Looking Up, Down, and Sideways: Reconceiving Cumulative Effects Assessment as a Mindset

A. John Sinclair, Meinhard Doelle and Peter N. Duinker

Abstract

Despite all the effort that has gone into defining, researching and establishing best practices for cumulative effects assessment (CEA), understanding remains weak and practice wanting. At one extreme of implementation, CEA can be described as merely an irritant to the completion of a project-specific environmental assessment (EA). At the other extreme, the conceptual view is that all effects in EA should be deemed cumulative unless demonstrated otherwise. Our purpose here is to consider how we might reconceive CEA as a mindset that is at the heart of absolutely every assessment of valued ecosystem component (VEC) to ensure that we understand the relative contributions of various stressors and can decide when cumulative effects may foreclose future activities due to impacts on VECs. Conceptually, we ground the CEA mindset in the context of three lenses that must all be functioning and working together for the mindset to be operative: a technical lens; a law and policy lens; and a participatory lens. Our arguments are based on a review of the CEA, strategic effects assessment (SEA) and regional effects assessment literatures, an examination and consideration of Canadian EA and SEA case practice, and our combined professional experiences. Through using the Bay of Fundy in Canada as a case example, we establish the concept of the CEA mindset and an approach for moving forward with implementation.

Keywords: cumulative effects assessment; valued ecosystem components; cumulative effect; strategic effects assessment; regional effects assessment; Canada

Electronic copy available at: http://ssrn.com/abstract=2774579

Introduction

Over the last twenty-five years, considerable attention has been given to cumulative effects assessment (CEA) by practitioners, academics, and legislators. Therivel and Ross (2007: 366) establish that "CEA has been required as part of many countries' project Environmental Assessment (and latterly also Strategic Effects Assessment) systems for years, and is supported by a range of guidance internationally" (e.g., Canadian Environmental Assessment Agency (CEAA), 2013a; Hegmann et al., 1999; Court et al., 1994; European Commission, 1999; Office of the Deputy Prime Minister (ODPM), 2005a, 2005b; Canter & Ross 2010; US Council on Environmental Quality, 1997). Duinker et al. (2013), in a review of over a hundred scholarly publications and agency documents, further establish that such requirements, definitions, and frameworks for implementing CEA in these countries has only increased in abundance in the time since Therivel and Ross did their research. Yet, despite all this effort, CEA understanding remains weak, practice wanting and progress slow (Duinker & Greig, 2006; Harriman & Noble, 2008; Canter & Ross, 2010; Hegmann & Yarranton, 2011; Lawrence, 2013; Duinker et al., 2013).

At one extreme of implementation, CEA can be described as merely an irritant to the completion of a project-specific environmental assessment (EA). In this view, cumulative effects are 'assessed' as a purely legal obligation without practical merit, and the results recorded in a separate chapter - usually short - of the environmental impact statement (EIS). Invariably, the conclusion is that, if any cumulative effects at all are expected, they will be insignificant and therefore ignorable (Duinker, 2013). The Whites Point Quarry and Marine Terminal project EA in Nova Scotia (Bilcon of Nova Scotia Ltd., 2006) and the Marathon PGM-Cu Project in Ontario (Stillwater Canada Inc., 2012) are both good examples of this type of thinking regarding CEA among the many we could have noted. In stating this we recognize that there is a continuum of CEA practice and that some authors have noted that certain aspects of good CEA have been present in a limited number of cases, such as the Cheviot Mine EA (Creasey and Ross 2009). Once assessors enter the underworld of cumulative

Electronic copy available at: http://ssrn.com/abstract=2774579

effects, they most often exit as quickly as possible, hoping that others (e.g., EIS reviewers and decision-makers) will sympathize with their unease and agree that cumulative effects are just too difficult to grapple with in a meaningful way.

At the other extreme, the conceptual view is that all effects in EA should be deemed cumulative unless demonstrated otherwise (Duinker & Greig, 2006). CEA becomes a mindset that guides all facets of EA (Duinker, 1994; Ross, 1994). Any attention to project-specific effects is immediately contextualized in terms of other anthropogenic stresses on the chosen valued ecosystem components (VECs). The focus is on VEC sustainability and the degree to which the human actions under assessment compromise that sustainability (Duinker & Greig, 2006). This supports the Therivel & Ross (2007, p. 365) finding that "CEA helps to link the different scales of EA in that it focuses on how a given receptor is affected by the totality of plans, projects and activities, rather than on the effects of a particular plan or project."

Our conception of CEA arises from the sustainability imperative, particularly ecological sustainability (Norton, 2005; Gibson et al., 2005; Greig & Duinker, 2011). This means that the focus of CEA should be on the condition of those elements of the biophysical environment that matter to us - in EA, these are called VECs (Beanlands & Duinker, 1983). The starting place, then, is that ecosystems and their components must be kept in good condition if proposed human activities that interact with such ecosystems and their components are to be sustainable. We plan, assess, evaluate, study, examine, and otherwise pay attention to VECs and their condition as we contemplate whether to undertake specific human activities.

Our resulting conception of cumulative effects is that they arise when two or more stimuli (or agents of change, or stressors, or causes) act together to influence the condition of a VEC. For example, a fish population in a river might be simultaneously affected by waterflow regulation, industrial water pollution, and fishing. Natural processes must be considered too; for example, a big hurricane could cause major flooding of the river in question. This view of cumulative effect is consistent with the

definition recently published by the Canadian Council of Ministers of the Environment (CCME) (2014): "cumulative effect is a change in the environment caused by multiple interactions among human activities and natural processes that accumulate across space and time". Based on these conceptions of cumulative effect, it seems reasonable to enter an EA process assuming that all effects of the human activities being assessed are cumulative.

To improve our collective ability to address cumulative effects satisfactorily, we argue that the impact-assessment community needs both sound CEA processes and adoption of a CEA mindset. The scholarly literature and the guidance materials on CEA abound with descriptions of CEA processes (see Duinker et al., 2013 for a selective review). While these can certainly be tweaked and improved, our stance is that the community of impact-assessment practitioners has not yet adopted a CEA mindset. Adopting a CEA mindset means that CEA should be at the heart of absolutely every assessment of VEC condition as influenced by human activity to ensure that we understand the relative contributions of various stressors and can decide when cumulative effects may foreclose future activities due to impacts on VECs (or require mitigation to make room for additional activities). Our purpose is to describe and conceptualize a CEA mindset through describing and applying three critical lenses that focus the mindset. In doing so, we outline an approach to supporting VEC sustainability that recognizes CEA not as a matter of elite practice or preference if we had the time and money, but rather as the only way to begin to understand how to adjust human activities for a sustainable future. For example, in predicting potential impacts of increased tidal power development on a harvested fish species in Canada's Bay of Fundy, application of a CEA mindset might reveal that the sustainability of a fish species is rather far more dependent on harvest mortality than on the mortality from tidal turbines.

Our arguments are based on a review of the CEA, SEA and regional effects assessment (REA) literatures, an examination and consideration of Canadian EA and SEA case practice, and our combined professional and academic involvement and

experiences over the past three decades in EA, SEA and CEA implementation. This includes years of experience researching EA process and the place of CEA in it, participating in EA processes, advising EA review panels, being members of EA review panels, writing guidance material for EA, CEA, public participation, etc. and engaging in consultations around the reform of EA law in various jurisdictions. In this paper, we first provide an explanation of what we mean by a CEA mindset. We then present case materials, drawn from Bay of Fundy initiatives, to demonstrate the state of affairs with respect to applications of CEA thinking. Finally, we propose an approach for reforming EA processes and broader environmental decision-making so that a CEA mindset might be fostered, adopted, cultured, nurtured, and implemented.

In modeling the CEA mindset, we define project-level EA as assessment of a single and specific proposed human endeavor of a physical nature (see, for example, the definition of a project under the Canadian Environmental Assessment Act, and Doelle 2008). This makes project EA distinct from REA through its focus on a specific undertaking and distinct from SEA through its focus on a physical human activity. All EAs carried out under Canadian Environmental Assessment Act (CEAA) and most EAs carried out under provincial legislation in Canada would meet our definition of project EA.

Drawing on the broad and often conflicting SEA literature (e.g., Connelly 2011; Lawrence 2003; 2013; Gunn and Noble 2009a) we define SEA as an umbrella for any EAs that go beyond traditional single-project EAs, but that focus on a collection of individual projects (e.g., Fisher 2007; Gibson 2010). For this paper, an SEA goes beyond individual projects, but it does not necessarily consider all human activities within a given region. An SEA can involve a specific industry sector or a number of industry sectors (Harriman & Noble, 2008). If it is limited to one industry sector, it is closer to a project EA. As it approaches a full consideration of all human activities within the study area, it begins to resemble an REA (as defined below). SEAs can also be initiated to consider a proposed policy, plan or program, to fill a policy gap,

or to respond to new understanding of how human activities interact with the natural world. The EAs carried out under the federal cabinet directive (Government of Canada 2004) for SEA in Canada would meet our definition of SEA. The Fundy Tidal Energy SEA carried out in Nova Scotia would also meet our definition of SEA (Doelle 2009; OEER Association 2008).

The term REA has also been used in many contexts, creating confusion in the literature and among practitioners alike (e.g., CCME 2009; Dube 2003; Gunn and Noble 2009b; Horvath et al. 2004). For us, an REA is as an EA whose primary or sole defining feature is its regional scope and its focus on understanding the interactions between human activities and the natural world. This means that in just about all aspects other than its spatial limitations, an REA should be comprehensive and integrated. This also means that processes such as regional integrated planning and integrated management processes are forms of REA.

Our approach also recognizes that several other environmental planning and resource management activities are relevant to the CEA mindset and should be considered in the context of project EA, SEA, and REA activities. Examples include recovery plans for species at risk that identify actions that must be taken in an attempt to ensure a species' survival and resource management plans that guide the uses of natural resources such as those developed for forest management or watersheds. So, for example, species at risk (see, for example, www.sararegistry.gc.ca) are by definition VECs and the cumulative impact of human activity on them should be an ongoing consideration of a recovery management process. Similarly, watershed planning, implemented to varying degrees across Canada, is aimed at protecting components of a regional ecosystem to maintain the quality and quantity of water available.

Modelling the CEA Rethink - The CEA Mindset

In the context of cumulative effects, a mindset would mean adopting the assumption in all environment and resource decision processes that every interaction between a human action and a VEC is characterized by cumulative effects unless demonstrated convincingly otherwise. So, in project EA, once there is a reasonable suspicion that the project may interact with a particular VEC, attention shifts immediately to understanding the sustainability of the VEC and examining all the stressors – human and natural – that may compromise that sustainability. The CEA mindset abandons the notion of looking first at the detailed nature of interactions between the project and the VEC and ignoring potential cumulative effects if those interactions are not expected to result in significant impacts, as is now commonly the case. The CEA mindset acknowledges that sources of stress, including the project at hand, can combine in ways that may bring undue compromise to VEC sustainability, ways that are masked or missed in any search for impacts of individual stressors on the VEC.

Conceptually, we ground the CEA mindset in the context of three lenses that one must always be thinking about in relation to CEA and that must all be functioning and working together for the mindset to be operative: a technical lens; a law and policy lens; and a participatory lens. The technical and participatory lenses line up well with Cashmore's (2004) analysis of the EIA process (his terms were "applied science" and "civic science", the latter implying stakeholder involvement), but we have added the law and policy lens because most EIA processes, and thus CEAs, need to operate in a proper legislative context to be effective. As Figure 1 establishes, we envision an interaction among the lenses and have identified key elements that capture the focus of each lens in the context of the CEA mindset. Each of the key elements associated with the lenses is described in detail below.

The Technical Lens

The technical lens is critical to the mindset as it represents the necessity of creating reliable, incisive scientific understanding of causes and effects in the search for insight about VEC sustainability in the future. Indeed, the technical domain has often been the sole focus of the CEA work to date (Duinker et al., 2013). The essential

elements of the technical lens for instigating the CEA mindset include:

- Scoping: selection of VECs and indicators of their state or condition and search for driving forces – both human activities and natural drivers – that influence each VEC;
- Analysis: modelling of the relationships between the driving forces and the VECs, and also between/among the driving forces themselves; creation of alternative, not-impossible scenarios for the full cadre of driving forces; impact prediction for each VEC under each driving-forces scenario;
- Mitigation and Evaluation: interpretation of the significance of the predicted impacts; if predicted impacts are deemed unacceptable, search for interventions (mitigation measures) that can lessen undesirable impacts to acceptable levels;
- Follow-up: if specific human activities (e.g., projects, undertakings) are approved and implemented, design and implement monitoring protocols to verify whether the predicted changes in VEC condition actually occur; feed the new information into ongoing processes of adaptive management.

When EA is applied to one discrete project or undertaking, the exercise of CEA becomes one of discerning the potential impacts of the project on selected VECs in the context of potential impacts of a range of other human activities and natural drivers. As noted, as soon as a potential interaction between the project under assessment and the chosen VECs is identified, the CEA mindset calls upon analysts and other EA participants to shift thinking immediately beyond only those interactions toward how all the major drivers influencing the VECs may alter their state or condition in the future. This aspect of CEA may be at odds with legal and practical dimensions of project EA in relation to what is reasonable to expect of a project proponent when it comes to specifying, or even imagining, future human activities in the temporal and spatial vicinity of the project under assessment. Contemporary practice of CEA has been, for example, heavily criticized for the narrow frame of reference used for future human activities (e.g., Duinker and Greig,

2006). When CEA is applied in REA or SEA, the full range of current and possible future human activities that may impinge on selected VECs needs to be assessed in terms of cumulative effects. The CEA mindset then draws particular attention to thresholds of stress on VECs (Duinker et al., 2013) and the carrying capacity of ecosystems to bear intensified human activity.

The Law and Policy Lens

The law and policy lens is critical to ensuring that the required CEA work is done. It identifies what should be required in terms of law, policy, regulation, and guidance and thereby establishes the basic requirements of a CEA. The essential elements of the law and policy lens for instigating the CEA mindset requires assessment legislation that includes:

- Integration of REA and SEA into EA legislation: clear process requirements for REA and SEA, including the need to establish and apply CEA that incorporate future development scenarios;
- Integration of CEA into project decisions: establish how the results of the CEA work done during REA and SEA are to be integrated into project EA and ultimately into follow-up decision making at the project level in a manner that embraces the CEA mindset;
- Allocation of responsibility for the information needs of CEA;
- Provision for filling information gaps: clear rules on how to fill information gaps where project EAs take place in the absence of REAs and SEAs; and,
- Assurances of the right of the public to be engaged meaningfully in CEA throughout the various processes.

Given the evolution of EA, and a continuing focus on project EA, it is perhaps appropriate to first consider this level of assessment through the law and policy lens. Currently, project EA legislation in Canada either does not require the consideration of cumulative effects, or it offers limited guidance on how CEA is to be carried out (Doelle 2008; Connelly 2011). Where there is guidance, such as in CEAA,

the obligation to carry out CEA tends to be placed on the proponent through the EIS guidelines. As explored elsewhere (e.g., Duinker & Greig, 2006), in practice, this has generally fallen apart once the proponent is asked to make the transition from identifying the VECs potentially affected by its proposed activity to considering other existing or future influences on those VECs.

The ideal solution is that by the time the proponent is asked to carry out the CEA analysis on the VECs potentially affected, the work on other existing and possible future activities that interact with the VEC has already been done in the context of a combination of REAs, SEAs, Species at Risk Management (SARM) plans and Resources Management (RM) plans. Where this is the case, the project EA legislation needs to clearly set out how that information is to be used. Where this information is missing or incomplete, which will be the case for most project EAs under current conditions, EA legislation needs to offer clear guidance on how these gaps are to be filled in such a manner as to encourage the effective implementation of the CEA mindset.

A basic choice any legislation must resolve is whether to impose the duty to fill the gap about other existing and future influences and stresses on a VEC on the project proponent or not. With respect to existing activities, this is a question of access to information and resources necessary for CEA, and whether it should be the role of a proponent to assess the effects of activities in which it has no vested interest. With respect to other planned or proposed activities, and future development scenarios, it seems clear that project proponents will not be in the best position to provide this information. Project EA legislation therefore needs to create clear legal obligations for appropriate government agencies to fill these gaps. In addition, interested members of the public need to be given the time, resources and opportunity to feed into this process.

In short, project EA legislation needs to be carefully rethought so as to clearly allocate responsibilities in this transition from identifying VECs potentially affected

by a proposed project to the implementation of the CEA mindset. The key is to ensure that in any legislation each of the main actors is given appropriate powers, responsibility, and resources to fulfill their role in ensuring the implementation of the CEA mindset. It also requires attention to timing and sequencing.

If we expect the CEA mindset to permeate an EIS, for example, we need to think carefully about the role of government and the public in ensuring that the proponent has adequate information about other existing and planned future activities, and about future development scenarios. If we recognize that it is unrealistic and perhaps even inappropriate to ask proponents to gather information about future human activities that may interact with their own, and to develop future development scenarios, then the preparation of an EIS has to be a much more collaborative exercise, with clear responsibilities assigned to government, and with clear and meaningful opportunities for public engagement. Otherwise, we have to live with an EIS that will inevitably not embrace the CEA mindset, and are left to introduce the CEA mindset in the post-EIS phase of the EA. This latter approach has failed to date, but it is conceivable that project EA legislation could establish a set of responsibilities after the preparation of the EIS that is designed to bring in the CEA mindset. We favour the former because it is more consistent with our basic point that CEA is a mindset throughout. The risk with the latter approach is that CEA remains an afterthought.

Considering SARM and RM through the law and policy lens, it is critical that project EA legislation clearly sets out the role of these processes in project EAs, and that it clarifies how the project EA process will strive to ensure that SARM plans and RM plans are updated as needed. Ideally, SARMs and RMs will serve as critical sources of information about the state of a VEC, its resilience, and how a proposed project fits with the sustainable management of the VEC. In the absence of SARM plans and RM plans, project EA legislation needs to clearly allocate responsibilities among proponents, governments and interested members of the public to fill this information gap in the EA process.

Contemplating SEAs and REAs through the law and policy lens is challenging, as both have so far largely operated in a legal vacuum. Ideally this would be addressed through comprehensive legislation for SEAs and REAs, the content of which has been considered elsewhere (Gibson et al. 2010). Whether or not such legislation is implemented, the roles of REAs and SEAs at the project EA level need to be clearly set out in project EA legislation. Key issues include the process and substantive requirements for REA and SEA, to what extent the project EA process is bound by the context provided through the REA and SEA, and what opportunities there are for the project EA to update the SEA or REA. One such mechanism that has been proposed is an off-ramp built into project EA legislation that allows for REAs and SEAs to be triggered to address policy gaps identified during the course of a project EA (Doelle and Sinclair, 2006).

The Participatory Lens

Participation of individuals and groups and ensuring mutual learning among them is essential to the CEA mindset and is inextricably linked with the technical and law and policy lens as has been noted in the discussion above. The essential elements of the participatory lens for instigating the CEA mindset include:

- Early and broad involvement
- Cutting-edge information management
- Attention to mutual learning
- Incorporation of deliberative forums for collaborative dialogue

Early and broad involvement in CEA is as essential to effective implementation of the CEA mindset as it is for EA practice more generally (Diduck and Sinclair, 2002; Diduck and Mitchell, 2003; O'Faircheallaigh, 2010; Doelle, 2012; Gibson, 2012). Interested individuals and groups must be involved in selecting VECs and evaluating the cumulative effects of a program or undertaking on those VECs. Information is essential to inspiring critical thinking and sound dialogue in this regard. To

overcome the information deficiencies often plaguing EA process, advanced information management is required to implement the CEA mindset, such as through the establishment of an easily accessed, well-organized and searchable electronic library (or linked set of libraries) (Gibson et al. 2016).

Numerous authors have established the importance of individual and mutual learning to effective EA processes (e.g., Webler 1995; Sinclair et al. 2008; Diduck et al. 2012; Gibson et al. 2016), which have implications for CEA. Approaches that encourage and support mutual learning in CEA can help to identify social values and the potential to learn from local or traditional knowledge critical to understanding the value that people place on VECs. Indigenous knowledge can also provide critical ecological understanding to enrich impact analysis (Canadian Environmental Assessment Agency, 2013). Such approaches also provide opportunities for members of the public to acquire scientific and technical knowledge, learn about their community and the interests of fellow citizens, and engage in collective political action (Sinclair and Diduck 2016). Key to ensuring that there is a strong foundation for mutual learning is the opportunity for dialogue and discussion within a CEA through approaches that encourage and enable ongoing and deliberative dialogue and communications, such as workshops, task forces, advisory committees and mediation. Promoting dialogue will be critical in the context of CEA since simply giving people the opportunity to offer comments passively (e.g., through a letter) is not going to be enough to make the sorts of judgements related to cumulative effects and VEC condition as they relate to public policy, public values and priorities.

Each of the lenses is well grounded in the EA theory and practice. For example, in terms of the law and policy lens, we know that since EA was born in 1970's in the US, it has developed largely as a process required by governments - at state, multi-state, and sub-state levels – to assess proponents' actions that could potentially have significant effects on the environment. To legitimize and guide the requirement, governments worldwide have developed EA-specific statutes, regulations and policies. Much scholarly literature examines EA from this perspective (e.g., Doelle,

2008). From a technical perspective, EA is fairly seen as a process of providing specific kinds of information to help decision-makers guide developments in a way that protects environmental values. The most respected source of reliable information for making such decisions is science (Greig and Duinker, 2011) as augmented with indigenous knowledge (CEAA, 2013b). Seminal pieces of scholarly literature on science in EA were generated in the 1970s (e.g., Munn, 1975; Holling, 1978; Ward, 1978), and much additional material has appeared since. From a participatory perspective, EA has been described as opening up the decision-making process in ways that recognize that not all the relevant information for development decision-making is scientific and that people who are affected by development have a right to participate in those decisions (e.g., Sinclair and Diduck 2016; Petts 2003, 1999; Forester 2006; Roberts 1998; Shepard and Bowler 1997).

Adopting a CEA mindset means that, whatever the human actions under assessment (whether projects, plans, policies, programs, or otherwise) and whatever the VECs under assessment (animals, plants, water, air, soil, or otherwise), each lens must be functioning and working in concert with the others for the mindset to be operative. Looking at CEA through any one of these lenses alone could indeed be interesting and yield powerful insights into the cumulative effects of project, plan, or policy, but this would generate a dangerously partial understanding. Recognizing the need to include all of the lenses also underscores that CEA cannot be an innocuous little chapter hidden in the last binder of an EIS – when implemented as a mindset, it is the essence of assessment if such assessment is to be aimed at securing sustainable development.

Considering the CEA Mindset in Practice

The Bay of Fundy provides an illustrative context within which to consider the notion – and potential implications - of a CEA mindset. We selected it because there are several examples of resource and environmental decision-making drawn from recent initiatives associated with the Bay of Fundy, so in this regard it is not unlike

other regions in Canada we might have selected. The examples include a project EA, an SEA, a species-at-risk recovery plan, and a coastal-zone management strategy. Each of these initiatives acknowledged the importance of cumulative effects as outlined below. We conclude with observations on the apparent CEA work undertaken in each process and what the work undertaken may contribute to the mindset and teach us about implementing each of the lenses of the mindset.

As shown in Figure 2, the Bay lies between the Canadian provinces of New Brunswick and Nova Scotia, with a small portion touching the US State of Maine. The Bay is well known because it has the highest tidal range in the world with an average range of ca. 13 m and a record amplitude of 16.3 m (Percy, 2001). Numerous communities surround the Bay, the largest being the port town of Saint John, NB, which provides sea access for a variety of industries in the region such a pulp and paper, and oil and gas. Communities such as St. Andrews attract a considerable number of tourists who come to see the tides and the Bay's wildlife. The rich abundance of natural spaces and ecosystems is in part reflected in the number of parks, preserves, and wildlife areas such as Fundy National Park, Five Islands Provincial Park, and the Isle Haute wildlife management area, to mention but a few.

Project Environmental Assessment: Whites Point Quarry and Marine Terminal

The Project

In 2003, Bilcon of Nova Scotia Corp. (Bilcon) applied for federal and provincial permits and approvals for the Whites Point Quarry and Marine Terminal (Bilcon of Nova Scotia Ltd., 2006). The project involved a basalt quarry, processing facility, ship-loading facility, and deep-water marine terminal at Whites Point, Nova Scotia, for the export of aggregate to New Jersey, USA. The quarry was expected to operate for 50 years, producing about two million tons of aggregate per year (Bilcon of Nova Scotia Ltd., 2006).

The project was proposed on a 152-hectare site located along the Bay of Fundy about 30 km southwest of Digby, Nova Scotia. The area includes traditional fishing communities with low population density, and almost no industrial activity. Other than fishing, the main economic driver for the area is tourism.

The Project EA

The proposal triggered both provincial and federal EA processes. An EA Joint Review Panel commenced its review of the proposed project in November, 2004, in line with EA requirements under federal but not provincial legislation. Guidelines for the EA were issued from the Panel to the proponent in March 2005 (Environmental Assessment Panel, 2005). The Guidelines required the proponent to assess cumulative effects on account of the requirement to do so in the Canadian Environmental Assessment Act. The proponent filed the first set of EIS documents in 2006 (Bilcon of Nova Scotia Ltd., 2006). The Panel issued deficiency statements in the summer of 2006 (Joint Review Panel, 2006), in response to which the proponent filed supplementary documents in 2007 (Bilcon of Nova Scotia Ltd., 2007).

The Panel's final hearings, which took place in June 2007, were the scene of emotionally charged and heated debate among those who presented cases for and against the project. The Panel (Joint Review Panel, 2007) strongly criticized the proponent's inadequate approach to public engagement, citing a "lack of meaningful consultation".

Criticisms of the technical and scientific work undertaken by Bilcon and reported in the EIS (Bilcon of Nova Scotia Ltd., 2006) were hyper-abundant during the Panel hearings and in the panel report (Joint Review Panel, 2007). For some VECs, the panel criticized the proponent for underestimating potential effects, and for others the panel found that the proponent had simply not reduced uncertainties sufficiently for a confident assessment of potential effects. In sum, the scientific

foundations of this project EA, and thus performance on the technical lens as defined in this paper, were found by most intervenors and by the Panel to be seriously inadequate.

In its final report (Joint Review Panel, 2007), the Panel recommended against approval of the project, citing significant adverse environmental effects, a failure of the project to make a net contribution to sustainable development, inadequate work by the proponent in preparing for the EA process, and an incompatibility between the project and community values as the primary reasons. In November 2007, the NS Minister of the Environment determined that the 'proposed Project poses the threat of unacceptable and significant adverse effects to the existing and future environmental, social and cultural conditions influencing the lives of individuals and families in the adjacent communities.' As a result, the province did not approve the project. In December 2007, the federal Minister of Fisheries and Oceans (approved by the Governor in Council) announced that he agreed with the Panel finding that the project is likely to cause significant adverse environmental effects that cannot be justified in the circumstances (Gibson and Fonseca, 2008; Mullen, 2008).

The CEA

As noted above, the Guidelines required the proponent to include a CEA in its document filings. This was done in the ten-page chapter 10 of the EIS (Bilcon of Nova Scotia Ltd., 2006). The CEA was entirely qualitative in nature and was underpinned by little scientific analysis. The proponent stated that all potential negative cumulative effects were insignificant (these VECs included air quality, marine mammals, Bay-of-Fundy aesthetics, and tourism), some potential positive cumulative effects were insignificant (i.e., on quality of life and social capital), and some potential positive cumulative effects were significant (i.e., on floral species at risk, employment, and municipal tax revenue). A sound scientific underpinning to the CEA was absent.

After its initial review of the document, the Joint Review Panel requested more information from the proponent regarding the CEA. It noted that the "cumulative effects analysis does not follow the methodology recommended in the guideline and the panel does not accept the proponent's justification for the approach taken" (Joint Review Panel, 2006: 23). Further, it noted that the proponent should "as directed in the guidelines, emphasize sensitive VECs or VECs (such as marine mammals) that may be at significant risk" (Joint Review Panel, 2006: 24). The proponent was directed by the panel in this regard to "assess effects over the lifecycle of the project; provide quantitative, verifiable and referenced information and data (avoiding vague qualifiers); and use the significance parameters of magnitude, duration, geographical extent, reversibility and ecological context, as appropriate, in the prediction of effects" (Joint Review Panel, 2006: 24).

Ultimately, neither the Panel nor any of the intervenors were satisfied with the proponent's efforts with the CEA. The findings of the Panel speak volumes about the inadequacy of the CEA done by Bilcon. They confirm our observations and others (e.g., Duinker & Greig 2006) that CEA is, in general, technically incompetent in most project EAs:

> "The Panel believes that in the EIS the Proponent's analysis of the cumulative effects of the Project, acting in concert with activities that should be considered as reasonably foreseeable, was not adequate . . . The Proponent failed to address cumulative effects that could arise due to induced developments triggered by the Proponent's inability to overcome constraints in working the proposed site, the need to expand operations to meet demand, or economic imperatives. Ownership of adjacent properties provides the Proponent with the potential opportunity of expansion. The Panel believes that expansion of the present Project and the development of an additional quarry or quarries is reasonably foreseeable, and that scenarios such as that should have been evaluated in the cumulative effects assessment" (Joint Review Panel, 2007: 11).

In sum, the CEA associated with the Whites Point Quarry and Marine Terminal project EA did not pass muster on any counts – scoping was inadequate, scientific analysis was flimsy, and mitigation and follow-up were ignored on account of the

judgement of no significant adverse cumulative effects. On the technical lens, no analytically rigorous predictions of potential cumulative effects were presented. This outcome could have been due in part to a lack of legal clarity on what is required of the proponent with respect to CEA, what obligations the government has with respect to CEA, and when and how the public has the opportunity for meaningful engagement on CEA. This is particularly so with respect to future projects and future development scenarios, but also with respect to the public's views on assimilative capacity, resilience and the importance of the VECs affected by the project. This outcome underscores the challenge associated with current practice of CEA at the project level, which is largely in the hands of proponents that are trying to limit and focus the breadth of consideration of their project EA. It also shows, though, the importance of project assessment in identifying VECs that require consideration and the value of completing the CEA process by connecting the breadth of the REA and SEA with the project detail available at the project EA level.

Strategic Environmental Assessment: Bay of Fundy Tidal Power

The SEA

In 2005, the Government of Nova Scotia was approached by several developers of tidal energy about the possibility of testing and commercially developing a number of emerging tidal technologies in the Bay of Fundy. In response, the Government of Nova Scotia decided to proceed with a Strategic Environmental Assessment (SEA) of tidal energy in the Bay of Fundy (OEER Association, 2008). The SEA was carried out in cooperation with the Government of New Brunswick, and in consultation with the federal government, as both of these jurisdictions clearly have some role to play in regulating activities such as tidal energy projects in the Bay of Fundy. The SEA document itself is supported by a detailed background report (Jacques Whitford, 2008).

Nova Scotia and New Brunswick specifically cooperated in the gathering of background information to inform their respective SEA processes. Each jurisdiction then conducted its own SEA and made its own independent decisions. The role of the federal government in the SEA was quite limited, surprising given its important regulatory role with respect to fisheries and transportation in the Bay of Fundy. It essentially played an observer role, even though it was requested by the provinces to become more actively involved.

The Nova Scotia SEA process was placed in the hands of an independent organization, the Ocean Energy Environmental Research Association. An SEA Steering Committee, created for the Nova Scotia portion of the SEA, decided that the scope of the SEA would be limited geographically to the Bay of Fundy and substantively to ocean renewable energy. The process otherwise remained open throughout to any issue relevant to informing decisions about whether, where, and under what conditions offshore renewable energy should be permitted or encouraged in the Bay of Fundy.

The main purpose of the various efforts early in the process to engage affected communities and key stakeholders was to identify what issues the SEA should focus on, while leaving it open to participants throughout the process to raise new issues and bring up new concerns. Proactive steps were taken to engage individuals and organizations that either made current use of the Bay of Fundy (such as fisheries and transportation) or that had an interest in possible future uses (such as aquaculture and ecotourism).

The outcome of the SEA process in Nova Scotia was a consensus report of the stakeholder roundtable. The consensus was possible in spite of the short time frame because all participants shared control over the scope of the SEA, the process, and the outcome – they were involved early in the design of the process. The process was assisted by the fact that there was a general recognition by all participants that while tidal energy posed risks to existing and possible future uses and natural

systems in the Bay of Fundy, it offered the potential to provide a long-term sustainable supply of energy to Nova Scotians (Doelle 2009).

The focus of the SEA process and of the final report in Nova Scotia was on how to better understand and minimize negative impacts, how to determine whether a tidal industry would offer net long-term benefits to the province, and how to ensure some distribution of impacts, benefits, risks, and uncertainties. The report concluded that development of a tidal industry in the Bay of Fundy should be guided by a number of sustainability principles developed specifically for the Bay of Fundy context. A key principle was that development of the tidal energy industry should only proceed incrementally, and that key issues had to be addressed at each step before deciding whether to proceed to the next level of development.

The CEA

From a cumulative-effects perspective, the SEA process was able to identify potential interactions between the impacts from tidal energy projects and those from other human activities, such as impacts of existing activities and proposed tidal developments on fish. However, because so little was understood about the interaction between the emerging tidal-energy technologies and the receiving environment, it was impossible to predict where and under what conditions the impacts of tidal development would interact cumulatively with the impacts of other human activities in the study area. The SEA considered future development scenarios for tidal energy (i.e., potential levels of tidal development), but data were too scarce for development of a strong understanding of the impacts. The effects of other existing uses were generally better understood than the potential impacts of tidal development.

The focus of the SEA therefore was to find a way to learn more about the potential impacts of tidal development with minimal risk of significant impacts. With this in mind, the SEA concluded that pilot projects could be tested in the Bay of Fundy

under specified conditions. Key among the conditions was that the pilots be used to fill information gaps in the understanding about the interaction between tidal turbines and the receiving environment in the Bay of Fundy including cumulative effects. A second key condition was that turbines tested at this stage could not remain in the water for more than two years. Thus, at the time this SEA was done, scientific knowledge was inadequate to make confident predictions of ecological effects of a fulsome implementation of tidal turbines, so the SEA required adaptive management in the form of pilot projects which were explicitly designed to create reliable knowledge of both the appropriateness of alternative technologies and the potential for adverse environmental and cumulative effects. Implementing several pilots in the same area, which is imminent at this time of writing, allows at least a cursory examination – and exploration - of cumulative effects.

This outcome illustrates at least three issues related to CEA at the SEA level: i. it demonstrates the limitations of doing an SEA without first doing an REA, i.e., a comprehensive integrated planning process. Without the REA, we may not know enough about current and future activities that are outside the scope of the SEA; ii. it also shows that future development planning, if done at the SEA level, has to go beyond the sector being studied; we need good information about the overall future development scenarios for the Bay of Fundy; and iii. it demonstrates the limitation of CEA at the SEA stage when compared to the project level, particularly the lack of detail on proposed activities. This was a new industry sector, and there were limited data available on how tidal turbines would interact with a number of VECs. This means that CEA at the SEA stage is valuable, but it works best when well coordinated with CEA at the REA and project levels.

The case also highlights that in the absence of a legal requirement to do an SEA or CEA, no legal guidance on how to carry out an SEA if one is initiated, and no legal guidance on what to do with the results of an SEA, the approach will be completely ad hoc – in this case, the result is failure to address most elements of the mindset. A thorough VEC analysis, even at a high level, was never completed nor was a

comprehensive assessment of other existing and proposed activities and their impact on the VECs potentially affected by tidal turbines. The case also reveals the notion that the lenses must all be functional – in this case, there was exemplary participation, even resulting in consensus, but the discussions of cumulative effects were at a high level and largely theoretical.

Species-at-Risk Recovery Planning: Inner-Bay-of-Fundy Salmon

The Plan

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) identifies species considered to be at some risk of eventual extinction and in need of a protection management plan. The Bay of Fundy is home to several species that are considered endangered according to COSEWIC, e.g. Atlantic Salmon (Inner Bay of Fundy), Right Whale, Blue Whale, Lynx, Leatherback Turtle, Piping Plover, Harlequin Duck, and Butternut. When species are put on the endangered list, a recovery plan is developed in hopes of seeing species stocks return to acceptable levels. Considering cumulative effects is not a formal requirement for recovery planning as mandated under the Species at Risk Act.

Canada's Department of Fisheries and Oceans (DFO) indicates that Inner Bay of Fundy Salmon suffered manifold stock declines, with runs of 30,000 to 40,000 fish in the mid-1980s to runs fewer than 500 in 1998 and below 200 in 2008. This put the species at critically low levels and thus it was listed by COSEWIC under the Canadian Species at Risk Act. As a result, a recovery strategy was finalized in April 2010 (DFO 2010). It includes identification of the Salmon's critical habitat and has five key recovery objectives: (i) conserve Inner Bay of Fundy Salmon genetic characteristics and re-establish self-sustaining populations to Inner Bay of Fundy rivers; (ii) identify and remedy anthropogenic threats limiting survival/recovery of Inner Bay of Fundy Salmon in the marine environment; (iii) identify and remedy anthropogenic threats limiting survival/recovery of Inner Bay of Fundy Salmon in

the freshwater environment; (iv) assess population status, sustainability, and recovery feasibility; and (v) communicate and increase the general awareness of the status and recovery of Inner Bay of Fundy Salmon.

The strategy development process was led by a recovery team that numbered some 68 members plus three co-chairs. These members had "a pertinent interest, knowledge or expertise associated with Inner Bay of Fundy Atlantic salmon, represent a stakeholder organization, industry or government agency… and/or contributed directly to the development of this {strategy} document" (DFO, 2010: 3). The final strategy indicates that "because the range of the species encompasses two provinces and a federal park, and the breadth of knowledge and expertise in relation to the species, broad engagement and consultations were sought in the development of the recovery strategy" (DFO, 2010: 74) acknowledging the importance of the participatory lens to the development of recovery plans.

The CEA

A considerable amount of scientific evidence was brought forward in the development of the recovery strategy. As a result of this work, key threats responsible for the decline were identified by COSEWIC (2006) and further reviewed at the March 2008 Recovery Potential Assessment for Inner Bay of Fundy Salmon (DFO, 2008). Potential marine and freshwater threats included issues such as: aquaculture; ecological community shifts; environmental shifts; changes in environmental conditions; contaminants; and barriers to fish passage. The report noted that, "Cumulative or synergistic interactions among threats are likely, but unknown" (DFO 2010: 21). So while the importance of these potential cumulative effects was recognized, no work, scientific or otherwise, was done to consider them, nor has it been since.

The work of identifying species at risk under the Act is important because it establishes the most vulnerable VECs, and we need to understand the potential

effects of the full suite of stresses that could impinge on such species if an activity (project or otherwise) is undertaken. As well, based on the intent and content of species at risk recovery plans, we feel that the plans developed for species at risk are invaluable sources of CEA information on likely VEC species. Scientific data are collected and the recovery plan development process is indeed participatory, satisfying at least some of the essential elements of the technical and participatory lens. The obvious point is that we need to make good use of the data that are generated during recovery plan development in the EA context, but unfortunately the species-at-risk recovery planning, in and of itself, does not undertake effective CEA and does not capture the mindset approach. In this regard, it seems essential to improve the legal basis of species-at-risk recovery planning to include CEA since it seems to us that a good recovery plan must consider all interactions between human activities and the species at risk in combination with natural changes and impacts in order to develop a meaningful recovery strategy.

Coastal-Zone Policy-making: Nova Scotia

There have been multiple calls over the years prompting the Government of Nova Scotia to get its coastal-zone policy house in order, but here we point to the second recommendation of the Joint Review Panel for the Whites Point Quarry and Marine Terminal: "The Panel recommends that the Province of Nova Scotia develop and implement a comprehensive coastal zone management policy or plan for the Province" (Joint Review Panel, 2007: 104). The Government took action soon after receiving this recommendation and set a process in motion to develop a coastal strategy for the province. This is relevant to the Bay of Fundy since it contributes substantially to the overall total length of Nova Scotia's coastline of 13,300 km (Government of Nova Scotia, 2011).

Milestones in the coastal-strategy process include the following documents: (a) the Coastal Management Framework (Government of Nova Scotia, 2008); (b) the 2009 State of Nova Scotia's Coast Report (Government of Nova Scotia, 2009); (c) a What

We Heard document arising from consultations in 2010 (Government of Nova Scotia, 2010); (d) a draft coastal strategy released in 2011 for public review (Government of Nova Scotia, 2011); and (e) a Feedback and Advice document on the strategy from the coastal working groups (Burbidge, 2012). At the time of writing (spring, 2016), a final strategy has yet to be released, and the process seems to be stalled.

The draft coastal strategy presents guidance in terms of principles (addressing the themes of leadership and collaboration, sustainability, informed decision-making, accountability and transparency, diversity, and stewardship), and presents a call to action on seven issues: coastal development; working waterfronts; public coastal access; sea-level rise and storm events; coastal ecosystems and habitats; coastal water quality; and governance. Given the observation from public consultations that "of particular concern among many residents were the cumulative impacts of development on the coastal environment" (Government of Nova Scotia, 2010), one might have expected that development of a coastal strategy would have included some level of CEA, or at least that it would address future cumulative effects in coastal ecosystems by calling for CEA to be competently accomplished in all future assessments of coastal development proposals, but it does not. The "Feedback and Advice" (Burbidge, 2012) document also notes that there are information needs and knowledge gaps, and indicates that one of these that must be addressed is the cumulative impacts of contaminants on coastal ecosystems.

Implications

The four initiatives discussed above impart a sense of little progress toward understanding any cumulative effects of ongoing development in the region-scale ecosystem called the Bay of Fundy. The project EA had a legal requirement for cumulative effects to be addressed, but all reviews pointed to its total inadequacy and the implications of this for the mindset are noted above. This suggests one (or more) of three things: (i) the proponents and consultants who prepared the EIS did

not know how to accomplish a competent CEA; (ii) the EIS was seen more as a rhetorical document than a synthesis of analytical work, so the proponent and consultants worked hard to deliver a finding of no significant adverse cumulative environmental effects; or (c) the case simply confirms the bad fit of CEA concepts in project-level EA, especially in the absence of an REA or at least of future development scenarios to guide the CEA analysis. In saying this we are not suggesting CEA in project EA is not important, just that the sorts of CEA called for the in the literature, and in some legislation, is going to be very difficult without linkages to other EA, planning and regulatory processes.

None of the other three initiatives considered above was under any legal obligation to consider or assess cumulative effects. The SAR recovery plan and the tidal energy SEA both acknowledged the existence and importance of cumulative effects but made no substantive contribution toward understanding them. They both noted an inability to assess cumulative effects at present on account of inadequate knowledge to do so. Admittedly, the SAR represents a synthesis of extant information about the status of the species at risk, information that should prove useful if the iBoF Atlantic salmon were chosen as a VEC in future EAs at any level, as noted above. Nova Scotia's state-of-the-coast report gives a couple of mentions about cumulative effects, but the draft strategy is silent about them. Below we offer ideas on potential solutions to this unfortunate situation, with a proposal about how REA may be pivotal.

Focusing the CEA mindset

We are calling for (a) widespread adoption of the CEA mindset captured in Figure 1, by all parties to assessment (proponents, consultants, regulators, Aboriginals, ENGOs, NGOs, learned people, etc.), (b) implementation of the CEA mindset in all resource and environmental decision-making processes, and (c) coordination of knowledge production across those processes to advance mutual learning among the parties involved (Sinclair et al., 2008; Sinclair and Fitzpatrick, 2002). Given the

issues and directions established thus far in the paper, we now turn to considering how to rectify the debilitating situation with respect to CEA practice in our Nova Scotia case in relation to each of the CEA mindset lenses as outlined above, and sketch out, in conceptual terms, the parameters of a solution.

As optimists, we assume that the resources needed to implement a much more substantive and rigorous CEA are by and large available – the people, the data, the money, the equipment. There may be severe limitations in some or even many cases, but these obstacles must be overcome if VEC sustainability is to be taken seriously. There are two concerns here - one is how to enculturate the notion of the CEA mindset, i.e., how to get impact assessment practitioners to see all impact situations as characterized by cumulative effects and guide them in how to consider and bring into focus each of the CEA lenses we have established. The other concern is how to orchestrate and integrate the various levels and types of decision processes so that CEA is robustly in place and implemented. Five levels/types of decision processes feature in our framework:

- Project-level EA
- SEA – strategic-level EA of a specific development type in a specific region
- REA – regional EA of multiple human activities in a specific region
- SARM – VEC-specific assessment for species recovery
- RM – e.g., management of forests, fish, watersheds, and other resources

The first step to implementing a CEA mindset process is to set the five decision processes in relation to each other to ensure that each CEA lens is integrated throughout. We propose the following:

- REA is the upper tier of decision-making – large areas, multiple types of development
- SEA is the middle tier – potentially large areas, limited types of development
- Project EA, SARM, and RM are the lower tier – specific developments/species, wide range of areas covered

Now we consider the Bay of Fundy ecosystem, including its terrestrial watershed. We have shown above that all levels and types of decision-making have been taking place in association with the Bay except for REA:

- SEA, e.g., Fundy Tidal Power
- Project EA, e.g., Whites Point Quarry and Marine Terminal
- SARM, e.g., Atlantic Salmon
- RM, e.g., NS Coastal Strategy (fisheries management, forest management could also be included)

In considering this case, we suggest a two-pronged approach:

1. Implement an REA for the Bay of Fundy ecosystem – in our view, an REA conducted under the CEA mindset and attending to each of the lenses we have described would set a strong stage for completion of effective SEA, project EA, SARM, and RM processes. The REA would consist of a CEA that considers each element of the mindset and would represent a sensitivity analysis to determine what specific scientific questions would need to be addressed in any SEA, project EA, SARM, and RM process implicating the Bay. These latter processes would sharpen the driving forces that may have been just guessed at in the REA. To help ensure this action, the REA process and its role in SEA need to be set out in law. At a minimum, the law needs to establish the process and substantive requirements for REA, especially the necessity to carry out CEA as we have described, how REA affects project decisions, and what happens when, at the project EA level, the conclusion is that there is a problem with the REA, such as that it did not consider a type of activity now being proposed, or things have changed significantly since the REA was developed (e.g., VEC condition has changed);

2. Coordinate the CEA work in the other four types of environment-related decision processes, and any others that may be operating, and integrate them under the REA.

In a perfect world from a VEC-sustainability point of view, we would stop all new economic development, undertake a comprehensive REA, then proceed with selected SEAs and SARM assessments, and finally re-engage economic development in the context of project EAs and RM initiatives. Given that the chance of that happening in the short term is nil, how might society proceed? We offer the following:

1. Continue with the project EA, SARM, and RM processes in place, with continual improvements in CEA practice in each process that reflect the essential elements of the lenses outlined in Figure 1. Strengthen project EA legislation in Nova Scotia and under CEAA in the short term by requiring the consideration of impacts of a project on VECs from a CEA mindset perspective – including consideration of a range of future development scenarios developed by provincial governments using a transparent public-engagement process. Establish in EA legislation the role SARM and RM play in project EAs, especially with respect to CEA. For a species at risk, the SARM process should already clearly identify a fullsome range of threats and what to do about them. EA legislation needs to be clear that it should take its guidance on cumulative effects from these documents where they exist under clear legislative direction, and it should be clear on what should happen if the EA concludes that the SARM or RM documents are inadequate or outdated. The same could be considered in relation to SARM legislation.

2. Consider ways to set SEA onto a statutory foundation. That foundation should establish requirements for creating and using development scenarios (Weber et al., 2012; Duinker & Greig, 2007), and engaging the public and stakeholders in identifying appropriate VECs and considering their resilience in the face of future development prospects. In anticipation of such a statutory foundation being established, SEAs conducted in the meantime should be consistent with these concepts and embody strong implementations of the CEA mindset. From a legal perspective, it will again be critical to identify, at a minimum, the process and substantive requirements a process has to meet to be considered an SEA, how an SEA updates an existing REA, and how it feeds into project decisions. As before, project EA legislation needs to be clear on the use it makes of SEA considerations of cumulative effects, and what happens when the project EA concludes that the SEA is inadequate or outdated. In appropriate circumstances involving significant CEA gaps, there could be a full off-ramp

process, meaning that the gap identified during the project EA triggers a separate but parallel SEA process to fill the gap and ideally feed back into the project EA process before it concludes. In other words, the SEA process so triggered would result in the development of new direction to fill the identified void through an open and consultative public process (Doelle and Sinclair 2006).

3. Pursue an agreement of engagement (memorandum of understanding to participate) – involving the Governments of Canada, New Brunswick, Nova Scotia and First Nations, municipal governments along the Fundy coast, key development sectors in the form of industrial associations and economic-development organizations, and civic-sector groups such as environmental organizations – to sponsor and participate in an REA for a five-year period – with the Government of Canada being the lead agency. Since REA currently has no legal foundation, the parties need to ensure adoption of a CEA mindset as they carry out the REA and establish how the results of the REA as they implicate CEA are to be used in SEAs and project EAs. Scenario planning and identification of the resilience of key VECs would occur during this stage. The objectives of the REA would be to further the basic scientific understanding of potential cumulative effects on selected VECs arising from a suite of possible future economic developments in the Bay of Fundy ecosystem, and to mobilize a wide range of stakeholders to learn together and direct their collective efforts toward sustainable prosperity in the Bay area.

4. While the REA is underway, work on mechanisms for aligning, to the extent possible, the technical and participatory lenses of the CEA mindset as part of ongoing project EA, species at risk, and RM processes with that of the REA in a way that facilitates and embeds learning. In other words, find meaningful ways to share information and knowledge (see Canter et al. 2014) related to VECs and cumulative effects 'up, down and sideways' among all the processes. This could include, for example, the establishment of a small

Technical Advisory Team tasked with coordinating and learning through implementing the CEA mindset (such as through the identification of key VECs and the assessment of their resilience relative to current and possible future stressors), the development of a common library of technical information, the potential development of VEC management plans that mimic those for species at risk, the identification of ways to collect technical information that can be best utilized and shared for CEA, creation of preliminary sets of regional development scenarios, and creation of a network of people willing to consider cumulative outcomes.

Conclusions

The CEA paradox outlined at the outset of the paper is deeply disconcerting – at a time when incisive assessment of cumulative effects is desperately needed to arrest the ongoing decline of so many VECs, and indeed of ecosystems at large, CEA practice is woefully deficient or simply absent from contemporary decision-making on economic development, as the cases above and the literature (e.g., Duinker and Greig 2006; Hegmann & Yarranton, 2011) clearly outline. What we have suggested is a way of thinking about CEA – a mindset conceptualized through three critical lenses – technical, law and policy, and participatory – that bring focus to the mindset. The serious shortcoming of CEA practice rests not just in the lack of attention to the technical lens – as often established in the literature and review of EIS documents – but in also not recognizing that meaningful CEA requires much more than just good science. The CEA mindset cannot just be legislated – legislation will just help to guide and encourage thinking toward the mindset by attending to what has been agreed to be important – but the mindset itself is an ethos of CEA that all engaged in CEA processes must embrace. Focusing and deliberating on each of the elements we have identified for each lens is essential to sound CEA practice. Our analysis of the development decision processes and resource management activities around the Bay of Fundy is illustrative of the current weaknesses and the imminent possibilities.

We have also suggested a pathway for thinking about how the different types of planning and decision-making might be coordinated and implemented in a way that provides greater assurance that a full suite of cumulative effects will be considered, thereby nurturing more-sustainable outcomes. Other recent considerations of CEA practice at least recommend shifting cumulative considerations from the project EA tier to the REA (e.g., WWF Canada, 2014), which is in line with our suggested coordination. As well, Harriman and Noble (2008) present different types of CEA approaches and characteristics - project, sector, regional, strategic - and suggested that a more holistic approach is required that considers cumulative effects at all levels. The CEA mindset establishes that ongoing planning and assessment processes need to focus on CEA at each level and more thoughtfully integrate the technical results of the work done in each process.

Our key messages have been illustrated by using the Bay of Fundy region and actual planning/assessment activities that have taken place or are ongoing in the region in order to draw lessons regarding CEA that have broader applicability. What we have described above for the Bay of Fundy is surely not uncommon in Canada and other jurisdictions. Other examples could be listed, such as the case of hydro-electric development in Manitoba where the cumulative effects of the generation and transmission aspect of the Wuskwatim dam development were considered separately, with little overall attention even to the other projects that may become part of the future and existing hydro system in Manitoba and more specifically in the northern region of the province (Clean Environment Commission (CEC), 2004). Another case is that of the Western Newfoundland and Labrador offshore area strategic environmental assessment that gave scant attention to CEA (C-NLOPB, 2012). The list could easily be continued. There are also plenty of examples internationally, such as how to consider the CEA of large water projects in Thailand, being established for irrigation and flood control, that have to be integrated into a complex existing irrigation network (NNT, 2013) or the CEA of projects on the boreal forest ecosystem (e.g., Sorensen et al. 2008; Esseen et al. 1997; Pew Charitable Trusts 2015).

Our suggestions are merely a start at resolving issues of VEC sustainability and we have left open some vexing questions that require more discussion and research. For example, we have not considered how specifically to address foreclosure of future options if the capacity of a VEC to absorb change or further impact has been taken up by approved and to-be-approved activities. If the conclusion is that a project will bring a VEC close to its ecological limits (notwithstanding difficulties in demonstrating this – see Johnson, 2013), should the project EA be explicit that the project's approval may foreclose options for future projects? This very issue may well be responsible for the low quality of CEAs that have been undertaken in project EAs to date.

Another example relates to how errors in the prediction of the effects of the activities being assessed influence what may be foreclosed in the future. For example, the prediction may be that tidal energy in the Bay of Fundy will have a modest impact on fish, but there is a high degree of uncertainty about this. If this prediction turns out to be wrong, in-stream tidal units can easily be taken out of the water, meaning that the activity is reasonably adaptable, as long as we carefully monitor and adapt quickly if predictions turn out to be wrong. If we went with lagoon or barrage tidal technology, adaptability is low, and uncertainty is still high, meaning that from a CEA perspective, many more future options for the use of the Bay are foreclosed, and in fact the risk of irreversible harm to a VEC is much higher.

Another set of issues relates to the roles of project proponents, the public, and governments in ensuring an appropriate CEA mindset in each of the processes we have discussed. An important element of this is to be more realistic about what can be expected of project proponents, and to enable, motivate, and sometimes require the public and governments to step in and fill the void. Key elements include a representative range of future development scenarios and a general understanding of the current and expected future resilience of key VECs, either as part of REAs or SEAs, or independent of them. Legislative criteria for good CEA within each of the

processes we have discussed can be an important contribution to supporting a CEA mindset, as can be legislative guarantees for effective public engagement and transparency in the process of carrying out CEA and making appropriate project and policy decisions in light of the outcomes. As Sinclair and Diduck (2016) suggest, however, just providing opportunities assumes people of different backgrounds and cultures are ready and able to participate, which is most often not the case. They make suggestions for participatory process that are civics-oriented, but that we have not fully problematized here.

These outstanding questions provide the fodder of future research while the work of implementing the CEA mindset can begin in earnest. In the Canadian context, we suggest that the mindset approach to CEA be considered by provincial decision-makers, industry, non-government organizations, and the interested public as they gather to review the provincial project EA processes, which many are currently doing, and engage more generally in resource decision-making. There seems to be little debate on the importance of considering cumulative effects; rather, the concerns noted at the outset of the paper are related to how to do CEA effectively, efficiently and fairly. The best approach is to apply a CEA mindset and harness and coordinate the resources committed to and resulting from multiple decision processes toward considering cumulative effects. If CEA is a mindset carried into every process of assessment or planning for activities in ecosystems, we may have a chance to arrest some of the ecological degradation we see happening all around despite the abundant good intentions and hopes of current assessment and planning processes. Collectively, we must find ways to effectively consider and mitigate the cumulative effects of human activities if we are to make genuine progress on achieving a more sustainable society.

References

Beanlands, G. E., & Duinker, P. N. (1983). *An ecological framework for environmental impact assessment in Canada*. Institute for Resource and Environmental Studies. Dalhousie University, Halifax, Nova Scotia, and Federal Environmental Assessment Review Office, Hull, Quebec.

Bilcon of Nova Scotia Ltd. (2006). *Plain Language Summary: Whites Point Quarry and Marine Terminal Environmental Impact Statement - Volume 1*. Bilcon of Nova Scotia Ltd., Digby, NS.

Burbidge, C. (2012). *Feedback and advice on Nova Scotia's draft coastal strategy: summary report of the coastal working groups*. Marine Affairs Program (pp. 65), Dalhousie University, Nova Scotia.

Canter, L. W., Chawla, M. K., & Swor, C. T. (2014). Addressing trend-related changes within cumulative effects studies in water resources planning. *Environmental Impact Assessment Review*, 44(1): 58-66.

Canter, L., & Ross, B. (2010). State of practice of cumulative effects assessment and management: the good, the bad and the ugly. *Impact Assessment and Project Appraisal*, 28(4), 261–268.

CCME (Canadian Council of Ministers of the Environment). (2009). *Regional strategic environmental assessment in Canada: principles and guidance*. CCME, Winnipeg, MB. Retrieved February 2014 from http://www.ccme.ca/files/Resources/enviro_assessment/CE%20Definitions%20and%20Principles%201.0%20EN.pdf

CCME (Canadian Council of Ministers of the Environment). (2014). *Canada-wide Definitions and Principles for Cumulative Effects*. Retrieved March 2015 from http://www.ccme.ca/en/current_priorities/cumulative_effects/index.html

CEAA (Canadian Environmental Assessment Agency). (2013a). *Operational policy statement: assessing cumulative environmental effects under the Canadian environmental assessment act, 2012.* Canadian Environmental Assessment Agency. Ottawa, ON.

CEAA (Canadian Environmental Assessment Agency). (2013b). Considering Aboriginal traditional knowledge in environmental assessments conducted under the Canadian Environmental Assessment Act -- Interim Principles**.** Ottawa, ON: CEAA. Retrieved February 3, 2016, from https://www.ceaa-acee.gc.ca/default.asp?lang=En&n=4A795E76-1

C-NLOPB. (Canada-Newfoundland Offshore Petroleum Board). (2012). *Strategic environmental assessments*. Retrieved July 15, 2013 from http://www.cnlopb.nl.ca/abt_mandate.shtml

Clean Environment Commission – Manitoba (CEC). (2004). *Report of public hearings: Wuskwatim generation and transmission projects*. CEC, Winnipeg, MB. Retrieved July 15, 2015 from www.cecmanitoba.ca/resource/reports/Commissioned-Reports-2004-2005-Wuskwatim_Generation_Transmission_Projects_Full_Report.

Connelly, R. (2011). Canadian and international EIA frameworks as they apply to cumulative effects. *Environmental Impact Assessment Review*, 31(5), 453-456.

COSEWIC. (2006). COSEWIC assessment and update status report on Atlantic salmon Salmo salar (Inner Bay of Fundy populations) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

Court, J.D., Wright, C.J., & Guthrie, A.C. (1994). *Assessment of Cumulative impact and Strategic Assessment in Environmental Impact Assessment*. Commonwealth Environment Protection Agency. Barton, Australia.

Creasey, R., and Ross, W.A. (2009) The Cheviot Mine project: Cumulative effects assessment lessons for professional practice. In *Environmental Impact Assessment: Practice and Participation*. Second edition, K.S. Hanna (ed.). Toronto: Oxford University Press, pp. 145-159.

DFO (Department of Fisheries and Oceans – Canada). (2010). *Recovery strategy for the Atlantic salmon (aalmo salar), Inner Bay of Fundy populations.* DFO: Canada.

DFO (Department of Fisheries and Oceans – Canada). (2008). *Recovery potential assessment for Inner Bay of Fundy salmon.* DFO Canada Science Advisory Secretariat. Report 2008/050.

Diduck, A., & Sinclair, A. J. (2002). Public involvement in environmental assessment: The case of the nonparticipant. *Environmental Management,* 29(4), 578-588.

Diduck, A., & Mitchell, B. (2003). Learning, Public Involvement and Environmental Assessment: A Canadian Case Study. *Journal of Environmental Assessment Policy and Management*, 5(3), 339-364.

Diduck, A.P., Sinclair, A.J., Hostetler, G., and Fitzpatrick, P. (2012). Transformative learning theory, public involvement, and natural resource and environmental management. *Journal of Environmental Planning and Management*, 55(10), 1311–30.

Doelle, M., Sinclair A. J. (2006). Time for a new approach to environmental assessments: Promoting cooperation and consensus for sustainability. *Environmental Impact Assessment Review*, 26(2), 185 - 205

Doelle, M. (2008). *The Federal Environmental Assessment Process: A Guide and Critique.* LexisNexis Butterworth, Markham, ON.

Doelle, M. (2009). The role of strategic environmental assessments (SEAs) in energy governance: A case study of tidal energy in Nova Scotia's Bay of Fundy. *Journal of Energy and Natural Resources Law,* 27, 112- 144.

Dubé, M. G. (2003). Cumulative effect assessment in Canada: a regional framework for aquatic ecosystems. *Environmental Impact Assessment Review*, 23(2), 723-745.

Duinker, P. N. (2013). Written submission from Peter Duinker in the Matter of Ontario Power Generation Inc.: Proposed environmental impact statement for OPG's deep geological repository (DGR) project for low and intermediate level waste. Retrieved March 2015 from www.ceaa-acee.gc.ca/050/documents/p17520/94202E.pdf

Duinker, P. N., Burbidge, E. L., Boardley, S. R., & Greig, L. A. (2013). Scientific dimensions of cumulative effects assessment: toward improvements in guidance for practice. *Environmental Reviews*, 21(1), 40-52.

Duinker, P. N. (1994). Cumulative effects assessment: What's the big deal? In A. J. Kennedy (Ed.), *Cumulative effects assessment in Canada: From concept to practice* (pp. 11-24*)*. Alberta Society of Professional Biologists, Calgary, Alberta.

Duinker, P. N., & Greig, L. A. (2007). Scenario analysis in environmental impact assessment: improving explorations of the future. *Environmental Impact Assessment Review,* 27(1), 206-219.

Duinker, P. N., & Greig, L. A. (2006). The impotence of cumulative effects assessment in Canada: ailments, and ideas for redeployment. *Environmental Management*, 37(2), 153-161.

Environmental Assessment Panel. (2005). *Environmental impact statement guidelines for the review of the Whites Point Quarry and Marine Terminal Project*. Canadian Environmental Assessment Agency. Ottawa: ON.

Esseen, P.A., Ehnstrom, B., Ericson, L., and Sjoberg, K. (1997). Boreal forests. *Ecological Bulletins*, 46(1), 16-47.

European Commission. (1999). *Guidelines for the assessment of indirect and*

cumulative impacts as well as impact interactions. Brussels. Retrieved February 2015 from http://ec.europa.eu/environment/eia/eia-studies-and-reports/guidel.htm

Gibson, R. B. (2012). In full retreat: the Canadian government's new environmental assessment law undoes decades of progress. *Impact Assessment and Project Appraisal,* 30(3), 179-188.

Gibson, R. B., Doelle, M., and Sinclair, A. J. (2016). Fulfilling the promise: Basic components of next generation environmental assessment. *Journal of Environmental Law & Practice, Forthcoming*.

Gibson, R. B., Benevides, H., Doelle, M., & Kirchoff, D. (2010). Strengthening strategic environmental assessment in Canada: An evaluation of three basic options. *Journal of Environmental Law and Practice*, 20(1), 175-211.

Gibson, R.B., Hassan, S., Holtz, S., Tansey, J., & Whitelaw, G. (2005). Sustainability Assessment: Criteria, Processes and Applications. London: Earthscan.

Gibson, R. and A. Fonseca. (2008). 'Application Denied', *Alternatives*, 34(4): online at www.alternativesjournal.ca/magazine/sustainability-taken-seriously-344.

Government of Nova Scotia. (2011). *Draft coastal strategy*. Government of Nova Scotia, Halifax, NS. Accessed October 2015 at: www.gov.ns.ca/coast

Government of Nova Scotia. (2010). *What we heard: Nova Scotia's coastal consultation,* pp. 25. Government of Nova Scotia, Halifax, Nova Scotia.

Government of Nova Scotia. (2009). *Our coast: live; work; play; protect. The 2009 state of Nova Scotia's coast report*. Government of Nova Scotia. Halifax: NS.

Government of Nova Scotia. (2008). *Coastal Management Framework.* Government of Nova Scotia. Halifax: NS.

Greig, L. A., & Duinker, P. N. (2011). A proposal for further strengthening science in environmental impact assessment in Canada. *Impact Assessment and Project Appraisal,* 29(2), 159-165.

Harriman, J. A. E., & Noble, B. F. (2008). Characterizing project and strategic approaches to regional cumulative effects assessment in Canada. *Journal of Environmental Assessment and Policy Management*, 10(1), 25-50.

Hegmann, G., & Yarranton, G. T. (2011). Alchemy to reason: Effective use of Cumulative Effects Assessment in resource management. *Environmental Impact Assessment Review,* 31(5), 484-490.

Hegmann, G., Cocklin, C., Creasey, R., Dupuis, S., Kennedy, A., Kingsley, L., & Stalker, D. (1999). *Cumulative Effects Assessment Practitioners Guide. Prepared for Canadian Environmental Assessment Agency*. Prepared by the Cumulative Effects Assessment Working Group and AXYS Environmental Consulting Ltd. Retrieved February 2015 from http://www.ceaa.gc.ca/43952694-0363-4B1E-B2B3-47365FAF1ED7/Cumulative_Effects_Assessment_Practitioners_Guide.pdf

Holling, C.S. (ed.) (1978). *Adaptive Environmental Assessment and Management*. Toronto, ON: John Wiley and Sons.

Jacques Whitford. (2008). Background Report for the Fundy Tidal Energy Strategic Environmental Assessment. Halifax, NS: Offshore Energy Environmental Research Association.

Johnson, C. J. (2013). Identifying ecological thresholds for regulating human activity: effective conservation or wishful thinking? *Biological Conservation,* 168, 57-65.

Joint Review Panel. (2006). *EIS information request – July 28, 2006*. *Whites Point Quarry and Marine Terminal Project*. Canadian Environmental Assessment Agency. Ottawa: ON.

Joint Review Panel. (2007). *Joint eview Panel Report, environmental assessment of the Whites Point Quarry and Marine Terminal Project*. Canadian Environmental Assessment Agency. Ottawa: ON.

Lawrence, D. P. (2013). *Impact Assessment: Practical Solutions to Recurrent Problems and Contemporary Challenges*. 2nd Edition. New Jersey: John Wiley and Son Inc.

Mullen (2008). Power of the People', *Alternatives*, 34(4), 10-14.

Munn, R.E. (ed.). (1975). Environmental Impact Assessment: Principles and Procedures. SCOPE Report 5. International Council of Scientific Unions - Scientific Committee on Problems of the Environment.

NNT (National News Bureau of Thailand). (2013). *Government confirms all water management projects must have EIA*. Retrieved December 2014 from http://thainews.prd.go.th/centerweb/newsen/NewsDetail?NT01_NewsID=WNEVN5607080010001

Norton B. (2005). *Sustainability. A Philosophy of Adaptive Ecosystem Management*. Chicago: University of Chicago Press.

Nova Scotia Department of Natural Resources (NSDNR). (2007). *Recovery plan for moose* (alces alces americana) *in mainland Nova Scotia*, Nova Scotia Department of Natural Resources, Halifax, NS.

OEER Association. (2008). *Fundy tidal energy strategic environmental assessment final report*. Offshore Energy Environmental Research Association, Halifax, NS.

Office of the Deputy Prime Minister (OPDM). (2005a). *A practical guide to the strategic environmental assessment directive*. London: Office of the Deputy Prime Minister. Retrieved February 2015 from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7657/practicalguidesea.pdf

Office of the Deputy Prime Minister (OPDM). (2005b). *Sustainability appraisal of regional strategies and local development frameworks*. London: Office of the Deputy Prime Minister. Retrieved February 2015 from http://www.communities.gov.uk/pub/346/SustainabilityAppraisalofRegionalSpatialStrategiesandLocalDevelopmentDocuments_id1161346.pdf

O'Faircheallaigh, C. (2010). Public participation and environmental impact assessment: purposes, implications, and lessons for public policy making. *Environmental Impact Assessment Review*, 30(1), 19–27.

Percy, J. A. (2001). *Fundy's Minas Basin: multiplying the pluses of Minas*. Fundy Issues #19. Bay of Fundy Ecosystem Partnership, Halifax, NS. Retrieved October 16, 2015 from www.bofep.org/minas1.htm

Petts, J. (1999). Public participation and environmental impact assessment. In J. Petts (Ed.), *Handbook of Environmental Impact Assessment*, pp. 145–77. Oxford: Blackwell Science.

Petts, J. (2003). Barriers to deliberative participation in EA: learning from waste policies, plans and projects. *Journal of Environmental Assessment Policy and Management*, 5, 269-293.

Pew Charitable Trusts. (2014). Environment: our work. Retrieved June 2015 from http://www.pewtrusts.org/en/topics/environment (www.pewenvironment.org/campaigns/international-boreal-conservation-campaign).

Roberts, R. 1998. "Public Involvement in Environmental Impact Assessment: Moving to a 'Newthink'." *Interact*, 4(1) 39–62.

Ross, W. A. (1994). Assessing cumulative environmental effects: both impossible and essential. Pages 1–9 in A. J. Kennedy (ed.), *Cumulative effects assessment*

in Canada: From concept to practice. Alberta Society of Professional Biologists, Calgary, Alberta.

Shepherd, A., & Bowler, C. (1997). Beyond the requirements: Improving public participation in EIA. *Journal of Environmental Planning and Management,* 40(6), 725-738.

Sinclair, A. J., & Fitzpatrick, P. (2002). Provisions for more meaningful public participation still elusive in proposed Canadian EA Bill. *Impact Assessment and Project Appraisal,* 20(3), 161-176.

Sinclair, A.J. and A.P. Diduck. (2016). Public participation in Canadian environmental assessment: enduring challenges and future directions. In *Environmental Impact Assessment: Practice and Participation*. Third edition, K.S. Hanna (ed.). Toronto: Oxford University Press, pp. 65-95.

Sinclair, A.J., Diduck, A.P. and Fitzpatrick, P.J. (2008). Conceptualizing learning for sustainability through environmental assessment: critical reflections on 15 years of research. *Environmental Impact Assessment Review*, 28(7), 415-522.

Sorensen, T., Mcloughlin, P. D., Hervieux, D., Dzus, E., Nolan, J., Wynes, B., & Boutin, S. (2008). Determining sustainable levels of cumulative effects for boreal Caribou. *The Journal of Wildlife Management,* 72(4), 900-905.

Stillwater Canada Inc. (2012). *Marathon PGM-Cu project environmental impact statement – main report*. Stillwater Canada Inc, Thunder Bay, ON.

Therivel, R., & Ross, B. (2007). Cumulative effects assessment: does scale matter? *Environmental Impact Assessment Review*, 27(3), 365-385.

US Council on Environmental Quality. (1997). *Considering cumulative effects under the National Environmental Policy Act*. CEQ, Washington, DC.

Ward, D.V. (1978). Biological Environmental Impact Studies: Theory and Methods. Academic Press, New York.

Weber, M., Krogman, N., & Antoniuk, T. (2012). Cumulative effects assessment: linking social, ecological, and governance dimensions. *Ecology and Society, 17*(2), 22.

Webler, T., Kastenholz, H., and Renn, O., 1995. Public participation in impact assessment: A social learning perspective. *Environmental Impact Assessment Review,* 15 (5), 443-463.

WWF Canada. (2014). Cumulative effects in Marine ecosystems: scientific perspectives on its challenges and solutions. WWF Canada, Vancouver.

Retrieved June 2015 from www.wwf.ca/newsroom/reports/oceans/