Assessing the Cumulative Social Effects of Projects: Lessons from Canadian Hydroelectric Development

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Abstract
Cumulative effects assessments are often expected to include an analysis of cumulative social effects to people, their communities, and livelihoods caused by resource development projects and land use activities. Understanding cumulative social effects is important for decisions about prospective resource development projects, but there has been limited attention devoted to how to complete such an assessment. This paper critically examines how cumulative effects frameworks are applied to social impacts during environmental assessments. We do this by analyzing semi-structured interviews exploring practitioner experience in environmental assessments for hydroelectric development in British Columbia and Manitoba, Canada. The results provide a conceptual framework for cumulative social effects and illustrate how identified challenges for cumulative effects assessment are exacerbated by social impacts that introduce additional complexities in impact identification, assessment, and decision-making. The paper concludes with a discussion of how these challenges can be addressed and recommendations for improving environmental assessment practice.

Keywords Cumulative effects assessment · Cumulative social effects · Social impacts · Environmental assessment

Introduction
A pressing question for resource management is the relationship between project-level environmental assessments (EA) and the need to account for and manage cumulative effects resulting from multiple projects and human activities, including social effects to people, their well-being, and livelihoods. Research and policy development for cumulative effects assessment (CEA) has primarily focused on advancing the scientific and technical capacities required to predict and monitor cumulative effects to biophysical components (Halseth 2016; Mitchell and Parkins 2011). CEA is intended to support project-based decision-making and broader strategic planning by evaluating environmental impacts in combination with other past, present, and foreseeable activities or stressors (Foley et al. 2017; Jones 2016). The implementation of CEA has been critiqued on many fronts including defining and generating the information needed to understand cumulative effects (Cronmiller and Noble 2018; Foley et al. 2017), ensuring the organizational capacity and institutional support for doing CEA (Chilima et al. 2017; Sheelanere et al. 2013), and for establishing meaningful connections to decision-making and planning at project-based EA and regional and strategic assessments levels (Arnold et al. 2019; Noble et al. 2017).

In addition to these challenges, there is a deficit in practical and applied knowledge for how to account for cumulative effects to people’s livelihoods and well-being.
We use the term cumulative social effects\(^1\) to collectively refer to these social, cultural, economic, and health impacts which are incremental, combined, and successive across space and time (Franks et al. 2012). There is general consensus that CEA should be inclusive of social impacts (Blakley 2021; Franks et al. 2013), but there has been limited research explicitly exploring how to do so, particularly when compared to the efforts devoted to developing processes to assess biophysical impacts (Halseth 2016; Mitchell and Parkins 2011).

Considering cumulative effects was first formalized in Canada through the Canadian Environment Assessment Act (1992). EA regimes at the federal level have sought to strengthen CEA and social impact assessments, and to implement regional assessment frameworks (see Impact Assessment Act 2019), though specific guidance is limited, and attention to cumulative effects is inconsistent across provincial and territorial regulations. However, an imperative to consider cumulative social effects has developed in response to the reality that they have become an issue confronting EA processes in practice, and a persistent concern for stakeholders and Indigenous communities. (Bakker and Hendriks 2019; Booth and Skelton 2011; Mantyka-Pringle et al. 2017; Sandlos and Keeling 2016). Cumulative social effects resulting from boom/bust cycles of development, multiple industries and projects operating in a region, and the alteration of socially or culturally important landscapes can be significant, and are often an important part of the public debate and evaluation of potential development actions, despite that assessment processes are often not well equipped to consider them (Atlin and Gibson 2017; Horowitz et al. 2018; Mantyka-Pringle et al. 2017). Cumulative effects have become particularly important for Indigenous communities in Canada who have been confronted with disproportionate environmental and social impacts as a result of development, inequitable shares in the benefits, and a legacy of exclusion from planning and decision-making (Bakker and Hendriks 2019; Bradley and McClurg 2012; Sandlos and Keeling 2016).

The focus of advances in data collection and analysis for CEA has largely remained biophysical, but the importance of cumulative social effects has been well documented (Franks et al. 2012; Mantyka-Pringle et al. 2017; Mitchell and Parkins 2011). The cumulative nature of social change has also been a persistent challenge for iterations of impact assessment that evolved to account for social impacts, such as social impact assessment (SIA), health impact assessment and gender or equity based assessment, and linkages between these fields are emerging. Numerous frameworks have been developed for SIA specifically (Koutouki et al. 2018; Lockie et al. 2009; Ross 1990), and methods for cumulative social effects have been explored such as narrative and social science based approaches (Hanna et al. 2016; Parlee et al. 2012; Westman and Joly 2019), participatory modeling (Hodgson and Halpern 2019; Larsen et al. 2017; Mantyka-Pringle et al. 2017), and spatial analysis (Huang and London 2016; Sadd et al. 2011; Tyson et al. 2018). There have been calls to further develop qualitative and interdisciplinary methods to better understand these impacts and the implications for Indigenous rights and environmental social justice (da Silva et al. 2020; Davies et al. 2018).

As methods for assessing cumulative social effects continue to be explored and regulatory processes evolve, there is a need to examine the process and framing of CEA within EA. CEA is important at a number of decision-making levels and assessment and planning scales. There is strong support for regional/strategic level CEA, but information about potential cumulative effects is also vital for making decisions at the project EA level (Arnold et al. 2019; Noble et al. 2017). Establishing relationships between different assessment levels, and developing effective processes for CEA that can be applied in EA is an ongoing area of work. But, there has been little exploration into how cumulative social effects can be meaningfully assessed during project EA. This is despite the importance of making management and mitigation decisions informed by the socioeconomic impacts and benefits of proposed projects across local and regional populations and within different demographics.

This paper examines how cumulative social effects are addressed in practice during EAs. By concentrating on practitioner experience in project-level EA for hydroelectric developments, we explore how an expectation to assess cumulative social effects has been translated into practice by those participating in EA, and identify challenges confronting CEA processes. We focus on two Canadian provinces with different EA regimes and regulatory contexts for CEA: British Columbia (BC) and Manitoba. In BC our analysis is focused on the Peace and Columbia River systems, and in Manitoba on the northern Nelson, Burntwood, and Churchill River System. While our analysis is situated in these provinces, we identify a number of ways in which cumulative social effects are presenting challenges for current CEA processes and we highlight key priorities for improvement that are applicable across other jurisdictions. The paper begins with a background and an overview of hydroelectric development and the regulatory context for EA in each study region. The study methods and results are presented, and are followed

\(^{1}\) The terms cumulative effect and impact are often used interchangeably. We recognize that effects can be distinguished as observable, measurable changes, and impacts as the consequences to environmental and social systems that result from these changes (Blakley 2021). However, we also note that the term cumulative effects is often used in project EA to refer to residual significant cumulative impacts to environmental and social systems. In this paper we do not distinguish between effects and impacts. Cumulative social effects/impacts are used to describe cumulative changes to social systems.
by a discussion of recommendations for supporting an analysis of cumulative social effects in EA.

**Study Areas and Data Collection**

Hydroelectric development has a long legacy in Canada and internationally. Hydroelectric developments are often framed as clean energy projects with substantial societal benefits, though the development and operation of hydroelectric facilities, including reservoirs, transmission lines, stations, and spillways, result in widely dispersed and long-term environmental and social impacts. The social impacts of hydroelectric development have been well documented worldwide, including landscape flooding, habitat destruction, community relocation, disruption of food sources, local economic and employment changes, social cohesion, and land use changes (Bakker and Hendriks 2019; da Silva et al. 2021; Hoffman 2008; Rosenberg et al. 1995). For Indigenous peoples, impacts can also include disruptions to their lands, rights, cultural and spiritual practices, and livelihoods (Baid et al. 2021; Bakker and Hendriks 2019; Hanna et al. 2016; Hoffman 2008). Canada is highly dependent on hydroelectricity with substantial expansion following the Second World War (Cohn et al. 2020). Development is geographically concentrated along the St Lawrence valley of Ontario and Quebec, and in clusters within western provinces such as Manitoba and BC. In Manitoba and BC, where this study is focused, hydroelectric facilities have been in operation for well over 50 years and in close proximity to urban and rural communities and Indigenous territories. This long development history, continued operation of historical facilities, and continuing expansion in both of these provinces provides an ideal context for examining cumulative social effects. Manitoba and BC have different EA regimes and approaches to CEA and social impacts. We focus on specific regions in each province where cumulative effects have emerged as a key issue across recent EAs. These regions are described below.

**Northern Manitoba**

About 97% of the electricity produced in Manitoba is drawn from 15 hydroelectric generating stations run by the crown (government owned) corporation Manitoba Hydro (Manitoba Hydro 2018). The generating capacity in the northern Nelson, Burntwood and Churchill River system accounts for over 70% of the province’s total hydroelectric capacity (Manitoba Hydro 2018). Hydroelectric development in northern Manitoba began in the early 1960s with construction of the Kelsey generating station in the Nelson river (Clean Environment Commission 2018). Development expanded rapidly for the next four decades including the construction of Kettle, Jenpeg, Long Spruce, and Limestone generating stations, the Radisson and Henday converter stations, the construction of Bipole I and Bipole II transmission lines, and the diversion of the Churchill River into the Nelson River to augment flow for future development (CEC 2018). In 1988 the Environment Act of Manitoba was passed which mandates the current EA process. Under this Act EAs are facilitated by the provincial Department of Conservation, and an arms-reach provincial government agency, the Clean Environment Commission (CEC), conducts public hearings and generates EA reports. Hydroelectric projects may also trigger a review by the Manitoba Public Utilities Board, and Canadian government bodies under federal EA legislation. The first project to be subject to EA review under the Environment Act was the Wusk-watim generating station and transmission line (2004).

Cumulative social effects have become one of the most pressing and contentious issues for hydroelectric EAs in northern Manitoba, owing in part to substantial flooding and changes to flow regimes, community relocation and displacement, loss of traditional lands and resources, and further entrenchment of health and socioeconomic inequities (CEC 2018). Under Manitoba’s Environment Act there is no formal legislative requirement to undertake CEA during an EA. Further, assessments of social, economic, and cultural effects are required only so far as they are directly caused by an environmental effect. Despite no formal requirement or guidance at the provincial level, discussions about cumulative impacts have been extensive in hearings for project reviews, and have been the subject of a Government of Manitoba and Manitoba Hydro regional cumulative effects study for northern Manitoba (2015) and a subsequent CEC public hearing (2018). This attention to cumulative impacts has been fueled by the expectations and subsequent CEC public hearing (2018). This attention to cumulative impacts has been fueled by the expectations and the information brought forward by interveners, Indigenous governments, and other public stakeholders, requirements at the federal level, and also the efforts of the CEC to respond to these concerns and to draw on existing research and national CEA best practices.

The CEC has repetitively called for regulation, regional assessments, and critiqued Manitoba Hydro’s approach to cumulative effects, and cumulative social effects specifically. In their review of the Bipole III Transmission Line the CEC expressed disappointment with the quality of the CEA and stated: “…the Commission finds it simply inconceivable—given the 50-plus-year history of Manitoba Hydro development in northern Manitoba and given that at least 35 Manitoba Hydro projects have been constructed in the north in that time—that there are few, if any, cumulative effects identified in this [Environmental Impact Statement]” (2013, 112). In response to the cumulative effects study completed by Manitoba Hydro and the Government of Manitoba (2015), the CEC critiqued the lack of engagement.
and the reliance on existing data and a retrospective analysis, and questioned its effectiveness as an assessment since it did not include an evaluation of how hydroelectric development has contributed to, created, or exacerbated cumulative social effects (CEC 2018, 70).

**British Columbia’s Peace River and Columbia River**

Hydroelectric development has occurred throughout BC since the end of the Second World War (Peyton 2017). Over 90% of the province’s electricity is derived from the 31 generating stations operated by the crown corporation BC Hydro (BC Hydro 2019a). BC Hydro was created in the 1960s to implement the provincial “Two Rivers Policy” aimed at capitalizing on the potential of the Peace River and Columbia River and increasing industrial growth and provincial energy autonomy (Peyton 2017). The Peace Region and the Columbia River Region provide about 30% and about 50% of BC Hydro’s total capacity respectively (BC Hydro 2019a).

The Peace Region has two major hydroelectric facilities. The W.A.C. Bennet dam was completed in 1968 along with the GM Shrum Generating Station and it remains the largest dam on the Peace River (BC Hydro 2019a). The construction of the Peace Canyon Dam and Generating Station followed in 1980 (BC Hydro 2019a). A third facility on the Peace River, the Site C project, will be the first large scale hydroelectric project in the region since the 1980s. Site C was required to undergo a joint federal and provincial EA by an independent review panel and the report was issued in 2014 along with conditions for approval. Site C is among the most expensive infrastructure projects undertaken in the province of BC and though construction has begun, there has been ongoing debate about social and economic impacts and benefits (Bakker and Hendriks 2019), and a number of legal challenges including the precedent setting Yahey v. British Columbia 2021 which affirms that Treaty 8 rights of the Blueberry River First Nation have been infringed on by the cumulative effects of industrial development.

In the Columbia River region early development was supported by the Columbia River Treaty, a transboundary water management agreement between Canada and the United States. There are four major hydroelectric dams which were built before 1985: the Mica Generating Station (1973); the Kootenay Canal Generating Station (1976); Seven Mile Generating Station (1979); and the Revelstoke Generating Station (1984) (BC Hydro 2019b). There are also two water storage dams which do not generate power but were constructed as part of the Columbia River Treaty, and seven smaller hydroelectric dams within the region. Recent provincial EA reviews have concerned capacity expansions to the Revelstoke Generating Station and the Mica Generating Stations. These expansions do not alter the operating regime, or relative footprint of the facility, but within the EAs cumulative effects were a focal point due to the concerns of Indigenous governments and public stakeholders about the social and environmental implications of development and the legacy of the hydroelectric industry along the Columbia River.

Under BC’s Environmental Assessment Act (2002; 2018), EAs are coordinated by the provincial Environmental Assessment Office. There are explicit requirements to include CEA and guidance is available specifically outlining the approach to CEA for BC led EAs (BC Environmental Assessment Office 2016). The development of the updated 2018 Act and guidance was shaped in part by the federal Impact Assessment Act 2019 which expanded the expectations to include human impacts such as social, economic, cultural, gendered impacts and Indigenous rights (BC Environmental Assessment Office 2016). Hydroelectric projects may also trigger reviews by the BC Utilities Commission and the Canadian government under federal EA legislation. Cumulative social effects have become an important focus of EAs for hydroelectric developments in the Peace and Columbia regions due in part to the legacy of large scale facilities that were brought into operation prior to the implementation of modern EAs.

**Data Collection**

Twenty-five semi-structured interviews were conducted with people who are directly involved in EA processes. Interview questions were designed to investigate: (1) the process for assessing cumulative social effects, including how impacts are identified, the scope of the assessment, impact evaluation, decision-making, and follow up and (2) the regulatory and professional capacity required to complete such an assessment. This paper is focused on an analysis of the questions and responses related to the process for assessing cumulative social effects and identifies where such impacts are presenting challenges for current practice.

The goal of the interviews was not to explore what social impacts exist or people’s experiences with them, but rather the process and how these impacts are assessed during EA. Therefore, it was important to examine practitioner experience and to target interviewees who have been involved in recent EAs for hydroelectric facilities in a professional capacity. Potential interviewees were identified through public websites, by reviewing contributions to EA reports, and with the help of key informants in each province. Preliminary meetings were completed with key informants to discuss the scope of the interviews and identify potential interviewees. Interviewees included people serving on regulatory review boards and government offices, employees of proponents (Manitoba Hydro and BC Hydro), Indigenous
government employees and their consultants, independent consultants, and academic researchers who have served as experts and interveners during EAs (Table 1). Some interviewees had worked in both provinces, and provided responses for both study regions. As noted above, the focus of the interview questions was obtaining a professional and organizational level perspective on the process for assessing cumulative social effects, rather than an exploration of individual experiences or perspectives. Therefore the goal in selecting interviewees was not to achieve saturation within proponent, government, or other organizations, but rather to select individuals who could act as representatives and provide insight into EA practices. In some cases, the interviewee was not a single individual, but a team or group of people working within an organization or government body who reviewed the questions together and provided responses.

The semi-structured approach allows examination of specific challenges and practices for cumulative social effects and the process during EA, while also providing interviewees the opportunity to raise additional information and contribute their professional insight and experiences. Interviewees were provided project information and the interview questions in advance, and were given the option to submit additional written feedback and documents. Due to the COVID-19 pandemic all interviews were completed via video conference or phone, and ranged from 1–2 h in length. Interviews were audio recorded (with permission), and transcribed with identifying information removed.

Qualitative coding was completed by the lead author to identify key emergent themes using NVivo Qualitative Analysis Software. Descriptive codes included interviewee occupation and role in EA. Analytic coding was used to refine information into categories and develop themes. Given the range of interviewees across proponent, governments, regulatory bodies, consulting organizations, and Indigenous governments, their professional perspectives and experience with cumulative social effects varied. The coding process focused on identifying key patterns, differences, and challenges in terms of the way each approaches the CEA process. A number of key analytic themes/categories guided the initial coding that align with the basic steps of the CEA process. These included the way that cumulative effects and cumulative social effects are defined and identified, spatial and temporal scoping decisions, impact analysis including the information and methods relied on, and key challenges for decision-making, EA outcomes, and follow-up.

## Results

As previously noted, the regulatory and political context for EA and CEA in BC and Manitoba differ, yet interviewees in both settings agreed that CEA is a challenging and inconsistent piece of EA, and that there are many different understandings of the concept of cumulative impacts amongst the parties involved in EA processes such as proponents, regulators, interveners, Indigenous governments. Interviewees also consistently identified that cumulative social effects are even more challenging, and even less understood, less supported by guidance, and less consistently attended to during EA than cumulative environmental effects. Additional complicating factors exist in respect to applying the typical CEA process to social impacts. Table 2 displays key CEA steps and associated challenges for cumulative social effects that were identified in the interviews. These challenges and how they have manifested in practice are discussed in the following sections.

### Scoping: Identifying Social Cumulative Effects

A key challenge for cumulative effects is defining them and identifying the issues that should be included within the scope of an assessment. Foundational to CEA in both regions is the identification of valued components (VCs) of the environment which are ecologically, socially, and/or culturally important and might be impacted by the proposed project. Interviewees were divided in their support for the VC concept and its effective application for CEA. Some described VCs as vital for providing focus and prompting detailed assessment on the components of the environment which are ecologically and socially important. Others noted that the VC approach results in a siloed assessment and presents a fundamental barrier to an assessment that is integrated or inclusive of the human and biophysical environments and the relationships between them. Indigenous interviewees and

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**Table 1 Interviews by province and occupation/role**

| Role and Province                  | British Columbia | Manitoba | Canada |
|------------------------------------|-----------------|----------|--------|
| Regulators and government offices  | 2               | 3        | 1      |
| Proponents                         | 1               | 2        |        |
| Indigenous governments and consultants working on their behalf | 3             | 6        |        |
| Interveners                        | 1               | 4        |        |
| Consultants                        | 4               | 1        |        |

*Total number of interviews was 25 but some interviewees provided responses for both provinces.*
consultants to Indigenous nations also noted that the VC concept sometimes does not resonate with Indigenous perspectives. As described by one consultant: “Whenever you talk about [VCs] to most people in communities they are like what are you crazy, everything is interconnected…so it is a struggle.” Many interviewees described difficulty in achieving meaningful consultation around VC identification for CEA since it requires Indigenous peoples to translate and integrate their perspectives into a western scientific ideology. As noted by a consultant reflecting on work in northern Manitoba:

[for cumulative effects] when it came to try to create a list or to try to decide what is most important, the community had nothing to say, it didn’t resonate and we couldn’t generate a dialogue. Then when we got to the workshops where these big consulting teams were coming together and trying to make the VCs list, the communities didn’t have much to say. So the list ended up being kind of broad, and in the consulting teams perspective, a western perspective, and those were the ones that went ahead.

Regardless of their support or opposition for a VC based CEA, interviewees consistently noted significant additional challenges with identifying VCs on which to base the assessment of the social environment, and that in practice there has been an oversimplification of social impacts and misalignment between the formal scope of the CEA process, and the range of social impacts which are most important to people affected by hydroelectric development. The analysis of interviews revealed three interrelated dimensions of cumulative social effects. First, are those changes to social systems and community infrastructure

### Table 2 Challenges identified for cumulative social effects

| Key CEA action | Challenges and complicating factors for social cumulative effects |
|----------------|---------------------------------------------------------------|
| Scoping: identifying valued components (VCs) with potential cumulative effects | • Uncertainty in how to define cumulative social effects  
• VC approach may result in a siloed assessment  
• VC approach may present barriers to consultation and engagement  
• Human experience dimensions of cumulative social effects are ignored |
| Identifying spatial scales | • Establishing socially significant spatial scales  
• Understanding the local and the regional lens |
| Identifying temporal scales and retrospective analysis | • Establishing social thresholds or benchmarks  
• Understanding historical impacts and conditions contributing to baseline  
• Determining a project’s relationship to impact legacy and existing social conditions |
| Impact prediction and evaluation | • Interpreting available information about social systems  
• Assigning project attribution for cumulative social effects |
| Follow-up | • Identifying meaningful and culturally specific mitigation  
• Ongoing follow-up for social impacts  
• Establishing compliance targets for social components  
• Ensuring projects meet their social objectives |

![Fig. 1 Conceptual framework for cumulative social effects of projects](image-url)

which are directly caused by project activities. This might include temporary or permanent population increases, or strain on community facilities. Second are social impacts directly linked biophysical changes, such as impacts to hunting or harvesting as a result of flooding or changes to key species habitat. Interviewees identified that EA processes tend to focus on these social impacts which are directly caused or exacerbated by a biophysical change or by project activities, but interviewees also described the importance of understanding a third dimension of social change, one that is embedded in human experience. In order to understand social impacts, it is essential to understand how people experience those impacts. This conceptual framework for understanding cumulative social effects is presented in Fig. 1.

One example illustrating this framework provided by a BC consultant is traditional resource use such as hunting
and harvest activities. This is a VC with a clear biophysical pathway; if the project impacts key habitat and the availability of key species, the ability to engage in hunting and harvesting activities is impacted. The assessment of traditional resource use is often based on whether key species are available and whether hunting and harvest locations are accessible, but this reliance on the availability of ecological resources does not capture the reality of the impact or the nature of the VC:

Traditional resource use. It is a human activity, the choice of whether to go out and harvest...It relies on biophysical resources to be there, but it relies on so many other things. It relies on having a quiet place to do this, having a well-known location that isn’t flooded, having a perception of risk that doesn’t suggest that your boat might be lost because the level of water has reduced by two feet over several hours and you don’t know where the rocks are, it relies on a sense that the country food that you are going to get is not contaminated by mercury...So getting past the biophysical proxy for what is very much a human choice and a human decision within perceived and real constraints, is a real problem with human CEA.

Interviewees described a reluctance to allow for the possibility of complex pathways between biophysical impacts and social systems, or to recognize that impacts are perceived and experienced and occur within a social context. These “intangible” experience-based dimensions are difficult to categorize, measure, or quantify, but were repetitively emphasized as among the most important issues confronting CEA and project reviews. EAs focus on the physical changes which may be caused by the project, but do not necessarily capture the way that those changes manifest within human systems and create or exacerbate social and cultural changes.

Spatial Scale

Interview data suggest that the implications of spatial extent for cumulative social effects present a similar set of considerations as those for cumulative biophysical effects. Interviewees in both provinces highlighted the need for regional level assessment for cumulative social effects noting that the piecemeal approach of identifying, evaluating, and mitigating social impacts and issues within the confines of each individual project obscures the cumulative effect. For example, interviewees from Manitoba highlighted a key disconnect between the reality that the network of hydroelectric developments in the north is often referred to as an “integrated system”, and is intended to function as such, but that each EA is an independent and project-focused assessment. In addition, interviewees noted the practice of splitting large undertakings into multiple EAs. An intervener stated: “…they brag about how it is this integrated system, but when they want to do an assessment they very narrowly look at what areas are being flooded.” Another similarly noted, “…they talk about it as an integrated system, but they never want to see an EA of the integrated system.” A regional CEA study completed by Manitoba Hydro and the Government of Manitoba (2015) was intended to fill this need, though most interviewees were critical about its effectiveness as an assessment since no new data was gathered, no additional community or Indigenous engagement was completed, and no specific analysis was made on how hydroelectric development contributed to, created, or exacerbated cumulative social effects (see also CEC 2018, 70).

Similar challenges were noted in BC where hydroelectric facilities are operating alongside other industries and impacts. In the Peace and Columbia River regions, there are multiple development pressures from hydroelectric facilities, extensive oil and gas development, forestry, agriculture and land use change. A regional perspective is in many ways necessary in order to understand the environmental and social pressures. A consultant reflected: “what we should be doing from a policy perspective is looking at a whole range of things that we are doing on the landscape. If we keep hanging this onto projects we will continue to fail.”

At the same time, interviewees in both provinces emphasized the importance of examining social change at a local scale, and understanding human impacts within a local community and cultural context. Cumulative social effects may manifest differently at local and regional scales, and impacts and benefits may be distributed differently across and within local and regional populations. For both provinces, the hydroelectric industry is an important economic driver, but the social and economic benefits and might primarily occur on the provincial scale, and the most significant social and economic impacts might be felt at a local level. There may be multiple appropriate spatial scales for any one social component or indicator that influence impact direction and significance, and the methods for identifying these scales and evaluating impacts are less developed for cumulative social effects.

Temporal Scale

A fundamental question that emerged in all interviews is: how far back in time should we examine social change? As stated by a proponent intervener: “the challenge with CEA is where do you start measuring the cumulative effects from? What do you pick as your starting point?” A CEA relies on establishing the current condition of VCs, including an understanding of historical changes in
CEA should define its temporal scale and how an analysis of historical change should be approached. The points of tension between the different parties involved in EA appears to be related to: (1) what impacts and issues should be integrated within an understanding of the current condition; (2) the extent to which the impacts related to past projects/ actions are considered to be “in the past”; and (3) how a current project should be expected to engage with the legacy of the industry or the region in which it is proposed.

Some interviewees described that it is essentially impossible to establish an ideal baseline condition for some social components, and that comparison to pre-hydro conditions is not useful due to the myriad of factors influencing societies and communities over time. Early hydroelectric development was accompanied by many other political, economic, and social changes, extensive urban development, increasing populations, and the expansion of other industries. But, others highlighted that for most Indigenous communities and governments, any conversation about cumulative effects requires an understanding of conditions pre-development, or at the least a pre-hydroelectric development era. Interviewees from Indigenous governments and consultants were clear that even where there have been mitigation and compensation agreements, the impacts related to past actions continue to exist in the present, and must be part of the story of the current condition and any assessment of cumulative effects. The importance of this temporal perspective was similarly described by interveners and consultants across both provinces with one explaining, looking at things historically is really important. Recognizing this whole idea of historical trauma for example and we can’t separate things that occurred 50 years ago or 100 years ago...In terms of cumulative impacts, the combined impacts of residential schools of gendered violence and of hydro, it is like the rivers I was talking about, they all meet and they all work together and put people at risk.

But, ensuring this context and that the contemporary impact of past actions is recognized during EA has been a challenge. As described by an interviewee from and Indigenous government BC, “You have these big projects, typically they want to say the past is the past and we are moving forward. It is a new day.” In both provinces, there are significant facilities built during the 1960s, 1970s, and 1980s which did not undergo an EA or that were approved under a different EA regime and political and social context, but which remain in operation. There is a legacy of impacts of early hydroelectric projects and other developments, and also legacy of a lack of consultation, little recognition of Indigenous rights and culture, and an exclusion of Indigenous governments and communities from decision-making. A proponent interviewee explained that it is unclear the extent to which an individual project should be expected to engage with development legacy “…how much does a single project inherit the history of everything that has come before it, and how much is it responsible for that?”

Some interviewees also questioned the logic and the feasibility of responding to such legacy impacts within a project-focused assessment and noted a need for other forums to assess these impacts. For instance, a BC consultant spoke about an EA which was focused on the addition of turbine to the already operational Revelstoke Dam located on the Columbia River in BC. The cumulative effects issues that dominated the EA, were tied to the Revelstoke Dam itself rather than the turbine which was the focus of the EA process:

some of the things that were driven by public concern and cumulative effects, they were not added to cumulatively by the project itself...It would be difficult to find a project in the BC EA process that had smaller effects, but there were a lot of people who were concerned that the dam was there at all and they were manifesting that concern into a project process.

However, many interviewees also challenged the notion that legacy issues do not fit within the scope of an EA and instead emphasized that a meaningful CEA cannot be completed without this lens. As stated by a BC consultant:

You can’t do a CEA without confronting legacy issues. If there are legacy issues, if there are cumulative effects from hydro damming, to ask people that they be considered in an assessment but not subject to any sort of compensatory measures, because that is done at another table...that is completely unacceptable.

Further, interviewees from both provinces emphasized that for any hydroelectric project the responsibility for legacy impacts cannot be questioned since it is always the same proponent, a crown corporation, in both provinces.

These legacy impacts are often raised during EA regardless of whether a process has been scoped to include them. For example, interviewees from Manitoba all noted the challenging relationship between Manitoba Hydro and northern communities spanning over five decades. In practice, any conversation about social impacts inevitably become conversations about cumulative social effects. Discussions during EA is often focused on past projects as much as the current project: “…we wind up in hearing processes where that legacy really does come to the
forefront to debate and discussion. I would say that some of those hearings were as much about legacy in their process as it was about the current environmental assessment.”

Assessing Social Cumulative Effects

Interviewees agreed that assessing cumulative social effects requires a suite of quantitative and qualitative information and engagement with Indigenous communities and the public. Some interviewees identified data deficits for social impacts, particularly a lack of historical data, and noted that even census data is sparse for some key communities in both provinces. Interviewees also highlighted that there is a challenge in terms of inconsistency in data availability and monitoring for social components. However, as a whole the interviews suggest that while a lack of data is an important consideration, it is not the root of the challenge for assessing cumulative social effects. Two interrelated issues are of greater concern: (1) interpreting available data about social impacts, and (2) the current practice of framing of CEA around attribution and causality.

Interpretation

Interviewees from both provinces challenged the notion that a lack of data is a significant barrier to assessing cumulative social effects and emphasized that there is an extensive record and knowledge available for understanding social change. The challenge is that a technical and quantitative bias exists in EA, and there is an unwillingness or lack of understanding amongst those involved to effectively engage with the available information. A consultant from BC explained, “So if you are talking about challenges for gathering that social baseline they are actually more about will of government, industry, and consultants to do the work than about real challenges. An historian does not have a lot of challenges characterizing cumulative effects, why should an EA?”

However, the nature of social impacts does present a challenge for interpreting and making meaning of the available information. Two regulator interviewees noted, “it is a much harder process than dealing with biophysical data which is not totally mechanical, but it is a lot easier to manipulate and draw conclusions from; much of the social impact assessment is not amenable to quantitative analysis… so you rely on what the community says and how you weigh that is a real challenge.” There is a need to consistently integrate cumulative social effects into EA processes in reputable ways and where the compliance and mitigation measures are verifiable, but also to recognize that indicators and thresholds for social change must be informed and justified by the social context.

Impact attribution

CEA as it is applied within an EA requires the identification of the relative contribution of the project to cumulative impacts for each VC. In both provinces interviewees noted that social conditions have changed over time due to a number of factors such as municipal development, government policies, and other industries. Parsing out the relative contribution of the hydroelectric development under review is challenging, if not impossible. As explained by a proponent interviewee “looking at the province as a whole and trying to tease out what was hydro, versus, mining, forestry, road development, shifting economies…there was so much going on in the province, prior to, during, and after hydro development…assigning attribution can be incredibly difficult.” A consultant used the example of health impacts and outcomes: “Health and health outcomes. I think there is an attempt to use whatever measurable social indicators you can. Numbers of people that are suffering from addictions, you could look at that but it is hard to connect that to a particular project or a suite of projects.” Further, for many social impacts attributing a specific portion of cumulative effects to the project is essentially impossible. An illustrative example is gendered impacts. A key cumulative social impact that has arisen in EA reviews and cumulative effects studies in northern Manitoba has been sexual assault and violence toward women as a result of the establishment of construction camps for hydroelectric facilities and the influx of temporary workers. To think about establishing a current or a historical baseline for sexual assault and gendered violence, defining a base case and projecting future scenarios of risk with and without a project, defining a threshold, parsing out other activities or conditions that might influence risk, and finally tying the project under review in a robust way to a specific portion of the cumulative impact is perplexing. Even for those social changes where quantitative technical information might be more readily available, it is challenging to connect those changes to a particular project or industry. The challenge is that arguably there is no amount of data that could answer the questions that EA processes are asking about cumulative social effects.

CEA Outcomes

Key gaps exist in the attention paid to CEA outcomes including meaningful culturally specific mitigation, accommodation, and monitoring social impacts. Interviewees noted that attention to ongoing management is often lacking for social impacts to determine the effectiveness of mitigation and whether projects are delivering on their commitments and socioeconomic projections. As stated by an intervener from Manitoba: “I am so tired of us
investing all of this energy and money into the EA and not paying attention to the follow up and monitoring.” This was similarly noted by interviewees in BC with one consultant stating: “why we don’t require retrospective assessments for projects and the cumulative effects around them on a continual basis? If you have a 30, 50, 100 year project this just seems like the logical course of action.” In addition, follow-up and monitoring including compliance targets are skewed toward biophysical impacts, with little long-term attention paid to project social impacts and performance. A further issue many interviewees raised is the practice of omitting positive social impacts from the CEA, which often includes employment and economic benefits. There is typically no mechanism to identify or to apply consequences if a proponent fails to deliver predicted project benefits.

Attention to follow-up is particularly important to understand the effectiveness of mitigation measures and whether the predictions made during the assessment were realized. Interviewees identified a tension related to the need to consistently integrate cumulative social effects into EA processes in a way that is reputable and where the compliance and mitigation measures are verifiable, and the reality that the information about these impacts are often embedded in individual experiences, local nuance, and cultural context. As discussed by a proponent interviewee: “this is my headache is where the rubber hits the road is how to you define the conditions that addresses the impact that you are trying to mitigate and how do you define specifically and measurably the compliance points that you have to meet?” Another proponent interviewee noted similar concerns and emphasized the importance of adaptive management for social impacts and behavior: “With EA as well, it is a prediction right? Human behavior is in many ways unpredictable…you have to be prepared as a project is unfolding to respond to what is actually being experienced.” A consultant from BC similarly stated: “…social and economic conditions change so readily into the future, nothing is static…so socioeconomic management and monitoring programs for any residual impact has to be put into place, and that is I think where we have had a real shortcoming.”

**Discussion**

The results from our analysis of EA experience in BC and Manitoba illustrate that cumulative social effects are presenting a number of challenges to EA processes. Understanding cumulative effects is important at multiple assessment and decision-making levels, including during project EAs to ensure project decisions are reflective of broader impact contexts and management goals. Our results echo observations that social impacts have been a weak aspect of CEA and that there is little practical knowledge available (Johnson 2016; Loxton et al. 2013; Mitchell and Parkins 2011). This is despite the emergence of EA systems which specifically require attention to these impacts, such as in BC, and/or the evolution of the expectation to include these impacts due to their importance to those impacted by development, as is the case in Manitoba. An important note is that many of the challenges identified here are not unique to cumulative social effects. Challenges in applying CEA during EA including identifying cumulative effects, establishing spatial and temporal scales (Foley et al. 2017), ensuring consistency and availability of information (Cronmiller and Noble 2018; Noble et al. 2017), interpretation and significance determination (Arnold et al. 2019), and meaningful follow-up have also been identified for biophysical impacts and VCs. However, we find that these challenges are exacerbated and further complicated for cumulative social effects due to the complexity of human social systems, and the limited attention these impacts have received in research and during CEA processes.

Despite over four decades of focused research, CEA remains plagued by inconsistent applications, challenges in converting ambitions to practice, and even uncertainty in defining cumulative effects (Duinker et al. 2013; Johnson 2016). We observed that there are specific challenges around how the concept of cumulative social effects is defined and translated within CEA processes. Social impacts are often understood and assessed as physical shocks to biophysical or socioeconomic systems (Booth and Skelton 2011; da Silva et al. 2021; Noble et al. 2017), but interviewees showed that in practice there are multiple dimensions of social impacts at play related to physical and environmental changes associated with hydroelectric development, but also to human experience and perception. Human experience is often invisible to CEA processes that have been focused on environmental components that can be measured and quantified with available data.

There has been recognition within the CEA field that impacts on individuals and communities include tangible biophysical and social changes and their perception of what these changes mean in terms of personal values, culture, land use, local economies, and social well-being (Atlin and Gibson 2017; Franks et al. 2013; Halseth 2016). This understanding of social impacts has also long been recognized within SIA research where social impacts are defined not just as measurable social or demographic changes, but must be felt and experienced physically and/or perceptually at the level of individual, household, and/or community (Serje 2017; Slootweg et al. 2001; Vanclay 2002). Many have identified important cumulative social effects, argued for their inclusion in assessment, and advocated for a definition inclusive of human experience and which is culturally grounded, but few have contended with what this means for the framing and application of
CEA processes, including the information and evaluation criteria needed.

A practical challenge exists in that if cumulative effects are to be defined as having important dimensions beyond strictly measurable phenomenon and that are tied to human experience, how can such impacts be accounted for in a meaningful, fair, and accurate way during an EA? Our analysis emphasized that these issues and impacts are inevitably raised as part of an EA and CEA regardless of whether they fit within the formal scope. The important question is perhaps not whether human experience should be scoped out of CEA since this has often been unsuccessful, but instead how assessment processes can engage with these dimensions of impact. We do not advocate for an abandonment of established CEA processes or of a VC based assessment. Nor do we argue for a siloed assessment where ecological and social impacts and components are assessed completely independently. Rather, we note that established CEA processes are not be well suited to answering all questions about cumulative change. Social impacts present unique challenges, require specific methods and approaches, and cannot be fully captured using the same frameworks as cumulative environmental effects. We provide a conceptual framework for the cumulative social effects of projects that accounts for human experience dimensions. Importantly, there is knowledge and methods that could be drawn upon from other research fields to support further innovation such as social ecological systems, Indigenous ecology, social and health impact assessment, and gender-based analysis (Davies et al. 2018; Halseth 2016; Huang and London 2016; Krieg and Faber 2004; Loxton et al. 2013; Willsteed et al. 2018).

A further challenge is the need to understand such social impacts as cumulative over space and time. One of primary tensions in CEA practice has been the scale(s) at which CEA should be carried out and how it can fulfill its goal of contributing to management decisions. Recognition that CEA should extend beyond the limits of any single project has shifted philosophy and methodology toward regional and strategic level assessments. A focused effort on scaling up monitoring and analysis to ecologically significant boundaries, for instance the watershed scale, has helped to advance the technical and scientific capacities required to understand impacts over broad spatial and temporal scales (Ball et al. 2013; Dubé et al. 2013; Harker et al. 2021). While the consistent application of such regional and strategic approaches and effective “tiering” between levels of assessment remain a challenge (Chilima et al. 2017; White and Noble 2013), there is broad acceptance that for biophysical impacts and environmental components ecologically driven, and often regional, spatial scales are necessary for CEA.

The ideal scale of analysis for cumulative social effects has not been subject to the same degree of attention or consensus. While there is a body of research focused on strategies and methods to define ecological scales for CEA, there is much less on defining appropriate social scales for CEA and how to apply these scales during project assessments. The local lens is clearly important for understanding social impacts and for developing specific and meaningful mitigation for project impacts (Christensen and Krogman 2012). But, a regional perspective and strategic planning and investment in social benefits is also important (Atlin and Gibson 2017), and EA has often overlooked spatial impacts which cumulatively might impact human systems and Indigenous rights and title (Audino et al. 2019; Booth and Skelton 2011; Garvie and Shaw 2016). Our results suggest a need to further explore the implications of spatial scale for cumulative social effects, and to focus assessment approaches within local and regional contexts.

Our results also show that decisions about the temporal scale of assessments are critical for understanding cumulative social effects. A key question is the extent to which applications of CEA at the project level can, or should, engage with the legacy of an industry or development in a region. EA is a project-based processes occupied with the implications of a particular plan, but in the context of BC and Manitoba it is also inevitably managing a past and an impact legacy. It is clear that in both jurisdictions, and likely also in the broader Canadian context, this legacy of environmental and social impacts demands meaningful assessment processes, mitigation, planning forums, and reconciliation beyond the scope of any individual EA. In BC this need has been increasingly recognized and has resulted in regulatory changes to expand consideration of impacts on Indigenous peoples and their rights and to establish the basis for Indigenous led assessments (BC Environmental Assessment Office 2020).

Assessments of cumulative social effects during EA will require having conversations outside of EA about social systems, socioeconomic conditions, and inequities and their relationship to development activities. Until these needs are filled, EA will continue to serve as a proxy for these broad and complex issues which are beyond its scope and power to address, as has been observed in other international settings (Larsen et al. 2017). However, it is also important that EA is not divorced from these broader conversations or the social, political, and environmental context in which the project is proposed. An individual project’s relationship to the legacy of development in the region, and to what extent it is, or can be, equipped to engage with that legacy and the existing cumulative effects is a key question that demands further guidance for proponents and decision-makers. For the hydroelectric industry, which in BC and Manitoba is controlled by provincial crown corporations, the role of...
government in engaging with this legacy and facilitating these broader conversations is even more clear.

Another set of challenges is associated with impact measurement. There is an often critiqued assumption underpinning CEA that a lack of data is a key limiting factor in the ability to assess and make decisions about cumulative effects (Arnold et al. 2019; Bond et al. 2015; Hegmann and Yarranton 2011). We support calls for improvements in the consistency and availability of data for cumulative effects and social impacts specifically, particularly as jurisdictions such as BC expand their requirements. But, our results suggest that the core challenges for social impacts at the project level will not be addressed by improving the available data, and are instead related to the framing of the process itself. In both BC and Manitoba interviewees emphasized that there is diverse and extensive information available for understanding social change from a variety of sources, including numerous past EAs. The key social impacts are not unknown, but challenges exist in terms of developing the will and the capacity to interpret the available information and apply it across individual EAs.

Interviewees noted fundamental challenges with framing the assessment process around impact attribution. Impact attribution has proven difficult for cumulative environmental effects, such as those to aquatic systems (Cronmiller and Noble 2018) and our results suggest this may be even more challenging for impacts to social systems. The establishment of impact pathways, and evaluating project impacts on identified components is an important part of an EA. However, the expectations of CEA require understanding the relative contribution of the project impacts to adverse cumulative effects, and the extent to which that contribution is significant. For many social impacts that have been included in project EAs for hydroelectric developments and where a potential pathway has been acknowledged, such as gendered impacts and increased sexual violence, substance abuse, and mental health, this expectation is not productive. These are important impacts for EA and CEA decision-making (Koutouki et al. 2018), but are difficult to meaningfully include within the current framing of the assessment process.

We do not believe this indicates that we should stop asking questions about an individual project’s social impacts and utilizing a range of available methods to examine them, or that a proponent should take on exclusive responsibility for existing social issues. But, we do propose that clarity is needed around the data and information expectations for assessing impacts to social components, and that there are additional questions about cumulative social effects that should be asked at the project level. Insight may be borrowed from those who have advocated for sustainability and goal-oriented assessment framings (Atlin and Gibson 2017; Bond et al. 2012). Establishing a clearer understanding of the condition of important social components and identifying strategic objectives could facilitate conversations about the extent to which a project contributes toward more healthy human systems, in addition to the focus on determining the extent and significance of its impact. Cumulative effects management requires planning beyond any one EA process. EA should not be expected to establish strategic social objectives, but it should be expected to be informed by and align with them once they are identified, and the framing of CEA at the project level should be supportive of this.

There is an important related need to bolster follow up and management for social impacts. Follow-up and monitoring for cumulative effects have been characterized as limited, and is often focused on biophysical impacts and components (Cronmiller and Noble 2018; Lawe et al. 2005). The complex nature of social change and the uncertainty associated with prediction demands pointed attention to meaningful EA outcomes including context specific mitigation, monitoring, and adaptative management (Canter and Atkinson 2010; Lawe et al. 2005). Further, the relative importance often given to projected social benefits in weighing development decisions suggests a need for targeted follow-up and reflection on the extent to which these benefits are being achieved. Cumulative social effects follow-up is particularly relevant in settings like BC and Manitoba where there has been extensive hydroelectric development, the expansion of and many other industries, and where ongoing hydroelectric operation and future development is likely.

Conclusion

CEA remains inundated with challenges at the project EA level, and these issues are further complicated for cumulative social effects. Improving the process for identifying and assessing cumulative social effects requires substantial innovation in how CEA is approached at the project-level. Our recommendations include adopting a conceptual definition and framework for cumulative social effects that includes human experience dimensions and developing specific guidance for cumulative social effects to apply during EAs. We also propose that improving understanding local and regional social contexts, contending with how legacy impacts can be meaningfully included, and clarity around CEA outcomes and expectations must be priorities for developing this guidance and approaches for social CEA. Finally, the practice of framing CEA around project attribution has been ineffective and creates an impossible expectation for important social impacts that has limited meaningful evaluation and discussion during EA. Attention must shift to improving understandings of social baselines,
and identifying social objectives and goals in addition to potential impacts, to support proactive discussions about cumulative social effects and their management.

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

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