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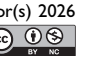

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Reckoning with the ways in which the mechanistic worldview is embedded in chemicals management and how Indigenous Knowledge Systems might help account for the complexities of chemical risk

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Abstract

Governmental institutions in nations that have adopted the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) are working to create appropriate institutional structures to support the implementation of the declaration. This opens up a window of opportunity to learn from and engage with Indigenous Knowledge Systems (IKS) and promote transformational change, provided that communication challenges are overcome. Canada recently elevated the inclusion of Indigenous Knowledge into existing practices as a top priority, following the revision of the Canadian Environmental Protection Act (CEPA) and the adoption of the UNDRIP Act. In this paper, we explore ways to support meaningful inclusion of IKS and Indigenous knowledge holders in chemicals management, areas that are highlighted in the revised CEPA. The study is based on a series of guided conversations that included government staff as well as Indigenous and non-Indigenous scholars, all with relevant expertise. We found that the invisibility of the ways in

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which the mechanistic worldview is embedded in regulatory science and the risk assessment system more broadly hinders meaningful engagement with IKS and Indigenous knowledge holders. We advocate that there is an urgent need to make the colonial legacies of chemicals management visible, in order to enable government staff to find concrete and effective ways to bring this legacy to light. We also advocate the need for governmental participants in conversational and consultational processes to enhance their understanding of the ways in which the inconspicuousness of mechanistic worldviews contributes to challenges in meaningful consultation and communication.

Keywords
Decolonization, indigenous knowledge systems, chemical risk

Introduction

Canada has recently elevated the inclusion of knowledge held by Indigenous Peoples in Canada into existing practices as a top priority (Government of Canada, 2023a, 2023b), following the revision of the Canadian Environmental Protection Act (CEPA) and the adoption of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (UNDRIP, 2007). As a result, governmental agencies are presently working to create appropriate institutional structures, including risk communication strategies. This opens up a window of opportunity to learn from and engage with the diverse Indigenous Knowledge Systems (IKS) help by various Indigenous Peoples in Canada and promote transformational change (Carroll et al., 2019; Fentem et al., 2021).

The gap between the relational worldview commonly held by many Indigenous Peoples and the more technocratic chemical-by-chemical thinking underpinning present-day chemical risk evaluation is, however, enormous and the communication challenges cannot be underestimated. Yet, we see a timely and transformative window of opportunity in the current movement toward a more holistic systems approach in all life sciences (*e.g.,* away from animal testing and the one organism/one chemical approach). This change requires a fundamental overhaul of thinking about chemical risk evaluation and an opportunity to substantially engage with IKS and knowledge holders.

Diverging views of nature sits at the heart of the communication challenges that must be overcome if we are to change to a more holistic chemicals management system and meaningfully engage with IKS and Indigenous knowledge holders. For many Indigenous Peoples, the interconnectedness and reciprocity of nature are important components of their worldviews. As opposed to regulatory science[1], which aims for generalizable, context-independent knowledge, many Indigenous communities believe that meaning is lost when something is removed from its context (Jimmy et al., 2019). The conceptual basis for the present chemical management system is what (Hepler-Smith, 2019) calls 'molecular bureaucracy' – that is, a system where substances are viewed, understood, and assessed on a molecule-by-molecule basis, predominantly using animals to test the effects. When chemicals are looked at without context or relations, the true risk or benefit of said chemical cannot be understood.

One key component of a more holistic way of understanding chemicals risk assessment/management is the idea of relationality, or the understanding of the ways in which relations are central to conversations and connections. Relationality is a central, vital component of many Indigenous Peoples' worldviews. Chemicals are both relational and diverse. What we mean by relationality in this case is that chemicals themselves are a reflection of the environmental factors that they exist within and operate within—they do not exist in a vacuum but rather are in flux based upon their surroundings.

Concepts of relationality can also be applied to how we assess and identify chemicals and the risks they pose to us and our broader environments. Regulatory science relies heavily on a mechanistic worldview, which hides these dynamic features of chemicals through its fixed classification system based on molecular properties independent of the continuous transformation processes. Notably, a classification based on the identity of individual molecules removes the complexity of context and the multiplicity of chemical relations among substances and therefore enables "regulators, scientists, industry and environmental advocates to cut through the complexity of environmental toxicity to mobilize evidence associated with molecules and to efface evidence of other kinds" (Hepler-Smith, 2019: 536). What this does, in sum, is to focus on chemical risk on an individual molecular level rather than considering the ways in which chemicals interact with one another and their environment, and how these interactions play out in broader contexts. This molecular focus, therefore, can miss key insights on the ways that chemicals can affect the things they come into contact with, such as people, places, and things (Murphy, 2008, 2017). It leads to the dangers of viewing chemical pollution as a capacity type of issue, versus a relational issue (Liboiron, 2021).

In our paper, we explore ways to support meaningful inclusion of IKS and Indigenous knowledge holders in chemicals management. This paper builds on conversations about chemical risk assessment and Indigenous data justice that occurred during a set of workshops involving a group of governmental experts in chemicals management and a group of Indigenous and non-Indigenous scholars with expertise in Indigenous studies, IKS, data justice and chemicals management. We focus on topics that emerged during the study that revealed points where the premises for shared conversations were not met, and we feel are important for participants on both sides of a consultation process to be mindful of. Based on our identification of central points for learning that crystallized during the dialogue between the two groups, we draw on relevant literature to elaborate on why these topics are essential to the inclusion of IKS and Indigenous knowledge holders in chemicals management. It is our intention to provide a meaningful potential roadmap forward in the areas of communication and consultation within settler-colonial contexts.

Positionality

The first author, Elina Eronen, is from Finland, and our paper is based on her master's research, which she conducted at the University of British Columbia (UBC) on a student visa. The other three of us comprised her advisory committee: Susan Chiblow (Anishinaabe kwe from Garden River), assistant professor at the University of Guelph; Niiyokamigaabaw Deondre Smiles (Ojibwe/Black from Leech Lake Band), adjunct professor at UBC; and Gunilla Öberg (recent settler from Sweden), professor at UBC. Two of us are, in other words, non-Indigenous settlers/visitors, whereas the other two are Indigenous from different communities in Canada and the United States. At the time of writing this article, all four had affiliations with major Canadian research universities, and Susan, Deondre and Gunilla were either tenured faculty or were on the tenure track. This identification is important as it speaks to the intersectional identities that we have navigated in writing this article—some of us are more connected to the impacts of colonization than others, but we all carry with us the privilege and power that comes with academic affiliation. We therefore write this article not to speak over Indigenous communities or position *ourselves* as objective experts—rather to recognize that we carry our own experiences and perspectives into dialogue.

It is also important to note in our positionality statement, that, in our analysis that follows, we recognize the diversity of perspectives among Indigenous communities in Canada. There is not one pan-Indigenous viewpoint, and individual communities will have different forms of response to issues surrounding chemical risk analysis — there may even be differences and fractures within communities. We provide a high-level overview of the lessons we learned from the workshops,

Governmental Experts from Canadian Government (Government Team)	Authorship/Research Team
Settler officials from Canadian governmental ministries such as Health Canada	Indigenous & settler researchers, including faculty and students

Figure 1. Information about the two groups engaged in the workshops, and their characteristics.

while doing our best to accommodate individual worldviews wherever possible. We fully acknowledge that by using a generalized Indigenous framing, we run the risk of committing epistemological violence (Hunt, 2014) — but hope that the reader views this as a provocation to go further into ground-level analyses of Indigenous responses, rather than a essentializing and flattening of perspectives.

Methodology

Over the course of approximately a year (April 2022-May 2023), a group of Canadian governmental experts engaged in chemical risk assessment (hereafter called the government team) took part in the project alongside a group of Indigenous and settler researchers with expertise in Indigenous studies, IKS, data justice and chemicals management (hereafter called the research team. The four co-authors were part of the second group (Figure 1).

We conducted two parallel online workshop series, inspired by the brokered dialogue method (Parsons & Lavery, 2012). The original method is designed to create respectful dialogue between individuals with divergent views on controversial and/or sensitive topics. This aligned with the overall goals of the workshops, which were to explore ways to bridge communication gaps between Indigenous knowledge holders and governmental officials when it comes to assessing chemical risk (Griffiths, 2018; Sorgen et al., 2025). The research team aimed to understand the potential pitfalls and barriers that inhibit or outright prevent meaningful consultation and engagement between Indigenous knowledge holders and governmental agencies when it comes to addressing the interests and concerns of Indigenous communities vis-à-vis chemical risk.

In the original brokered dialogue method, the counsellor/researcher records each individual separately as they describe their perceptions, and the recording is then shared with the other person, who is recorded as they view and respond to the recording. Instead of recording one side and presenting the recording to the other side, we organized a series of workshops that allowed the teams to take turns presenting to each other. The participants in the 'listening team' were given the opportunity to express questions and concerns in individual conversations after the workshop. The government team provided workshops on risk assessment, and the research team offered workshops on Indigenous data justice (Figure 2). The workshops, which were recorded and transcribed, were moderated by Elina Eronen (the 1st author) who also engaged individually with participants who wished to contribute via email or one-on-one conversations, which were offered after each workshop, thus acting as a broker between the groups.

The feedback shared after each workshop informed the content of the following workshop. In other words, the workshops influenced the content of the one-on-one conversations, and the conversations helped to establish the content of the subsequent workshop (Figure 2). The recordings from each workshop and individual conversation were transcribed and iteratively analyzed in NVivo for recurring themes that emerged during the analysis (Marshall & Rossman, 2016).

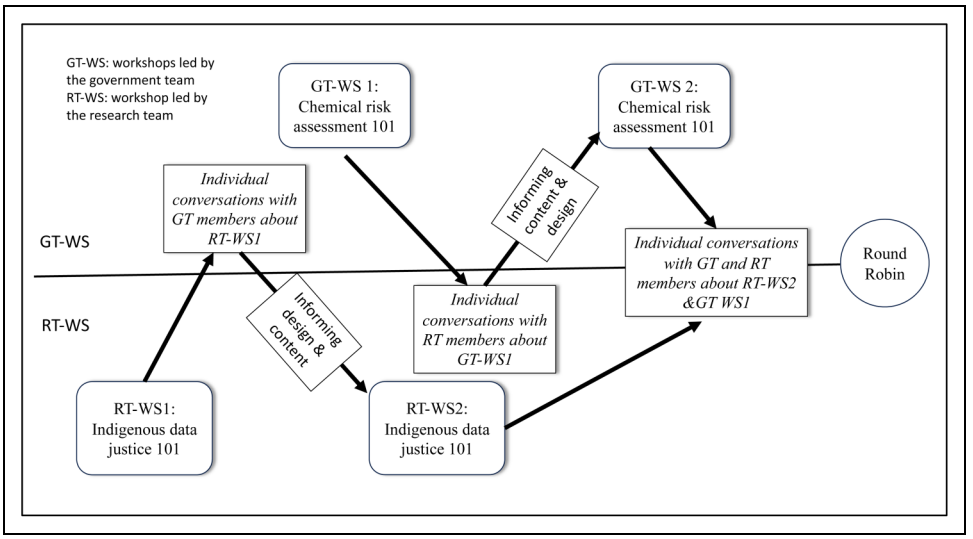

Figure 2. A schematic timeline of the workshops and individual interviews carried out during the project.

We modeled an Indigenous research methodology in how we collected data and disseminated it—scholars such as Linda Tuhawai Smith (2021), Shawn Wilson (2001, 2020), Niiyokamigaabaw Deondre Smiles (2023), and Audra Simpson (2007) have spoken about the need to ensure that participants are in control of how their data is used and shared. Prior to engaging in the study, all participants gave their written consent to participate in the study, but after reviewing a first draft of this article, which included anonymized quotes, a couple of the government participants requested that all direct quotes were removed. We raise this here to demonstrate that lack of quotes is not a lack of empirics—but rather, our modeling of the type of engagement we wish to see from governmental officials by respecting their wishes regarding their research data.

Four points where dialogue didn't happen

In a brokered dialogue, it is expected that differences in thought and opinion will arise, and the modified version used here with workshops between the government team and the listening team proved effective to that end. The idea with the brokered dialogues is that it facilitates conversations about challenging topics. As hoped, the combination of workshops and conversations allowed the facilitation of mutual learning from one another, the possibility of expressing one's own perspectives, and the opportunity to influence the trajectory of the learning. Several participants explicitly expressed that they felt that the format created room for dialogue between the participants in a respectful and trust-building way, while also introducing moments of reflection and realization through new ways of knowing and seeing. However, the analysis of the transcripts from the workshops and interviews led to the identification of four topics where the premises for shared conversations were not met. Participants from both sides emphasized that they thought dialogue would eventually have been possible, if the workshops had continued. This was unfortunately not possible due to time and resource constraints. Below, we describe and elaborate on each of the four topics where only partial dialogue was achieved, drawing on relevant literature. These challenges, we argue, are indicative of central gaps that need to be overcome to facilitate communication between different knowledge systems – which is necessary to reduce chemical risk for Indigenous Peoples and everyone else.

The invisible colonial roots of the system

In our analysis of the transcripts and field notes from the interviews following the first workshop on data justice, all members of the government team notably commented on the research team's use of the term 'colonial'; implying they were perplexed over the research team's use of the word to describe existing data systems in Canada, as Canada is no longer a colony. The term was used on two of the slides in the slide-deck and verbally by the presenter during the presentation. In the one-on-one conversations government staff members shared that their coworkers reacted strongly to the term when they shared the slide-deck and described the conversation that was held following the presentation. This suggests that the coloniality of the chemicals management system is not recognized by government staff, more broadly speaking.

When the government team's reflection on the term colonial was shared with the individuals in the research team, they all seemed somewhat perplexed, in various ways expressing that they thought the coloniality of the system was self-evident. Several conversations among ourselves (the authors) were dedicated to the topic as we found it challenging to design a workshop on data justice that would better clarify to the government team in what ways data relevant to risk assessment can be colonial. The transcripts and field-notes from the second data-justice workshop show that participants from both groups felt that the workshop was only partially successful in that regard, despite considerable preparatory work. A central take-home lesson from these workshops is that the coloniality of the chemical management system is virtually invisible to those working in the system. We therefore see it as essential to dedicate time and effort to develop material that helps government staff grapple with the ways in which the system retains colonial aspects that hinder meaningful inclusion of IKS and Indigenous knowledge holders, despite Canada no longer being a colony. Below follows an overview of the coloniality of the chemicals management system, based on central points of learning that crystallized through the dialogue between the two groups and relevant literature.

The coloniality of the present-day chemicals management system. The legal and administrative systems that were introduced when Canada was formed, were based on the British (Westminster) system, which is rooted in the values, norms, and priorities that were dominant at the time. The existing Indigenous systems were ignored, as the people of the land were assumed not to have any developed social, legal, or administrative systems (Harris, 2004).

One of the explicit priorities of the colonial powers was the physical and cultural dominance over Indigenous peoples in Canada – First Nations, Inuit, and Métis[2] – and the erasure of their cultures (TRC, 2015). This quest for physical and cultural dominance meant that the new structures were established at the cost of Indigenous peoples' own modes of legal and administrative governance (TRC, 2015). Through numerous assimilation policies such as the *Indian Act* in 1876, Indigenous peoples were disempowered and their cultures and rights undermined (Joseph, 2016; Wilson-Raybould, 2022). Indigenous peoples, communities and Nations were forbidden to speak their languages, practice or engage in their own culture, and prevented from exerting their right to autonomy, self-determination, and sovereignty, despite treaties enshrining these rights. In accordance with the *Indian Act*, Indigenous peoples were made subjects or as described by the Deputy Superintended of the Department of Indian Affairs in 1876, "wards or children of the state" (Department of the Interior, 1876: XIV). Systems of data collection, analysis, usage, and storage enforced by colonial powers were established to serve dominant values, interests and beliefs, meaning that data, often functioned in tandem with the colonial powers' undermining and disempowering of Indigenous peoples. Today's information systems, particularly in institutions with colonial legacies (think universities, government, and industry), continue to be influenced by dominant perceptions and values (Murphy, 2008, 2015; Murphy, 2017).

In the 1970s, in response to increasing concerns over the chemical industry's negative impact on human and environmental health, various jurisdictions in Europe as well as in the US started to formulate chemicals management systems, leading to the development of regulatory science (OECD, 2011). Canada followed suit, creating a series of Acts designed to protect human and environmental health from potentially harmful chemicals (e.g., the *1985 Food and Drug Act*; the *1985 Department of Fisheries and Oceans Act*; the *1995 Pest Management Regulatory Act*, PMRA; and the *1999 Environmental Protection Act,* CEPA). Administrative structures were created at federal, provincial, and municipal levels to distribute responsibility for the implementation of these Acts. These administrative structures follow the logic of the systems put in place when Canada was formed in 1867. For example, the Canadian Department of Health, which was created in 1919 in response to the Spanish flu, had a structure that was built on the Department of Health in the UK. In 1993, the Canadian Department of Health was transformed into Health Canada, one of the administrative units responsible for chemicals management in Canada.

Indigenous peoples in Canada were not involved in the creation of the administrative or governance structures put in place in 1867, nor were they involved in the creation of the Acts or administrative bodies that formed the chemicals management framework in the 1980s and 1990s, including the type of methods, data, or analytical frameworks used in chemicals management. Accordingly, Indigenous peoples in Canada have historically had little, if any, influence on the content or structure of the laws, regulations, administration, or data-systems surrounding chemicals. This led to that the relational worldviews of many Indigenous peoples being overlaid by the context-independent molecule-by-molecule approach which is applied in regulatory science, as described in the introduction. As such, the administrative systems were, and still are, colonial in that they reflect the priorities of the colonial state while erasing the existence, values, norms, knowledge, and cultures of Indigenous Peoples in Canada (Walter, 2018). In other words, the information and terms used to assess chemical risk are a direct result of colonialism and they have a direct influence on how chemical risk is assessed today and the way regulatory science frames chemicals – predominantly as discrete entities rather than continuously changing, involved in complex networks and relations.

The exclusion of Indigenous Peoples from the creation of legal and administrative structures led to the data used for the management of chemical pollution is not designed to meet their interests, needs, or rights, meaning that the resulting management decisions rarely, if ever, benefit Indigenous people. As such, harm caused by chemical pollution to Indigenous communities is typically misestimated or not managed in a way that is beneficial to the communities. It is, in other words, no surprise that colonial legacies have led to a situation in which Indigenous people are disproportionately exposed to chemical pollution (Gochfeld & Burger, 2011; Hepler-Smith, 2019; Langston, 2010; Liboiron et al., 2018; Murphy, 2017).

Also, the logic of the existing system has led to the data that exists about Indigenous people historically being damage-centred as it is collected and compiled in a way that creates disruptive, demeaning, and destructive narratives about them (Tuck, 2009). Data on chemicals, chemical exposure and chemical risk is not exempt from damage-centered tendencies. When researching and reporting on chemical risk and harm, it is a common practice to highlight the damage chemicals do to individual bodies (Murphy, 2017). Such practices focus solely on the victimhood of many Indigenous communities when it comes to chemical risk and harm, thereby oftentimes overlooking the underlying systemic structural inequities which have led to higher exposure and harm (Murphy, 2017; Tuck, 2009). These damage-centered data/narratives deprive Indigenous people of their agency by further reinforcing harmful and demeaning narratives of their decrepitude and inadequacy. These damage-centered data collection activities and narratives do, in part, result from the lack of Indigenous involvement in data-related decisions. Therefore, data about Indigenous people still largely is not collected *with* or *for* Indigenous people (Taylor & Kukutai, 2016;

Walter, 2018; Walter et al., 2021), but instead runs the risk of being extracted by researchers and governments *about* and *from* Indigenous people, communities, and Nations, without sharing the data with the people, communities and/or Nations. Such data systems have resulted in a paradox of scarcity and abundance of Indigenous data[3] that exists today: The paradox of scarcity and abundance points to the fact that there currently exists a wealth of Indigenous data in governance systems (Carroll et al., 2020). Yet, there is a scarcity in terms of data that is useful and relevant to Indigenous communities. As mentioned earlier in the paragraph, such data landscapes have created legal and administrative systems for chemical risk management that rarely, if ever, bring benefits to Indigenous communities. There is a small but increasing number of initiatives that contradict this pattern, under the motto 'no research about us without us', such as the Northern Contaminants Program, which is primarily driven by Inuit needs (Van Oostdam et al., 2005).

The conversations that were ignited by the government team through questions about the use of the term colonial, and the failure for the two teams to fully reach each other, demonstrate that there is additional work that needs to be done to bridge gaps between different perspectives. The gap between the two groups' perceptions of the problem with the present system was considerably larger than anticipated. Notably, the brokered dialogue process allowed for the creation of common ground and trust-building, which in turn nurtured and supported continued dialogue. An important factor enabling the creation of common ground was the time periods between workshops (about a month), which allowed participants to consider and digest the other side's questions. Importantly, the initial bewilderment brought about by the term colonial was replaced by cautious curiosity and an explicit interest in understanding how the other team perceived the challenges ahead, and enabled formulation of the above description of the coloniality of the chemicals management system.

Isn't data objective?

The analysis of the transcripts and fieldnotes from the workshops and the conversations revealed diverging perceptions of the context dependance of 'data': while the government team primarily saw data as context-independent and thus objective, the research team saw it primarily as context-dependent and imbued with values, interests and preferences. In the conversations that followed the workshop, the government team asked the research team to expand on the context-dependance of data, as this idea stands in stark contrast to the backbone of regulatory science that the use of best practices in every step of the research process will result in high-quality data, which is a guarantee for objective and generalizable knowledge (Carrier, 2013). The conversations surrounding the nature of data illustrate that there is a need for creative and constructive ways to convey why meaningful inclusion of IKS and Indigenous knowledge holders cannot happen unless the context dependance of data is recognized. Following the same structure as in the previous section, we provide an overview of the context-dependance of data, based on central points of learning that emerged during the conversations held in the workshops and the individual meetings.

On the context-dependance of data. The perception of data as context-dependent is rooted in the recognition that deciding what data to collect, what not to collect, and how to analyze, use, interpret, store, and share it, is based on the values and norms of the individuals that are making those decisions (Dencik & Sanchez-Monedero, 2022; Gitelman, 2013). The perception of data as context-dependent is not limited to Indigenous Peoples but is also embraced by many social sciences. Numerous studies in history, sociology and philosophy of science, as well as related fields such as science and technology studies (STS) illustrate ways in which data is impacted by the context (Douglas, 2017; Elliott & Richards, 2017; Fleck, [1935] 1979; Harding, 1986; Latour, 1987). It is increasingly accepted that the background, training and experience of the researcher matter for

the outcome (AlShebli et al., 2018; Hofstra et al., 202; Wilson et al., 2007). Strictly following procedures that are carefully documented so that an outsider can repeat them is no doubt necessary for rigorous research, but it is not sufficient. This is because questions of interest and relevance to the individuals, groups, and societies that have the means to conduct research are more commonly investigated, oftentimes leaving questions of relevance to other groups overlooked (Elliott, 2011; Harding, 2015). Looking back in time, it becomes evident that the idea that the individual is irrelevant to the outcome of a study has paved the way for poor, biased, misleading, and unethical studies. The list of unethical studies conducted in the name of science is shockingly long (Criado, 2019; Gamble, 1997; Ledford, 2019). In his book, *Descent of Man*, Darwin does, for example, describe Indigenous people and women as inferior to European men. Another example is the 'scientific' theory of eugenics in the early twentieth century (i.e., the idea that systematic breeding of 'superior' individuals would 'improve' the human race), which was used to justify forced mass sterilization of people who were judged as lesser (Dikötter, 1998). Another troubling example is the systematic exposure of Indigenous children in Canadian residential schools to starvation to study the impact of malnutrition on child development (Mosby, 2013). It is important to note that these studies were not outliers on the fringe: all three examples mentioned above are rooted in race biology, which became mainstream research at the end of the nineteenth century (Comfort, 2012). These examples illustrate that science can cause considerable harm when the values embedded in the research go unrecognized. Notably, the perception that data is context-dependent is increasingly embraced in the natural sciences, albeit still not widely accepted See for example: Calow, 2019, 2020).

To illustrate that the values and norms guiding data systems in Canada hail from mechanistic/colonial viewpoints, the research team used an example comparing data on salmon (*Oncorhynchus sp.*) as compared to eulachon (*Thaleichthys pacificus*, a.k.a. oolichan, ooligan, uthlecan, candlefish). Both species are important to many Indigenous Peoples in Canada, particularly among the Coast Salish, but eulachon has little to no commercial value. While the Canadian authorities early collected data about salmon, as this species was relevant to commercial salmon fisheries, data was not collected about eulachon. As a result, there is today a wealth of data on the various salmon species, but data on eulachon is still sparse, in comparison. Notably, this data is of high value to Indigenous communities. This points towards a situation where there is no shortage of data available about Indigenous people — but the specific data that they need is scarce.

The salmon/euchalon example used to illustrate the coloniality of data was only partly successful. The follow-up questions and one-on-one conversations about data and their objectivity revealed that the government team still found the idea of data as context-dependent perplexing. Our analysis of the transcripts shows that the members of the government team did no find the examples used in the presentation helpful in clarifying the ways in which today's institutions rest on the logic, preferences, and values of dominant systems and that these have guided decisions as to what data gets collected, how it is used, and how it is stored and accessed. All in all, the research team found it challenging to find effective ways to convey that the data systems that are in place support values and priorities rooted in the mechanistic worldview. Our analysis of the conversations led to the conclusion that there is a need to co-develop concrete and specific examples and cases that effectively illustrate the ways in which the data for chemicals management is collected, analyzed, used, stored and shared are based on dominant values, norms and practices. Such examples and cases also need to clearly and concretely illustrate how the existing practices are harmful to Indigenous people and the ways in which the exclusion of Indigenous' needs and values leads to an erasure of their rights to self-determination.

A central conclusion is that it becomes difficult to decolonize and transform a system if there exists little to no knowledge of colonial legacies or the need to reconcile them. Lack of knowledge also makes it less likely that changes will be kept, honored, and respected (McGregor et al., 2023;

Mussett et al., 2023; TRC, 2015). A way forward is to enhance educational material on colonization, colonial legacies, ethical research, collaboration practices, Indigenous data sovereignty and governance, and data justice. Importantly, the material needs to be specifically tailored to the needs of different governmental departments to support the staff's understanding of how data is context dependent and the ways in which colonialism affects their decisions about the data used to assess chemical risk.

On dialogue

The research team found the risk assessment workshops provided by the government team to be very informative; however, there was a lack of time for questions, and consequently, it was not possible to probe further in real-time. In our analysis of the transcripts and field notes from the follow-up conversations, we found that several of the research team members commented that they felt the lack of time for questions was frustrating and requested that the government team leave time for questions moving forward. When the first author brought this question to members of the government team, they explained that they, in their preparation, set out to respond to all questions that were conveyed to them by the research team, and this was a central reason to them running out of time. Members of the government team shared that it is common practice to try to leave time for questions at the end of any presentation they give, while recognizing that running out of time is a common phenomenon.

Our analysis of the conversations indicate that the government team largely view communication as a linear process with the speaker delivering information to the listener, similar to the process of delivering a package. It is a common phenomenon in science communication to prescribe to the 'deficit model' where the role of the communicator is to fill the listeners' knowledge gap (Cook & Overpeck, 2018; Seethaler et al., 2019). Communications based on the deficit model are built on the idea that students, non-experts, or the public, are unaware or unknowledgeable about the specific topic (Kuchel, 2019). The deficit model does not consider that the listener might be misunderstanding the message, have relevant questions or have valuable information to contribute to the topic. The deficit model of communication is commonly used in dominant systems and worldviews, which in regulatory science positions government staff as the knowledge holders and the Indigenous people as those in need of being educated. The presumed need to fill knowledge gaps in Indigenous communities is widely documented in reports from North American missionaries (often referring to the need to teach Indigenous people about civilization, building, communication etc.), indicating in the minds of the settlers that Indigenous people lacked in knowledge and skills whereas colonial powers did not (Parliamentary Select Committee, 1837). As argued by both Spivak (1994) and Schiller (1978), colonial powers confined "judgments and decisions on what should be known and how it should be made known into the hands of a few" (Schiller, 1978: 38), thereby leaving those not in the select few (i.e., Indigenous Peoples, among others) simply to be the recipients of information and not active participants. We posit that moving to a Deweyan model of science communication at the end of academics and encouraging governmental officials to explore such a model can provide a key way of overcoming this fundamental gap of knowledge dissemination. Halpern and Elliott (2022) present the benefits of such a model, which prioritizes the lived and personal experiences of all participants in science communication, and actively subverts any 'paternalistic' models of science communication, where 'knowledge experts' are the ones positioned to teach others. However, it's important to note that a Deweyan model, as presented by Halpern and Elliot, does not silence the 'experts', as it takes *their* experiences and viewpoints into account as well, moving towards an equitable model.

In the context of this study, the government team's careful response to all questions posed was noted as being positively different from the Indigenous team members' previous experiences. The

transcripts and field notes from the conversations with members of both teams suggest, however, that when government staff interact with Indigenous people, they predominantly adhere to the deficit model. This type of engagement can give the appearance of talking *at,* rather than *with,* the audience. This can be problematic, as it not only gives the impression of ignorance of the rights of Indigenous Peoples to assert their comments, opinions, needs and wants, but it also prevents relationship building. The prevailing idea that the government has a habit of talking at and not with, as well as its roots in the deficit model of communication, is reflected in the public engagement process where the public is given the opportunity to provide comments and feedback on a given chemical risk assessments following the release of its initial draft. This comment period lasts 60 days, during which the draft risk assessment is publicly available on the government's website (The Government of Canada, 2022). The intention is to create a forum for dialogue between the government and the public, including Indigenous communities. The Indigenous participants emphasized that the comment period fails to do so in a meaningful way. Several of the Indigenous participants, who have experience of engaging with the Canadian authorities as members of their communities or working for other communities, expressed that the comment period fails to engage communities because it happens too late in the process and is also too short for many Indigenous communities to participate meaningfully. Several commented that due to capacity deficits, particularly financial, that many Indigenous communities face, mainly due to colonial legacies rather than their own ineptitude, commenting within the 60-day period remains difficult, a position that finds considerable support in the literature (Bruhn, 2014; FNIGC, 2014; McGregor et al., 2023; Tsosie, 2020). When communities decide to make comments and are able to do so within the time period, which is not very often, according to members of the government team, the design of the public comment period does not lead to a meaningful dialogue.

Communication research demonstrates that information conveyance is more complex than represented in the linear and deficit models. In contrast to delivering a package, where the content remains the same, information changes as it moves from one person to another – in simplified terms: there is no guarantee that what one person says is what the other person hears (Bradac & Reid, 2006). It is held that a more efficient way to communicate is to engage in dialogue, as this will make it possible to understand what the audience is learning (Bohm, 1996). Engaging in dialogue with the audience can help the communicator tailor the message to their learning needs.

Notably, a verbal back-and-forth exchange does not automatically lead to meaningful communication. For meaningful communication to happen, all participants need to be willing to listen and truly try to understand the perspectives of others, and listening sessions should be designed to facilitate that. For Bohm (1996), such form of communication, or dialogue, creates opportunities for "creation of something new together" (p.3). For chemical risk assessments, this "something new" would constitute building systems that not only serve Indigenous Peoples relevantly and beneficially, but also respect the rights of Indigenous Peoples to have sovereignty and control over their data. Bohm also asserts that when communication is not established on grounds of openness, active listening and reflection, the goal of creating "something new" cannot be achieved. Bohm says: "If, however, two people merely want to convey certain ideas or points of view to each other, as if these were items of information, then they must inevitably fail to meet" (ibid, p.3).

What Bohm (1996) is describing applies clearly to the current conditions of communication within chemical risk management. The Government conveys material about chemical risk assessments to Indigenous communities. There is little room for Indigenous people to share their ideas or points of view in meaningful ways. This inhibits the ability to disseminate knowledge in different ways and formats, especially in ways that are based upon the needs and values of specific Indigenous communities. In other words, without meaningful dialogue based on two-way communication, Indigenous Peoples cannot actively contribute to improving the chemical management system in ways that make the most sense for them. The solution for this is relatively straightforward,

in that we recommend that the system put in place for the evaluation of chemical risk needs to include more effective communication methods to ensure that active two-way dialogue is achieved.

The "creation of something new" is not only dependent on two-way communication but also relationship-building, which needs to be built on trust and respect. The lack of listening involved in the evaluation and management of chemical risk hinders relationship and trust building between the Government and Indigenous Peoples. Relationships and trust are cornerstones in the creation of spaces for communication where people feel comfortable sharing their expertise and knowledge. As Rainie et al. (2017) outlines, the absence of truly engaging dialogue in data-related projects contributes to the mistrust towards government entities. Indigenous Peoples have not been given the space to assert comments, opinions or needs in chemical management. Similarly, Love et al. (2022) demonstrate that building trust and relationships requires that sufficient time is given to open and respectful communication of expectations, needs and benefits. In their case, relationships were the foundation that enabled joint data systems to be created. Maldonado et al. (2016) on the other hand, establish that relationships are built on effective, open, and reflective communication. The linear communication system currently surrounding the evaluation of chemical risk does not support such open dialogue communication. The way the system is presently constituted consequently makes it nearly impossible to establish meaningful relationships between governments and Indigenous Peoples. To return to Halpern and Elliott (2022), we recommend that space be made for all perspectives in a dialogue — this will allow for relationship building to occur organically, and in a way that can support all participants within the dialogue. Without meaningful relationships, Indigenous Peoples will not have the safety, security, or trust to collaborate on data systems of relevance for the evaluation of chemical risk.

To begin changing the process of chemical risk assessment, effective communication is needed, which can only be achieved when the government staff not only convey information but also are given the time to actively listen and reflectively consider questions and concerns. It is in this context important to recognize that dialogue between government staff and Indigenous people is not happening on a level playing field. While generations of Indigenous people have been forced - literally - to learn about Anglo-European ways of knowing, thinking, speaking, and governing, most non-Indigenous people in Canada are just beginning to learn about IKS.

Rightsholders, not stakeholders

There were several instances during the risk assessment workshops when members of the government team described Indigenous people as stakeholders, or in the same sentiment as stakeholders. This in itself is not extraordinary, as there is a long legacy, both in governmental/Indigenous relations, as well as in the literature, surrounding defining Indigenous people as stakeholders, or having key interests in dialogue processes between themselves and outsiders (Banerjee, 2001, 2003; Murphy & Arenas, 2010; Olabisi et al., 2019). However, we argue that a more expansive definition/label is needed in order to fully understand the grounds through which Indigenous Peoples engage in protecting their interests—they are rightsholders, not stakeholders.

Why is this distinction important? In response to references to Indigenous people as stakeholders, research team members shared that this was a common phenomenon and reacted strongly as Indigenous Peoples are not stakeholders, they are rightsholders. Noting that it can be argued that all members of the public are rightsholders who have rights to consent to the imposition of chemical risk (see Thomson, 1986; Shrader-Frechette, 1991; Cranor, 1993; Cranor, 2006), the rights of Indigenous Peoples in Canada is distinct from the rights of other people in Canada as they have a *legal* right to be engaged and consulted, as repeatedly documented in the Royal Proclamation of 1763 and in the Treaties. This right to consultation has been affirmed by more recent legislation in Canada, particularly section 35 of the Constitution Act, 1982 (The Government of Canada,

2025). It is therefore a fundamental part of the relationship between the Crown, and Indigenous communities in Canada, which was emphasized by several of the research team members.

Notably, the Supreme Court of Canada has requested meaningful engagement of Indigenous Peoples from the government on multiple occasions. In other words, including Indigenous Peoples, communities, and Nations in the blanket term of stakeholders, erases their inherent rights for engagement and consultation through their right to sovereignty and self-determination. The research team members maintained that it is necessary to have governments come to Indigenous communities and create meaningful engagement processes-it is not only their obligation, but it is also a key component of building strong relationships built upon trust. Team members emphasized that treating Indigenous Peoples as stakeholders is in direct conflict with the rightsholder status that Indigenous peoples, communities and Nations legitimately hold, as has been agreed to is enshrined in the Canadian constitution.[4] As of 2021, Canada is also a signatory of UNDRIP (Government of Canada, 2021; Slattery, 2000).

Several of the research team members also highlighted that, in addition to being categorized as stakeholders, Indigenous people are commonly seen as synonymous with "the [general Canadian] public'. They noted that there is no more obvious example of this than the very name of the engagement process: *public* comment period. While the term "public" in and of itself is not problematic, a research team member argued that when thinking about consultations and engagements, Indigenous Peoples have a "much more elevated status", thus referring to their formally recognized status as original inhabitants.

Meaningful engagement with Indigenous Peoples means that they cannot be treated as part of the public or as stakeholders. To be meaningfully engaged, Indigenous Peoples need to be afforded the right to influence the risk assessment process from the very beginning, including the design of policies, and the collection and use of data as stated in Constitutional law and government policies. Only when true, meaningful consultation with two-way dialogue is consistently being applied in all government processes, can Indigenous communities begin building and influencing chemical risk assessments in ways that align with their right to self-determination and are representative of the needs and priorities of each community and Nation. Changing the narrative about Indigenous Peoples and the methods through which they are engaged is paramount. These are the narratives which emphasize Indigenous Peoples as rightsholders. This will require collaborative dialogue to support knowledge and capacity building on behalf of governments involved in chemical management and Indigenous Peoples. It will mean much more than just simply consulting, but also helping to build capacity for Indigenous communities to be able to assess risks and address them from their own values and perspectives, particularly when it comes to access to environmental data (Hetoevėhotohke'e Lucchesi, 2020; Carroll et al., 2023, 2024). As such, moving chemical risk management towards decolonization requires that the legally-granted rightsholder status of Indigenous Peoples is recognized. To return to Hunt (2014), it will also require shaping and adjusting consultation efforts to meet the needs of individual communities—there is no one-sized fits all approach to consultation. This will take extra time and effort, but we argue it will also result in more meaningful conversations and an opening for more positive ways forward in the consultation process.

Conclusions

This study confirms and illustrates several ways in which colonial legacies, through their inconspicuousness, hinder meaningful inclusion of IKS and Indigenous knowledge holders in Canadian chemicals management. Our study suggests that there is a need to make these legacies visible, not only the ways in which they manifest in chemicals management more broadly, but also how they concretely impact the type of data that goes into the management decisions and

how this data is stored, used, accessed and shared. The invisibility of the persisting impacts of colonization on these administrative structures and regulatory science makes it very difficult, if at all possible, to break with unproductive communication and engagement styles.

Our study points to the importance of creating opportunities for government staff to find ways to bring the coloniality of the system to light by enhancing their understanding of how the mechanistic worldview is embedded in the system and how this hinders not only meaningful engagement with IKS but also creates a lock-in that stalls change. Notably, meaningful and respectful engagement with IKS, requires identifying and breaking away from colonial legacies that lead to Indigenous Peoples not being treated according to their legally recognized status as rightsholders, i.e., including the practice of speaking to them and treating them as stakeholders in public consultations. When engaging with Indigenous communities and Indigenous Knowledge holders, it is crucial to recognize that it is not an even playing field: while Indigenous Peoples in Canada have been forced – often literally - to learn to navigate colonial legal and administrative structures, which includes learning their language, the knowledge about Indigenous knowledge, law, administration, language etcetera among most non-Indigenous Canadians is rudimentary, at best.

We also conclude by pointing towards an optimistic future for this engagement —while we have identified key challenges towards a new model of consultation around chemical risk in Indigenous communities, we also feel that by identifying the challenges and gaps, we are positioning ourselves to be able to do something about them, and move towards a more fruitful model of communication amongst the different key constituencies in chemical/environmental risk.

Highlights

- Canada's revision of its Environmental Protection Act (CEPA) and adoption of UNDRIP create a timely window of opportunity to meaningfully engaging Indigenous Knowledge Systems (IKS) and Indigenous knowledge holders.
- Current "molecular bureaucracy" (chemical-by-chemical, context-independent regulatory science) clashes with relational worldviews central to many IKS, risking misestimation of chemical harms and benefits when context is stripped away.
- Using a brokered-dialogue-inspired workshop series, we identify four recurring situations where premises for dialogue were not met between governmental risk assessors and Indigenous/settler researchers.
- Key barriers include: the invisibility of colonial legacies within administrative/data systems; divergent assumptions about whether data are value-laden; reliance on deficit-model communication that "talks at" communities; and misframing Indigenous Peoples as stakeholders rather than constitutionally and internationally recognized rightsholders.
- The authors offer a roadmap for decolonizing risk communication and consultation in settler-colonial contexts by foregrounding relationality, data justice and sovereignty, early-stage rights-based engagement, and relationship-building as prerequisites for transformative change in chemical risk governance.

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Data statement

The raw data consists of audio recordings and notes taken during workshops. Per the ethics certificate, these are only available to the research team. Anonymized transcripts can be made available on request.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Ethics approval

The study has been reviewed and approved by UBC's ethics board (certificate number: H22-01227). All participants have signed the consent form.

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Notes

1. Regulatory science is the codified science that most governments use to assess chemical risk, typically following so called 'Good Laboratory Practices - GLP' as defined in detail by OECD guildelines (e.g., type of test animal, number of replicates, length of study, type of analysis, etcetera).
2. Colonial powers in Canada initially only recognized First Nations as Indigenous peoples in Canada.
3. Indigenous data is data that either is about Indigenous peoples, collected by Indigenous peoples, or collected for Indigenous peoples.
4. Government of Canada has an explicit duty to consult Indigenous peoples to understand "how and when their activities could have an adverse impact on Aboriginal and treaty rights" (Government of Canada, 2021), which include, but are not limited to, the right to self-determination and sovereignty (Slattery, 2000)

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