in academia, by NGOs, and in Canadian policymaking?* A database search for academic sources was conducted on May 31st, 2021 across two databases: Web of Science: Core Collection and Academic Search Complete. The search terms were “Nature based solutions” and “Natur* climate solutions”. Quotation marks were used to ensure searches returned results that specifically utilized the phrases, and a wildcard (*) was employed to obtain search results that would include the variants “natural climate solutions” as well as “nature-climate solutions”. Basic search functions were used on both databases to ensure that results would include findings from titles, abstracts, and keywords.

The author information and abstracts for the amassed sources were imported into Covidence, a website designed to facilitate academic review projects. From an initial volume of 2040 studies, a body of 733 papers was obtained after the removal of duplicates and non-English sources. The titles and abstracts of these 733 papers were screened to obtain a body of 202 sources for further analysis. These 202 sources were exported to Zotero and were further screened using a modified three-pass approach (Kashev, 2007).

The academic search process was complemented by an ad-hoc and snowball web-based search for additional literature concerning NbS and NCS. Of particular focus were publications from prominent environmental organizations and from the Government of Canada concerning NbS and NCS to obtain a clearer understanding of how these concepts are understood in non-academic settings. All sources obtained in this manner were imported directly into Zotero and included in the three-pass screening process. The inclusion and exclusion criterion applied to determine which studies would be included in the results of the scoping review were as follows:

- Included: Publications which as their primary focus examined, defined, critiqued, or otherwise explained the concepts of NbS and/or NCS and/or their conceptual limits.
- Excluded: Case studies that focused solely on physical outcomes from NbS and NCS interventions (e.g., flooding resilience, urban ambient temperatures, air quality); case studies that were limited to a single geographic area; studies focused primarily on non-landscape management NbS actions (e.g., green infrastructure, ecosystem-based adaptation/management).

The scoping review ultimately yielded a total of 22 sources. Of these, 15 were academic, 3 were from the Government of Canada, and 4 were from non-academic NGO sources, all of which were published from 2015 onwards (a list of references is provided in Appendix C). Of these, 10 offered a conceptual definition of NbS and/or NCS. These definitions were categorized based upon which concept they were defining within the context of their respective publications and listed in Table 3 to allow for a side-by-side comparison. This approach was inspired by a similar comparative analysis between the principles of ecosystem-based approaches and NbS principles conducted by Cohen-Shacham et al. (2019). Relevant facts related to the conceptual limits and critiques of the two concepts are discussed in the “Conceptual Critiques and Limits” section of this paper.

Nature-based Solutions

The use of nature to address human societal problems is by no means itself a novelty, but the term "nature-based solutions" and its encapsulation of the many ways in which natural elements can be used to address human challenges is itself a fairly recent development in the realms of academia and policymaking. The term "nature-based solutions" and its associated concept was first employed in a 2008 World Bank report and then subsequently adopted by the IUCN in a 2009 position paper for the United Nations (Seddon, Smith et al., 2021) and subsequently featured NbS prominently as a part of its 2013-2016 program (IUCN, 2009). The NbS concept was also adopted by the European Commission during this period, which has led to a marked increase in the scope and scale of knowledge concerning NbS (European Commission, 2015; Faivre et al., 2017; Davies et al., 2021).

In 2019, the IUCN drafted a set of working principles for successful NbS (Cohen-Shacham et al., 2019) which were subsequently refined and ultimately adapted into the *Global Standard for Nature-based Solutions* (hereafter referred to as the Global Standard) (Cohen Shacham et al., 2019; IUCN, 2020a). The Global Standard details eight criteria by which NbS practitioners can plan, monitor, and implement projects that effectively address multi-scalar societal challenges sustainably (see Table 1) (IUCN, 2020a, 2020b).

Each criterion within the Global Standard includes a set of specific indicators that can be used to design, assess, and monitor key components of any NbS intervention (IUCN, 2020a). The Global Standard explicitly acknowledges that such criteria and indicators are vital because as NbS are adopted into policy and planning, there is a need for clarity and precision in how to enact them successfully and sustainably (IUCN, 2020a).

Table 1: *Criteria of the IUCN Global Standard for Nature-based Solutions* (source: IUCN, 2020a)

No.	Criterion
1	NbS address societal challenges
2	Design of NbS is informed by scale
3	Nbs result in a net gain to biodiversity and ecosystem integrity
4	NbS are economically viable
5	NbS are based on transparent, inclusive, and empowering governance processes
6	NbS equitably balance trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits
7	NbS are managed adaptively, based on evidence
8	NbS are sustainable and mainstreamed within an appropriate jurisdictional context

Nowadays, the NbS concept is academically understood as an umbrella term for a wide spectrum of interventions including but not limited to ecosystem-based disaster risk reduction (eco-DRR), green infrastructure (GI), ecosystem-based management, ecosystem-based adaptation, ecological engineering, landscape restoration, and NCS (Cohen-Shacham et al., 2016; Kabisch et al., 2016; Eggermont et al., 2015; Seddon, Chausson et al., 2020). It is common for NbS initiatives to offer multiple benefits beyond climate mitigation, although trade-offs can be expected in certain circumstances as well (Chausson et al., 2020).

The IUCN defines nature-based solutions as "actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits" (Cohen Shacham et al., 2019; IUCN, 2020). In addition, the IUCN also states that for an intervention to be considered an NbS, it "must address one or multiple societal challenges in an integrated manner" and "provide simultaneous benefits to biodiversity and human well-being" (IUCN, 2020b). The IUCN definition for NbS is also the one utilized by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) (2019) and in the joint IPBES-IPCC workshop report (Pörtner et al., 2021). This paper utilizes the definition offered by the IUCN with regards to NbS. This is done to maintain a contextual definition consistent with the Global Standard and because it includes both biodiversity and human co-benefits, which are crucial components in successful NbS endeavours (IUCN, 2020b).

Natural Climate Solutions

The concept of natural climate solutions emerged most prominently in a 2017 research paper quantifying the global GHG sequestration potential of 20 land stewardship options (Griscom et al., 2017). This paper provided a set of conservation, restoration, and land management options (termed "pathways") that would help serve as cost-effective methods for climate change mitigation that could also potentially provide human and biodiversity co-benefits. The GHG sequestration potential for NCS posited was indeed substantial, theoretically providing up to 37% of the needed cost-effective mitigation measures required by 2030 to keep global temperatures from rising 2°C by 2100. Moreover, two-thirds of this mitigation potential was to be found in forest pathways via actions such as reforestation and avoiding further degradation or conversion of existing forests (Griscom et al., 2017). This finding was expanded upon by Chapman et al. (2020) who explored in closer detail the mitigation potential of adding trees to agricultural lands.

Since 2017, several papers have been published in a similar vein to quantify the potential of NCS in more specific geographic regions. Fargione et al. (2018) examine NCS potential for the United States. Drever et al. (2021) analyze NCS potential in the Canadian context while Griscom et al. (2020) measure such potential in the tropics while

accounting for governance factors. Natural climate solutions have also been endorsed by organizations such as The Nature Conservancy (2021) and Nature United (2021), both of whom have contributed to research papers concerning NCS (for respective examples, see Griscom et al., 2017 and Drever et al., 2021).

It is important to note that although the NCS concept is distinguished within the broader body of NbS initiatives by its primary goal of GHG sequestration and emission reduction, research papers seeking to quantify GHG sequestration potential via NCS tend to include mention of how such endeavours may produce auxiliary benefits such as improvements to local water and soil quality and increasing biodiversity. In addition, it is common practice for such papers to include constraints to their maximum estimates to ensure no net loss to either biodiversity or human food security (e.g., Smith, 2020; Griscom et al., 2017).

Conceptual Critiques and Limits

It is likely a testament to the utility of the nature-based solutions concept that it has developed a substantial and robust theoretical and practical body of knowledge in recent years (Seddon, Daniels et al., 2020). NbS simultaneously encompasses a wide array of approaches to addressing social and environmental challenges but remains both coherent and cohesive with regards to its core principles, which are handily encapsulated in the Global Standard (IUCN, 2020b).

This utility does not mean that NbS are a panacea, nor beyond critique in theory or practice; conceptual criticisms of NbS include issues of anthropocentrism (e.g., Maller, 2021; Randrup et al., 2020) and a general bias in research to the Global North (Chausson et al., 2020). Another vital subsection of this body of knowledge concerns itself with placing NbS within the broader set of policies and methods for pursuing global human sustainability goals (Seddon, Smith et al., 2021). It is necessary for anyone involved with NbS to recognize its limits, both in terms of actual physical implementation and total potential contribution to addressing the climate and biodiversity crises (Seddon, Chausson et al., 2020). Indeed, it is for this reason that Criterion 8 of the Global Standard calls for NbS initiatives to contribute to further mainstreaming of NbS practices through knowledge-sharing and bringing about policies that facilitate future endeavours (IUCN 2020a).

The most tangible limit to the concept of NbS is that even with a substantial increase in political and financial support, any serious efforts to curb the rise in global atmospheric temperatures must also involve rapid decarbonization of economies, and ultimately, a fundamental rethinking of many of the economic and governance structures that have caused these crises in the first place (Seddon, Smith et al., 2021; Pörtner et al., 2021).

Natural climate solutions are interestingly situated with regards to critique. As they are considered by academics to be a category of NbS, all conceptual critiques of NbS necessarily also apply to NCS. This is arguably a boon to the NCS concept, as it means responsible implementation can draw on existing guidelines such as the Global Standard to deal with barriers and problems. However, despite their relative newness, NCS have not escaped critical scrutiny of their reach and concept. Anderson et al. (2019) caution that NCS cannot be treated as a substitute for emission reductions in GHG-emitting sectors, but should serve as a complement to such efforts. Mori et al. (2021) illustrate that the biodiversity is a crucial and often overlooked aspect of programs that seek to use forests as a means to GHG sequestration ends. Bellamy and Osaka (2020) express concerns with the framing of the concept itself, arguing that the term "natural" poses framing risks: presenting a body of options as being inherently "natural" or "unnatural" may limit the range of options that planners and policymakers find attractive. A more subtle critique of NCS is offered by evidence suggesting that policies that pursue NbS in tandem with rapid decarbonization are one of the most viable methods of averting environmental breakdown, but this potential is compromised if these NbS initiatives are designed with the overriding objective of GHG sequestration (Stafford et al., 2020). Although this criticism was not levelled directly at NCS, it is worth noting that NCS are overwhelmingly designed with GHG sequestration as their primary goal (Seddon, Smith et al., 2021).

Perhaps the most consequential aspect of NCS in their current conceptual form is that while the Global Standard exists and can serve as a set of criteria for proper planning and deployment of NbS, there is no comparable set of criteria for NCS. This is arguably somewhat offset by safeguards frequently included by NCS researchers in their publications, but as the mitigation potential of NCS achieves widespread public attention, there is the possibility for the importance of such safeguards to be downplayed in planning and policy. Although NCS and NbS are not commonly perceived by the public as distinct concepts, they are typically recognized as such in academic circles. Thus, it is useful to be aware of how they tend to compare with the criterion of the Global Standard. For illustrative purposes, a non-exhaustive comparison of this kind can be found in Table 2.

Table 2: *Comparison of Academic NCS Theory against the Criteria of the Global Standard*

Global Standard Criterion No.	Status of Criterion in Existing NCS Theory
1	Mandated - albeit restricted primarily to climate change mitigation (e.g., Griscom et al., 2017; Drever et al., 2021).
2	Encouraged - complementary interventions are often encouraged; considerations for synergies between ecological, economic, and social systems are limited (e.g., Seddon, Daniels et al., 2020).
3	Common - safeguards for preserving existing biodiversity are typical; maintenance of existing ecosystems also frequently encouraged (e.g., Drever et al., 2020).
4	Common - NCS literature often accounts for economic viability of interventions (Griscom et al., 2017).
5	Limited - NCS literature does not frequently engage with the topic of transparent and inclusive governance processes.
6	Limited - NCS literature commonly includes safeguards for provisioning services, and sometimes considers trade-offs (e.g., Griscom et al., 2017).
7	Limited – improved management is a core NCS tenet, but adaptive management is infrequently invoked (e.g., Drever et al., 2020).
8	Limited – NCS literature frequently considers ecological sustainability of initiatives, but rarely engages directly with how interventions may inform policy.

Definitional Challenges

A notable aspect of researching NbS and NCS is the variety of terminologies and jargons ascribed to these two approaches. This may be due to the relative novelty of both concepts as well as a lack of clarity regarding their respective theoretical backgrounds outside of specialized circles. There is also the possibility that confusion arises simply due to the linguistic and semantic similarity of their names. This situation is made more confounding by the use of other similar terms in this field such as “nature-based climate solutions”, “nature-based solutions to climate change” and “nature-based solutions for climate change mitigation”, all three of which tend to refer to interventions more characteristic of natural climate solutions (Seddon, Chausson et al., 2020; Seddon, Smith et al., 2021).

Despite the potentially confusing terminologies, a basic understanding of the key difference between the NbS and NCS can be achieved through a comparison of their respective key objectives: NbS seek to address a variety of societal challenges through ecologically and socially sound means that also increase biodiversity, while NCS seek to mitigate climate change and its effects through land stewardship means with possible co-benefits (Seddon, Chausson, et al., 2020).

Where difficulties arise is in determining if these differences are understood by policymakers and practitioners. One significant confounding factor in this research endeavour has been the task of forming an understanding of how the Government of Canada, the HEHE plan, and associated departments conceptualize NbS and NCS (see Table 3). The HEHE plan itself uses the terms "nature-based solutions", "natural climate solutions", and "nature-based climate solutions" seemingly interchangeably, with all three used in reference to the same concept, which the HEHE plan describes as follows:

> "Nature-based solutions unlock the power of nature to reduce emissions in the atmosphere through things like planting trees, restoring grasslands and wetlands, and improving agricultural land management to capture and store much more carbon. Large amounts of carbon are stored in Canada's forests, soils, wetlands, grasslands and oceans today, and nature-based solutions can increase that storage, keeping harmful emissions out of the atmosphere" (Environment and Climate Change Canada, 2020).

The website for Canada's Nature Smart Climate Solutions Fund (NSCSF) defines nature-based solutions as "actions to conserve, sustainably manage, and restore ecosystems" (Environment and Climate Change Canada, 2021). The website also states:

> "While the primary objective of the NSCSF initiative is to reduce Canada's net GHG emissions, projects…must also provide benefits for biodiversity and should support benefits for human well-being."

Under this definition, projects approved must sequester emissions and provide biodiversity benefits, but may not account for human well-being, meaning that not all projects approved may qualify as NbS under the IUCN definition. An informational website for the 2 Billion Trees Program does differentiate the concepts of NbS and NCS, using the IUCN definition for nature-based solutions and offering the following definition for natural climate solutions:

> "Nature-based climate solutions, or natural climate solutions, are actions to mitigate climate change by reducing greenhouse gas emissions, or adapt to climate change" (Natural Resources Canada, 2020).

A possible explanation for these discrepancies in defining the concept of NbS is the fact that the HEHE Plan and the Nature Smart Climate Solutions Fund are under the supervision of Environment and Climate Change Canada while the 2 Billion Trees Program falls under the purview of Natural Resources Canada. Regardless of origin, this confusion of conceptual differences between NbS and NCS could pose a significant challenge to the ultimate success of efforts to utilize either concept.

Table 3: *Institutional and Academic Conceptual Definitions of NbS and NCS*

Source	Definition (NbS)	Definition (NCS)
Global Standard for Nature-based Solutions (IUCN, 2020)	"Nature-based solutions are actions to protect, sustainably manage and restore natural and modified ecosystems in ways that address societal challenges effectively and adaptively, to provide both human well-being and biodiversity benefits."	
European Commission (n.d.)	"Solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions." Nature-based solutions must therefore benefit biodiversity and support the delivery of a range of ecosystem services.'	
Natural Climate Solutions (Griscom et al., 2017)		"Conservation, restoration, and improved land management actions that increase carbon storage and/or avoid greenhouse gas emissions across global forests, wetlands, grasslands, and agricultural lands."
Natural Climate Solutions for Canada (Drever et al., 2021)		"Natural climate solutions (NCS) are a suite of protection, improved management, and restoration actions ("pathways") in forests, grasslands, agricultural areas, and wetlands that provide additional climate mitigation beyond business as usual"
IPBES-IPCC co-sponsored workshop report synopsis on biodiversity and climate change (Version 1). (Pörtner et al., 2021)	*IUCN Definition*	

Source	Definition (NbS)	Definition (NCS)
Nature United (2021)		"Natural Climate Solutions are actions to **protect, better manage and restore nature** to reduce greenhouse gas emissions." (Emphasis theirs).
The Nature Conservancy (2021		"Natural climate solutions are conservation, restoration and improved land management actions that increase carbon storage or avoid greenhouse gas emissions in landscapes and wetlands across the globe."
World Wildlife Fund (WWF)	"Ecosystem conservation, management and/or restoration interventions intentionally planned to deliver measurable positive climate adaptation and /or mitigation benefits that have human development and biodiversity co-benefits managing anticipated climate risks to nature that can undermine their long-term effectiveness." (2020)	
A Healthy Environment and A Healthy Economy (Environment and Climate Change Canada, 2020)	"Nature-based solutions unlock the power of nature to reduce emissions in the atmosphere through things like planting trees, restoring grasslands and wetlands, and improving agricultural land management to capture and store much more carbon."	
Nature Smart Climate Solutions (Environment and Climate Change Canada, 2021)	"Nature-based solutions are actions to conserve, sustainably manage, and restore ecosystems."	
The Power of Trees (Natural Resources Canada, 2020)	*IUCN Definition*	"Nature-based climate solutions, or natural climate solutions, are actions to mitigate climate change by reducing greenhouse gas emissions, or adapt to climate change."

Directed Content Analysis

To answer the research questions posed in this paper, it was necessary to develop a thorough understanding of the NbS and NCS elements present within the HEHE plan before examining it within the realm of NbS and NCS conceptual literature. For this purpose, a directed content analysis was conducted on the text of the HEHE plan.

Content analysis is a research method that seeks to evaluate and understand literal and latent meanings within texts by reading them and classifying segments of interest into a set of codes and then categorizing them to varying levels of abstraction (Erlingsson & Brysiewicz, 2017). Its use has precedent in the field of NbS: Xie and Bulkeley (2020) used this method to study the use of nature-based solutions for increasing and protecting biodiversity in urban settings.

Directed content analysis is a specialized method of content analysis which utilizes prior theory and research to provide categories or themes that can be used to analyze other texts (Hsieh & Shannon, 2005). For this project, directed content analysis was an apt choice of method as the eight criteria of the IUCN Global Standard provided a set of ready-made themes and keywords with which to analyze the contents of the HEHE plan.

The directed content analysis was carried out using QDA Miner. A codebook of keywords pertaining to NCS and the criteria of the Global Standard was first created (Appendix A). There was a degree of overlap between the keywords chosen for each criterion, and in some cases certain keywords were chosen that corresponded to several indicators simultaneously. For example, the keyword “benefits” corresponded to indicators for both Criterion 4 and Criterion 6 in the Global Standard. Certain search hits also corresponded to more than one criterion. A wildcard (*) was employed once again to find terms with similar spelling. As an example, a search query for “sustainab*” would return results for both “sustainable” and “sustainability”.

Text retrieval of each keyword was then conducted within the HEHE plan to locate text segments which contained these keywords, and all search hits were exported into Microsoft Excel. In addition to this keyword retrieval, the text of the *HEHE* plan was periodically read in its entirety to familiarize the author with the text and to ensure that no relevant sections were excluded from the final analysis, even if they did not feature any keywords (the full list of search results can be made available upon request).

The text of each search hit was examined in its original context to determine if it offered a definition of NbS or NCS, detailed a specific NbS or NCS intervention, and/or outlined a specific objective of said interventions. All search hits which met these standards were tabulated and categorized accordingly (see Table 4). The purpose of this was to clarify the conceptualization of NbS offered by the HEHE plan and to allow for comparison against other definitions.

A particular challenge of conducting a rigorous assessment of the HEHE Plan stems from its function as a policy document which serves both informative and political purposes, which is to say that it is written so that it will appeal to laypeople. As a result, there is a considerable amount of ambiguity in certain written aspects of the HEHE Plan regarding NbS and NCS, as well as a number of what might be termed "auxiliary pledges" meant to accompany and complement the proposed initiatives. To avoid contending with these ambiguities, it was decided that if a provision or passage in the HEHE Plan did not specifically describe or relate to the proposed NbS or NCS initiatives, it was excluded. As an example, consider the following passages from the HEHE Plan:

> "Building resilience will not only help Canadian communities adapt to the current realities of a changing climate, it reduces lost productivity and economic losses from climate-related disasters, as well as enhances the health, well-being, and safety of Canadians and communities" (p. 65).

The plan also states that the Government of Canada will "Work with the United Kingdom and Italy through their respective G7 and G20 Presidencies to build ambition for upcoming international negotiations on climate change and on biodiversity, and to deliver enhanced global action and support for climate change, nature, and biodiversity, including by advancing nature-based solutions as an opportunity for addressing these issues holistically" (p. 76).

Although these sections mention concepts relevant to NbS such as resilience, biodiversity, and the provision of co-benefits, they do not specifically describe the actual NbS initiatives proposed in the HEHE plan. Consequently, both were excluded from Table 4.

The HEHE plan also includes pledges to promote the advancement of the concept and potential use of NbS nationally and globally, such as in the following excerpts:

> "The Government will press the urgency of global coal phase-out through Canada's leadership of the growing and influential Powering Past Coal Alliance, and raise the profile of nature-based solutions at the Climate Adaptation Summit" (p. 76).
>
> "As a next step, the Ministers of Environment and Climate Change and Natural Resources will jointly appoint an advisory committee of experts on nature-based

climate solutions to advise on program delivery to maximize emission reductions, while also delivering biodiversity and human wellbeing co-benefits" (p. 55).

Criterion 8 of the Global Standard mandates that NbS initiatives be sustainably implemented, and their use brought to greater prominence. However, this is a feature required of an NbS initiative itself (IUCN 2020a, 2020b). Advocating for the use of NbS is not the same as designing NbS with the purpose of mainstreaming their uptake. As a result, provisions related solely to promoting or advocating for the use of NbS were excluded from the final table, as was the pledge to create an advisory body on the subject.

As a final note on the subject of evaluation, although repeated efforts were made to compare each search hit against the criteria of the Global Standard, this task proved unwieldy due to the generalized language employed by the HEHE plan and a pervasive lack of necessary details concerning its NbS and NCS initiatives that would allow for such an evaluation to be conducted effectively.

Reliability and Validity of Qualitative Methods

The qualitative nature of this research necessarily entailed considerations for the rigor of its methodology and the ultimate trustworthiness of its results and conclusions. These concerns are possibly amplified by the fact that the research credibility of the author has not yet been fully established. To address these concerns, strategies were adopted to satisfy as optimally as possible the four criteria for trustworthiness in qualitative research (Shenton, 2004).

This project first and foremost was supervised from conception to completion by both a primary supervisor and a second reader, both of whom have extensive combined academic experience in the fields of NbS and sustainability. Throughout the course of the project, both supervisors were frequently debriefed concerning progress and any difficulties. They also contributed feedback, reviews, and editorial suggestions at all stages of the writing.

The research employed the use of two previously established research methods: directed content analysis and a scoping review. Both of these methods have been used in research concerning nature-based solutions previously (e.g., Xie & Bulkeley, 2020; Albert et al., 2021). Additionally, efforts were made to provide accurate descriptions of all relevant terms and concepts; direct quotations of the definitions and criteria provided by the Global Standard as well as the language used within the HEHE plan were used to best reflect the literal meanings of the texts. Furthermore, given the necessary presence of grey literature within the research subject, all efforts were made to trace relevant scientific figures and assertions to primary sources.

Table 4: *Key Text Extracts Concerning NbS and NCS from the HEHE plan*

Text	Category
"By planting two billion trees and better managing, conserving and restoring natural spaces, Canada will protect and enhance the natural areas that surround us and that contribute to fighting climate change. This will help cut pollution, clean the air Canadians breathe, make communities more resilient to extreme weather and create thousands of jobs for tree planters, technicians, nursery growers, field biologists, urban planners, and many others" (p. 9).	Intervention Objective
"Nature-based solutions unlock the power of nature to reduce emissions in the atmosphere through things like planting trees, restoring grasslands and wetlands, and improving agricultural land management to capture and store much more carbon. Large amounts of carbon are stored in Canada's forests, soils, wetlands, grasslands and oceans today, and nature-based solutions can increase that storage, keeping harmful emissions out of the atmosphere" (p. 52).	Definition
"Investments to protect nature and accelerate the sequestration potential of the natural environment have important co-benefits for society. For example, natural wetlands have been shown to reduce climate-related flooding costs by as much as 38%, making Canada's communities more resilient to a changing climate" (p. 52).	Definition
"Canada has conserved over 12% of its lands for future generations. But it is increasingly understood that more needs to be protected – for the health and well-being of Canadians, and for Canada's economy. Conserving and sustainably managing ecosystems that are high in carbon, such as forests, native grasslands, and wetlands, also helps to safeguard against releasing more carbon into the atmosphere. And on average, the benefits of land restoration are 10 times higher than the costs" (p. 54).	Definition
"Building on those commitments, over the next ten years the Government of Canada will deliver on its promise to use nature-based climate solutions for the benefit of all Canadians, including by planting two billion trees and by supporting actions in other ecosystems through a new Natural Climate Solutions Fund. This will be done while protecting a quarter of Canada's land and oceans in five years" (p. 54).	Intervention
"Invest up to $631 million over 10 years to work with provinces, territories, conservation organizations, Indigenous communities, private landowners, and others to restore and enhance wetlands, peatlands, grasslands and agricultural lands to boost carbon sequestration. This initiative will support improved land and resource management practices in sectors that have some of the greatest potential for increased carbon storage, and will conserve carbon-rich ecosystems" (p. 54).	Intervention

Text	Category
"The Government of Canada will also continue to move forward with delivering on its commitment to conserve and protect 25% of Canada's land and 25% of Canada's oceans by 2025, working towards 30% of each by 2030. The Government will ground these efforts in science, Indigenous knowledge, and local perspectives" (p.55).	Intervention Objective
"Combined, these actions to accelerate nature-based climate solutions will reduce Canada's carbon emissions by an estimated four to seven million tonnes annually in 2030" (p. 55).	Objective
"In pursuing Canada's goal of protecting 25% of its lands and oceans by 2025, partner with Indigenous communities to lead the development and management of Indigenous Protected and Conserved Areas" (p.71).	Intervention
"Through the commitment on Nature-Based Solutions, partner with Indigenous communities and organizations in the two billion trees initiative, as well as efforts to conserve wetlands, grasslands and restore land and habitat" (p.71).	Intervention

Discussion

The results of both the scoping review and the directed content analysis reveal a noticeable level of confusion between the core concepts of NbS and NCS on the part of the Government of Canada. This is exemplified in two primary ways. The first is in the inconsistent definitions for the two concepts employed across the various relevant government departments (see Tables 3 and 4). The second is in how the terms "nature-based solutions", "nature-based climate solutions", and "natural climate solutions" are used interchangeably within the HEHE plan itself with seemingly no regard for their conceptual differences.

Regardless of the cause or intent behind these definitional inconsistencies, they are a reason for serious concern. In framing NbS and NCS as equivalent or interchangeable concepts, planners and practitioners may, either deliberately or incidentally, fail to give due consideration to important non-GHG factors outlined in the Global Standard, such as biodiversity or empowering local governance, all of which are crucially important in attaining broader sustainability goals (Seddon et al., 2019; Seddon, Smith et al., 2021).

Conceptual Confusion

The HEHE plan defines the concept of NbS in the following way:

> "Nature-based solutions unlock the power of nature to reduce emissions in the atmosphere through things like planting trees, restoring grasslands and wetlands, and improving agricultural land management to capture and store much more carbon" (p. 52).

This definition is more aligned with the academic and institutional definitions of NCS than NbS in that the priority is about emissions reduction and sequestration through land stewardship actions (Seddon, Smith, et al., 2021). The HEHE plan acknowledges that its NbS and NCS initiatives may produce important co-benefits such as human well-being, cleaner air, and protecting biodiversity (p. 53). However, these benefits are framed as desirable auxiliary outcomes and not as primary objectives, which is another aspect more typical of NCS than NbS.

From a definition standpoint, framing the protection of biodiversity as a benefit rather than an essential component effectively disqualifies the HEHE plan's conceptualizations of NbS and NCS from being considered as NbS under the definitions of both the IUCN (2020b) and the European Commission (n.d.). This precludes an evaluation of Canada's NbS plans against benchmarks such as the Global Standard, which poses a sizeable problem for the advancement of effective NbS in Canada. In choosing to prioritize GHG sequestration as the chief goal of their (so-called) NbS initiatives, the Government of Canada is running the consequential and tangible risk of missing the forest for the trees in both the literal and figurative senses of the term when it comes to realizing the full potential of NbS.

Despite these failures of nuanced conceptualization, the various initiatives that have been presented in the HEHE plan as NbS do not warrant outright dismissal. The very fact that the HEHE plan includes mention of aspects such as partnerships with Indigenous Peoples and biodiversity suggests that there is at least a semblance of hope for an improved approach. Thus, an examination of the individual merits and shortcomings of the HEHE plan's NbS and NCS initiatives may provide useful further insight into the effects of the conceptual confusion as well as lead to some constructive recommendations.

The 2 Billion Trees Program

What the HEHE plan and associated government resources make clear is that the 2 Billion Trees program is the most significant portion of the Government of Canada's NCS proposals by far. Of the $4 billion allocated by the Government of Canada for the NSCSF, the amount allocated for the 2 Billion Trees program is either $3.16 billion according to the HEHE plan or $3.19 billion according to the website for NSCSF (Natural Resources Canada, 2021). This financial emphasis is not without precedent nor reason,

as NCS forest pathways have significant global mitigation potential (Griscom et al., 2017). As well, forest ecosystems have been the most-studied landscapes in terms of research on the effectiveness of NbS interventions (Chausson et al., 2020). Guidelines for how best to pursue forest ecosystem restoration while maximizing both carbon sequestration and biodiversity benefits were published recently by Di Sacco et al. (2021). These guidelines are aligned with those of the Global Standard in acknowledgement of the fact that reforestation initiatives can indeed be designed and implemented as NbS using their criteria.

Whether the 2 Billion Trees program can be classified as NbS is not entirely clear. The plan is ambitious, and its merits include considerations for selecting trees based upon expected climate changes, as well as the inclusion of Indigenous Peoples. However, the extent to which these promises are honoured remains to be seen. Ultimately, the 2 Billion Trees program is myopic in aspects reminiscent of the flawed conceptualization of NbS found in the HEHE plan, wherein biodiversity and direct human co-benefits are still framed as auxiliary outcomes rather than primary goals. In addition, the sequestration effects of tree planting take decades to be fully realized, which does not align with the urgent need to reduce emissions in the near term in accordance with the Paris Climate Accord (Qin et al., 2021; Anderson et al., 2019).

Regardless of the designatory label, the literature suggests that there are caveats that must be considered while promoting and using trees for climate mitigation purposes (Mori et al., 2021; Seddon et al., 2019). Prominent among these is that the importance of maintaining existing ecosystems and avoiding degradation frequently supersede that of tree planting (Di Sacco et al., 2021; Seddon et al., 2019). In Canada, for instance, although forest pathways represent the largest mitigation opportunity by 2050, the most critical immediate NCS action is avoiding the loss or conversion of existing carbon-dense ecosystems such as old-growth forests in British Columbia (Smith, 2020) and grasslands in the Canadian prairies (Drever et al., 2021).

In the pursuit of reforestation and afforestation, provisions for biodiversity, ecosystem connectivity, and resilience must be included, as climate change poses considerable biotic and abiotic risks to forest systems (Anderegg et al., 2020; Fleischman et al., 2020; Seddon et al., 2019). Such risks can under no circumstances be ignored. This is particularly relevant for Canada, which has experienced the conversion of forests in British Columbia from a net sink of GHGs to a net source as a result of the pine beetle infestation (Kurz et al., 2008). Moreover, there is a dearth of research on the impact of NbS interventions on wildfire risk (Chausson et al., 2020) which must also be considered given the risks posed to forest ecosystems by a warmer climate. Finally, as with all NbS and NCS initiatives, the use of forests and tree planting cannot be used as a distraction from, nor a substitute for rapid decreases in fossil fuel emissions, nor can they be used

as a justification or offset for a failure to pursue decarbonization. (Anderegg et al., 2020; Seddon, Smith et al., 2021).

Agricultural Climate Solutions

The HEHE plan includes a section detailing several plans for improving Canada's agricultural practices through investments in the development of clean technology and reducing the emissions from the production and use of synthetic fertilizers (p. 44-45). It also includes a pledge to:

> "Work with provinces and territories under the Canadian Agricultural Partnership to boost climate-smart agriculture, including actions related to crop and livestock production" (p. 45).

The exact definition of "climate-smart agriculture" pertaining to specific practices concerning crops and livestock is somewhat unclear within the HEHE plan. However, the associated website for Agricultural Climate Solutions does offer a more holistic take on the subject, highlighting certain co-benefits of agricultural practices that can contribute to climate change mitigation and adaptation such as soil and water conservation and increasing biodiversity. However, the website explicitly states:

> "Projects in each province will be selected based on the potential to store carbon and/or reduce greenhouse gases" (Agriculture and Agri-Food Canada, 2021).

While the sequestration potential of improved agricultural practices is a factor worth considering, this narrow focus once again presents two significant risks: the omission of non-sequestration benefits, and the potential missed opportunity to pursue additional desirable policy options. For instance, a systematic review of urban and peri-urban agriculture (UPA) practices in the global north determined that these kinds of interventions can operate as NbS and make significant contributions to achieving climate and sustainability goals (Artmann and Sartison, 2018). Furthermore, options such as agroecology and agroforestry can positively contribute to food security as well as biodiversity while still sequestering GHGs (Chapman et al., 2020; Pörtner et al., 2021). Although these options are not necessarily precluded from future consideration by their lack of mention in the HEHE plan or on the associated website, their absence further indicates a restricted perspective on the potential for the agricultural sector to improve in ways that contribute societal benefits beyond GHG sequestration.

Conservation and IPCAs

The HEHE plan includes mention of the intention to pursue the conservation and protection of 25% of both Canada's lands and oceans by 2025 with further ambitions to expand these amounts to 30% of each by 2030 (p. 55). Although initially unclear in the governance nature of these conservation efforts, the HEHE plan goes on to state of them that:

> "The Government will ground these efforts in science, Indigenous knowledge, and local perspectives" (p.55).
>
> "In pursuing Canada's goal of protecting 25% of its lands and oceans by 2025, partner with Indigenous communities to lead the development and management of Indigenous Protected and Conserved Areas" (p.71).

As such, it seems clear that these conservation efforts will be conducted in partnership with Indigenous Peoples through a variety of methods, including the establishment of IPCAs. The Indigenous Circle of Experts' report *We Rise Together* (2018) detailed the exact definition of IPCAs to be as follows:

> "IPCAs are lands and waters where Indigenous governments have the primary role in protecting and conserving ecosystems through Indigenous laws, governance and knowledge systems. Culture and language are the heart and soul of an IPCA."

IPCAs can be distinguished from traditional conservation by the fact that they are primarily led and managed by Indigenous Peoples. The definition given in *We Rise Together* does not preclude co-operation nor partnerships with other governing bodies but does emphasize the need for any such partnerships to operate in accordance with the principles of Free, Prior and Informed Consent (FPIC) as expressed in the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP).

Due to their localized nature and emphasis on Indigenous-led governance and management, IPCAs may in theory be one of the most promising forms of NbS on display in the entire HEHE plan. Protected areas can offer important co-benefits for biodiversity and humans (Pörtner et al., 2021), and consultation with Indigenous Peoples is recognized as a key action which can improve the design and implementation of NbS efforts (Seddon, Daniels et al., 2020; Townsend et al., 2021). Furthermore, the widespread use of IPCAs could have significant positive implications for GHG sequestration and biodiversity (Townsend & Craig, 2020; Townsend et al., 2021) as well as reconciliation (Artelle et al., 2019). Nonetheless, there are political implications inherent in these ventures which could pose a significant challenge to the potential of IPCAs. This is particularly true for Canada, which has a fraught history of Crown-Indigenous relations (Townsend et al., 2021).

Green Infrastructure

Another notable aspect of the HEHE plan was the inclusion of a section regarding funding for green infrastructure (GI). Although the HEHE plan treats GI and programs for reducing the carbon footprint of government buildings as a separate topic from its NbS and NCS programs, GI can still be classified as an NbS and designed in accordance with the Global Standard (IUCN, 2020b; Seddon, Chausson, et al., 2020). There is a robust

body of evidence that demonstrates that GI can help to address numerous climate and sustainability challenges while delivering additional benefits, especially in urban areas (Anderson & Gough, 2021; Bayulken et al., 2021; IPBES, 2019; Pörtner et al. 2021). The IUCN states of green infrastructure:

> "It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas. On land, GI is present in rural and urban settings" (2020b, p. 48).

The GI measures proposed in the HEHE Plan make no mention of the use of green or blue spaces with regards to their construction, retrofitting, or function, instead focusing more singularly on more traditional grey approaches to energy efficiency and material sourcing. As a result, they do not meet the IUCN definition of green infrastructure, and hence could not be designated nor properly evaluated as NbS. This is worth noting because it is another indication that the Government of Canada has a severely restricted view of NbS and NCS, which in turn has needlessly limited the potential of its plans.

A Way Forward for NbS and NCS in Canada

NbS and NCS as conceptualized by the Government of Canada are problematic because as shown by their depiction within the HEHE plan, the concepts are confused. Furthermore, either as a result of this confusion or as a consequence of other factors, the relevant initiatives within the HEHE plan possess numerous shortcomings in their designs, many of which could be ameliorated: The 2 Billion Trees program could provide opportunities for the pursuit of agroforestry projects in conjunction with the Agricultural Climate Solutions program; the plan to conserve 25% of Canadian land and oceans by 2025 could in theory be done entirely by using IPCAs (The Indigenous Circle of Experts, 2018). The Agricultural Solutions Fund could base its resource allocations on more than the single deciding factor of GHG sequestration potential. The plans for green infrastructure could be broadened to incorporate the creative and innovative use of green and blue spaces instead of being restricted to traditional grey engineering practices (Depietri & McPhearson, 2017). In all of these scenarios, the substantial theoretical and practical assets of the NbS concept could be employed to potentially transformative effect while still providing real climate mitigation and adaptation benefits.

As previously established, NbS and NCS have limits in terms of their feasible prospects as well as the extent of their conceptual reach. This second limit is more subtle, but still important, particularly when it comes to NCS (Bellamy & Osaka, 2020). The delimiting of potential "natural" or "nature-based" solutions to societal problems is one considerable advantage of the NbS concept over the NCS concept, as NbS

encompasses a more diverse range of interventions that account for the presence of anthropic elements such as built infrastructure (Seddon, Smith et al., 2021; IUCN, 2020a, 2020b). This idea was asserted succinctly in a paper contending with this subject:

> "A major advantage of applying the NbS concept is that it encourages recognition of a wider range of outcomes of a given intervention than these more specific terms. Referring to a restoration project as NbS rather than NCS or eco-DRR avoids the implication that the sole purpose and outcome of the project is either storing carbon or reducing floods and landslides" (Seddon, Smith et al., 2021).

Indeed, the notion that a unifying set of guiding principles and criteria could be applied to all interventions under the NbS umbrella has been one of the most foundational guiding ideas in the development of the Global Standard (Cohen-Shacham et al., 2016; Cohen-Shacham et al., 2019).

It would be difficult to argue that initiatives such as reforestation, improving agricultural practices, improving the state of land stewardship, and increasing the amount of conserved land could not be enacted through a paradigm that seeks to achieve beneficial outcomes beyond simple climate change mitigation. The language in the HEHE plan suggests that while it is not solely concerned with GHG sequestration, it is nonetheless the primary objective. This kind of approach risks doing disservice to the concept and practice of NbS, both through missed opportunities and failing to use these interventions as a means to enact the kinds of changes that will be ultimately required to fully address the climate and biodiversity crises (Anderson et al., 2019; Pörtner et al., 2021; Seddon, Smith et al., 2021).

Based upon this analysis, there is a potential argument to be made that the very concept of NCS is superfluous for the purpose of addressing current sustainability challenges. The idea that NCS may result in interventions that fail to fully meet the needs of global sustainability challenges or that end up being maladaptive could be taken as a damning indictment of the very idea of NCS (Barnett & O'Neill, 2010). The HEHE plan is certainly an exacerbating factor in this regard because of its muddled depiction of the concepts of NbS and NCS. These are not inconsequential shortcomings and might serve as evidence for discarding the NCS concept entirely and simply using the NbS label and Global Standard for all such endeavours. However, this is likely a step too far. The NCS concept is not equivalent to the NbS concept, but it is a useful descriptive term for a specific type of intervention.

A more pragmatic approach would be for practitioners to understand the conceptual and pragmatic limits of the NCS concept, and then use NbS standards to accommodate and mitigate the shortcomings and trade-offs that may be incurred by its implementation. The use of the Global Standard to design Canada's NbS and NCS projects would allow planners and practitioners to draw upon an expansive body of

theoretical and practical research that has already explored and expounded upon ideas such as making NbS resilient to climate change (Calliari et al., 2019, Ossola & Lin, 2021), incorporating dimensions of justice (Cousins, 2021), gender equality (Kabisch et al., 2016), reconciliation with Indigenous Peoples (Seddon, Smith et al., 2021; Townsend et al., 2020) and contending with their anthropocentric tendencies (Maller, 2021).

Finally, by embracing the NbS concept and utilizing existing knowledge resources, the Government of Canada will be less likely to run the risk of spending unnecessary time trying to reinvent the wheel in terms of designing and deploying effective NbS and NCS programs. Such a risk should be precluded by the very existence of the Global Standard (Cohen-Shacham et al., 2021; IUCN 2020b), but the temporal aspect cannot be ignored either; even for well-designed NbS and NCS, setbacks from poor design or delayed implementation will result in significantly delayed effects on GHG emissions (Qin et al., 2021). Should the Government of Canada follow through on its promise to create an expert advisory body on nature-based solutions, these points should all warrant serious consideration.

Limitations of this Study and Avenues for Future Research

The HEHE plan is worthy of critical analysis for the reasons presented in this paper, but it is nonetheless a political document. As such, its programs and promises are almost inevitably subject to change in response to social circumstances. Moreover, the climate and biodiversity crises that have partially fuelled the need for the HEHE plan are also persistent reminders that plans change. As a result, much of this paper's critical analysis may prove irrelevant in future circumstances should the HEHE plan be significantly altered or discarded by future governments. In spite of the transient nature of political promises, critically evaluating policies and plans for the use of NbS and NCS is still a useful exercise; it clarifies both the merits and shortcomings of plans from a sustainability perspective, and it provides a clearer picture of the theoretical and pragmatic differences between NbS and NCS, which will hopefully assist planners and policymakers in designing future initiatives.

This research has endeavoured to contribute to the body of literature aimed at clarifying conceptual differences between NbS and NCS in an effort to establish improved consensus regarding their definitions and core tenets (Seddon, Daniels et al., 2020). The scoping review methodology employed herein for this purpose has provided a useful set of results, although this field will likely require further study as NbS and NCS continue to evolve in theory and application. Future research may seek to undertake a more systematic review of NCS literature, including perhaps a comparison of NCS norms and principles with the criterion of the Global Standard. Such an approach could

emulate the one taken by Cohen-Shacham et al. (2019) which compared the eight NbS principles to those of other ecosystem-related approaches.

Conclusion

The growing popularity of nature-based solutions and natural climate solutions as means for achieving climate change adaptation and mitigation goals is cause for cautious optimism amongst those who recognize their potential to address the climate and biodiversity crises confronting global human societies. Yet, the novelty of these concepts entails the risk that they will be misunderstood and misapplied by policymakers. This research sought to critically evaluate the NbS and NCS elements outlined in Canada's *A Healthy Environment and A Healthy Economy* plan, which proposes a series of initiatives which it labels alternately as NbS and NCS.

Through a directed content analysis of the HEHE plan and a scoping review of the various conceptual definitions of NbS and NCS, the findings indicated that there is a significant level of confusion and equivocation between these two concepts on the part of Canadian policymakers which is reflected in the text of the HEHE plan and in the scope and details of its initiatives, most of which are explicitly framed as having the primary goal of greenhouse gas sequestration. The implications of this are troubling for the ultimate efficacy of the proposed NbS and NCS interventions, which run a variety of considerable risks in failing to account for important biodiversity and human factors. This also poses risks to the concepts themselves through misapplication and missed opportunities to utilize the rapidly expanding field of relevant available theoretical and practical knowledge.

The crises of anthropogenic climate change and biodiversity loss are forcing a reckoning on the part of human societies worldwide with longstanding patterns of governance and a dismissive or destructive approach to environmental stewardship. Well-designed NbS that align with the Global Standard offer one of the most promising avenues for addressing many of these issues in conjunction, but only if their definitions and limitations are clearly understood by practitioners and policymakers. It is the hope of this author that this research has contributed to such understanding.

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Appendix A

Table 5: *Keywords used for Directed Content Analysis*

Global Standard Criterion	Keywords
NbS address societal challenges	Assess Societal Nature-based Natural
Design of NbS is informed by scale	Scale Synergies Monitor
Nbs result in a net gain to biodiversity and ecosystem integrity	Biodiversity Ecosystem Conservation Assess
NbS are economically viable	Cost Benefits
NbS are based on transaparent, inclusive, and empowering governance processes	Inclusion Governance Consent
NbS equitably balance trade-offs between achievement of their primary goal(s) and the continued provision of multiple benefits	Trade-offs Benefits
NbS are managed adaptively, based on evidence	Science Knowledge Management
NbS are sustainable and mainstreamed within an appropriate jurisdictional context	Sustainability Sustainable

(IUCN, 2020a)

Appendix B

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	9
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	N/A
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	9
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	8, 10
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	N/A
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	10
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	9-10
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	9-10
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	9-10
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	N/A
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	N/A
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	N/A
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	9-10
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	10
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	44 - 46

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	N/A
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	13-18
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	13-18, 24, 28
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	13-18,
Limitations	20	Discuss the limitations of the scoping review process.	30
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	13-18, 30
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	N/A

(Tricco et al., 2018).

Appendix C

List of References from Scoping Review

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