Workshop Summary Report

Cumulative Effects Assessment and Management: Sharing Knowledge & Building Capacity in the North Coast

North Coast Meeting & Convention Centre
Prince Rupert, B.C.
10-11 December 2015

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WWF

UNBC University of Northern British Columbia | CIRC The Cumulative Impacts Research Consortium

Bulkley Valley Research Centre

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ACRONYMS

BVRC	Bulkley Valley Research Centre
CE	Cumulative Effects
CEA	Cumulative Effects Assessment
CEF	Cumulative Effects Framework
CEM	Cumulative Effects Management
CIRC	Cumulative Impacts Research Consortium
EA	Environment Assessment
EAO	Environmental Assessment Office
EwE	Ecopath with Ecosim and Ecospace
FLNRO	Ministry of Forests, Lands and Natural Resource Operations
GBR	Great Bear Rainforest
InVEST	Integrated Valuation of Ecosystem Services and Trade-offs
IPCC	Intergovernmental Panel on Climate Change
LRMP	Land and Resource Management Plan
MaPP	Marine Plan Partnership for the North Pacific Coast
MSP	Marine Spatial Planning
PMV	Port Metro Vancouver
VC	Valued Component

DEFINITIONS

Benchmark	A benchmark represents a system state where we are confident that the system is functional.
Indicators	Indicators are surrogate measures used to represent, monitor or assess the condition, state or change in stress to a value or a Valued Component (VC). Effects based indicators provide measure of the effects on a value e.g. fish abundance while stressor-based indicators assess the condition of - or trends in - stress, disturbance or risk to a value e.g. percent of disturbed riparian area.
Management Target	An indicator value established as a matter of policy or as legal requirements.
Scenarios	Descriptions of a possible and plausible set of events that might reasonably take place.
Threshold	A threshold is the point past which a system changes into a state where it is no longer fully functional.
Valued Components	Encompasses wide variety of values resonate with people (ecological, economic, social and cultural values). These values are critical to consider and assess in a cumulative effects assessment.

EXECUTIVE SUMMARY

Multiple impacts from human activities are escalating pressures on species, ecosystems. Cumulative effects can result from individually minor but collectively significant actions taking place over time. Accurately accounting for cumulative effects however can be difficult considering the complex interactions between stressors, species, and ecosystem processes, and compounded by the effects of natural variability and climate change.

Managing the accumulation of past, current, and foreseen activities is a foremost issue in the Skeena region which supports a wide range of values, uses, and economic activities. In December 2015, WWF-Canada, together with Bulkley Valley Research Centre and University of Northern British Columbia's Cumulative Impacts Research Consortium (UNBC-CIRC), held a two-day workshop "Cumulative Effects Assessment & Management: Sharing Knowledge and Building Capacity in the North Coast" in Prince Rupert. The goal of the workshop was to share insight and best practices on assessing and managing cumulative effects to better inform resource development considerations both in the Skeena region and in a broader sense.

The workshop, attended by 52 participants from government, First Nations, civil society, academia, and industry, demonstrated vast and varied interest on the topic. On Day One, policies and procedures for completing a cumulative effects assessment were shared. Day Two focused on policy and decision-making procedures for cumulative effects management.

Over the course of the two days, 13 experts highlighted best practices on cumulative effects. Building off the shared expertise in the room, group discussions provided the opportunity to share knowledge and ideas relevant to improve cumulative effects considerations in the Skeena region, particularly around addressing data gaps and identifying near- and long-term priorities to promote action. A World Café presented diverse tools and resources to facilitate assessments (e.g. expert elicitation) and/ or address some of the challenges to implementing cumulative effects assessment in the region (e.g. Skeena Knowledge Trust).

This document captures key messages from presenters and group discussions during the workshop. In-depth case studies and examples provided by speakers were not described in this report but they are available in the Supplementary Materials along with speaker biographies.

This report includes challenges were identified that are impeding effective assessment and implementation of cumulative effects in the Skeena and in British Columbia broadly. Ideas and best practices to improve assessments and institutionalize cumulative effects put forth in the workshop are also captured. Key messages from the workshop include:

- Cumulative effects as practiced in the Environmental Assessment process is not fulfilling a broader understanding of the concept.
- Cumulative effects assessment is useful at the regional scale to aid decision-making on development.
- Project-specific assessments should feed into a broader regional scale of planning.
- The methodologies for cumulative effects assessment should be transparent, repeatable and defensible.

- For all stages of an assessment, practitioners should consider the following: maintaining transparency, handling uncertainty, multi-stakeholder collaboration, and creating an iterative process to changing conditions and contexts.
- Before any assessment is completed, it is important to define the values we want to protect and our objectives for the assessment carefully: what question(s) are we trying to answer?
- Cumulative effects data can be interpreted differently based on inherent human values and varying biases. Collaboration and transparency is crucial to build trust between different stakeholders. Cumulative impact maps and models can simplify communications on assessments and help engage broad audiences.
- Communications need to be consistent and consumable and deliver key messages to audiences.
- The Province of B.C. has developed a Cumulative Effects Framework that will soon be available for public comment. The Province is still strengthening some of its elements e.g. institutional arrangements, stakeholder and First Nations engagement
- Land-use planning in B.C. was suggested as a potential existing institutional arrangement for cumulative effects management several times in the workshop.
- Participants recognized a need for increased administrative capacity and leadership on cumulative effects in the region to coordinate assessments and address data challenges.

Selecting Values and Indicators	Setting Thresholds and Benchmarks	Spatial Analyses	Scenario Development
• Incorporating local/ traditional knowledge • Broad suites of values (ecological, economic, social/cultural) resonate with people • Values can be quantified in monetary and non-monetary terms • Collaborative process • Based on pre-defined regional objectives • Include a narrative for consumable communications • Transparency on how and why certain values were selected Case study: Metlakatla Cumulative Effects Management Framework	• Collaboration can build trust and support • Open conversations on acceptable risk based on accessible science • Transparency, engagement, accountability, and policy coherence • Establish interim measures while decisions are being made • Can be stressor or effects-based Case study: Great Bear Rainforest Planning Process	• Data is often disconnected from decision-making. Maps and graphs can help visualize complex data to support informed decision-making • Use and collection of data needs to be strategic • Other models can be easily combined with spatial CE models to provide more information, or achieve multiple objectives (e.g. SeaSketch, Ecosim) Case study: Regional cumulative effects assessment in the Bering Strait, AK	• Useful to analyze trade-offs among values especially when planning for multiple (synergistic and conflicting) objectives e.g. broad landscape planning • Scenario analyses can help identify policy gaps and the need for different policies • Can be qualitative or quantitative • Indicators help track current progress towards/ away from a defined scenario Case study: Defining Future Development Scenarios in Port Metro Vancouver's Port 2050 Initiative

WORKSHOP AGENDA

December 10th 2015

SESSION I IDENTIFYING VALUES AND INDICATORS

Grounded in Values, Informed by Science: Value and Indicator Selection in a First Nation Cumulative Effects Management (CEM) Framework
Taylor Zeeg – Metlakatla Stewardship Society
Katerina Kwon – Simon Fraser University

Values and Indicators: What Matters and How Do We Measure It?
Karen Price – Independent Consultant

SESSION II SETTING BENCHMARKS AND THRESHOLDS

Thresholds and Benchmarks: Setting Limits Based on Knowledge
Dave Daust – Independent Consultant

How Much is Too Much? – Examples from the Elk River Valley in the East Kootenays
Stella Swanson – Swanson Environmental Strategies

SESSION III CUMULATIVE EFFECTS ANALYSIS TOOLS

A Regional Cumulative Effects Assessment in the Bering Sea Region
Jamie Afflerbach - National Centre for Ecological Analysis and Synthesis (NCEAS)

Combining Cumulative Effects Models with GeoDesign in SeaSketch
Will McClintock - University of California Santa Barbara, Marine Science Institute

Ecosystem Modeling - Fundamentals and Concepts and Use in Environmental and Cumulative Effects Assessment
Darrell Desjardin - Hemmera

WORLD CAFÉ CUMULATIVE EFFECTS TOOLS AND RESOURCES

December 11th 2015

SESSION I SCENARIO DEVELOPMENT

Charting a Course to a Sustainable Gateway: Scenario Planning as a Strategic Tool
Jennifer Natland - Port Metro Vancouver

Scenario Development for the Skeena Watershed
Don Morgan - Ministry of Environment

SESSION II CUMULATIVE EFFECTS IN ENVIRONMENTAL ASSESSMENT AND DECISION-MAKING

Cumulative Effects Considerations in EA's and Decision-Making
Kevin Hanna - University of British Columbia

ROUNDTABLE DISCUSSION ON CUMULATIVE EFFECTS ASSESSMENT AND MANAGEMENT IN THE SKEENA

SESSION III CUMULATIVE EFFECTS AS A PLANNING TOOL

B.C. Cumulative Effects Management Framework
Steve Kachanoski – B.C. Ministry of Forests, Lands, and Natural Resources Operations

Cumulative Effects Assessments to Support Marine Planning: Case Studies and Contexts
Spencer Wood - Stanford Woods Institute for the Environment; Natural Capital Project

INTRODUCTION

WWF-Canada, along with Bulkley Valley Research Centre (BVRC) and University of Northern British Columbia's Cumulative Impacts Research Consortium (UNBC-CIRC), held a two-day workshop on cumulative effects assessment and management on 10-11 December 2015.

The goal of the workshop was to share key insights and best practices in assessing and managing cumulative effects by practitioners working in cumulative effects or related areas.

The "Cumulative Effects Assessment & Management Workshop: Sharing Knowledge and Building Capacity in the North Coast" workshop was held in Prince Rupert, British Columbia, and was well-attended by approximately 50 participants from government, First Nations, consultancies, civil society, and academia.

The objectives of the workshop were to build capacity for assessing and managing cumulative effects in the Skeena region by enhancing the understanding of:

- Key terms as they relate to the field of cumulative effects assessment and management
- Key challenges in cumulative effects assessment and sharing knowledge on solutions
- Current tools and applications of cumulative effects assessments and management in British Columbia

This report summarizes the key messages from presentations and group discussion throughout the workshop. A summary of the World Café event is not provided but a description of each tool presented along with contact information for the Café presenters is included in this document.

Welcome Address

Elizabeth Hendricks, Vice-President of WWF-Canada's Freshwater Program, acknowledged we were on Coast Tsimshian territory and thanked the Moore Foundation for making this event possible. WWF-Canada has been working in the Skeena region since 2001 and, over the next 5 years, we plan to continue to work on regional marine and freshwater initiatives in the region.

Hereditary Chief Clarence Nelson welcomed participants to the Metlakatla First Nations traditional territory. Chief Clarence described how risk from anthropogenic activities and climate change has affected species, ecosystems, and consequently cultural practices and communities both at the coast and in the watershed area of the Skeena over time.

James Casey, WWF-Canada's Freshwater Conservation Analyst, stated the workshop goals and encouraged participants to build off the expertise in the room, and share their knowledge to improve the consideration of cumulative effects in the region. A recent report by the Auditor General's office identified a need to consider cumulative effects in resource management in the Skeena and the Marine Plan Partnership for the North Pacific Coast (MaPP) has committed to complete a regional cumulative effects assessment in its sub-regional plan. James explained that we are on the brink of a new approach and hoped that new considerations for assessing resource development in the region would develop out of this workshop. Chris Buse, the workshop facilitator, seconded James' message and encouraged people to share their knowledge on cumulative effects, and particularly to enhance their recognition past environmental concerns alone.

DEC 10 SESSION SUMMARIES - CUMULATIVE EFFECTS ASSESSMENT

Session I: Identifying Values and Indicators

Taylor Zeeg and Katerina Kwon presented the value and indicator selection approach developed in the Metlakatla First Nation's Cumulative Effects Management Initiative (CEM). The Initiative will track the condition of identified priority values over time and develop monitoring, mitigation, and management strategies to maintain or improve it. This Initiative represents a move past the project level at which cumulative effects are assessed and considers a broader regional scale.

The selection process was loosely based on FLNRO and BC EAO guidelines. This Initiative improved on existing methods which usually comprise an inherently subjective process for only environmental values. This initiative explicitly incorporated Aboriginal values and local knowledge, and both biophysical and socio-economic values were selected based on a set ecological, socio-economic, and cultural criteria. Taylor described the process of value selection which involved an extensive review of literature (e.g. environmental assessments, socio-economic and traditional use studies, planning documents) to create an inventory of values, from which a candidate list was derived based on a set of pre-defined ecological, socio-economic, and cultural criteria. Workshops and interviews with experts, managers, and decision-makers led to the final priority list of values.

The candidate list of biophysical values included: Chinook salmon, bivalves (clams and cockles), eulachon, and Dungeness crab. Taylor and Katerina also explained the modified approach to indicator selection which, for example, sought responsible and practical indicators. Implementation feasibility planning where key barriers were identified was also a critical component of their process to balance comprehensive and practicality in the project. The next steps of the project are to prioritize biophysical values for pilot projects, develop a bi-valve monitoring program and identify priority socio-economic values.

In her presentation, Karen Price noted that to identify values we need to clearly define what matters and to whom. The "what" can refer to setting principles, for example, "low risk to ecological integrity" in the Great Bear Rainforest land-use planning process, or it can specify components and services. Only creating a list of values is not sufficient and clear objectives need to be set for each value that can translate to levels of acceptable risk to indicators which measure impacts to values.

Presenters identified the following important elements for a value and indicator selection process:

- Use broad values that represent public agreement. Top-level state indicators should represent broad public values.
- Selection process should be deliberative, consensus-based/ collaborative, incorporate local/ Aboriginal values, and iterative to changing conditions and new information.
- Lack of baseline data can restrict value and indicator selection.
- The best-available information to identify values can be collected using a consultation or consensus-based approach, for which good resources exist in B.C. e.g. land-use plans
- The assessment of what was selected and why should be transparent.
- Objectives and narratives should exist for each value.
- Implementation feasibility planning and defining acceptable risk should be completed prior as part of the value selection process.
- "Good indicators for cumulative effects must be indicative of the cause(s) of change/ sources of stress, and not only the existence of change." – Bram Noble

Session II: Setting Benchmarks and Thresholds

Dave Daust explained how understanding the factors that drive threshold dynamics, and when and how rapidly a threshold will be crossed is important to help set non-arbitrary management targets. An ecological threshold is the point after which a population, community, or ecosystem, demonstrates a marked response to some critical level of human disturbance. Ecological thresholds are knowledge-based while management targets are indicators selected as a matter of policy or legal requirement and therefore not necessarily based on knowledge of ecological systems.

In identifying and setting thresholds and benchmarks, uncertainties and challenges arise due to the complexities of our socio-ecological systems (states, pressures or rates of change), our incomplete knowledge on the current system states, and diverse stakeholder views to how to manage uncertainty and define acceptable risk.

Dave identified some tools which he has used to identify ecological thresholds. Conceptual models (or concept maps) identify the factors that influence a value while explicit risk hypotheses (or risk curves) identify the risk posed by each factor. Concept maps can provide a holistic view of an ecosystem, including ecosystem types, values, processes, and threats in an explicit, transparent manner. They can aid in communicating uncertainty and facilitate the selection process of values and indicators. Risk curves estimate risk over a range of indicator values, considering the probability and uncertainty of one relevant outcome. Risk curves also help set management targets by serving as a visual aid. For example, they can help answer questions like "should the target be above or below the ecological threshold? How cautious do we want to be?" Dave also presented several case studies where these tools were used.

Stella Swanson provided an overview of indicators and thresholds. Two types of thresholds exist related to effects and stressors and Stella explained how the choice between the two can be based on criteria such as usefulness for decision-makers and across different types of human activity, reliability over time and the level of existing knowledge and information. Pros and cons of stressor- and effects-based thresholds are shown below.

Effects-based thresholds		**Stressor-based thresholds**	
Pros	Cons	Pros	Cons
• Meaningful because they are direct measurements of the valued component • Can integrate effects across many human activities	• Not as useful to decision-makers because there may be prolonged scientific debate due to poorly-understood cause/effect linkages • Data intensive and can be highly specific to location • "After-the-Fact"	• Useful to decision-makers because easily linked to land use management • Usually well understood and can be efficiently measured • Reliable over time – thus useful for examining trends in accumulated stress	• Not always applicable across several human activities • Correlations with effects can be complex and confounded by other variables • Don't capture total effects, only the stressors we choose to measure

Stella also described the Elk Valley Cumulative Effects Management Framework she was involved with, highlighting the benefits its collaborative process to avoid deadlock and contributing to setting broadly accepted thresholds and management targets. More information is available on the Elk Valley framework here.

Key messages on setting thresholds and benchmarks captured during the presentations include:

- The process should be democratized and include multiple perspectives. Scientists, community members, and First Nations should be participating along with decision-makers.
- A lack of meaningful discussion, mistrust, or perceived unfairness can derail a collaborative process to manage cumulative effects. Principles for good collaboration include: transparency, engagement, accountability, and policy coherence. Accessible science, inclusive discussions, and an open about acceptable risk, and how thresholds and targets are derived can enhance collaborative discussions on thresholds.
- Interim measures should be established to regulate ongoing impacts while decisions on thresholds are being made, especially if negative impacts are already occurring and growing.
- CEA results can be interpreted differently to inherent human values and varying biases.
- Data (monitoring, modelling, past assessments) should be used to inform decision-making on values and thresholds.

Session III: Spatial Analysis

Spatial analysis is a crucial part of the CEA process, as it displays the synthesis and subsequent visualization of data which can inform management decisions. Three types of models were presented related to CE to: assess cumulative effects, model ecosystem interactions, and facilitate cumulative effects management. Key aspects of each tool, summarized below, were presented by Jamie Afflerbach, Will McClintock, and Darrell Desjardins respectively.

Jamie Afflerbach Regional assessment of cumulative impacts in the Bering Strait, AK	Will McClintock SeaSketch applications	Darrell Desjardin Ecosystem modelling – Ecopath with Ecosim and Ecospace (EwE)
• Assessed the impacts of 4 stressors (climate change, fishing, shipping and debris) to 17 habitat types in the Bering Strait • Requires spatial data on stressors and habitats, and impact weight scores that represent the relative vulnerability of a habitat to a stressor. Produces a gridded map of cumulative effects • Approach has been applied globally. Detailed methods are in Halpern et al. (2007) • Jamie provided some solutions to data limitations and other challenges associated with spatial data in her presentation. • Bering Strait study results will be uploaded to SeaSketch.	• Has been used in marine spatial planning processes worldwide • Scale-able – users can work at a regional scale and drill down to specific areas • Can incorporate other models: e.g. Marxan, trade-off analysis, ecosystem services, energy-use and create reports • For cumulative, visualizes impacts to prospective areas. Can also artificially adjust human activities to better understand the implications of various potential management priorities. • Can sketch zones using simple drawing tools and submit for group discussion. Iterative sketching and analysis supports collaborative planning. • The demonstration portal will presented during the workshop can be viewed on Seasketch here.	• Darrell's presentation explains how the ecosystem model can inform CEA, the variables that can be assessed, and how this information is useful for resource managers and stakeholders e.g. use in EA's and offsetting programs • Ewe has been used globally and in major EA's in Canada (e.g. PMV Roberts Bank Terminal 2) • Model is scientifically defensibly; incorporates a lot of disciplines • Takes an integrated rather than additive approach to cumulative effects • Can consider multiple objectives, scenarios, species, stakeholder interests, and analyses uncertainty • Can be used in scenario analysis and planning

DEC 11 SESSION SUMMARIES - CUMULATIVE EFFECTS MANAGEMENT

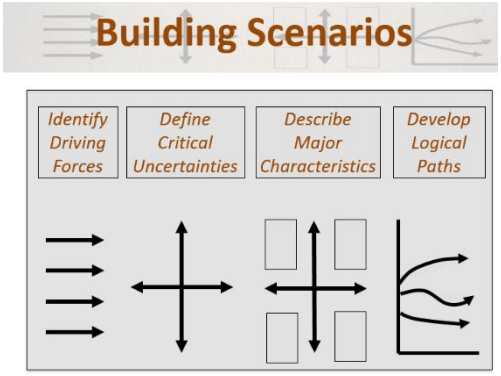
Session I: Scenario Development

Scenarios allows us to better understand complex systems, where many factors combine. Scenario modeling can support decision-makers when choosing strategies, depending on their preferred outcomes e.g. avoiding an undesirable future, achieving a desirable future, or adapting to an unavoidable one. Identifying our possible and preferred futures can help identify existing gaps and the need for different policies.

The value of scenario planning was highlighted by Jennifer Natland at Port Metro Vancouver (PMV). Since 2010, PMV has used scenario planning as a strategic tool to test its thinking and challenge its assumptions about the future. The process was used to inform its ongoing business planning. More than 100 stakeholders were engaged in the Initiative to establish a shared vision for the future and identify key drivers of change, on the basis of which, four scenarios of plausible futures were developed.

In 2014, updates to key drivers of change and the scenarios were made based on interviews, research, and participant input from a stakeholder engagement workshop involving community groups, First Nations, industry and all levels of government.

PMV also identified a preferred scenario and measures its progress towards it regularly using over 50 metrics which relate back to the key drivers of change. These "early warning indicators" are monitored early in the year to demonstrate the current location and the projected path to their preferred scenario to help adjust business planning as needed. More information on the Port 20105 Initiative is available here.



Don Morgan presented scenario planning from an ecological perspective. Landscapes are complex systems with interactions at multiple scales in time and space. Further difficulties arise from complex decision-making structures, changing societal priorities, and the uncertainties associated with impacts like climate change. System-wide cumulative effects assessment and scenario building can help us better understand complex system. Scenarios can be qualitative (narrative-based) or quantitative (analytical or based on formal models). Narratives can also include quantitative information to infer a more detailed representation of local and regional conditions.

The schematic on the left explains how to build scenarios and Don stressed the importance of identifying key drivers of change and socioeconomic pathways in the process. Don described some scenario building tools including SELES, used to model landscape processes and events taking into account pressures and natural variability over time. He presented several examples from his work in scenario planning, local to global in scale:

- assessing land- and waterscape changes in the Skeena watershed over time
- assessing risk to values such as grizzly bears and forest biodiversity in the Morice Watershed
- down-scaling climate change predictions and scenario plotlines from the 5th IPCC Assessment report to the Skeena (See Supplem. Mat.)

Session II: Cumulative Effects in Environmental Assessment and Decision-Making

Kevin Hanna explained that Environmental Assessment (EA) is a systematic process intended to inform decision-makers on a specific project. It does not provide a decision but rather embodies a process to identify impacts that may come from an action as well as options to eliminate, mitigate, or accept them.

Kevin also discussed cumulative effects from an EA perspective. CEA is a regulatory requirement of the EA process as it applies to project-based EAs despite the scope of CEAs being much broader in scope than EAs - spatially, temporally, and in the consideration of past, present and foreseeable actions. Kevin suggested that currently there is a lack of clarity on how CEA will be used to inform future EAs. Three key uncertainties exist regarding CE and decision-making:

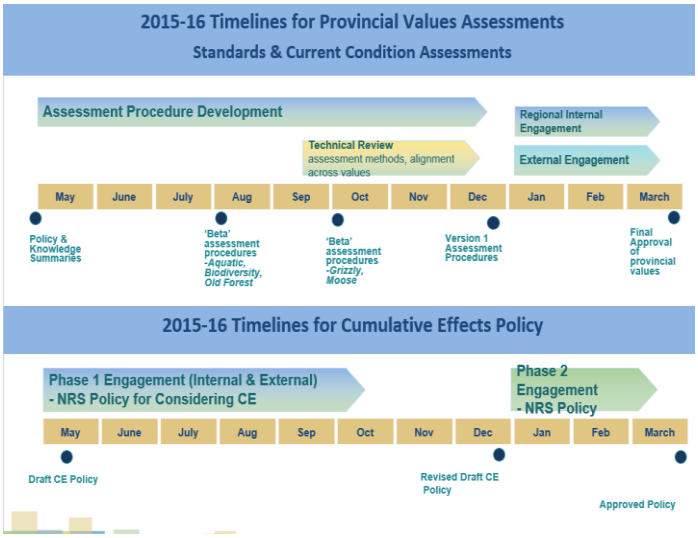
- Institutional arrangements are central to effective CEA. They are essential for connecting data and analysis to needs and decision-making. Are existing arrangements adequate?
- CEA needs to be technically strong and data-rich. But how such tools and data are used to actually support policy, planning and decision-making, and how well they reflect values is a challenge.
- There is uncertainty about the relationship between new CEA frameworks and existing land use planning and regulatory EA processes – should they be integrated or kept separate?

Kevin identified the following elements as crucial to successful up-take of CE data by decision-makers:

- Identify whether existing or new institutional arrangements are needed to connect CE data to decision-makers e.g. LRMPs
- Clarity, consistency, and transparency in defining "significance" and communicating risk.
- We are currently assuming that climate is going to stay at its current state, which we now know is not true. This ties back into scenario planning for a changing climate.
- We need to be very clear when embarking on a CEA about what knowledge we have, what we are trying to achieve and what it will mean.

Session III: Cumulative Effects Assessment as a Planning Tool

Steve Kachanoski presented the Province of B.C.'s Cumulative Effects Framework (CEF). The CEF lays out policy and procedures for assessing and managing cumulative effects. The policy, currently under development, will speak to how cumulative effects information will be used.

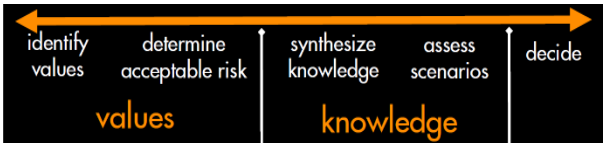


The Province is currently defining their approaches to assess current condition and cumulative effects for a subset of the priority values they identified based on a set of standardized criteria e.g. support for Aboriginal/ Treaty Rights, data availability, existing policy or legal objectives. The CEF will support decision-making in the Province to guide decision-making and working with First Nations rights and interests. This includes identifying priorities for monitoring and research, informing Major Project Assessments, and consulting and utilizing

information from First Nations to help manage valued resources.

Steve identified that the following enabling elements in the CEF need to be strengthened: First Nations and stakeholder engagement, research and monitoring, and legislation/ policy to incorporate CE in planning and decision-making. For the Skeena, a CEA will be completed and it will include future scenarios of risk. The CEF will be available for public comment (see Timeline). More details on the provincial framework are available from Steve's presentation.

Spencer Wood began his presentation by outlining and tying together the key points and main themes of the workshop. Similar to Karen Price, he described the assessment process under two related but distinct themes of values and knowledge. Spencer identified the importance of identifying the values we care about, and determining acceptable risk to them. He explained that we then need to identify and synthesize the different types of knowledge that we have (scientific, observational etc.) and apply this knowledge to assess various scenarios and guide the decisions we make on various management priorities or policies. In terms of implementation and in accord with other presenters, Spencer spoke about the utility of CEA in broader regional planning processes and potential linkages with the structured decision-making process of land-use planning in B.C.



Spencer also presented two case study examples of the use of CE in marine spatial planning (MSP): coastal planning in Belize and risk assessment in Clayoquot Sound, B.C. For the B.C. example, Spencer explained that the first step was defining what questions needed to be answered. Baseline situations were then compared various possible futures for the effects they would have on the values stakeholders considered most important (e.g. species and habitats, water quality). The Risk Framework used takes into account two variables: exposure and consequence. In combining exposure and consequence, risk was calculated to values under different scenarios and subsequently mapped out to help planners identify which species and habitats are at risk and where, and evaluate different management options that may reduce risk. InVEST is the open source spatial model that was used calculate risk. The model can also be used to map and model ecosystem services. More information is available on the InVEST website.

Spencer identified the following as crucial elements in CEA:

- A key challenge and current gap is a method to consider tradeoffs across multiple values, stressors and pathways.
- Science needs to demonstrate the trade-offs between different values and scenarios to users, and the information should feed back into decision-making and large-scale planning processes that typically work towards meeting multiple objectives.
- It is crucial not to talk about our values in purely monetary terms but also consider social and biophysical metrics. Ecosystem services need not be quantified in terms of absolute dollar values, but it is useful to assess the change in the value under different scenarios.
- Characterizing uncertainty is crucial

WORLD CAFÉ CUMULATIVE EFFECTS TOOLS AND RESOURCES

A description of the various CE-related tools and approaches presented during the 90 minute World Café is shown below.

Developer	Name of Tool	Tool Description	Presenters
WWF-Canada	Marine & Coastal Kernel Density Toolbox for a Regional Cumulative Effects Analysis	This toolbox is used to calculate the cumulative effects of various activities in which spatial data is available as point or line features within the estuary and Chatham Sound, as well as activities on land along the coast that occur within impact distance of the coastline. The intention of the toolbox was to automate the analysis and ensure consistency when running the tool multiple times, such as when running the tool to explore various scenarios.	Selina Agbayani James Casey
Pacific Salmon Foundation	Skeena Data Visualization Tool	A web-based data visualization platform that allows users to dynamically explore the status of all Skeena salmon populations and their habitats. The PSE is intended to facilitate a deeper understanding of the core data that exists for salmon populations and relevant pressures on their freshwater and estuarine habitats. In addition to visualizing and interacting with salmon datasets, users will also be able to download the source data directly from the visualization tool as well as print figures and maps of interest.	Katrina Connors, Eileen Jones, and Leah Honka
McClintock Lab, University of California, Santa Barbara	Cumulative Effects Models in SeaSketch	SeaSketch puts powerful tools into the hands of ocean planners, stakeholders and the public that were once limited to GIS professionals, enabling participatory marine spatial planning processes. Easy to use, SeaSketch allows users to generate hundreds of alternative scenarios representing a range of perspectives and interests, including zoning, regulatory or management plans which can now incorporate diverse ideas of stakeholders, planners and scientists most affected by these decisions, while generating analytical feedback to inform the development of marine spatial plans.	Will McClintock
Crossroads Cultural Resource Management	Skeena Knowledge Trust	Skeena Knowledge Trust is the most comprehensive source of accurate, reliable and timely pacific salmon habitat and population information for the Skeena watershed. Spatial data and non-spatial data are compiled and made available to the public, making it much easier to access and integrate well-documented information into current and future projects. The Skeena Knowledge Trust helps to add meaning to raw data and inform discussions around available information and knowledge management. This is an important step towards sustainable watershed management, and its ability to capture knowledge and make it available to the service of others creates a powerful opportunity to inform people over time, and help the Skeena watershed be managed sustainably for generations to come.	Johanna Pfalz
Natural Capital Project	Integrated Valuation of Ecosystem Services & Tradeoffs (InVEST) Habitat Risk Assessment Model	The InVEST Habitat Risk Assessment model allows user to identify regions on a landscape or seascape where human impacts are highest, allowing users to screen the risk of current and future human activities in order to inform and prioritize management strategies that therefore best mitigate those risks. Model outputs are useful for understanding the relative risk of human activities and climate change to habitats within a study region, and among alternative future scenarios. Users can identify areas of the seascape where human activities may create trade-offs between ecosystem services by posing a risk high enough to compromise habitat structure and function, thus helping to identify priority areas for conservation and informing the design and configuration of spatial plans. Though built for marine and coastal systems, the InVEST Habitat Risk Assessment model can easily be applied to terrestrial systems and mobile species as well.	Spencer Wood
Dave Daust & Karen Price Consulting	Values Identification Using Concept Maps	The process of selecting values and indicators is crucial for any cumulative effects assessment. Having a diverse group of people from multiple organizations and industries will highlight how complex the process of selecting all the variables that influence a specific action is. We hope to harness the range in background with the participants at this workshop to demonstrate how powerful a concept map can be. Harnessing the range of workshop participants, creating a concept map will illustrate how sharing knowledge helps to identify locally-specific conditions and responses, explore the wide range of possible variables, and eventually prioritize certain values and indicators.	Dave Daust & Karen Price
CHANS Lab, University of British Columbia	Using Experts and Networks to Understand Causes and Risks of Cumulative Impacts	Expert elicitation is a versatile, cost-effective, and potent approach to understand environmental risk. The use of expert elicitation is growing in many contexts yet there is often a worrying lack of attention to elicitation design. One use of experts is to help establish causal links between human activities and impact on the environment. This tools table will help participants understand the major considerations to design an expert elicitation study. Participants can choose to learn about two separate but complementary approaches at this table - expert elicitation and network analysis - to understand cumulative impacts. Participants also have the chance to understand how to structure cumulative impacts as directional networks from human activities to impacts on the environment, which allows for causal understanding of cumulative impacts and determine leverage points for intervention. Strategies will be shown to analyse the networks in quantitative and semi-quantitative ways, emphasizing the cause, magnitude, and uncertainty of impacts.	Gerald Singh
Hemmera	Ecosystem Modeling Tool - Ecopath with Ecosim (EwE)	EwE is a free ecological/ecosystem modeling software suite used to address spatial and temporal impacts and the placement of protected areas to address ecological questions and explore management and policy options. Darrell will be going over what goes into building an ecosystem model: choosing objectives and spatial area, constructing a food web, being correctly informed of the environment, determining the drivers of change, running the model without and with effects drivers, analyze results and address uncertainty.	Darrell Desjardin

GROUP DISCUSSIONS

On Data for Cumulative Effects Assessments in the Skeena

Break-out groups during the workshop were asked to write down their responses to the following questions related to data availability and challenges in the Skeena on flip charts:

1. What kinds of data or information are currently available to you, but are perhaps underutilized, that could support the CEA process for projects in the Skeena?
2. What kinds of data or knowledge gaps have you encountered in your work?
3. How might we collectively fill this knowledge or data gap, and how could it enhance your capacity to improve CEA processes in your work?

Participants highlighted that they did not always know what data was available, some was inaccessible. They recognized a need for increased administrative capacity and leadership on cumulative effects to coordinate and organize cumulative effects projects and to fill data gaps. A collective data/ knowledge hub was acknowledged. The participant feedback is summarized below.

Data identified by participants that can support cumulative effects work in the Skeena*	Data gaps and challenges with data in the Skeena	Recommendations to collectively fill identified gaps

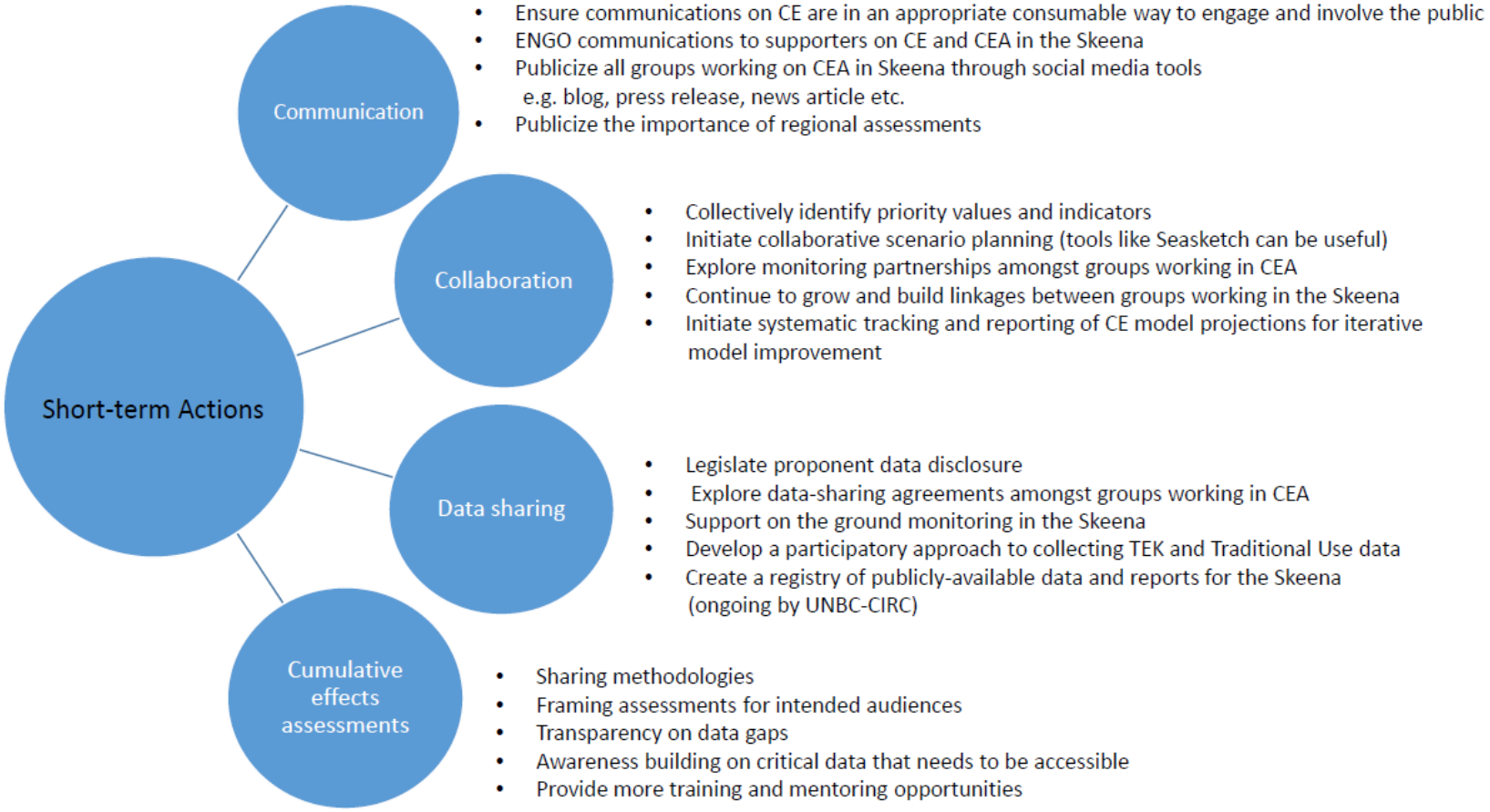
• Aerial photos of the Skeena (ongoing WWF-UBC project)
• Old DFO reports
• Ecosystem, salmon escapement, climate hydrological and meteorological data
• Digitized eulachon habitat data from WWF-Canada (model/ expert-derived)
• Academic research
• Grey literature e.g. Project EAs
• Traditional use data
• Environment Canada shoreline zone mapping data
• Commercial harvest data
• Census, health, environmental effects monitoring data
• Environment Canada sediment and contaminant data for the Skeena
• Micro-data on stand structures e.g. soil invertebrates
	• **Coordination:**
	  • Disconnect with data collected at different scales (local, regional) and inappropriate resolution
	• **Data gaps:**
	  • Species distribution and historical abundance data
	  • Health, and socio-economic data, including on the informal economy, at the right scale and resolution**
	  • Eulachon data
	  • Local fishermen knowledge
	  • Environmental health determinants
	  • High resolution satellite imagery, remote-sensing or crowd-sourced data
	• **Data-sharing challenges:**
	  • Inaccessibility to proponent proprietary information;
		•**Co-ordination:**
		  •Increase administrative capacity, leadership on CE management to regulate monitor and organize data e.g. habitat/ social changes over time
		  •Broad-scale scenarios tool that can be applied for different areas
		  •A system to coordinate and organize the multiple ongoing cumulative effects projects
		•**Data collection:**
		  •Digitizing and organizing available data e.g old DFO reports, traditional use studies
		  •Forecasting climate change impacts based on trend data
		  •Use social media to crowd-source data
		  •Restructure social-economic data to be area based
		  •Design a participatory approach to capturing data
		  •Support ongoing monitoring
		  •Ground-truthing modeled data
		  •Guidance on how to replicate and measure qualitative date for significance determination
		•Policy:
		  •Restructure CEAA decision making to ensure broader context is key part of the decision
		•**Data sharing:**
		  •Create a "human library" compiling knowledge of long-term researchers and First Nations TEK in the region
		  •Clear direction on data availability and contact persons for permissions for use
		  •Data portals, open source "data catalogues"
		  •Data consortiums to purchase data together and fill critical gaps
		  •Increasing public pressure for corporate stewardship can enhance proponent data-sharing

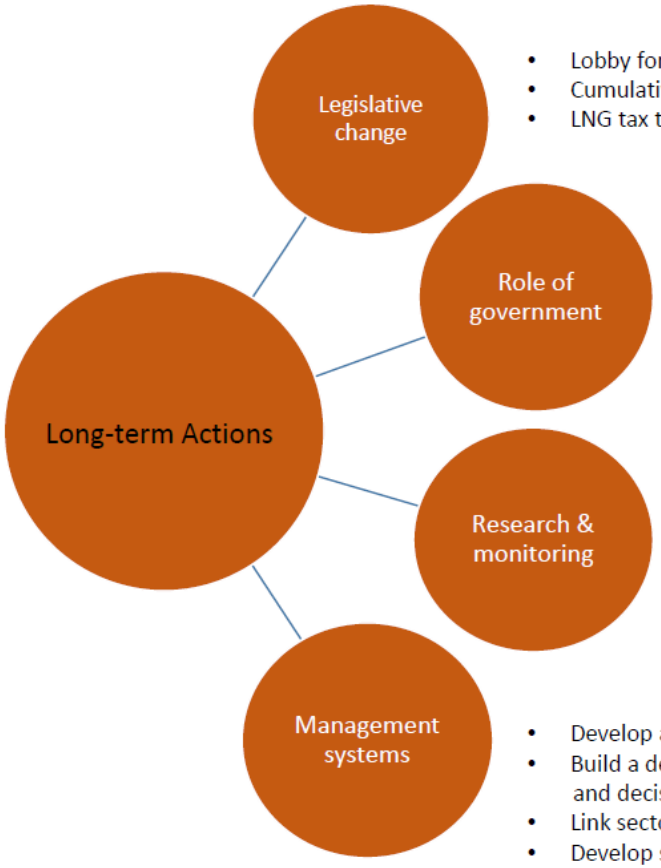
*The Cumulative Impacts Research Consortium is creating a 'living bibliography' of resources relevant to cumulative impacts of resource development in Northern B.C.

**E.g. food security, housing, health, education, crime, spiritual and cultural values. A workshop participant also noted that socio-economic data is not available at the community level.

On Promoting Future Action in the Skeena

The final discussion session focused on short-term and long-term actions to advance cumulative effects in the Skeena. Participant groups were encouraged to reflect on the training workshop and identify short- and long-term actions that can improve cumulative effects science and practice in the Skeena. The feedback provided, posted on sticky-notes by each break-out group, is presented below.





- Lobby for cumulative effects to be included in the new federal EA legislation
- Cumulative effects assessment processes led by government and not by proponents
- LNG tax to support cumulative effects

- Push for the government to get back into convening different groups on cumulative effects assessments.
- Increased technical and managerial staff presence in workshops such as this one
- Hold workshops for decision-makers on cumulative effects to raise awareness of on existing knowledge and data as well as their needs

- Further research on functional response curves and thresholds
- Research on social economic factors
- Create a cumulative effects expert practitioners group
- Link research needs from different groups to academic research projects (can be a source for capacity and funding)
- Create regional monitoring body for the Skeena. Could be funded by industry, and with established area-specific managers, dedicated monitoring and reporting capacity
- Update values and indicators periodically as more studies are conducted and more data is available in the Skeena

- Develop adaptive management plans to address climate change impacting the region
- Build a decision support system to help managers address uncertainty in CEA and decision-making
- Link sector specific technicians to big picture adaptive management
- Develop scenario narratives to help give meaning to data
- Develop tools for visualizing tradeoffs between scenarios